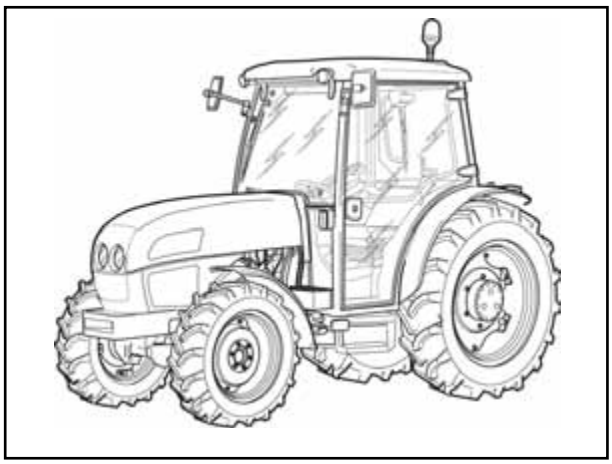
F-N Series (T2)

65-75 GE-F
80-90-100-105 GE-F-XL

Speed Five - Power Shuttle - E-Line



Service Manual

P/N° 3676090M3

McCORMICK

PREFACE

This manual contains the technical specifications, mechanical, hydraulic layouts and wiring diagrams, plus instructions on how to operate and djust McCormick's **F-N Series (T2)** series tractors. It does not contain all the necessary information as it is completed with the theoretical and actical explanations and theoretical descriptions given by the instructors during the training courses. This information is therefore dedicated to the persons who frequent training courses at the McCormick training center.

Note: The descriptions and technical specifications in this manual are strictly not binding. McCormick therefore reserves the right to modify the components and accessories for technical or commercial reasons without being obliged to update this manual each time

McCORMICK
PRE-SALE SERVICE
January 2009
42042 FABBRICO (RE) ITALY

TABLE OF CONTENTS

Chap.1 INTRODUCTION

Chap.2 ENGINE

Chap.3 CLUTCH

Chap.4 TRANSMISSION

Chap.5 FRONT AXLE

Chap.6 REAR POWER TAKE-OFF

Chap.7 HYDRAULIC CIRCUIT

Chap.8 MECHANICAL POWER LIFT

Chap.9 ELECTRONIC POWER LIFT

Chap.10 ELECTRICAL SYSTEM

Chap.11 CALIBRATION

Chap.12 CHECK-CONTROL AND TROUBLESHOOTING

Chap.13 AC SYSTEM

Chap.14 SPECIAL TOOLS

Chapter 1 : Introduction

Index

Section 1 : How to consult the manual 1-3
1.1 Introduction 1-4
1.2 Structure of the manual 1-4

Section 2 : Tractor identification 1-5
2.1 Tractor identification 1-6

Section 3 : Working in safety 1-7
3.1 Essential rules for accident prevention 1-8
3.2 Danger warning decals 1-14
3.3 Replacement of tractor parts 1-22
3.4 Safe use of the tractor 1-23

Section 4 : Pre-delivery inspection and maintenance 1-27
4.1 General information 1-28
4.2 Pre-delivery inspections 1-29
4.3 Periodical maintenance table 1-30

Section 5 : Conversion tables 1-33
5.1 Length 1-34
5.2 Area 1-40
5.3 Volume 1-42
5.4 Weight 1-48
5.5 Pressure 1-52
5.6 Moment of rotation 1-56
5.7 Temperature 1-60

Section 6 : Sealants 1-61
6.1 Types of Loctite sealant 1-62
6.2 Practical advice 1-63

Section 7 : Driving torques 1-65
7.1 Driving torques 1-66

Section 8 : General assembly instructions 1-67
8.1 Seals 1-68
8.2 O-ring seals 1-69
8.3 Bearings 1-70

Section 1 : How to consult the manual

Index

1.1 Introduction.....1-4

1.2 Structure of the manual.....1-4

1.1 Introduction

The purpose of this training manual is to provide the user with the information, operating principles and instructions about the adjustments to which the various parts of F-N Seriestractors must be subjected.

The manual does not give full details about how to disassemble the parts as it has been compiled for assistance technicians who have already taken part in the training courses. It must therefore be used along with the theoretic and practical information that the instructor gives during these courses.

Before reading the whole manual, it is essential to read section 3: WORKING IN SAFETY, in order to prevent errors or mistakes that could jeopardize the safety of the technicians in the workshop.

The information in this manual was up to date at the time of publication. McCormick reserves the right to make modifications without being obliged to give notice. Please contact your dealer or the importer if discrepancies are discovered or for any other requirement.

1.2 Structure of the manual

The manual is divided into chapters (chap.), and each chapter into sections (sect.). Numbering of the figures begins with 1 in each chapter, with the chapter number alongside.

Example: 5.7 indicates page 7 of chapter 5.

Numbering of the figures also begins with 1 in each chapter, with the chapter number alongside.

Example: Fig. 5.73 indicates figure 73 of chapter 5.

Section 2 : Tractor identification

Index

2.1 Tractor identification.....1-6

2.1 Tractor identification

The tractor is identified by a serial number stamped on the front support (ballast support) and on the bonnet. Each engine has a serial number of its own, stamped on the engine block.

To ensure a quick and efficient service when ordering spare parts or asking for technical specifications or other information, always state the chassis and engine serial numbers.

Chassis serial number	
Engine serial number	
Cab serial number	
Type of tractor	
Owner/Operator	
Dealer's or Agent's address	
Delivery date	
Warranty expiry date	

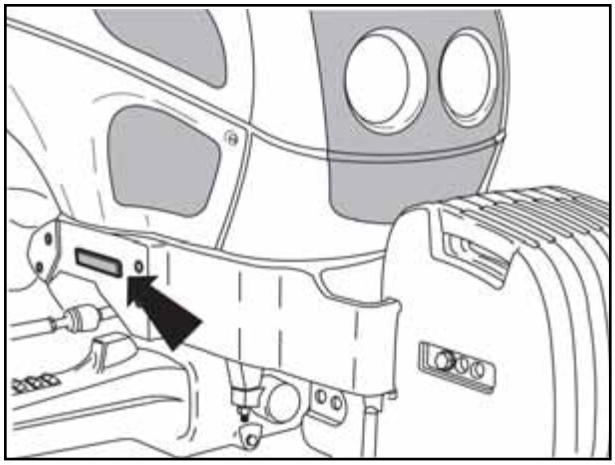


Fig. 1.1

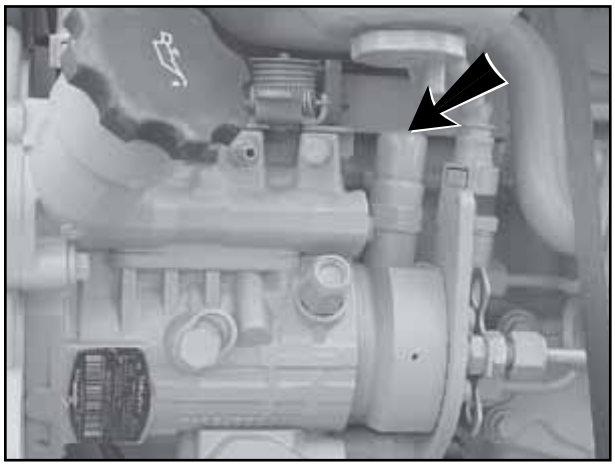


Fig. 1.2

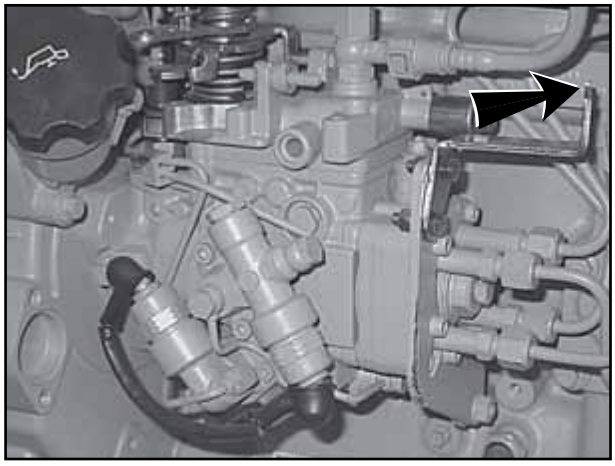


Fig. 1.3

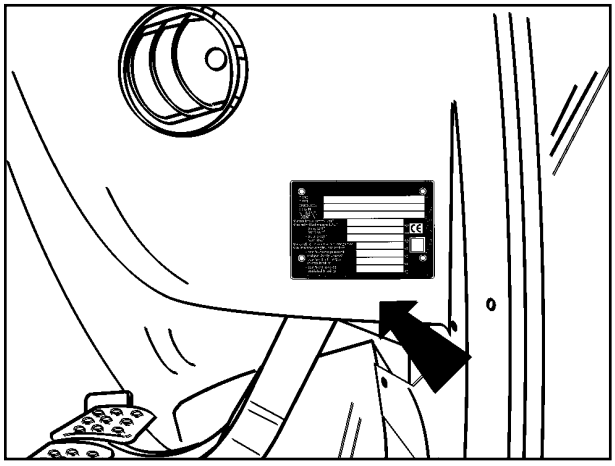


Fig. 1.4

Section 3 : Working in safety

Index

3.1 Essential rules for accident prevention 1-8
3.1.1 Rules of a general character 1-9
3.1.2 Equipment 1-12
3.1.3 First Aid 1-12
3.1.4 Tractor safety regulations 1-13

3.2 Danger warning decals 1-14

3.3 Replacement of tractor parts 1-22

3.4 Safe use of the tractor 1-23
3.4.1 Safety frame 1-24

3.1 Essential rules for accident prevention

The structures, systems and equipment in repair shops must conform to the current laws governing labour safety in order to safeguard the health and safety of each worker.

Although they are obviously only partial, the regulations given in this section inform the workers about the dangers they may encounter on the job.

Always bear your safety and that of others in mind whenever you work on a machine, whichever type it may be.

To work in complete safety, it is essential to know the nature of the job, to correctly use the tools and materials required and to reply on your common sense. Read the safety messages in the introductory part of this manual and pay attention to the "warning" notes when they appear in the text.

Important factors that help to prevent accidents are:

- the **behaviour** and prudent conduct of each worker;
- your **caution** and ability to remain alert and keep your actions under control;
- your compliance with the **regulations** and rules of conduct of a general character.

	Attention: This is the caution symbol. Pay attention when you see it on the machine or in the manual as it denotes a potential risk of injury.

Fig. 1.5

3.1.1 Rules of a general character

3.1.1.1 Preliminiary instructions

- always comply with the instructions received from superiors;
- always comply with the indications on the stickers and signs;
- never use machines or systems without authorization and never carry out operations and manoeuvres that are the competence of others;
- use the safety devices and other means of protection with care;
- inform your superiors if the safety and protective means and devices are defective or about any danger conditions of which you may have become aware;
- never remove or modify the safety devices and other means of protection without having been authorized to do so;
- let your superiors know immediately about any accidents you have had or about which you may have become aware;
- keep your place of work clean and orderly. Keep the floor clear of any materials that are not strictly required for the job in hand and prevent greasy or oily substances from being spilt (clean them up with absorbent material if this should occur).

3.1.1.2 Work clothes

- Do not wear loose clothing that could become caught up in moving parts or garments that are not tight at the cuffs;
- do not wear necklaces, rings, bracelets and similar;
- do not clean garments with inflammable or harmful substances, or using compressed air;
- do not wear sandals, slippers, clogs or shoes with high heels.
- always wear protective clothing (goggles - visors - gloves - footwear, etc.).

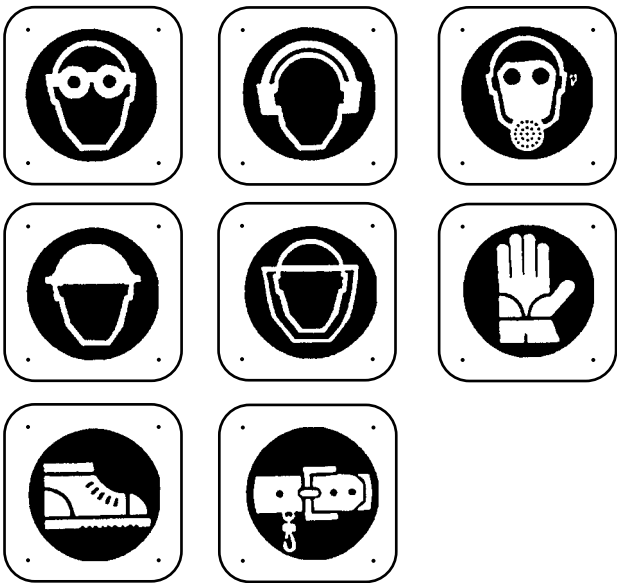


Fig. 1.6

3.1.1.3 Machines and systems

- Before beginning work, make sure that the guards and screens are in place, in a good condition and that the safety devices are functional;
- check the operation of any exhaust or ventilating systems installed;
- never remove the guards or safety devices from the machine unless this is strictly necessary and only after having been authorized to do so by your superiors, who will also indicate the precautions that must be taken;
- the protections and safety devices must be fitted back in place and re-activated as soon as the reasons for their having been temporarily removed have ceased;
- it is forbidden to clean, oil or grease moving parts of machines and systems by hand;
- it is forbidden to carry out any work or adjustment on moving parts.

3.1.1.4 Lifting and carrying

By hand

- do not bend your back to lift loads;
- hold the load safely where it is easy to get a good grip;
- do not carry loads with greasy or oily hands;
- hand trucks without drawbars should be pushed, not pulled;
- never deposit loads near stairs, fire-fighting systems, first-aid means or places of transit.

On vehicles

- comply with the capacity limits and regulate your speed according to the road conditions, the load and the braking distance;
- make sure that the loads are well harnessed and fastened;
- avoid passing with hanging loads in places where dropping could cause a danger hazard. If this is inevitable, indicate when the manoevure is made or have all bystanders move out of the area.

3.1.1.5 Internal circulation

People

- use the correct and authorized routes (pedestrian crossings, gangways and similar);
- do not run;
- do not walk or stand under hanging loads or in places where loads could drop;
- do not ride on means of transport or lifting equipment designed for handling materials alone.

Vehicles

proceed at a moderate speed and with due care, depending on the road conditions. Comply with the farm/company rules and with the road signs.

3.1.1.6 Electricity

- proceed at a moderate speed and with due care, depending on the road conditions. Comply with the farm/company rules and with the road signs.
- Do not make electrical connections with makeshift means and never ever insert the ends of wet conductors into sockets;
- disconnect plugs from sockets by holding the outer casing, never by pulling the electric cable;
- avoid twisting the cables;
- frequently check the insulating material of conductors and electrical equipment and make sure that it is in a good condition;
- point out any damage to electrical equipment and systems, with particular reference to the condition of the ground conductors;
- do not open cabinets or containers housing electrical equipment or carry out work inside unless you are trained and authorized to do so;
- watch out for overhead electricity lines when approaching or working in their vicinity.

3.1.1.7 Fire outbreaks

In departments or processes where there may be a danger of fire outbreaks owing to the presence or use of inflammable substances:

- it is forbidden to smoke;
- it is forbidden to use equipment with naked flames or to handle glowing materials;
- do not place inflammable materials near heat sources;
- do not store materials in front of extinguishers or fire hydrants.

3.1.1.8 Dangerous substances and preparations

Take the following precautions when using dangerous chemical products (fire, explosion, irritation, caustic burning, scalding, intoxication):

- only keep receptacles containing dangerous products open for the time strictly required for their use;
- do not use or transfer dangerous products into containers that are not designed for this use, or into those without indications as to their contents or without the relative marking;
- comply with the indications on the relative labels when using chemical products.

3.1.1.9 Defence against gas, fumes, dust, harmful vapours

- make sure that the exhausting systems are operating;
- use protective clothing and equipment;
- install temporary exhausts as near as possible to the sources, if necessary;
- do not work in the direction of the flow of polluting substances blown out by exhaust systems.

3.1.1.10 Agents of a biological nature

- in the event of fermentation (development of algae), avoid direct contact and act with appropriate protective means;
- only enter places where anaerobic fermentation may have taken place and produced fumes (e.g. ammoniacal) after having work a protective mask.

3.1.1.11 Guide to choosing the right extinguisher

	Extinguishing agent				
Class of fire	Water	Powder	CO2	Foam	Special powders
ordinary solid fuels	YES	YES	YES Only for small fire outbreaks	YES	NO
inflammable liquids	NO Except when suitable equipment is used	YES	YES	YES	NO
inflammable gases	NO	YES	YES	NO	NO
combustible metals	NO May react with water	NO	NO	NO	YES
Electrical equipment	NO	YES	YES	NO	NO

Fig. 1.7

3.1.2 Equipment

Makeshift, inadequate or defective tools may cause faults or accidents. Never use the wrong tools since such action could cause injuries and spoil the finished job.

Always use the special tools recommended by the manufacturer when disassembling, overhauling and re-assembling the various parts of a tractor.

Use of specific tools will reduce the effort and time required for the job and, consequently, the cost. You will also be certain that the work has been correctly done.

Never use:

- A hammer with a loose head or cracked handle.
- Pincers or pieces of iron instead of a hammer; drill bits or bolts instead of pin drivers.
- Drill bits or bolts instead of pin drivers;
- Worn or welded wrenches.
- A steel hammer to tap bearings or stress-relieved components (use one made of bronze or brass).

The engine and gearbox and the front and rear transmissions must be split for certain jobs on the tractor components. This operation is facilitated and made safer by use of the special divider kit.

When lifting weights, make sure that the chains, lifting brackets, hooks, cables or ropes comply with EC standards. Unless different indications are given, an adjustable bracket must be used when particularly heavy parts are removed.

All chains and cables must be parallel to each other and as near to the vertical as possible, depending on the component being lifted.

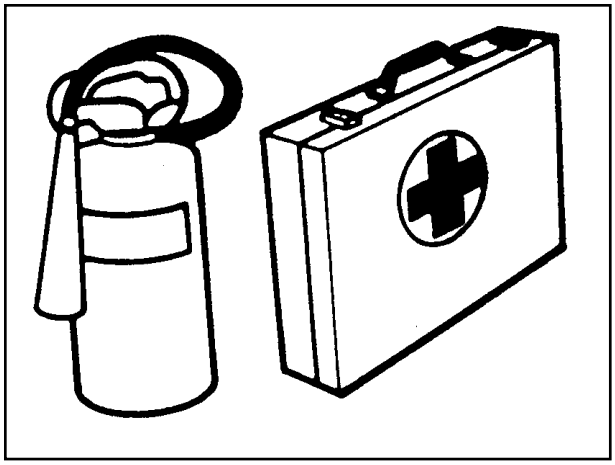


Fig. 1.8

3.1.3 First Aid

Mechanics are exposed to various risks at work.

If anyone should be injured, use sterile materials and disinfectants for first aid purposes. These materials should be kept in the first-aid box, equipped in compliance with the laws in force.

3.1.4 Tractor safety regulations

Note: Before you get on to the tractor, it is essential for you to have read and strictly complied with the instructions in the operation and maintenance manual.

3.1.4.1 Starting

- Do not allow the engine to run in a closed room without adequate ventilation systems able to dispose of the exhaust gas.
- Never put your head, body, limbs, feet, hands or fingers near spinning fans or belts.

3.1.4.2 Engine

- Before removing the radiator plug completely, turn it very slowly to relieve the pressure in the circuit. Coolant fluid must only be topped up with the engine at a standstill or idling, if hot.

  Coolant fluid must only be topped up with the engine at a standstill or idling, if hot.
- Do not refuel whilst the engine is running, particularly if it is hot. This could lead to the risk of a fire outbreak if fuel were to be spilt.
- Do not attempt to check or adjust the tension of the fan belts with the engine running. Do not regulate the fuel injection pump whilst the machine is on the move.
- Never lubricate the machine when the engine is running.

3.1.4.3 Electrical system

- If auxiliary batteries must be used, remember that the cables must be connected in the prescribed way at both ends: (+) with (+) and (-) with (-). Do not short-circuit the terminals.

	Attention: The gas issued by batteries is highly inflammable.

Always leave the battery compartment uncovered when recharging, to ensure a more efficient ventilation. Never ever check the battery charge using the "jumpers" obtained by placing metal objects on the terminals. Prevent sparks or flames in the battery area. Do not smoke as this could cause explosions.

- Before proceeding with any work, make sure that there are no fuel or electricity leaks: repair these leaks before proceeding.
- Do not recharge batteries in closed places: make sure that there is adequate ventilation to prevent accidental explosions from occurring due to an accumulation of the gas issued when recharging.
- Always disconnect the batteries before working on the electrical system.

3.1.4.4 Hydraulic circuit

- Fluid leaking from a very small hole can be almost invisible yet have sufficient force to penetrate under the skin. Use a piece of cardboard or wood if you must check for such leaks. NEVER CHECK FOR LEAKS WITH THE HANDS: immediately seek medical help if fluid penetrates under the skin. Serious infections or dermatitis may occur if you fail to receive prompt medical treatment.
- Use the right tools to check the pressure in the circuits.

3.1.4.5 Lifting and lowering

- Lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the parts are supported by appropriate harness and hooks. Use the lifting eyelets provided. Take care of bystanders near the load being lifted.
- Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next. Wear approved safety clothing, such as goggles, gloves and safety footwear.
- Do not twist metal ropes or chains. Always wear safety gloves when handling cables or chains.

3.2 Danger warning decals

If a tractor part bearing a decal with a safety note (yellow colour) is replaced, it is ESSENTIAL to affix the same decal to the spare part.

A complete list of all the places where decals are applied is given below.

Positions of the danger warning decals - WEO markets

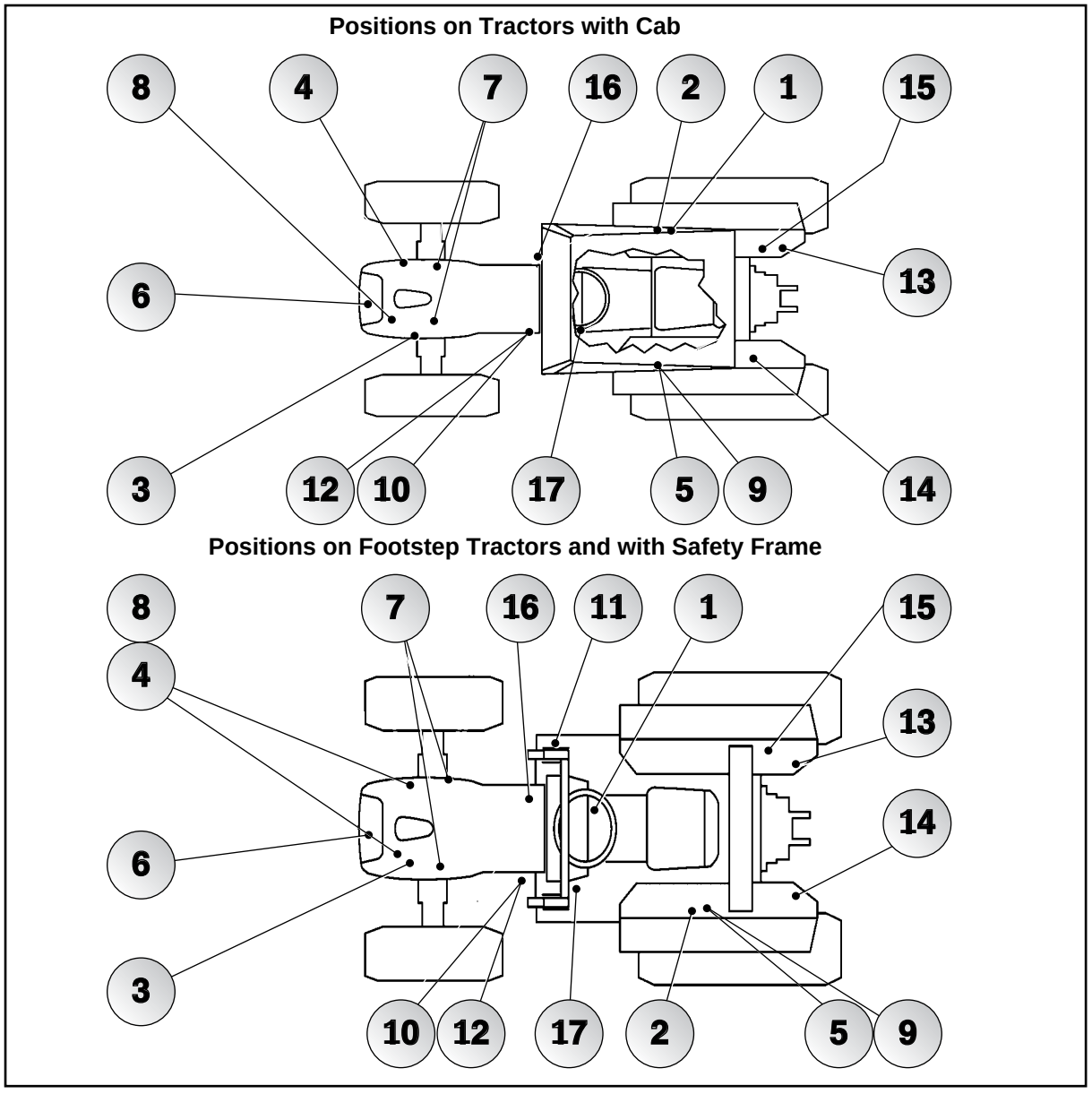


Fig. 1.9

Decal 1

Inside the cab, on the upper lining or on left-hand fender for tractors with safety frame.

DANGER: The tractor could overturn and crush the chest. Hold firmly on to the steering wheel if the tractor is overturning. DO NOT leave your seat or jump off the tractor.

Decal 2

Tractors with safety belts. On the engine in the cab, or on left-hand fender for tractors with safety frame.

WARNING: Danger of being crushed. Always wear the seat belt when the safety frame is in the vertical position.

Decal 3

Placed on the expansion vessel of engine cooling circuit.

DANGER: Jets of hot steam or hot water. Protect the face. The radiator will be under pressure when the engine is hot. Remove the plug with caution when the engine is cold.

Decal 4

Positioned on the left and right sides of the shroud.

WARNING: Danger of entanglement. Keep your hands well clear of the fan blades when the engine is running. Always keep the guards and screens mounted.

Decal 5

Inside the cab, on the upper lining or on left-hand fender for tractors with safety frame.

WARNING: Take care. Consult the operation and maintenance manual for information about safety and how to use the tractor.

Decal 6

Positioned inside the side panel near the battery support.

WARNING: Danger of electric shock. Always disconnect the negative battery terminal before removing the battery or before servicing the electrical system.

Decal 7

Positioned on both sides of the radiator or on the intake manifold.

WARNING: Very hot surfaces. The hands and fingers could be scorched. Warning: keep well clear of hot parts. Keep at a safe distance.

Decal 8

Positioned on both sides of the radiator or on the intake manifold.

WARNING: Danger of entanglement. Keep your hands well clear of spinning parts. Take care not to become entangled in the belts or pulleys whilst the engine is running. Keep the guards in place.

Decal 9

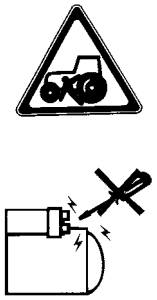
Located on the cover inside the cab, on tractors without 2nd passenger seat, and on the left-hand fender on tractors with safety frames.

WARNING: Danger of being crushed. DO NOT allow anyone to sit on the mudguards or on any other part of the tractor or towed implements.

Decal 10

Positioned on the inside of the left fender.

DANGER: Danger of being crushed. DO NOT start the engine by shorting across the terminals of the starter motor. This operation will place your life in danger. Only start the engine when you are sitting in the driving seat.



Decal 11

Affixed to the safety frame (only on footstep tractors).

WARNING: Danger of being crushed. Always keep the safety frame in its correct position during work. Never use the tractor without mounting the safety frame.

Decal 12

On the starter motor.

WARNING: Electric shock. Always disconnect the negative battery terminal before removing the cover of the solenoid and before servicing the electrical system.

Decal 13

Located on the cover inside the cab, on tractors without 2nd passenger seat, and on the left-hand fender on tractors with safety frames.

DANGER: Danger of entanglement. Keep well away from spinning shafts. Take care NOT to remain caught up by the PTO driveline. Keep all the guards mounted on the transmission shafts of the tractor or implements.

Decal 14

On the rear left-hand fender, only with electronic power lift.

DANGER: Risk of collisions and serious accidents. Keep to one side of the tractor when using external lift controls. NEVER STAND between tractor and implement - you could be hit by the implement.

Decal 15

On the rear right-hand fender, only with electronic power lift.

DANGER: Risk of collisions and serious accidents. Keep to one side of the tractor when using external lift controls. NEVER STAND between tractor and implement - you could be hit by the implement.

Decal 16

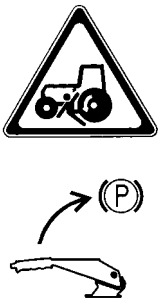
Near the fluid reservoir of the brake system.

WARNING: Risk of damage to the brake circuit. Before servicing the tractor, it is essential for you to have read through the warnings and the instructions in the operation and maintenance manual.

Decal 17

Near the parking brake lever.

DANGER: Danger of being crushed. Always apply the parking brake lever when you stop the tractor and before getting off it.



POSITION OF SAFETY NOTICES ON TRACTOR - North American markets

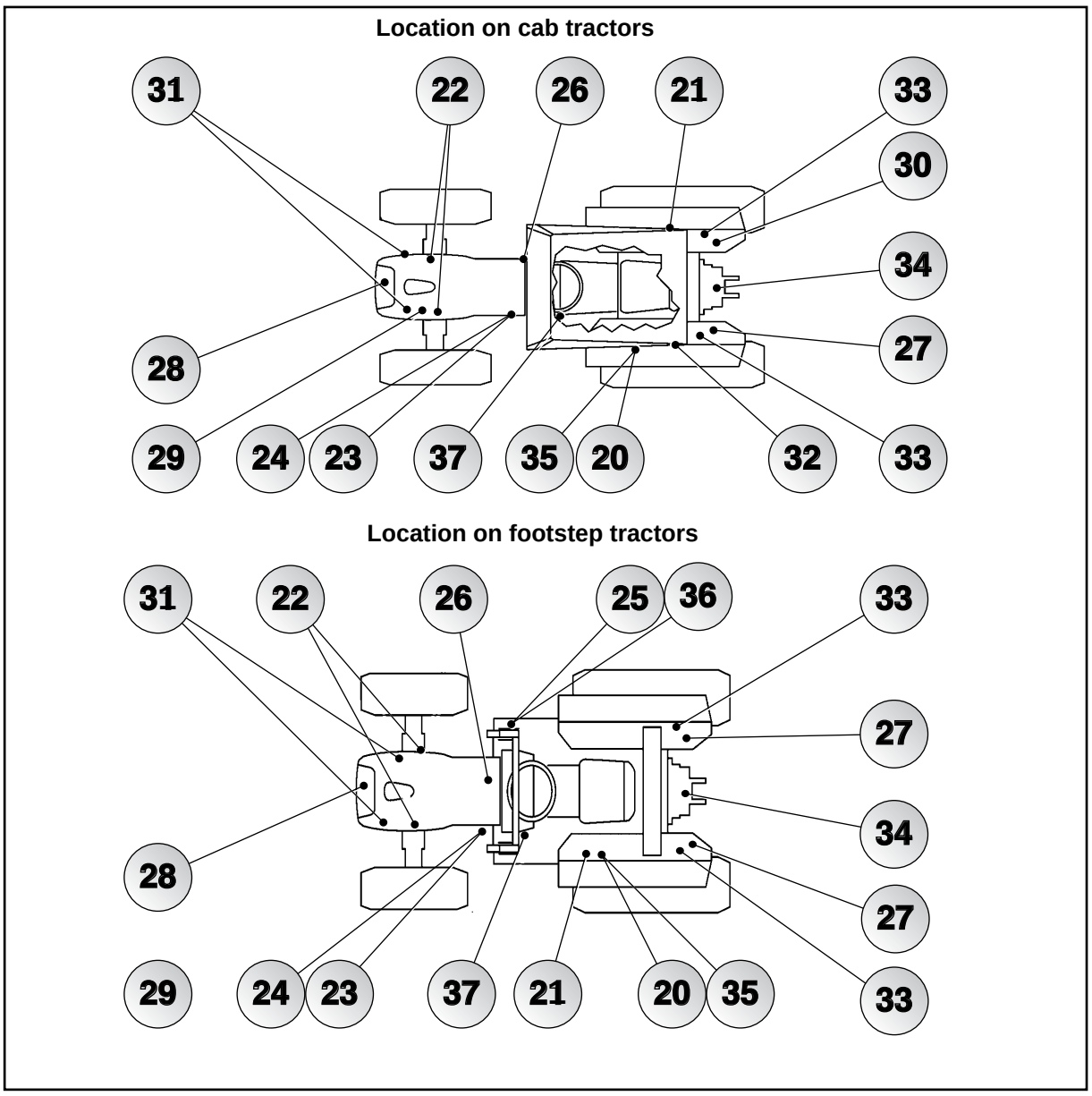
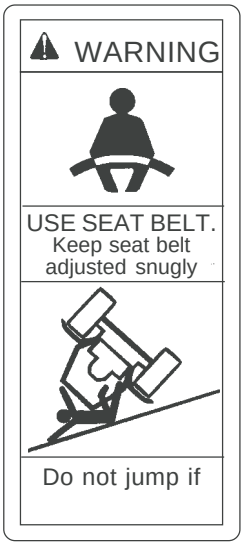


Fig. 1.10

Decal 20

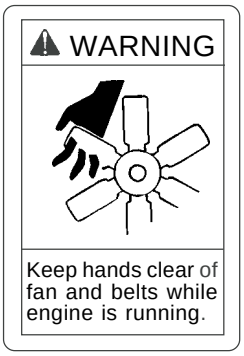
Located inside cab on left-hand pillar or on the left-hand fender for footstep tractors.

Decal 21



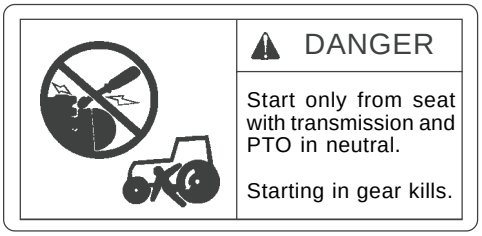
Located inside cab on right-hand pillar or on the right-hand fender for footstep tractors.

Decal 22



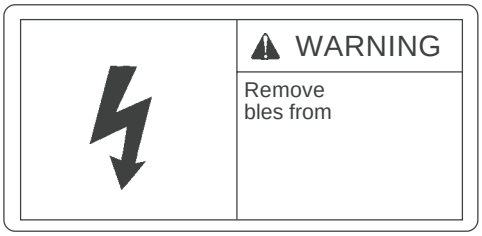
Located on right and left-hand side of radiator.

Decal 23



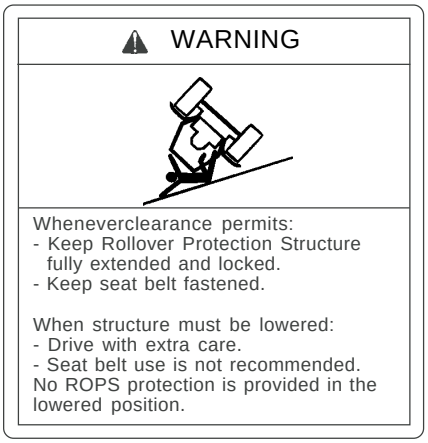
Located on the starter motor.

Decal 24



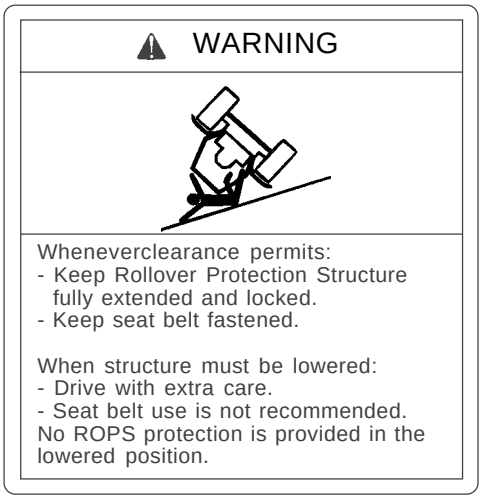
Located on the starter motor.

Decal 25



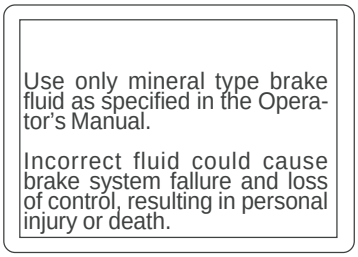
Located on the safety ROPS for footstep tractor.

Decal 26



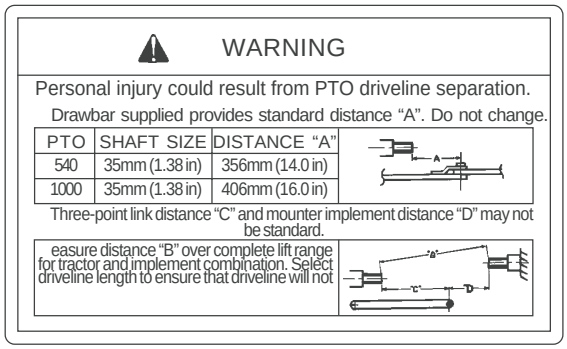
Located near the brake reservoir bracket on the hood rear bracket or on the dashboard.

Decal 27



Located at rear of cab on the inner side of the left fender

Decal 28

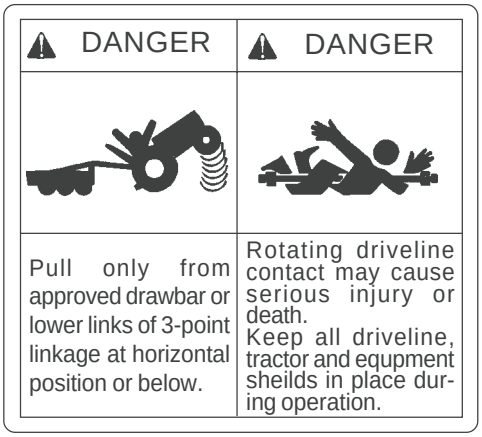


Located inside the battery cover

Decal 29

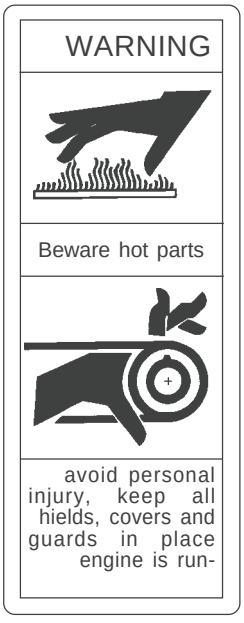
Located over the radiator.

Decal 30



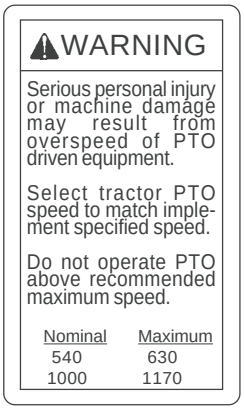
Located at rear of cab on the rear window fender.

Decal 31



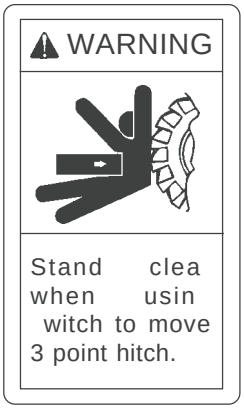
Located on right - and lefthand side of radiator, or on the air conveyor.

Decal 32



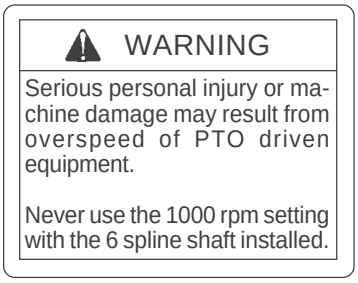
Located inside cab on the left hand pillar or on the rear fender for footstep tractors.

Decal 33



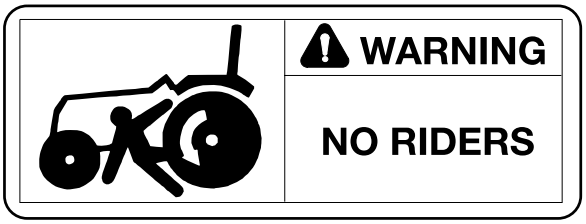
Located at rear of cab or on the rear fenders only with electronic lift.

Decal 34



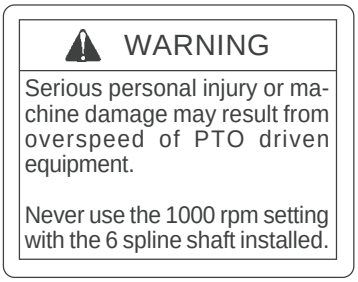
Located on PTO cover.

Decal 35



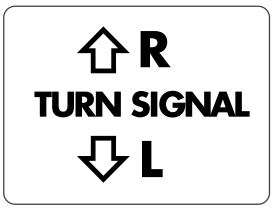
Located on the rear fender

Decal 36



Located on the ROPS (Only on platform tractors)

Decal 37



Located near the turn switch

3.3 Replacement of tractor parts

It is essential to use genuine McCormick spare parts when repairing the tractor.

Pay particular attention to the following instructions when repairing and assembling parts and spares accessories.

Use of spurious spare parts can jeopardize tractor safety. Strictly comply with the torque wrench settings indicated in the workshop manual and, where indicated, install the required locking devices during disassembly operations where a new part must be assembled.

Installation of spurious spare parts will automatically invalidate your tractor's warranty, since all McCormick parts are guaranteed by the manufacturer. McCormick's Dealers and Agents must only supply genuine spare parts.

3.4 Safe use of the tractor

Only qualified and authorized operators are able to use farming tractors in safety. To be qualified you also need to be familiar with the instructions in the operation and maintenance manual and to strictly comply with these indications.

Moreover, operators need to know the labour safety regulations.

For example, some regulations specify that no one under the age of 18 years may use a tractor.

You are responsible for knowing these regulations and for complying with them at work.

They also include the following instructions for safe use of the tractor.

	Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Observe the following precautions

- Do not allow children or unauthorized persons to drive your tractor.
- Fasten your seat belt if the tractor is fitted with a safety frame.
- Whenever possible, do not use the tractor near ditches or embankments.
- Reduce speed when turning the tractor, crossing slopes and on rough, slippery or muddy surfaces.
- Keep clear of slopes too steep for safe operation.
- Watch where you are going - especially at row ends and around trees.
- Never let anyone else get on to the tractor or the implement.
- Operate the tractor smoothly, with no sudden movements: do not turn, start or stop abruptly.
- Hitch only to the drawbar and recommended hitch points. Never hitch above the central line of the rear axle.
- Apply the parking brake whenever the tractor is stopped.
- Never alter or remove any part of the equipment.
- Keep others well clear of your work area.
- Never use attachments that are not designed for your tractor.

Caution

This is the caution symbol. Pay attention when you see it on the machine or in the manual as it denotes a potential risk of injury.	**Fig. 1.11**

3.4.1 Safety frame

The tractor is equipped with a safety frame and safety belts. If the safety frame has been removed, you must equip the tractor with a new safety frame and safety belts. The safety frame reduces the risk of injury should the tractor tip over. Tipping over without a safety structure can cause damage and serious injury.

3.4.1.1 Use

- Before using the tractor, ensure that the safety frame has not been damaged and that it is securely fastened to the tractor.
- DO NOT ATTACH chains, cables, etc., to the safety frame of cab for towing purposes as this could cause the tractor to tip up: always use the drawbar for this purpose.
- Always fasten your safety belt. DO NOT not fasten your seat belt if the tractor is not fitted with a safety frame or cab.
- Check the safety belts for damage. Damaged belts must be replaced.

3.4.1.2 Damaged safety frames

If the tractor has tipped over and the safety frame has been damaged (e.g. in the case of a crash against a bridge), it must be replaced in order to ensure the original degree of protection.

After an accident, check the safety frame, the driving seat, the safety belts and the anchor points of the safety belts. Replace all damaged parts before using the tractor again.

DO NOT WELD, DRILL, BEND OR STRAIGHTEN THE SAFETY FRAME OR CAB: to do so reduces the degree of protection that is ensured by the original equipment.

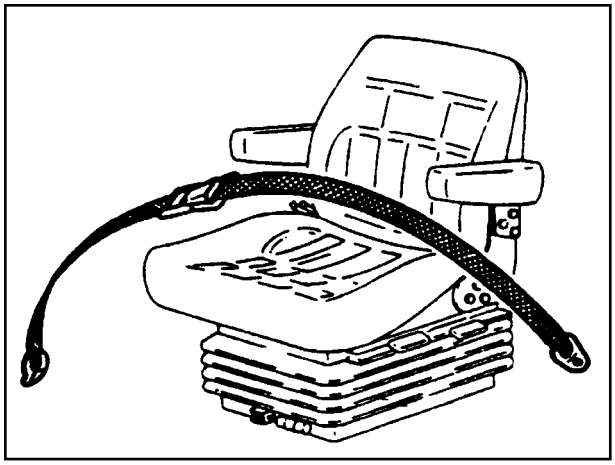


Fig. 1.12

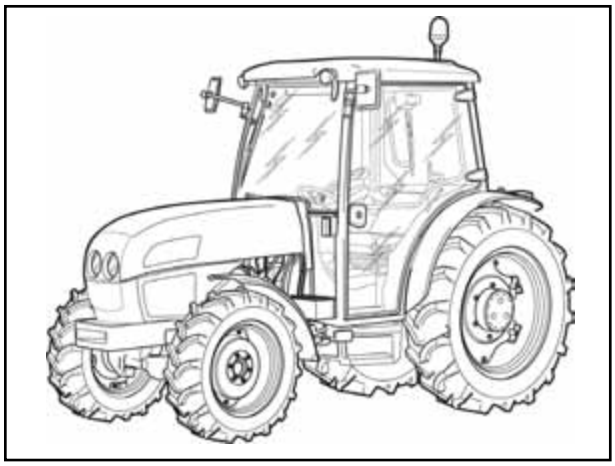


Fig. 1.13

3.4.1.3 Safety - cab

The safety cab has been specially designed for assembly on these tractors and complies with all the safety requirements and noise limits established by the current laws.

The safety cab conforms to international safety standards. The cab MUST NEVER be drilled or modified in order to install accessories or implements. IT IS FORBIDDEN to weld components to the cab or to repair damaged cab components. Never attach chains or cables to the main framework of the cab for towing purposes.

3.4.1.4 Safety precautions

- Protect yourself
- Wear all protective clothing and any personal protection devices called for by the work conditions.
- Never take any risks (Fig.).

You need the following protective clothing:

- A hard hat.
- Safety goggles or mask.
- Hearing protection.
- Respirator or filter mask.
- Clothing for bad weather.
- Reflective clothing.
- Heavy-duty gloves (neoprene for chemicals, leather for rough work);
- Safety shoes.

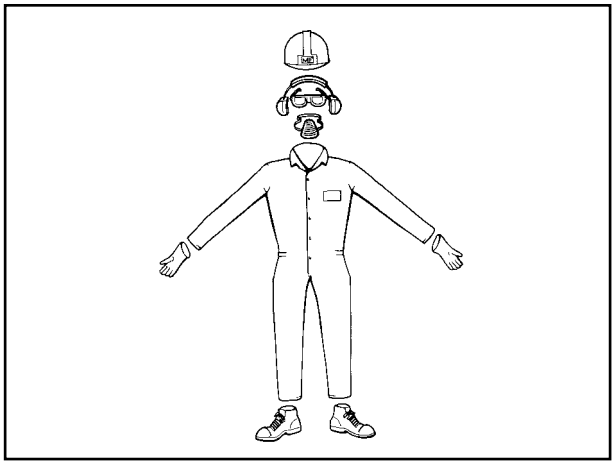


Fig. 1.14

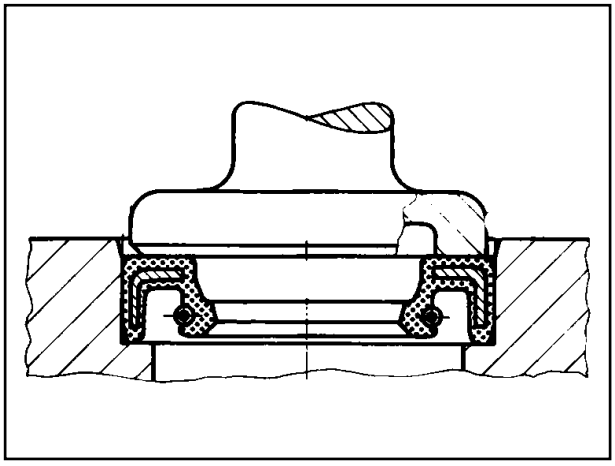


Fig. 1.15

Section 4 : Pre-delivery inspection and maintenance

Index

4.1 General information 1-28

4.2 Pre-delivery inspections 1-29

4.3 Periodical maintenance table 1-30

4.1 General information

To guarantee regular tractor maintenance during the 12-month warranty period, the McCormick dealer must carry out servicing work after 50 and 250 hours service.

The purpose of these interventions is to ensure the tractor maintains the utmost efficiency throughout the entire warranty period, while providing reliable service.

4.2 Pre-delivery inspections

Both the dealer prior to delivery to the Concessionaire and the Concessionaire prior to delivery to the customer of operator, must have carried out the following operations:

a - **General installation**

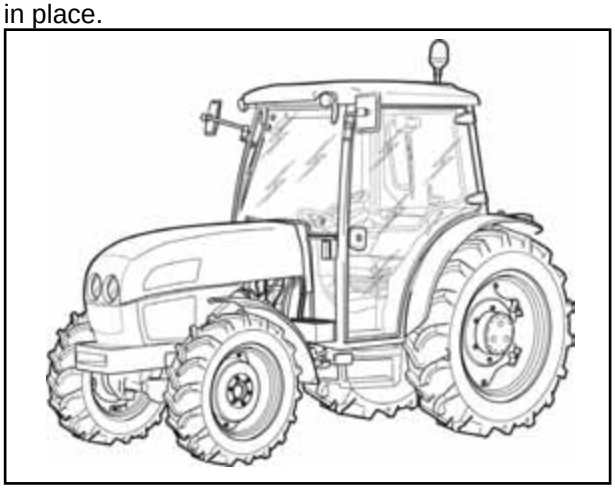
- Clean the lower surface of the battery and spread Vaseline grease on the terminals.
- Charge the battery if necessary.
- Check all the electrical connections and make sure that the cables, the pipes and indicator lights are firmly fixed.
- Check and top up the oil levels in the engine and transmission housings.
- Lubricate all greasing points..
- Check the tension of the belts (alternator, fan, pumps of the servo controls) and adjust if necessary.
- Unless it contains an antifreeze product, flush out the cooling circuit and fill it with soft water.
- Make sure that the tank contains sufficient fuel of the correct type.
- Make sure that the nuts and bolts that fix the cylinder head are well tightened at the correct driving torque. Make sure that the screws and fixing nuts of the intake and exhaust manifolds are well tightened.
- Check and adjust the tappet gap and visually examine the valve springs.
- Check the injectors, bleed the fuel circuit and tighten all the fuel pipe unions.
- Make sure that the engine's air filtering pipes are firmly fastened.
- Check the way the engine's articulations are regulated and make sure that they function freely.
- Start the engine.
- Make sure that the indicator lights and monitoring instruments function correctly.
- Check the engine rate on the speed indicator using the throttle.
- Hitch a towed implement and make sure that the tractor's hydraulic accessories work properly.
- Make sure that all nuts, bolts, centering pins, pipe unions and fixing devices are correctly fastened.
- Make sure that there are no leaks from the pipes.
- Make sure that the headlights operate correctly.
- Make a trial run with the tractor and check to make sure that the brakes, monitoring instruments and accessories function correctly.

b - Driving torques

- Check the driving torques of the nuts and bolts that fix the various chassis connections:
- Engine/Gearbox
- Gearbox/Rear axle
- Axle shaft housings/Rear axle
- Check the driving torques of the nuts and bolts that fix the driving wheels.

Total safety 7

Before consigning the machine to the customer, make sure that everything functions correctly, especially the safety systems. Fit all the guards and protections in place.



4.3 Periodical maintenance table

Work hours	Operation N°	Maintenance operations	Top up level	Cleaning	Adjustment	Replace	Check efficiency	Lubrication
Maintenance when required (4)	1	Engine oil level	●					
	2	Oil level in transmission, power lift and steering circuits	●					
	3	Battery	●					
	4	Fuel filter		●				
	5	Expansion vessel of engine coolant radiator	●					
	6	Engine coolant radiator		●				
	7	Gearbox and hydraulic circuit oil radiator (if installed)		●				
	8	Condenser of cab air conditioning system		●				
	9	Dry air filter discharge valve		●				
	10	Dry air filter outer cartridge		●				
	11	Fan and alternator belt			●			
	12	Air conditioning compressor belt (cab version)			●			
	13	Speed Four mechanical clutch pedal			●			
	14	Mechanical PTO clutch lever			●			
	15	Brake circuit oil level	●					
	16	Brake pedals (3)			●			
	17	Parking brake			●			
	18	Oil level in rear final drives	●					
	19	Oil level in front differential housing and front final drives	●					
	20	Check tyre pressures					●	
	Miscellaneous	Check wheel nut tightness					●	
		Check tightness of nuts and bolts in general					●	
		Check tightness of safety frame fixing bolts					●	
		Windscreen wash liquid	●					
Every 100 hours service	21	General lubrication						●
	22	Lubrication of 4WD front axle						●
	23	Lubrication of 2WD front axle (if installed)						●
Every 250 hours service	24	Engine sump				●		
	25	Engine oil filter				●		
	26	Replace intake oil filter of steering and power lift circuits				●		
	27	Replace delivery oil filter of steering and Powershuttle (if installed) circuits				●		

Every 500 hours service	28	Engine valves			○			
	29	Fuel filter				●		
	30	2WD front wheel hubs (if installed)						●
	30b	Clean engine vent (depending on type of engine)(5)				○		
After every 1000 hours service or once a year	31	Injectors and injection pump			○			
	32	Oil of transmission, power lift and steering systems (1)				●		
	33	Rear axle final drives				●		
	34	Steering cylinder ball joints			○			
	35	Replace oil in front differential housing and front final drives				●		
	36	Starter motor and alternator					○	
	37	Dry air filter				●		
	38	Engine cooling system		○				
	39	Drain sludge from fuel tank		○				
General maintenance		Bleed air from the fuel system						
		Bleed air from rear and front brake system						
		Electrical system						
		Preparing for long idle periods						

Notes

○	Operations that must be carried out by an authorized Dealer or service Agent.
(1)	Change the gearbox oil for the first time after 500 hours, then change it after every 1000 hours service (1000-2000-3000 etc...)
(2)	**Warning:** To safeguard the power lift and steering circuits, wash the filter on the pump intakes and change the filter on the steering circuit delivery for the first time after 50 hours. After this, repeat the same operations after every 250 hours service (i.e. 250-500-750-1000 hours…).
(3)	To protect the steering circuit, wash the steering circuit filter after the first 50 hours service. After this, clean filter after every 500 hours service.
(4)	**Warning:** Use your own discretion and experience when deciding the actual intervals for variable interval service and maintenance operations. Always remember, however, that it is better to carry them out too often than not often enough.
(5)	Adjust the brakes after the first 50 hours.
(6)	The closed circuit breather unit (depending on the type of engine) must be replaced after every 8000 hours service or when the engine is completely overhauled.

Section 5 : Conversion tables

Index

5.1 Length.....1-34

5.2 Area.....1-40

5.3 Volume.....1-42

5.4 Weight.....1-48

5.5 Pressure.....1-52

5.6 Moment of rotation.....1-56

5.7 Temperature.....1-60

5.1 Length

From mm to inches

mm	inches	mm	inches	mm	inches	mm	inches
1	0.0394	26	102.36	51	2.0079	76	2.9921
2	0.0387	27	1.0630	52	2.0472	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1102
5	0.1968	30	1.1811	55	2.1653	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	31890
7	0.2756	32	1.2598	57	2.2441	82	3.2283
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3779	60	2.3622	85	3.3464
11	0.4331	36	1.4173	61	2.4016	86	3.33858
12	0.4724	37	1.4567	62	2.4409	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5039
15	0.5905	40	1.5748	65	2.5590	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6535	67	2.6378	92	3.6220
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7165	94	3.7008
20	0.7874	45	1.7716	70	2.7559	95	3.7401
21	0.8268	46	1.8110	71	2.7953	96	3.7795
22	0.8661	47	1.8504	72	2.8346	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8976
25	0.9842	50	1.9685	75	2.9527	100	3.9370

From inches to mm

inches	mm	inches	mm
1/64	0.3969	33/64	13.0969
1/32	0.7937	17/32	13.4937
3/64	1.1906	35/64	13.8906
1/16	1.5875	9/16	14.2875
5/64	1.9844	37/64	14.6844
3/32	2.3812	19/32	15.0812
7/64	2.7781	39/64	15.4781
1/8	3.1750	5/8	15.8750
9/64	3.5719	41/64	16.2719
5/32	3.9687	21/32	16.6687
11/64	4.3656	43/64	17.0656
3/16	4.7625	11/16	17.4625
13/64	5.1594	45/64	17.8594
7/32	5.5562	23/32	18.2562
15/64	5.9531	47/64	18.6531
1/4	6.3500	3/4	19.0500
17/64	6.7469	49/64	19.4469
9/32	7.1437	25/32	19.8437
19/64	7.5406	51/64	20.2406
5/16	7.9375	13/16	20.6375
21/64	8.3344	53/64	21.0344
11/32	8.7312	27/32	21.4312
23/64	9.1281	55/64	21.8281
3/8	9.5250	7/8	22.2250
25/64	9.9219	57/64	22.6219
13/32	10.3187	29/32	23.0187
27/64	10.7156	9/64	23.4156
7/16	11.1125	15/16	23.8125
29/64	11.5094	21/64	24.2094
15/32	11.9062	31/32	24.6062
31/64	12.3062	63/64	25.0031
1/2	12.7000	1	25.4

From ft to meters

ft.	0	1	2	3	**4**
-	**m**	**m**	**m**	**m**	**m**
-	-	0.305	0.610	0.914	1.219
10	3.048	3.353	3.658	3.962	4.267
20	6.096	6.401	6.706	7.010	7.315
30	9.144	9.449	9.754	10.058	10.363
40	12.192	12.497	12.802	13.106	13.411
50	15.240	15.545	15.850	16.154	16.459
60	18.288	18.593	18.898	19.202	19.507
70	21.336	21.641	21.946	22.250	22.555
80	24.384	24.689	24.994	25.298	25.603
90	27.432	27.737	28.042	28.346	28.651
100	30.480	30.785	31.090	31.394	31.699
ft.	**5**	**6**	**7**	**8**	**9**
-	**m**	**m**	**m**	**m**	**m**
-	1.524	1.829	2.134	2.438	2.743
10	4.572	4.877	5.182	5.486	5.791
20	7.620	7.925	8.230	8.534	8.839
30	10.668	10.973	11.278	11.582	11.887
40	13.716	14.021	14.326	14.630	14.935
50	16.764	17.069	17.374	17.678	17.983
60	19.812	20.117	20.422	20.726	21.031
70	22.860	23.165	23.470	23.774	24.079
80	25.908	26.213	26.518	26.822	27.127
90	28.956	29.261	29.566	29.870	30.175
100	32.004	32.309	32.614	32.918	33.223

From meters to ft

m	0	1	2	3	**4**
	ft.	**ft.**	**ft.**	**ft.**	**ft.**
-		3.2808	6.5617	9.8425	13.1234
10	32.8084	36.0892	39.3701	42.6509	45.9318
20	65.6168	68.8976	72.1785	75.4593	78.7402
30	98.4252	101.7060	104.9869	108.2677	111.5486
40	131.2336	134.5144	137.7953	141.0761	144.3570
50	164.0420	167.3228	170.6037	173.8845	177.1654
60	196.8504	200.1312	203.4121	206.6929	209.9738
70	229.6588	232.9396	236.2205	239.5013	242.7822
80	262.4672	265.7480	269.0289	272.3097	275.5906
90	295.2756	298.5564	301.8373	305.1181	308.3990
100	328.0840	331.3648	334.6457	337.9265	341.2074
m	**5**	**6**	**7**	**8**	**9**
	ft.	**ft.**	**ft.**	**ft.**	**ft.**
-	16.4042	19.6850	22.9659	26.2467	29.5276
10	49.2126	52.4934	55.7743	59.0551	62.3360
20	82.0210	85.3018	88.5827	91.8635	95.1444
30	114.8294	118.1102	121.3911	124.6719	127.9528
40	147.6378	450.9186	154.1995	175.4803	160.7612
50	180.4462	183.7270	187.0079	190.2887	193.5696
60	213.2546	216.5354	219.8163	223.0971	226.3780
70	246.0630	249.3438	252.6247	255.9055	259.1864
80	278.8714	282.1522	285.4331	288.7139	291.9948
90	311.6798	314.9606	318.2415	321.5223	324.8032
100	344.4881	347.7690	351.0499	354.3307	357.6116

Da miles to kilometers

miles	0	1	2	3	**4**
	km	**km**	**km**	**km**	**km**
-		1.609	3.219	4.828	6.437
10	16.093	17.703	19.312	20.921	22.531
20	32.187	33.796	35.406	37.015	38.624
30	48.280	49.890	51.499	53.108	54.718
40	64.374	65.983	67.593	69.202	70.811
50	80.467	82.077	83.686	85.295	86.905
60	96.561	98.170	99.779	101.390	103.000
70	112.650	114.260	115.870	117.480	119.090
80	128.750	130.360	131.970	133.580	135.190
90	144.840	146.450	148.060	149.670	151.280
100	160.930	162.540	164.150	165.760	167.370
miles	**5**	**6**	**7**	**8**	**9**
	km	**km**	**km**	**km**	**km**
-	8.047	9.656	11.265	12.875	14.484
10	24.140	25.750	27.359	28.968	30.578
20	40.234	41.843	43.452	45.062	46.671
30	56.327	57.936	59.546	61.155	62.764
40	72.421	74.030	75.639	77.249	78.858
50	88.514	90.123	91.733	93.342	94.951
60	104.610	106.220	107.830	109.440	111.040
70	120.700	122.310	123.920	125.530	127.140
80	136.790	138.400	140.010	141.620	143.230
90	152.890	154.500	156.110	157.720	159.330
100	168.980	170.590	172.200	173.810	175.420

From kilometers to miles

km	0	1	2	3	**4**
-	**miles**	**miles**	**miles**	**miles**	**miles**
-	-	0.621	1.243	1.864	2.486
10	6.214	6.835	7.457	8.078	8.699
20	12.427	13.049	13.670	14.292	14.913
30	18.641	19.263	19.884	20.506	21.127
40	24.855	25.477	26.098	26.720	27.341
50	31.069	31.690	32.311	32.933	33.554
60	37.282	37.904	38.525	39.147	39.768
70	43.497	44.118	44.739	45.361	45.982
80	49.711	50.332	50.953	51.575	52.196
90	55.924	56.545	57.166	57.788	58.409
100	62.138	62.759	63.380	64.002	64.629
km	**5**	**6**	**7**	**8**	**9**
-	**miles**	**miles**	**miles**	**miles**	**miles**
-	3.107	3.728	4.350	4.971	5.592
10	9.321	9.942	10.562	11.185	11.805
20	15.534	16.156	16.776	17.399	18.019
30	21.748	22.370	22.990	23.613	24.233
40	27.962	28.584	29.204	29.827	30.447
50	34.175	34.797	35.417	36.040	36.660
60	40.389	41.011	41.631	42.254	42.874
70	46.603	47.225	47.845	48.468	49.088
80	52.817	53.439	54.059	54.682	55.302
90	59.030	59.652	60.272	60.895	61.515
100	65.244	65.866	66.486	67.109	67.729

5.2 Area

From square inches to square centimeters

sq in	0	1	2	3	**4**
-	**sq cm**	**sq cm**	**sq cm**	**sq cm**	**sq cm**
-	-	6.452	12.903	19.355	25.806
10	64.516	70.968	77.419	83.871	90.322
20	129.032	135.484	141.935	148.387	154.838
30	193.548	200.000	206.451	212.903	219.354
40	258.064	264.516	270.967	277.419	283.870
50	322.580	329.032	335.483	341.935	348.386
60	397.096	393.548	399.999	406.451	412.902
70	451.612	458.064	464.515	470.967	477.418
80	516.128	522.580	529.031	535.483	541.934
90	580.644	587.096	593.547	599.999	606.450
100	645.160	651.612	658.063	664.515	670.966
sq in	**5**	**6**	**7**	**8**	**9**
-	**sq cm**	**sq cm**	**sq cm**	**sq cm**	**sq cm**
-	32.258	38.710	45.161	51.613	58.064
10	96.774	103.226	109.677	116.129	122.580
20	161.290	167.742	174.193	180.645	187.096
30	225.806	232.258	238.709	245.161	251.612
40	290.322	296.744	303.225	309.677	316.128
50	354.838	361.290	367.741	374.193	380.644
60	419.354	425.806	432.357	138.709	445.160
70	483.870	490.322	496.773	503.225	509.676
80	548.386	554.838	561.289	567.741	574.192
90	612.902	619.354	625.805	632.257	638.708
100	677.418	683.870	690.321	696.773	703.224

From square centimeters to square inches

sq cm	0	1	2	3	**4**
-	**sq in**	**sq in**	**sq in**	**sq in**	**sq in**
-	-	0.155	0.310	0.465	0.620
10	1.550	1.705	1.860	2.015	2.170
20	3.100	3.255	3.410	3.565	3.720
30	4.650	4.805	4.960	5.115	5.270
40	6.200	6.355	6.510	6.665	6.820
50	7750	7.905	6.510	6.665	6.820
60	9.300	9.455	9.610	9.765	9.920
70	10.850	11.005	11.160	11.315	11.4708
80	12.400	12.555	12.710	12.865	13.020
90	13.950	14.105	14.260	14.415	14.570
100	15.500	15.655	15.810	15.965	16.120
sq cm	**5**	**6**	**7**	**8**	**9**
-	**sq in**	**sq in**	**sq in**	**sq in**	**sq in**
-	0.775	0.930	1.085	1.240	1.395
10	2.325	1.480	2.635	2.790	2.945
20	3.875	4.030	4.185	4.340	4.495
30	5.425	5.580	5.735	5.890	6.045
40	6.975	7.130	7.285	7.440	7.595
50	8.525	8.680	8.835	8.990	9.145
60	10.075	10.230	10.385	10.540	10.695
70	11.625	11.780	11.935	12.090	12.245
80	13.175	13.330	13.485	13.640	13.795
90	14.725	14.880	15.035	15.190	15.345
100	16.275	16.430	16.385	16.740	16.895

5.3 Volume

From cubic inches to cubic centimeters

sq in	0	**1**	**2**	**3**	**4**
-	**cc**	**cc**	**cc**	**cc**	**cc**
-	-	16.387	32.774	49.161	65.548
10	163.871	180.258	196.645	213.032	229.419
20	327.741	344.128	360.515	376.902	393.290
30	491.612	507.999	524.386	540.773	557.160
40	655.483	671.870	688.257	704.644	721.031
50	819.353	835.740	853.127	868.514	884.901
60	983.224	999.611	1015.998	1032.385	1048.772
70	1147.094	1163.482	1179.869	1196.256	1212.643
80	1310.965	1327.352	1343.739	1360.126	1376.513
90	1474.836	1491.223	1507.610	1523.997	1540.384
100	1638.706	1655.093	1671.481	1687.868	1704.255
miles	**5**	**6**	**7**	**8**	**9**
-	**km**	**km**	**km**	**km**	**km**
-	81.935	98.322	114.709	131.097	147.484
10	245.806	262.193	278.580	294.967	311.354
20	209.677	426.064	442.451	458.838	475.225
30	573.547	589.935	606.321	622.702	639.095
40	737.418	753.805	770.192	786.579	802.966
50	901.289	917.676	934.063	950.450	966.837
60	1065.159	1081.546	1097.933	1114.320	1130.707
70	1229.030	1245.417	1261.804	1278.191	1294.578
80	1392.200	1409.288	1425.675	1442.062	1458.449
90	1556.771	1573.158	1589.545	1605.932	1622.319
100	1720.642	1737.092	1753.416	1769.803	1786.190

From cubic centimeters to cubic inches

cc	0	1	2	3	**4**
-	**cubic in**	**cubic in**	**cubic in**	**cubic in**	**cubic in**
-	-	0.0610	0.1220	0.1831	0.2441
10	0.6102	0.6713	0.7323	0.7933	0.8543
20	1.2205	1.2815	1.3425	1.4035	1.4646
30	1.8307	1.8917	1.9528	2.0138	2.0748
40	2.4409	2.5020	2.5630	2.6240	2.6850
50	3.0512	3.1122	3.1732	3.2343	3.2953
60	3.6614	3.7224	3.7835	3.8445	3.9055
70	4.2717	4.3327	4.3937	4.4547	4.5158
80	4.8819	4.9429	5.0039	5.0650	5.1260
90	5.4921	5.5532	5.6142	5.6752	5.7362
100	6.1024	6.1634	6.2244	6.2854	6.3465
cc	**5**	**6**	**7**	**8**	**9**
-	**cubic in**	**cubic in**	**cubic in**	**cubic in**	**cubic in**
-	0.3051	0.3661	0.4272	0.4882	0.5492
10	0.9154	0.9764	1.0374	1.0984	1.1595
20	1.5256	1.5866	1.6476	1.7087	1.7697
30	2.1358	2.1969	2.2579	2.3189	2.3799
40	2.7461	2.8071	2.8681	2.9291	2.9902
50	3.3563	3.4173	3.4784	3.5394	3.6004
60	3.9665	4.0276	4.0886	4.1495	4.2106
70	4.5768	4.6378	4.6988	4.7599	4.8209
80	5.1870	5.2480	5.3091	5.3701	5.4311
90	5.7973	5.8583	5.9193	5.9803	6.0414
100	6.4075	6.4685	6.5295	6.5906	6.6516

From gallons (U.S.) to liters

U.S. gal.	0	1	2	3	**4**
-	**liters**	**liters**	**liters**	**liters**	**liters**
-	**-**	**3.7854**	**7.5709**	**11.3563**	**15.1417**
10	**37.8543**	**41.6397**	**45.4251**	**49.2105**	**52.9960**
20	**75.7085**	**79.4940**	**83.2794**	**87.0648**	**90.8502**
30	**113.5528**	**117.3482**	**121.1337**	**124.9191**	**128.7045**
40	**151.4171**	**155.2025**	**158.9879**	**162.7734**	**166.5588**
50	**189.2713**	**1930568**	**196.8422**	**200.6276**	**204.4131**
60	**227.1256**	**230.9110**	**234.6965**	**238.4819**	**242.2673**
70	**264.9799**	**268.7653**	**272.5507**	**276.3362**	**280.1216**
80	**302.8342**	**306.6196**	**310.4050**	**314.1904**	**317.9759**
90	**340.6884**	**344.4738**	**348.2593**	**352.0447**	**355.8301**
100	**378.5427**	**382.3281**	**386.1135**	**389.8990**	**393.6844**
U.S. gal.	**5**	**6**	**7**	**8**	**9**
-	**liters**	**liters**	**liters**	**liters**	**liters**
-	**18.9271**	**22.7126**	**26.4980**	**302834**	**34.0638**
10	**56.7814**	**60.5668**	**64.3523**	**68.1377**	**71.9231**
20	**94.6357**	**98.4211**	**102.2065**	**105.9920**	**109.7774**
30	**132.4899**	**136.2754**	**140.0608**	**143.8462**	**147.6316**
40	**170.3442**	**174.1296**	**177.9151**	**181.7005**	**185.4859**
50	**208.1985**	**211.9839**	**215.7693**	**219.5548**	**223.3402**
60	**246.0527**	**2498382**	**253.6236**	**257.4090**	**261.1945**
70	**283.9070**	**287.6924**	**291.4779**	**295.2633**	**299.0487**
80	**321.7613**	**325.5467**	**329.3321**	**333.1176**	**336.9030**
90	**359.6156**	**363.4010**	**367.1864**	**370.9718**	**347.7573**
100	**397.4698**	**401.2553**	**405.0407**	**408.8261**	**412.6115**

From liters to gallons (U.S.)

Liters	0	1	2	3	**4**
-	**gal.**	**gal.**	**gal.**	**gal.**	**gal.**
-	**-**	**0.2642**	**0.5283**	**0.7925**	**1.0567**
10	**2.6417**	**2.9059**	**3.1701**	**3.4342**	**3.6984**
20	**5.2834**	**5.5476**	**5.8118**	**6.0759**	**6.3401**
30	**7.9251**	**8.1893**	**8.4535**	**8.7176**	**8.9818**
40	**10.5668**	**10.8310**	**11.0952**	**11.3594**	**11.6235**
50	**13.2086**	**13.4727**	**13.7369**	**14.0011**	**14.2652**
60	**15.8503**	**16.1144**	**16.3786**	**16.6428**	**16.9069**
70	**18.4920**	**18.7561**	**19.0203**	**19.2845**	**19.5487**
80	**21.1337**	**21.3979**	**21.6620**	**21.9262**	**22.1904**
90	**23.7754**	**24.0396**	**24.3037**	**24.5679**	**24.8321**
100	**26.4171**	**26.6813**	**26.9454**	**27.2096**	**27.4738**
Liters	**5**	**6**	**7**	**8**	**9**
-	**gal.**	**gal.**	**gal.**	**gal.**	**gal.**
-	**1.3209**	**1.5850**	**1.8492**	**2.1134**	**2.3775**
10	**3.9626**	**4.2267**	**4.4909**	**4.7551**	**5.0192**
20	**6.6043**	**6.8684**	**7.1326**	**7.3968**	**7.6610**
30	**9.2460**	**9.5102**	**9.7743**	**10.0385**	**10.3027**
40	**11.8877**	**12.1519**	**12.4160**	**12.6802**	**129444**
50	**14.5294**	**14.7936**	**15.0577**	**15.3219**	**15.5861**
60	**17.1711**	**17.4353**	**17.6995**	**17.9636**	**18.2278**
70	**19.8128**	**20.0770**	**20.3412**	**20.6053**	**20.8695**
80	**22.4545**	**22.7187**	**22.9829**	**23.2470**	**23.5112**
90	**25.0962**	**25.3604**	**25.6246**	**25.8888**	**26.1529**
100	**27.7380**	**28.0021**	**28.2663**	**28.5305**	**28.7946**

From gallons (IMP) to liters

Imp. gal.	0	1	2	3	**4**
-	**liters**	**cubic in**	**cubic in**	**cubic in**	**cubic in**
-	**-**	**4.5460**	**9.0919**	**13.6379**	**18.1838**
10	**45.4596**	**50.0056**	**54.5515**	**59.0975**	**63.6434**
20	**90.9192**	**95.4652**	**100.0111**	**104.5571**	**109.1030**
30	**136.3788**	**140.9248**	**145.4707**	**150.0167**	**154.5626**
40	**181.8384**	**186.3844**	**190.9303**	**195.4763**	**200.0222**
50	**227.2980**	**231.8440**	**236.3899**	**240.9359**	**245.4818**
60	**272.7576**	**277.3036**	**281.8495**	**286.3955**	**290.9414**
70	**318.2172**	**322.7632**	**327.3091**	**331.8551**	**336.4010**
80	**363.6768**	**368.2223**	**372.7687**	**377.3147**	**381.8606**
90	**409.1364**	**413.6824**	**418.2283**	**422.7743**	**427.3202**
100	**454.5960**	**459.1420**	**463.6879**	**468.2339**	**472.7798**
Imp. gal.	**5**	**6**	**7**	**8**	**9**
-	**liters**	**liters**	**liters**	**liters**	**liters**
-	**22.7298**	**27.2758**	**31.8217**	**36.3677**	**40.9136**
10	**68.1894**	**72.2354**	**77.2813**	**81.8275**	**86.3732**
20	**113.6490**	**118.1950**	**122.7409**	**127.2869**	**131.8328**
30	**159.1086**	**163.6546**	**168.0005**	**172.7465**	**177.2924**
40	**204.5682**	**209.1142**	**213.6601**	**218.2061**	**222.7520**
50	**250.0278**	**254.5738**	**259.1197**	**263.6675**	**268.2116**
60	**295.4874**	**300.0334**	**304.5793**	**309.1253**	**313.6712**
70	**340.9470**	**345.4930**	**350.0389**	**354.5849**	**359.1308**
80	**386.4066**	**390.9526**	**395.4985**	**400.0445**	**404.5004**
90	**431.8662**	**436.4122**	**440.9581**	**445.9041**	**450.0500**
100	**477.3258**	**4818718**	**4864177**	**490.9637**	**495.5096**

From liters to gallons (IMP)

Liters	0	1	2	3	**4**
-	**gal.**	**gal.**	**gal.**	**gal.**	**gal.**
-	**-**	**0.2200**	**0.4400**	**0.6599**	**0.8799**
10	**2.1998**	**2.4197**	**2.6397**	**2.8597**	**3.0797**
20	**4.3995**	**4.6195**	**4.8395**	**5.0594**	**5.2794**
30	**6.5993**	**6.8193**	**7.0392**	**7.2592**	**2.4792**
40	**8.7990**	**9.0190**	**9.2390**	**9.4590**	**9.6789**
50	**10.9988**	**11.2188**	**11.4388**	**11.6587**	**11.8787**
60	**13.1986**	**13.4185**	**13.6385**	**13.8585**	**14.0785**
70	**15.3983**	**15.6183**	**15.8383**	**16.0582**	**16.2782**
80	**17.5981**	**17.8181**	**18.0380**	**18.2580**	**18.4780**
90	**19.7978**	**20.0178**	**20.2378**	**20.4578**	**20.6777**
100	**21.9976**	**22.2176**	**22.4376**	**22.6575**	**22.8775**
Liters	**5**	**6**	**7**	**8**	**9**
-	**gal.**	**gal.**	**gal.**	**gal.**	**gal.**
-	**1.0999**	**1.3199**	**1.5398**	**1.7598**	**1.9798**
10	**3.2996**	**3.5196**	**3.7396**	**3.9596**	**4.1795**
20	**5.4994**	**5.7194**	**5.9394**	**6.1593**	**6.3739**
30	**7.6992**	**7.9191**	**8.1391**	**8.3591**	**8.5791**
40	**9.8989**	**10.9189**	**10.3389**	**10.5588**	**10.7788**
50	**12.0987**	**12.3187**	**12.5386**	**12.7586**	**12.9786**
60	**14.2984**	**14.5184**	**14.7384**	**14.9584**	**15.1783**
70	**16.4982**	**16.7182**	**16.9382**	**17.1581**	**17.3781**
80	**18.6980**	**18.9179**	**19.1379**	**19.3579**	**19.5779**
90	**20.8977**	**21.1177**	**21.3377**	**21.5576**	**21.7776**
100	**23.0975**	**23.3175**	**23.5374**	**23.7574**	**23.9774**

5.4 Weight

From Pounds to Kilograms

lbs.	0	1	2	3	**4**
-	**kg**	**kg**	**kg**	**kg**	**kg**
-	**-**	**0.454**	**0.907**	**1.361**	**1.814**
10	**4.536**	**4.990**	**5.443**	**5.897**	**6.350**
20	**9.072**	**9.525**	**9.979**	**10.433**	**10.886**
30	**13.608**	**14.061**	**14.515**	**14.969**	**15.422**
40	**18.144**	**18.597**	**19.051**	**19.504**	**19.958**
50	**22.680**	**23.133**	**23.587**	**24.040**	**24.494**
60	**27.216**	**27.669**	**28.123**	**28.576**	**29.030**
70	**31.571**	**32.205**	**32.659**	**33.112**	**33.566**
80	**36.287**	**36.741**	**37.195**	**37.648**	**38.102**
90	**40.823**	**41.277**	**41.730**	**42.184**	**42.638**
100	**45.359**	**45.813**	**46.266**	**46.720**	**47.174**
lbs.	**5**	**6**	**7**	**8**	**9**
-	**kg**	**kg**	**kg**	**kg**	**kg**
-	**2.268**	**2.722**	**3.175**	**3.629**	**4.082**
10	**6.804**	**7.257**	**7.711**	**8.165**	**8.618**
20	**11.340**	**11.793**	**12.247**	**12.701**	**13.154**
30	**15.876**	**16.329**	**16.783**	**17.237**	**17.690**
40	**20.412**	**20.865**	**21.319**	**21.772**	**22.226**
50	**24.948**	**25.401**	**25.855**	**26.308**	**26.762**
60	**29.484**	**29.937**	**30.391**	**30.844**	**31.298**
70	**34.091**	**34.473**	**34.927**	**35.380**	**35.834**
80	**38.555**	**39.009**	**39.463**	**39.916**	**40.370**
90	**43.092**	**43.545**	**43.998**	**44.453**	**44.906**
100	**47.627**	**48.081**	**48.534**	**48.988**	**49.442**

From Kilograms to Pounds

kg	0	1	2	3	**4**
-	**lbs.**	**lbs.**	**lbs.**	**lbs.**	**lbs.**
-	**-**	**2.205**	**4.409**	**6.614**	**8.818**
10	**22.046**	**24.251**	**26.455**	**28.660**	**30.865**
20	**44.092**	**46.297**	**48.502**	**50.706**	**52.911**
30	**66.139**	**68.343**	**70.548**	**72.752**	**74.957**
40	**88.185**	**90.389**	**92.594**	**94.799**	**97.003**
50	**110.230**	**112.440**	**114.640**	**116.840**	**119.050**
60	**132.280**	**134.480**	**136.690**	**138.890**	**141.100**
70	**154.320**	**156.530**	**158.730**	**160.940**	**163.140**
80	**176.370**	**178.570**	**180.780**	**182.980**	**185.190**
90	**198.420**	**200.620**	**202.830**	**205.030**	**207.230**
100	**220.460**	**222.670**	**224.870**	**227.080**	**229.280**
cc.	**5**	**6**	**7**	**8**	**9**
-	**cubic in**	**cubic in**	**cubic in**	**cubic in**	**cubic in**
-	**11.023**	**13.228**	**15.432**	**17.637**	**19.842**
10	**33.069**	**35.274**	**37.479**	**39.683**	**41.888**
20	**55.116**	**57.320**	**59.525**	**61.729**	**63.934**
30	**77.162**	**79.366**	**81.571**	**83.776**	**85.980**
40	**99.208**	**101.410**	**103.620**	**105.820**	**108.030**
50	**121.250**	**123.460**	**125.660**	**127.870**	**130.070**
60	**143.300**	**145.510**	**147.710**	**149.910**	**152.120**
70	**165.350**	**167.550**	**169.760**	**171.960**	**174.170**
80	**187.390**	**189.600**	**191.800**	**194.010**	**196.210**
90	**209.440**	**211.640**	**213.850**	**216.050**	**218.260**
100	**231.490**	**233.690**	**235.890**	**238.100**	**240.300**

From Kilograms to Newtons

kg	0	1	2	3	**4**
-	**N**	**N**	**N**	**N**	**N**
-	**-**	**9.81**	**19.61**	**29.42**	**39.23**
10	**98.07**	**107.87**	**117.68**	**127.49**	**137.29**
20	**196.13**	**205.94**	**215.75**	**225.55**	**235.36**
30	**294.20**	**304.01**	**313.81**	**323.62**	**333.43**
40	**392.27**	**402.07**	**411.88**	**421.69**	**431.49**
50	**490.33**	**500.14**	**509.95**	**519.75**	**529.56**
60	**558.40**	**598.21**	**608.01**	**617.82**	**627.63**
70	**686.47**	**696.27**	**706.08**	**715.89**	**725.69**
80	**784.53**	**794.34**	**804.15**	**813.95**	**823.76**
90	**882.60**	**892.41**	**902.21**	**912.02**	**921.83**
100	**980.66**	**990.47**	**1000.30**	**1010.08**	**1019.89**
kg	**5**	**6**	**7**	**8**	**9**
-	**N**	**N**	**N**	**N**	**N**
-	**49.03**	**58.81**	**68.65**	**78.45**	**88.26**
10	**147.10**	**156.91**	**166.71**	**176.52**	**186.33**
20	**245.17**	**254.97**	**264.78**	**274.59**	**284.39**
30	**343.23**	**353.04**	**362.85**	**372.65**	**382.46**
40	**441.30**	**451.11**	**460.91**	**470.72**	**480.53**
50	**539.37**	**549.17**	**558.98**	**568.79**	**578.59**
60	**637.43**	**647.24**	**657.05**	**666.85**	**676.66**
70	**735.50**	**745.31**	**755.11**	**764.92**	**774.73**
80	**833.57**	**843.37**	**853.18**	**862.99**	**872.79**
90	**931.63**	**941.44**	**951.25**	**961.05**	**970.86**
100	**1029.69**	**1039.47**	**1049.31**	**1059.11**	**1068.92**

From Newtons to Kilograms

N	0	1	2	3	**4**
-	**kg**	**kg**	**kg**	**kg**	**kg**
-	**-**	**1.020**	**2.039**	**3.059**	**4.079**
100	**10.197**	**11.217**	**12.237**	**13.256**	**14.276**
200	**20.394**	**21.414**	**22.434**	**23.453**	**24.473**
300	**30.591**	**31.611**	**32.631**	**33.651**	**34.670**
400	**40.789**	**41.808**	**42.828**	**43.848**	**44.868**
500	**50.986**	**52.006**	**53.025**	**54.045**	**55.065**
600	**61.183**	**62.203**	**63.222**	**64.242**	**65.262**
700	**71.380**	**72.400**	**73.420**	**74.439**	**75.459**
800	**81.577**	**82.597**	**83.617**	**84.636**	**85.656**
900	**91.774**	**92.794**	**93.814**	**94.834**	**95.853**
1000	**101.972**	**102.990**	**104.011**	**105.031**	**106.051**
cc.	**5**	**6**	**7**	**8**	**9**
-	**kg**	**kg**	**kg**	**kg**	**kg**
-	**5.099**	**6.118**	**7.138**	**8.158**	**9.177**
100	**15.296**	**16.315**	**17.335**	**18.355**	**19.375**
200	**25.493**	**26.513**	**27.513**	**28.552**	**29.572**
300	**35.690**	**36.710**	**37.729**	**38.749**	**39.769**
400	**45.887**	**46.907**	**47.927**	**48.946**	**49.966**
500	**56.084**	**57.104**	**58.124**	**59.144**	**60.163**
600	**66.282**	**67.301**	**68.321**	**69.341**	**70.360**
700	**76.479**	**77.498**	**78.518**	**79.538**	**80.558**
800	**86.676**	**87.696**	**88.715**	**89.735**	**90.755**
900	**96.873**	**97.893**	**98.912**	**99.932**	**100.951**
1000	**107.071**	**108.090**	**109.110**	**110.130**	**111.149**

5.5 Pressure

From pounds per square inch to kilograms per square centimeter

lb/sq in (psi)	0	1	2	3	4
-	kg/sq cm	kg/sq cm	kg/sq cm	kg/sq cm	kg/sq cm
-	0.0703	0.1406	0.2100	0.2812	-
10	0.7031	0.7734	0.8437	0.9140	0.9843
20	1.4062	1.4765	1.5468	1.6171	1.6874
30	2.1092	2.1795	2.2498	2.3202	2.3905
40	2.8123	2.8826	2.9529	3.0232	3.0935
50	3.5154	3.5857	3.6560	3.7263	3.7966
60	4.2185	4.2888	4.3591	4.4294	4.4997
70	4.9216	4.9919	5.0622	5.1325	5.2028
80	5.6246	5.6949	5.7652	5.8356	5.9059
90	6.3277	6.3980	6.4683	6.5386	6.6089
100	7.0308	7.1011	7.1714	7.2417	7.3120
lb/sq in (psi)	5	6	7	8	9
-	kg/sq cm	kg/sq cm	kg/sq cm	kg/sq cm	kg/sq cm
-	0.3515	0.4218	0.4921	0.5625	0.6328
10	1.0546	1.1249	1.1952	1.2655	1.3358
20	1.7577	1.8280	1.8983	1.9686	2.0389
30	2.4608	2.5311	2.6014	2.6717	2.7420
40	3.1639	3.2342	3.3045	3.3748	3.4451
50	3.8669	3.9372	4.0072	4.0779	4.1482
60	4.5700	4.6403	4.7106	4.7809	4.8512
70	5.2731	5.3434	5.4137	5.4840	5.5543
80	5.9762	6.0465	6.1168	6.1871	6.2574
90	6.6793	6.7495	6.8199	6.8902	6.9605
100	7.3823	7.4526	7.5229	7.5933	7.6636

From kilograms per square centimeter to pounds per square inch

kg/sq cm	**0**	**1**	**2**	**3**	**4**
-	**lb/sq in (psi)**	**lb/sq in (psi)**	**lb/sq in (psi)**	**lb/sq in (psi)**	**lb/sq in (psi)**
-	-	14.22	28.45	42.67	56.89
10	142.23	156.45	170.68	184.90	199.12
20	284.46	298.69	312.91	327.13	341.36
30	426.70	440.92	455.14	469.36	483.59
40	568.93	583.15	597.37	611.60	625.82
50	711.16	725.38	739.61	753.83	768.05
60	853.39	867.61	881.84	896.06	910.28
70	995.62	1009.80	1024.10	1038.30	1052.50
80	1137.80	1152.10	1166.30	1180.50	1194.70
90	1280.10	1294.30	1308.50	1322.70	1337.00
100	1422.30	1436.50	1450.80	1465.00	1479.20
lb/sq in (psi)	**5**	**6**	**7**	**8**	**9**
-	**kg/sq cm**	**kg/sq cm**	**kg/sq cm**	**kg/sq cm**	**kg/sq cm**
-	71.12	85.34	99.56	113.78	128.01
10	213.35	227.57	241.79	256.02	270.24
20	355.58	369.80	384.03	398.25	412.47
30	497.81	512.03	526.26	540.48	554.70
40	640.04	654.27	668.49	682.71	696.94
50	782.28	796.50	810.72	824.94	839.17
60	924.51	938.73	952.95	967.18	981.40
70	1066.70	1081.00	1095.20	1109.40	1123.60
80	1209.00	1223.20	1237.40	1251.60	1265.90
90	1351.20	1365.40	1379.60	1393.90	1408.10
100	1493.40	1507.70	1521.90	1536.10	1550.30

From kilograms per square centimeter to Pascal kilos

kg/sq cm	0	1	2	3	4
-	KPa	KPa	KPa	KPa	KPa
-	-	98.1	196.1	294.2	392.3
10	980.7	1078.7	1176.8	1274.9	1372.9
20	1961.3	2059.4	2157.5	2255.5	2353.6
30	2942.0	3040.1	3138.1	3236.2	3334.3
40	3922.7	4020.7	4118.8	4216.9	4314.9
50	4903.3	5001.4	5099.5	5197.5	5295.6
60	5584.0	5982.1	6080.1	6178.2	6276.3
70	6864.7	6962.7	7060.8	7158.9	7256.9
80	7845.3	7943.4	8041.5	8139.5	8237.6
90	8826.0	8924.1	9022.1	9120.2	9218.3
100	9806.6	9904.7	10003.7	10101.8	10198.9
kg/sq cm	**5**	**6**	**7**	**8**	**9**
-	**KPa**	**KPa**	**KPa**	**KPa**	**KPa**
-	490.3	588.4	686.5	784.5	882.6
10	1471.0	1569.1	1667.1	1765.2	1863.3
20	2451.7	2549.7	2647.8	2745.9	2843.9
30	3432.3	3530.4	3628.5	3726.5	3824.6
40	4413.0	5411.1	4609.1	4707.2	4805.3
50	5393.7	5491.7	5589.8	5687.9	5785.9
60	6374.3	6472.4	6570.5	6668.5	6766.6
70	7355.0	7453.1	7551.1	7649.2	7747.3
80	8335.7	8433.7	8531.8	8629.9	8727.9
90	9316.3	9414.4	9512.5	9610.5	9708.6
100	10296.9	10395.0	10493.1	10591.1	10689.2

From Pascal kilos to kilograms per square centimeter

KPa	**0**	**1**	**2**	**3**	**4**
-	**kg/sq cm**	**kg/sq cm**	**kg/sq cm**	**kg/sq cm**	**kg/sq cm**
-	-	1.020	2.039	3.059	4.079
1000	10.197	11.217	13.237	13.256	14.276
2000	20.394	21.414	22.434	23.453	24.473
3000	30.591	31.611	32.631	33.651	34.670
4000	40.789	41.808	42.828	43.848	44.868
5000	50.986	52.006	53.025	54.045	55.065
6000	61.183	52.203	63.222	64.242	65.262
7000	71.380	72.400	73.420	74.439	75.459
8000	81.577	82.597	83.617	84.636	85.656
9000	91.774	92.794	93.814	94.834	95.853
10000	101.972	102.990	104.011	105.031	106.051
KPa	5	6	7	8	9
-	kg/sq cm	kg/sq cm	kg/sq cm	kg/sq cm	kg/sq cm
-	5.099	6.118	7.138	8.158	9.177
1000	15.296	16.315	17.335	18.355	19.375
2000	25.493	26.513	27.532	28.552	29.572
3000	35.690	36.710	37.729	38.749	39.769
4000	45.887	46.907	47.927	48.946	49.966
5000	56.084	57.104	58.124	59.144	60.163
6000	66.282	67.301	68.321	69.341	70.360
7000	76.479	77.498	78.518	79.538	80.558
8000	86.676	87.696	88.715	89.735	90.755
9000	96.873	97.893	98.912	99.932	100.951
10000	107.071	108.090	109.110	110.130	111.149

5.6 Moment of rotation

From ft/pounds to kilogrammeters

ft. lbs.	0	1	2	3	4
-	kg-m	kg-m	kg-m	kg-m	kg-m
-	-	0.138	0.276	0.415	0.553
10	1.382	1.520	1.658	1.796	1.934
20	2.764	2.902	3.040	3.178	3.316
30	4.146	4.284	4.422	4.560	4.698
40	5.528	5.666	5.804	5.942	6.080
50	6.910	7.048	7.186	7.324	7.462
60	8.292	8.430	8.568	8.706	8.844
70	9.674	9.812	9.950	10.088	10.227
80	11.056	11.194	11.332	11.470	11.609
90	12.438	12.576	12.714	12.855	12.991
100	13.820	13.958	14.096	14.235	14373
ft. lbs.	5	6	7	8	9
-	kg-m	kg-m	kg-m	kg-m	kg-m
-	0.691	0.829	0.967	1.106	1.244
10	2.073	2.211	2.349	2.487	2.625
20	3.455	3.593	3.731	3.869	4.007
30	4.837	4.975	5.113	5.251	5.389
40	6.219	6.357	6.495	6.633	6.771
50	7.601	7.739	7.877	8.015	8.153
60	8.983	9.121	9.259	9.397	9.535
70	10.365	10.503	10.641	10.779	10.918
80	11.747	11.885	12.023	12.161	12.300
90	13.129	13.267	13.405	13.544	13.682
100	14.511	14.649	14.787	14.925	14.064

From kilogrammeters to ft/pounds

kg-m	0	1	2	3	4
-	ft.lbs.	ft.lbs.	ft.lbs.	ft.lbs.	ft.lbs.
-	7.23	14.47	21.70	28.93	-
10	72.33	79.57	86.80	94.03	101.27
20	144.67	151.90	159.13	166.37	173.60
30	217.00	224.23	231.46	238.70	245.93
40	289.34	296.57	303.79	311.04	318.27
50	361.66	368.89	376.12	383.36	390.59
60	434.00	441.23	448.45	455.70	462.93
70	506.34	513.57	520.80	528.04	535.27
80	578.68	585.91	593.14	600.38	607.61
90	651.00	658.23	665.46	672.70	679.93
100	723.34	730.57	737.80	745.04	752.27
kg-m	5	6	7	8	9
-	ft.lbs.	ft.lbs.	ft.lbs.	ft.lbs.	ft.lbs.
-	36.17	43.40	50.63	57.87	65.10
10	108.50	115.74	122.97	130.20	137.43
20	180.84	188.08	195.30	202.54	209.77
30	253.17	260.41	267.63	274.87	282.10
40	325.50	332.75	339.98	347.21	354.44
50	397.82	405.07	412.30	419.53	426.76
60	470.17	477.41	484.64	491.87	499.10
70	542.50	549.75	556.98	564.21	571.44
80	614.85	622.09	629.41	636.55	643.78
90	687.17	694.41	701.63	708.87	716.10
100	759.51	766.75	774.07	781.21	788.44

From kilogrammeters to Newton meters

kg-m	0	1	2	3	4
-	N-m	N-m	N-m	N-m	N-m
-	-	9.81	19.61	29.42	39.23
10	98.07	107.87	117.68	127.49	137.29
20	196.13	205.94	215.75	225.55	235.36
30	294.20	304.01	313.81	323.62	333.43
40	392.27	402.07	411.88	421.69	431.49
50	490.33	500.14	509.95	519.75	529.56
60	558.40	598.21	608.01	617.82	627.63
70	686.47	696.27	706.08	715.89	725.69
80	784.53	794.34	804.15	813.95	823.76
90	882.60	892.41	902.21	912.02	921.83
100	980.66	990.47	1000.30	1010.08	1019.89
kg-m	5	6	7	8	9
-	N-m	N-m	N-m	N-m	N-m
-	49.03	58.81	68.65	78.45	88.26
10	147.10	156.91	166.71	176.52	186.33
20	245.17	254.97	264.78	274.59	284.39
30	343.23	353.04	362.85	372.65	382.46
40	441.30	451.11	460.91	470.72	480.53
50	539.37	549.17	558.98	568.79	578.59
60	637.43	647.24	657.05	666.85	676.66
70	735.50	745.31	755.11	764.92	774.73
80	833.57	843.37	853.18	862.99	872.79
90	931.63	941.44	951.25	961.05	970.86
100	1029.69	1039.47	1049.31	1059.11	1068.92

From Newton meters to kilogrammeters

N-m	0	1	2	3	4
-	kg-m	kg-m	kg-m	kg-m	kg-m
-	-	1.020	2.039	3.059	4.079
100	10.197	11.217	12.237	13.256	14.276
200	20.394	21.414	22.434	23.453	24.473
300	30.591	31.611	32.631	33.651	34.670
400	40.789	41.808	42.828	43.848	44.868
500	50.986	52.006	53.025	54.045	55.065
600	61.183	62.203	63.222	64.242	65.262
700	71.380	72.400	73.420	74.439	75.459
800	81.577	82.597	83.617	84.636	85.656
900	91.774	92.794	93.814	94.834	95.853
1000	101.972	102.990	104.011	105.031	106.051
N-m	5	6	7	8	9
-	kg-m	kg-m	kg-m	kg-m	kg-m
-	5.099	6.118	7.138	8.158	9.177
100	15.296	16.315	17.335	18.355	19.375
200	25.493	26.513	27.532	28.552	29.572
300	35.690	36.710	37.729	38.749	39.769
400	45.887	46.907	47.927	48.946	49.966
500	56.084	57.104	58.124	59.144	60.163
600	66.282	67.301	68.321	69.341	70.360
700	76.479	77.498	78.518	79.538	80.558
800	86.676	87.696	88.715	89.735	90.755
900	96.873	97.893	98.912	99.932	100.951
1000	107.071	108.090	109.110	110.130	111.149

5.7 Temperature

From Fahrenheit to degrees Centigrade

°F	°C	°F	°C
-20	-28.9	90	32.2
-15	-26.1	95	35.0
-10	-23.3	100	37.8
-5	-20.6	105	40.6
0	-17.8	110	43.3
1	-17.2	115	46.1
2	-16.7	120	48.9
3	-16.1	125	51.7
4	-15.6	130	54.4
5	-15.0	135	57.2
10	-12.2	140	60.0
15	-94	145	62.8
20	-6.7	150	65.6
25	-3.9	155	68.3
30	-1.1	160	71.1
35	1.7	165	73.9
40	4.4	170	76.7
45	7.2	175	79.4
50	10.0	180	82.2
55	12.8	185	85.0
60	15.6	190	87.8
65	18.3	195	90.6
70	21.1	200	93.3
75	23.9	205	96.1
80	26.7	210	98.9
85	29.4	212	100.0

From degrees Centigrade to Fahrenheit

°F	°C	°F	°C
-30	-22.0	28	82.4
-28	-18.4	30	86.0
-26	-14.2	32	89.6
-24	-11.2	34	93.2
-22	-7.6	36	96.8
-20	-4.0	38	100.4
-18	-04	40	104.0
-16	3.2	42	107.6
-14	68	44	112.2
-12	10.4	46	114.8
-10	14.0	48	118.4
-8	17.6	50	122.0
-6	21.2	52	125.6
-4	24.8	54	129.2
-2	28.4	56	132.8
0	32.0	58	136.4
2	35.6	60	140.0
4	39.2	62	143.6
6	42.8	64	147.2
8	46.4	66	150.8
10	50.0	68	154.4
12	53.6	70	158.0
14	57.2	75	167.0
16	60.8	80	176.0
18	64.4	85	185.0
20	68.0	90	194.0
22	71.6	95	203.0
24	75.2	100	212.0
6	78.8	-	-

Section 6 : Sealants

Index

6.1 Types of Loctite sealant.....1-62

6.2 Practical advice.....1-63

6.2.1 Thread-locking Loctite.....1-63
6.2.2 Assembly of parts.....1-63
6.2.3 Union sealant.....1-63
6.2.4 Liquid seals.....1-63

6.1 Types of Loctite sealant

	Denomination	Type	Use
Thread locking	Weak thread locking	Loctite 222	Weak locking and sealing of screws, adjuster screws.
	Medium-strong thread locking	Loctite 243 (formerly 242)	Medium-strong locking and sealing of threaded parts in general.
	Strong thread locking	Loctite 271 (formerly 270)	Highly resistant fixing, locking and sealing of stud bolts, nuts, screws.
	Penetrating thread locking	Loctite 290	Capillary locking and sealing of already mounted parts. Microporosity sealing.
Assembly of parts	Locker	Loctite 603 (formerly 601)	Highly resistant fixing of coupling surfaces.
	Fixer	Loctite 641	Medium-strong resistance fixing of bushes, bearings, etc. Demounting possible using normal tools.
	Super-locker	Loctite 638	Highly resistant fast fixing of cylindrical parts. Dynamic work.
	High-temperature locker	Loctite 648	Fast fixing of cylindrical parts highly resistant to heat.
Union sealant	Hydraulic and pneumatic	Loctite 542	Sealing of threaded unions on hydraulic or pneumatic pipes up to 3/4” in diameter
	Slow setting	Loctite 572	Sealing of threaded unions in general.
Liquid seals	Thick flat-hermetic	Loctite 510	Sealing of flat surfaces. Manual application.
	Flat-hermetic	Loctite 573	Sealing of precise flat surfaces. Applied by hand or by screen-print systems.
Cleaning	Cleaner and degreaser	Loctite 7063	Prepares components for application of an adhesive or sealant.
	Seal remover	Loctite 7200	Removes all traces of sealant and seals.

6.2 Practical advice

Before applying the products, comply with the specific instructions for each sealant family, as indicated below:

6.2.1 Thread-locking Loctite

1 - Clean all parts with Loctite 7063 and dry;

2 - - If the thread-locker must be applied at a temperature of less than 5°C, pretreat the parts with 7240 (Activator);

3 - If the parts have been in contact with watery washing solutions, remove all traces of these with hot water before use.

6.2.2 Assembly of parts

1 - If the parts have been in contact with watery washing solutions, rinse them with hot water before use;

2 - All parts must be cleaned and dried before application: use Loctite 7063;

3 - Pretreat with activator 7240 if the product is applied at a temperature of less than 5°C.

6.2.3 Union sealant

1 - Clean all parts with Loctite 7063 and dry;

2 - If the parts have been in contact with watery washing solutions, remove them with hot water before use;

3 - If the sealant must be applied at a temperature of less than 5°, pretreat the parts with Loctite 7240 (Activator).

6.2.4 Liquid seals

1 - If there are old seals on the parts, they must be completely removed with Loctite 7200;

2 - All parts must be cleaned and dried before application: use Loctite 7063.

Section 7 : Driving torques

Index

7.1 Driving torques 1-66

7.1 Driving torques

Material	8.8		10.9		12.9	
Screw	Z	B	Z	B	Z	B
M8 x 1	25	27	36	38	43	46
M8 (1.25)	23	25	33	35	40	42
M10 x 1.25	50	55	70	75	85	90
M10 (1.5)	46	50	66	70	80	85
M12 x 1.25	90	97	127	135	143	055
M12 (1.75)	82	86	115	120	138	145
M14 x 1.5	142	153	200	215	240	260
M14 (2)	130	140	182	195	220	235
M16 x 1.5	215	230	300	320	360	390
M16 (2)	200	215	280	300	340	360
M18 x 1.5	310	330	435	470	520	560
M18 (2.5)	270	295	385	415	460	495
M20 x 1.5	430	460	610	660	720	770
M20 (2.5)	390	415	550	585	660	705
3/8” -24 UNF	44	47	62	67	75	80
3/8” -16 UNC	40	43	56	60	68	72
1/2” -20 UNF	105	112	147	157	175	190
1/2” -13 UNC	95	102	135	145	160	173
9/16” -18 UNF	150	160	210	225	250	270
9/16” -12 UNC	135	145	190	205	230	245
5/8” -18 UNF	205	215	285	305	345	365
5/8” -11 UNC	185	200	260	280	315	335
3/4” -16 UNF	355	380	500	535	600	645
3/4” -10 UNC	325	345	455	490	550	585

Driving torques in Nm

Z - galvanized bolt

B - burnished bolt

Torquing tolerances

Crtitical assembly	+5% / -5%
Important assembly	+5% / -15%
Secondary assembly	+5% / -30%

Section 8 : General assembly instructions

Index

8.1 Seals 1-68
8.1.1 General rules 1-68
8.1.2 Assembly 1-68
8.1.3 Replace 1-68

8.2 O-ring seals 1-69
8.2.1 Assembly 1-69

8.3 Bearings 1-70
8.3.1 Introduction 1-70
8.3.2 How to prepare for assembly 1-70
8.3.3 Assembly 1-71
8.3.4 Disassembly 1-72

8.1 Seals

8.1.1 General rules

One single seal is generally sufficient to ensure tightness. The seal lip must point towards the fluid it must retain or from the side on which a pressure is exercised.

Prevent mechanical parts from coming into contact with the seal lip since, besides impairing the actual sealing action, it would also considerably shorten the life of the actual seal.

Thoroughly lubricate the retention ring with grease before assembly to prevent it from operating dry as the shaft turns the first few times.

Retention rings with scoring must bot be lubricated with grease but with oil, as grease would fill the grooves and annul the lubricating effect.

8.1.2 Assembly

1 - The shaft must have a chamfer to facilitate seal assembly.

2 - Protect the seal edge from damage due to threads, rakes, sharp edges, slots for splines, etc. These parts of the shaft should be adequately covered at the time the seal is assembled.

3 - It is advisable to fit the seal in its housing with the aid of a mechanical hydraulic press.

4 - The force required to insert the seal must be exercised as near as possible to the outer diameter of the seal itself. Particularly make sure that the seal is perpendicular to the hole axis.

5 - It is inadvisable to glue the seal to the housing as, even though precautions are taken, the seal lip could be covered with glue and this would lead to deterioration and leaking fluid right from the very first shaft turns.

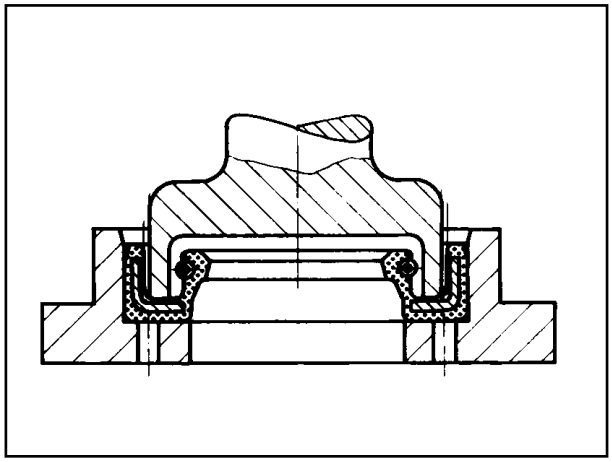


Fig. 1.16

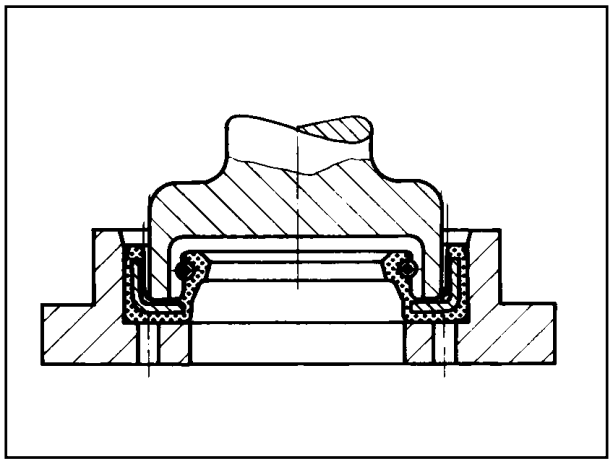


Fig. 1.17

8.1.3 Replace

If an assembly is overhauled, it is always advisable to replace the retention rings on the rotation shafts and the other seals in general.

Make sure that the sealing edge of the new ring does not acts on the same sliding track as the previous ring.

8.2 O-ring seals

8.2.1 Assembly

1 - The O-Ring seal must not be forced on to sharp edges, threaded or grooved parts. In these cases, where constructional requirements make it impossible to avoid it, it is advisable to use a tapered assembly bush or some other similar device.

2 - Before assembling the seal, make sure that the O-Ring corresponds to the case in question. The housing and the other parts must be cleaned with the utmost care. Impurities can damage both the seals and the sliding surfaces.

3 - To facilitate assembly and provide the necessary lubrication right from the start, it is advisable to immerse the seal in the oil it must keep out or to spread it with a light layer of lubricating grease compatible with the material with which the seal is made.

4 - Fit the O-Ring in its housing, taking care not to twist it.

5 - Having finished assembling the components, operate with the greatest care to prevent the seal from being damaged.

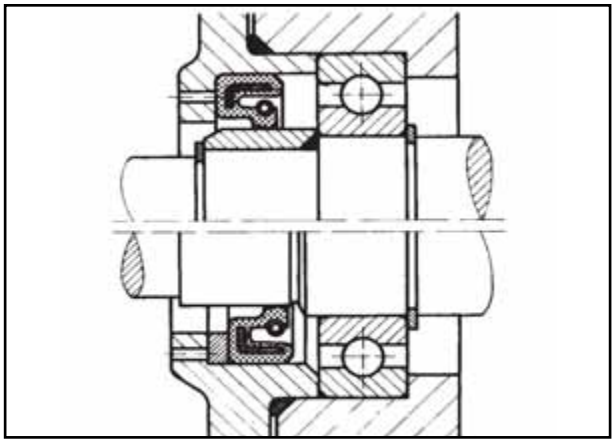


Fig. 1.18

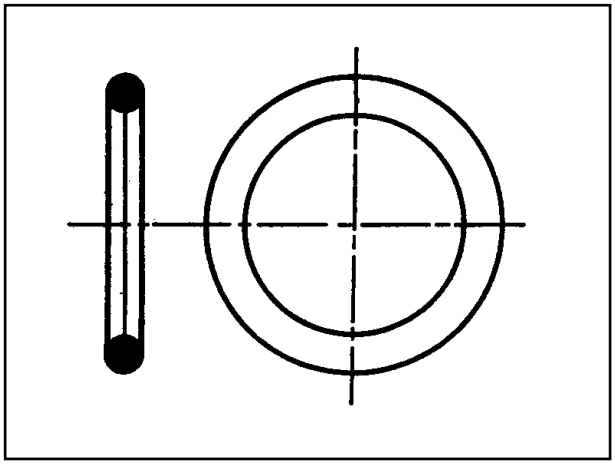


Fig. 1.19

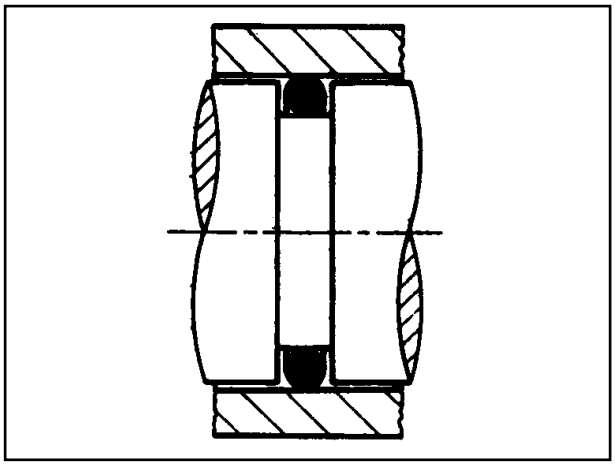


Fig. 1.20

8.3 Bearings

8.3.1 Introduction

Experience and cleanliness when assembling bearings are essential if good performances are to be ensured and to prevent premature yielding. Bearings should be assembled in a dust-free, dry place far from machine tools that produce swarf or machines that create dust.

8.3.2 How to prepare for assembly

1 - Before bearings are assembled, all the necessary parts, the tools and equipment must be ready to hand in the order in which the various components must be assembled, as established by the instructions or drawings in question.

2 - All components involved in bearing application (housings, shafts, etc.) must be thoroughly cleaned and freed from residues due to machining. The rough inner surfaces of cast iron housings must be free from foundry sand. All the bearing components must be checked for size and defects. Bearings will only operate perfectly when the prescribed tolerances are complied with.

3 - The bearings must only be removed from their original packaging when they are about to be assembled, this to prevent foreign bodies from entering them.

4 - It is generally necessary to remove the rust-inhibitor with which the bearings are covered before they leave the factory, this only from the external cylindrical surface and from the hole unless they must be lubricated with grease and used at very high or low temperatures.

In these cases, the bearings must be washed and dried to prevent harmful effects on the lubricating properties of the grease used for these critical temperature conditions.

5 - Bearings that have been contaminated through negligent handling (damaged packaging, etc.) must be washed and dried before assembly. Those bearings which, when removed from their original packaging, have a relatively thick and greasy layer of rust-inhibitor or have been hot-dipped, must also be washed and dried (hot-dipping is still done, particularly when the bearings are very large). Bearings that are supplied already lubricated and equipped with watertight shields or protective shields on both sides must never be washed before they are assembled.

8.3.3 Assembly

- It is very important to avoid impact on the rights, cages and rolling bodies during assembly as they could be damaged. In no case must a pressure be applied to a ring in order to indirectly assemble another. Before the bearings are assembled, the surfaces of the relative housings must be slightly oiled.
- By and large, the first ring to be assembled is the one that creates the greater interference. Small bearings, which must be coupled with a slight interference, can be fitted into their housings by slightly tapping with a mallet and soft metal punch, or preferable a piece of pipe positioned adjacent to the ring face. These blows must successively act on the entire face to prevent the ring from settling off center in relation to the housing. The cup tool illustrated in Fig. allows a well-centered centrifugal force to be applied, thus one that acts evenly on the entire face of the ring. Mechanical or hydraulic presses are generally used for mass production assembly.
- When a non-modular bearing must be assembled with interference on the shaft and housing at the same time, it is advisable to insert a disc between the actual bearing and the tubular fixture (Fig.) in order to divide the assembly force evenly over the faces of the two rings. This method is particularly recommended in the case of positionable bearings to prevent the relative outer ring from settling off-center in relation to the housing. Alternatively, a special cap can be used with two bearing surfaces, one for the inner ring and the other one for the outer ring (Fig.): these surfaces must be coplanar.
- The inner and outer rings of modular bearings can be assembled separately. This facilitates assembly to a considerable extent especially if forced couplings are required for both rings. The moment the two parts of the bearing, already assembled in their respective housings, must be re-coupled, care must be taken to prevent the two rings and the row of balls from having slanting axes, otherwise the tracks could be damaged.
- Rather large bearings cannot always be assembled cold on the shaft or in the housing owing to the entity of the force required (the force required for assembly increases with the size of the bearing). The bearings, their rings or supports (hubs, etc.) should therefore be heated prior to assembly.

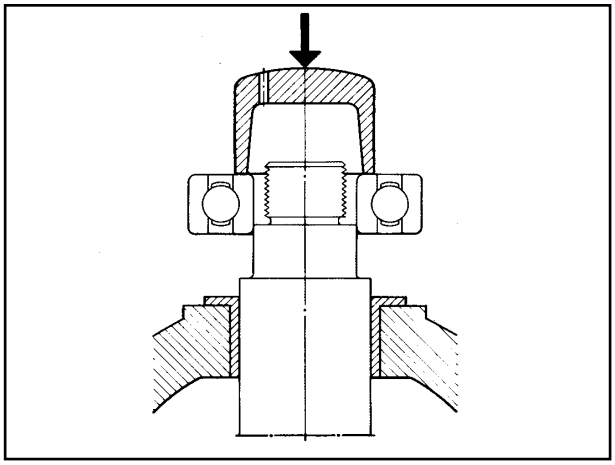


Fig. 1.21

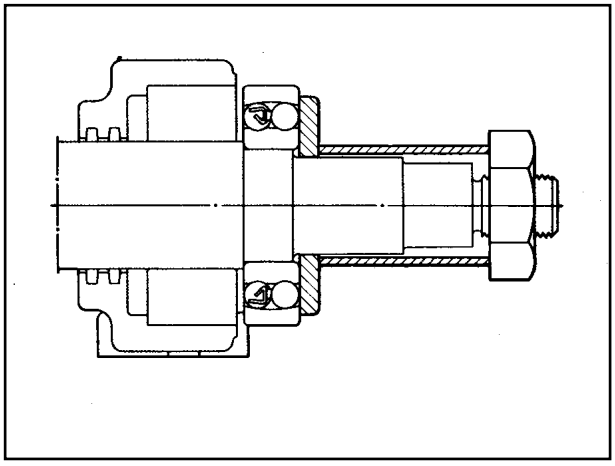


Fig. 1.22

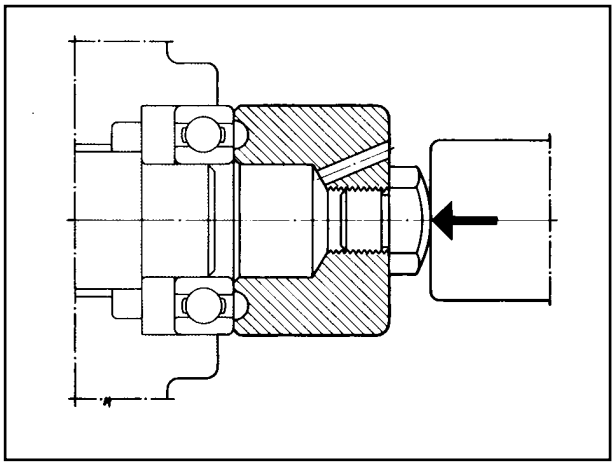


Fig. 1.23

- The temperature difference required between the ring and the part to be coupled depends on the interferences required and the diameter of the housing. However, the bearing should not be heated more than 125°C otherwise there could be structural transformations in the material with consequent dimensional variations and a reduction in hardness. Localized heating should be avoided. Bearings with protective shields and watertight bearings should not be heated before assembly as this could impair the characteristics of the lubricant.
- The bearings should be heated in an oil bath or muffle furnace. If electric plates are used, the bearings should be turned several times to make sure that they are heated evenly.

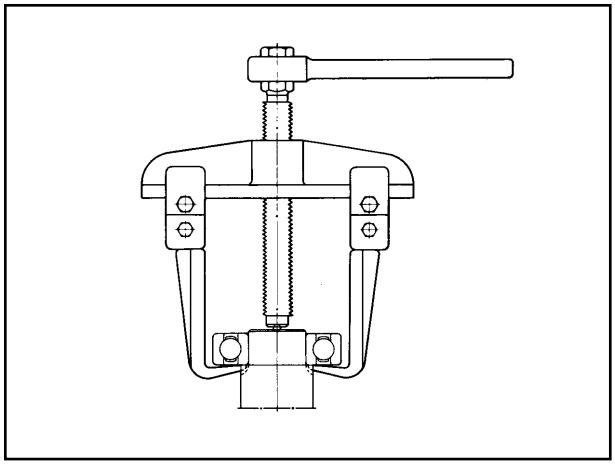


Fig. 1.24

8.3.4 Disassembly

- When bearings are reused after they have been removed from their housings, the forces to apply in order to disassemble them must never be transmitted through the rolling bodies. The ring with the looser coupling must be removed first in non-modular bearings. To remove the rings assembled with a strong interference use the tools and fixtures described below depending on the type of bearing and its size.
- Small bearings can be removed from their housing using a mallet and soft metal punch to tap lightly all over the face of the ring in question. Better still, use a mechanical puller: this latter can be applied straight on to the face of the ring to be removed (Fig.), or to a part adjacent to this. Disassembly is facilitated in cases where the application project envisages stop points on the shaft and housing, notches for the puller jaws, or threaded holes for the puller screws.
- To disassemble the inner rings of parallel roller bearings without borders or with one single border, there are special tools with which the rings can be quickly heated before the shaft can sensibly heat and thus expand.

Chapter 2 : Engine

Index

Section 1 : Precautions and safety recommendations 2-2

Section 2 : Technical specifications 2-5

2.1 Main technical specifications 2-6

Section 3 : Driving torques 2-11

3.1 Standard driving torques 2-12

3.2 Recommended driving torques 2-13

Section 4 : Engine timing 2-17

4.1 Introduction 2-18

4.2 Finding the TDC on the compression stroke of cylinder n. 1 .. 2-20

4.3 Check the injection pump timing 2-21

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol (Fig.2.1):

Fig. 2.1

CAUTION

- Do not fill the engine with lubricating oil beyond the mark on the dipstick, since it could damage the engine itself.
- Lubricate the balance shaft and camshaft before starting the engine to prevent this latter from being damaged if the lubrication system has been discharged.
- These engines must only be used for the type of application for which they have been designed.
- Do not modify the technical specifications of the engine.
- Do not smoke while refuelling.
- Clean up any spilt fuel. Materials soiled with fuel must be taken to a safe place.
- Do not refuel when the engine is running (unless this is absolutely necessary).
- Do not clean, add lubricant or tune the engine while it is running (unless you have received the appropriate training and even then, you must pay the utmost attention to avoid accidents).
- Do not attempt to make adjustments that you do not understand.
- Make sure that you do not run the engine in places where toxic emissions could build up.
- Unauthorized persons must be kept at a safety distance when the engine or auxiliary equipment are operating.
- Keep loose garments and long hair well away from moving parts.
- Keep well away of moving parts when the engine is running. Danger ! Some of the moving parts are not clearly visible when the engine is on.
- Do not run the engine if a protection has been removed.
- Do not remove the fill plug from the cooling system when the engine is hot and the coolant is under pressure as a jet of boiling fluid could squirt out.
- Keep the batteries well away from naked flames or sparks (especially when they are being charged) as the gas produced by the electrolyte is highly inflammable. Battery fluid is dangerous for the skin and particularly for the eyes.
- Always disconnect the battery terminals before working on the electrical system.
- Make sure that you only operate the engine from the control panel or from the driving seat.
- Immediately seek medical help if pressurized fuel squirts on to the skin.
- Diesel fuel and lubricating oil (especially used oil) can be harmful for the skin of certain persons. Protect your hands by wearing gloves or applying a special protective cream.
- Do not wear garments soiled by lubricating oil. Do not put items soiled by lubricating oil into your pockets.
- Dispose of used lubricating oil in a safe way to prevent it from dispersing in the environment.
- Make sure that the gearshift lever is in the neutral position before turning on the engine.
- Take the utmost care if emergency repairs must be made in difficult conditions.
- The combustible material with which certain engine components are made (e.g. certain of the seals) can become extremely dangerous if burnt. Never allow burnt material to come into contact with the skin or eyes.

- Do not allow compressed air to come into contact with the skin. Immediately seek medical help if compressed air penetrates into the skin.
- Turbocompressors operate at high speeds and temperatures. Keep your fingers, tools and other objects well away from the suction and exhaust ports of the turbocompressor and do not touch hot surfaces.
- Do not clean the engine while it is operating. Certain of the components could be damaged if cold cleaning fluids were to be applied to a hot engine.
- Only use genuine spare parts.

Lifting the engine in safe conditions

⚠	**Attention:** make sure that there are no bystanders near the load being handled.

⚠	**Attention:** the engine is very heavy. Proceed with care and comply with all the safety instructions.

Before lifting the engine:

- Always use engine lifting equipment of the approved type and correct lifting capacity in order to lift the engine.

  Use lifting apparatus of the type illustrated in figure 2-2, able to raise the engine vertically, above the lifting brackets (1). Never ever use a single lifting bracket to lift the engine.

- Make sure that the lifting brackets are not damaged and that they are firmly fastened before you lift the engine.

- To prevent the rocker arm cover from being damaged, make sure that there is a clear gap between the hooks and the cover itself.

- Use lifting equipment or ask for help from another technician when lifting the heavy parts of the engine, such as the cylinder block, the cylinder head, the flywheel housing, the drive shaft and the flywheel.

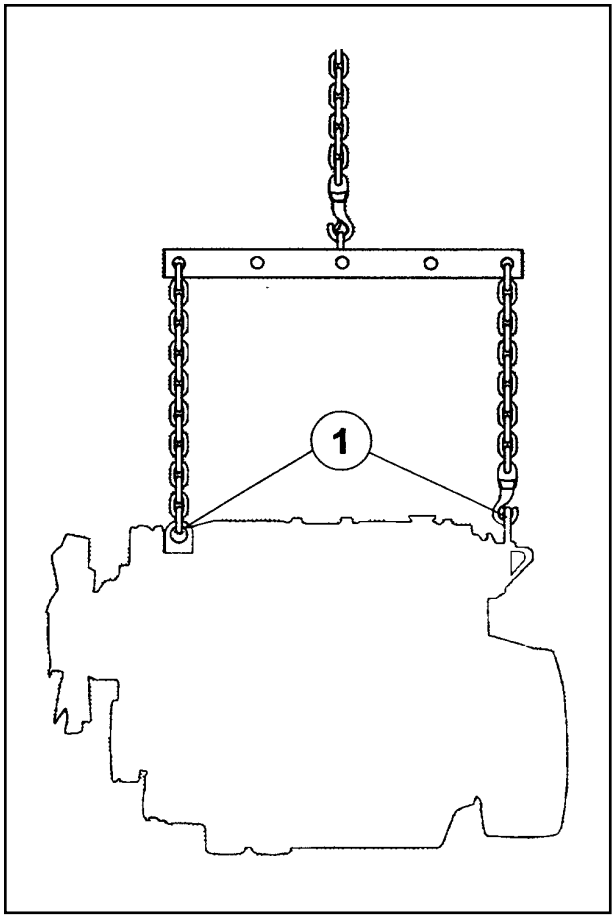


Fig. 2.2

Section 2 : Technical specifications

Index

2.1 Main technical specifications.....2-6

2.1 Main technical specifications

Engine

		Rex 60	Rex 70	Rex 80
Type		Perkins Diesel, 4-stroke with direct injection		
Code		1103C-33	1103C-33T	1103C-33T
Fuel system		Natural	Turbo	Turbo
Number of cylinders		3	3	4
Bore	mm	105	105	105
Stroke	mm	127	127	127
Swept volume	liters	3.3	3.3	3.3
Compression ratio		19.3:1	18.2:1	18.2:1
ISO max. power rating	HP/kW	58,5/43	66,9/49,2	74,8/55
Engine rate	RPM	2200	2200	2200
Maximum torque	Nm	222	270	291
Max. torque rating	RPM	1400	1400	1400
Idling speed	RPM	750	750	750
Issue	EURO	2	2	2

Timing system

Type		With overhead valve controlled by tappets		
Tappet gap, cold engine:	Intake (mm)	0.20	0.20	0.20
	Exhaust (mm)	0.45	0.45	0.45

Fuel system

Feed pump		Electric pump		
Injection pump		Dpx (2645K016)	Dpx (2643B303)	Dpx (2643B302)
Filter on injection pump delivery				
Firing order		1-2-3	1-2-3	1-2-3
Injectors		Perkins (2645K016)	Perkins (2645K017)	Perkins (2645K017)
Injector pressure setting	Bar			
Cold starting device		Thermostarter		
Air filter		Dry filter with two elements removable for maintenance		

Lubrication

Forced, by means of pump.

Oil cleaning by means of:

1 - Wire mesh filter on pump intake pipe

2 - Replaceable cartridge filter on the engine delivery side.

Oil pressure (with engine at top power rate): 3.5/4.2 bar.

Engine starting

Thermostarter device for starting in cold weather.

Cooling

Water, with forced circulation by centrifugal pump operated by the gears of the timing system.

Vertical tube radiator.

Water circulation from engine to radiator controlled by a thermostat.

Opening begins at: 83°/92° C.

Engine

		Rex 75	Rex 85	Rex 95	Rex 105
Type		Perkins Diesel, 4-stroke with direct injection			
Code		1104C-44T	1104C-44T	1104C-44T	1104C-44T
Fuel system		Natural	Natural	Turbo	Turbo
Number of cylinders		4	4	4	4
Bore	mm	105	105	105	105
Stroke	mm	127	127	127	127
Swept volume	liters	4.4	4.4	4.4	4.4
Compression ratio		19.3:1	19.3:1	18.2:1	18.2:1
ISO max. power rating	HP/kW	68.2/50.2	81.6/60	91.9/67.6	98.6/72.5
Engine rate	RPM	2200	2200	2200	2200
Maximum torque	Nm	273	292	380	364
Max. torque rating	RPM	1400	1400	1400	1400
Idling speed	RPM	750	750	750	750
Issue	EURO	2	2	2	2

Timing system

Type		With overhead valve controlled by tappets			
Tappet gap, cold engine:	Intake (mm)	0.20	0.20	0.20	0.20
	Exhaust (mm)	0.45	0.45	0.45	0.45

Fuel system

Feed pump		Electric pump			
Injection pump		Dpx (2644N201)	Dpx (2644N203)	Dpx (2644H012)	Dpx (2644H022)
Filter on injection pump delivery					
Firing order		1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Injectors		Perkins (2645K013)	Perkins (2645K013)		
Injector pressure setting	Bar	290 bar	290 bar	294 bar	294 bar
Cold starting device		Thermostarter			
Air filter		Dry filter with two elements removable for maintenance			

Lubrication

Forced, by means of pump.

Oil cleaning by means of:

1 - Wire mesh filter on pump intake pipe

2 - Replaceable cartridge filter on the engine delivery side.

Oil pressure (with engine at top power rate): 3.5/4.2 bar.

Engine starting

Thermostarter device for starting in cold weather.

Cooling

Water, with forced circulation by centrifugal pump operated by the gears of the timing system.

Vertical tube radiator.

Water circulation from engine to radiator controlled by a thermostat.

Opening begins at: 83°/92° C.

Section 3 : Driving torques

Index

3.1 Standard driving torques.....2-12

3.2 Recommended driving torques.....2-13

Driving torques

The driving torque values given below refer to components that are slightly lubricated with new engine oil before being torqued.

3.1 Standard driving torques

Driving torque values for fixing screws and nuts

Driving torque		
Thread size	Nm	kgfm
M 6 x 1.00	9	0,9
M 8 x 1.25	22	2,2
M10 x 1.50	44	4,5
M12 x 1.75	78	8,0
M14 x 2.00	124	12,6
M16 x 2.00	190	19,3

Standard driving torque values for stud bolts (metal ends)

Driving torque		
Thread size	Nm	kgfm
M 6 x 1.00	5	0,5
M 8 x 1.25	11	1,1
M10 x 1.50	18	1,8
M12 x 1.75	25	2,5

Standard driving torques for pipe unions, plugs and adapters

Driving torque		
Thread size	Nm	kgfm
1/8 PTF	9	0,9
1/4 PTF	17	1,7
3/8 PTF	30	3,0
3/4 PTF	45	4,5

3.2 Recommended driving torques

Cylinder head

Complying with the numeric order (Fig.2.3, 2.4), tighten all the screws to a 110 Nm torque value.

Using the tool (1) shown (Fig.2.5) or making a mark on the screws and on the head, tighten the screws to a further degree in compliance with the numeric order and rotation degrees given (Fig.2.6).

The screws **marked by the letter (L) through 270° and the remaining ones through 225°.**

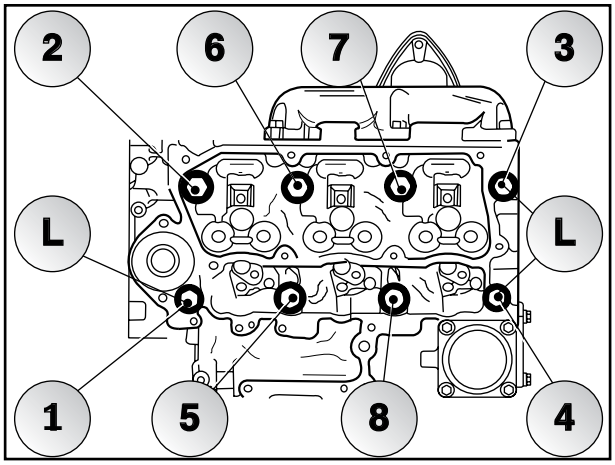


Fig. 2.3

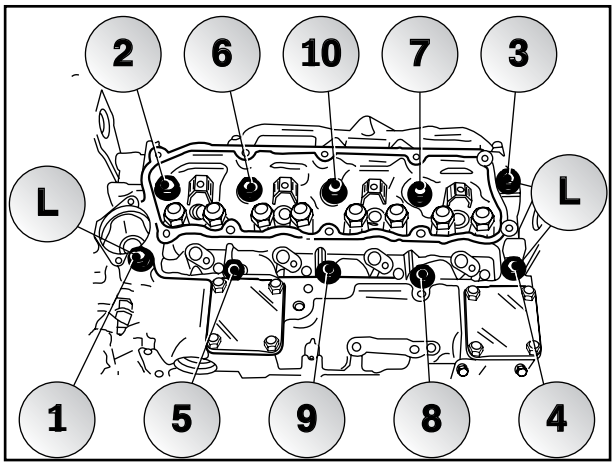


Fig. 2.4

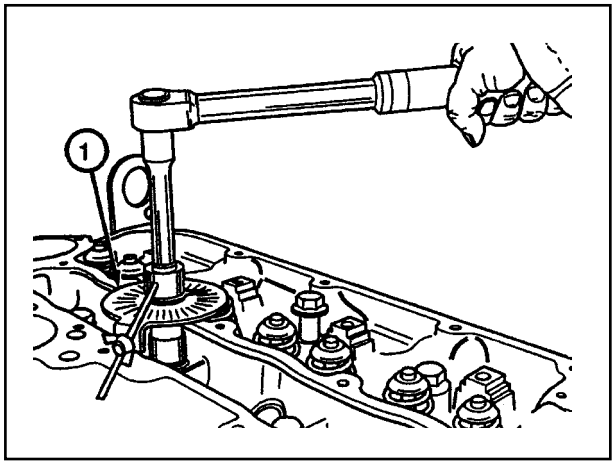


Fig. 2.5

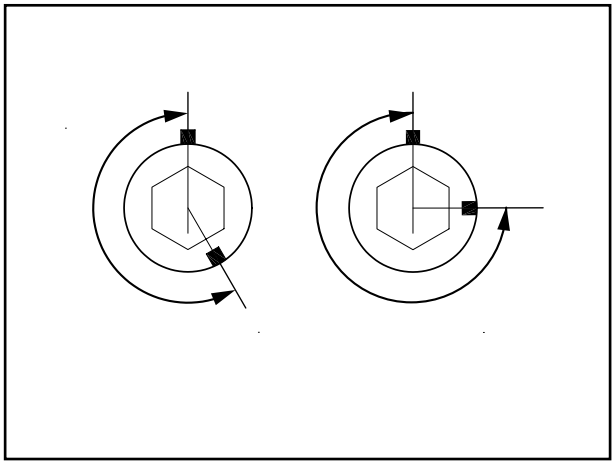


Fig. 2.6

1100 Series

Specific driving torque values

The following driving torque values apply to components previously lubricated with a quantity of clean engine oil.

Description	Thread	Driving torque		
		Nm	lbf ft	kgfm
Cylinder head				
Head retainer screw				
Torx screw, rocker arm	M8	35	26	4,1
Check nut, rocker arm lever adjustment	3/8 UNF	27	20	2,7
Fixing device, rocker arm casing	M6	9	7	0,9
Retention screw, partition on casing	M6	9	7	0,9
Retention screw, exhaust manifold on head	M10	33	24	0,9
Piston and connecting rods				
Retainer screw, connecting rod				
Drive shaft				
Retainer screw, main bearings	5/8 UNF	245	180	25
Retainer screws, drive shaft pulley	7/16 UNF	115	85	12
Allen screws, cylinder block connection	M6	16	12	1,6
Torx screw, rear part of oil seal housing	M8	22	16	2,2
Retainer screws, rocker arm on cylinder block	M10	54	39	5,5
Valve system housing and transmission block				
Retainer screws, camshaft gear	M12	95	70	9,7
Retainer screws, plastic PTO closing plate	M10	22	16	2,2
Retainer screws, plastic oil top-up	M8	22	16	2,2
Cylinder block				
Plug, compressor oil delivery	M10	22	16	2,2
Plug, rear part of oil duct	7/8 UNF	68	50	7,0
Plug, front delivery	M12	46	34	4,6
Plug, turbocompressor delivery	M10x1	19	14	1,9
Plug, coolant fluid outlet	1/4 NSPM	40	29	4,0

Description	Thread	Driving torque		
		Nm	lbf ft	kgfm
Fuel circuit				
Nuts, high pressure fuel pipes	M12	30	22	3,0
Retainer screw, atomizer bracket	M8	35	26	3,5
Nut, fuel injection pump on gear (mechanical)	M14	88	65	9,0
Retainer screws, fuel injection pump on gear (electronic)	M8	22	16	2,2
Retainer screws, valve system housing on fuel injection pump	M8	25	18	2,5
Retainer screw on Bosch fuel injection pump shaft	M10	31	23	3,1
Retainer screw on DP210 fuel injection pump shaft	M12	17	12	1,7
Retainer screw in DP210 fuel injection pump operating position	M12	12	9	1,2
Lubrication circuit				
Plug, lubricating oil sump	G 3/4	34	25	3,4
Oil control valve	M10x1	12	9	1,2
Oil control valve plug	M10x1	12	9	1,2
Nut, level dipstick	M16	18	13	1,8
Oil filter element	3 1/2 ACME	25	18	2,5
Cooling circuit				
Retention screws, fan motor housing on head	M10	44	32	4,5
Retention screws, fan motor pulley on head	M8	12	9	1,2
Screw for fixing fan control pulley to hub	M10	44	4,5	
Retention screws, fan	M8	12	9	1,2
Flywheel and block				
Motors type RE,RF,RG, RJ and RH:				
Retainer screws, flywheel on drive shaft	1/2 UNF	05	77	10,7
Type RK motors:				
Retainer screws, flywheel on drive shaft	1/2 UNF	15	85	11,7
Retainer screws, cast iron flywheel block on cylinder block:	M10	44	32	4,5
- 8.8 stamped on head	M12	75	55	7,6
- 10.9 stamped on head	M10	63	46	6,4
- 10.9 stamped on head	M12	115	85	11,7
Retainer screws, flywheel block on cylinder block (paper seal)	M10	70	52	7,1

Description	Thread	Driving torque		
		Nm	lbf ft	kgfm
Intake circuit				
Nuts, turbocompressor on manifold	M10	47	35	4,8
Perforated bolt, turbo supply	M10x1	22	16	2,2
Fixing device, breather on head	M6	9	7	0,9
Electric circuit				
Engine oil pressure sensor	M12x1.5	10	7	1,0
Engine oil pressure plug	M12x1.5	12	9	1,2
Sensor, intake manifold temperature	M18	20	15	2,0
Plug, intake manifold temperature	M18	20	15	2,0
Sensor, intake manifold pressure	M12	10	7	1,0
Sensor, coolant fluid temperature	M18	20	15	2,0
Fixing screw, ECM plug on ECM	M5	6	4	0,6
KSB	1/2 PTF	30	22	3,0
Glow plug on head	M10	18	13	1,8
Nut, bar on glow plug	M4	2	1	0,2
Nut, bar on glow plug	M4	2	1	0,2
Nut, alternator pulley:	M16	80	59	8,1
- CAV AC5RA and ACRS				
- A127 thin nut and Motorola pulley, 22mm A/F				
- A127 thick nut and Motorola pulley, 24 mm A/F				
- Bosch 55A				
- Bosch 55A				
- Butec 552A				
Nut, starter motor	M10	44	32	4,5

Section 4 : Engine timing

Index

4.1 Introduction.....2-18

4.2 Finding the TDC on the compression stroke of cylinder n. 1 ..2-20

4.3 Check the injection pump timing.....2-21

4.1 Introduction

To ensure that the 1100 Series engines have an accurate timing system, the engines are timed by means of pins (A) (Fig.2.8).

In this system, piston N° 1 is at top dead center (TDC) on the compression stroke.

Fuel injection pumps of last generation have a fixed TDC phasing, to achieve a fuel injection as required by statutory rules concerning engine emissions.

It is of the utmost importance that fuel injection is exactly calibrated to conform to these rules. Comply with the instructions described in Section 3-2 to obtain the TDC on the compression stroke of cylinder N° 1.

Attention: the fuel injection pump is provided with a screw (1)(Fig.2.9, 2.10) that locks the shaft.

It is important for the locking screw to be loosened and for the pump shaft to turn freely.

The pump driving shaft must not be turned without the spacer (2)(Fig.2.9, 2.10) installed under the locking screw. The drive shaft can be damaged if it is turned while the locking screw is still tightened on it.

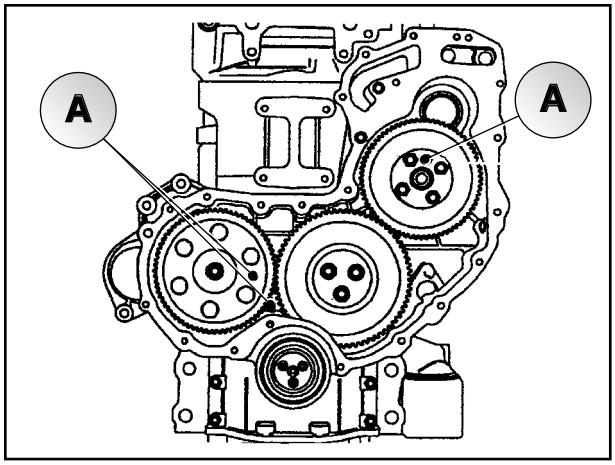


Fig. 2.7

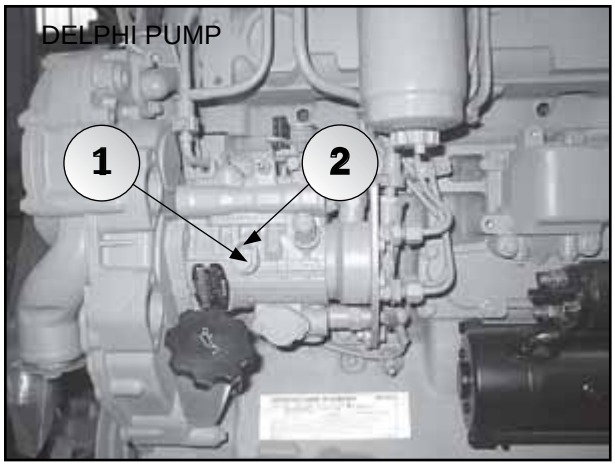


Fig. 2.8

The more recent injection pumps are provided with a screw (3)(Fig.2.7) **that is permanently installed** on the control shaft.

The hub is mounted on the pump by the manufacturer to assure a very precise phasing. In engines with these features, the driving gear is fixed on the hub, not on the pump shaft. A pin (4) (Fig.2.7) is used for precisely phasing these pumps during service.

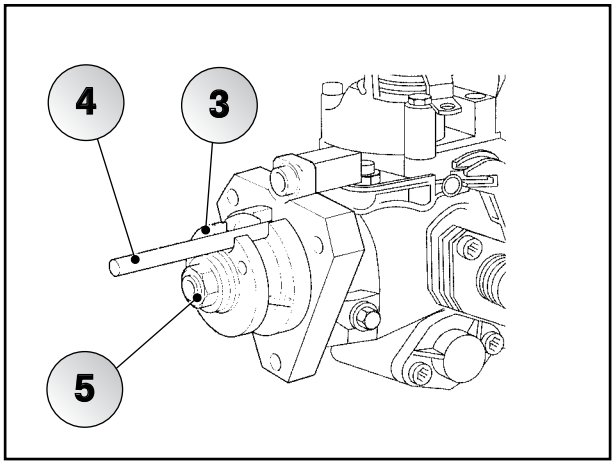


Fig. 2.9

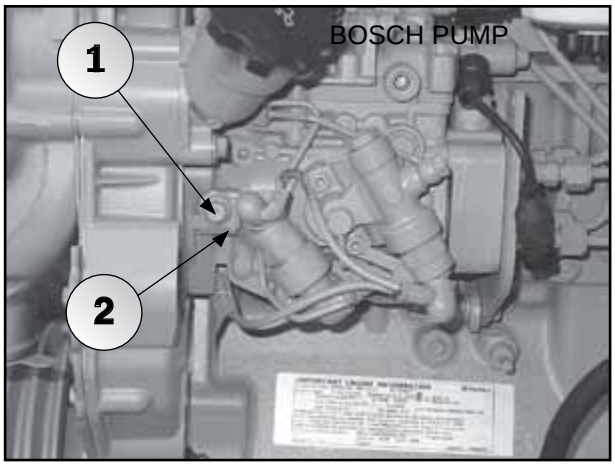


Fig. 2.10

4.2 Finding the TDC on the compression stroke of cylinder n. 1

- Remove the valve cover, the glow plugs and the front casing.

  Note: The phasing pin of the drive shaft can be inserted after mounting the pulley.

- Turn the drive shaft in the normal engine rotation direction, until the piston of cylinder N° 1 is in the upper part of the cylinder in the compression phase.

- Carefully turn he drive shaft in the normal engine rotation sense to line up the hole in the shaft with the ones on the cylinder block and on the valve system. Fit the timing pin of the drive shaft (code N° **27610211**) into the hole on the shaft support

- Fit the timing pin of the camshaft (code N° **27610212**) into the hole in the shaft's gear and allow it to slide until it reaches the timing block. In this way the engine cylinder n. 1 will be in the compression TDC.

  Note: when the pin is installed, the camshaft gear can still perform a minimum rotation.

- Remove the phasing pins from the camshaft gear and from the and drive shaft shoulder.

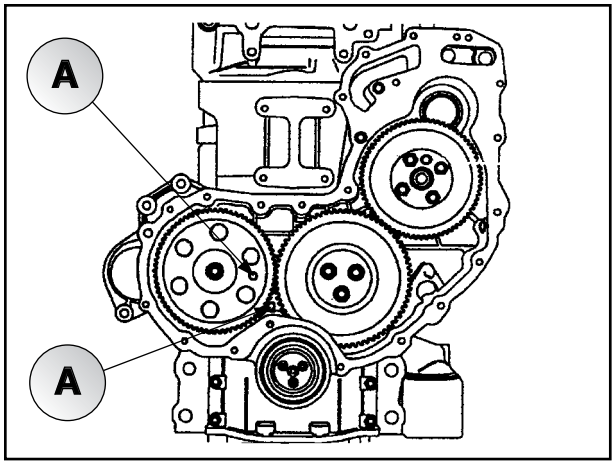


Fig. 2.11

4.3 Check the injection pump timing

Fuel injection pump Delphi DP210

Note: The timing of the Delphi DP210 fuel injection pump cannot be checked or adjusted in any way. If you have a strong suspicion of something wrong in its timing, please refer to your Perkins Dealer.

Only a Delphi authorized technician may service a Delphi DP210 fuel injection pump. For further information concerning pump repairs, please refer to your Perkins Dealer. The internal timing of the pump is tamper-proof. High and low idle rates are set by the manufacturer. No adjustment can be made to the idling speed of the pump.

Checking the timing of the Bosch EPVE fuel injection pump

- Bring the piston of cylinder N° 1 to TDC in the compression stroke.
- Remove the high pressure fuel hoses from the fuel injection pump.
- Remove the plug (3, fig.).2.12) and the washer from the rear of the fuel injection pump and install adapter (4) (**27610248**) for timing the pump (Fig.2.13). This should then be fitted with an indicator (5) (Fig.2.13) (**27610248**). Set the indicator to a value of about 3 mm (0.1181 inches).
- Turn the drive shaft in the anticlockwise direction, until the gauge (5) indicates that the piston of the fuel injection pump has reached the lowest position. At this point, set the gauge (5) to zero.
- Turn the drive shaft in the clockwise direction, until the phasing pin on the shaft can be inserted into the hole in the shaft's shoulder. The piston of fuel injection pumps with ER code has a lift of 1.55 mm (0.061 inches).
- Read the value on the gauge (5) with the piston of cylinder N° 1 in the TDC position.
- If timing value is correct, remove the indicator (5) and the adapter (**27610248**) from the pump Mount a new washer on the plug and install on the back of the fuel injection pump.
- Connect the high pressure fuel hoses to the fuel injection pump again. Bleed all air in the fuel circuit.
- If the fuel injection pump timing is not correct, please refer to your Perkins Dealer.

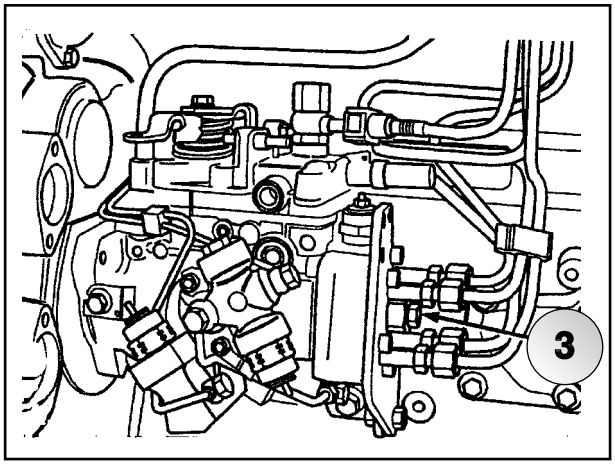


Fig. 2.12

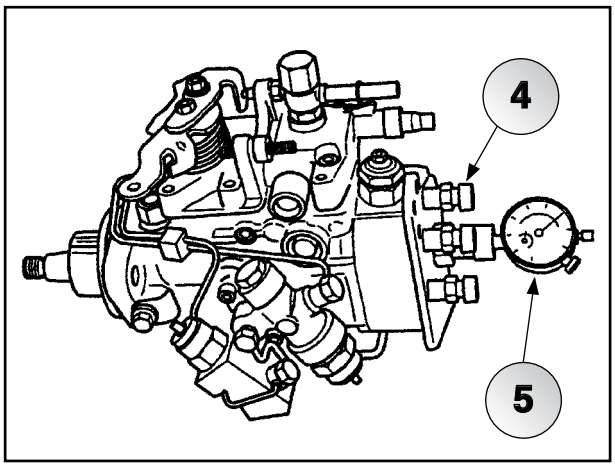


Fig. 2.13

Chapter 3 : Clutch

Index

Section 1 : Precautions and safety recommendations 3-2

Section 2 : General description 3-3
- 2.1 Drawing of assembly (Speed Five version) 3-4
- 2.2 Description of operation 3-5
- 2.3 Damper (Power Shuttle version) 3-6

Section 3 : Technical specifications 3-9
- 3.1 Main technical specifications 3-10

Section 4 : Inspections 3-11
- 4.1 Inspection and overhaul 3-12
- 4.2 Adjustment 3-13
- 4.3 Main clutch adjustment 3-15

Section 5 : Special tools 3-17

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: treat the clutch with care to prevent injuries to the hands.

	Attention: if the bolts that fix the safety frame or cab are loosened or if the actual safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

	Attention: make sure that all persons keep a due distance away from the danger zone. Avoid vibrations when the bolts are loosened.

	Attention: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

	Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

	Attention: use the right tools to align holes. Never use your fingers or hands.

	Attention: handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

	Attention: if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

Section 2 : General description

Index

2.1 Drawing of assembly (Speed Five version) 3-4

2.2 Description of operation 3-5

2.3 Damper (Power Shuttle version) 3-6

2.1 Drawing of assembly (Speed Five version)

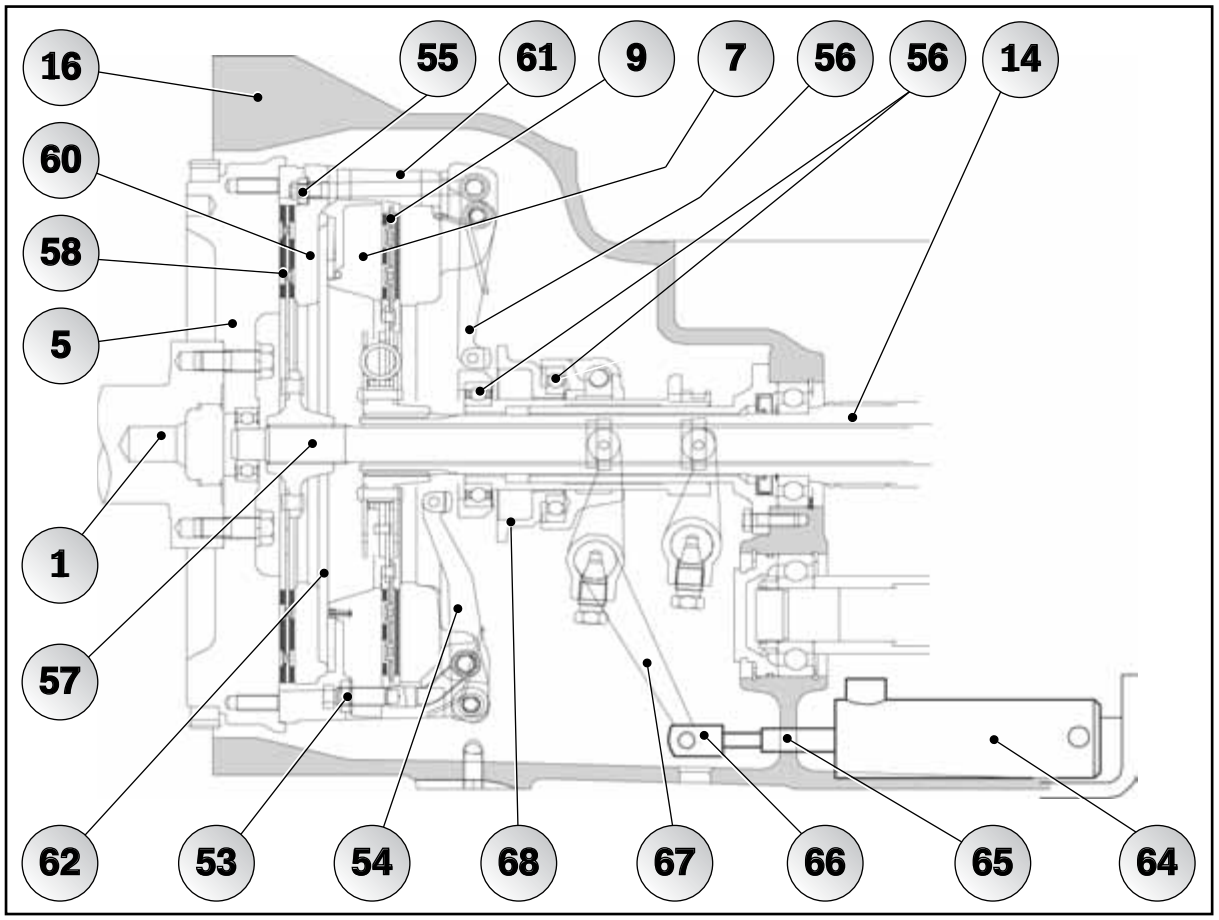


Fig. 3.1

1 - Drive shaft
2 - Flywheel
5 - PTO clutch adjuster screw
6 - P.T.O. clutch plate
7 - P.T.O. clutch pressure plate
8 - Belleville washer
9 - Main clutch pressure plate
10 - Main clutch disc
11 - P.T.O. clutch disengaging lever
12 - Thrust bearings
13 - Engine gearbox assembly housing
14 - Clutch unit
15 - Main clutch lever adjuster screw
16 - Adjuster screw lock nut
17 - Main clutch disengaging lever
18 - PTO clutch thrust control fork
19 - Main clutch thrust control fork
20 - Clutch disengaging collar
21 - P.T.O. shaft
24 - Gearbox input shaft
25 - PTO lever rod

2.2 Description of operation

The clutch is the component of the tractor that transmits drive from the engine to the transmission.

It is engaged or disengaged as needed by means of the pedal lever for the main clutch or by means of a hand lever (Q1 Fig.3.3)(Q2-E-Line versions, Fig.3.4) for the power take-off.

This lever activates a hydraulic control that allows the oil to supply the cylinder (64), causing the collar (68) to move by means of the levers (67 and 52).

This collar presses on the levers (56) and disengages the power take-off disc (58) by means of the rod (69).

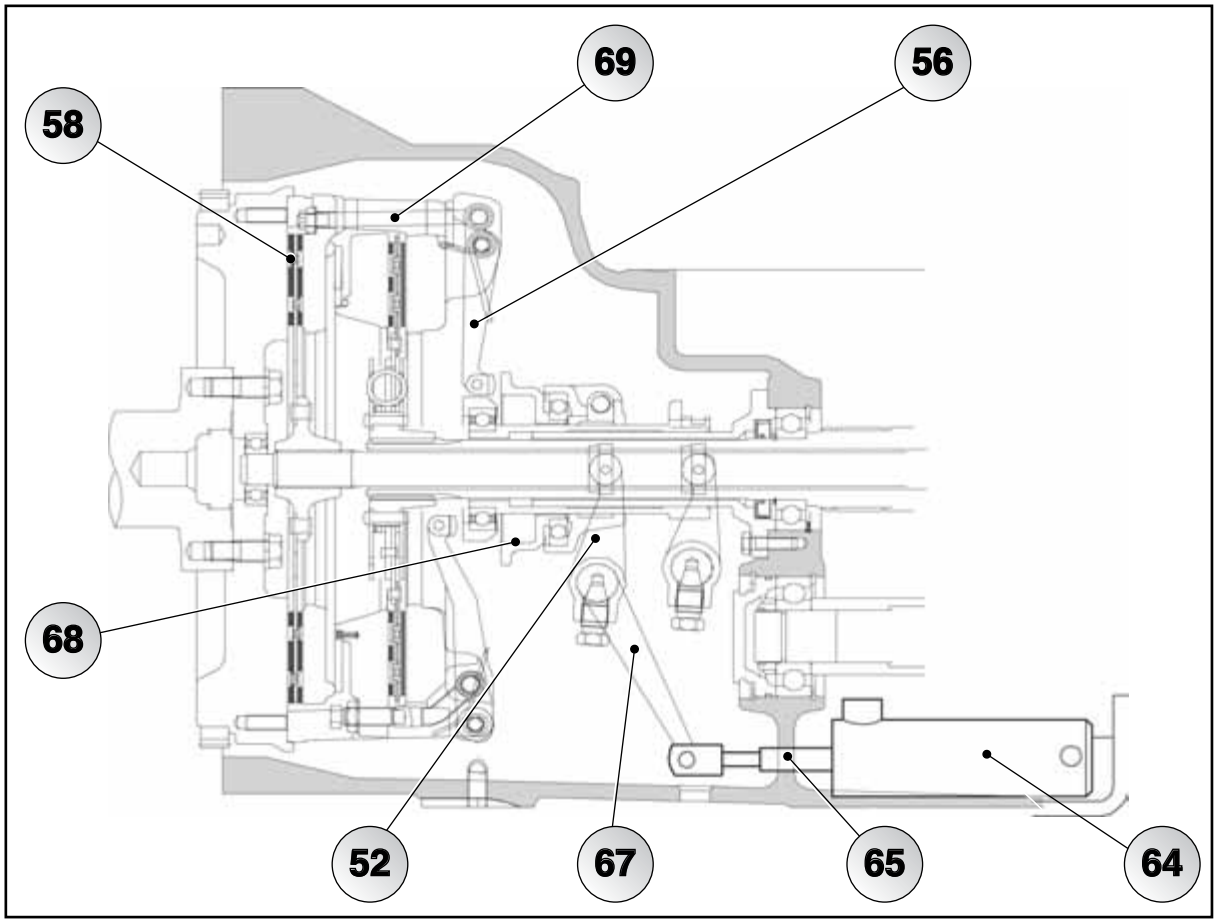


Fig. 3.2

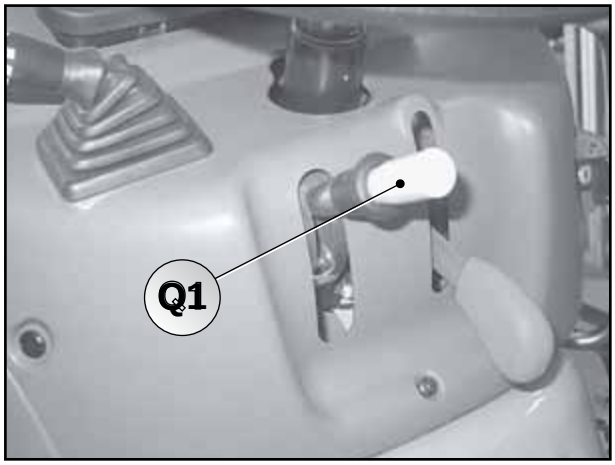


Fig. 3.3

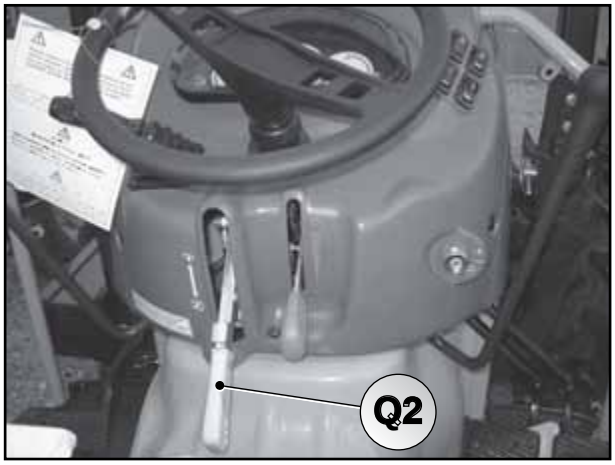


Fig. 3.4

2.3 Damper (Power Shuttle version)

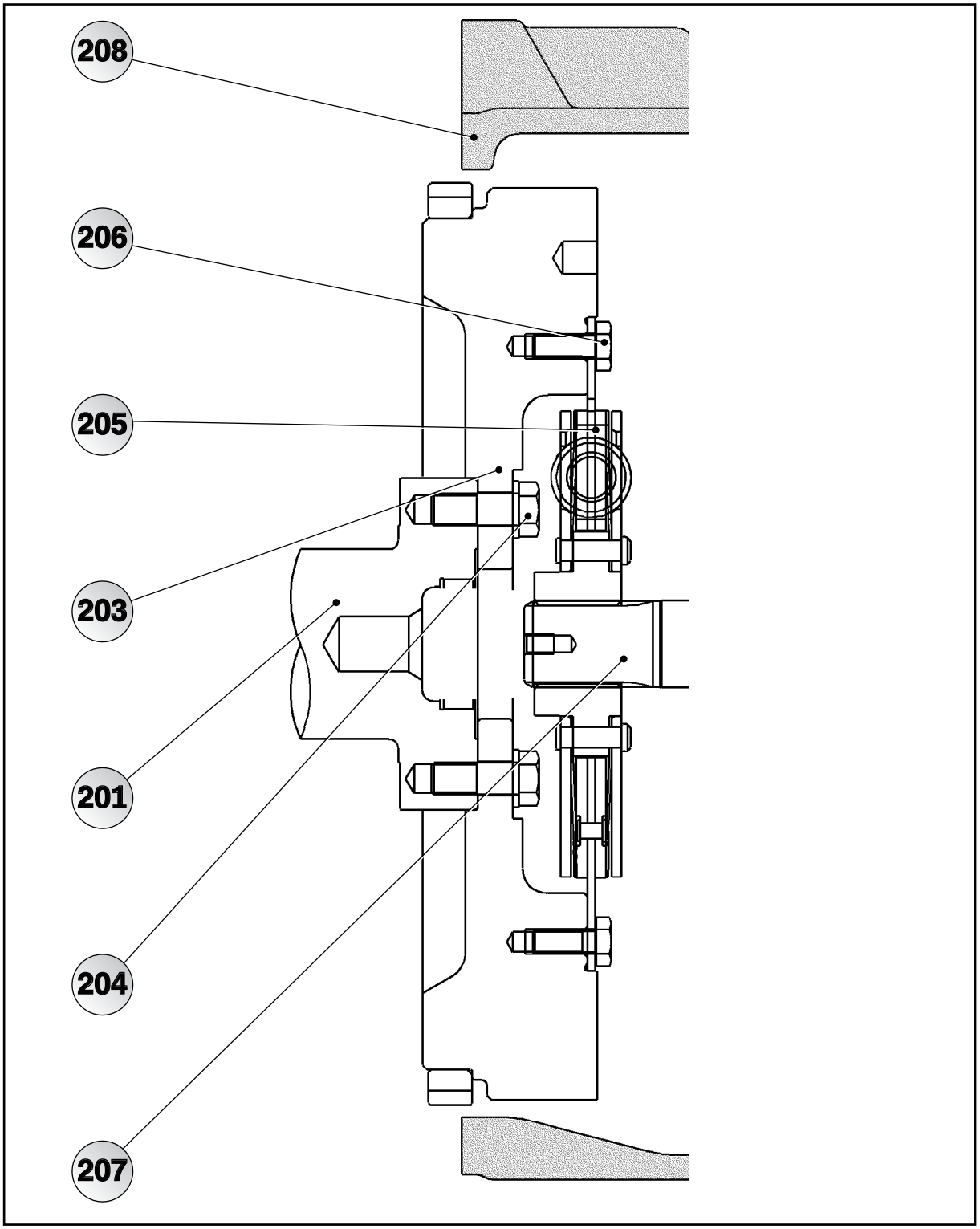


Fig. 3.5

201 - Drive shaft
203 - Flywheel
204 - Flywheel fixing screw
205 - Damper
206 - Damper fixing screw
207 - Input shaft
208 - Engine-gearbox assembly

The Powerfive and/or Powershuttle versions of **F-N SeriesPower Shuttle version** tractors have a damper disc instead of the conventional clutch. It is installed on the flywheel. It absorbs the vibrations created by the engine and transmits drive to the gearbox.

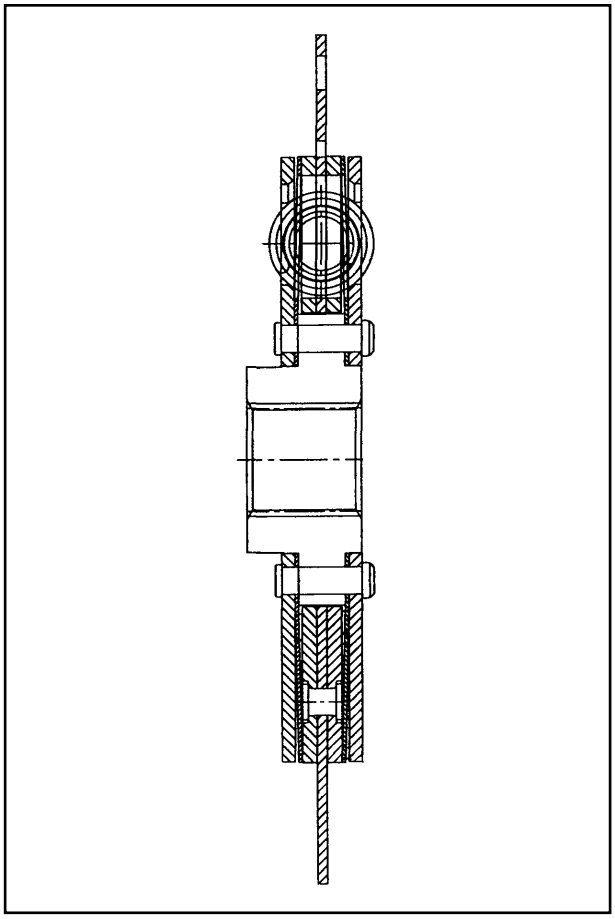


Fig. 3.6

Section 3 : Technical specifications

Index

3.1 Main technical specifications.....3-10

3.1 Main technical specifications

Manufacturer	Lx (Ox)
Type	Double-plate
Disc diameter	11” (PTO/gearshift disc)(F-N Series65-75) 12” (PTO/gearshift disc)(F-N Series80-90-100-105)
Material	Gearshift disc cerametallic PTO disc: organic

Section 4 : Inspections

Index

4.1 Inspection and overhaul 3-12

4.2 Adjustment 3-13

4.3 Main clutch adjustment 3-15

4.1 Inspection and overhaul

Attention: treat the clutch with care to prevent injuries to the hands.

1 - Thoroughly clean all the parts and check them visually;

2 - Replace any worn parts;

3 - Check the retainer bearing (12)(Fig.3.1to make sure that it operates smoothly when turned and that it provides an adequate seal;

4 - Check the friction plane on the flywheel, then check the pressure plates (7-9) and clutch casing (14).

The friction surfaces can be ground if necessary. Comply with the minimum tolerated measurements shown in (Fig.3.8).

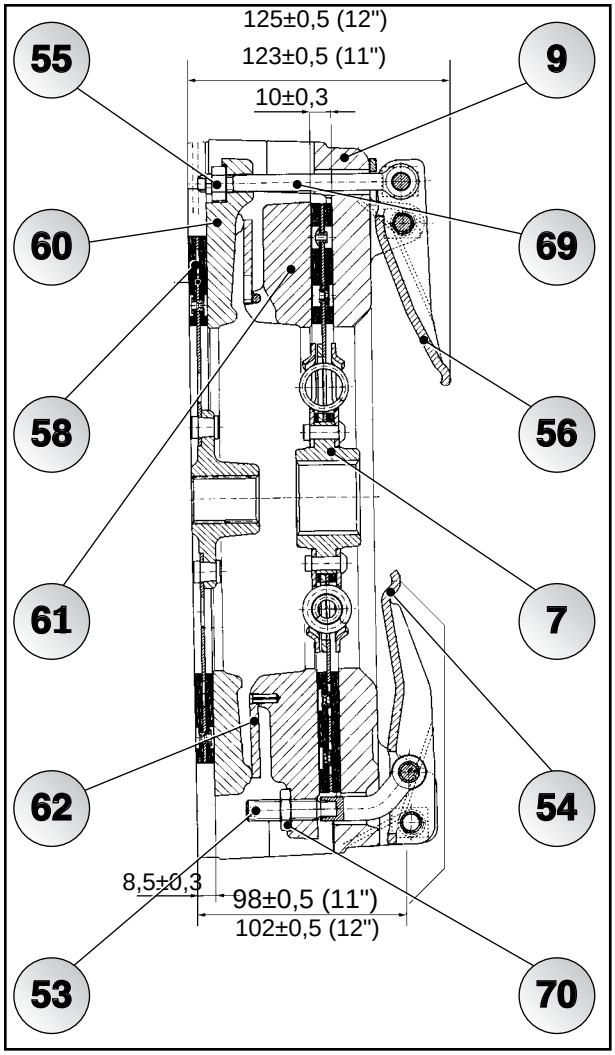


Fig. 3.7

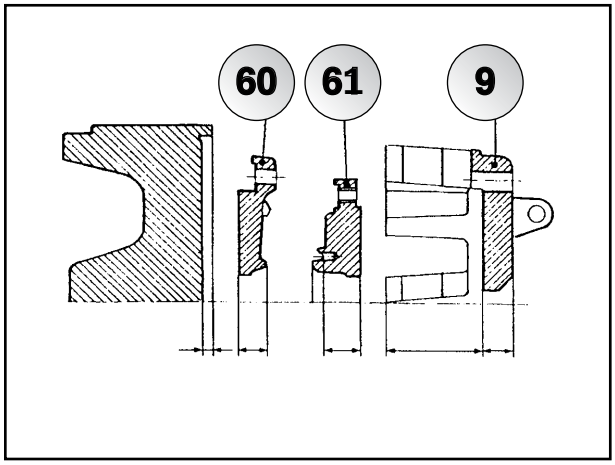


Fig. 3.8

4.2 Adjustment

1 - Insert tool 01 FRI REX on to the clutch, fitting it on the disc (62) and inserting the PTO disc (58);

2 - Assemble this unit on the flywheel, making sure that the two discs are centered perfectly by turning tool 01 FRI REX;

3 - Tighten the screws to fix the clutch to the flywheel after having applied Loctite 243 to them;

4 - Proceed by checking the coplanarity of the levers (54-56) by using tool 01 FRI REX. The tool consists of two rings: one for the 11" clutch and one for the 12" clutch. Use adjuster nut (55) to regulate the complanation of the levers (56) and the nut (70) to adjust the levers (54) themselves;

5 - After the adjustments have been made, lock the nut (55) and clinch it, then tighten the nut (70) against the pressure plate (61).

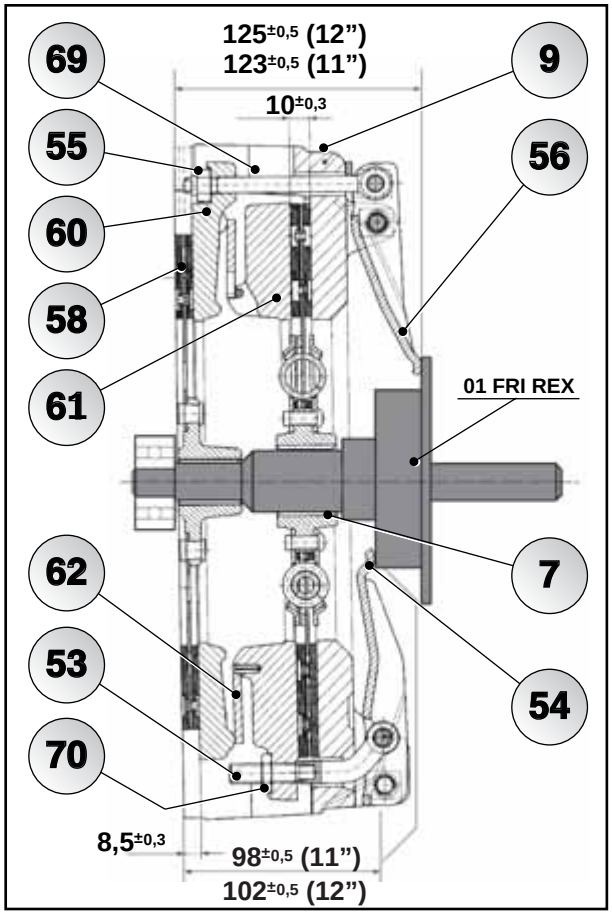


Fig. 3.9

4.3 Main clutch adjustment

Check the clutch pedal travel at regular intervals.

An excessive play reduces the travel to disengage the clutch and could cause problems in gear shifting. On the other hand, insufficient play may lead to abnormal wear on the disengaging thrust bearing as well as overheating and abnormal clutch wear.

Free travel, measured on the pedal should be 3.5-4 cm. To adjust, loosen the jam nut on the control linkage, then tighten or loosen the adjuster screw.

Lock the check nut. To regulate the adjuster (B Fig.3.10), first remove the three screws (X Fig.3.11) that fix the panel.

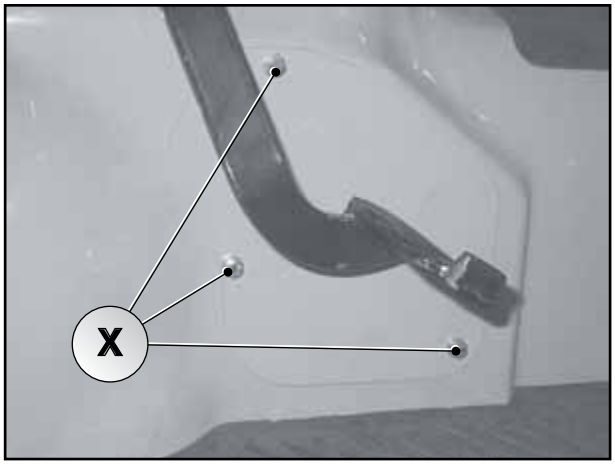


Fig. 3.10

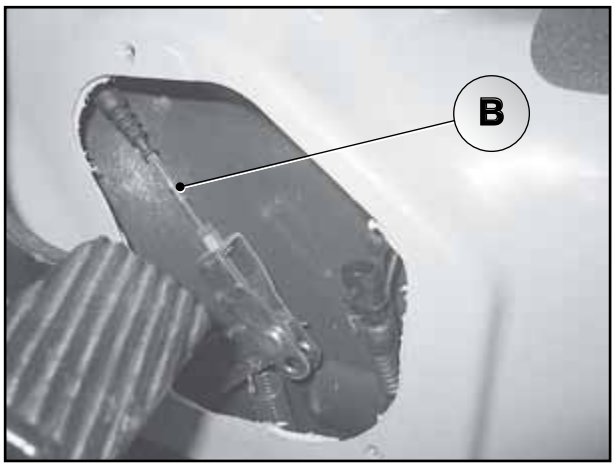


Fig. 3.11

Section 5 : Special tools

01 FRI MYT

Clutch centering pin.

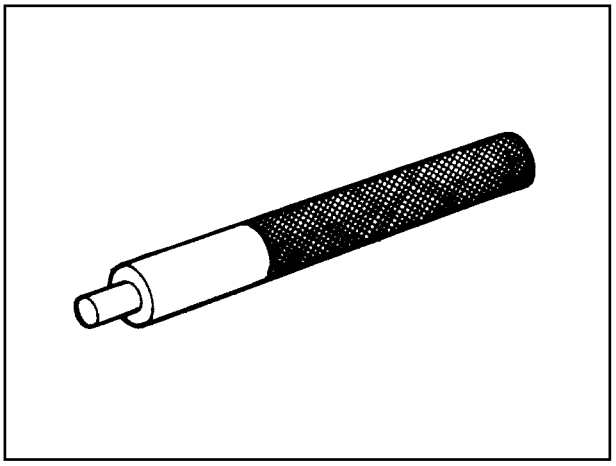


Fig. 3.12

01 FRI REX

Clutch plate centering pin and lever height checking.

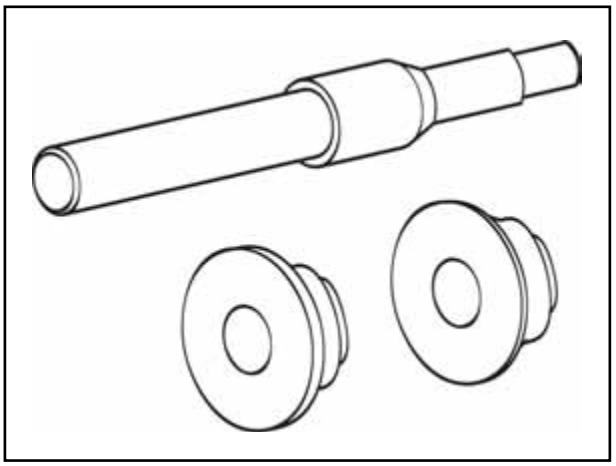


Fig. 3.13

Chapter 4 : Transmission

Index

Section 1 : Precautions and safety recommendations 4-2

Section 2 : General description 4-3

2.1 Introduction 4-4
2.2 Drawing of assembly and main units (Speed Five version)(4 WD) .. 4-8
2.3 Drawing of assembly and main units (Power Five version)(4 WD).. 4-12
2.4 Differences between the 2 WD, 4 WD, Techno versions. . 4-15
2.5 Control devices 4-20
2.6 Power train diagrams 4-23

Section 3 : Technical specifications 4-33

3.1 Main technical specifications 4-34
3.2 Driving torques 4-36

Section 4 : Guide lines for disassembly, re-assembly and adjustments 4-41

4.1 Engine-gearbox assembly (Speed Five/Four and Techno version) 4-44
4.2 Engine-gearbox assembly (Power Shuttle and Power Five version)(4WD version) 4-60
4.3 Version without Power Shuttle 4-88
4.4 Gearbox (Speed Five/Four and Techno version) 4-94
4.5 Gearbox (Power Shuttle version) 4-118
4.6 4WD housing 4-140
4.7 Bevel gear pair and rear differential 4-155
4.8 Side final drives 4-164
4.9 Rear brakes 4-169
4.10 Control levers 4-173

Section 5 : Special tools 4-183

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: keep clear of the sharp edges around the top of the gearbox.
	Attention: if the bolts that fix the safety frame or cab are loosened or if the actual safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.
	Attention: make sure that all persons keep a due distance away from the danger zone. Avoid vibrations when the bolts are loosened.
	Attention: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.
	Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.
	Attention: use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.
	Attention: handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.
	Attention: used oil must be collected and disposed of in compliance with the anti-pollution laws in force.
	Attention: the hub is very heavy and difficult to handle. Take all the necessary precautions when dismantling and re-assembling this part.
	Attention: if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.
	Attention: wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.
	Attention: the differential unit is very heavy and difficult to handle. Take the greatest care when removing and remounting it.

Section 2 : General description

Index

2.1 Introduction.....4-4

2.2 Drawing of assembly and main units (Speed Five version)(4 WD). 4-8
2.2.1 Description of operation (Speed Five version) (4WD) ... 4-10

2.3 Drawing of assembly and main units (Power Five version)(4 WD) .. 4-12
2.3.1 Description of operation (Power Five version) (4WD) ... 4-14

2.4 Differences between the 2 WD, 4 WD, Techno versions..... 4-15

2.5 Control devices.....4-20

2.6 Power train diagrams.....4-23

2.1 Introduction

Regardless of its power rating, the transmission of F-N Series tractors can consist of various mechanical assemblies that enable it to move forwards and in reverse with different speed ratios.

It is the modular type and features various composition options in the engine-gearbox assembly:

- assembly formed by a double clutch and mechanical reverse shuttle (“Speed Five” version) (Fig.4.1).
- assembly formed by a dampener plate and hydraulic reverse shuttle (“Power Shuttle” version)(Fig.4.2).
- assembly formed by a dampener plate, a hydraulic reverse shuttle (Power Shuttle) and a further half-gear (Power Five), that can be engaged on load.

The gearbox has 5 synchronized speeds (4WD version), three ranges (slow-medium-fast), a pinion-ring gear assembly and differential, brakes and side final drives. The 2WD tractors are have a gearbox with 4 synchronized speeds, for a max. speed of 30 Kph.

The Power take-off is mechanically engaged by means of a dedicated lever under the steering wheel.

On request, the gearbox can be fitted in both cases with a creeper operated by means of the range control lever. The creeper can be therefore engaged as an alternative to these ranges.

In Speed Four/Five version tractors, the PTO is engaged mechanically by a power control lever, located under the steering wheel. In Power Shuttle version tractors, it is electro-hydraulically engaged by means of a switch located on the right of the driver’s seat.

The synchronized reverse shuttle allows the operator to make fast, safe manoeuvres and facilitates handling jobs or work with front loaders.

Speed Five axle version (4 WD)

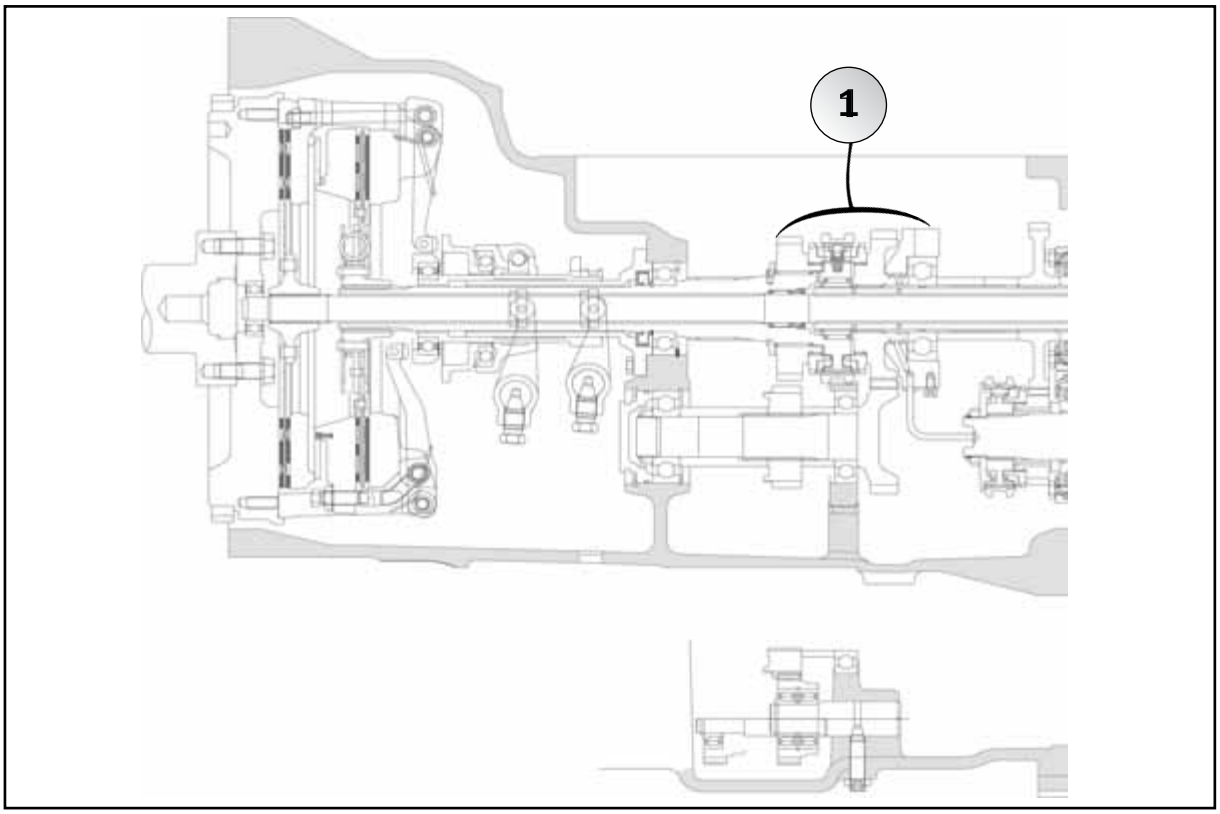


Fig. 4.1

Power Shuttle axle version (4 WD)

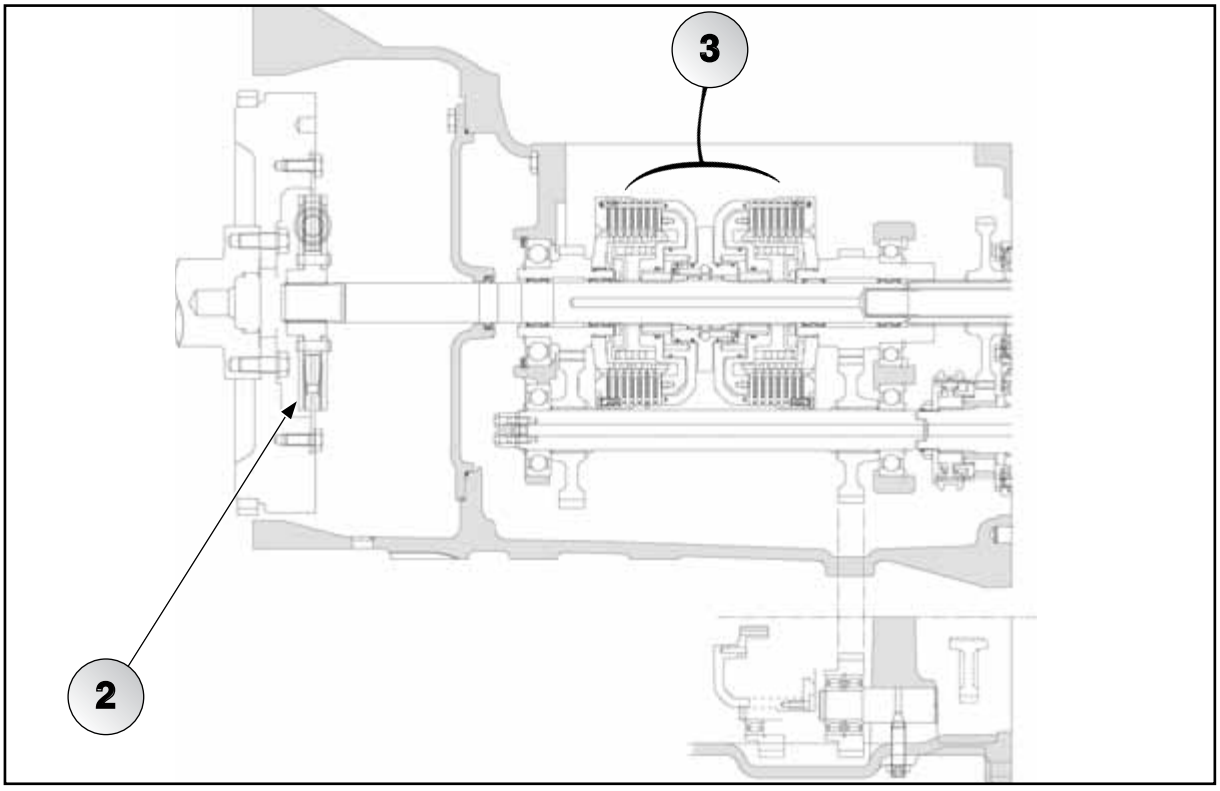


Fig. 4.2

Power Five axle version (4 WD)

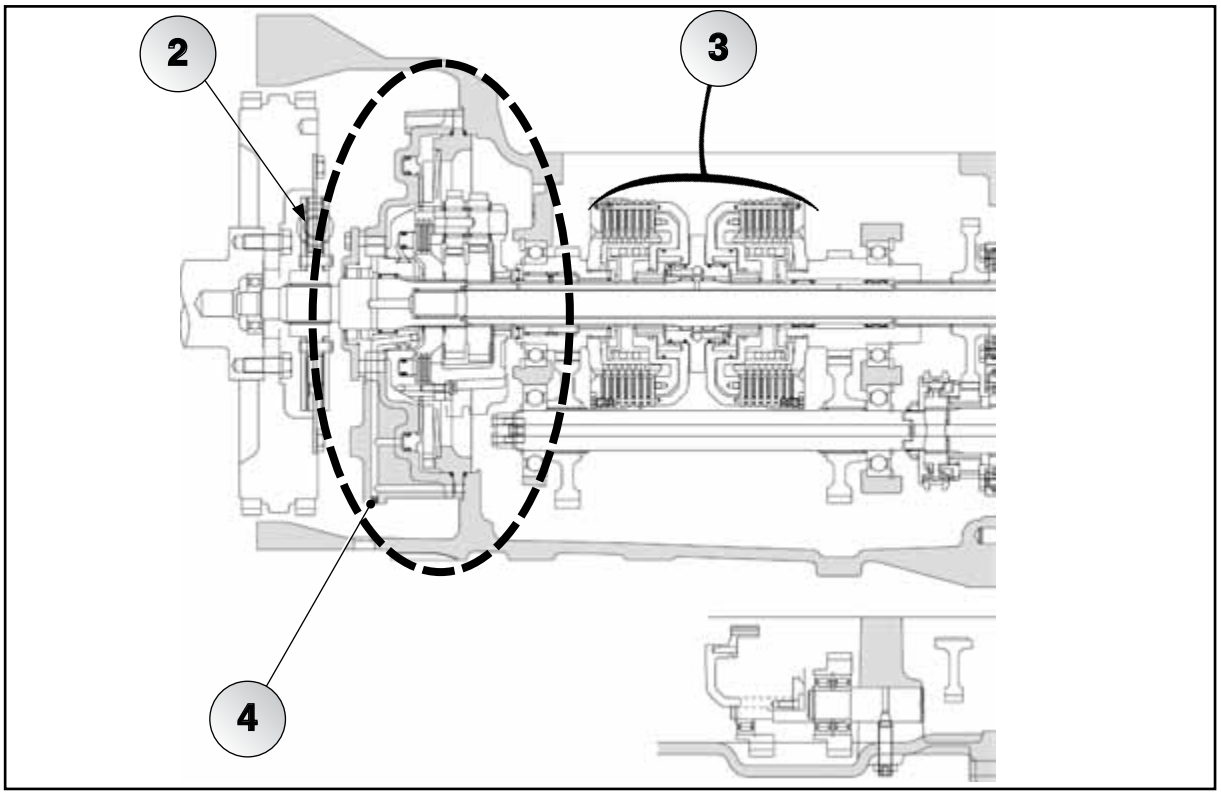


Fig. 4.3

Speed Four (2 WD) and Techno axle version

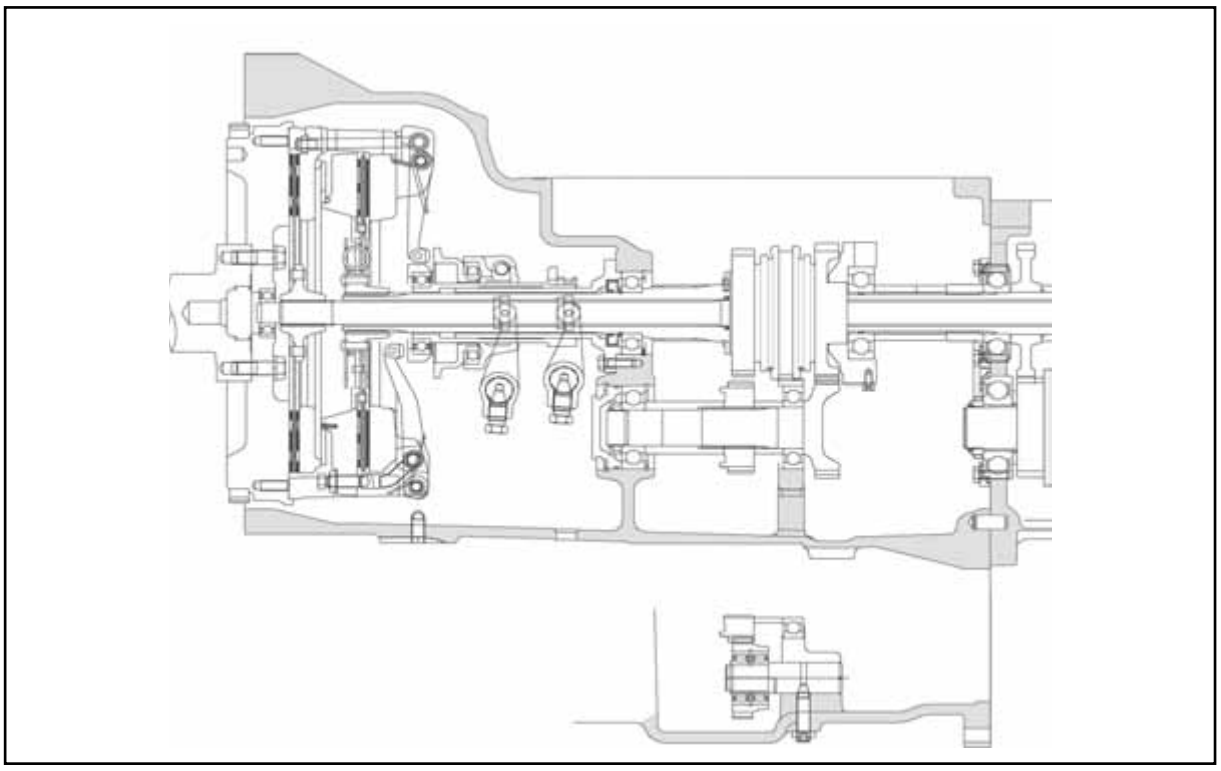


Fig. 4.4

2.2 Drawing of assembly and main units (Speed Five version)(4 WD)

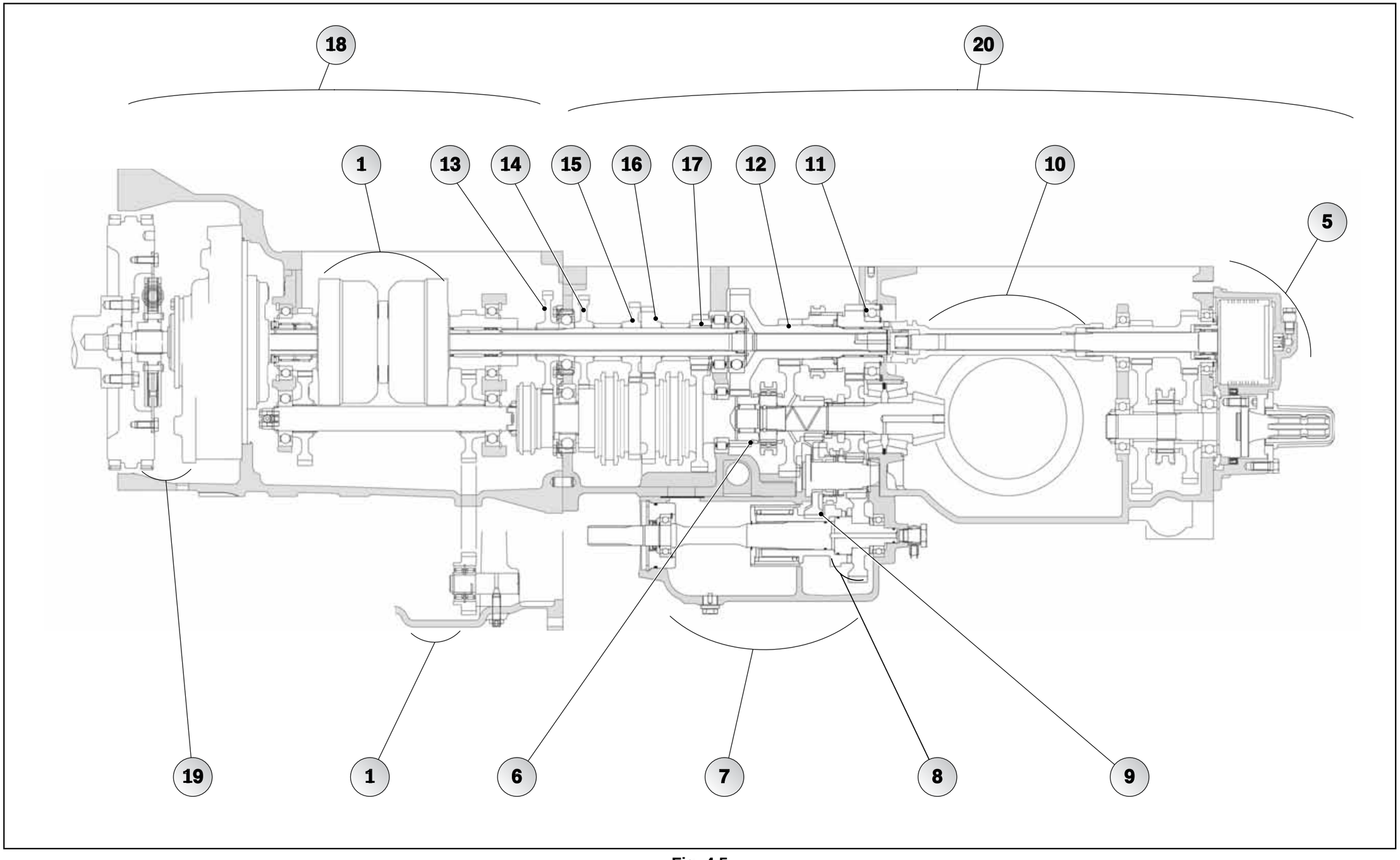


Fig. 4.5

19 - Clutch
18 - Engine/gearbox assembly
20 - Gearbox
5 - rear P.T.O. assembly
6 - fast range
7 - 4WD housing
8 - Spring-on assembly
9 - Creeper
10 - pinion, ring gear and differential assembly
11 - Medium range
12 - Slow range
13 - 5th speed gear
14 - 4th speed gear
15 - 3rd speed gear
16 - 2nd speed gear
17 - 1st speed gear

2.2.1 Description of operation (Speed Five version) (4WD)

Drive passes from the flywheel to the gearbox input shaft (14) by means of the single-plate clutch, thus reaching the reverse shuttle. The operator can choose which direction to take whilst the tractor is on the move, since engagement is synchronized. Drive enters the gearbox via the main shaft (101), which is splined on to the reverse shuttle unit. The main shaft (101) has all the gears of the five speeds, which thus transmit drive to the gear shaft (131). The driven gears of the five speeds and the relative synchronizers are free to move on the secondary shaft. They allow the operator to change gear whilst the tractor is on the move. Regardless of the gear engaged, drive thus passes from the secondary shaft (131) to the permanently meshed upper shaft (116). This latter shaft has the driving gear (117) of the slow range and is fitted with the idling driving gear (122) of the medium range. The ranges are engaged by means of sleeves with frontal toothing. The driven gear (143) of the slow range and the creeper (if installed) are free to turn on the output shaft (142), which is also splined with the driven gear (145) of the medium range. Regardless of the range engaged, drive thus reaches the pinion-ring gear assembly and from thence passes to the side final drives and wheels. The driven gears of the creeper (if installed) and the relative engaging sleeve are installed in the 4WD housing. This always contains the “Spring-on” unit and the optional creeper. The PTO assembly is installed in the rear part. It is manually servo controlled and supplied by the low flow circuit. The PTO has two speeds and is the type proportional to the ground speed. Drive reaches the PTO assembly by means of the shaft (2) splined to the hub (3) fixed to the flywheel. Drive then reaches the PTO clutch unit by means of the selector sleeve (501) and from thence to the gears (600/590). Drive thus reaches the output shaft (512), depending on the selected speed.

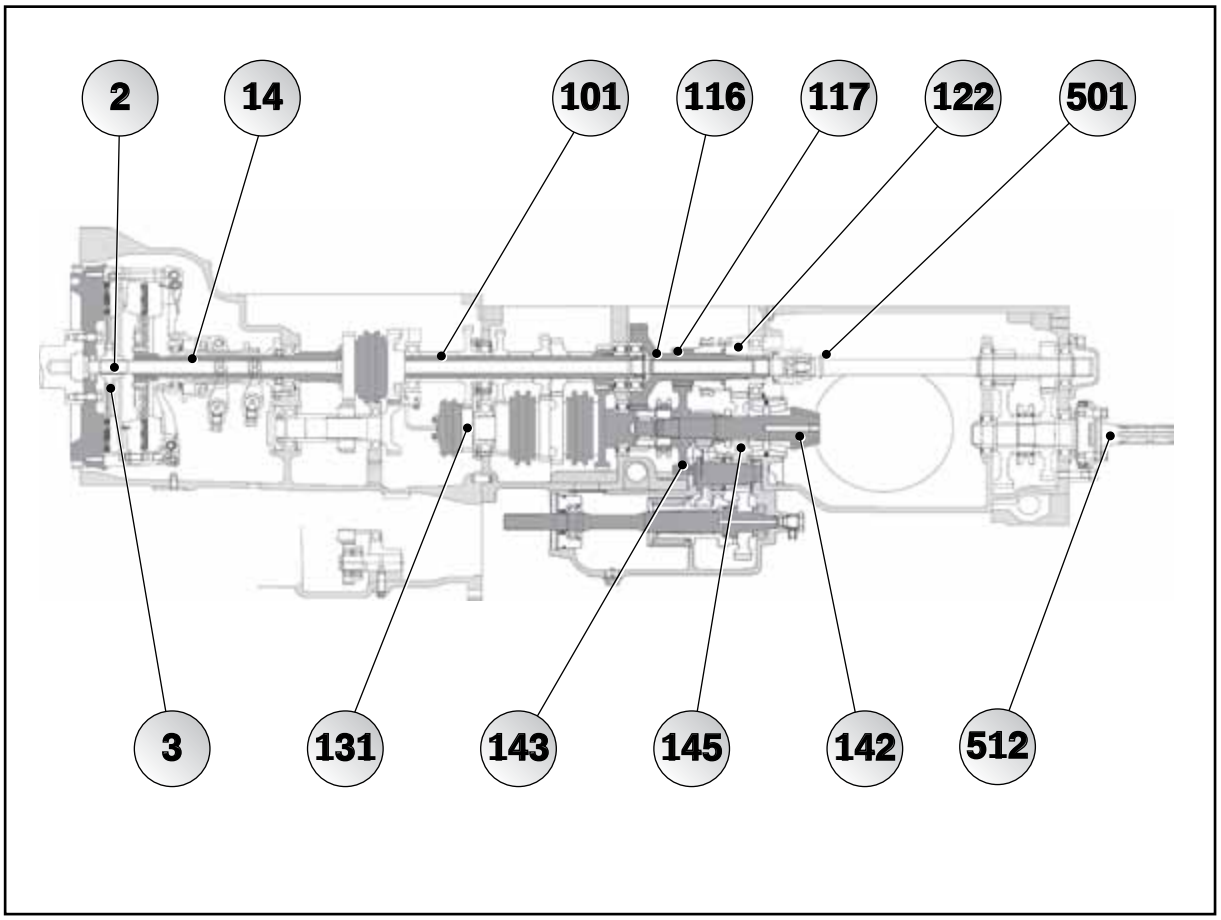


Fig. 4.6

2.3 Drawing of assembly and main units (Power Five version)(4 WD)

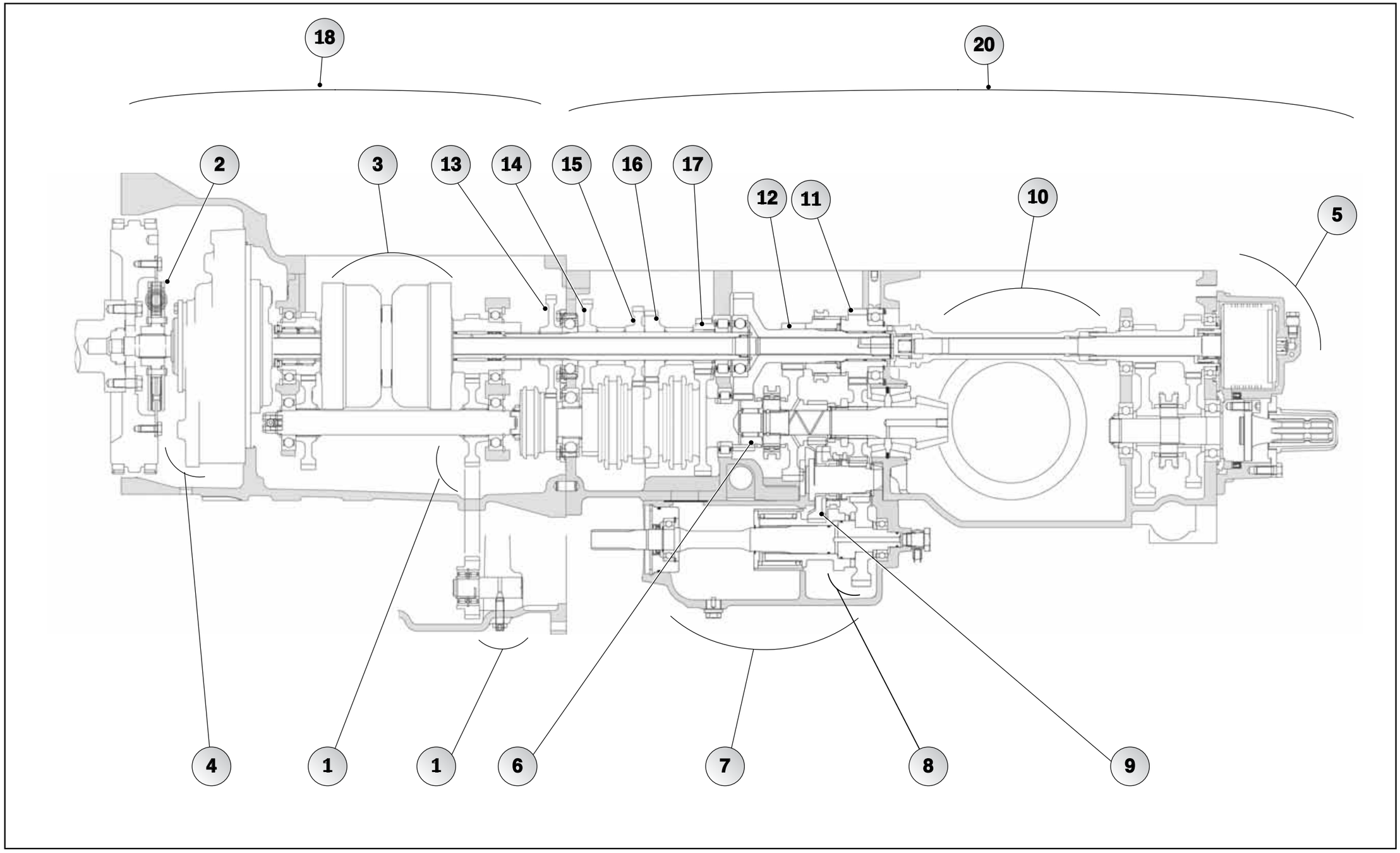


Fig. 4.7

1 - Reverse shuttle
2 - Clutch
3 - Power Shuttle assembly
4 - Power Five/Four assembly
5 - rear P.T.O. assembly
6 - fast range
7 - 4WD housing
8 - Spring-on assembly
9 - Creeper
10 - pinion, ring gear and differential assembly
11 - Medium range
12 - Slow range
13 - 5th speed gear
14 - 4th speed gear
15 - 3rd speed gear
16 - 2nd speed gear
17 - 1st speed gear
18 - Engine/gearbox assembly
20 - Gearbox

2.3.1 Description of operation (Power Five version) (4WD)

Drive passes from the flywheel to the input shaft (207) through the dampener disc(205). Drive reaches thus the “Power Five” unit, which reduces it by 20%. the electrohydraulic control system allows the drive to be engaged with the tractor moving and under full load. Drive now reaches the clutch shaft (225). If the tractor is being driven FORWARDS (Fig.4.8), drive passes through the secondary clutch and thus reaches the main shaft (301) of the gearbox. The driving direction is reversed by means of the main clutch. In this case, drive passes to the driven gear (230), which is keyed to the transmission shaft of the reverse shuttle (231). The driving direction is therefore reversed thanks to the combination between gears (235) and (240). This latter transmits reversed drive to the gearbox via gear (223). The main gearbox shaft (301) is always meshed on this latter and is keyed with all the driving gears of the five speed gears which thus transmit drive to the transmission shaft (331). The driven gears of the five speeds and the relative synchronizers are free to move on the secondary shaft. They allow the operator to change gear whilst the tractor is on the move. Regardless of the gear engaged, drive thus passes from the secondary shaft (331) to the permanently meshed upper shaft (316). This latter shaft has the driving gear (317) of the slow range and is fitted with the idling driving gear (322) of the medium range. The ranges are engaged by means of sleeves with frontal toothing. The driven gear (343) of the slow range and the creeper (if installed) are free to turn on the output shaft (342), which is also splined with the driven gear (345) of the medium range. Regardless of the range engaged, drive thus reaches the pinion-ring gear assembly and from thence passes to the side final drives and wheels. The driven gears of the creeper (if installed) and the relative engaging sleeve are installed in the 4WD housing. The housing always contains the “Spring-on” and “Park Lock” assemblies, and the creeper as an option. The Park Lock assembly is a mechanical lock that blocks the transmission and acts as a safety device, since it inhibits all mechanical connections between the actual engine and the transmission when the engine is at a standstill. The PTO assembly is installed at the rear. It is electrohydraulically engaged and supplied by the low flow circuit. The PTO has two speeds and is proportional to the ground speed. Drive is transmitted to the PTO assembly through the shaft (202) splined to the shaft (207). Drive then passes through selector sleeve (501) to the PTO clutch assembly and from thence, to the double gear. It finally reaches the output shaft (512) depending on the speed selected.

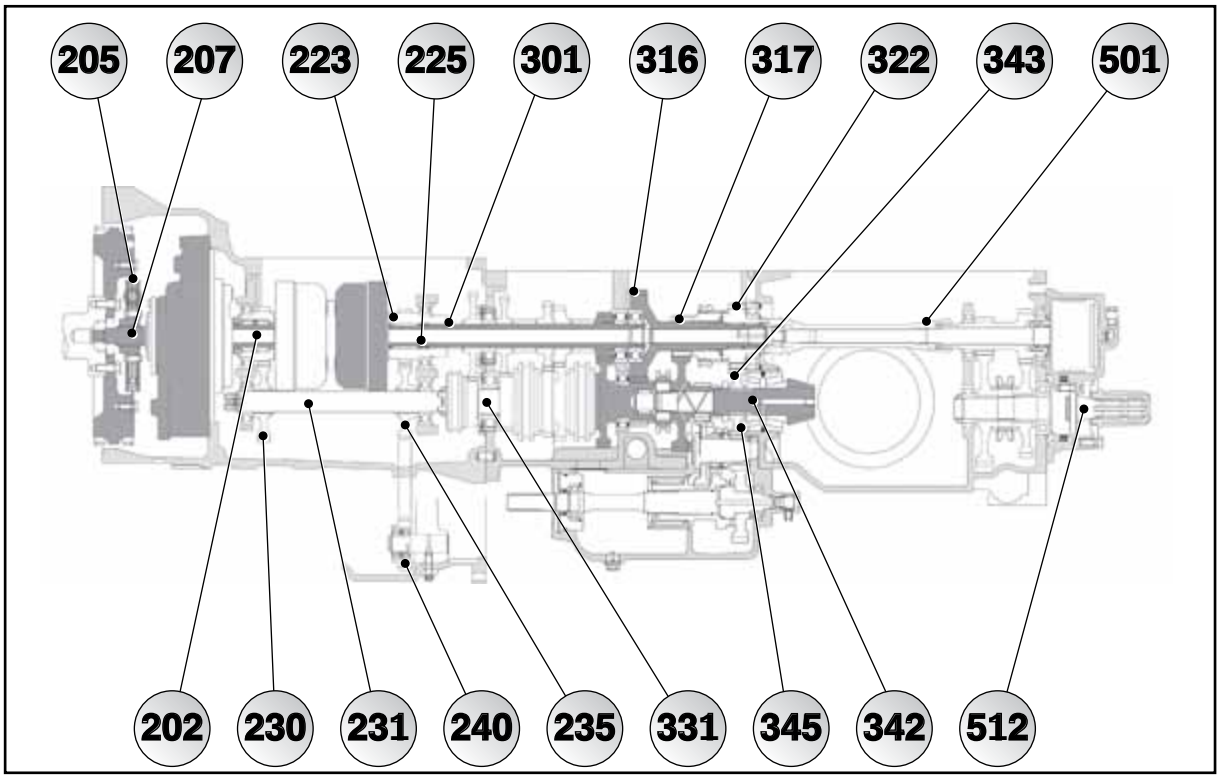


Fig. 4.8

2.4 Differences between the 2 WD, 4 WD, Techno versions.

The gearbox of the 2WD tractors and the Techno versions has 4 speed gears instead of 5, as 2WD tractors are not allowed to reach the speed of 40 Kph.

Thus in these tractors, the entire synchronizer unit (A) of the fifth speed (from 127 to 130) and of gear (103) is missing.

The shaft (101) is the same and a spacer is mounted in place of gear (103), while the lay shaft (131) is replaced by shaft (158). In 2WD tractors the four-wheel drive housing is empty and only contains a baffle (159) that allows oil to be correctly supplied to the pumps of the hydraulic circuit.

A-5th speed synchromesh assembly

Note: In echno versions, the gearbox has 4 speed gears and the 4WD housing can be equipped with the “Spring-on” unit so as to engage the Four-wheel Drive.

Speed Five transmission version (4 WD)

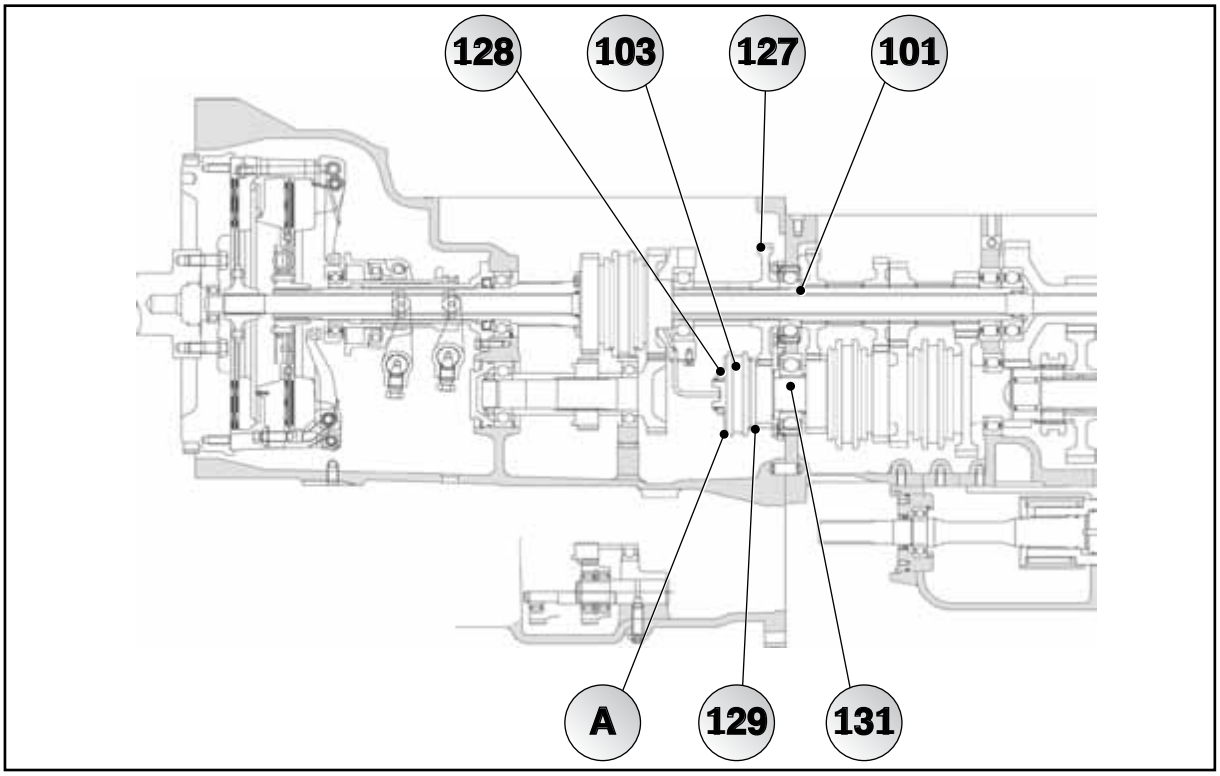


Fig. 4.9

SPEED FOUR TRANSMISSION version (2 WD)

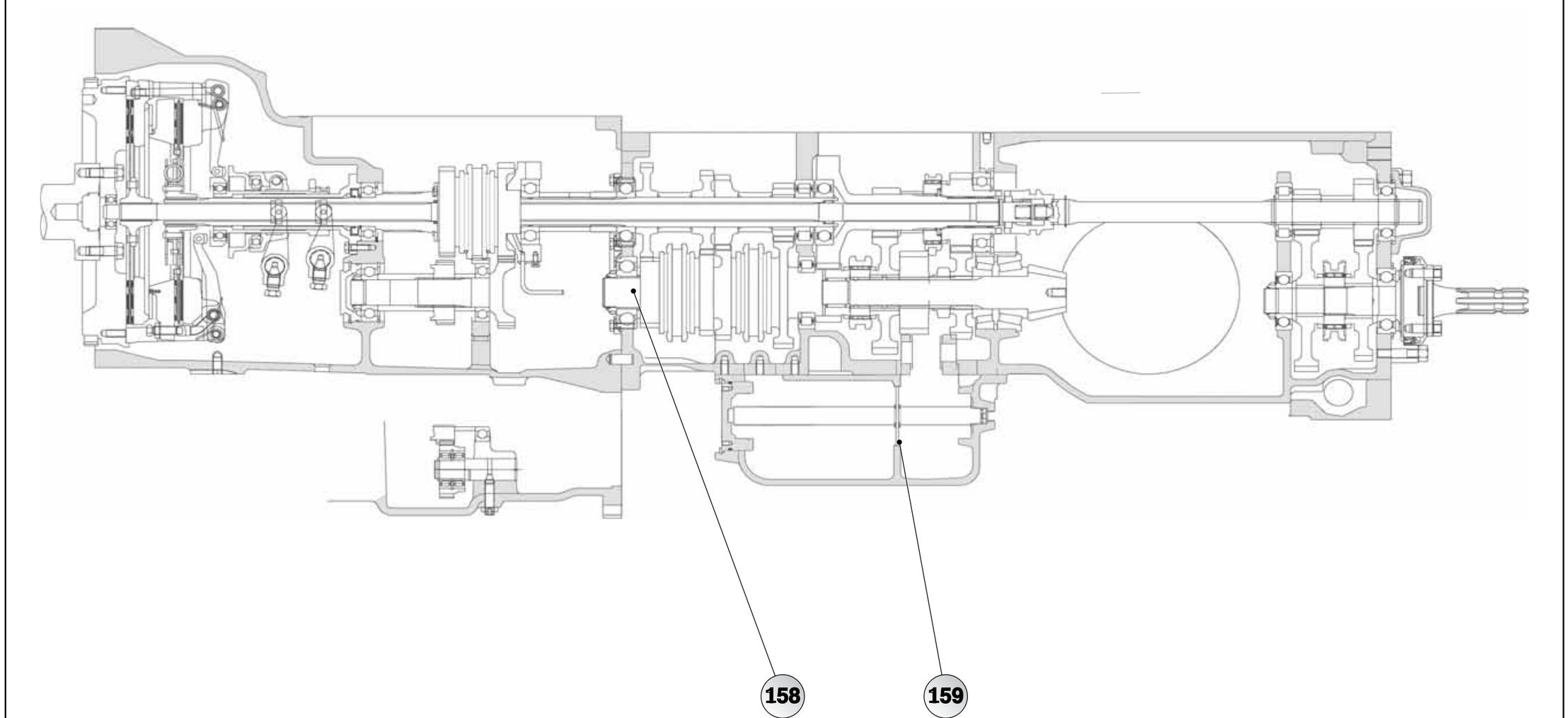


Fig. 4.10

F-N Series E-Line TRANSMISSION version (4 WD)

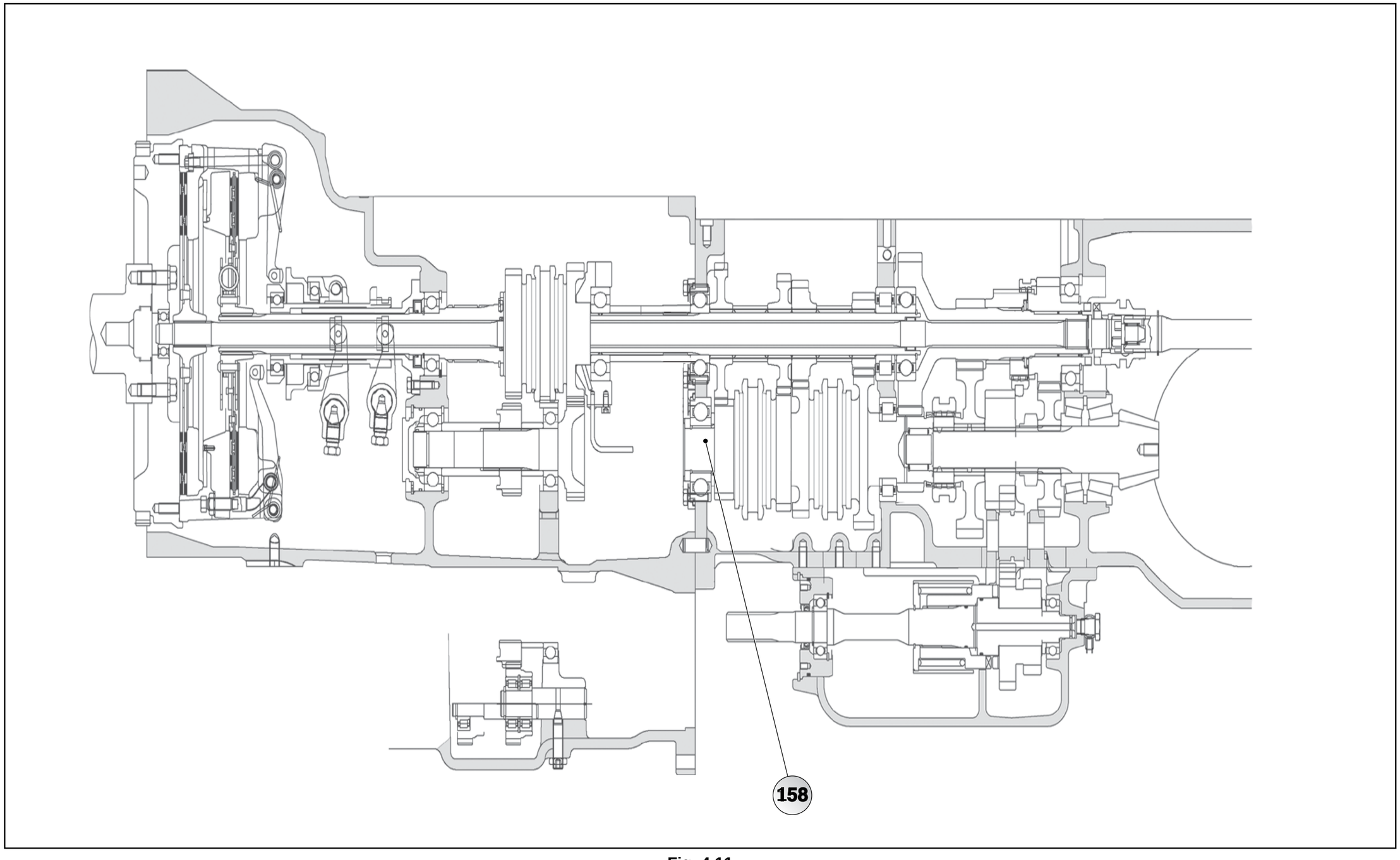


Fig. 4.11

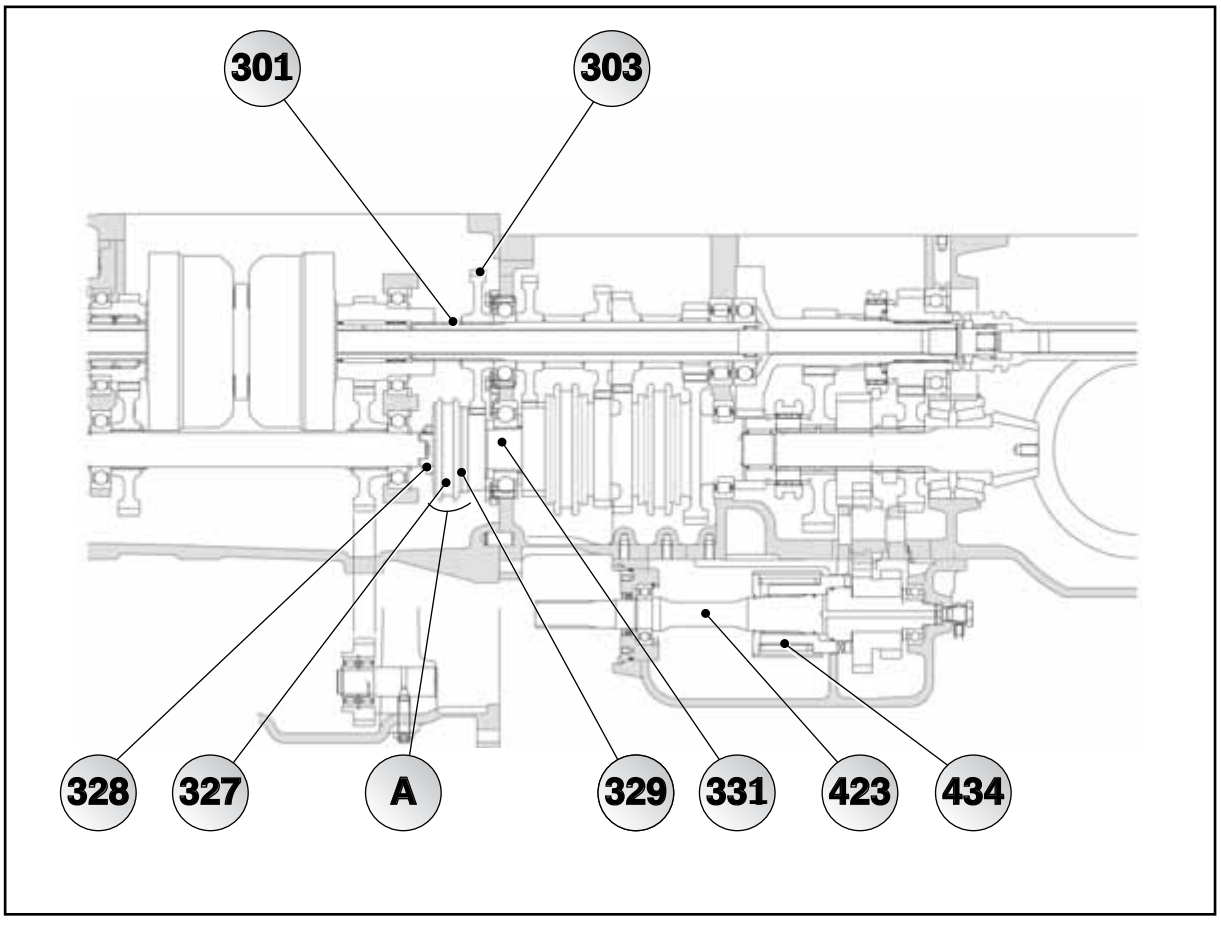
The gearbox of the POWER SHUTTLE versions of the 2WD tractors also has 4 speeds available instead of 5, as 2WD tractors are not allowed to reach the speed of 40 Kph.

Thus in these tractors, the entire synchronizer unit (A) of the fifth speed (from 327 to 330) and of gear (303) is missing.

The shaft (301) is the same and a spacer is mounted in place of gear (303), while the lay shaft (331) is replaced by shaft (378). In 2WD tractors, most of the internal components of the four-wheel drive housing are different, as the shaft (423) is shorter (it does not transmit drive to the 4WD shaft), and there is no “Spring-on” unit (434) or the ducts that supply it with oil.

A-5th speed synchromesh assembly

Power Shuttle transmission version (4 WD)



Power Four transmission version (2 WD)

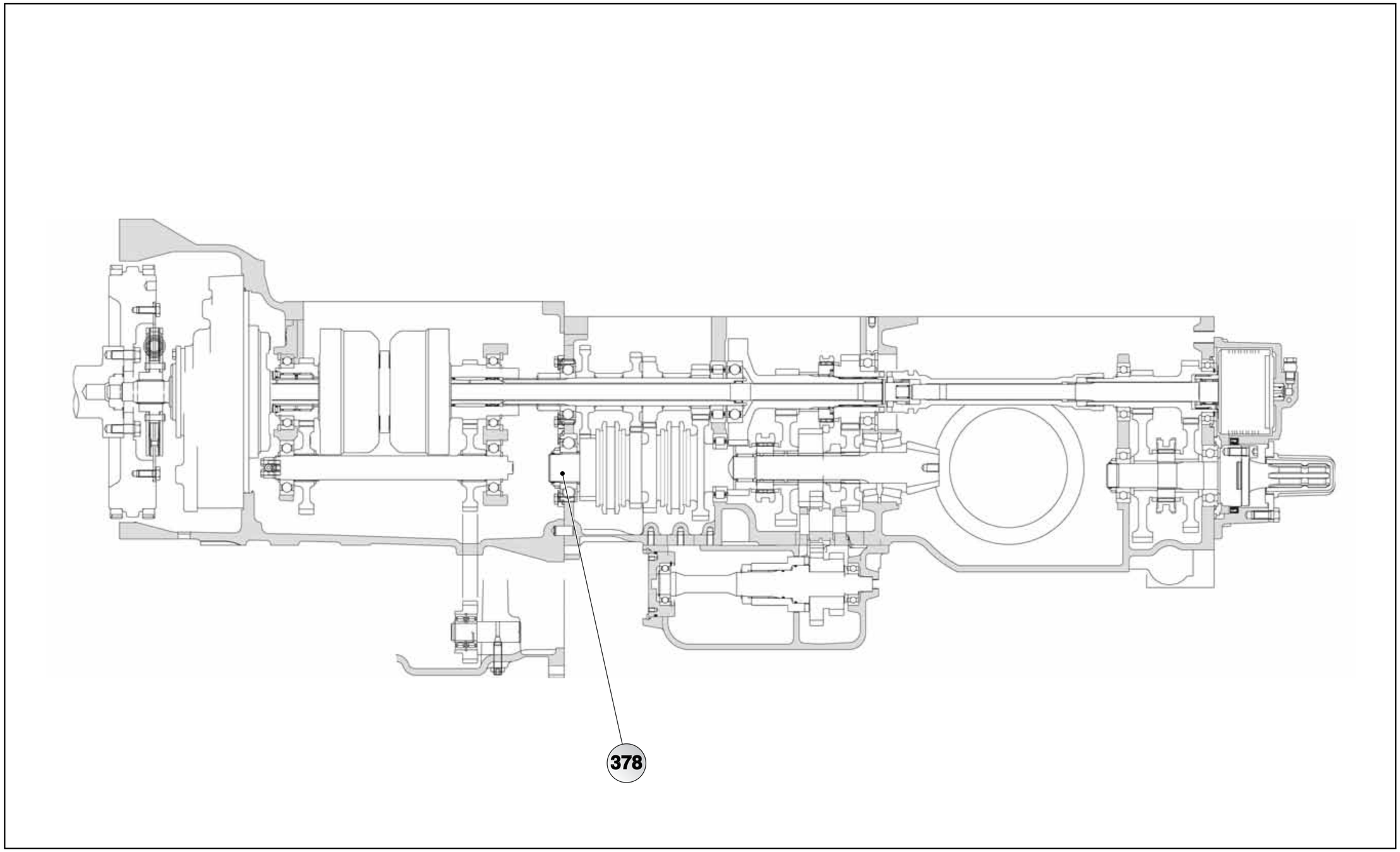


Fig. 4.13

2.5 Control devices

GEARSHIFT LEVERS

The gearshift lever (M) is located in a lateral position, on the right side of the dashboard, in the Speed Four/Five and Techno versions, and in the Power Shuttle version. Thanks to the functional position of each speed, driving is easy, safe and suited to any handling requirement.

There are two buttons on the lever of Power Shuttle versions:

- SB3) for gearshifting in the “automatic mode” (without using the clutch pedal).
- (SB2) to change the range of the “Power Four/ Five unit (if installed).

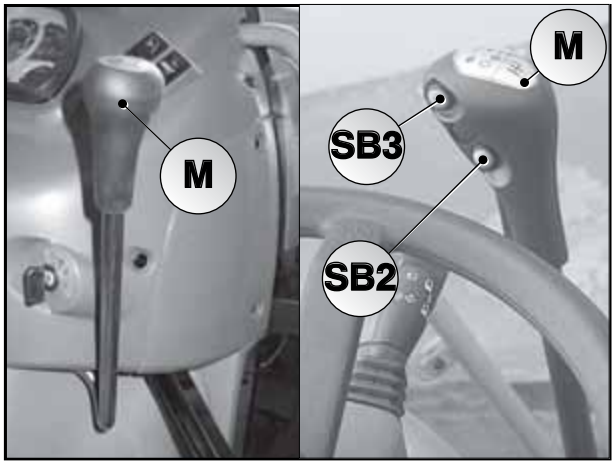


Fig. 4.14

The range shift (G) (slow, normal, fast) and creeper (if installed) lever is on the left, just under the seat.

Fig. 4.15

REVERSE SHUTTLE LEVER (SPEED FOUR/FIVE AND TECHNO VERSIONS)

The reverse shuttle lever (S) is located at the side, to the left of the dashboard. The lever can be moved to three positions, corresponding to precise ways of using the ground speeds, neutral or reverse speeds of the tractor:

A - forward speeds
N - neutral
R - reverse

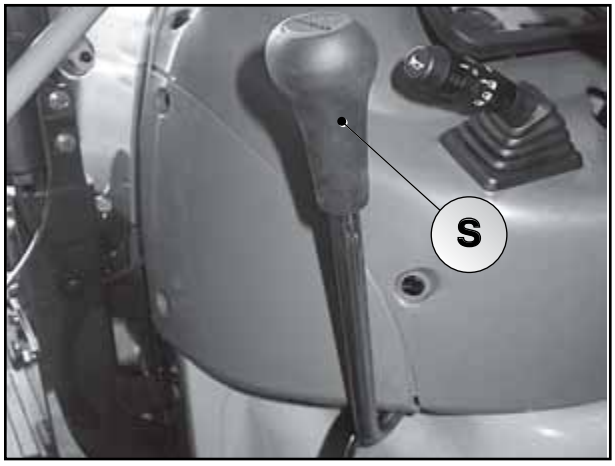


Fig. 4.16

REVERSE SHUTTLE LEVER (POWER SHUTTLE VERSION)

The reverse shuttle lever (I) is located at the side, to the left of the dashboard. It allows the driver to reverse the direction of the tractor when its speed is less than 10 kph and to start either forwards or in reverse without using the clutch pedal ("automatic" mode).

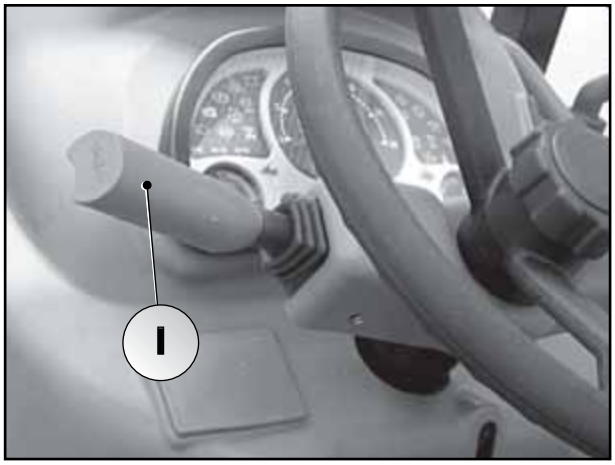


Fig. 4.17

PARK LOCK LEVER

This lever (P) is only installed in the Power Shuttle versions and is used to engage/disengage the "Park Lock" unit. It is installed in addition to the parking brake to guarantee a more reliable braking action. It is installed just under the steering wheel.

Note: in Speed Four/Five versions, the rear PTO engaging lever (Q) is installed instead of the lever (P).

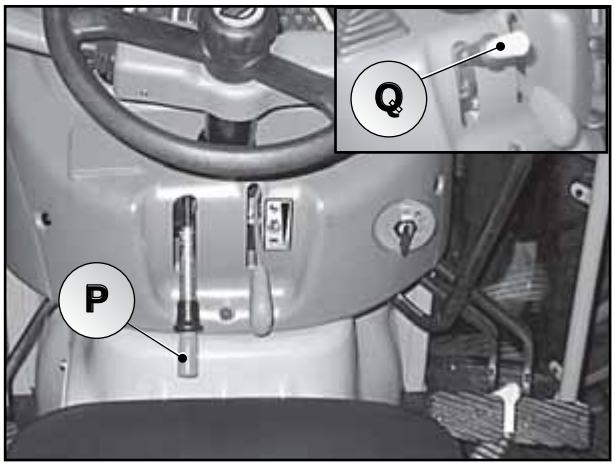


Fig. 4.18

DIFF LOCK AND 4WD SWITCHES

The switches (SB8 and SB11) installed on the driver's right, respectively engage/disengage the diff lock and 4WD. The diff lock can be disengaged with the brake pedals.

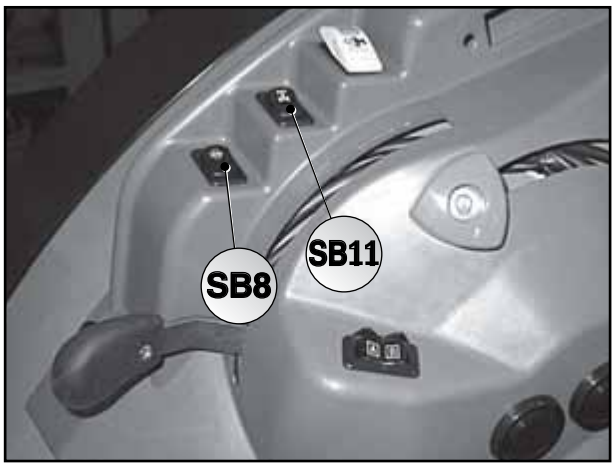


Fig. 4.19

PTO LEVER (TECHNO VERSION)

The lever (M) controls the PTO in the Techno versions. The PTO is mechanically engaged.

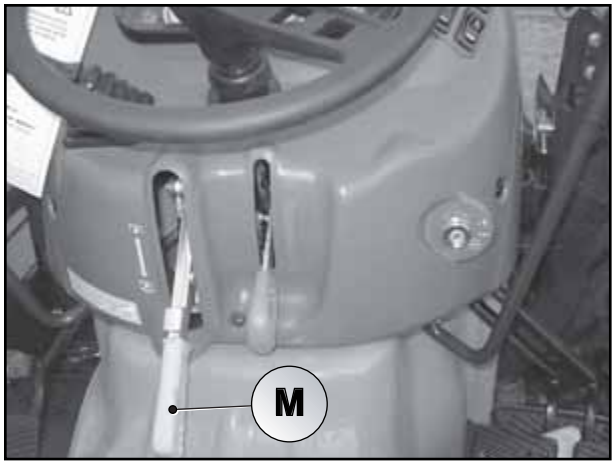


Fig. 4.20

2.6 Power train diagrams

Mechanical transmission of F-N Series Speed Five version tractors, with creeper and 4WD

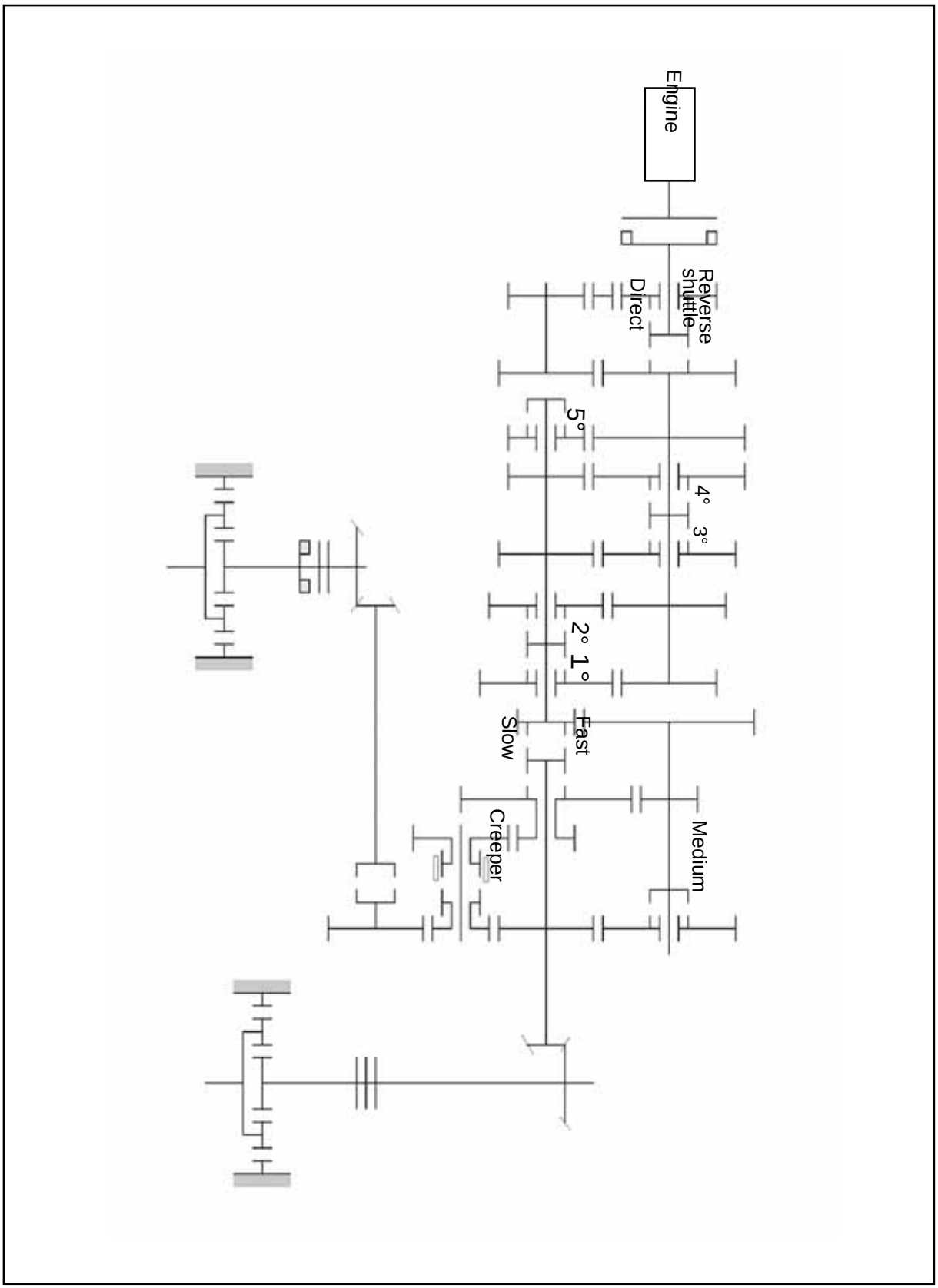


Fig. 4.21

Mechanical transmission of F-N Series Speed Five version tractors, without creeper and 4WD

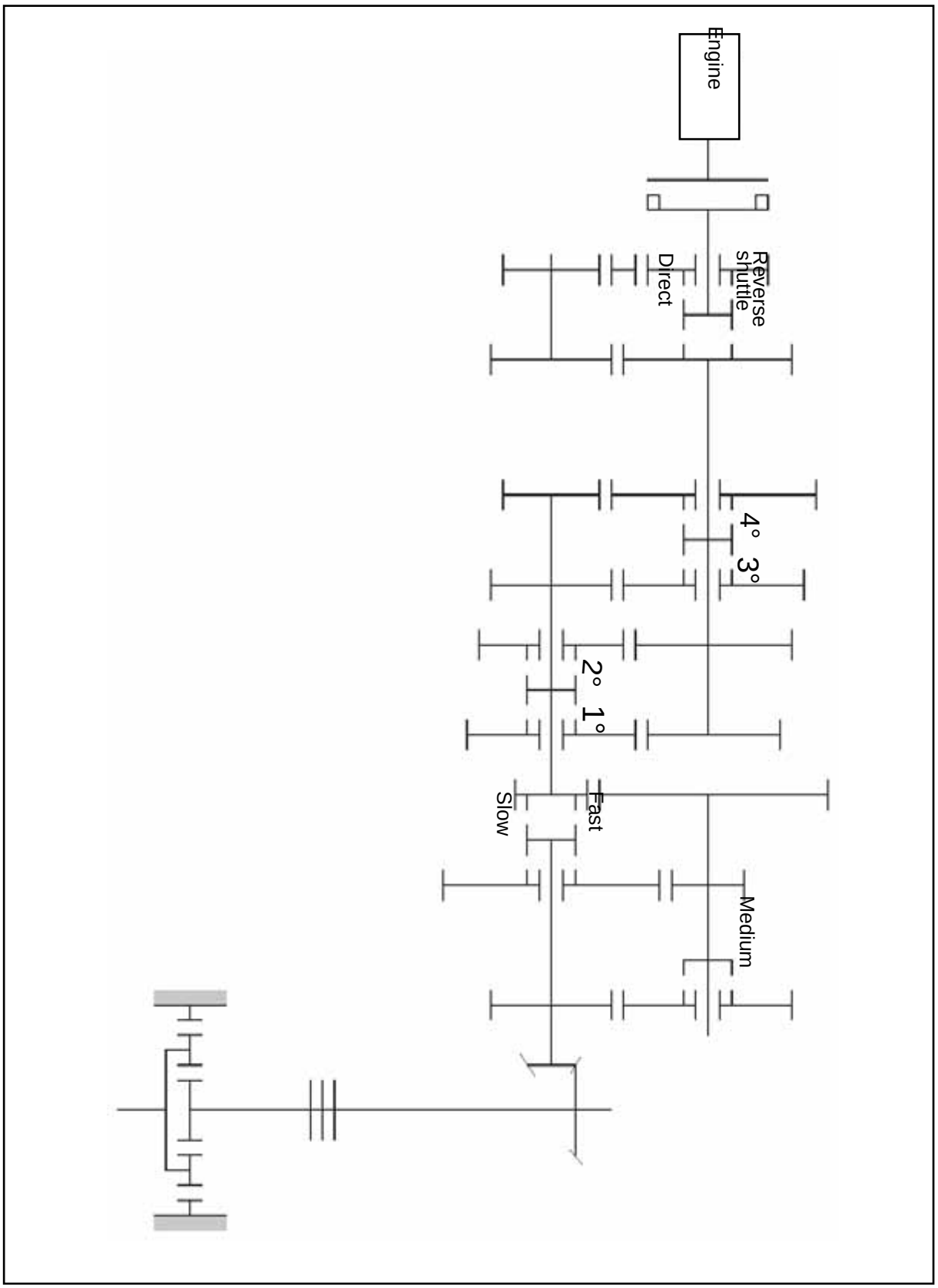


Fig. 4.22

Mechanical transmission of F-N Series Speed Four version tractors, with creeper and 2WD

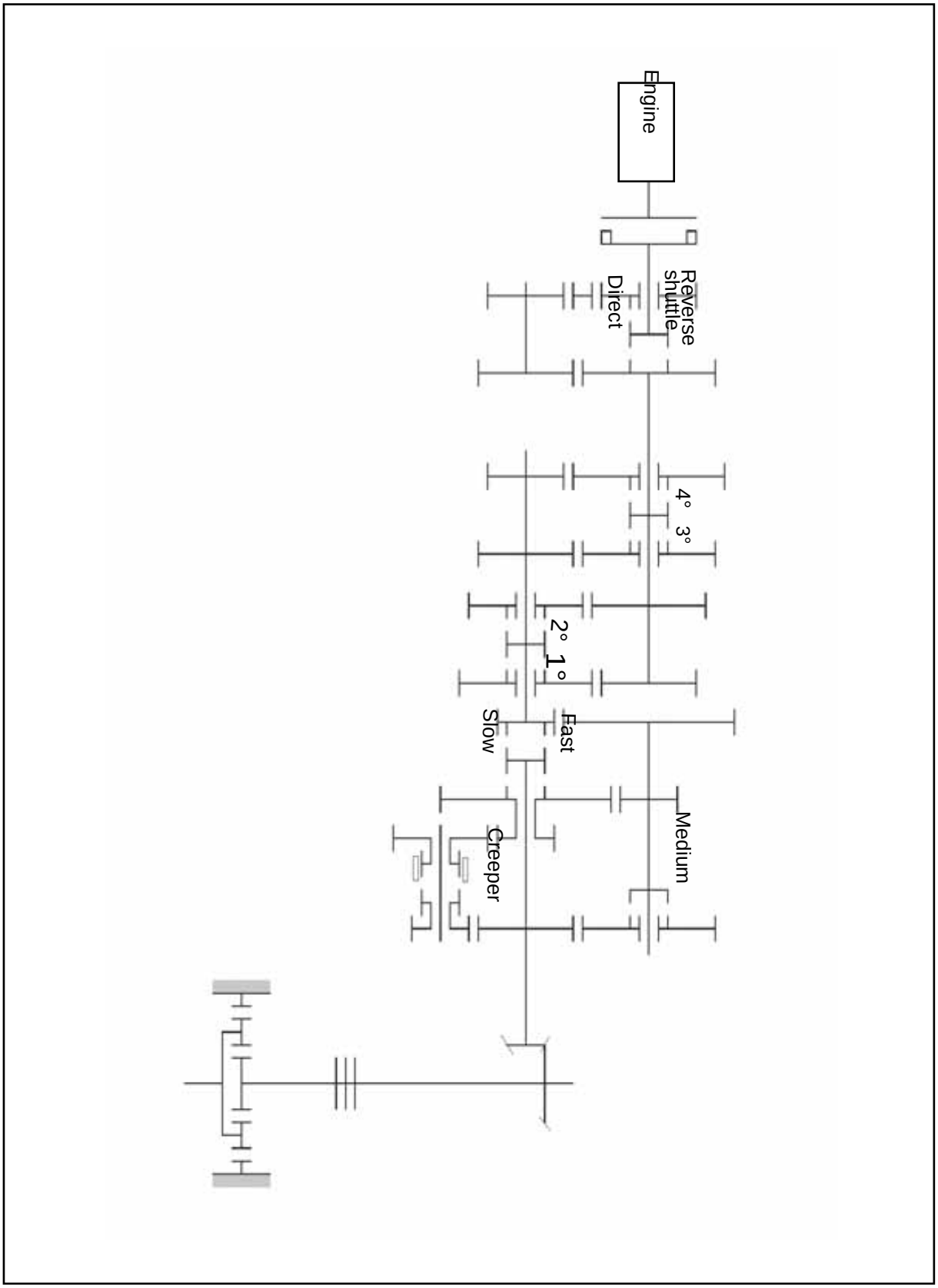


Fig. 4.23

Mechanical transmission of F-N Series Speed Four version tractors, without creeper and 2WD

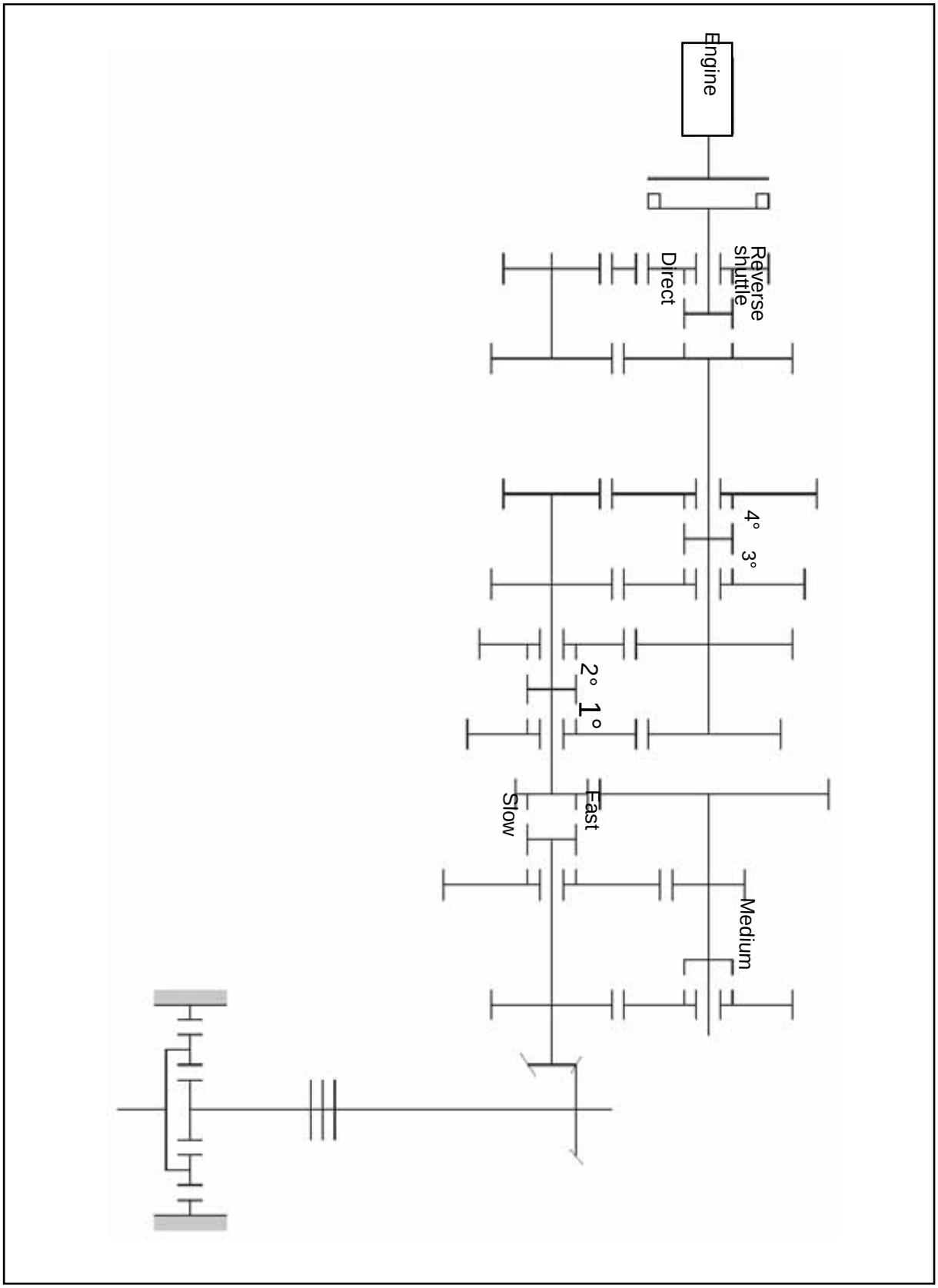


Fig. 4.24

Mechanical transmission of F-N Series Power Shuttle version tractors with Power Five, creeper and 4WD

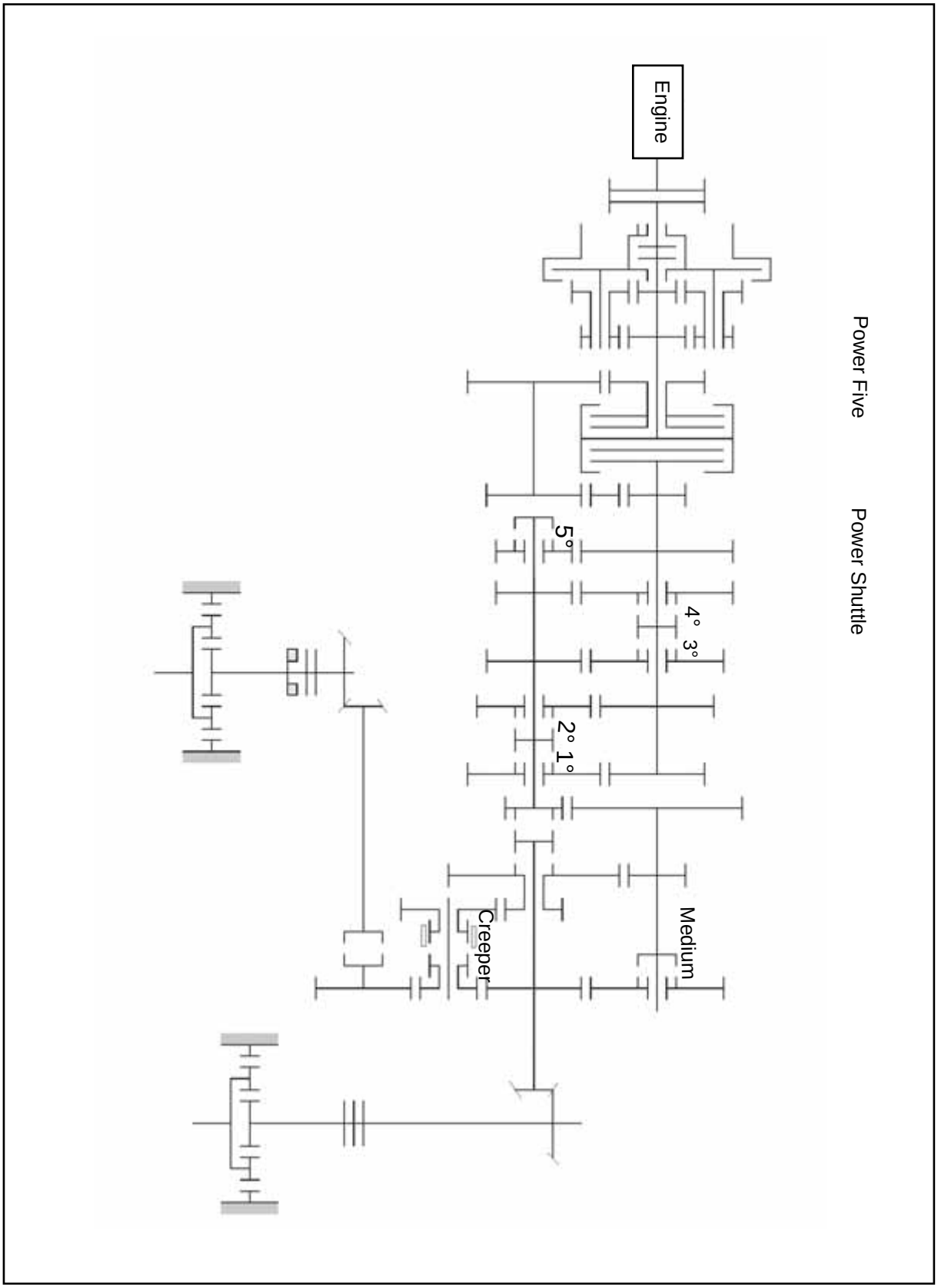


Fig. 4.25

Mechanical transmission of F-N Series Power Shuttle version tractors without Power Five, without creeper, with 4WD

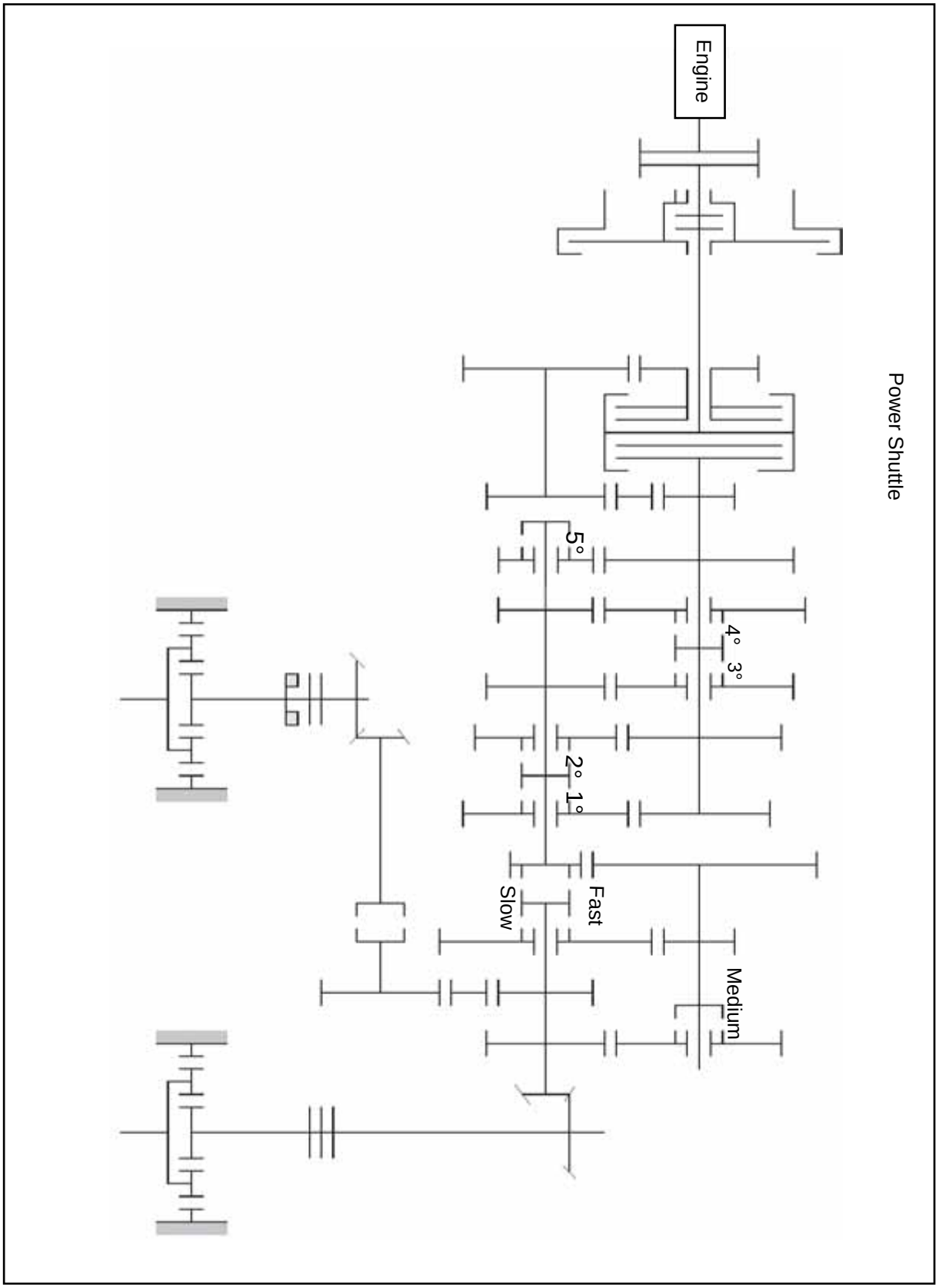


Fig. 4.26

Mechanical transmission of F-N Series Power Shuttle version tractors with Power Four, with creeper, with 2WD

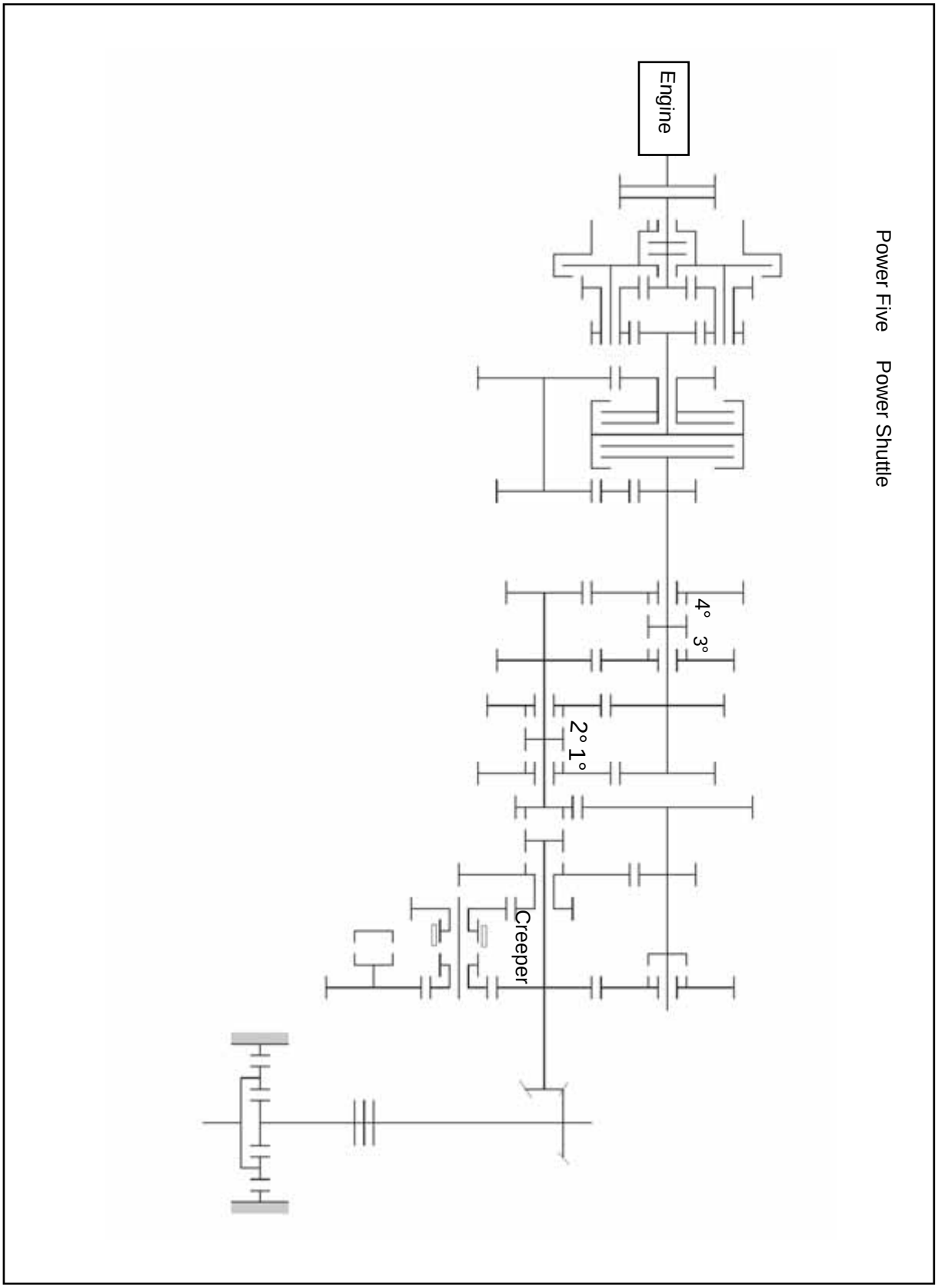


Fig. 4.27

Mechanical transmission of F-N Series Power Shuttle version tractors without Power Four, without creeper, with 2WD

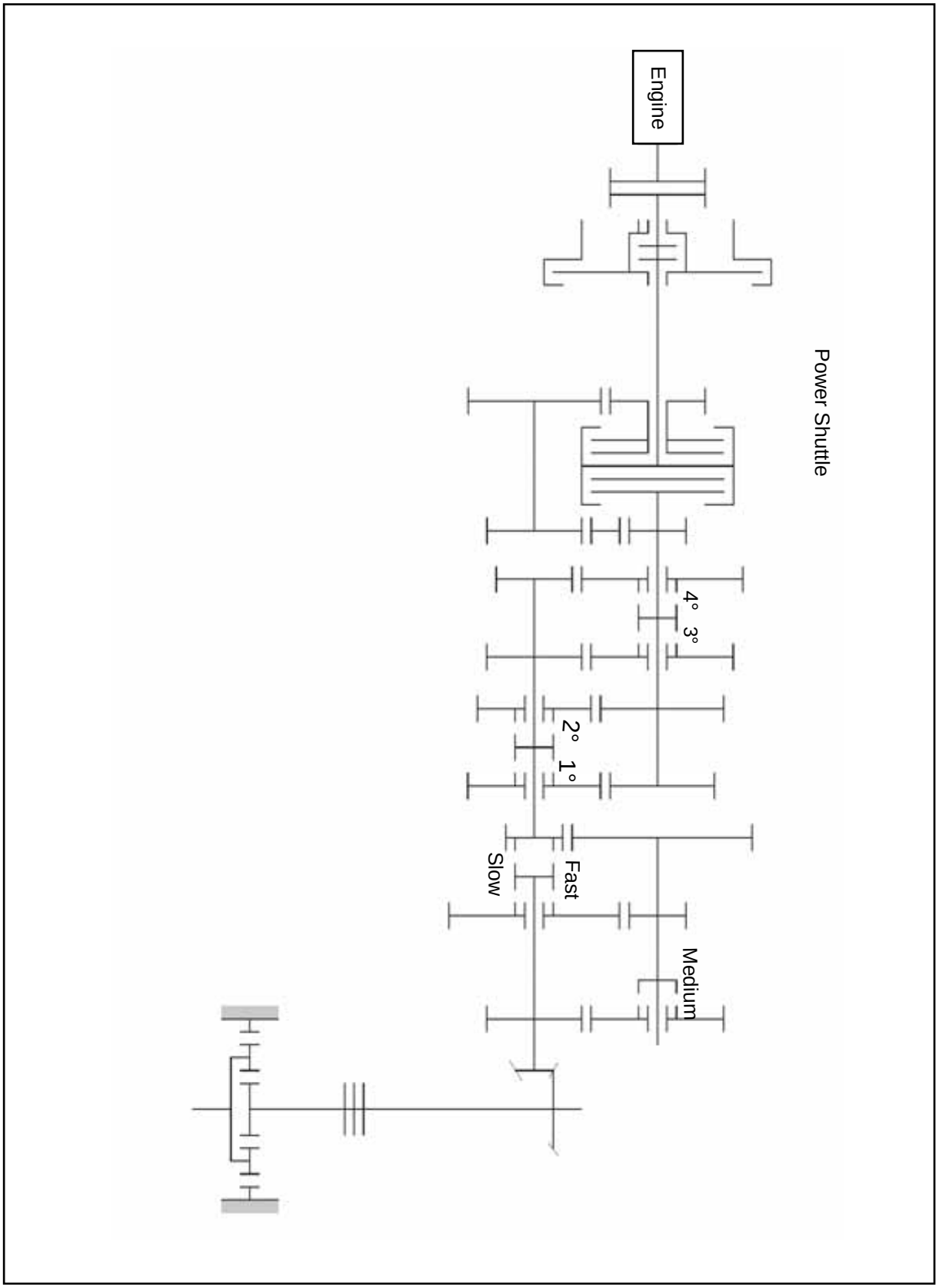


Fig. 4.28

Mechanical transmission of F-N Series Techno version tractors, with creeper and 4WD

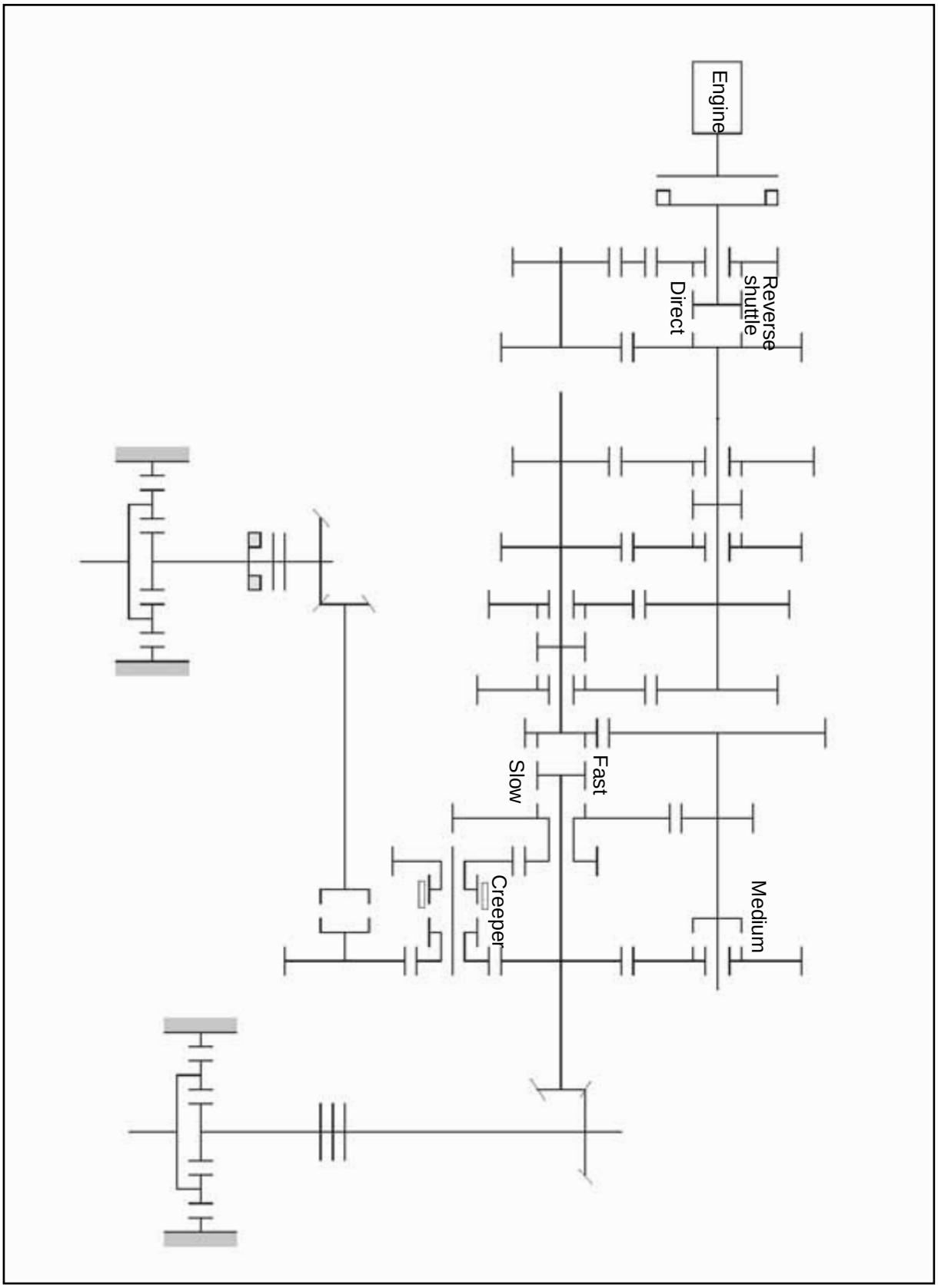


Fig. 4.29

Mechanical transmission of F-N Series Techno version tractors, without creeper, with 4WD

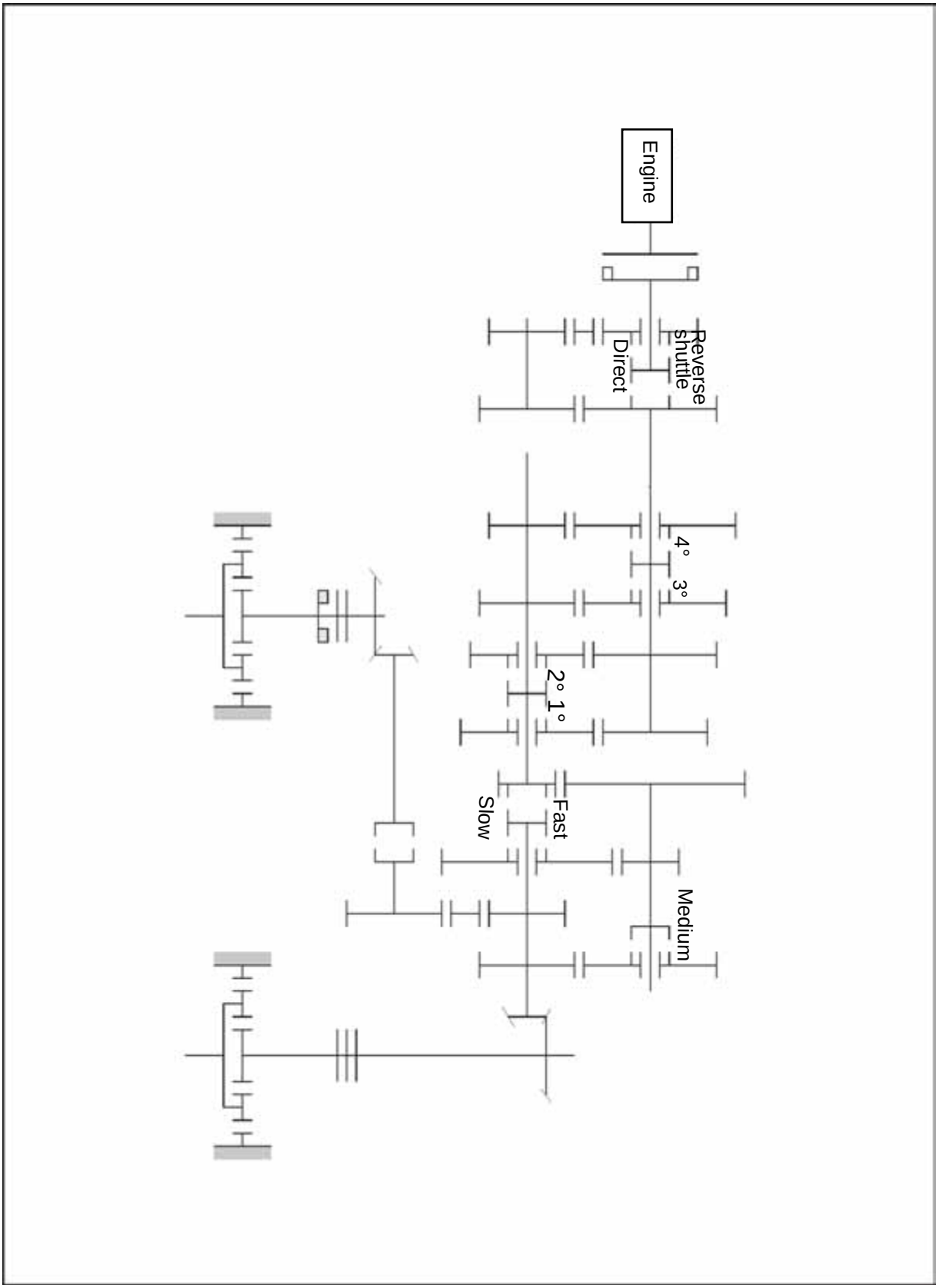


Fig. 4.30

Section 3 : Technical specifications

Index

3.1 Main technical specifications 4-34

3.2 Driving torques 4-36

3.1 Main technical specifications

Gearbox

Manufacturer	McCormick
Speed gears (4WD version) (2WD version) (Techno Version)	Five synchronized speeds with helical tooth gears Four synchronized speeds with helical tooth gears
Type of range	Three ranges (slow - standard - fast) Creeper (5.68% reduction) Power Four/Five (1.203 reduction)
Reverse shuttle	Synchronized at gearbox input (Speed Four/Five) With hydraulic control (Power Shuttle) on gearbox input
Number of speeds (4WD version)	15 forward and 15 reverse with Speed Five gearbox 20 forward and 20 reverse with Speed Five gearbox and creeper 15 forward and 15 reverse with Power Shuttle 20 forward and 20 reverse with Power Shuttle and creeper 30 forward and 30 reverse with Power Five and Power Shuttle 40 forward and 40 reverse with Power Five, Power Shuttle and creeper
Number of speeds (2WD version)	12 forward and 12 reverse with Speed Four gearbox 16 forward and 16 reverse with Speed Four gearbox and creeper 12 forward and 12 reverse with Power Shuttle 16 forward and 16 reverse with Power Shuttle and creeper 24 forward and 24 reverse with Power Four and Power Shuttle 32 forward and 32 reverse with Power Four, Power Shuttle and creeper
Number of speeds (Techno 4WD version)	12 forward and 12 reverse 16 forward and 16 reverse with creeper

Rear axle

Bevel gear pair	
(F-N Series DT 65 GE)	9/37
(F-N Series DT 65 F)	9/44
(F-N Series DT 70/100 GE)	9/37
(F-N Series DT 70/100 F-XL)	9/44
Final reduction of final drives (F-N Series DT 65 F-GE)	epicyclic with ratio: 5,200
(F-N Series DT 70/100 F-GE-XL)	epicyclic with ratio: 5,077
Total reduction ratio (F-N Series 65 GE)	21,372
(F-N Series 70/100 GE)	20,866
(F-N Series 70/100 XL)	24,816
Type of differential	mechanical with 2 planetaries
Differential lock	electro-hydraulic control and mechanical engagement, disengaged with braking action or button

Front brakes (4WD only)

Type	Oil-cooled multiple-plate with hydraulic control
Total number of plates	4 (2 per side)
Friction material	Graphitic resin
Plate dimensions	143 x 91 mm
Total braking area	955.18 cm²

Rear brakes

Type	Oil-cooled multiple-plate with hydraulic control
Total number of plates	Oil-cooled multiple-plate with hydraulic control
Total number of plates (F-N Series 65 GE)	6 (3 each side)
(F-N Series 70/100 GE/F)	6 (3 each side)
(F-N Series 70/100 XL and Techno version)	8 (4 each side)
Friction material	Graphitic resin
Plate dimensions	178 x 141 mm
Total braking area (F-N Series 65 GE)	1500 cm2
(F-N Series 70/100 GE/F)	1500 cm2
(F-N Series 70/100 XL and Techno version)	1875 cm2
Parking brake	Mechanical control activated with a hand lever
	Park Lock (Power Shuttle versions)

3.2 Driving torques

Speed Five version

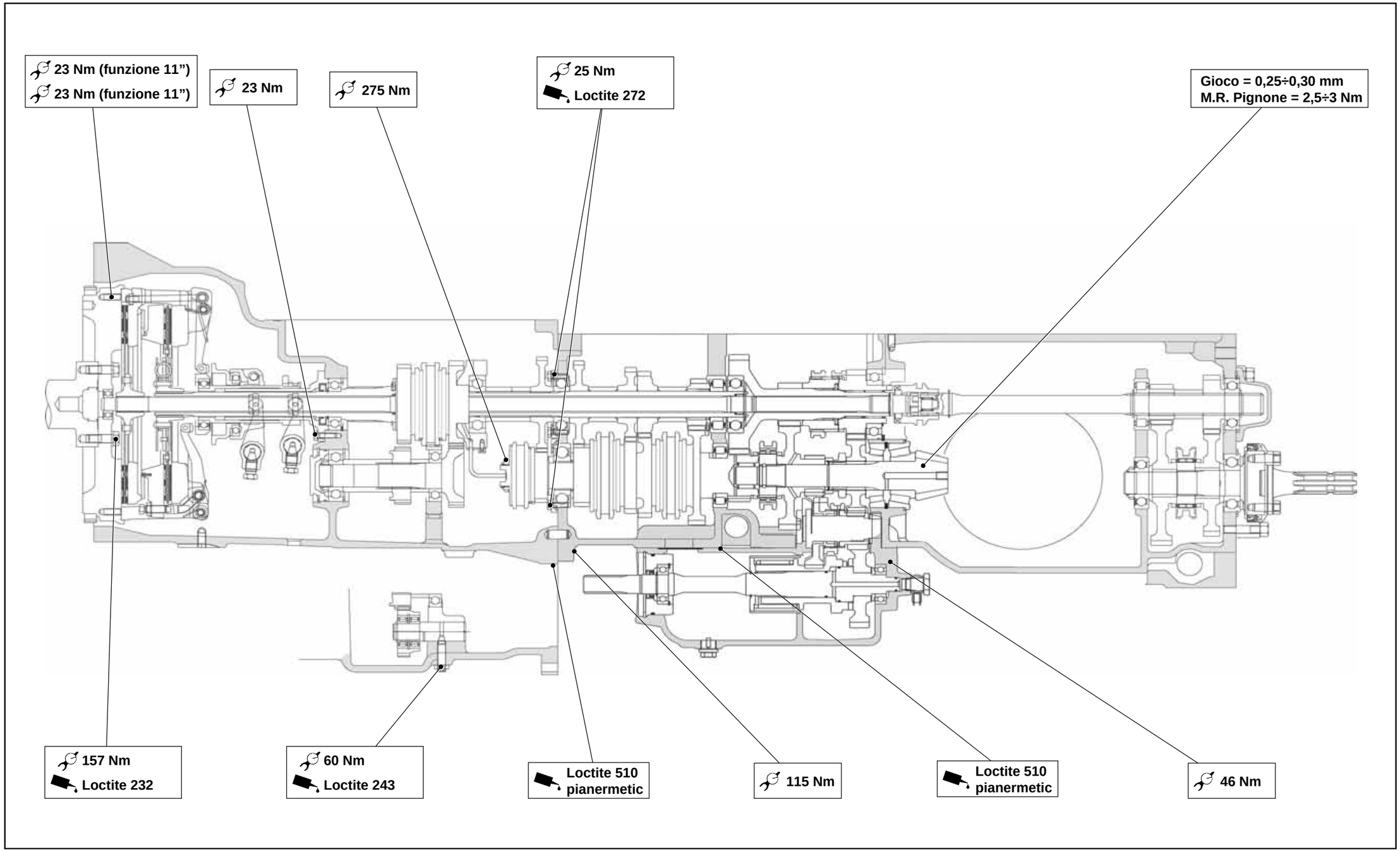


Fig. 4.31

Versione Power Shuttie (con Power Five)

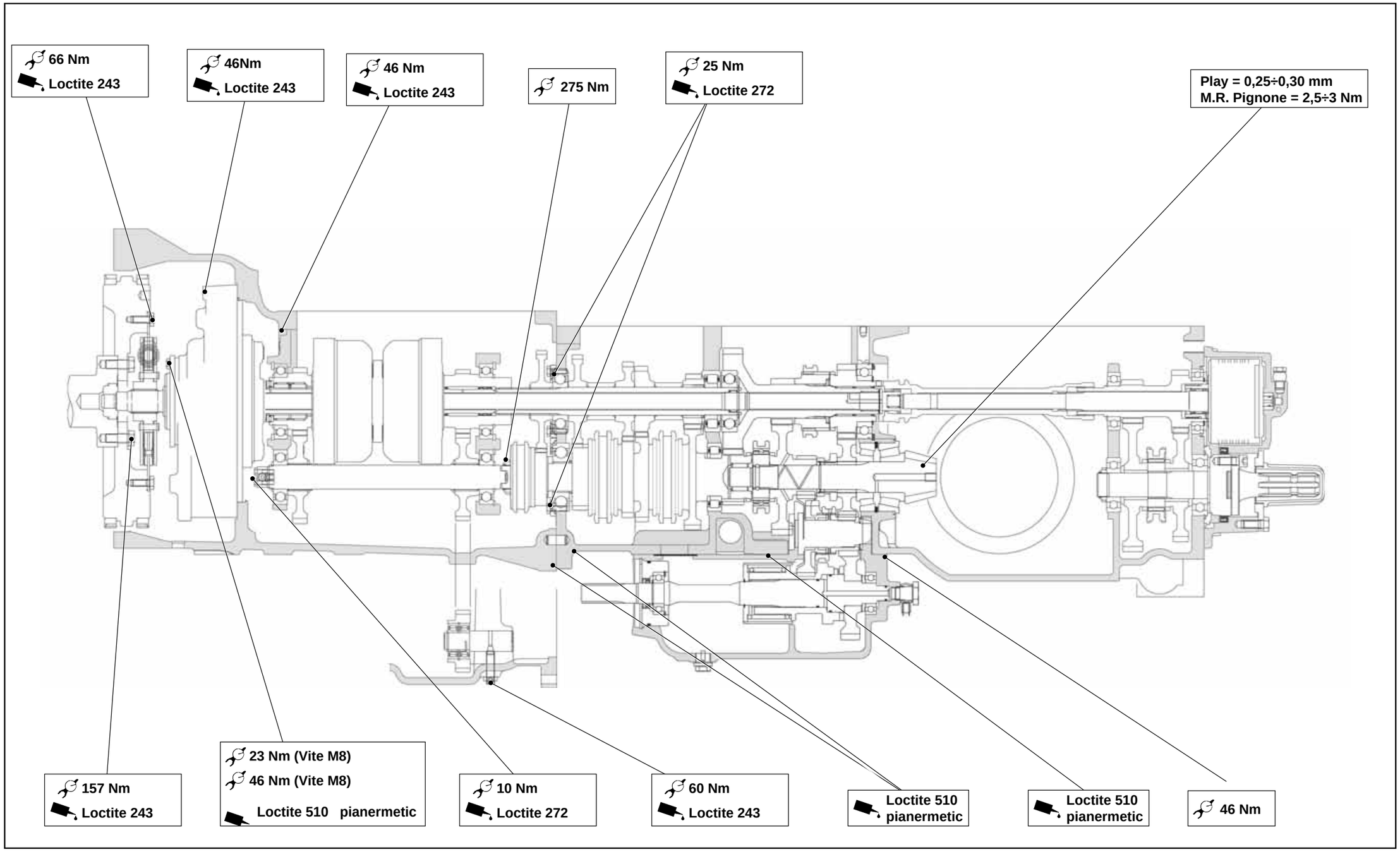


Fig. 4.32

F-N Series Techno version and versions with 2WD

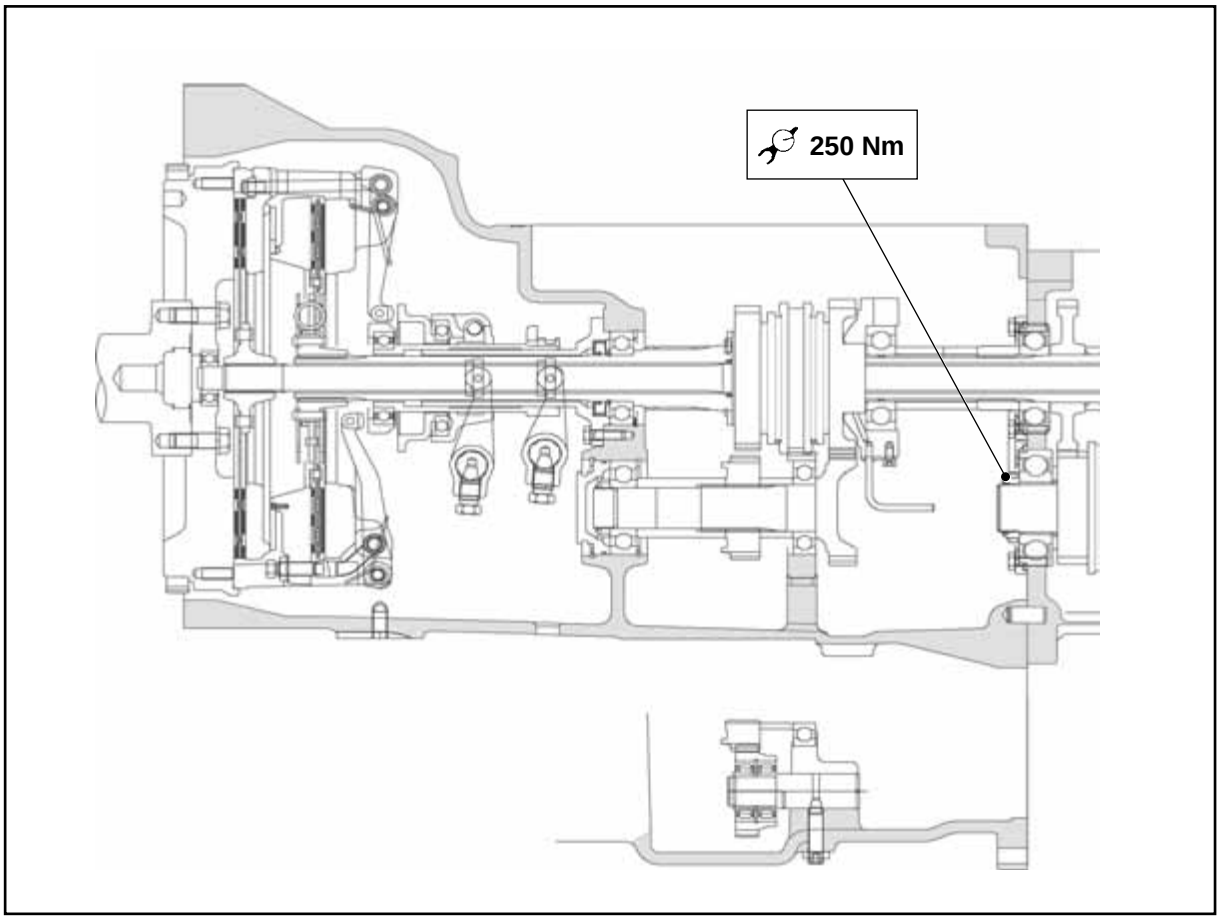


Fig. 4.33

- Driving torque
- Type of sealant

P - Preload

Version without creeper

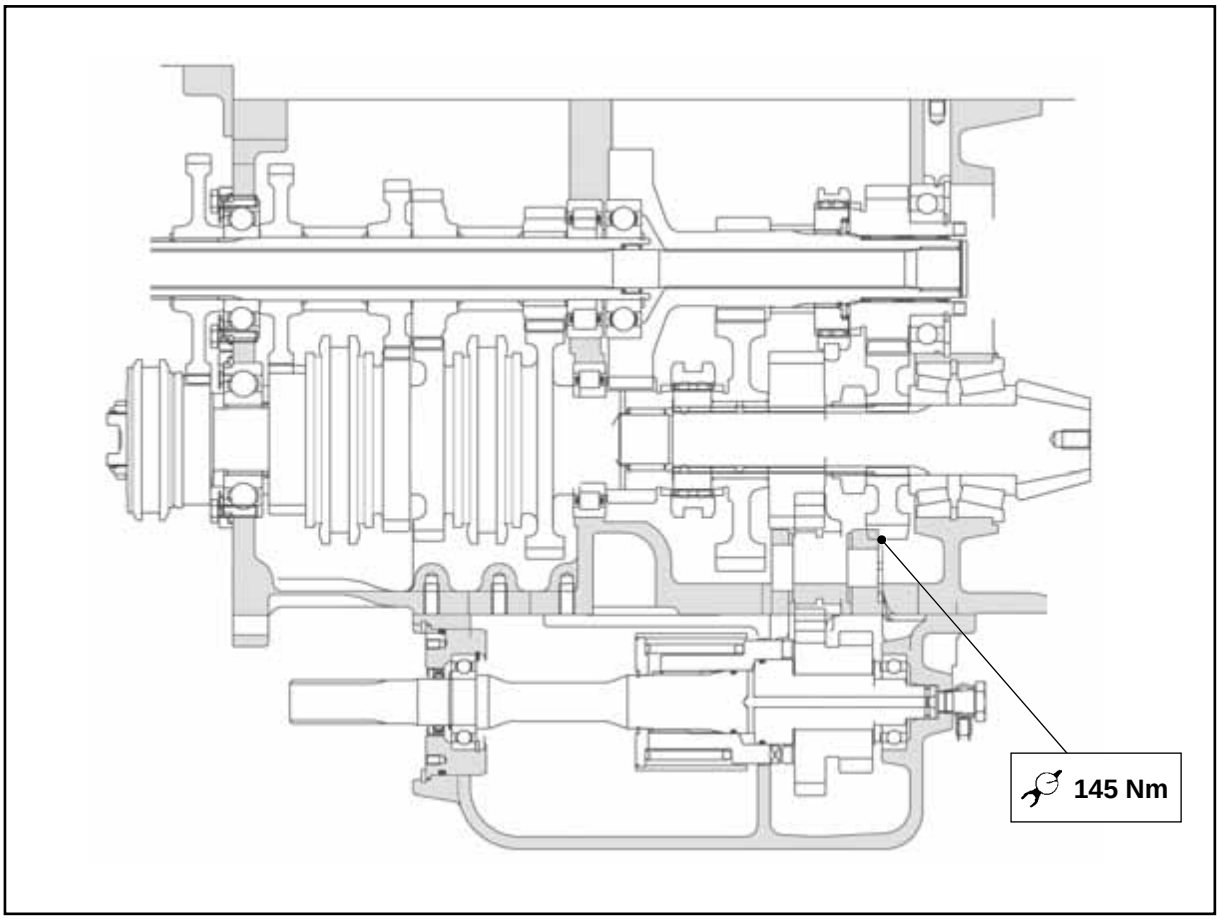


Fig. 4.34

- Driving torque
- Type of sealant

P - Preload

Section 4 : Guide lines for disassembly, re-assembly and adjustments

Index

4.1 Engine-gearbox assembly (Speed Five/Four and Techno version) .. 4-44
4.1.1 Drawing of assembly and main components (Speed Five version) 4-44
4.1.2 Description of operation (Speed Five version) 4-46
4.1.3 Guidelines for disassembly 4-48
4.1.4 Guidelines for re-assembly and inspections 4-54

4.2 Engine-gearbox assembly (Power Shuttle and Power Five version)(4WD version) 4-60
4.2.1 Drawing of assembly and main components 4-60
4.2.2 Description of operation 4-62
4.2.3 Drawing of the “Power Five” assembly 4-64
4.2.4 Description of “Power Five” operation 4-66
4.2.5 Guidelines for disassembly 4-67
4.2.6 Guidelines for re-assembly and inspections 4-76

4.3 Version without Power Shuttle 4-88
4.3.1 Drawing of assembly and main components 4-88
4.3.2 Description of operation 4-90
4.3.3 Guide lines for disassembly, re-assembly and adjustments ... 4-92

4.4 Gearbox (Speed Five/Four and Techno version) 4-94
4.4.1 Drawing of assembly (Speed Five version) 4-94
4.4.2 Description of operation 4-96
4.4.3 Guidelines for disassembly 4-98
4.4.4 Guidelines for re-assembly and inspections 4-109

4.5 Gearbox (Power Shuttle version) 4-118
4.5.1 Drawing of the assembly (Version with creeper) 4-118
4.5.2 Description of operation 4-120
4.5.3 Guidelines for disassembly (4WD version) 4-122
4.5.4 Guidelines for re-assembly and inspections (4WD version) . 4-133

4.6 4WD housing 4-140
4.6.1 Drawing of the assembly (Version with creeper) 4-140
4.6.2 Drawing of the assembly (version without creeper) 4-142
4.6.3 Assembly drawings of the housing in 2WD tractors 4-144
4.6.4 Park Lock 4-146
4.6.5 Guidelines for disassembly 4-150
4.6.6 Guidelines for re-assembly and inspections 4-153

4.7 Bevel gear pair and rear differential 4-155
4.7.1 Drawing of assembly and main components 4-155
4.7.2 Description of operation 4-156
4.7.3 Driving torques and sealants 4-156
4.7.4 Guidelines for disassembly, inspections and re-assembly 4-157
4.7.5 Guidelines for adjustments 4-159

4.8 Side final drives 4-164
4.8.1 Drawing of assembly and main components 4-164
4.8.2 Description of operation 4-165
4.8.3 Guidelines for re-assembly, adjustments and inspections 4-166
4.8.4 Driving torques and sealants 4-168

4.9 Rear brakes 4-169
4.9.1 Drawing of assembly and main components (version 8 discs) 4-169
4.9.2 Description of operation 4-170
4.9.3 Guidelines for re-assembly, adjustments and inspections 4-171

4.10 Control levers 4-173
4.10.1 Drawing of assembly and main components 4-173
4.10.2 General description 4-175
4.10.3 Driving torques and sealants 4-180

It is important for the operators to comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual in order to prevent accidents.

Carefully comply with the precautions and recommendations highlighted by the symbol below when reading the guidelines for assembly and re-assembly:

Fig. 4.35

Examples

	Attention: if the bolts that fix the safety frame or cab are loosened or if the actual safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

	Attention: if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

4.1 Engine-gearbox assembly (Speed Five/Four and E-Line version)
4.1.1 Drawing of assembly and main components (Speed Five version)

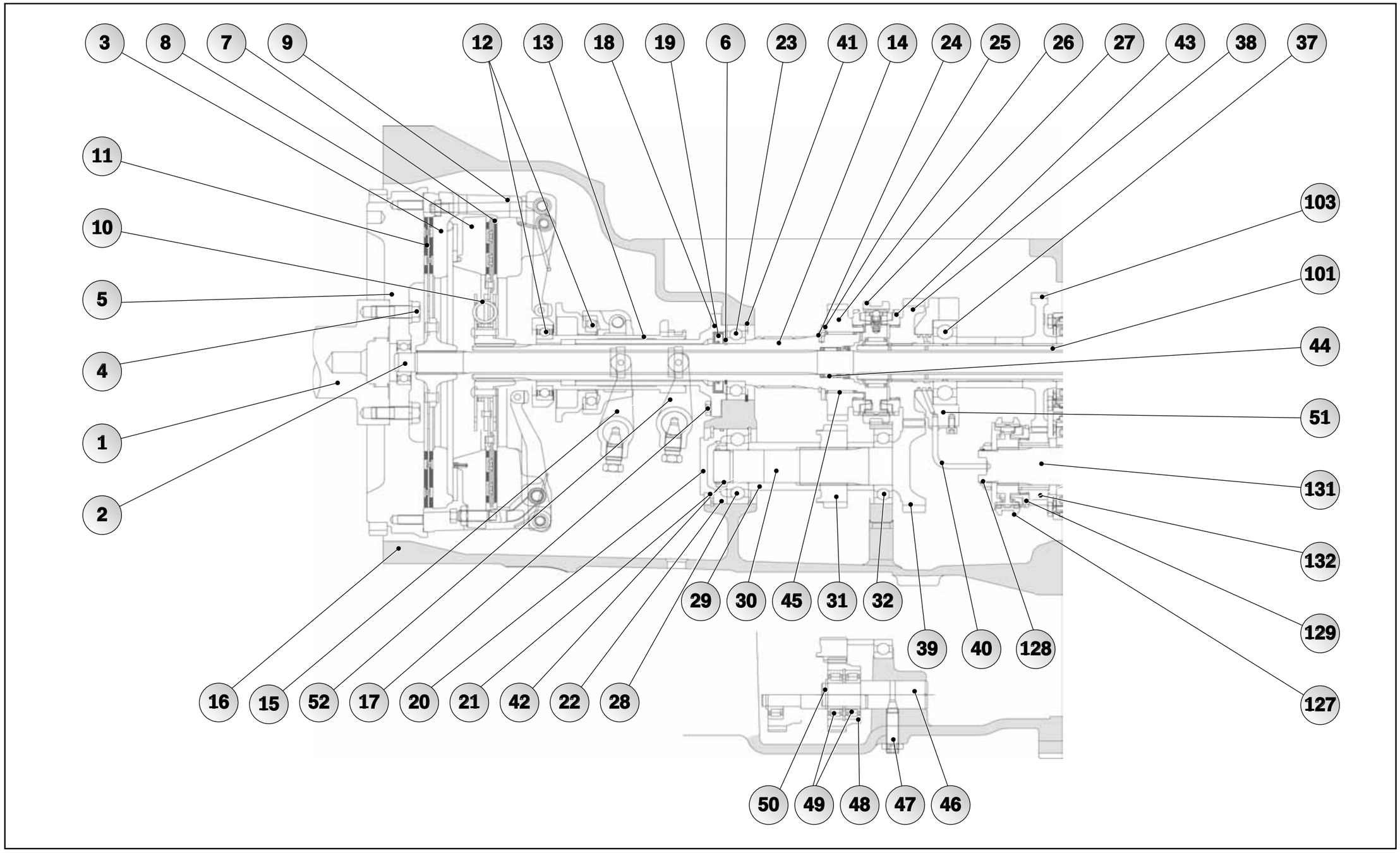


Fig. 4.36

1 - Drive shaft
2 - Flywheel
3 - Splined hub
4 - Flywheel fixing screw
5 - Flywheel
6 - Spring ring
7 - Main clutch disc
8 - Pressure plate
9 - Clutch cover
10 - Even tension spring
11 - Diaphragm spring
12 - Thrust bearings
13 - Clutch disengaging collar
14 - Gearbox input shaft
15 - Thrust bearing control fork
16 - Engine/gearbox assembly housing
17 - Clutch collar support fixing screw
18 - Clutch collar support
19 - Retention ring
20 - Plug
21 - Spring ring
22 - O-ring
23 - Ball bearing
24 - Spring ring
25 - Thrust plate
26 - Reverse shuttle gear
27 - Reverse shuttle synchro-mesh
28 - Ball bearing
29 - Spacer
30 - Reverse shuttle input shaft
31 - Reverse shuttle gear
32 - Ball bearing
33 - Lubrication supply union
34 - O-ring
35 - Lubrication supply tube
36 - O-ring
37 - Ball bearing
38 - Forward/reverse drive gear
39 - Reverse shuttle gear
40 - Gearbox lubrication tube
41 - Spring ring
42 - Ring nut
43 - Reverse shuttle synchromesh tapered ring
44 - Needle cage
45 - Needle cage
46 - Shaft for reverse shuttle gear
47 - Reverse shuttle shaft fixing pin
48 - Reverse shuttle gear
49 - Roller bearings
50 - Spring ring
51 - Ball bearing seat
101 - Main shaft
103 - 5th speed driving gear
127 - 5th gear synchro-mesh unit
128 - Ring nut
129 - 5th speed synchromesh tapered ring
131 - Layshaft
132 - 5th speed driven gear

4.1.2 Description of operation (Speed Five version)

4.1.2.1 Forward speeds

Drive is transmitted from the flywheel (5) to the input shaft (14) of the gearbox, via the clutch (7).

The reverse shuttle gear (26) idles on the input shaft.

The forward/reverse gear (38) is splined to the main shaft (101) of the gearbox. When the sleeve of the synchro-mesh device (27) is moved towards the right, drive thus passes on to the main shaft thanks to the mesh achieved between the synchro-mesh (27) and gear (38).

The union on the axle housing thus supplies lubricant to the ball bearing (37) and to the layshaft of the gearbox through the tube (40).

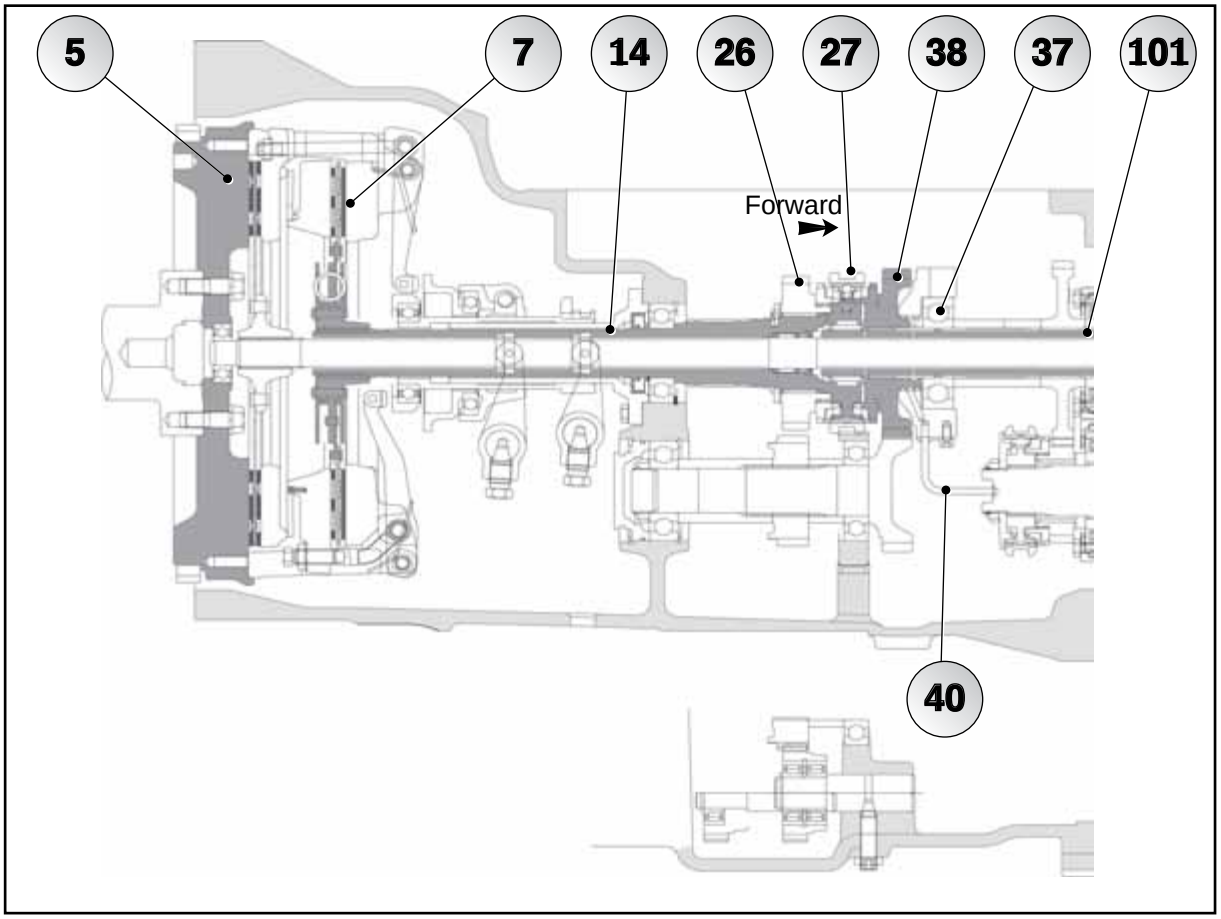


Fig. 4.37

4.1.2.2 Reverse

Drive is transmitted from the flywheel (5) to the input shaft (14) of the gearbox, via the clutch (7).

The reverse shuttle gear (26) idles on the input shaft.

When the sleeve of the synchro-mesh device (27) moves towards the left, drive reaches the main shaft (101) of the gearbox in the reverse running direction.

The synchromesh (27) transmits drive to the gear (26), permanently meshed with the gear (48). This latter transmits drive to the gear (31), keyed on the shaft (30).

Drive thus reaches gear (39), which is permanently meshed with the forward/reverse gear (38) keyed to the main shaft (101).

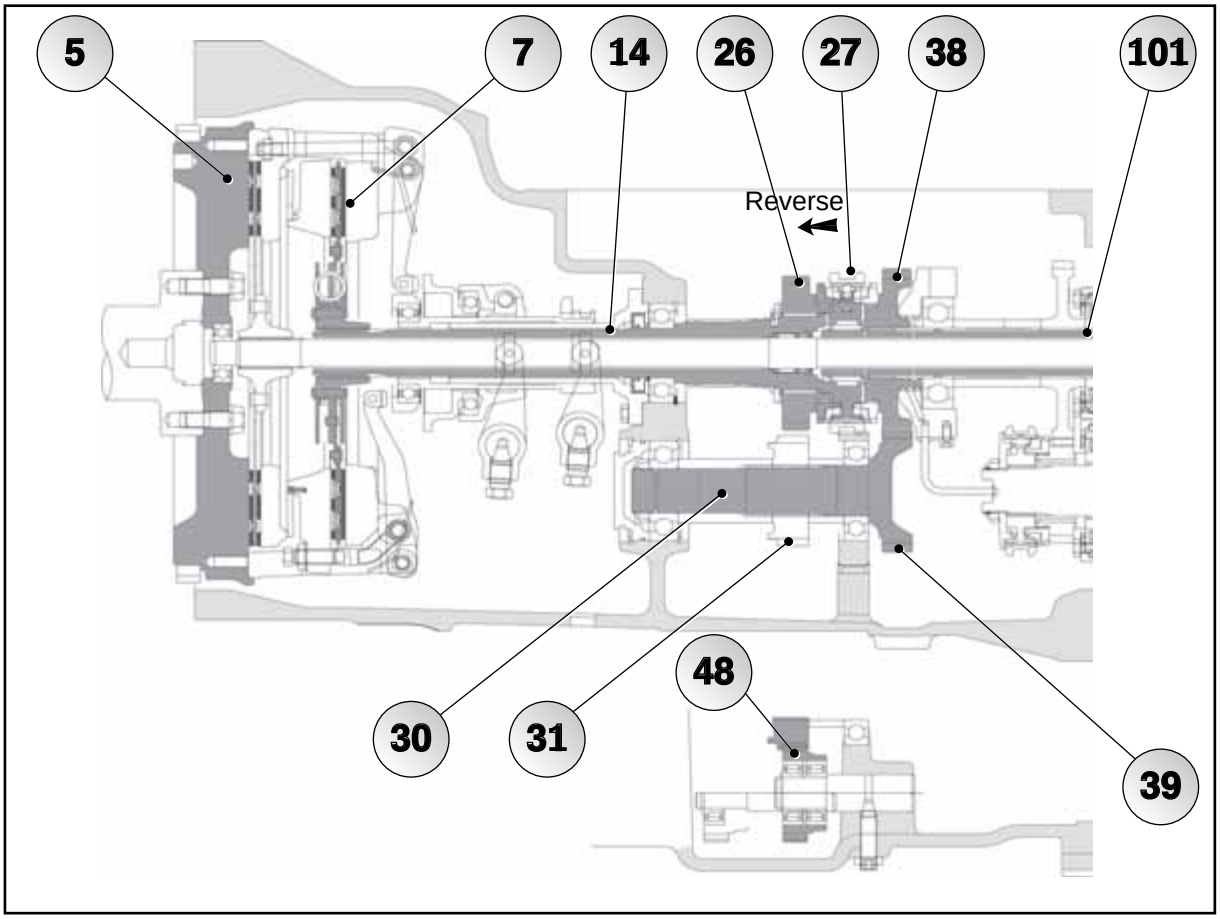


Fig. 4.38

4.1.3 Guidelines for disassembly

How to remove the engine gearbox assembly

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

Note: The operations described for disassembling the “Speed Five” axle also apply to the “Speed Four” and Techno versions, with the sole differences described in sect. 1 of this chapter.

- split the engine from the axle;
- unscrew the fixing screws from the covers of the axle housing and of the gearbox housing;

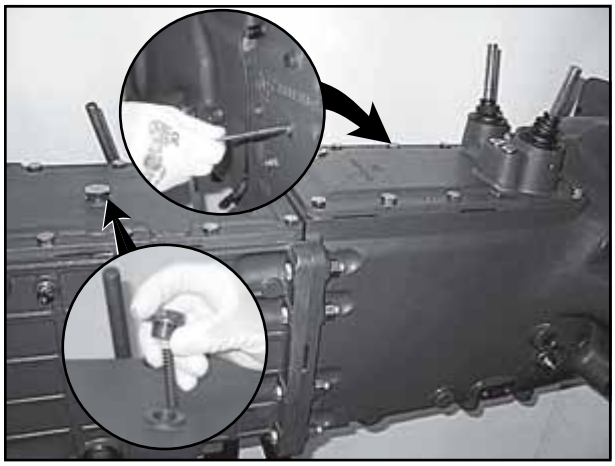


Fig. 4.39

Note: remove the 5th speed plug, spring and ball from the gearbox cover. Remove the lubrication tube from the left-hand side of the axle housing (Fig.4.39);

- remove the cover from the axle and the gearbox;

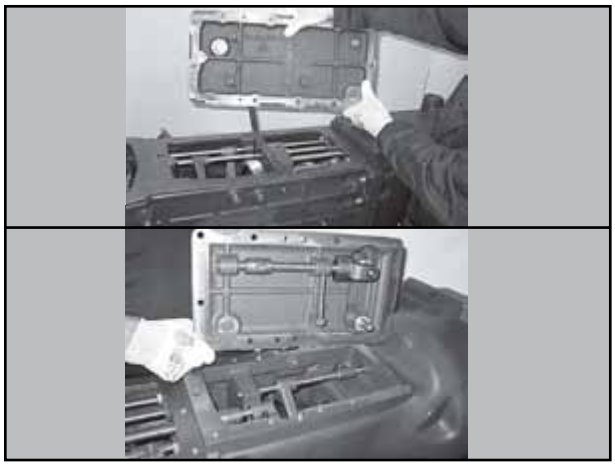


Fig. 4.40

Note: the balls and springs removed from the gearbox housing must be set aside;

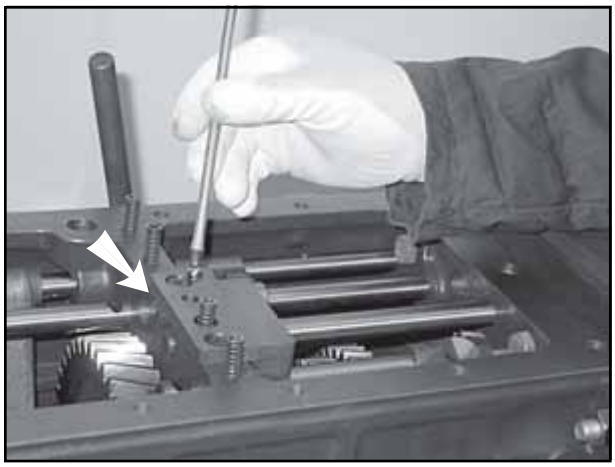


Fig. 4.41

How to remove the engine gearbox assembly

- remove the spring pins that fix the blocks (951), (952) and (953);

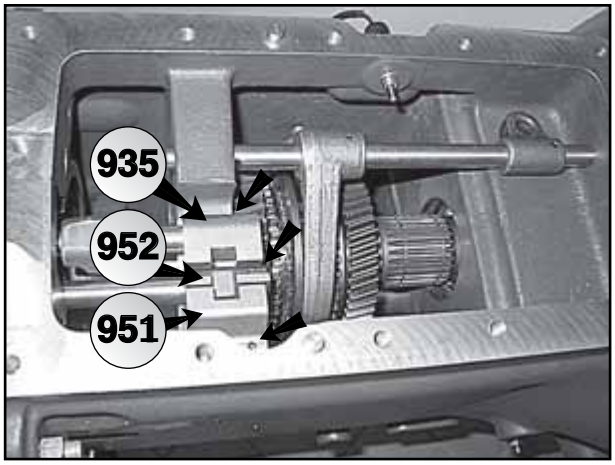


Fig. 4.42

Attention: WARNING: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

- fix the axle to an adequate support (Fig.4.43) so as to align the housings in a better way, then unscrew the two internal screws that fix the axle to the gearbox, along with the external screws;
- slightly detach the axle from the gearbox, so that the blocks (951), (952) and (953) can be removed;

Fig. 4.43

Note: before splitting the axle housing from the gearbox, note and possibly mark the correct positions of the blocks (951), (952), (953). This is important, as it allows the axle to be correctly re-assembled on the gearbox.

- remove the blocks (951), (952), (953) and split completely the shaft from the gearbox.

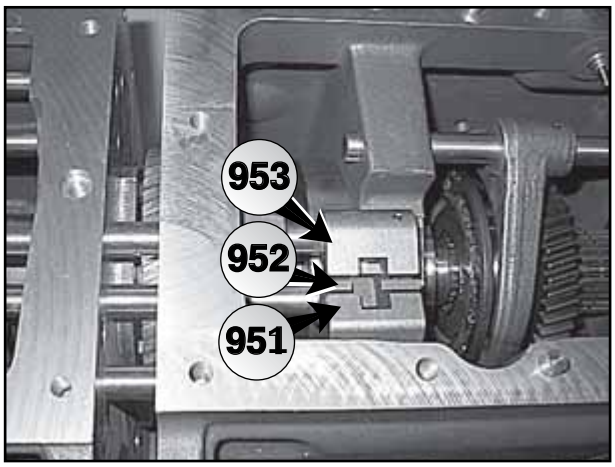


Fig. 4.44

How to remove the input shaft

- remove the levers and forks, as well as the clutch disengaging collar (13);

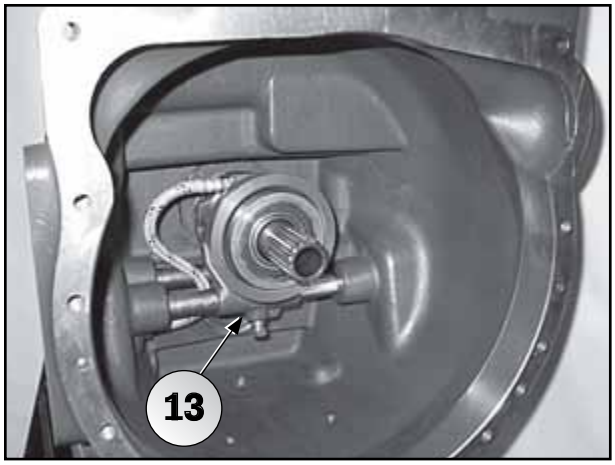


Fig. 4.45

- remove the clutch collar support (18);

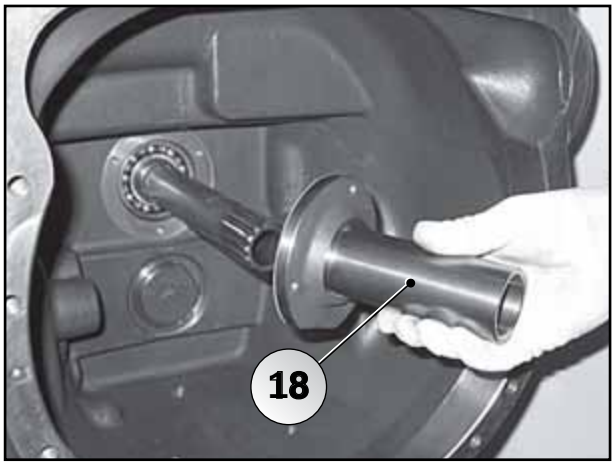


Fig. 4.46

- remove the plug (969), the pawl (970), the spring (971) and the ball (972);

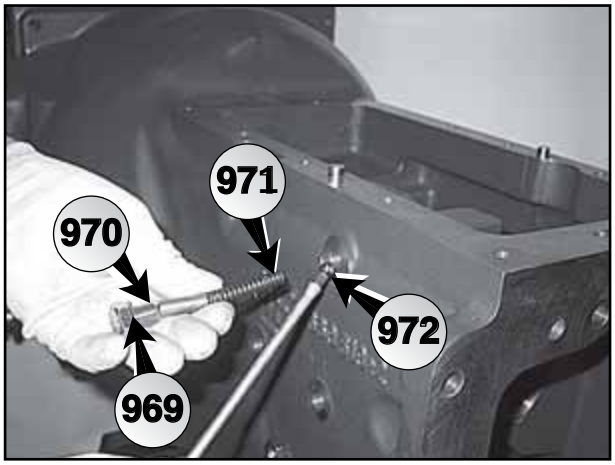


Fig. 4.47

- draw out the rod (974) and remove the block (975), remove the fork (973) of the reverse shuttle unit;

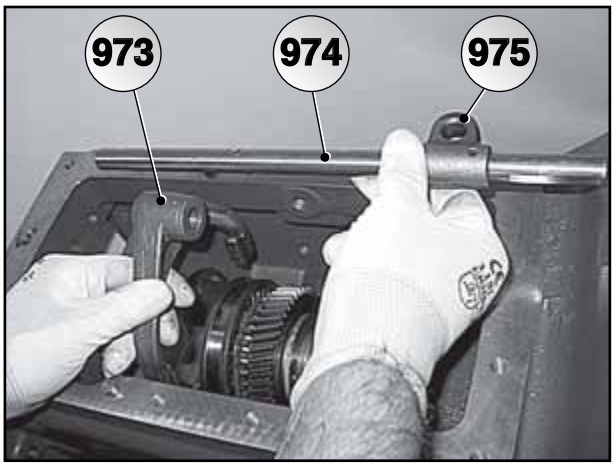


Fig. 4.48

- remove the spring ring (6);

Fig. 4.49

- remove the input shaft (14).

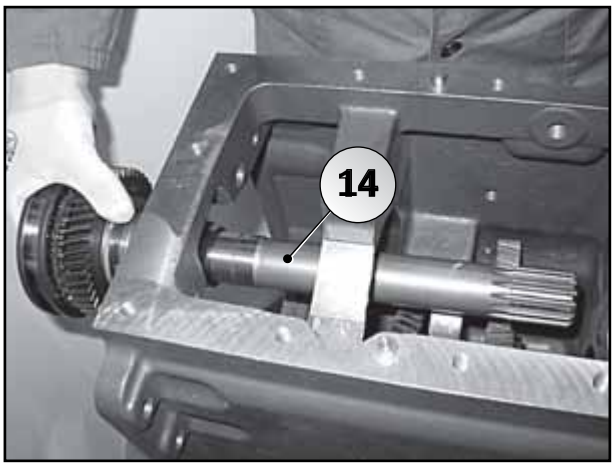


Fig. 4.50

How to remove the reverse shuttle shaft

- remove the spring ring (21) and the plug (20);

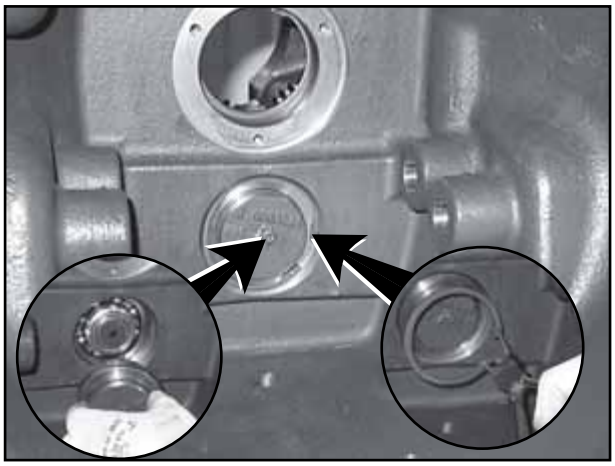


Fig. 4.51

- unscrew the ring nut (42);

Fig. 4.52

- remove the reverse shuttle shaft (30).

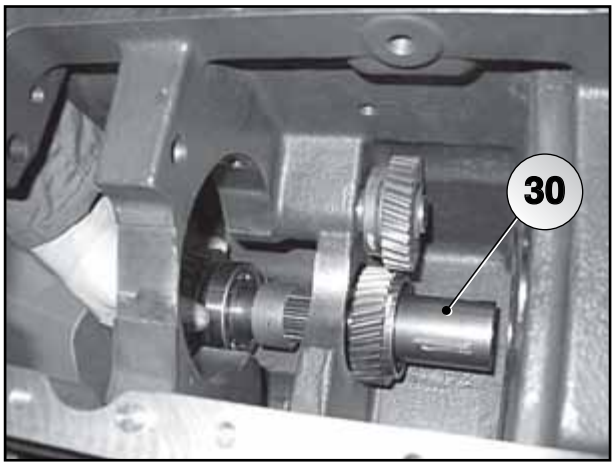


Fig. 4.53

How to remove the reverse shuttle gear shaft

- remove the plug (47) that fixes the shaft;

Fig. 4.54

- remove the shaft (46) for the reverse shuttle gear.

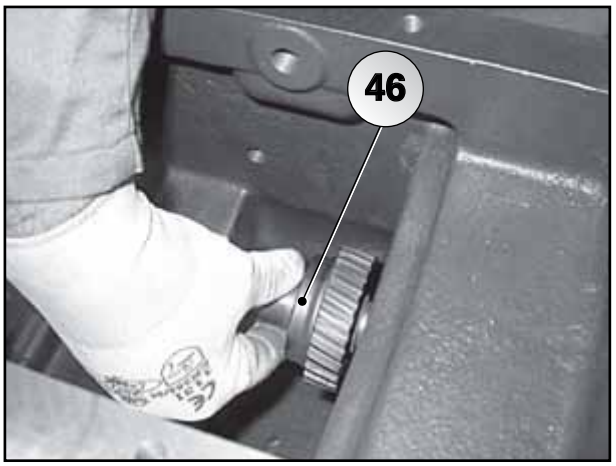


Fig. 4.55

4.1.4 Guidelines for re-assembly and inspections

Note: The operations described for disassembling and inspecting the “Speed Five” axle also apply to the “Speed Four” and Techno versions, with the sole differences described in this chapter.

Reverse shuttle gear shaft re-assembly

- check the parallel roller bearings (49) for wear;

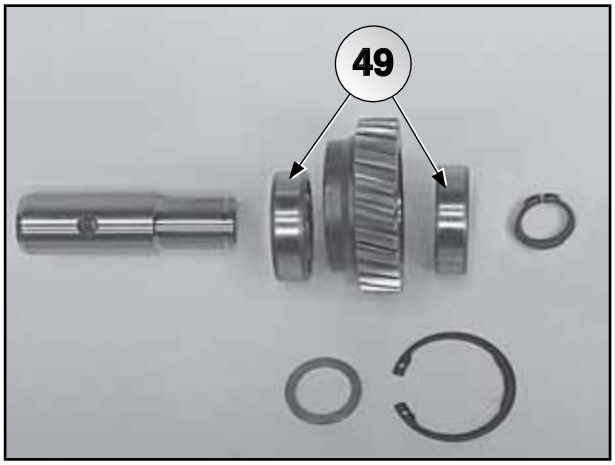


Fig. 4.56

- re-assemble the shaft (46) complete with reverse shuttle gear (48).

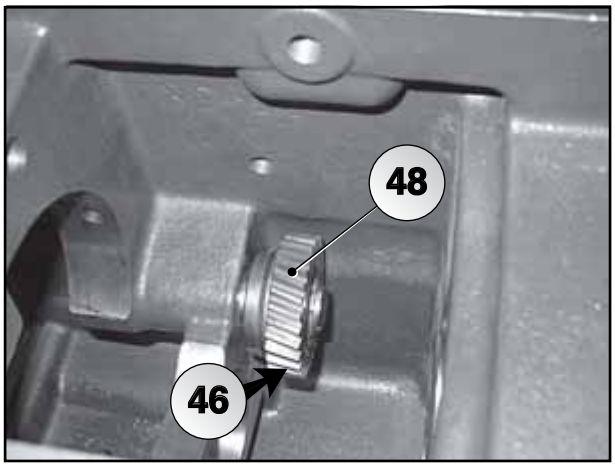


Fig. 4.57

How to re-assemble the reverse shuttle receiver shaft

- check the ball bearings (28) and (32) for wear;
- replace the ring nut (42);

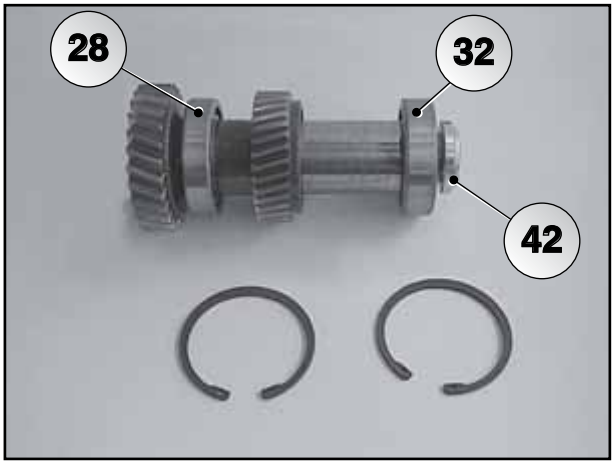


Fig. 4.58

- fit the shaft (30) back in place complete with all its components;

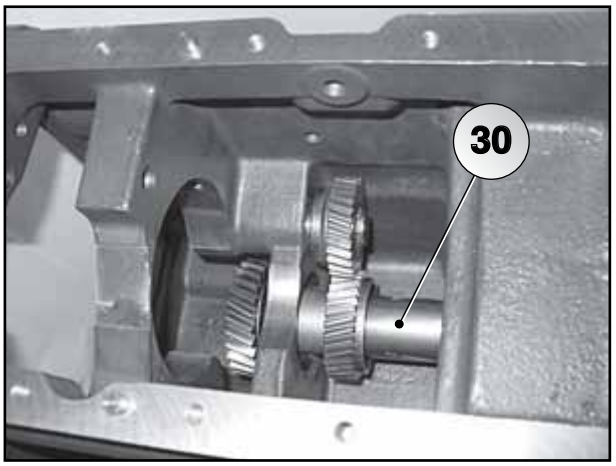


Fig. 4.59

- replace the retention ring (22) and fit the plug back on (20).

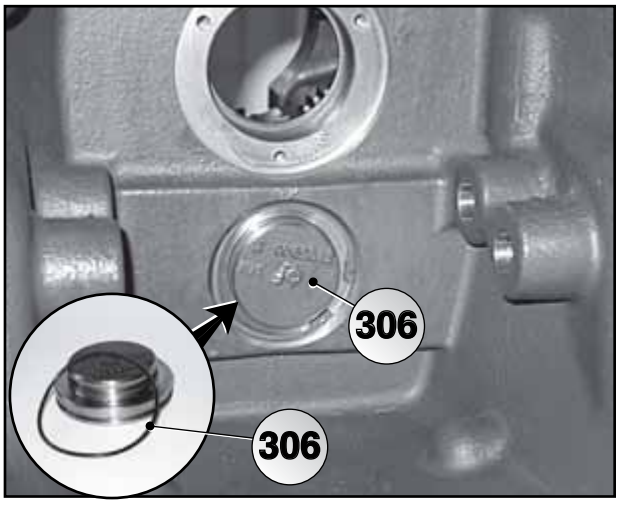


Fig. 4.60

How to re-assemble the input shaft

- check the bearing (23) and the needle cages (44 and 45) for wear.
- make sure that the scoring on the sintered material of the synchro-rings (27) is clearly visible, replace them if this is not the case;

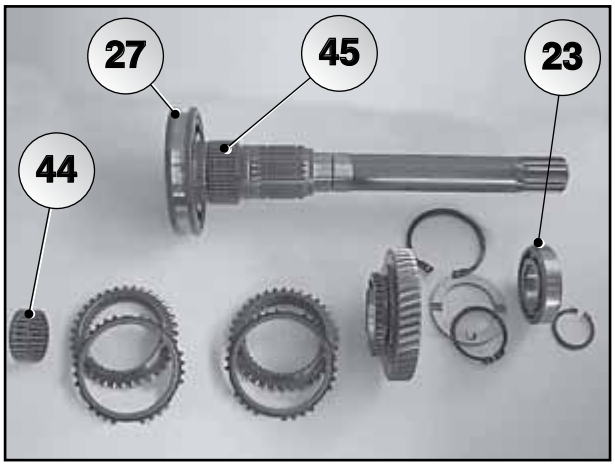


Fig. 4.61

- remove the input shaft (14);

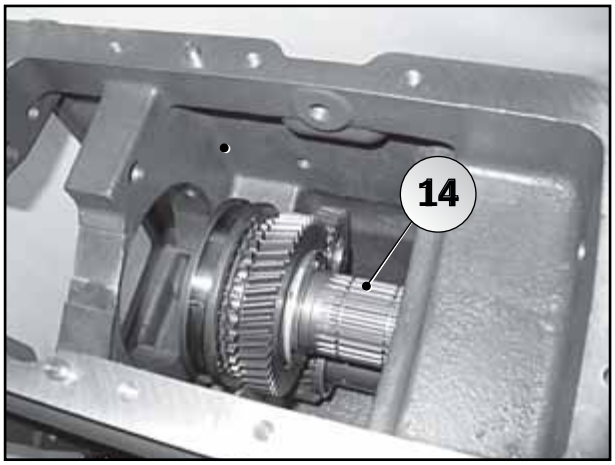


Fig. 4.62

- re-assemble the spring ring (6).

Fig. 4.63

- replace the seals of the collar bearing (18) and re-assemble this latter;

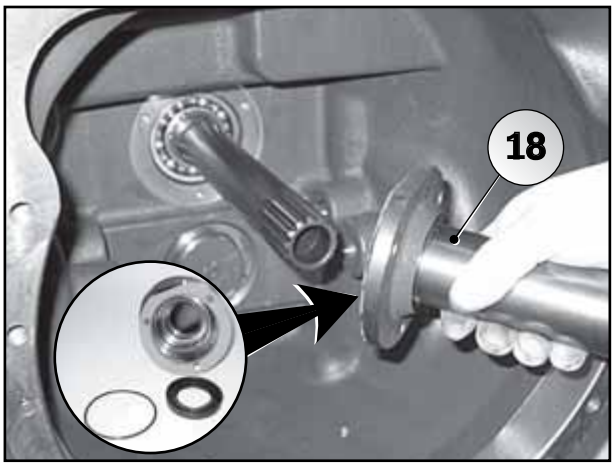


Fig. 4.64

- re-assemble the rod (974), fork (973) and relative block (975);

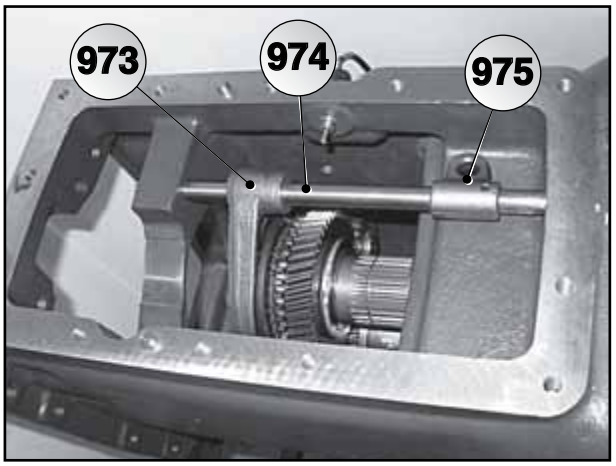


Fig. 4.65

- complete the axle re-assembly operations.

Fig. 4.66

How to fit the axle back on the gearbox

⚠	**Attention:** avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

- fix a suitable support to the axle so as to allow the housings to be aligned in a better way, then slightly move the axle near the to gearbox so as to be able to mount the blocks (951), (952), (953);

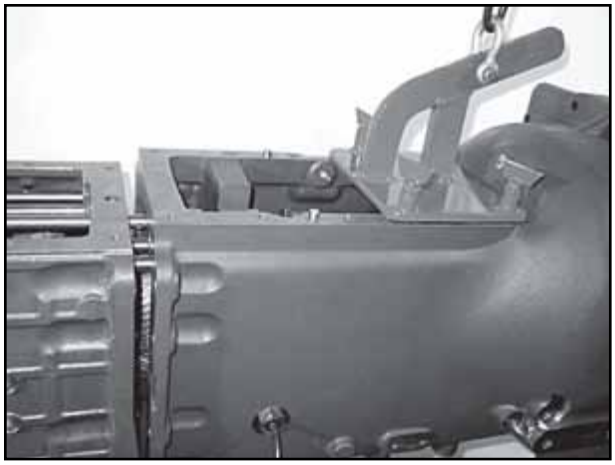


Fig. 4.67

- assemble the blocks (951), (952) and (953);

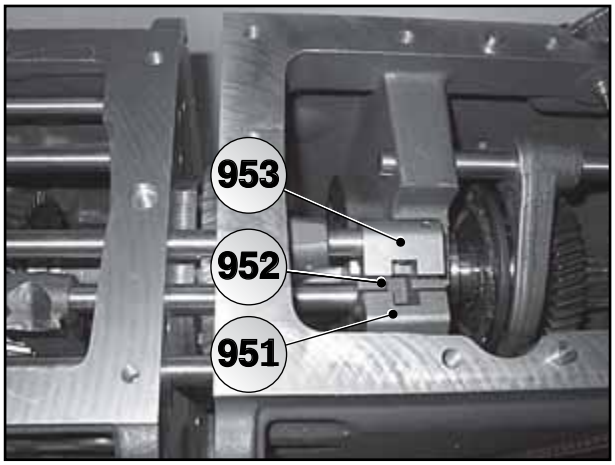


Fig. 4.68

- fit the axle housing and gearbox back together again.

Fig. 4.69

4.2 Engine-gearbox assembly (Power Shuttle and Power Five version)(4WD version)

4.2.1 Drawing of assembly and main components

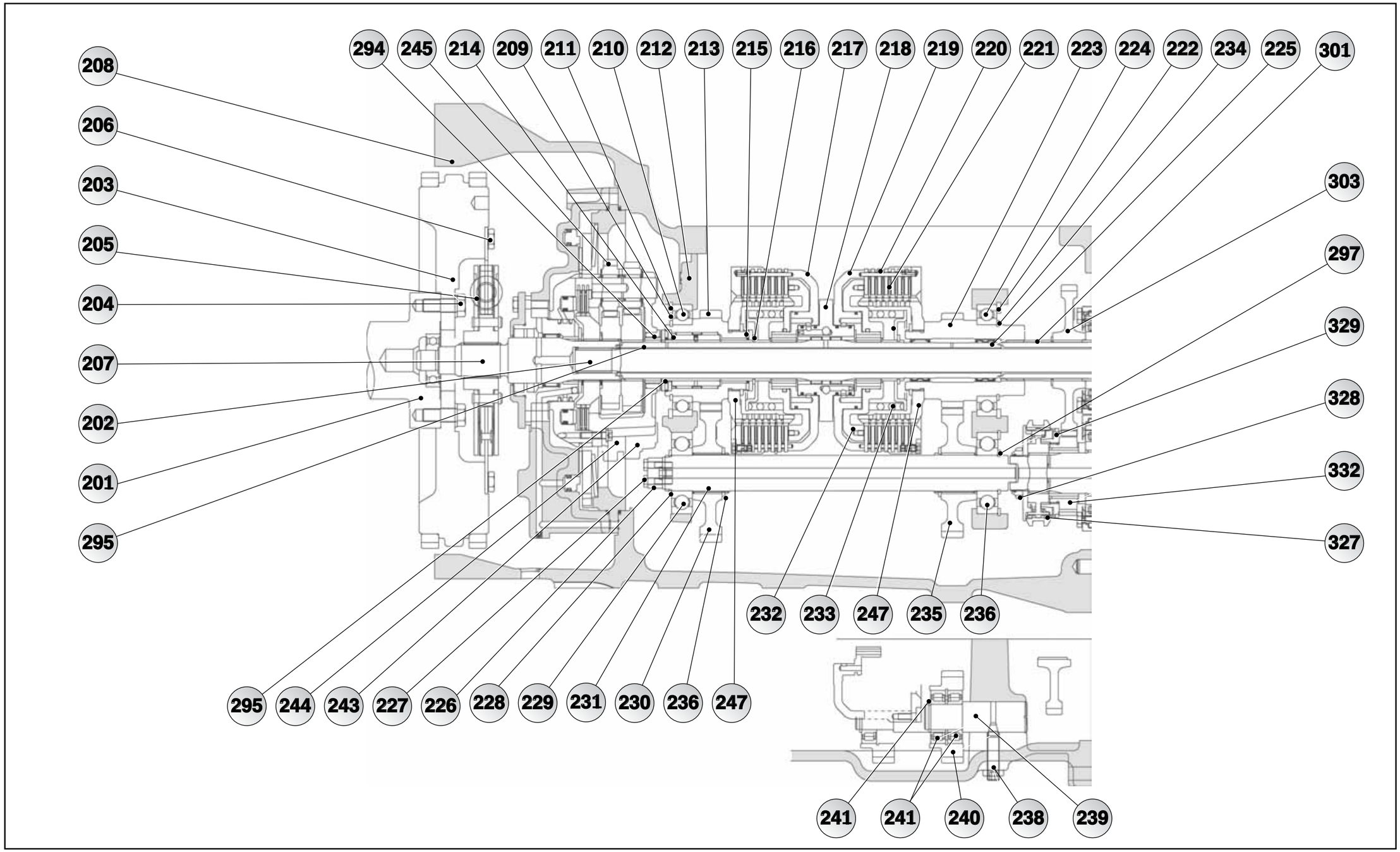


Fig. 4.70

201 - Drive shaft
202 - PTO drive shaft
203 - Flywheel
204 - Flywheel fixing screw
205 - Damper
206 - Damper fixing screw
207 - Input shaft
208 - Engine-gearbox assembly
209 - Spring ring
210 - Ball bearing
211 - Spring ring
212 - Rear cover
213 - Reverse shuttle gear
214 - Thrust bearing
215 - Thrust plate
216 - Spring ring
217 - Main clutch bowl
218 - Clutch central body
219 - Secondary clutch bowl
220 - Metal counterdisc
221 - Clutch plate
222 - Spring ring
223 - Forward/reverse drive gear
224 - Ball bearing
225 - Clutch bearing shaft
226 - Gearbox lubrication block
227 - Block fixing screw
228 - Spring ring
229 - Ball bearing
230 - Reverse shuttle driven gear
231 - Reverse shuttle transmission shaft
232 - Clutch piston
233 - Piston return spring
234 - Spring ring
235 - Reverse shuttle gear
236 - Ball bearing
238 - Fixing pin
239 - Shaft for reverse shuttle gear
240 - Reverse shuttle gear
241 - Roller bearings
242 - Spring ring
243 - Output crown wheel
244 - Input crown wheel
245 - Planetary gear
246 - Secondary clutch hub
247 - Main clutch hub
294 - Bush
295 - Spring ring
296 - Spring ring
297 - Spring ring
301 - Gearshift main shaft
303 - 5th speed drive gear
327 - 5th gear synchro-mesh unit
328 - Ring nut
329 - 5th speed synchromesh tapered ring
332 - 5th speed driven gear

4.2.2 Description of operation

Direct drive range and forward direction

Drive is transmitted from the flywheel (203) to the input shaft (207) of the gearbox, via the damper plate (205).

Drive thus reaches the “Power Five” assembly which reduces it by 20%. This option can be engaged whilst the tractor is on the move and at full load, since the control is electrohydraulic.

If the Power Five unit is being driven in the DIRECT range, drive reaches the clutch shaft (225) through the connection with the output crown wheel (243).

If the tractor is being driven FORWARDS, drive reaches the bowl (219) of the secondary clutch, which is keyed to the clutch shaft (225). Oil at a pressure of 20 bar blocks the plates of the secondary clutch, thus transmitting drive to the hub (246). This latter is keyed to the forward/reverse gear (223), which is permanently meshed with the main shaft (301) of the gearbox.

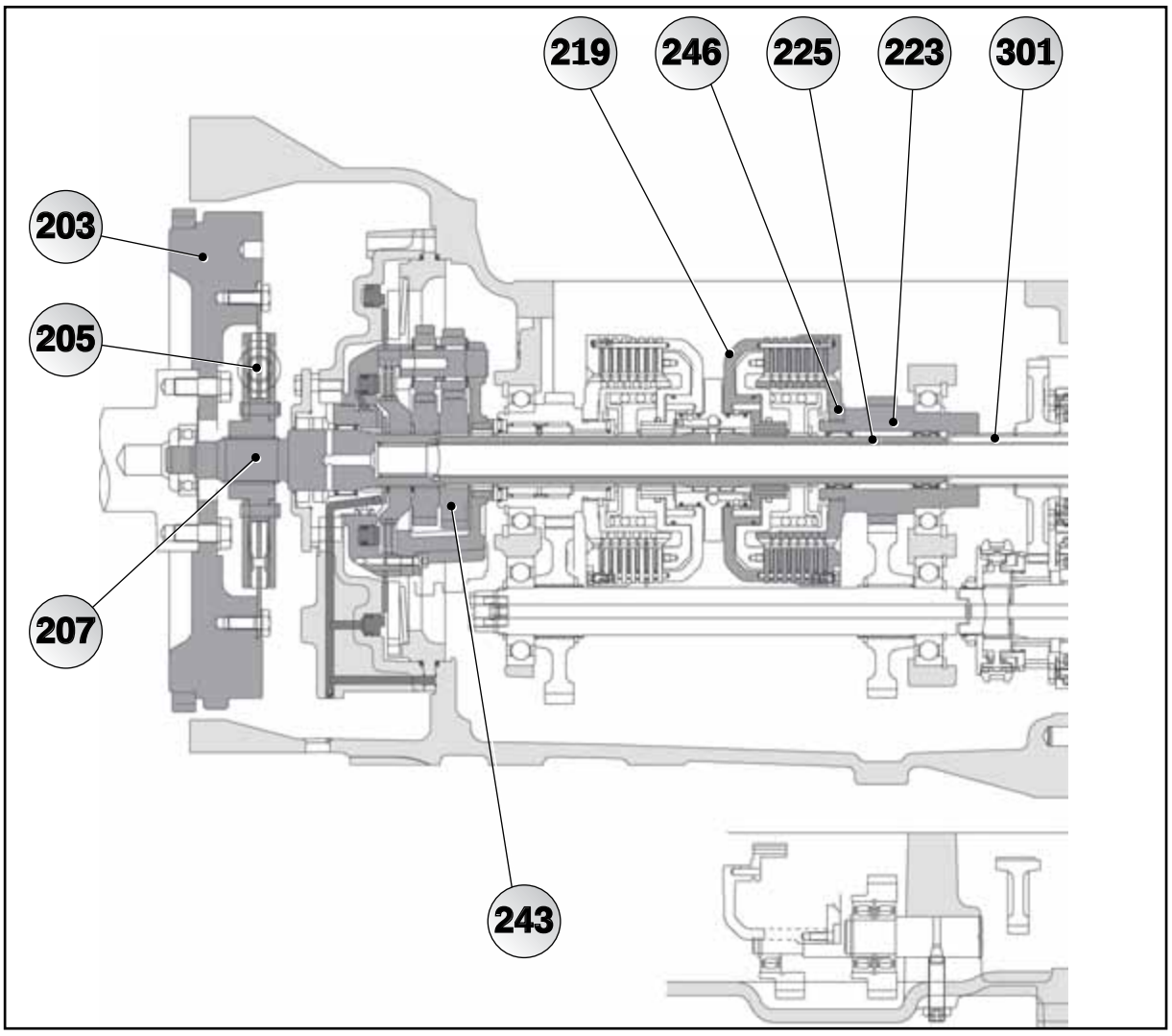


Fig. 4.71

Reduced range and reverse direction

Drive is transmitted from the flywheel (203) to the input shaft (207) of the gearbox, via the damper plate (205).

Drive thus reaches the “Power Five” assembly which reduces it by 20%. This option can be engaged whilst the tractor is on the move and at full load, since the control is electrohydraulic.

If the Power Five unit is being driven in the CREEPER range, drive reaches the clutch shaft (225) through the connection with the output crown wheel (243).

If the tractor is being driven in REVERSE, drive reaches the bowl (217) of the main clutch, which is keyed to the clutch shaft (225).

Oil at a pressure of 20 bar blocks the plates of the main clutch, thus transmitting drive to the hub (247). This latter is keyed to the reverse gear (213), which is permanently meshed with the driven gear (230) on the reverse shuttle layshaft (231).

Drive thus reaches gear (235), which is keyed to (240), to allow to reverse the drive direction. Drive is transmitted to the main shaft (301) of the gearbox when the gears (240) and (223) mesh together.

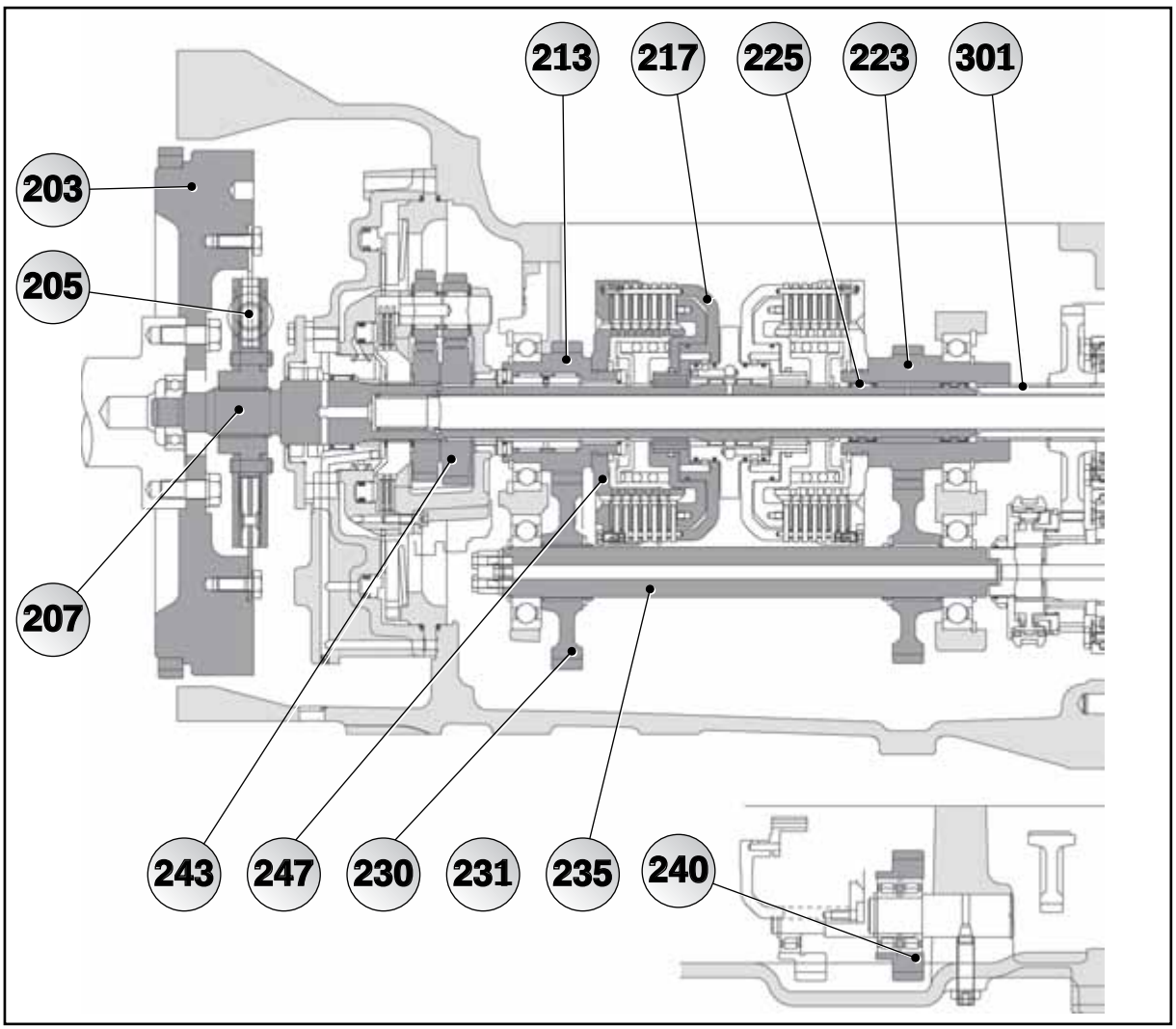


Fig. 4.72

4.2.3 Drawing of the “Power Five” assembly

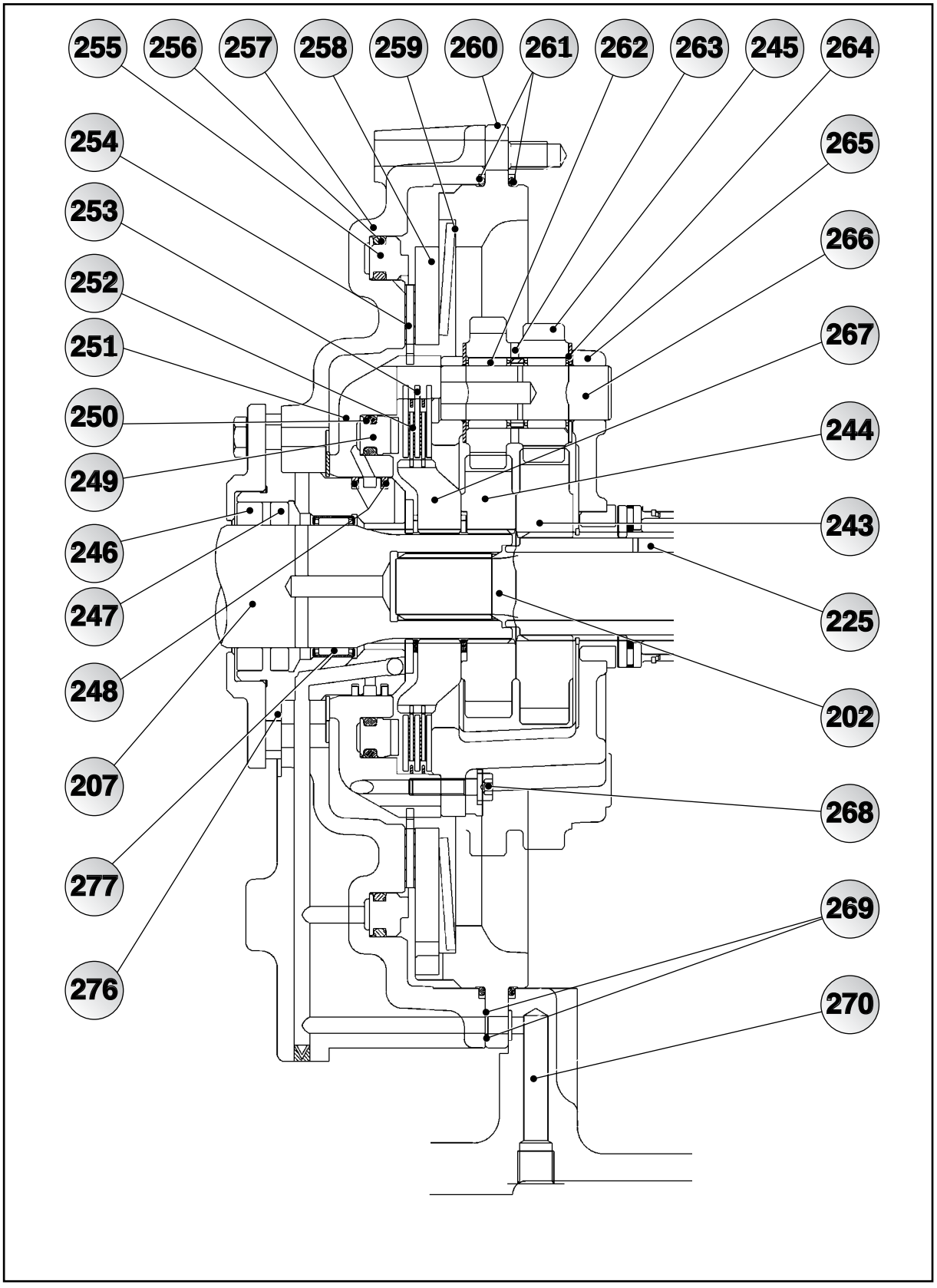


Fig. 4.73

202 - PTO drive shaft
207 - Input shaft
225 - Clutch bearing shaft
243 - Output crown wheel
244 - Input crown wheel
245 - Double planetary gear
246 - Front retention ring
247 - Rear retention ring
248 - Retention rings
249 - Clutch piston
250 - Piston retention ring
251 - Clutch bowl
252 - Clutch plate
253 - Intermediate clutch plate
254 - Brake disc
255 - Brake piston
256 - Piston retention ring
257 - Complete cover
258 - Pressure plate
259 - Pressure plate spring
260 - Flange
261 - O-rings
262 - Needle bearing
263 - Spacer
264 - Shimming washer
265 - Spider housing
266 - Planetary pin
267 - Clutch hub
268 - Cover fixing screw
279 - O-rings
270 - Supply duct (20 bar)
276 - Input shaft suppor
277 - Needle bearing

4.2.4 Description of "Power Five" operation

Power Five is a device that comprises an epicyclic reduction which reduces each gearbox speed gear by 20%, thus doubling the number of speeds available. The device is controlled by means of a button on the gearshift lever that transmits a signal to a solenoid valve. This allows pressurized oil to act on the brake piston (255) and on the clutch piston (249 Fig.4.73).

The assembly transmits 2 ratios to the gearbox:

Creep speed and Direct drive.

When the tractor engine is switched on, the solenoid valve energizes, thus setting the "Power Five" unit to the direct drive mode. Transmission of an electric signal to the solenoid valve allows oil to flow at a pressure of 20 bar through duct (270) towards the chambers of the 2 pistons involved (255 and 249). Thus activated, the piston (249) will pack the clutch plates and inter-plates, thus forming a single block with the hub (267) splined to the input shaft (207). The piston (255) then acts on the pressure plate (258), overcoming the thrust of the Belleville washer (259) and thus relieving the disc (254) from its task of preventing the bowl (251), on which it is splined, from turning.

In these conditions, the input shaft can transmit its rotational movement via the hub (267) to the plates and inter-plates, to the bowl (251) and to the entire epicyclic assembly, as a single block on the shaft itself. The difference in the number of teeth between the double planetary gears (245) and crown wheels (243 and 244) will create a mechanical block, thus obliging the output shaft (225) to turn along with the entire assembly and input shaft in a direct ratio of 1:1. To obtain the "creep speed" ratio on the output from Power Fiove, press the control button to cut off the electric signal transmitted to the solenoid valve in question.

By returning to its initial position, this latter will immediately shut off the flow of pressurized oil towards the pistons (249 and 255).

The clutch plates will be freed again, while the plate (254) will block thanks to the thrust exercised by the Belleville washer (259) on the pressure plate (258). The bowl (251) allows the drive from the input shaft to pass from the input crown wheel (244) to the output one (243) through the double planetary gears (245), thus achieving a 20% reduction on the output shaft.

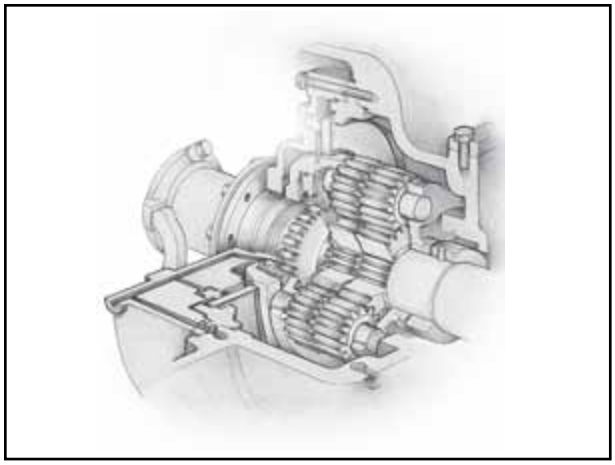


Fig. 4.74

4.2.5 Guidelines for disassembly

How to remove the engine gearbox assembly

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

- split the engine from the axle;
- unscrew the fixing screws from the covers of the axle housing and of the gearbox housing;

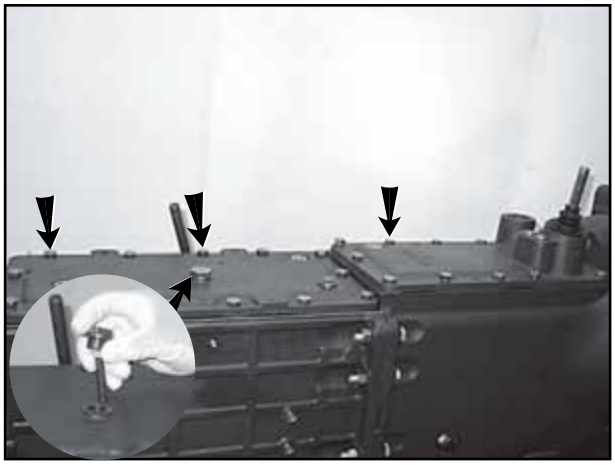


Fig. 4.75

Note: remove the 5th speed plug, spring and ball;

- remove the cover from the axle and the gearbox;

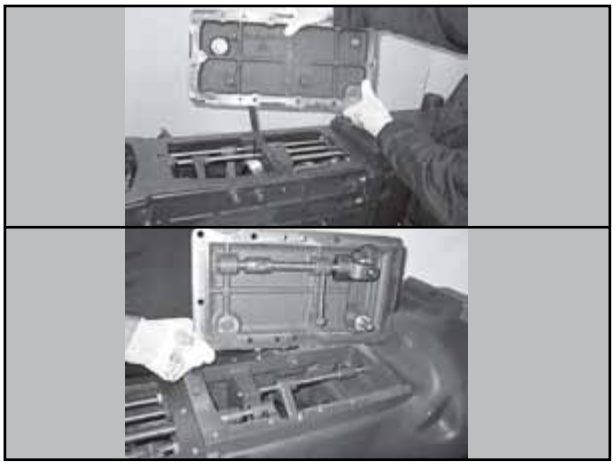


Fig. 4.76

Note: the balls and springs removed from the gearbox housing must be set aside;

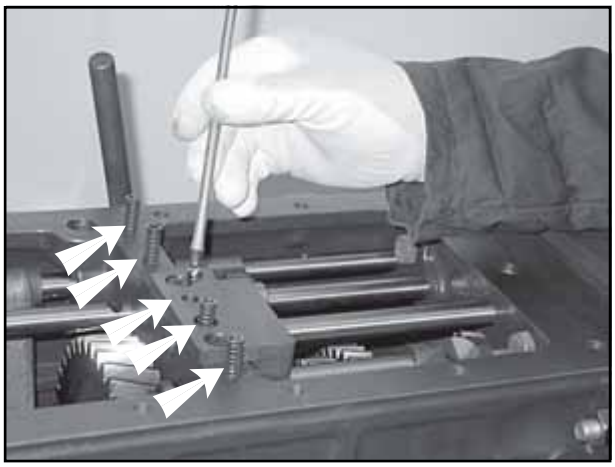


Fig. 4.77

- remove the spring pins that fix the blocks (951), (952) and (953);

⚠	**Attention:** avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

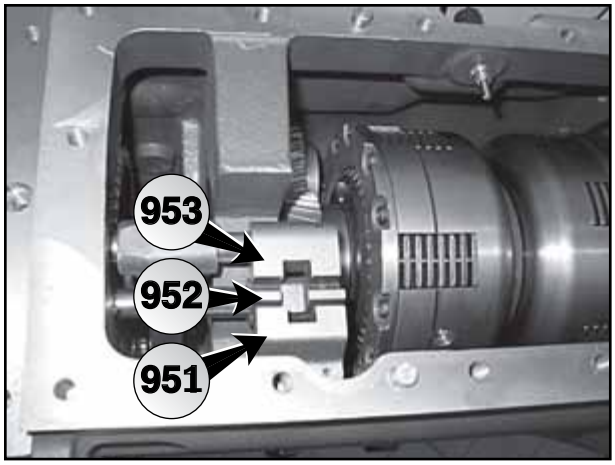


Fig. 4.78

- fix a suitable support to the axle so as to achieve a better alignment of the housings, then unscrew the two internal screws that fix the axle to the gearbox, along with the external screws;
- slightly detach the axle from the gearbox, so that the blocks (951), (952) and (953) can be removed;

Fig. 4.79

Note: before splitting the axle housing from the gearbox, note and possibly mark the correct positions of the blocks (951), (952), (953). This is important, as it allows the axle to be correctly re-assembled on the gearbox.

- remove the blocks (951), (952), (953) and split completely the shaft from the gearbox.

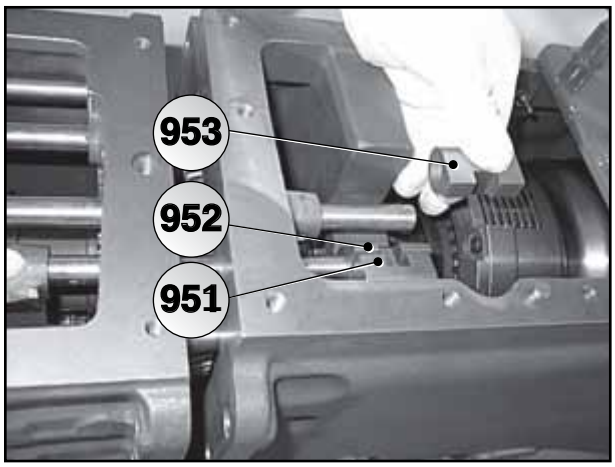


Fig. 4.80

Removal of the "Power Five" assembly

- loosen the screws that fix the complete cover (257).

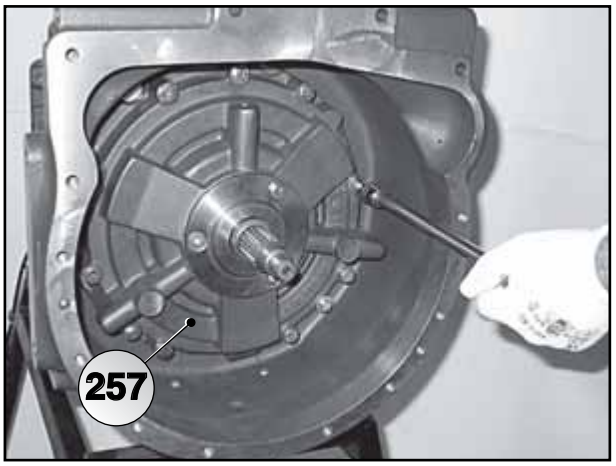


Fig. 4.81

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

- disassemble the whole "Power Five" unit with the aid of tool 141 DS LG and bushing 02 DS VS.

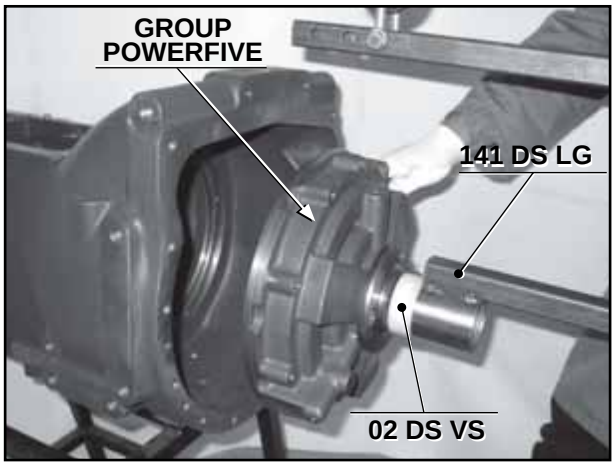


Fig. 4.82

Clutch shaft removal

- remove the solenoid valve block (15) and relative supply tubes (271 - Direct drive), (273 - Reverse shuttle) and lubrication tubes (274).
- unscrew the retention screw (275) of the central clutch assembly (218);

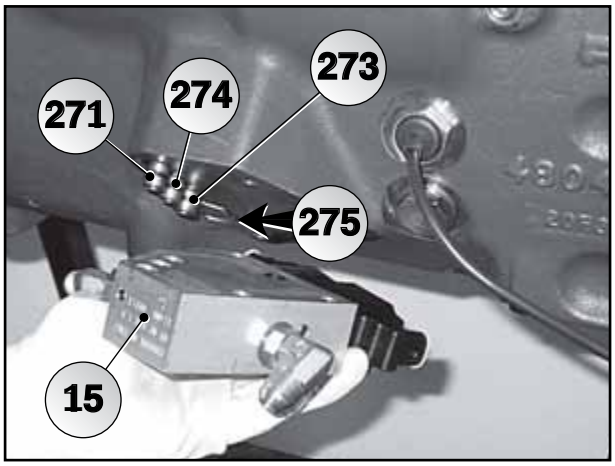


Fig. 4.83

- remove the lubrication pipe;

Fig. 4.84

- unscrew the retainer screws (227) and remove the lubrication block (226);

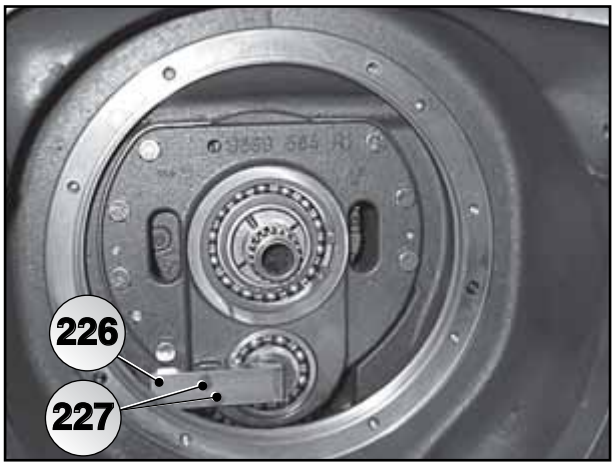


Fig. 4.85

- remove the spring ring (295), the bush (294) and the thrust bearing (214);

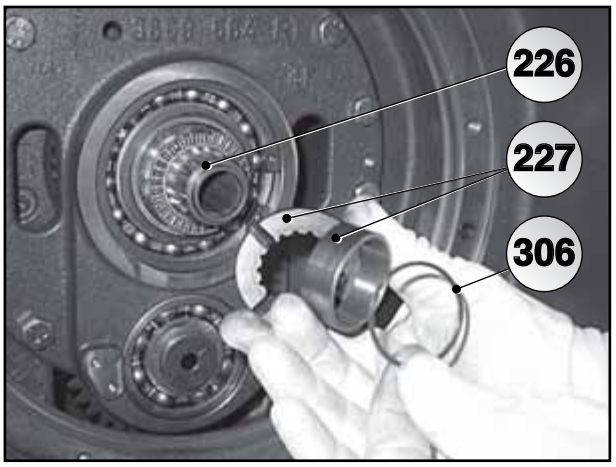


Fig. 4.86

- remove the spring rings (209 and 228);

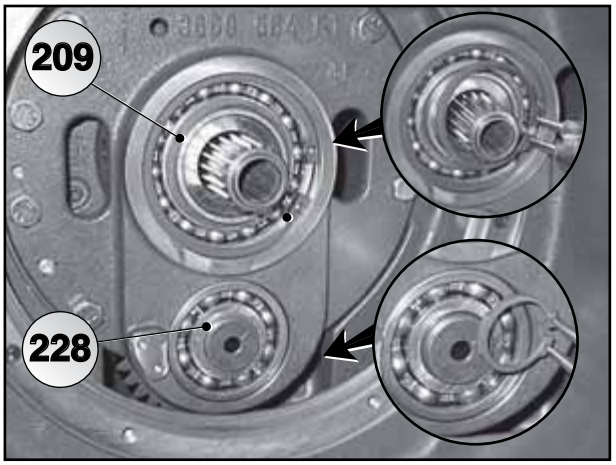


Fig. 4.87

- remove the rear cover (212);

Note: while removing the cover (212) from the axle housing, keep the hub (247) of the main clutch in its position.

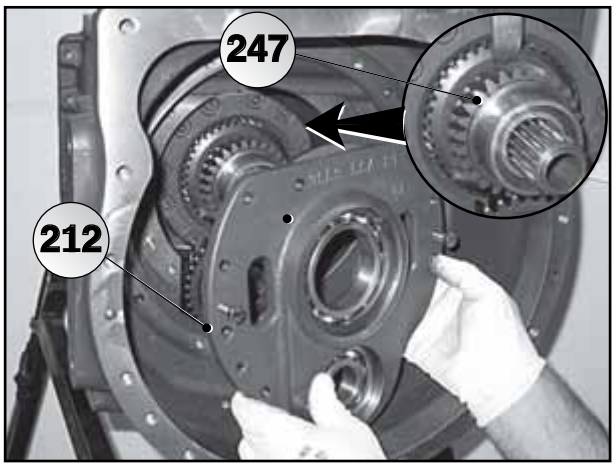


Fig. 4.88

- remove the reverse shuttle's driven gear (230);

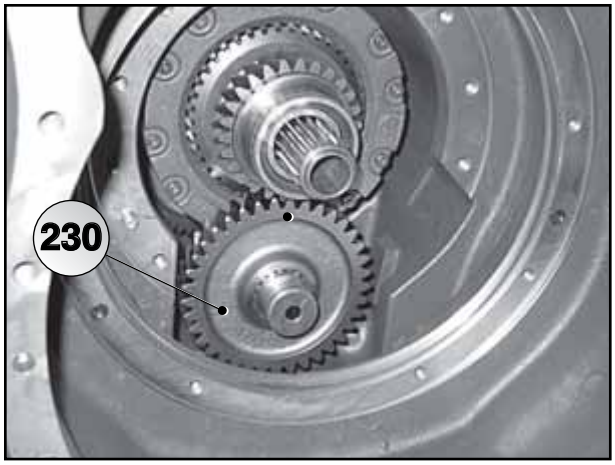


Fig. 4.89

- remove the spring ring (296);

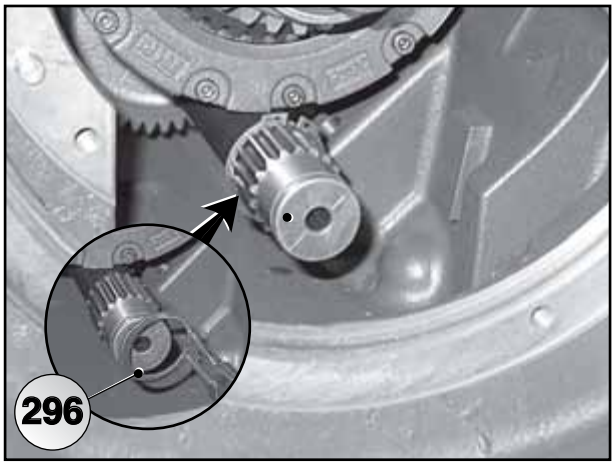


Fig. 4.90

- remove the spring ring (222);

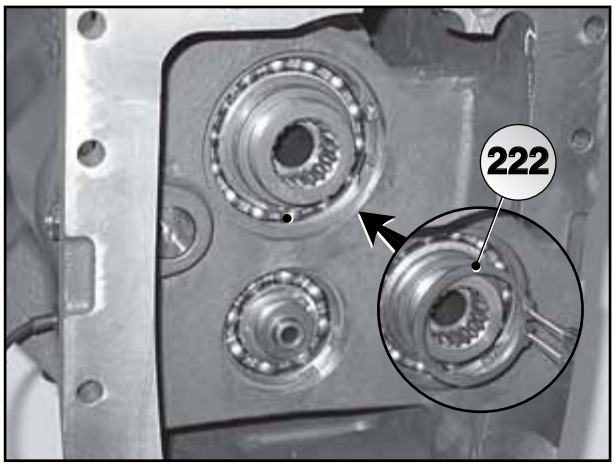


Fig. 4.91

- disassemble the clutch shaft (225) along with the clutch assemblies using tool 141 DS LG and sleeve 01 DS F-N Series to maintain a good alignment.

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

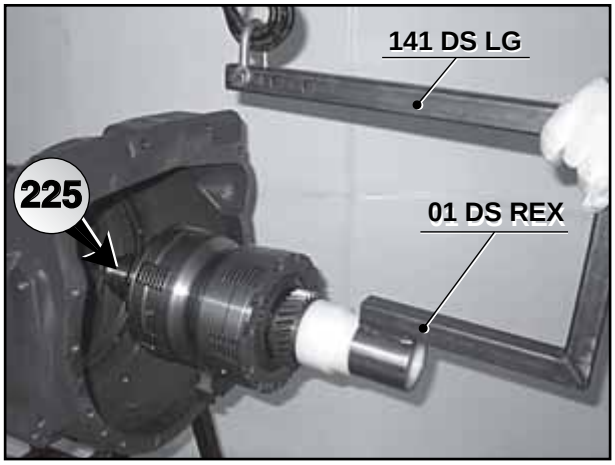


Fig. 4.92

Removal of the reverse shuttle layshaft

Note: before removing the reverse shuttle transmission shaft, it is advisable to remove the two sensors (SR3 and SR4), connected by screws to the side of the axle housing, to prevent them from being damaged.

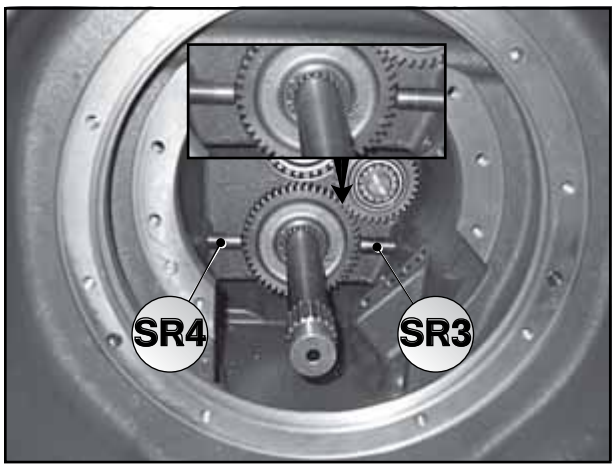


Fig. 4.93

- remove the spring ring (297);

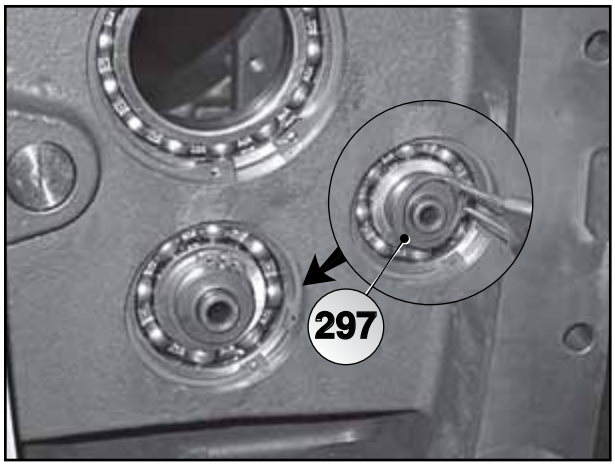


Fig. 4.94

- remove the layshaft (231).

Fig. 4.95

How to remove the reverse shuttle gear shaft

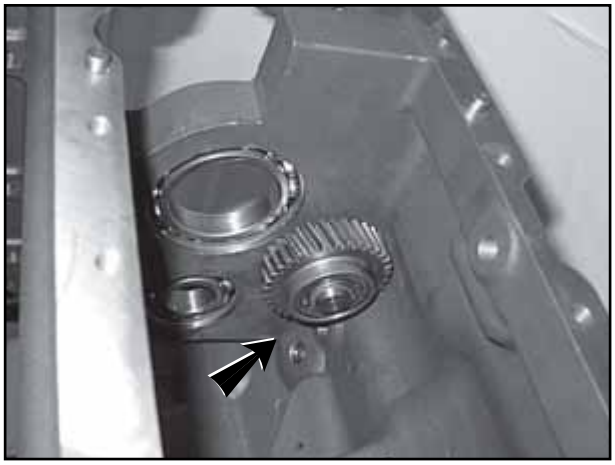


Fig. 4.96

- remove the plug (238) that fixes the shaft;

Fig. 4.97

- remove the reverse shuttle shaft (239) and gear (240).

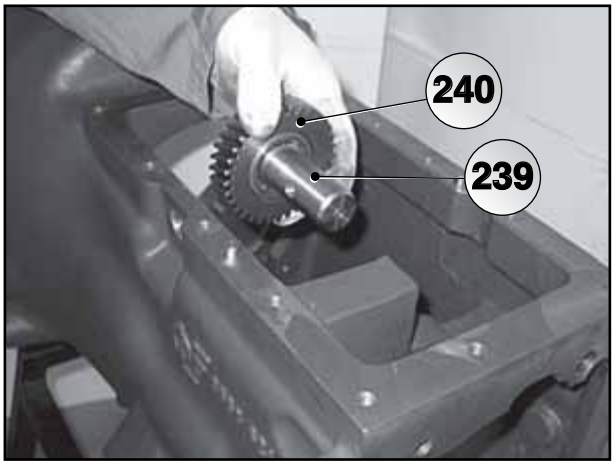


Fig. 4.98

4.2.6 Guidelines for re-assembly and inspections

Reverse shuttle gear shaft re-assembly

- check the parallel roller bearings (241) for wear;

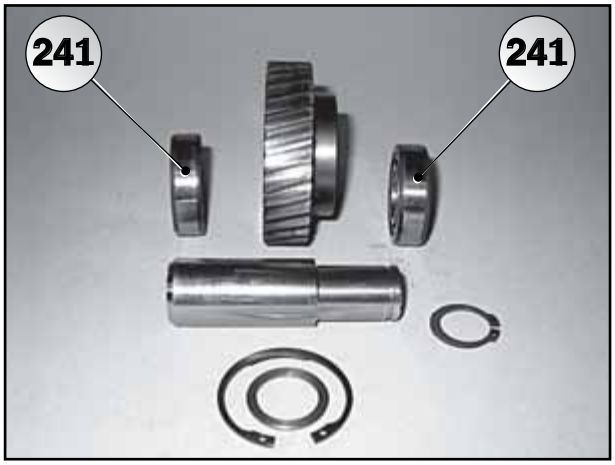


Fig. 4.99

- assemble the shaft (239) complete with reverse shuttle gear (240).

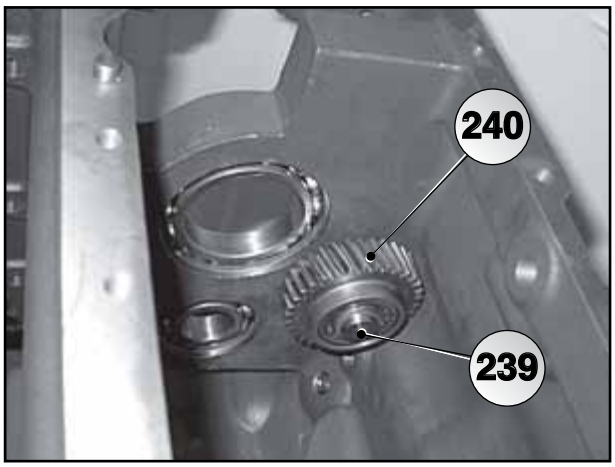


Fig. 4.100

Reverse shuttle layshaft re-assembly

- check the ball bearings (236) and (229) for wear;

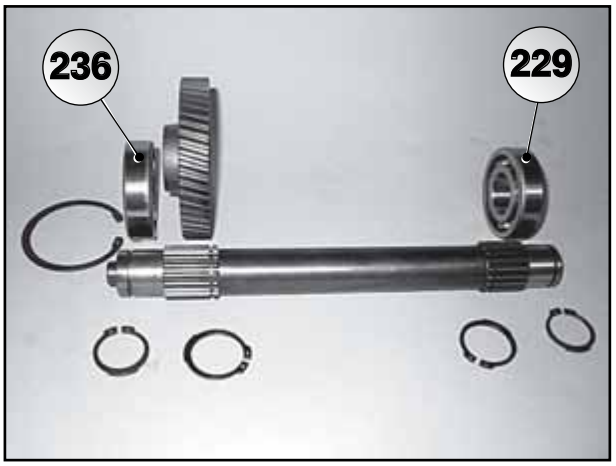


Fig. 4.101

- fit the shaft (231) into the axle housing.

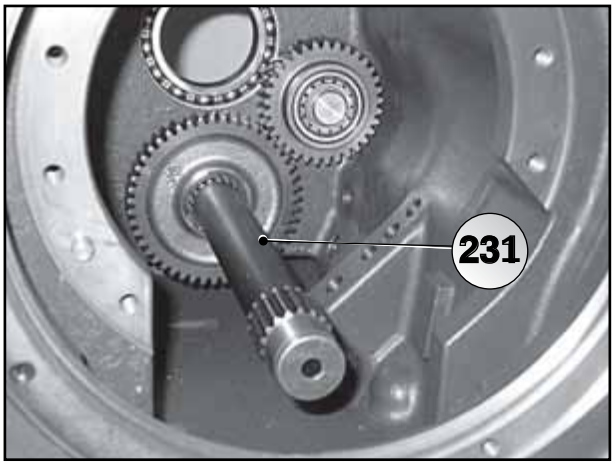


Fig. 4.102

Clutch bearing shaft inspection

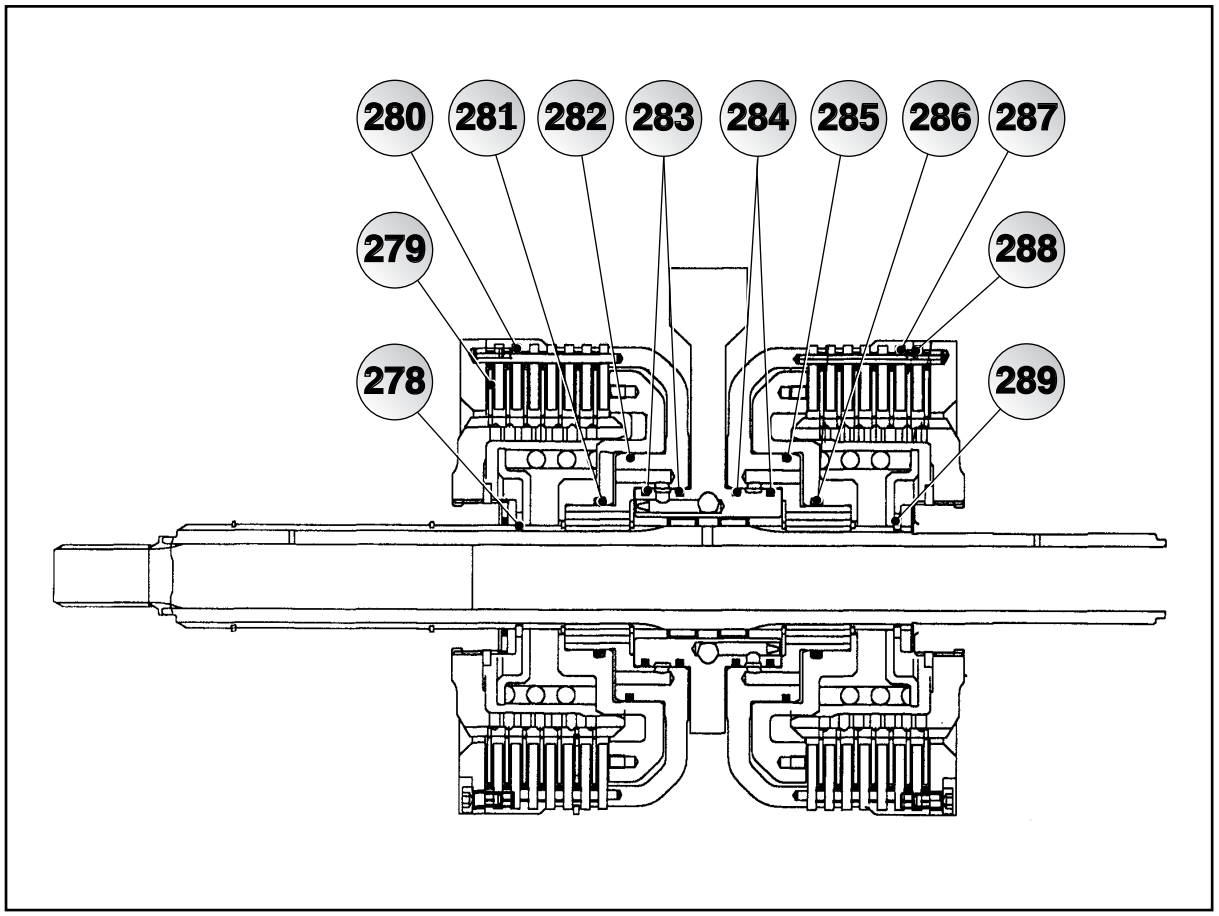


Fig. 4.103

- check the ball bearings (210) and (224) for wear;
- check the thrust bearing (214) for wear;

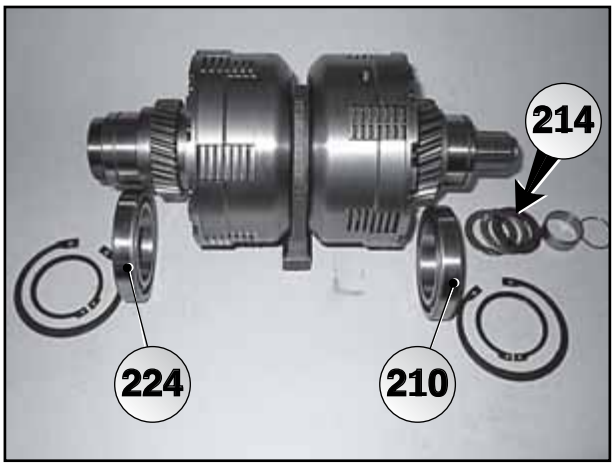


Fig. 4.104

Both clutches (main and secondary) must be split to check the components for wear;

- to access the clutch pistons, remove the spring rings (278 and 289, Fig4.103) that hold the return spring using a press and tool 143 DS LG;

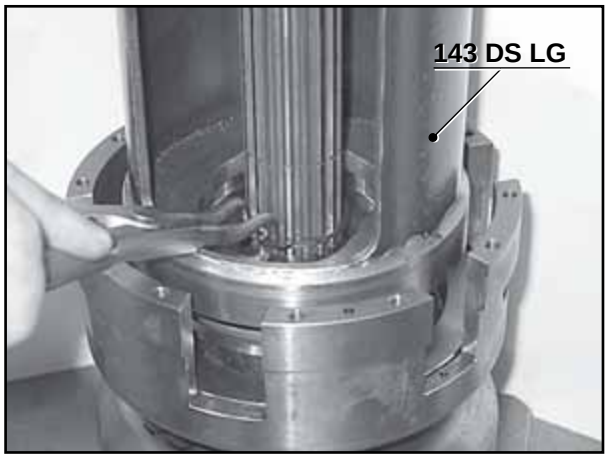


Fig. 4.105

- replace the rings (283 and 284) (made of Teflon);

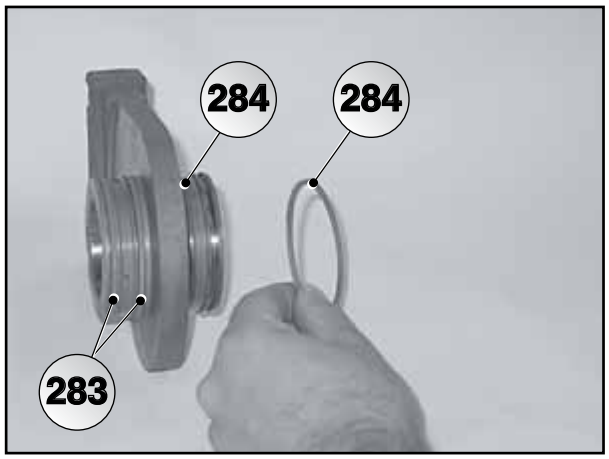


Fig. 4.106

- replace the piston rings (282 and 285) (made of “Teflon”).

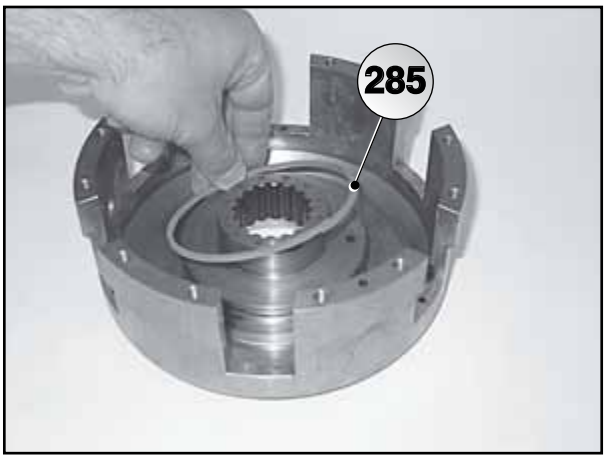


Fig. 4.107

- replace the piston retention rings (281 and 286) (O-Rings);

Fig. 4.108

- make sure that the grooves in the friction discs (A) are visible. Change the discs if this is not the case;
- make sure that the intermediate plates (B) have not become warped owing to overheating or scorching. Replace them if this is the case.

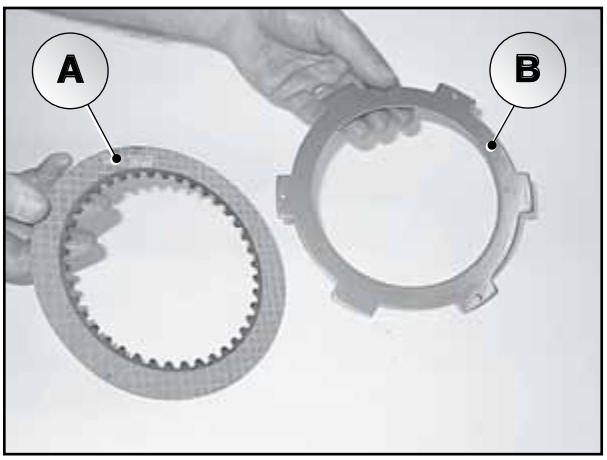


Fig. 4.109

Clutch shaft re-assembly

Attention: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that the lifted load is firmly fastened.

- screw tool 02 DS F-N Seriesa on to the clutch bearing shaft (225), on the rear side.

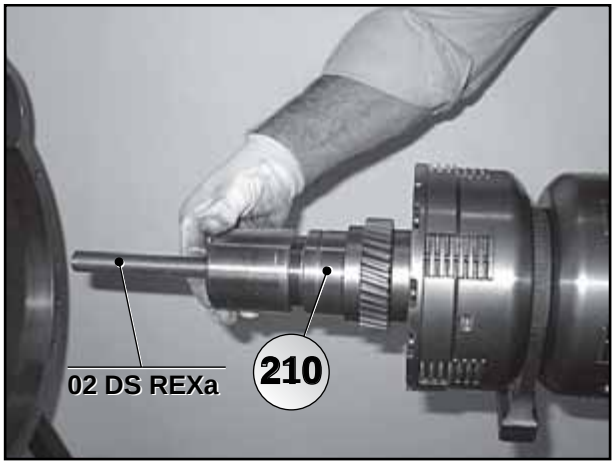


Fig. 4.110

- insert the shaft into the axle housing until it touches the bearing (224) using tool 141 DS LG and sleeve 01 DS F-N Series;

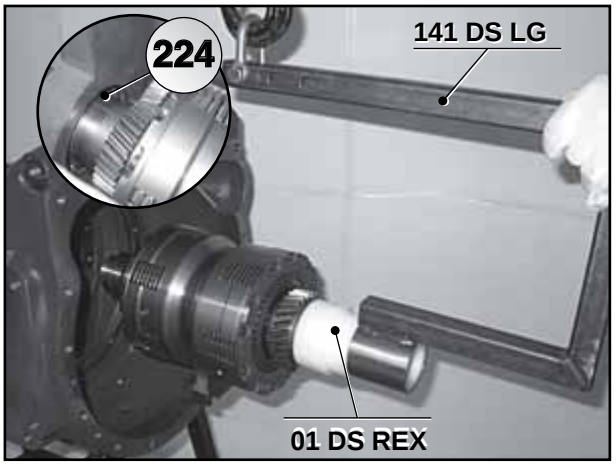


Fig. 4.111

- finish assembling the tool 02 DS F-N Seriesb;

Fig. 4.112

- use tool 02 DS F-N Series and screw down until the clutch shaft is fully inserted on to the bearing (224).

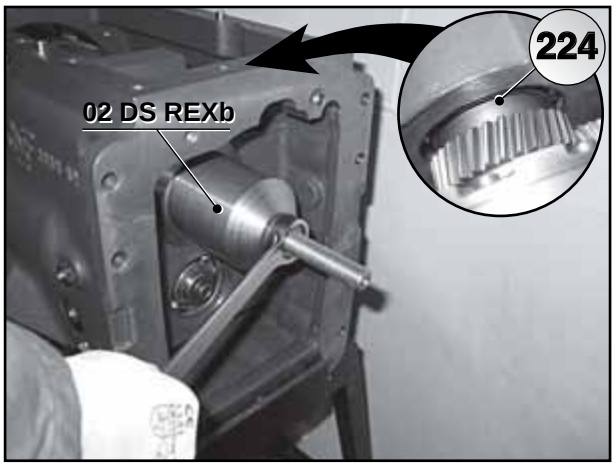


Fig. 4.113

- comply with the disassembly operations in reverse order until the cover (212), so as to completely re-assemble the axle.

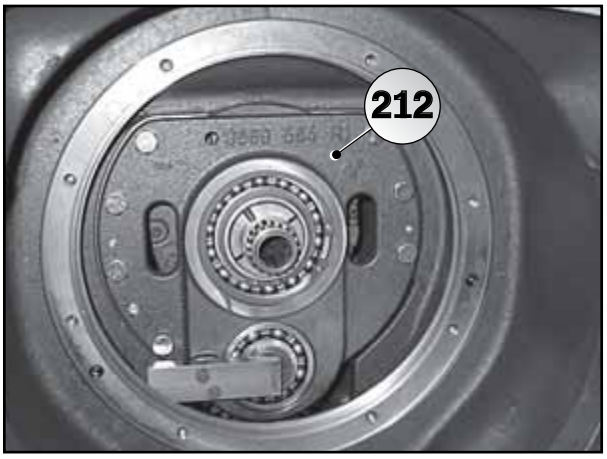


Fig. 4.114

Inspection of the "Power Five" unit

The cover (257) and the planet carrier must be disassembled in order to check the components in the Power Five unit for wear;

Fig. 4.115

- replace the retention rings (250);

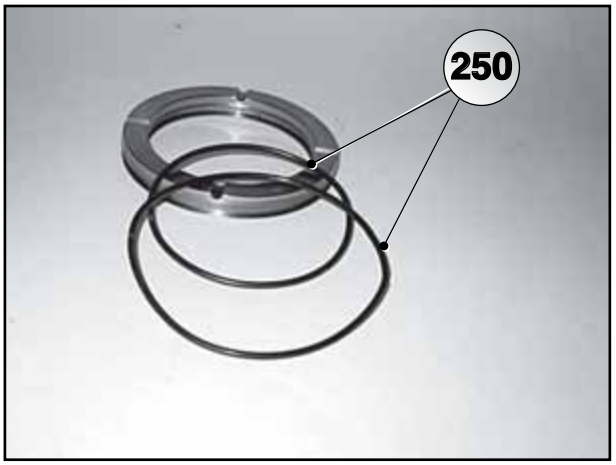


Fig. 4.116

- make sure that the grooves in the friction discs (252) are visible. Change them if this is not the case;
- make sure that the intermediate plates (253) have not become warped owing to overheating or scorching. Replace them if this is the case;

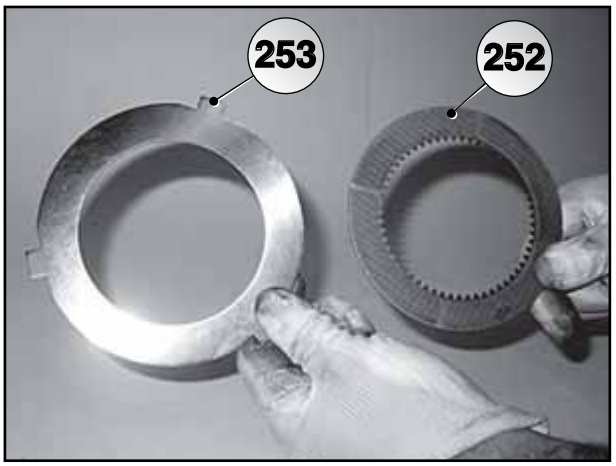


Fig. 4.117

- replace the retention rings (256);

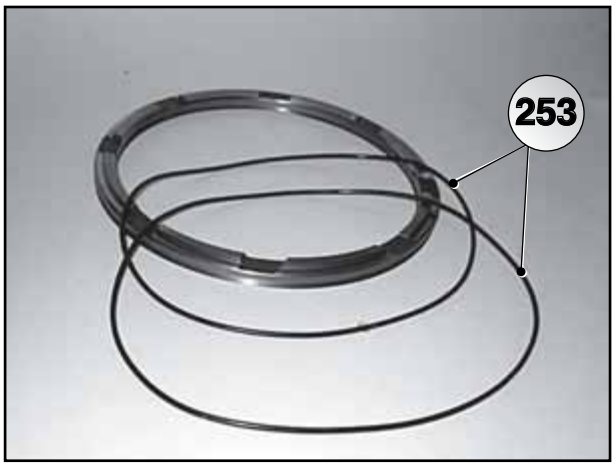


Fig. 4.118

- make sure that the grooves in the brake discs (254) are visible. Change them if this is not the case;

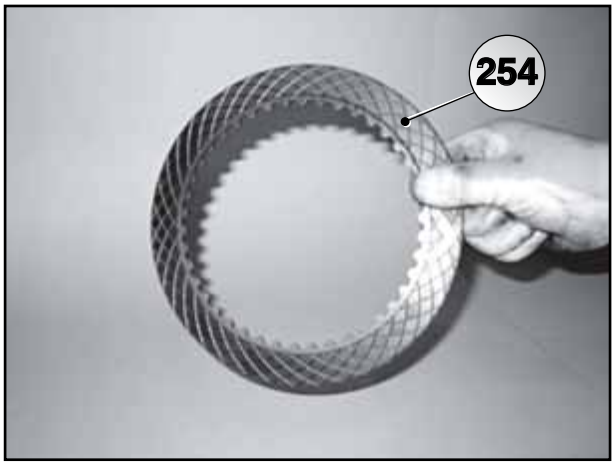


Fig. 4.119

- replace the retention rings (248);

Fig. 4.120

Re-assembly of the "Power Five" unit

- assemble the planetary gear pins (266) with the lubrication hole positioned as shown in the figure;

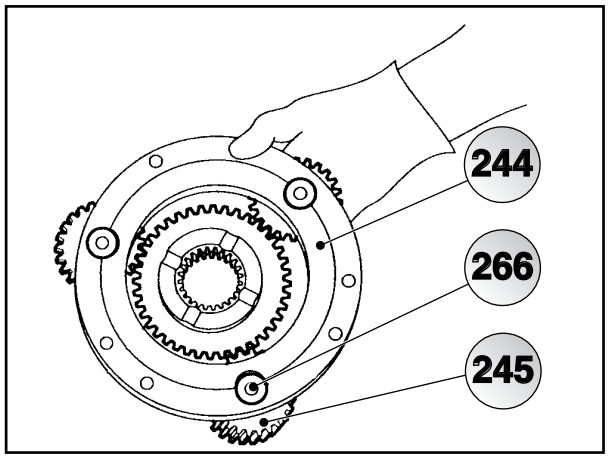


Fig. 4.121

Note: timing errors affecting one tooth will make the assembly noisy, while an error affecting two teeth will create a mechanical block.

- before assembling the third planetary gear, install the input crown wheel (244), taking care to position the mark on the tooth of each of the three planetary gears (245) so that it converges towards the center at 120°, as shown in Fig.4.122once the third planetary gear has been fixed (245) with the relative pin (266), check again to make sure that the three marks point toward the center. Repeat the assembly operations if this is not the case;

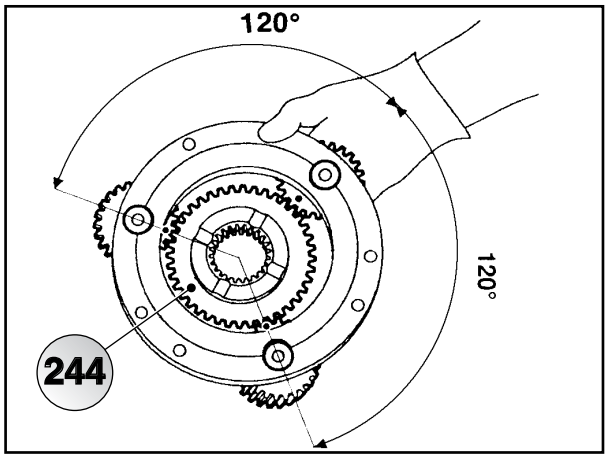


Fig. 4.122

- take care when assembling the two retention rings (246 and 247) on the support (276). The ring (246) with scoring on the outer and inner diameters must be installed on the left, while the normal one (247) must be installed on the right. Both must comply with the assembly dimensions indicated in the figure. Use tool 03 DS VS to make the two retention rings easier to assemble.

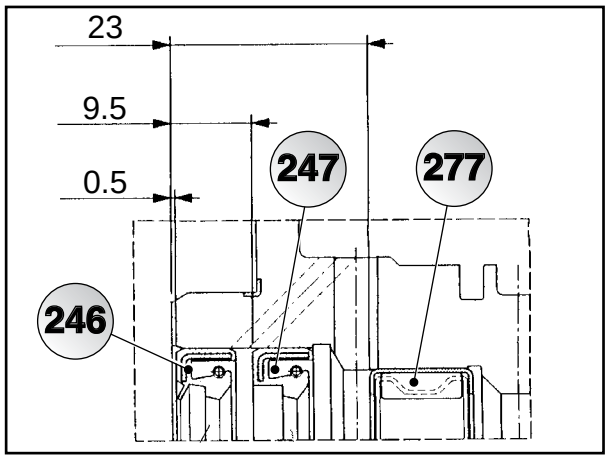


Fig. 4.123

- remember that the needle bearing (277) must be installed before the two retention rings;

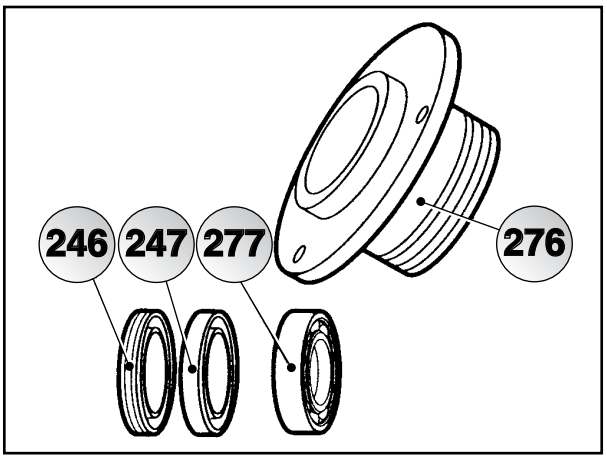


Fig. 4.124

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

- re-assemble the entire Power Five unit in the axle housing using tool 141 DS LG and sleeve 02 DS VS.

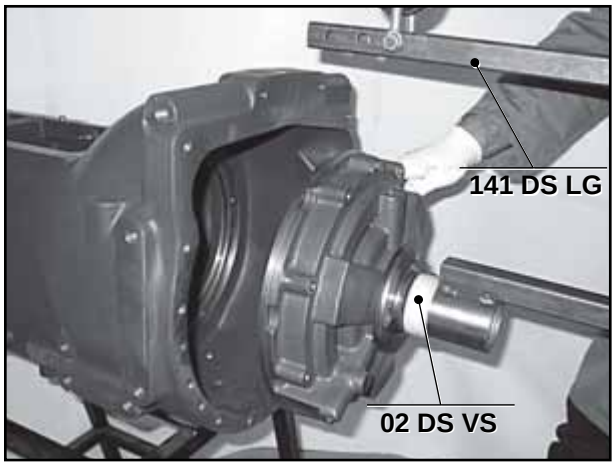


Fig. 4.125

How to fit the axle back on the gearbox

Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

- fix a suitable support to the axle so as to allow the housings to be aligned in a better way, then slightly move the axle near the to gearbox so as to be able to mount the blocks (951), (952), (953);

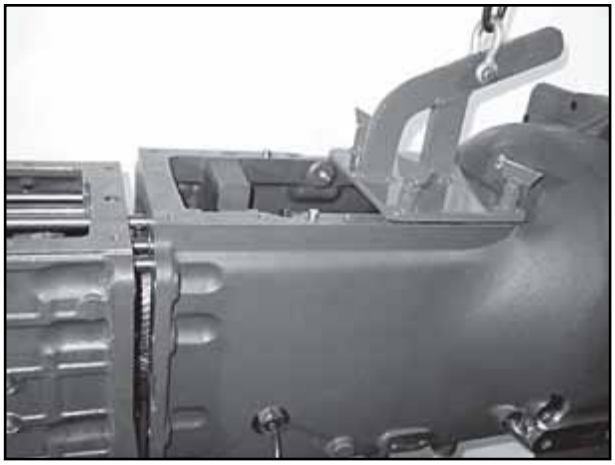


Fig. 4.126

- assemble the blocks (951), (952) and (953);

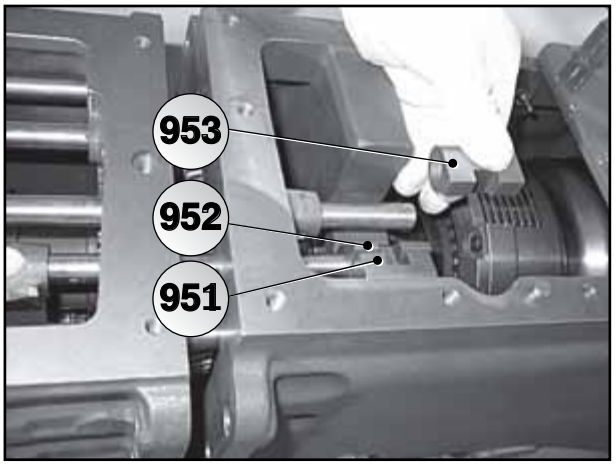


Fig. 4.127

- fit the axle housing and gearbox back together again.

Fig. 4.128

4.3 Version without Power Shuttle

4.3.1 Drawing of assembly and main components

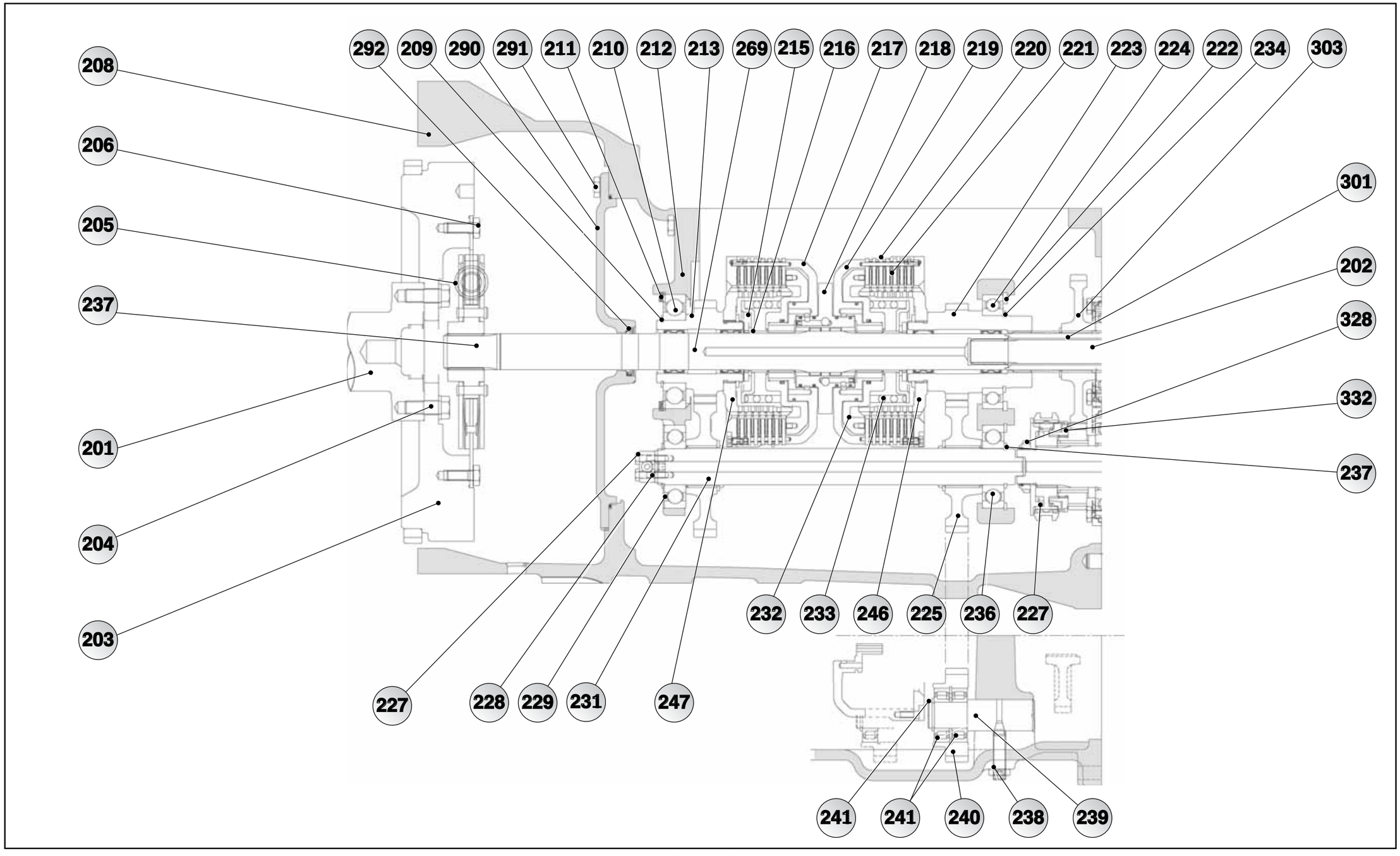


Fig. 4.129

201 - Drive shaft
202 - PTO drive shaft
203 - Drive shaft
204 - Flywheel fixing screw
205 - Damper
206 - Damper fixing screw
208 - Engine-gearbox assembly
209 - Spring ring
210 - Ball bearing
211 - Spring ring
212 - Rear cover
213 - Reverse shuttle gear
215 - Thrust plate
216 - Spring ring
217 - Main clutch bowl
218 - Clutch central body
219 - Secondary clutch bowl
220 - Metal counterdisc
221 - Clutch plate
222 - Spring ring
223 - Forward/reverse drive gear
224 - Ball bearing.
226 - Lube block
227 - Block fixing screw
228 - Spring ring
229 - Ball bearing
230 - Reverse shuttle gear
231 - Reverse shuttle transmission shaft
232 - Clutch piston
233 - Piston return spring
234 - Spring ring
235 - Reverse shuttle driven gear
236 - Ball bearing
237 - Input shaft
236 - Fixing pin
239 - Shaft for reverse shuttle gear
240 - Reverse shuttle gear
241 - Roller bearings
242 - Spring ring
246 - Secondary clutch hub
247 - Main clutch hub
290 - Front cover
291 - Cover fixing screw
292 - Retention ring
293 - Internal cover fixing screw
296 - Spring ring
297 - Spring ring
301 - Gearshift main shaft
303 - 5th speed driving gear
327 - 5th gear synchro-mesh unit
328 - Ring nut
332 - 5th speed synchromesh tapered ring

4.3.2 Description of operation

Forward speeds

Drive is transmitted from the flywheel (203) to the input shaft (237) of the gearbox, via the damper plate (205).

Drive thus reaches the main and secondary clutch assemblies.

If the tractor is being driven FORWARDS, drive reaches the bowl (219) of the secondary clutch, which is keyed to the input shaft (237). Oil at a pressure of 20 bar blocks the plates of the secondary clutch, thus transmitting drive to the hub (246). This latter is keyed to the forward/reverse gear (223), which is permanently meshed with the main shaft (301) of the gearbox.

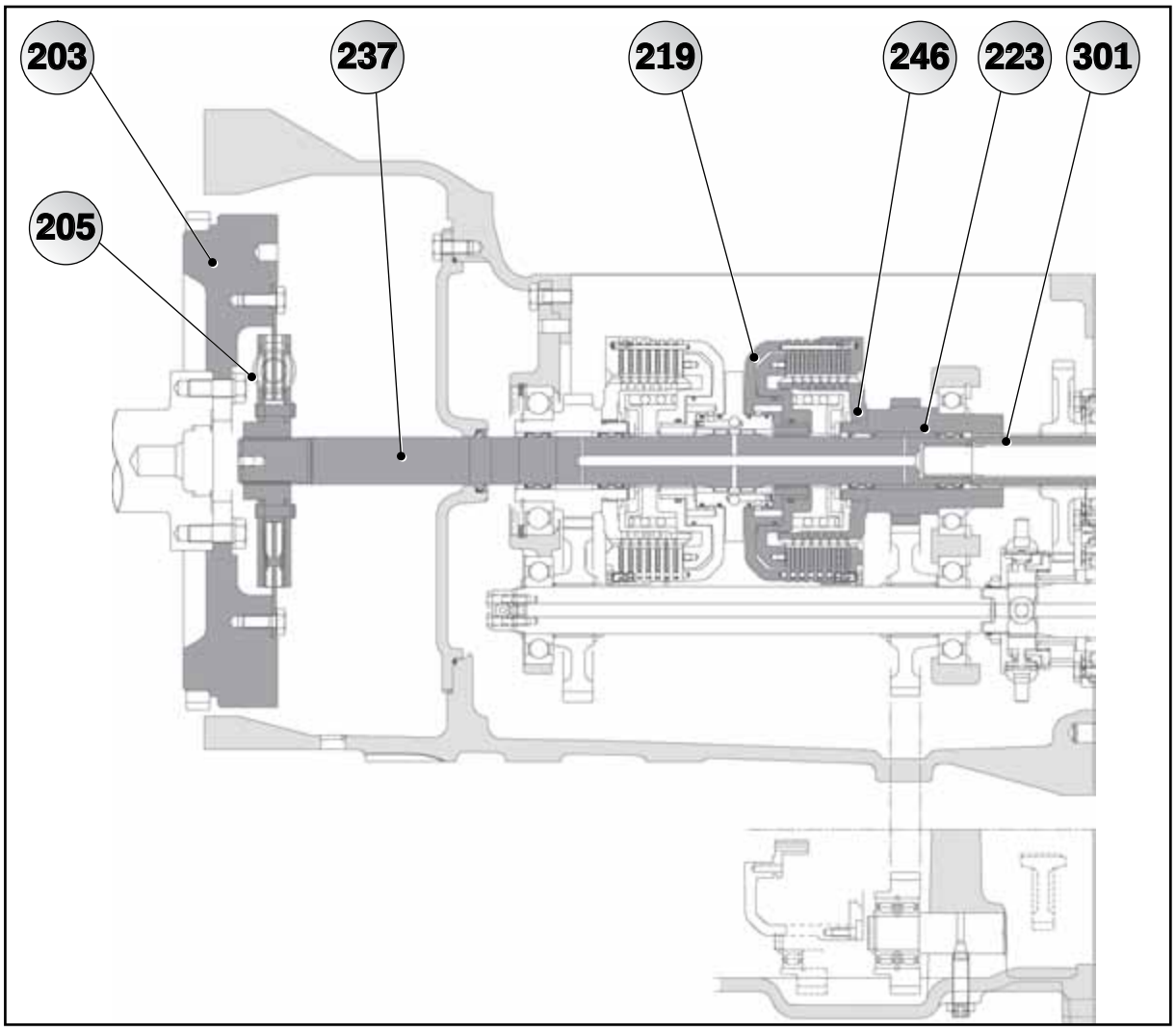


Fig. 4.130

Reverse

Drive is transmitted from the flywheel (203) to the input shaft (237) of the gearbox, via the damper plate (205). Drive thus reaches the main and secondary clutch assemblies.

If the tractor is being driven in REVERSE, drive reaches the bowl (217) of the main clutch, which is keyed to the input shaft (237).

Oil at a pressure of 20 bar blocks the plates of the main clutch, thus transmitting drive to the hub (247). This latter is keyed to the reverse gear (213), which is permanently meshed with the driven gear (230) on the layshaft (231). Drive then reaches the gear (235), which is keyed with gear (240). The mesh between it and gear (223) allows this latter to transmit drive to the main shaft (301) of the gearbox.

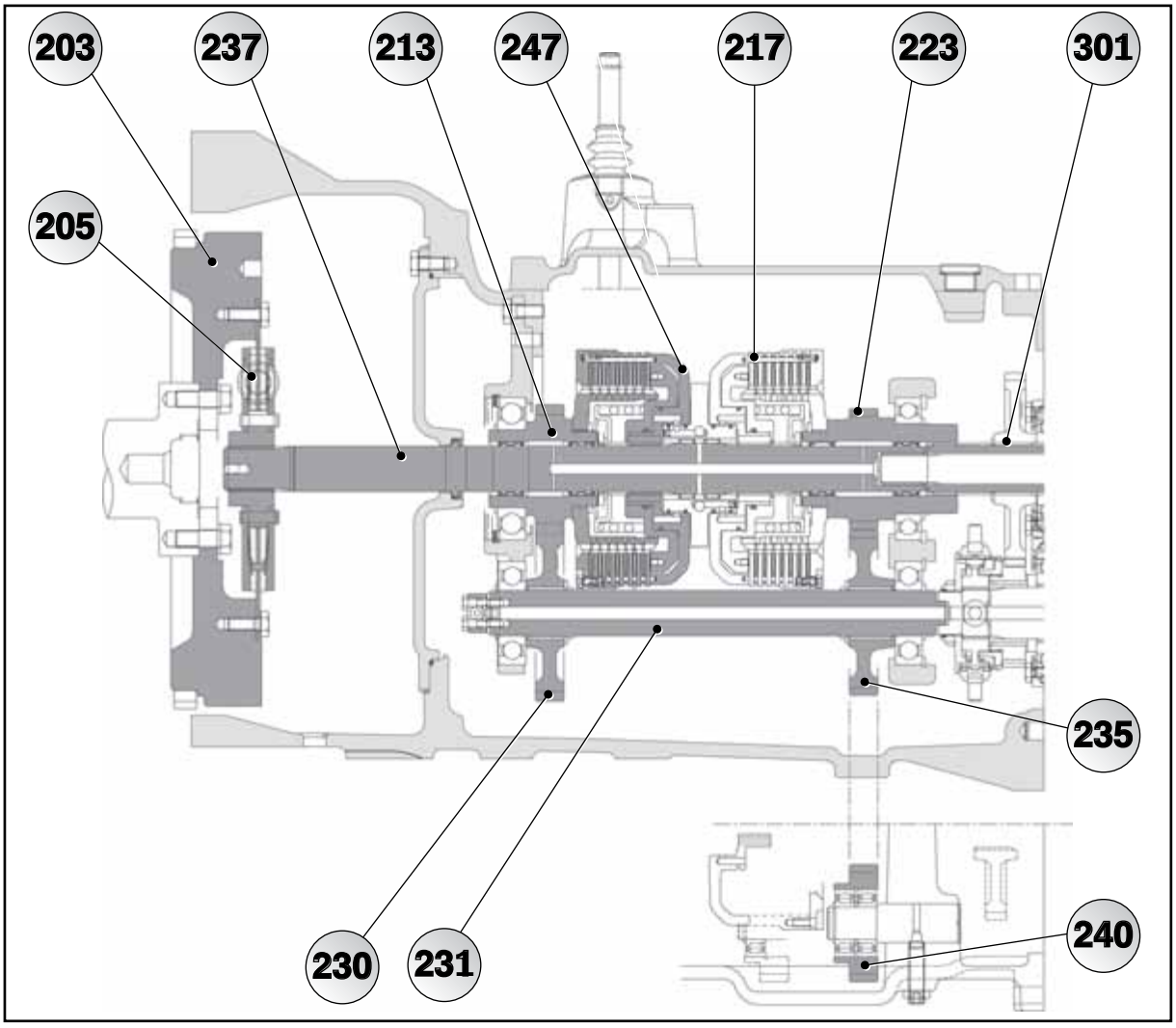


Fig. 4.131

4.3.3 Guide lines for disassembly, re-assembly and adjustments

For the engine-gearbox assembly as mounted on F-N Series tractors without optional half speeds (Power Four/Five unit), the splitting, re-assembly and adjustment operations are the same as described in the previous pages.

The half-speed unit is replaced by a cover (290), installed between the damper plate and the clutch assembly of the Power Shuttle unit. The shaft (237 Fig.4.133) bearing the above mentioned clutches differs from the one in the Power Four/five versions in its extension. In the version with the Power Four/Five unit, the shaft is directly splined on the input shaft (207 Fig.4.131) while in the version without Power Four/Five, the shaft receives drive directly from the engine flywheel, thus doubling its function both as input shaft and clutch bearing shaft.

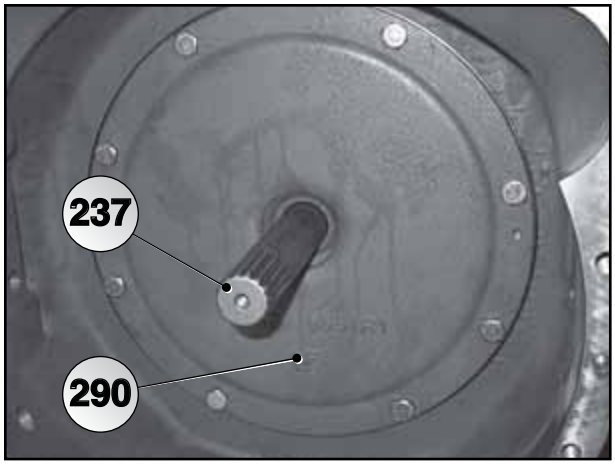


Fig. 4.132

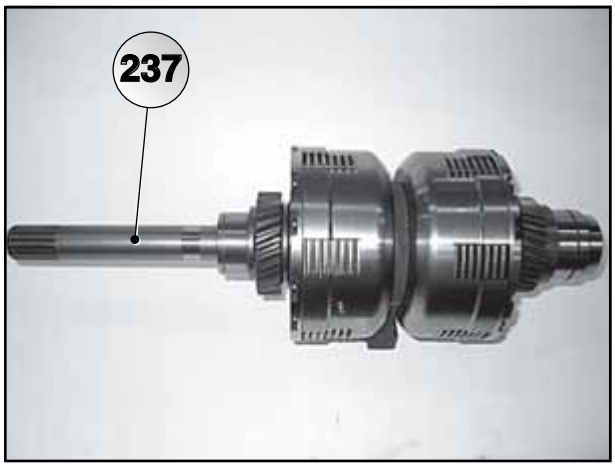


Fig. 4.133

4.4 Gearbox (Speed Five/Four and E-Line version)
4.4.1 Drawing of assembly (Speed Five version)

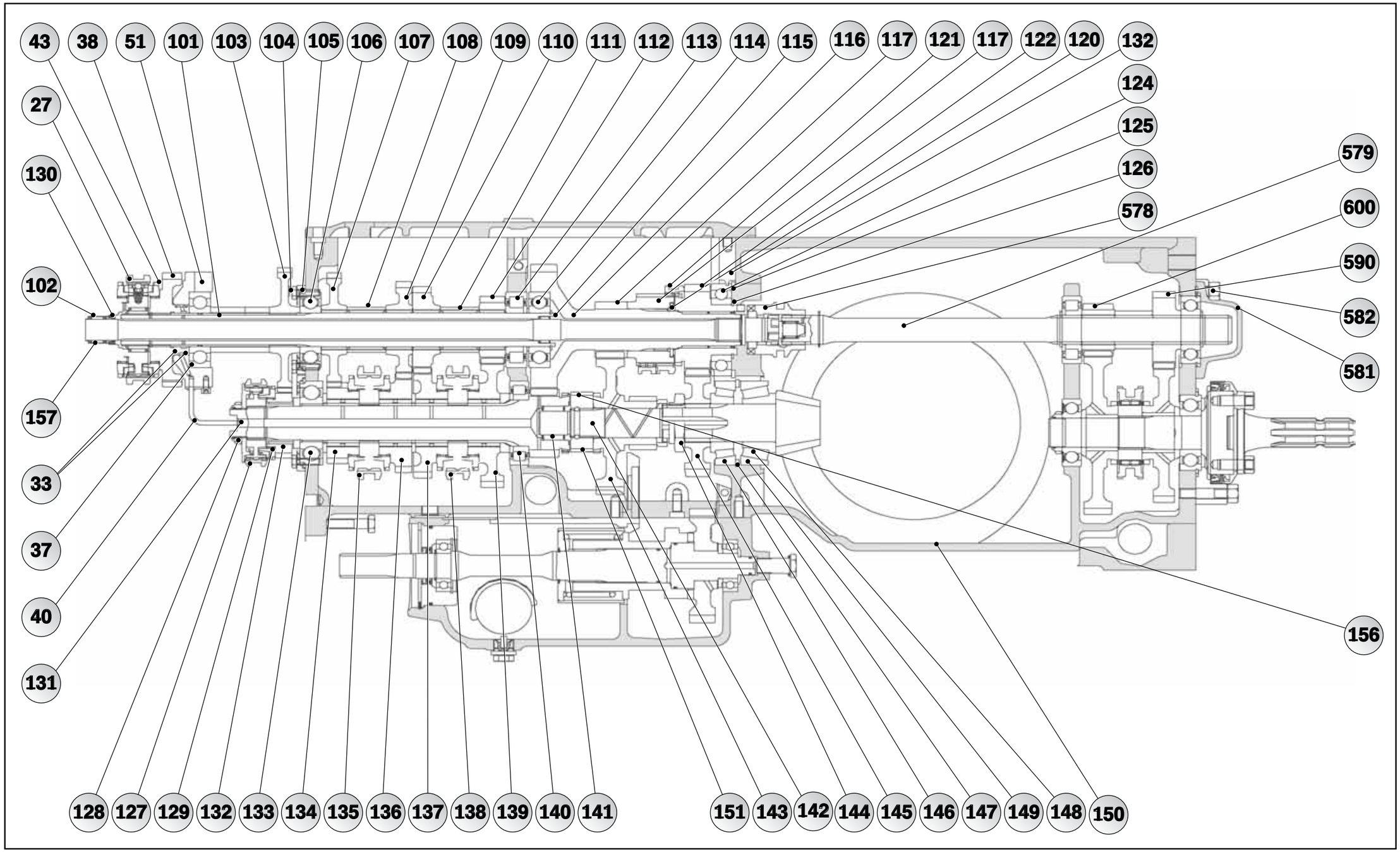


Fig. 4.134

27 - Reverse shuttle synchro-mesh
33 - Retention rings
37 - Ball bearing
38 - Forward/reverse drive gear
40 - Lube pipe
43 - Reverse shuttle synchromesh tapered ring
51 - Ball bearing seat
101 - Main shaft (input)
102 - Spring ring
103 - 5th speed driving gear
104 - Flange fixing screw
105 - Flange
106 - Ball bearing
107 - 4th speed driving gear
108 - Spacer
109 - 3rd speed driving gear
110 - 2nd speed driving gear
111 - Spacer
112 - 1st speed driving gear
113 - Roller bearing
114 - Ball bearing
115 - Spring ring
116 - Upper shaft (ranges)
117 - Low range drive gear
118 - Hub sleeve
119 - Spring ring
120 - Thrust bearing
121 - Standard range engagement sleeve
122 - Standard range driving gear
123 - Bearing retainer pin
124 - Ball bearing
125 - Spring ring
126 - Spring ring
127 - 5th gear synchro-mesh unit
128 - Ring nut
129 - 5th speed synchromesh tapered ring
130 - Bush
131 - Layshaft
132 - 5th speed driven gear
133 - Ball bearing
134 - 4th speed driven gear
135 - 4th and 3rd speed synchro-mesh
136 - 3rd speed driven gear
137 - 2nd speed driven gear
138 - 2nd and 1st speed synchro-mesh
139 - 1st speed driven gear
140 - Roller bearing
141 - Needle bearing
142 - Output shaft (bevel pinion)
143 - Driven gear for low range and creeper
144 - Bevel pinion fixing nut
145 - Standard range driven gear
146 - Pinion support tapered bearing
147 - Spring ring
148 - Pinion support tapered bearing
149 - Pinion adjustment shims
150 - Gearbox housing
151 - Normal and high range engagement sleeve
152 - Output shaft (bevel pinion) (version without creeper)
153 - Bevel pinion fixing nut (version without creeper)
154 - 4WD drive transmission gear (version without creeper)
155 - Driven gear for low range (version without creeper)
156 - Hub sleeve
157 - Adjustment ring
578 - PTO selection sleeve
579 - PTO rear shaft
581 - P.T.O. cover
582 - Cover fixing screw
590 - 1000/540E PTO gear
600 - 540 PTO gear

4.4.2 Description of operation

This is the assembly that varies the speed ratios and, thus, that modulates the value of the torque delivered depending on the power required by each application. The gearbox housing contains 4 or 5 synchronized speed gears (depending on the version), all with helical toothing. They are engaged by the respective forks operated by the gearshift lever installed on the platform on the driver's right. 4 are installed in the front compartment, while the 5th speed gear is installed outside, in the front side of the housing. 3 reduction ranges with straight toothing are installed at the rear and can be engaged in facilitated mode by means of sliding sleeves and the relative forks, operated by the control lever also installed near to the gearshift lever on the platform on the driver's left. A creeper unit can be installed on request. This is positioned in the 4WD compartment. In tis case, the gearbox will differ in some ways from the version with creeper, i.e.: the bevel pinion shaft (152), the gears (154) and (155), the pinion fixing nut (153) and the levers used to engage/disengage the creeper itself. The speed gears and ranges are engaged through the longitudinal sliding movement made by a sleeve that connects the gears permanently meshed but idle on their shafts, to a central hub keyed to the relative driving shaft.

Since the gearbox in Speed Five and Techno version tractors is mechanical, changes from one gear to the other must necessarily occur without the main shaft (or gearbox input shaft) being on load. In other words, the clutch must be used to interrupt the drive transmitted between the engine and gearbox. The connection sleeve is able to engage the ratio selected when the idle gear to engage spins at the same speed as the splined hub and the sleeve itself. A determinant contribution from the synchro-rings facilitates this operation to the utmost, also and above all whilst the tractor is on the move. Range engagement by means of the facilitated engagement sleeve must occur when the tractor is practically at a standstill. Thus the gearbox in its various configurations consists of the following number of speed gears:

Number of speeds (4WD version)	15 forward and 15 reverse with Speed Five gearbox 20 forward and 20 reverse with Speed Five gearbox and creeper
Number of speeds (2WD version)	12 forward and 12 reverse with Speed Four gearbox 16 forward and 16 reverse with Speed Four gearbox and creeper
Number of speeds (Techno version)(4WD)	12 forward and 12 reverse 16 forward and 16 reverse with creeper

VERSION WITHOUT CREEPER

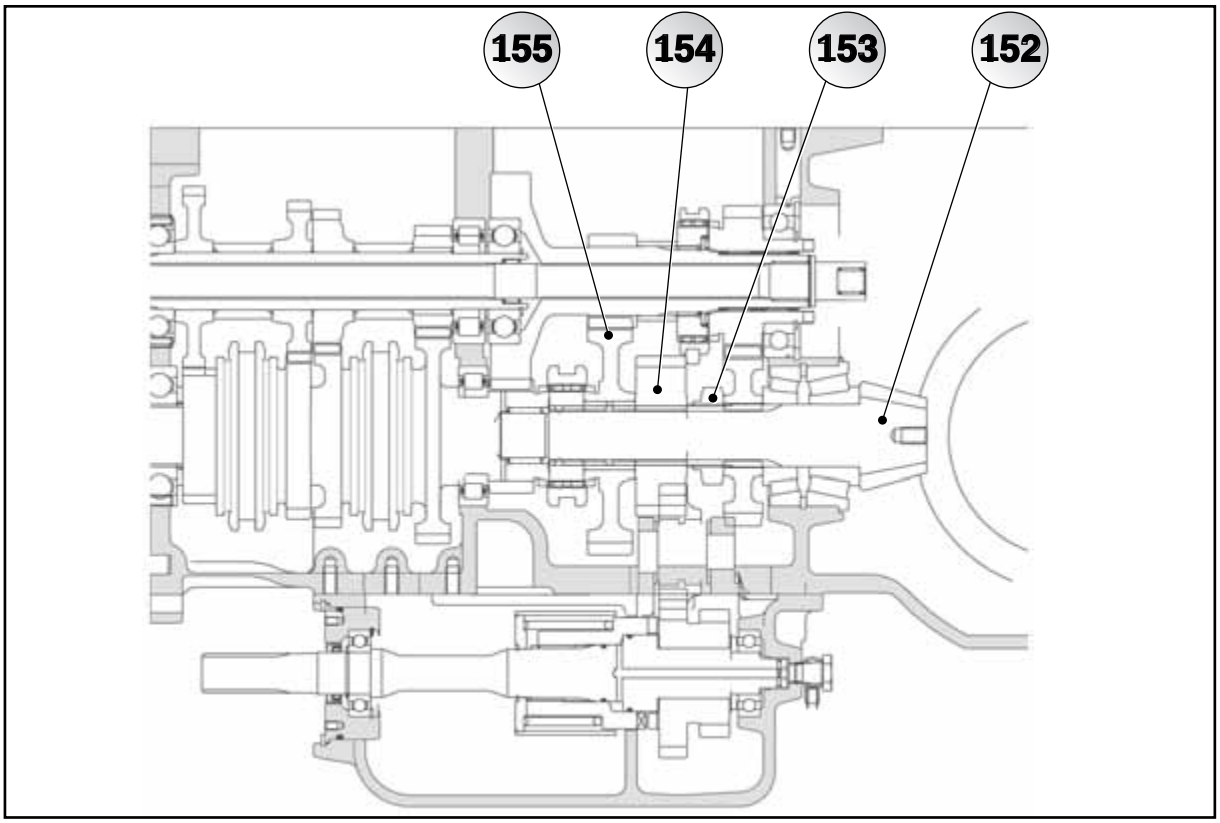


Fig. 4.135

VERSION WITH CREEPER

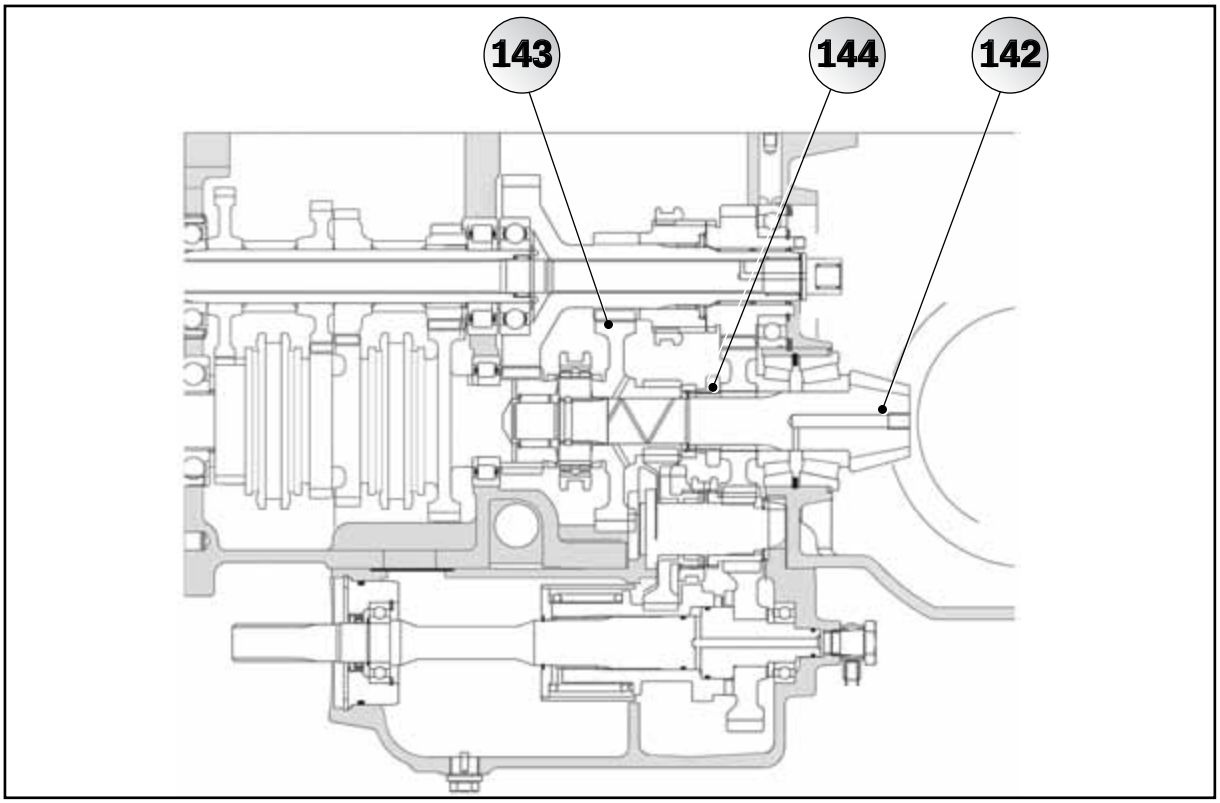


Fig. 4.136

4.4.3 Guidelines for disassembly

How to remove the engine gearbox assembly

⚠	**Attention:** WARNING: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

Note: The operations described for the version with the 5-speed gearbox also apply to the 4-speed version (Speed Four and Techno), with the sole difference described in sect. 1 of this chapter.

- split the engine from the axle;
- unscrew the fixing screws from the covers of the axle housing and of the gearbox housing;

Note: remove the 5th speed plug, spring and ball from the gearbox cover. Remove the lubrication tube from the left-hand side of the axle housing;

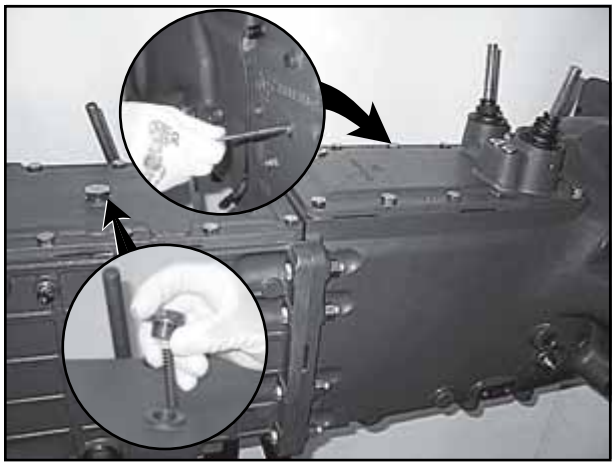


Fig. 4.137

- remove the cover from the axle and the gearbox;

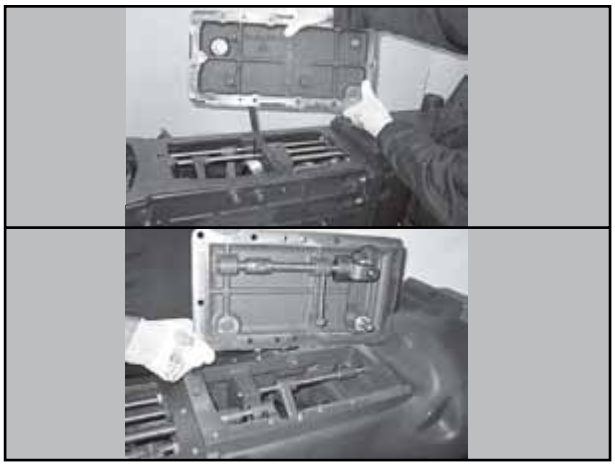


Fig. 4.138

Note: the balls and springs removed from the gearbox housing must be set aside;

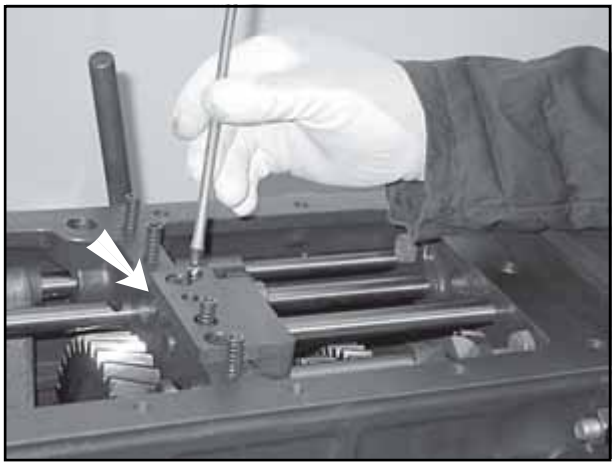


Fig. 4.139

Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

- remove the spring pins that fix the blocks (951), (952) and (953).

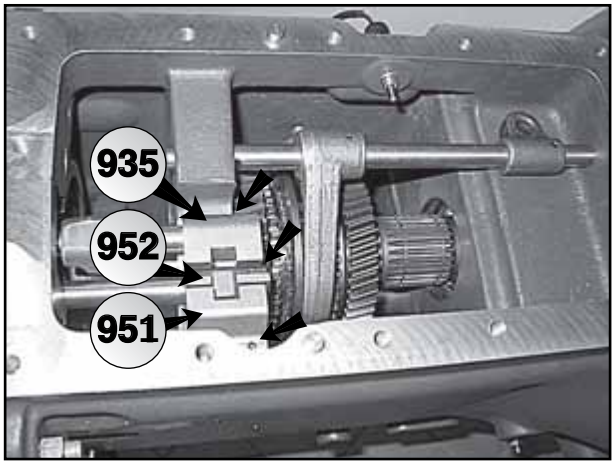


Fig. 4.140

- fix a suitable support to the axle so as to align the housings in a better way, then unscrew the two internal screws that fix the axle to the gearbox, along with the external screws;
- slightly detach the axle from the gearbox, so that the blocks (951), (952) and (953) can be removed;

Fig. 4.141

Note: before splitting the axle housing from the gearbox, note and possibly mark the correct positions of the blocks (951), (952), (953). This is important, as it allows the axle to be correctly re-assembled on the gearbox.

- remove the blocks (951), (952), (953) and split completely the shaft from the gearbox.

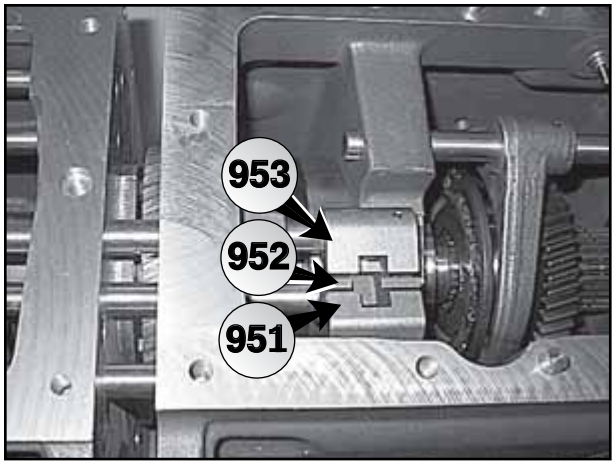


Fig. 4.142

Attention: keep clear of the sharp edges around the top of the gearbox.

- place the gearbox housing on adequate supports.

Note: the 5th speed assembly shown in the figure is not installed in the Speed Four and Techno versions. The operations described for assembling the gearbox components also apply to the 4-speed versions.

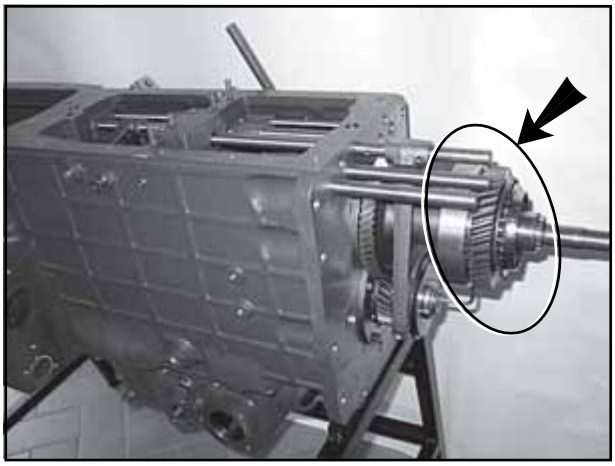


Fig. 4.143

Attention: wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.

- disassemble the diff lock rod and fork unit.

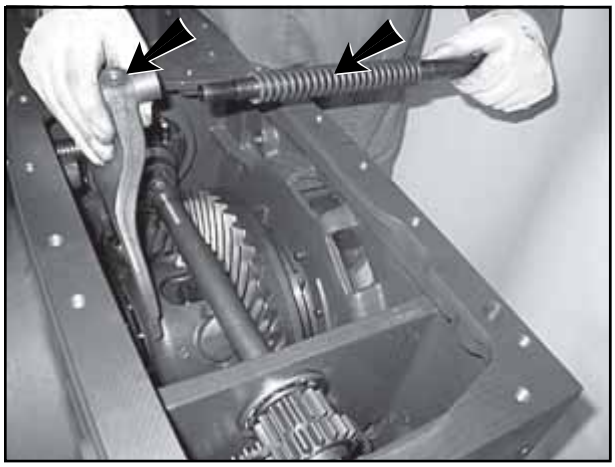


Fig. 4.144

- remove the PTO cover (581) and draw out the PTO's rear shaft (591);

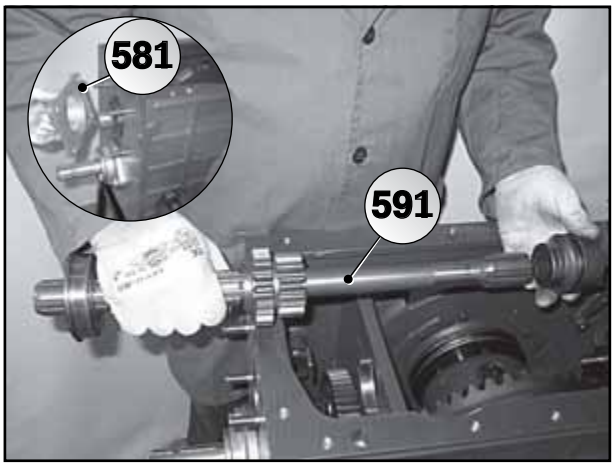


Fig. 4.145

- remove the PTO transmission shaft (2).

Fig. 4.146

Removal of the upper shaft (ranges)

- remove the rods (964) and (965) and the forks (966) and (967) of the speed ranges;

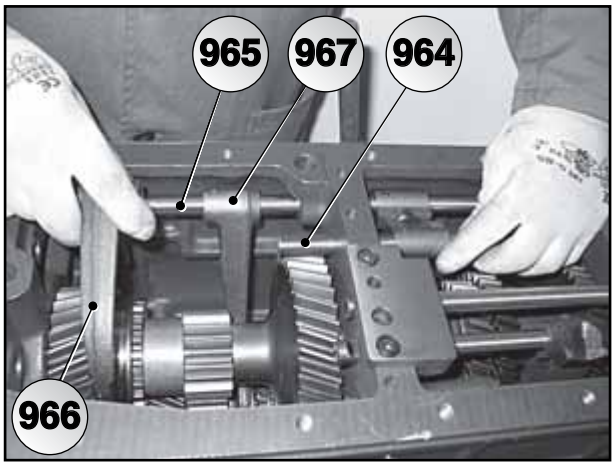


Fig. 4.147

- with the aid of a screw, remove the pin (123) that holds the bearing in place;

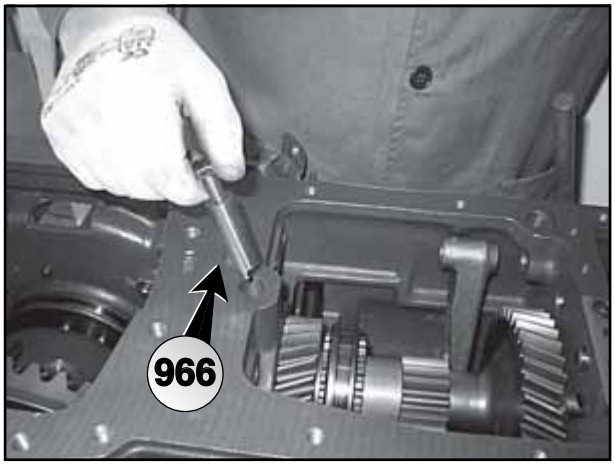


Fig. 4.148

Note: before removing the upper shaft of the ranges, the ground speed sensor (SR1), connected by screws to the left side of the gearbox housing, should be removed to prevent damage.

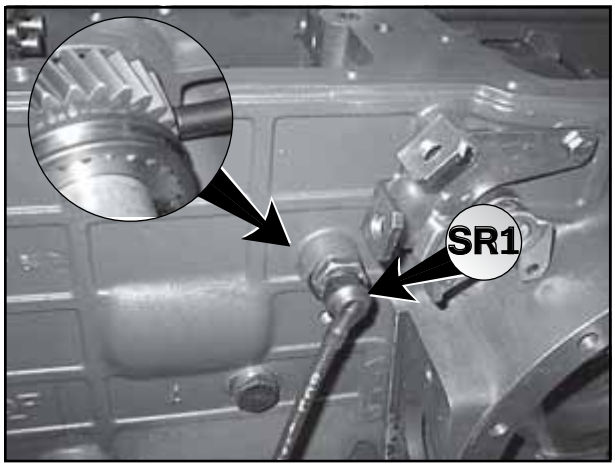


Fig. 4.149

- remove the spring ring (126);

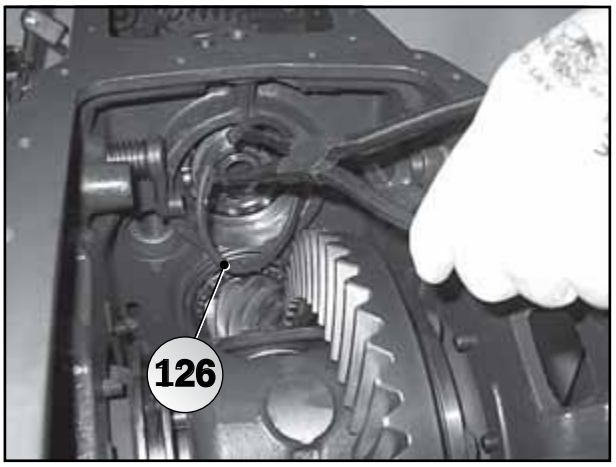


Fig. 4.150

- remove the upper shaft (116);

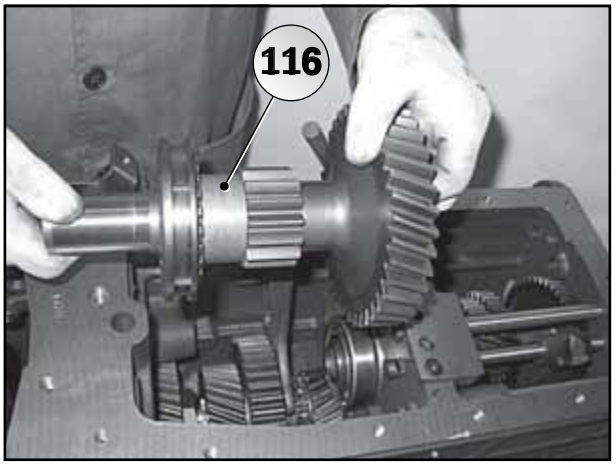


Fig. 4.151

Main shaft removal

- remove rods (954), (955) and (956);
- remove the support (960);

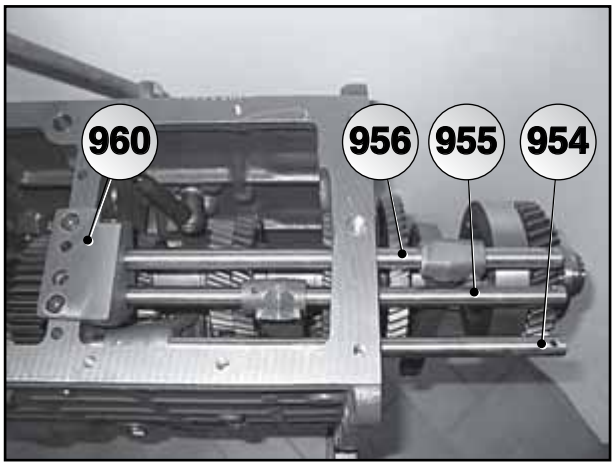


Fig. 4.152

Note: the ring nut (128a) must be removed with the aid of tool CR347 and the spring ring (115) in order to remove the main shaft in the 4-speed versions. After this, the main shaft (158) can be taken out;

- remove the ring nut (128) with the aid of tool 26 DIF VS;

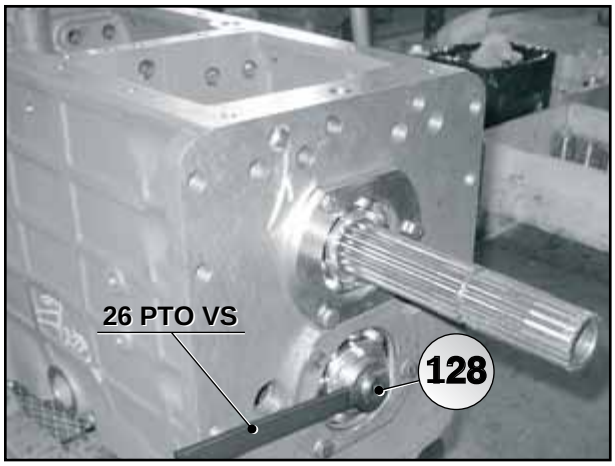


Fig. 4.153

- remove the spring ring (102);
- remove the gearbox lubrication unit (38) (51);

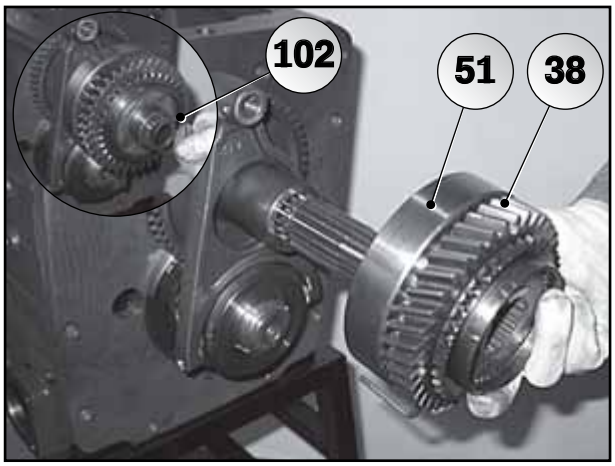


Fig. 4.154

- remove the 5th gear synchro-mesh unit (127);
- remove the 5th speed driving gear (103);

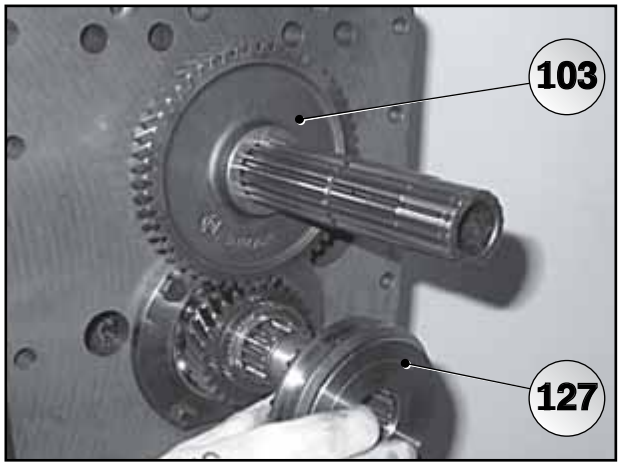


Fig. 4.155

- remove the spring ring (115);

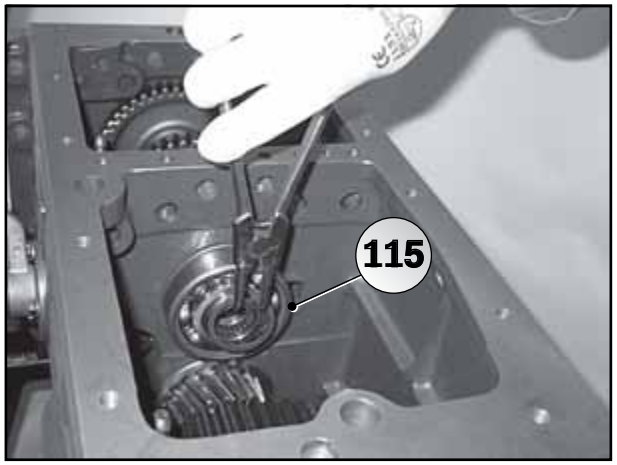


Fig. 4.156

- remove the main shaft (101 Speed Five version), (158 Speed Four and Techno versions).

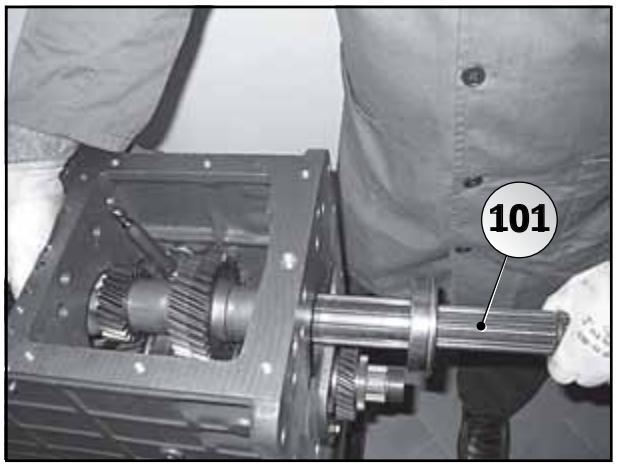


Fig. 4.157

Output shaft removal

⚠	**Attention:** if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

- split the 4WD housing assembly.

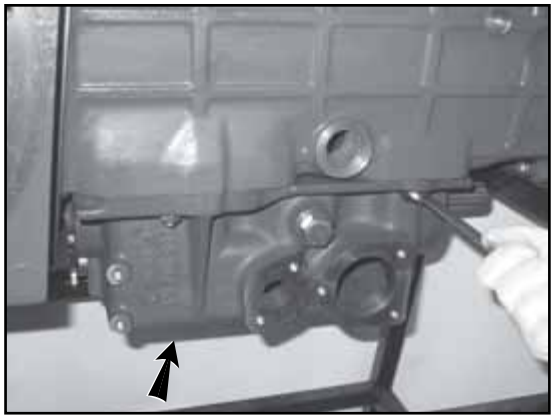


Fig. 4.158

⚠	**Attention:** the differential unit is very heavy and difficult to handle. Take the greatest care when removing and remounting it.

- remove the differential housing with the aid of tool 01 CMB MYT.

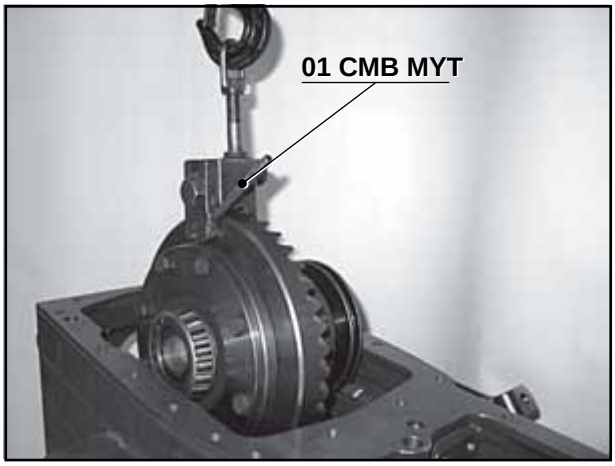


Fig. 4.159

- remove the spring pins that fix the hub (156);

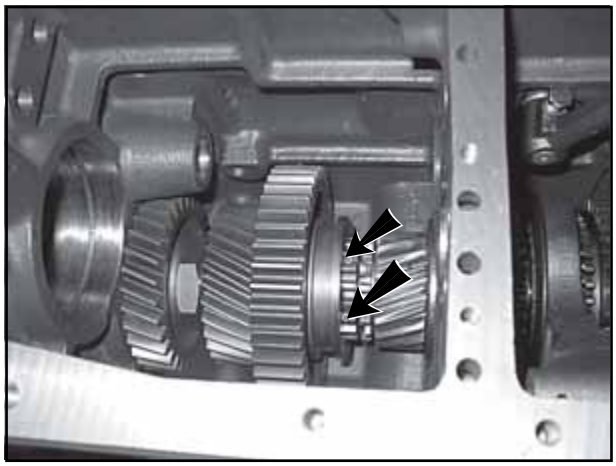


Fig. 4.160

- unscrew the nut (144) with tool 03 CMB F-N Series;

Fig. 4.161

- draw out the output shaft/bevel pinion (142).

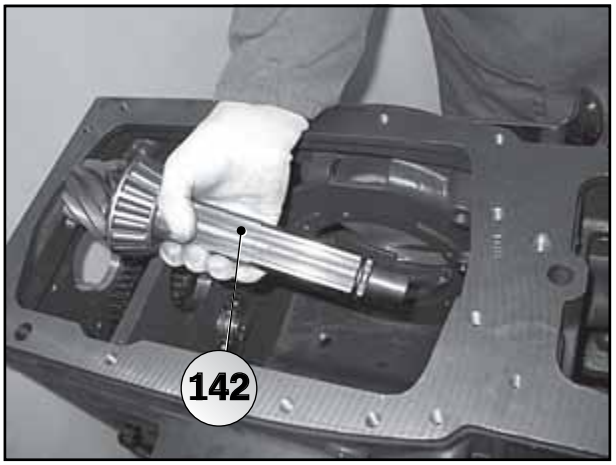


Fig. 4.162

Layshaft removal

- remove the driven gear (132;

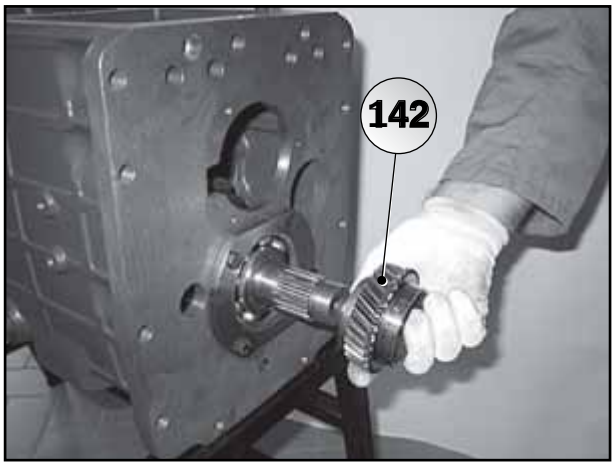


Fig. 4.163

- take out the shaft (131) from the rear side.

Fig. 4.164

4.4.4 Guidelines for re-assembly and inspections

Inspection and re-assembly of the layshaft

- check the ball bearings (140) and (133) for wear;
- check the synchro rings (127), (135) and (138) for wear;
- replace the ring nut (128);

Fig. 4.165

- fit the layshaft (131) back into the gearbox housing complete with all its components;

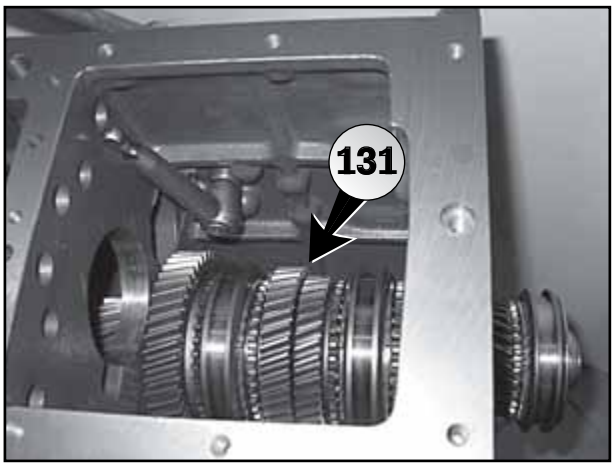


Fig. 4.166

Note: before torquing the ring nut (128 Speed Five version)(Fig.4.167) or the ring nut (128a Speed Four and Techno version)(Fig.4.168) with the aid of tool CR 347, check that the synchro rings are correctly seated;

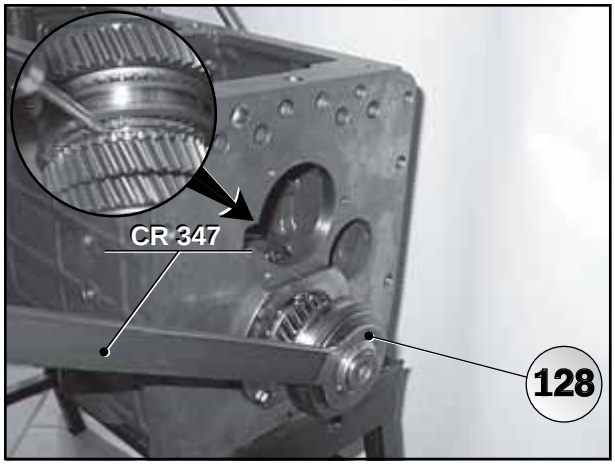


Fig. 4.167

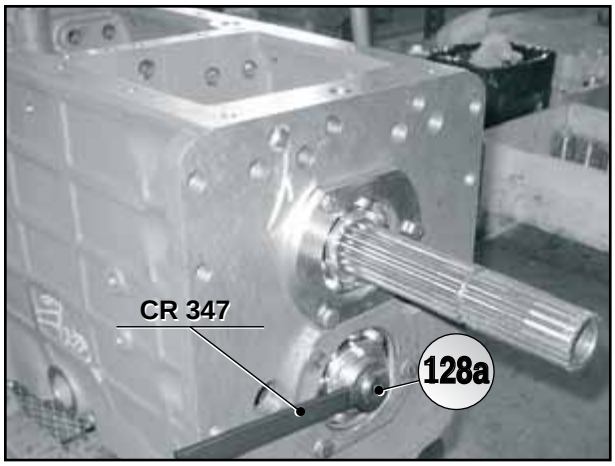


Fig. 4.168

Inspection and re-assembly of the output shaft

- check the ball bearings (146) and (148) for wear;
- check the needle bearing (141) for wear;
- replace the fixing nut (144);

Fig. 4.169

Note: the hub (156) must be fitted with the hole housing the spring pins toward the front side of the gearbox. The sleeve must be keyed on the hub with the gaps properly aligned to allow the pins to be inserted.

Fig. 4.170

- fit the output shaft (142) into the gearbox housing complete with all its components;
- tighten the nut (144) with the aid of tool 03 CMB F-N Series (see the guidelines for the correct driving torque).

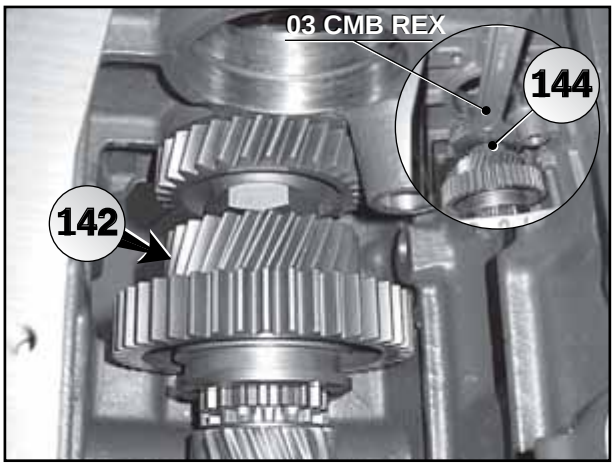


Fig. 4.171

Inspection and re-assembly of the output shaft

- check the bearings (106), (114) and (37) for wear;
- check the roller bearing (113) for wear;
- replace the retention rings (33);

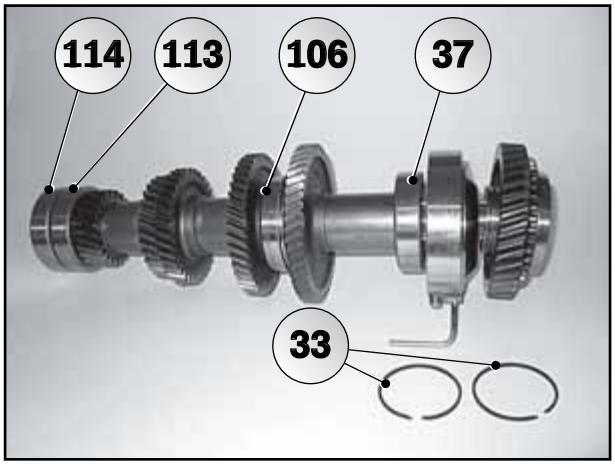


Fig. 4.172

Note: before assembling the main shaft (101), position the gear engagement forks (957) and (958) in their seats.

- fit the transmission shaft (101) back into the gearbox housing complete with all its components;

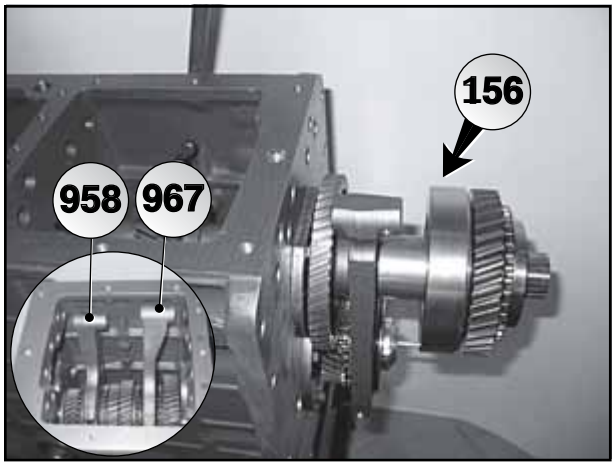


Fig. 4.173

- install the adjustment shim (157) to eliminate any play between the bush (130) and the spring ring (102).

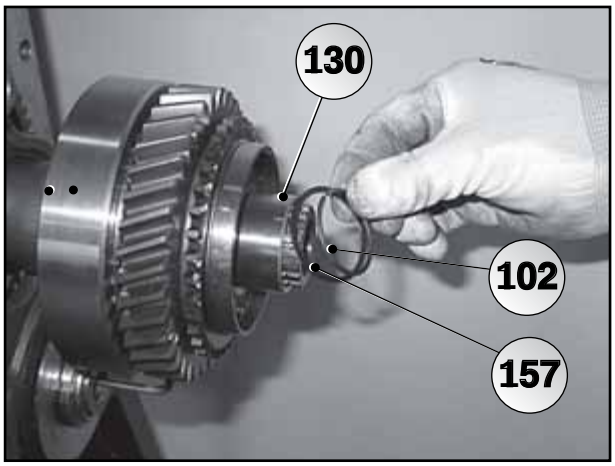


Fig. 4.174

Inspection and re-assembly of the output shaft

- check the ball bearing (124) for wear;
- check the thrust bearing (120) for wear;

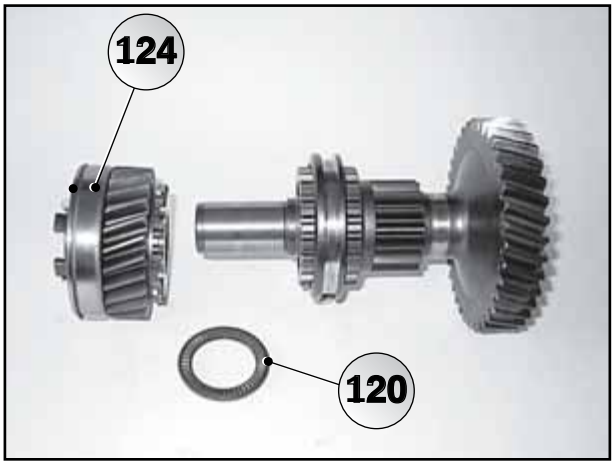


Fig. 4.175

Note: before mounting the upper shaft of the ranges (116), position the fork (967) for slow/fast range engagement in its seat (Fig.4.176);

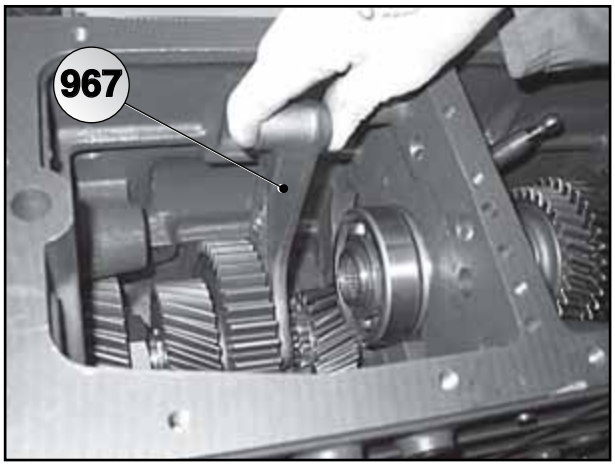


Fig. 4.176

- fit the range upper shaft (116) back into the gearbox housing complete with all its components.

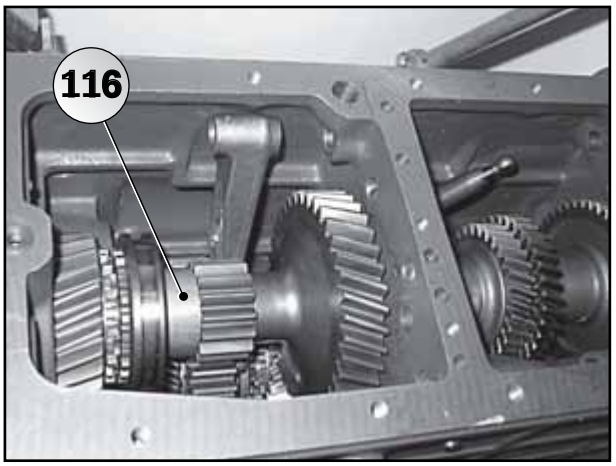


Fig. 4.177

⚠	**Attention:** the differential unit is very heavy and difficult to handle. Take the greatest care when removing and remounting it.

- re-assemble the differential housing with the aid of tool 01 CMB MYT.

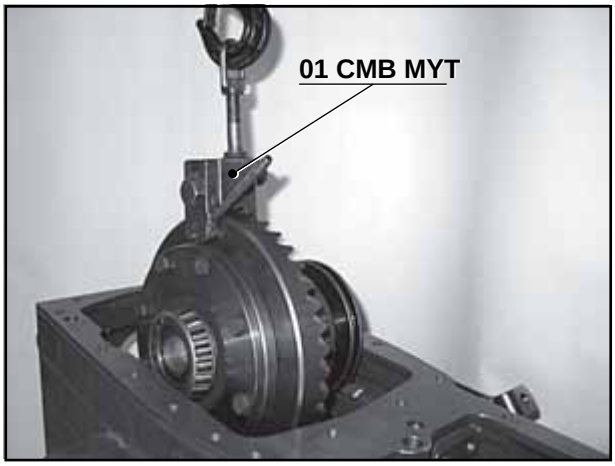


Fig. 4.178

- assemble the drive shaft (2) and the rear shaft (591) of the rear PTO;

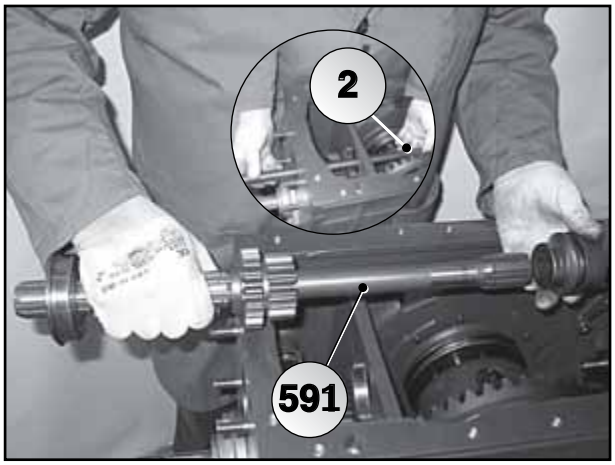


Fig. 4.179

- compress the differential lock spring in tool 02 CMB F-N Series;

Fig. 4.180

- with the aid of the same tool 02 CMB F-N Series, fit the differential lock spring back into the gearbox housing.

Fig. 4.181

4WD housing re-assembly on the gearbox casing

- to assemble the 4WD housing (only versions with creeper) on the gearbox housing, the creeper must be engaged both in the gearbox and in the housing;
- move the gearbox housing nearer and check that the rocker arm is properly inserted in the creeper engaging fork;
- no special precaution is required to assemble the 4WD housing (version without creeper) on the gearbox housing.

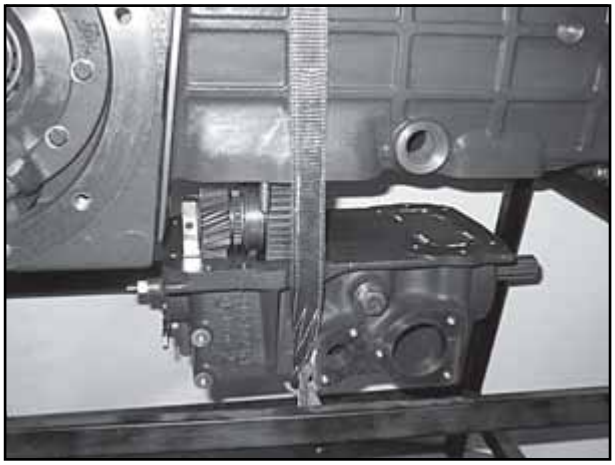


Fig. 4.182

- finish assembling the rods and forks (Fig.4.183)(5-speed version) (Fig.4.184)(4-speed version)

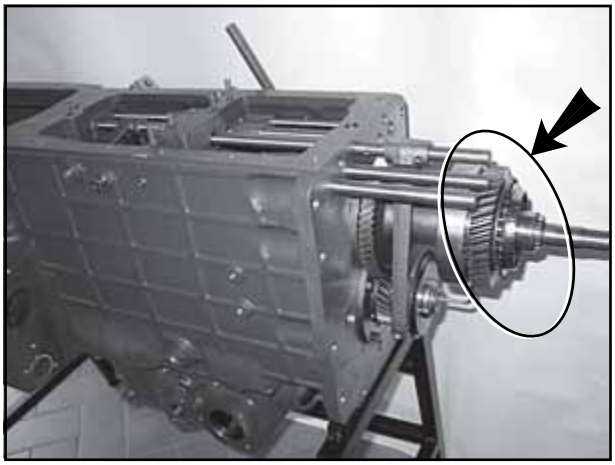


Fig. 4.183

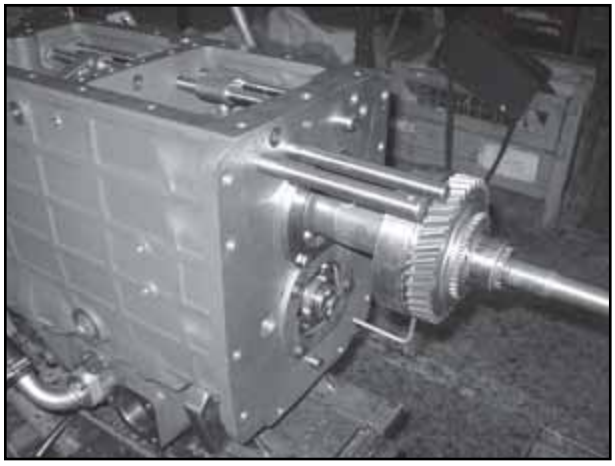


Fig. 4.184

How to fit the axle back on the gearbox

Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

- fix a suitable support to the axle so as to allow the housings to be aligned in a better way, then slightly move the axle near the to gearbox so as to be able to mount the blocks (951), (952), (953);

Fig. 4.185

- assemble the blocks (951), (952) and (953);

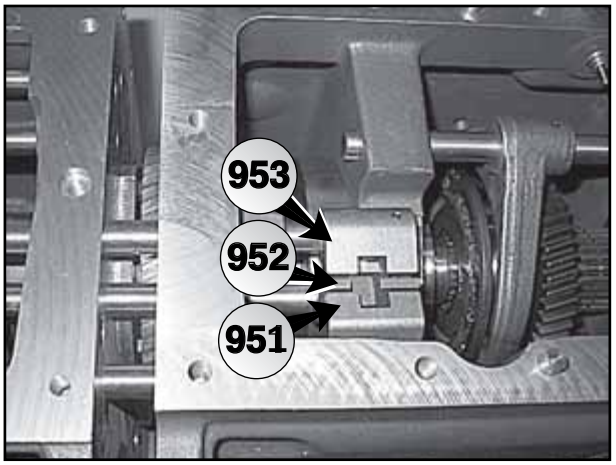


Fig. 4.186

- fit the axle housing and gearbox back together again.

Fig. 4.187

4.5 Gearbox (Power Shuttle version)

4.5.1 Drawing of the assembly (Version with creeper)

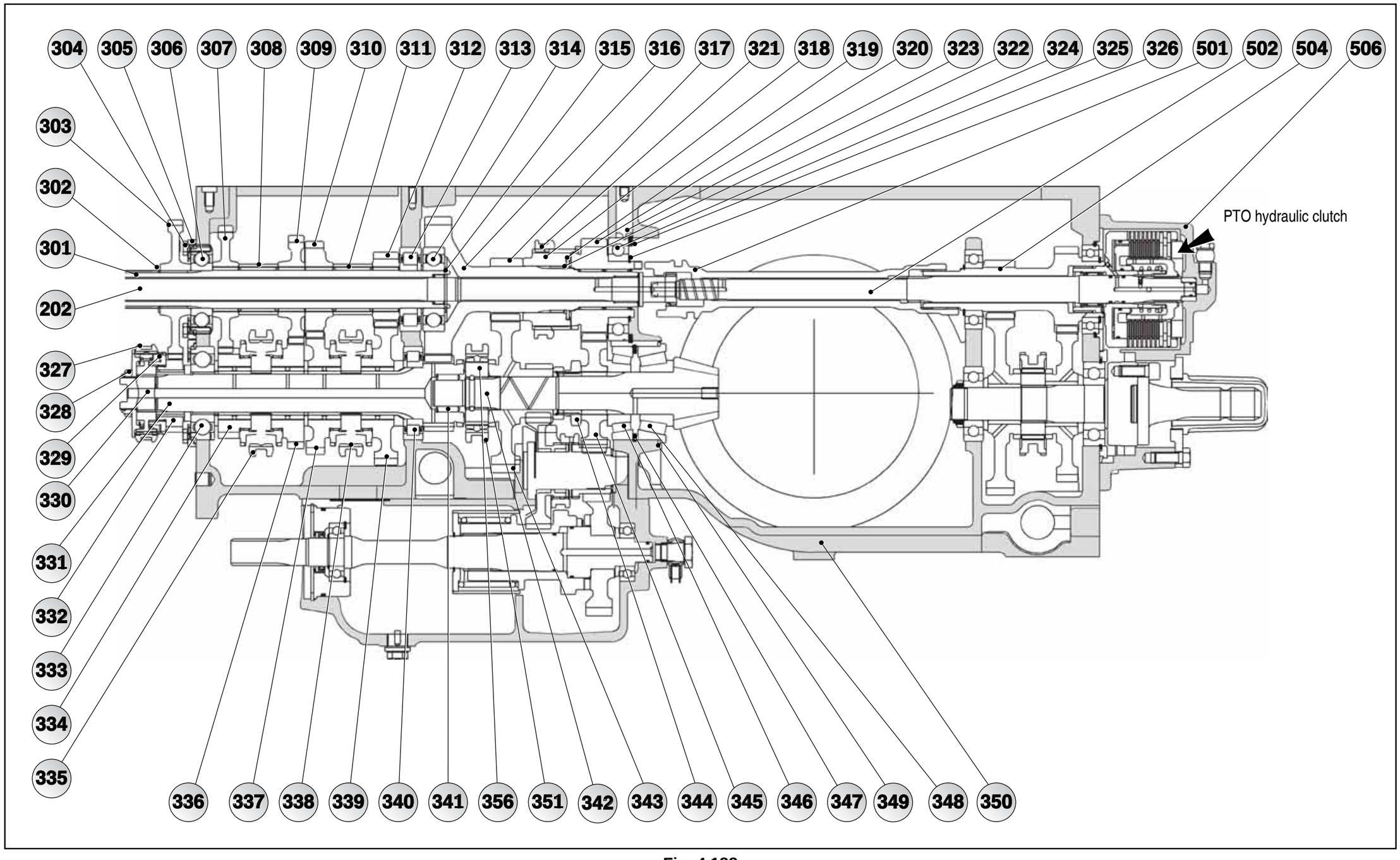


Fig. 4.188

202 - PTO drive shaft
301 - Main shaft (input)
302 - Spring ring
303 - 5th speed driving gear
304 - Flange fixing screw
305 - Flange
306 - Ball bearing
307 - 4th speed driving gear
308 - Spacer
309 - 3rd speed driving gear
310 - 2nd speed driving gear
311 - Spacer
312 - 1st speed driving gear
313 - Roller bearing
314 - Ball bearing
315 - Spring ring
316 - Upper shaft (ranges)
317 - Low range drive gear
318 - Hub sleeve
319 - Spring ring
320 - Thrust bearing
321 - Standard range engagement sleeve
322 - Standard range driving gear
323 - Bearing retainer pin
324 - Ball bearing
325 - Spring ring
326 - Spring ring
327 - 5th gear synchro-mesh unit
328 - Ring nut
329 - 5th speed synchromesh tapered ring
330 - Lubrication duct
331 - Layshaft
331 - 5th speed driven gear
334 - Ball bearing
335 - 4th speed driven gear
336 - 4th and 3rd speed synchro-mesh
337 - 3rd speed driven gear
338 - 2nd speed driven gear
339 - 2nd and 1st speed synchro-mesh
340 - 1st speed driven gear
341 - Roller bearing
342 - Needle bearing
343 - Output shaft (bevel pinion)
344 - Driven gear for low range and creeper
345 - Bevel pinion fixing nut
346 - Standard range driven gear
347 - Pinion support tapered bearing
348 - Spring ring
349 - Pinion support tapered bearing
350 - Pinion adjustment shims
351 - Gearbox housing
352 - Normal and high range engagement sleeve
353 - Output shaft (bevel pinion) (version without creeper)
354 - Bevel pinion fixing nut (version without creeper)
355 - 4WD drive transmission gear (version without creeper)
356 - Driven gear for low range (version without creeper)
501 - Hub sleeve
502 - PTO rear shaft
504 - Double gear
506 - PTO clutch cover

4.5.2 Description of operation

This is the assembly that varies the speed ratios and, thus, that modulates the value of the torque delivered depending on the power required by each application. The gearbox housing contains 4 or 5 synchronized speed gears (depending on the version), all with helical toothing. They are engaged by the respective forks operated by the gearshift lever installed on the platform on the driver's right. 4 are installed in the front compartment, while the 5th speed gear is installed outside, in the front side of the housing. 3 reduction ranges with straight toothing are installed at the rear and can be engaged in facilitated mode by means of sliding sleeves and the relative forks, operated by the control lever also installed near to the gearshift lever on the platform on the driver's left. A creeper unit can be installed on request. This is positioned in the 4WD compartment. In tis case, the gearbox will differ in some ways from the version with creeper, i.e.: the bevel pinion shaft (352), the gears (354) and (355), the pinion fixing nut (353) and the levers used to engage/disengage the creeper itself. The speed gears and ranges are engaged through the longitudinal sliding movement made by a sleeve that connects the gears permanently meshed but idle on their shafts, to a central hub keyed to the relative driving shaft. In Power Five and Powershuttle version tractors, changes from one gear to the other may occur under load, as the clutch is the hydraulic type, and is electronically controlled. The connection sleeve is able to engage the ratio selected when the idle gear to engage spins at the same speed as the splined hub and the sleeve itself. A determinant contribution from the synchro-rings facilitates this operation to the utmost, also and above all whilst the tractor is on the move. Range engagement by means of the facilitated engagement sleeve must occur when the tractor is practically at a standstill. Thus the gearbox in its various configurations consists of the following number of speed gears:

Number of speeds (4WD version)	15 forward and 15 reverse with Power Shuttle 20 forward and 20 reverse with Power Shuttle and creeper 30 forward and 30 reverse with Power Five and Power Shuttle 40 forward and 40 reverse with Power Five, Power Shuttle and creeper
Number of speeds (2WD version)	12 forward and 12 reverse with Power Shuttle 16 forward and 16 reverse with Power Shuttle and creeper 16 forward and 16 reverse with Power Four and Power Shuttle 16 forward and 16 reverse with Power Four, Power Shuttle and creeper

Version without creeper

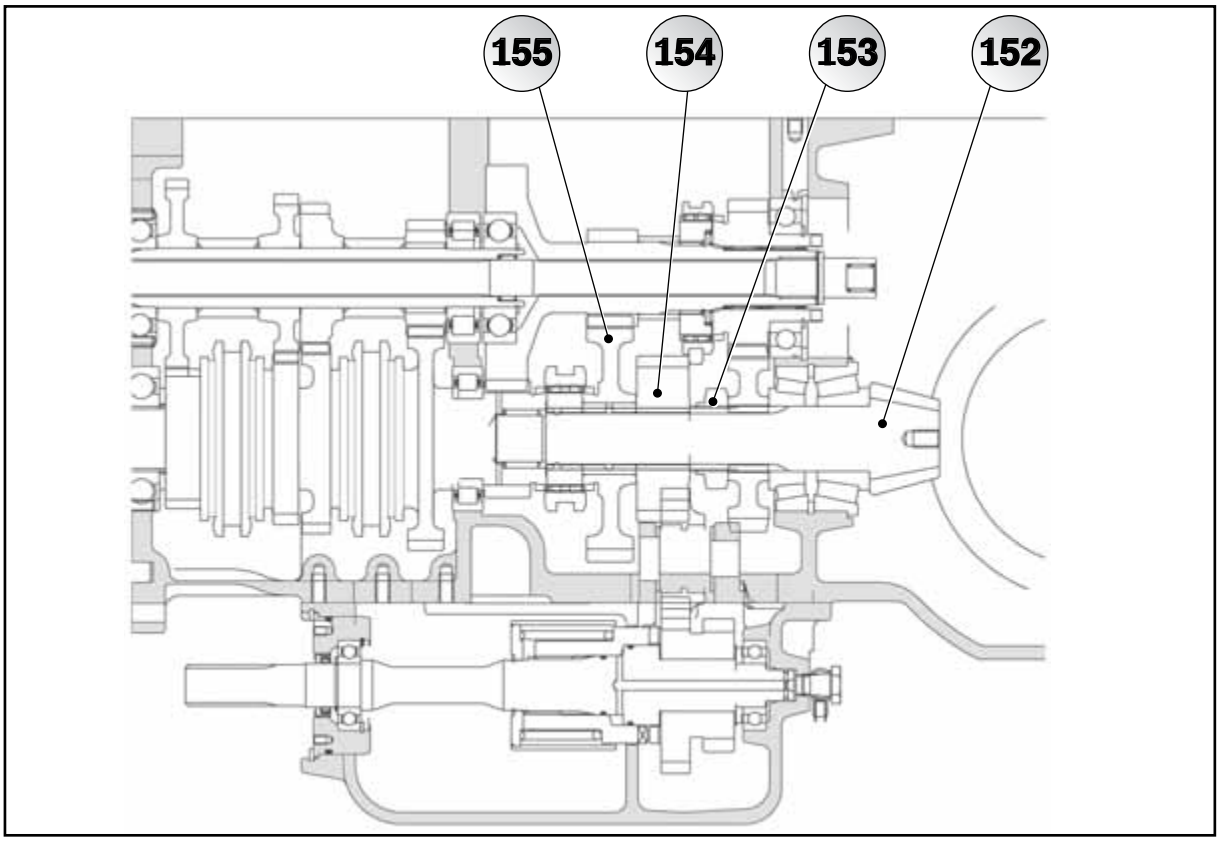


Fig. 4.189

Version with creeper

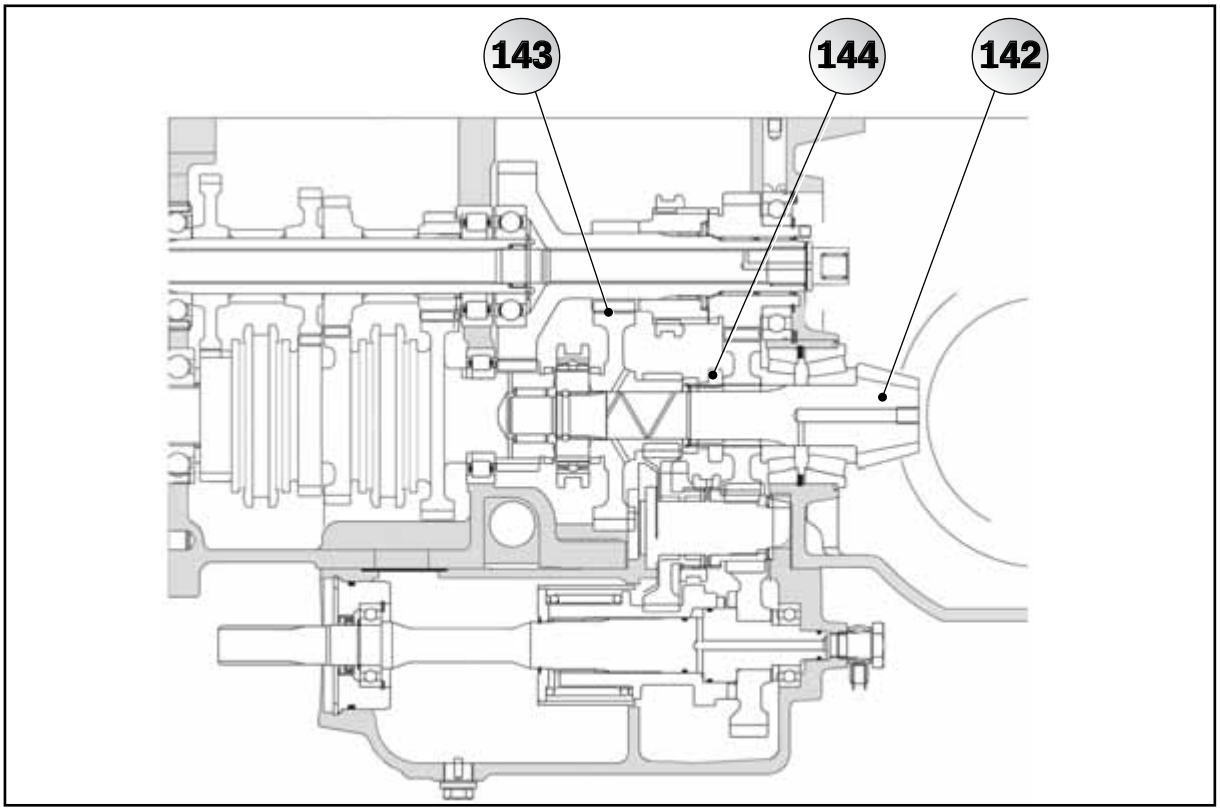


Fig. 4.190

4.5.3 Guidelines for disassembly (4WD version)

How to remove the engine gearbox assembly

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

Note: the operations described for the 4WD version also apply to the 2WD version, with the sole difference described in sect. 1 of this chapter.

- split the engine from the axle;
- unscrew the fixing screws from the covers of the axle housing and of the gearbox housing

Note: remove the 5th speed plug, spring and ball;

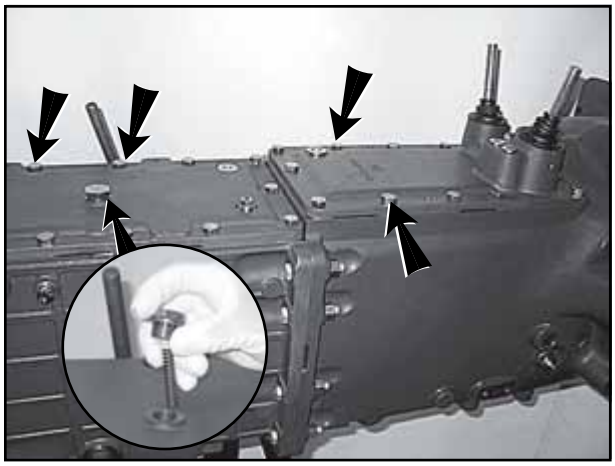


Fig. 4.191

- remove the cover from the axle and the gearbox;

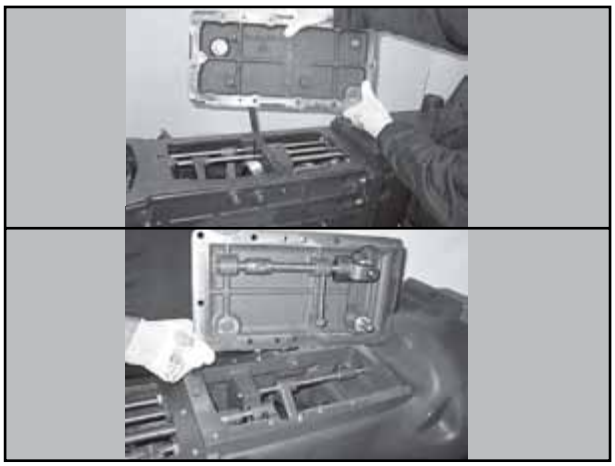


Fig. 4.192

Note: the balls and springs removed from the gearbox housing must be set aside;

Fig. 4.193

- remove the spring pins that fix the blocks (951), (952) and (953);

⚠	**Attention:** avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

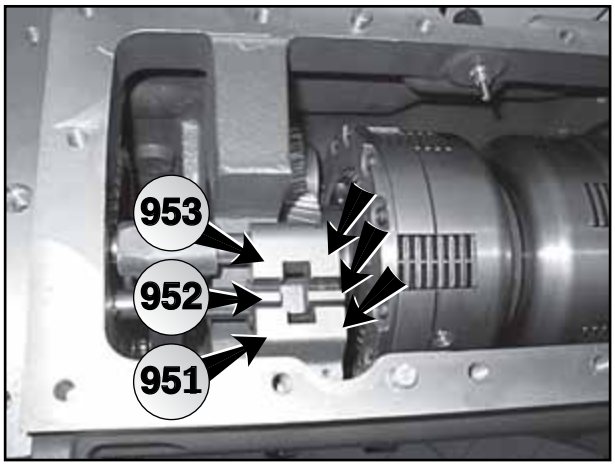


Fig. 4.194

- fix a suitable support to the axle (Fig.186-4) so as to align the housings in a better way, then remove the two internal screws fixing the axle shaft to the gearbox, along with the external screws;
- slightly detach the axle from the gearbox, so that the blocks (951), (952) and (953) can be removed;

Fig. 4.195

Note: before splitting the axle housing from the gearbox, note and possibly mark the correct positions of the blocks (951), (952), (953). This is important, as it allows the axle to be correctly re-assembled on the gearbox.

- remove the blocks (951), (952), (953) and split completely the shaft from the gearbox.

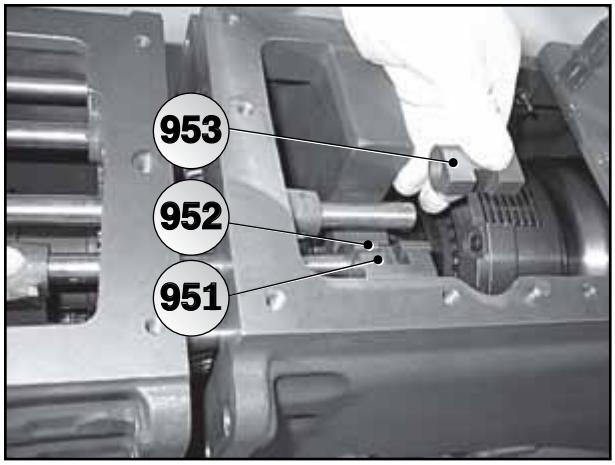


Fig. 4.196

Attention: keep clear of the sharp edges around the top of the gearbox.

- place the gearbox housing on adequate supports.

Note: the 5th speed assembly shown in the Figure alongside is not installed in the Power Four and Power Shuttle with 2WD versions.

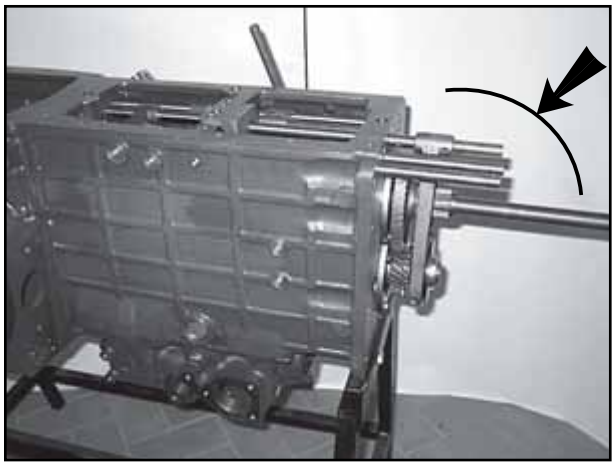


Fig. 4.197

- remove the PTO cover (506) and hydraulic clutch;

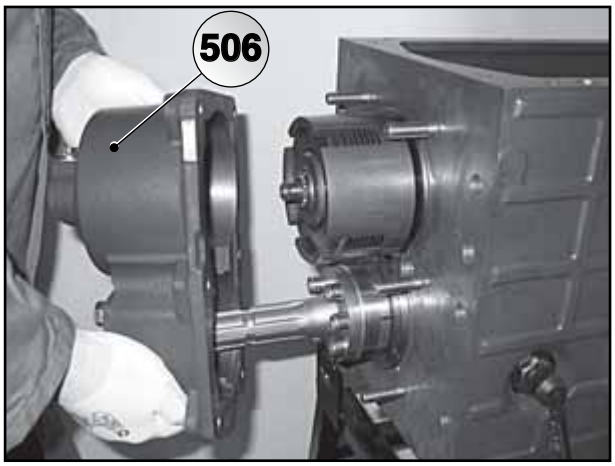


Fig. 4.198

- remove the rear PTO shaft (502);

Fig. 4.199

⚠	**Attention:** wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.

- disassemble the diff lock rod and fork unit.

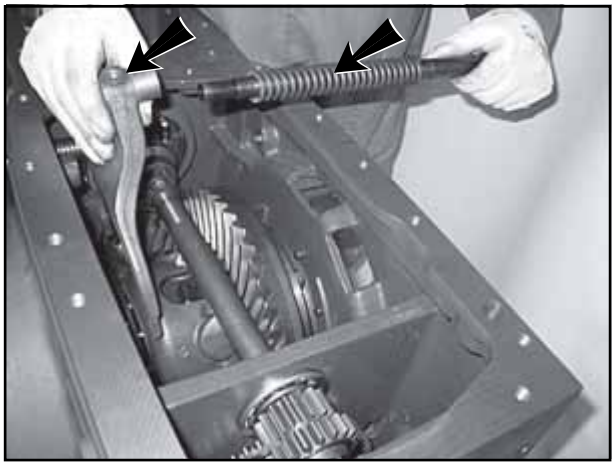


Fig. 4.200

- disassemble the double gear (504);

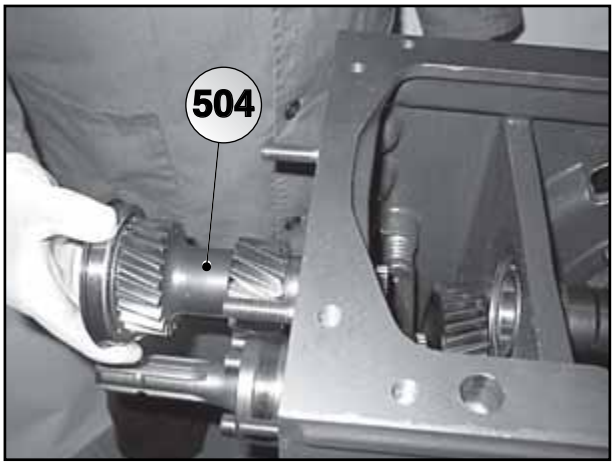


Fig. 4.201

- remove the PTO selector sleeve (501);

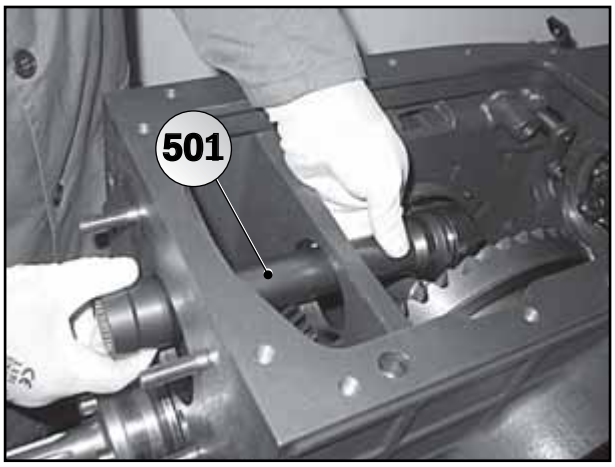


Fig. 4.202

- remove the PTO transmission shaft (202);

Fig. 4.203

Removal of the upper shaft (ranges)

- remove the rods (964) and (965) and the forks (966) and (967) of the speed ranges;

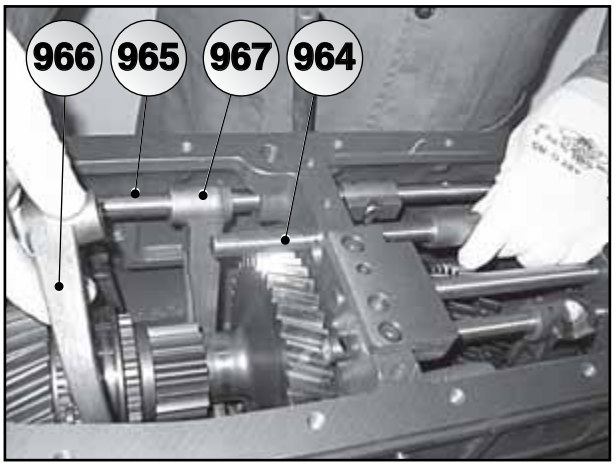


Fig. 4.204

- with the aid of a screw, remove the pin (323) that holds the bearing in place;

Fig. 4.205

Note: before removing the upper shaft of the ranges, the ground speed sensor (SR1), connected by screws to the left side of the gearbox housing, should be removed to prevent damage.

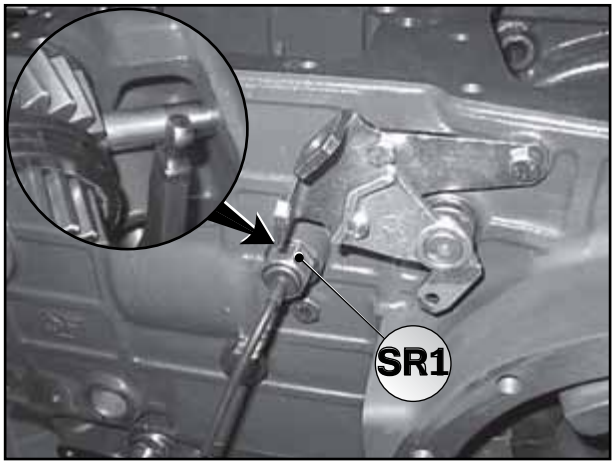


Fig. 4.206

- remove the spring ring (326);

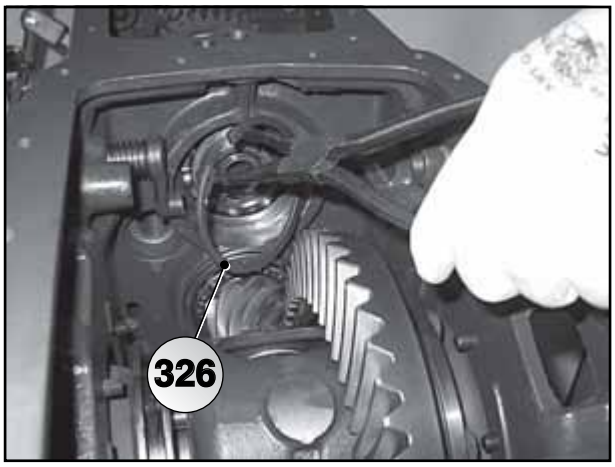


Fig. 4.207

- remove the upper shaft (316);

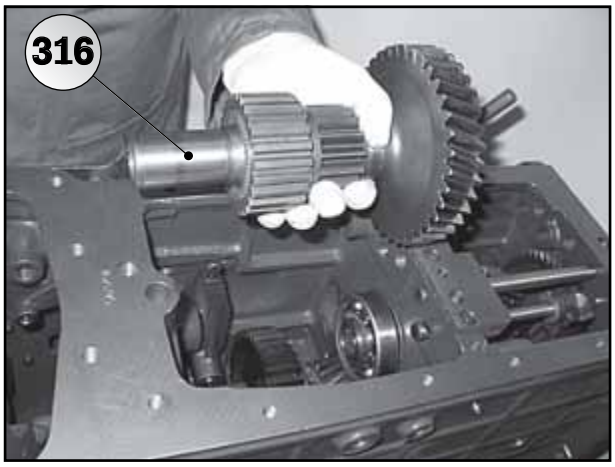


Fig. 4.208

Main shaft removal

- disassemble the 5th speed rod (956) and fork (959):
- remove the support (960);
- remove rods (954) and (955);

Fig. 4.209

- remove the spring ring (315);

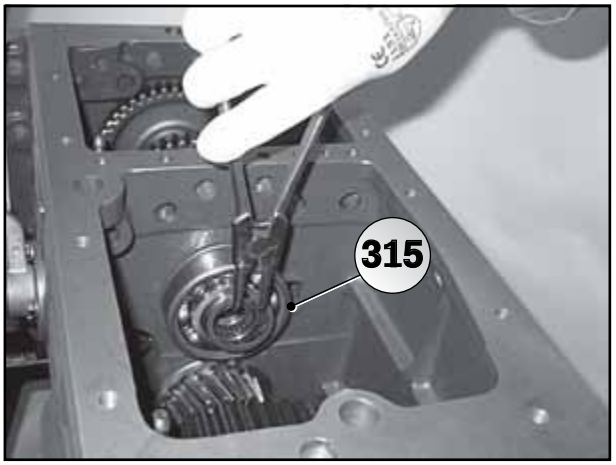


Fig. 4.210

- draw out the main shaft (301) (378- 4-speed version).

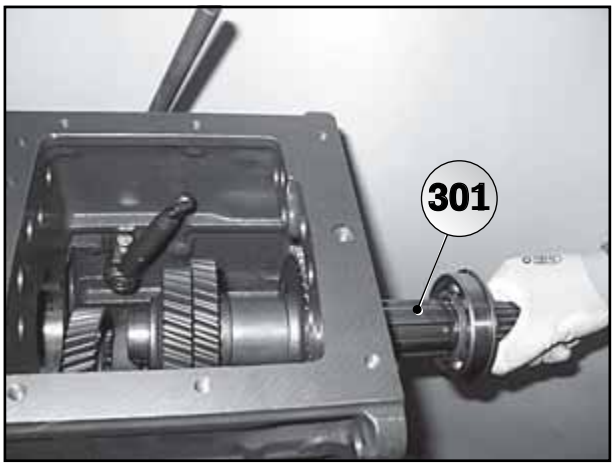


Fig. 4.211

Output shaft removal

⚠	**Attention:** if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

- split the 4WD housing unit;

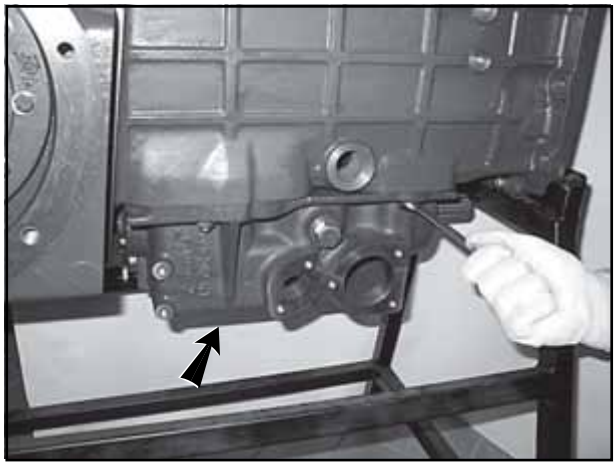


Fig. 4.212

⚠	**Attention:** the differential unit is very heavy and difficult to handle. Take the greatest care when removing and remounting it.

- remove the differential housing with the aid of tool 01 CMB MYT;

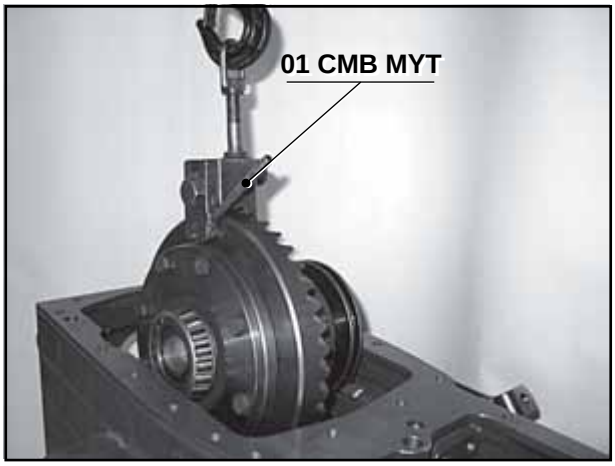


Fig. 4.213

- remove the spring pins that fix the hub (356);

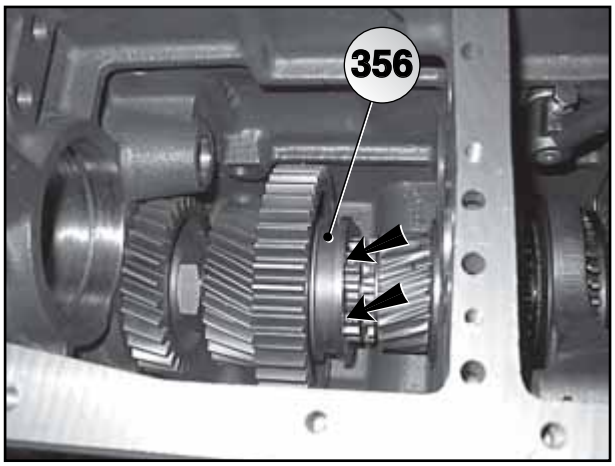


Fig. 4.214

- unscrew the nut (344) with tool 03 CMB F-N Series;

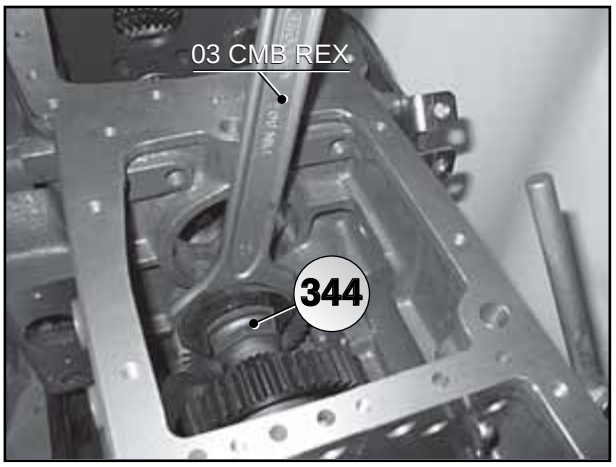


Fig. 4.215

- draw out the output shaft/bevel pinion (342).

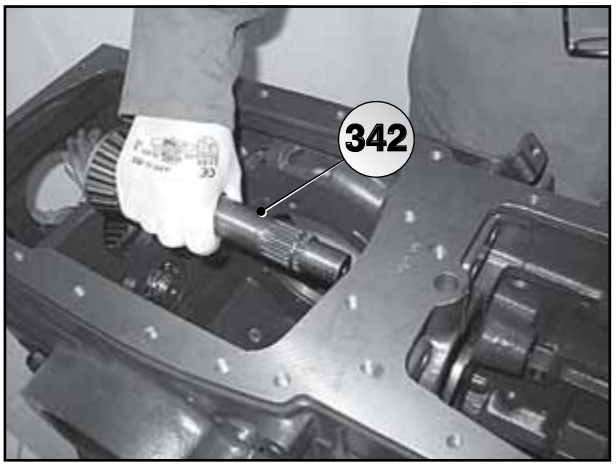


Fig. 4.216

Layshaft removal

- remove the ring nut (328) with the aid of tool 26 PTO VS;

  Note: tool 26 PTO VS can also be used to remove the ring nut (328) installed in the 4-speed versions.

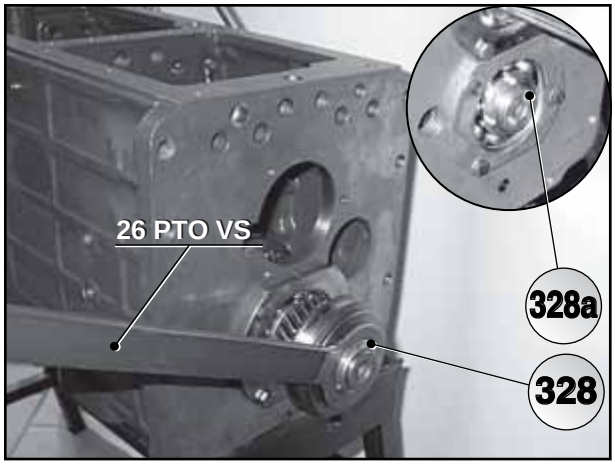


Fig. 4.217

- remove the synchro-mesh unit (327) and the driven gear (332);

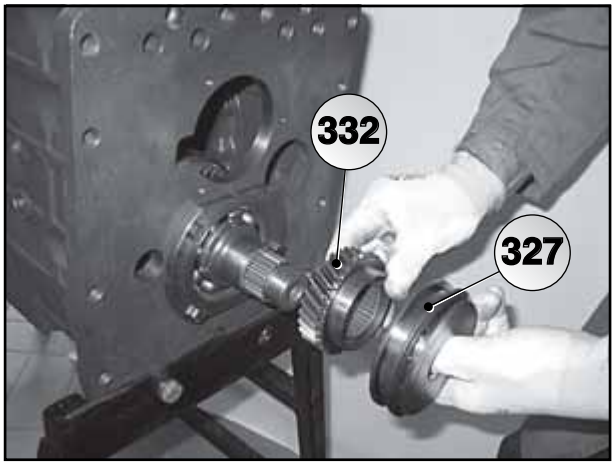


Fig. 4.218

- take out the shaft (331) from the rear side.

Fig. 4.219

4.5.4 Guidelines for re-assembly and inspections (4WD version)

Inspection and re-assembly of the layshaft

- check the ball bearings (340) and (333) for wear;
- check the synchro rings (327), (335) and (338) for wear;
- replace the ring nut (328);

Fig. 4.220

- fit the layshaft (331) back into the gearbox housing complete with all its components;

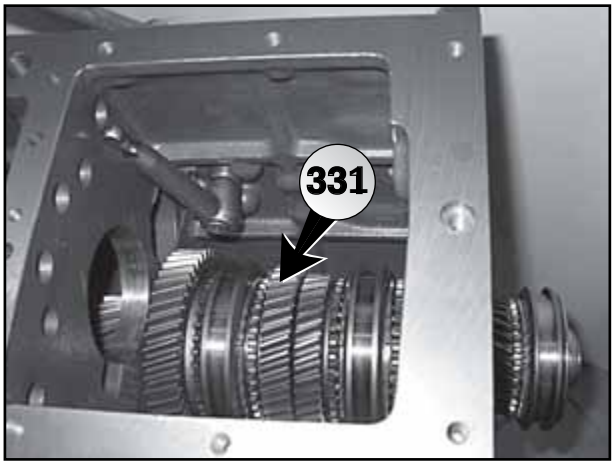


Fig. 4.221

Note: check that the synchro rings are correctly seated before tightening the ring nut (328).

- use tool CR 347 to tighten the ring nut (328).

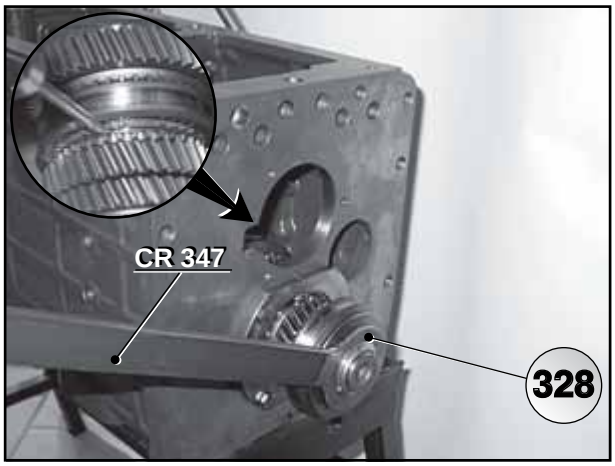


Fig. 4.222

Inspection and re-assembly of the output shaft

- check the ball bearings (346) and (348) for wear;
- check the needle bearing (341) for wear;
- replace the fixing nut (344);

Fig. 4.223

Note: the hub (356) must be fitted with the hole housing the spring pins toward the front side of the gearbox. The sleeve must be keyed on the hub with the gaps properly aligned to allow the pins to be inserted.

Fig. 4.224

- fit the output shaft (342) into the gearbox housing complete with all its components;
- tighten the nut (344) with the aid of tool 03 CMB F-N Series (see the guidelines for the correct driving torque).

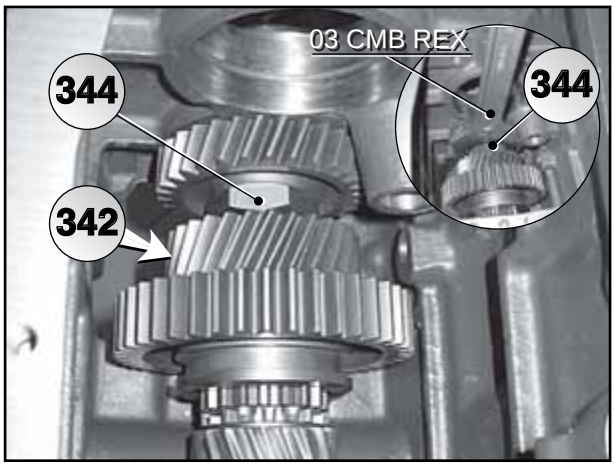


Fig. 4.225

Inspection and re-assembly of the main shaft

- check the ball bearings (306) and (314) for wear;
- check the roller bearing (313) for wear;

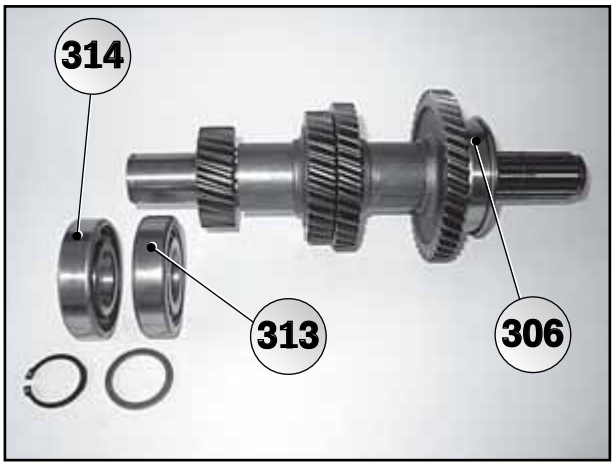


Fig. 4.226

Note: before assembling the main shaft (301), position the gear engagement forks (957) and (958) in their seats.

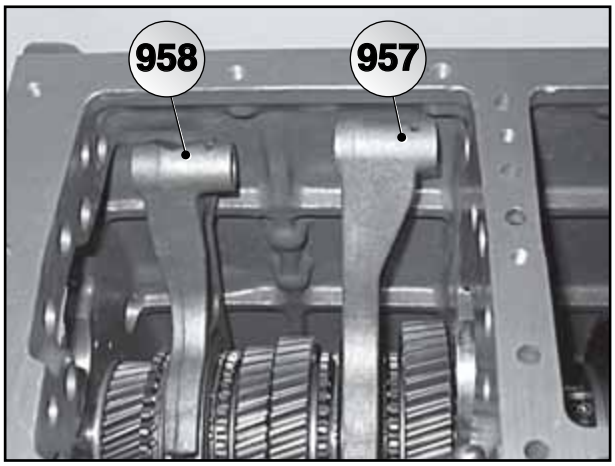


Fig. 4.227

- fit the transmission shaft (301) back into the gearbox housing complete with all its components;

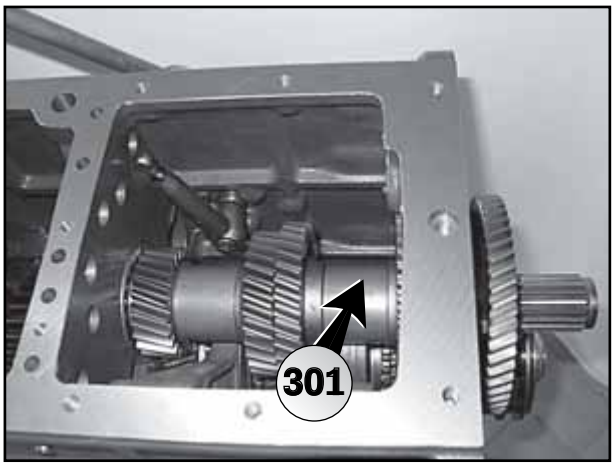


Fig. 4.228

Inspection and re-assembly of the upper shaft (ranges)

- check the ball bearings (324) and (320) for wear;

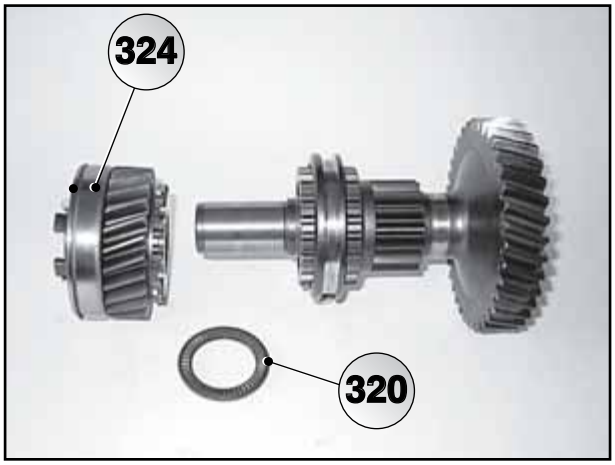


Fig. 4.229

Note: before assembling the upper shaft (316) of the ranges, position the rocker arm lever (968) for creeper engagement in its seat.

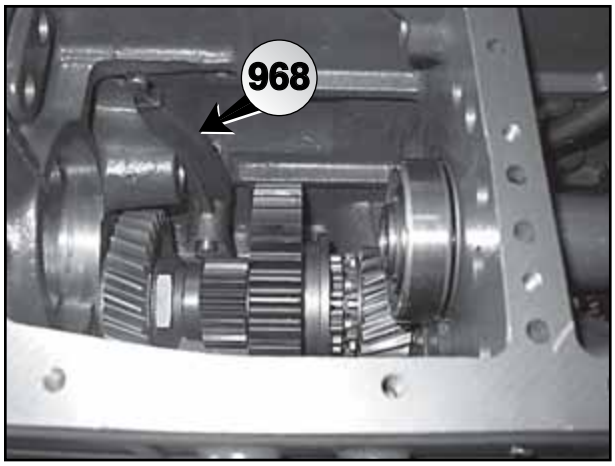


Fig. 4.230

- fit the range upper shaft (316) back into the gearbox housing complete with all its components.

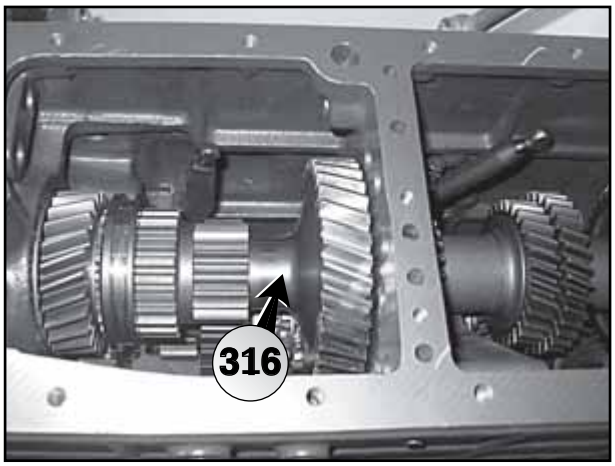


Fig. 4.231

Attention: the differential unit is very heavy and difficult to handle. Take the greatest care when removing and remounting it.

- re-assemble the differential housing with the aid of tool 01 CMB MYT;

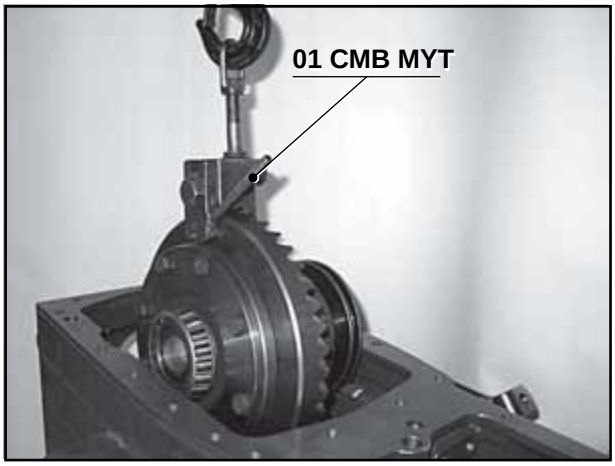


Fig. 4.232

- assemble the PTO sleeve (501) and shaft (502);

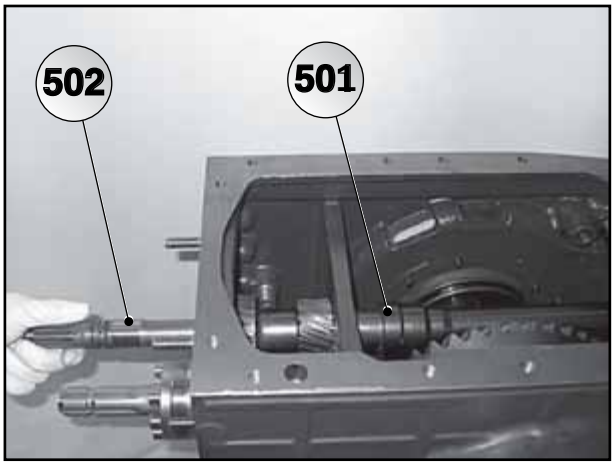


Fig. 4.233

- compress the differential lock spring in tool 02 CMB F-N Series;

Fig. 4.234

- with the aid of the same tool 02 CMB F-N Series, fit the differential lock spring back into the gearbox housing.

Fig. 4.235

4WD housing re-assembly on the gearbox housing

- to assemble the 4WD housing (only versions with creeper) on the gearbox housing, the creeper must be engaged both in the gearbox and in the housing;
- move the gearbox housing nearer and check that the rocker arm is properly inserted in the creeper engaging fork;
- no special precaution is required to assemble the 4WD housing (version without creeper) on the gearbox housing.

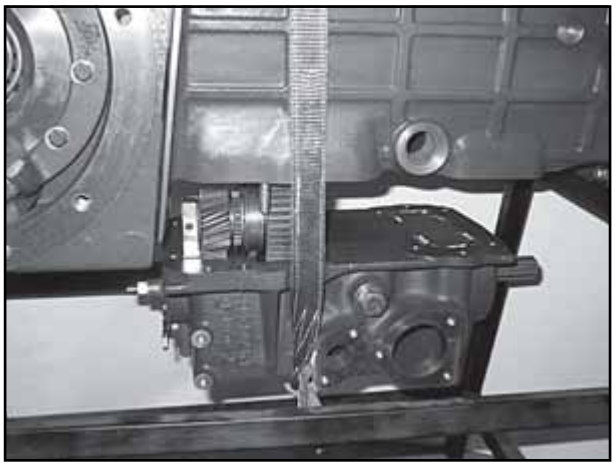


Fig. 4.236

- finish assembling the rods and forks (5-speed version).

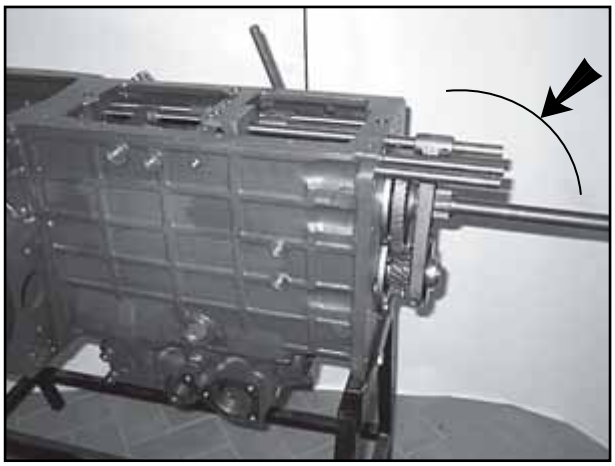


Fig. 4.237

How to fit the axle back on the gearbox

⚠	**Attention:** avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

- fix a suitable support to the axle so as to allow the housings to be aligned in a better way, then slightly move the axle near the to gearbox so as to be able to assemble the blocks (951), (952), (953);

Fig. 4.238

- assemble the blocks (951), (952) and (953);

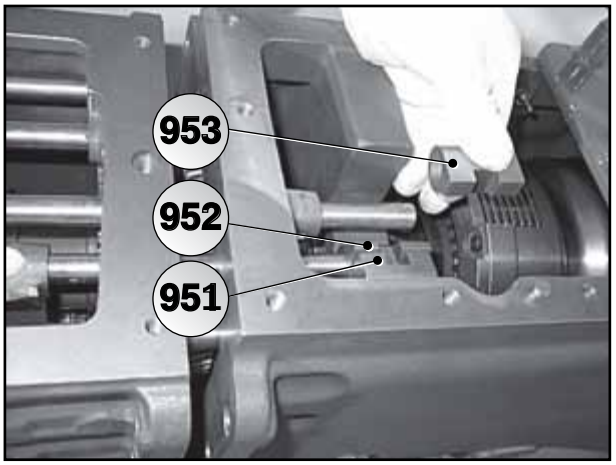


Fig. 4.239

- fit the axle housing and gearbox back together again.

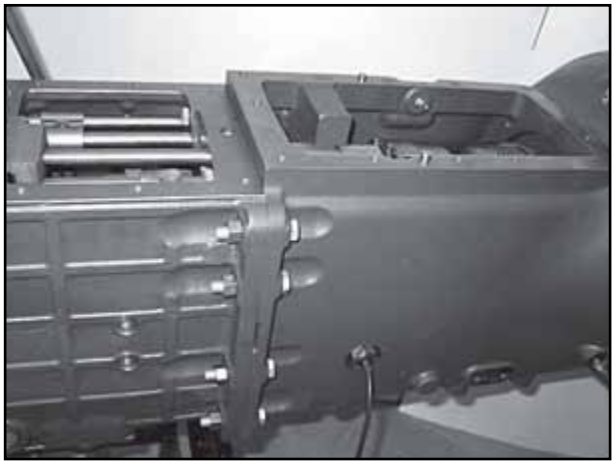


Fig. 4.240

4.6 4WD housing

4.6.1 Drawing of the assembly (Version with creeper)

Version with creeper

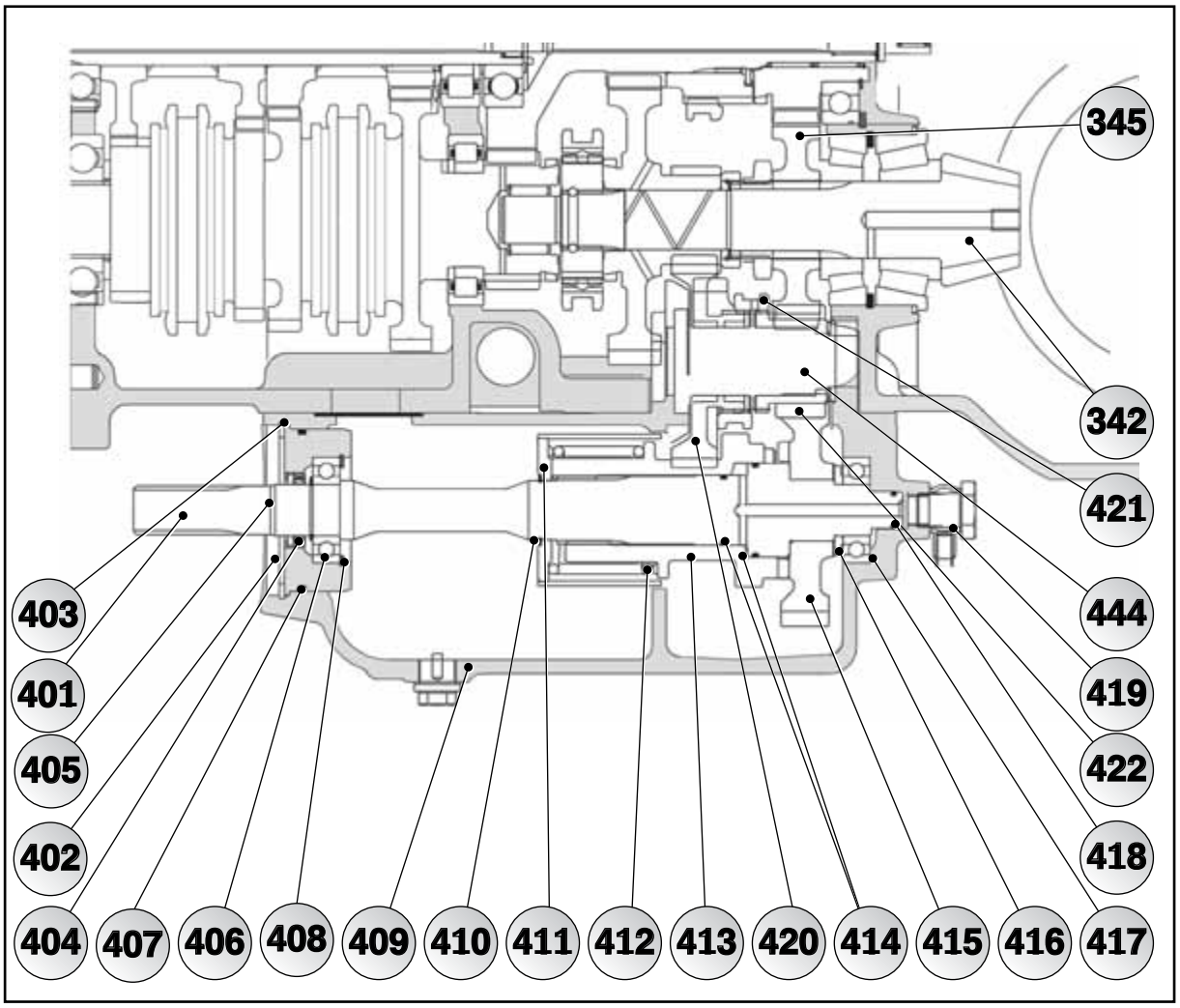


Fig. 4.241

342 - Bevel pinion
345 - Driving gear
401 - Spring-on transmission shaft
402 - Front bearing support
403 - Spring ring
404 - Retention ring
405 - Spring ring
406 - Ball bearing
407 - O-ring
408 - Spring ring
409 - 4WD housing
410 - Spring ring
411 - Thrust washer with guard
412 - 4WD engaging spring
413 - 4WD engaging sleeve
414 - Retention rings
415 - Driven gear
416 - Bearing plate
417 - Ball bearing
418 - Retention ring
419 - Supply union (20 bar)
420 - Driven gear for creeper
421 - Creeper engaging sleeve
422 - Driven gear for creeper
444 - Upper unit support shaft

Description of operation

The 4WD housing consists of the shaft (401) that transmits drive to the front axle, the “Spring-on” unit, two gears (415) and (422), a shaft that supports the creeper (optional) and the “Park Lock” unit (only installed in Power Shuttle versions). The control levers of the Park Lock unit are installed in the lower part of the housing.

In the condition illustrated in the figure, drive from the bevel pinion (342) reaches the transmitter shaft (401) via gears (345), (422) and (415), which are permanently meshed with each other.

4WD (Spring-on) engagement is mechanical while disengagement is hydraulic.

Oil at a pressure of 20 bar allows the four-wheel drive to be disengaged. It shifts the engaging sleeve (413) in the axial direction and consequently compresses the spring (412).

The sleeve section (413) is shown at the top in the disengaging phase (20 bar pressure) and in the engaging phase (0 bar pressure) at the bottom.

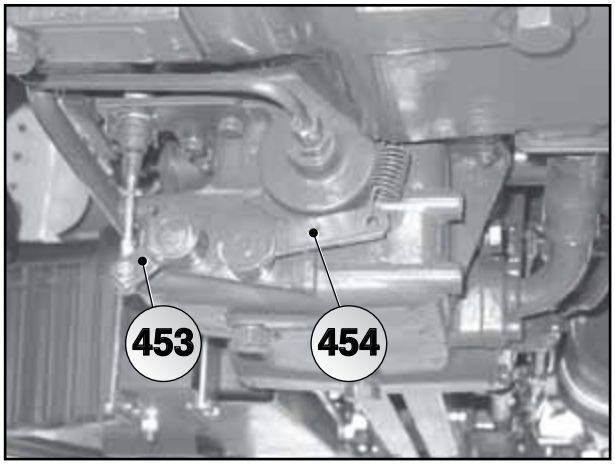


Fig. 4.242

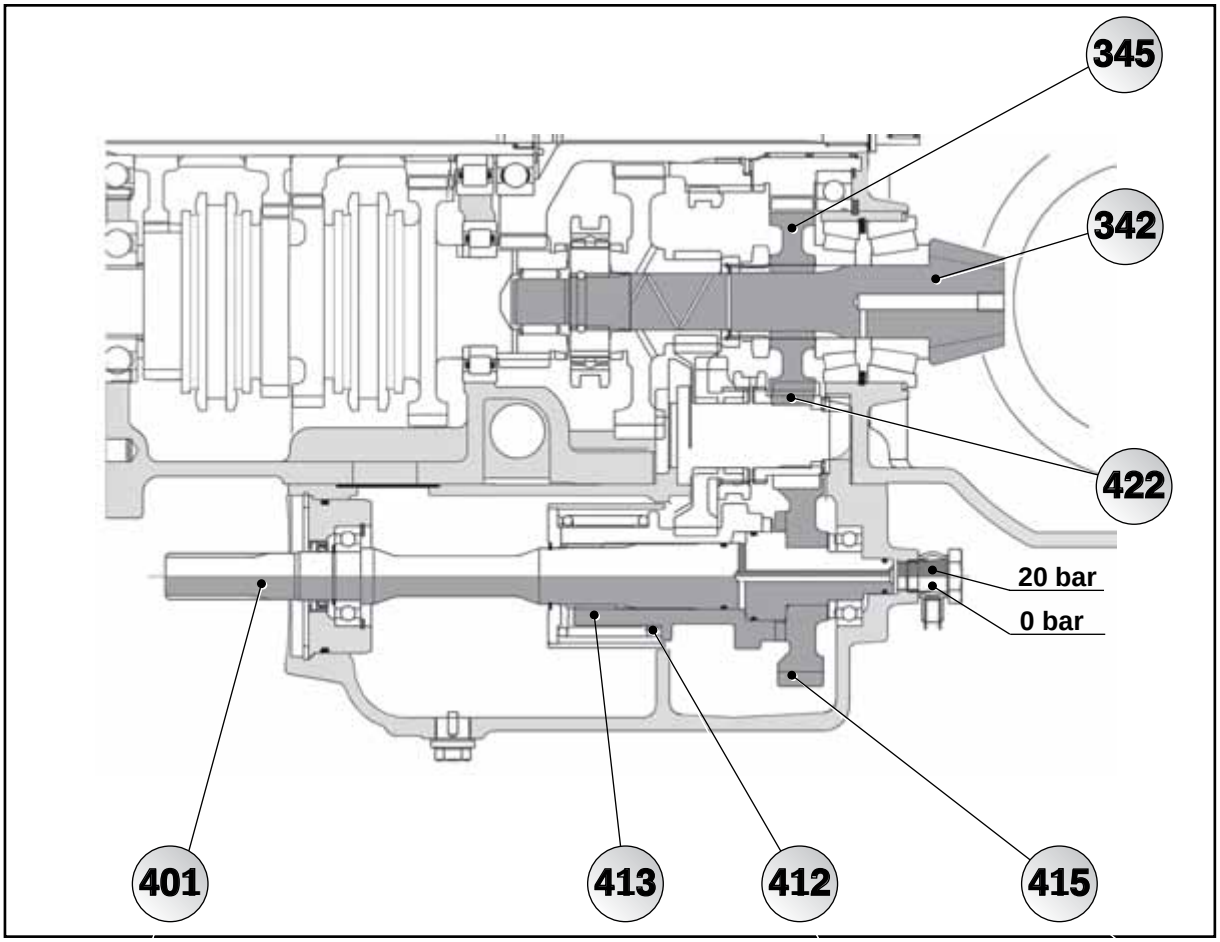


Fig. 4.243

4.6.2 Drawing of the assembly (version without creeper)

Version without creeper

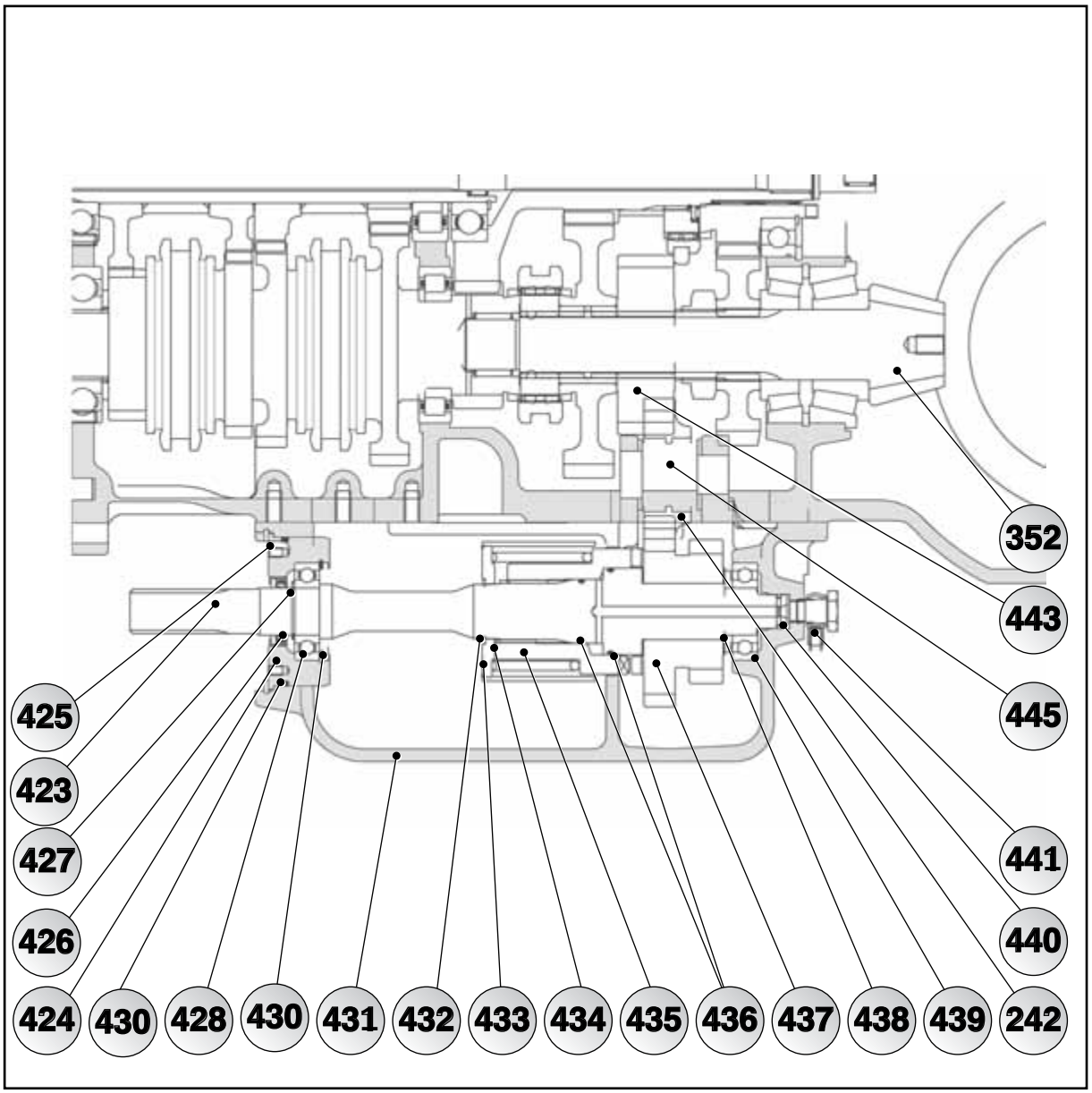


Fig. 4.244

352 - Bevel pinion
423 - Spring-on transmission shaft
424 - Front bearing support
425 - Spring ring
426 - Retention ring
427 - Spring ring
428 - Ball bearing
429 - O-ring
430 - Spring ring
431 - 4WD housing
432 - Spring ring
433 - Thrust washer with guard
434 - 4WD engaging spring
435 - 4WD engaging sleeve
436 - Retention rings (O-rings)
437 - Driven gear
438 - Bearing plate
439 - Ball bearing
440 - Retention ring
441 - Oil supply union
442 - Engagement driven gear
443 - 4WD engagement driving gear
445 - Driven gear support pin

Description of operation

The version of the 4WD housing without creeper consists of the shaft (423) that transmits drive to the front axle, the “Spring-on” unit, two gears (437) and (442), a pin (445) that supports the driven gear, and the “Park Lock” unit (only installed in Power Shuttle versions). The control levers of the Park Lock unit are installed in the lower part of the housing.

In the condition illustrated in the figure, drive from the bevel pinion (352) reaches the transmitter shaft (423) via gears (443), (442) and (437), which are permanently meshed with each other.

4WD (Spring-on) engagement is mechanical while disengagement is hydraulic.

Oil at a pressure of 20 bar allows the four-wheel drive to be disengaged. It shifts the engaging sleeve (435) in the axial direction and consequently compresses the spring (434).

Fig.4.246), the sleeve section (435) is shown at the top in the engaging phase (0 bar pressure) and in the disengaging phase (20 bar pressure) at the bottom.

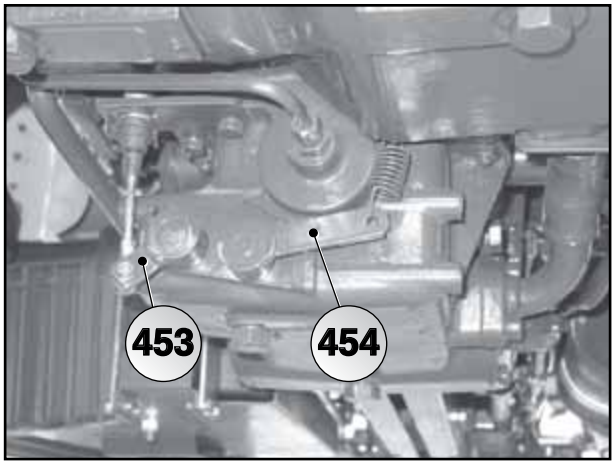


Fig. 4.245

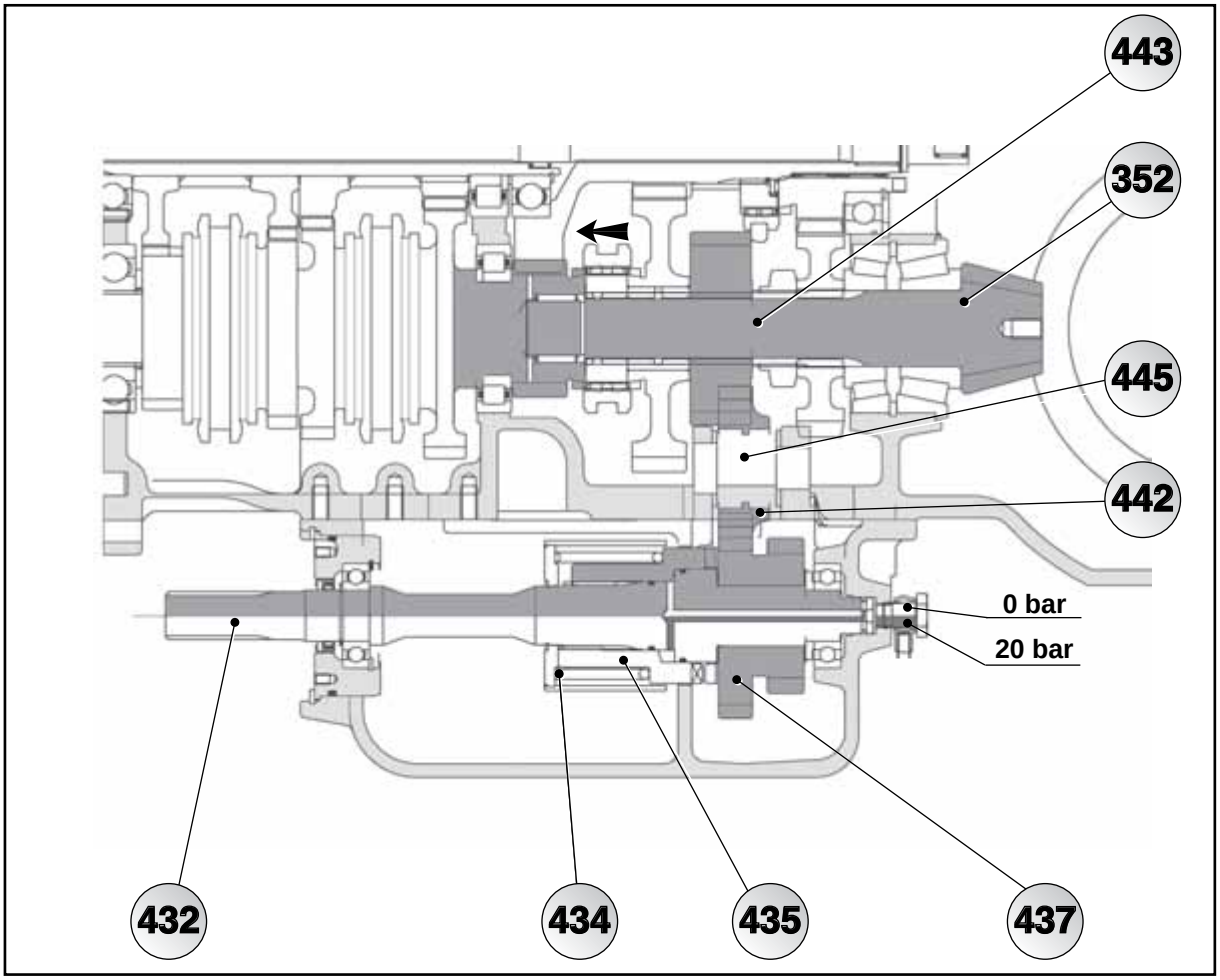


Fig. 4.246

4.6.3 Assembly drawings of the housing in 2WD tractors

The gearbox mounted on F-N Series tractors without four-wheel drive has a different transmitter shaft and no Spring-on unit. In tractors without four-wheel drive, the above mentioned shaft acts as a support. In Speed Four/Five versions without creeper (Fig.4.247) there is a partition (482) to ensure that oil circulates continuously in the intake circuit.

In the versions with creeper, the shaft supports the relative gears and, ed inoltre, in Power Shuttle versions, the Park Lock meshing teeth are formed on the shaft itself.

Speed Five version without creeper

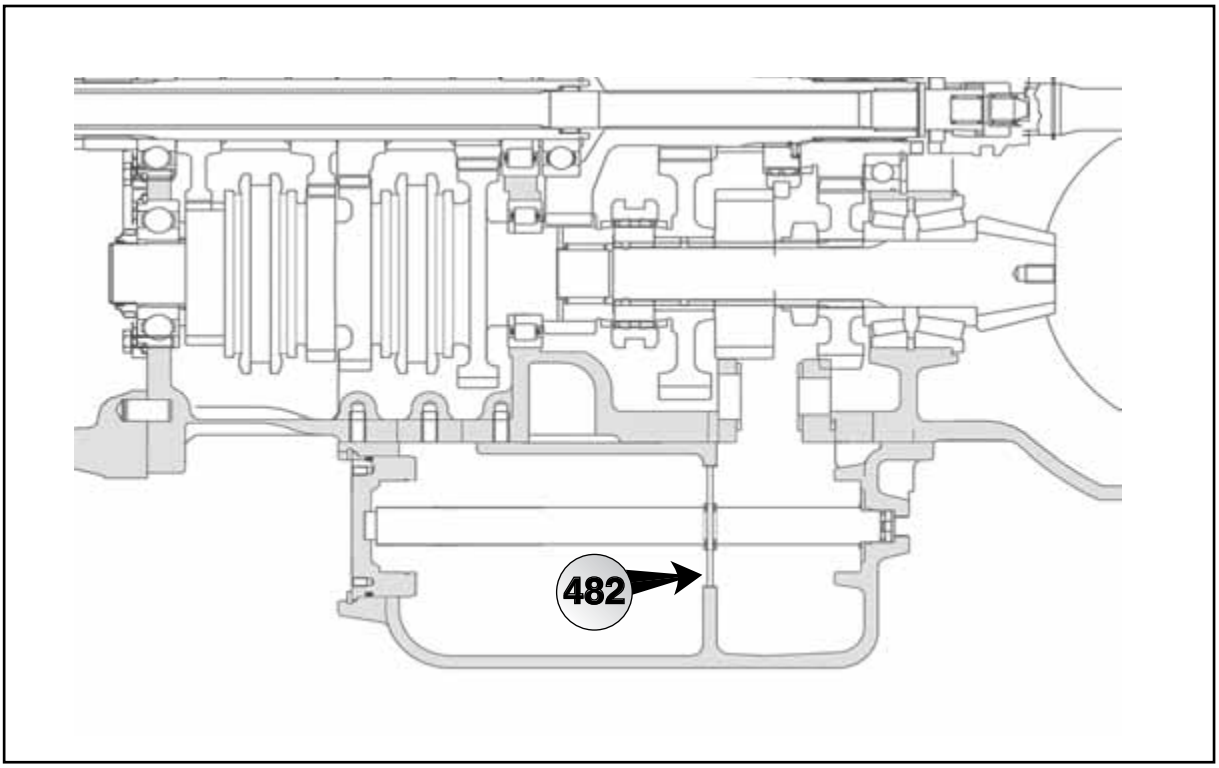


Fig. 4.247

Version with creeper

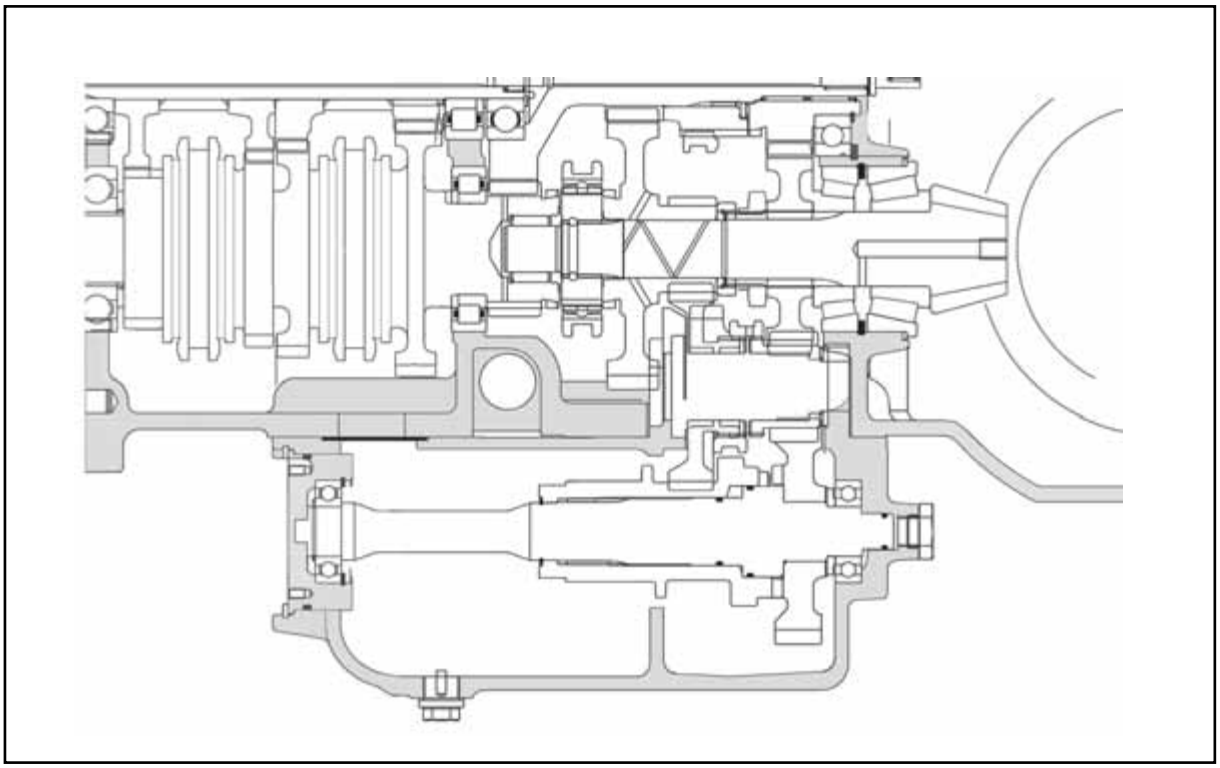


Fig. 4.248

Version without creeper

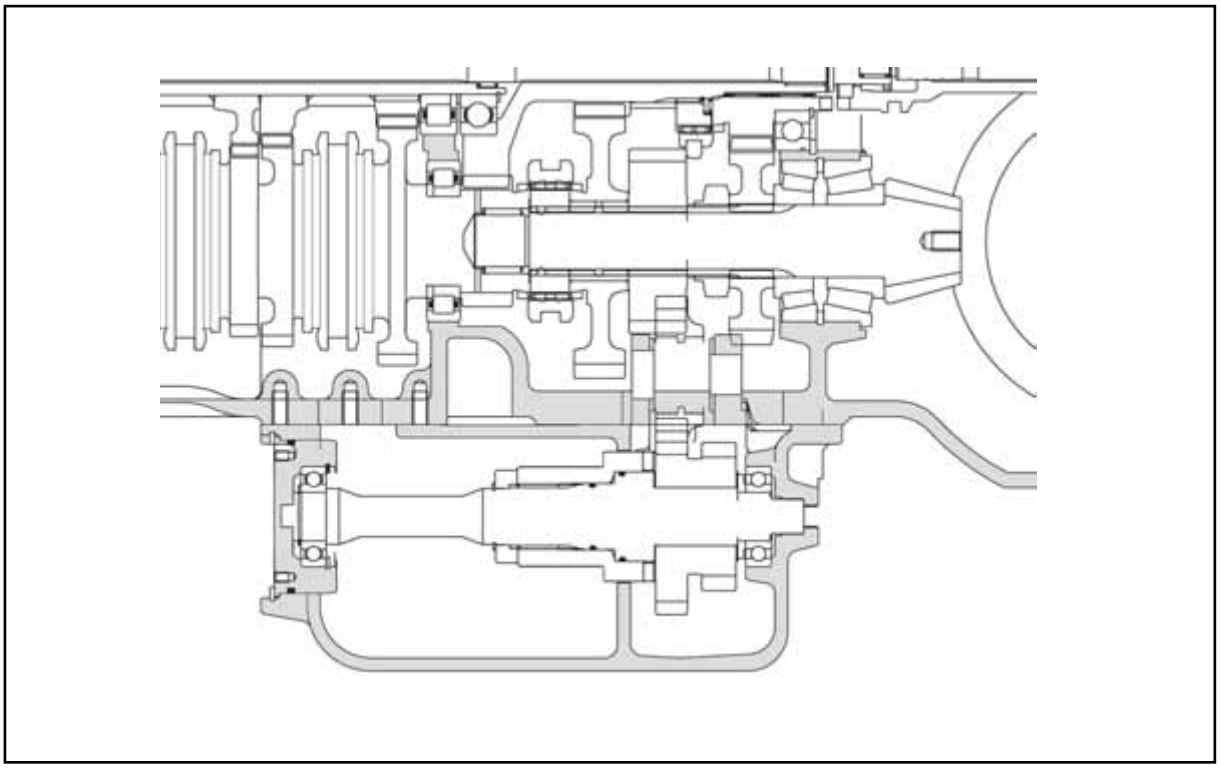


Fig. 4.249

4.6.4 Park Lock

Park Lock is a mechanical locking system that ensures the tractor is braked even in high load conditions and on slopes. This system is installed in the Power Shuttle tractor version, as this version features no mechanical connection between engine and rear wheels when the engine is at a standstill.

The “Park Lock” unit is therefore installed in addition to the parking brake so as to provide a more reliable braking action.

It is installed in the 4WD housing and consists of: coupling teeth (446) formed on the sleeve (413) in the creeper version (Fig.4.241) and on the gear (437) in the version without creeper (Fig.4.247), by a coupling lever (447) and relative pin (451) to support the coupling cam (452).

The lower part of the housing is fitted with the engaging (453) and disengaging (454) levers which are operated by means of a control lever (P) installed just under the steering wheel (Fig.4.251). A steel cable connects the levers.

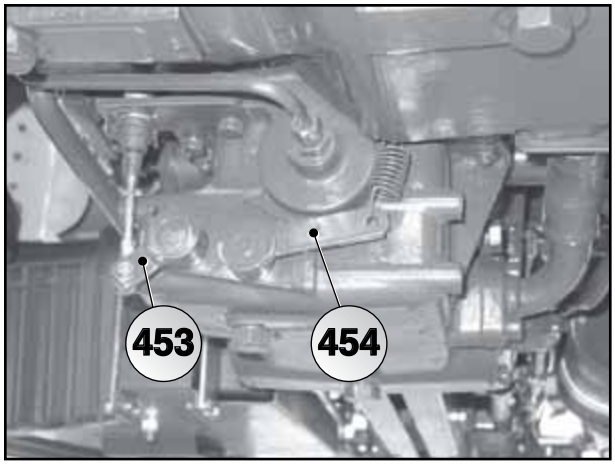


Fig. 4.250

Fig. 4.251

Park Lock engaging safety device

To prevent the Park Lock from engaging when the tractor is on the move and thus prevent the driving components from “violently” stopping with consequent damage to the transmission, there is a safety device that prevents the Park Lock from being even accidentally engaged unless the parking brake (L) has been engaged. When engaged, brake (L) ensures that the tractor remains at a standstill.

Pull the lever (L) to shift the pin (481) through connection with the cable (477), thus releasing the movement of lever (P) and allowing the Park Lock to engage.

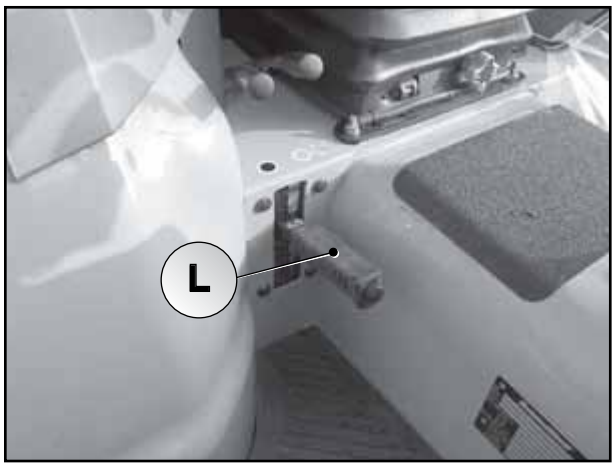


Fig. 4.252

Adjustment of the Park Lock engaging safety device

The following adjustments must be made if the parking brake or the Park Lock On the platform are repaIred or replaced:

- regulate the adjuster (478), and pull the lever (L) so that once this latter has reached its 6th/ 7th position, the pin (481 Fig.4.167) will have released the movement of the Park Lock engaging lever (P).
- lock the adjuster (478) in place with the check nut (479).

When the parking brake lever (L) is released, a spring in the union (480) returns the pin (481) to the position where the lever (P) movements are locked.

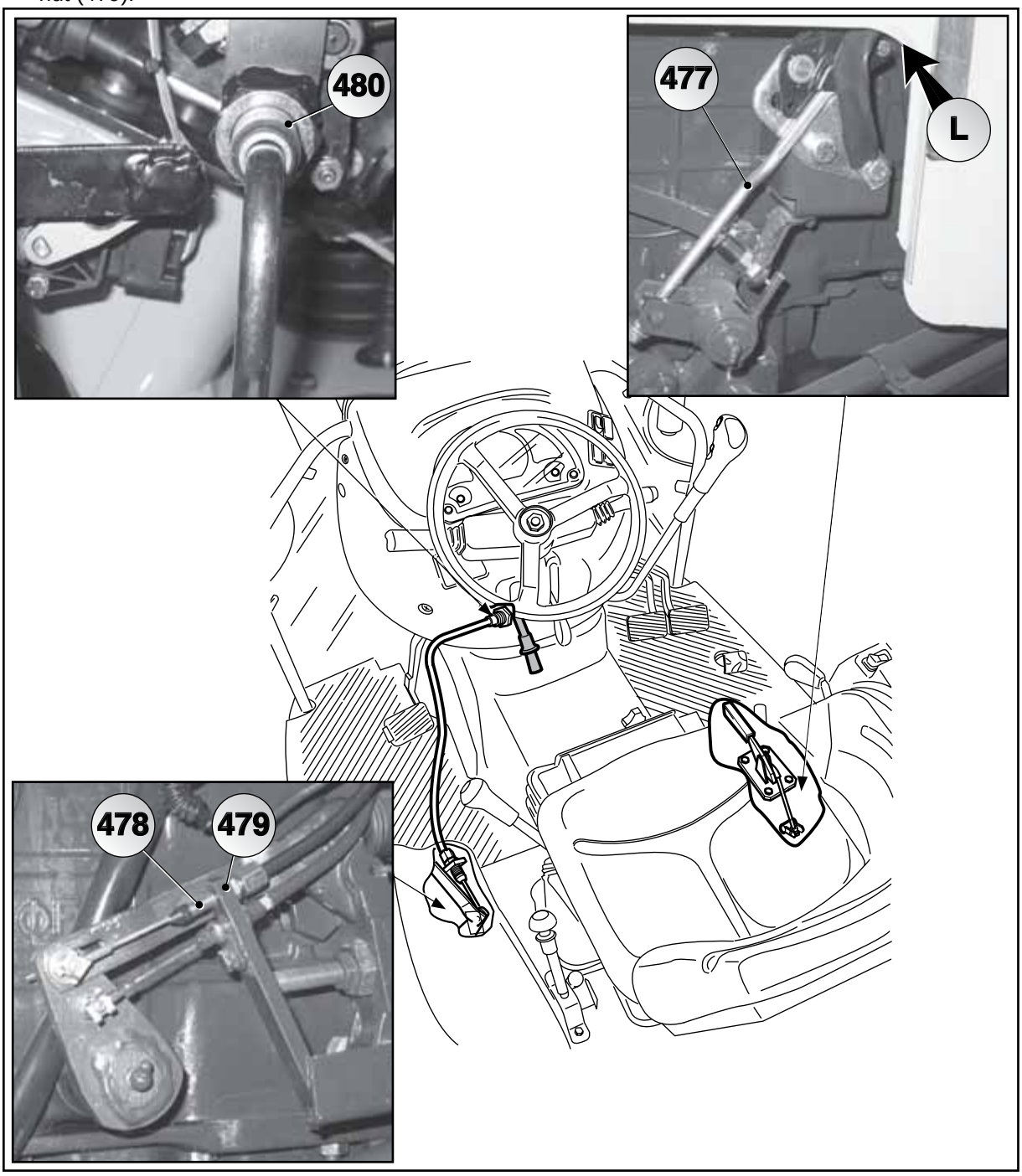


Fig. 4.253

4WD housing with Park Lock disengaged

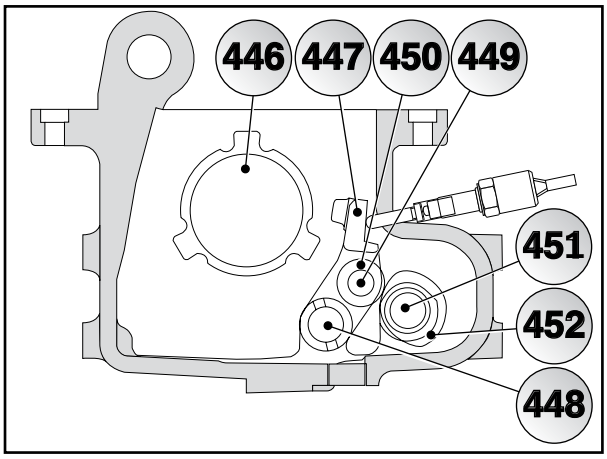


Fig. 4.254

4WD housing with Park Lock engaged

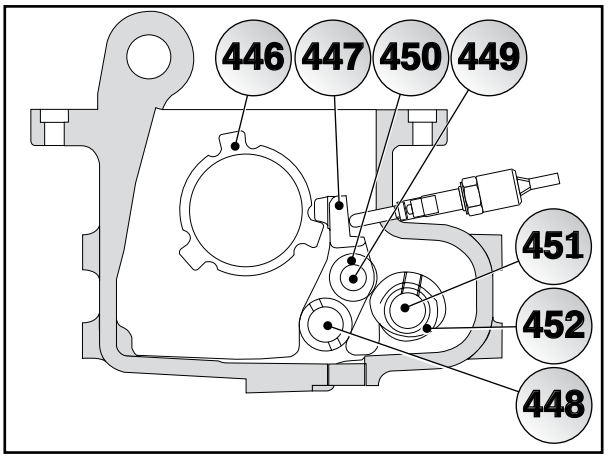


Fig. 4.255

Park Lock control adjustment

To ensure the teeth (446) and lever (447) correctly mesh, the travel of this lever must be adjusted by means of the lenXLh of the cable that connects the engaging/disengaging levers and the control lever (P) just under the steering wheel:

- move the lever (P) to the disengaging position (neutral);
- operate the engaging lever (453) so as to bring the pin (455) up against the reference pin (466);
- adjust the lenXLh of the cable (467), by means of nuts (468) and (469) so as to obtain 1 mm of play between pins (455) and (466);
- lock the adjuster nuts (468) and (469).

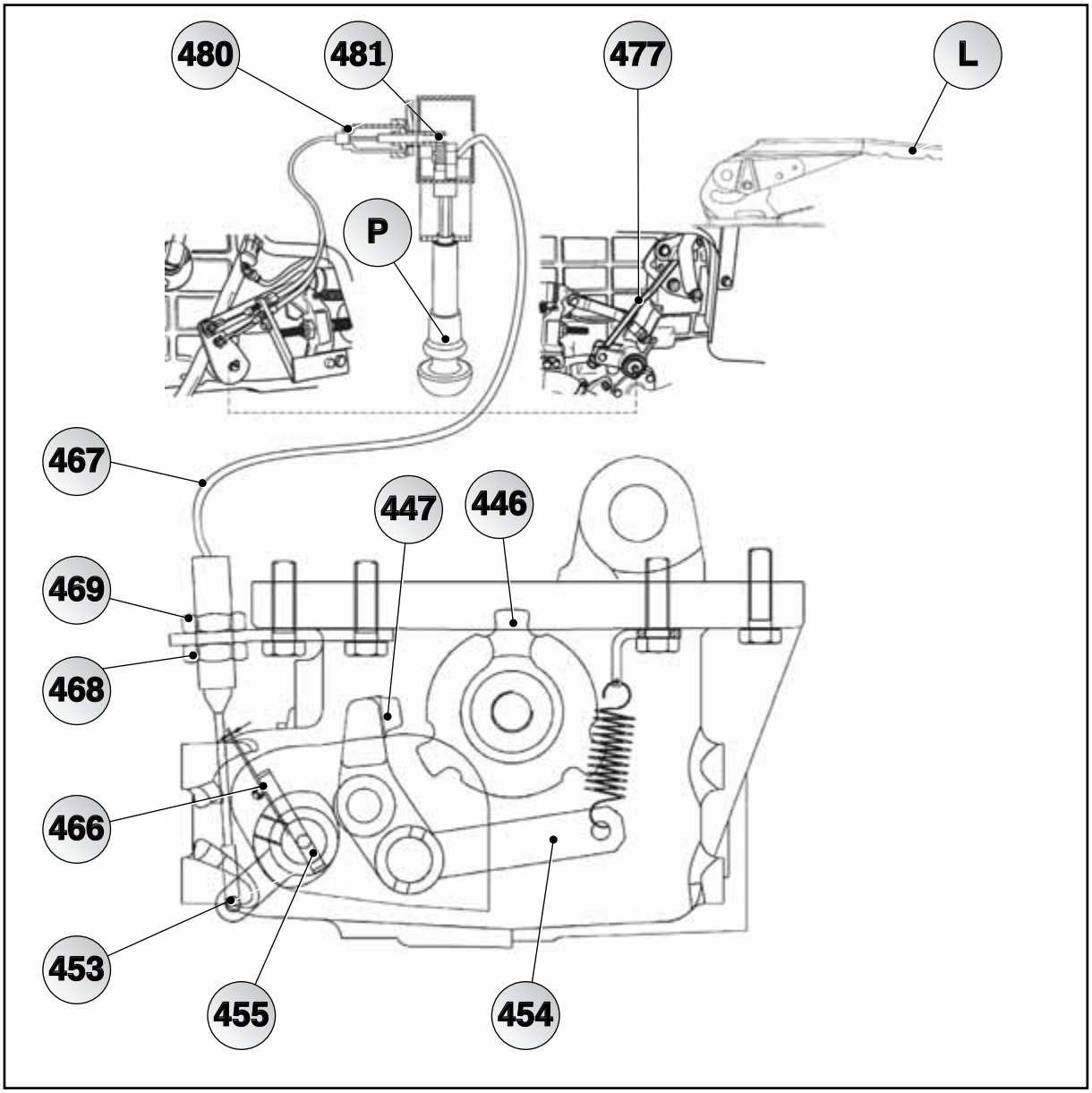


Fig. 4.256

4.6.5 Guidelines for disassembly

⚠	**Attention:** if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

- remove the 4WD housing from the gearbox housing.

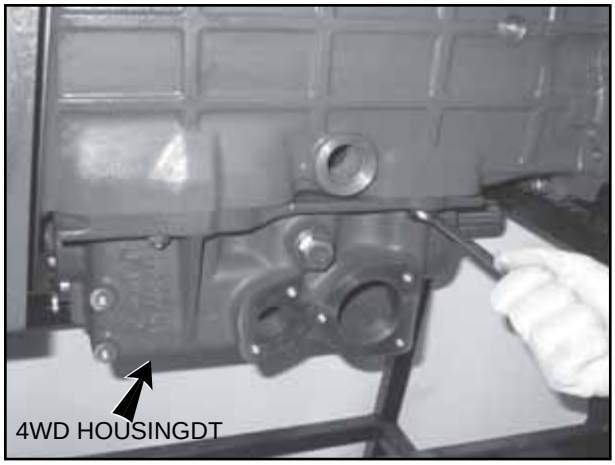


Fig. 4.257

How to disassemble the creeper bearing shaft (4WD housing with creeper)

- remove the spring pin (470) and disassemble the creeper engaging fork and rod;
- take out the spring pin (471) that fixes the bearing shaft (444);

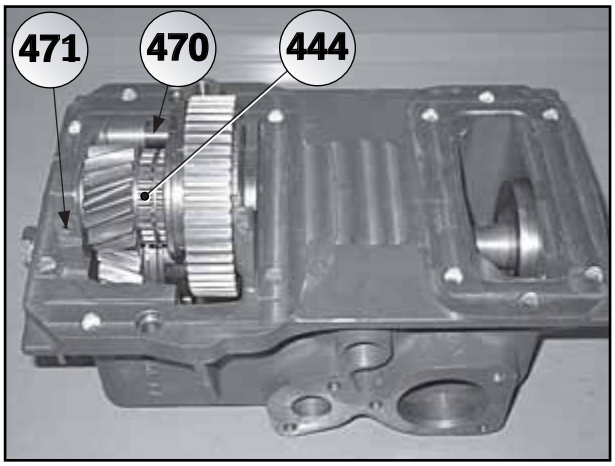


Fig. 4.258

- remove the shaft (444) that supports the creeper.

Fig. 4.259

How to disassemble the driven gear bearing pin (4WD housing without creeper)

- remove the ring nut (476) and take out the pin (445).

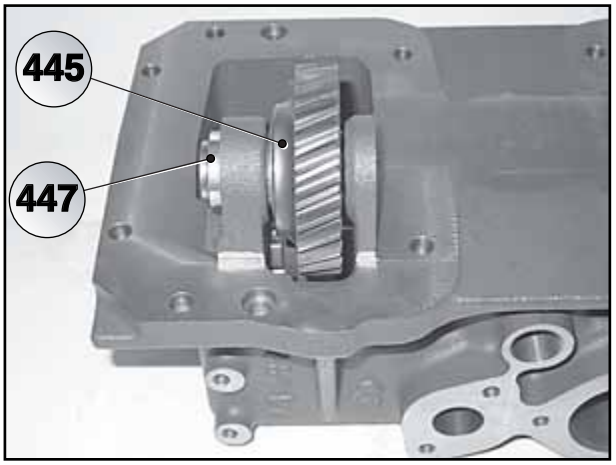


Fig. 4.260

Disassembly of the "SPRING-ON" unit

- remove the spring ring (403);

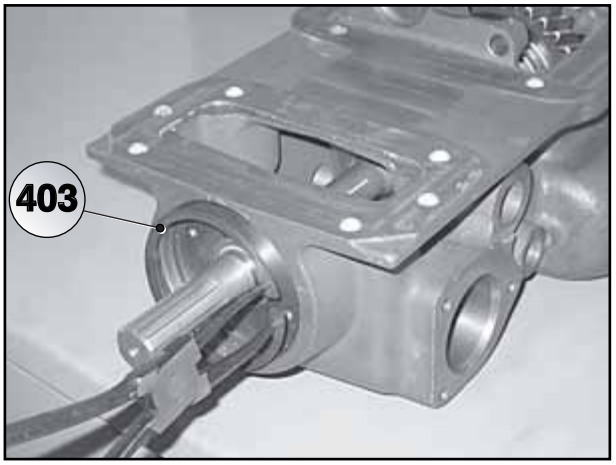


Fig. 4.261

- disengage the Park Lock and remove the Spring-on transmitter shaft (401) along with the driven gear (415).

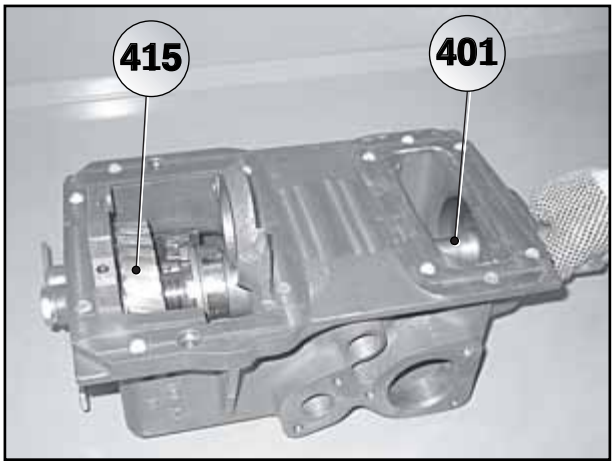


Fig. 4.262

Removal of the engaging and disengaging levers

- take out the spring pins (455) and (473) and remove the Park Lock disengaging lever (454).

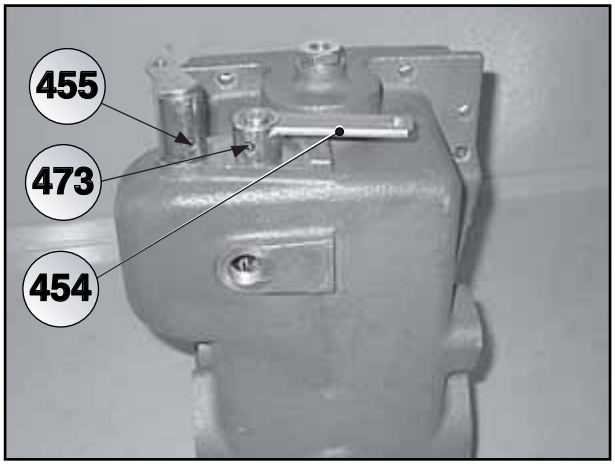


Fig. 4.263

- remove the spring ring (474) and rod (448);

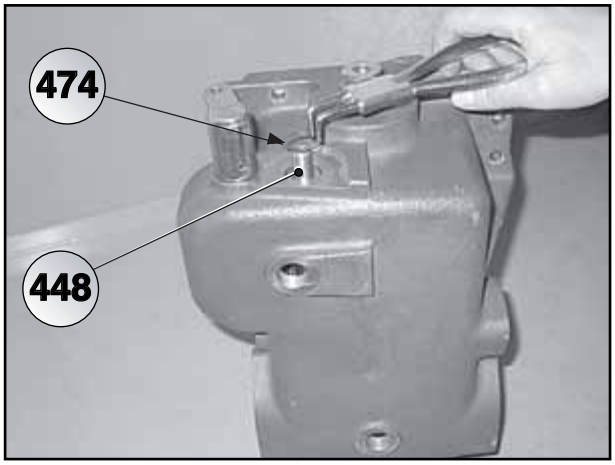


Fig. 4.264

- remove the retainer plug and take out the rod with the relative cam (452).

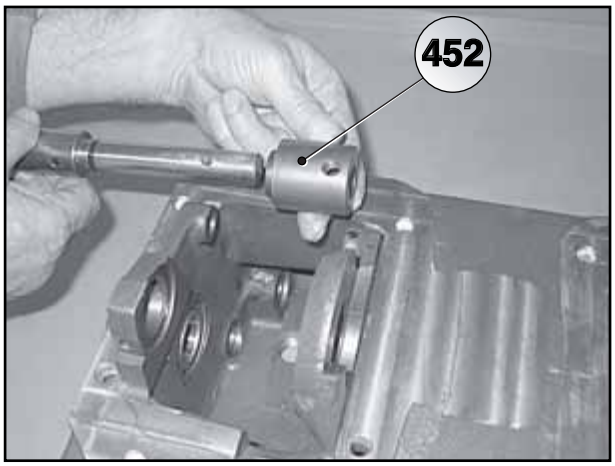


Fig. 4.265

4.6.6 Guidelines for re-assembly and inspections

- replace the ring seals and check the bearings for wear;
- no particular recommendations are necessary for re-assembling the shafts and 4WD housing components;
- work through the disassembly operations in reverse order.

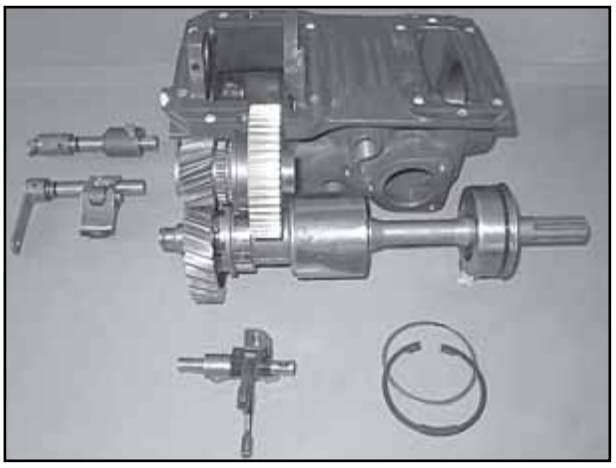


Fig. 4.266

“SPRING-ON” shaft inspection

- compress the spring (412) with the aid of tool 02 DT MYT and a press;
- remove the spring ring (410);

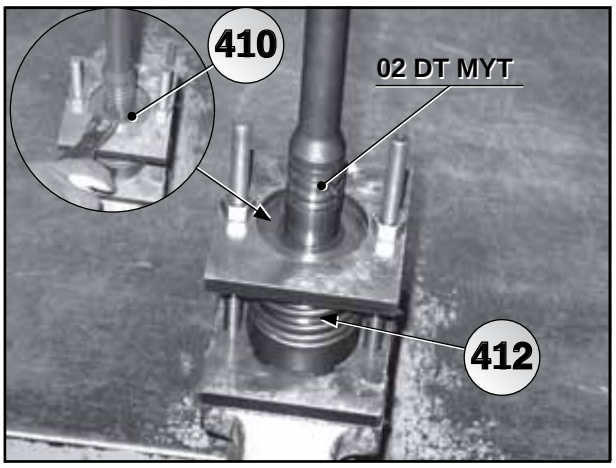


Fig. 4.267

- replace the retention rings (414), (404), (407) and check the ball bearing for wear (406).

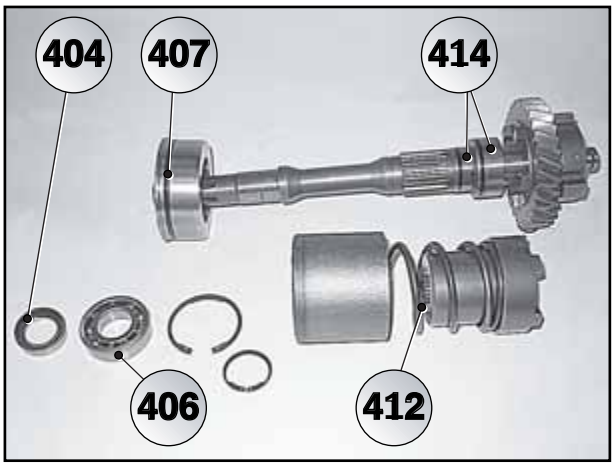


Fig. 4.268

4WD housing re-assembly on the gearbox casing

- to assemble the 4WD housing (only versions with creeper) on the gearbox housing, the creeper must be engaged both in the gearbox and in the housing;
- move the gearbox housing nearer and check that the rocker arm is properly inserted in the creeper engaging fork;
- tighten the fixing screws;
- no special precaution is required to assemble the 4WD housing (version without creeper) on the gearbox housing.

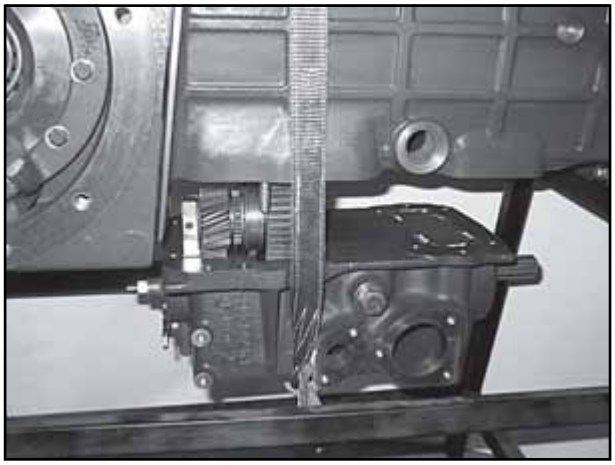


Fig. 4.269

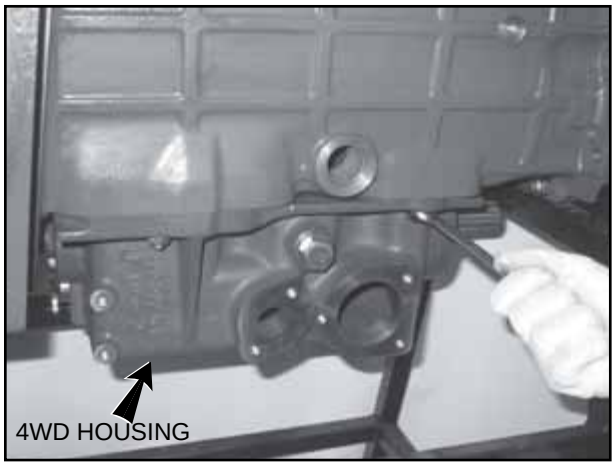


Fig. 4.270

4.7 Bevel gear pair and rear differential

4.7.1 Drawing of assembly and main components

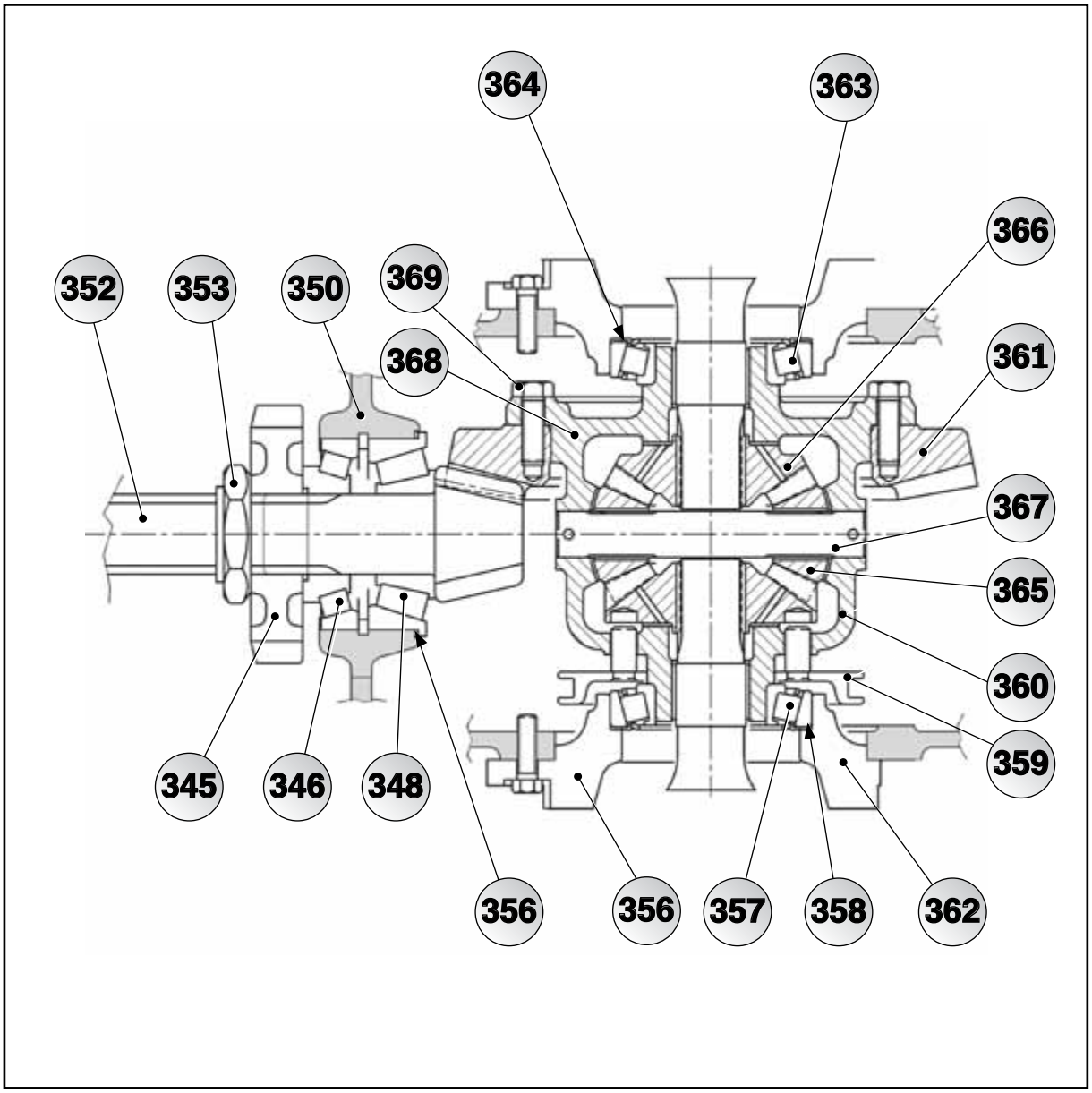


Fig. 4.271

350 - Gearbox housing
353 - Bevel pinion fixing nut
345 - Standard range driven gear
348 - Pinion support tapered bearing
346 - Pinion support tapered bearing
352 - Bevel pinion
349 - Pinion adjustment shims
356 - Lh differential support
357 - Taper bearing
358 - Adjustment shims
359 - Diff lock ring
360 - Differential housing
361 - Bevel ring gear
362 - Rh differential support
363 - Taper bearing
364 - Adjustment shims
365 - Planetary gear
366 - Crown wheel
367 - Planetary pin
368 - Cover
369 - Cover fixing screw

4.7.2 Description of operation

This is the end part of the transmission. It has a tough and massive structure as it has to distribute the power between the driving wheels (also during turns) by means of the actual differential and the side final drives. It also transmits drive to the 4WD front axle and to the output shaft of the proportional PTO. The oil-cooled disc brake assembly is installed in the compartment where the side final drives are fixed. The differential unit can be locked as required by a mechanically engaged sleeve with electrohydraulic control which locks the two side axle shafts together in order to turn the wheels at the same rate as each other.

Besides receiving and transmitting drive to the actual differential, the bevel pinion also acts as driver for the proportional PTO gear and for the 4WD Spring-on engaging and disengaging unit.

4.7.3 Driving torques and sealants

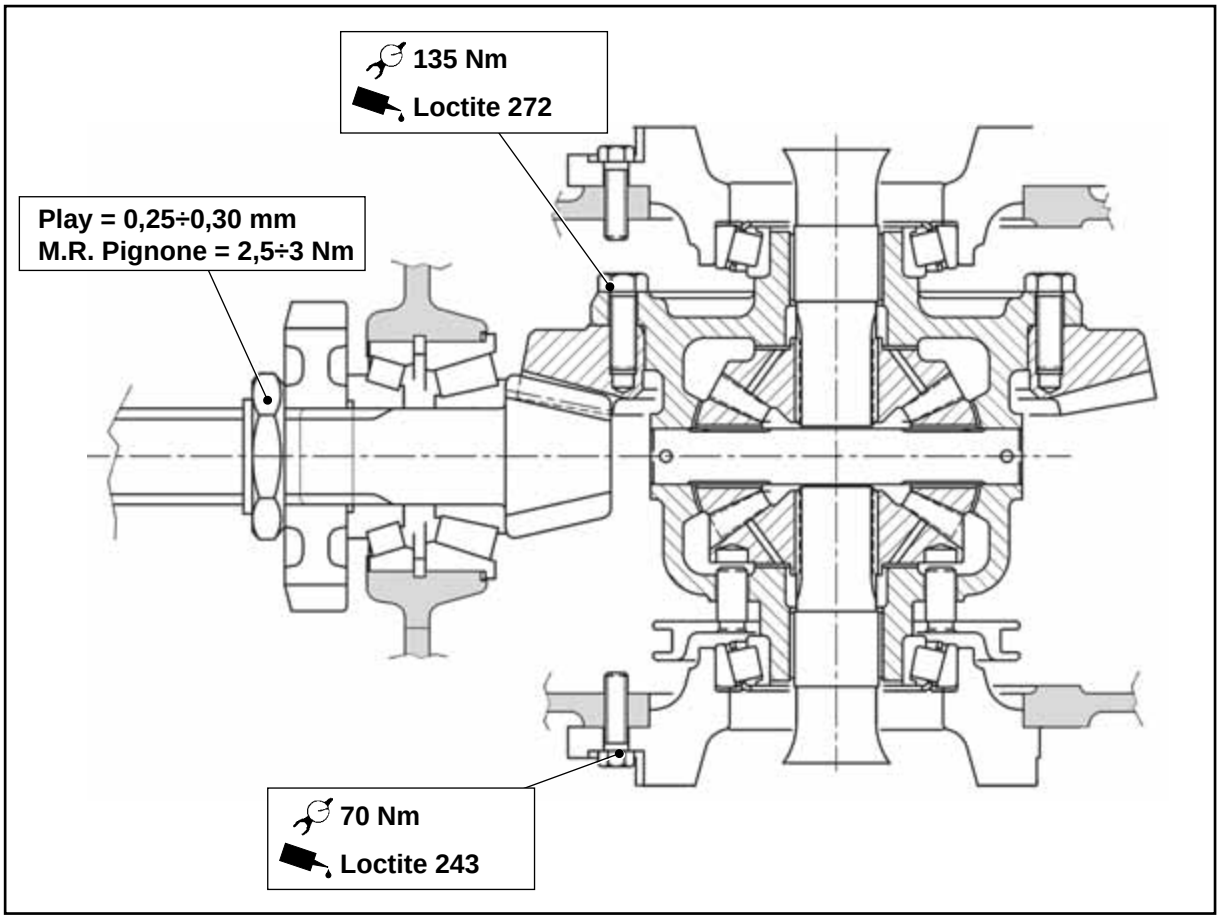


Fig. 4.272

- Driving torque
- Type of sealant

4.7.4 Guidelines for disassembly, inspections and re-assembly

- comply with the indications given for the gearbox when disassembling and re-assembling the bevel gear pair and rear differential assemblies.

⚠	**Attention:** wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.

Differential housing removal

use tool 01 CMB MYT to remove the housing from the gearbox housing.

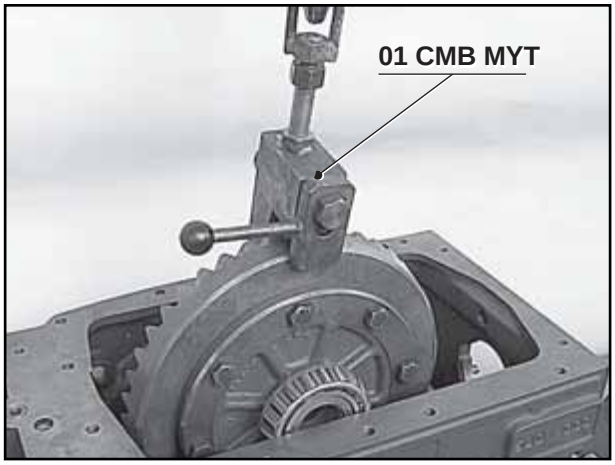


Fig. 4.273

Inspections

- Clean and check all the components;
- Replace all the retention rings and the bevel pinion nut (344);
- Check the rolling tracks of all bearings and make sure that there are no faults during the rolling action;
- Replace all defective or worn components.

How to inspect the differential housing

The differential housing (360) consists of a cover (368) and planetary gear unit.

To split the housing, remove the cover fixing screws (369), the spring pins (370) and take out pin (367).

The planetary gear unit consists of a central pin (367), two differential gears (366) and two planetary gears (365). Check the teeth of the crown wheels and planetary gears along with their respective shimming plates.

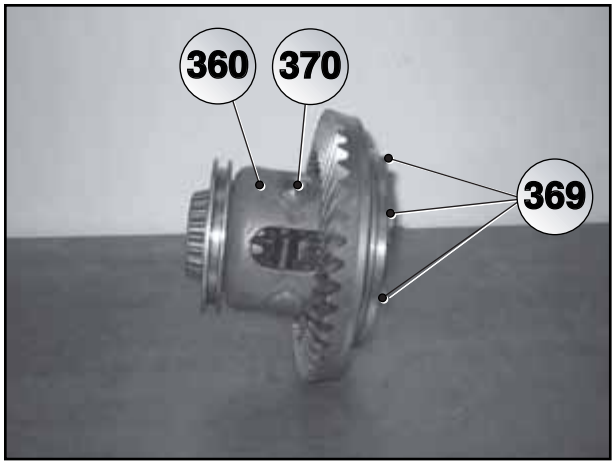


Fig. 4.274

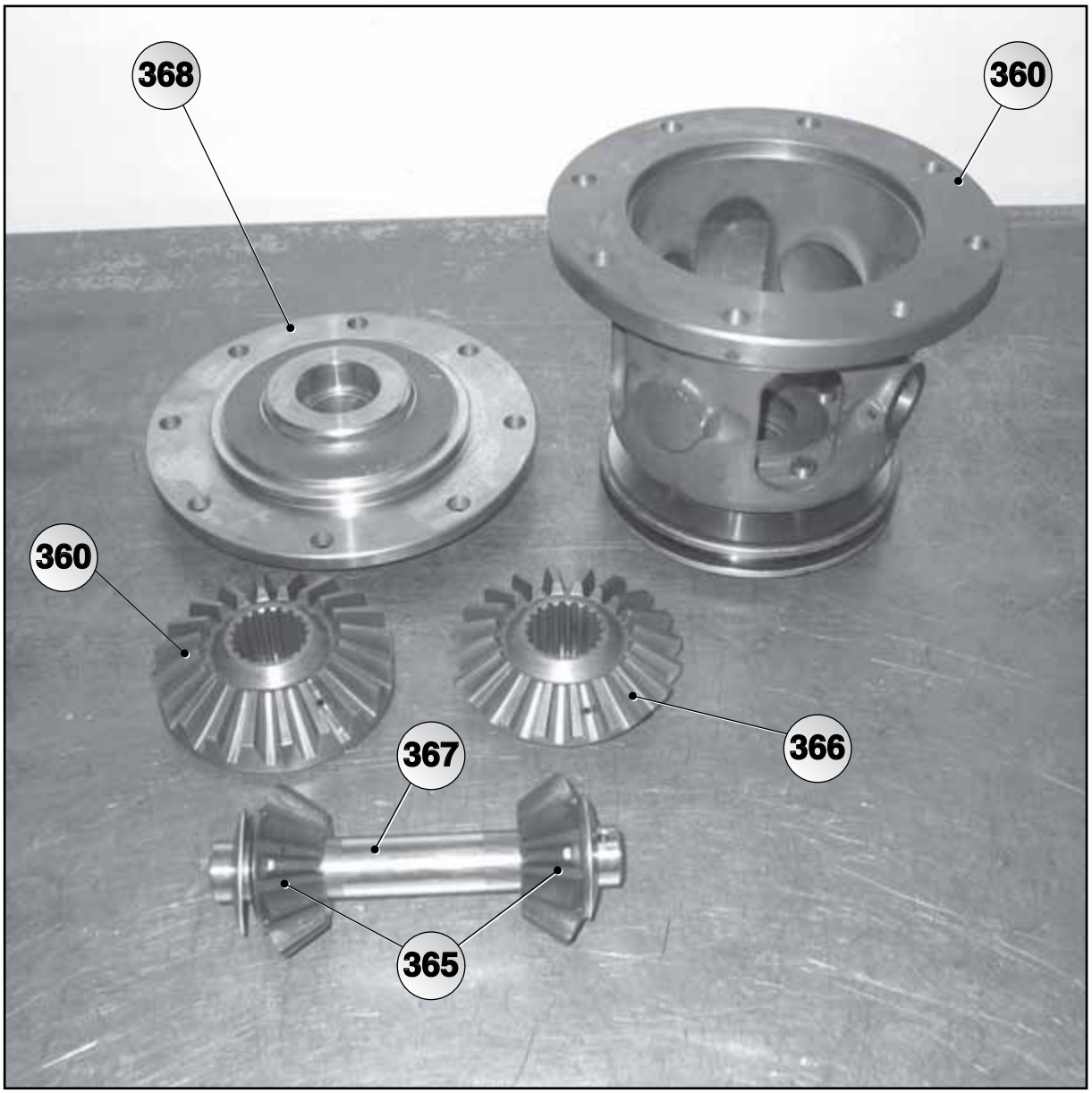


Fig. 4.275

4.7.5 Guidelines for adjustments

The bevel gear pair must be adjusted in four different ways to ensure optimum operating conditions:

- Adjust the position of the pinion in relation to the ring gear in order to ensure the two components mesh perfectly together; (1)
- Give the right preload to the two taper bearings that support the pinion in order to obtain the exact moment of rotation; (2)
- Give the right preload to the taper bearings that support the differential in order to obtain the exact moment of rotation; (3-4)
- Adjust the right play between the pinion and ring gear teeth; (3-4).

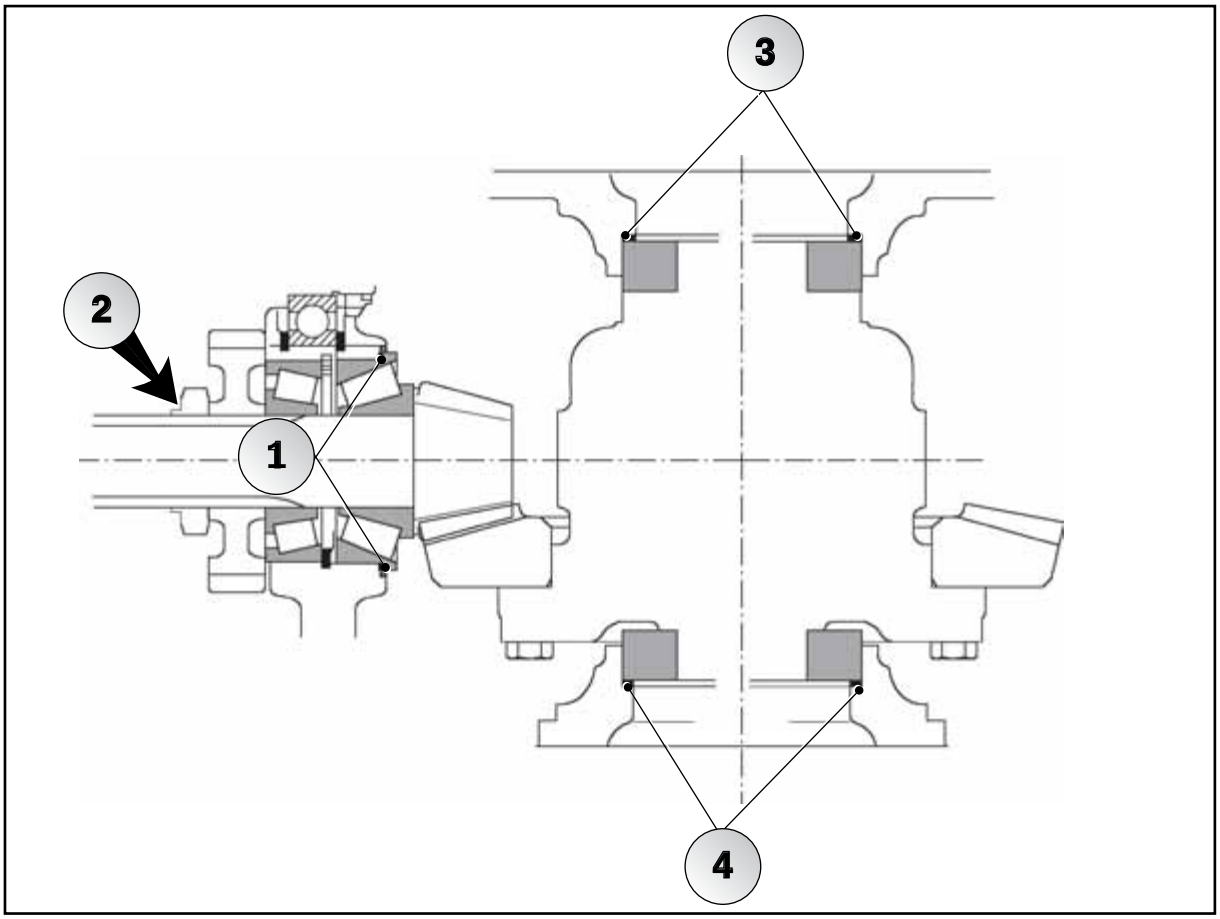


Fig. 4.276

Adjustment of the position of the pinion shaft in relation to the ring gear

Foreword: this adjustment must be made whenever the rear taper bearing (348), the bevel gear pair or the differential housing are replaced during a general overhaul.

- The purpose of the adjustment is to determine the value of shim Sh which is mounted between the outer bearing ring and the relative stop point on the housing.
- Apply the following expression for the calculations:

SH = A - (B + C)

where:

A	is the distance between the bearing surface of the rear taper bearing and the axis of the bevel ring gear (Fig.4.279). This dimension is measured along the assembly line and is stamped on the differential housing (Fig.4.278);
B	is the nominal dimension (150 mm) which must be complied with in order to perfectly center the pinion on the ring gear. This dimension can be corrected by writing with the electric pen on the end of the pinion (Fig.4.280). These values should be added to or subtracted from the nominal value of 150 mm, depending on the + or - sign that precedes this value.

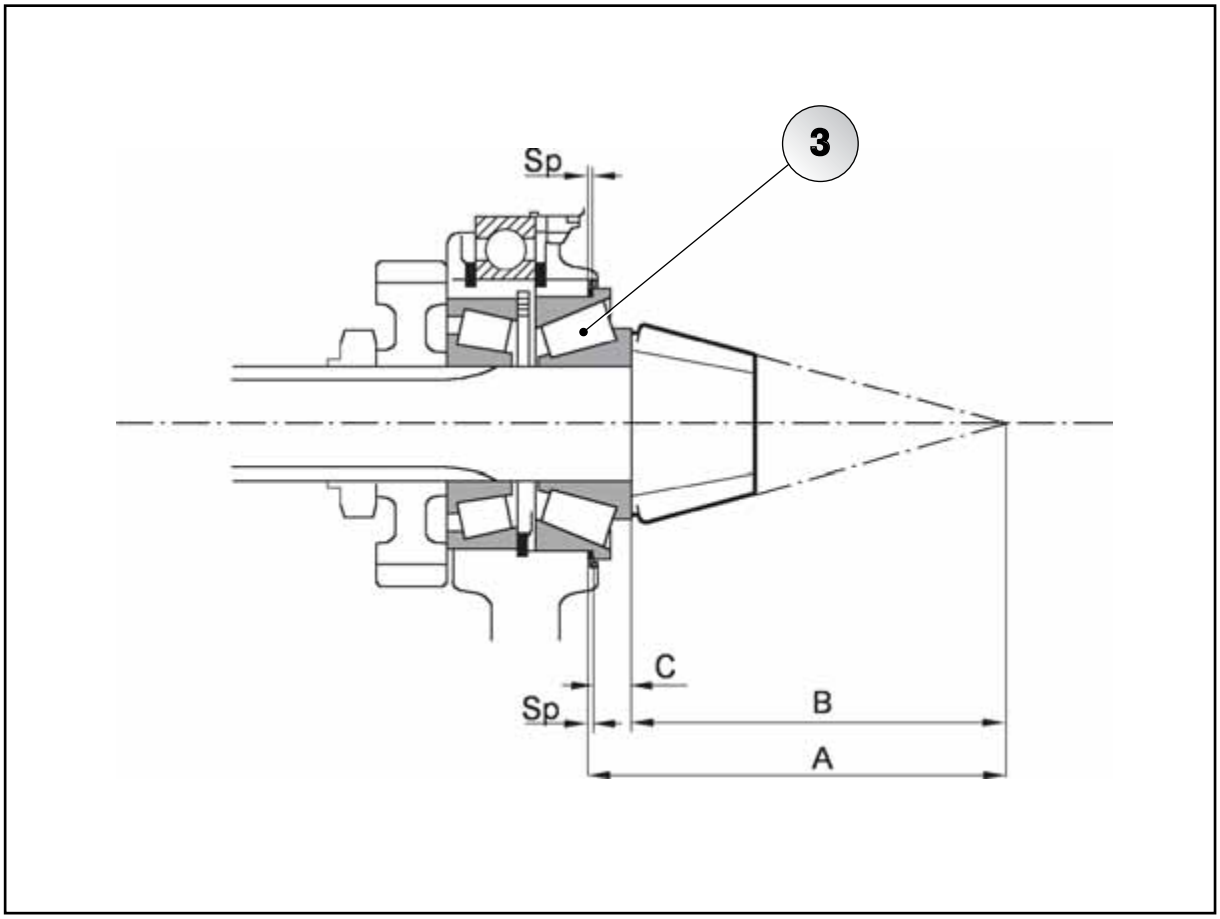


Fig. 4.277

Example:

If + 0.15 is written on the end of the pinion, dimension B will be 150 + 0.15 = 150.15 mm

If - 0.10 is written on the end of the pinion, dimension B will be 150 - 0.10 = 149.90 mm

C	is the distance between the stop point of the bevel pinion (348 Fig.4.271) on the casing and the bearing surface of the bevel pinion. This measurement must be taken on the taper bearing using tool 02 DIF MYT (Fig.4.281).

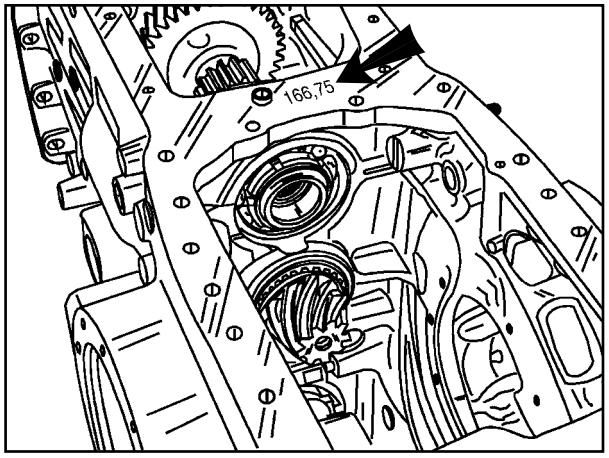


Fig. 4.278

Example:

- If 166.75 mm is stamped on the housing
  If + 0.15 is written on the end of the pinion
  If the measured dimension C is 15.5 mm

The thickness of shim SH is:

SH = 166.75 - (150.15 + 15.5) = 1.1mm

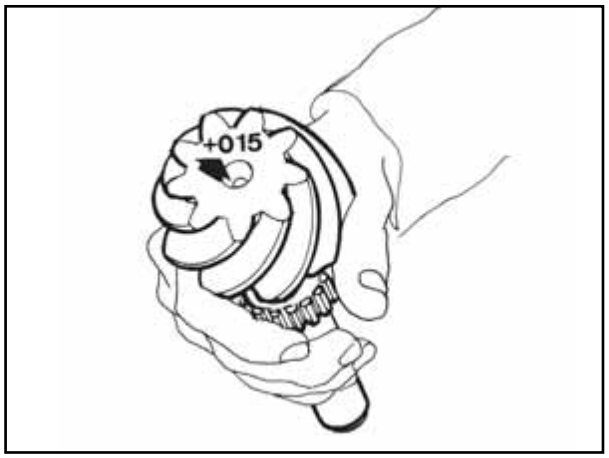


Fig. 4.279

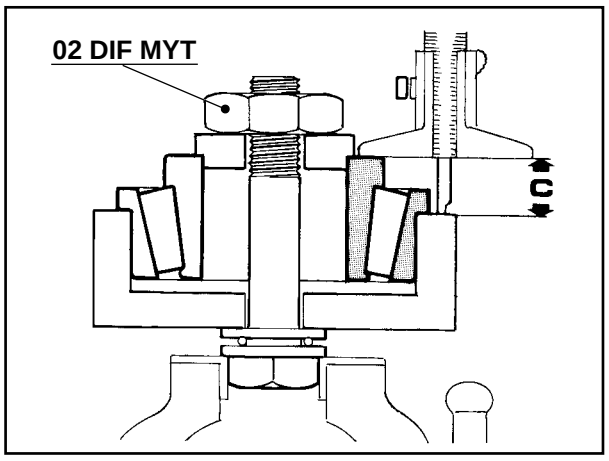


Fig. 4.280

How to give the right preload to the two taper bearings that support the pinion

- Fit the bevel pinion back in the differential housing, remembering to insert and fit the spring ring into its housing;
- Mount and tighten the nut until a moment of rotation between 2.5 and 3 Nm is obtained.
- Clinch the outer edge of the nut near the two cavities made on the pinion.

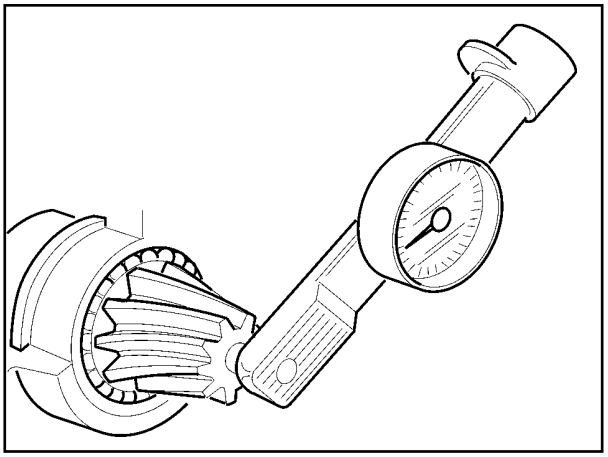


Fig. 4.281

How to give the right preload to the two taper bearings that support the differential

- Mount the bevel ring gear on the complete differential assembly, and tighten the screws;
- Assemble two dummy bearings (tool 01 DIF MYT) on the differential housing without inserting any shim between them and the differential housing itself. Now fit the entire assembly, including the ring gear, into the differential housing.
- Adequately fix the two supports and consider that, from this moment onwards, the two supports must not be exchanged with each other;
- Using a lever, move the differential assembly fully against the support (B) and use a thickness gauge to measure the distance between the dummy bearing and the stop point of the bearing on the differential housing (X).

  Measure a couple of times, making sure that the differential assembly is fully against the dummy bearing on the support (A).

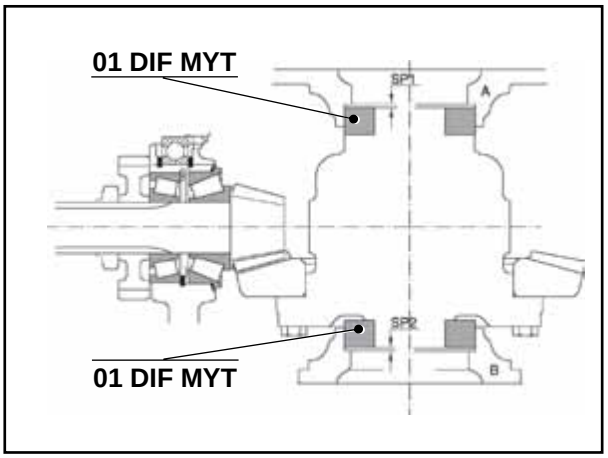


Fig. 4.282

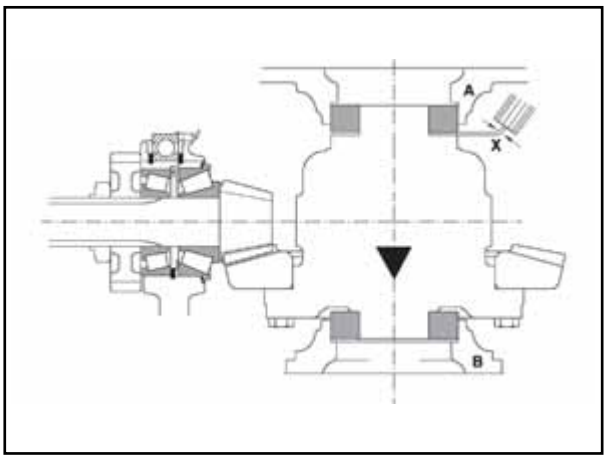


Fig. 4.283

The dimension measured corresponds to the total value of the shims that must be inserted to eliminate the float (X = X1 + X2). However, to correctly preload the two taper bearings in order to obtain the exact moment of rotation, 0.1mm must be added to the measured value; thus the total value of the shims will be: X + 0.1.

These shims must then be distributed between flange A and flange B to achieve the correct play between the teeth of the pinion and those of the ring gear.

How to adjust the right play between the pinion and ring gear teeth

- Keep the differential assembly fully shifted on support B and apply a comparator perpendicularly on the center line of one flank of a ring gear tooth.
- Delicately move the differential assembly axially toward the support (A) while measuring the variation in play between the pinion teeth and those of the ring gear.

  When the rotational play between the pinion and ring gear teeth is between 0.25 and 0.30 mm, stop the axial movement and measure its entity by inserting the thickness gauge between support A and the relative dummy bearing (X1);
- Since maximum float X and that of movement X1 are now known, the value of X2 can be easily found:

  - **X2 = X - X1**
- The values of X1 and X2 would correspond to the effective values of shims Sh1 and Sh2 if the thickness of the dummy bearings was the same as that of the taper bearings to be subsequently mounted.

  It is therefore necessary to check for differences by using a depth gauge to measure the difference in thickness between the dummy bearing and the true bearing to be mounted. This difference must then be added or subtracted from the values of X1 and X2:

  Z1 - V1 = difference to add to X1 if positive and to subtract from X1 if negative, in order to obtain Sh1.

  Obviously, the same procedure and the same calculation must be applied for the X2 value.
- Proceed by definitively assembling the entire differential unit, inserting the calculated shims, tightening the screws of the supports.

  After assembly, check again to make sure that the play between the pinion/ring gear teeth is between 0.25-0.30 mm.

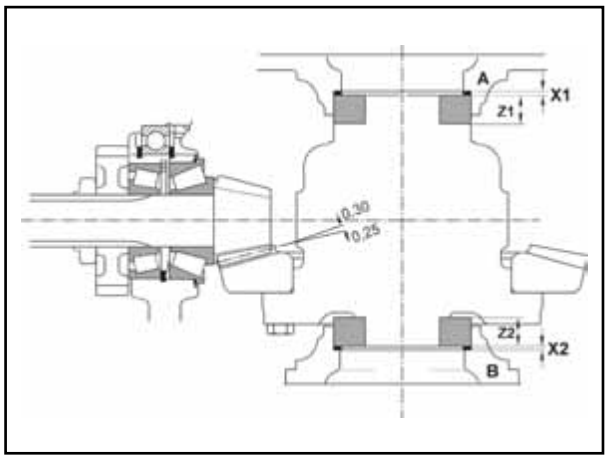


Fig. 4.284

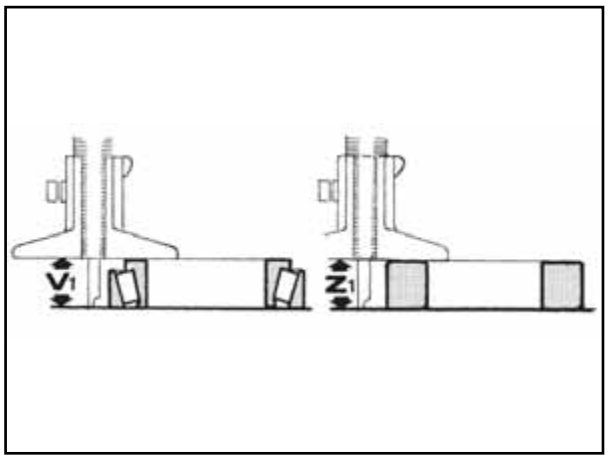


Fig. 4.285

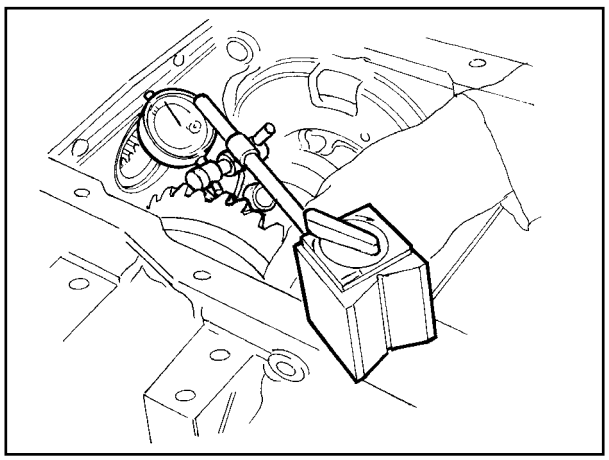


Fig. 4.286

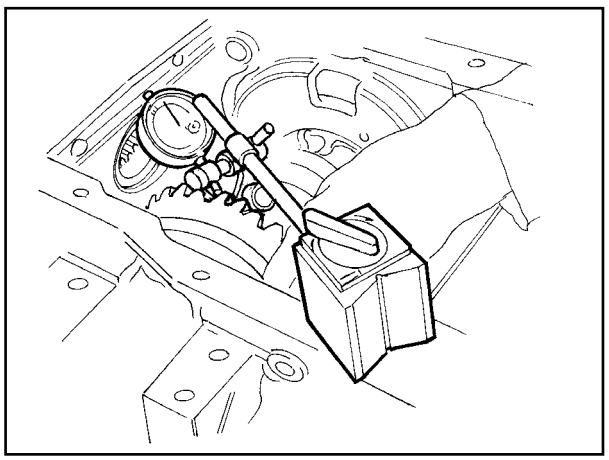


Fig. 4.287

4.8 Side final drives

4.8.1 Drawing of assembly and main components

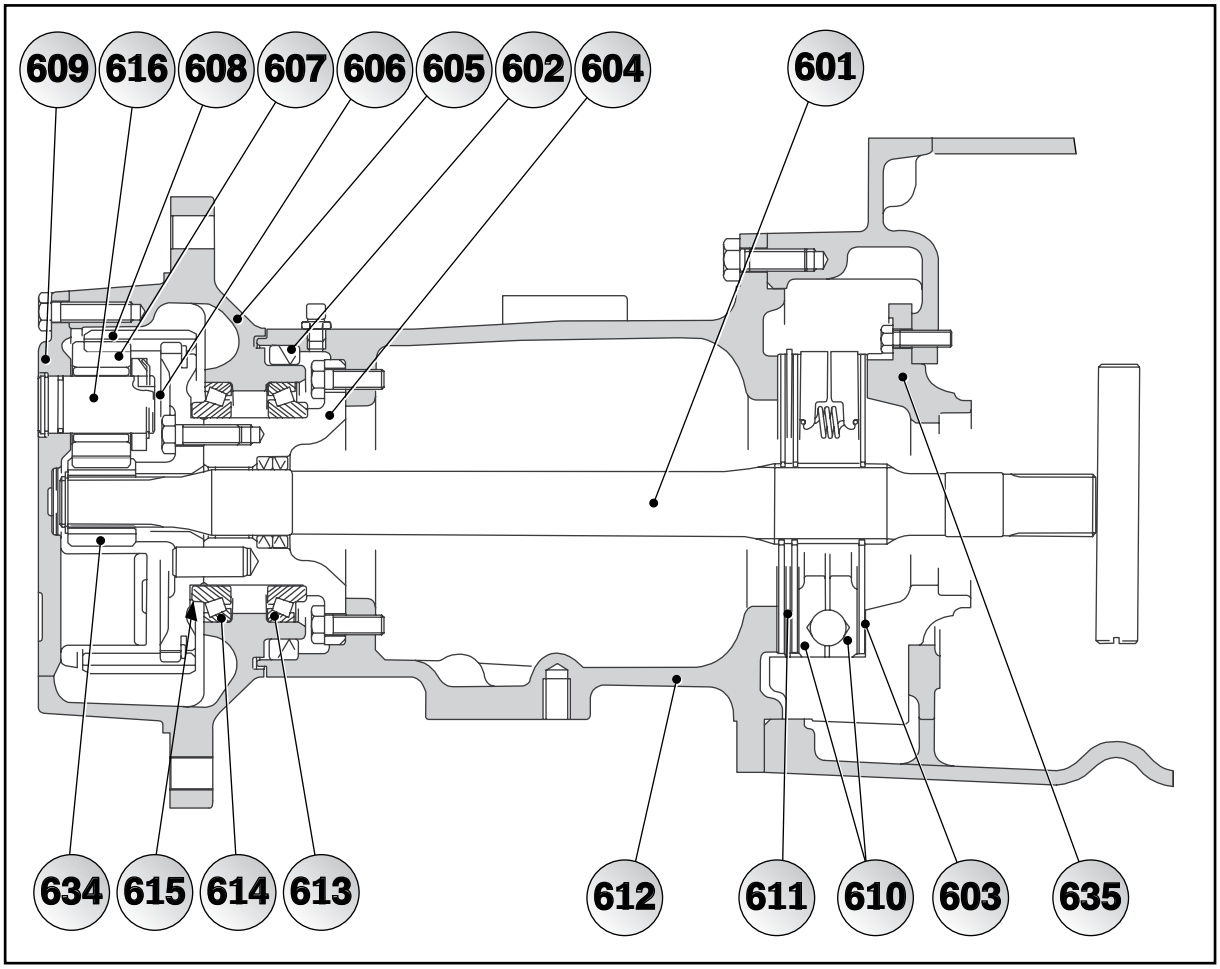


Fig. 4.288

601 - Axle shaft
602 - Retention ring
603 - sintered disc
604 - Spindle
605 - Hub housing
606 - Flange
607 - Planetary gear
608 - Ring gear
609 - Spider cover
610 - Support plates
611 - Steel plates
612 - Final drive housing
613 - Taper bearing
614 - Taper bearing
615 - Adjustment shims
616 - Planetary gear pin
634 - Crown wheel
635 - Differential bearing flange

4.8.2 Description of operation

The final drive housings support the right and left axle shaft and contain the final drives which transmit drive from the differential unit.

The two side final drives consist of a final drive housing (612), an axle shaft (601) supported by two taper roller bearings (613 and 614), a ring gear (608) and a wheel hub, also supported by two taper roller bearings.

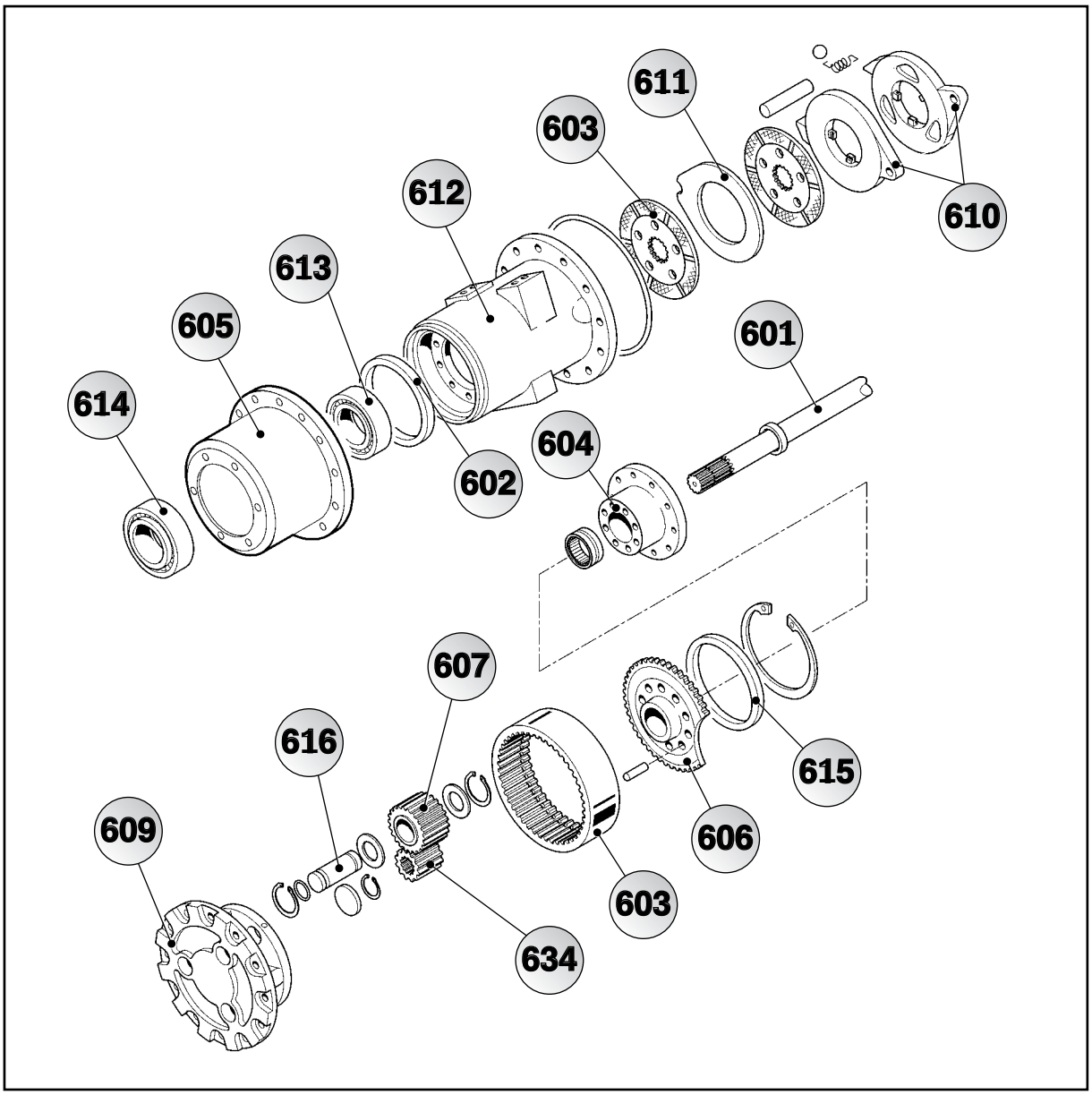


Fig. 4.289

4.8.3 Guidelines for re-assembly, adjustments and inspections

Inspections

- Clean and check all the components;
- Replace all the retention rings;
- Check the rolling tracks of all bearings and make sure that there are no faults during the rolling action;
- Particularly make sure that the surfaces of the teeth are not pitted or worn; replace all defective parts;
- Blow compressed air into the oil channel to check for obstructions.
- Replace all defective or worn components.

Adjustments

The only adjustment required by the side final drive is to calculate the thickness of shims Sh (615) to be inserted between the outer taper bearing (614) and the crown carrier flange (606), to obtain correct preload of the two taper bearings. To calculate the value of shims Sh (615), measure dimensions (A) and (B) when re-assembling and use the following formula:

Sh = A - B + 0.1

Example: Dimension A = 9.2 mm, Dimension B = 7.7 mm, Sh = 9.2 - 7.7 + 0.1 = 1.6 mm

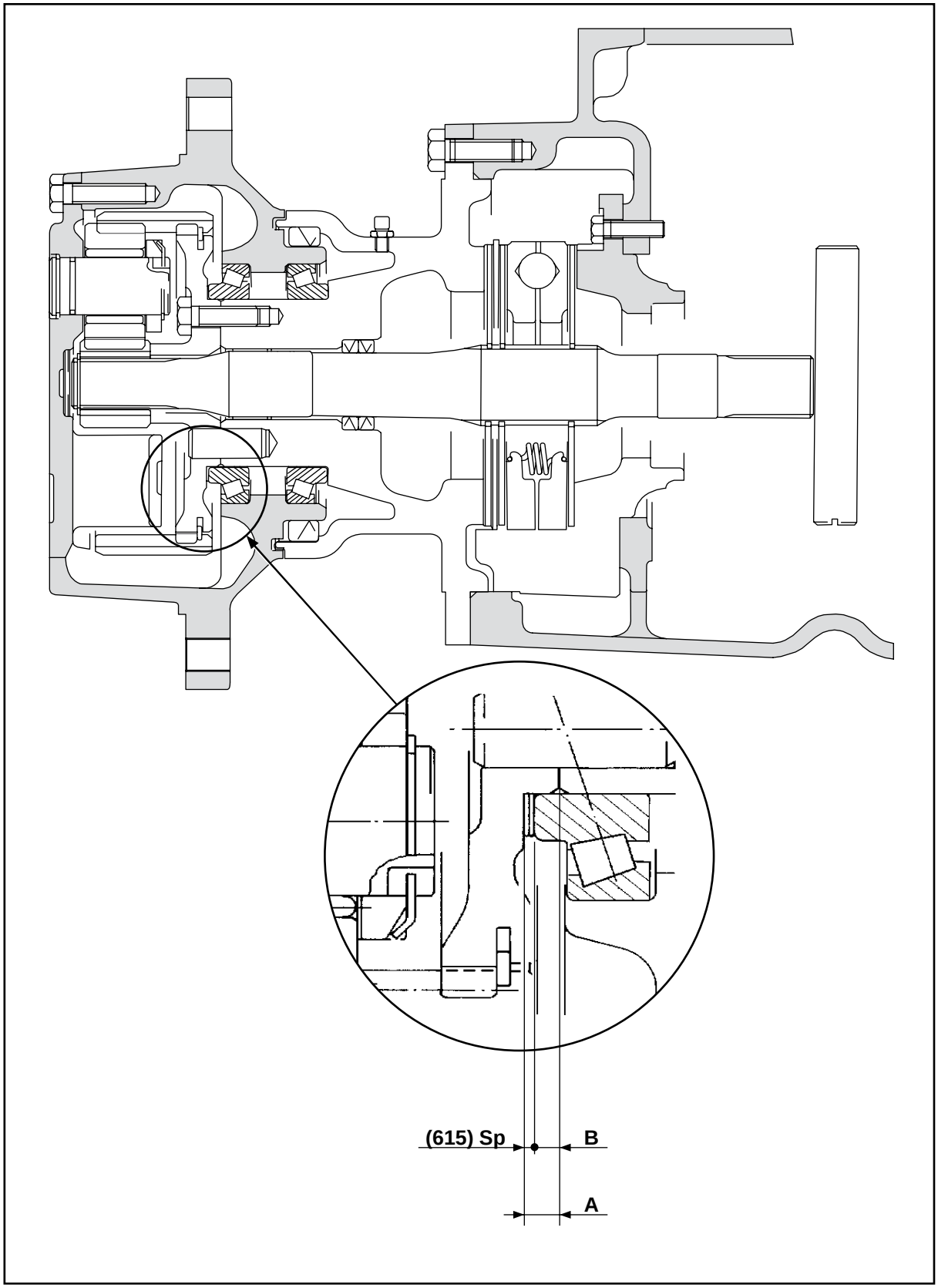


Fig. 4.290

4.8.4 Driving torques and sealants

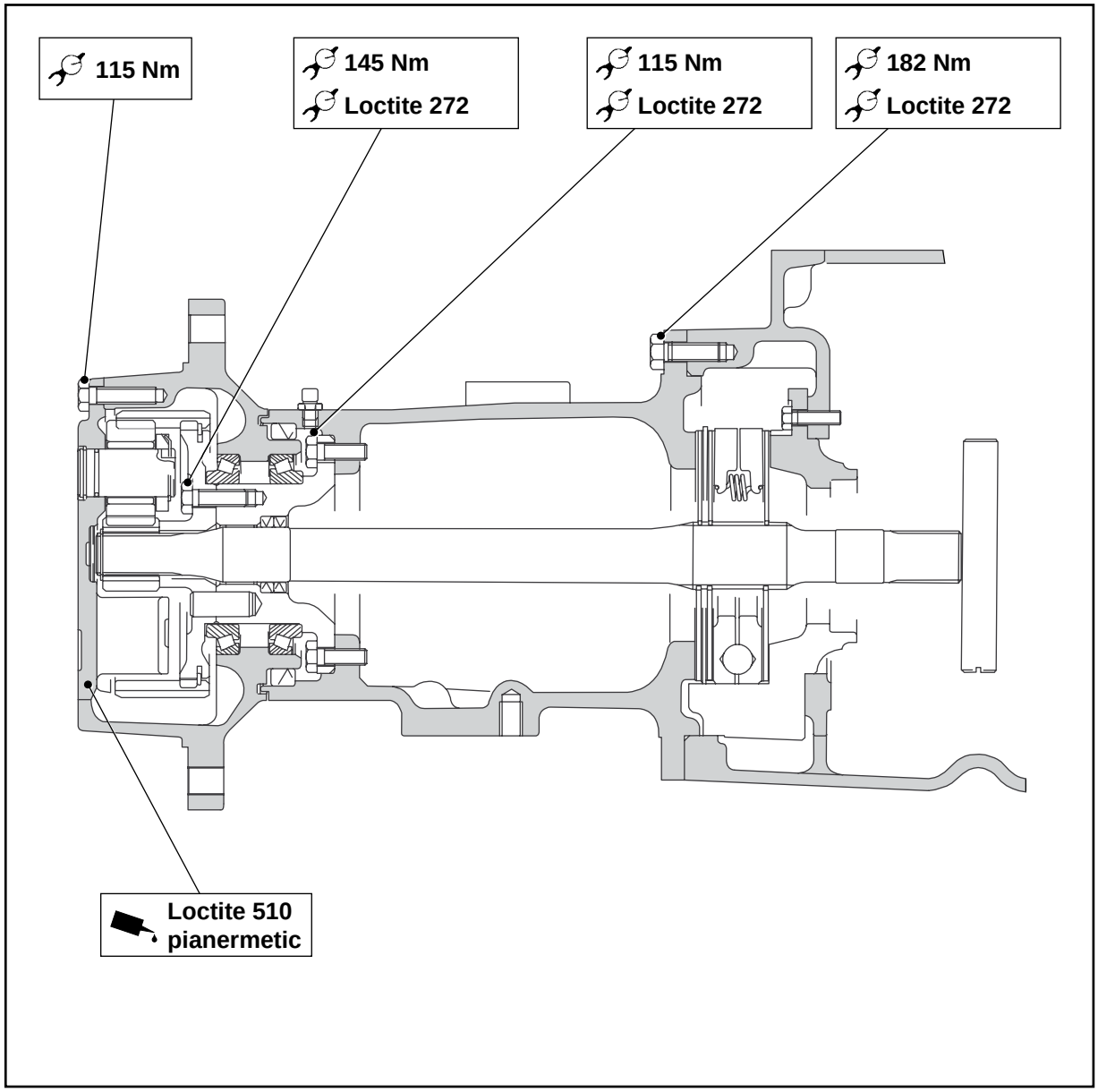


Fig. 4.291

- Driving torque
- Type of sealant

4.9 Rear brakes

4.9.1 Drawing of assembly and main components (version 8 discs)

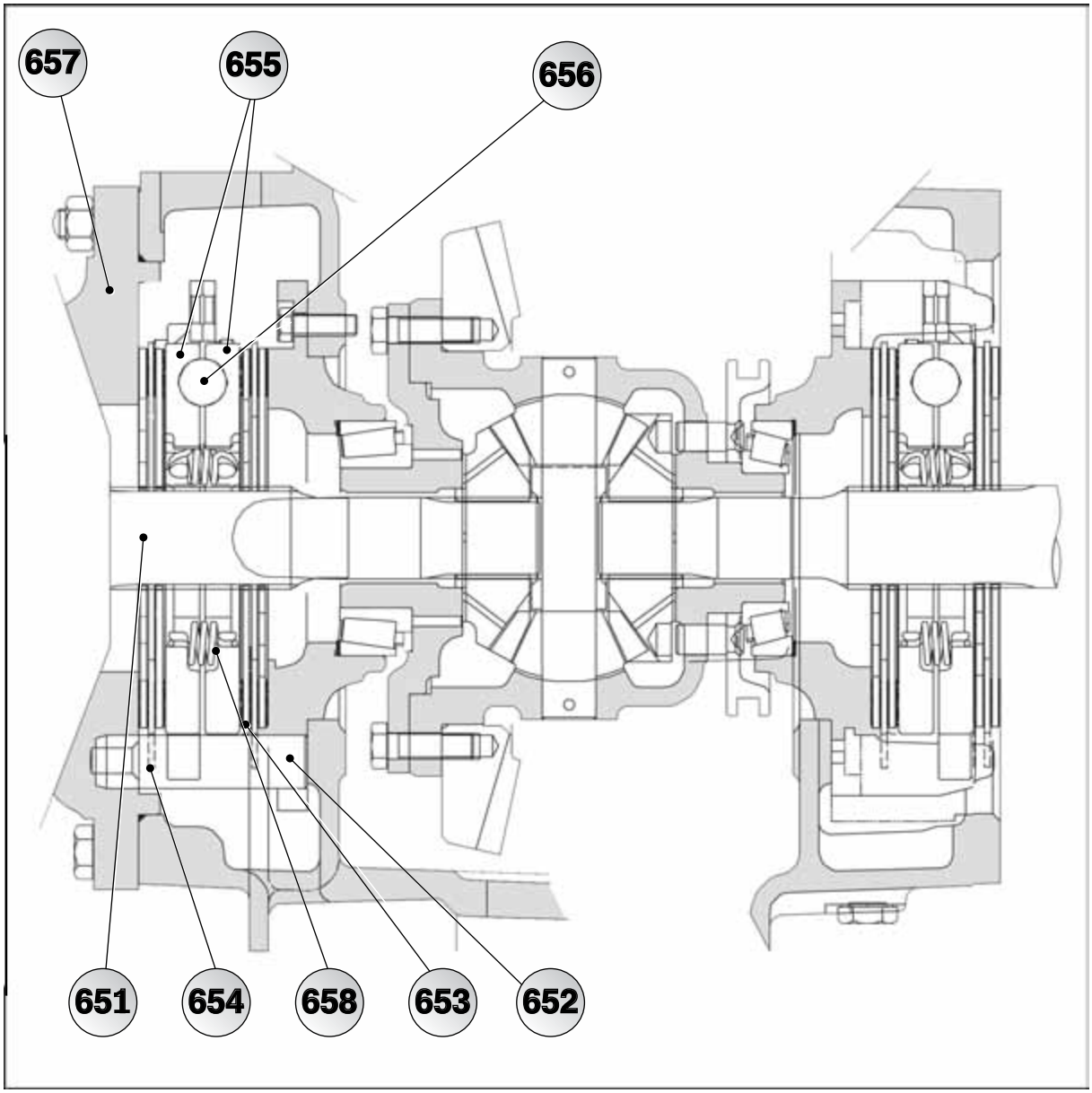


Fig. 4.292

651 - Axle shaft
652 - Driven disc check pin
653 - Sintered discs
654 - Steel plates
655 - Expansion plate
656 - Ball
657 - Final drive housing
658 - Plate return spring

4.9.2 Description of operation

The final drive housings support the right and left axle shaft and contain the final drives which transmit drive from the differential unit.

The two side final drives consist of a final drive housing (612), an axle shaft (601) supported by two taper roller bearings (613 and 614), a ring gear (608) and a wheel hub, also supported by two taper roller bearings.

Note: The Techno and 2WD versions have 8 discs (4 per side) to increase the braking action, since the front axle has no brake discs.

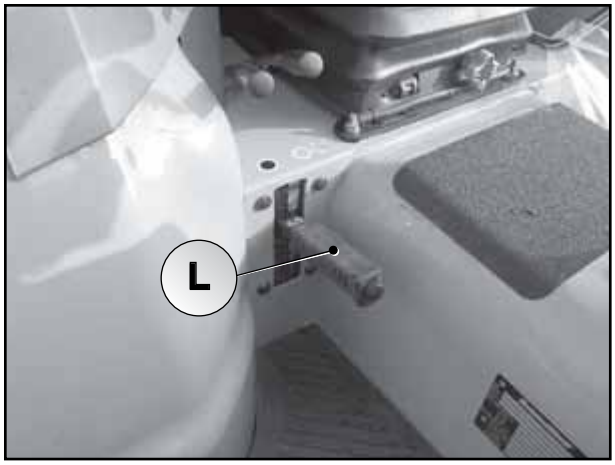


Fig. 4.293

4.9.3 Guidelines for re-assembly, adjustments and inspections

Inspections

Clean and check all the components. Particularly check to make sure that:

- the surfaces of the intermediate discs are not scorched or warped;
- the scoring on the friction discs is perfectly visible. Replace the discs if this is not the case;

Adjustments

The pedal brakes and parking brake must be adjusted after the rear brake unit has been assembled.

- Jack up the tractor with a hydraulic jack until the rear wheels are raised from the ground.
- Release the hand brake lever (L) and loosen the adjuster nut (659) of the rod (663) so as to relieve all tension from the brace (662).
- Separate the two pedals by raising the latch.
- Tighten the adjuster nut (661) until the wheels can be turned by hand.
- Now loosen the adjuster nut by one turn, i.e. until the wheel can be turned by hand. Lock the adjuster nut with the relative check nut.
- Repeat the same operations for the other brake.
- Check that the brake pedal has a free travel of the prescribed value (A = 30 to 40 mm). If this is not the case, check that there are no leaks or trapped air in the circuit.
- Tighten the nut (659) until a minimum play is obtained between the brace (662) and the control lever (660), so that the hand brake rod (663) does not remain taut when the brake is disengaged. When the pedal free travel becomes greater than 80 to 100 mm owing to wear of friction discs, it can be adjusted again by means of the adjuster nuts (661).

The friction discs must be replaced if the nuts (661) use all the threaded part of their respective rods after further adjustments.

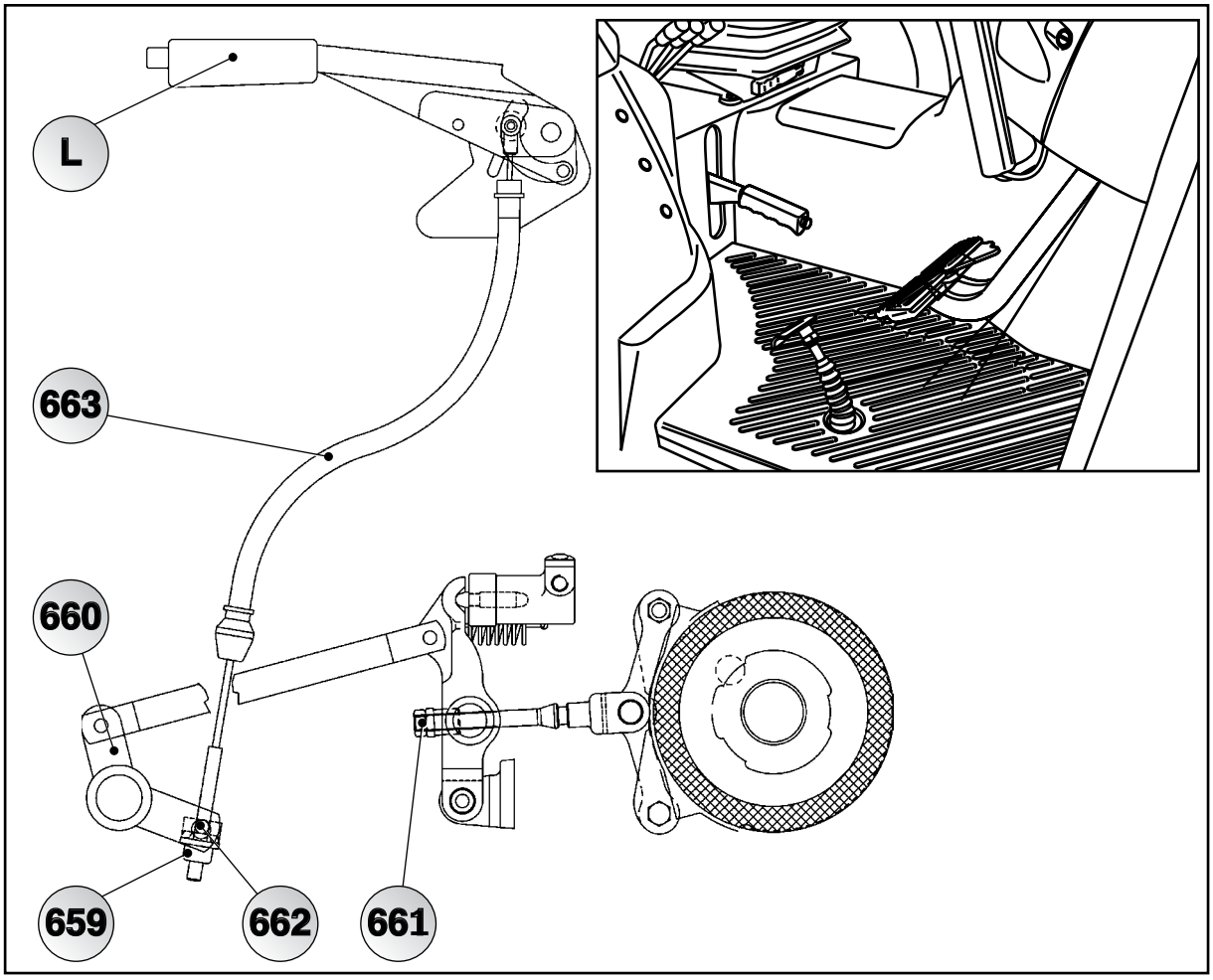


Fig. 4.294

606 - Control lever
659 - Parking brake lever adjuster nut
661 - Brake pedal lever adjuster nut
662 - Latch for parking brake rod
663 - Parking brake cable

4.10 Control levers

4.10.1 Drawing of assembly and main components

Speed Four/Five version

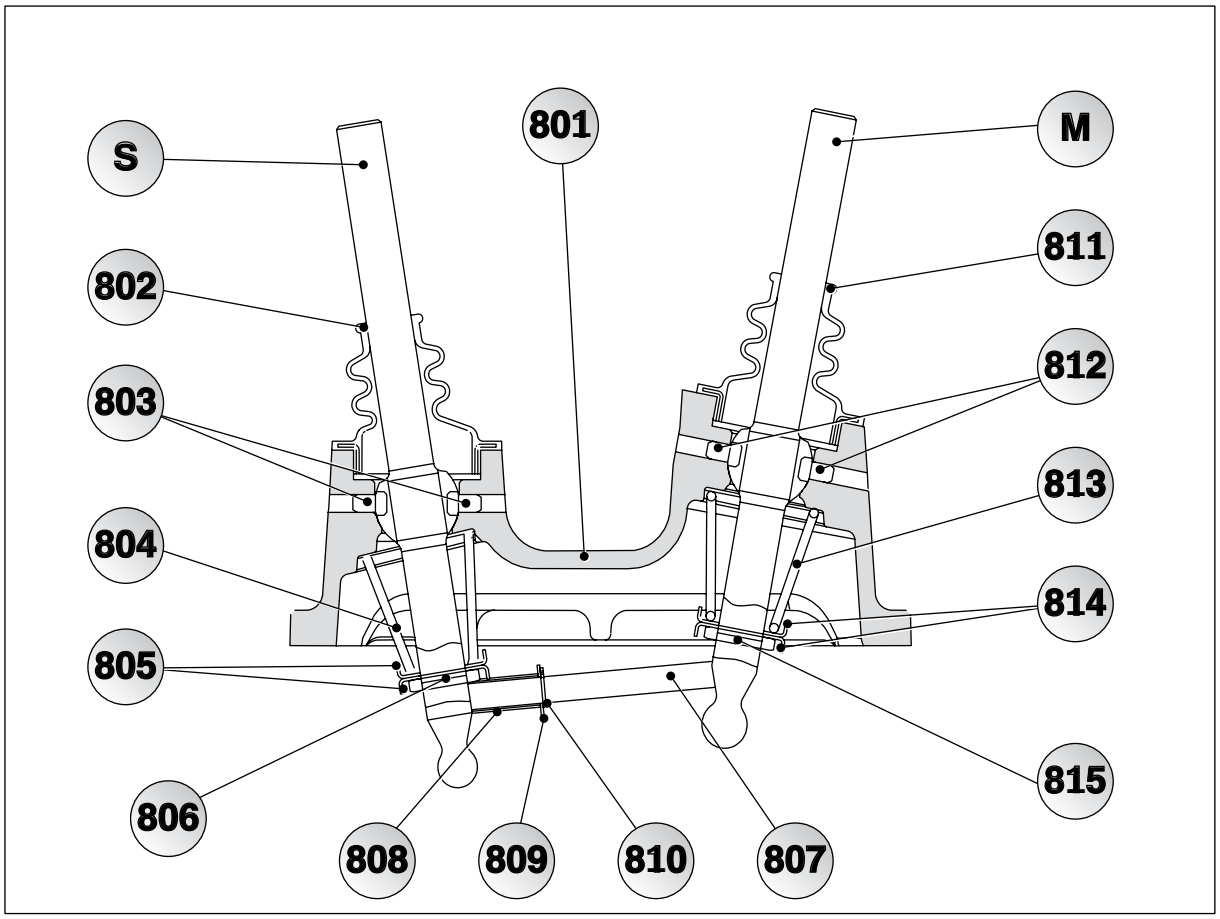


Fig. 4.295

S - Reverse shuttle control lever
M - Gearshift lever
801 - Cover (Speed Four/Five version)
802 - Lever cover
803 - Lever guiding pin
804 - Spring
805 - Spring guide disc
806 - Spring pin
807 - Switch pawl
808 - Pawl spring
809 - Plain washer
810 - Spring ring
811 - Lever cover
812 - Lever guiding pin
813 - Spring
814 - Spring guide disc
815 - Spring pin

Power Shuttle version

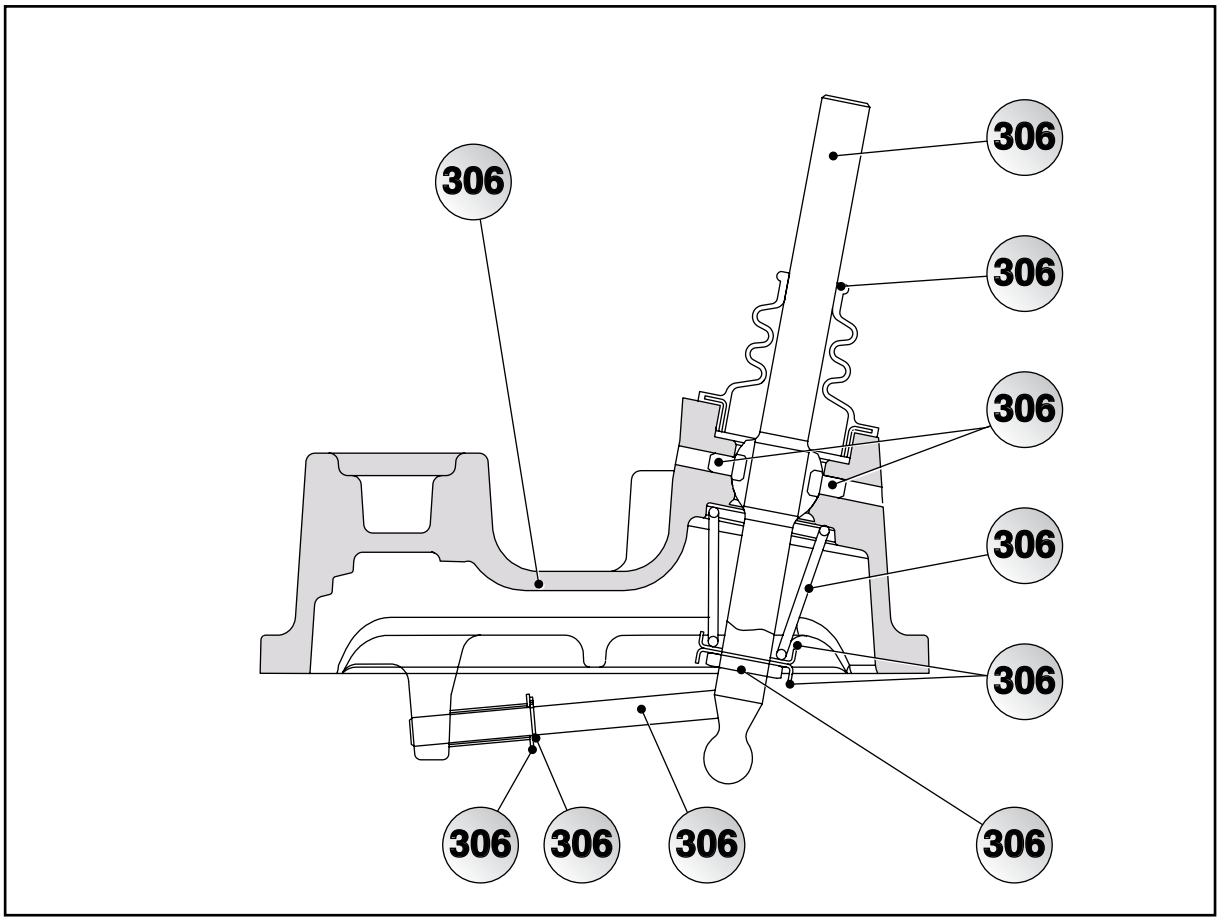


Fig. 4.296

M - Gearshift lever
816 - Cover (Power Shuttle version)
817 - Lever cover
818 - Lever guiding pin
819 - Spring
820 - Spring guide disc
821 - Spring pin
822 - Switch pawl
823 - Plain washer

4.10.2 General description

The gearshift (M) and reverse shuttle (S) levers (Speed Four/Five version) are located on the cover of the axle housing. They shift the synchro rings in the gearbox housing by means of rods and forks. Tractors with hydraulic reverse shuttle feature only the gearshift lever on the axle housing cover (M) since the driving direction is obtained by controlling the clutch assemblies of the “Power Shuttle” module.

Ranges and creeper (if mounted) are controlled by the lever (G), on the left-hand side of the gearbox housing.

The H-shaped movement of the lever engages the relative range, thanks to the axial displacement of the sleeves with frontal toothing. The lever (826) connects lever (G) with the range engaging fork through blocks (962 - 963) and rods (964 - 965).

The spring (828) keeps lever (826) stopped against the block (963).

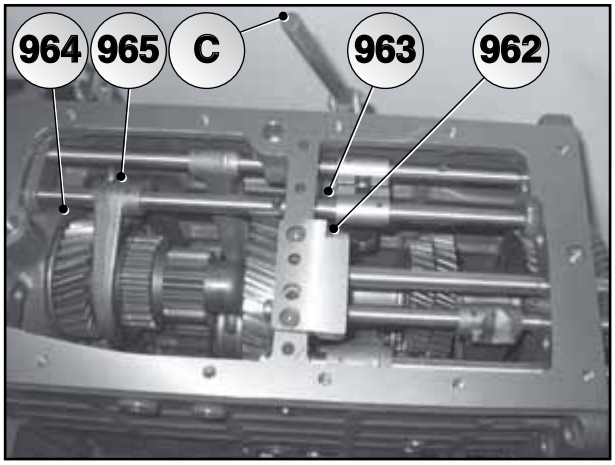


Fig. 4.297

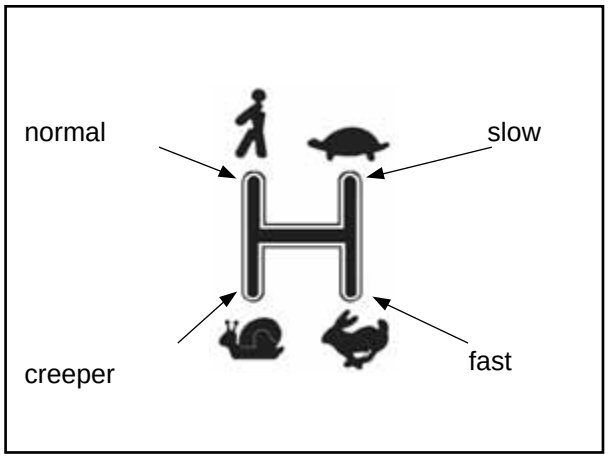


Fig. 4.298

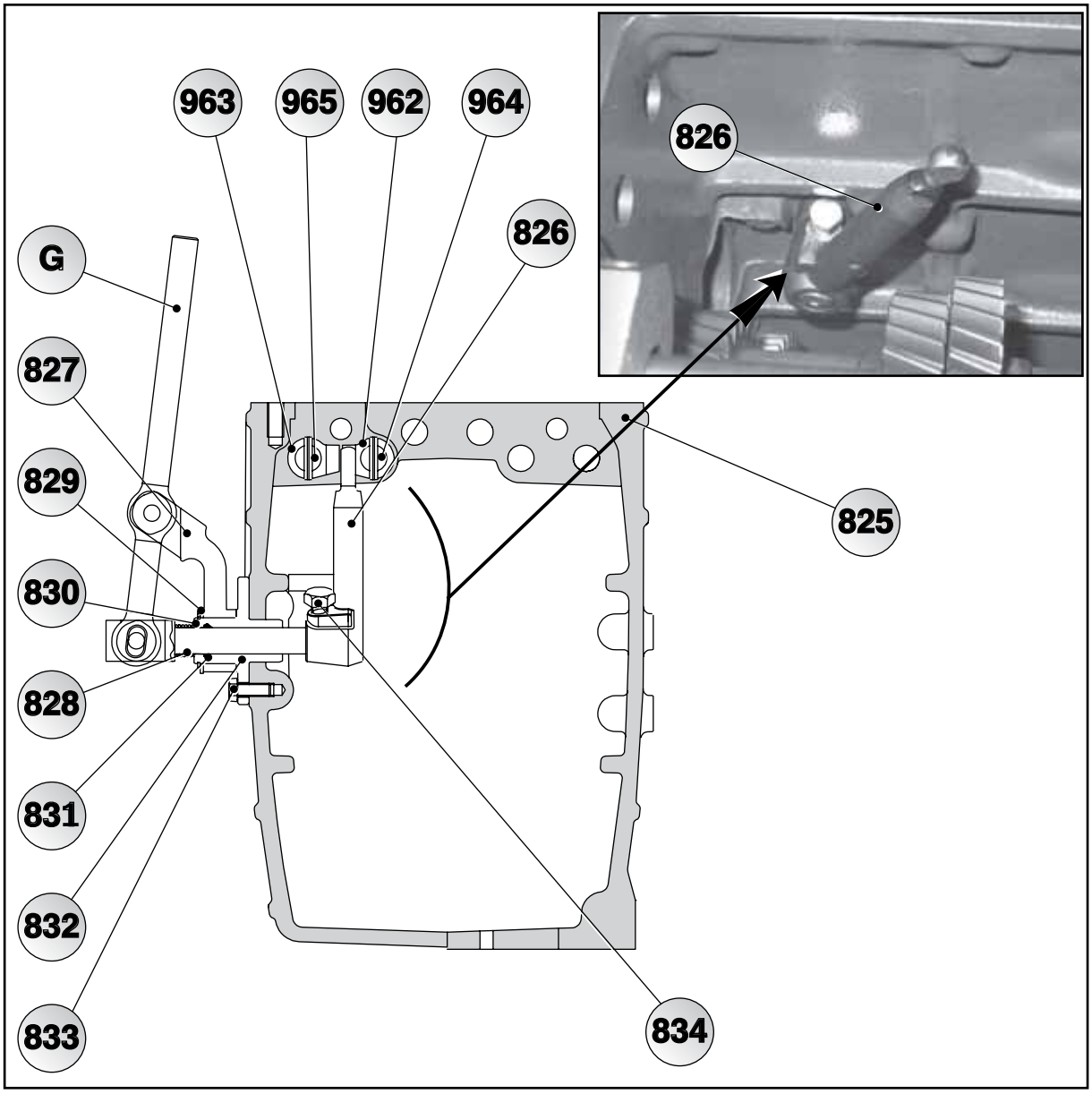


Fig. 4.299

The pins (835 and 836) (837 in the 2WD version) are installed on the axle cover (801-816) near the gearshift lever. They contact the transmission block (838) and their purpose is to return the control lever (M) to the central position in the moment a gear is disengaged (M lever in “neutral”). The combined operation of the springs (839 and 840) (841 in the 2WD version) makes the control lever (M) move more easily.

In the 2WD versions, the pins (836 and 837) play the same role as in the 4WD versions. The pin (835) is replaced by a longer one (837) to avoid that the lever (M) moves toward the 5th speed engagement.

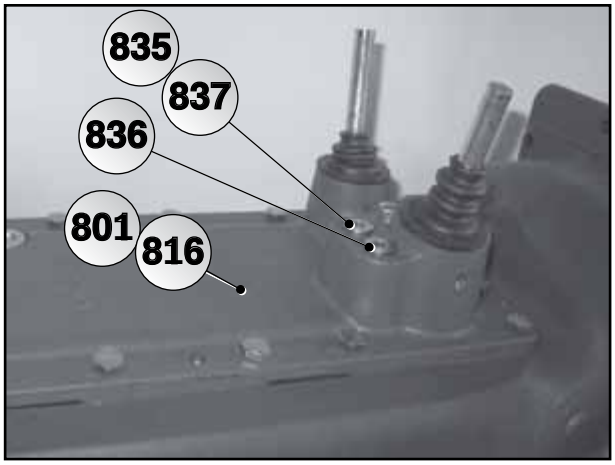


Fig. 4.300

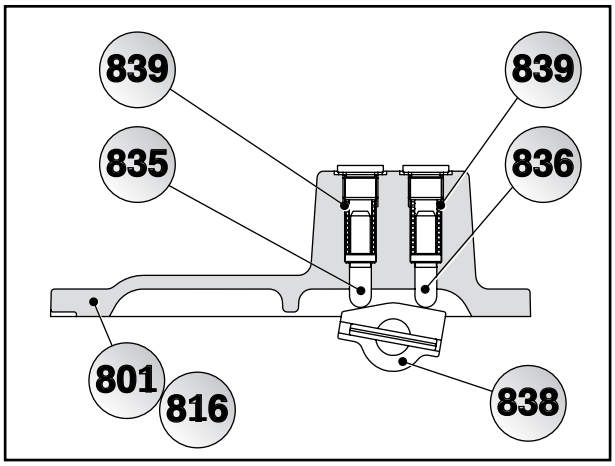


Fig. 4.301

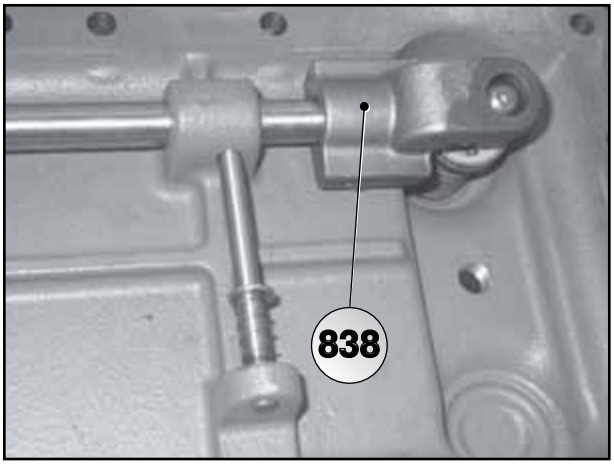


Fig. 4.302

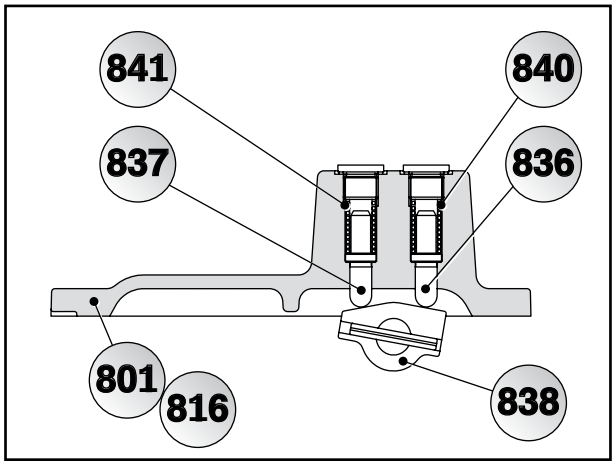


Fig. 4.303

"Safety" pawls

In the middle part, just under the cover of the gearbox housing, three "safety" pawls are installed for the gearshift and range control levers.

These three pawls (842), (843) and (844) act on the grooves in the rods; in this way they avoid that two speeds/ranges are engaged simultaneously.

The balls and springs retain the control rods in the position selected by the operator.

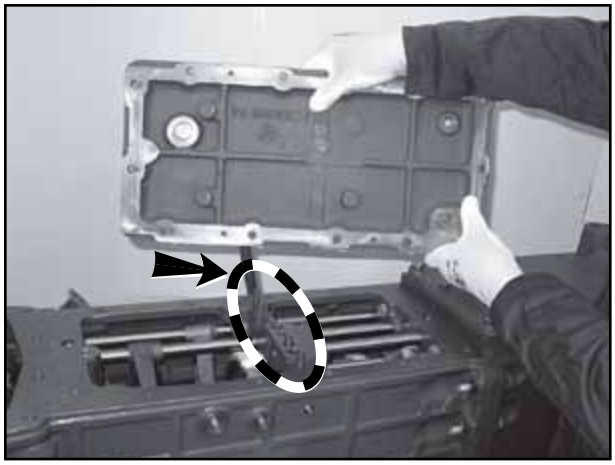


Fig. 4.304

842 - 3rd - 4th - 5th speed safety pawl
843 - 1st - 2nd speed safety pawl
844 - Speed range safety pawl
954 - Control rod for 1st - 2nd speed fork
955 - Control rod for 3rd - 4th speed fork
956 - 5th speed fork control rod
964 - Control rod for normal range/creeper
965 - Control rod for low/high range

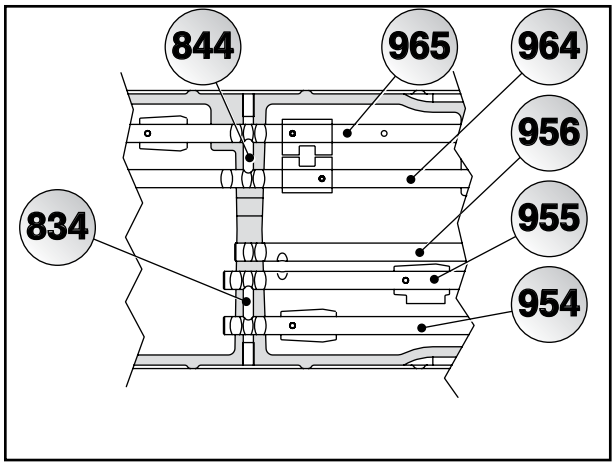


Fig. 4.305

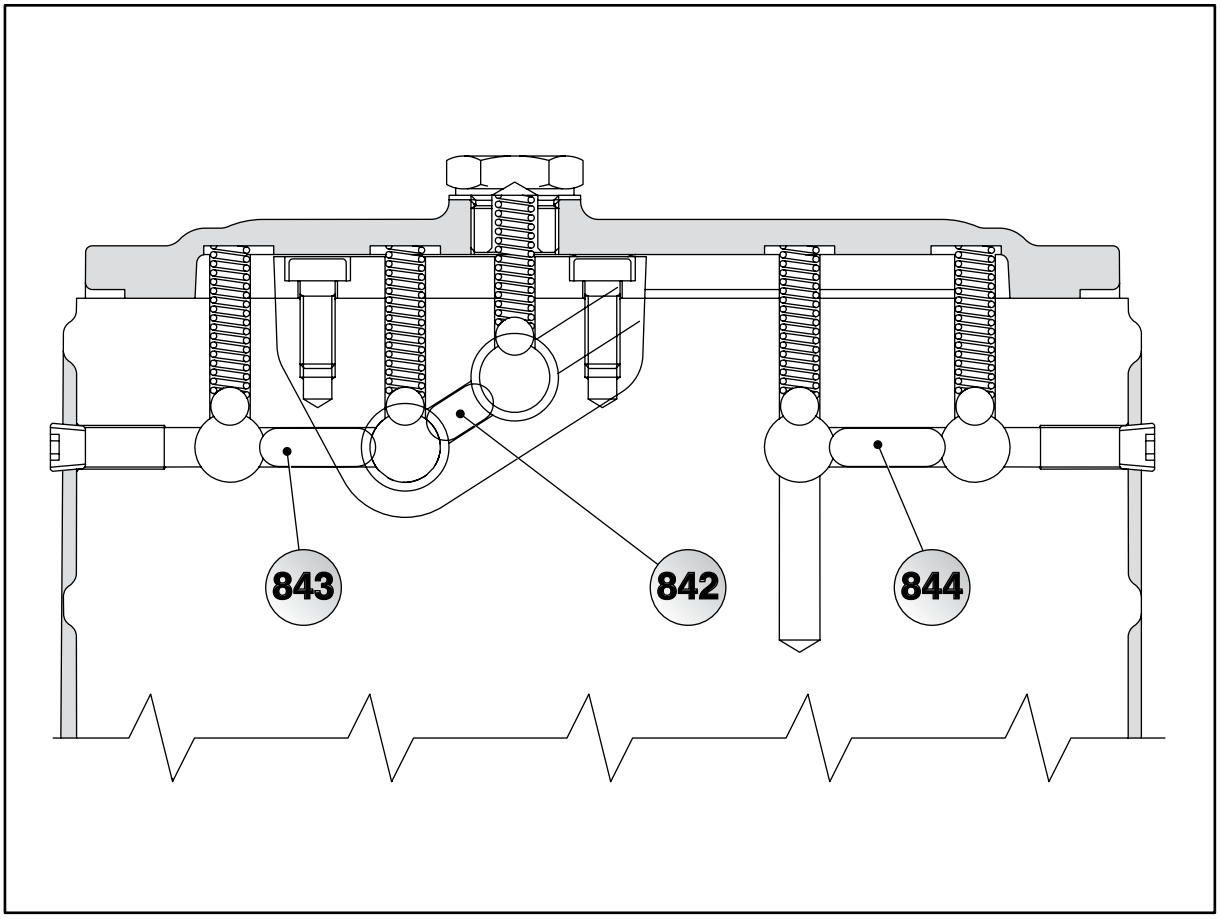


Fig. 4.306

4.10.3 Driving torques and sealants

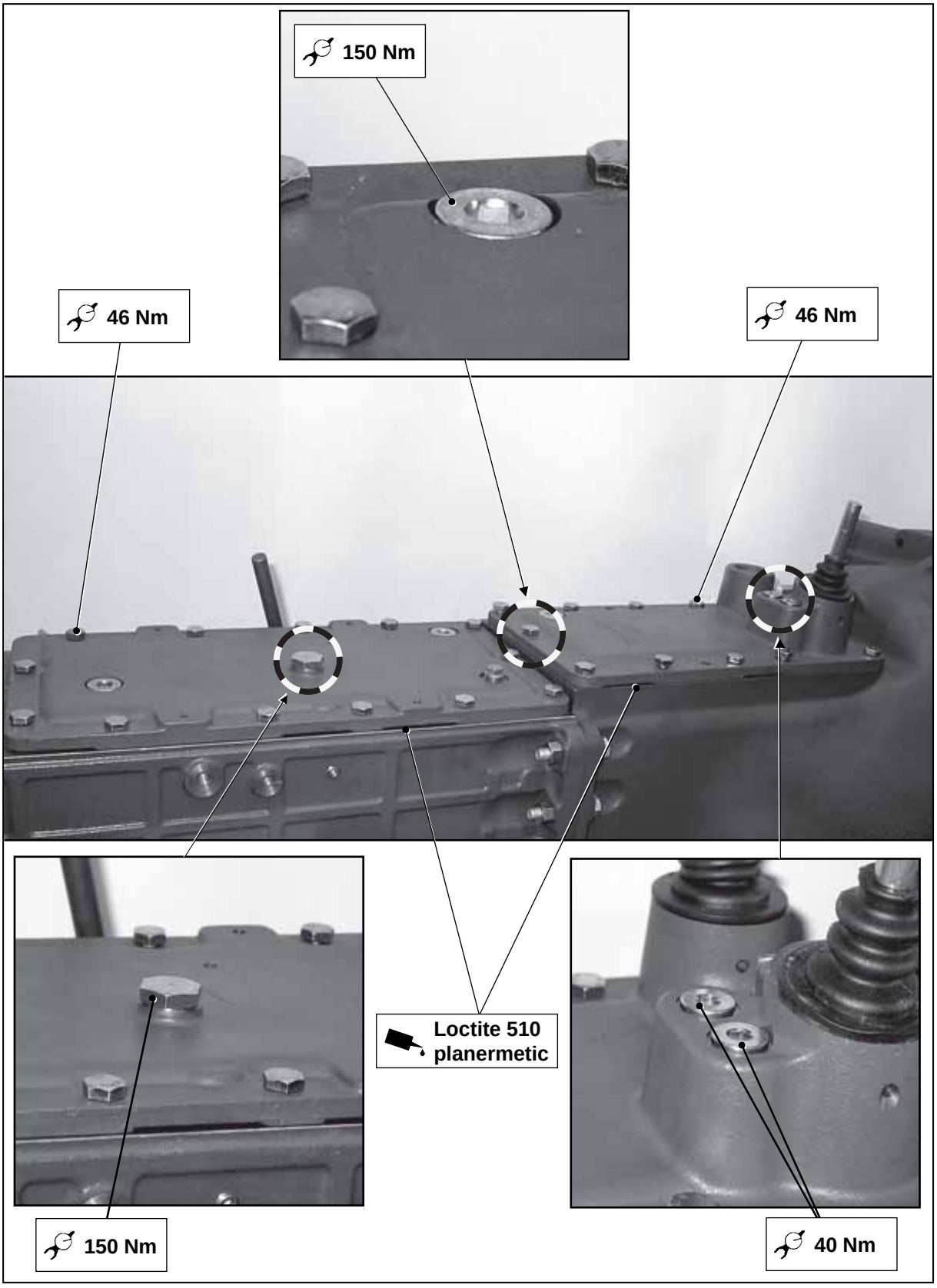


Fig. 4.307

- Driving torque
- Type of sealant

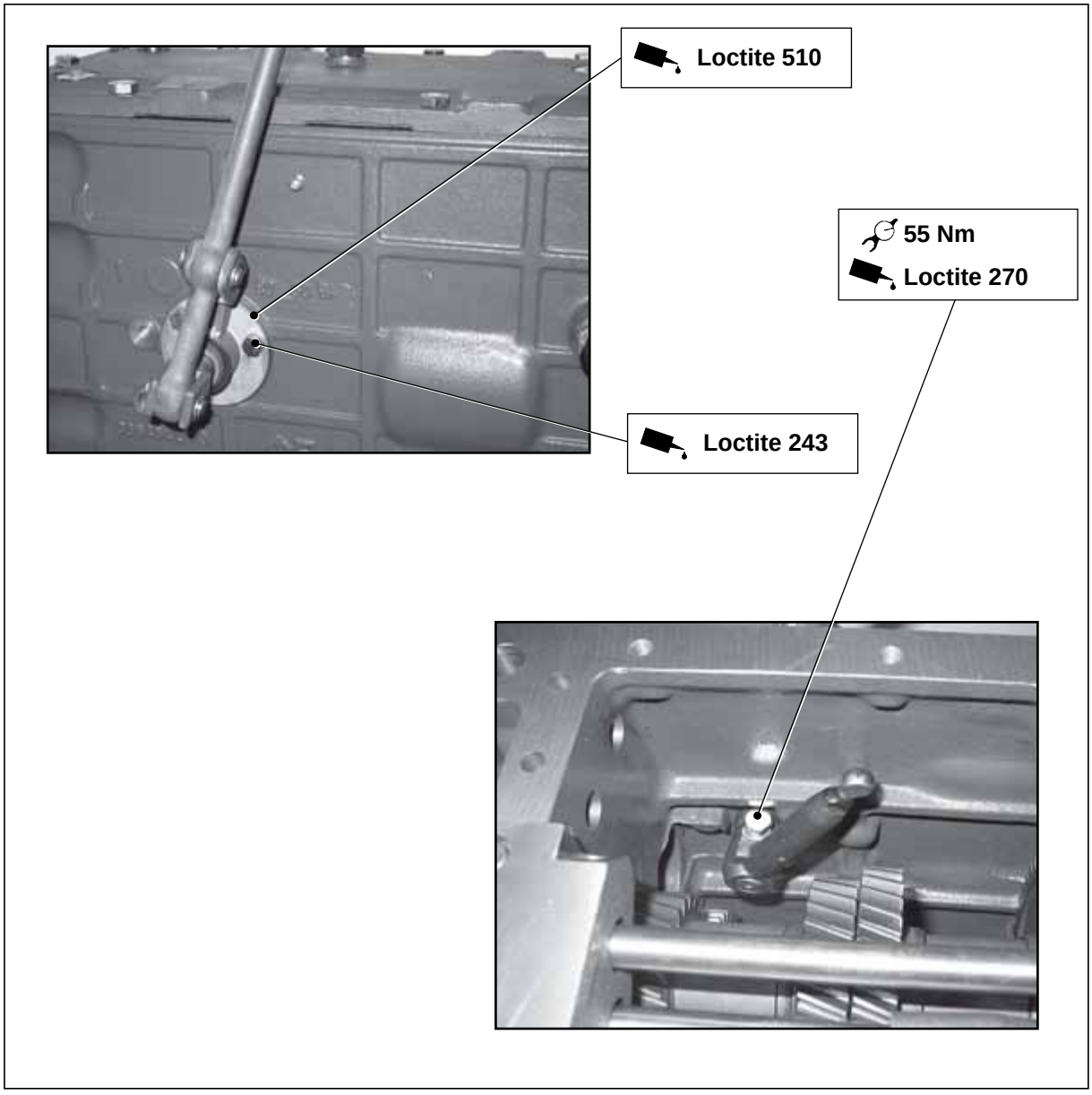


Fig. 4.308

- Driving torque
- Type of sealant

Section 5 : Special tools

141 DS LG

Support for assembling and disassembling the main shaft-clutch assembly

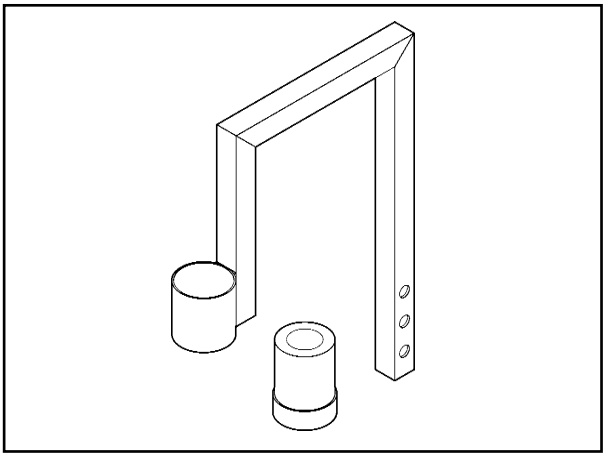


Fig. 4.309

143 DS LG

Compressor for assembling and disassembling the hydraulic clutch spring

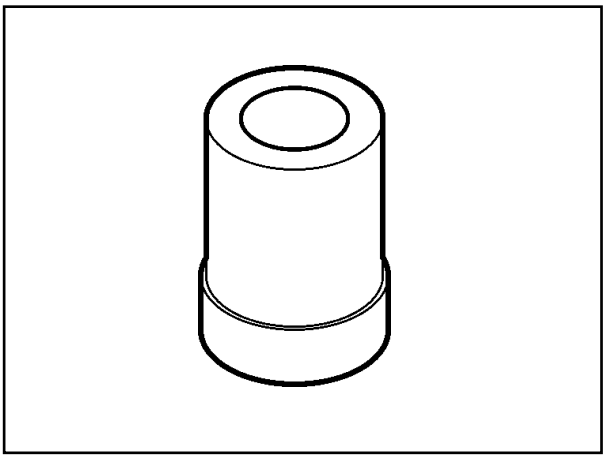


Fig. 4.310

01 DS VS

Bush to use with tool 141 DS LG for assembling and disassembling the Power Shuttle clutch shaft assembly

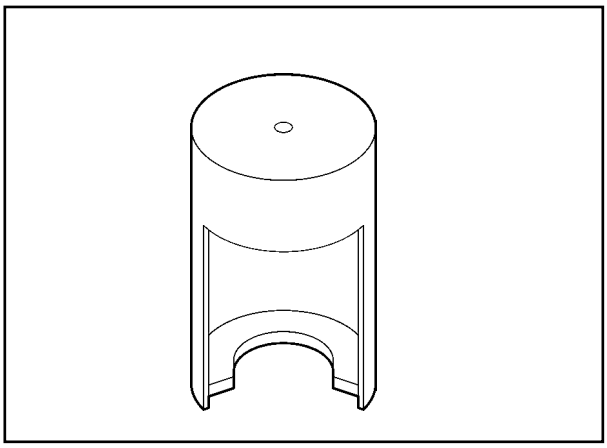


Fig. 4.311

02 DS VS

Bush to use with tool 141 DS LG for assembling and disassembling the Power Five clutch shaft assembly

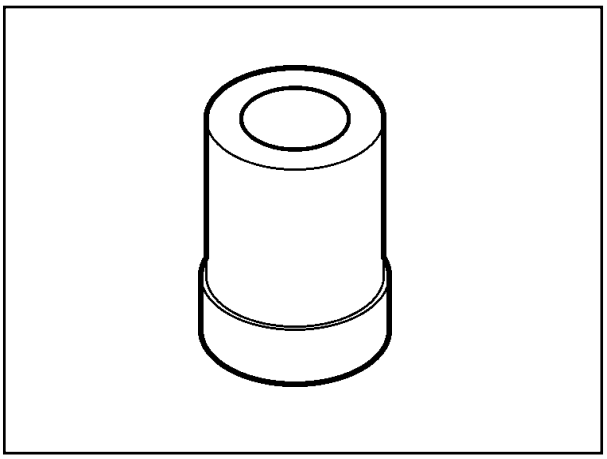


Fig. 4.312

03 DS VS

Plug for assembling the Power Five hub retention rings.

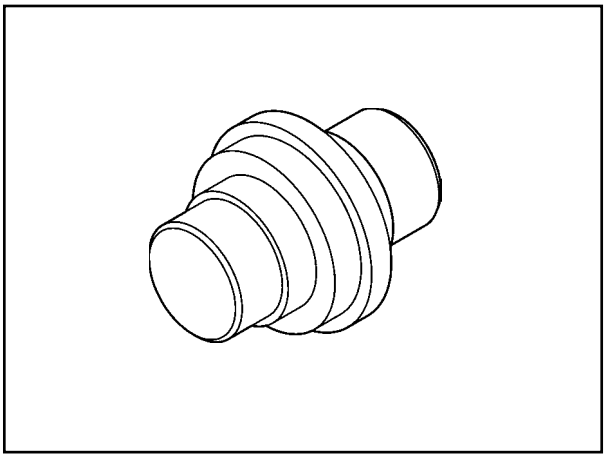


Fig. 4.313

01 CMB MYT

Support for disassembling and assembling the differential unit complete with ring gear.

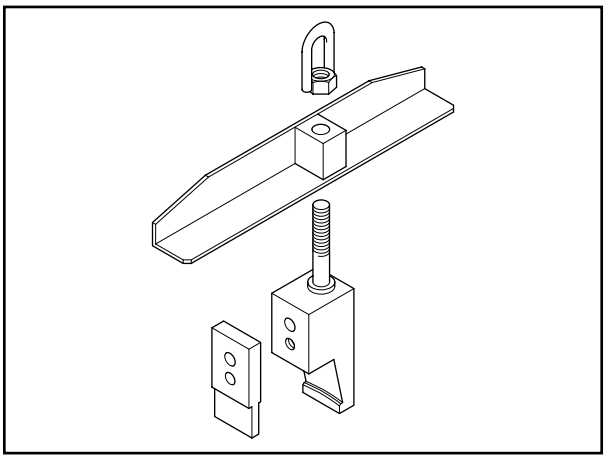


Fig. 4.314

02 DT MYT

Compressor for disssembling and re-assembling the Spring-on spring

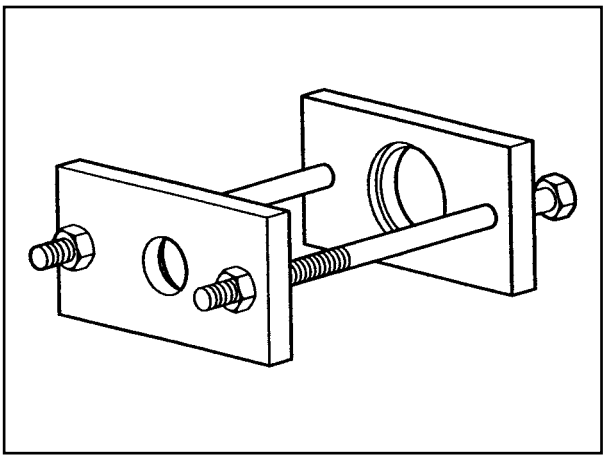


Fig. 4.315

01 DIF MYT

Dummy bearings.

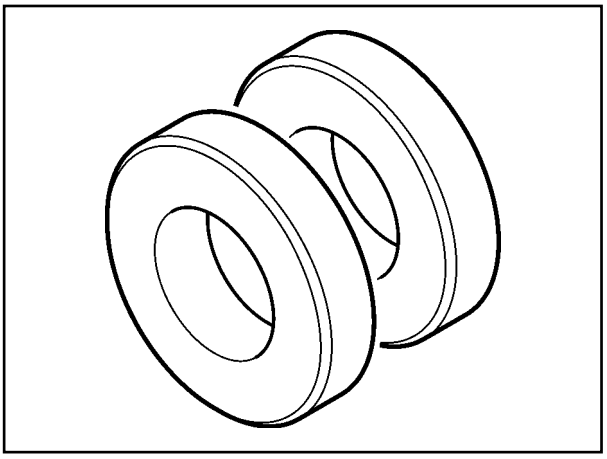


Fig. 4.316

03 CMB F-N Series

Wrench for bevel pinion nut.

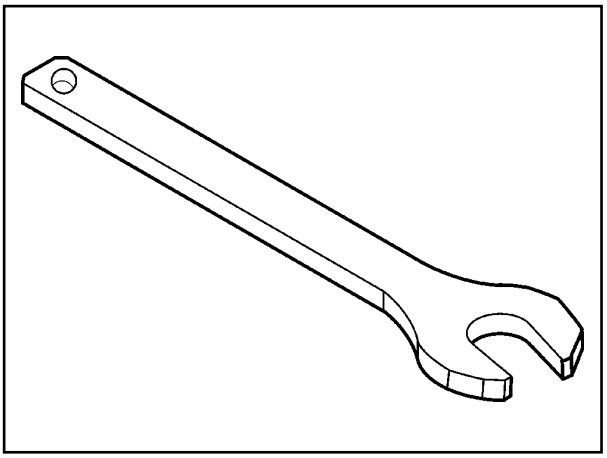


Fig. 4.317

02 CMB F-N Series

Differential lock spring re-assembly compressor.

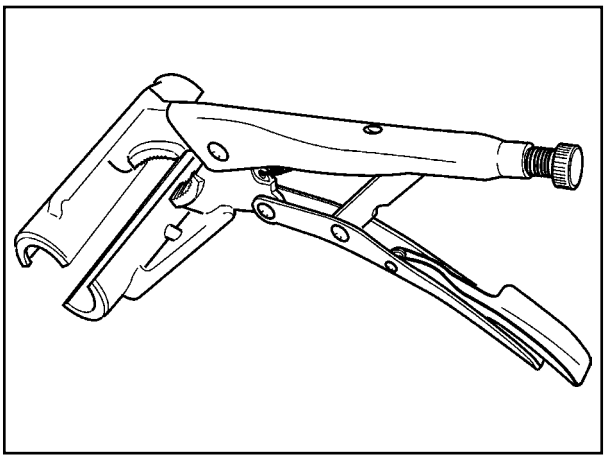


Fig. 4.318

26 PTO VS

Wrench for ring nut of transmission shaft.

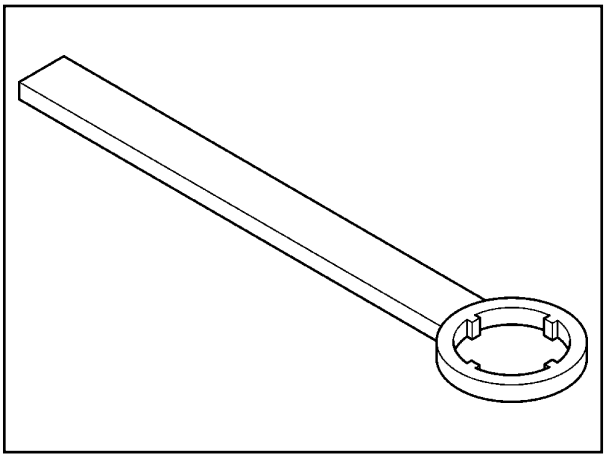


Fig. 4.319

02 DIF MYT

Bevel pinion bearing shim gauge

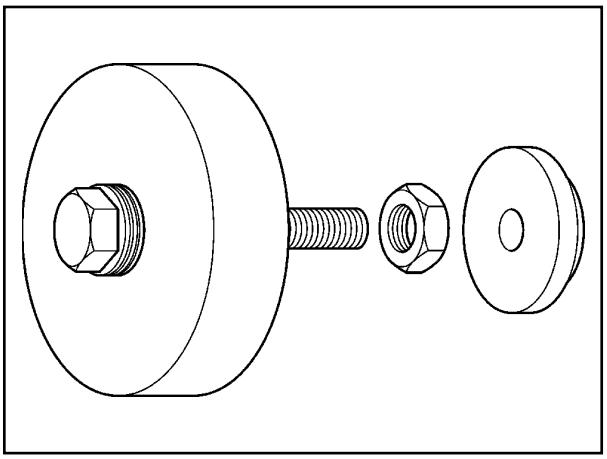


Fig. 4.320

02 DS F-N Series

Tool to introduce the main shaft into bearing of the Power Shuttle unit

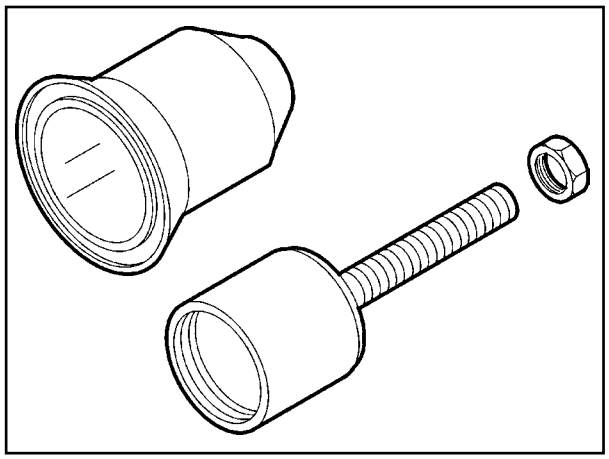


Fig. 4.321

Chapter 5 : Front axle

Index

Section 1 : Precautions and Safety Recommendations. 5-2

Section 2 : General description 5-3

2.1 Drawing of assembly and main components (Speed Five Power Shuttle version) 5-4
2.2 Drawing of assembly and main components (E-Line version) 5-6
2.3 Description of operation 5-8
2.4 4WD engagement (Spring-on) 5-12
2.5 4WD engagement during braking (E-Line version) 5-14
2.6 Front brakes 5-15

Section 3 : Technical specifications 5-17

3.1 Main technical specifications 5-18
3.2 Driving torques and sealants (Speed Five and Power Five version) 5-19
3.3 Driving torques and sealants (E-Line version) 5-20

Section 4 : Guide lines for disassembly, re-assembly and adjustments 5-21

4.1 Guidelines for disassembly 5-22
4.2 Guidelines for re-assembly, inspections and adjustments 5-28

Section 5 : Special tools 5-39

Section 1 : Precautions and Safety Recommendations.

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual. Carefully comply with the Warnings indicated by means of this symbol:

⚠	**Attention:** if the bolts that fix the safety frame or cab are loosened or if the actual safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

⚠	**Attention:** make sure that all persons keep a due distance away from the danger zone. Avoid vibrations when the bolts are loosened.

⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

⚠	**Attention:** avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

⚠	**Attention:** use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

⚠	**Attention:** handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

⚠	**Attention:** if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

Section 2 : General description

Index

2.1 Drawing of assembly and main components (Speed Five Power Shuttle version) 5-4

2.2 Drawing of assembly and main components (E-Line version) ... 5-6

2.3 Description of operation 5-8
2.3.1 Drive transmission 5-11

2.4 4WD engagement (Spring-on) 5-12
2.4.1 Description of Spring-on operation 5-13
2.4.2 How to disassemble the “Spring-on” unit 5-13

2.5 4WD engagement during braking (E-Line version) 5-14

2.6 Front brakes 5-15

2.1 Drawing of assembly and main components (Speed Five Power Shuttle version)

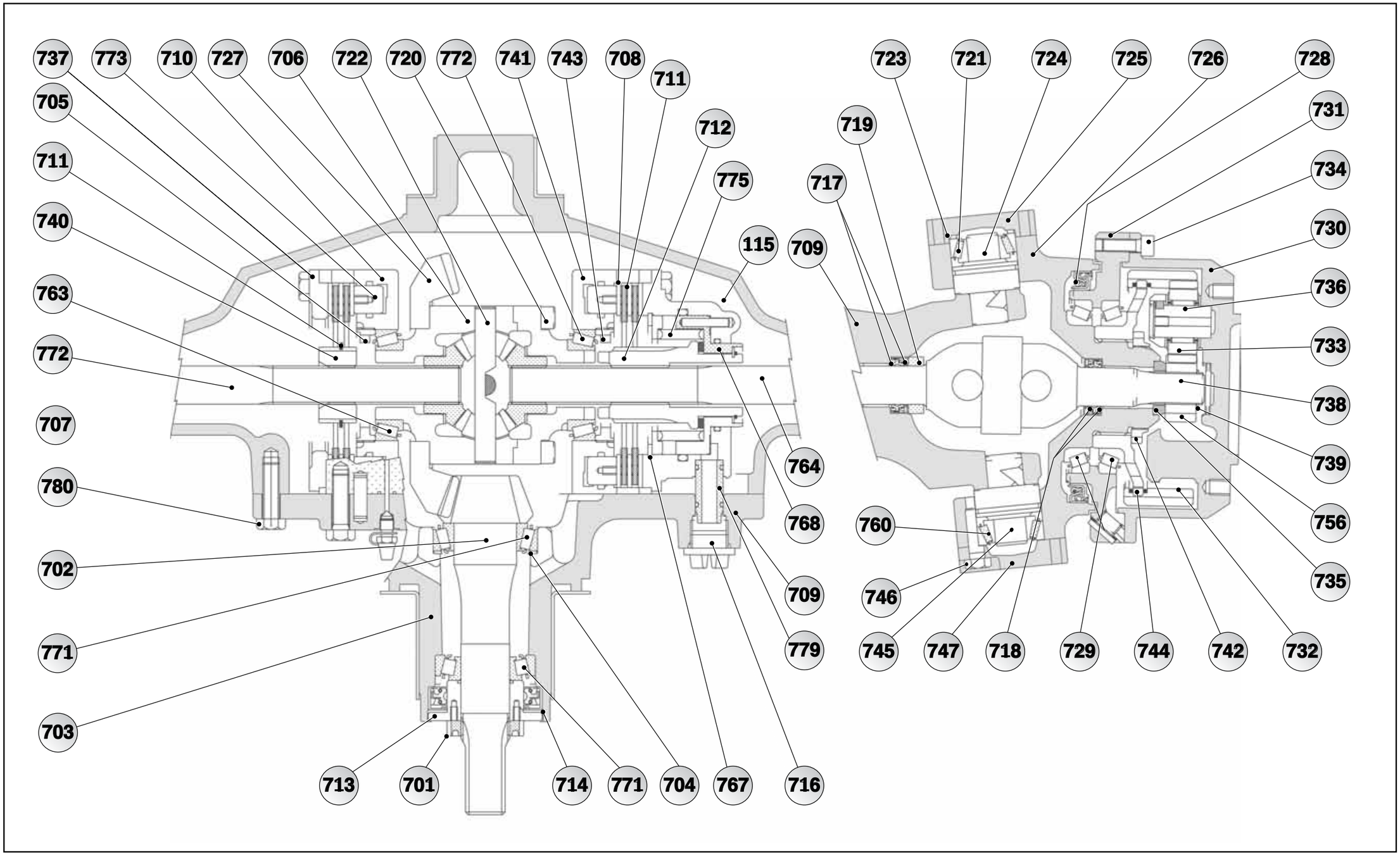


Fig. 5.1

801 - Ring nut
802 - Bevel pinion
803 - Complete rear support
804 - Adjustment shims
805 - Ring nut (lh)
806 - Differential assembly
807 - Screw
809 - Complete axle assembly
810 - Support (lh)
813 - Spacer
814 - Retention ring
717 - Retention ring
718 - Retention ring
719 - Axle shaft guard
820 - Screw
721 - Taper roller bearing
822 - Planetary pin
723 - Adjuster shims
724 - Pin
725 - Upper cover
726 - Fork
827 - Ring gear
728 - Retention ring
729 - Taper roller bearing
730 - Hub
731 - Plate
732 - Final drive ring gear
733 - Planetary gear
734 - Cover fixing screw
735 - Spacer
736 - Planetary gear pin
738 - Axle shaft end
739 - Outer spring ring
841 - Support (rh)
742 - Ring gear fixing nut
843 - Ring nut (rh)
744 - Flange
745 - Lower pin
746 - Cover fixing screw
747 - Lower cover
760 - Taper roller bearing
863 - Complete lh axle shaft
864 - Complete rh axle shaft
871 - Taper bearings for pinion
872 - Differential housing taper bearings
880 - Screw

2.2 Drawing of assembly and main components (E-Line version)

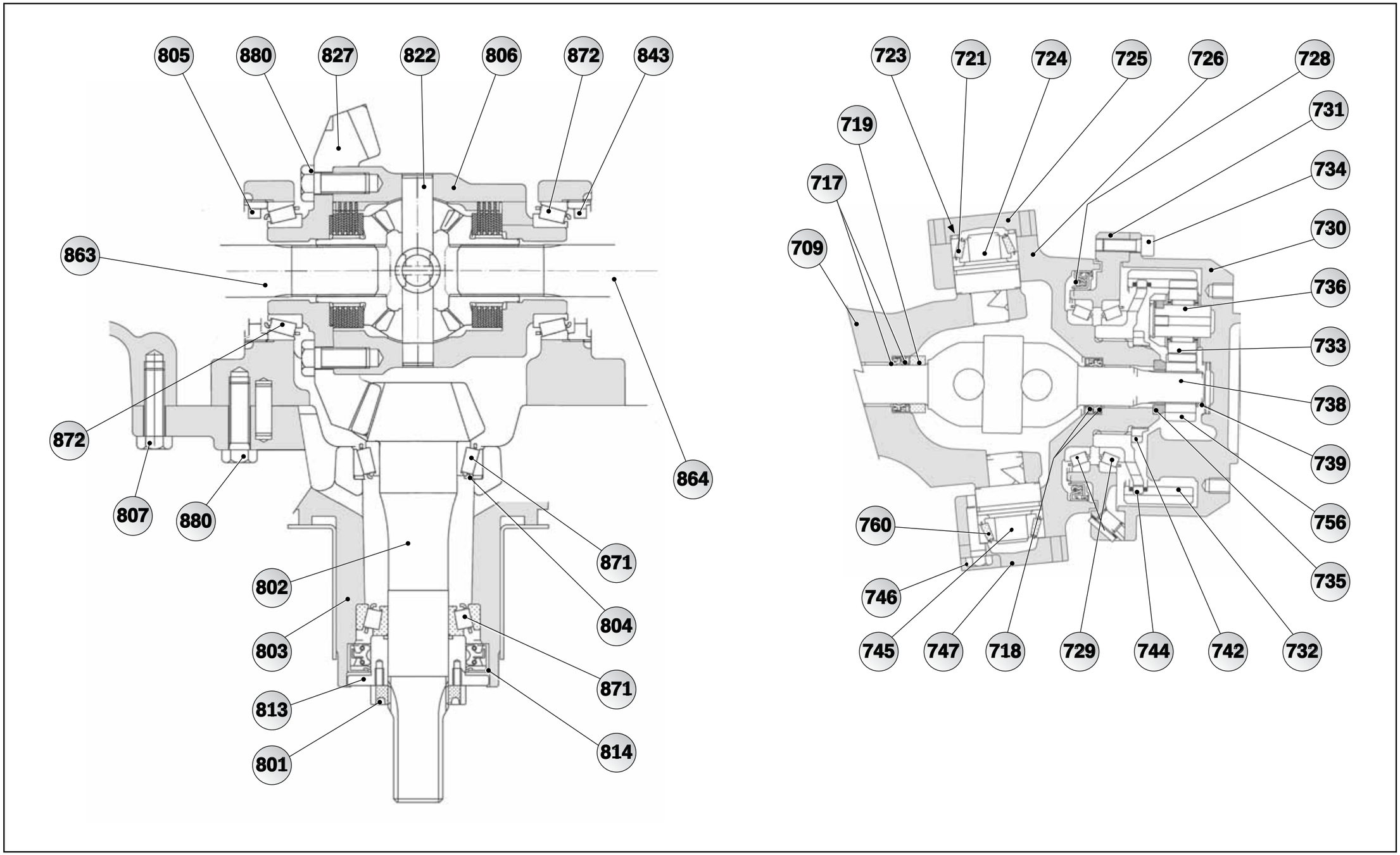
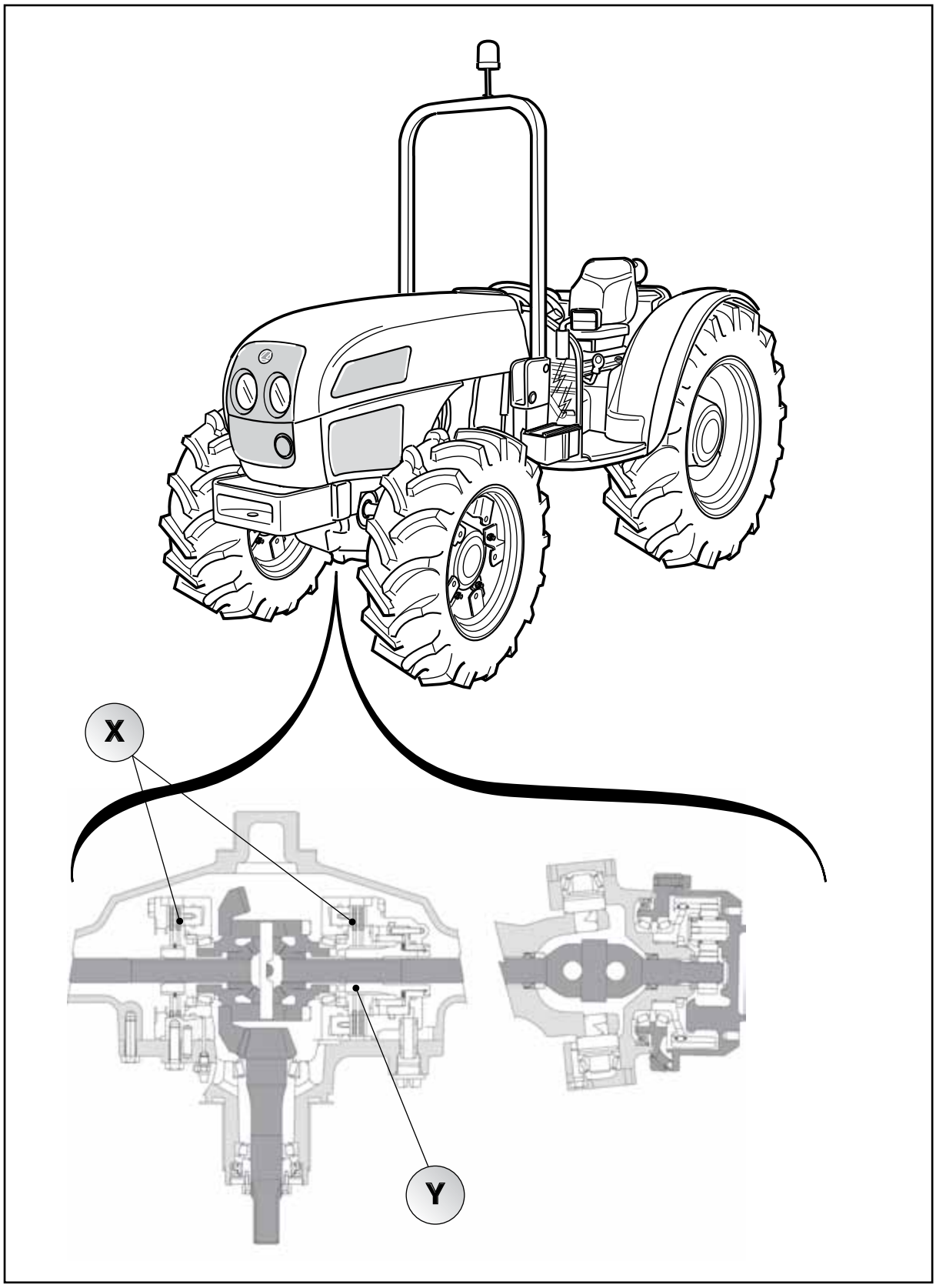


Fig. 5.2

2.3 Description of operation

Speed Five/Power Five version



Y - Electrohydraulic differential lock "**Hydralock**"
X - Oil-cooled disc brakes

Fig. 5.3

It is a very strongly built axle able to support and bear the front part of the tractor through hinging to the radiator core, where very heavy ballast can be installed as well as various other components such as forks, loaders, front PTO complete with power lift, etc...

The central structure houses the mechanically engaged bevel gear pair-differential assembly (Y Fig.5.3), electrohydraulically controlled by means of a button (Speed Five version with Power Five). In 4WD versions, drive received from the 4WD housing on the rear differential housing reaches the front driving wheels by means of the relative axle shafts and epicyclic final drive assemblies slightly in advance (by 1 to 4%) of the rear wheel turns.

The oil-cooled brake discs (X Fig.5-3) are installed in the internal part (Speed Five and Power Five version), at the sides of the differential and keyed to the axle shafts, along with the relative piston activated by a hydraulic control through the pressure exercised on the latched brake pedals, at the same time as the rear brakes.

The ~ 55° (4WD) ~ 52° (2WD) maximum turning radius is achieved by means of a balanced double-acting cylinder supplied by the steering valve system and operated by the steering wheel.

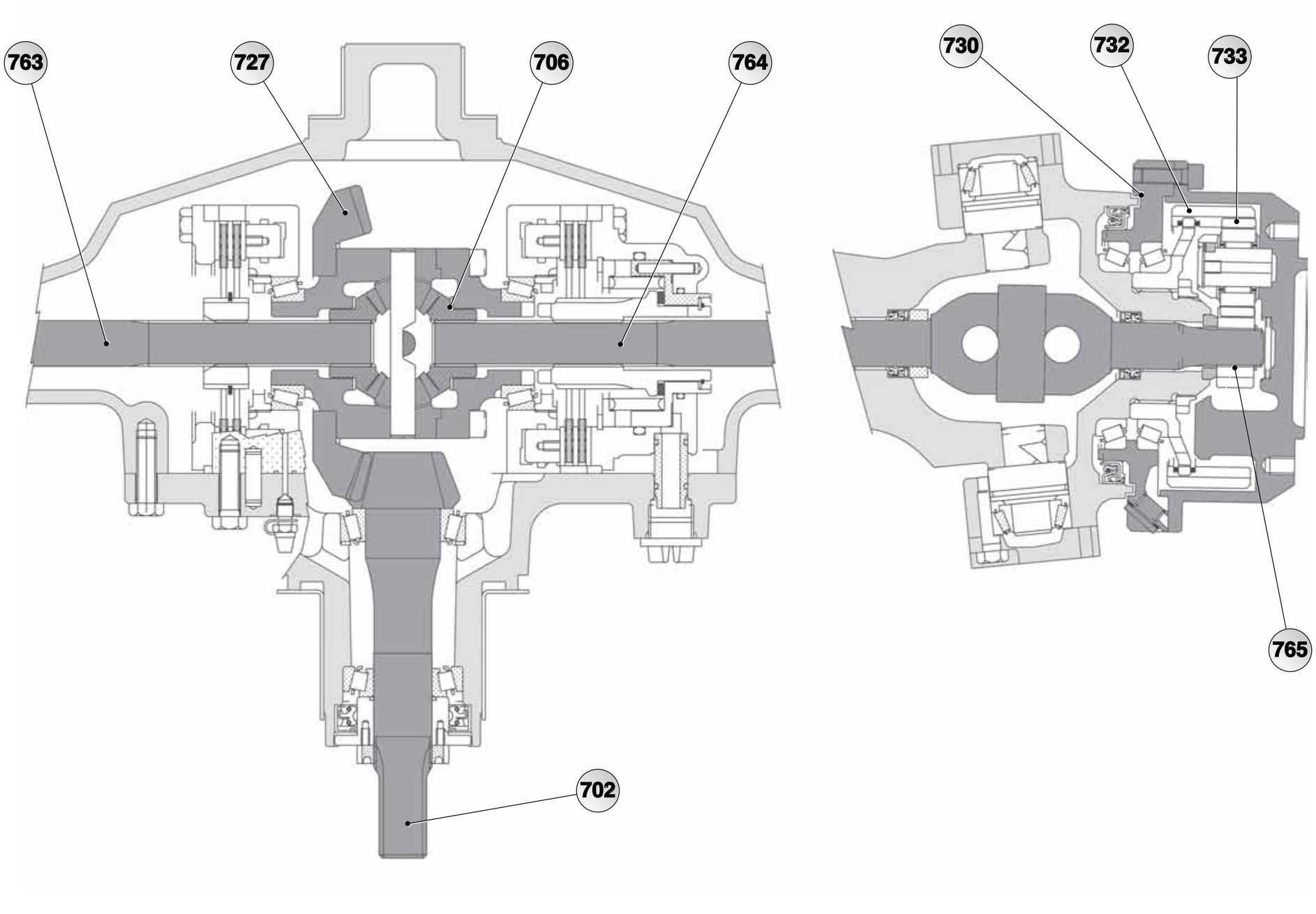


Fig. 5.4

2.3.1 Drive transmission

Drive is transmitted by the Spring-on transmission shaft (401 Fig.5-5) in the 4WD housing, to the front bevel pinion (760) coupled to the ring gear (761 Fig.5-4).

Passing through the differential housing (762), drive reaches the lh (763) and rh (764) axle shaft. Drive then enters the side final drives. It passes through the crown wheel (737), the planetary gear (733) and the ring gear (732) until it reaches the hub (730) fitted with the wheel (Fig.5.4).

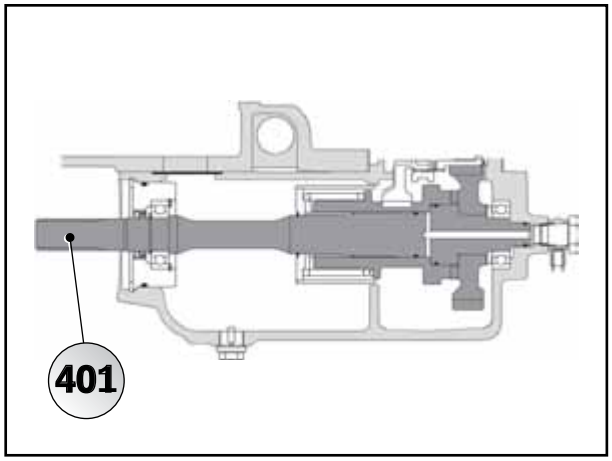


Fig. 5.5

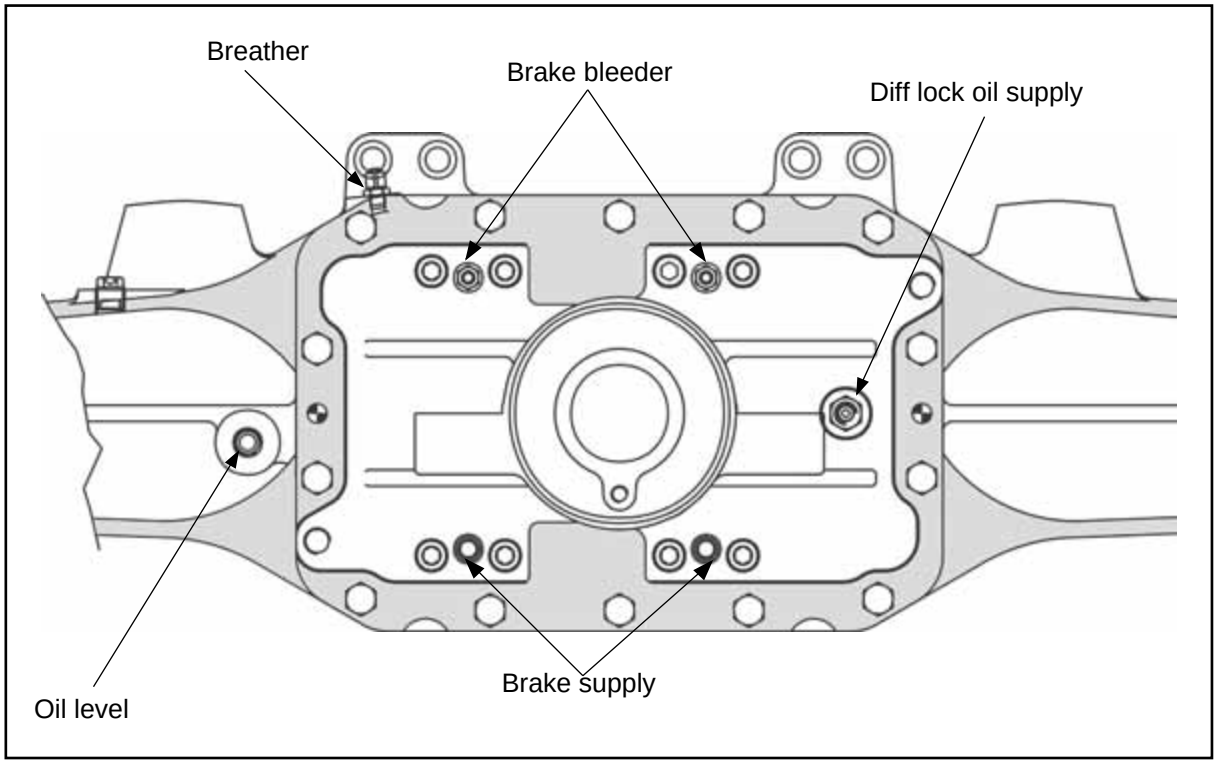


Fig. 5.6

2.4 4WD engagement (Spring-on)

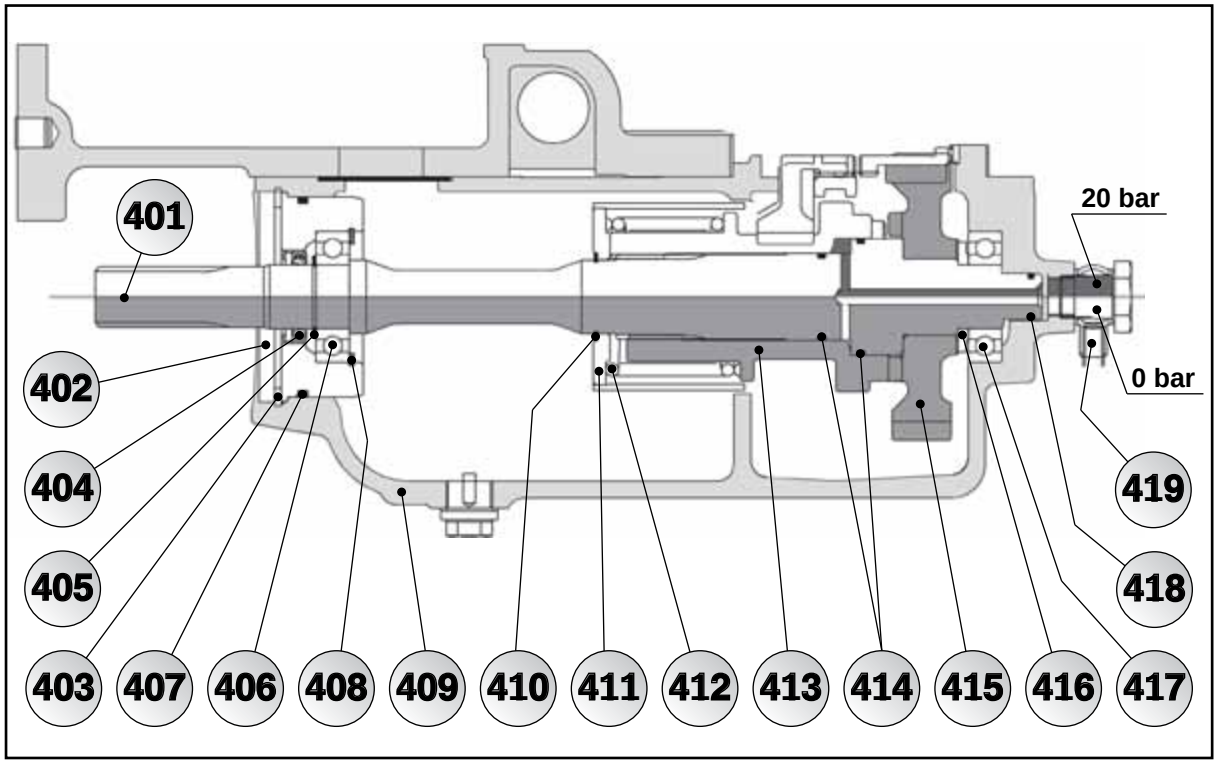


Fig. 5.7

401 - Spring-on transmission shaft
402 - Front bearing support
403 - Spring ring
404 - Retention ring
405 - Spring ring
406 - Ball bearing
407 - O-ring
408 - Spring ring
409 - 4WD housing
410 - Spring ring
411 - Thrust washer with guard
412 - 4WD engaging spring
413 - 4WD engaging sleeve
414 - O-rings
415 - Driven gear
416 - Shimming washer
417 - Ball bearing
418 - Retention ring
419 - Supply union (20 bar)

2.4.1 Description of Spring-on operation

The "**Spring-on**" is a device that mechanically engages the four driving wheels. Disengagement is hydraulically controlled by means of the switch (SA11). When the tractor engine is off, the four-wheel drive is always engaged, thus guaranteeing a safe braking action.

When the tractor is on the move, 4WD can be engaged or disengaged by means of the switch (SA11).

The 4WD is disengaged thanks to the oil that flows into the duct (419) at a pressure of 20 bar, and shifts the engaging sleeve (413) in the axial direction, thus compressing the spring (412).

The section of the sleeve (443) is shown in the upper part (ON) in the 4WD engaging phase and in the lower part (OFF) in the disengaging phase.

Fig. 5.8

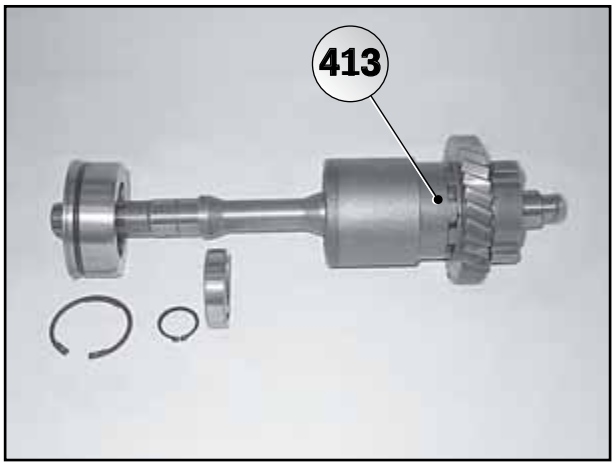


Fig. 5.9

2.4.2 How to disassemble the "Spring-on" unit

Disassemble and re-assemble the Spring-on unit with the aid of tool **02 DT MYT**. This compresses the spring (412) and allows the spring ring (410) to be disassembled and re-assembled again.

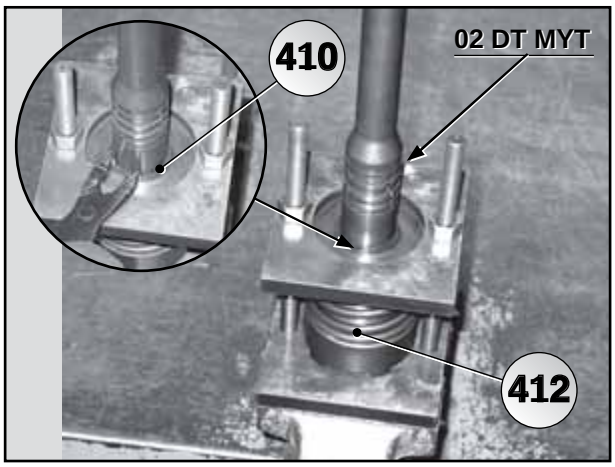


Fig. 5.10

2.5 4WD engagement during braking (E-Line version)

The **F-N Series E-Line** versions allow the 4WD to be engaged during the braking action, to support the assist of the rear brakes. When the brake pedals are operated, the solenoid valve (YV3) de-energizes, thus freeing the action of the spring of the Spring-on unit and engaging the four-wheel drive. The switch (SP2) on the brake pump, just under the dashboard covering, shuts off the power transmitted to the solenoid valve (YV3), thus de-energizing it.

When the brake pedals are depressed (individually or latched), they transmit a signal to the solenoid valve (YV3). By de-energizing, this latter shuts off the flow of pressurized oil (20 bar) to the 4WD unit, thus freeing the movement of the spring (Spring-on) in order to mechanically engage the four-wheel drive. When the brake pedals are released, the solenoid valve (YV3) returns to the energized status, thus allowing pressurized oil to flow and disengage the 4WD.

Fig. 5.11

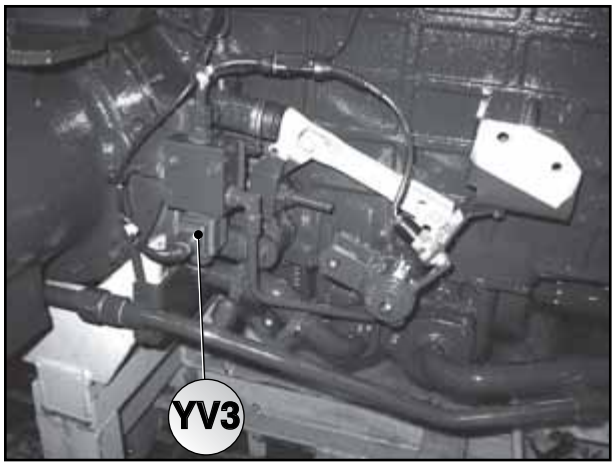


Fig. 5.12

2.6 Front brakes

The oil-cooled disc brakes installed in **F-N Series Speed Five and Power Five version**tractors, ensure IBS integral braking on all four wheels with monitoring valve. This latter brakes with the rear wheel only when a single pedal is used for braking and the brake pedals are not latched together during work on field or when turning in a tight space, or braking on all 4 wheels when pedals are latched (transport or driving on the roads).

There are two plates per side. No adjustments are required during assembly.

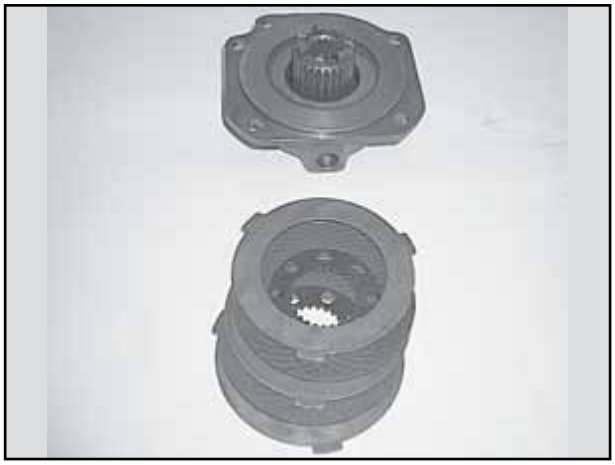


Fig. 5.13

Section 3 : Technical specifications

Index

3.1 Main technical specifications 5-18
3.1.1 Axle 5-18
3.1.2 Brakes 5-18

3.2 Driving torques and sealants (Speed Five and Power Five version) 5-19

3.3 Driving torques and sealants (E-Line version) 5-20

3.1 Main technical specifications

3.1.1 Axle

Axle with 4 driving wheels

Manufacturer	DX
Type of axle (4WD)	In spheroidal cast iron, pivoting at the center around two supports
Type of reductions	Central pinion and ring gear
Meshing control	Spring-on with electrohydraulic disengagement
Max. steering angle	55°

Ratios

Mod. 60GE-70GE-80GE-75GE-85GE-95GE-105GE	Interflange	1282
	Bevel gear pair	11/32
	Epicyclic final drives	1:4,6
	Total reduction ratio	1:13,3818
Mod. 60F	Interflange	1282
	Bevel gear pair	11/38
	Epicyclic final drives	1:4,6
	Total reduction ratio	1:15,8907
Mod. 70F-80F-75F-85F-95F-105F	Interflange	1282
	Bevel gear pair	11/34
	Epicyclic final drives	1:4,6
	Total reduction ratio	1:15,64
Mod. 75XL-85XL-95XL-105XL	Interflange	1442
	Bevel gear pair ratio	11/34
	Epicyclic final drives	1:4,6
	Total reduction ratio	1:15,64

Axle with 2 driving wheels

Manufacturer	DX
Type of axle (2WD)	in spheroidal cast iron, swinging around a central pivot
Max. steering angle	52°

3.1.2 Brakes

Brakes (Speed Five and Power Five version)

N° plates	2 per side
Outer plate diameter	143 mm
Total braking area	764 cm2

3.2 Driving torques and sealants (Speed Five and Power Five version)

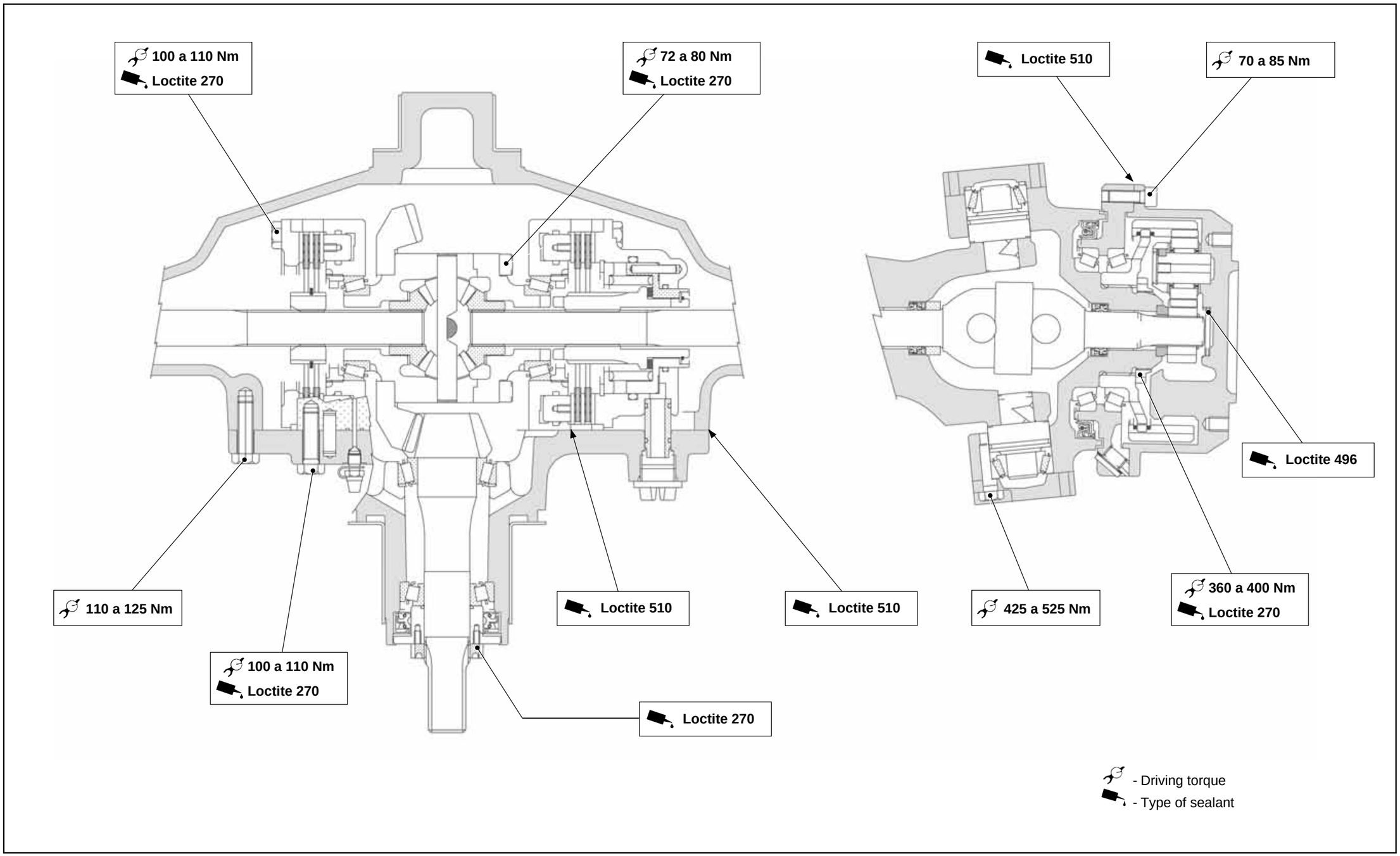


Fig. 5.14

3.3 Driving torques and sealants (E-Line version)

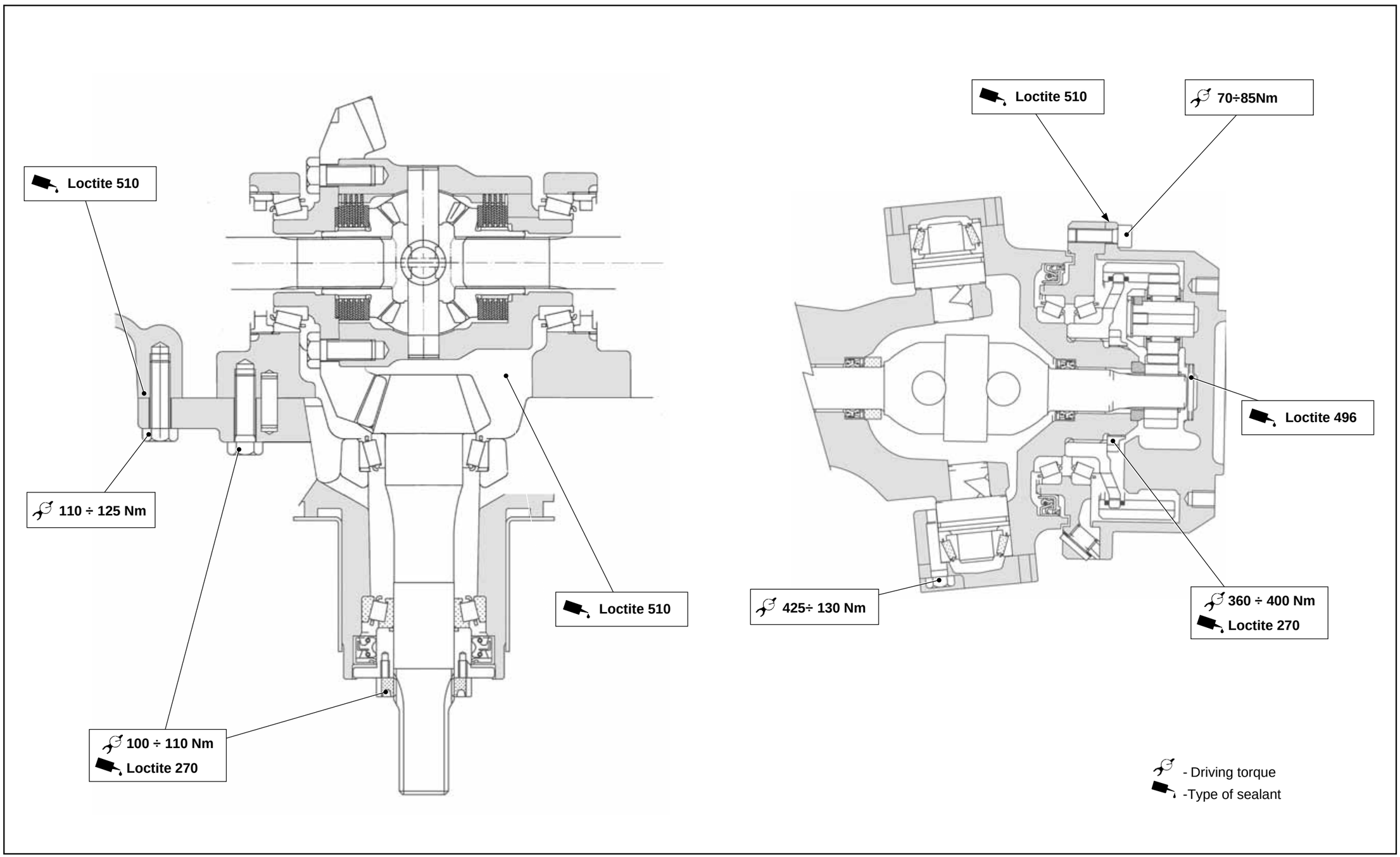


Fig. 5.15

Section 4 : Guide lines for disassembly, re-assembly and adjustments

Index

4.1 Guidelines for disassembly.....5-22

4.2 Guidelines for re-assembly, inspections and adjustments..5-28

4.1 Guidelines for disassembly

Side final drive disassembly

Note: the side final drives can also be overhauled when the axle is assembled on the tractor.

Remove the hub (730).

Remove the spring ring (739) and crown wheel (765);

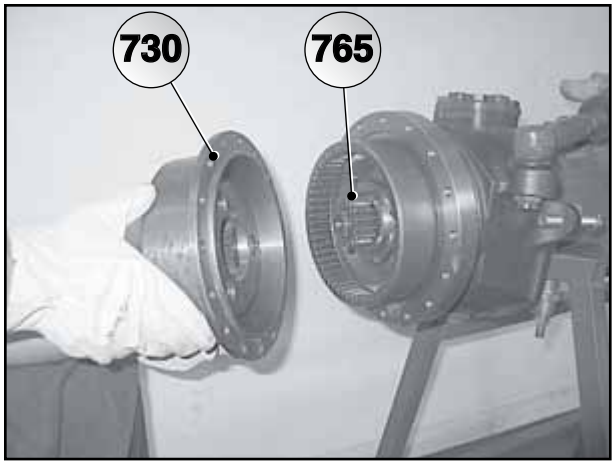


Fig. 5.16

Straighten the retainers and, using tool **04 DT Rex** , unscrew the ring nut that fixes the ring gear.

Fig. 5.17

Remove the ring gear (732) complete with the flange (744).

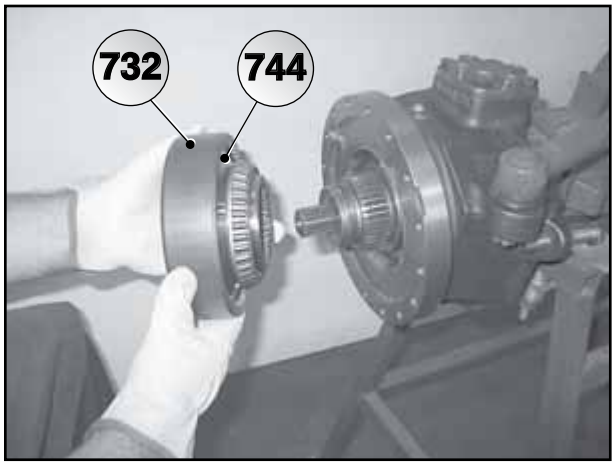


Fig. 5.18

Remove the plate (731).

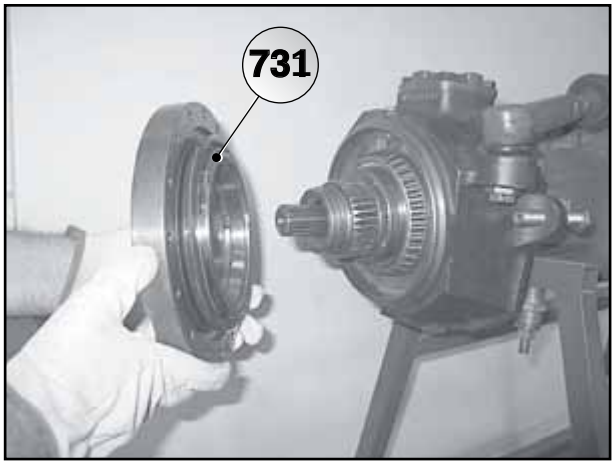


Fig. 5.19

Axle shaft disassembly

Disconnect the steering cylinder rod (766) with the aid of a puller;

Remove the upper cover (725) and lower cover (747).

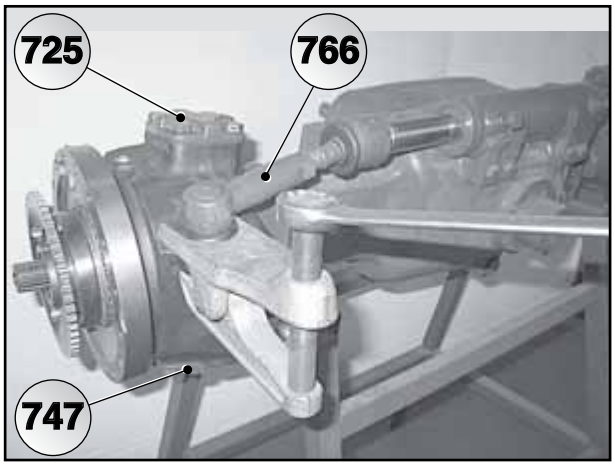


Fig. 5.20

Disassemble the upper and lower fork bearing pins with the aid of tool **R 504**

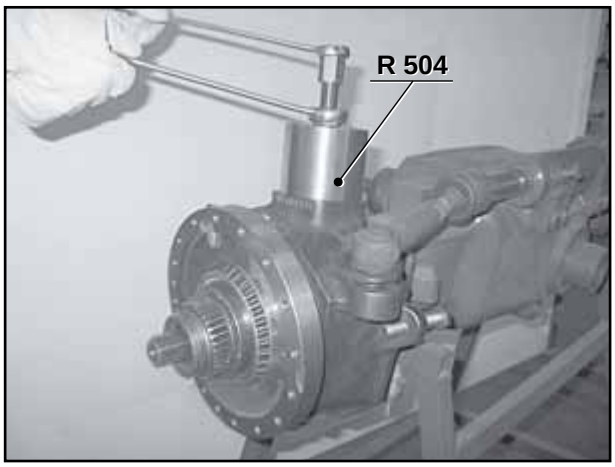


Fig. 5.21

⚠	**Attention:** avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Remove the fork (726).

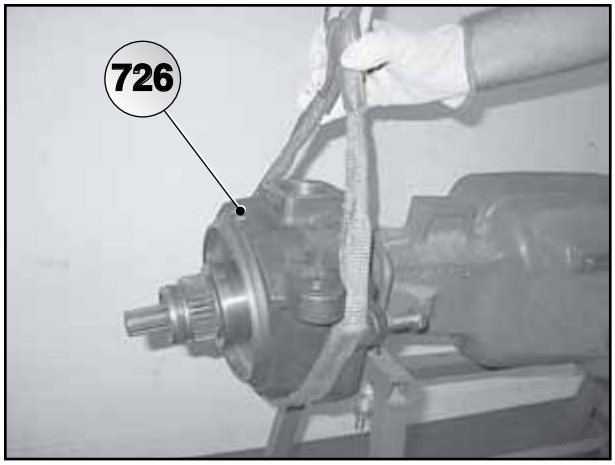


Fig. 5.22

Remove the axle shaft (738).

Note: the disassembly operations described above are valid for both right and left axle shafts and final drives.

Fig. 5.23

Differential unit disassembly (Speed Five and Power Five version)

Note: the differential can be disassembled from the axle by removing the bearing pins, the final drives complete with fork and the axle shafts.

⚠	**Attention:** if you remove the bolts from parts that are liable to drop, always leave two opposed bolts in place for safety reasons. Only remove these bolts after you have hooked the assembly to a lifting means or after you have positioned bearing blocks underneath the actual part itself.

Remove the screws (707) that fix the differential assembly.

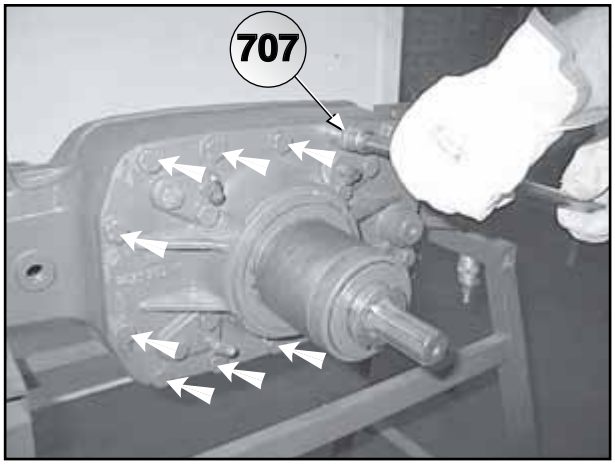


Fig. 5.24

Remove the differential assembly from the axle unit.

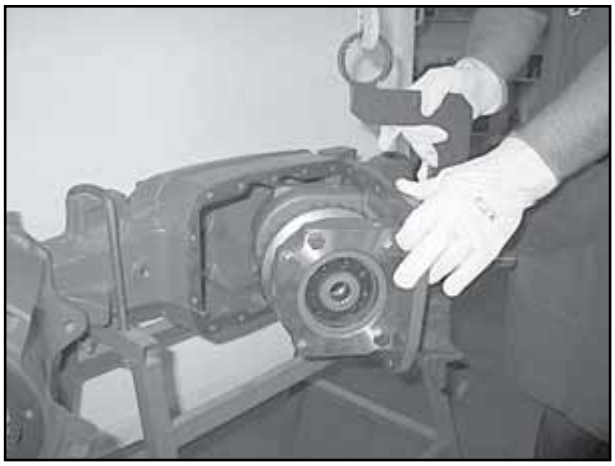


Fig. 5.25

How to dismantle the differential assembly

Remove the tube (779) that supplies the differential lock.

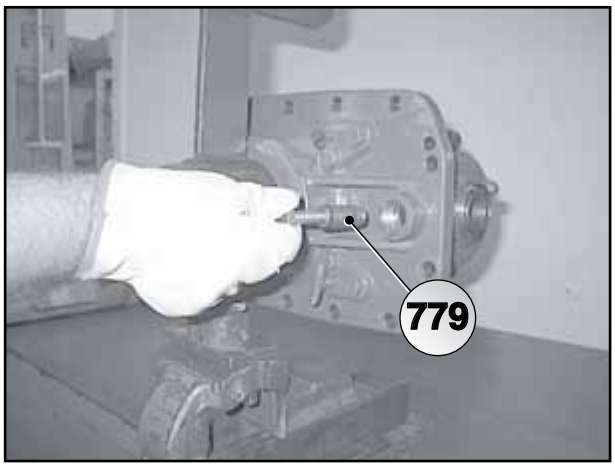


Fig. 5.26

remove the differential lock assembly (715) together with the brake discs (708 and 711).

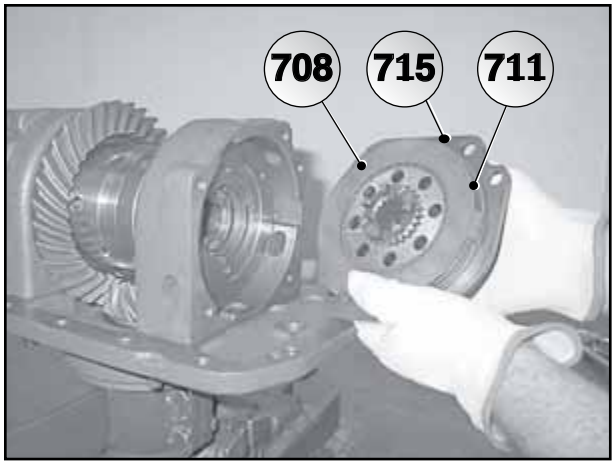


Fig. 5.27

Remove the ring nut (743) with tool **02 DT Rex .**

Fig. 5.28

Remove the cover (737), the discs, the brake and the ring nut (705) from the opposite support.

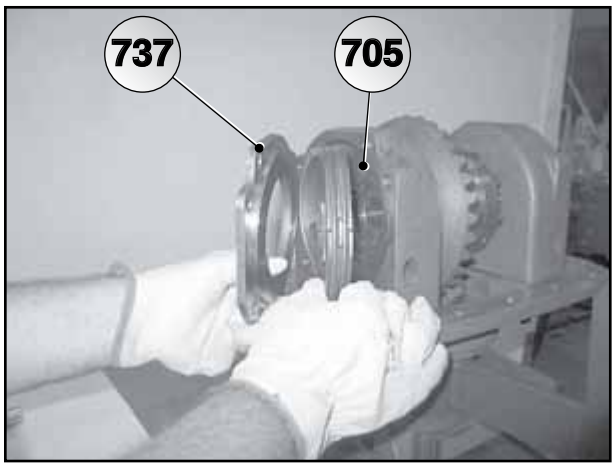


Fig. 5.29

Remove the 4 + 4 screws (780) that fix the two supports (710 and 741).

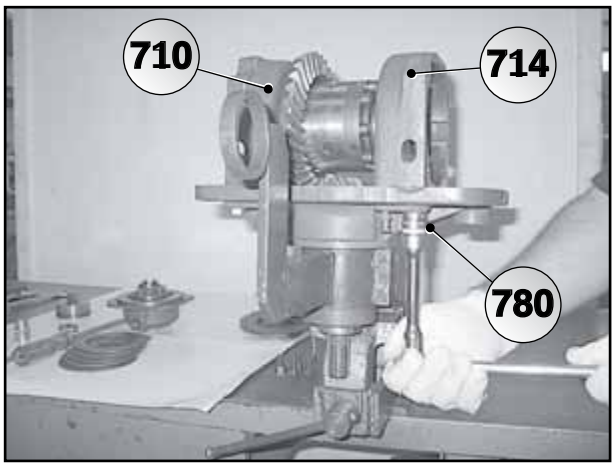


Fig. 5.30

Emove the two supports and the differential unit with the aid of a lever.

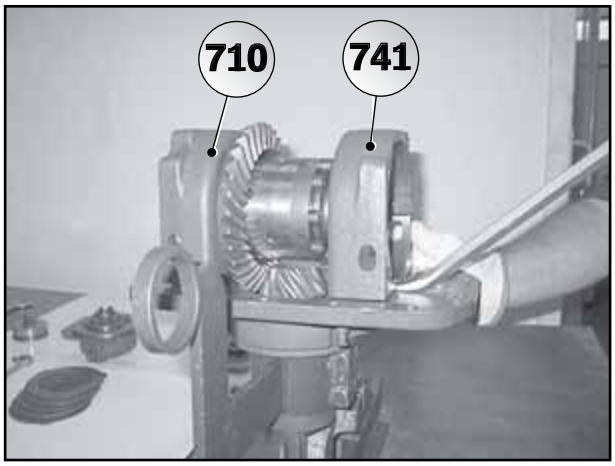


Fig. 5.31

4.2 Guidelines for re-assembly, inspections and adjustments

Work through the disassembly instructions in reverse order when re-assembling the axle components. Before proceeding, inspect the parts liable to wear, replace the seals and make any adjustments required.

Inspection of the differential assembly components

Check the bearings (771) that support the pinion.

Check the bearings (772) of the differential housing.

Check the teeth of the planetary gears and crown wheels for wear.

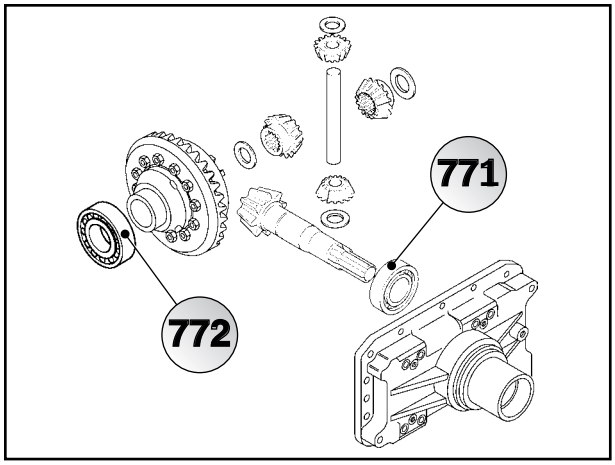


Fig. 5.32

Differential assembly adjustments

The "**differential**" assembly requires the following adjustments:

1 - Bevel pinion positioning on the ring gear

2 - Preload of the bearings that support the bevel pinion

3 - Adjustment of the play between the teeth of the pinion ring gear and preload of the differential bearings

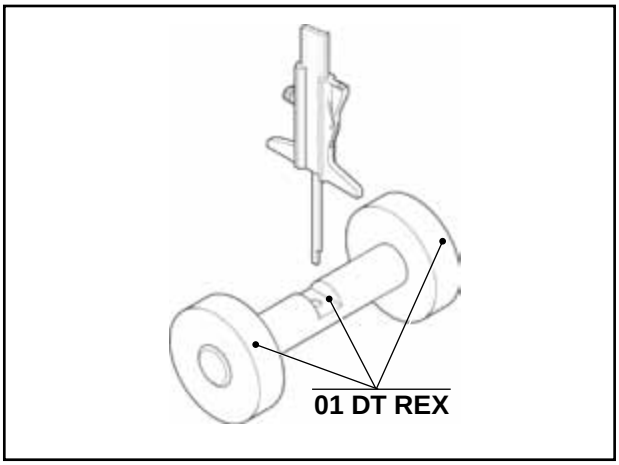


Fig. 5.33

Bevel pinion positioning on the ring gear

The purpose of this adjustment is to establish the value of shim sh (704), which is assembled between the ring of bearing (771) and the relative stop point on the support (703), so as to allow the bevel pinion to be at a distance R from the axis of the bevel ring gear. R is the nominal dimension (99 mm) which must be complied with in order to perfectly center the pinion on the ring gear. To calculate the value of sh (704) that allows the pinion to center on the ring gear, calculate the value of distance R1 between the center of the ring gear and the bearing surface of the taper bearing (771). To make the dimension (R1) easier to measure, it is advisable to use special tool **01 DT Rex** comprising: two dummy bearings and a plug.

Assemble the tool and then measure dimension R1.

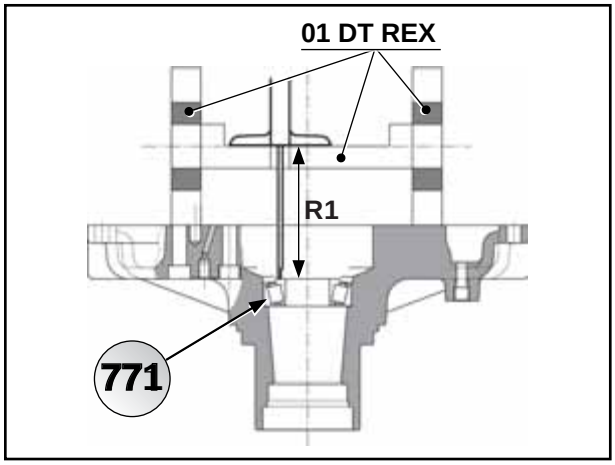


Fig. 5.34

Calculate a pack of shims (B) by means of the following formula:

Sh (704) = R1 - (R ± S)

R = nominal dimension 99 mm

R1 = dimension measured with tool 01 DT Rex

S = real constructional tolerance of dimension “R” (value stamped on the pinion and to add (+) or subtract (-) from 99 mm).

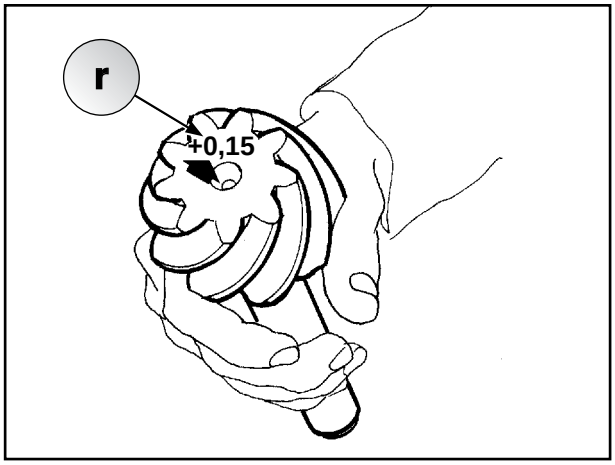


Fig. 5.35

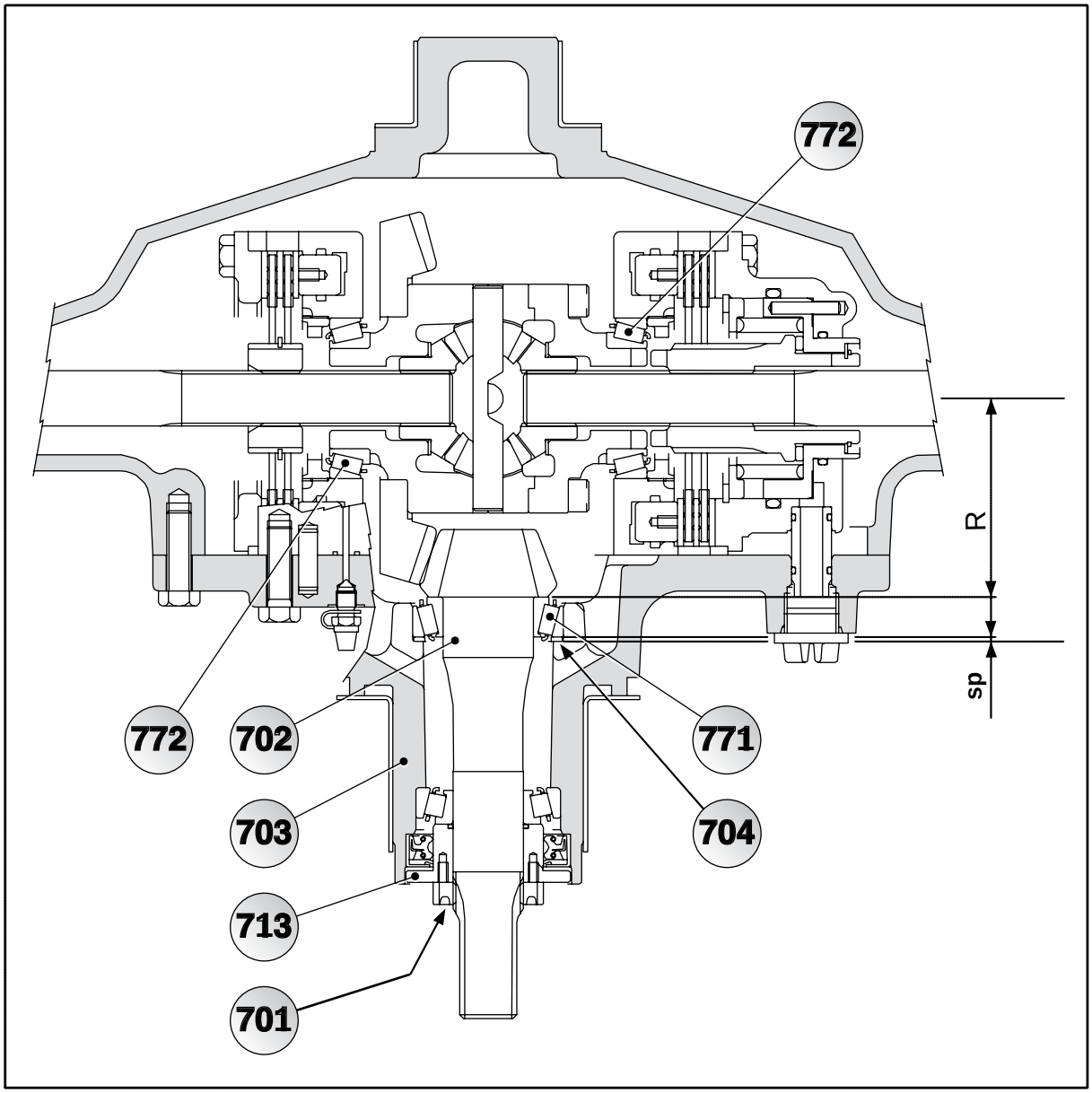


Fig. 5.36

Preload of the bearings that support the bevel pinion

1 - Fit the previously calculated shim (704) into the housing of the support (703) along with the outer bearing ring (771).

2 - Assemble the bevel pinion (702) along with all the components shown in Fig.5.37;

3 - Tighten the ring nut (701) until a 3-4 Nm moment of rotation has been obtained, inclusive of the resistance opposed by the retention ring.

4 - Bed the pinion on to the two bearings using a plastic mallet, then check the moment of rotation again and change the degree at which the nut is torqued until the required moment of rotation has been obtained (Fig.5.38)

5 - After the adjustments have been made, clinch the lip of the ring nut into the relative cavity in the pinion.

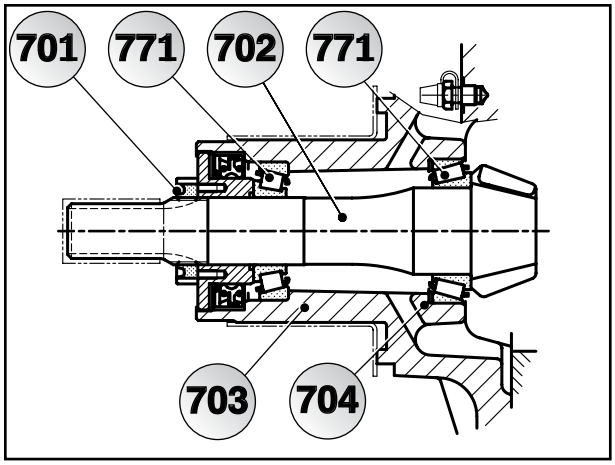


Fig. 5.37

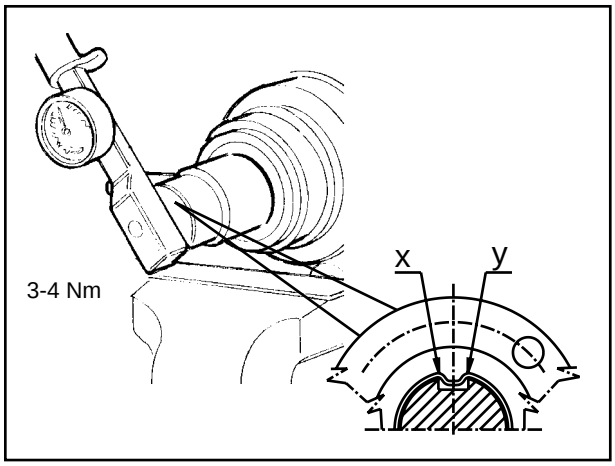


Fig. 5.38

Adjustment of the play between the teeth of the pinion and ring gear, and preload of the two taper bearings of the differential

⚠	**Attention:** handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

1 - Assemble the two supports (710 and 741) together with the differential complete with ring bevel gear (727) on the support (703);

2 - Use tool (02 DT Rex) to tighten the two ring nuts (705 and 743 Fig.5.39) until the play between the teeth of the pinion and ring gear, measured in three points of the ring gear, is 0.10-0.25 mm;

3 - Tighten the ring nut (743) until the float of the differential unit has been annulled, then turn the ring nut (743) a further 60° again until the two taper bearings have been adequately preloaded;

4 - After assembly, check again to make sure that the play between the pinion/ring gear teeth is between 0.10-0.25 mm.

5 - Clinch the lip of the two ring nuts into the relative cavity again.

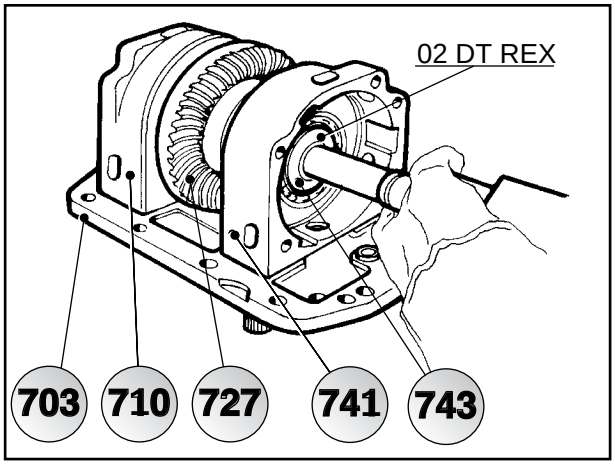


Fig. 5.39

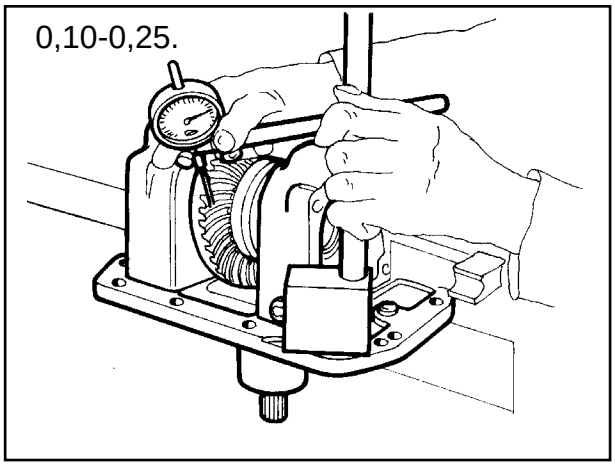


Fig. 5.40

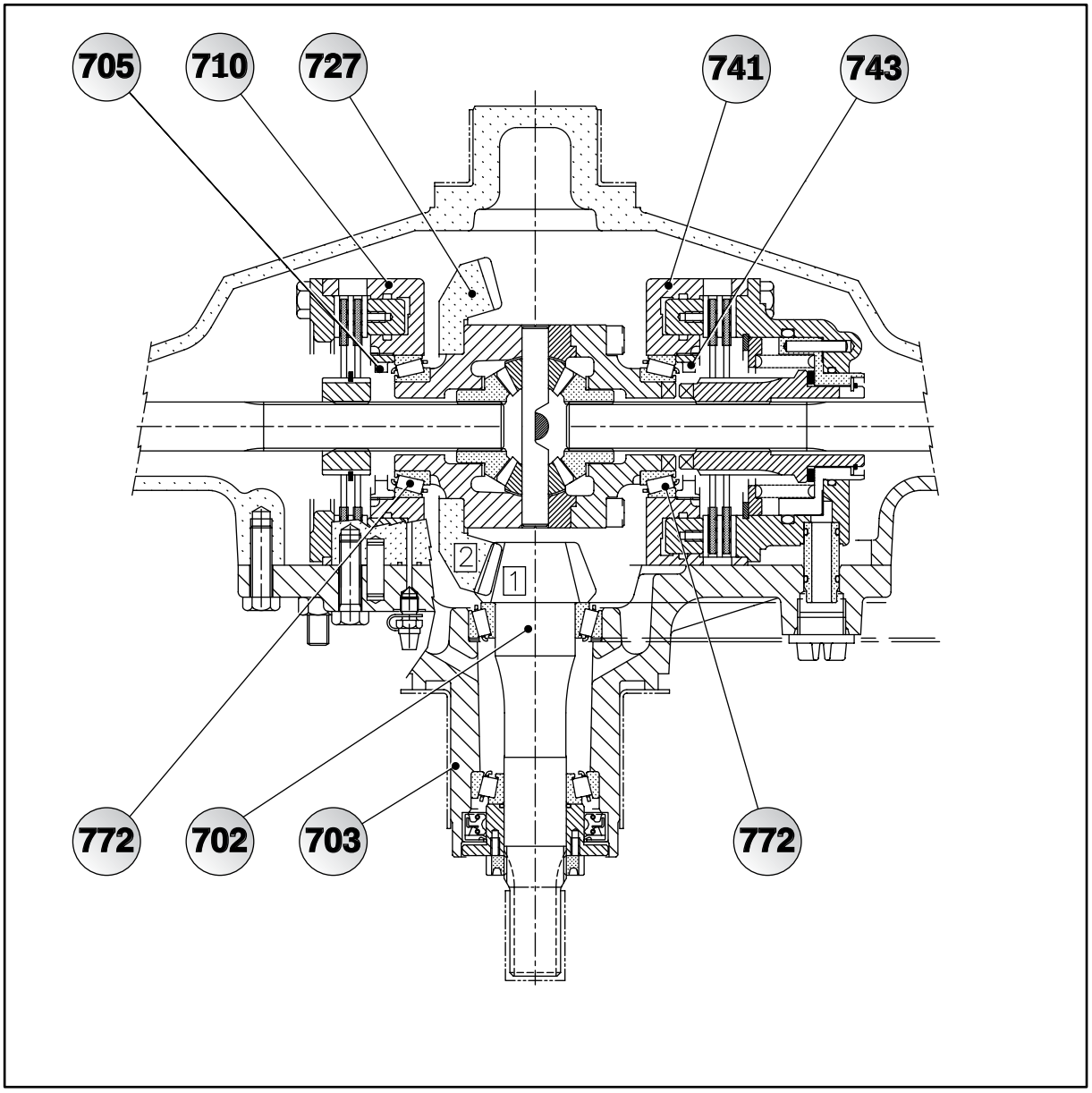


Fig. 5.41

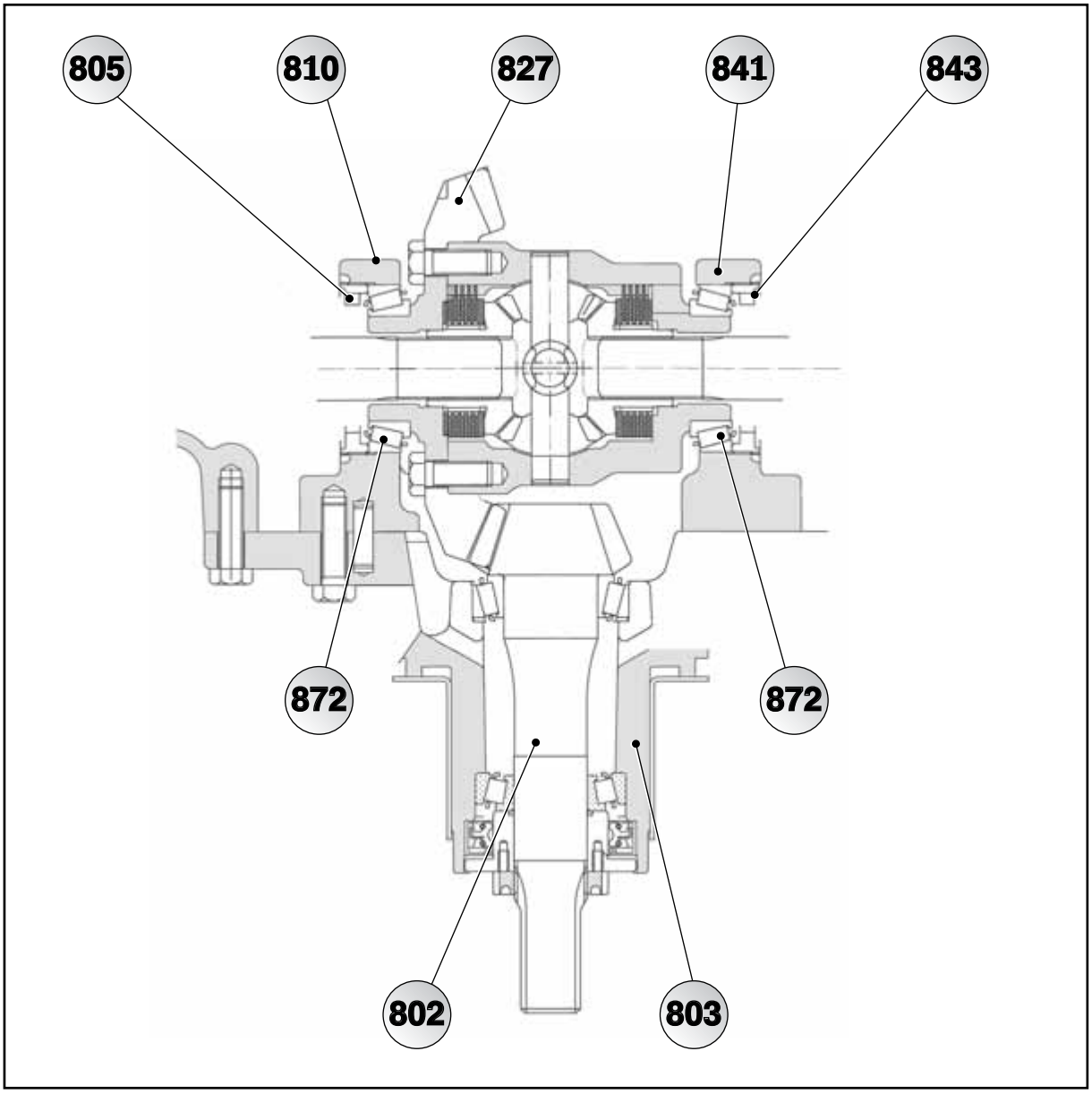


Fig. 5.42

Front brake inspection

Remove the piston (773) with the aid of two screws;

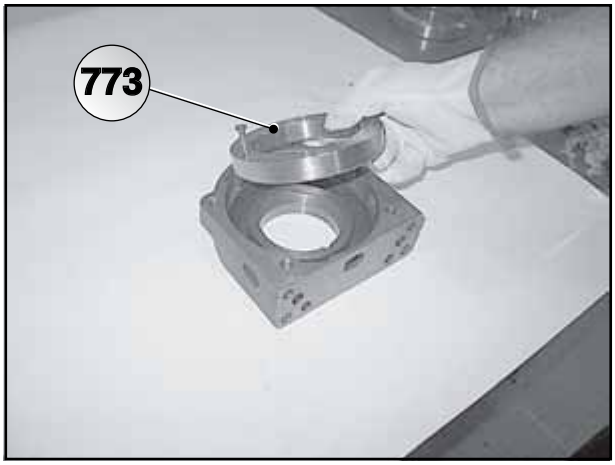


Fig. 5.43

Replace the retention rings on the support (741);

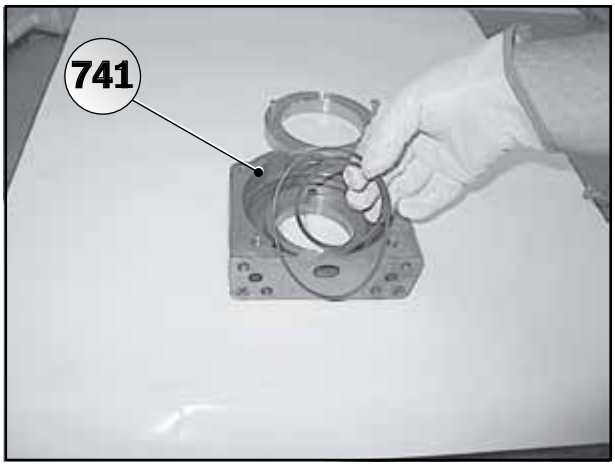


Fig. 5.44

Make sure that the grooves in the friction discs (771) are visible. Change them if this is not the case.

Make sure that the intermediate plates (708) have not become warped owing to overheating or scorching. Replace them if this is the case.

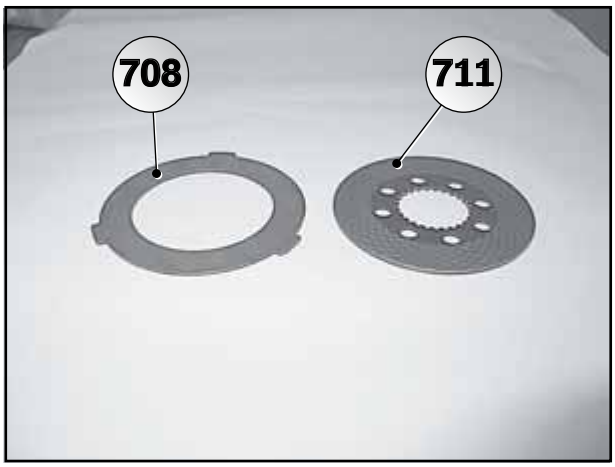


Fig. 5.45

Differential lock inspection

Compress the spring (775) with the aid of a press.

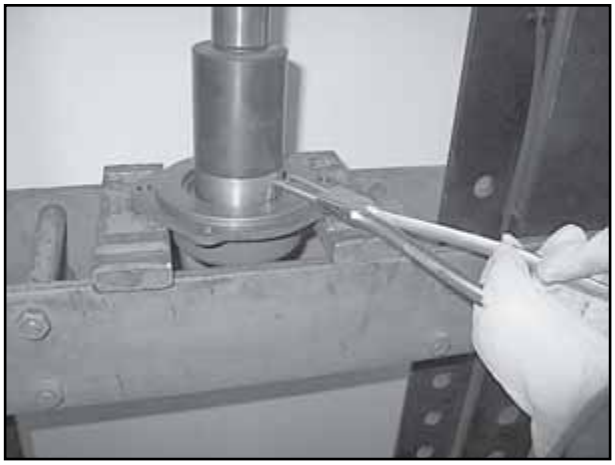


Fig. 5.46

Remove the spring ring (767).

Remove the piston (768) of the differential lock and replace the retention rings (306).

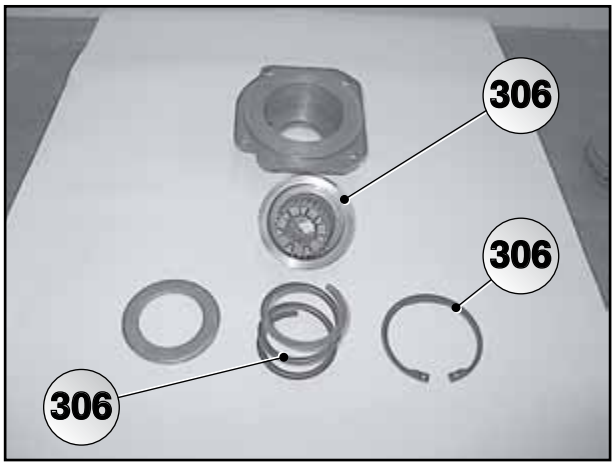


Fig. 5.47

Fork and side final drive adjustment

1 - Assemble the lower pin (745), the taper bearing (760) and the cover (747) and fix this permanently;

2 - Mount the upper pin (724) and the taper bearing (721).

3 - Apply a force that brings the cone into contact with the cup of the lower bearing (760), and use a depth gauge to measure dimension “y” between the outer ring of the taper bearing (721) and the surface of the fork (726 Fig.5.48);

4 - Using the depth gauge again, measure dimension “x” on the upper cover (725), between the surface where the cover reats on the fork and the supporting housing of the taper bearing (Fig.5.49);

5 - Calculate the valve of shim Sh (723) by applying the following formula:

Sh = x-y+0.20

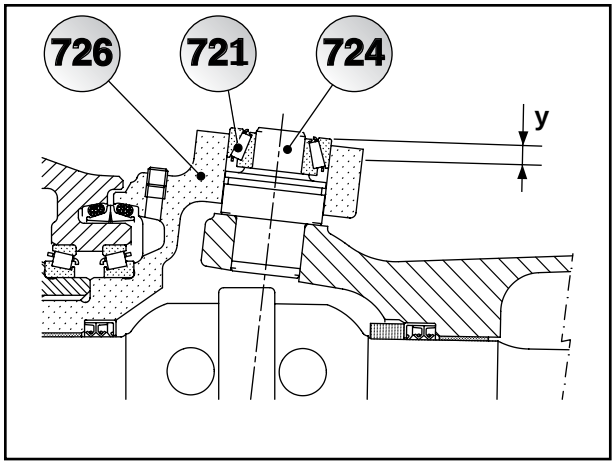


Fig. 5.48

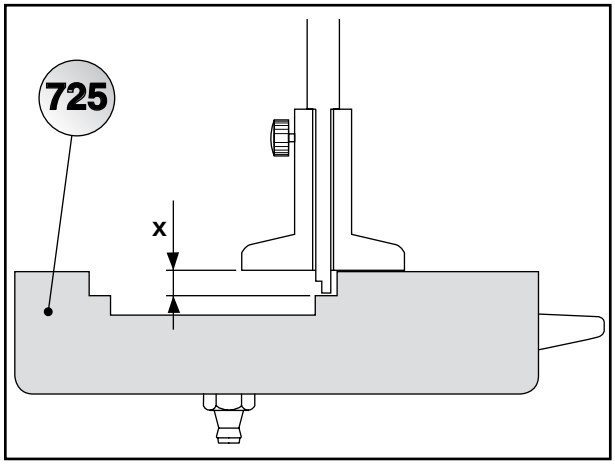


Fig. 5.49

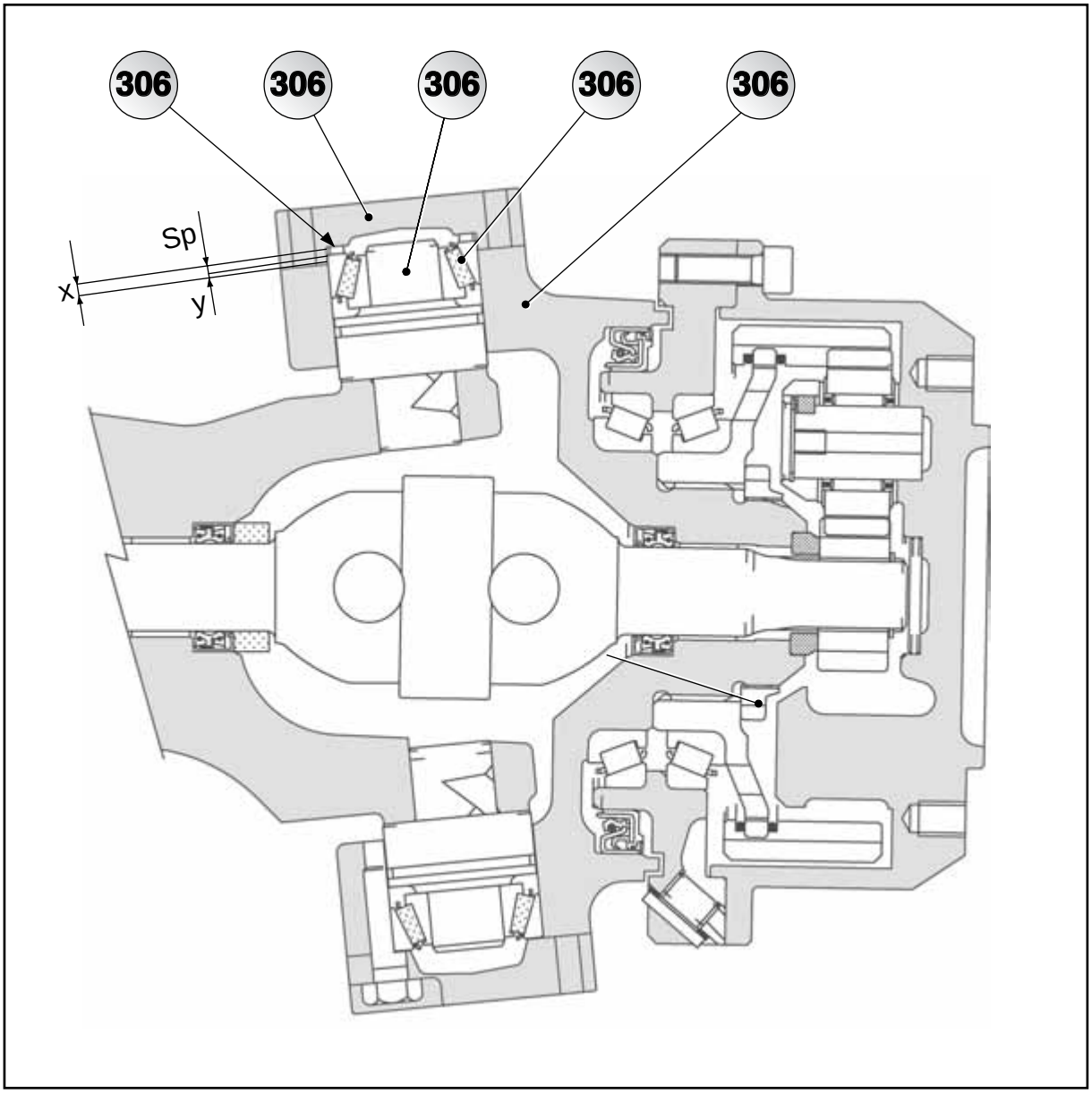
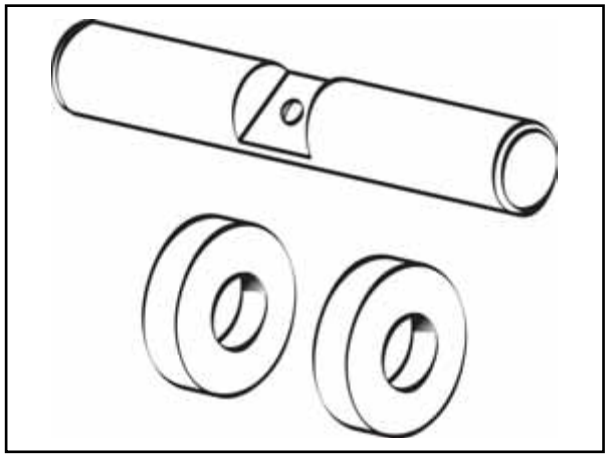


Fig. 5.50

Section 5 : Special tools

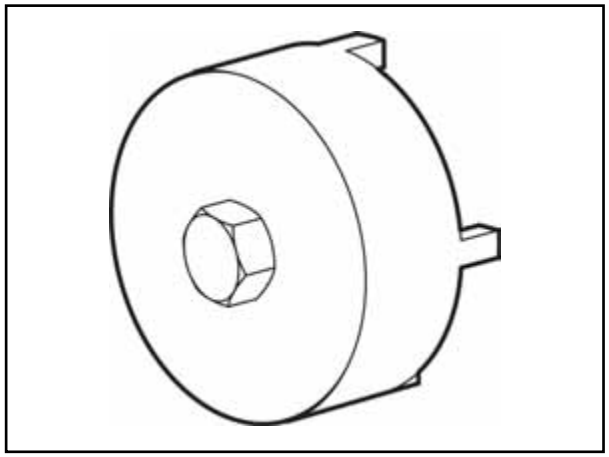
01 DT Rex

Dummy bearings with 4WD shaft bevel gear pair adjuster shaft



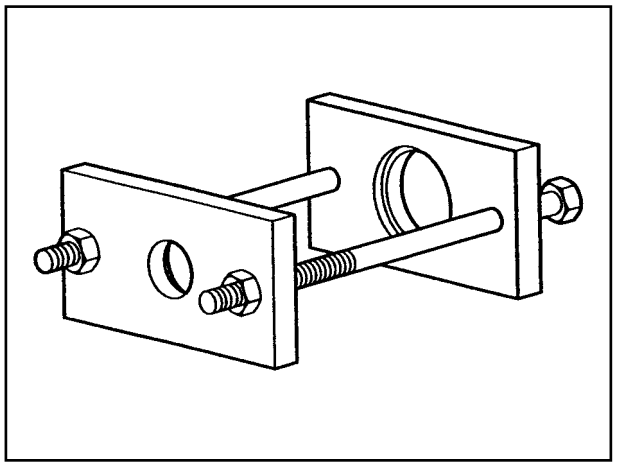
02 DT Rex

Wrench for 4WD differential ring nuts



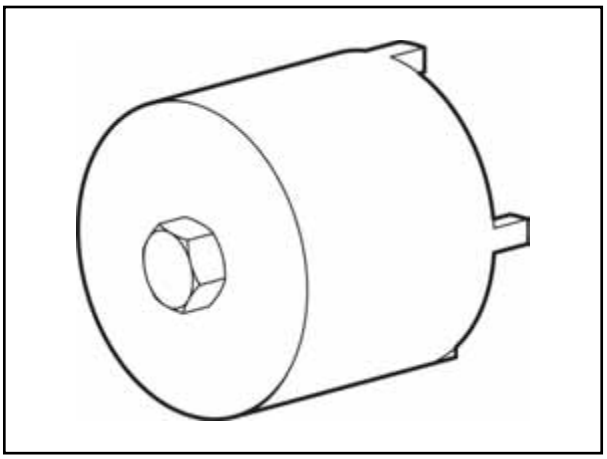
02 DT MYT

Compressor for disssembling and re-assembling the Spring-on spring



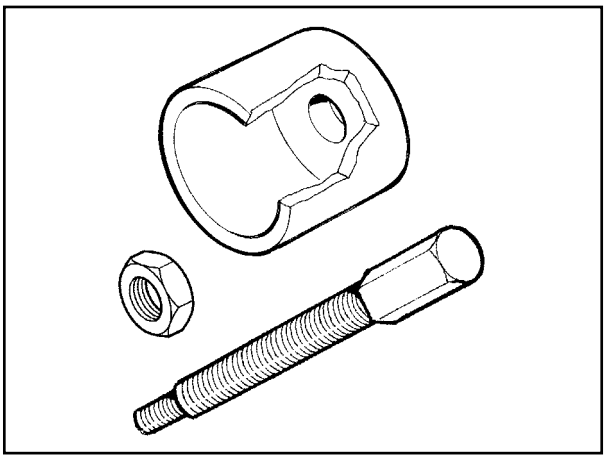
04 DT Rex

Wrench for ring nut of 4WD side final drive



R 504

Puller for the hinge pin of the fork bearing the axle final drive



Chapter 6 : Rear power take-off

Index

Section 1 : Precautions and safety recommendations 6-2

Section 2 : General description of the hydraulic power take-off 6-3

2.1 Drawing of assembly and main components (only version with independent PTO) 6-4
2.2 Description of operation (only version with independent PTO) ... 6-6
2.3 Drawing of assembly and main components (version with proportional PTO) 6-8
2.4 Description of operation (only version with proportional PTO) .. 6-10
2.5 Description of the controls 6-13
2.6 Power train diagrams 6-15

Section 3 : General description of the mechanical power take-off .. 6-17

3.1 Drawing of assembly and main components 6-18
3.2 Description of operation (only version with proportional PTO) .. 6-20
3.3 Description of the controls 6-21
3.4 Power train diagram 6-22

Section 4 : Technical specifications 6-23

4.1 Main technical specifications 6-24
4.2 Driving torques and sealants 6-25

Section 5 : Guidelines for disassembly, re-assembly and adjustment of the hydraulic PTO 6-27

5.1 Guidelines for disassembly 6-28
5.2 Guidelines for re-assembly, adjustment and inspections .. 6-31

Section 6 : Guidelines for disassembly, re-assembly and adjustment of the mechanical PTO 6-35

6.1 Guidelines for disassembly (F-N Series 90-100-105) 6-36
6.2 Guidelines for re-assembly, adjustments and inspection (F-N Series 90-100-105) 6-39
6.3 Guidelines for disassembly, re-assembly, adjustments and inspection (F-N Series 65-75-80) 6-41

Section 7 : Special tools 6-42

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual. Carefully comply with the Warnings indicated by means of this symbol:

	Attention: keep clear of the sharp edges around the top of the gearbox.
	Attention: make sure that all persons keep a due distance away from the danger zone. Avoid vibrations when the bolts are loosened.
	Attention: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.
	Attention: avoid twisting the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.
	Attention: use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.
	Attention: handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.
	Attention: used oil must be collected and disposed of in compliance with the anti-pollution laws in force.
	Attention: wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.

Section 2 : General description of the hydraulic power take-off

Index

2.1 Drawing of assembly and main components (only version with independent PTO) 6-4

2.2 Description of operation (only version with independent PTO) .. 6-6

2.3 Drawing of assembly and main components (version with proportional PTO) 6-8

2.4 Description of operation (only version with proportional PTO) ... 6-10

2.5 Description of the controls 6-13

2.6 Power train diagrams 6-15

2.1 Drawing of assembly and main components (only version with independent PTO)

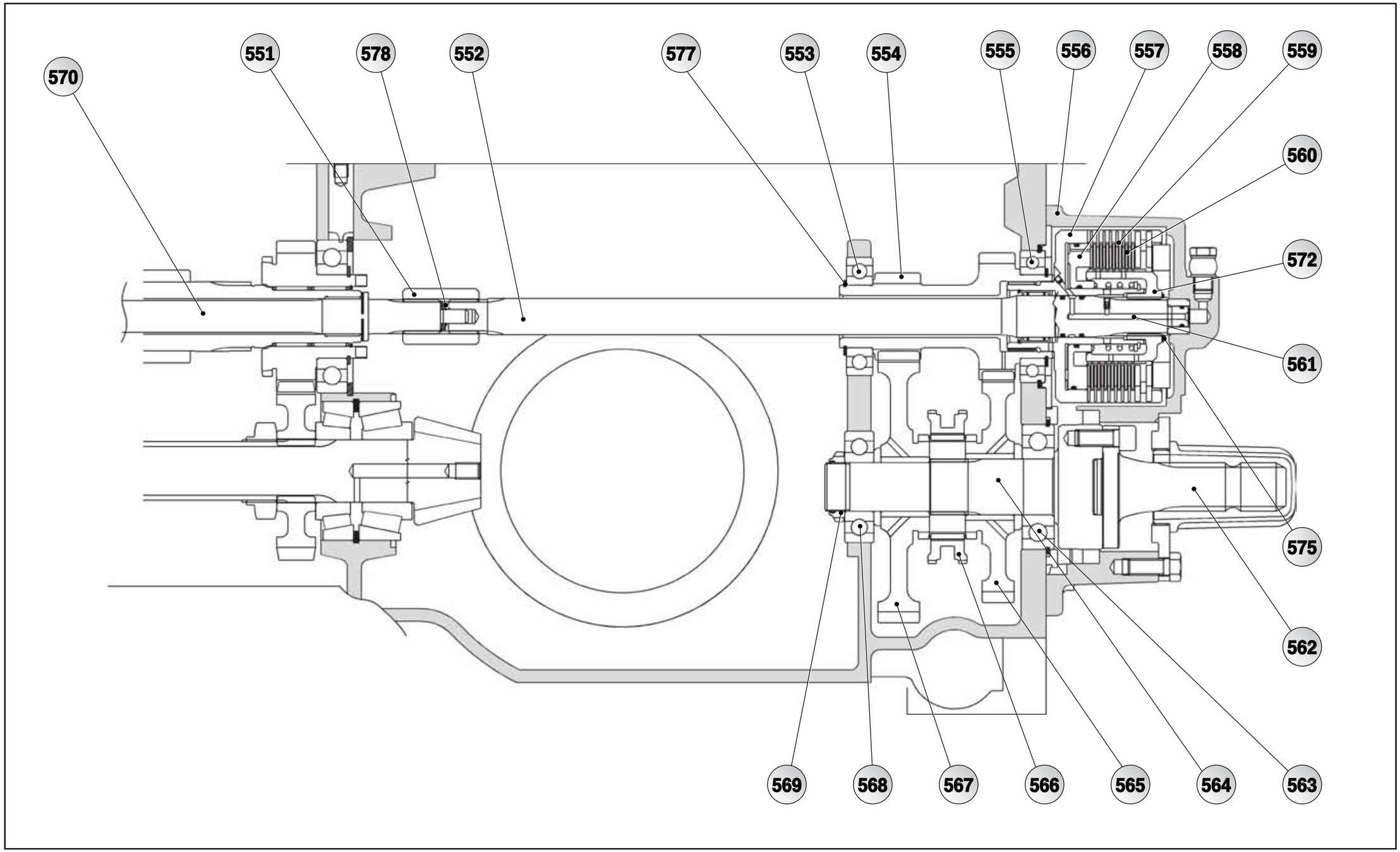


Fig. 6.1

551 - PTO connecting sleeve
552 - PTO rear shaft
553 - Ball bearing
554 - Double gear
555 - Ball bearing
556 - PTO clutch cover
557 - PTO clutch cover
558 - Piston
559 - Intermediate clutch disc
560 - Friction clutch disc
561 - Supply duct (20 bar)
562 - Output shaft
563 - Ball bearing
564 - Lower shaft
565 - 1000 RPM driven gear
566 - Ball bearing
567 - Lower shaft
568 - Ball bearing
569 - Ring nut “to clinch”
570 - PTO front shaft
572 - Clutch hub
575 - Spring ring
577 - Spring ring
578 - Spring ring

2.2 Description of operation (only version with independent PTO)

The power take-off installed in **F-N Series** tractors has an oil-cooled multiple-plate clutch with modulated hydraulic engagement by means of an engaging/ disengaging lever located on the left-hand side of the driver's seat. The available speeds are 540 RPM, or alternatively 1000 RPM or 540 ECONOMY (750 RPM). The P.T.O. assembly is installed in the rear part of the tractor and comprises:

in the upper part

- a rear shaft (552), which is permanently meshed with the front shaft (570) by means of the sleeve (551);
- the clutch unit, including the braking system of the rear shaft, powered by the low flow rate circuit (20 bar);
- the double gear (554) that transmits drive to the output shaft;

in the lower part

- -houses the driven gears (567) and (565), which idle on the lower shaft (564);
- this latter is fitted with the output shaft (562). This shaft is interchangeable with other types of shaft, depending on the type of implement to be hitched.

The PTO speed is selected by the axial movement of the sleeve (566). When the PTO is disengaged, the rear shaft brake is always active, thus preventing the shaft from being "dragged" round.

Drive is transmitted from the flywheel to the front shaft (570) and reaches the rear shaft (552) through the sleeve (551). The clutch hub (572) is splined to the shaft.

When the PTO is engaged, oil at a 20 bar pressure is sent to the clutch. Passing through duct (561), oil reaches piston (558) which, by moving, packs the friction discs on to the intermediate discs, thus transmitting drive to the bowl (557). The bowl is splined on to the double gear (554), which transmits drive to the driven gears (567) and (565). If the sleeve (566) is shifted towards the rear part of the tractor, drive reaches the output shaft (562) at a speed of 1000 RPM, while if the sleeve (566) is shifted towards the front part, drive reaches the output shaft (562) at a speed of 540 RPM.

When the sleeve (501) is displaced toward the front part of the tractor, the proportional PTO is selected; if the sleeve (501) is displaced toward the rear part of the tractor, the independent PTO is selected.

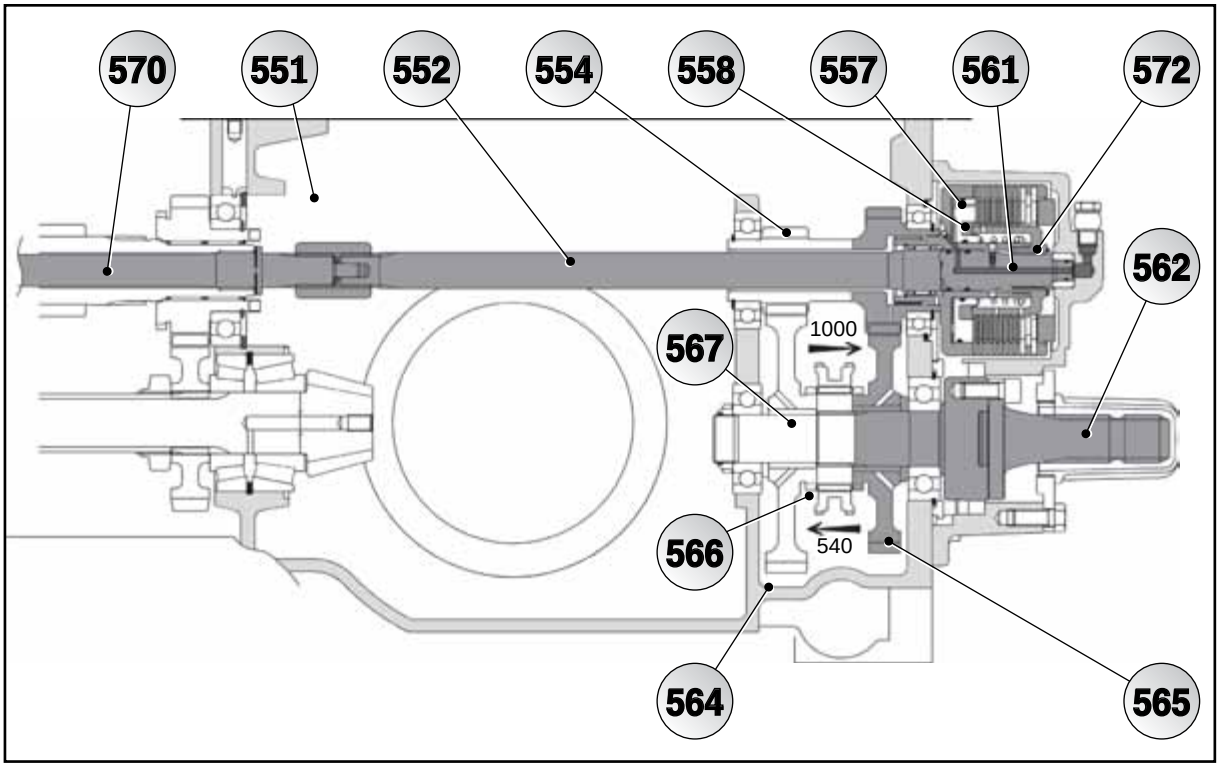


Fig. 6.2

2.3 Drawing of assembly and main components (version with proportional PTO)

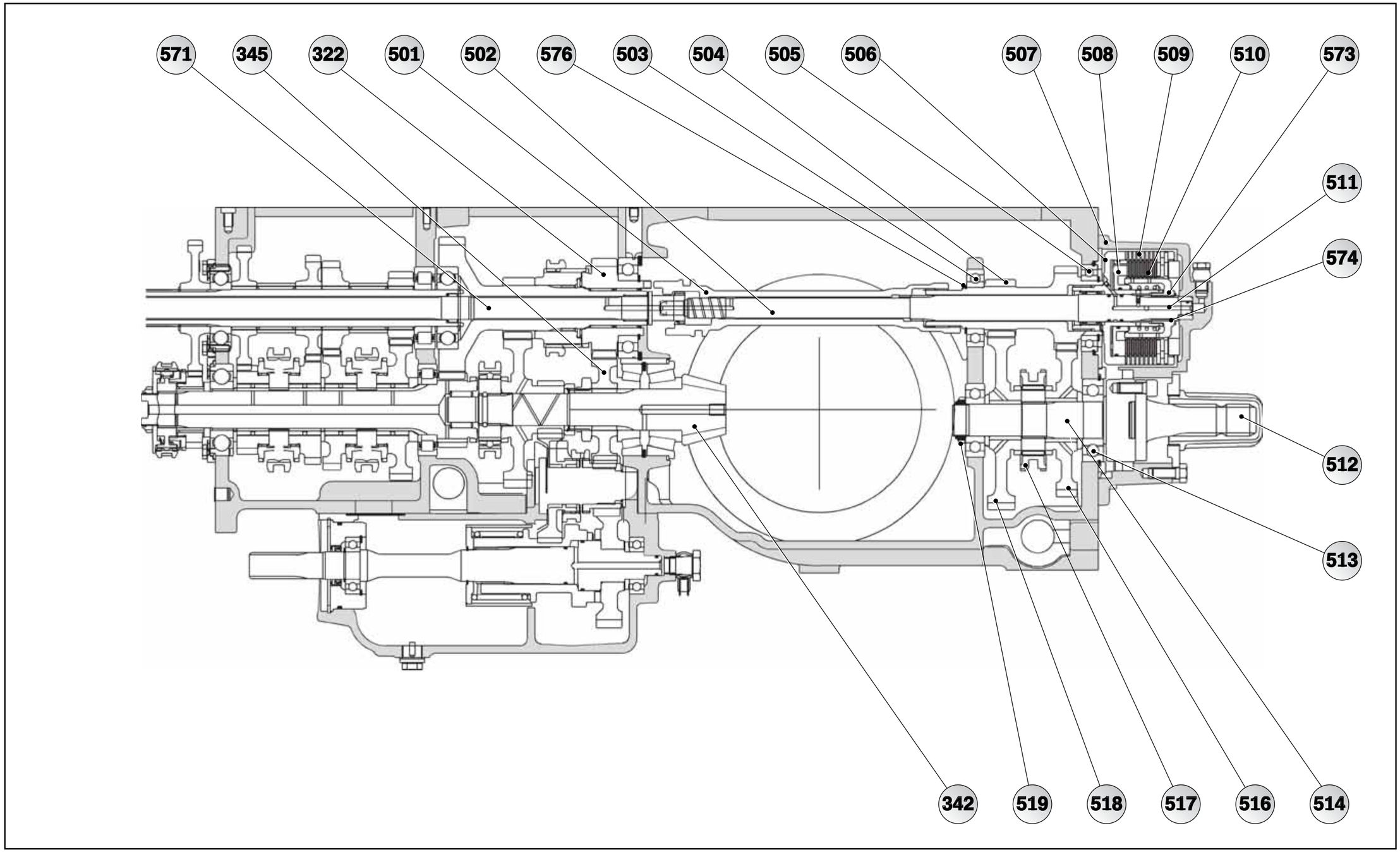


Fig. 6.3

322 - Standard range driven gear
342 - Bevel pinion
345 - Standard range driving gear
501 - PTO selection sleeve
502 - PTO rear shaft
503 - Ball bearing
504 - Double gear
505 - Ball bearing
506 - PTO clutch cover
507 - Clutch bowl
508 - Piston
509 - Intermediate clutch disc
510 - Friction clutch disc
511 - Supply duct (20 bar)
512 - Output shaft
513 - Ball bearing
514 - Lower shaft
515 - 1000 RPM driven gear
516 - 540 or 1000 RPM PTO selection sleeve
517 - 540 RPM driven gear
518 - Ball bearing
519 - Ring nut “to clinch”
571 - PTO front shaft
573 - PTO clutch hub
574 - Spring ring
576 - Spring ring

2.4 Description of operation (only version with proportional PTO)

The power take-off installed in **F-N Series** tractors has an oil-cooled multiple-plate clutch with modulated hydraulic engagement by means of an engaging/disengaging lever located on the left-hand side of the driver's seat.

The speeds available with the independent PTO are: 540, alternatively 1000 RPM or Economy 540 (750 RPM). With the proportional PTO there are two available speeds, and the RPM rate is calculated as a ratio of the wheel RPM rate.

The P.T.O. assembly is installed in the rear part of the tractor and comprises:

in the upper part

- a front shaft (571) and a rear shaft (502), which are connected by means of a sliding sleeve (501);
- the clutch unit, including the braking system of the rear shaft, powered by the low flow rate circuit (20 bar);
- the double gear (504) that transmits drive to the output shaft;

in the lower part

- the driven gears (517) and (515), that idle on the lower shaft (514);
- this latter is fitted with the output shaft (512). This shaft is interchangeable with other types of shaft, depending on the type of implement to be hitched.

The PTO speed is selected by the axial movement of the sleeve (516).

When the PTO is disengaged, the rear shaft brake is always active, thus preventing the shaft from being "dragged" round.

The PTO type is selected by the axial displacement of the sleeve (501), controlled by a lever located in the cab on the left of the driver's seat. When the sleeve (501) is displaced toward the front part of the tractor, the proportional PTO is selected; if the sleeve (501) is displaced toward the rear part of the tractor, the independent PTO is selected.

Proportional PTO selection

Drive is transmitted from the flywheel to the front shaft (571) and reaches the rear shaft (502) through the selector sleeve (501). The clutch hub (573) is splined to the shaft.

When the PTO is engaged, oil at a 20 bar pressure is sent to the clutch. Passing through duct (511), oil reaches piston (508) which, by moving, packs the friction discs on to the intermediate discs, thus transmitting drive to the bowl (507).

The bowl is splined on to the double gear (504), which transmits drive to the driven gears (517) and (515). If the sleeve (516) is shifted towards the rear part of the tractor, drive reaches the output shaft (512) at a speed of 1000 RPM, while if the sleeve (516) is shifted towards the front part, drive reaches the output shaft (512) at a speed of 540 RPM.

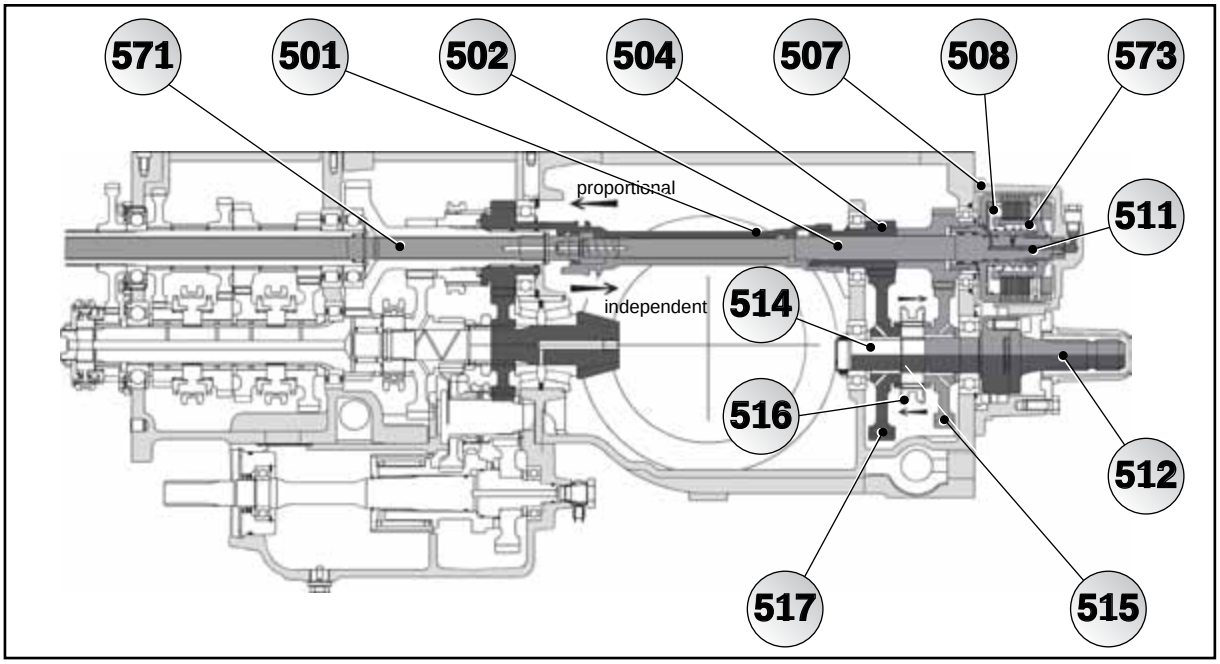

571
501
502
504
507
508
573
proportional
511
independent
514
516
512
517
515

Fig. 6.4

Proportional P.T.O. selection

Drive is transmitted from pinion (342) to the driven gear (345) of the standard range, which is splined to it. This gear is permanently meshed with the gear (322), which is meshed frontally with the sleeve (501).

Drive reaches thus the double gear (504). Depending on the speed selected, drive is transmitted to the output shaft (512) through gears (517) or (515).

When the proportional PTO is engaged, the brake of the rear shaft (502), located in the clutch housing, is automatically disengaged. This is obtained by means of the microswitch (SQ8 Fig.6.5), which transmits an electric signal to the electronic power unit. This automatically deactivates the solenoid valve that supplies the brake and meanwhile transmits a signal to the indicator light on the instrument, to indicate that engagement has occurred.

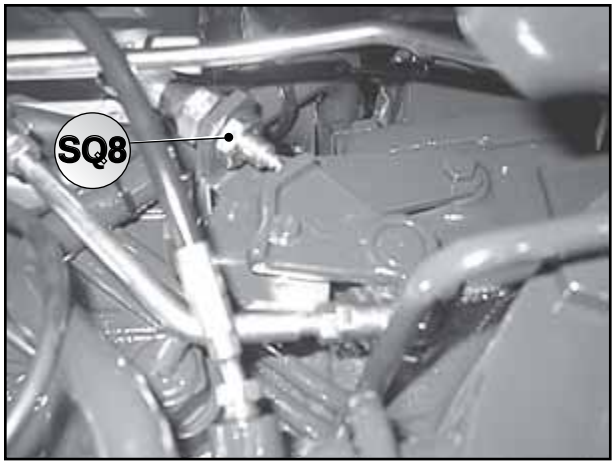


Fig. 6.5

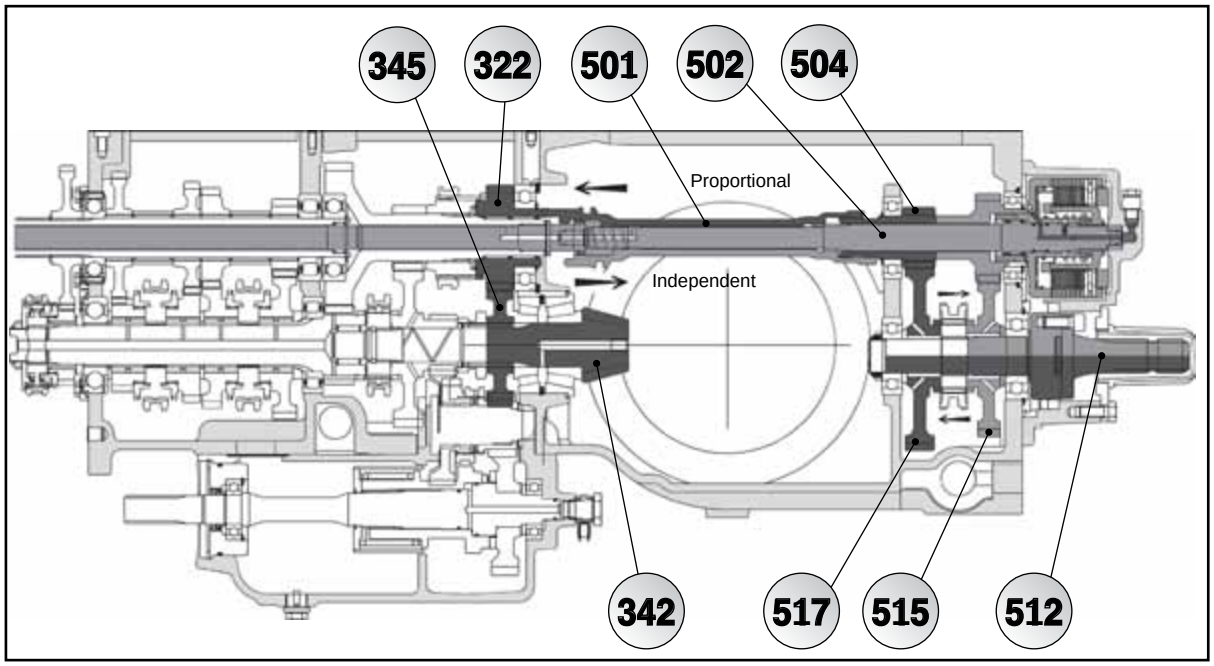


Fig. 6.6

2.5 Description of the controls

The P.T.O. is engaged/disengaged by means of the engaging button (SA2) (Fig.6.7) on the right-hand side of the cockpit.

When operated, the switch (SA2) sends a signal to the control unit which activates the proportional solenoid valve (YV9 Fig.6.8) that controls PTO engagement. At the same time, the control unit deactivates the ON/OFF solenoid valve (YV8) (Fig.6.8), which engages the brake.

PTO engagement is controlled by the control unit which, by means of the solenoid valve (YV9), pilots the oil pressure from 0 to 20 bar in a gradual and progressive way.

Fig. 6.7

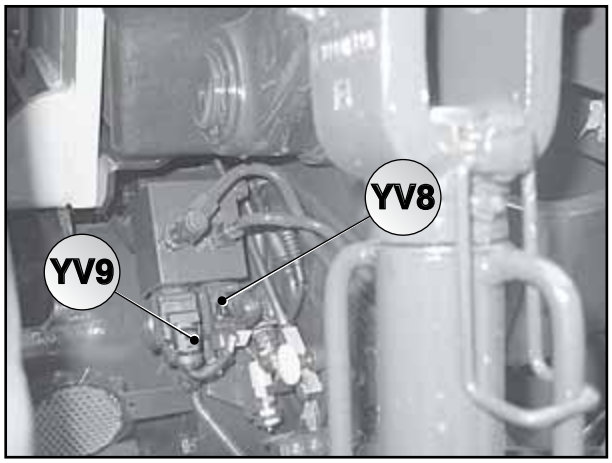


Fig. 6.8

PTO control button

To engage the PTO, release the switch (SA2) by moving the orange safety button (2) as indicated by the arrow (Fig.6.9), then depress side of the switch.

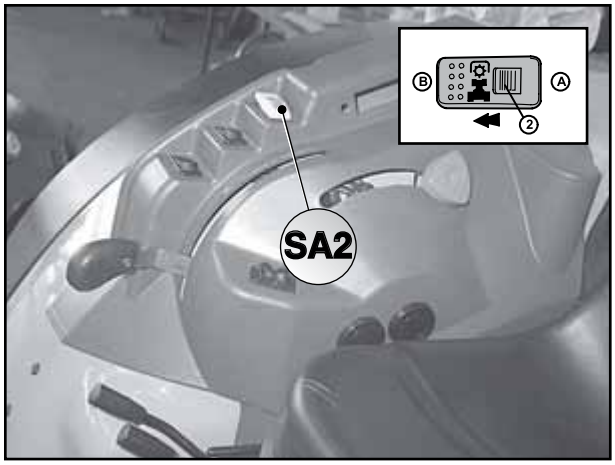


Fig. 6.9

PTO selection sleeve

The lever (R Fig.6.10) selects the speed of the PTO shaft at the output of the gearbox housing.

The lever (V Fig.6.10) selects the PTO mode: independent or proportional to the tractor's ground speed.

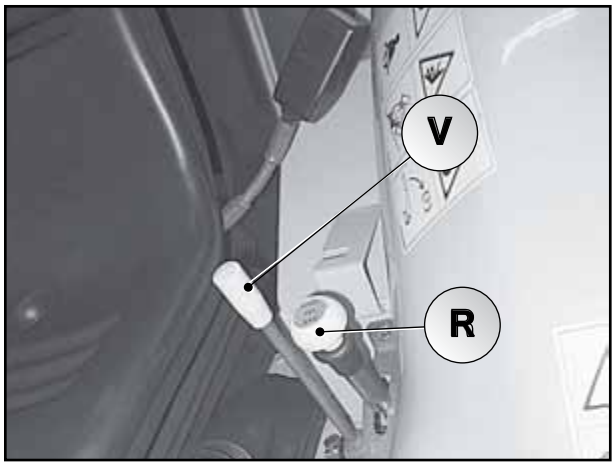


Fig. 6.10

2.6 Power train diagrams

Independent PTO

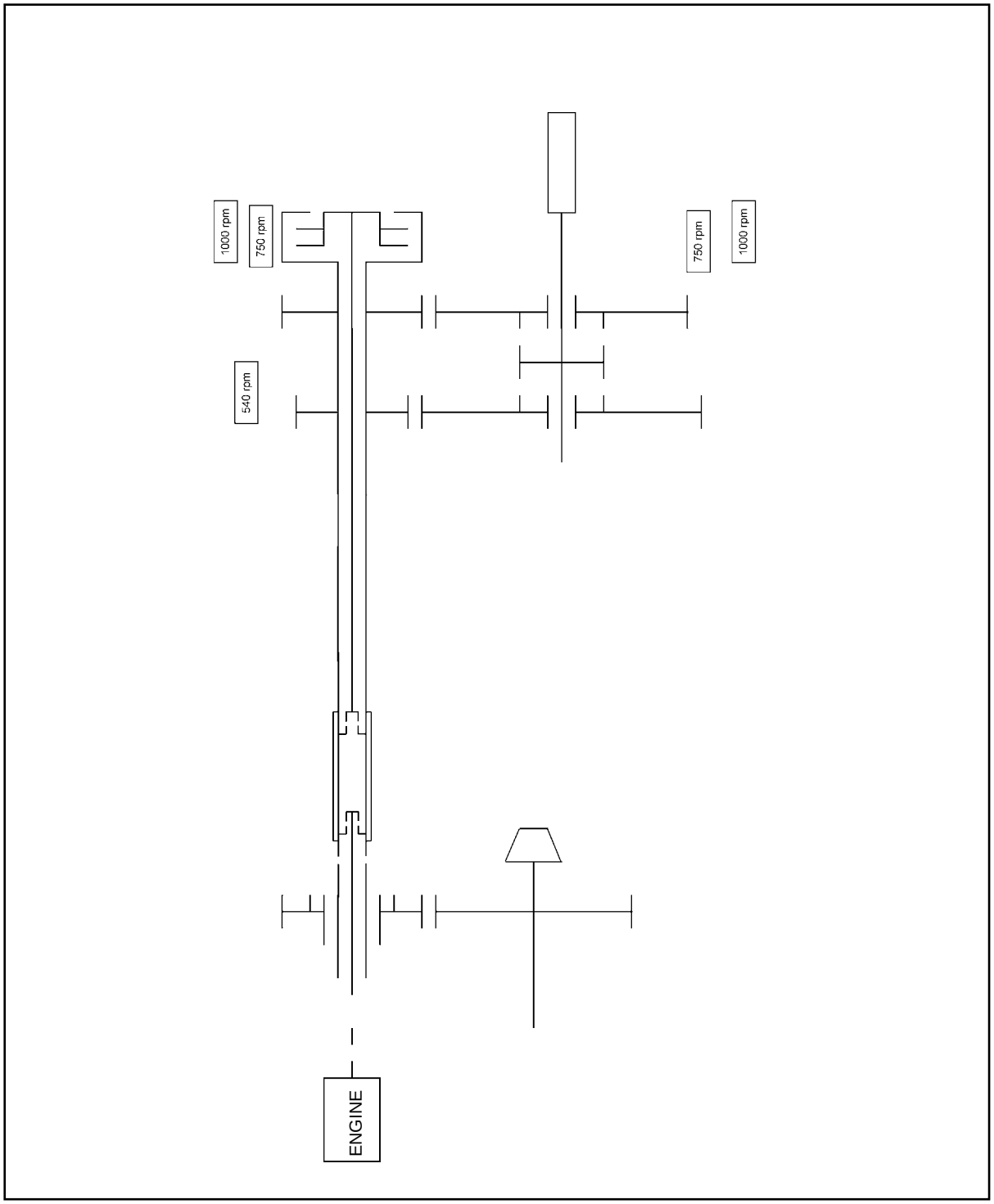


Fig. 6.11

PTO proportional to ground speed

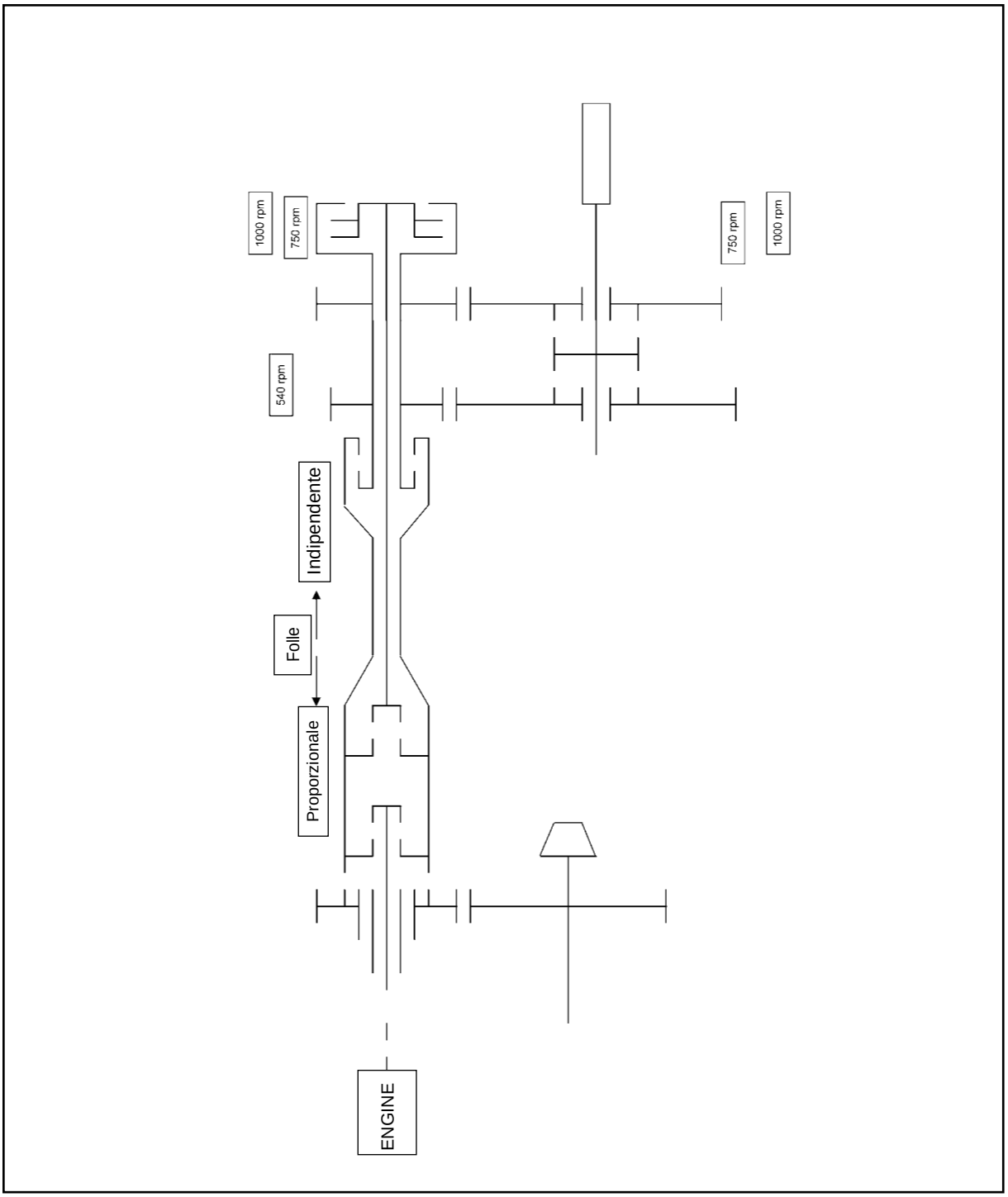


Fig. 6.12

Section 3 : General description of the mechanical power take-off

Index

3.1 Drawing of assembly and main components 6-18

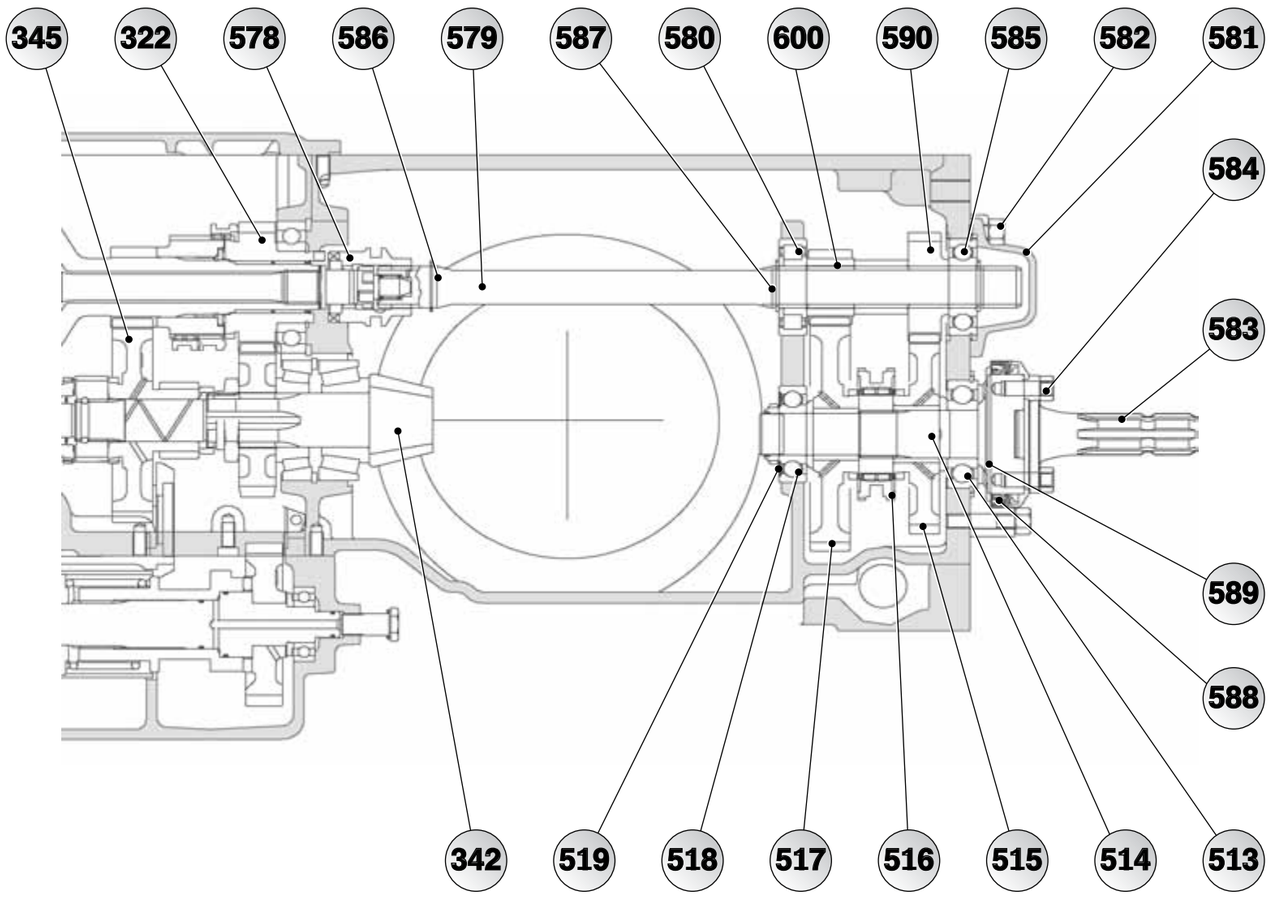
3.2 Description of operation (only version with proportional PTO) .. 6-20

3.3 Description of the controls 6-21

3.4 Power train diagram 6-22

3.1 Drawing of assembly and main components

F-N Series 90-100-105 version



F-N Series 65-75-80 version

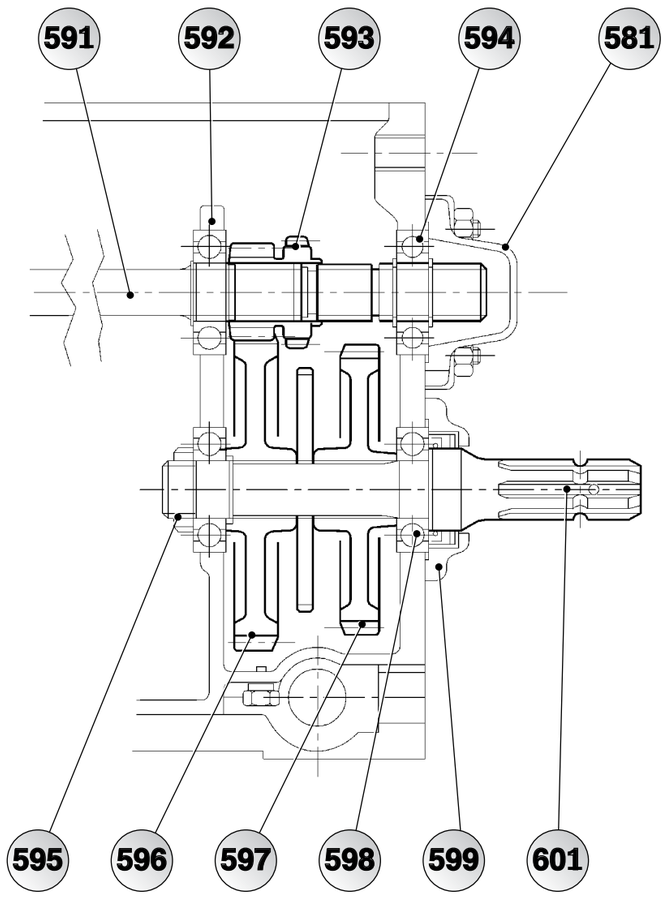


Fig. 6.13

322 - Standard range driven gear
342 - Bevel pinion
345 - Standard range driving gear
513 - Ball bearing
514 - Lower shaft
515 - 1000 RPM driven gear
516 - 540 or 1000 RPM PTO selection sleeve
517 - 540 RPM driven gear
518 - Ball bearing
519 - Ring nut “to clinch”
578 - PTO selection sleeve
579 - PTO rear shaft
580 - Roller bearing
581 - Cover
582 - Cover fixing screw
583 - Interchangeable end
584 - Interchangeable end fixing screw
585 - Ball bearing
586 - Spring ring
587 - Spring ring
588 - Retention ring
589 - O-ring
590 - 1000/540 E PTO gear
591 - Upper PTO shaft
592 - Ball bearing
593 - Sliding double gear
594 - Ball bearing
595 - Ring nut “to clinch”
596 - 540 RPM gear
597 - 540 E/1000 RPM gear
598 - Ball bearing
599 - Cover
600 - 540 PTO gear
601 - PTO lower shaft

3.2 Description of operation (only version with proportional PTO)

When the sleeve (578) is shifted to the right, the independent PTO speed is selected, while, when it is shifted to the left, the proportional PTO is selected. In this condition, drive reaches the gear (322) from the gear (345) coupled to the bevel pinion (342) (Fig.6.13).

The sleeve (516) or the double gear (593) select the 540 RPM speed rate if shifted to the left, and the 750 or 1000 RPM rates if shifted to the right. The lever (Q Fig.6.15) controls the clutch via a hydrostatic control activated by the control valve (8).

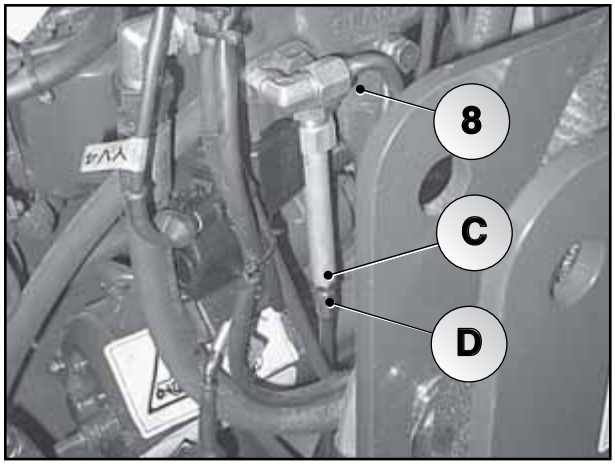


Fig. 6.14

3.3 Description of the controls

The rear PTO is engaged and disengaged by means of a lever (Q Fig.6.15) under the tractor's steering wheel.

The lever (Q) is connected by a steel cable to the power control inside the valve system (8) (Fig.6.14). The power control modulates the PTO engagement.

Modulation is achieved in the manual mode: it is proportional to the movement of the control lever (Q).

When the lever is shifted to engage the PTO, the oil pressure in the supply duct of the PTO clutch remains at 0 bar for a short travel, then rises gradually to 5-6 bar and finally reaches the maximum value of 20 bar in the last part of the lever's travel.

PTO engagement automatically disengages the relative brake.

If the connecting cable is dismounted, it should then be adjusted as follows:

- loosen the check nut (C);
- unscrew the adjuster screw (D) until it stops against the protective sheath of the steel cable;
- lock the check nut.

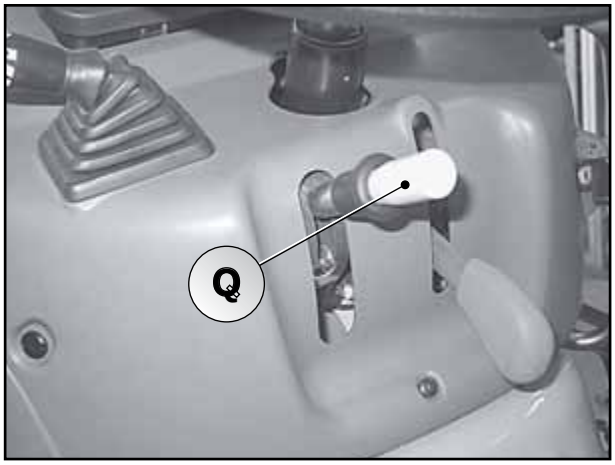


Fig. 6.15

PTO selection sleeve

The lever (R) selects the speed of the PTO shaft at the output of the gearbox housing.

The lever (V) selects the PTO mode: independent or proportional to the tractor's ground speed.

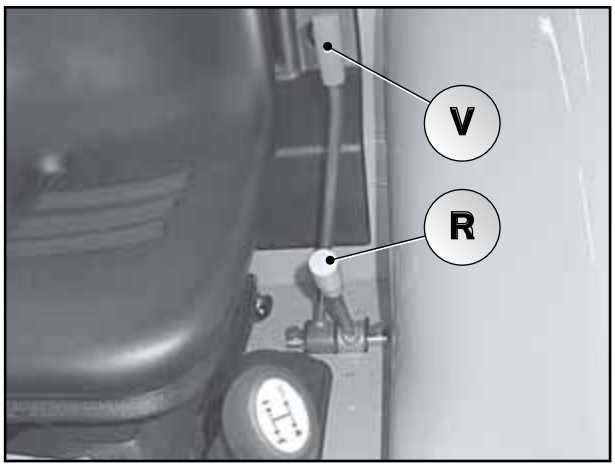


Fig. 6.16

3.4 Power train diagram

PTO proportional to ground speed

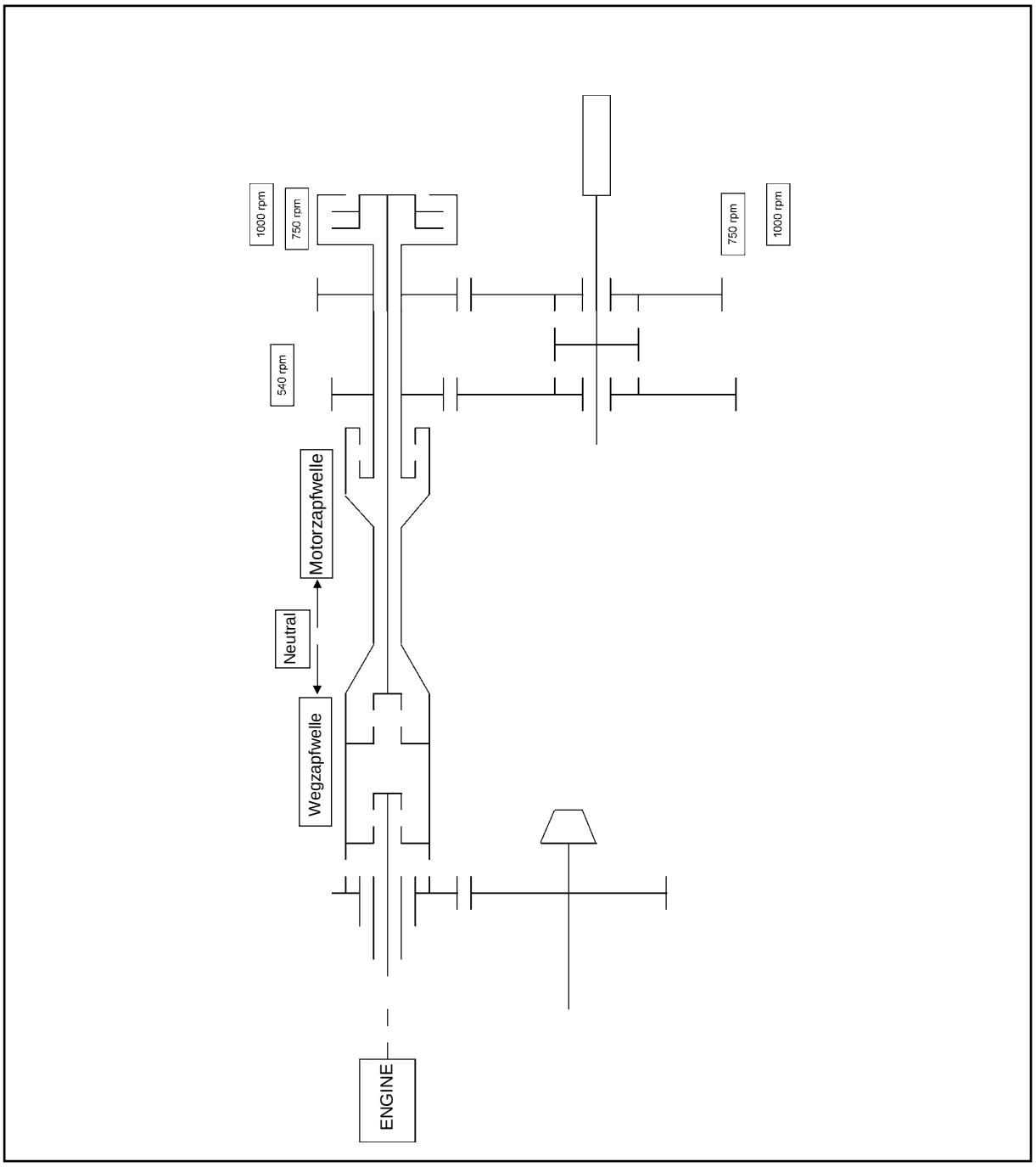


Fig. 6.17

Section 4 : Technical specifications

Index

4.1 Main technical specifications 6-24

4.2 Driving torques and sealants 6-25

4.1 Main technical specifications

Mechanically engaged power take-off

Type	PTO independent / proportional to the ground speed
Type of engagement	Power control, 2 speeds, with manual engagement

Electro-hydraulic PTO

Type	PTO independent / proportional to the ground speed
Type of engagement	Engagement by means of hydraulic clutch with electrohydraulic control through cab switch.
PTO output shaft	Conforms to Asae standards (13/8”) (34.9 mm) with 6 splines (34.9 mm) with 21 splines
PTO speed	Available in the following configurations: with two speeds: 1st Type: 540/540 ECO RPM 2nd Type: 540/1000 RPM

Type of PTO	P.T.O. RPM	Engine rate
540	540	1944
540 ECO	540 ECO	1377
1000	1000	1917

PTO speed proportional to ground speed	Rotation rate in the proportional mode (PTO shaft revolutions for each turn of the rear wheel):

	PTO shaft revolutions	
Type of PTO	P.T.O. RPM	Engine rate
540	8.474	8.274
540 E	11.829	11.549
1000	15.917	15.540

4.2 Driving torques and sealants

Hydraulic power take-off

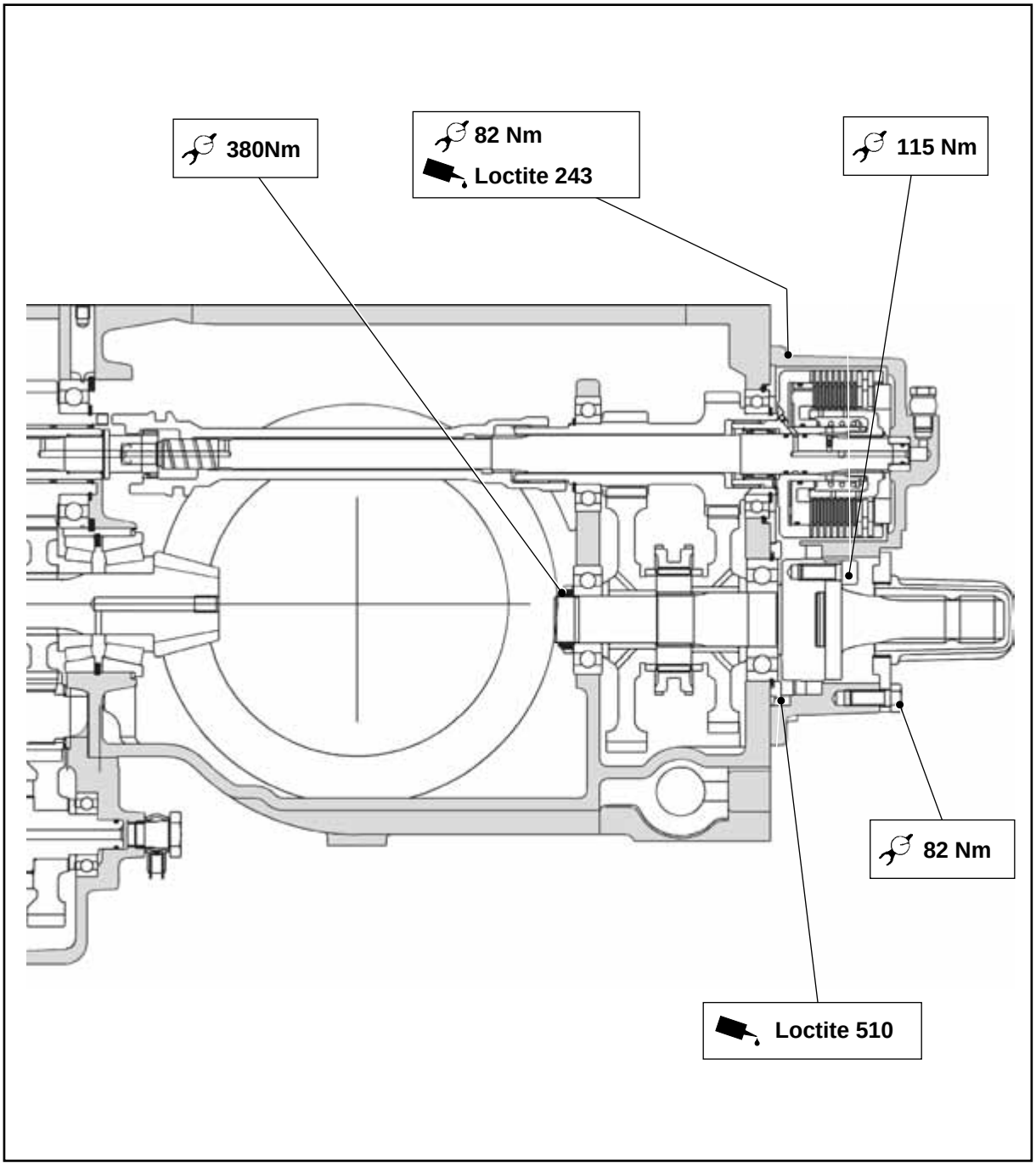
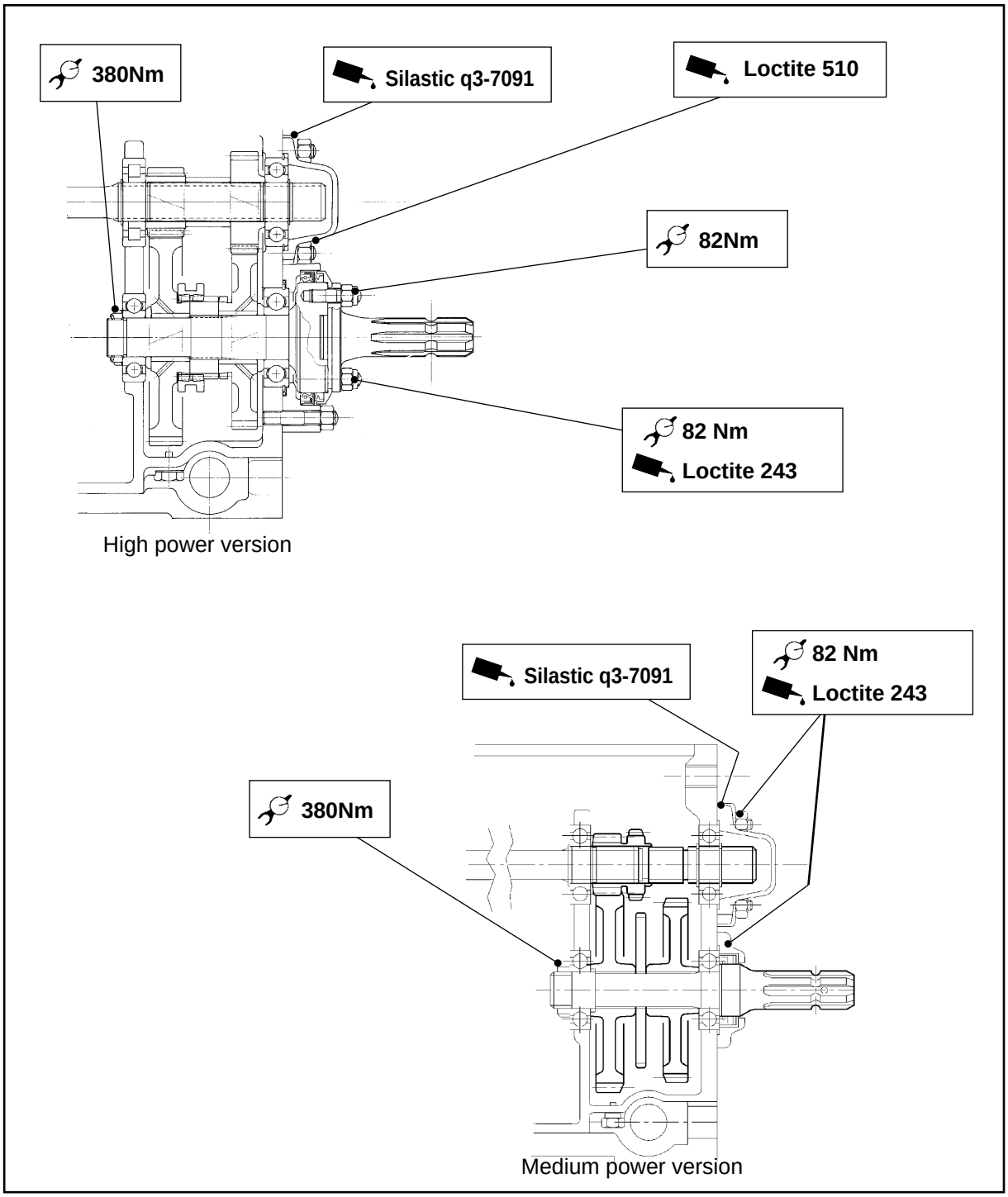


Fig. 6.18

- Driving torque
- Type of sealant

Mechanical power take-off



- Driving torque
- Type of sealant

Fig. 6.19

Section 5 : Guidelines for disassembly, re-assembly and adjustment of the hydraulic PTO

Index

5.1 Guidelines for disassembly.....6-28

5.2 Guidelines for re-assembly, adjustment and inspections..6-31

5.1 Guidelines for disassembly

Clutch disassembly

Note: the clutch unit may be disassembled with the hydraulic lift unit assembled.

- remove the cover (506);

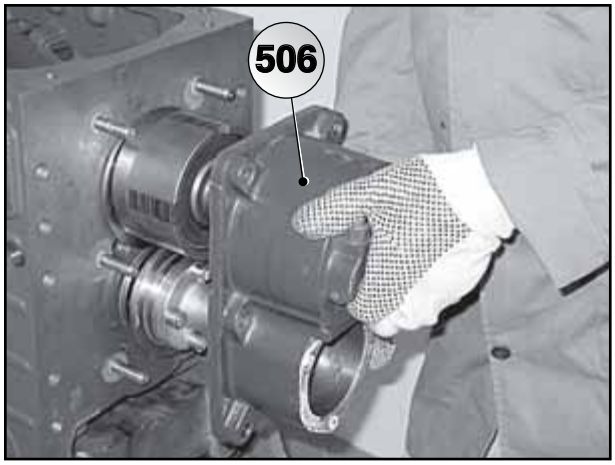


Fig. 6.20

- remove the spring ring (574);

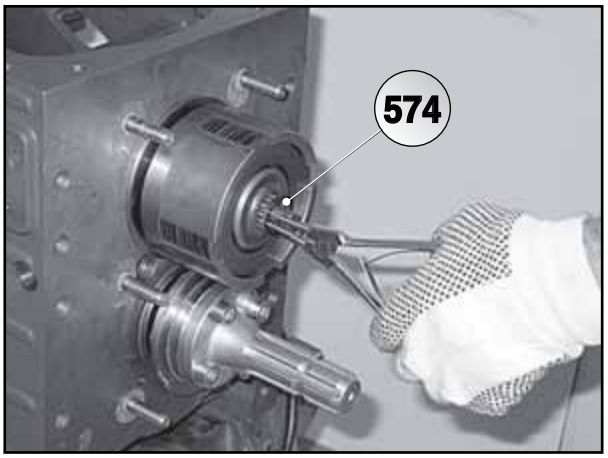


Fig. 6.21

- remove the clutch unit while maintaining the rear shaft (502) in the gearbox housing.

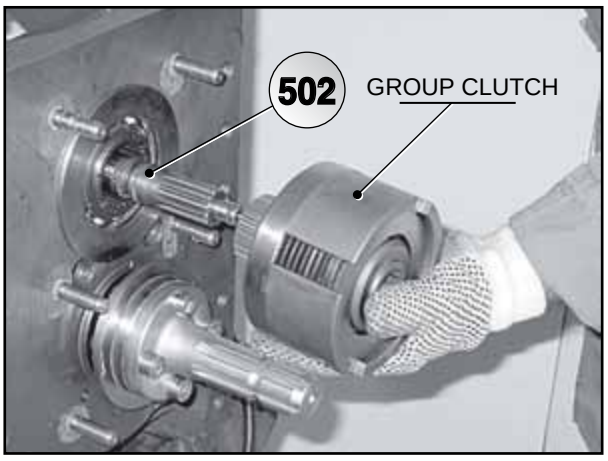


Fig. 6.22

Double gear removal

- Draw out the rear shaft (502) (version with proportional PTO); in **F-N Series** tractors with the independent PTO, when the rear shaft (552) is drawn out, the sleeve (551) remains on the front shaft (570), retained by the spring ring (578);

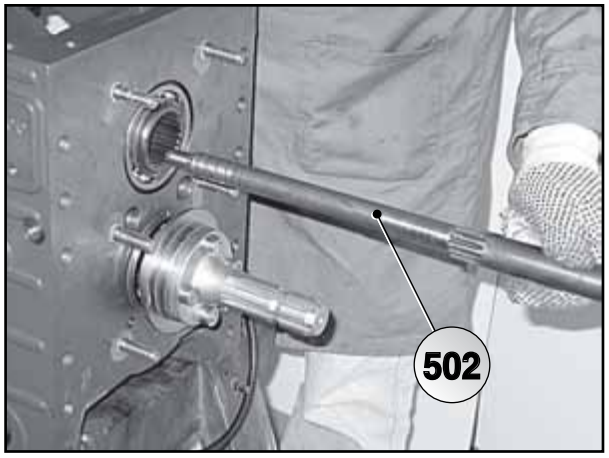


Fig. 6.23

Attention: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the assemblies or parts are supported by appropriate harness and hooks. Make sure that there are no bystanders near the load being lifted.

- remove the hydraulic lift unit to access the rear part of the gearbox;
- remove the spring ring (576);

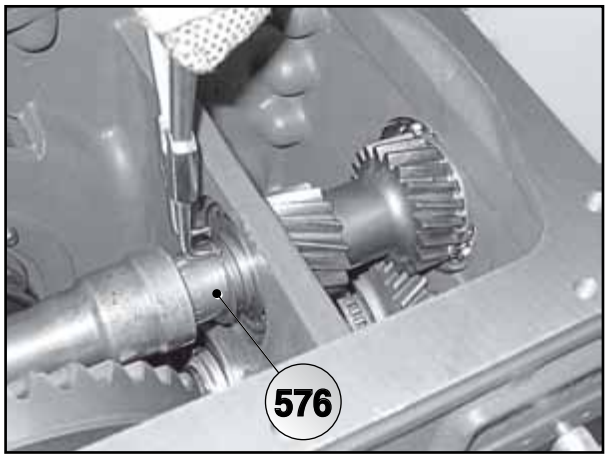


Fig. 6.24

- remove the double gear (504).

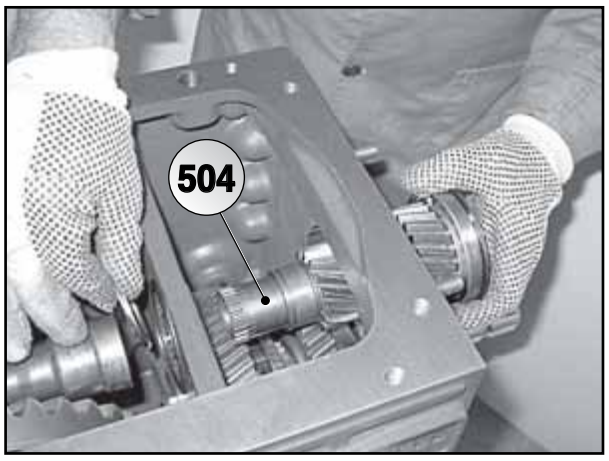


Fig. 6.25

The bearing (503) that supports the double gear is the ball type in **F-N Series 60-70**tractors and the roller type in **F-N Series 90 and 100 tractors.**

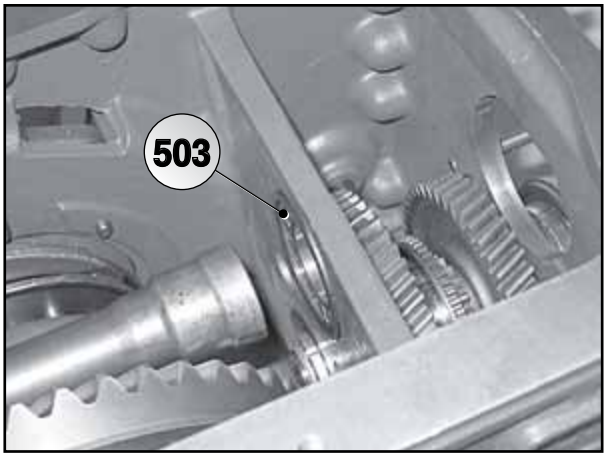


Fig. 6.26

Lower shaft removal

- remove the PTO RPM sensor (SR5);
- unscrew the ring nut (519) with tool 26 PTO VS;
- draw out the lower shaft (514) along with the output shaft (512).

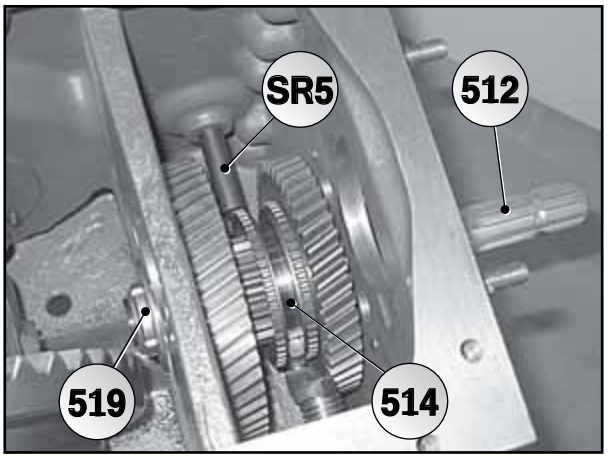


Fig. 6.27

How to remove the PTO selection sleeve (version with proportional PTO)

⚠	**Attention:** wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.

- to make the sleeve (501) easier to remove, it is advisable to disassemble the diff lock engaging unit.

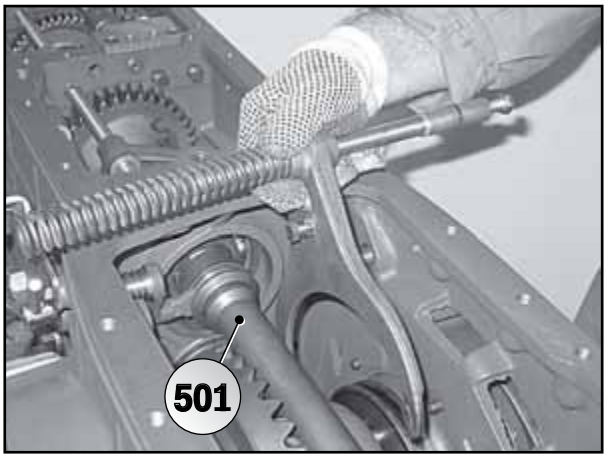


Fig. 6.28

5.2 Guidelines for re-assembly, adjustment and inspections

How to re-assemble the lower shaft and double gear

- check the ball bearings that support the shaft (514) and the double gear (504) for wear;
- re-assemble the lower shaft and the double gear by working through the disassembly operations in reverse order;
- replace the ring nut (519) retaining the lower shaft.

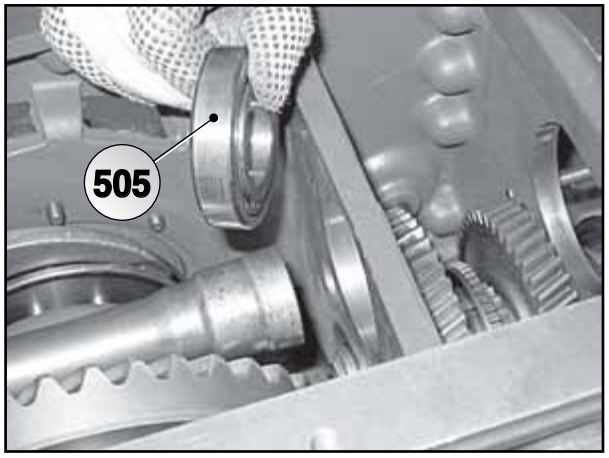


Fig. 6.29

Rear shaft re-assembly

- reassemble the PTO selector sleeve (501) and the diff lock engaging unit;

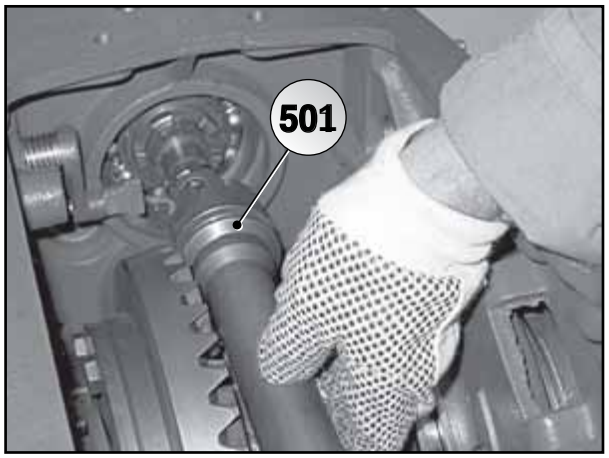


Fig. 6.30

- replace the seals and make sure that the lubrication and cooling ducts (C) are not clogged;
- re-assemble the rear shaft (502) in the gearbox housing.

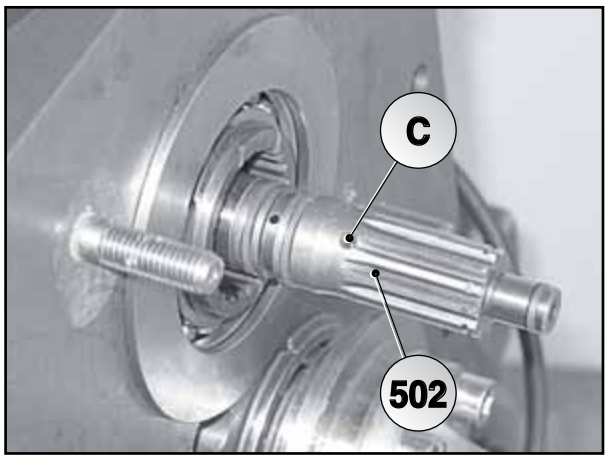


Fig. 6.31

Clutch assembly inspection

- disassemble the piston (508) by compressing the return spring with the aid of tool **02 PTO MYT** ;

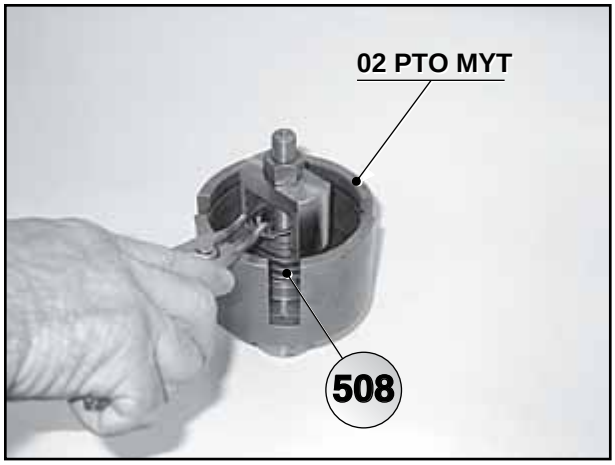


Fig. 6.32

- replace the retention rings (in "**TEFLON**") and the **O-rings**);
- check that the scoring on the friction discs is clearly visible; if not, replace the discs;
- check that the middle discs are not warped by overheating or scorching; replace the discs if this is the case.

Fig. 6.33

Re-assembly of the clutch unit

- re-assemble the clutch unit on the gearbox housing;

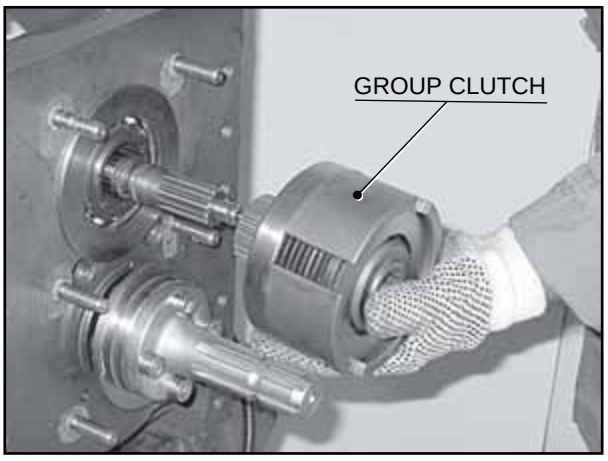


Fig. 6.34

- replace the retention ring and check that the scoring on the brake disc is clearly visible; if not, replace the disc.
- re-assemble the clutch unit cover (506) onto the gearbox housing.

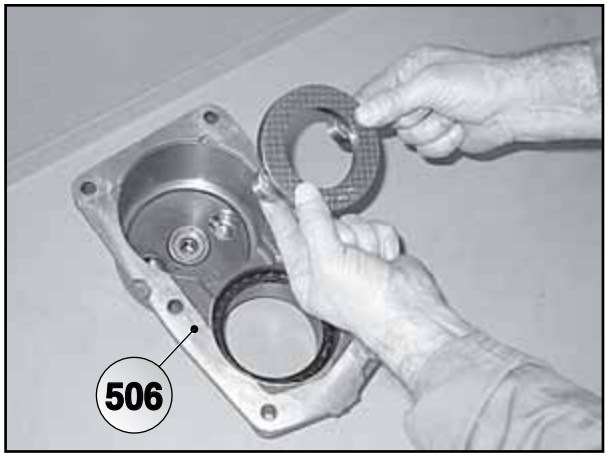


Fig. 6.35

How to adjust the PTO speed sensor

The sensor (SR5), of the type indicated in Fig.6.36 and 6.37 , has an internal cylinder made of ferromagnetic material surrounded by a winding.

When the sensor is set in the frontal position in relation to the teeth of a turning gear, an alternate voltage is obtained (by induction) on the external winding of the sensor itself. The magnetic field of the plunger strikes the teeth of the gear which, by turning, influences the continuity.

The frequency of the voltage thus obtained allows the rotation rate to be calculated.

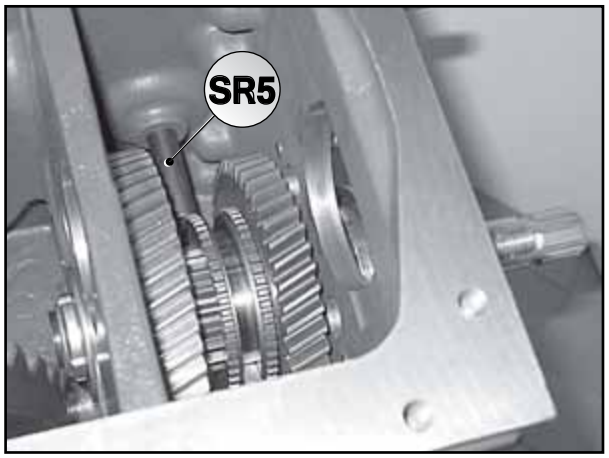


Fig. 6.36

Sensor adjustment

- screw down the sensor on to the PTO gear;
- loosen it by about half a turn;
- tighten the check nut to secure the adjustment.

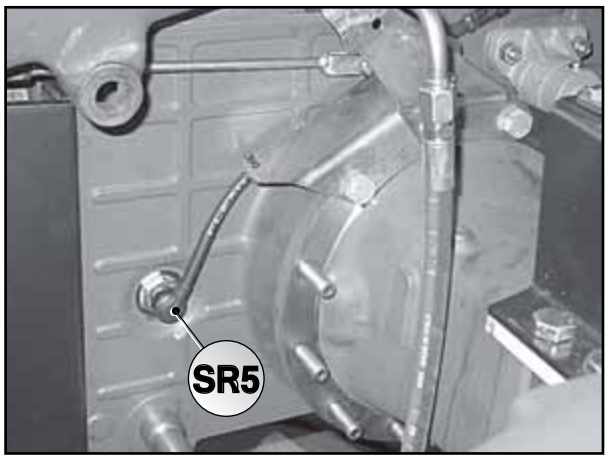


Fig. 6.37

Section 6 : Guidelines for disassembly, re-assembly and adjustment of the mechanical PTO

Index

6.1 Guidelines for disassembly (F-N Series 90-100-105) 6-36

6.2 Guidelines for re-assembly, adjustments and inspection (F-N Series 90-100-105) 6-39

6.3 Guidelines for disassembly, re-assembly, adjustments and inspection (F-N Series 65-75-80) 6-41

6.1 Guidelines for disassembly (F-N Series 90-100-105)

Removal of the mechanical power take-off

Note: the disassembly operations cannot be carried out with the hydraulic lift assembled.

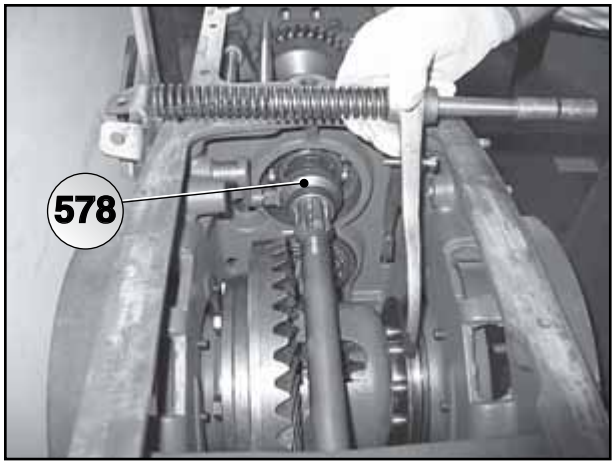


Fig. 6.38

How to remove the PTO selection sleeve (version with proportional PTO)

⚠	**Attention:** wear protective gloves when removing the differential lock spring and hold the actual spring firmly with the hand.

- to make the sleeve (578) easier to remove, it is advisable to disassemble the diff lock engaging unit.
- remove the cover (581);

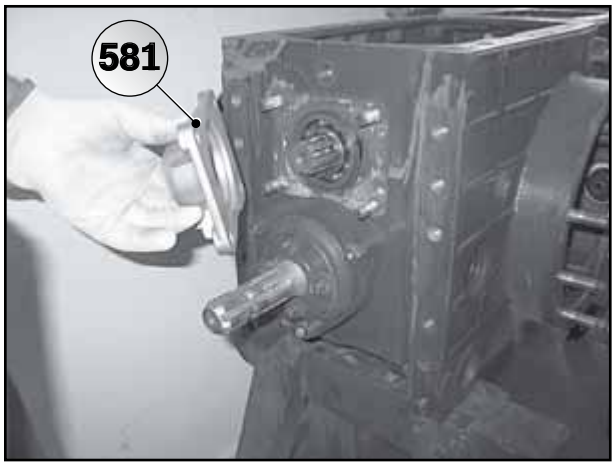


Fig. 6.39

- remove the spring rings (586 and 587);

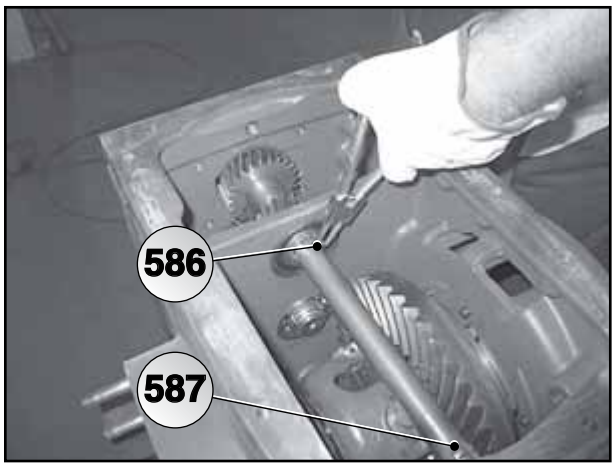


Fig. 6.40

- remove the rear shaft (579).

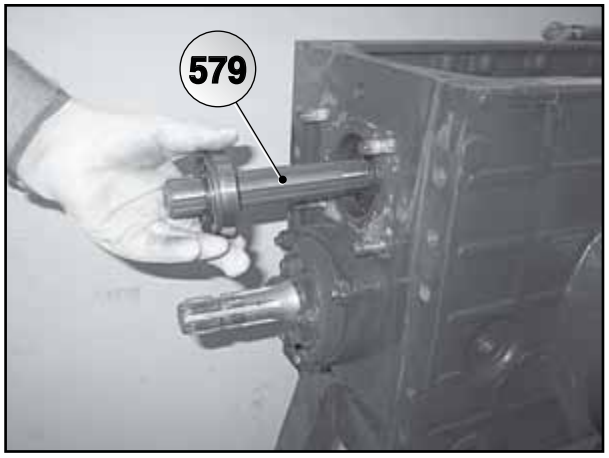


Fig. 6.41

- remove the selector sleeve (578).

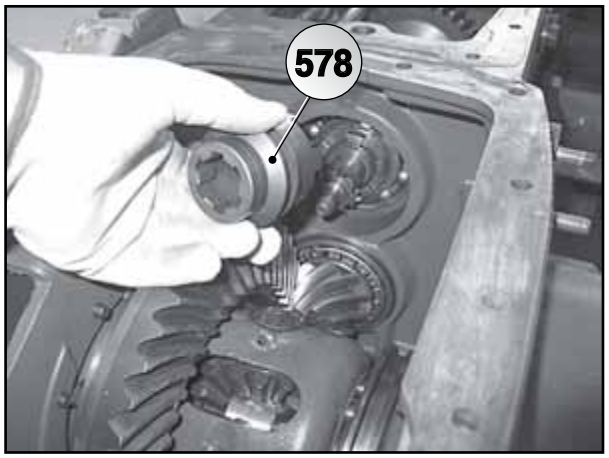


Fig. 6.42

- remove gears (600 and 590).

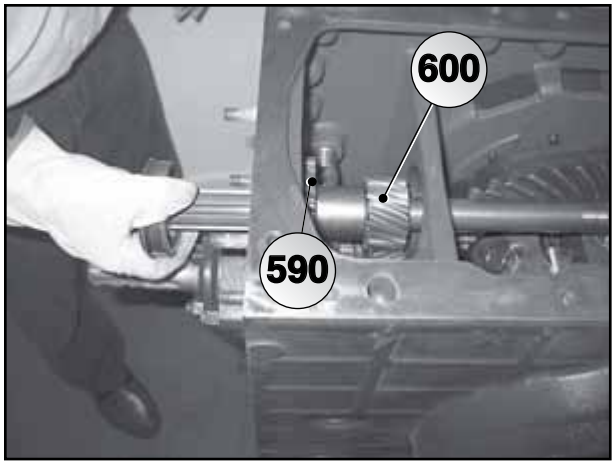


Fig. 6.43

Lower shaft removal

- remove the PTO RPM sensor (SR5);

Fig. 6.44

- U**nscrew the ring nut (519) with tool 26 PTO VS.** .

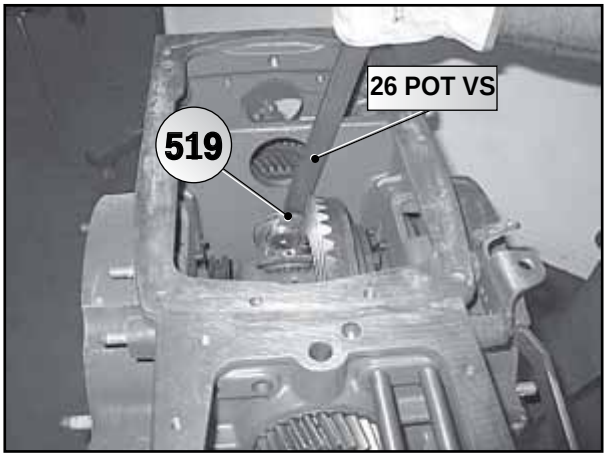


Fig. 6.45

6.2 Guidelines for re-assembly, adjustments and inspection (F-N Series 90-100-105)

Lower shaft removal

- check the bearings supporting the shaft (514) for wear;
- re-assemble the lower shaft following the disassembling operations in reverse order;
- replace the ring nut (519) retaining the lower shaft;
- replace the retention rings (588) and (599).

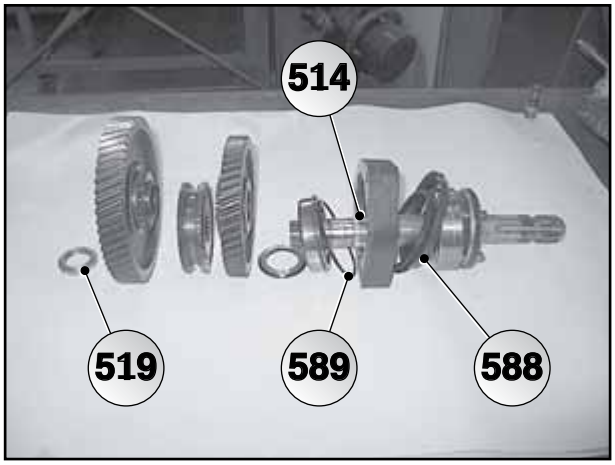


Fig. 6.46

Rear shaft re-assembly

- reassemble the PTO selector sleeve (578) and the diff lock engaging unit;

⚠	**Attention:** wear gloves and hold the spring firmly with one hand when re-assembling the diff lock spring.

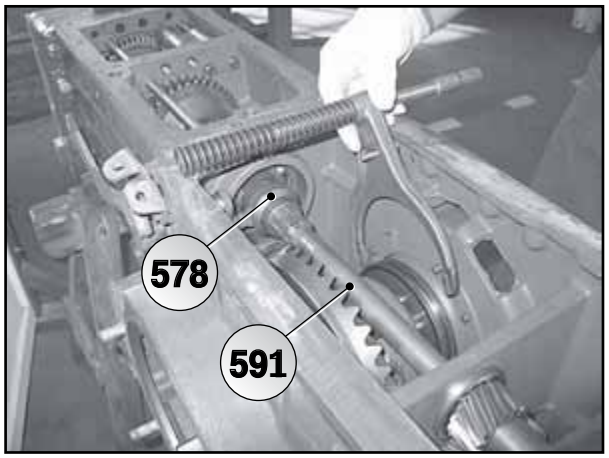


Fig. 6.47

- check the bearings (580) and (585) that support the shaft (579) for wear.
- replace all the spring rings.

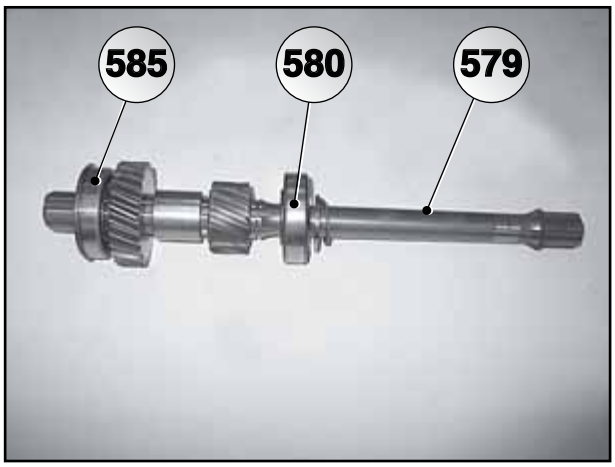


Fig. 6.48

How to adjust the PTO speed sensor

The sensor (SR5) has an internal cylinder made of ferromagnetic material surrounded by a winding.

When the sensor is set in the frontal position in relation to the teeth of a turning gear, an alternate voltage is obtained (by induction) on the external winding of the sensor itself. The magnetic field of the plunger strikes the teeth of the gear which, by turning, influences the continuity.

The frequency of the voltage thus obtained allows the rotation rate to be calculated.

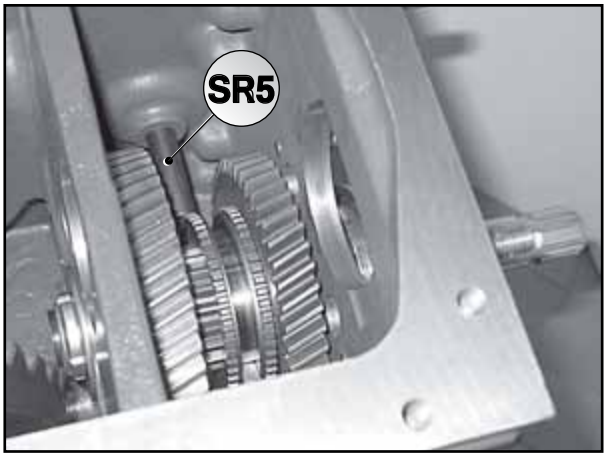


Fig. 6.49

Sensor adjustment

- screw down the sensor on to the PTO gear;
- loosen it by about half a turn;
- tighten the check nut to secure the adjustment.

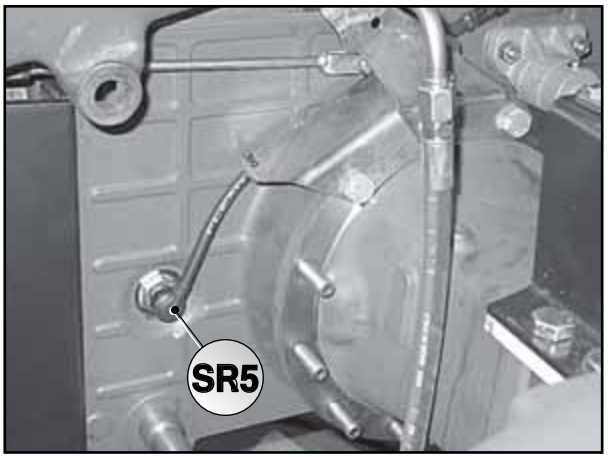


Fig. 6.50

6.3 Guidelines for disassembly, re-assembly, adjustments and inspection (F-N Series 65-75-80)

These guidelines for disassembly, re-assembly, adjustment and inspection are the same as described in points 6.1 and 6.2 for the PTO instaklled on F-N Series 90-100-105 tractors.

Fig. 6.51 and 6.52 show the layout of the PTO mounted on F-N Series 65-75-80 tractors.

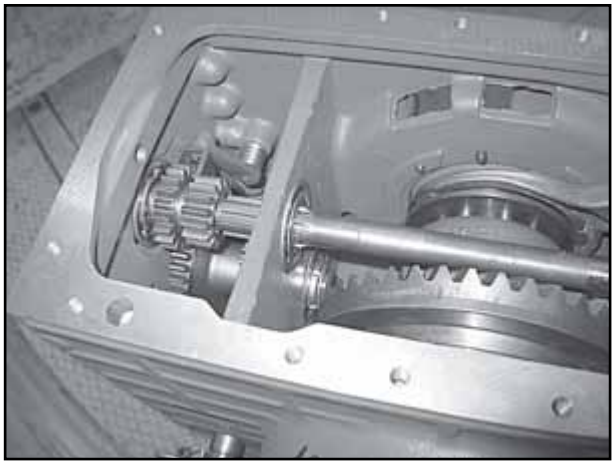


Fig. 6.51

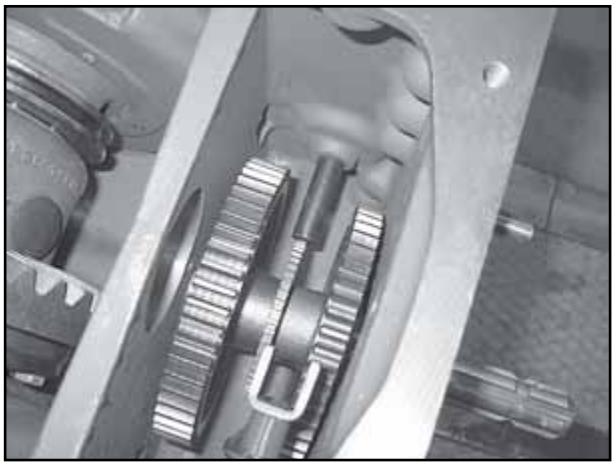


Fig. 6.52

Section 7 : Special tools

26 PTO VS

Wrench for the PTO shaft ring nut

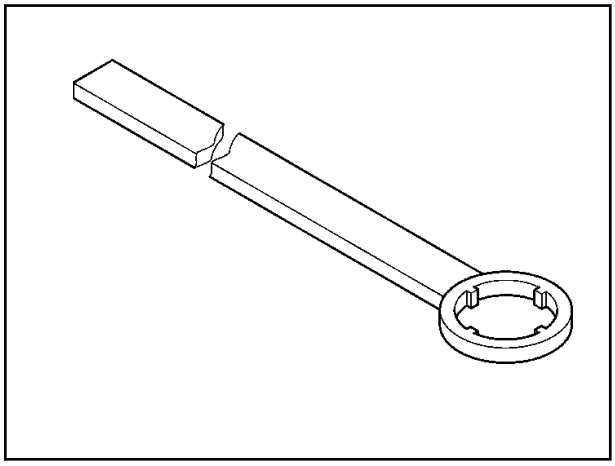


Fig. 6.53

02 PTO MYT

Puller for disassembling and re-assembling the PTO clutch piston spring.

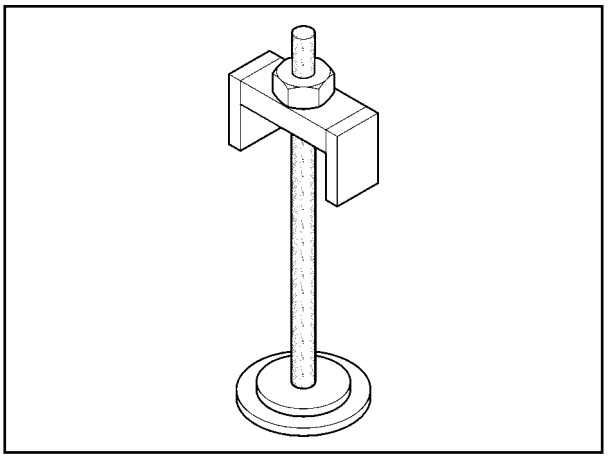


Fig. 6.54

Chapter 7 : Hydraulic circuit

Index

Section 1 : Precautions and safety recommendations 7-2

Section 2 : General description 7-3

2.1 Main hydraulic circuit (Speed Five version) 7-4
2.2 Main hydraulic circuit (Power Shuttle version) 7-18
2.3 Main hydraulic circuit (E-Line version) 7-32

Section 3 : Technical specifications 7-47

3.1 Main technical specifications (Speed Four version) 7-48
3.2 Main technical specifications (Power Shuttle version) 7-50
3.3 Main technical specifications (E-Line version) 7-52

Section 4 : Hydraulic braking system 7-55

4.1 Hydraulic brake circuit 7-56
4.2 Description of operation 7-58
4.3 Operation of the brake pump with compensator 7-60
4.4 How to bleed air from the rear brake circuit 7-61
4.5 Bleeding air from the front brake circuit 7-62
4.6 Brake adjustment 7-64
4.7 Brake circuit on-off valve 7-65

Section 5 : Main components of the low flow circuit 7-67

5.1 Hydraulic pump 7-70
5.2 Hydrostatic steering system 7-72
5.3 Users' hydraulic circuit (Power Shuttle version) 7-84
5.4 Block for forced lubrication valve 7-90
5.5 Block for reverse shuttle solenoid valves and lubrication .. 7-94
5.6 Block for PTO solenoid valves and brake unit 7-98
5.7 Servo clutch valve system (Speed Five version) 7-102
5.8 Adjustments 7-114
5.9 Hydraulic clutch assemblies (Power Shuttle version) 7-116
5.10 Front/rear diff lock supply (Power Shuttle version) 7-120

5.11 Rear PTO and brake unit supply system (Powershuttle version) .. 7-122
5.12 4WD engagement (Spring-on) (Power Shuttle version) .. 7-128
5.13 "Power Five" oil supply (Power Shuttle version) 7-130
5.14 Users' hydraulic power pack (E-Line version) 7-132
5.15 Block for 4WD solenoid valve (E-Line version) 7-140

Section 6 : Main components of the high flow circuit 7-145
6.1 Hydraulic pump 7-146
6.2 Trailer brake 7-148
6.3 Auxiliary control valves 7-160
6.4 Electrohydraulic flow selector (Speed Five and Power Shuttle version) 7-182
6.5 Mechanical power lift supply system 7-189
6.6 Triple pump with independent hydraulic circuit (Power Shuttle version) 7-192

Section 7 : Operating pressure tests 7-199
7.1 Introduction 7-200
7.2 Operating pressure tests for the low flow circuit 7-201
7.3 High flow pressure test 7-206

Section 8 : Special tools 7-207

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

⚠	**Attention:** do not begin work until the pressure in the hydraulic circuit has dropped to zero.

⚠	**Attention:** splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.

⚠	**Attention:** always comply with the operating instructions supplied by the manufacturer when using adhesive materials or detergents.

⚠	**Attention:** used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

⚠	**Attention:** take care to avoid burns when working with boiling oil. Never heat oil at a temperature exceeding **190° C**as the oil or its vapours could suddenly catch fire.

Section 2 : General description

Index

2.1 Main hydraulic circuit (Speed Five version) 7-4
2.1.1 Hydraulic diagram 7-4
2.1.2 General description 7-6
2.1.3 Functional diagram 7-8
2.1.4 Description of the low flow circuit 7-12
2.1.5 Description of the high flow circuit 7-14
2.1.6 Description of the lubrication circuit 7-16

2.2 Main hydraulic circuit (Power Shuttle version) 7-18
2.2.1 General description 7-18
2.2.2 Functional diagram 7-22
2.2.3 Description of the low flow circuit 7-26
2.2.4 Description of the high flow circuit 7-28
2.2.5 Description of the engine cooling and lubrication circuits .. 7-30

2.3 Main hydraulic circuit (E-Line version) 7-32
2.3.1 General description 7-32
2.3.2 Functional diagram 7-36
2.3.3 Description of the low flow circuit 7-40
2.3.4 Description of the high flow circuit 7-42
2.3.5 Description of the engine cooling and lubrication circuits .. 7-44

2.1 Main hydraulic circuit (Speed Five version)

2.1.1 Hydraulic diagram

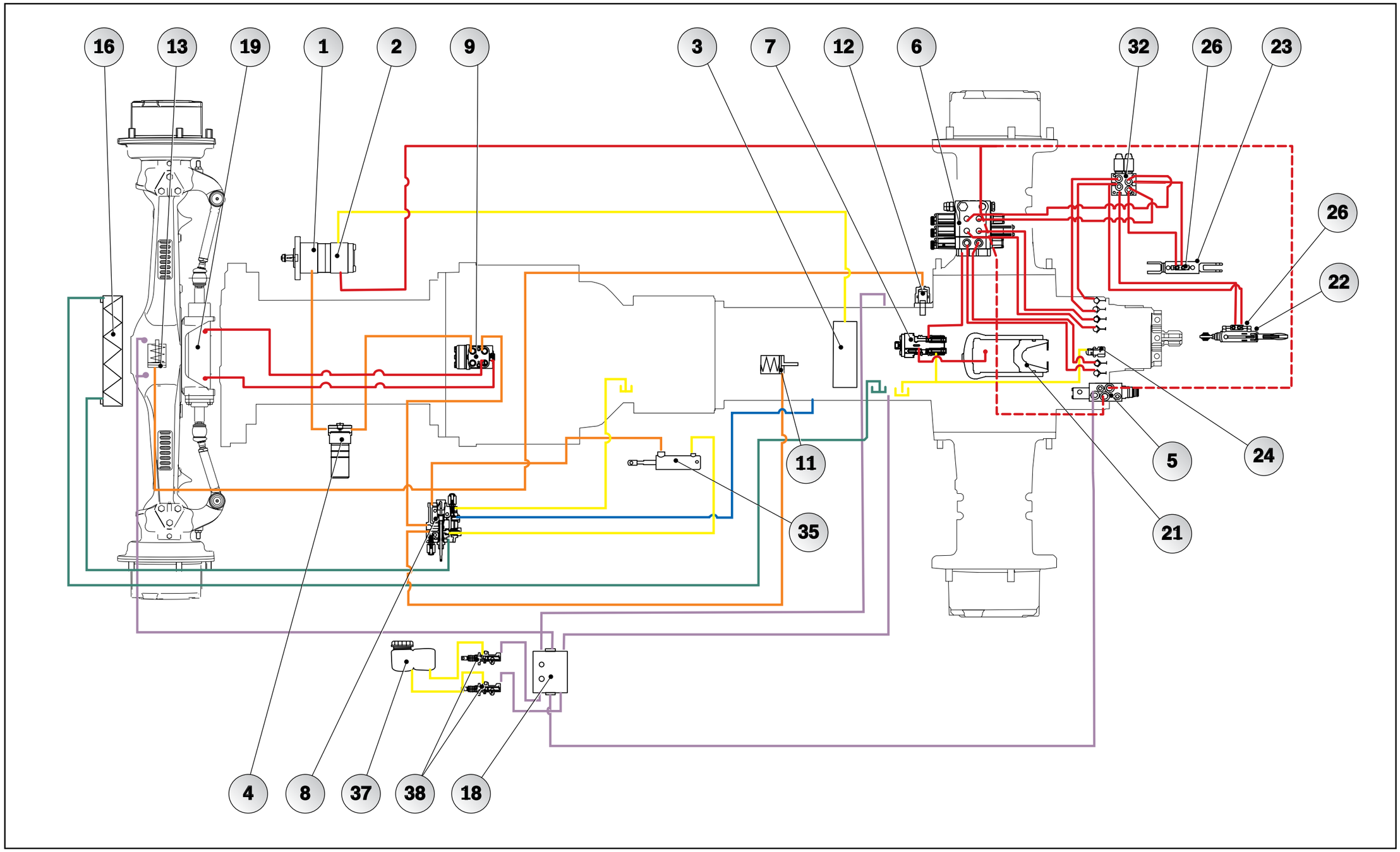


Fig. 7.1

1 - Low flow pump
2 - High flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
8 - Servo clutch valve system
9 - Hydrostatic steering system
12 - 4WD engagement (Spring-on)
13 - Rear differential lock
15 - Front differential lock
16 - Transmission oil cooling radiator
19 - Brake circuit on-off valve
21 - Steering cylinder
22 - Mechanical power lift's internal ram
23 - Hydraulic top link
25 - Vertical hydraulic lift rod
24 - Free discharge for hydraulic motors
26 - Shut-off valves
32 - Electro-hydraulic flow selector
35 - Power clutch cylinder

- high pressure
- low pressure
- discharge/inlet
- discharge/inlet
- lubrication
- brakes

2.1.2 General description

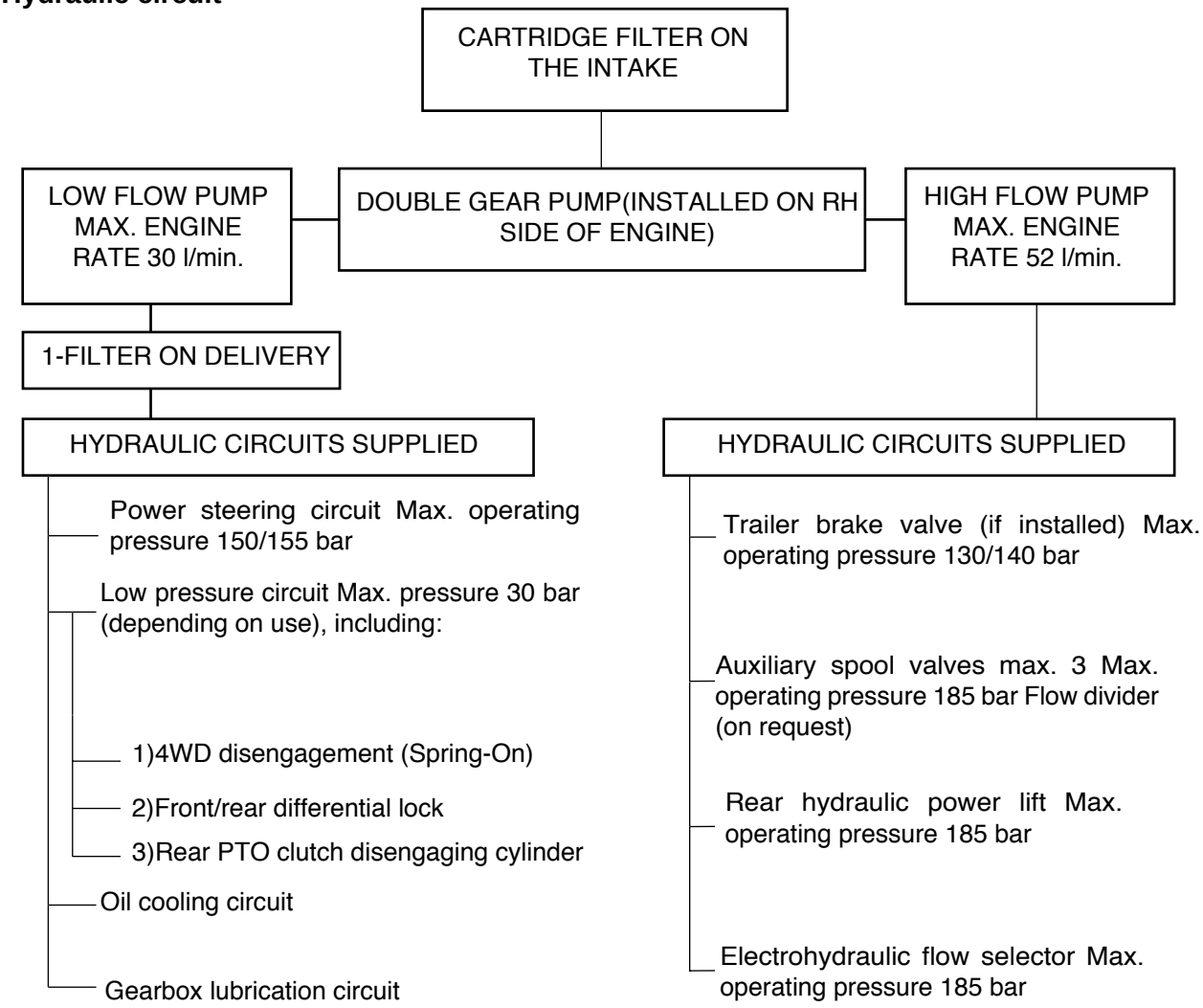
The quality, versatility and correct operation of a farming tractor mainly depend on its hydraulic circuit.

To achieve all this, the tractors in the **Speed Five** version of **F-N Series** tractors are equipped with two hydraulic circuits supplied by a double gear pump. They operate in tandem with common oil intake and use the transmission oil.

- A "**Low flow**" circuit (orange colour) **30 l/min**: supplies the "power steering" system as first priority, followed by the "low pressure" circuit for the hydraulically activated functions, such as: 1) 4WD disengagement (Spring-on); Front/ Rear diff lock; 3) Rear PTO clutch disengaging cylinder.

  Meanwhile, most of the oil is directed towards a cooling circuit and then towards a lubricating/forced flushing duct of the gearbox. Having terminated its route, the oil is conveyed to the transmission compartment which acts as a single reservoir for the main hydraulic system and which lubricates the transmission itself by immersion.
- A second "**High flow**" (red colour) **52 l/min**: supplies the trailer brake valve as first priority (if installed) and then: the flow divider (if installed) and the auxiliary control valves, the mechanically controlled hydraulic power lift and the electrohydraulic flow selector (if installed).t

Hydraulic circuit



2.1.3 Functional diagram

Low flow

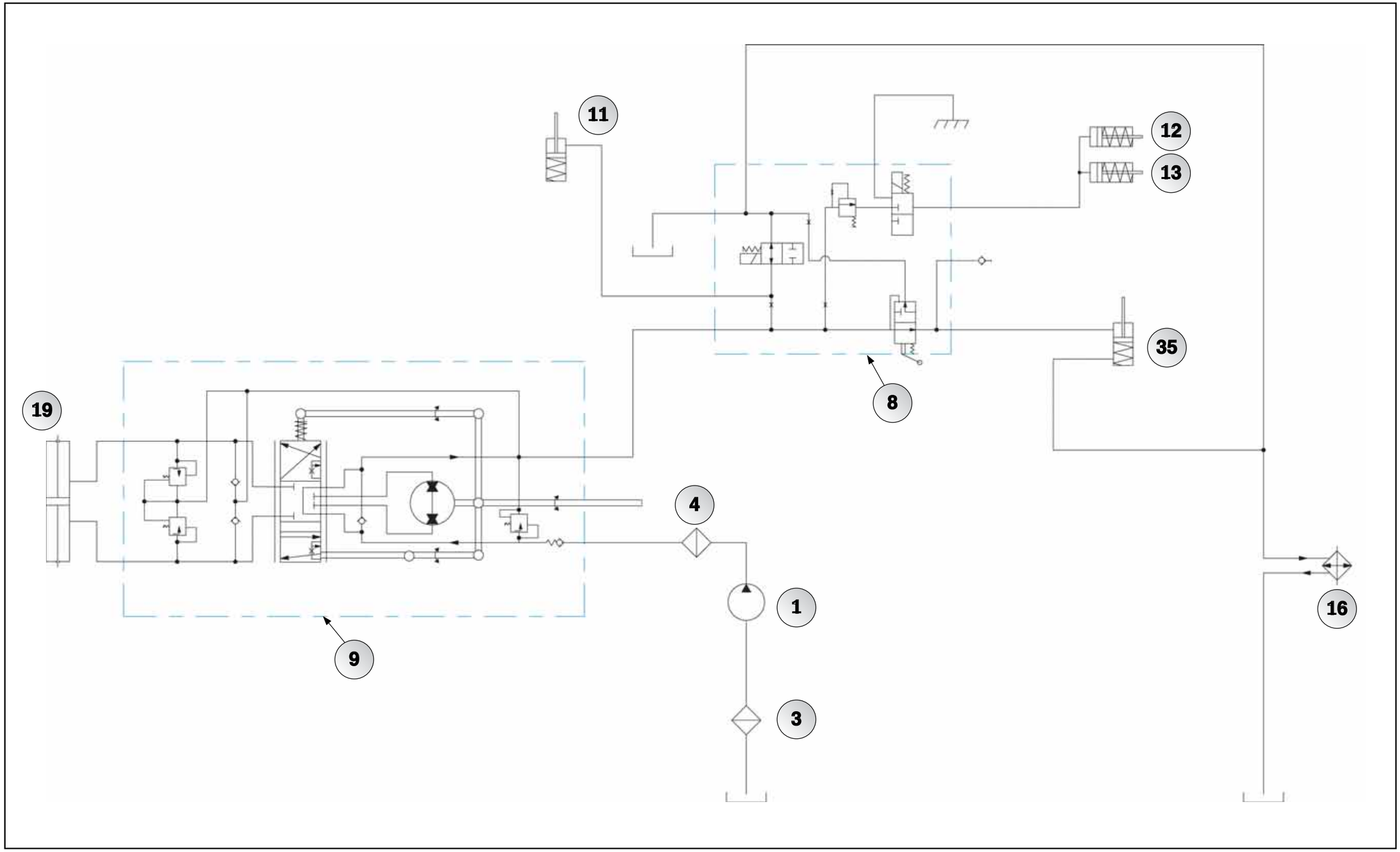


Fig. 7.2

1 - Low flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
8 - Servo clutch valve system
9 - Hydrostatic steering system
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
13 - Front differential lock
16 - Transmission oil cooling radiator
19 - Steering cylinder
35 - Power clutch cylinder

High flow

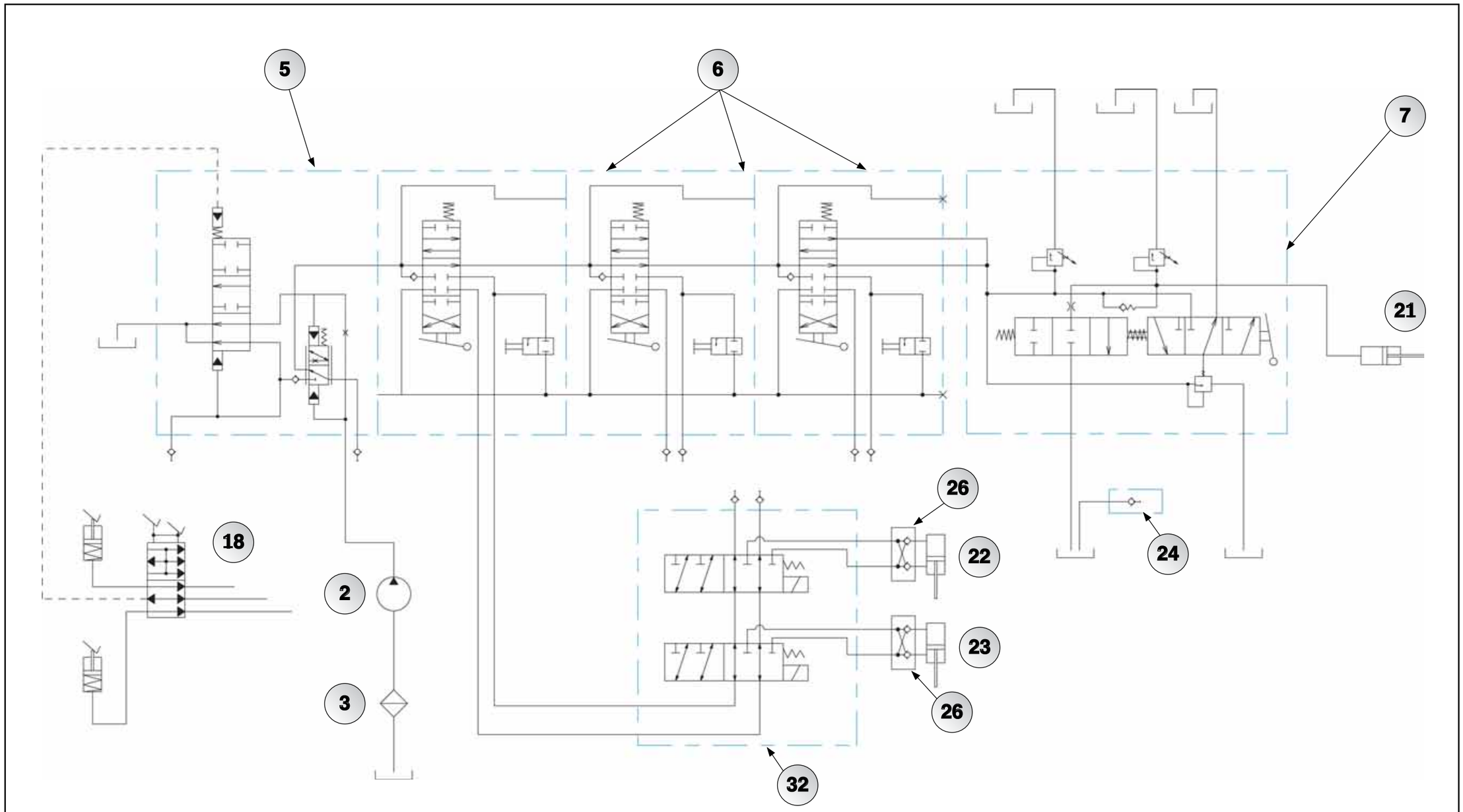


Fig. 7.3

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift’s valve system
18 - Brake circuit on-off valve
21 - Power lift’s internal ram
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
24 - Free discharge for hydraulic motors
26 - Shut-off valves
32 - Electro-hydraulic flow selector

2.1.4 Description of the low flow circuit

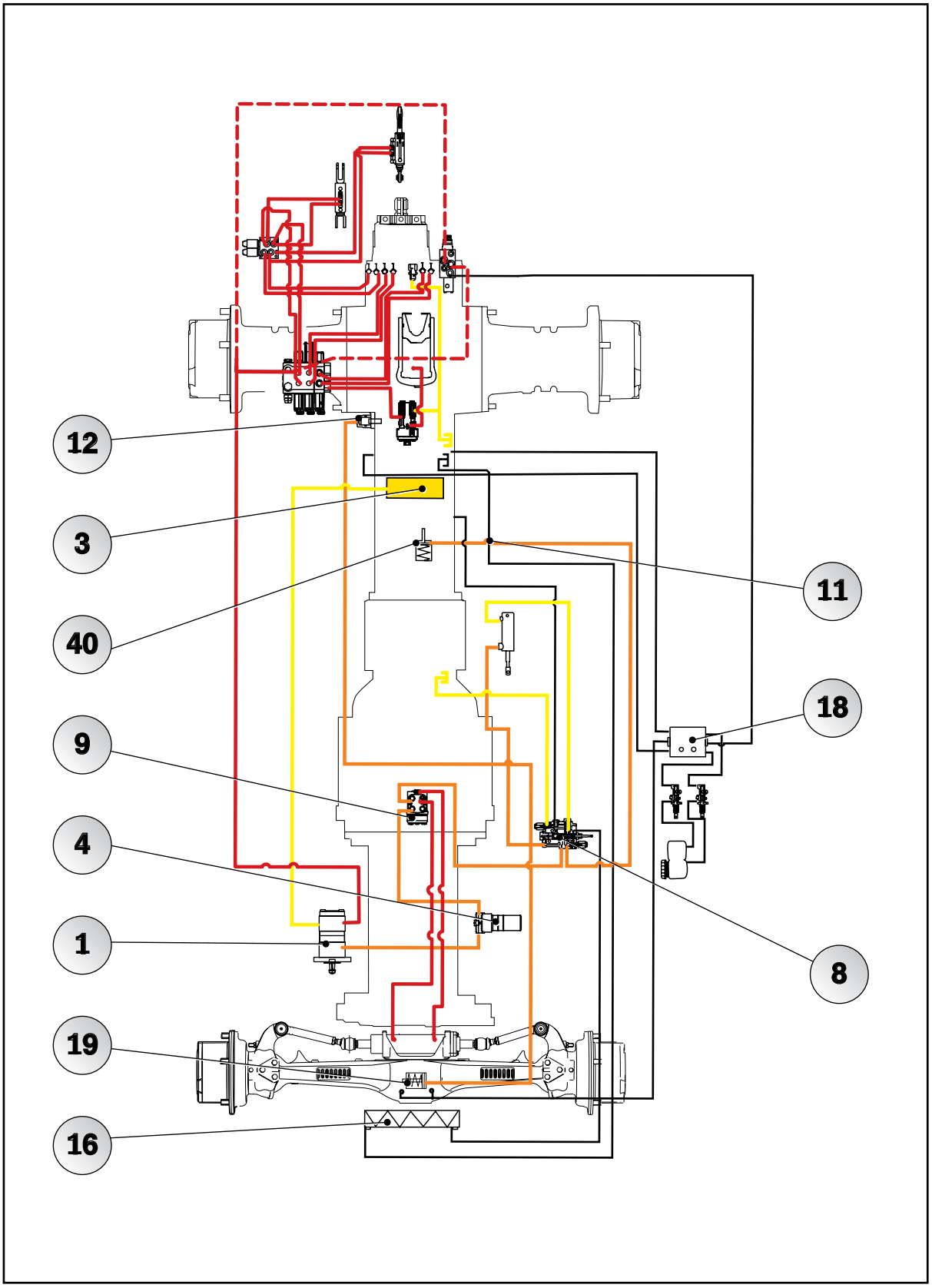


Fig. 7.4

1 - Low flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
8 - Servo clutch valve system
9 - Hydrostatic steering system
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
13 - Front differential lock
16 - Transmission oil cooling radiator
18 - Brake circuit on-off valve
19 - Steering cylinder
- high pressure
- low pressure
- discharge/inlet

The “low flow” circuit is supplied by the pump (1), which is connected to the reservoir (4). The pump supplies the power steering system (9) at “high pressure” by absolute priority (150/155 bar).

Oil discharged by this first section supplies the power pack (8), which pressurizes oil received at “low pressure”. The circuit switches to closed center, allowing pressurized oil to supply the user connected, the front and rear diff lock.

Unused oil flows back to the low flow reservoir (4) in order to supply the circuit itself.

2.1.5 Description of the high flow circuit

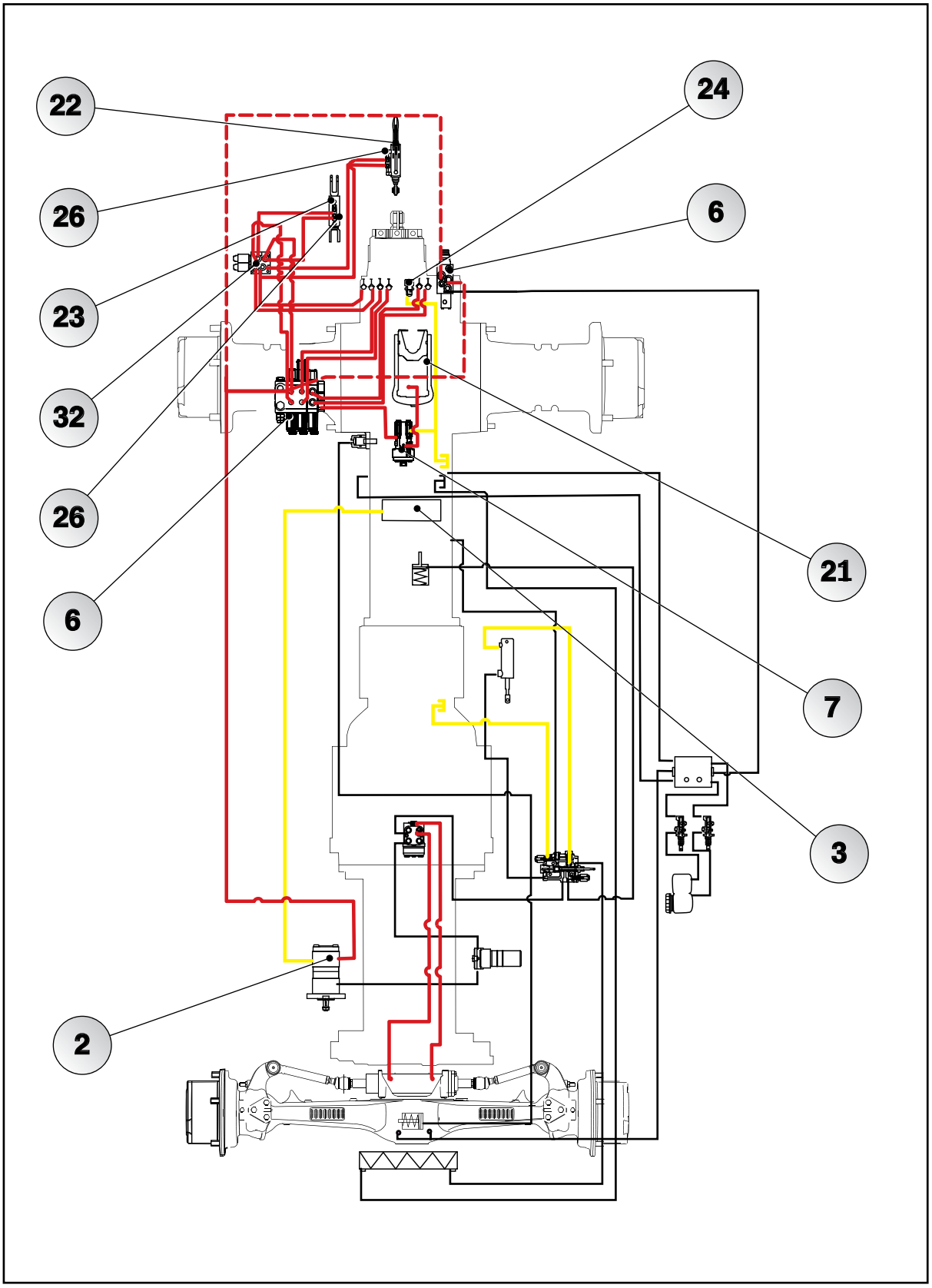


Fig. 7.5

2 - High flow pump
3 - High flow suction filter
5 - Trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift's valve system
21 - Power lift's internal ram
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
24 - Free discharge for hydraulic motors
26 - Shut-off valves
32 - Electro-hydraulic flow selector
- high pressure
- discharge/inlet

The "high flow" circuit is so called as it deals with a larger flow rate than the "low flow" circuit.

This circuit is also supplied by the independent hydraulic pump, assembled and operating in tandem with the low flow one.

The hydraulic oil of the transmission used, is intaken by the pumps through a single pipe after first passing through a cartridge filter.

Thus supplied, the high flow hydraulic pump can deliver pressurized oil to the trailer brake valve (5) (if installed) with absolute priority, controlled by a valve with a **130/140 bar.**

The oil flows then to the auxiliary control valves (6), in second priority, and can be directed to the quick couplings, with relative rams, and also to the flow selector (32), then flow on to the valve controlling the rear hydraulic power lift. In both cases, a valve with a **185 bar** setting installed in the flow divider (when installed) or on the inlet plate of the auxiliary control valves, monitors the pressure, discharging the oil sent by the pump into the differential housing. The power lift's valve system can send pressurized oil to its lifting cylinders (21) when required by the operator.

2.1.6 Description of the lubrication circuit

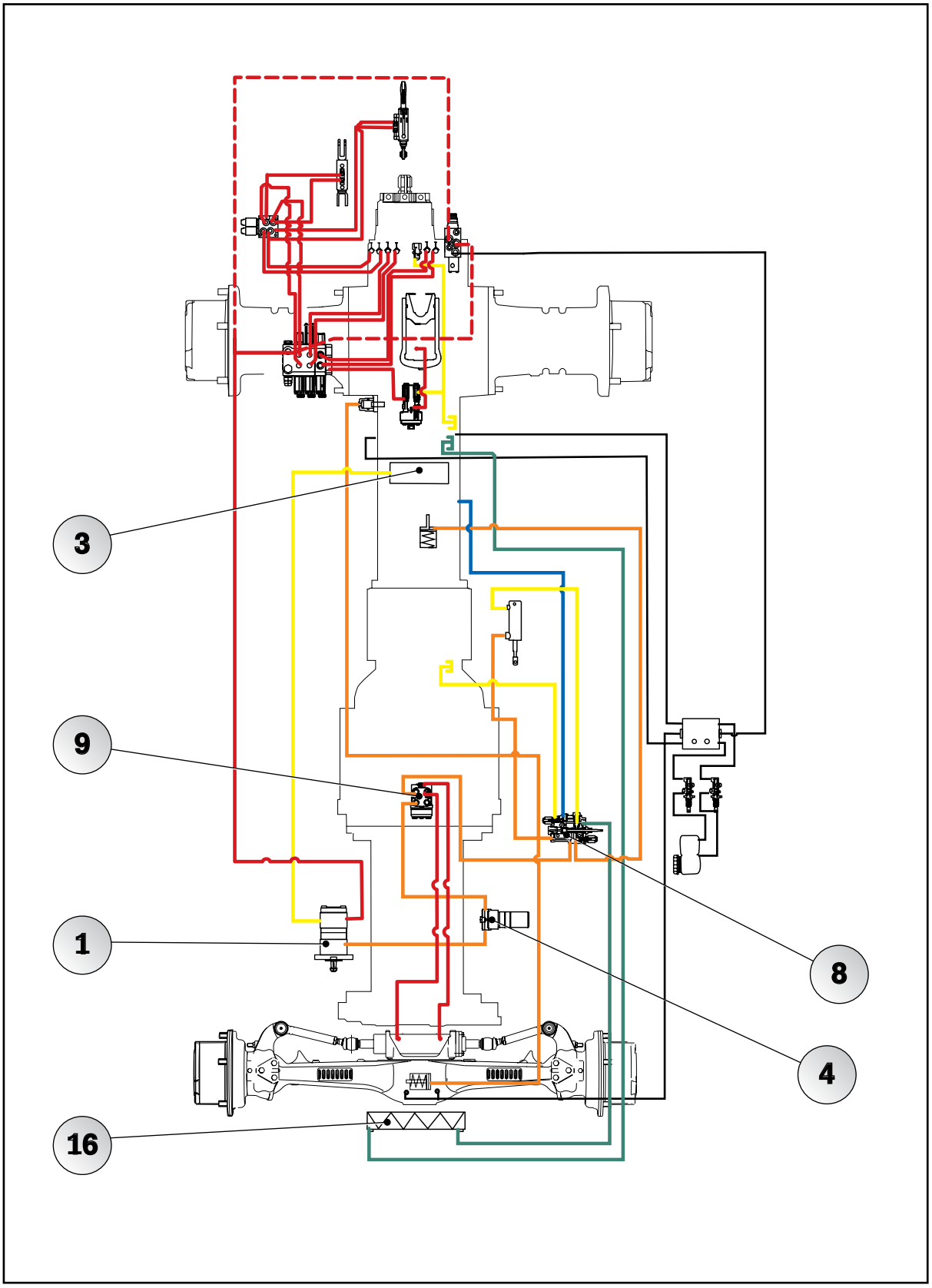


Fig. 7.6

2 - High flow pump
6 - Auxiliary control valves
15 - 1.5 bar governor valve
- high pressure
- discharge/inlet
- lubrication

The “high flow” circuit deals with forced lubrication and flushes the transmission.

Oil is sent by the circuit towards the auxiliary control valves (6) through the regulating valve (15) (1.5 bar) and from thence for forced lubrication inside lower the transmission shafts of the axle and gearbox.

2.2 Main hydraulic circuit (Power Shuttle version)

2.2.1 General description

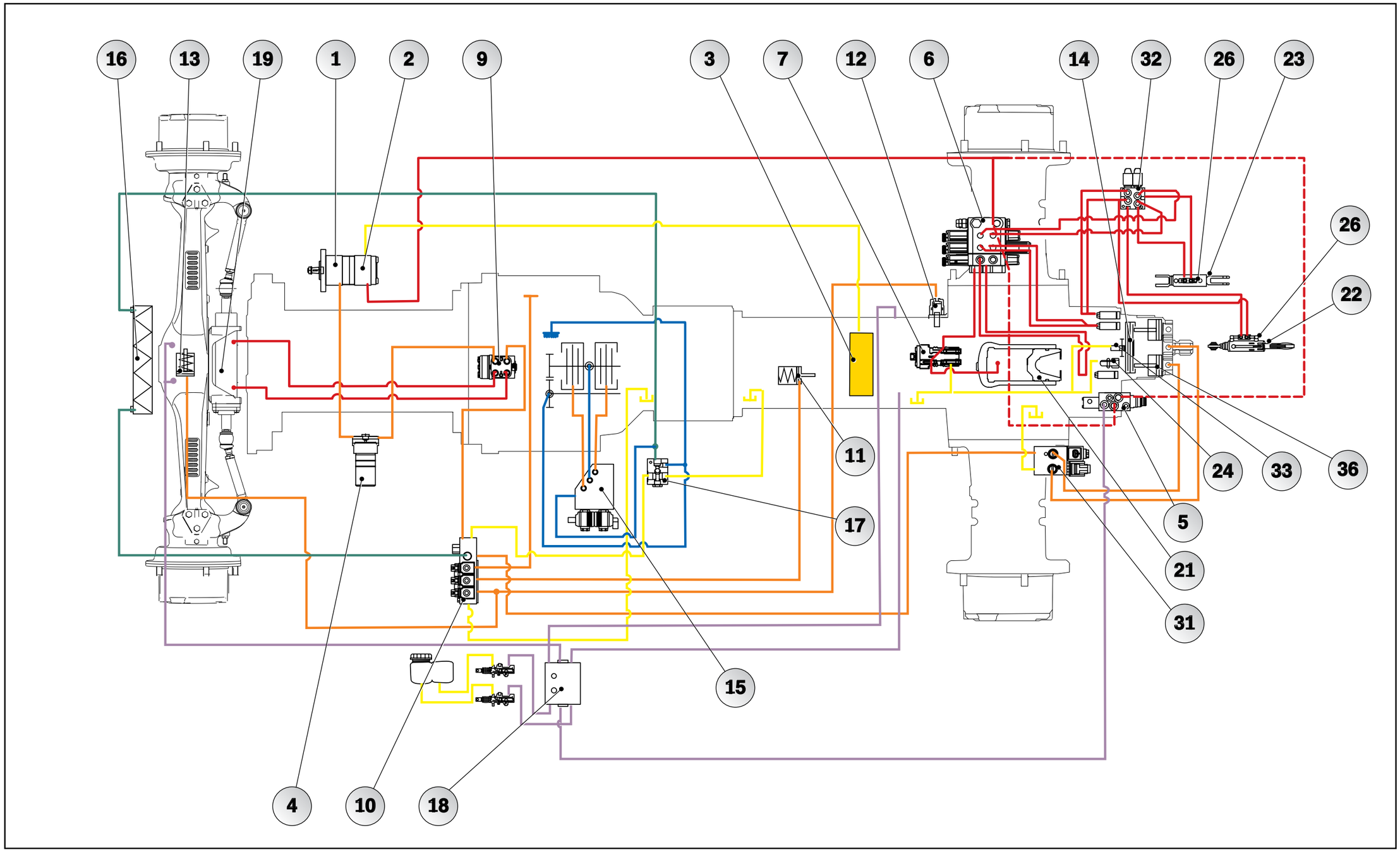


Fig. 7.7

1 - Low flow pump
2 - High flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
9 - Hydrostatic steering system
10 - Hydraulic power pack
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
13 - Front differential lock
14 - P.T.O. hydraulic clutch
15 - Block for solenoid valves
16 - Transmission oil cooling radiator
17 - Block for forced lubrication valve
18 - Brake circuit on-off valve
19 - Steering cylinder
21 - Mechanical power lift's internal ram
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
24 - Free discharge for hydraulic motors
26 - Shut-off valves
31 - Block for brake unit and PTO solenoid valves
32 - Electro-hydraulic flow selector
33 - PTO rear shaft
34 - "Power Five/Four" assembly
36 - Rear P.T.O. brake
37 - Brake fluid reservoir
38 - Brake pumps

- high pressure
- low pressure
- discharge/inlet
- lubrication
- brakes
- cooling

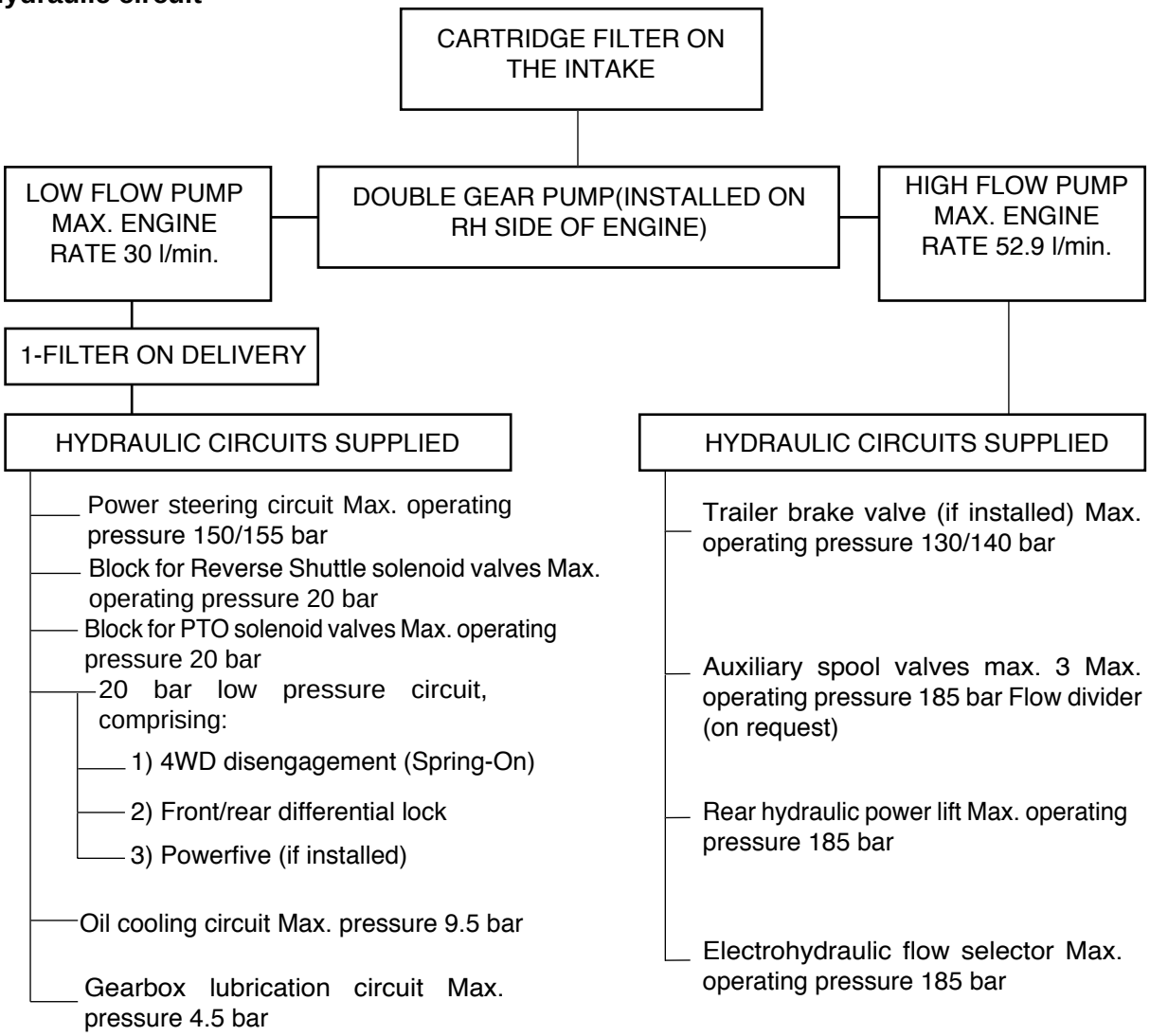
The quality, versatility and correct operation of a farming tractor mainly depend on its hydraulic circuit.

To achieve all this, the tractors in the **Power Shuttle** version of **F-N Series** tractors are equipped with two hydraulic circuits supplied by a double gear pump. They operate in tandem with common oil intake and use the transmission oil.

- A "**Low flow**" circuit (orange colour) **30 l/min**: supplies the "power steering" system as first priority, followed by the blocks (15) of the Powershuttle and (31) of the rear PTO, and the "low pressure" circuit for the hydraulically activated functions, such as: 1) 4WD disengagement (Spring-on); Front/Rear diff lock; 3) Powerfive (if installed).

  Meanwhile, most of the oil is directed towards a cooling circuit and then towards a lubricating/forced flushing duct of the gearbox. Having terminated its route, the oil is conveyed to the transmission compartment which acts as a single reservoir for the main hydraulic system and which lubricates the transmission itself.
- A second "**High flow**" (red colour) **52 l/min**: supplies the trailer brake valve as first priority (if installed) and then: the flow divider (if installed) and the auxiliary control valves, the mechanically controlled hydraulic power lift and the electrohydraulic flow selector (if installed).

Hydraulic circuit



2.2.2 Functional diagram

Low flow

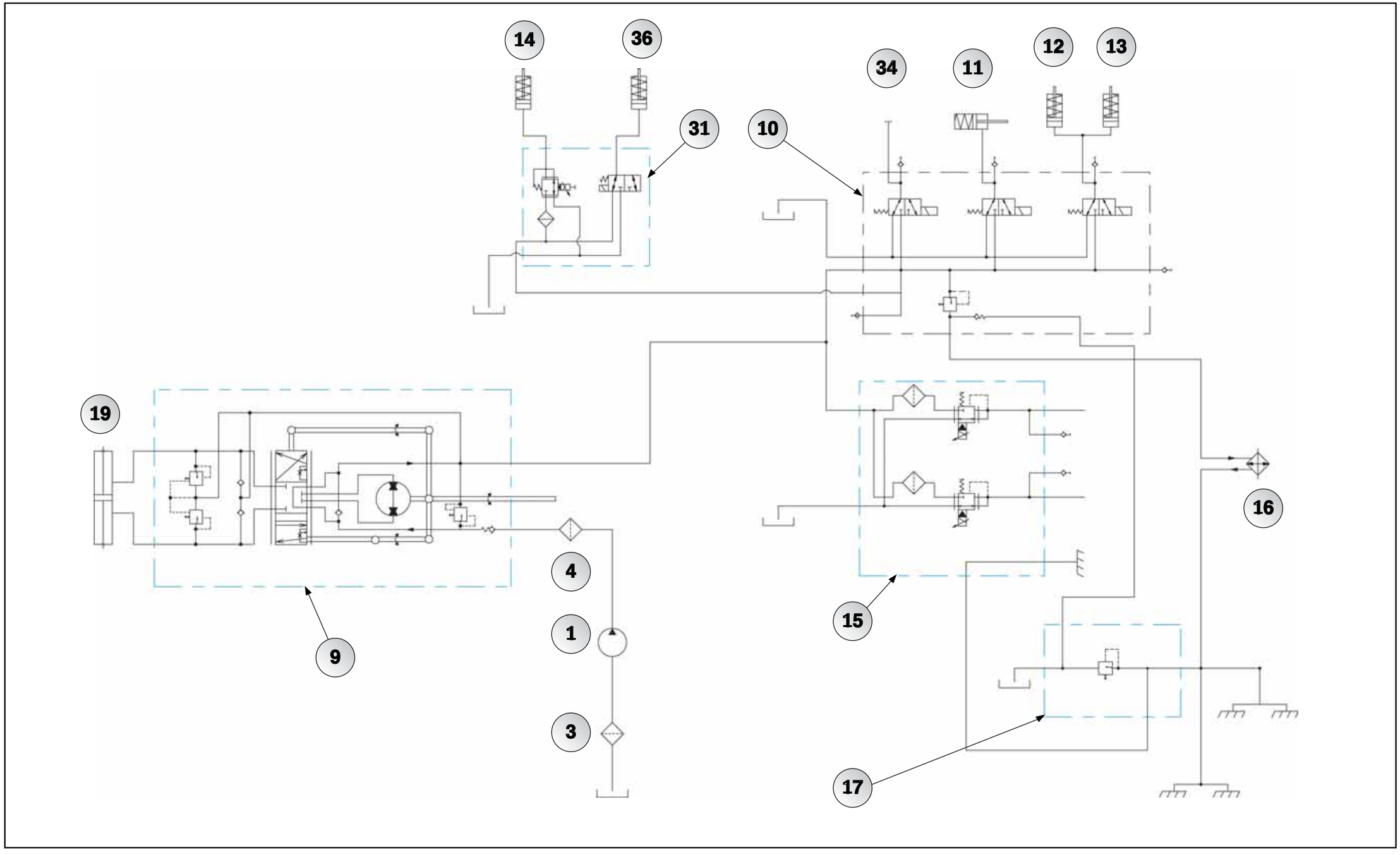


Fig. 7.8

1 - Low flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
9 - Hydrostatic steering system
10 - Hydraulic power pack
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
13 - Front differential lock
14 - P.T.O. hydraulic clutch
15 - Valve block for clutch control solenoid valves
16 - Transmission oil cooling radiator
17 - Block for forced lubrication valve
19 - Steering cylinder
31 - Valve block for PTO solenoid valves and brake unit
34 - “Powerfive” unit
36 - Rear P.T.O. brake

High flow

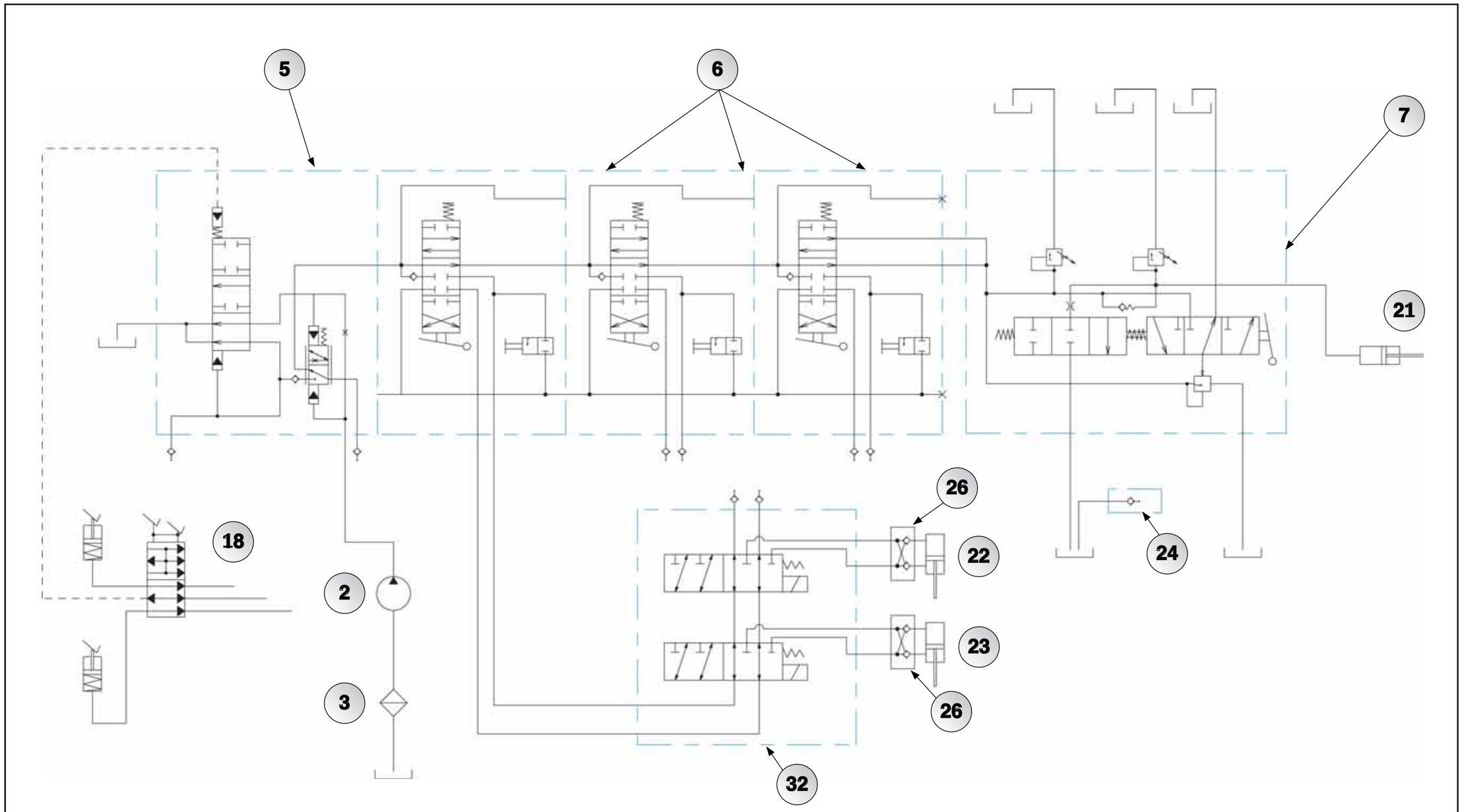


Fig. 7.9

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
18 - Brake circuit on-off valve
21 - Mechanical power lift's internal ram
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
24 - Free discharge for hydraulic motors
26 - Shut-off valves
32 - Electro-hydraulic flow selector

2.2.3 Description of the low flow circuit

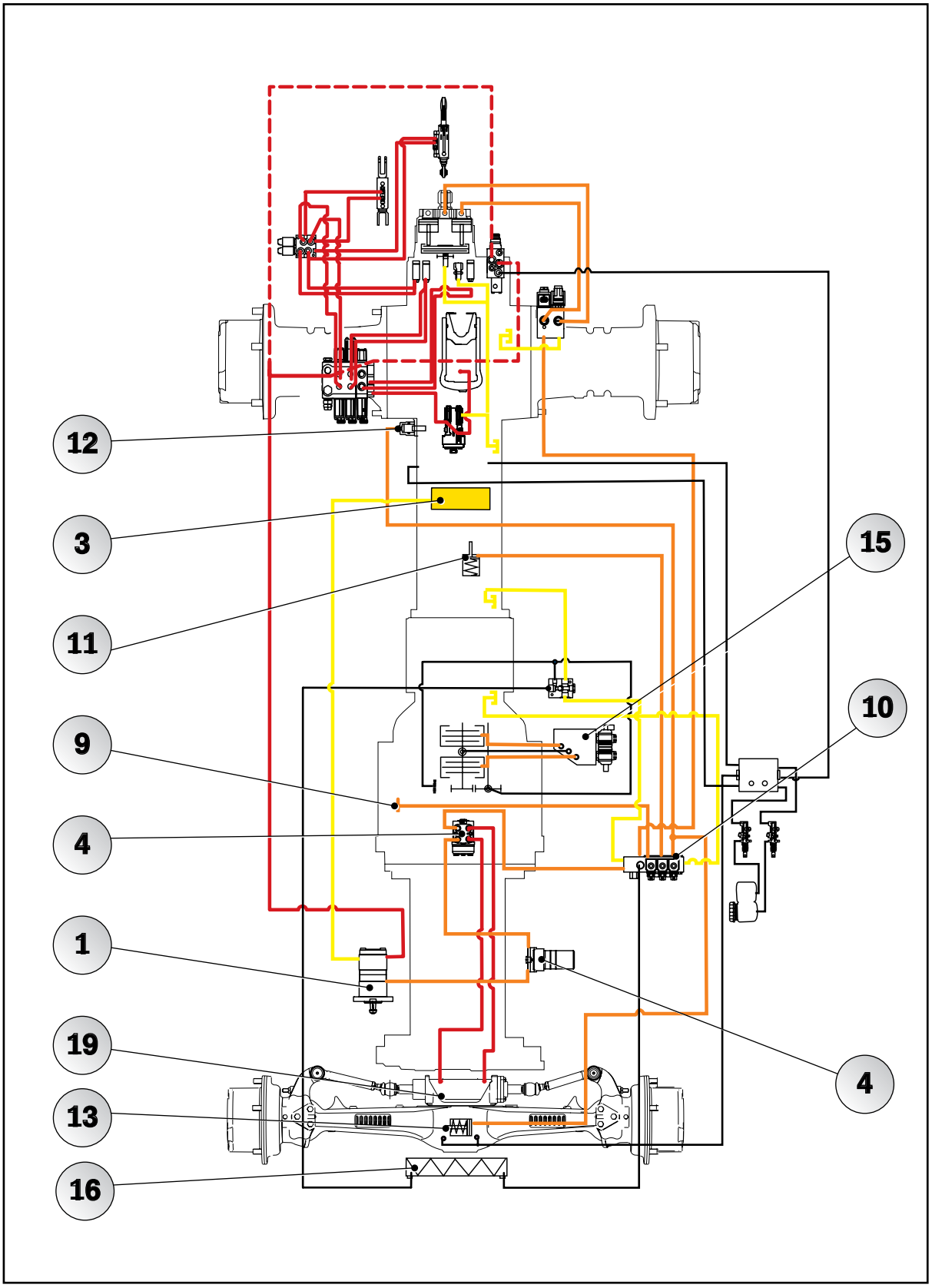


Fig. 7.10

1 - Low flow pump
3 - Low flow pump
4 - Oil filter on the delivery
9 - Hydrostatic steering system
10 - Hydraulic power pack
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
13 - Front differential lock
14 - P.T.O. hydraulic clutch
15 - Valve block for clutch control solenoid valves
16 - Transmission oil cooling radiator
19 - Steering cylinder
31 - Valve block for PTO solenoid valves and brake unit
33 - PTO rear shaft
34 - “Powerfive” unit

- high pressure
- low pressure
- discharge/inlet

The “low flow” circuit is a mixed system, both as to type of circuit and pressure. The first part supplies the power steering system (9) at “high pressure” (150/155 bar) by absolute priority, via a circuit of the open center type. The oil discharged from this first section supplies both the valve block (15) for solenoid valves and reverse shuttle lubrication, and the valve block (31), for control of the rear PTO and of the hydraulic power pack (10). This latter pressurizes oil received at “low pressure” to 20 bar by means of a pressure maintaining valve in the power pack itself. The circuit converts into a closed center one, thus allowing permanently pressurized oil to supply all the users connected: 4WD disengagement, front and rear differential locking, Power Five assembly (if installed).

The unused oil is sent to the radiator (16) at a pressure of 9.5 bar, after which most of it is used by the gearbox for forced lubrication at a pressure of 4.5 bar.

2.2.4 Description of the high flow circuit

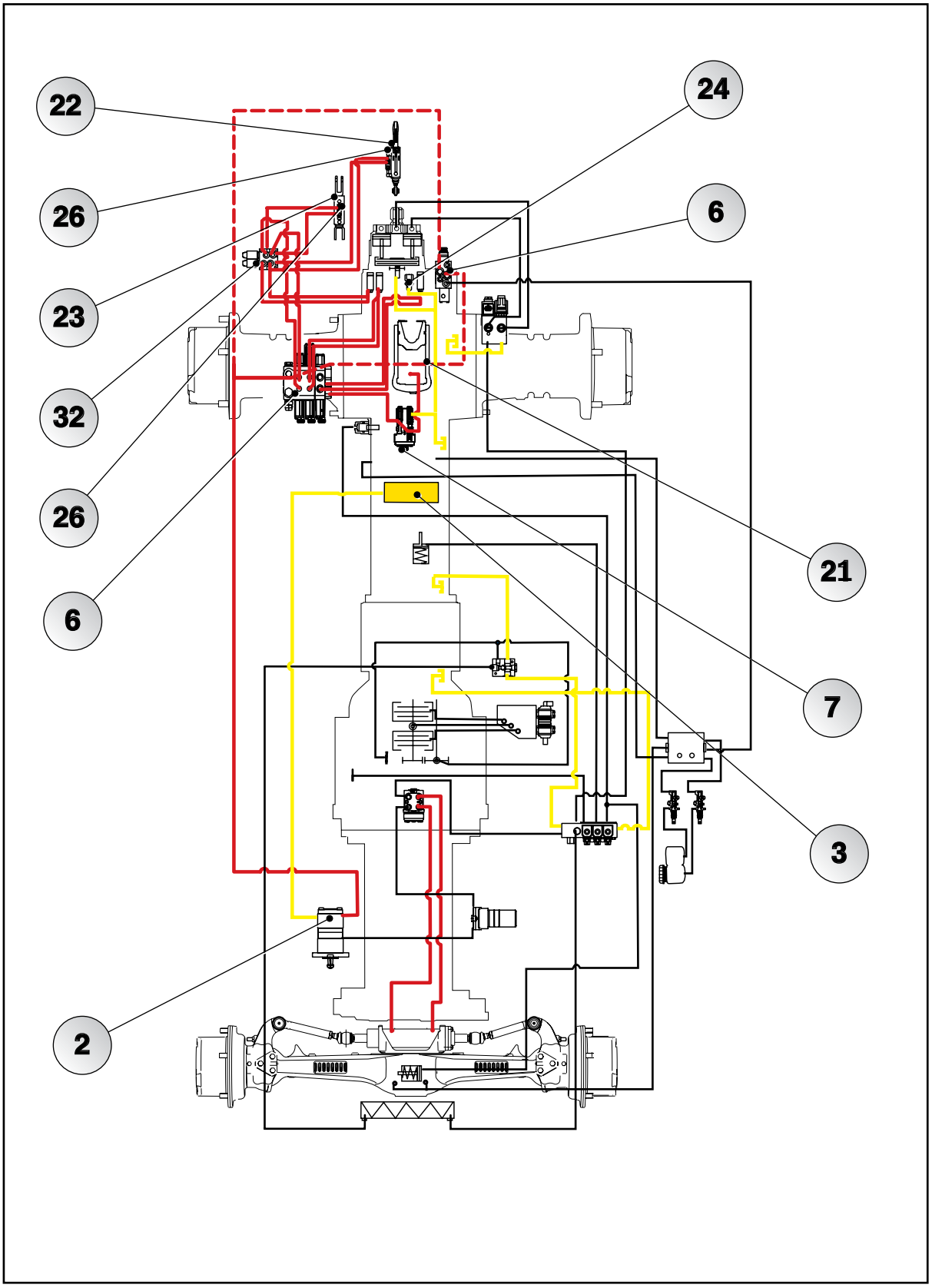


Fig. 7.11

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
21 - Mechanical power lift's internal ram
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
24 - Free discharge for hydraulic motors
26 - Shut-off valves
32 - Electro-hydraulic flow selector
- high pressure
- discharge/inlet

The "high flow" circuit is so called as it deals with a larger flow rate than the "low flow" circuit.

This circuit is also supplied by the independent hydraulic pump, assembled and operating in tandem with the low flow one.

The hydraulic oil of the transmission used, is intaken by the pumps through a single pipe after first passing through a cartridge filter.

Thus supplied, the high flow hydraulic pump can deliver pressurized oil to the trailer brake valve (5) (if installed) with absolute priority, controlled by a valve with a **130/140 bar.**

The oil flows then to the auxiliary control valves (6), in second priority, and can be directed to the quick couplings, with relative rams, and also to the flow selector (32), then flow on to the valve controlling the rear hydraulic power lift. In both cases, a valve with a **185 bar** setting installed in the flow divider (when installed) or on the inlet plate of the auxiliary control valves, monitors the pressure, discharging the oil sent by the pump into the differential housing. The power lift's valve system can send pressurized oil to its lifting cylinders (21) when required by the operator.

2.2.5 Description of the engine cooling and lubrication circuits

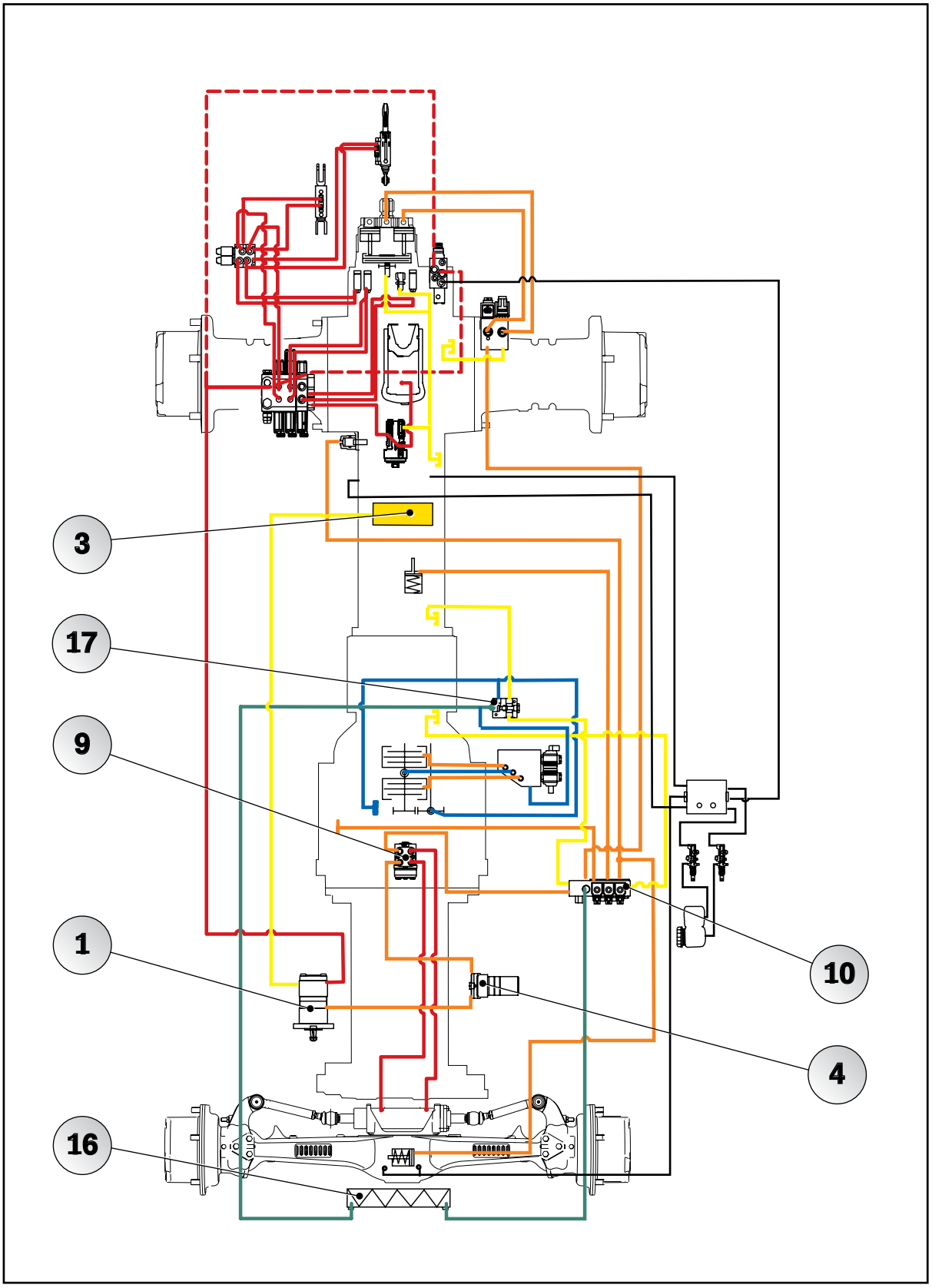


Fig. 7.12

1 - Low flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
9 - Hydrostatic steering system
10 - Hydraulic power pack
16 - Transmission oil cooling radiator
17 - Calibration valve of lubrication circuit

- high pressure
- low pressure
- discharge/inlet
- cooling
- lubrication

The “low flow” circuit cools the oil, flushes and cools the transmission and deals with forced lubrication.

Oil discharged by the 20 bar valve in the power pack (10) is sent to the cooling radiator (16). It is controlled by the 9.5 bar valves installed inside the power pack itself.

Thus cooled, the oil is sent to the block (17) and then proceeds towards the transmission where it accomplishes the following functions: forced lubrication inside the lower transmission shafts of the axle and gearbox.

2.3 Main hydraulic circuit (E-Line version)

2.3.1 General description

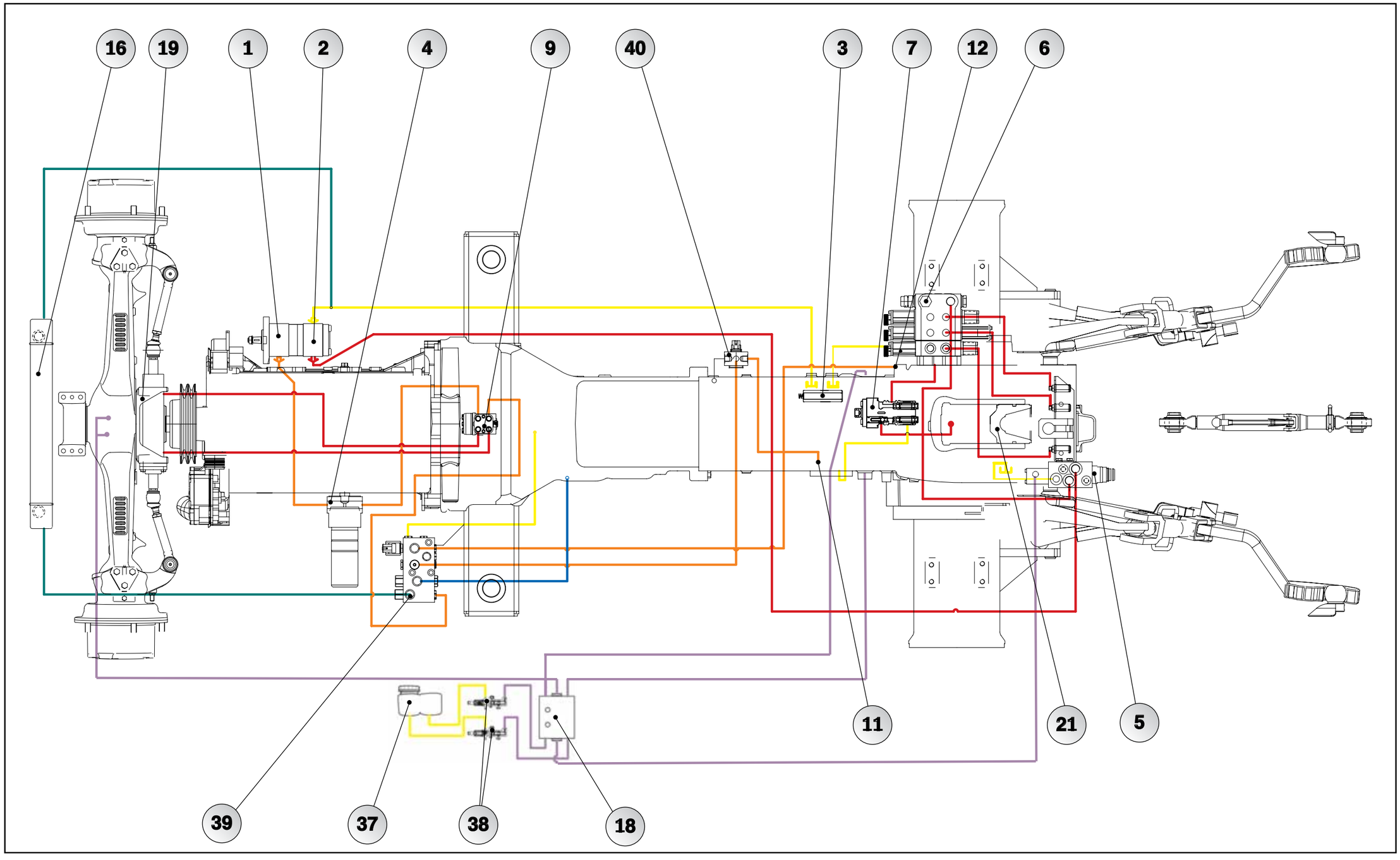


Fig. 7.13

1 - Low flow pump
2 - High flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
9 - Hydrostatic steering system
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
16 - Transmission oil cooling radiator
18 - Hydraulic trailer brake valve
19 - Steering cylinder
21 - Mechanical power lift's internal ram
37 - Brake fluid reservoir
38 - Brake pumps
39 - Hydraulic power pack for users
40 - Block for 4WD hydraulic control

- high pressure
- low pressure
- discharge/inlet
- lubrication
- brakes
- cooling

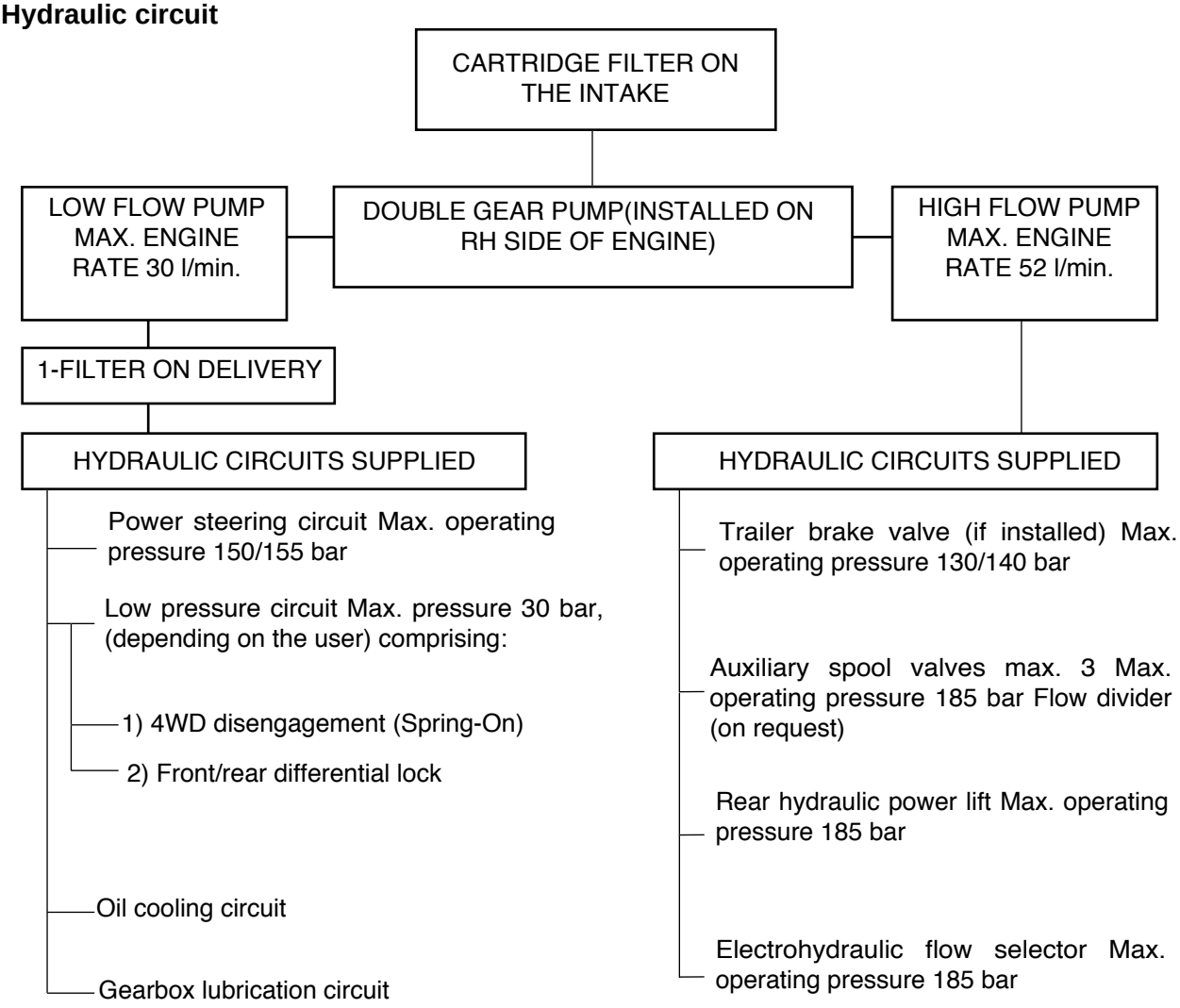
The quality, versatility and correct operation of a farming tractor mainly depend on its hydraulic circuit.

To achieve all this, the tractors in the **E-Line** version of **F-N Series** tractors are equipped with two hydraulic circuits supplied by a double gear pump. They operate in tandem with common oil intake and use the transmission oil.

- A "**Low flow**" circuit (orange colour) **30 l/min**: supplies the "power steering" system as first priority, followed by the "low pressure" circuit for the hydraulically activated functions, such as: 1) 4WD disengagement (Spring-on); Front/ Rear Diff Lock.

  Meanwhile, most of the oil is directed towards a cooling circuit and then towards a lubricating/forced flushing duct of the gearbox. Having terminated its route, the oil is conveyed to the transmission compartment which acts as a single reservoir for the main hydraulic system and which lubricates the transmission itself.
- A second "**High flow**" (red colour) **52 l/min**: supplies the trailer brake valve as first priority (if installed) and then: the flow divider (if installed) and the auxiliary control valves, the mechanically controlled hydraulic power lift and the electrohydraulic flow selector (if installed).

Hydraulic circuit



2.3.2 Functional diagram

High flow

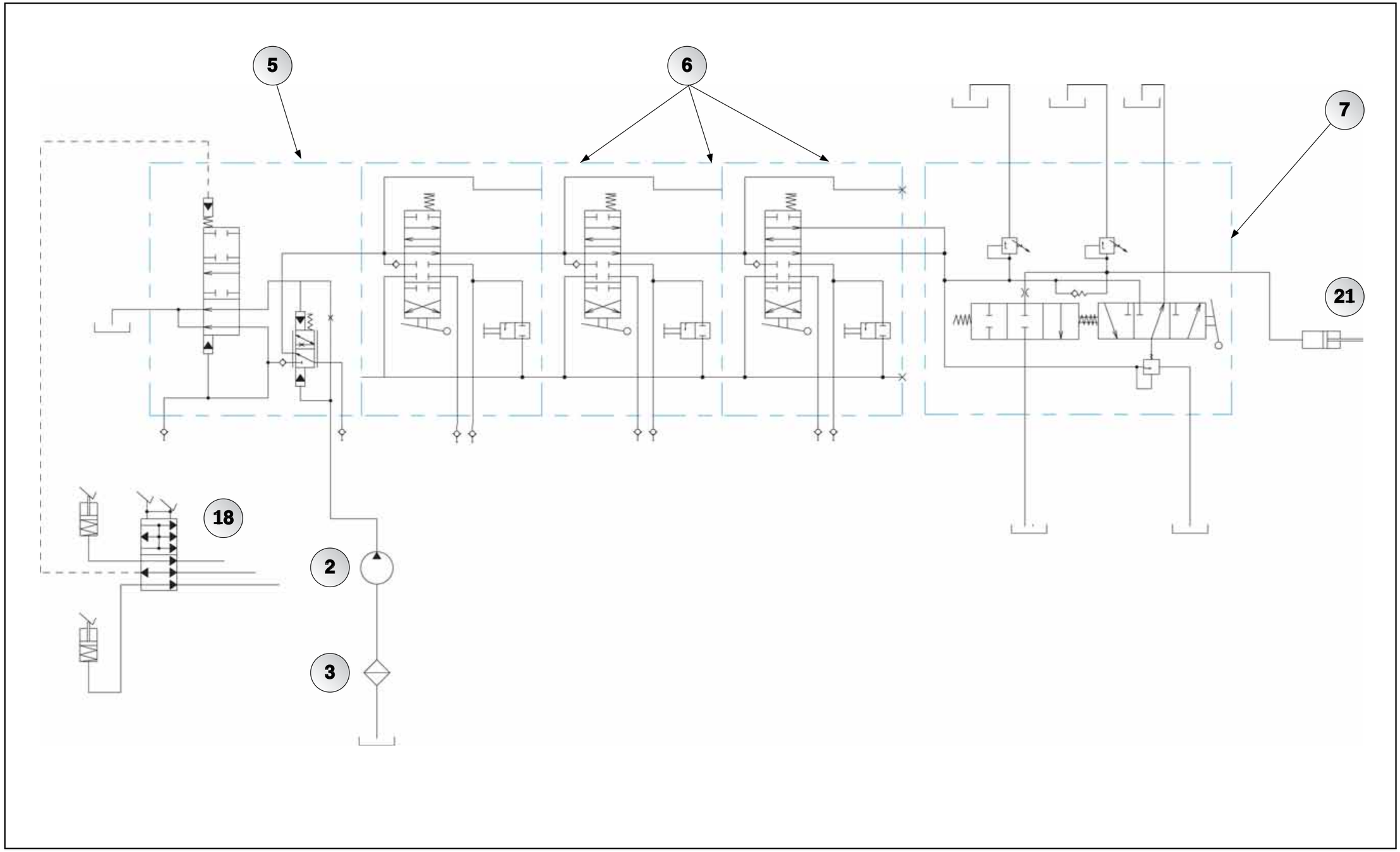


Fig. 7.14

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
18 - Brake circuit on-off valve
21 - Mechanical power lift’s internal ram

Low flow

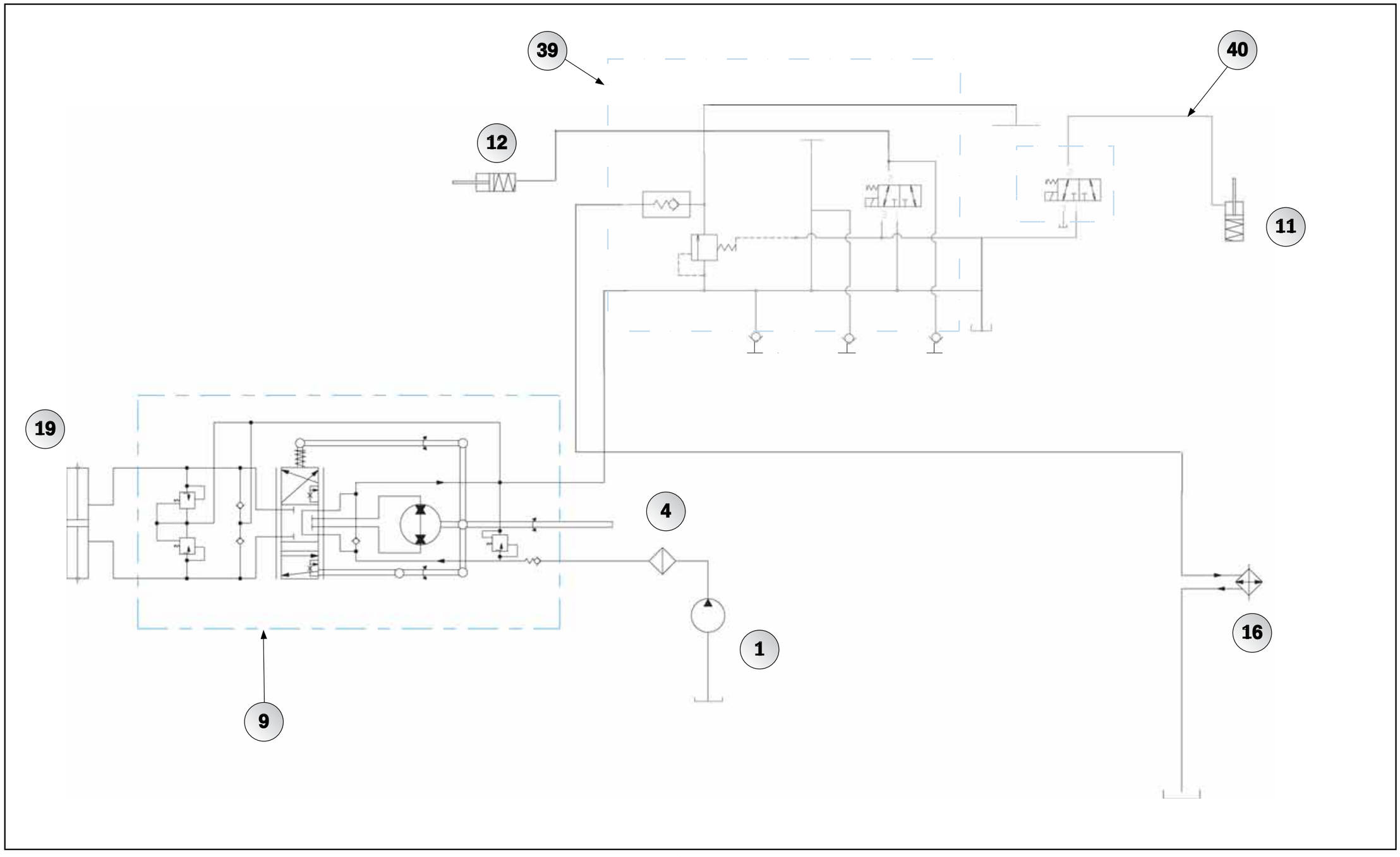


Fig. 7.15

1 - Low flow pump
4 - Oil filter on the delivery
9 - Hydrostatic steering system
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
16 - Transmission oil cooling radiator
19 - Steering cylinder
39 - Hydraulic power pack for the users
40 - Block for 4WD hydraulic control

2.3.3 Description of the low flow circuit

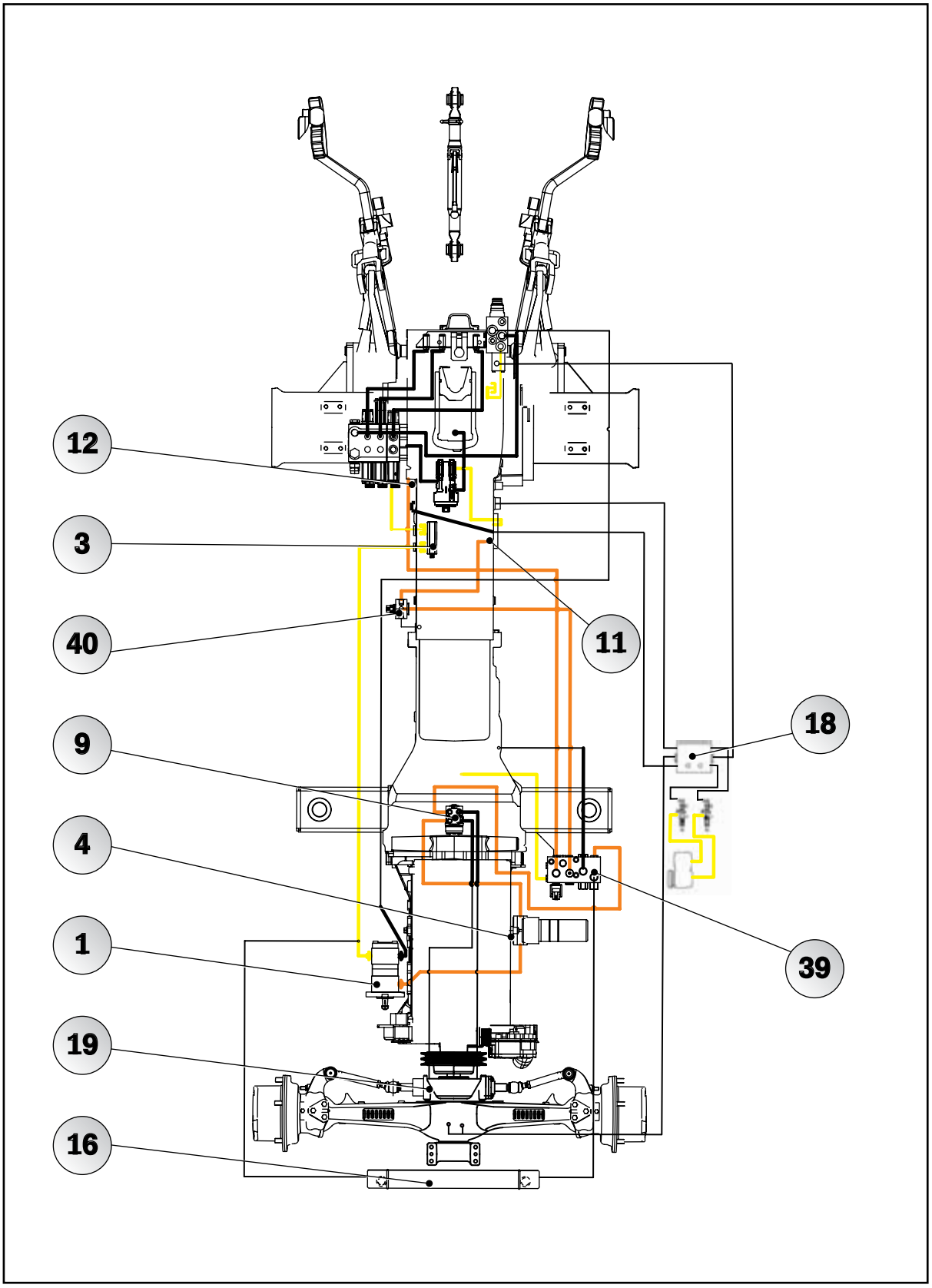


Fig. 7.16

1 - Low flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
9 - Hydrostatic steering system
11 - 4WD engagement (Spring-on)
12 - Rear differential lock
16 - Transmission oil cooling radiator
19 - Steering cylinder
39 - Hydraulic power pack for the users
40 - Block for 4WD hydraulic control

- low pressure

- discharge/inlet

The “low flow” circuit is a mixed system, both as to type of circuit and pressure. The first part supplies the power steering system (9) at “high pressure” (150/155 bar) by absolute priority, via a circuit of the open center type. Oil discharged by this first section supplies the hydraulic power pack (39), which pressurizes oil received at “low pressure”. The circuit converts into a closed center one, thus allowing permanently pressurized oil to supply all the users connected: 4WD disengagement and rear differential locking.

Unused oil is sent to the radiator (16), and then used mostly for forced lubrication of the gearbox.

2.3.4 Description of the high flow circuit

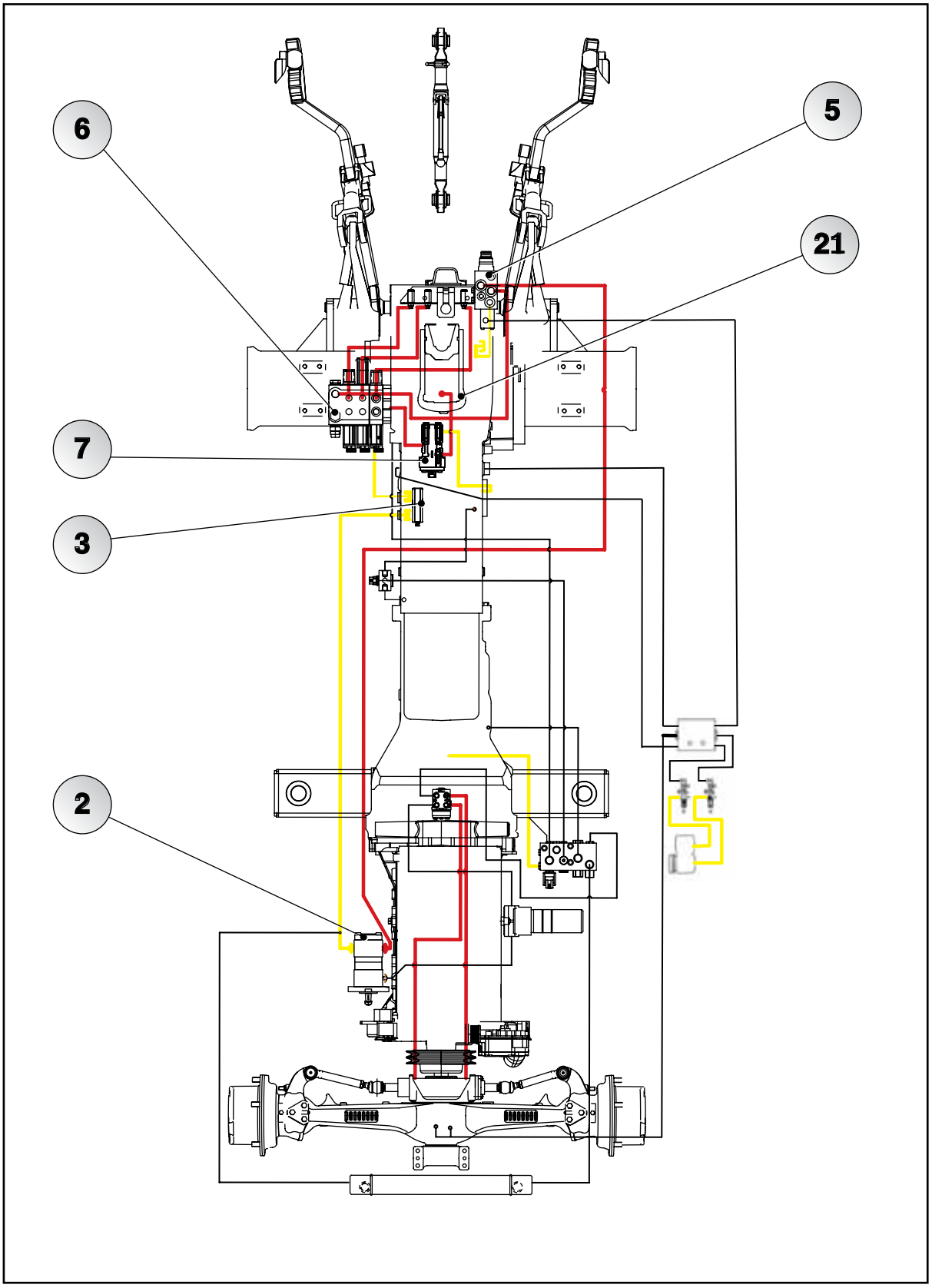


Fig. 7.17

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift's valve system
21 - Power lift's internal ram
- high pressure
- discharge/inlet

The "high flow" circuit is so called as it deals with a larger flow rate than the "low flow" circuit.

This circuit is also supplied by the independent hydraulic pump, assembled and operating in tandem with the low flow one.

The hydraulic oil of the transmission used, is intaken by the pumps through a single pipe after first passing through a cartridge filter.

Thus supplied, the high flow hydraulic pump can deliver pressurized oil to the trailer brake valve (5) (if installed) with absolute priority, controlled by a valve with a **130/140 bar**.

The oil then flows to the auxiliary control valves (6), in second priority, and can be directed towards the quick couplings and their relative rams, and also towards the valve system of the rear hydraulic power lift.

In both cases, a valve with a **185 bar** setting installed in the flow divider (when installed) or on the inlet plate of the auxiliary control valves, monitors the pressure, discharging the oil sent by the pump into the differential housing. The power lift's valve system can send pressurized oil to its lifting cylinders (21) when required by the operator.

2.3.5 Description of the engine cooling and lubrication circuits

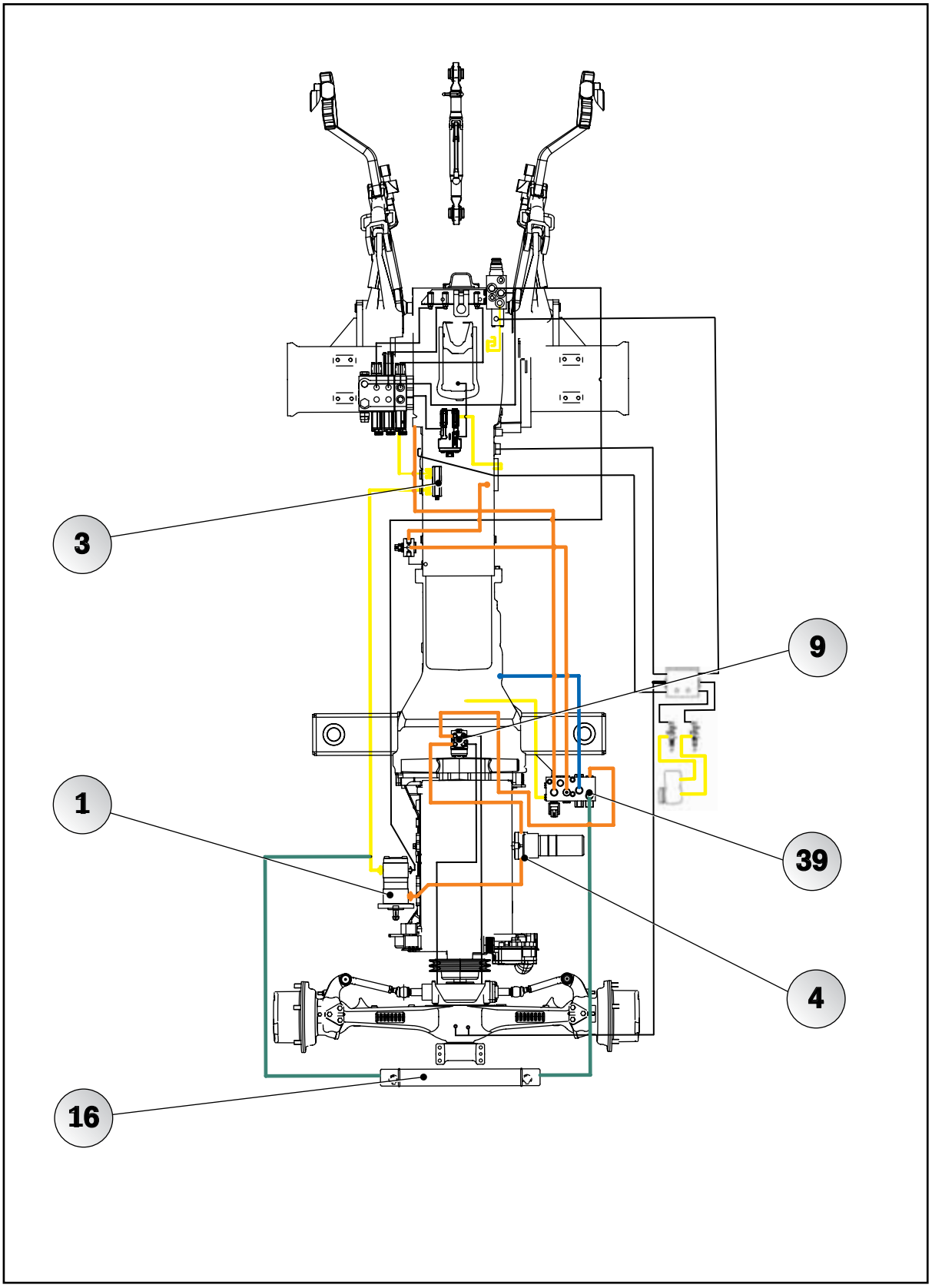


Fig. 7.18

1 - High flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
9 - Hydrostatic steering system
16 - Transmission oil cooling radiator
39 - Hydraulic power pack for the users
- low pressure
- discharge/inlet
- cooling
- lubrication

The “low flow” circuit cools the oil, flushes and cools the transmission and deals with forced lubrication.

Oil discharged from the hydraulic power pack (39) is sent to the radiator (16), and to the internal forced lubrication of the lower layshafts of the axle and gearbox.

Section 3 : Technical specifications

Index

3.1 Main technical specifications (Speed Four version)..... 7-48

3.2 Main technical specifications (Power Shuttle version)..... 7-50

3.3 Main technical specifications (E-Line version)..... 7-52

3.1 Main technical specifications (Speed Four version)

Pump

Type	Double gear type (in tandem)
Manufacturer	Bx
Maximum operating pressure	190 bar
Maximum flow rate	52 l/min
Drive	valve system gears
Quantity of hydraulic oil /transmission	35 l

Filters

Type (on the intake)	with replaceable cartridge
Filtering degree	60 micron
Type (on the delivery)	with replaceable single paper cartridge
filtering degree	15 micron

Steering

System	Power steering system
Make	McCormick
Type (2WD axles)	Orbitrol ospc 50
Type (4WD axles)	Orbitrol ospc 80
Calibration valve	150±5 bar
Antishock valve setting	200 bar
Steering cylinder	1 cylinder
Type	double acting, balanced
Make	McCormick
Oil pump manufacturer	Bx
Pump-engine-ratio	1:1,70

Servo clutch valve system

PTO power clutch calibration valve	30 bar
Type of PTO engagement	servo assisted hand control
Users	Front/rear diff lock - 4WD disengagement (spring-on) (4WD)
Type of engagement	electro-hydraulic

Auxiliary control valves

Manufacturer	Hyx
Operation	Standard - Floating - Kick-out - hydraulic motor
Type of connection	With open center and “Push-Pull” quick couplings
Calibration valve	185 bar
Maximum flow rate	60 l/min
Maximum quantity	3 elements
Connection to the circuit	in series
Position	lateral monoblock

Mechanical hydraulic power lift

Manufacturer	McCormick
Operating modes	position control / draft control / intermix
Hydraulic system	open-center type
Standard cylinder	single-acting
Dimensions	ø 100 x 125 stroke
Supplementary cylinders	N° 2 single-acting
Antishock valve	210 ± 5 bar

Rated lifting capacity

Maximum lifting capacity at ends of lower links in horizontal position	2600 kg

3.2 Main technical specifications (Power Shuttle version)

Pump

Type	Double gear type (in tandem)
Manufacturer	Bx
Maximum operating pressure	190 bar
Maximum flow rate	52 l/min
Drive	valve system gears
Quantity of hydraulic oil /transmission	30 l

Filters

Type (on the intake)	with replaceable cartridge
filtering degree	60 micron
Type (on the delivery)	with replaceable single paper cartridge
filtering degree	15 micron

Steering

System	Power steering system
Make	McCormick
Type (2WD axles)	Orbitrol ospc 50
Type (4WD axles)	Orbitrol ospc 80
Calibration valve	150±5 bar
Antishock valve setting	200 bar
Steering cylinder	1 cylinder
Type	double acting, balanced
Make	McCormick
Oil pump manufacturer	Bx
Type	geared
Pump-engine-ratio	1:1,70

Hydraulic power pack for the users

Type	Hydraulic
Low pressure calibration valve	20 bar
Cooling circuit calibration valve	9.5 bar
Forced lubrication valve	4.5 bar
Users	Front/rear diff lock - 4WD disengagement (spring-on) Power Five (if installed)

PTO hydraulic power pack

Type	Hydraulic
Users	Main clutch (reverse)- Secondary clutch (forward speeds)

Hydraulic power pack for Power Shuttle clutch assemblies

Type	Hydraulic
Users	Main clutch (reverse)- Secondary clutch (forward speeds)

Auxiliary control valves

Manufacturer	Hyx
Operation	Standard - Floating - Kick-out - hydraulic motor
Type of connection	With open center and “Push-Pull” quick couplings
Calibration valve	185 bar
Maximum flow rate	60 l/min
Maximum quantity	3 elements
Connection to the circuit	in series
Position	lateral monoblock

Mechanical hydraulic power lift

Manufacturer	McCormick
Operating modes	position control / draft control / intermix
Hydraulic system	open-center type
Standard cylinder	single-acting
Dimensions	ø 100 x 125 stroke
Supplementary cylinders	N° 2 single-acting
Antishock valve	210 ± 5 bar

Rated lifting capacity

Maximum lifting capacity at ends of lower links in horizontal position:	2600 kg

3.3 Main technical specifications (E-Line version)

Pump

Type	Double gear type (in tandem)
Manufacturer	Bx
Maximum operating pressure	190 bar
Maximum flow rate	52 l/min
Drive	valve system gears
Quantity of hydraulic oil /transmission	30 l

Filters

Type (on the intake)	with replaceable cartridge
filtering degree	60 micron
Type (on the delivery)	with replaceable single paper cartridge
filtering degree	15 micron

Steering

System	Power steering system
Make	McCormick
Type (2WD axles)	Orbitrol ospc 50
Type (4WD axles)	Orbitrol ospc 80
Calibration valve	150±5 bar
Antishock valve setting	200 bar
Steering cylinder	1 cylinder
Type	double acting, balanced
Make	McCormick
Oil pump manufacturer	Bx
Type	geared
Pump-engine-ratio	1:1,70

Hydraulic power pack for the users

Type	Hydraulic
Low pressure calibration valve	20 bar
Forced lubrication valve	1.5 bar
Users	Front/rear diff lock

Hydraulic power pack (4WD)

Type	Hydraulic
Users	4WD disengagement (spring-on) (4WD)

Auxiliary control valves

Manufacturer	Hyx
Operation	Standard - Floating - Kick-out - hydraulic motor
Type of connection	With open center and “Push-Pull” quick couplings
Calibration valve	185 bar
Maximum flow rate	60 l/min
Maximum quantity	3 elements
Connection to the circuit	in series
Position	lateral monoblock

Mechanical hydraulic power lift

Manufacturer	McCormick
Operating modes	position control / draft control / intermix
Hydraulic system	open-center type
Standard cylinder	single-acting
Dimensions	ø 100 x 125 stroke
Supplementary cylinders	N° 2 single-acting
Antishock valve	210 ± 5 bar

Rated lifting capacity

Maximum lifting capacity at ends of lower links in horizontal position:	2600 kg

Section 4 : Hydraulic braking system

Index

4.1 Hydraulic brake circuit 7-56

4.2 Description of operation 7-58

4.3 Operation of the brake pump with compensator 7-60

4.4 How to bleed air from the rear brake circuit 7-61

4.5 Bleeding air from the front brake circuit 7-62

4.6 Brake adjustment 7-64

4.7 Brake circuit on-off valve 7-65

4.1 Hydraulic brake circuit

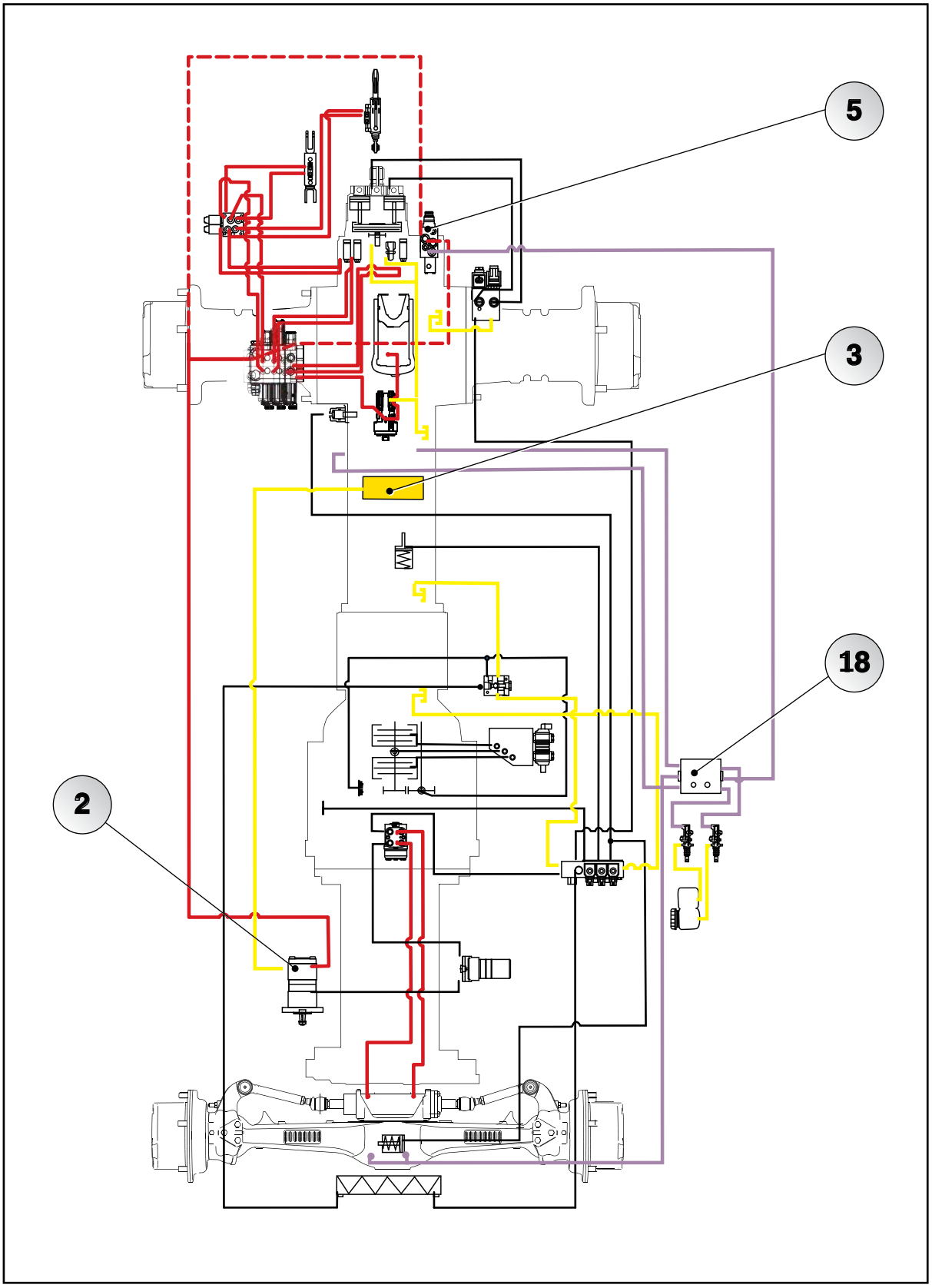


Fig. 7.19

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
15 - Brake circuit on-off valve

- high pressure
- discharge/inlet
- brakes

4.2 Description of operation

The brakes are the oil-cooled type. The driven plates are made of steel with sintered material on both faces. The rear brakes are controlled by pedals (51 Fig.7.25), which act on them through a hydraulic circuit formed by two hydraulic pumps (52 Fig.7.21 / 7.25) and two plungers (53 Fig. 7.22 / 7.25). The oil pumps are installed near the steering column, under the dashboard covering, and are hinged to the control pedals, while the plungers are installed near the rear brake assemblies and their travel is transmitted to the rods by means of two levers. Thanks to two levers hinged to the expansion plates, the rods turn these latter, each in the opposite direction to the other. Balls installed between the two plates and on opposing conical housings, cause the plates to expand in the axial direction. This expansion compresses the two packs of brake discs alongside the plates, clamping them on one side against the differential supports and on the other, against the side final drive housings. The braking action is obtained through the friction between the sintered discs splined to the axle shafts, and the steel discs held in place by pins. As soon as the pedals are released, the packs of discs slacken off thanks to the springs installed between the four plates, which cause the balls to retract into their housings. Moreover, when the latched brake pedals are used, the two pumps (52 Fig.7.21 /7.25) supply oil to the rear and front brakes at the same time, as well as the piloting line of the trailer brake valve (5 Fig.7.19/7.25) (if fitted). This process achieves **IBS** integral braking on all four wheels. The brake fluid reservoir (56 Fig.7.23 /7.25) is located under the dashboard cover, near the bonnet hinges, and is common to both circuits.

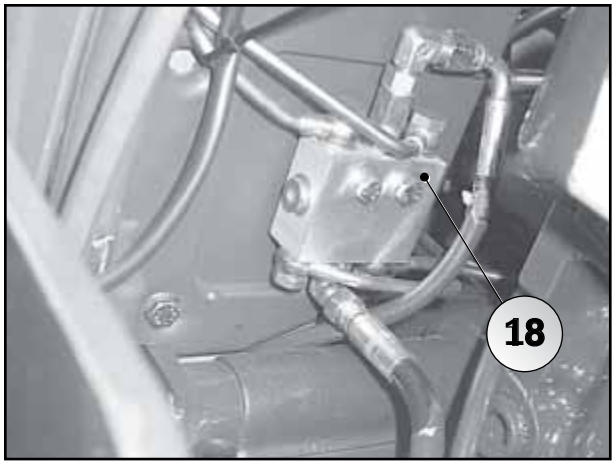


Fig. 7.20

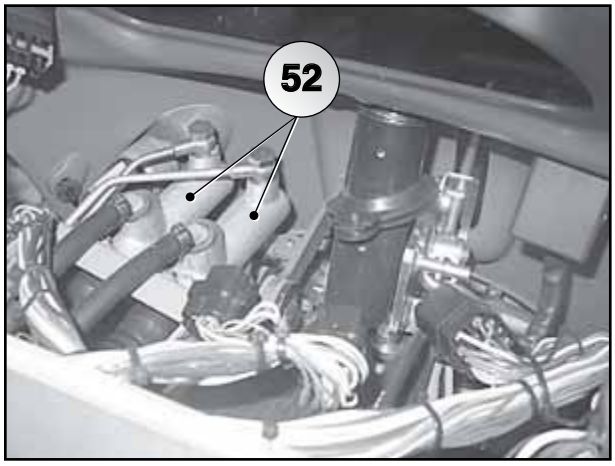


Fig. 7.21

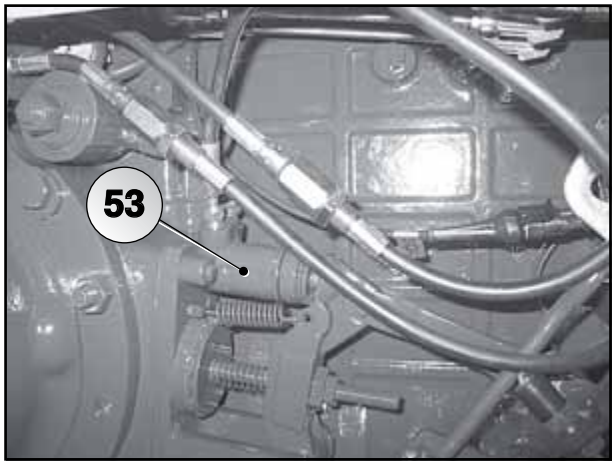


Fig. 7.22

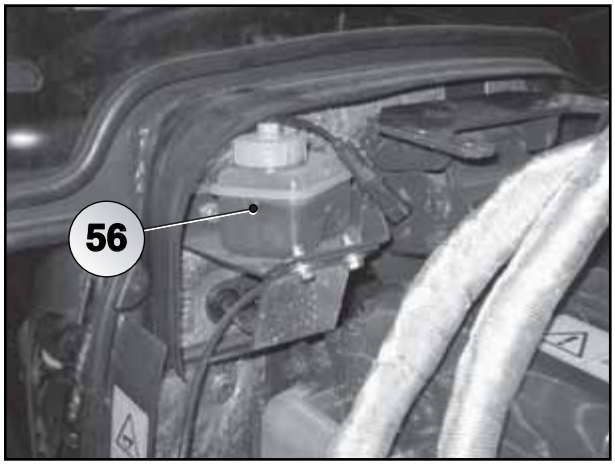


Fig. 7.23

The parking or emergency brake operates mechanically on the expansion units rods and is controlled by a hand lever.

In addition, the **Power Shuttle** version of **F-N Series** tractors is fitted with a further mechanical locking system that ensures the tractor is braked even in high load conditions and on slopes. This system, called "**Park Lock**", is mechanically engaged by means of a lever (P Fig.7.24) installed just under the steering wheel. In the absence of a mechanical connection between the engine and rear wheels, this system provides a more reliable braking action for the tractor.

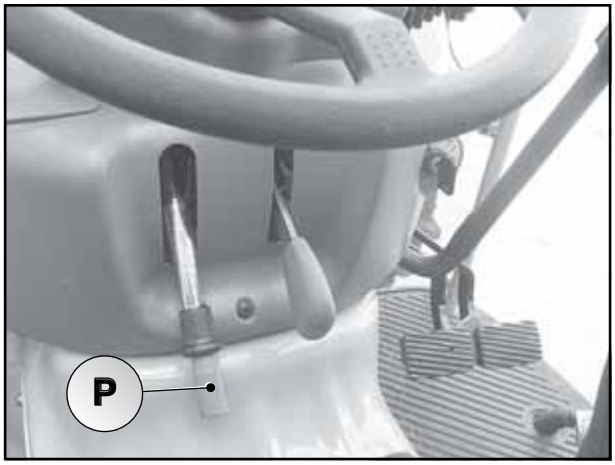


Fig. 7.24

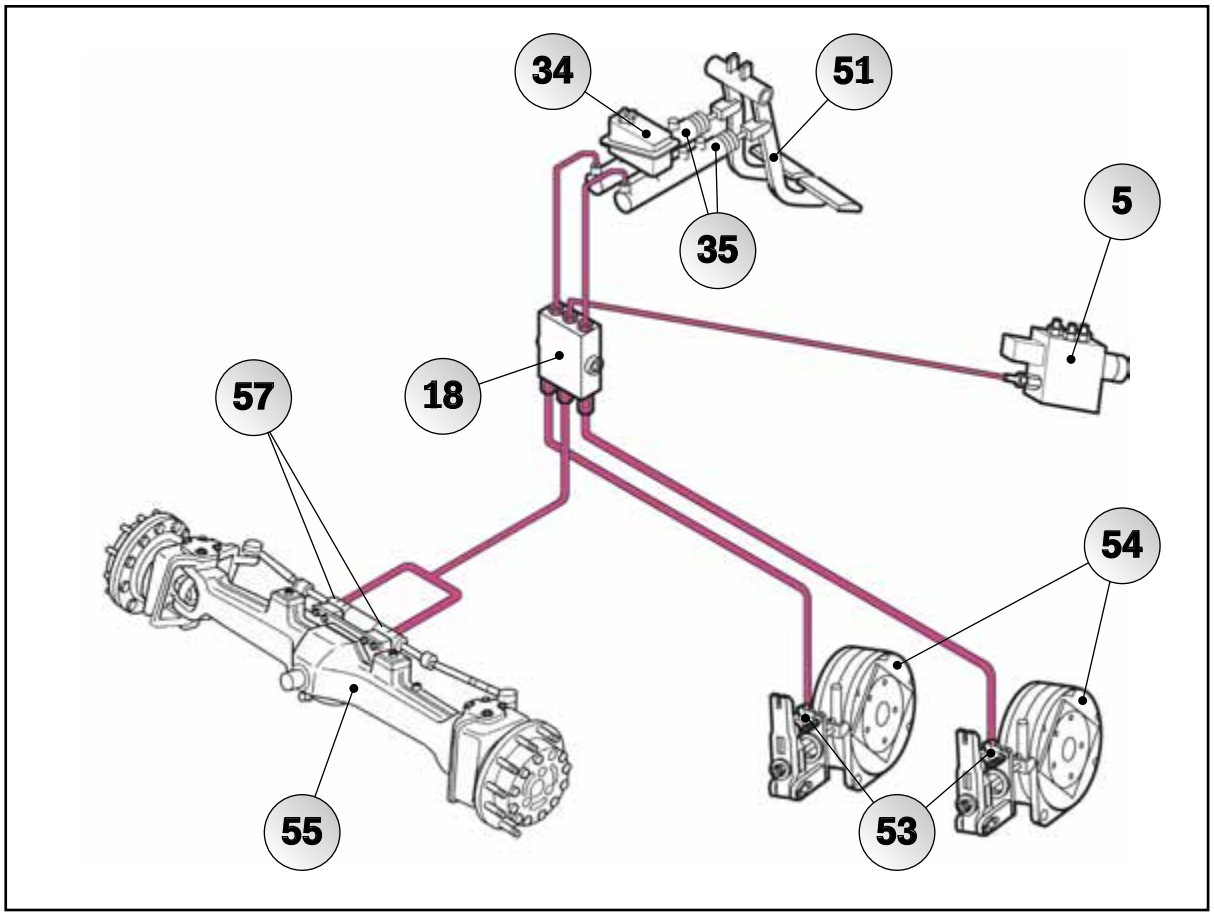


Fig. 7.25

5 - Hydraulic trailer brake valve
18 - Brake circuit on-off valve
51 - Pedal brakes
52 - Brake pumps
53 - Cylinders
54 - Rear brake assembly
55 - 4WD front axle
56 - Brake fluid reservoir
57 - Front axle brake supply line

4.3 Operation of the brake pump with compensator

The brake pump consists of the parts shown in (Fig.7.26). When the brake pedal is pressed (single braking) on to the pump control pin, the piston (58) moves towards the delivery union (68). Meanwhile, the piston (64) also moves and uncovers the hole of the union (65), which supplies the compensator, thus increasing the pressure values in the circuit. In this case, the pressure acts on the plunger of a single wheel. Despite the fact the two unions (65) are connected, the oil is unable to pass into the other circuit, as the piston (64) of the other pump blocks its route. When the two pedals are latched and the control pins (60) are depressed (simultaneous braking), the pistons (58) are shifted towards the delivery union (68). Meanwhile, pistons (64) are also shifted and uncover the holes that supply oil to the compensator, thus allowing the oil to supply the two circuits at the same time, with the same pressure on the plungers (53) and accounting for any differences in travel due to different wear on the brake discs. This guarantees a braking action of equal entity on both wheels.

Note: the brake pump (Fig.7.26) and control plunger (Fig.7.27) cannot be disassembled for safety reasons dictated by their manufacturers. The drawings are shown here for explanatory purposes only.

Pump

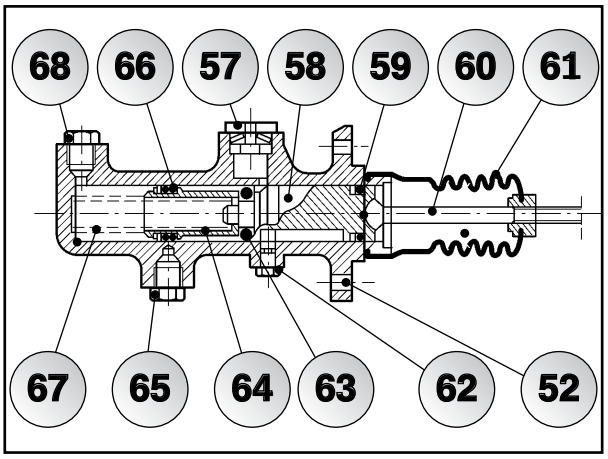


Fig. 7.26

52 - Brake pump casing
57 - Oil supply union
58 - Piston N° 1
59 - Retention ring
60 - Pump control pin
61 - Bellows
62 - Piston guiding pin
63 - Piston N° 1 retention ring
64 - Piston N° 2
65 - Compensator union
66 - Piston N° 2 retention ring
67 - Piston return spring
68 - Delivery union

Hydraulic cylinder for brake control

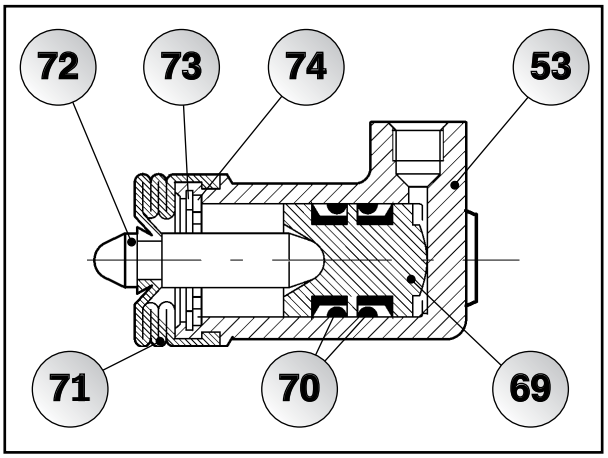


Fig. 7.27

53 - Plunger casing
69 - Piston
70 - Piston rings
71 - Bellows
72 - Pin
73 - Spring ring
74 - Washer

4.4 How to bleed air from the rear brake circuit

The air must be bled from the circuit when there is no oil in the reservoir or when parts of the hydraulic braking system are replaced or repaired. This operation must be carried out in a precise sequence, as described below:

- Fill the reservoir with brake fluid of the recommended type. The reservoir must be kept topped up throughout the entire bleeding operation.
- Insert an adequate length of rubber or plastic tubing into the bleed screw (75 Fig.7.28).
- Place the other end of the tube in a clean, transparent vessel.
- Unlatch the two pedals so that they can be used separately.
- Depress the left-hand brake pedal completely. Meanwhile, loosen the bleed screw (75 Fig.7.28) half a turn and allow any air mixed with oil to flow out. The pedal will move to the end of its travel. Tighten the screw and remove your foot from the pedal.

  Repeat the operation described above until bubble-free oil flows from the bleed screw. Check to make sure that the pedal travel has returned to normal and is not spongy.

  Carry out the operations described above for the left-hand side of the braking circuit.

  Top up the level of the fluid in the reservoir once the operations have terminated.
- Repeat the operation described above until bubble-free oil flows from the bleed screw.

  Check to make sure that the pedal travel has returned to normal and is not spongy.
- Carry out the operations described above for the left-hand side of the braking circuit.
- Top up the level of the fluid in the reservoir once the operations have terminated.

  Note: only use brake fluid to top up the level in the circuit. Different types of fluid will quickly lead to an inefficient braking system and all the consequent risks. Do not reuse previously bled oil.

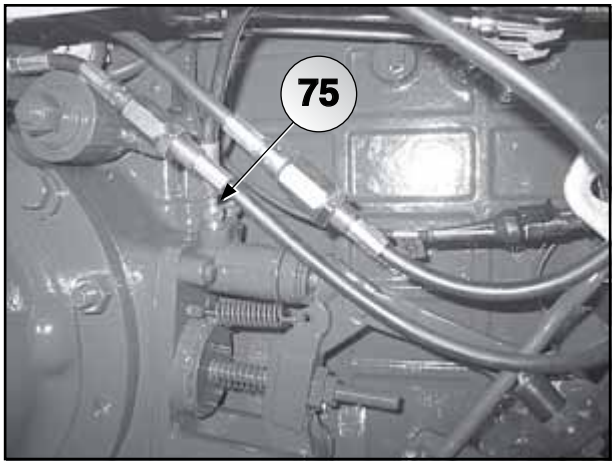


Fig. 7.28

4.5 Bleeding air from the front brake circuit

Proceed as described below after having carefully bled the rear brake circuit:

- Depress the latched brake pedals at the same time and unscrew the bleed screw (76 Fig.7.29) on the on-off valve (18) until bubble-free oil flows out (tractor without trailer brake valve).
- Tighten the screw and remove your foot from the pedals.
- Depress the pedals at the same time and loosen the two bleed screws (77 Fig.7.30) behind the central part of the front axle (trailer with trailer brake valve). Repeat this operation until bubble-free oil flows out.

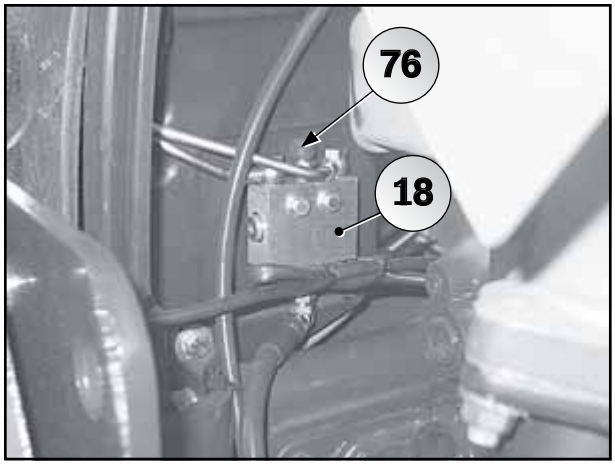


Fig. 7.29

How to bleed air from the trailer brake valve

If the tractor is equipped with the hydraulic trailer braking valve (5 Fig.7.31), air from the piloting tube of this valve must also be removed. A screw (78 Fig.7.31) on the valve casing allows the air to be easily bled off.

- Conduct a road test to check the pedal travel and to make sure that the front brakes act at the same time.
- Top up the level of the fluid in the reservoir with oil of the recommended type once the operations have terminated.

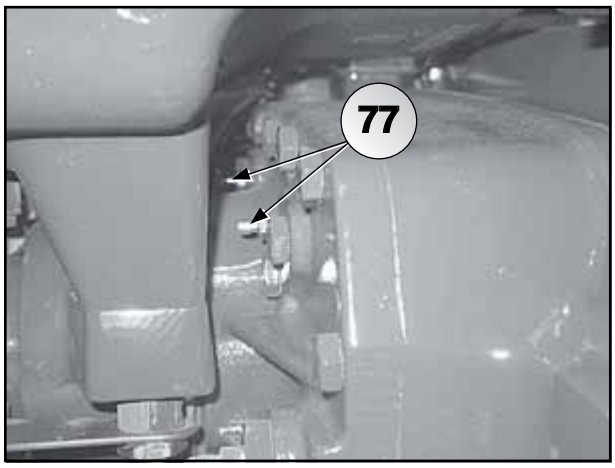


Fig. 7.30

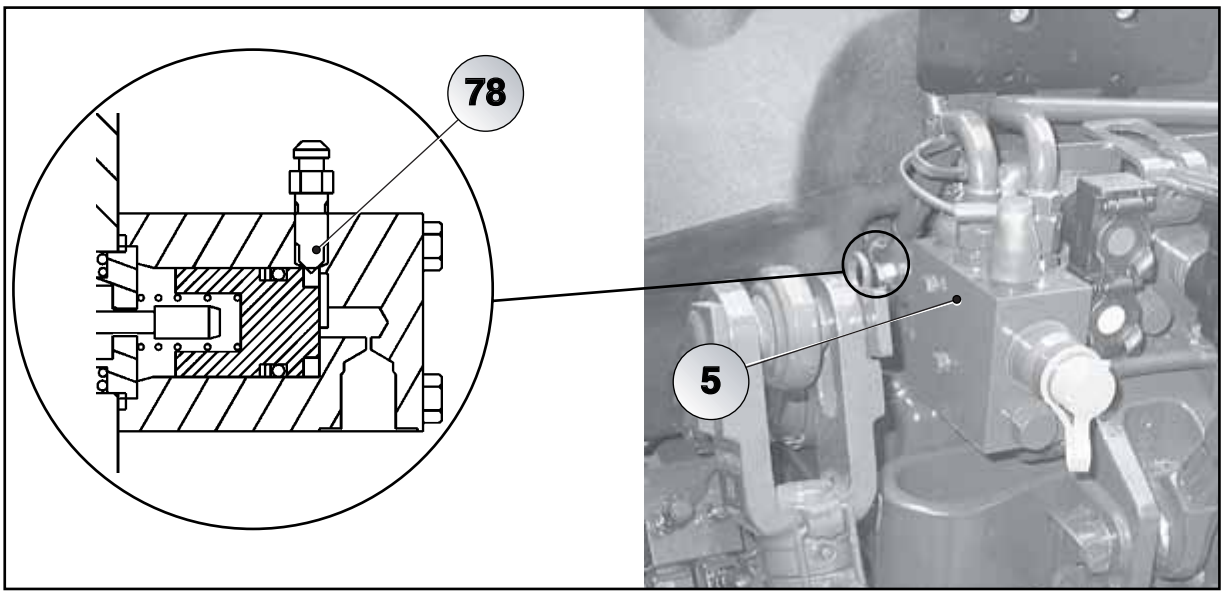


Fig. 7.31

4.6 Brake adjustment

Rear brakes

The pedal brakes and parking brake must be adjusted after the rear brake unit has been assembled.

- Jack up the tractor with a hydraulic jack until the rear wheels are raised from the ground.
- Release the hand brake lever (L) and loosen the adjuster nut (659) of the rod (663) so as to relieve all tension from the brace (662).
- Separate the two pedals by raising the latch.
- Tighten the adjuster nut (661) until the wheels can be turned by hand.
- Now loosen the adjuster nut by one turn, i.e. until the wheel can be turned by hand. Lock the adjuster nut with the relative check nut.
- Repeat the same operations for the other brake.
- Check to make sure that the free travel is within the prescribed values (**A = 30 to 40 mm**) must appear on the display after a few seconds (Fig.7.32). If this is not the case, first check to make sure that the brake circuit is efficient and that there are no leaks or air in the circuit.
- Tighten the nut (659) until a minimum play is obtained between the brace (662) and the control lever (660), so that the hand brake rod (663) does not remain taut when the brake is disengaged. When, following wear on the friction discs, the idle travel of the pedals tends to increase and exceeds **80 to 100 mm** , it can be regulated by merely tightening the adjuster nuts to the required extent (661).

The friction discs must be replaced if the nuts (661) use all the threaded part of their respective rods after further adjustments.

Front brakes

The front braking system does not need to be adjusted since the wear on the discs is compensated automatically.

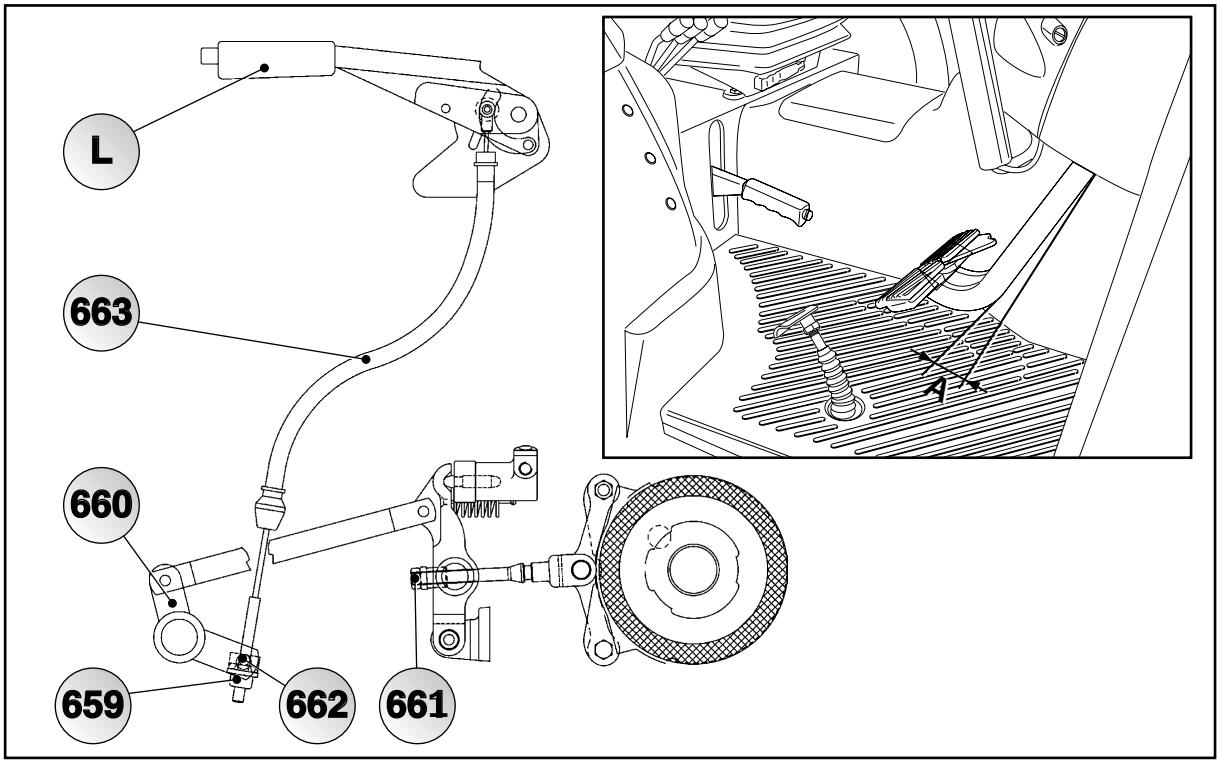


Fig. 7.32

L - Hand brake lever
606 - Control lever
659 - Parking brake lever adjuster nut
661 - Brake pedal lever adjuster nut
662 - Latch for parking brake rod
663 - Parking brake cable

4.7 Brake circuit on-off valve

Left pedal depressed

Oil from the brake pump (52) passes through duct (a) and supplies the plunger of the left rear brake.

- pressurized oil
- discharged oil

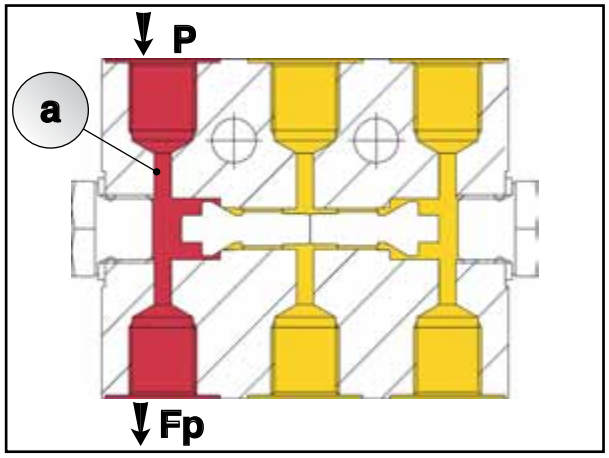


Fig. 7.33

Right pedal depressed

Oil from the brake pump (52) passes through duct (b) and supplies the plunger of the right rear brake.

- pressurized oil
- discharged oil

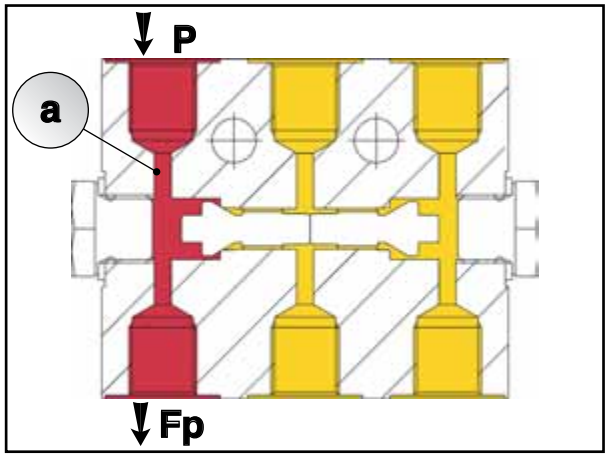


Fig. 7.34

Pedals latched

Oil from the pumps (52) supplies the rear brakes through ducts (a) and (b). Pressurized oil also supplies the front brakes through duct (c) and the trailer brake piloting line through duct (d).

- pressurized oil

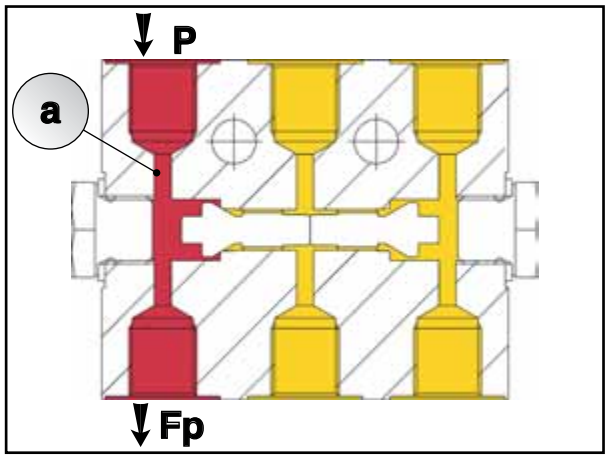


Fig. 7.35

Functional diagram

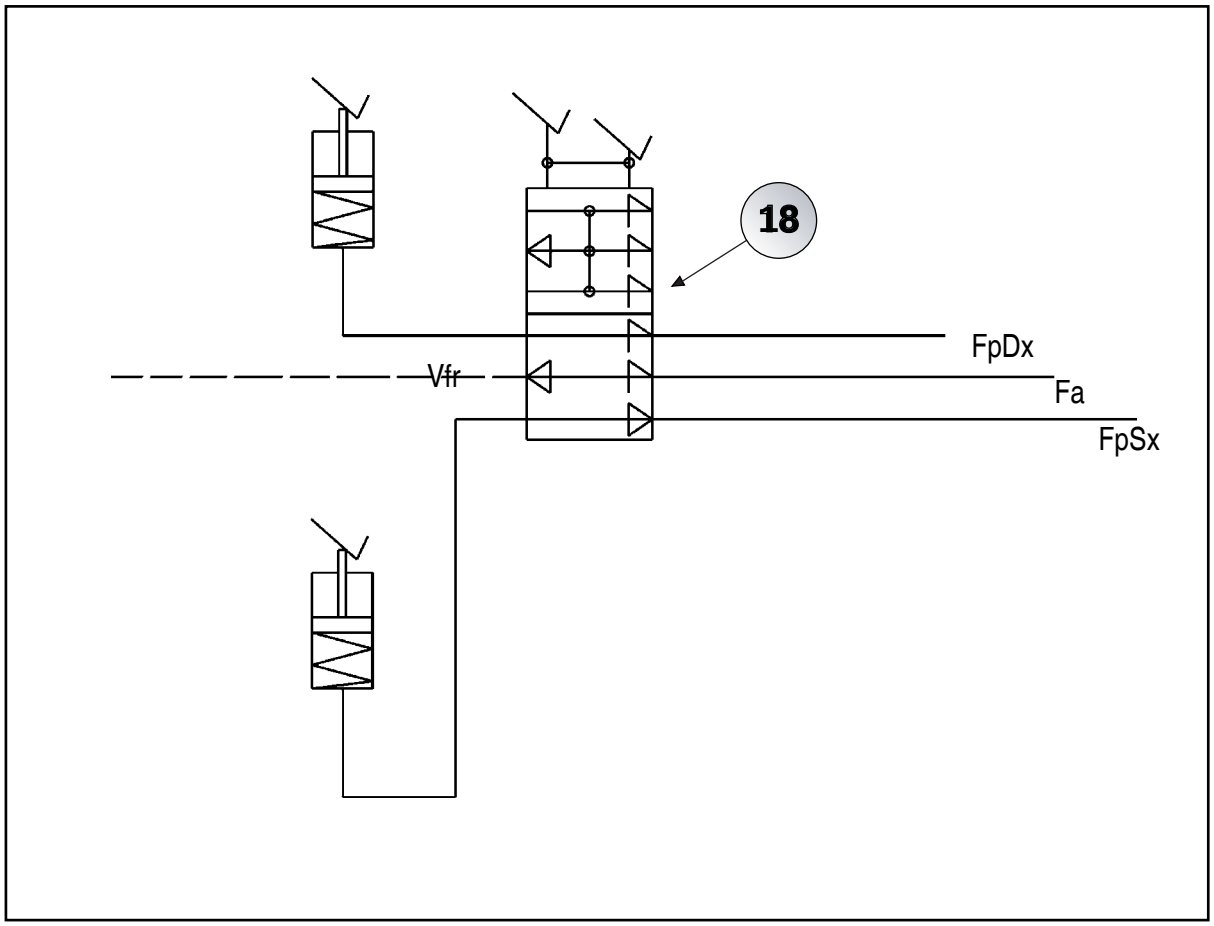


Fig. 7.36

Section 5 : Main components of the low flow circuit

Index

5.1 Hydraulic pump 7-70
5.1.1 Main components 7-70
5.1.2 Description of operation 7-71

5.2 Hydrostatic steering system 7-72
5.2.1 Hydraulic circuit 7-72
5.2.2 Description of the circuit 7-74
5.2.3 Description of operation 7-77
5.2.4 Drawing of the “Orbitrol” valve system assembly 7-80
5.2.5 Main components of the “Orbitrol” valve system assembly . 7-82

5.3 Users’ hydraulic circuit (Power Shuttle version) 7-84
5.3.1 Main components and functional diagram 7-84
5.3.2 Description of operation 7-86
5.3.3 9.5 and 20 bar calibration valves 7-88

5.4 Block for forced lubrication valve 7-90
5.4.1 Main components and position 7-90
5.4.2 Description of operation 7-91
5.4.3 Functional diagram 7-93

5.5 Block for reverse shuttle solenoid valves and lubrication . 7-94
5.5.1 Main components and position 7-94
5.5.2 Description of operation 7-95
5.5.3 Functional diagram 7-97

5.6 Block for PTO solenoid valves and brake unit 7-98
5.6.1 General description and position 7-98
5.6.2 Description of operation 7-99
5.6.3 Functional diagram 7-101

5.7 Servo clutch valve system (Speed Five version) 7-102
5.7.1 General description and position 7-102
5.7.2 Main components 7-103
5.7.3 Operating phases 7-104

5.8 Adjustments 7-114

5.9 Hydraulic clutch assemblies (Power Shuttle version) 7-116
5.9.1 General description 7-116
5.9.2 Main components and description of operation 7-117

5.10 Front/rear diff lock supply (Power Shuttle version) 7-120
5.10.1 Main components 7-120
5.10.2 Description of operation 7-121

5.11 Rear PTO and brake unit supply system (Powershuttle version) 7-122
5.11.1 Main components and description 7-122
5.11.2 Description of operation 7-124

5.12 4WD engagement (Spring-on) (Power Shuttle version) 7-128
5.12.1 Main components 7-128
5.12.2 Description of operation 7-129

5.13 "Power Five" oil supply (Power Shuttle version) 7-130
5.13.1 Main components 7-130
5.13.2 Description of operation 7-131

5.14 Users' hydraulic power pack (E-Line version) 7-132
5.14.1 Main components 7-132
5.14.2 Description of operation 7-134
5.14.3 Calibration valves 7-138

5.15 Block for 4WD solenoid valve (E-Line version) 7-140
5.15.1 Main components 7-140
5.15.2 Description of operation 7-141

5.1 Hydraulic pump

5.1.1 Main components

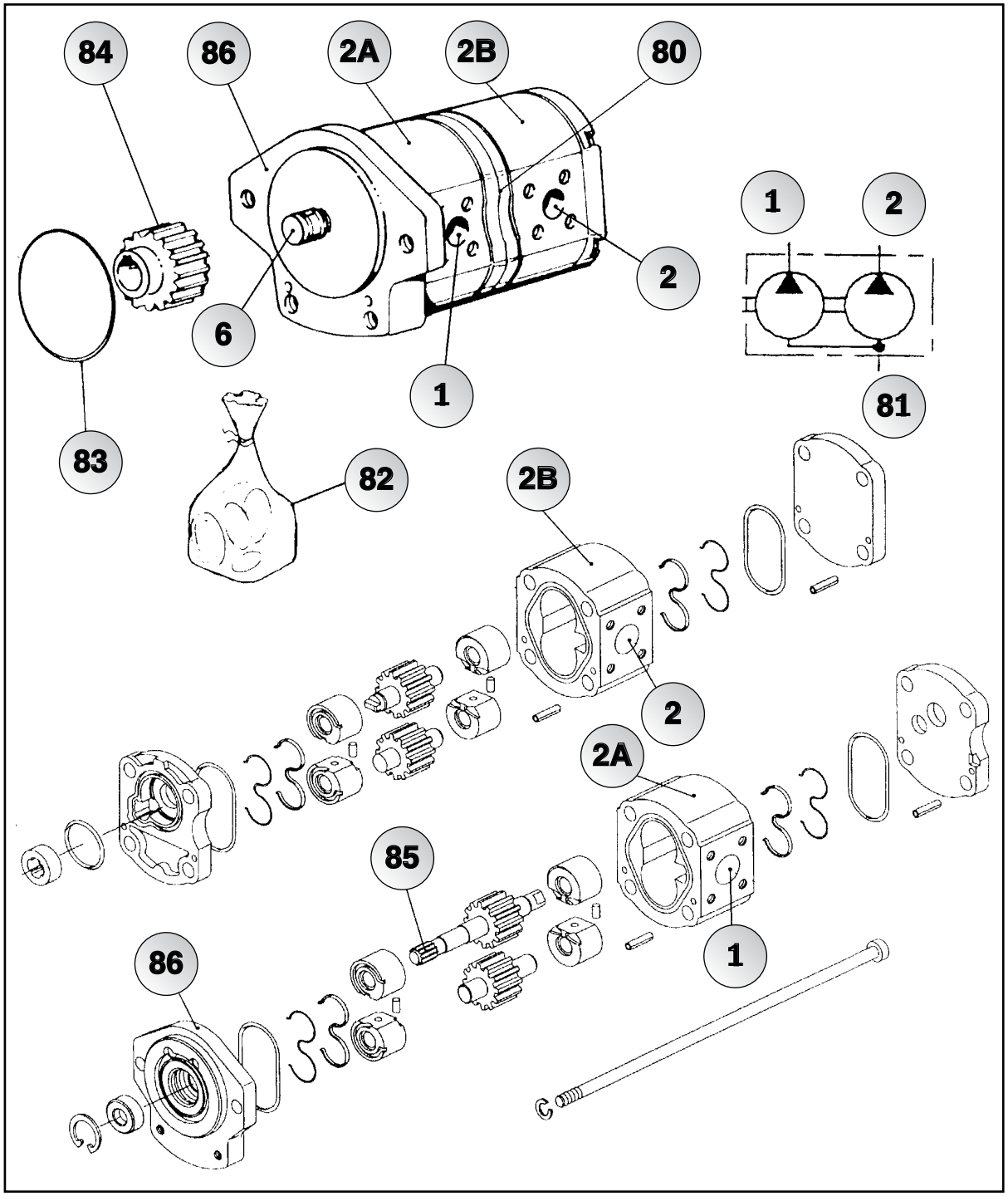


Fig. 7.37

1 - Low pressure delivery hole 2A
2 - High pressure delivery hole 2B
80 - Double casing pump
81 - Common intake hole
82 - Seal set
83 - O-ring for flange
84 - Pump driving gear
85 - Pump shaft
86 - Engine coupling flange

5.1.2 Description of operation

The hydraulic gear pump consists of a single block, with two different stages, one intake duct (81) and two separate supply lines (1 and 2) and two different flow rates. The common oil suction hole (81) has been made on the stage with the widest section.

Since it is connected straight to the engine, the pump activates whenever the engine runs, drawing filtered oil from the transmission and sending it to both the low and high flow circuits at the same time.

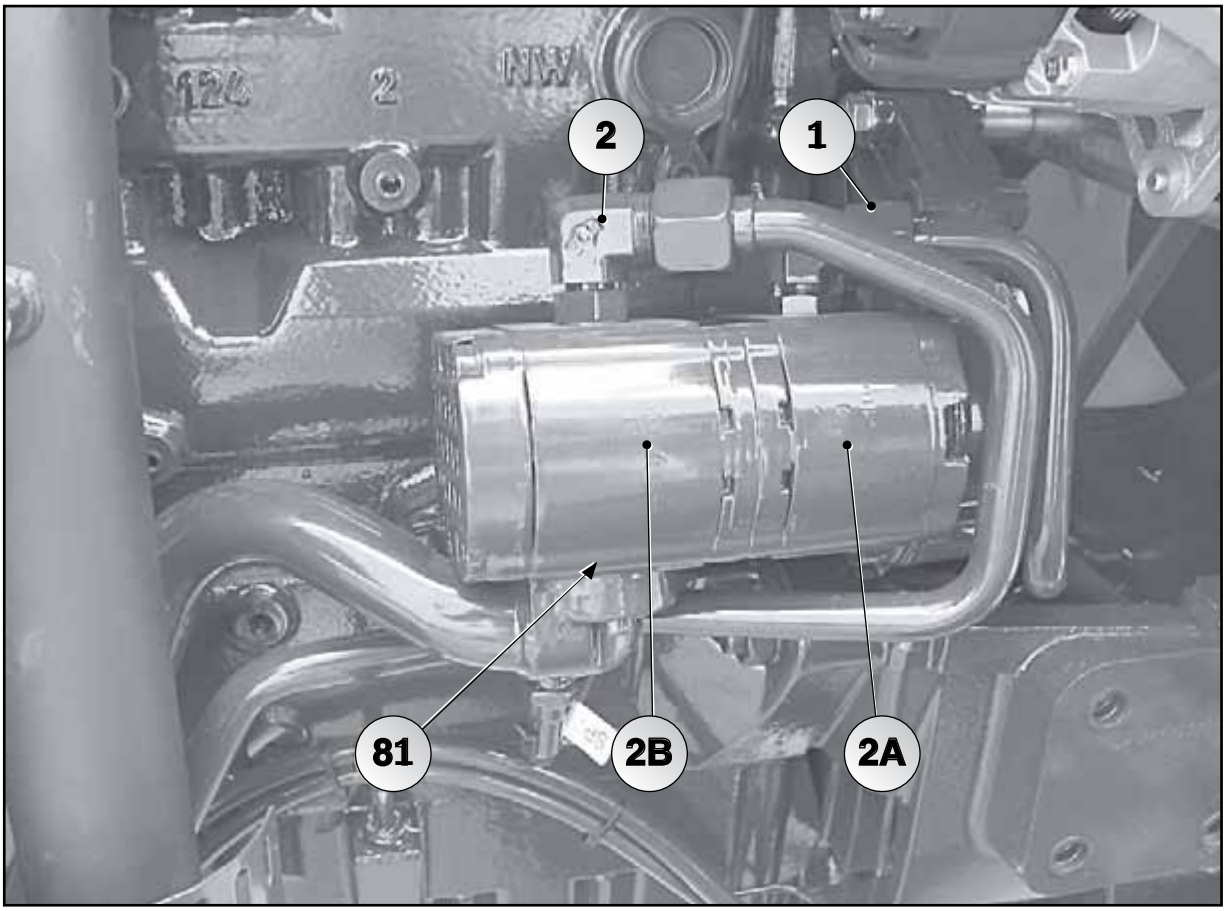


Fig. 7.38

5.2 Hydrostatic steering system

5.2.1 Hydraulic circuit

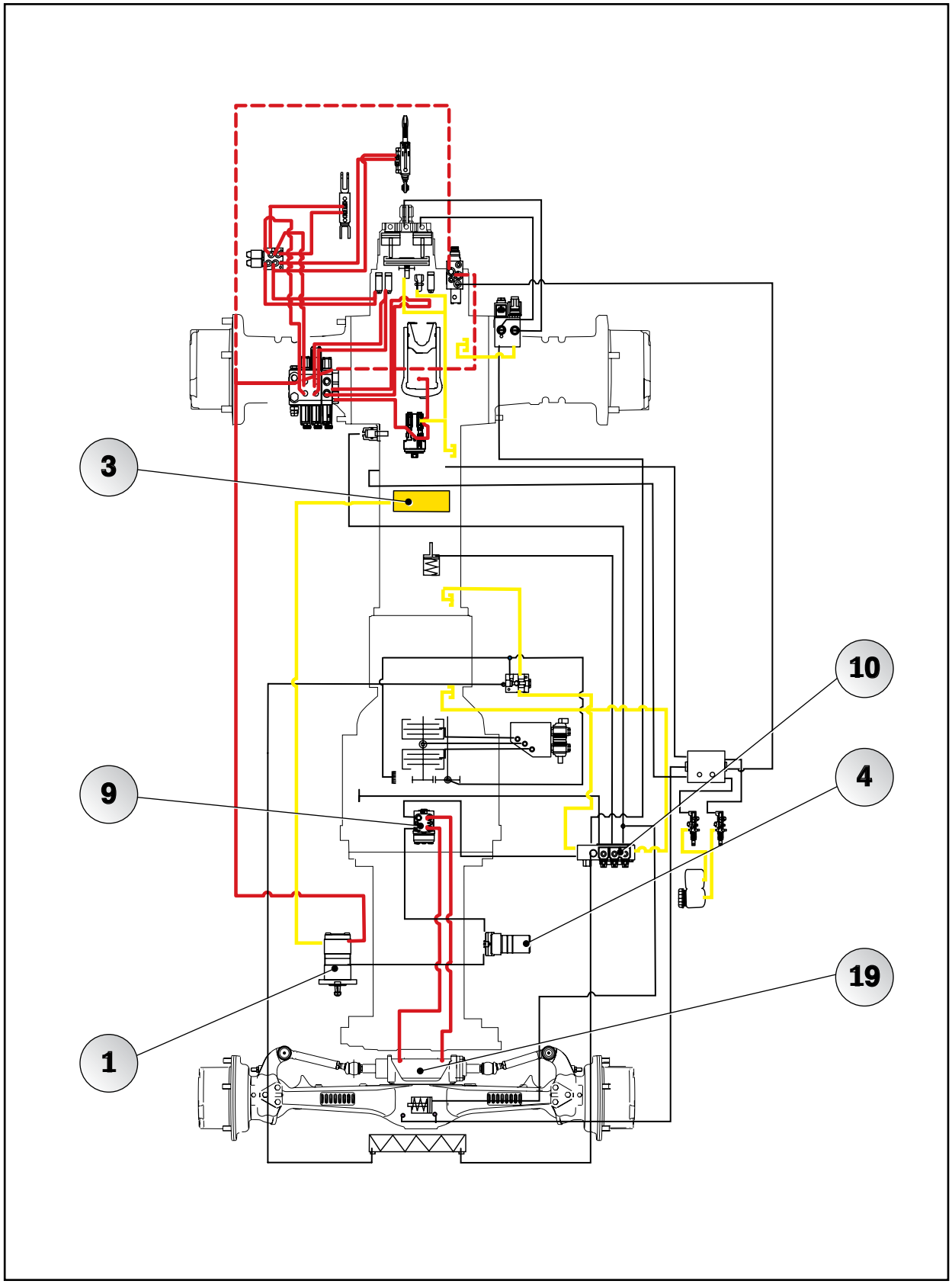


Fig. 7.39

1 - Low flow pump
3 - Intake cartridge filter
4 - Oil filter on the delivery
9 - Hydrostatic steering system
10 - Hydraulic power pack
19 - Steering cylinder

- high pressure

- discharge/inlet

5.2.2 Description of the circuit

The low flow circuit comprises a first high pressure section to operate the power steering system. Oil from the low flow stage of the pump (1 Fig.7.40) supplies the Orbitrol steering valve system (9) through the filter (4), after which it supplies the relative steering cylinder (19). Oil discharged from the Orbitrol returns to the reservoir (10 **Power Shuttle version**) (8 **Speed Five version**) (39 **E-Line version**) and proceeds towards the various users by means of a low pressure circuit.

The steering system installed in **F-N Series** tractors is the hydrostatic type and there is no mechanical connection between the steering wheel and steering cylinder.

Each minimum turn of the steering wheel corresponds to an equivalent turn of the wheels.

If the engine breaks down or the hydraulic pump fails to operate, the Orbitrol system acts like a hand pump operated by the steering wheel which allows the turn to be made.

Power Shuttle version

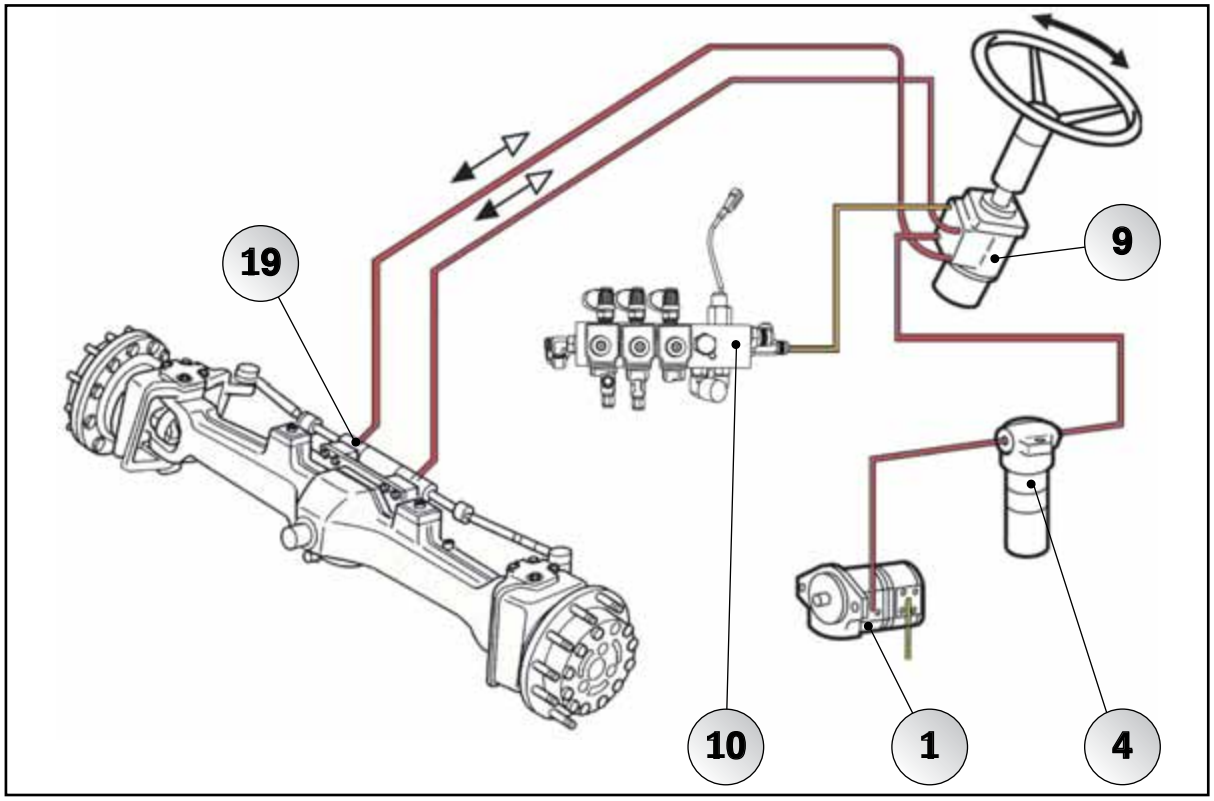


Fig. 7.40

Speed Five version

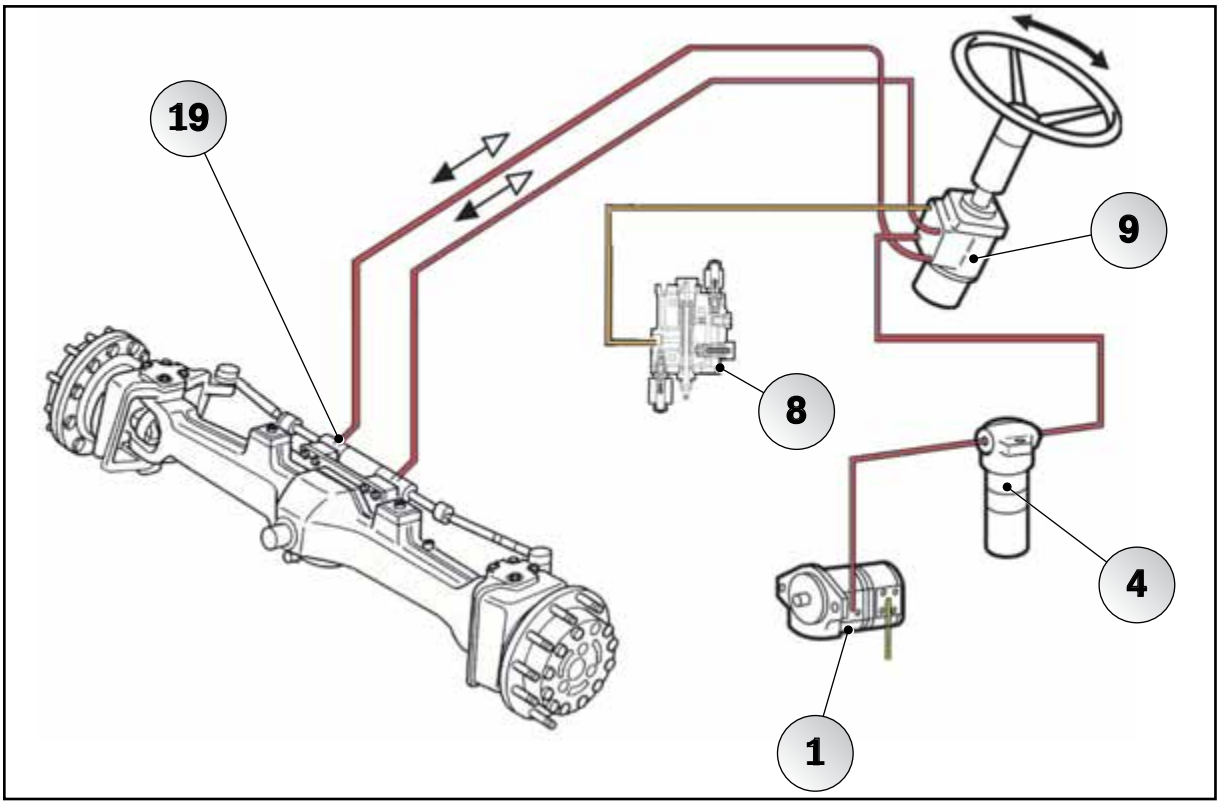


Fig. 7.41

E-Line Version

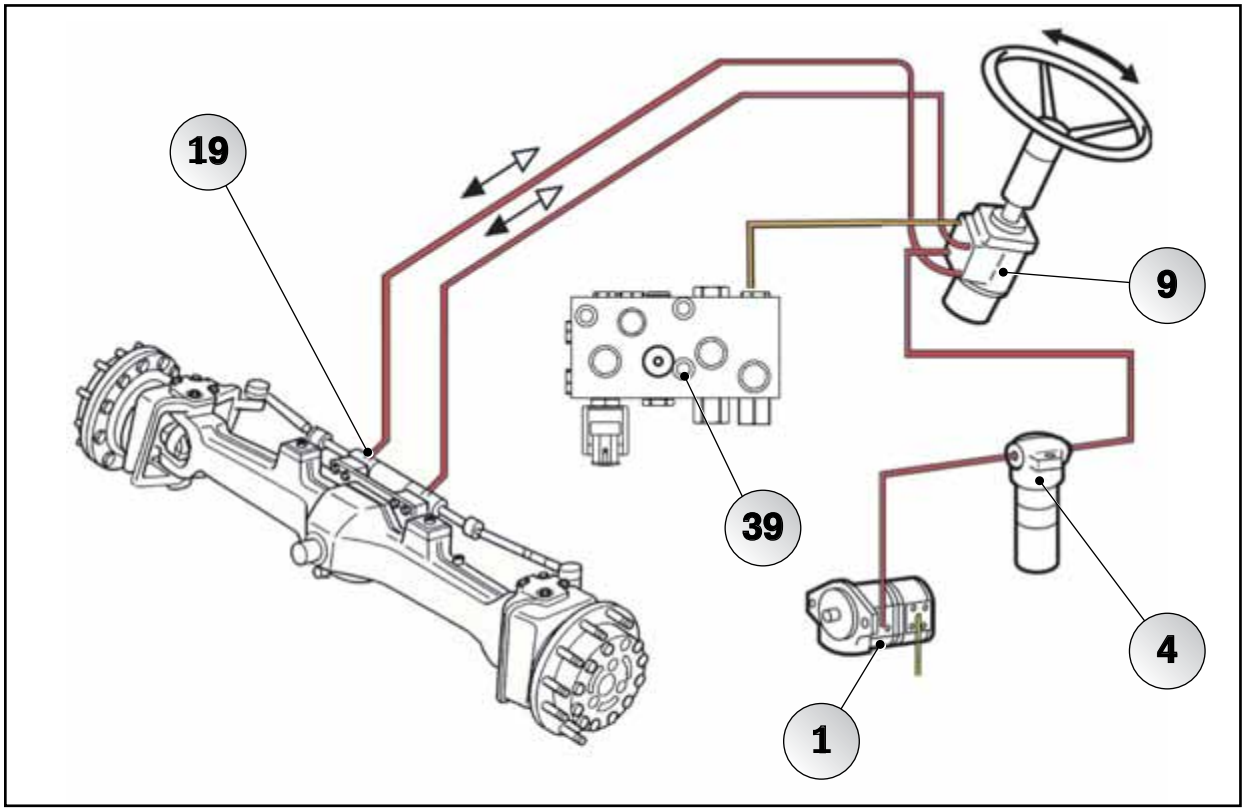


Fig. 7.42

Functional diagram

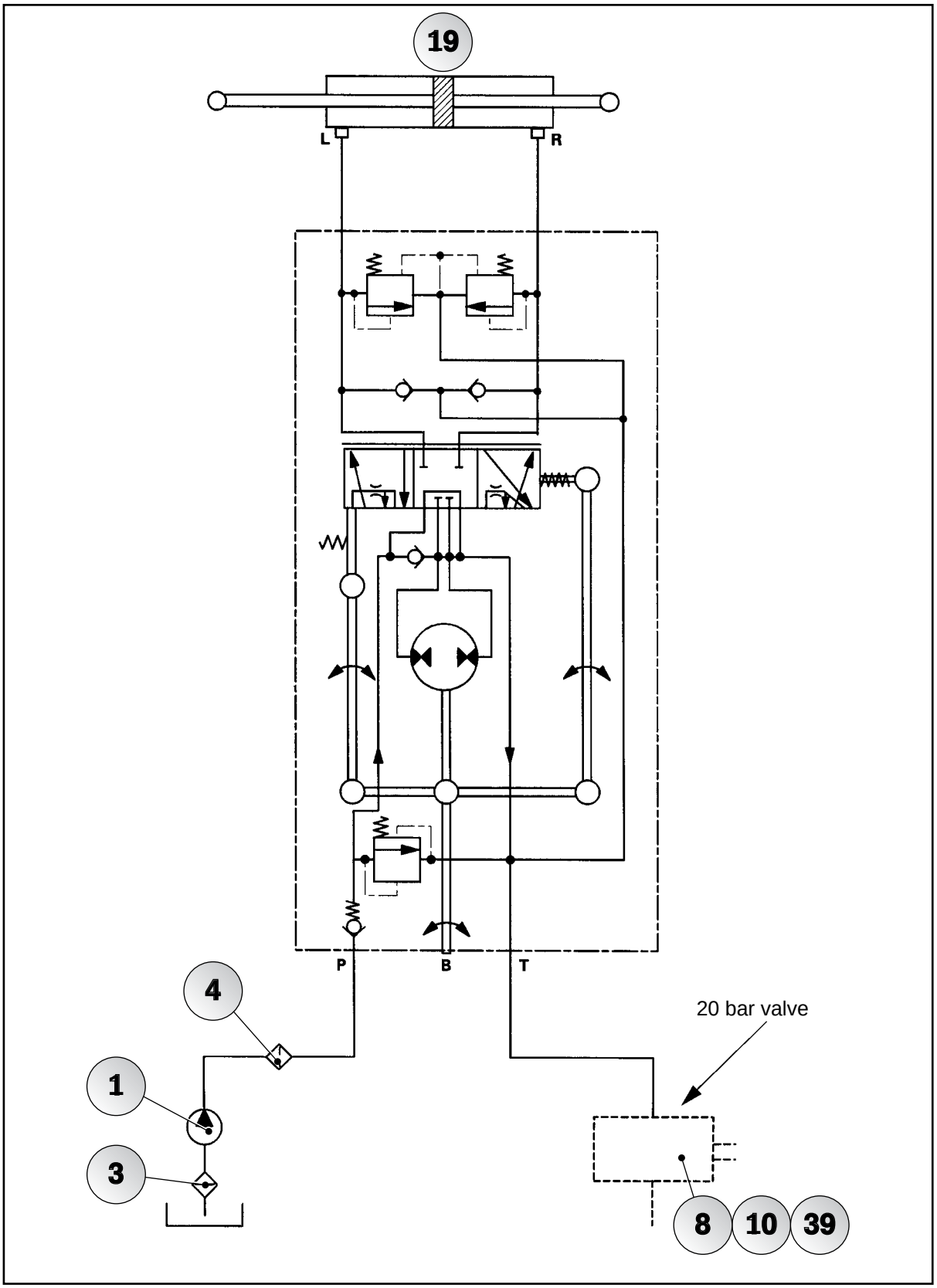


Fig. 7.43

5.2.3 Description of operation

5.2.3.1 Neutral position (engine running)

In this position, the drum (91) is centered in relation to the sleeve (92) by means of the springs (93 Fig.7.44).

Ducts P1-L-R are not supplied.

Two antishock valves (94) and two anticavitation valves (95) are installed in holes L and R of the valve system.

The antishock valves (94) protect the circuit between the steering cylinder and valve system from impact on the wheels. The anticavitation valves (95) allow the oil discharged from the antishock valves (94) to flow from the right-hand duct to the left-hand one or vice versa, depending on the way the piston moves in the steering cylinder.

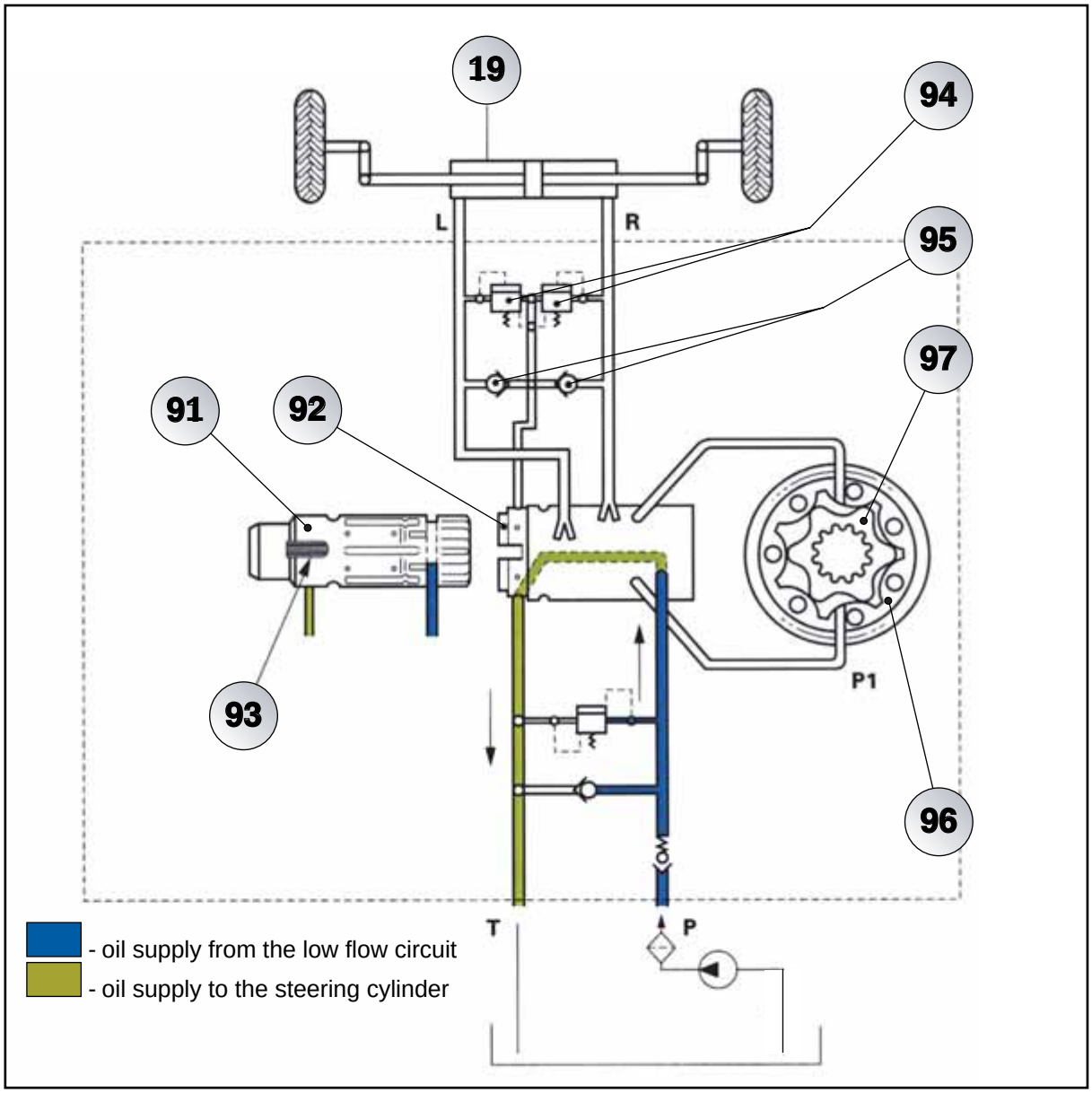


Fig. 7.44

19 - Steering cylinder
L - Oil supply towards the union on the left of the steering cylinder
P - Low flow oil supply from the hydraulic pump
P1 - Supply to the metering device (stator (96) and rotor (97))
R - Oil supply towards the union on the right of the steering cylinder
T - Oil discharged towards the hydraulic power pack

5.2.3.2 Steering position (engine running)

Action on the steering wheel (towards the right or left) causes the drum (91) to make an angular turning movement in relation to the sleeve (92). Oil flow from the pump is sent towards the metering devices (stator (96) and rotor (97)). The rotor (97) is made to turn and allows a quantity of oil proportional to the rotation angle to return towards the cylinder. The rotor (97) turns to the same extent as the steering wheel.

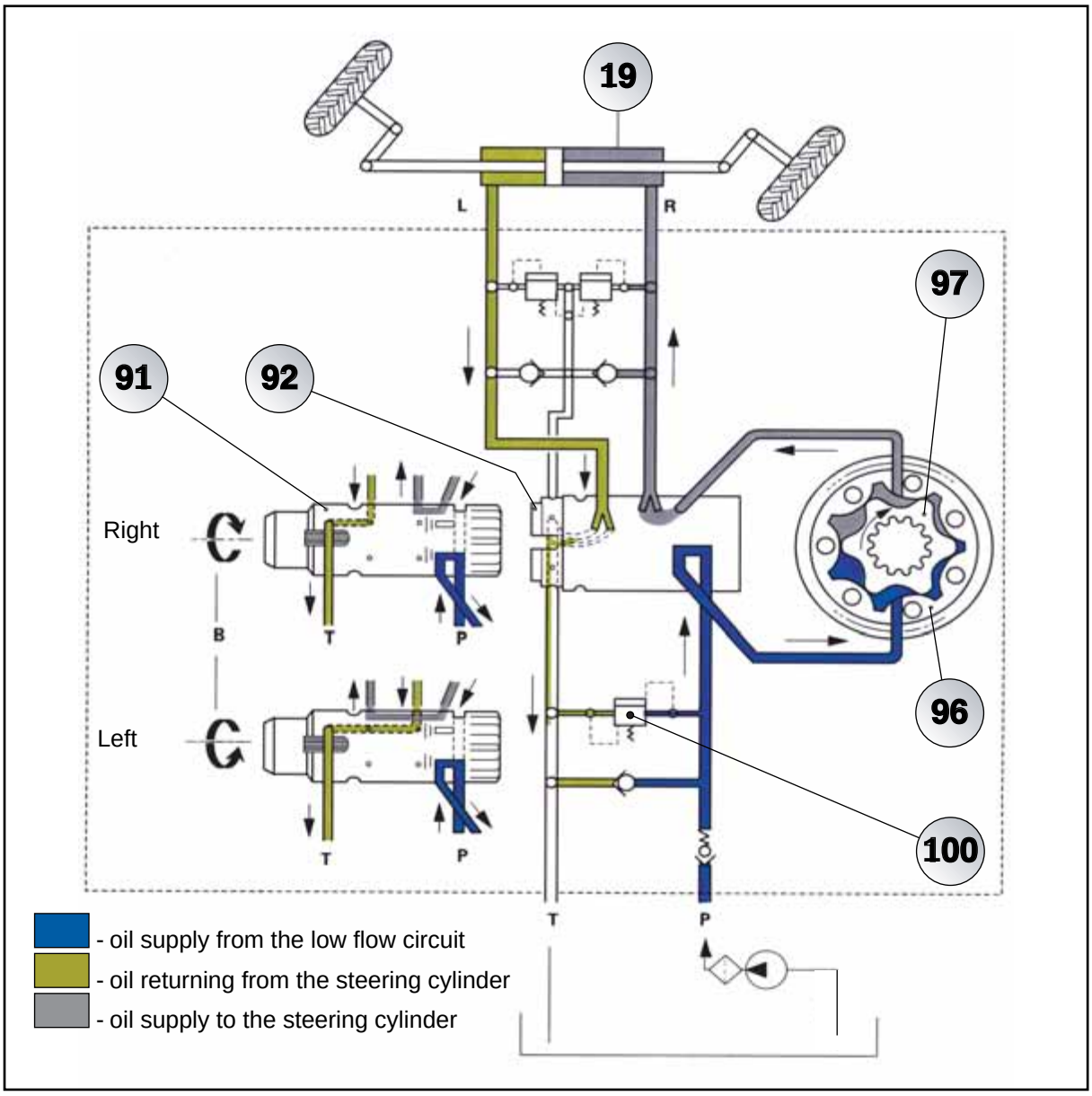


Fig. 7.45

19 - Steering cylinder
B - Steering column positioning
L - Oil supply towards the union on the left of the steering cylinder
P - Low flow oil supply from the hydraulic pump
P1 - Oil supply towards the metering devices (stator (96) and rotor (97))
R - Oil supply towards the union on the right of the steering cylinder
T - Oil discharged towards the hydraulic power pack

5.2.3.3 Manual steering (engine at a standstill)

The rotor (97) is no longer turned hydraulically when the pump no longer delivers oil, or when the pressure available is too weak. In this case, there is no assistance.

When the steering wheel is turned, the centering springs (93) are compressed, the angular play between the pin (99 Fig.7.49) and the sleeve (92) is annulled, and the rotor (97) is turned mechanically. The valve system thus operates like a hand pump.

Oil returning from cylinder A passes through the non-return valve (98) and supplies the metering device.

The pressure created is proportional to the torque exercised on the steering wheel. In this case, the torque on the steering wheel is high.

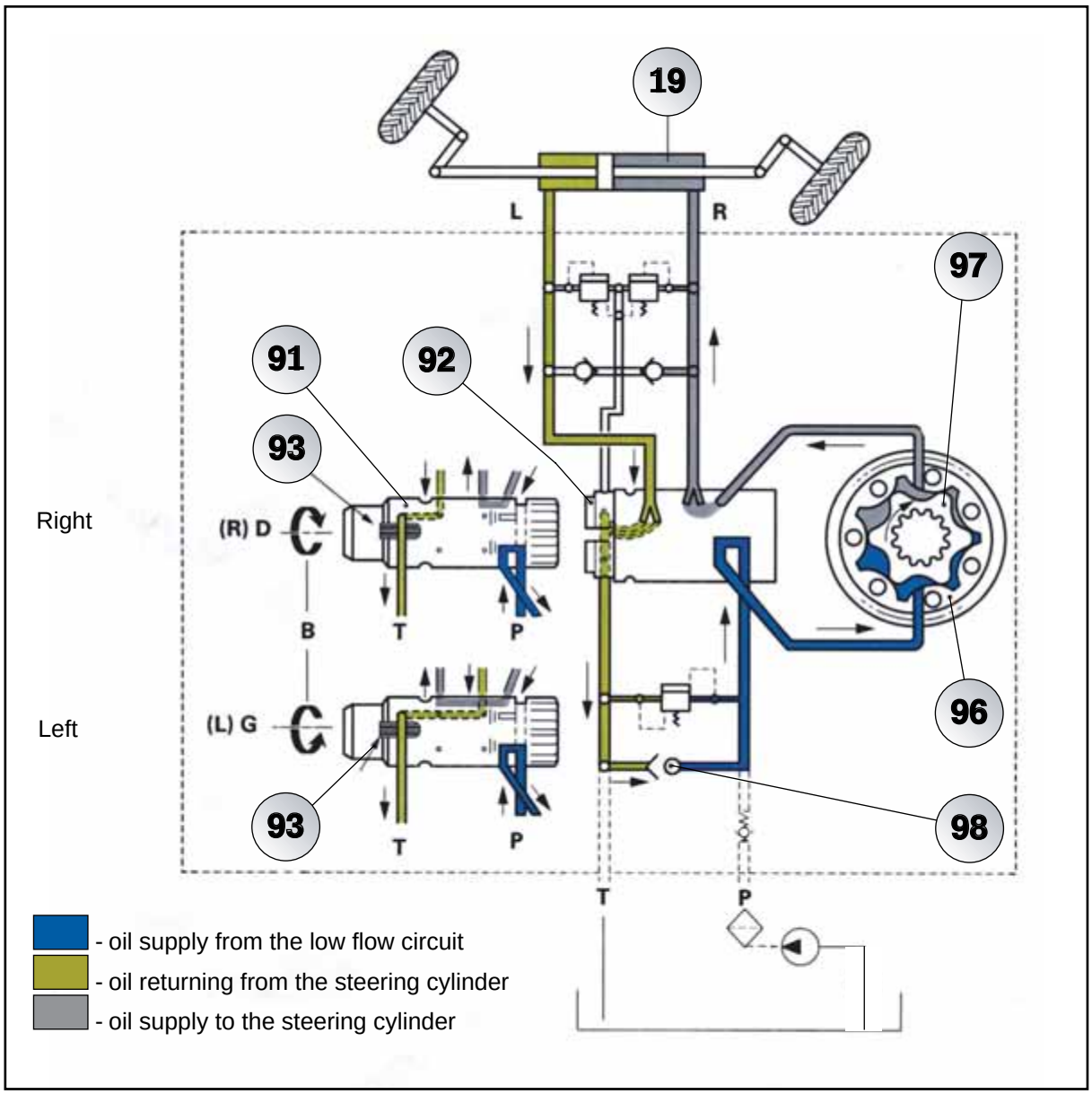


Fig. 7.46

19 - Steering cylinder
B - Steering column positioning
L - Oil supply towards the union on the left of the steering cylinder
P - Low flow oil supply from the hydraulic pump
P1 - Oil supply towards the metering devices (stator (96) and rotor (97))
R - Oil supply towards the union on the right of the steering cylinder
T - Discharge towards the diff lock block

5.2.4 Drawing of the "Orbitrol" valve system assembly

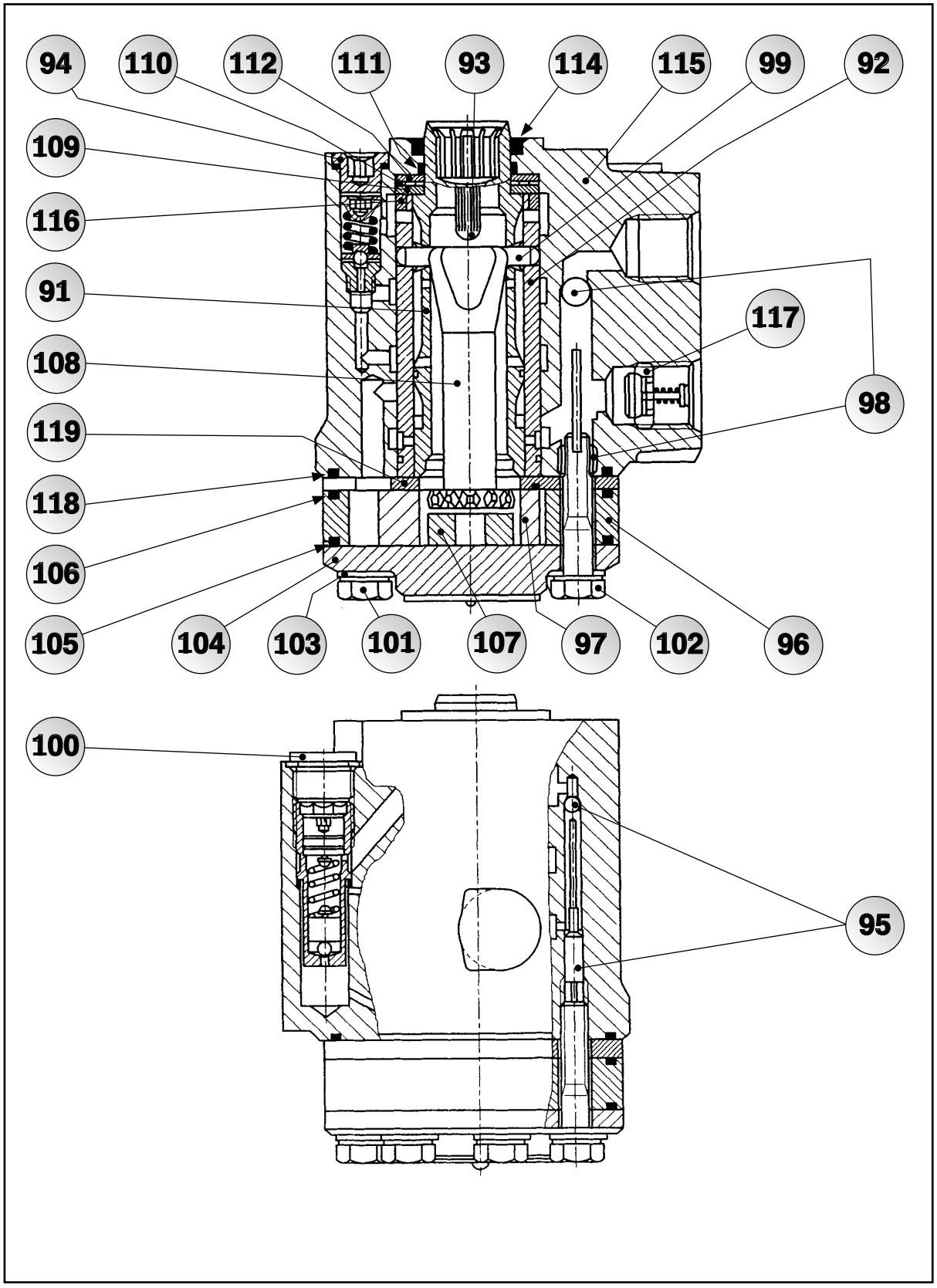


Fig. 7.47

5.2.5 Main components of the “Orbitrol” valve system assembly

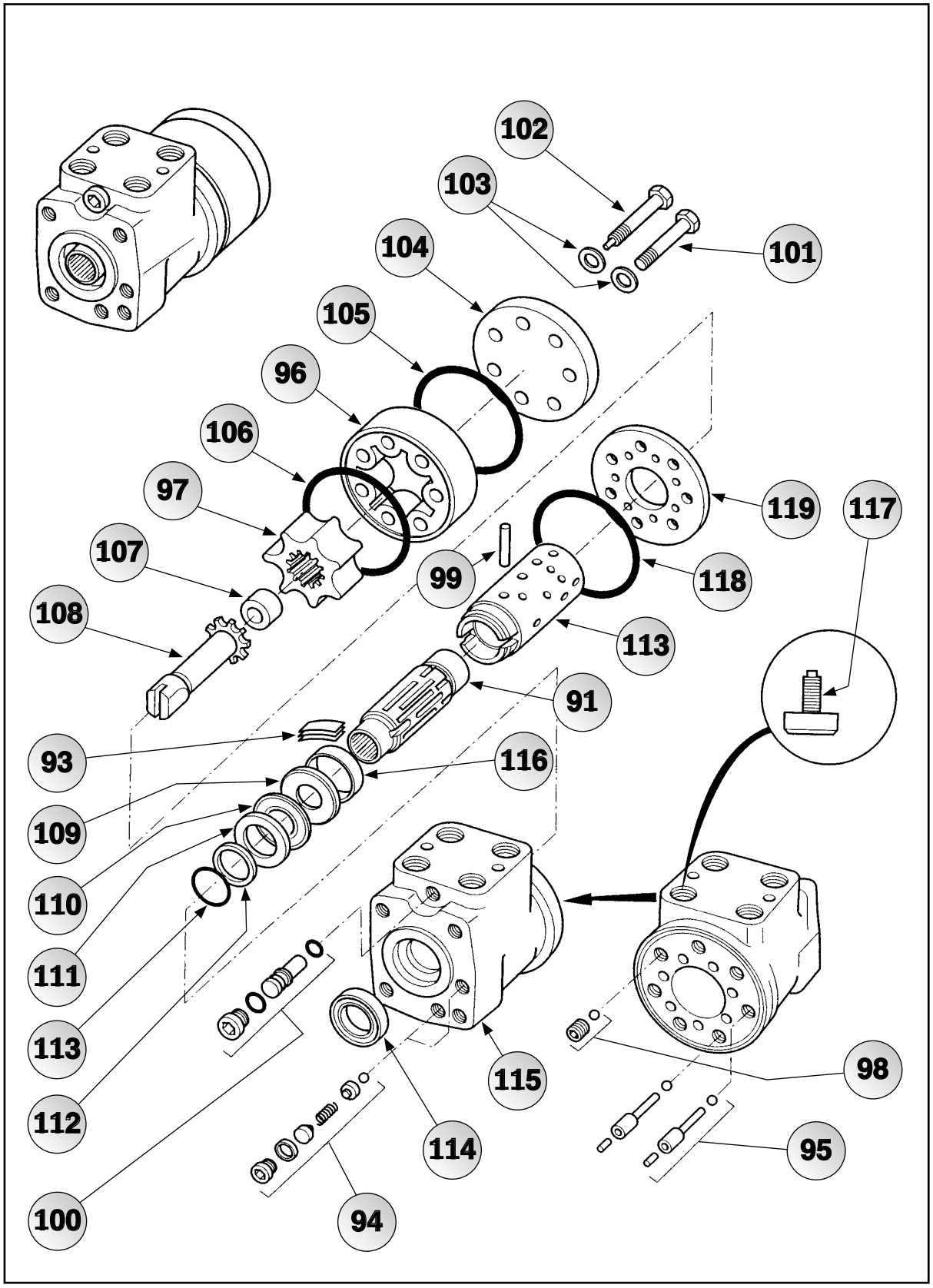


Fig. 7.48

91 - Drum
92 - Sleeve
93 - Centering springs
94 - Antishock valve
95 - Anticavitation valve
96 - Stator
97 - Rotor
98 - One-way valve
99 - Pin
100 - Safety valve
101 - Screw
102 - Screw
103 - Seal
104 - Closing plates
105 - O-ring seal
106 - O-ring seal
107 - Spacer
108 - Connection shaft
109 - Washer
110 - Needle bearing
111 - Ring
112 - Washer
113 - O-ring seal
114 - Retention ring
115 - “Orbitrol” valve system
116 - Ring
117 - Check valve
118 - O-ring seal
119 - Distributor plate

5.3 Users' hydraulic circuit (Power Shuttle version)

5.3.1 Main components and functional diagram

Power Shuttle version (with Power Five/Four assembled)

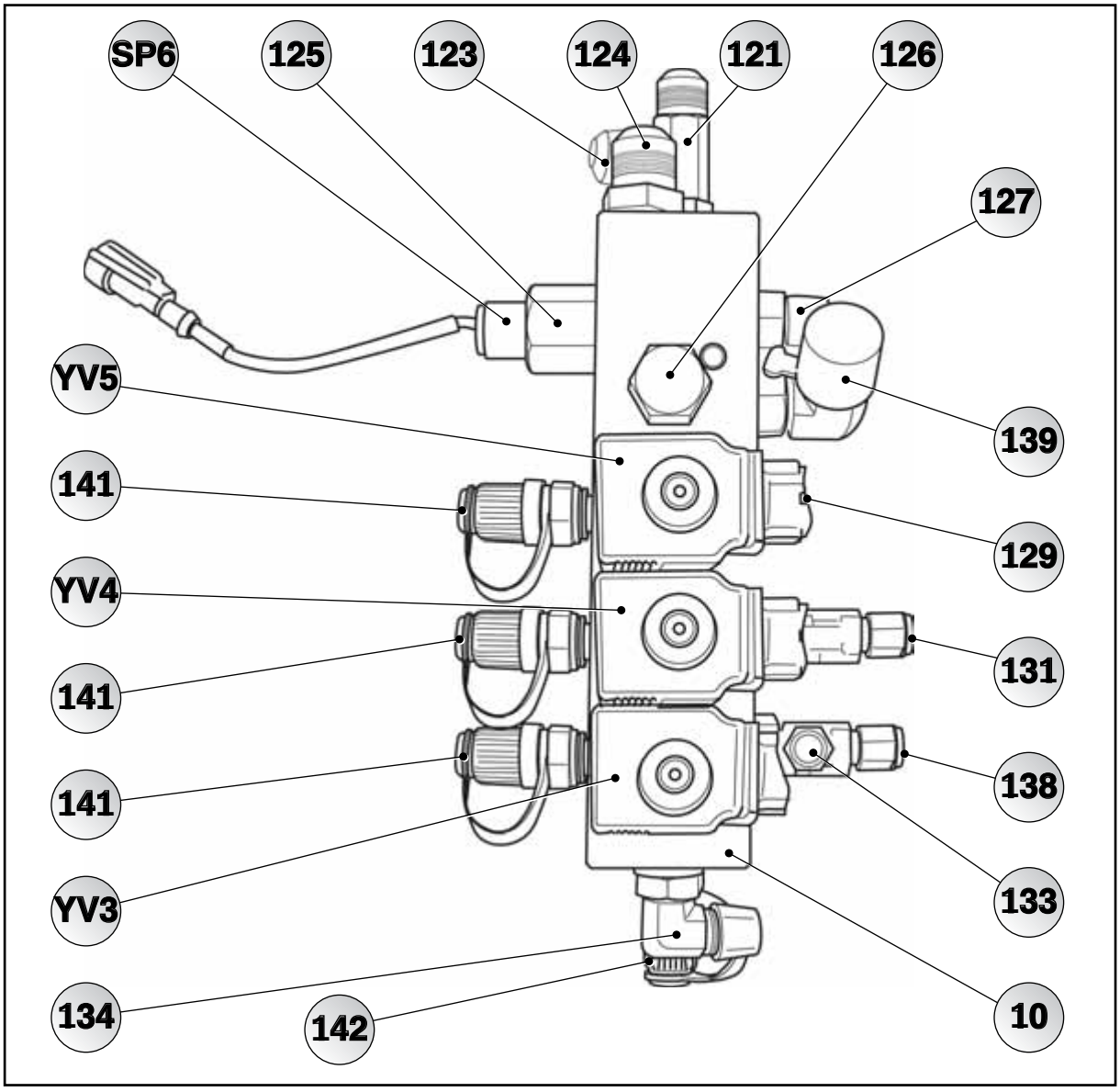


Fig. 7.49

10 - Hydraulic power pack
121 - Oil supply (from power steering system)
123 - Towards hydraulic block (15) for clutch monitoring solenoid valves
124 - 9.5 bar valve discharge (cooling)
125 - 9.5 bar valve
126 - 20 bar valve
127 - Block supply (31) for rear P.T.O.
129 - Powerfive oil supply
131 - 4WD disengagement oil supply
133 - Front diff lock oil supply
134 - Returns
135 - Rear P.T.O. oil supply
136 - Rear P.T.O. brake oil supply
138 - Diff lock oil supply
139 - Towards radiator
141 - Quick couplings for "user" pressure monitoring
142 - Quick couplings for supply pressure monitoring
SP6 - Pressure indicator bulb
YV3 - Diff lock solenoid valve
YV4 - 4WD disengagement solenoid valve
YV5 - Powerfive solenoid valve

5.3.1.1 Power Shuttle version (without Power Five)

The **Power Shuttle** version of **F-N Series** tractors without the “Power Five” unit have a hydraulic power pack (Fig.7.50) that is similar, as to operation and components, to the one installed in tractor versions with the “Power Five” unit (Fig.7.51).

In the version with Power Shuttle only, instead of the solenoid valve that controls the Power Five unit, there is a plug (141 Fig.7.50) that shuts off the oil supply to the previously mentioned user.

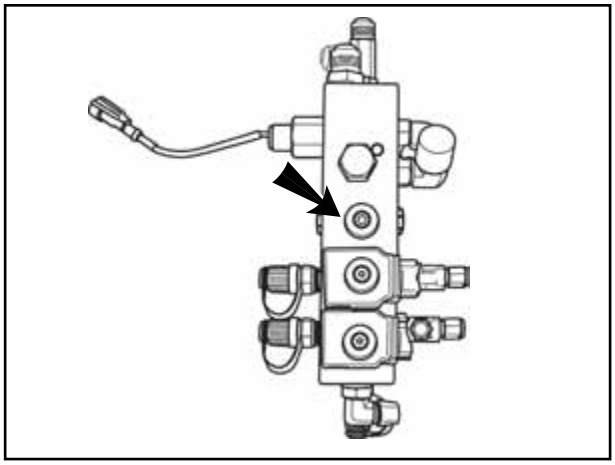


Fig. 7.50

Functional diagram

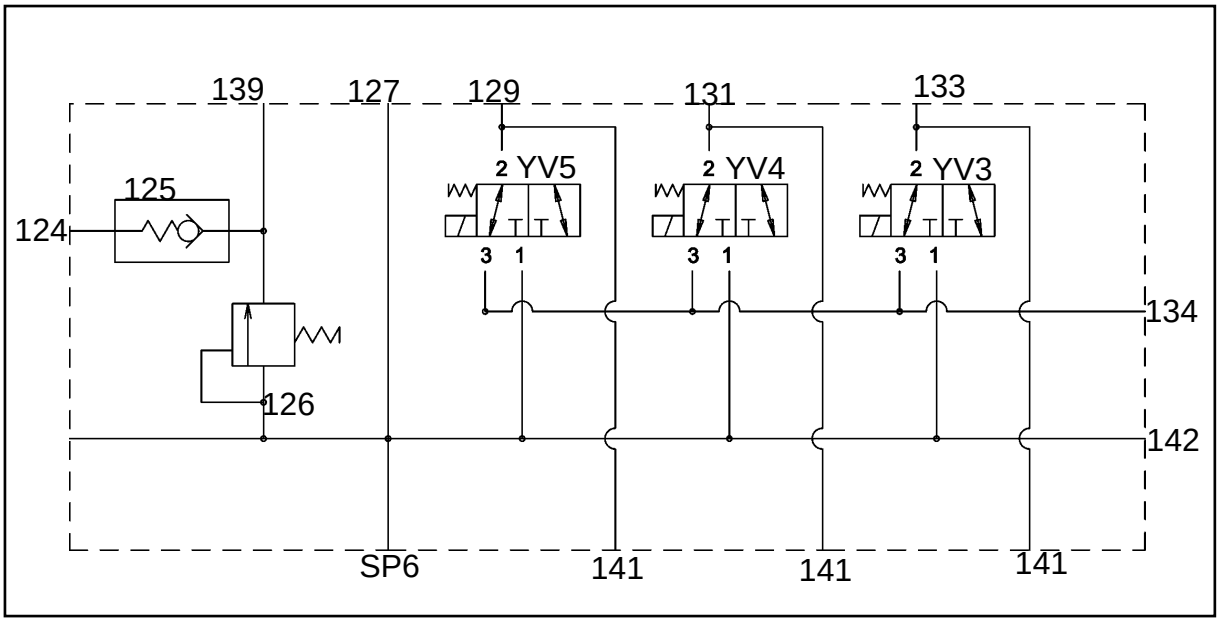


Fig. 7.51

5.3.2 Description of operation

The users' hydraulic power pack (10 Fig.7.52) Is located on the left-hand side of the tractor, near the platform. It consists of a machined parallelepiped shaped aluminium block that houses: the low pressure (20 bar) valve (126), the pressure indicator bulb (122) and the calibration valve (125) of the 9.5 bar cooling circuit (Fig.7.49). A plate is screwed to the power pack itself (X Fig.7.52) to protect these components.

The power pack also has 3 solenoid valves with unions and tubes to supply oil to various users, to the cooling circuit, the lubrication circuit and to the free discharge. These 3 solenoid valves are used like a tap that completely opens or closes the flow of pressurized oil to the respective users. They are installed on the top part of the power pack and are connected to the electric wiring of the rear line (Fig.7.52). The solenoid valve opens and closes, thus allowing oil to proceed towards the users or to be shut off, by transmitting voltage to its winding.

The solenoid valves (YV3/YV5/YV4) let pressurized oil flow on when they are energized. Solenoid valve (YV3) engages the differential lock, valve (YV5) engages the "Powerfive" unit (if installed) and valve (YV4) disengages the 4WD (spring-on).

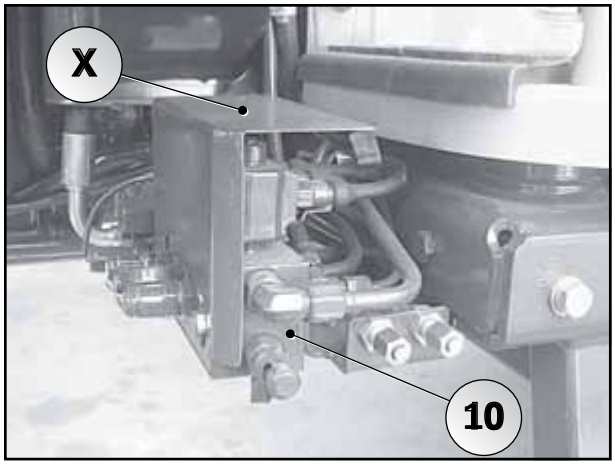


Fig. 7.52

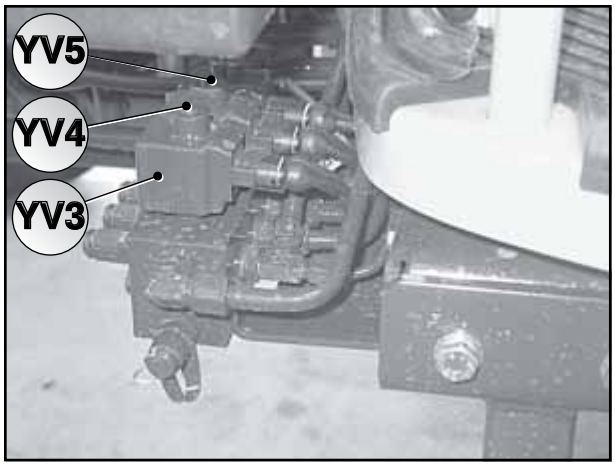


Fig. 7.53

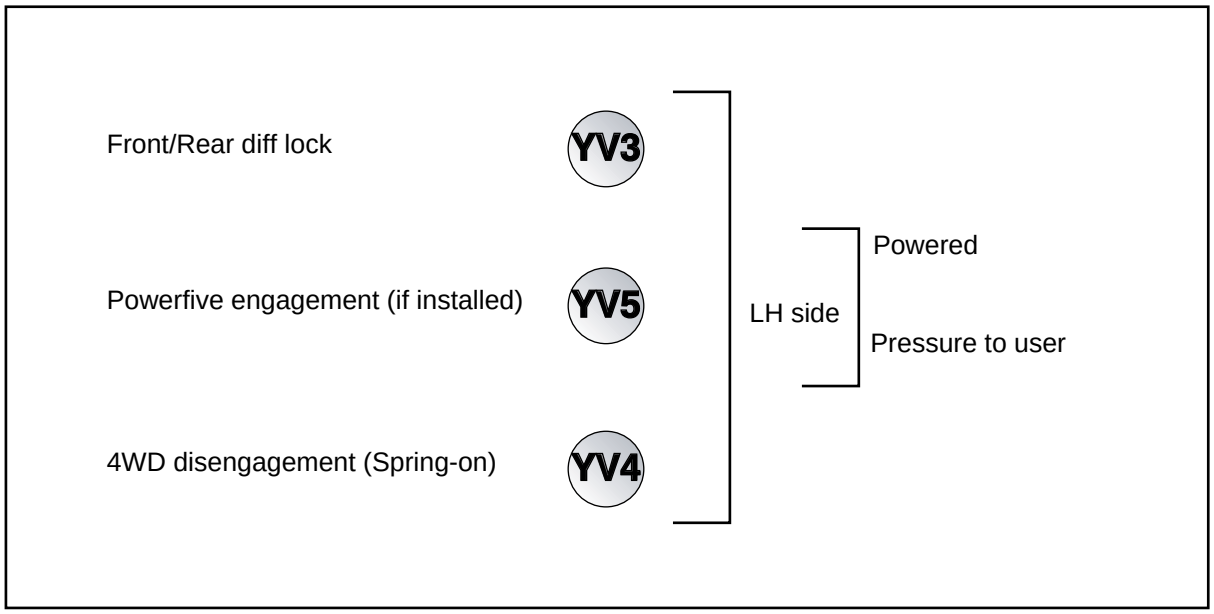


Fig. 7.54

5.3.2.1 Description of the oil circuit within the power pack

The hydraulic power pack (10 Fig.7.56) controls the “low pressure” oil circuit that supplies the users on the tractor. The block also houses the low pressure (20 bar) calibration valve (126) and the 9.5 bar calibration valve (125) of the cooling circuit. During normal operation of the tractor, oil reaches the power steering unit, enters the chamber (128) and, through the duct (130), reaches the calibration valve (126). Here oil is brought to the pressure of **20 bar**, as required by the users connected. Through the chamber (182) and the duct (130) the oil reaches the chambers (177-178-179). The plunger of the energized solenoid valve moves and the oil can thus supply the required user.

In Fig.7.56 , the oil flowing towards the users (180-181-183) communicates with the outlet through duct (184) and chamber (185). Through intersecting ducts that communicate with each other (164-165-166-167), the oil also reaches the **9.5 bar**calibration valve, which is the maximum pressure for oil flowing towards the cooling radiator.

If the oil pressure in the chamber (166) exceeds 9.5 bar, the valve (125) opens the passage to the chamber (168), that communicates with the discharge circuit.

USER	STATUS	PRESSURE
Power Five	disengaged	0 bar
4WD	engaged	0 bar
Diff. lock	disengaged	0 bar

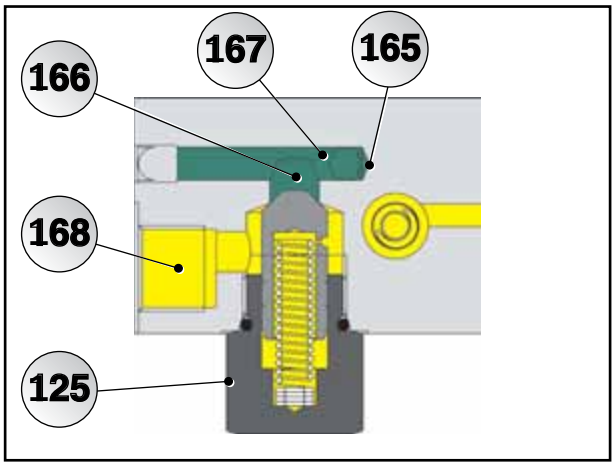


Fig. 7.55

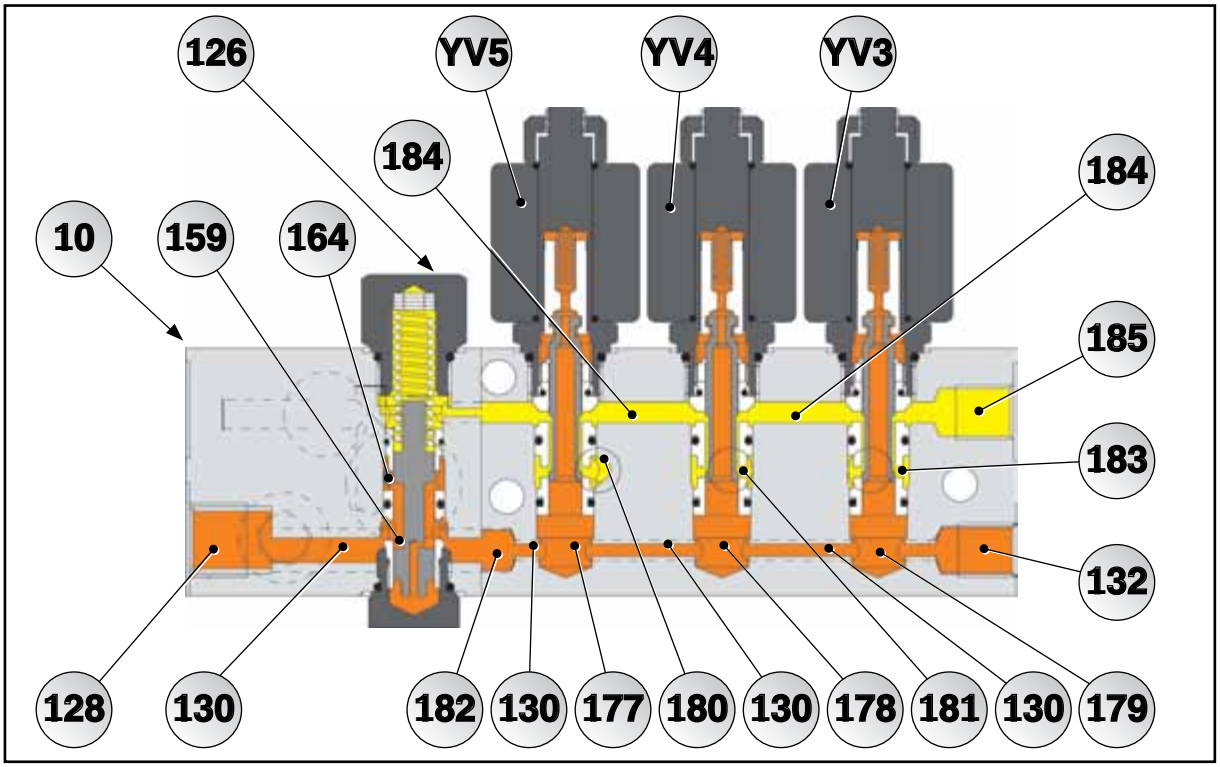


Fig. 7.56

5.3.3 9.5 and 20 bar calibration valves

Oil discharged by the steering system (Fig.7.57) enters in communication with the 20 bar valve (126) through the chamber (128) and the duct (130). It reaches the chamber (169) through the calibrated hole (170) and, upon reaching a pressure of 20 bar, pushes the plunger (158) upwards, thus compressing the spring (157). Thanks to its characteristics, the spring maintains the pressure of **20 bar** , as required by the users. They are controlled by the three ON/OFF solenoid valves installed on the power pack (YV3/YV4/YV5).

When the plunger (158) moves up, it allows the oil discharged by the power steering circuit to flow into the chamber (166), through the crosswise intersection of the ducts (164-165-167). Oil flowing into the chamber (166) pushes the plunger (151) up and opens the communication with the outlet through the chamber (168)(Fig.7.58).

During normal operation of the tractor, when oil is hot, the spring (152) makes sure that the oil pressure toward the radiator is maintained within **9.5 bar**. If the oil pressure exceeds the force of the spring (152), the valve opens the communication with the outlet (Fig.7.60).

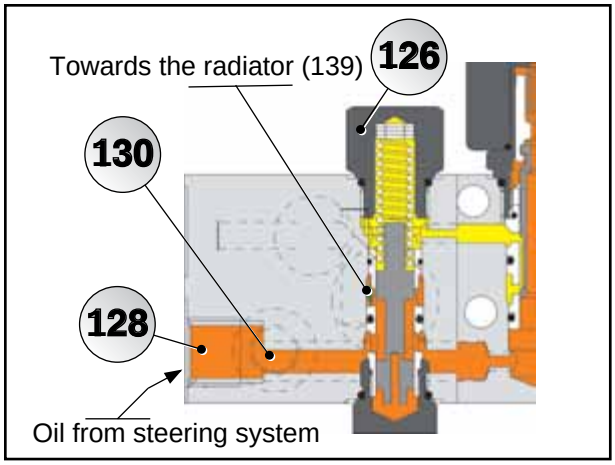


Fig. 7.57

9.5 bar calibration valve (cold oil)

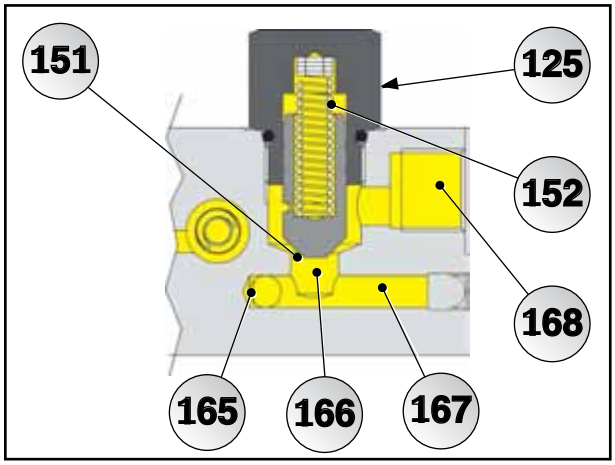


Fig. 7.58

20 bar calibration valve

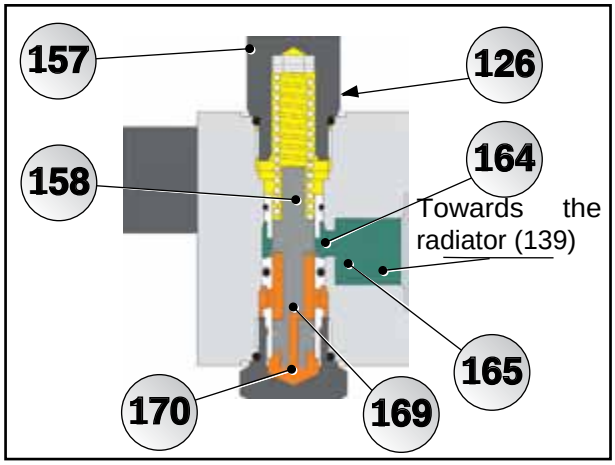


Fig. 7.59

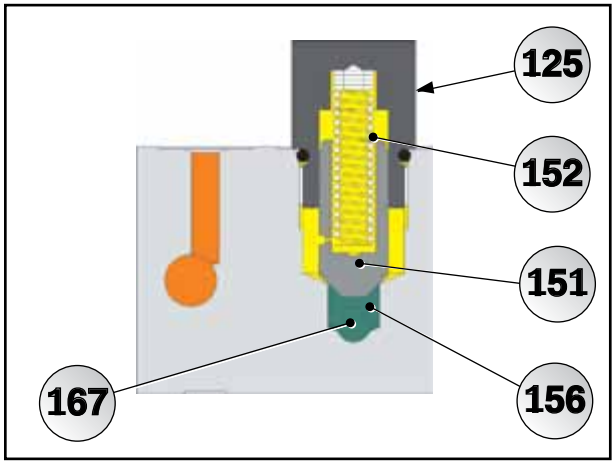


Fig. 7.60

The figures on the right show the main components installed in the calibration valves (125) and (126). Thanks to their characteristics, the relative springs (152) and (157) allow the required pressure to be maintained.

9.5 bar calibration valve (125)

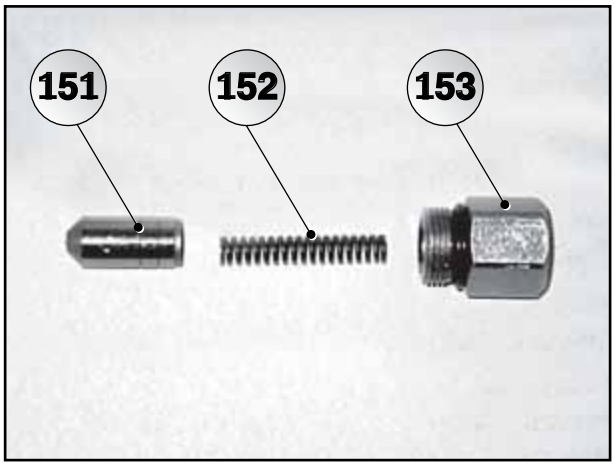


Fig. 7.61

151 - Plunger
152 - Spring
153 - Plug

20 bar calibration valve (126)

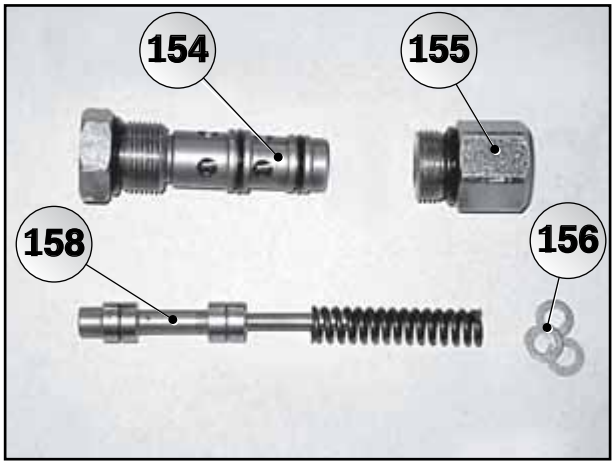


Fig. 7.62

154 - Cylinder for plunger
155 - Plug
156 - Shims
157 - Spring
158 - Valve plunger

5.4 Block for forced lubrication valve

5.4.1 Main components and position

The block (17 Fig. 7.63) is positioned, through a union, on the outlet of the **9.5 bar** calibration valve of the oil cooling circuit in the hydraulic power pack (10 Fig.7.46).

The function of this block is to guarantee that the forced lubrication circuit of the transmission receives a maximum pressure of **1.5 bar** or **4.5 bar**.

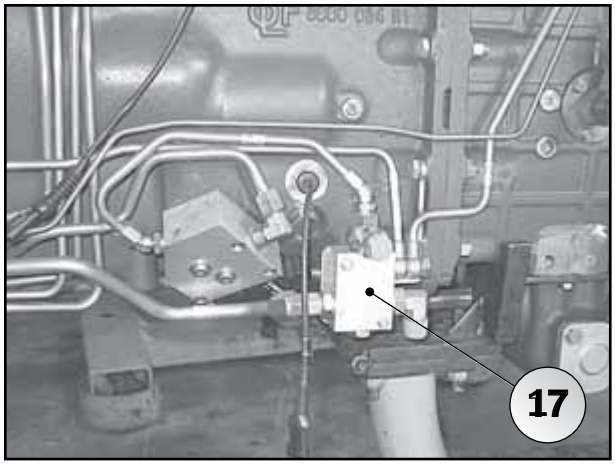


Fig. 7.63

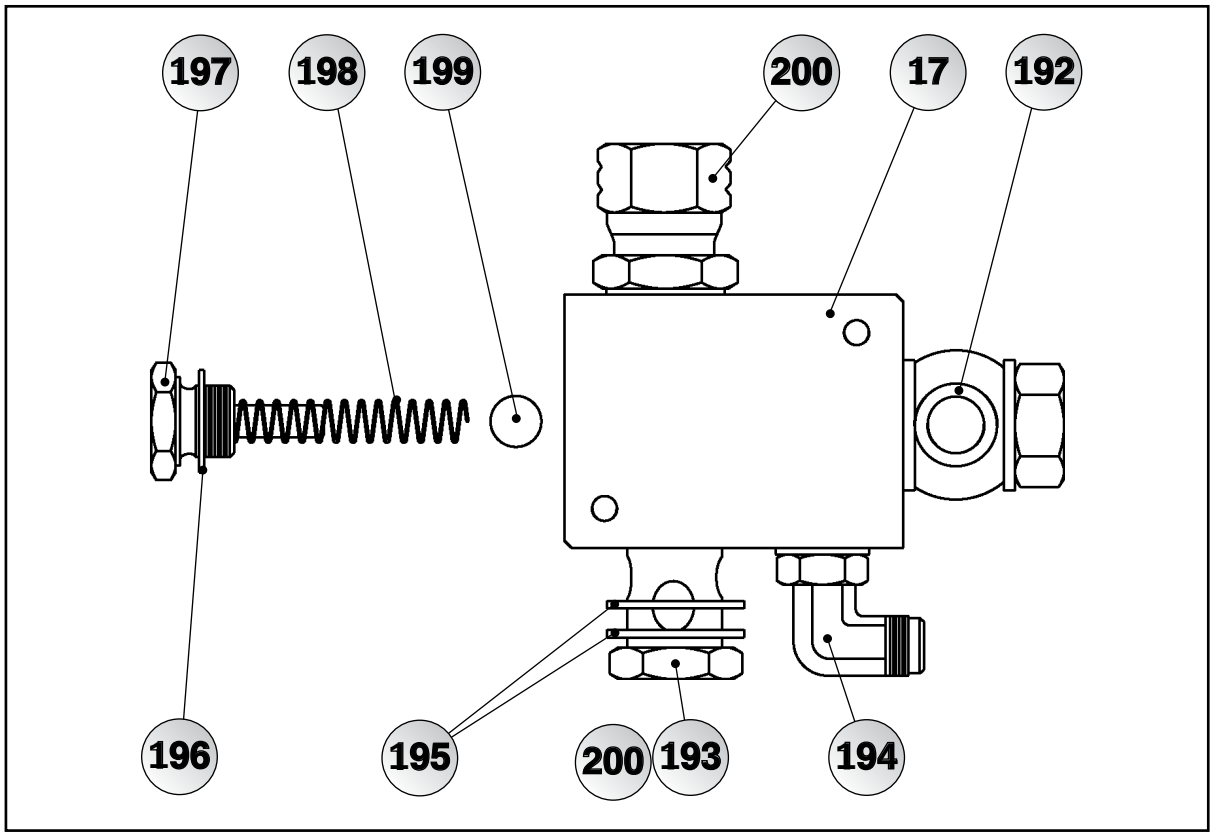


Fig. 7.64

17 - Block for the lubrication valve
192 - From the oil cooling radiator
193 - Engine gearbox assembly lubrication
194 - Discharge to housing
195 - Seals
196 - Seals
197 - Spring guiding plug
198 - Valve calibration spring
199 - Ball
200 - From hydraulic power pack (10)

5.4.2 Description of operation

The **4.5 bar** pressure value is obtained through spring (198) calibration.

During the phase when the engine is off (Fig.7.65), oil in the block is at a 0 bar pressure.

During the phase when the engine is on (Fig.7.66), oil (192) from the cooling radiator passes through the block and lubricates (193) the engine-gearbox assembly. The spring (198) keeps the ball (199) depressed until this pressure (4.5 bar) has been reached. If the inlet oil (192) is at a higher pressure, the ball (199) is moved towards the left, thus allowing excess oil to pass through until the spring calibration pressure (198) has been reached.

Engine off

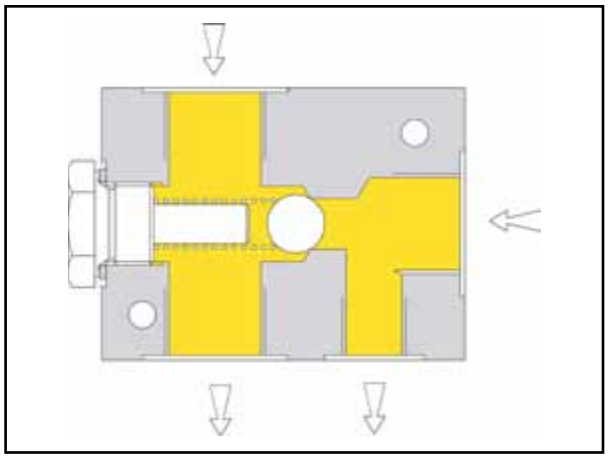


Fig. 7.65

Engine on

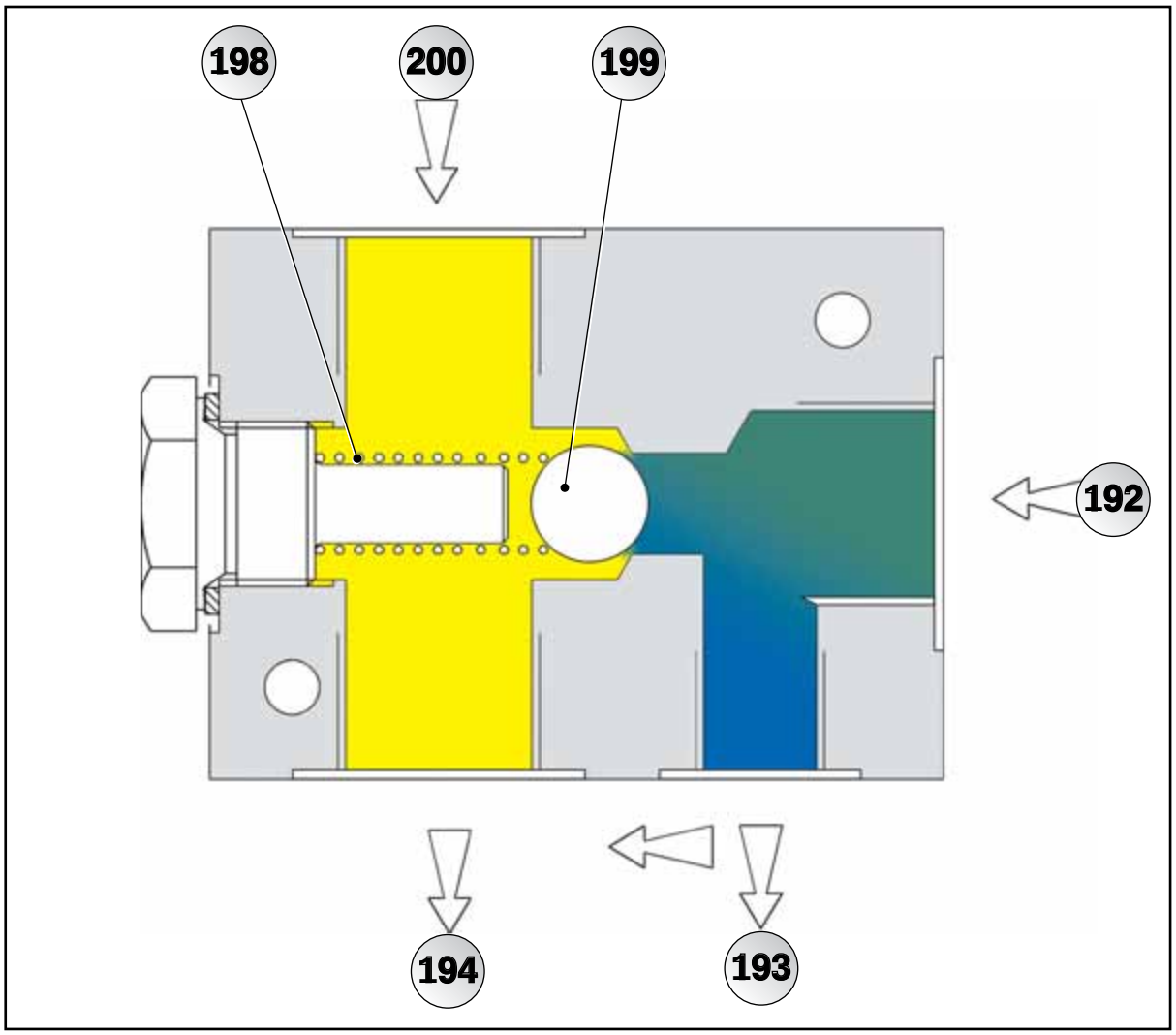


Fig. 7.66

5.4.2.1 Main components of the lubrication circuit

Fig.7.67 shows the main components of the lubrication circuit in **F-N Series Power Shuttle**. tractors. Cooled oil (16) enters the valve (17) at a 9.5 bar pressure, and leaves then the valve toward the lubrication circuits of the lay shaft (49) and of the gearbox, and toward the block (15) to lubricate the main and secondary clutches and the input shaft (21).

Excess oil in the valve (17) discharges into the 4WD housing. The same valve is also reached by the oil discharged by the 9.5 bar valve in the users' hydraulic power pack (10).

- oil for lubrication
- oil for cooling
- discharged oil

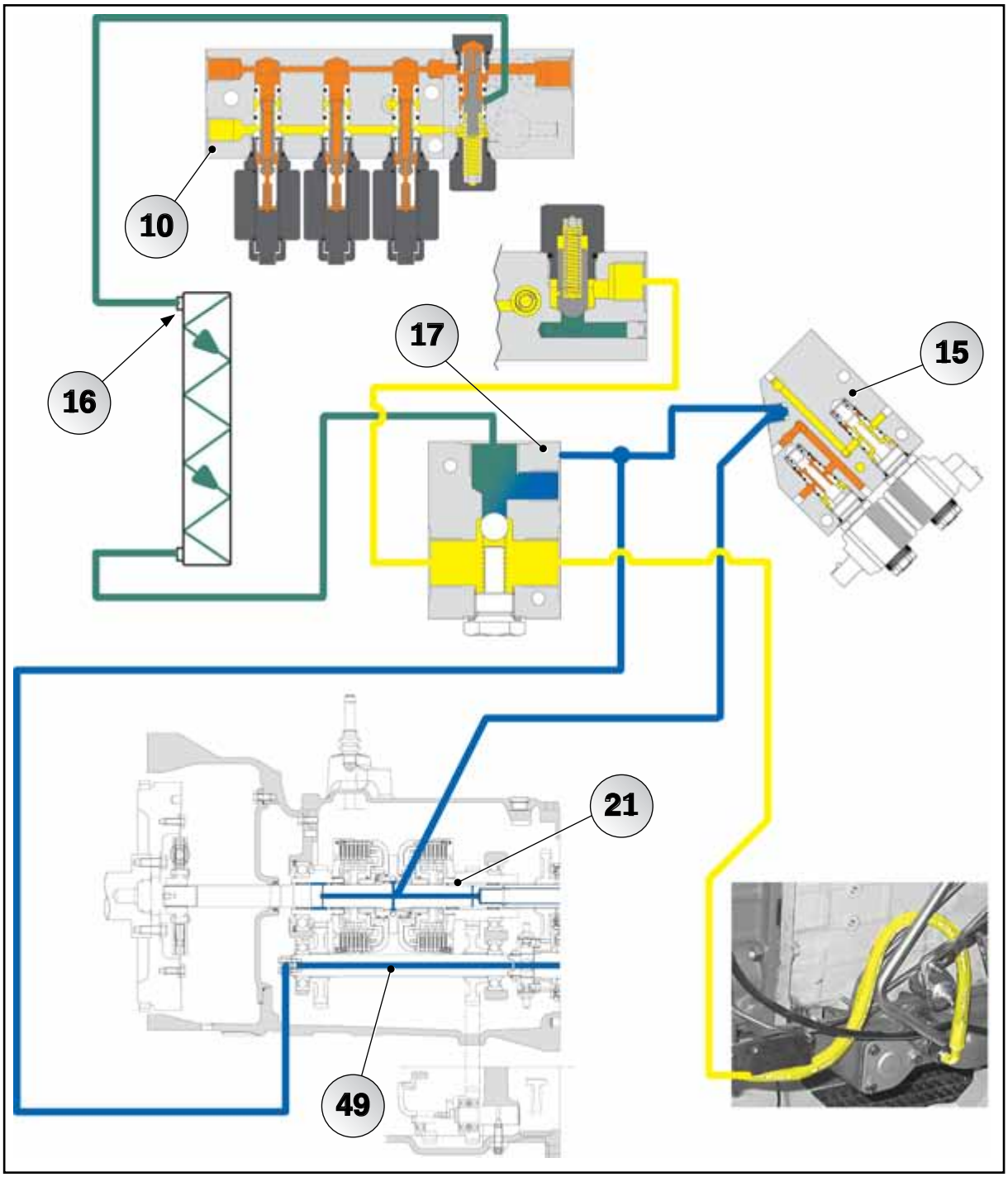


Fig. 7.67

5.4.3 Functional diagram

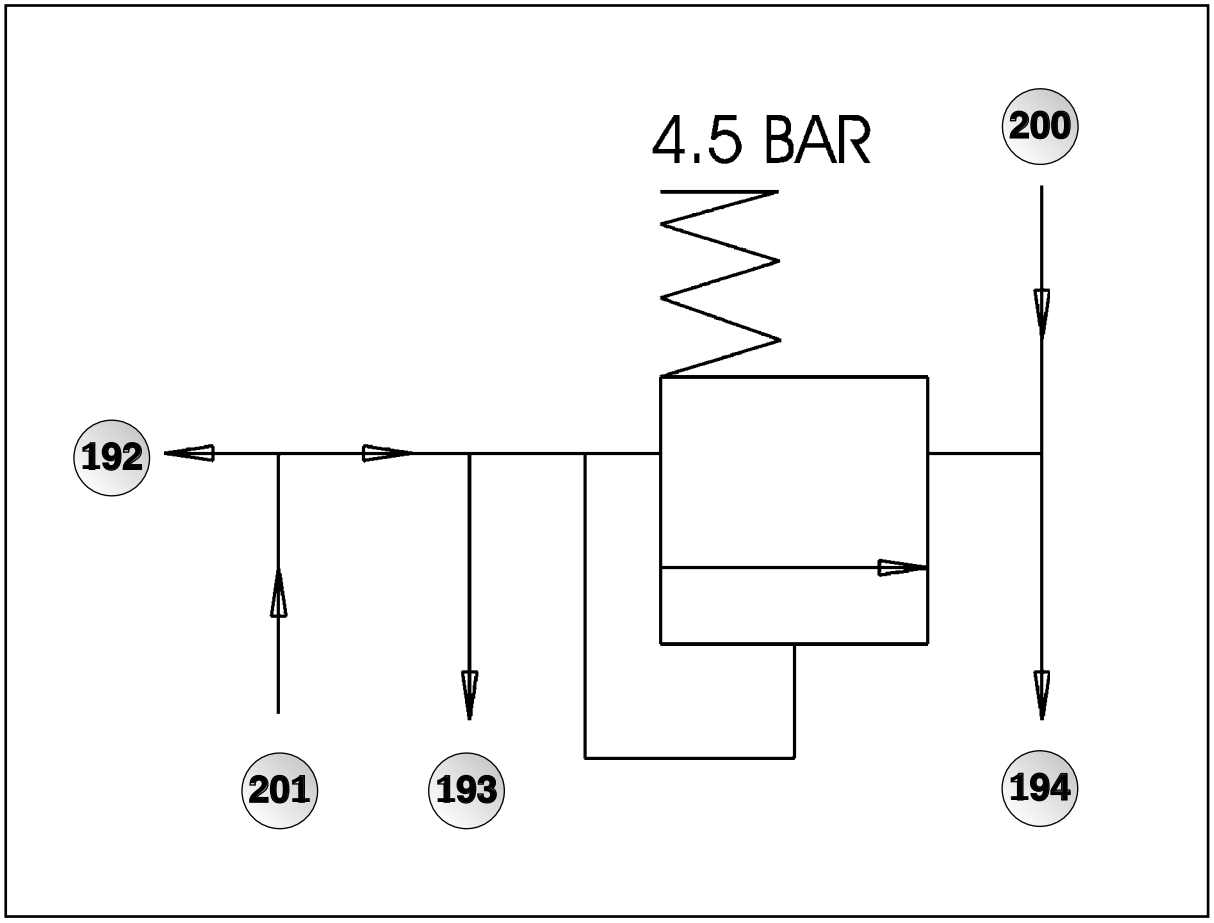


Fig. 7.68

129 - From the oil cooling radiator
193 - Towards engine-gearbox assembly lubrication
194 - Housing discharge
200 - From Sx hydraulic power pack (10)
201 - Towards solenoid valve block (15)

5.5 Block for reverse shuttle solenoid valves and lubrication

5.5.1 Main components and position

The block (15 Fig. 7.69) is located on the right-hand side of the engine-gearbox assembly housing.

The block houses both the proportional solenoid valves (YV1) and (YV2) that control the hydraulic reverse shuttle clutches.

The block (15) also houses the duct (210 Fig.7.70) for lubricating the central clutch unit and the bearings on the clutch shaft.

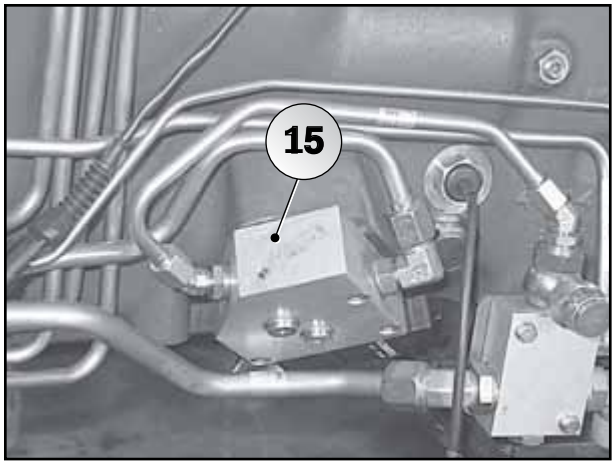


Fig. 7.69

REAR VIEW

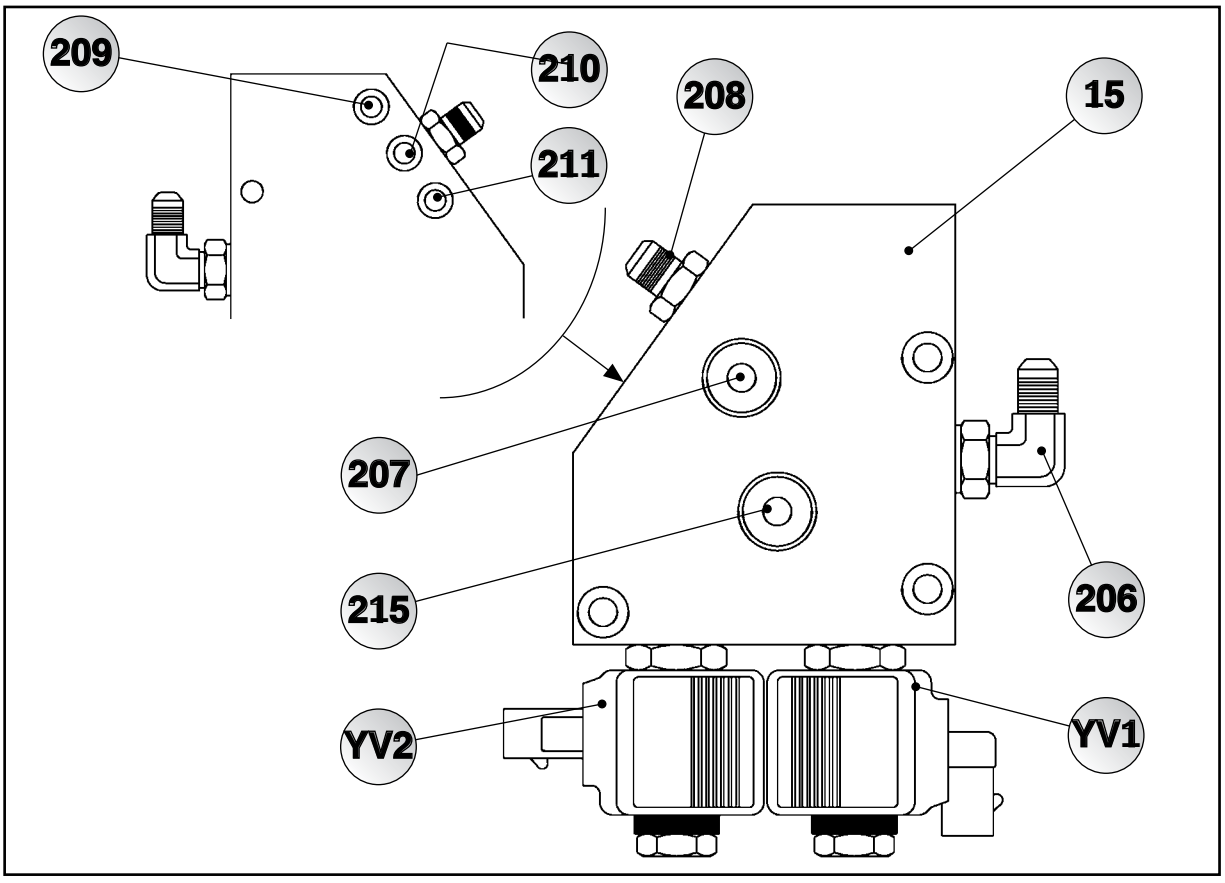


Fig. 7.70

15 - Block for solenoid valves
206 - Supply at 20 bar
207 - Reverse drive pressure sensor plug
208 - Lubrication union
209 - Clutch supply (direct)
210 - Lubrication supply
211 - Reverse gear clutch supply
215 - Forward drive pressure sensor plug
YV2 - Solenoid valve (direct)
YV1 - Solenoid valve (reverse)

5.5.2 Description of operation

5.5.2.1 Secondary clutch supply phase (forward speeds)

Oil flowing in from the power steering control valve (9), at 20 bar pressure, is always present in the duct (212 Fig.7.71) and supplies the two solenoid valves (YV1) and (YV2) at the same time

When the reverse shuttle lever is moved forwards, it energizes the solenoid valve (YV1 Fig.7.70). This allows pressurized oil to flow towards the duct (209), and thus supplies the secondary clutch.

Progressive engagement of the clutch is achieved by the gradual opening of the relative proportional valve, controlled by the electronic power pack.

Oil in the main clutch has 0 bar pressure, as it discharges through the duct (213 Fig.7.71).

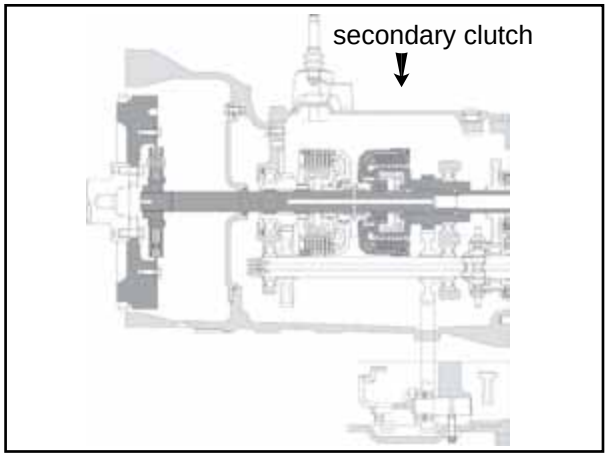


Fig. 7.71

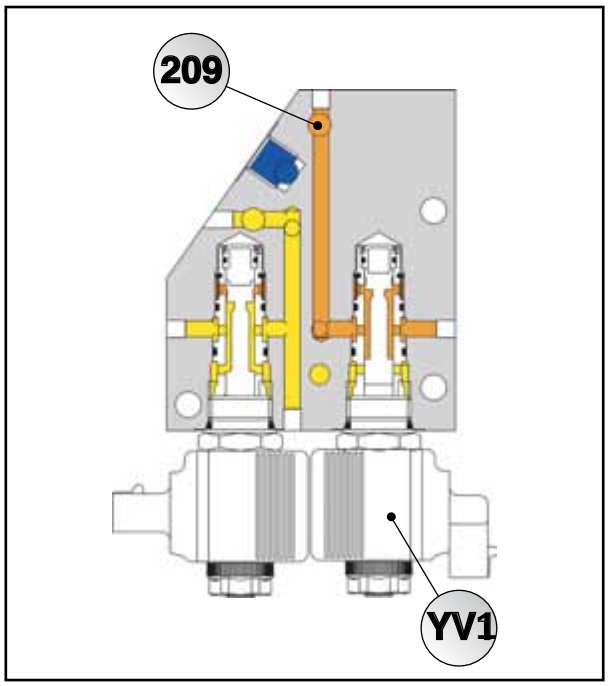


Fig. 7.72

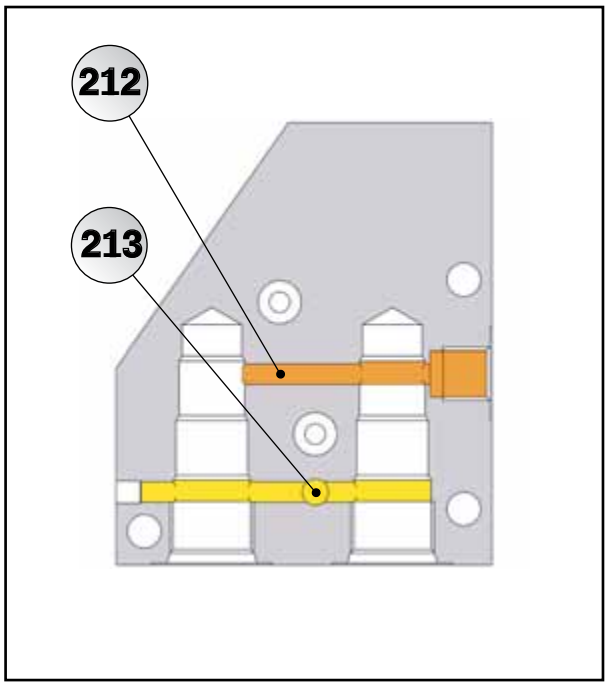


Fig. 7.73

- 20 bar
- 4.5 bar
- 0 bar

5.5.2.2 Main clutch supply phase (reverse speeds)

Oil flowing in from the power steering control valve (9), at 20 bar pressure, is always present in the duct (212 Fig.7.76) and supplies the two solenoid valves (YV1) and (YV2) at the same time

When the reverse shuttle lever is moved back, it energizes the solenoid valve (YV2 Fig.7.75). This allows pressurized oil to flow towards the duct (214), and thus supplies the main clutch.

Progressive engagement of the clutch is achieved by the gradual opening of the relative proportional solenoid valve, controlled by the electronic controller.

Oil in the secondary clutch has 0 bar pressure, as it discharges through the duct (213 Fig.7.76).

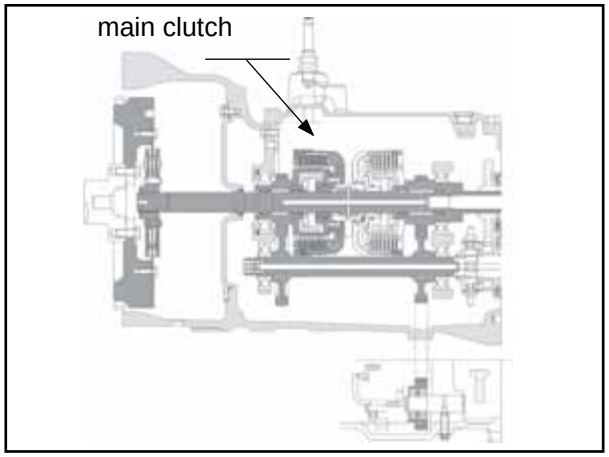


Fig. 7.74

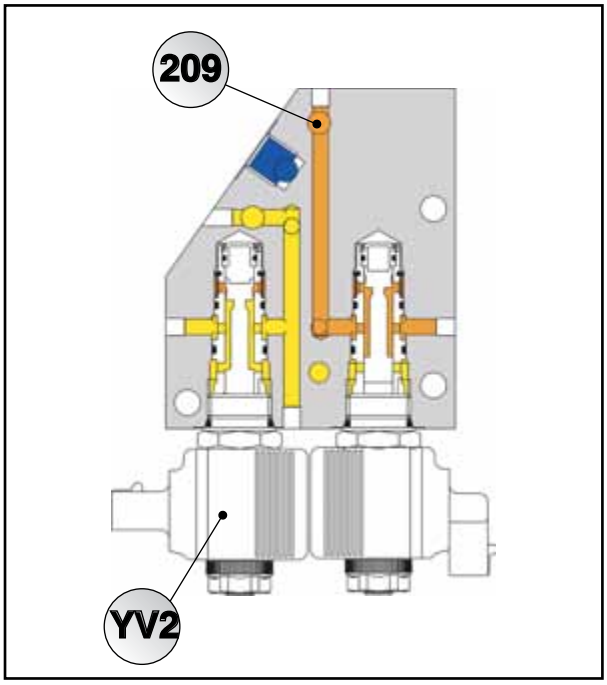


Fig. 7.75

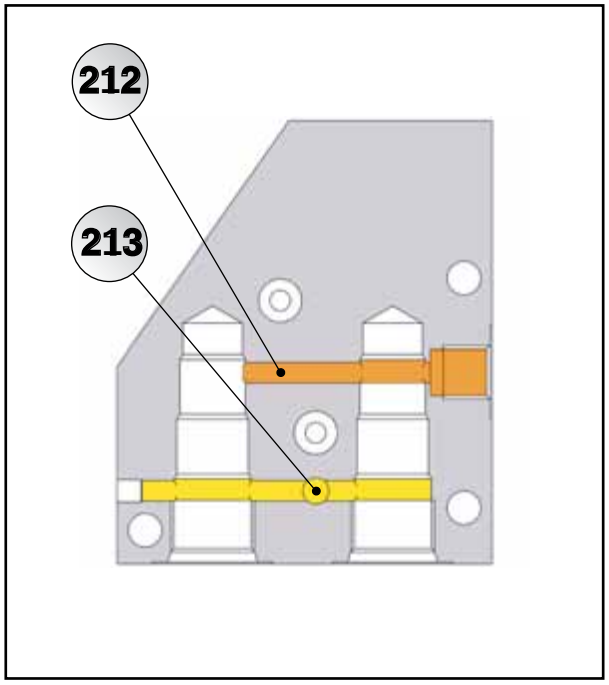


Fig. 7.76

- 20 bar
- 4.5 bar
- 0 bar

5.5.3 Functional diagram

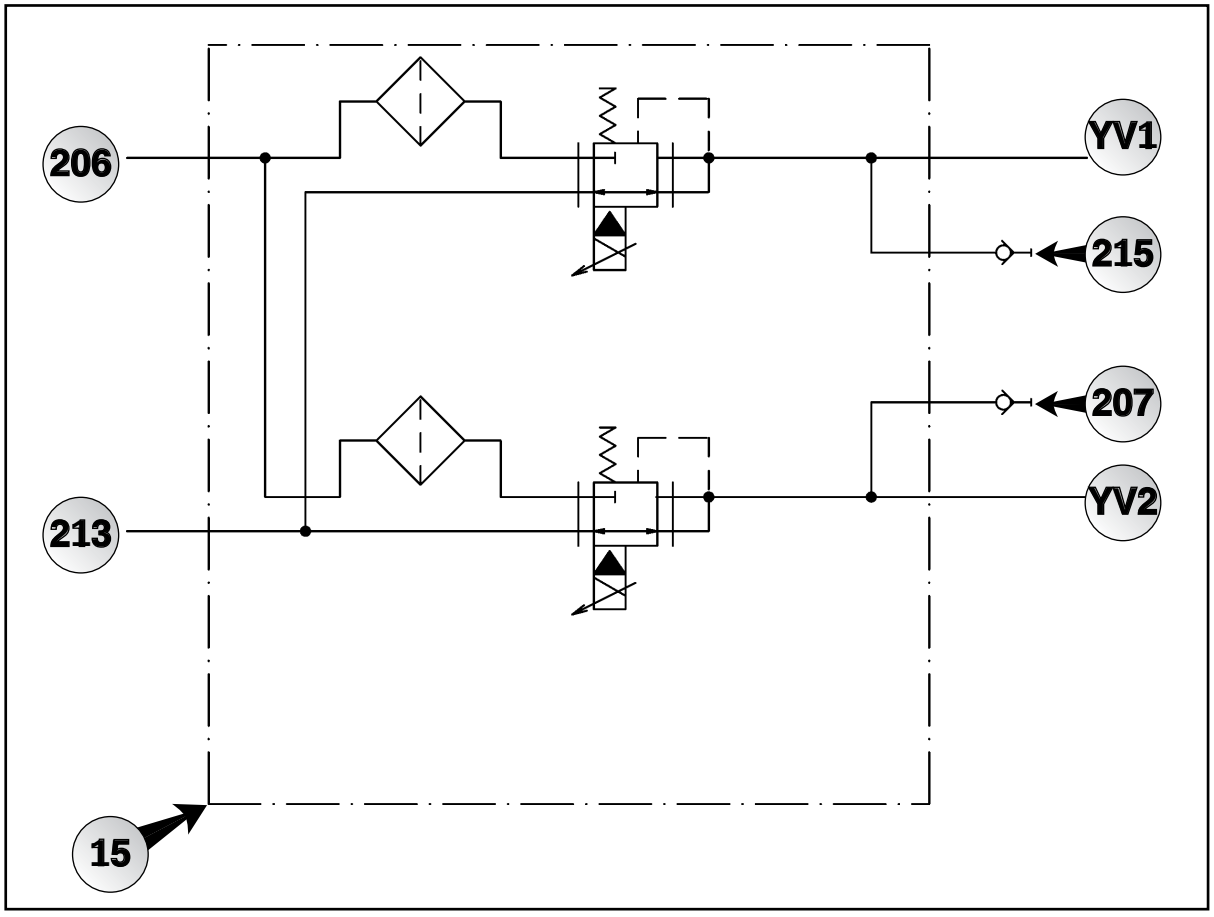


Fig. 7.77

15 - Block housing
206 - Supply at 20 bar
207 - “Reverse drive” pressure sensor plug
213 - “Oil discharge” duct
215 - “Forward drive” pressure sensor plug
YV1 - Solenoid valve (direct)
YV2 - Solenoid valve (reverse)

5.6 Block for PTO solenoid valves and brake unit

5.6.1 General description and position

The block (31 Fig. 7.1) is located on the left-hand side of the gearbox housing, just above the side final drive, near the switches of the rear PTO speed indicators.

This valve block includes two solenoid valves, one of the ON/OFF type (YV8) to control the PTO brake unit, and one of proportional type (YV9) to control the PTO clutch (Fig.7.80).

This valve block allows the electronic power pack to progressively and proportionally engage and disengage the PTO, by piloting the gradual movement of the plunger of solenoid valve (YV9).

The valve block (31) is supplied with oil discharged by the steering control valve (9 Fig.7.7) via the hydraulic power pack (10 Fig.7.7).

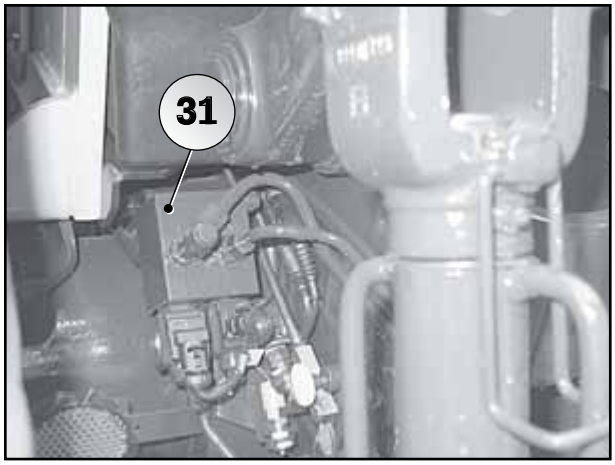


Fig. 7.78

Rear view

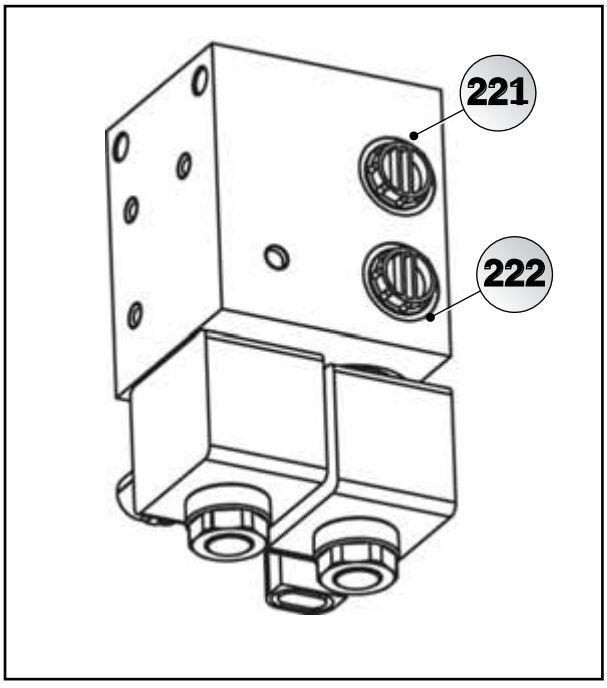


Fig. 7.79

221 - From power pack (10)
222 - Towards discharge outlet

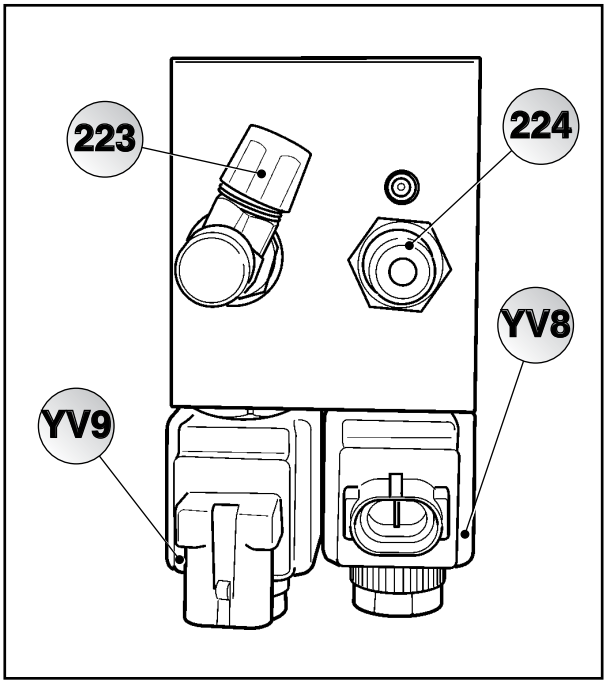


Fig. 7.80

223 - Towards PTO clutch
225 - Towards PTO brake

5.6.2 Description of operation

PTO disengaged and brake engaged

In this phase (Fig.7.83), oil flowing in from the power steering (221) enters the block (31) through the chamber (225). The de-energized solenoid valve (YV9) closes the passage of the pressurized oil flow to the chamber (223), thus shutting off the supply to the PTO clutch. The chamber (223) communicates with the chamber (226), which is connected to the discharge outlet (222).

The solenoid valve (YV8), on the other hand, allows the pressurized oil (20 bar) to flow toward the chamber (227), and supplies the PTO brake.

Solenoid valve (YV8) 0 V = brake engaged

Solenoid valve (YV9) 0 V = PTO disengaged

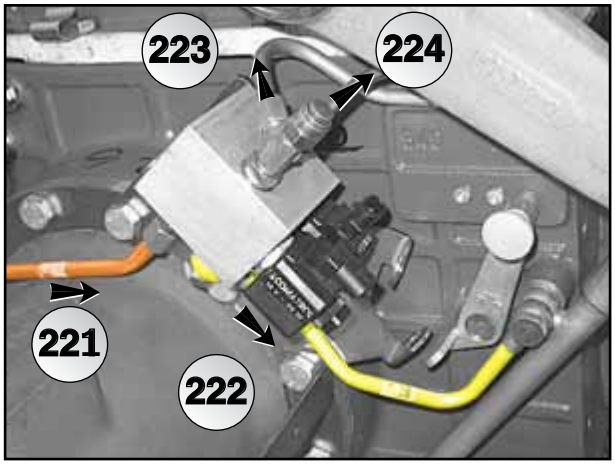


Fig. 7.81

221 - From power pack (10)
222 - Towards discharge outlet
223 - Towards PTO clutch
224 - Towards PTO brake

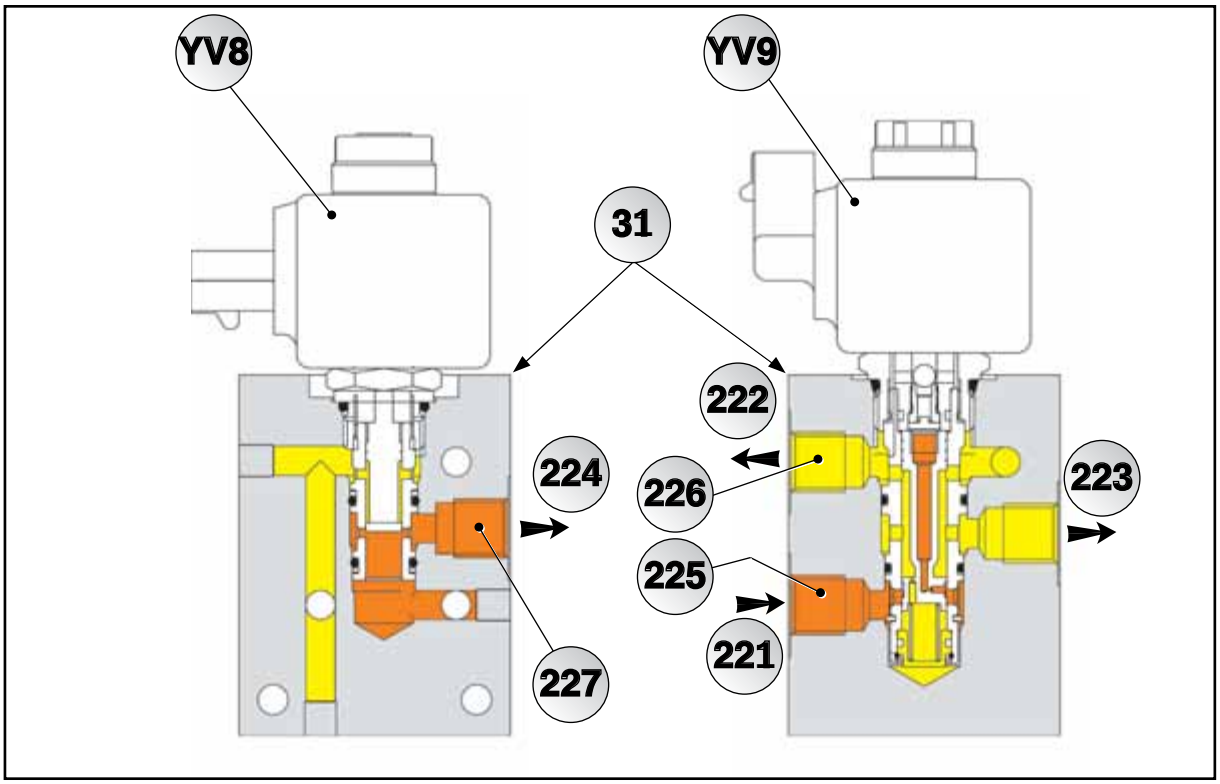


Fig. 7.82

PTO disengaged and brake engaged

In this phase (Fig.7.84), oil flowing in from the power steering (221) enters the block (31) through the chamber (225). The energized solenoid valve (YV9) opens the passage of the pressurized oil flow (20 bar) to the chamber (223), thus supplying the PTO clutch. The gradual movement of the plunger (228) is controlled by the electronic power unit and provides smooth and progressive engagement of the PTO clutch.

The solenoid valve (YV8), also energized, shuts off the flow of pressurized oil to the chamber (227) and prevents the PTO brake from being supplied.

Solenoid valve (YV8) 12 V = brake disengaged

Solenoid valve (YV9) 12 V = PTO engaged

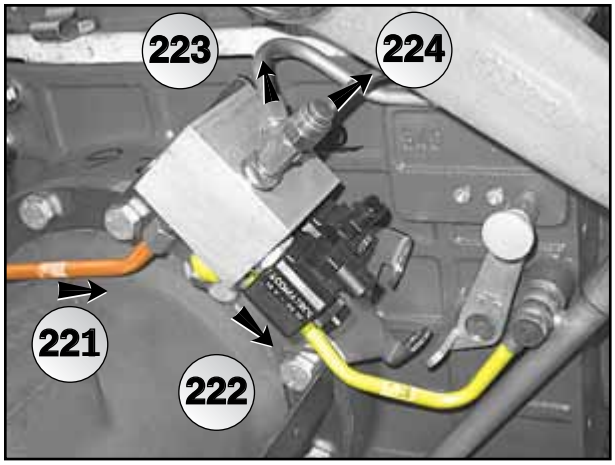


Fig. 7.83

221 - From power pack (10)
222 - Towards discharge outlet
223 - Towards PTO clutch
224 - Towards PTO brake

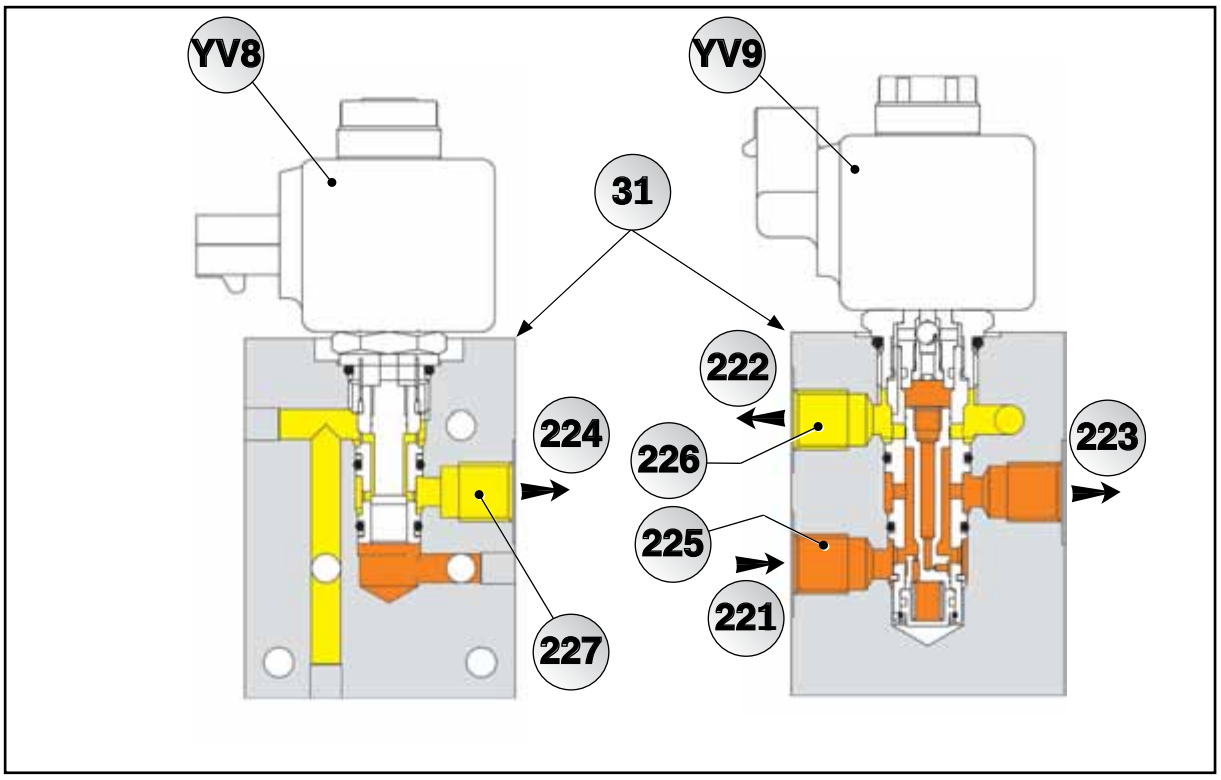


Fig. 7.84

5.6.3 Functional diagram

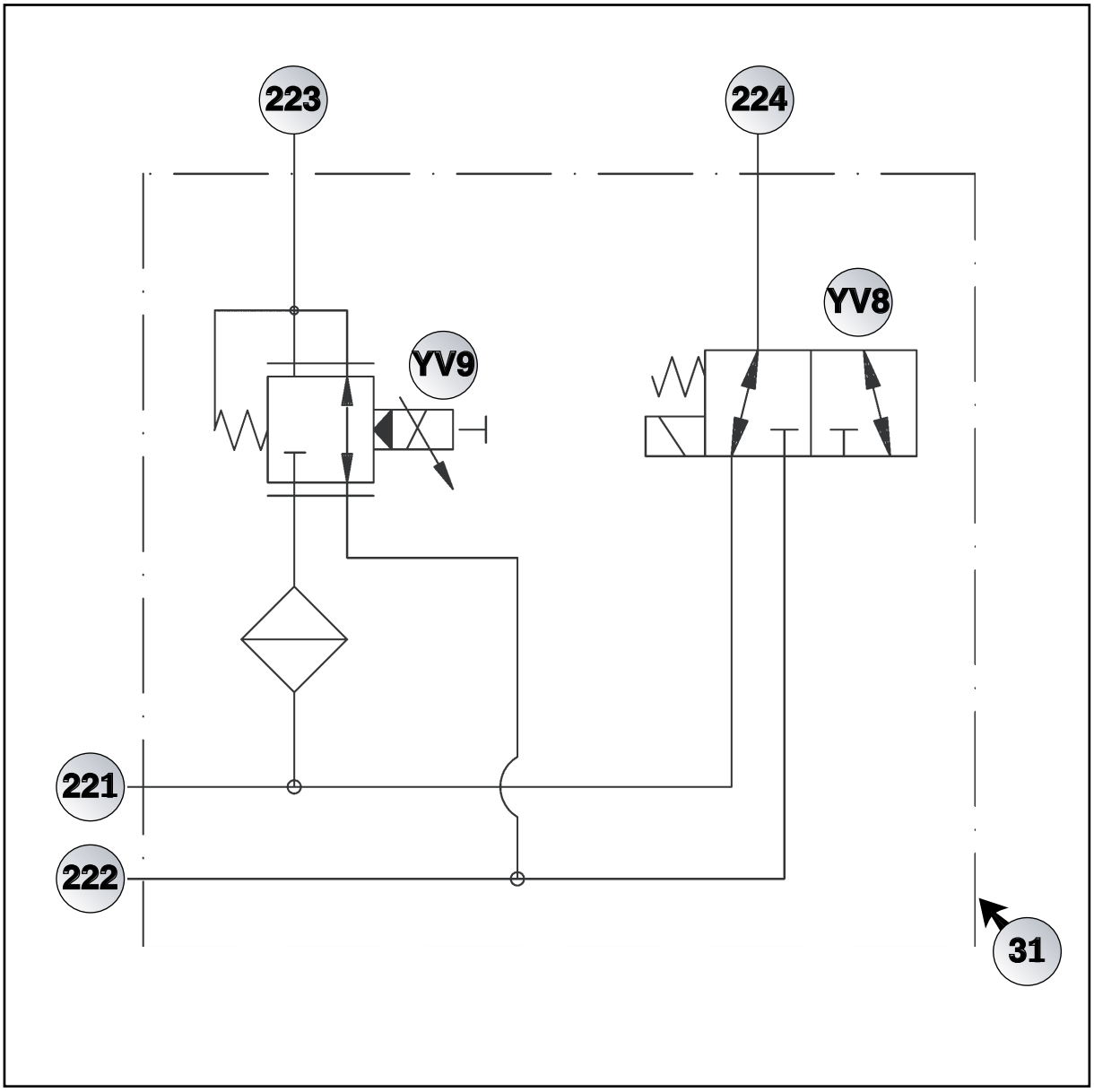


Fig. 7.85

31 - Solenoid valve block
221 - From hydraulic power pack (10)
222 - Towards discharge outlet
223 - Towards PTO clutch
224 - Towards PTO brake
YV8 - ON/OFF solenoid valve for brake
YV9 - Proportional solenoid valve for PTO clutch

5.7 Servo clutch valve system (Speed Five version)

5.7.1 General description and position

The block (8 Fig. 7.86) is located on the left-hand side of the engine block, just under the bonnet, near the front of the platform. In the Speed Five version, this control valve is provided with two solenoid valves of the ON/OFF type to control the differential lock (YV3) and the four-wheel drive (YV4). This control is achieved by means of buttons (SB8) and (SA11) on the right-hand side of the platform (Fig.7.87).

This valve block also includes a “servo-control” for the rear PTO. This type of servo-assisted manual control allows the PTO clutch to engage in the modulated mode. The connection between the rod (463) and the control lever (Q) installed just under the steering wheel comprises a steel cable (Fig.7.88)

Note: Speed Four versions (2WD) have a block (8) without solenoid valve (YV4), which is replaced by a plug.

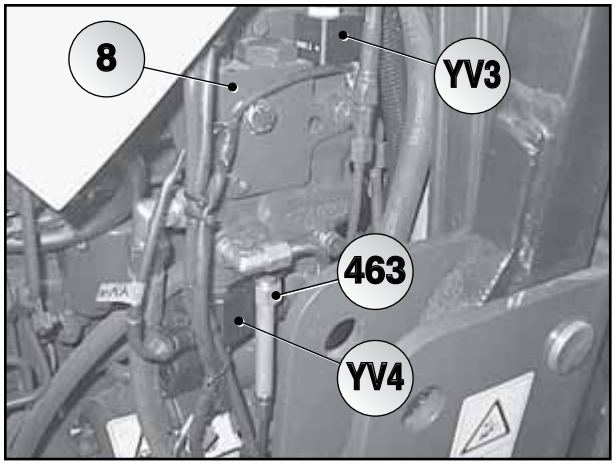


Fig. 7.86

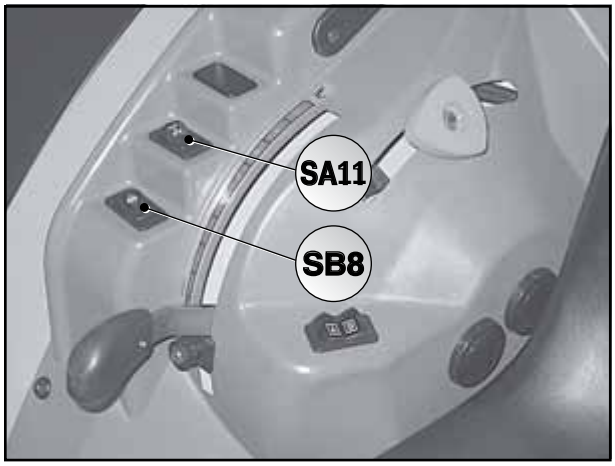


Fig. 7.87

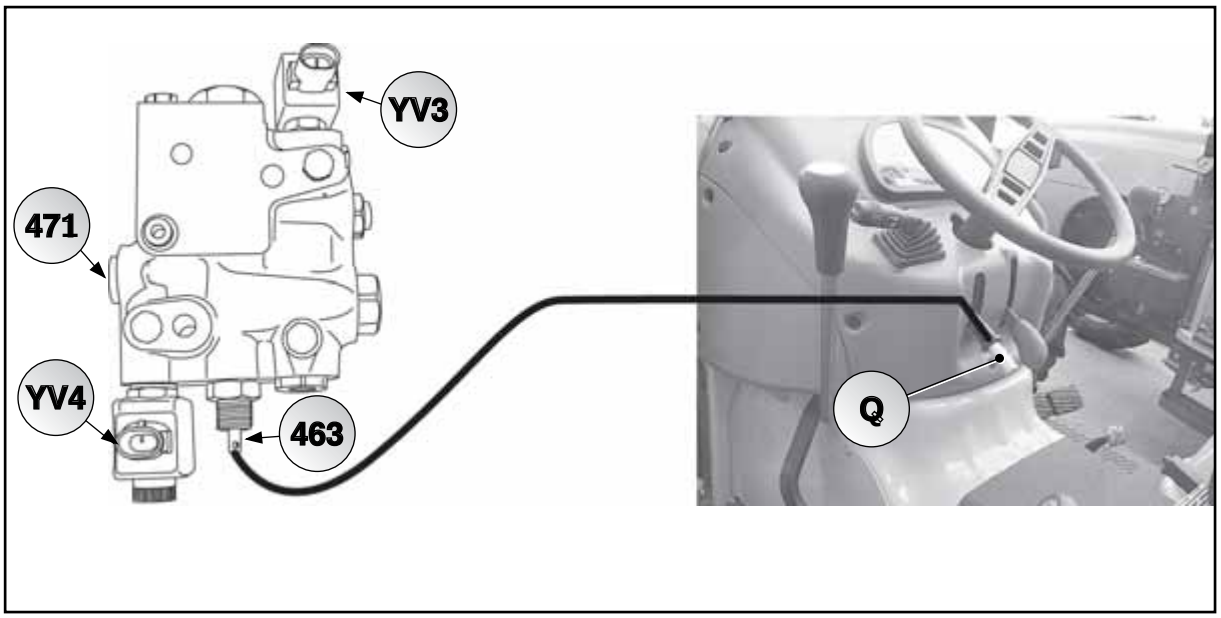


Fig. 7.88

5.7.2 Main components

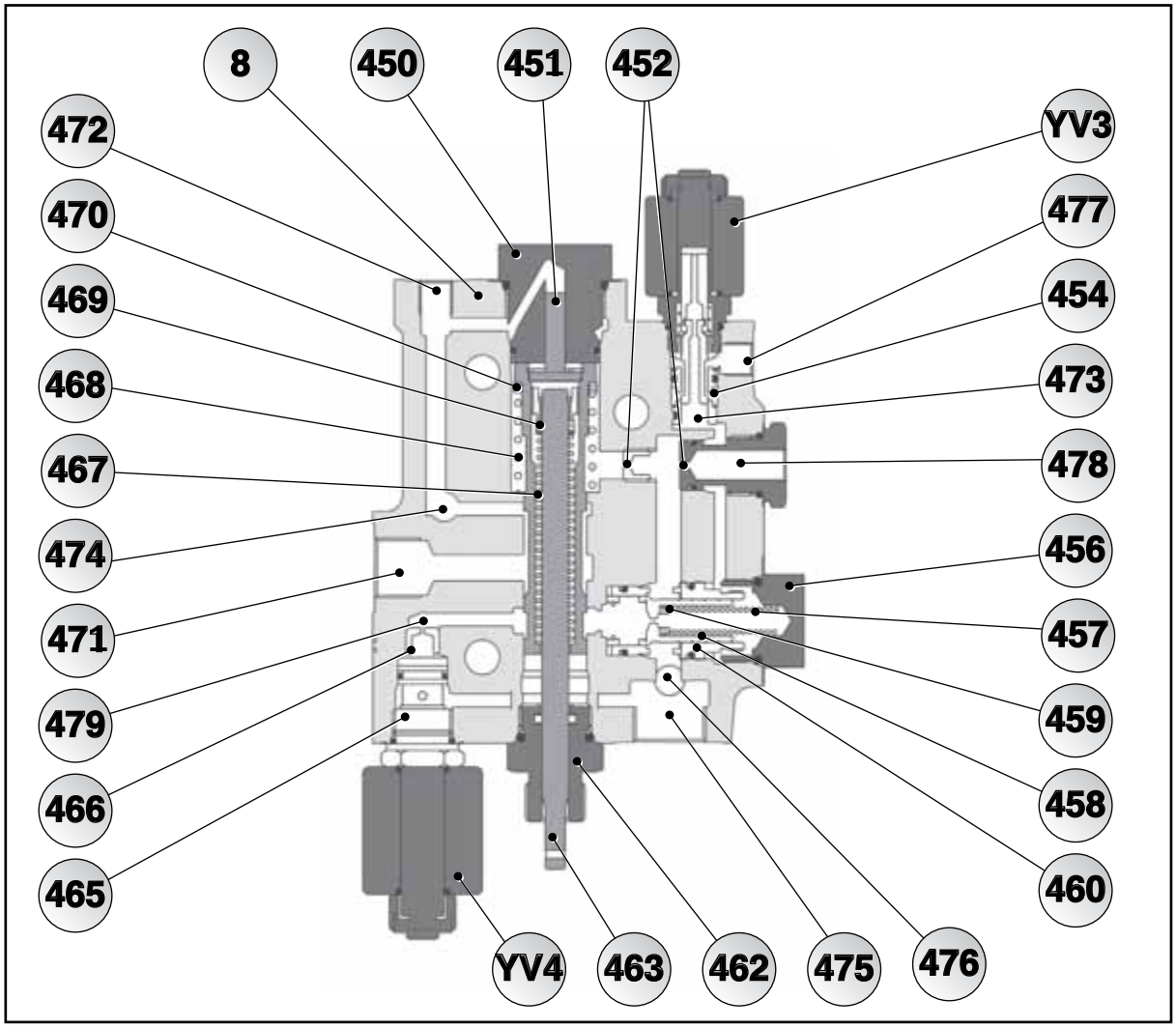


Fig. 7.89

450 - Pilot plunger carrier plug
451 - Pin
452 - Throttles
458 - Valve system casing
454 - Diff lock solenoid valve housing
456 - 18-bar control valve housing plug
457 - 18-bar valve spring
458 - 18-bar valve plunger
459 - 18-bar valve adjustment shims
460 - 18-bar control valve housing
462 - Rod guide plug
463 - Control valve control rod
465 - Spring-on solenoid valve housing
466 - Throttle
467 - Spring for PTO clutch engagement/disengagement modulation
468 - 30-bar adjustment spring
469 - Modulation adjustment shims
470 - 30-bar valve adjustment shims
474 - 18/30-bar pressure tap
473 - Oil supply to diff locks
471 - Oil flowing in from Orbitrol unit
472 - PTO disengagement cylinder oil supply
475 - Orbitrol discharge duct
476 - PTO cylinder return
477 - Differential lock return
478 - Gearbox lubrication
479 - 4WD disengagement oil supply
YV4 - Diff lock solenoid valve
YV4 - Spring-on solenoid valve

5.7.3 Operating phases

Phase with engaged PTO, disengaged diff lock and engaged 4WD

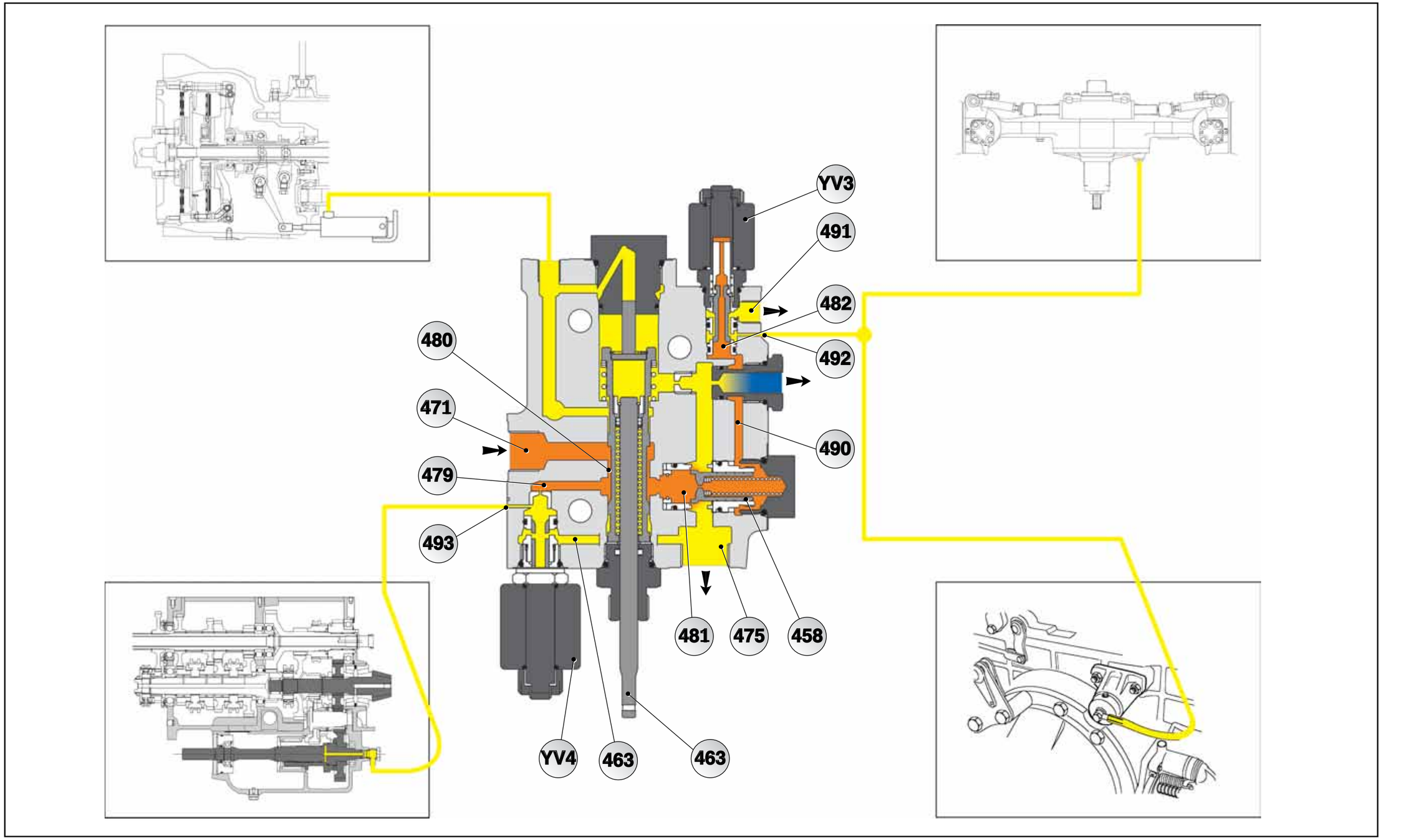


Fig. 7.90

In this phase, the rod (463) is pulled out of the control valve by the lever (Q Fig.7.91) and both solenoid valves are de-energized.

Oil from the Orbitrol unit enters the control valve through the hole (471) and, through the race (480), enters the chamber (481). Once a pressure of **18 bar** is reached, it displaces the plunger (458) and flows to the outlet (475). As the solenoid valve (YV3) is de-energized, the chamber (482) supplied by the duct (490) remains at 18 bar, whilst the supply duct of the diff locks (492) is in communication with the outlet (491). Since is is de-energized, the solenoid valve (YV4) also allows the oil in the Spring-On supply duct (493) to flow towards the outlet (489), while the duct (479) maintains an 18-bar pressure.

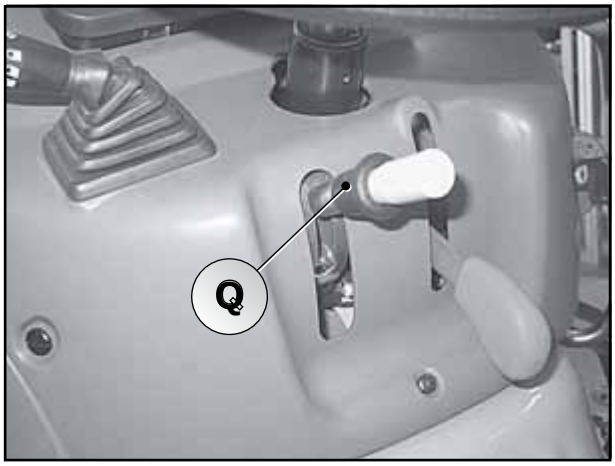


Fig. 7.91

Fig. 7.92

Phase with PTO clutch engaged, diff lock engaged and 4WD engaged

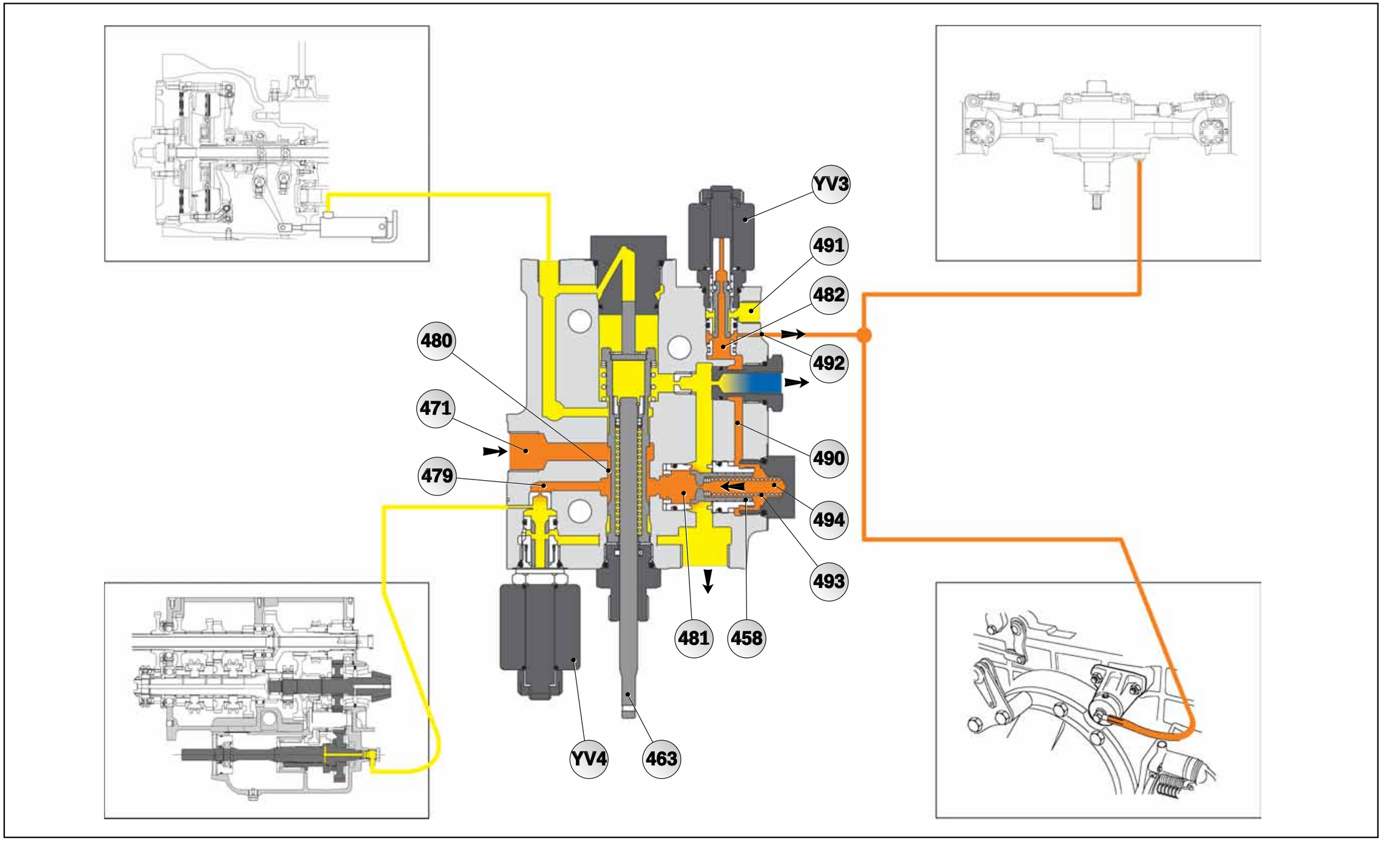


Fig. 7.93

In this phase, the rod (463) is pulled out of the control valve by the lever (Q Fig.7.94), the solenoid valve of the Differential Lock (YV3) is energized thanks to use of the button (SB8 Fig.7.95) and that of the Spring-On is not energized.

Oil from the Orbitrol enters the control valve through hole (471) and, through the race (480), enters the chamber (481), flows through the calibrated hole (493), supplies the chamber (494), the duct (490), the chamber (482) and, through the hole (492), the front and rear diff locks at a pressure of **18 bar**. As it is not energized, the solenoid valve (YV4) also allows the oil in the Spring-On supply duct (493) to flow towards the outlet (489), while the duct (479) maintains a pressure of **18 bar**.

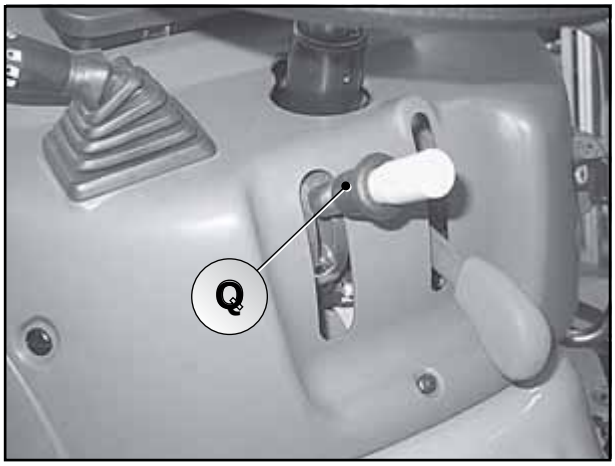


Fig. 7.94

Fig. 7.95

Phase with PTO clutch engaged, diff lock engaged and 4WD disengaged

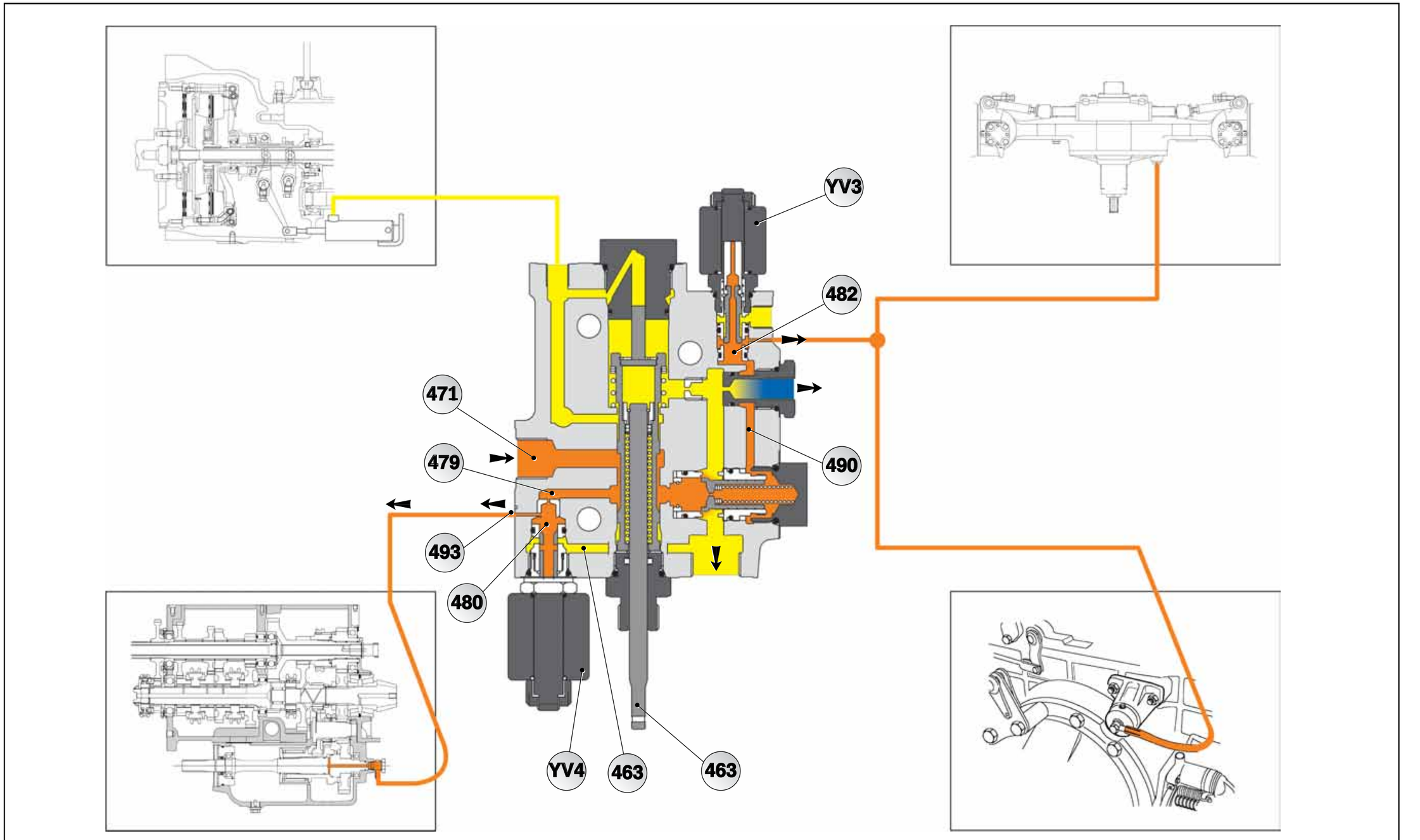


Fig. 7.96

In this phase, the rod (463) is pulled out of the control valve by the lever (Q Fig.7.97) and the two solenoid valves are energized thanks to use of the two buttons (SB8 and SA11 Fig.7.98).

Oil from the Orbitrol unit enters the control valve through the hole (471) and, through the race (480), enters the chamber (481), flows through the calibrated hole (493), supplies the chamber (496), the duct (490), the chamber (482) and the front and rear diff locks at a pressure of **18 bar**. As the solenoid valve (YV4) is also energized, the oil in the duct (479) is allowed to flow through the chamber (496), as this no longer communicates with the outlet (489).

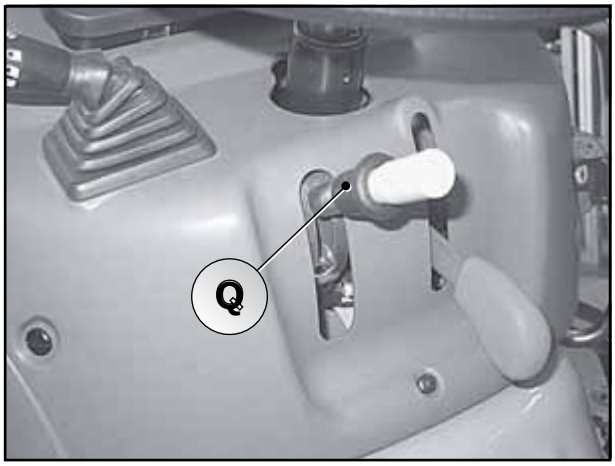


Fig. 7.97

Fig. 7.98

Phase with PTO clutch disengaged, diff lock not engaged and 4WD disengaged

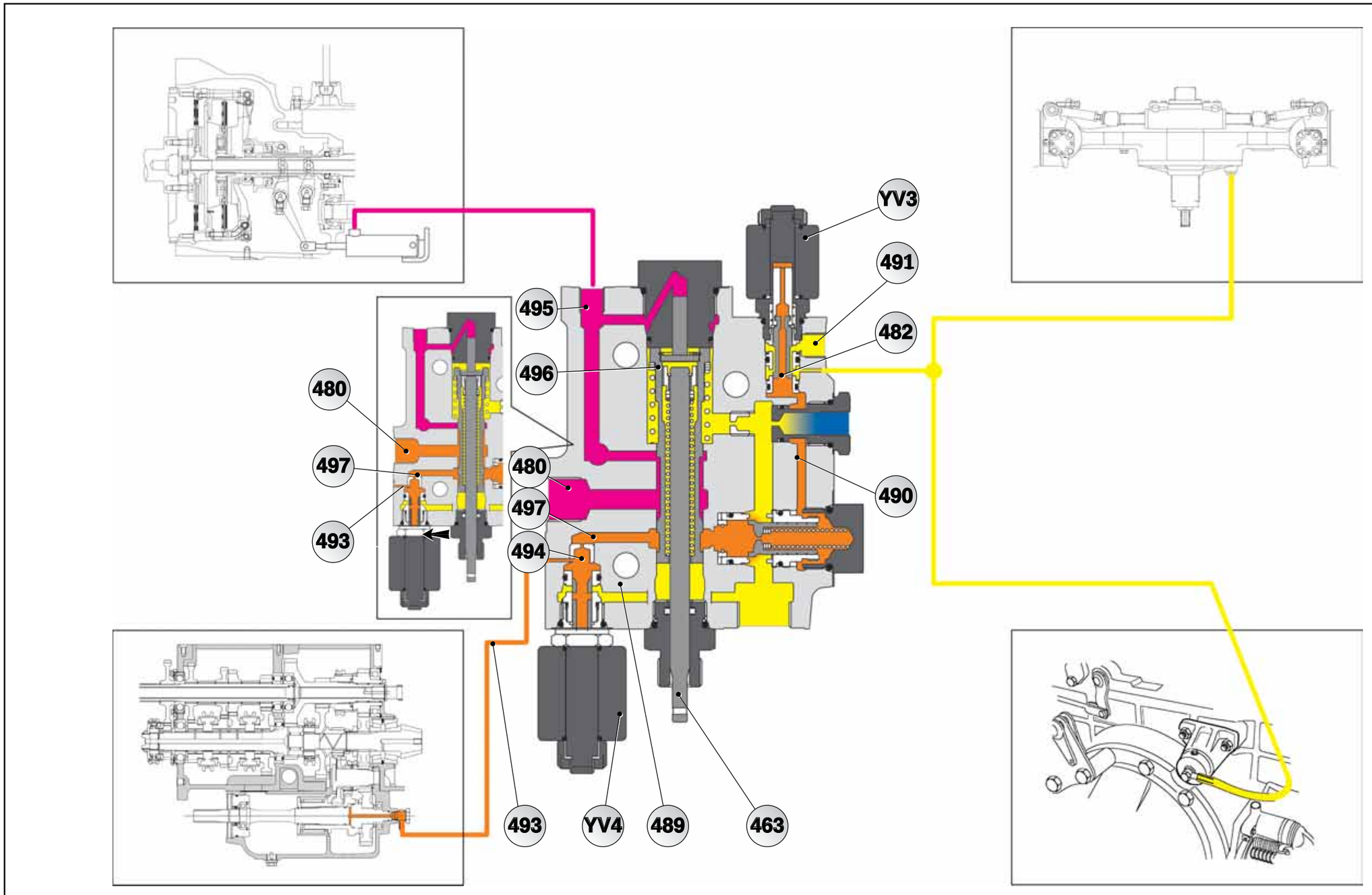


Fig. 7.99

In this phase, the rod (463) is completely inside the control valve, since the lever (Q Fig.7.100) is brought down on the sector. The PTO clutch is disengaged. The solenoid valve of the diff lock (YV3) is de-energized and the Spring-On solenoid valve is energized by the activation of the two buttons (SA11 Fig.7.101).

Oil from the Orbitrol unit enters the control valve through the hole (480) and, through the race (495), feeds the power clutch cylinder that disengages the PTO clutch. (496).

Once a pressure of **30 bar**has been reached, the clutch disengages and the oil pressure on the pin (451) pushes the plunger (497) downwards, thus opening the communication between the hole (480) and the duct (479 Fig.7.99).

Since the soenoid valve (YV3) is not energized, the chamber (482) supplied by the duct (490) remains at **18 bar**, while the duct that supplies the locks (492) communicates with the outlet (491).

The solenoid valve (YV4) is energized, thus oil from the duct (479) can feed the Spring-On unit through the chamber (496), as this no longer communicates with the outlet (489).

Fig. 7.100

Fig. 7.101

Phase with rod (q) in PTO clutch engagement modulation mode, diff lock not engaged and 4WD disengaged

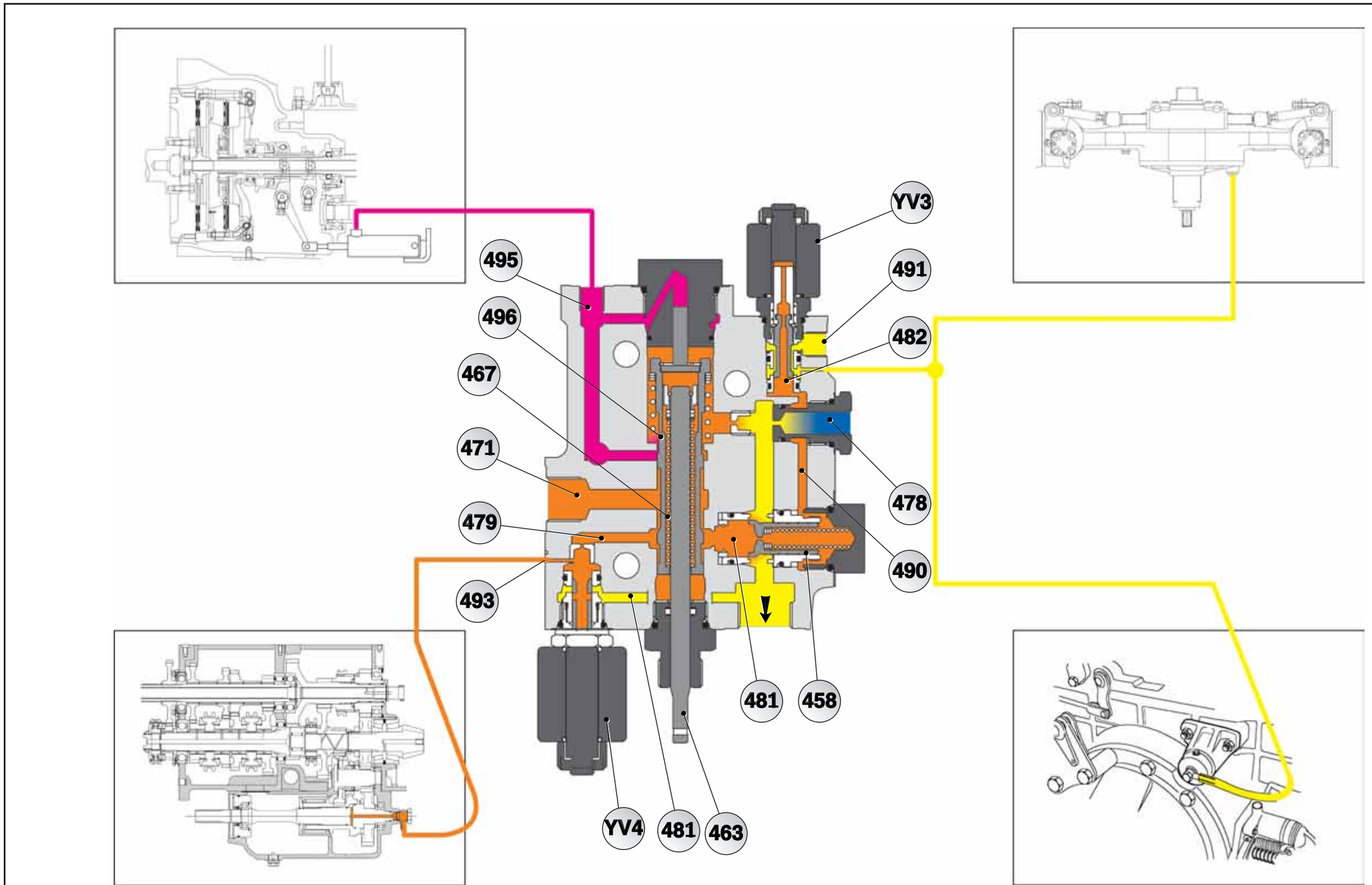


Fig. 7.102

In this phase the lever (Q) is gently raised to engage the power take-off.

The rod (464) is pulled out of the control valve and its gradual displacement compresses the modulation spring (467) that gradually displaces the piston (497), thus opening the communication of the duct (495) with the chamber (497), which communicates with the outlet (478).

The oil in the power clutch cylinder gradually flows out and the PTO clutch begins to engage. When the lever (Q) is first moved, pressure quickly goes from 30 to 17 bar, then slowly decreases to 9 bar and then quickly again to **0 bar**. In this condition, oil flowing to the control valve through the hole (471) enters the duct (479) and the chamber (481) and, when an **18 bar**pressure is reached, displaces the plunger (458) and flows to the outlet, while maintaining an 18 bar pressure in ducts (479) and (490).

Since the soenoid valve (YV3) is not energized, the chamber (482) supplied by the duct (490) remains at **18 bar**, while the duct that supplies the locks (492) communicates with the outlet (491).

The solenoid valve (YV4) is energized, thus oil from the duct (479) can feed the Spring-On unit through the chamber (493), as this no longer communicates with the outlet (489).

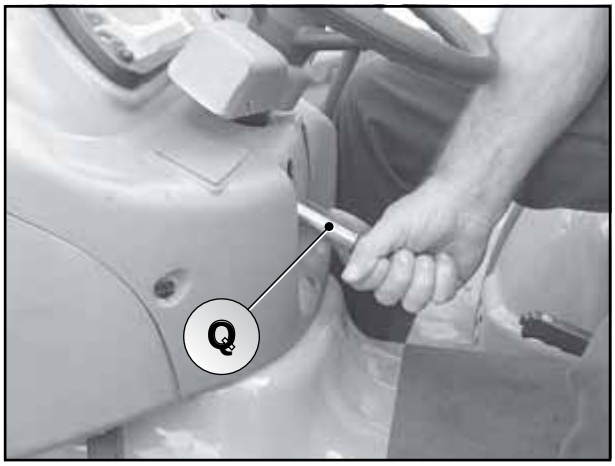


Fig. 7.103

Fig. 7.104

5.8 Adjustments

The following adjustments are to be made to the power clutch valve system:

- **30 bar valve calibration**
- **Checking and adjusting the PTO engagement modulation**
- **18 bar valve calibration**

30 bar valve calibration

1 - Assemble tool **122 IDR GL** instead of plug (474) and install the pressure gauge (Fig.7.105).

2 - Start the tractor engine and accelerate to about **900/1000 RPM** with the oil at about **30-40°**.

3 - The calibration pressure of the PTO clutch disengagement valve spring must be **30±2bar**.

4 - To correct the setting, add or remove shims (470 Fig.7.106); **1mm** of shims change the pressure by about **2 bar**.

Checking and adjusting the PTO engagement modulation

1 - Assemble tool **122 IDR GL** instead of plug (474) and install the pressure gauge (Fig.7.105).

2 - Start the tractor engine and accelerate to about **900/1000 RPM** with the oil at about **30-40°**.

3 - Slowly operate the lever (Q Fig.7.103) while reading on the gauge the oil pressure at the precise moment the lever is shifted; the pressure should quickly drop to about **17 bar**. When the lever is moved further, the pressure should gradually decrease to about **9 bar**. Once this pressure has been reached and continuing to move the lever, the oil pressure should quickly drop to 0 bar (Fig.7.108).

4 - The beginning and, consequently, the end of this PTO engagement modulating phase can be corrected by adding or removing shims (269 Fig.7.107 /7.109). In any case, it must have an interval of **8 bar**; **1mm** of shims change the pressure by about **1/1.5 bar**. Add shims to lower the modulation starting point.

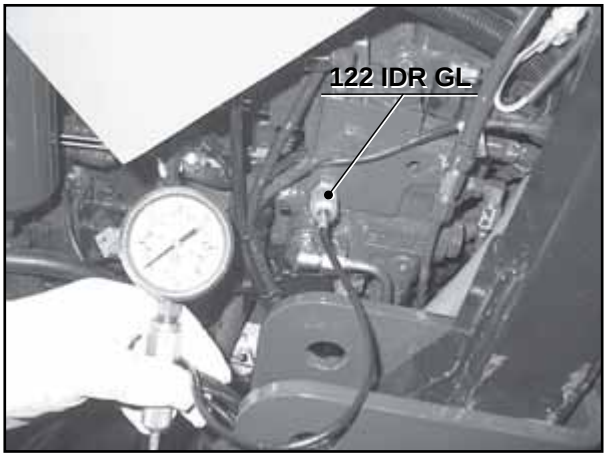


Fig. 7.105

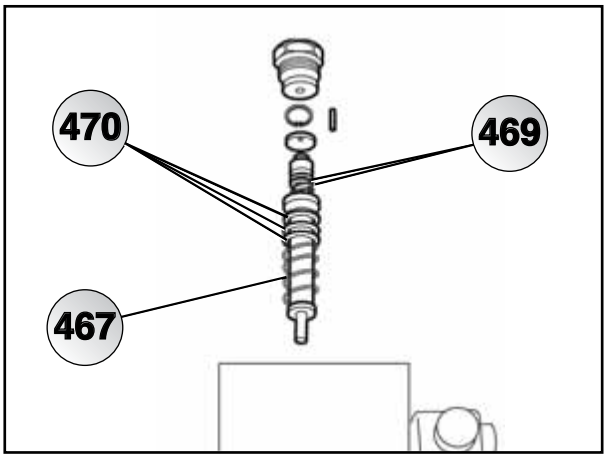


Fig. 7.106

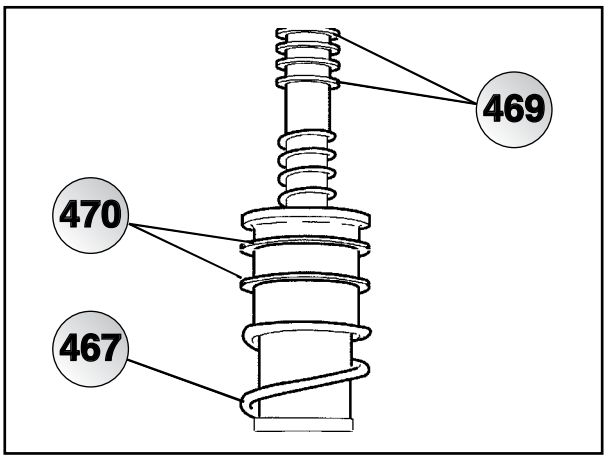


Fig. 7.107

18 bar valve calibration

1 - Assemble tool **125 IDR GL** instead of plug (474) and install the pressure gauge (Fig.7.111).

2 - Start the tractor engine and accelerate to about **900/1000 RPM** with the oil at about **30-40°**. Engage the differential lock.

3 - The calibration pressure of the valve (456) should be **18 bar**.

4 - To correct the setting, add or remove shims (459 Fig.7.110); **1mm** of shims change the pressure by about **1/1.5 bar**.

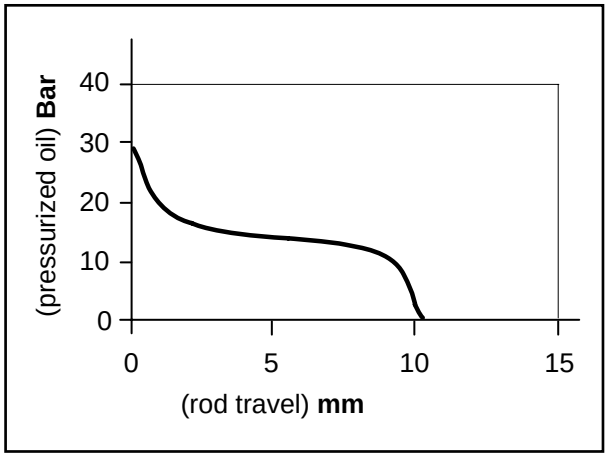


Fig. 7.108

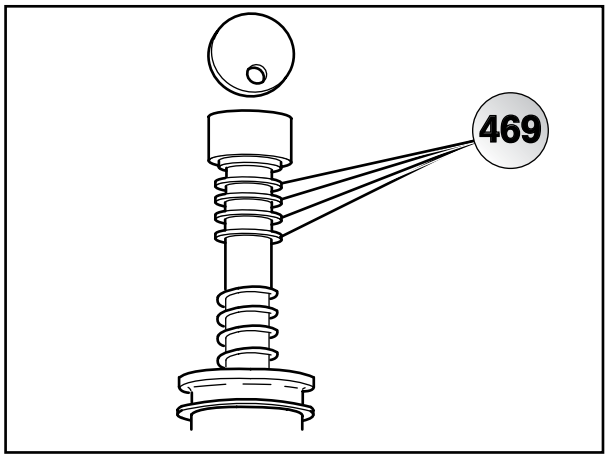


Fig. 7.109

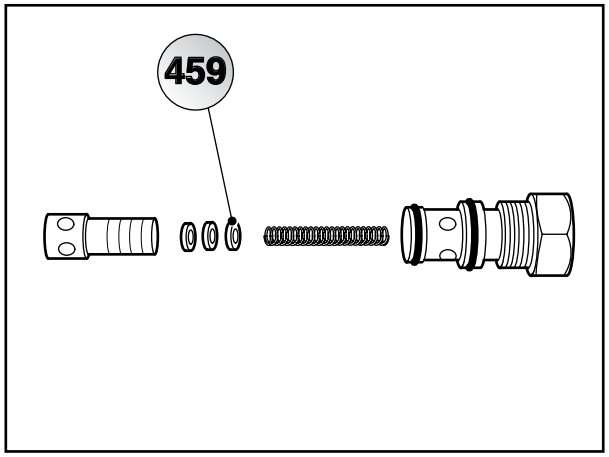


Fig. 7.110

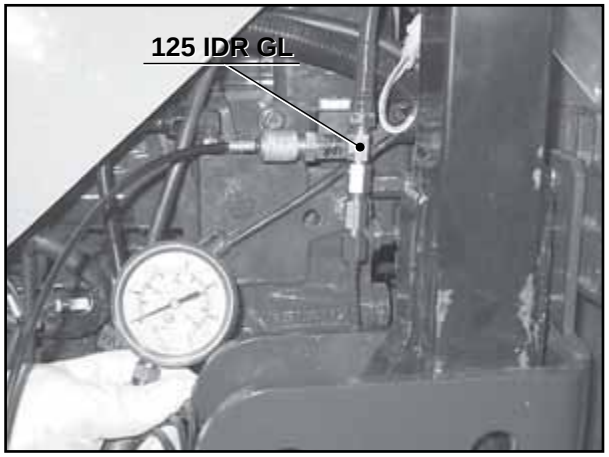


Fig. 7.111

5.9 Hydraulic clutch assemblies (Power Shuttle version)

5.9.1 General description

The hydraulic clutch assemblies of **F-N Series Power Shuttle** tractors are installed on the main shaft. They are housed in the engine-gearbox assembly and transmit drive from the engine, to the gearbox shafts depending. Moreover, they completely do away with the classic main clutch.

They are hydraulically supplied, at a pressure of **20 bar**, by a power pack (15 Fig. 7.112) on which two proportional solenoid valves are installed. These allow oil to gradually flow through so as to progressively engage the clutch assemblies.

The oil that supplies and lubricates the clutch assemblies flows through a hub (15b Fig.7.113) installed in the center of the main clutch and on which the rings are housed.

The clutch assemblies are engaged and disengaged electronically by a control unit which handles Powershuttle operation depending on the electric signals transmitted by the various sensors in the tractor.

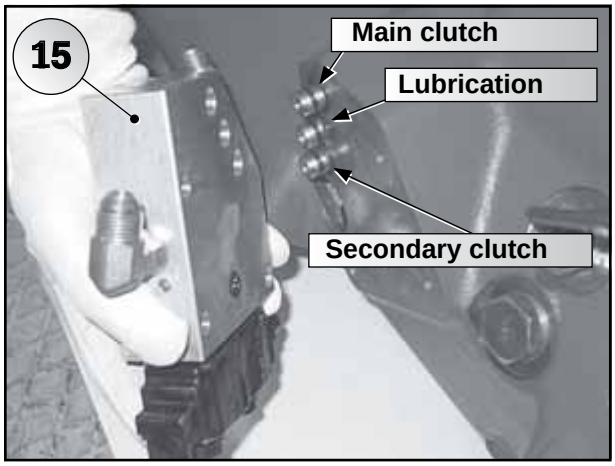


Fig. 7.112

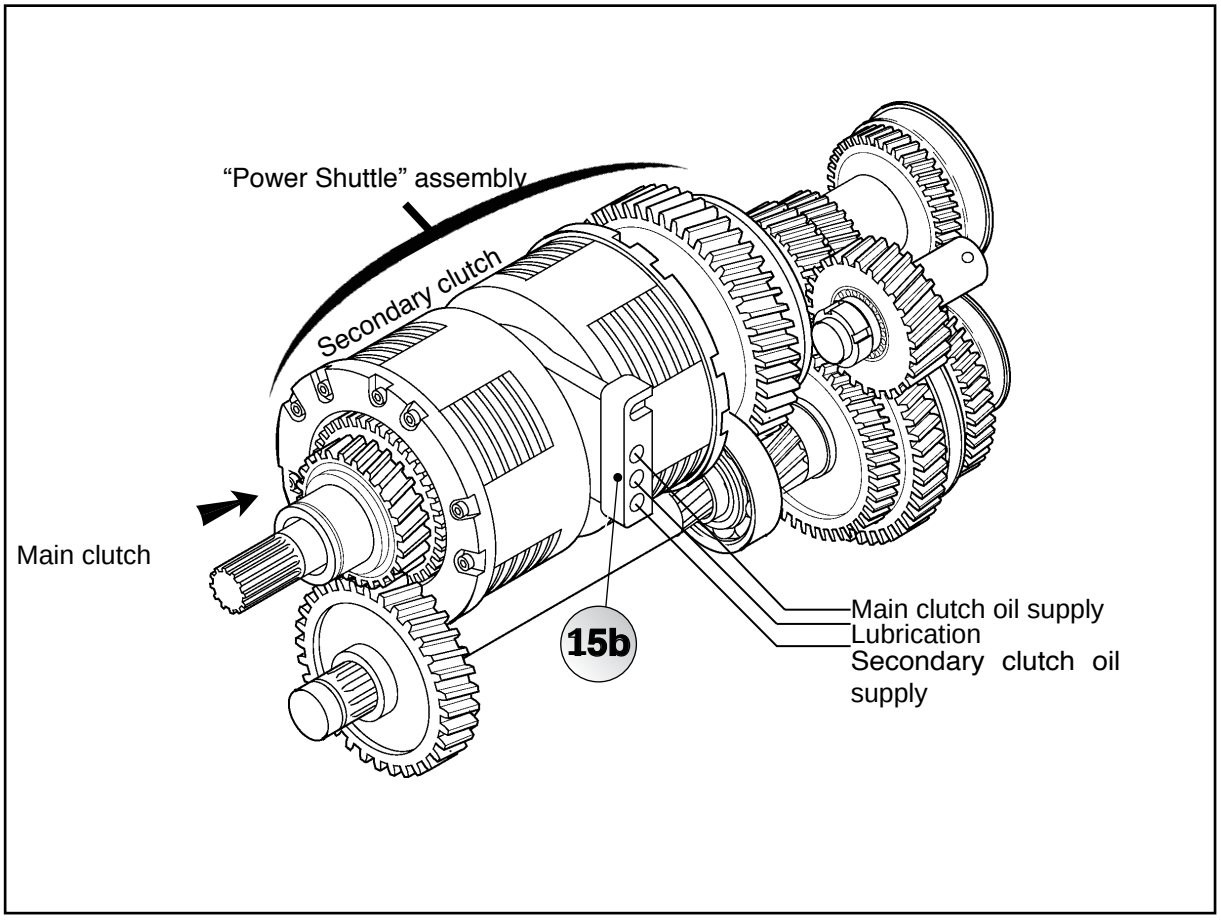


Fig. 7.113

5.9.2 Main components and description of operation

Main clutch oil supply

After having checked the tractor's operating conditions, the electronic power pack (D02) transmits an electric signal to pilot the solenoid valves mounted on the power pack (15), opening and shutting off the oil supply to the main and secondary clutch assemblies. In the situation shown in Fig.7.114, valve (YV2) allows oil at a pressure of 20 bar to flow towards the main clutch, thus engaging it gradually.

Meanwhile, valve (YV1) shuts off the oil supply to the secondary clutch and disengages it. The main clutch transmits drive in the operation mode "reverse", the secondary clutch transmits drive in the operation mode "forward".

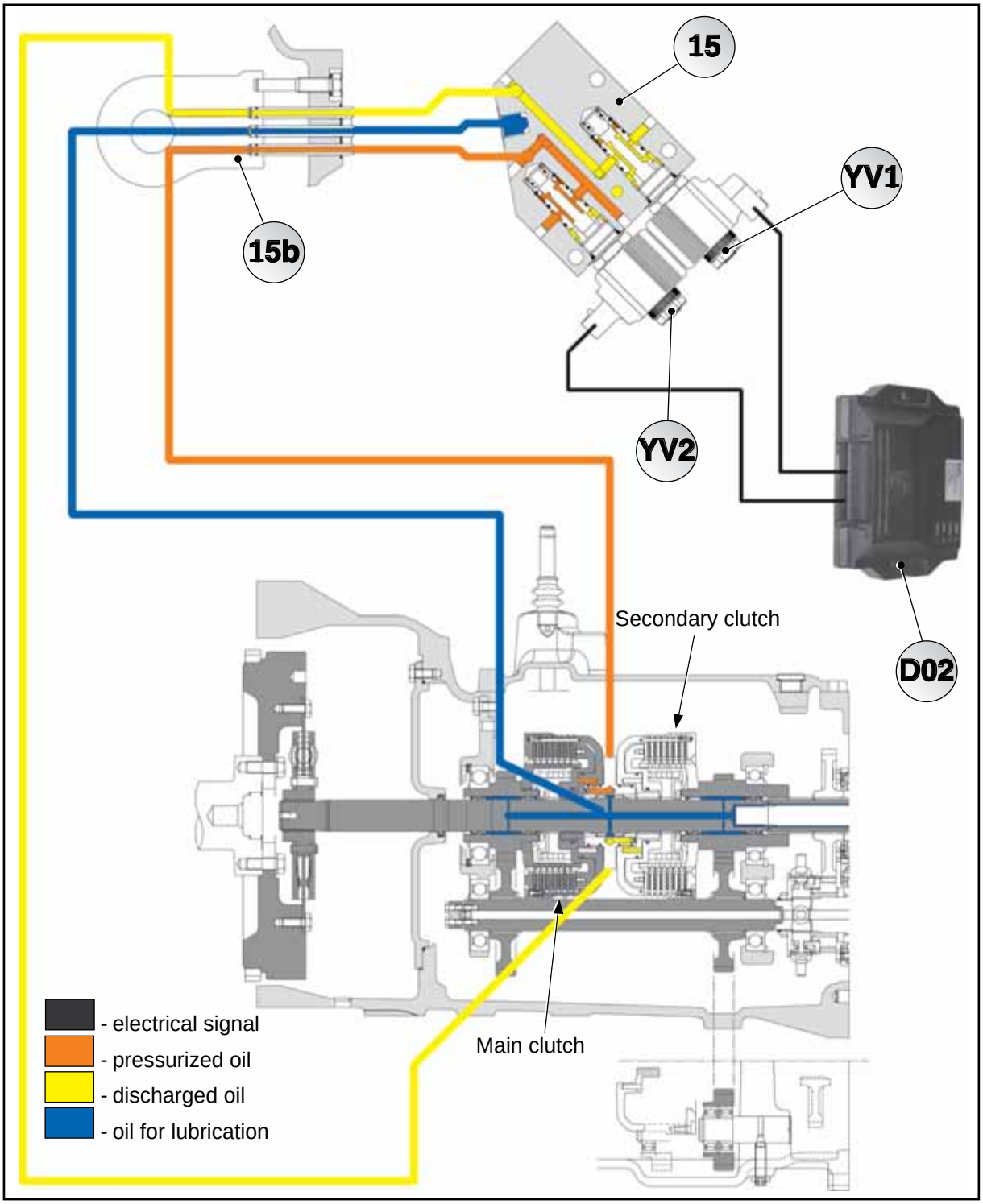


Fig. 7.114

Secondary clutch oil supply

After having checked the tractor's operating conditions, the electronic power pack (D02) transmits an electric signal to pilot the solenoid valves mounted on the power pack (15), opening and shutting off the oil supply to the main and secondary clutch assemblies. In the situation shown in Fig.7.115 , the valve (YV1) allows oil at a pressure of 20 bar to flow towards the secondary clutch, thus engaging it gradually.

Meanwhile, the valve (YV2) shuts off the oil supply to the main clutch and disengages it. The main clutch transmits drive in the operation mode "reverse", the secondary clutch transmits drive in the operation mode "forward".

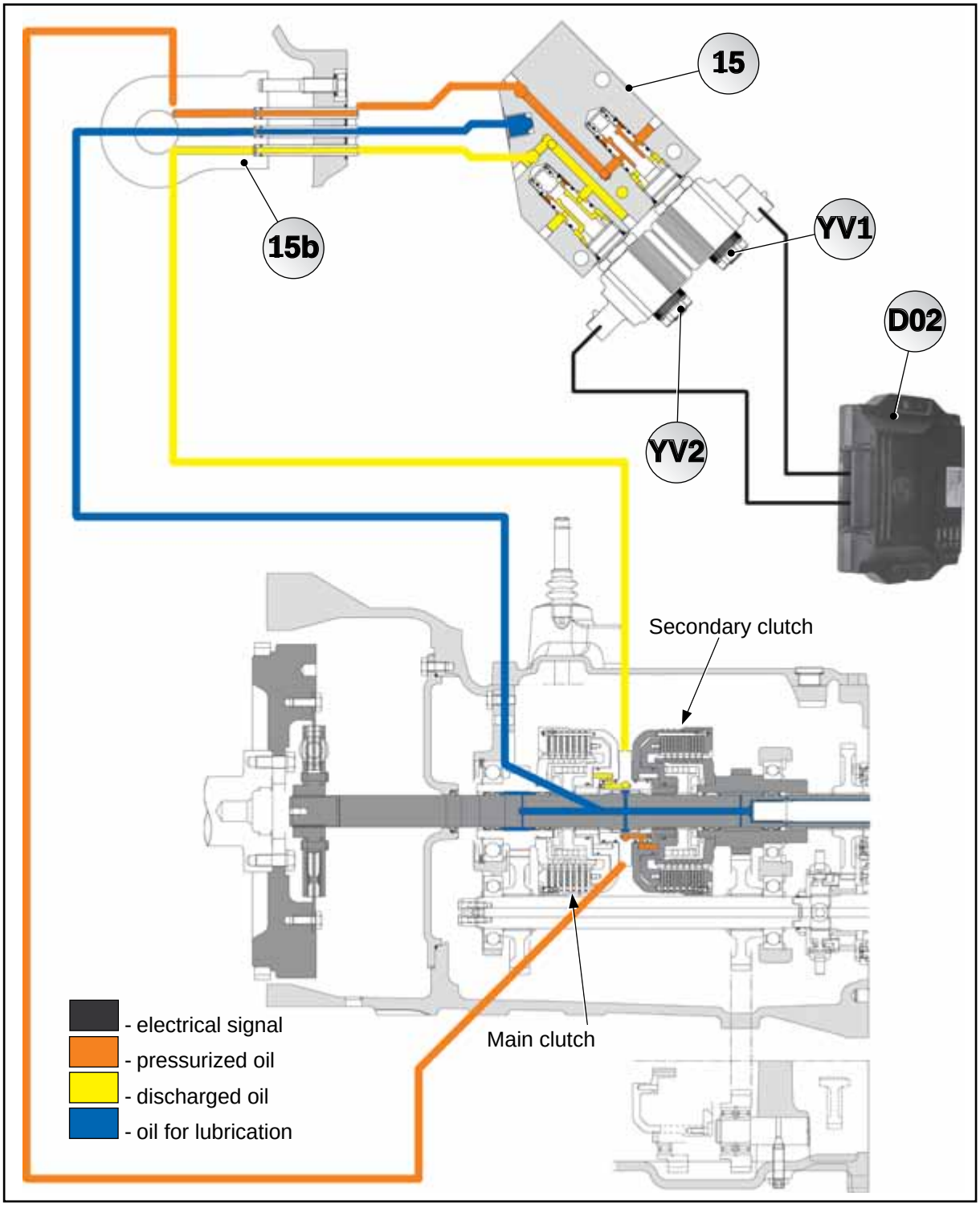


Fig. 7.115

5.10 Front/rear diff lock supply (Power Shuttle version)

5.10.1 Main components

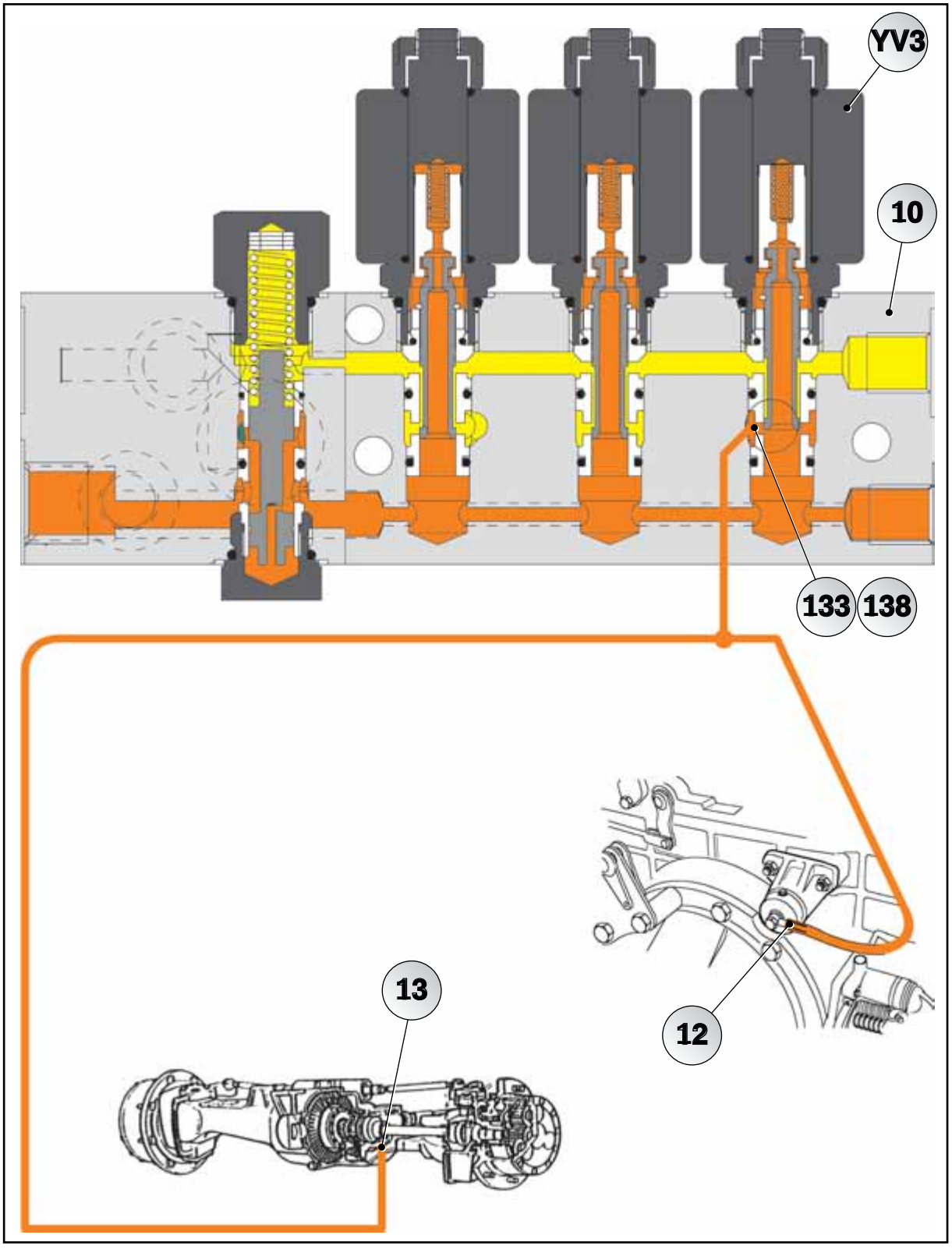


Fig. 7.116

10 - Hydraulic power pack
133/138 - Front/rear diff lock supply
YV3 - Diff lock solenoid valve
12 - Front differential assembly
13 - Rear differential assembly
- pressurized oil
- discharged oil

5.10.2 Description of operation

The front and rear differential locks are mechanically engaged and electrohydraulically controlled. They are engaged by two sliding sleeves operated by two pistons supplied with oil at a pressure of **20 bar**. This occurs when the driver presses the control button (SB3 Fig.7.117) on the right-hand side of the driver's seat, thus energizing the solenoid valve (YV3 Fig.7.117) installed on the hydraulic power pack (10).

Thus energized, the solenoid valve supplies oil to the rear (13) and front (12) diff locks at the same time.

The differential lock is disengaged by pressing the brake pedals, also individually, thus de-energizing the solenoid valve (YV3).

The de-energized solenoid valve shuts off the oil supply and opens the route to the outlet.

Fig. 7.117

5.11 Rear PTO and brake unit supply system (Powershuttle version)

5.11.1 Main components and description

The rear PTO and relative brake are controlled by an electro-hydraulic system. The block (31 Fig. 7.118) installed on the left-hand side of the gearbox housing, just under the side final drive, regulates the oil flow at a pressure of **20 bar** towards the P.T.O. clutch and towards the Brake (Fig.7.121). The solenoid valve (YV8) opens or shuts off the passage of oil flow to the brake. The solenoid valve (YV9) controls the gradual passage of oil to the PTO clutch. This latter is controlled by a proportional solenoid valve. Modulated engagement of the PTO takes place thanks to the progressive movement of the plunger of the solenoid valve (YV9), which is controlled by a current ramp established by the electronic controller (D02).

Progressive engagement of the P.T.O. clutch automatically disengages the relative brake. By transmitting an electric signal to control PTO clutch engagement, the controller (D02) also transmits a signal to solenoid valve (YV8), thus energizing it. Its movement thus shuts off the flow of pressurized oil to the brake. The P.T.O. is engaged by means of the switch (SA2 7.120) on the right-hand side.

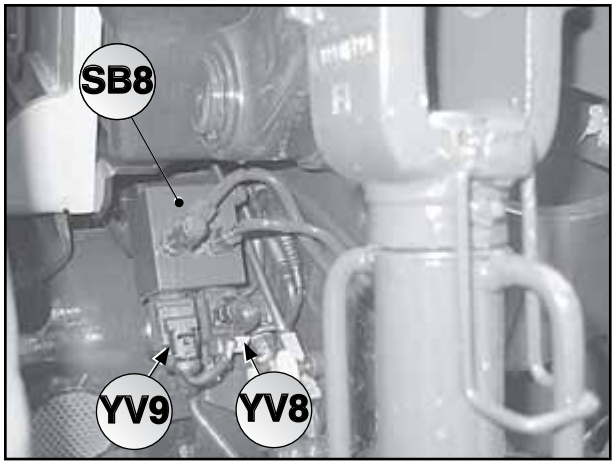


Fig. 7.118

Fig. 7.119

Fig. 7.120

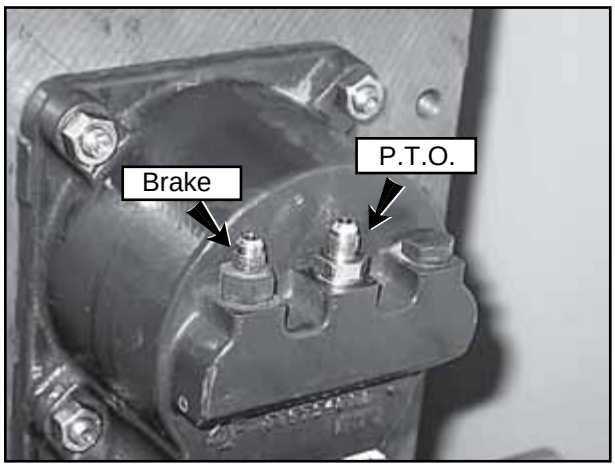


Fig. 7.121

Proportional P.T.O. selection

Selection of the PTO operating mode proportional to the tractor's ground speed by means of the lever (V Fig.7.122) shuts off the oil supplied (20 bar) to the rear brake by energizing the solenoid valve (YV8 Fig.7.123/7.124). The switch (SQ8) (Fig.7.124) linked to the movement of the selector lever (V) transmits an electric signal to the electronic control unit (D02 Fig.7.119), which energizes the solenoid valve that controls the brake.

Solenoid valve (YV8) 12 V = brake disengaged

The energized solenoid valve (YV8) thus shuts off the flow of pressurized oil at 20 bar to the brake pistons. Thus, the PTO shaft is free to turn at a speed rate proportional to the tractor's ground speed.

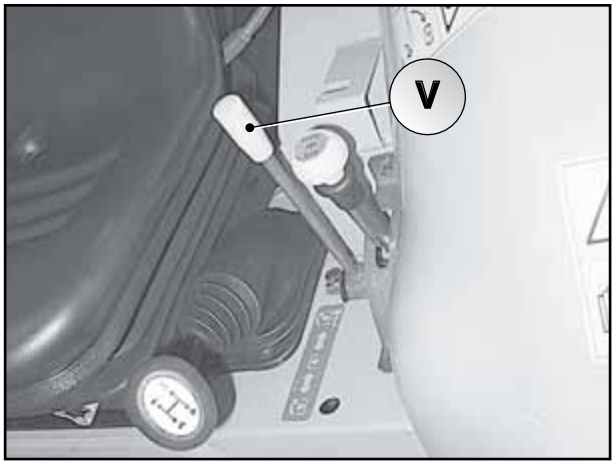


Fig. 7.122

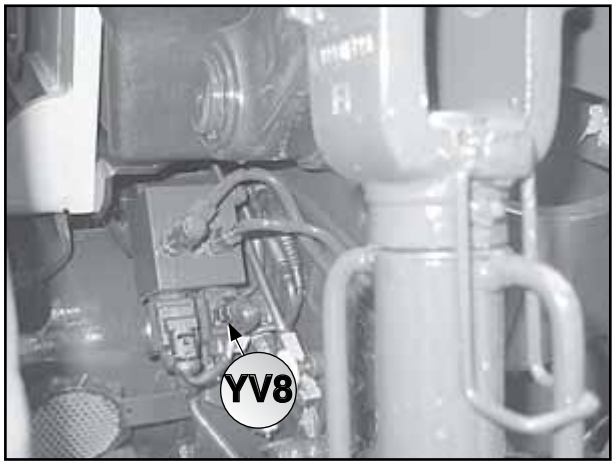


Fig. 7.123

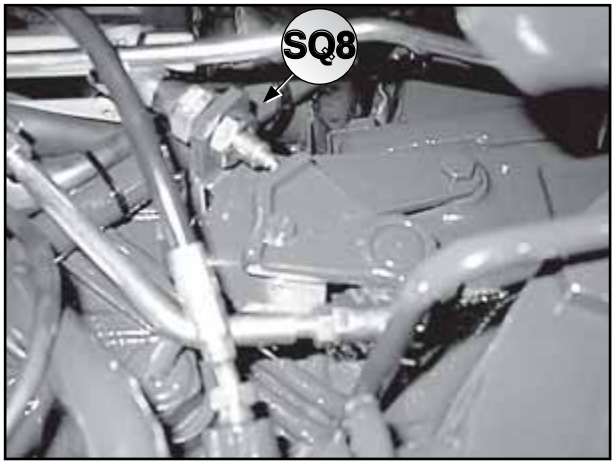


Fig. 7.124

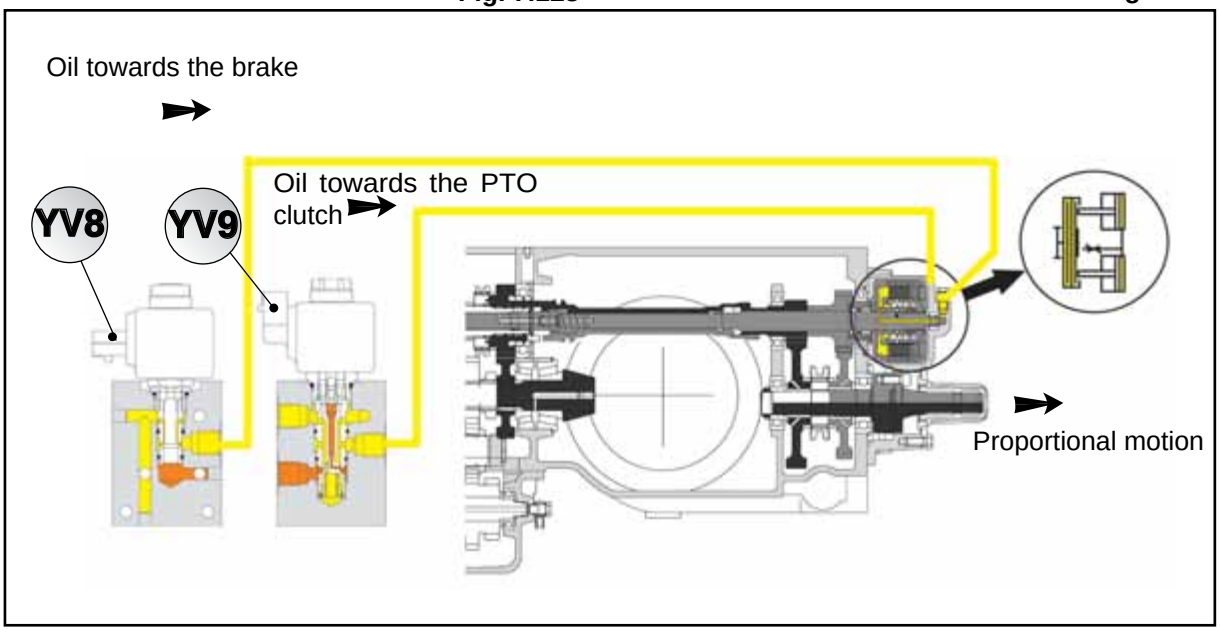


Fig. 7.125

- pressurized oil
- discharged oil

5.11.2 Description of operation

P.T.O. disengaged - brake engaged (Fig.7.126)

The valve block (31) is supplied with oil by the power steering control valve (9 Fig.7.105). The engagement of the PTO clutch and of the PTO brake pistons is controlled by the tractor's electronic control system. The electronic control unit (D02) controls the opening and closing functions of the solenoid valves (YV8) and (YV9).

Solenoid valve (YV8) allows oil at a pressure of (**20 bar**) to flow towards the brake pistons, thus activating the brake itself. On the other hand, solenoid valve (YV9) shuts off the flow of pressurized oil to the PTO clutch and disengages it.

Valve block (31) for rear PTO solenoid valves and brake unit

Voltage	Solenoid valve	User	Status	Pressure
0 V	YV8	P.T.O. brake	activated	20 bar
0 V	YV9	P.T.O.	disengaged	0 bar

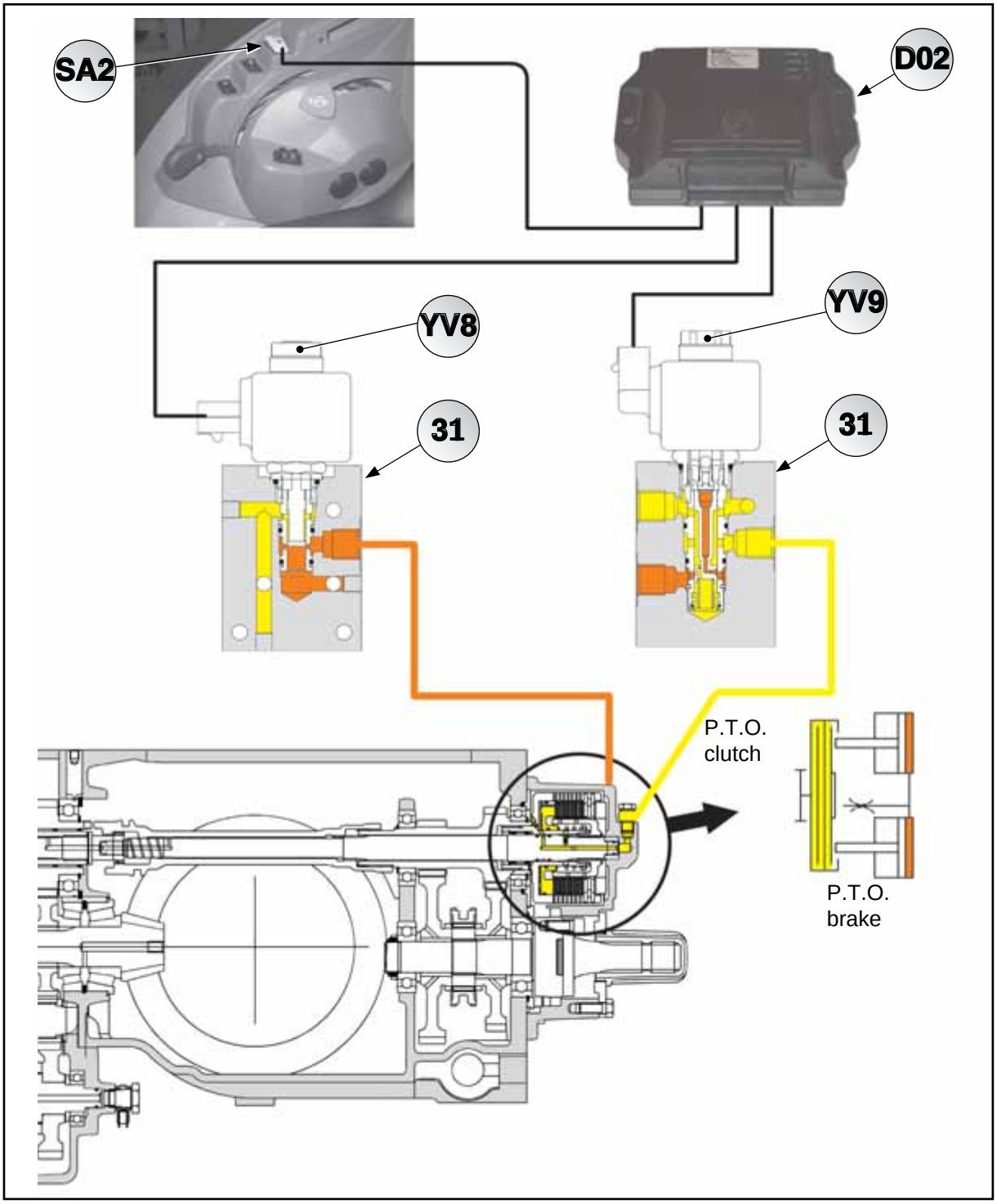


Fig. 7.126

- electrical signal
- discharged oil
- pressurized oil

P.T.O. engaged - brake disengaged (Fig.7.126)

The valve block (31) is supplied with oil by the power steering control valve (9 7.105). The engagement of the PTO clutch and of the PTO brake pistons is controlled by the tractor's electronic control system. The electronic control unit (D02) controls the opening and closing functions of the solenoid valves (YV8) and (YV9).

When the PTO is engaged, the switch (SA2) transmits an electric signal to the electronic controller (D02), which processes the electric signal so as to energize the solenoid valves (YV8) and (YV9) at the same time. The valve (YV8) shuts off the flow of pressurized oil to the PTO brake and disengages it, while the valve (YV9) enables oil at a pressure of **20 bar** to flow towards the P.T.O. clutch, thus engaging it.

PTO engagement is modulated by the gradual movement of the plunger of the proportional solenoid valve (YV9).

Valve block (46) for rear PTO solenoid valves and brake unit

Voltage	Solenoid valve	User	Status	Pressure
12 V	YV8	P.T.O. brake	deactivated	0 bar
12 V	YV9	P.T.O.	engaged	20 bar

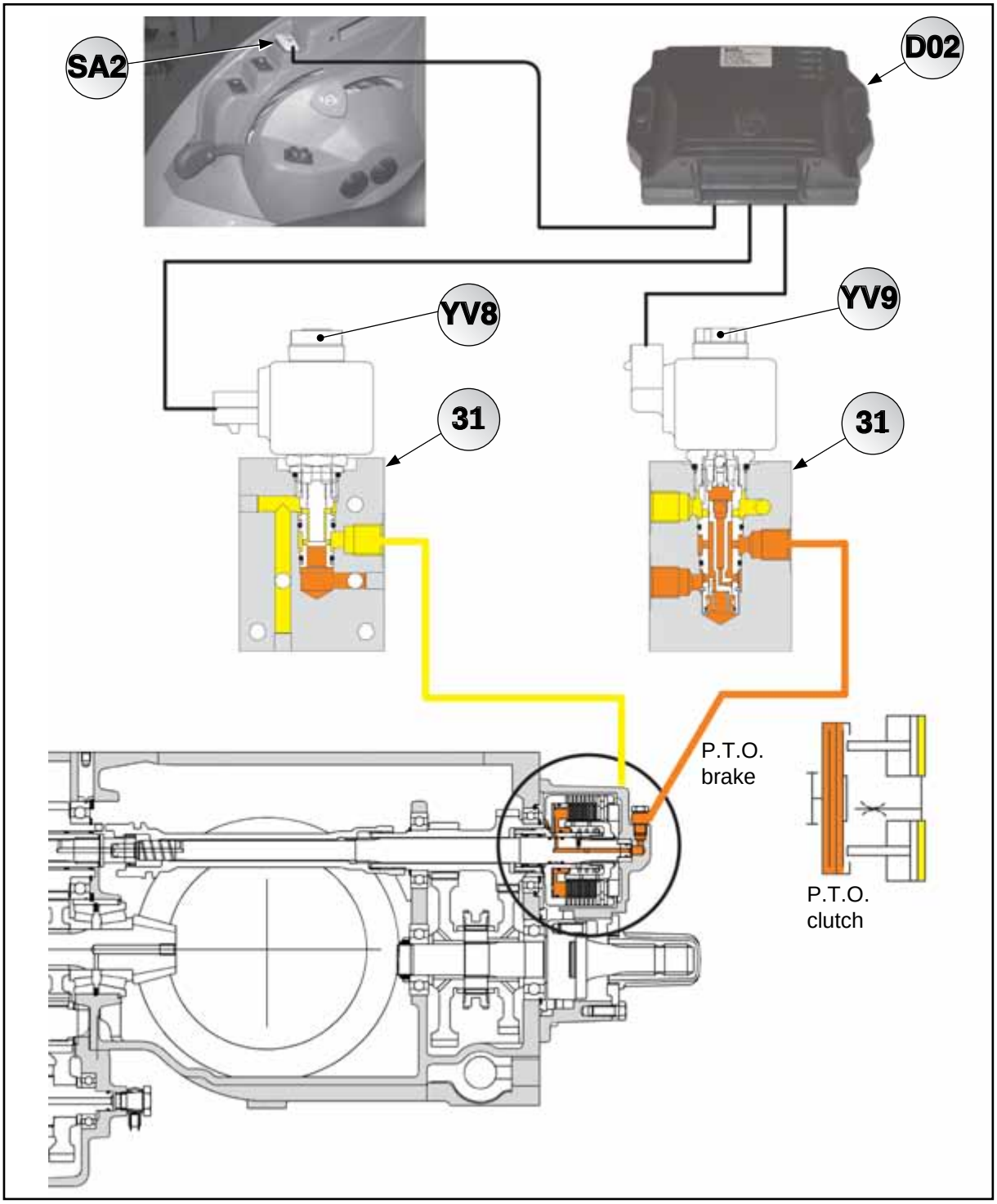


Fig. 7.127

- electrical signal
- discharged oil
- pressurized oil

5.12 4WD engagement (Spring-on) (Power Shuttle version)

5.12.1 Main components

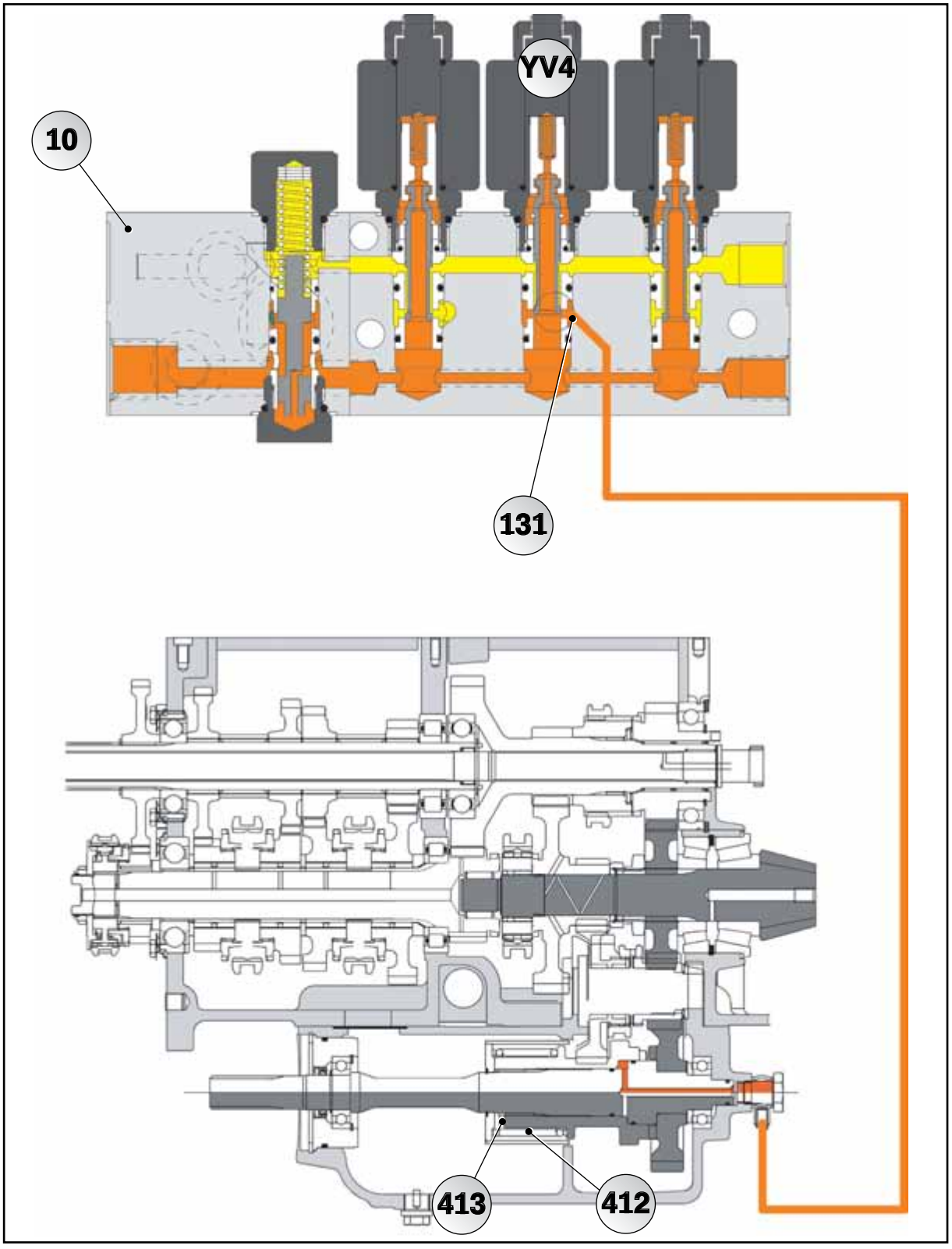


Fig. 7.128

5.12.2 Description of operation

The 4WD is engaged and disengaged by means of a mixed system: mechanical/electrohydraulic.

4WD disengagement is electrohydraulically disengaged by pressing the switch (SA11 7.129) on the right-hand side of the driver's seat, thus energizing the solenoid valve (YV4 7.128/7.131) and allowing oil at a pressure of **20 bar** to disengage the 4WD through the axial movement of the sleeve (413 Fig.7.128).

Figure 7 shows the sleeve (413) in the top part in the 4WD disengagement position (pressure 20 bar), and in the lower part in 4WD engagement position (pressure 0 bar).

4WD (Spring-on) engagement is mechanical. When the solenoid valve (YV4 Fig.7.128/7.131) is de-energized, the spring (412 Fig.7.128) returns the sleeve (413) to the 4WD engaged position.

The 4WD remains engaged when the tractor engine is off, thus guaranteeing a safe braking action.

10 - Hydraulic power pack
131 - 4WD disengagement oil supply
412 - 4WD engaging spring
413 - 4WD engaging/disengaging sleeve
YV4 - 4WD disengagement solenoid valve
- pressurized oil
- discharged oil

Fig. 7.129

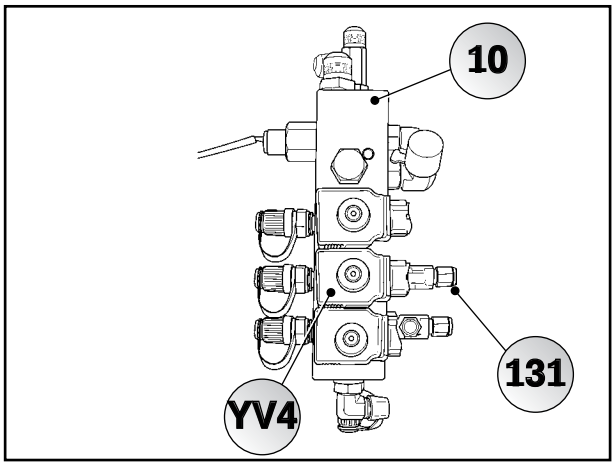


Fig. 7.130

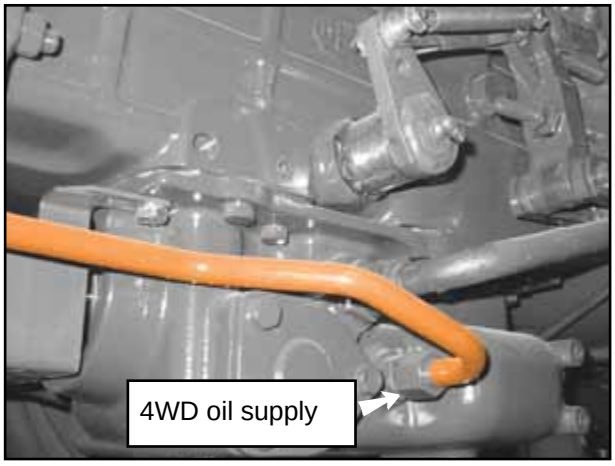


Fig. 7.131

5.13 “Power Five” oil supply (Power Shuttle version)

5.13.1 Main components

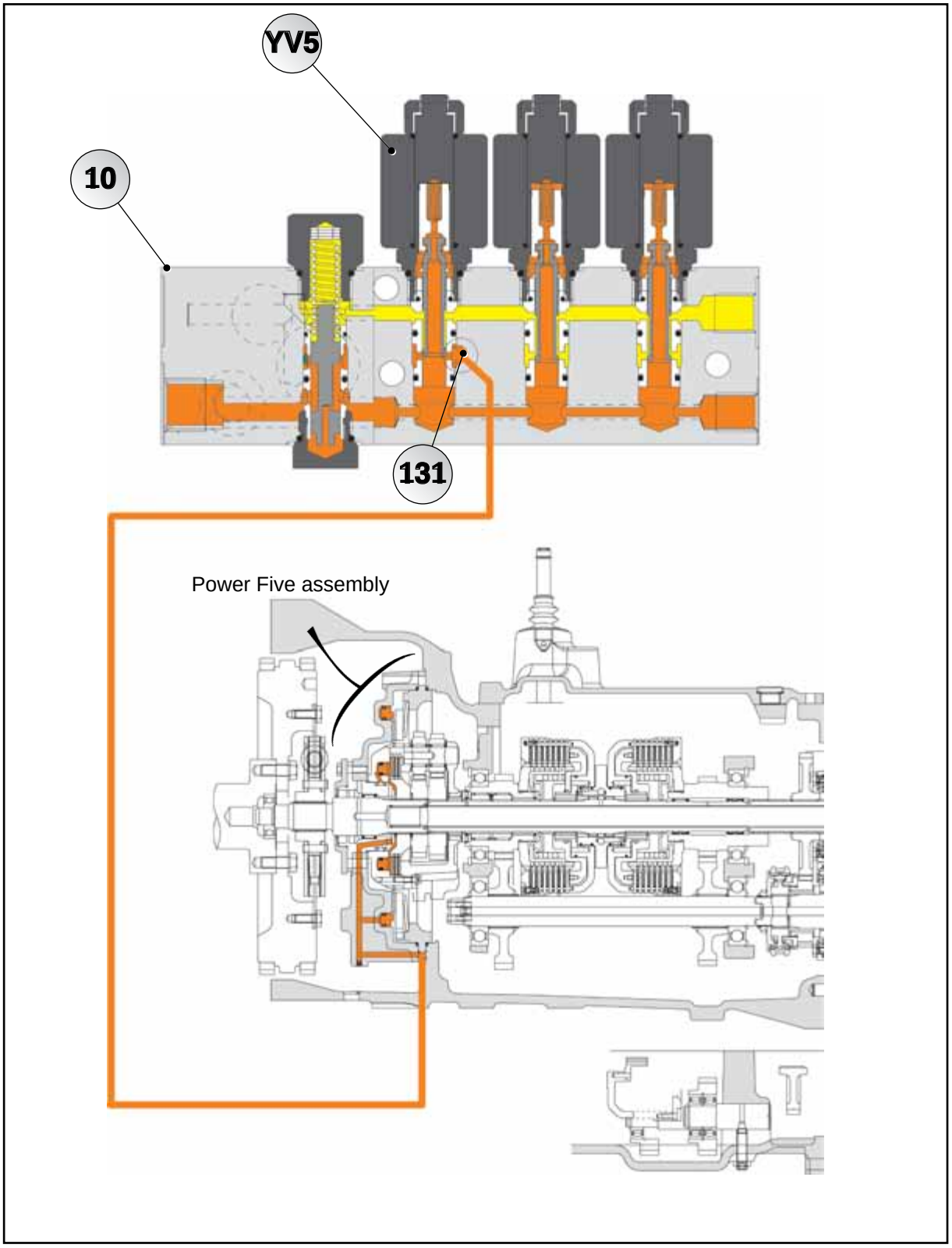


Fig. 7.132

5.13.2 Description of operation

Installed at the gearbox input, the Powerfive unit reduces all the speeds by 20%. Two ranges are available: fast (1:1 ratio), slow (reduced by 20%). The ranges can be engaged whilst the tractor is on the move and with the engine at full rate. The unit is engaged and disengaged by means of a button (SB2 Fig.7.133) on the gearshift lever. When this button is pressed, the solenoid valve (YV5 Fig.7.132/7.135) energizes, allowing pressurized oil to supply the Power Five clutch assembly and thus engaging the creeper speeds, since the pressure of the oil blocks the hydraulic clutch. When the solenoid de-energizes (YV5 Fig.7.132/7.135) the oil pressure drops to **0 bar** , thus allowing the epicyclic final drive to function and reduce the speed by 20%.

10 - Hydraulic power pack
129 - Powerfive unit oil supply
YV5 - Solenoid valve that controls the Powerfive unit
- pressurized oil (22 bar)
- discharged oil

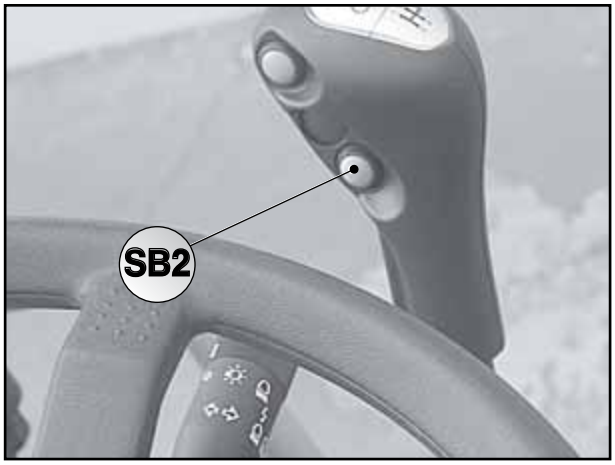


Fig. 7.133

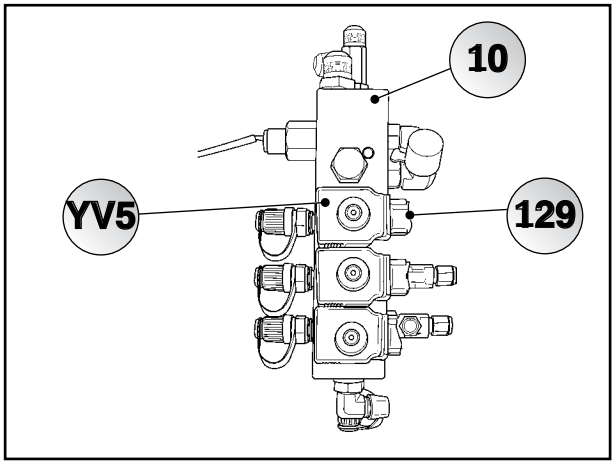


Fig. 7.134

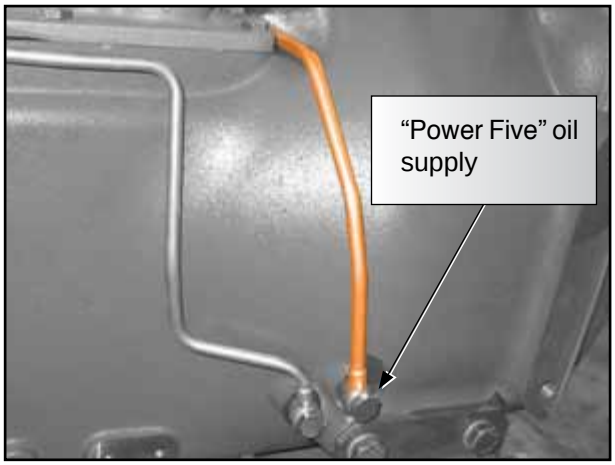


Fig. 7.135

5.14 Users' hydraulic power pack (E-Line version)

5.14.1 Main components

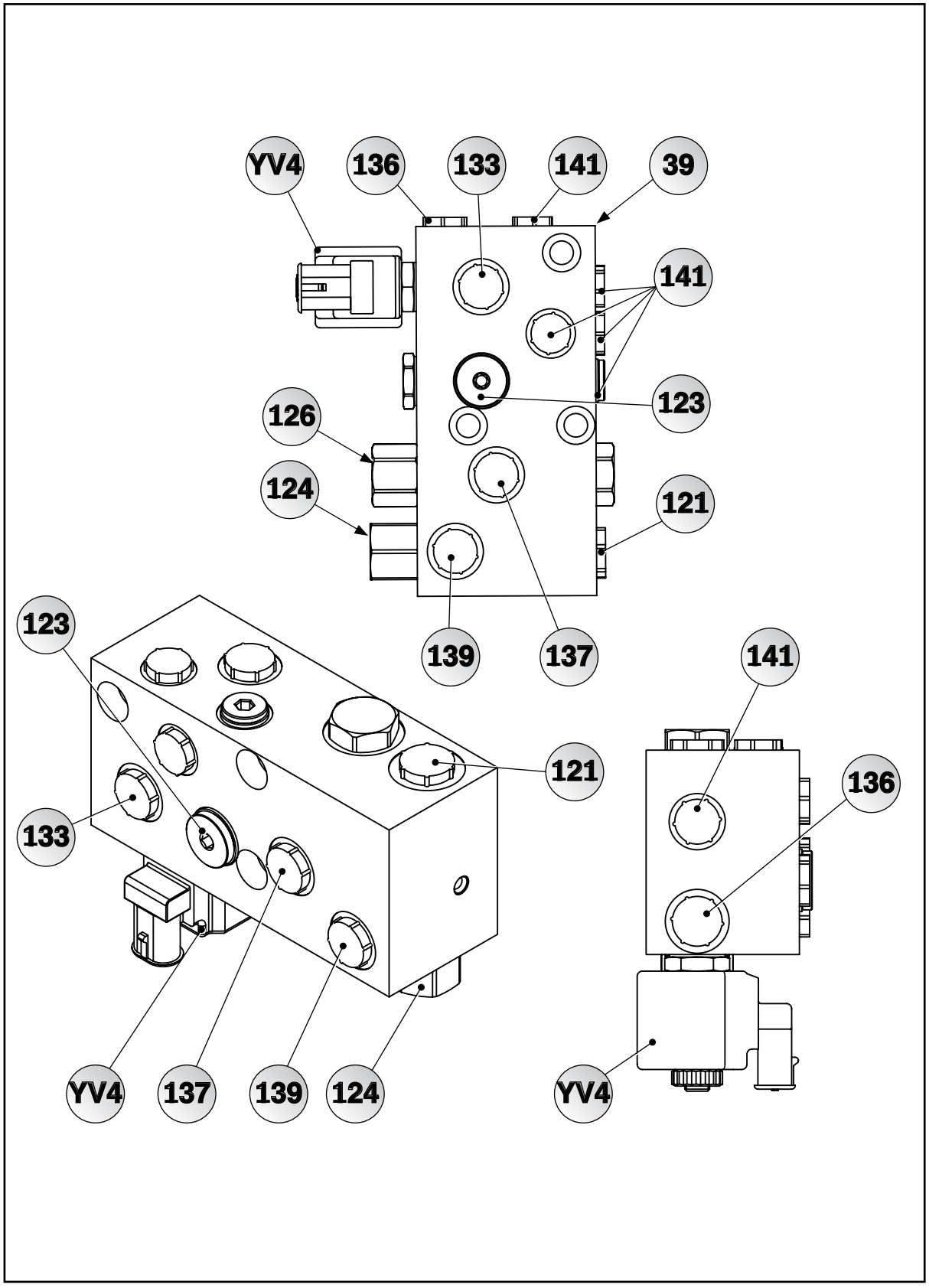


Fig. 7.136

39 - Hydraulic power pack
121 - Oil supply (from power steering system)
123 - Towards hydraulic block (40) for 4WD monitoring solenoid valve
126 - 20 bar valve
124 - 1.5 bar valve
129 - “Users” discharge
133 - Front diff lock oil supply
136 - Towards transmission shaft lubrication
137 - Discharge (gearbox housing)
139 - Towards heat exchanger
141 - Plugs
YV4 - Diff lock solenoid valve

Functional diagram

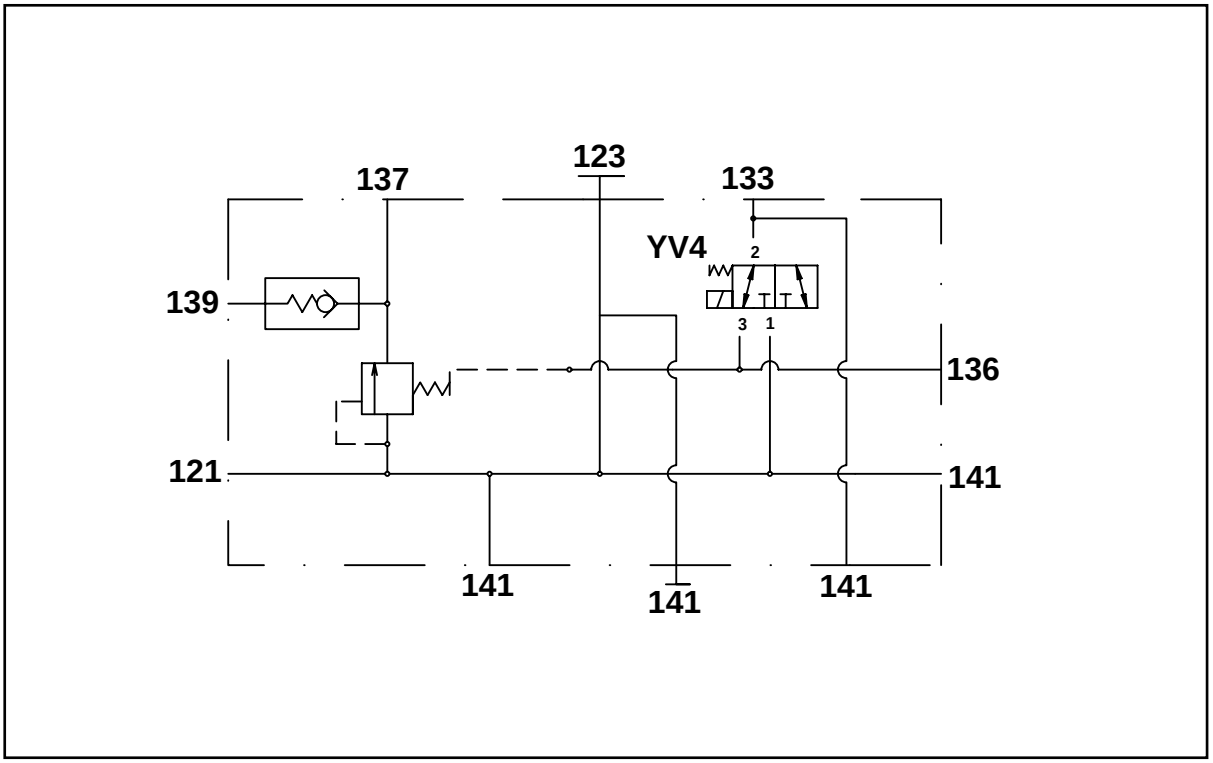


Fig. 7.137

5.14.2 Description of operation

The users' hydraulic power pack (39) Is located on the left-hand side of the tractor, near the platform. It consists of a machined parallelepiped shaped aluminium block that houses: the low pressure (20 bar) calibration valve (126), the 1.5 bar cooling circuit calibration valve (124) and the solenoid valve (YV4) that controls the diff lock.

There are also screwed unions and pipes for conveying oil to the users, to the cooling circuit, the lubrication circuit and to the free outlet. The solenoid valve (YV4) is used like a cock that opens or completely shuts off the flow of pressurized oil towards the relative users. The solenoid valve opens and closes, thus allowing oil to proceed towards the users or to be shut off, by transmitting voltage to its winding. The valve is controlled by means of the button (S4) on the right-hand side of the cab.

The solenoid valve (YV4) allows pressurized oil to flow when powered by electric voltage (or energized): diff lock engagement. Thus maintained at a low pressure (20 bar), the oil is also conveyed to the power pack (40) that controls the 4WD (4WD version).

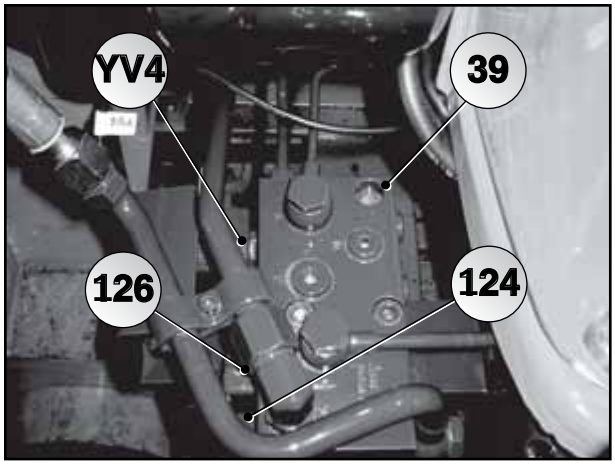


Fig. 7.138

Fig. 7.139

5.14.2.1 Description of the oil circuit within the power pack

The hydraulic power pack (39) controls the “low pressure” oil circuit that supplies the users on the tractor. The power pack also houses the “low pressure” (max 21 bar) calibration valve (126) and the 1.5 bar calibration valve (124) of the cooling circuit. During normal operation of the tractor, oil reaches the power steering unit, enters the chamber (128) and, through the duct (130), reaches the calibration valve (126). Here oil is brought to the pressure of **22 bar**, as required by the users connected. Through the duct (130) the oil reaches the chambers (177-178). The plunger of the energized solenoid valve moves and the oil can thus supply the required user. However, the oil in the chamber (177) remains blocked by a plug (141). In the Figure below, the oil flowing towards the user (133) communicates with the outlet through the chamber (136).

Through intersecting ducts that communicate with each other, the oil also reaches the **1.5 bar**calibration valve, which is the maximum pressure for oil flowing towards the cooling radiator (139). If the oil pressure in the chamber (166) exceeds 1.5 bar, the valve (124) opens the passage to the chamber that communicates with the outlet.

In the 4WD versions, pressurized oil (max 21 bar), is also conveyed to the power pack (40) that controls the 4WD.

USER	STATUS	PRESSURE
Diff. lock	disengaged	0 bar
Diff. lock	engaged	20 bar

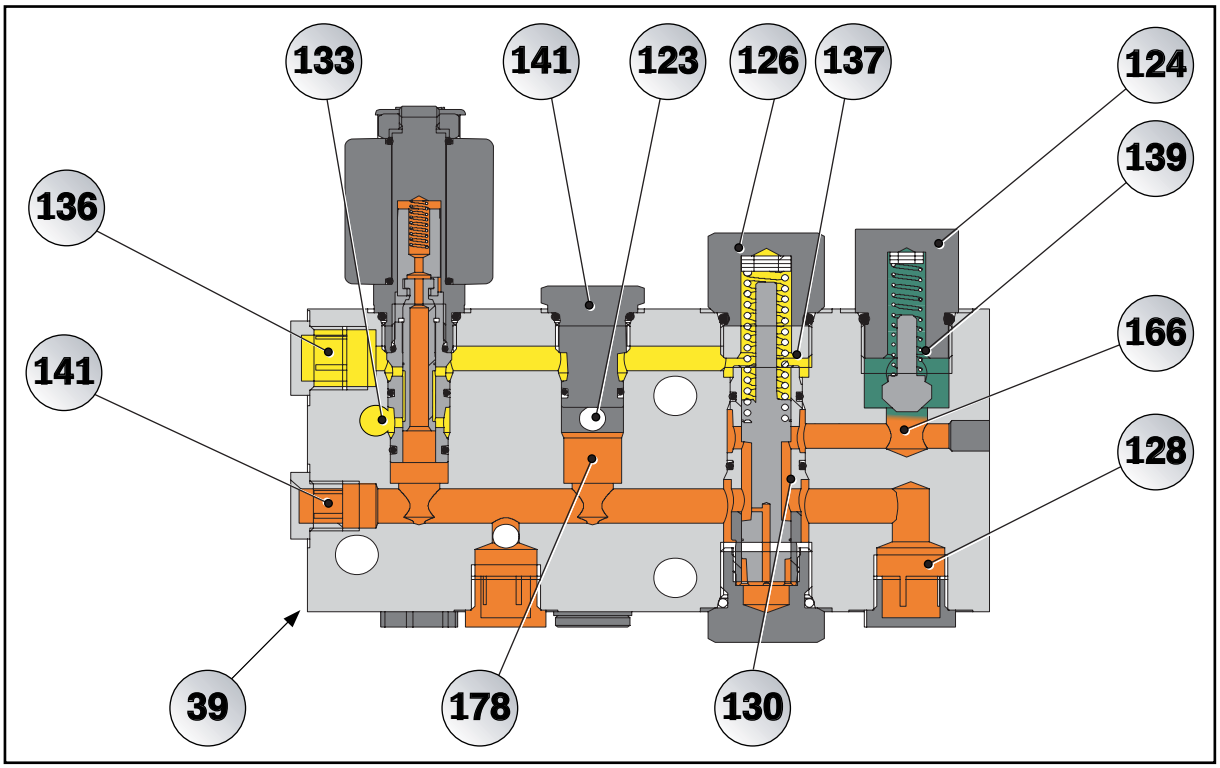


Fig. 7.140

5.14.2.2 Phase with solenoid valve (YV4) energized, diff lock engaged

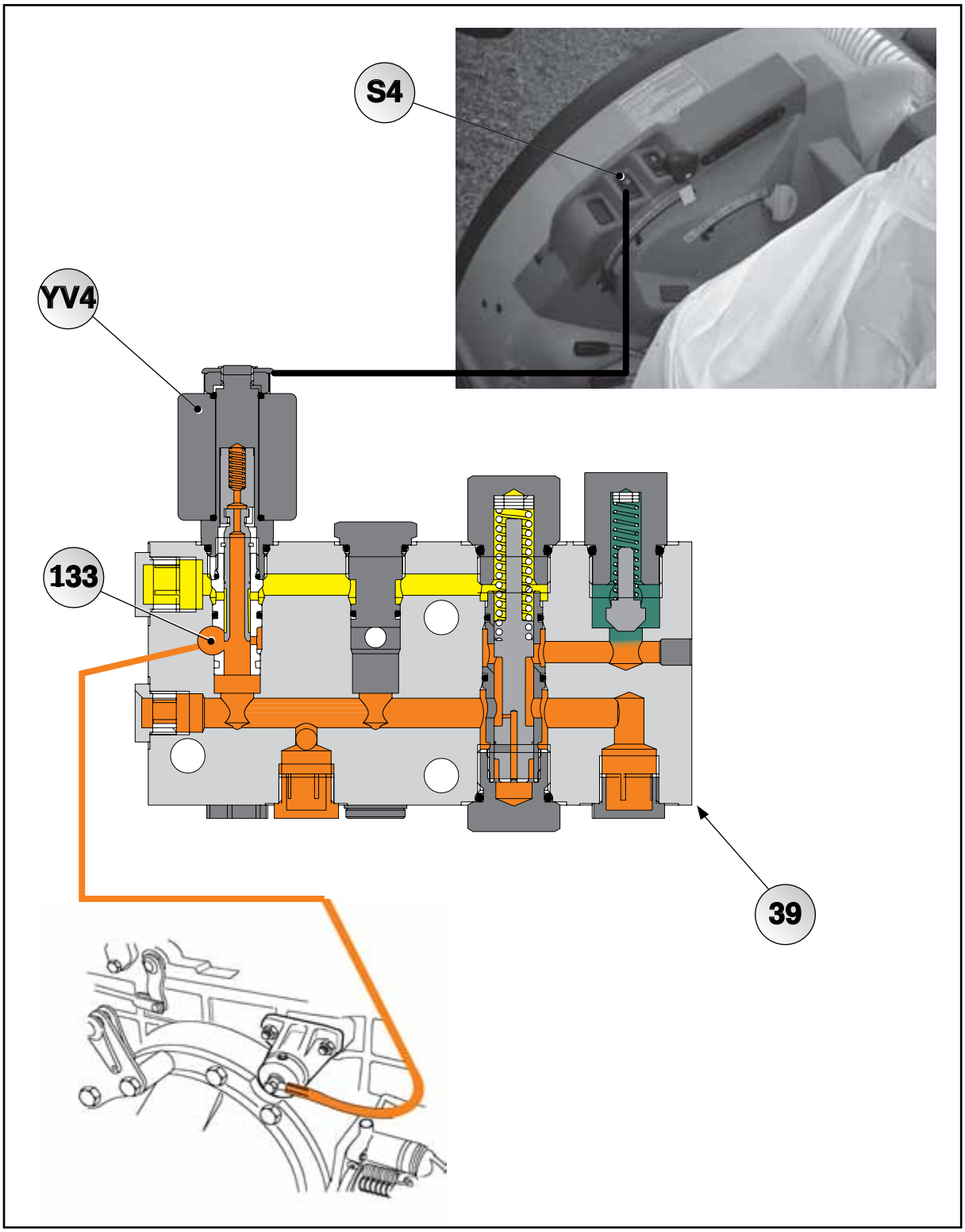


Fig. 7.141

- pressurized oil (20 bar)
- discharged oil
- Oil towards the cooling circuit

The rear differential lock is mechanically engaged and electrohydraulically controlled.

The diff lock is engaged by means of two sliding sleeves, operated by two pistons supplied with oil at a pressure of 20 bar. This occurs by pressing the control switch (S4) installed on the right-hand side of the cab, thus energizing the solenoid valve (YV4) installed on the hydraulic power pack (39).

Thus energized, the solenoid valve supplies oil to the rear (133) diff lock.

The differential lock is disengaged by depressing the brake pedals (also individually), thus de-energizing the solenoid valve (YV4).

The de-energized solenoid valve shuts off the oil supply and opens the route to the outlet.

USER	STATUS	PRESSURE
Diff. lock	disengaged	0 bar
Diff. lock	engaged	20 bar

5.14.3 Calibration valves

Oil from the power steering outlet flows to the 20 bar valve (126) through the chamber (128) and the duct (130). It reaches the chamber (169) through the calibrated hole (170) and, upon reaching a pressure of 20 bar, pushes the plunger (158) leftwards, thus compressing the spring (157). The spring maintains the 20 bar pressure required to supply the users. These latter are controlled by the two ON/OFF solenoid valves (YV4) and (YV3), this latter installed on the power pack (40) in the 4WD versions.

When the plunger (158) moves towards the left, it puts the oil flowing in from the power steering circuit discharge into communication with the chamber (166), through duct (164). The oil flowing into the chamber (166) pushes the plunger (151) towards the left. During normal operation of the tractor, when oil is hot, the spring (152) makes sure that the oil pressure toward the radiator is maintained within **1.5 bar**. If the oil pressure exceeds the spring strength (152), the valve opens the communication with the discharge circuit.

VALVE	FUNCTION	PRESSURE
valve (126)	low pressure	20 bar
valve (124)	cooling	1.5 bar

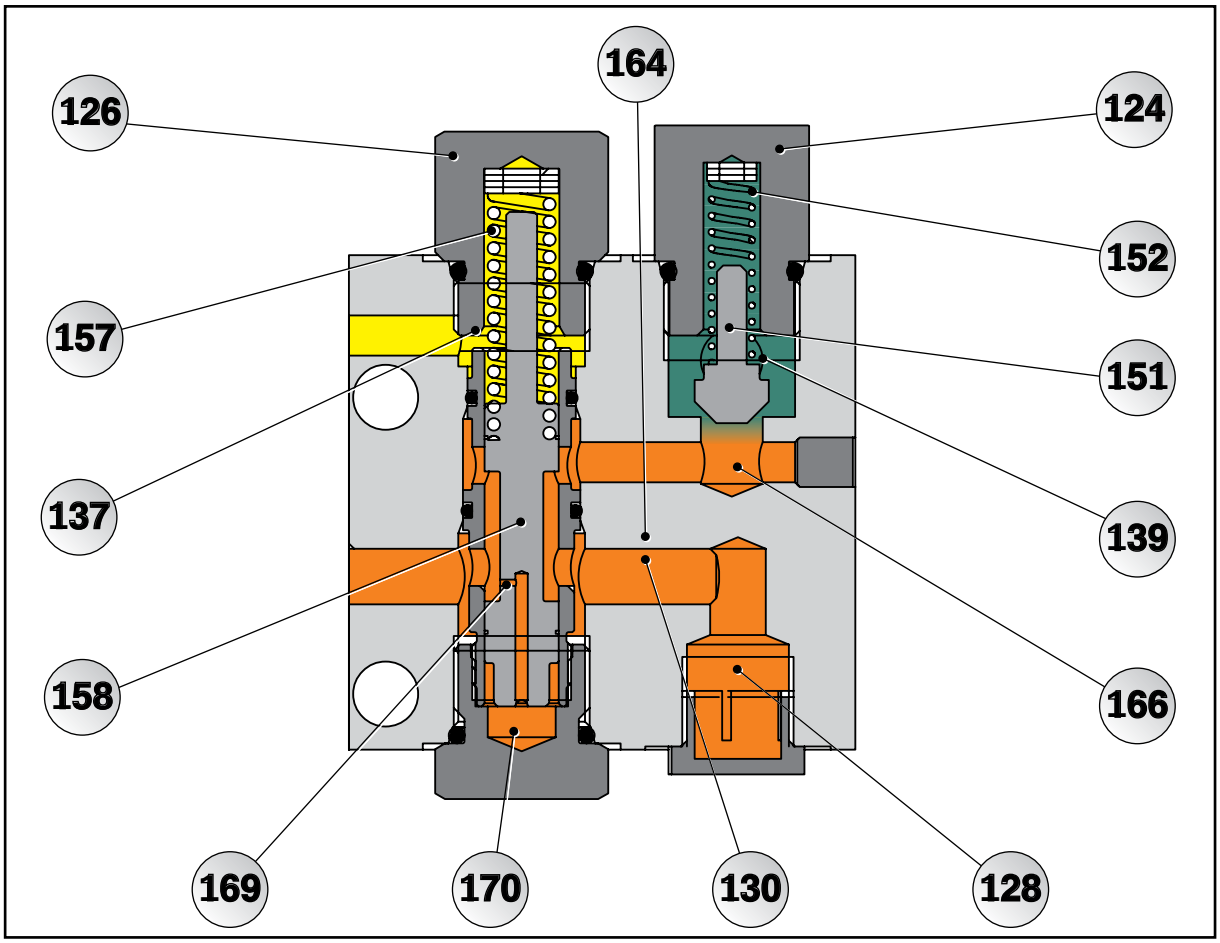


Fig. 7.142

The figures on the right show the main components installed in the calibration valves (124) and (126).

Thanks to their characteristics, the relative springs (152) and (157) allow the required pressure to be maintained.

20 bar calibration valve (126)

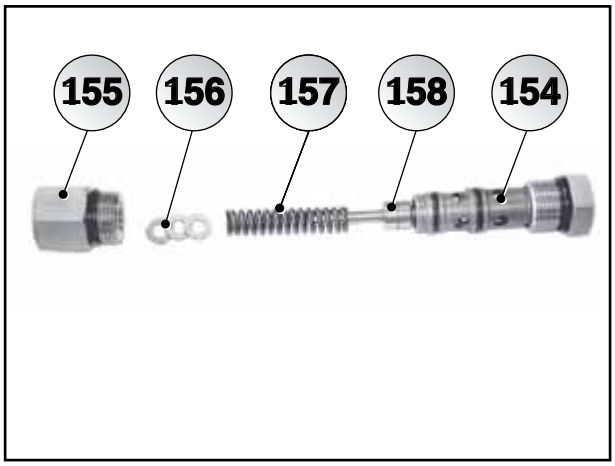


Fig. 7.143

154 - Cylinder for plunger
155 - Plug
156 - Shims
157 - Spring
158 - Valve plunger

1.5 bar calibration valve (124)

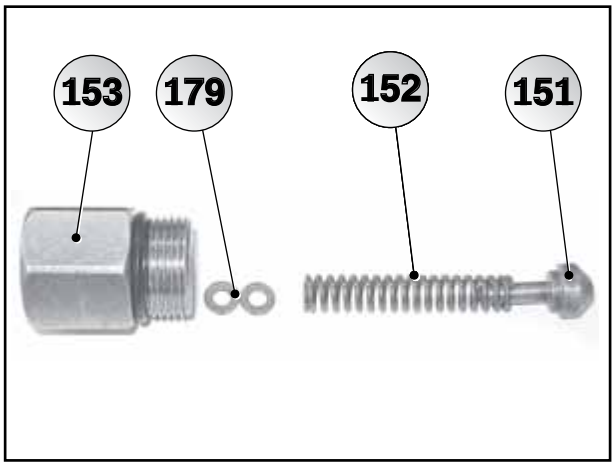


Fig. 7.144

151 - Plunger
152 - Spring
153 - Plug
179 - Shims

5.15 Block for 4WD solenoid valve (E-Line version)

5.15.1 Main components

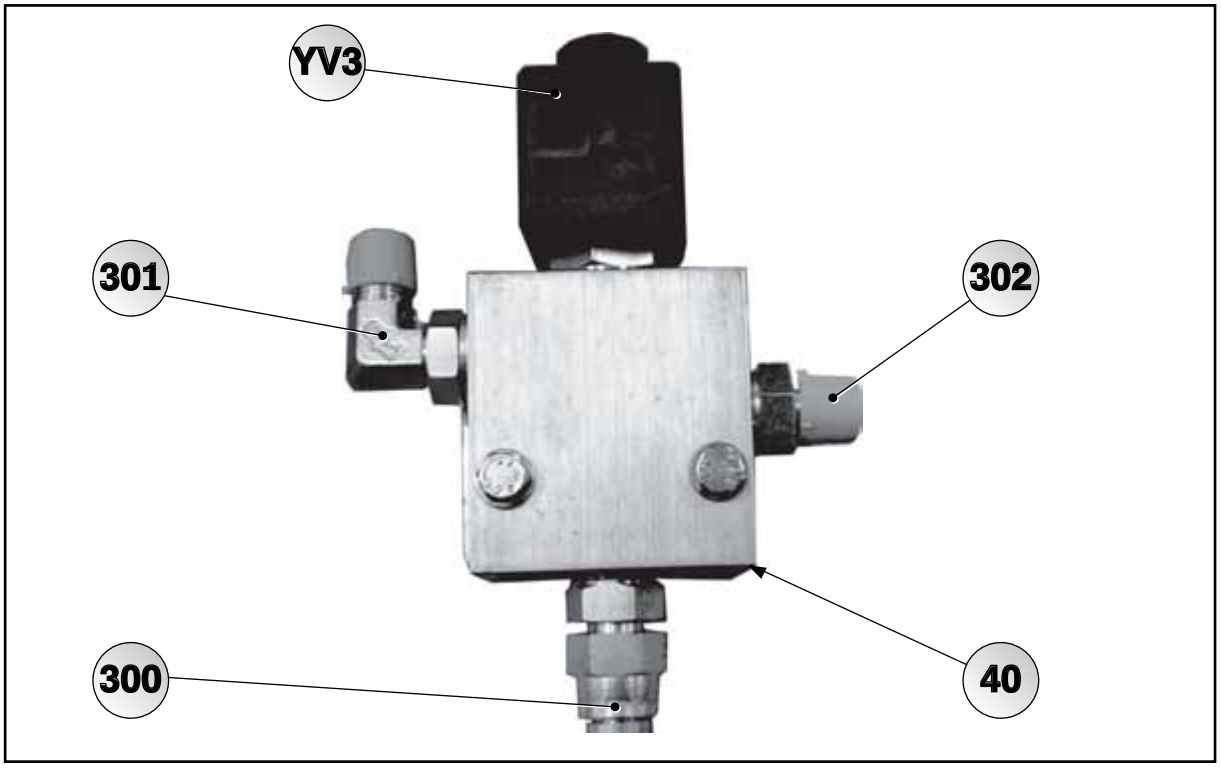


Fig. 7.145

40 - Block for 4WD hydraulic control
300 - Oil supply (from hydraulic power pack (39))
301 - Discharge (gearbox housing)
302 - 4WD disengagement oil supply
YV3 - 4WD solenoid valve

Functional diagram

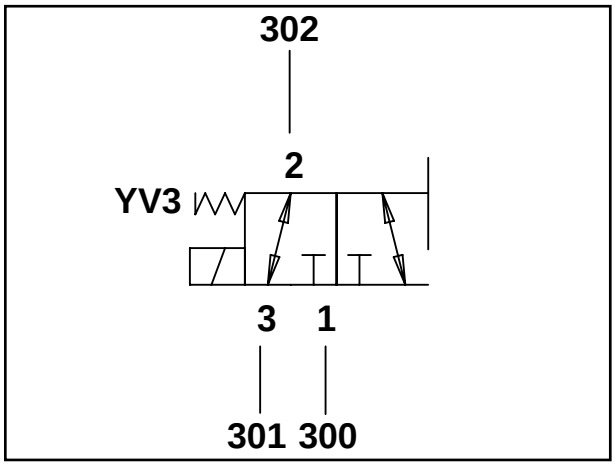


Fig. 7.146

5.15.2 Description of operation

Phase with solenoid valve (YV3) energized, 4WD engaged

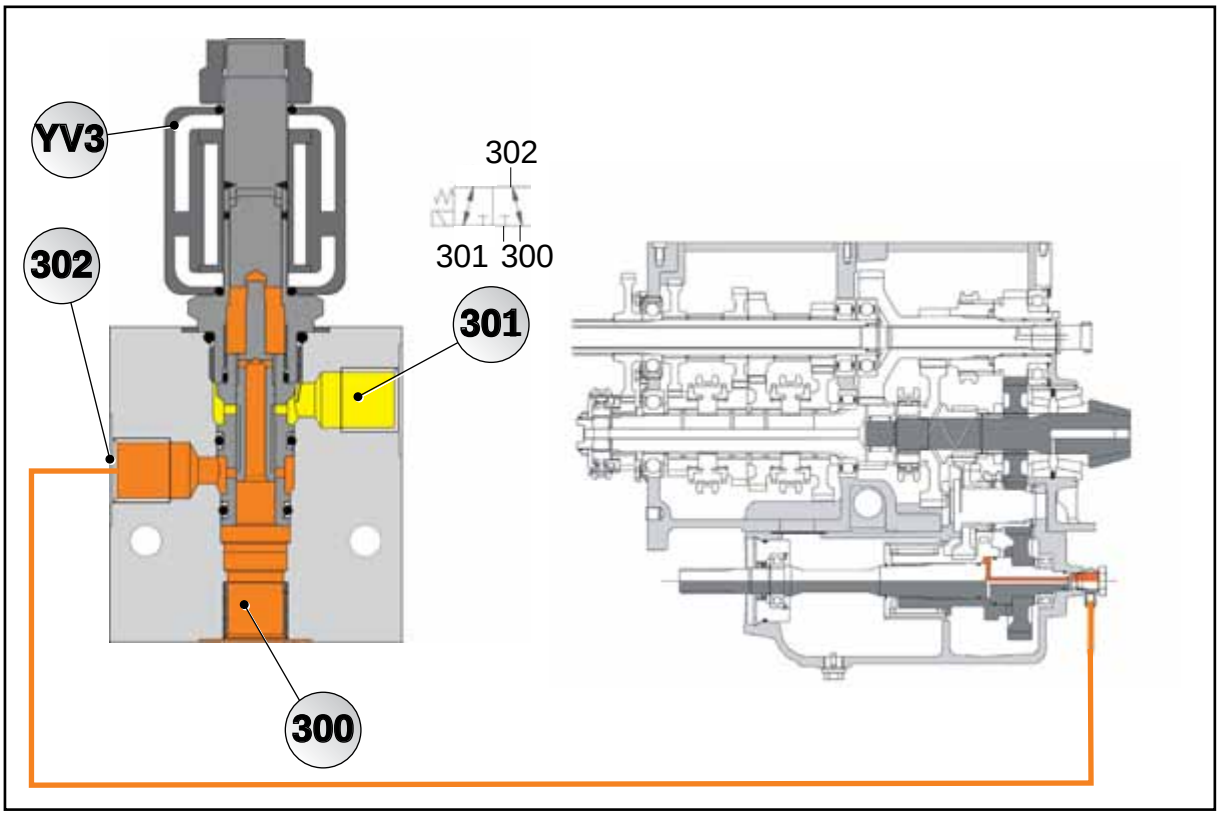


Fig. 7.147

Phase with solenoid valve (YV3) de-energized, 4WD engaged

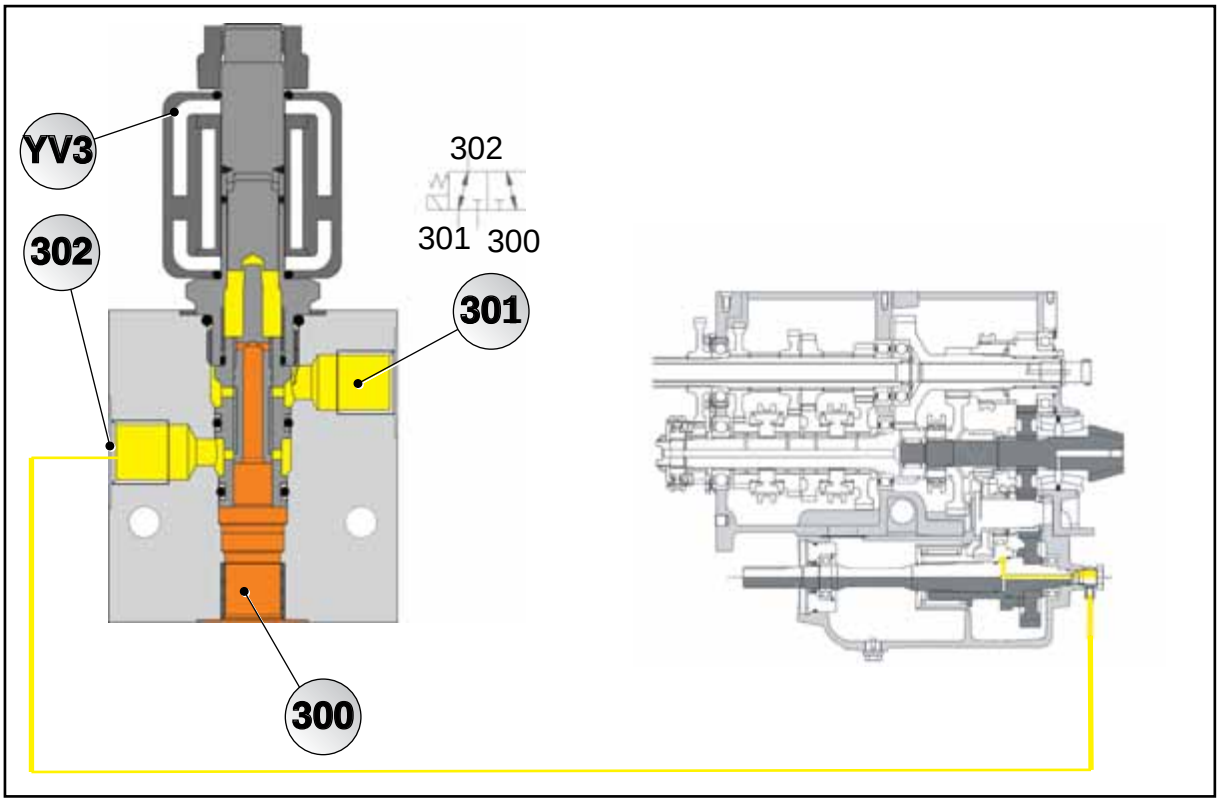


Fig. 7.148

The 4WD is engaged and disengaged by means of a mixed system: mechanical/electrohydraulic.

The 4WD is disengaged by an electro-hydraulic control. Press the switch (S2) on the right-hand side of the driver's seat to de-energize the solenoid valve (YV), thus enabling oil at a pressure of **20 bar** to disengage the 4WD through the axial movement of the sleeve (413).

The previous Figures show the sleeve (413) in the lower part in the 4WD disengagement position (pressure 20 bar), and in the top part in 4WD engagement position (pressure 0 bar).

4WD engagement (Spring-on) is mechanically controlled. When the solenoid valve (YV3) is de-energized, the spring (412) returns the sleeve (413) to the 4WD engaged position.

The 4WD remains engaged when the tractor engine is off, thus guaranteeing a safe braking action.

USER	STATUS	PRESSURE
4WD	disengaged	0 bar
4WD	engaged	20 bar

- pressurized oil (20 bar)
- discharged oil

Fig. 7.149

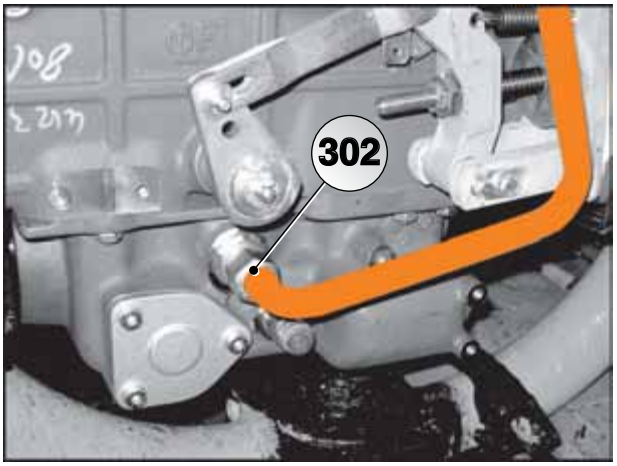


Fig. 7.150

Checking the pressure of the low flow circuit's calibration valve (E-Line version)

Remove the plug (141) from the hydraulic power pack (39) and assemble adapter **122 IDR GL** with a **0 to 60 bar pressure gauge.** When the engine is running, the pressure gauge must indicate a value between **18** and **21 bar**.

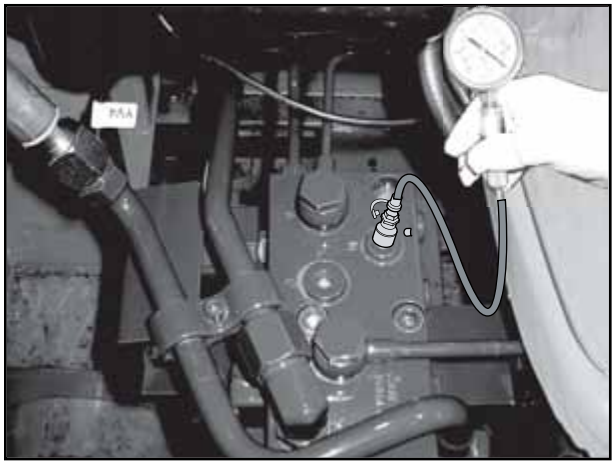


Fig. 7.151

How to check the pressure of the cooling circuit's calibration valve (1.5 bar) (E-Line version)

Remove the connecting pipe (A) from between the hydraulic power pack (39) and the radiator and assemble tool with adapter **122 IDR GL** along with a **0 to 25** bar pressure gauge. Re-connect the tube (A) to the tool and measure the pressure value. When the engine is running, it must be between **1 and 2 bar.**

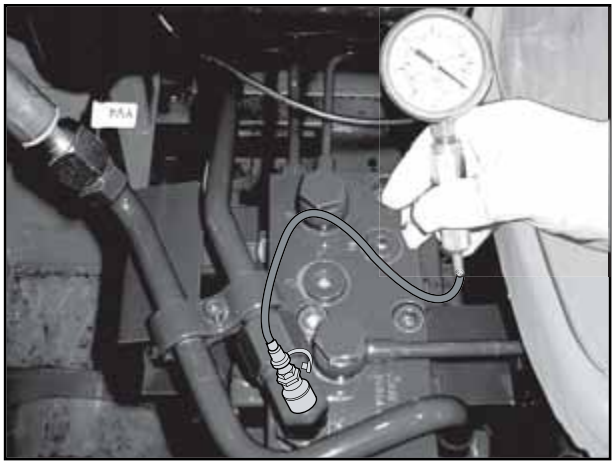


Fig. 7.152

Checking the rear differential lock engaging pressure (E-Line version)

Remove the plug (141) from the hydraulic power pack (39) and assemble adapter **122 IDR GL** with a **0 to 60 ba**r pressure gauge. When the engine is running and the differential lock engaged, the pressure gauge must indicate a value between **18 and 21 bar.**

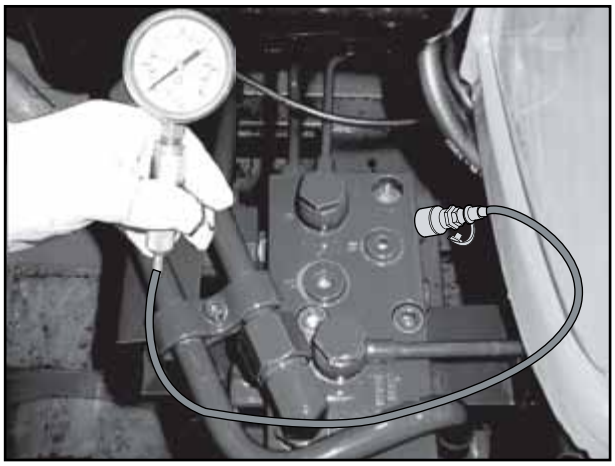


Fig. 7.153

4WD disengaging pressure test (Spring-on) (E-Line version)

Remove the plug (141) from the hydraulic power pack (39) and assemble adapter **122 IDR GL** with a **0 to 60 bar pressure gauge**. When the engine is running and the differential lock engaged, the pressure gauge must indicate a value between **18 and 21 bar.**

Fig. 7.154

Section 6 : Main components of the high flow circuit

Index

6.1 Hydraulic pump 7-146
6.1.1 Main components 7-146
6.1.2 Description of operation 7-147

6.2 Trailer brake 7-148
6.2.1 Main components 7-148
6.2.2 General description 7-150
6.2.3 Trailer brake of the type for ITALY 7-152
6.2.4 Trailer brake of the EXPORT type 7-156

6.3 Auxiliary control valves 7-160
6.3.1 Hydraulic circuit 7-160
6.3.2 General description 7-162
6.3.3 Inlet plate with flow divider 7-164
6.3.4 Control valve for hydraulic motor (with flow divider) 7-166
6.3.5 Standard single and double-acting control valve (for excess flow) (with flow divider) 7-168
6.3.6 Floating control valve 7-170
6.3.7 Control valve with automatic release (kick-out) 7-172
6.3.8 Interface plate (with mechanical power lift) 7-174
6.3.9 Interface plate (with electronic power lift) 7-175
6.3.10 Monoblock for auxiliary control valve unit 7-176
6.3.11 Standard control valve for monoblock (E-Line version) 7-178

6.4 Electrohydraulic flow selector (Speed Five and Power Shuttle version) 7-182
6.4.1 General description 7-183
6.4.2 Main components 7-184
6.4.3 Description of operation 7-186

6.5 Mechanical power lift supply system 7-189
6.5.1 Main components 7-189
6.5.2 Description of operation 7-190

6.6 Triple pump with independent hydraulic circuit (Power Shuttle version) 7-192
6.6.1 Main components 7-192
6.6.2 Description of operation 7-196
6.6.3 Adjustments 7-198

6.1 Hydraulic pump

6.1.1 Main components

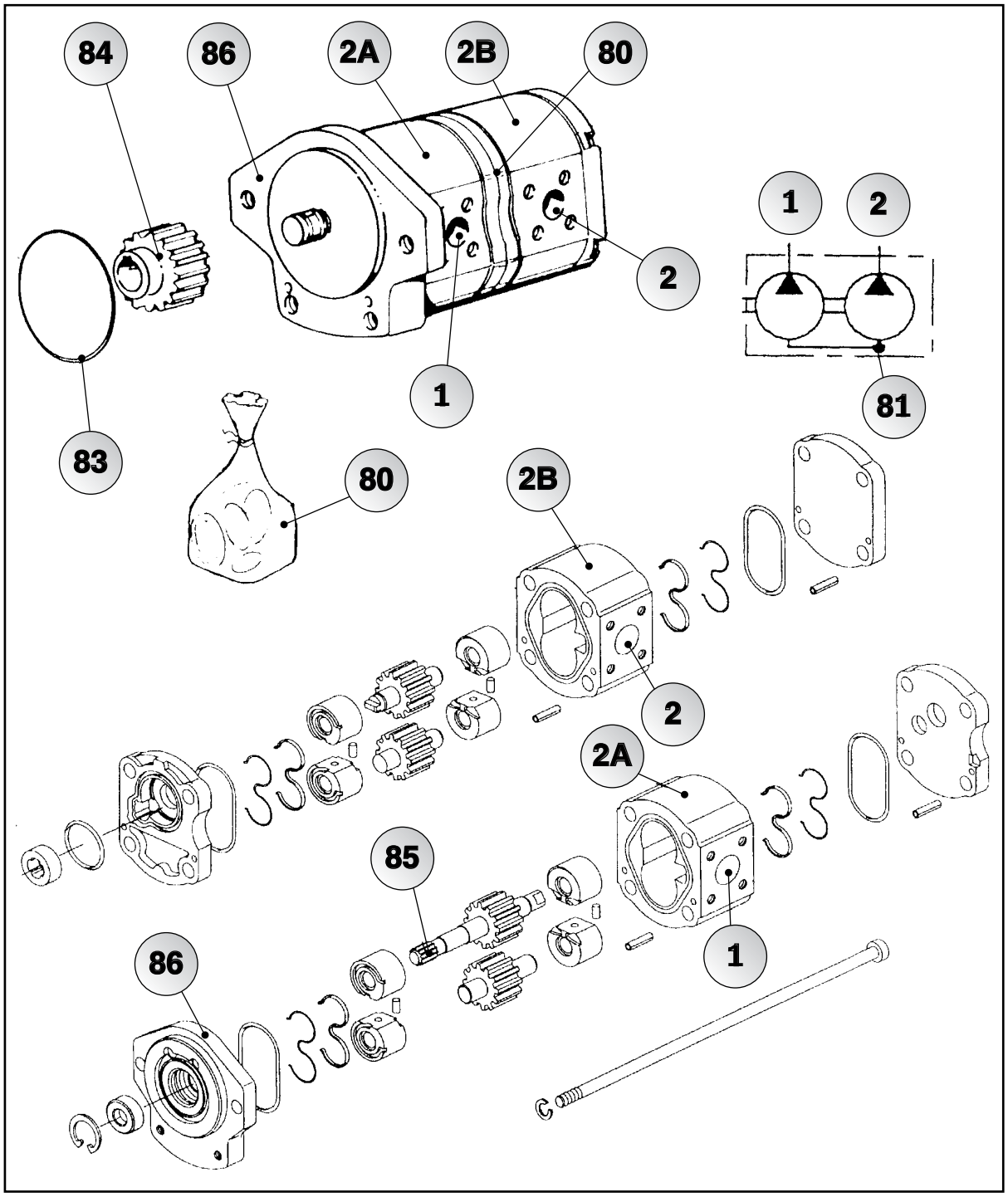


Fig. 7.155

1 - High pressure delivery hole 2A
2 - High pressure delivery hole 2B
80 - Double casing pump
81 - Intake hole H-P
81a - Intake hole L-P
82 - Seal set
83 - O-ring for flange
84 - Pump driving gear
85 - Pump shaft
86 - Engine coupling flange

6.1.2 Description of operation

The hydraulic gear pump consists of a single block, with two different stages, one intake duct (81) and two separate supply lines (1 and 2) and two different flow rates. The common oil suction hole (81) has been made on the stage with the widest section.

Since it is connected straight to the engine, the pump activates whenever the engine runs, drawing filtered oil from the transmission and sending it to both the low and high flow circuits at the same time.

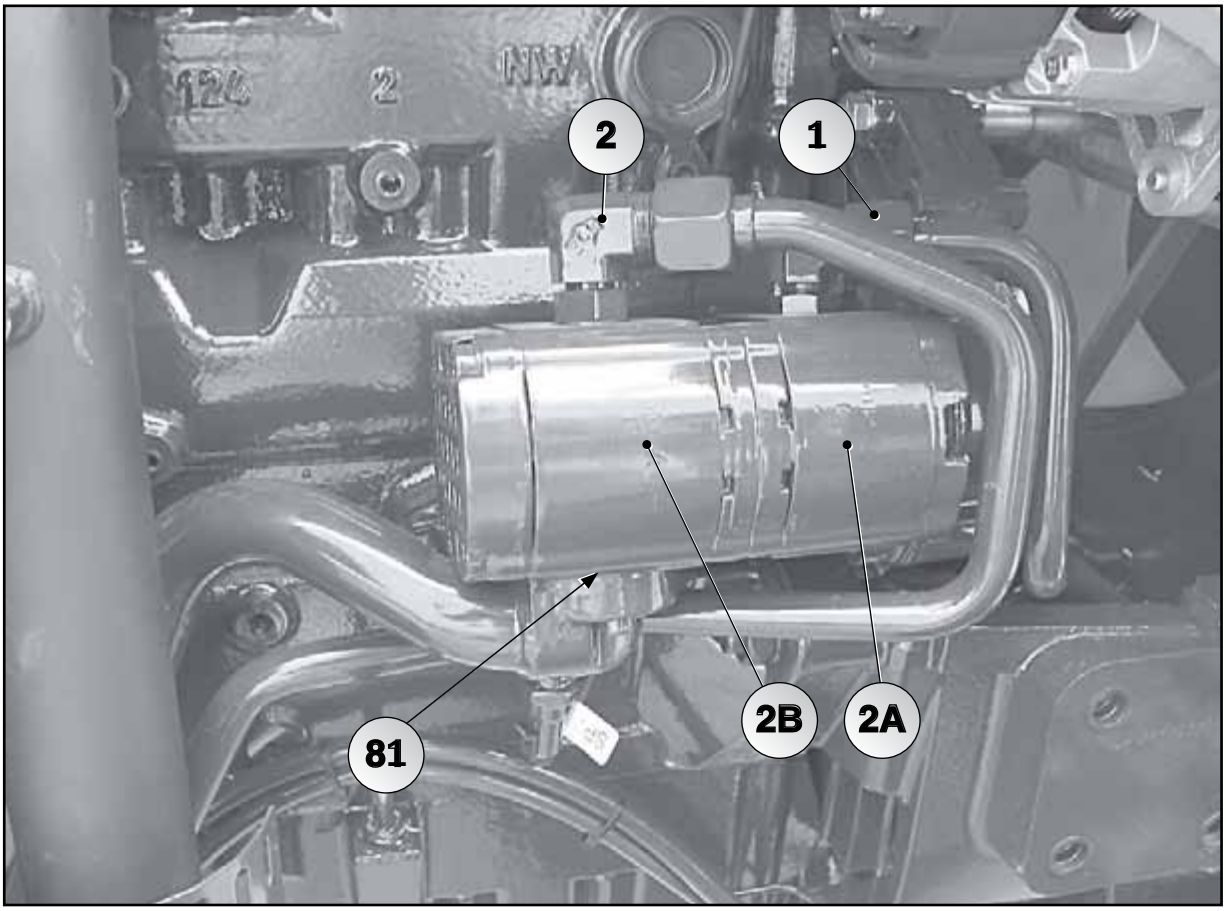


Fig. 7.156

6.2 Trailer brake

6.2.1 Main components

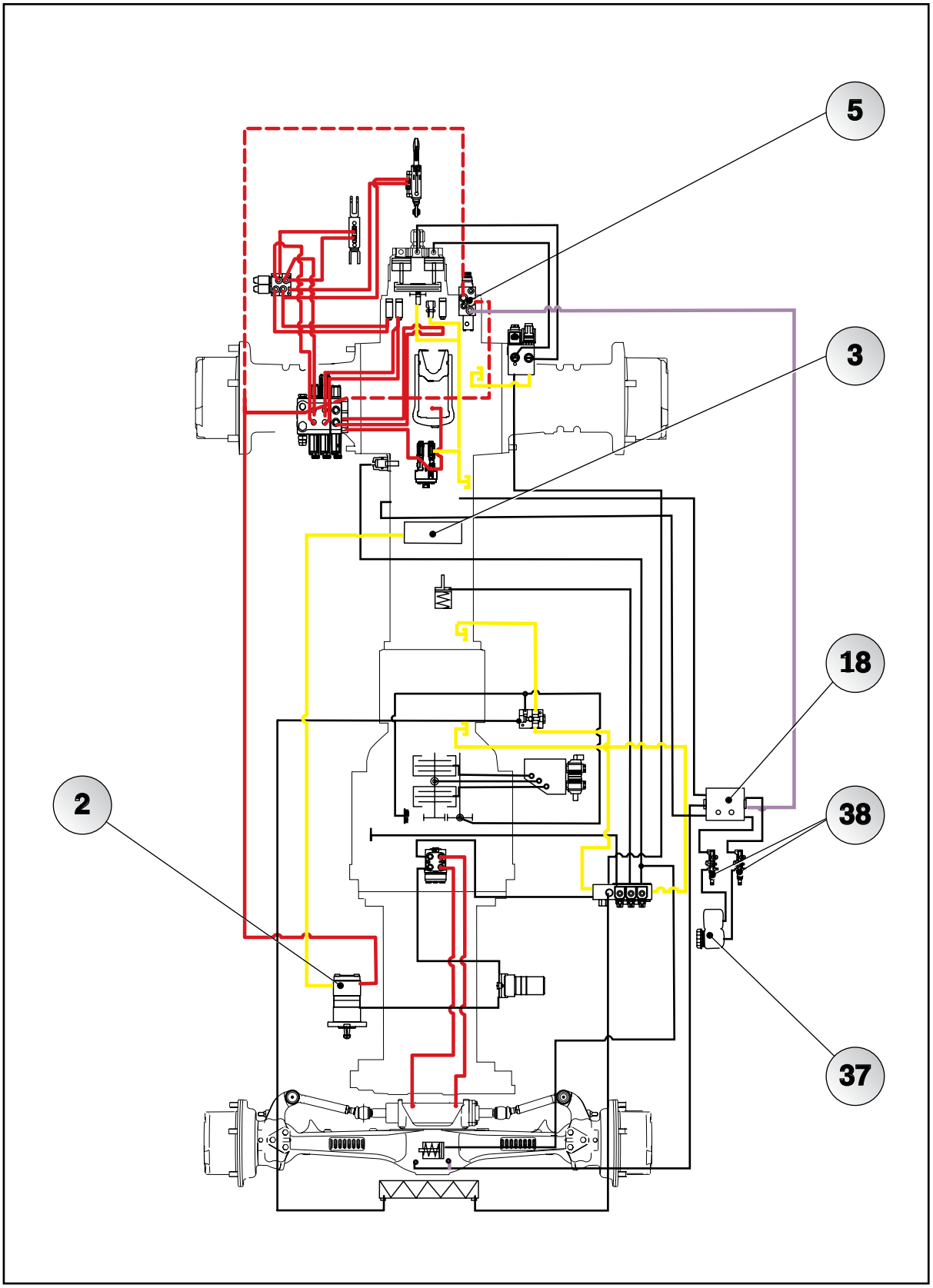


Fig. 7.157

2 - High flow pump
3 - High flow suction filter
5 - Hydraulic trailer brake valve
18 - Brake circuit on-off valve
37 - Brake fluid reservoir
38 - Brake pumps

- high pressure

- discharge/inlet

6.2.2 General description

The trailer brake valve (5 Fig. 7.158) is installed in the rear part of the tractor and supplies the trailer by means of the oil tap union (A).

Oil is supplied to the valve by absolute priority via the high flow circuit.

The oil not used by the trailer braking action is sent towards the auxiliary control valves. The trailer brake only engages at the same time as the tractor's brakes when the pedals are latched.

The tractor can be equipped with two types of valve:

a - Trailer brake valve of the type for Italy (Fig.7.161).
b - Trailer brake valve of the Export type (Fig.7.166).

As compared to the Export valve type, the trailer brake valve for the Italian market has an additional device in the lower part, with a rod connected to the parking brake.

Italian laws require trailers to have a self-braking device. It must allow the trailer to brake the moment in which it is unhitched from the tractor. Moreover, this braking mechanism must operate the moment in which the tractor stops and the parking brake is engaged. Consequently, to tow a trailer, oil must still be sent to the "trailer brake" device at a steady pressure of 10-15 bar (required for disengaging the mechanical brake) even when the brakes are not used.

When the trailer brake of the type for Italy is installed, comply with the following instructions to correctly connect and disconnect the flexible trailer brake hose to and from the union (A) at the rear of the tractor and to always operate in conditions of the utmost safety.

With the engine at a standstill: there are no difficulties when either connecting or disconnecting as there is no oil pressure in the brake circuit.

With the engine running: it is essential to engage the hand brake since this ensures that no pressure remains in the brake circuit.

⚠	**Attention:** it is extremely important to always carry out this operation before unhitching the trailer from the tractor since it ensures the immediate action of the automatic safety braking system with which this trailer braking system is obligatorily equipped.

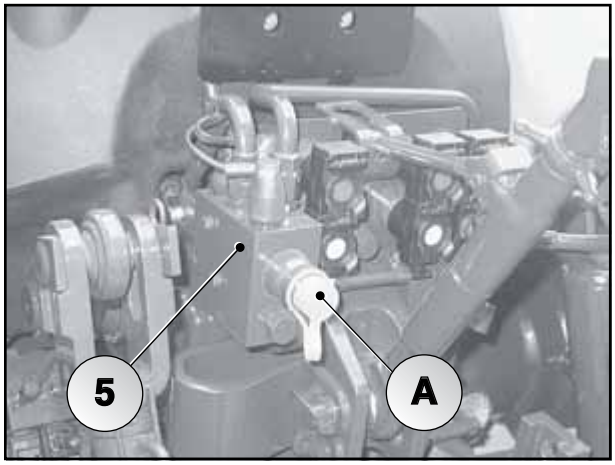


Fig. 7.158

Valve of the type for ITALY (bracketed)

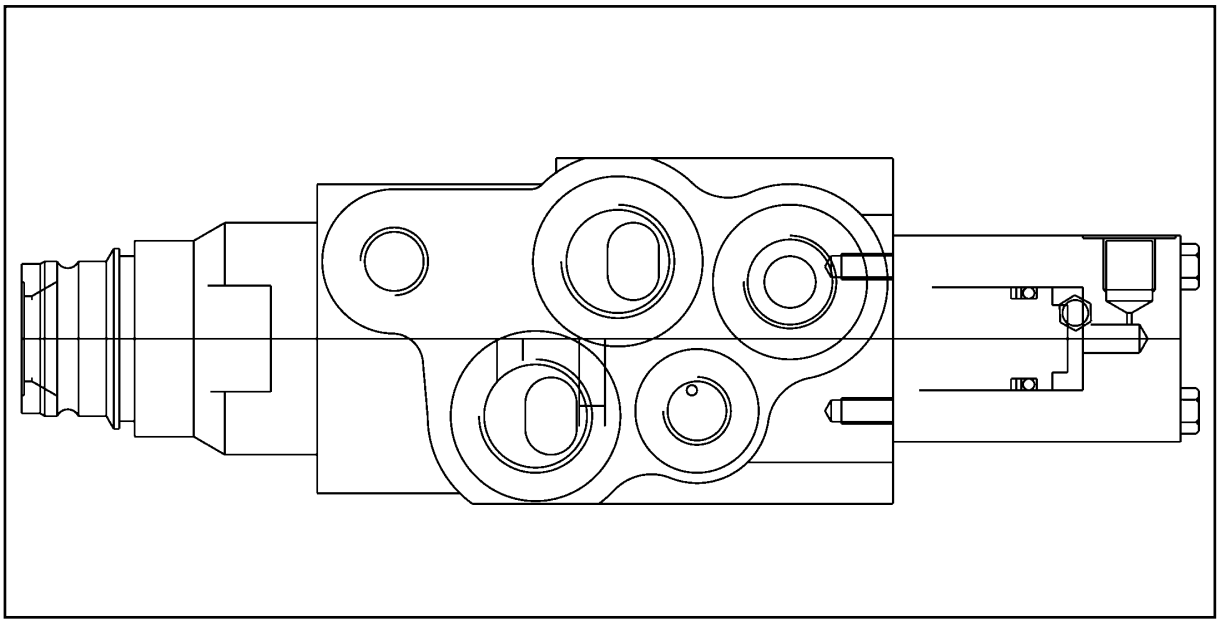


Fig. 7.159

Valve of the type for EXPORT (bracketed)

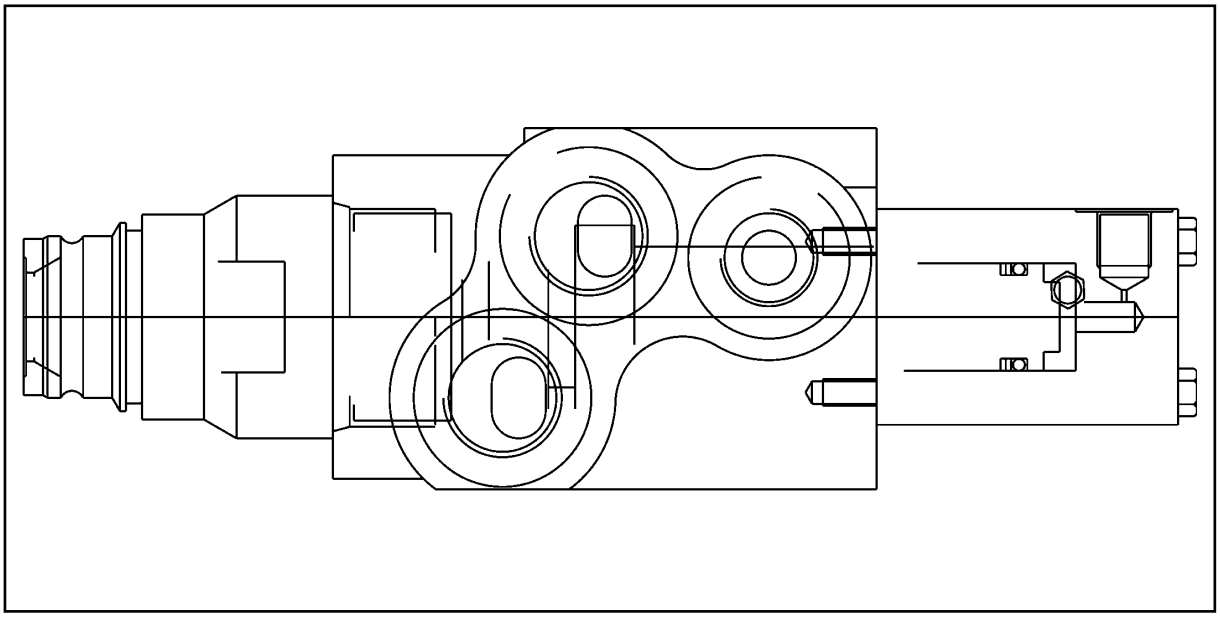


Fig. 7.160

The trailer brake valve installed in footstep tractors is the “bracketed” type.

Oil flows from the pump towards the auxiliary control valves through the connection with the hose pipes outside the valve itself.

6.2.3 Trailer brake of the type for ITALY

Italian laws require the trailer to self-brake when unhitched from the tractor.

Moreover, the trailer brake must engage when the tractor stops and the parking brake is engaged.

Thus, when the tractor has hitched the trailer, a constant pressure between **10 and 15 bar** is still required even when the brakes are not used so as to keep the mechanical brake disengaged.

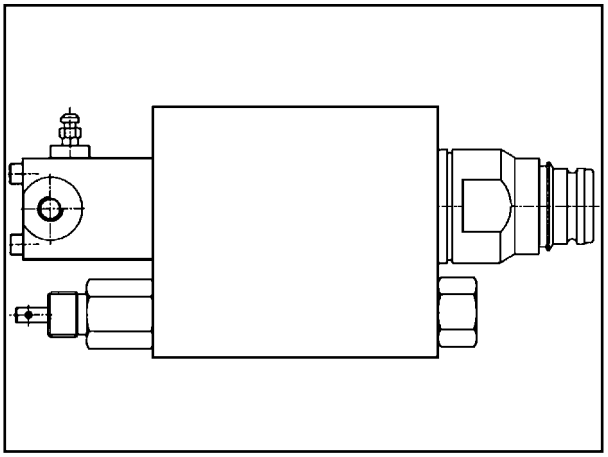


Fig. 7.161

Functional diagram

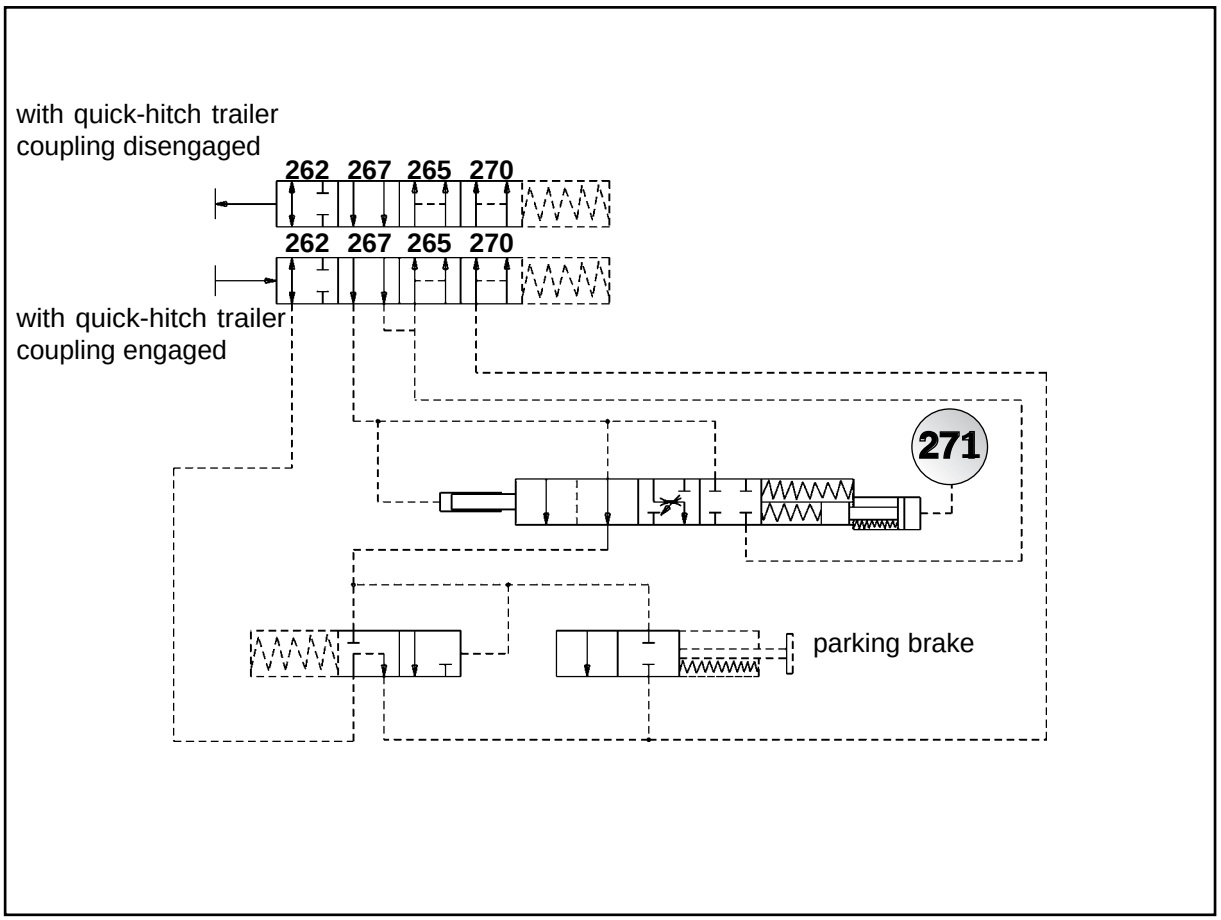


Fig. 7.162

6.2.3.1 Phase with trailer hitched and pedal brakes unused

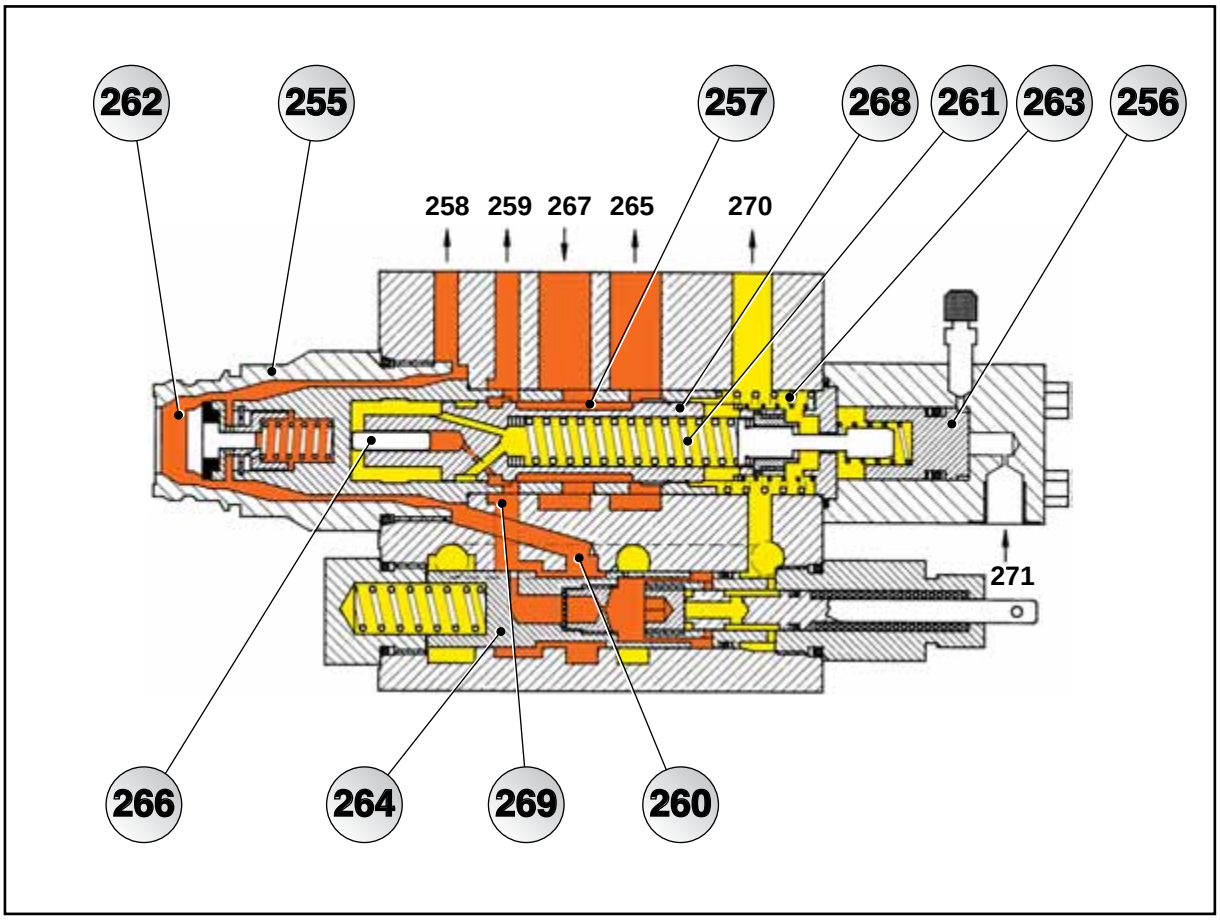


Fig. 7.163

Oil from the pump in duct “267” passes through race “257”, enters channel “269” and race “260”, then supplies the trailer brake through chamber “262”, thus disengaging the automatic braking device. Spring “263” ensures that the pressure is maintained at **10-15 bar** by allowing the plunger “264” to fluctuate. The main plunger “268” allows oil from the pump to supply the power lift by means of race “257”.

255 - Quick coupling for trailer brake connection
256 - Auxiliary valve activating plunger
257 - Pump-power lift connecting race
258 - Pressure switch
259 - Pressure switch
260 - Race
261 - 140 bar pressure upkeep valve
262 - Trailer brake outlet
263 - 10-15 bar pressure upkeep valve
264 - Sliding plunger
265 - To power lift
266 - Return plunger
267 - From pump
268 - Main valve system plunger
269 - Trailer brake race
270 - To outlet
271 - From tractor brakes
- discharge
- oil at a pressure of 10-15 bar

6.2.3.2 Phase with trailer hitched and pedal brakes depressed

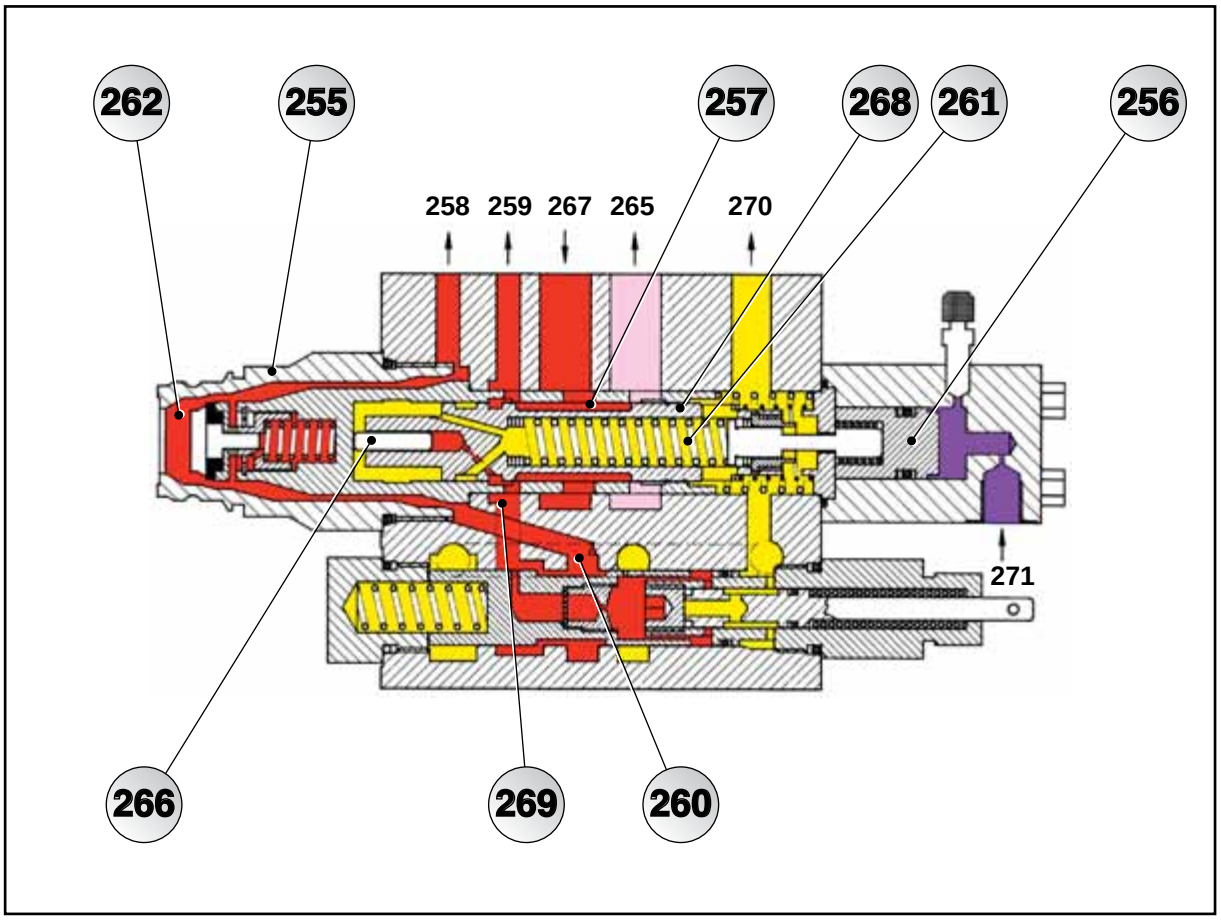


Fig. 7.164

Oil from the brakes shifts plunger “256” causing spring “261” to compress and moving main plunger “268”. The full flow of fluid in channel “269” passes through race “260”, supplying chamber “262” and, consequently, the trailer brake. This achieves a braking action up to a max. pressure of **140 bar**

Once the braking action has been obtained, the pressure increase causes plunger “266” to shift. This sets main plunger “268” back in the neutral position, opening the passage to channel “265” again in order to supply the power lift.

255 - Quick coupling for trailer brake connection
256 - Auxiliary valve activating plunger
257 - Pump-power lift connecting race
258 - Pressure switch
259 - Pressure switch
260 - Race
261 - 140 bar pressure upkeep valve
262 - Trailer brake outlet
265 - To power lift
266 - Return plunger
267 - From pump
268 - Main valve system plunger
269 - Trailer brake race
270 - To outlet
271 - From tractor brakes

- discharge
- from high pressure pump (maximum 140 bar)
- to power lift
- from on-off valve (pedal brakes)

6.2.3.3 Phase with trailer hitched and parking brake engaged

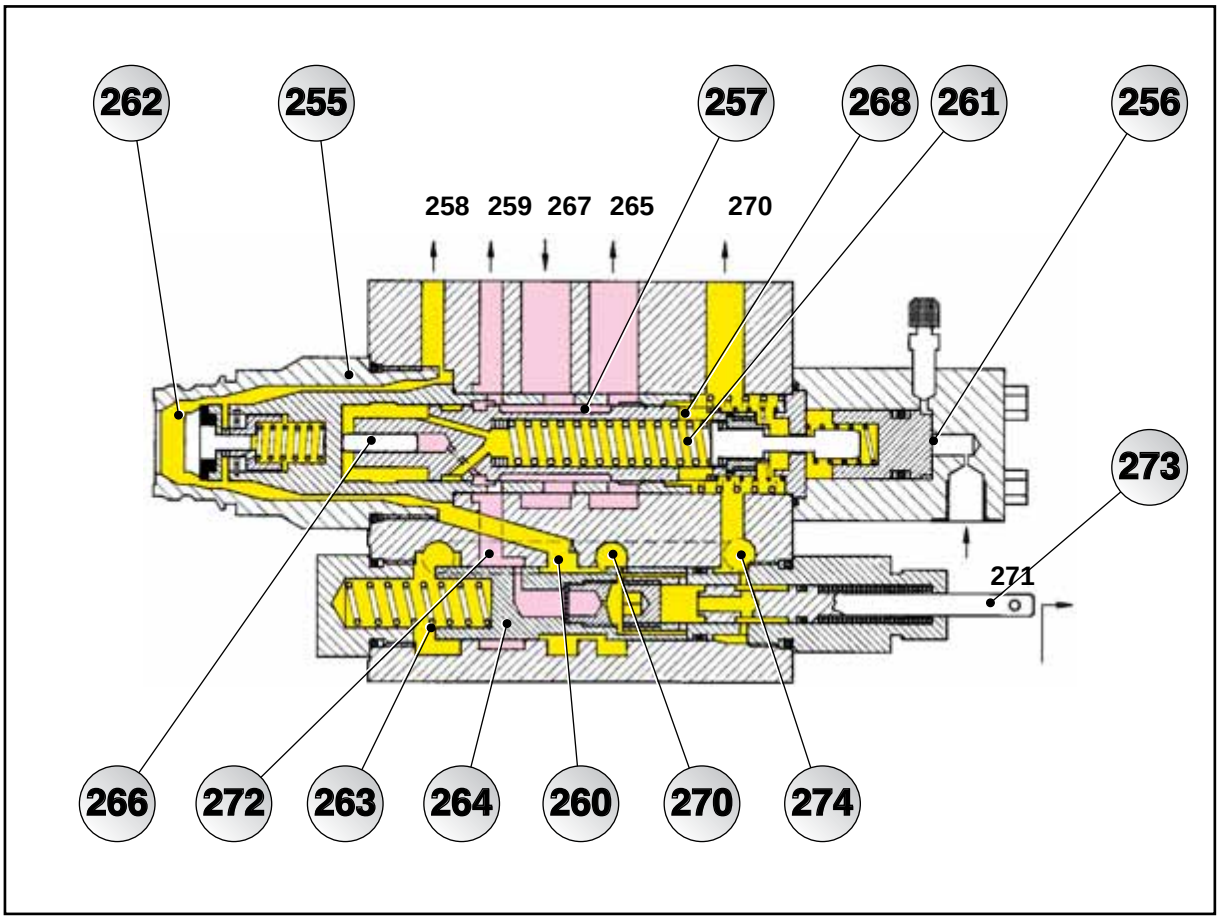


Fig. 7.165

Activation of hand brake “273” sets internal channel “274” in communication with outlet “270” and, consequently, with all the chambers that communicate with the trailer brake. This allows the pressure to drop to **0 bar** and the automatic trailer brake to engage.

After filling chamber “272”, oil from the pump supplies the hydraulic power lift through duct “265”.

255 - Quick coupling for trailer brake connection
256 - Auxiliary valve activating plunger
257 - Pump-power lift connecting race
258 - Pressure switch
259 - Pressure switch
261 - 140 bar pressure upkeep valve
262 - Trailer brake outlet
265 - To power lift
266 - Return plunger
267 - From pump
268 - Main valve system plunger
269 - Trailer brake race
270 - To outlet
271 - From tractor brakes
- discharge
- to power lift

6.2.4 Trailer brake of the EXPORT type

Unlike the valves installed in tractors for the Italian market, the trailer brake valve of the Export type installed in **Power Shuttle** tractors for the foreign market does not need a device that releases the trailer's self-braking system, this owing to a different type of legislation.

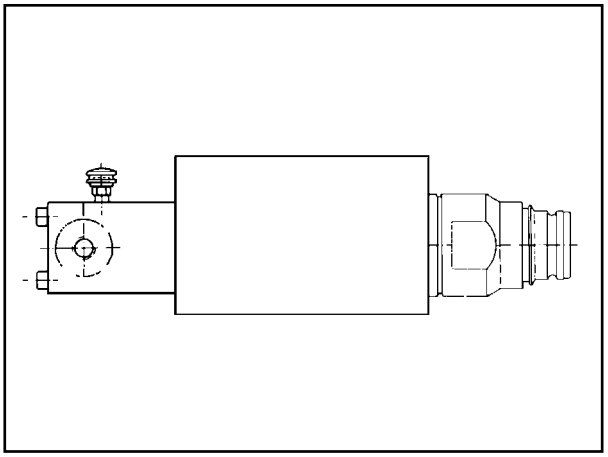


Fig. 7.166

Functional diagram

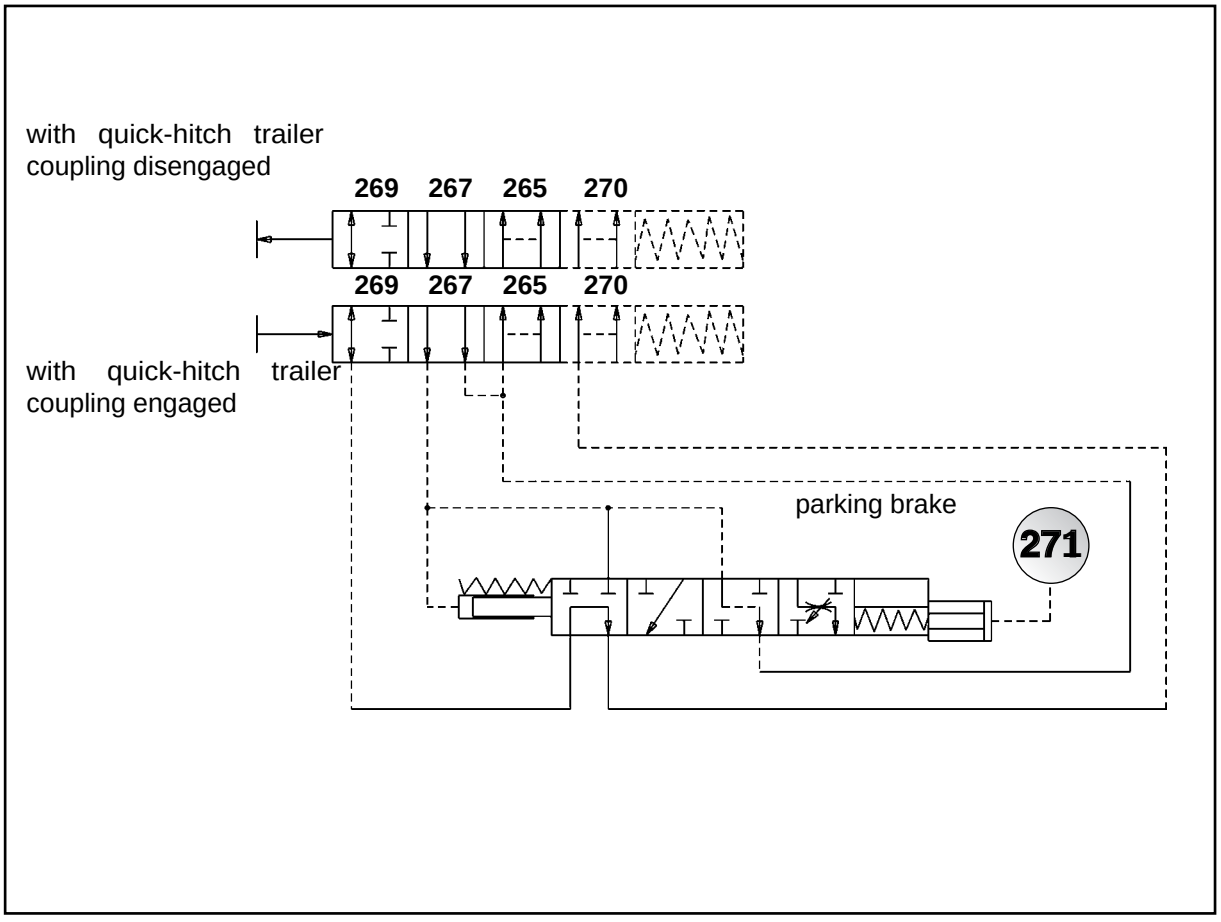


Fig. 7.167

6.2.4.1 Phase with trailer hitched and pedal brakes unused

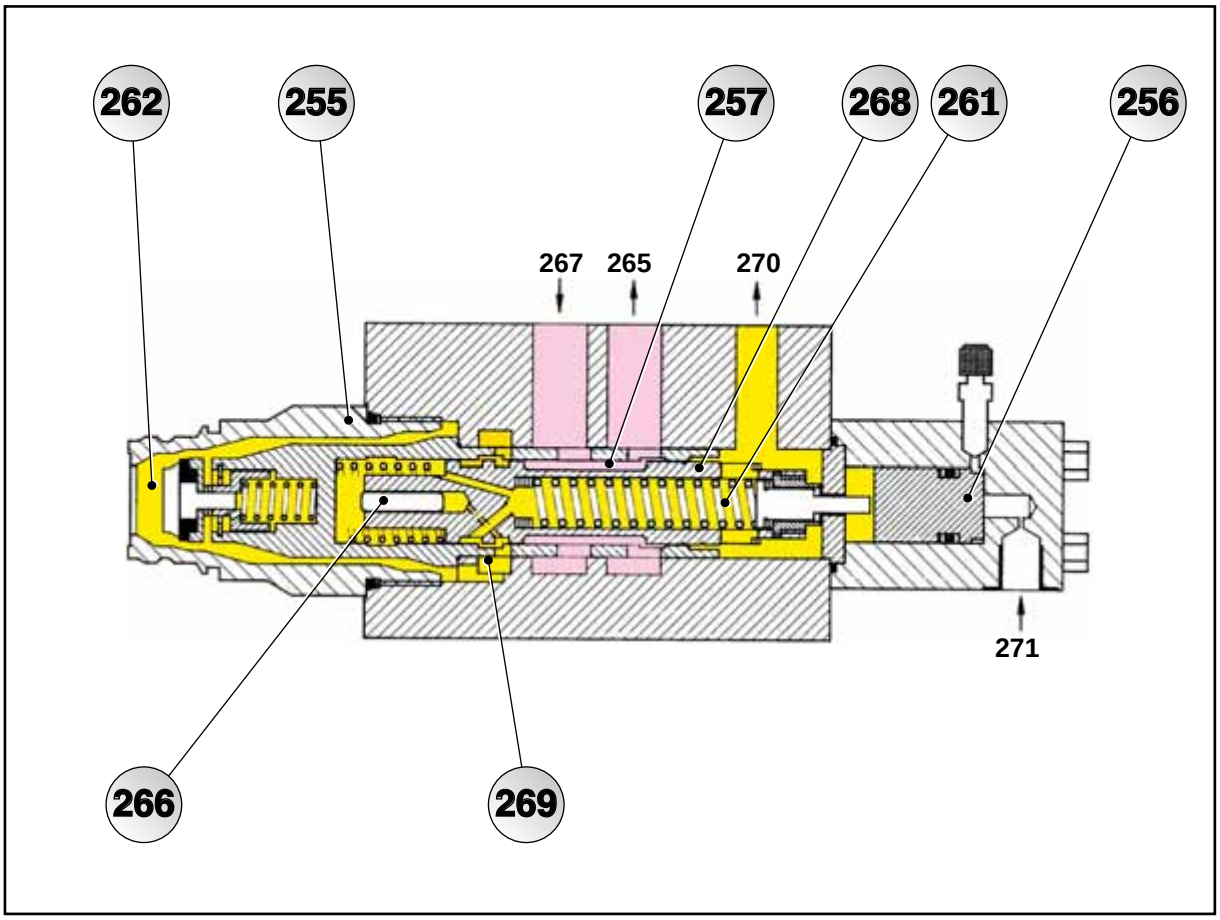


Fig. 7.168

Oil from the pump passes through race “257” and leaves through duct “265” to supply the hydraulic power lift.

The oil in duct “262” flows toward outlet “270” through ducts “269” and spring chamber “261”.

255 - Quick coupling for trailer brake connection
256 - Auxiliary valve activating plunger
257 - Pump-power lift connecting race
261 - 140 bar pressure upkeep valve
262 - Trailer brake outlet
265 - To power lift
266 - Return plunger
267 - From pump
268 - Main valve system plunger
269 - Trailer brake race
270 - To outlet
271 - From tractor brakes

- discharge
- to power lift

6.2.4.2 Phase with trailer hitched and pedal brakes depressed

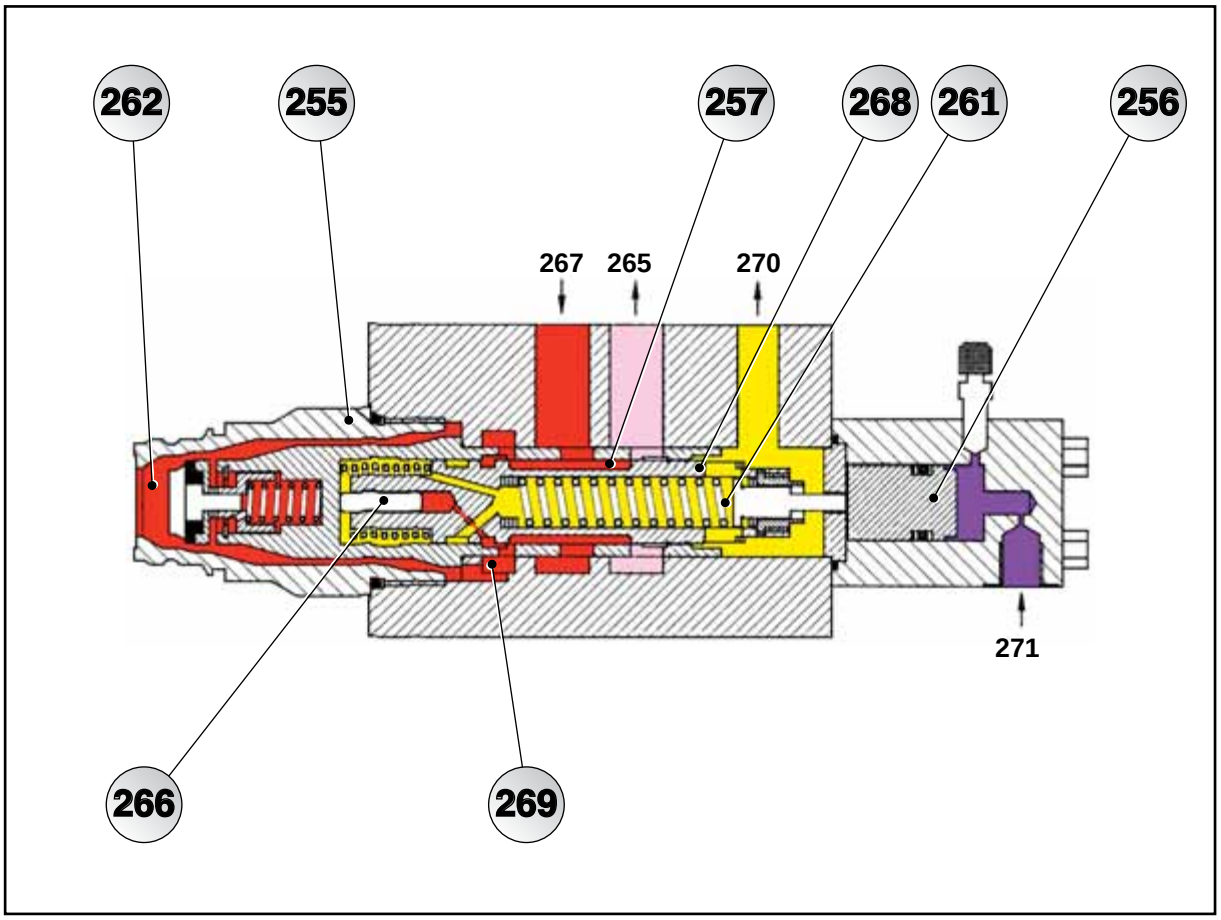


Fig. 7.169

Oil from the brakes shifts plunger “256” which moves the main plunger “268” by compressing spring “261”, opening the flow by means of race “269” to chamber “262”, which conveys the oil to the trailer brake.

Thus oil from the pump supplies the trailer brake through duct “267”. The pressure increase also shifts plunger “266” which allows main plunger “268” to return to neutral pressure, opening the oil supply toward the power lift through duct “265” again.

255 - Quick coupling for trailer brake connection
256 - Auxiliary valve activating plunger
257 - Pump-power lift connecting race
261 - 140 bar pressure upkeep valve
262 - Trailer brake outlet
265 - To power lift
266 - Return plunger
267 - From pump
268 - Main valve system plunger
269 - Trailer brake race
270 - To outlet
271 - From tractor brakes

- discharge
- to power lift
- from high pressure pump (maximum 140 bar)
- from on-off valve (pedal brakes)

6.3 Auxiliary control valves

6.3.1 Hydraulic circuit

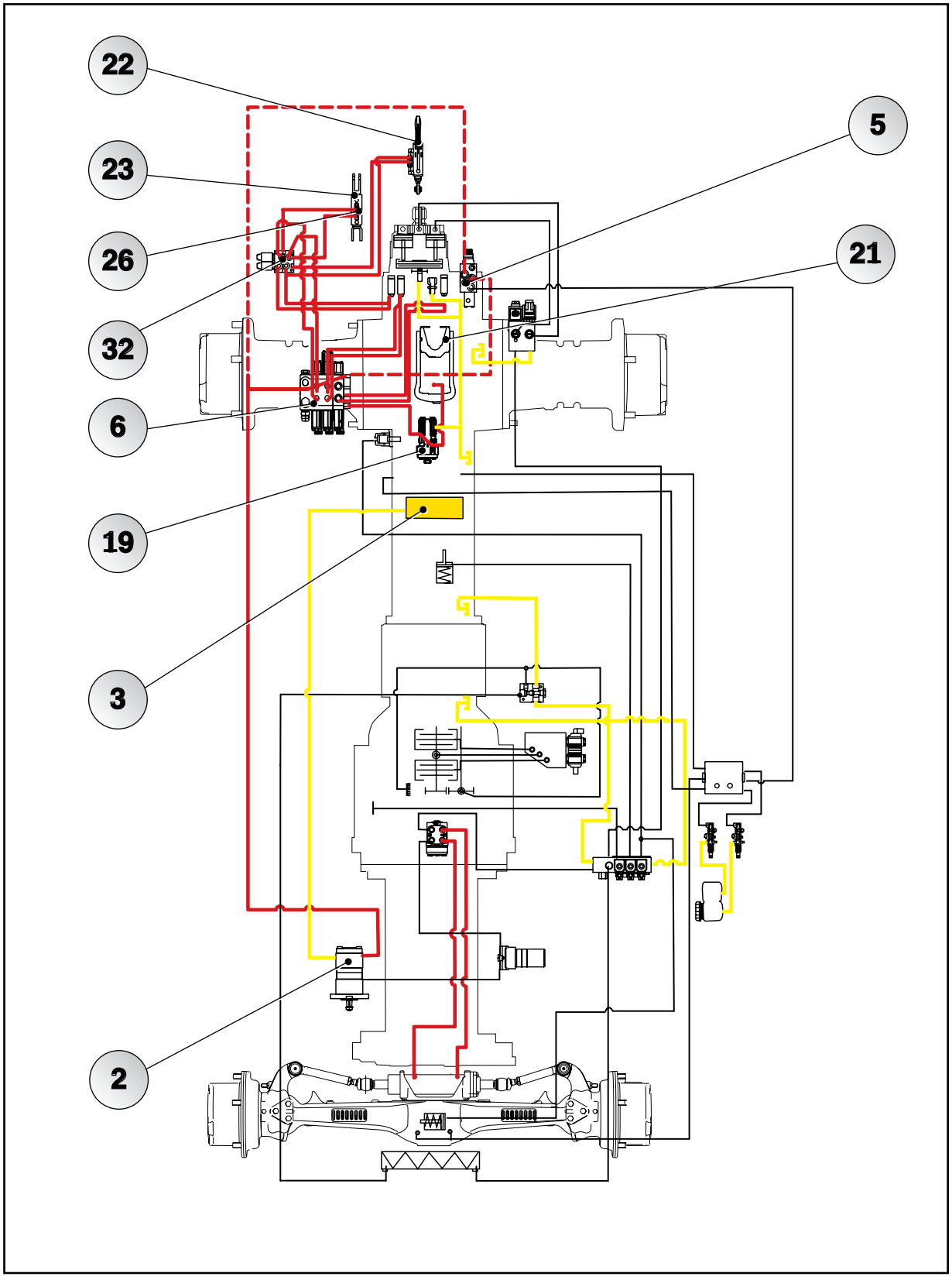


Fig. 7.170

2 - High flow pump
5 - Hydraulic trailer brake valve
6 - Rear auxiliary control valve unit
7 - Power lift valve system
21 - Power lift's internal ram
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
26 - Shut-off valves
32 - Electro-hydraulic flow selector

- high pressure
- discharge/inlet

6.3.2 General description

The auxiliary control valves are installed on the right-hand side (Fig.7.171) of the hydraulic power lift and are used to control the external rams.

They are used in conjunction with the hydraulic power lift's circuit, so they use the same transmission oil in an open center circuit.

Auxiliary control valve unit

The unit with the auxiliary control valves consists of:

- an inlet casing, reached by oil with priority, composed either of the trailer brake valve (if mounted) or of a plate that houses the 180 bar calibration valve, or also of a flow governor;
- one or more control valves, up to a maximum of 3;
- an outlet casing that, if a mechanical power lift is installed, consists of a plate from which the oil supply line of the lift departs, or, if an electronic power lift is installed, of a control valve unit of the lift itself.

The control valves are supplied at the same time but, when one of them is activated, the oil supply to the next control valves and to the lift is shut off, thus excluding their contemporary operation. The flow divider (mounted on request) controls the oil flow to the first control valve, leaving the residual flow from the pump available to a second control valve or to the hydraulic power lift.

Control valve types

The control valves are available in the following versions:

a - **Standard single and double-acting control valve;**
b - Single and double-acting control valve with automatic release;
c - **Single and double-acting control valve with floating position;**
d - **Control valve to supply hydraulic motors.**

The maximum number of control valves tha can be mounted depends on the tractor version:

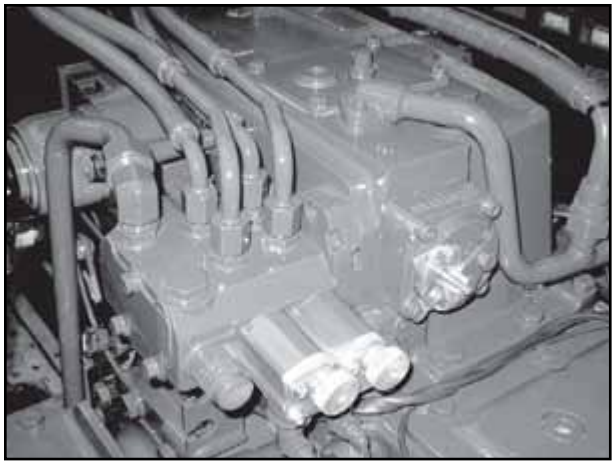


Fig. 7.171

Control levers

The control levers of the auxiliary control valves (F) are mounted on the right of the driving position.

Above the control levers (F) the knobs (G) are located. Each one can select three operating modes of the control valves:

a - Knob turned anti-clockwise for single-acting operation mode (A Fig.7.173);
b - Knob in central position for double-acting operating mode;
c - Knob turned clockwise to lock the lever in the neutral position (AB Fig.7.173).

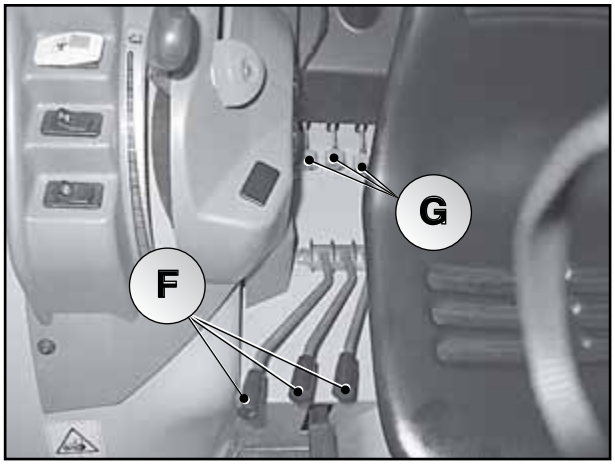


Fig. 7.172

Flow divider (on request)

On request, a flow divider (6c) can be mounted that is coupled to the first auxiliary control valve, preset for this use. The adjuster knob (H Fig.7.174) can be regulated to obtain a regulated flow to the first control valve next to the flow divider (6a).

Knob (H) turned clockwise: the flow to the adjacent control valve is reduced to a minimum 2 liters/min. The excess flow may be used by the next control valves or by the hydraulic power lift.

Knob (H) turned anti-clockwise: increases the oil flow to the auxiliary control valve connected until the pump's maximum flow rate is reached. The excess flow may be used by the next control valves or by the hydraulic power lift.

If the auxiliary control valve connected to the flow divider is not used after adjusting this latter, the whole flow from the hydraulic pump is available for the next control valves or for the hydraulic power lift.

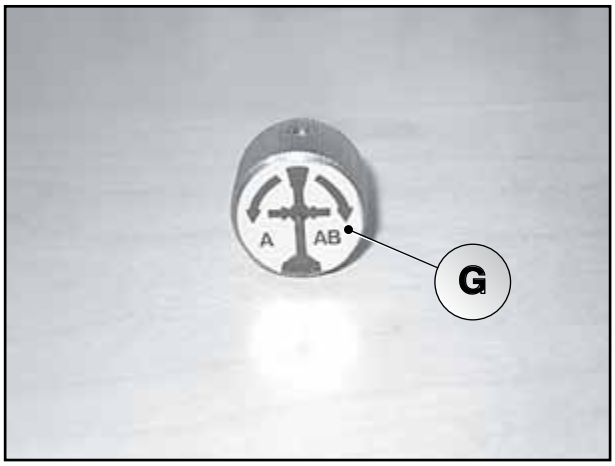


Fig. 7.173

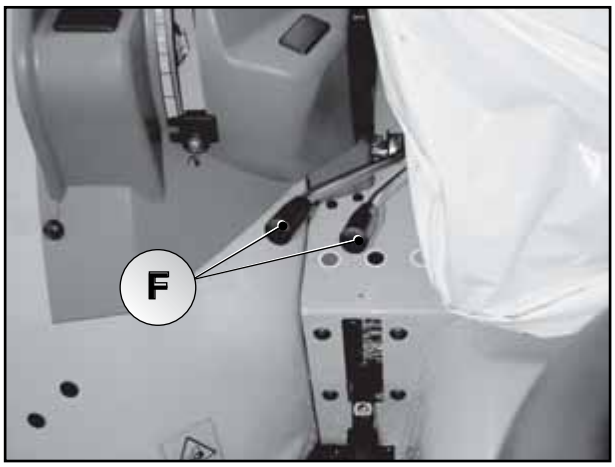


Fig. 7.174

6.3.3 Inlet plate with flow divider

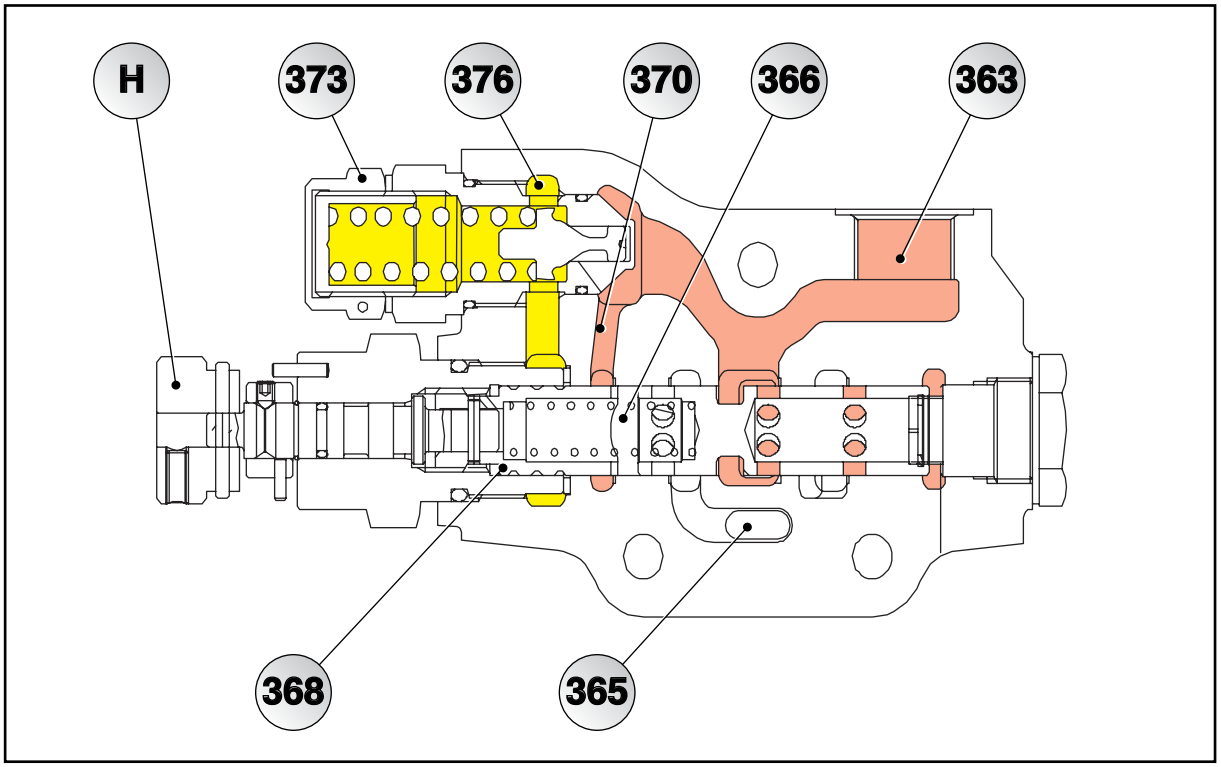


Fig. 7.175

Phase without regulated flow

Oil from the pump flows into chambers (386) and (380) at the same time.

When the stem is in neutral position, oil from the chamber (386) displaces the non return valve (385) and reaches chambers (384) and (387), where there is no outlet. The race in the stem (389) lets oil from chamber (380) flow into chamber (388). This ensures a continuous flow to the next control valves or to the hydraulic power lift.

If the stem is shifted to the left, oil from chamber (386) may flow through (381) and supply the external ram. Oil returning from hole (379) through the duct (378), flows to the discharge.

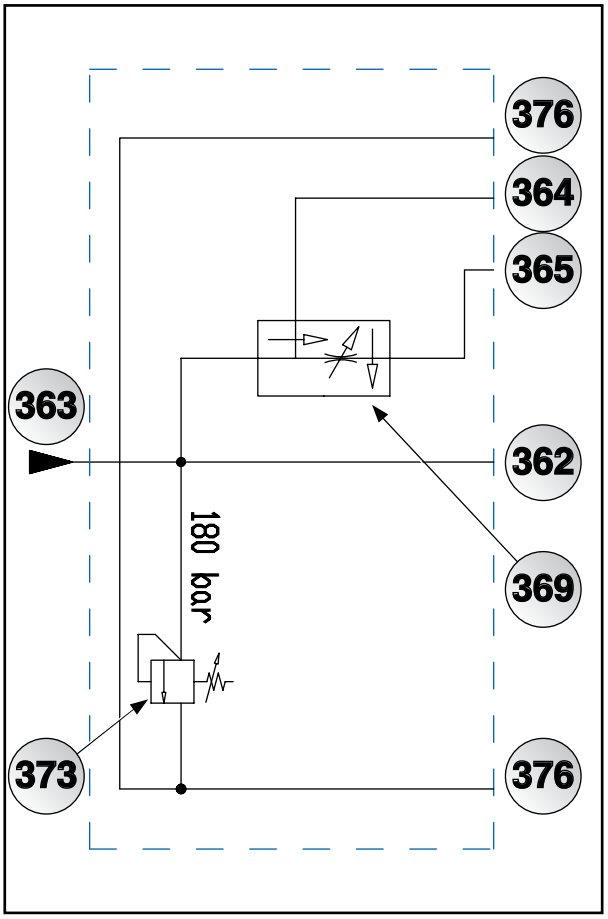


Fig. 7.176

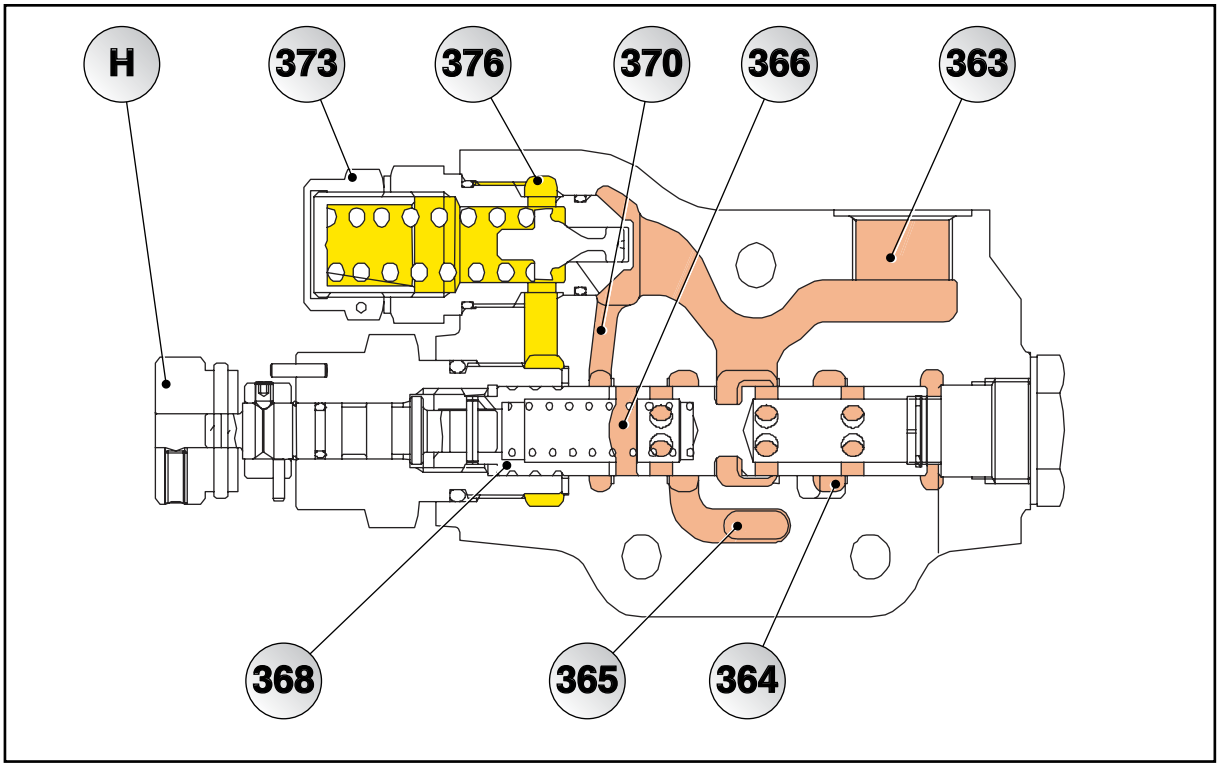


Fig. 7.177

Phase without regulated flow

Oil from the pump flows into chambers (386) and (380) at the same time.

If the stem is shifted to the right, oil from chamber (386) flows to (387) and supplies hole (379), operating the external ram.

Oil returning from hole (381) through the duct (382), flows to the discharge outlet.

When the lever is no longer operated, the stem is always returned to the neutral position by a spring.

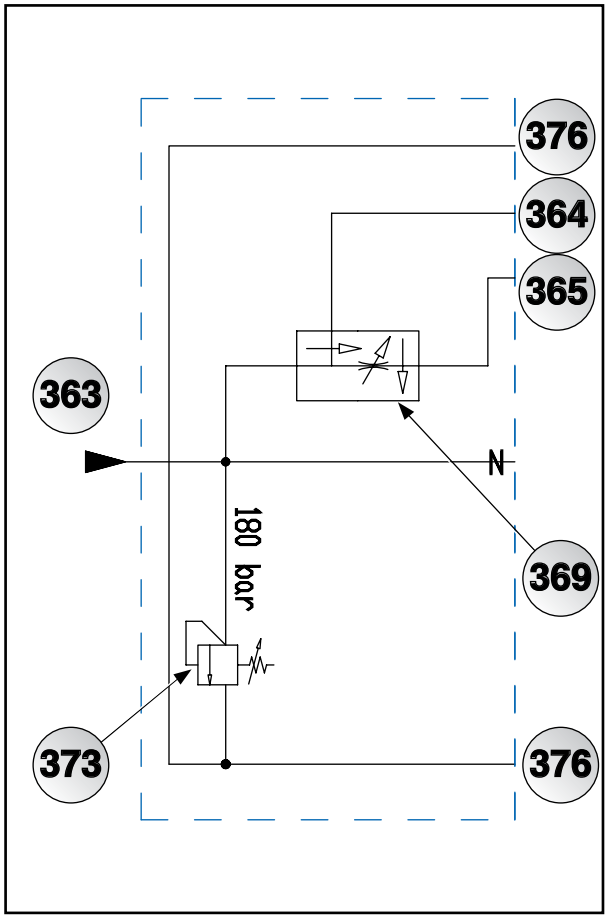


Fig. 7.178

6.3.4 Control valve for hydraulic motor (with flow divider)

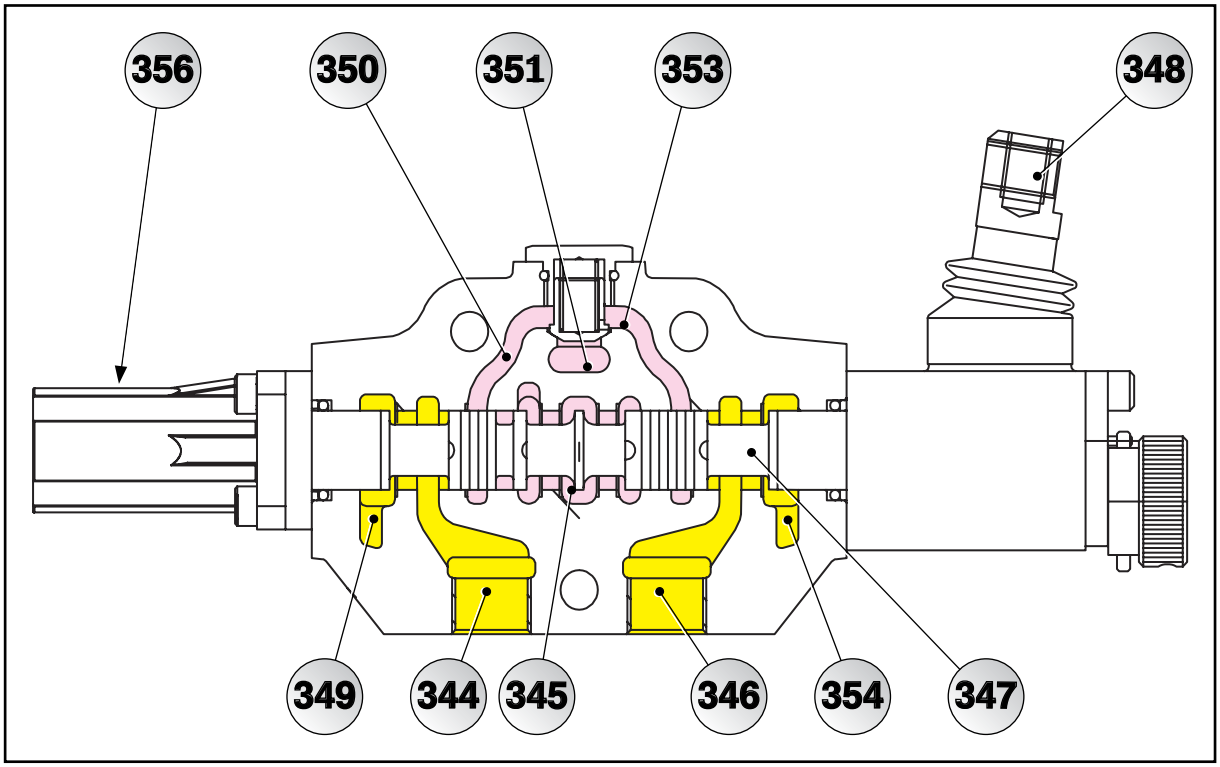


Fig. 7.179

344 - User
345 - Continuity duct
346 - User
347 - Stem
348 - Remote control lever
349 - Discharge
350 - Supplies
351 - Oil arriving from pump
353 - Supplies
354 - Discharge
356 - Plunger unit

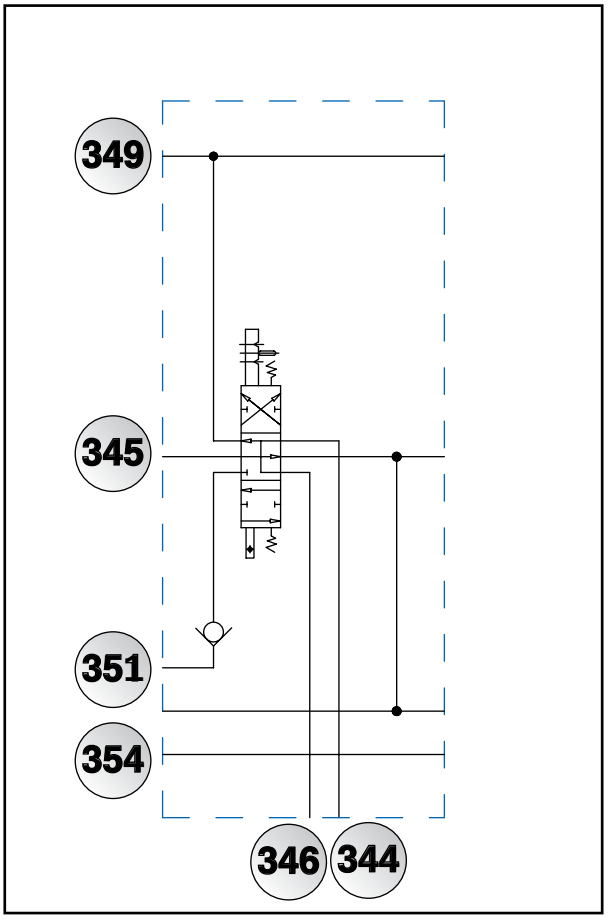


Fig. 7.180

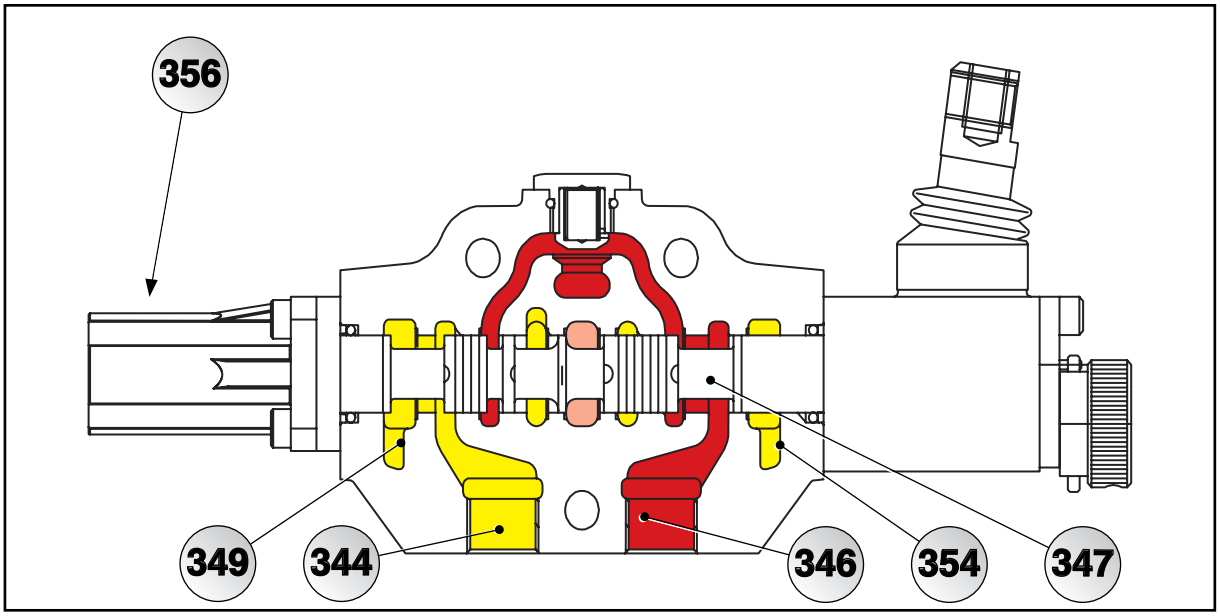


Fig. 7.181

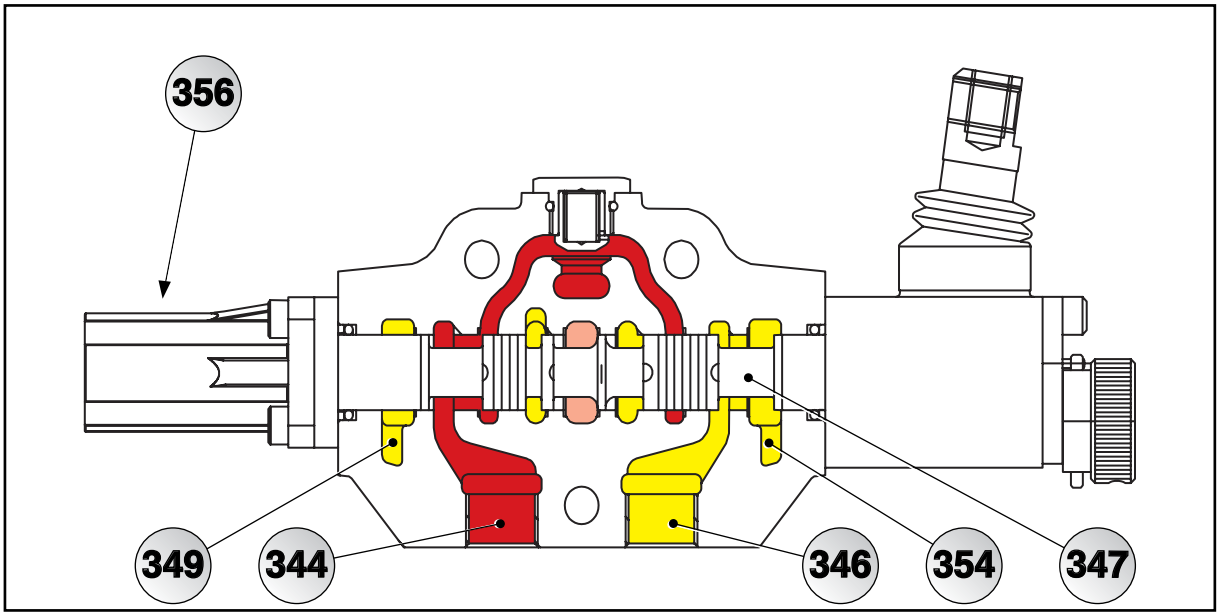


Fig. 7.182

Description of operation

The control valve that supplies a hydraulic motor differs in two ways from a standard single-acting control valve:

- when the stem (347) is in the neutral position, the two chambers (344) and (346) are always in communication with the outlets (349) and (354), so that the pressure is always reduced to 0;
- the stem is locked when it is shifted both to the right and to the left thanks to the action of the balls, which seat in their respective races in the plunger (356). The stem must be returned to the neutral position by the operator.

Refer to the standard control valve for a description of its normal operation.

6.3.5 Standard single and double-acting control valve (for excess flow) (with flow divider)

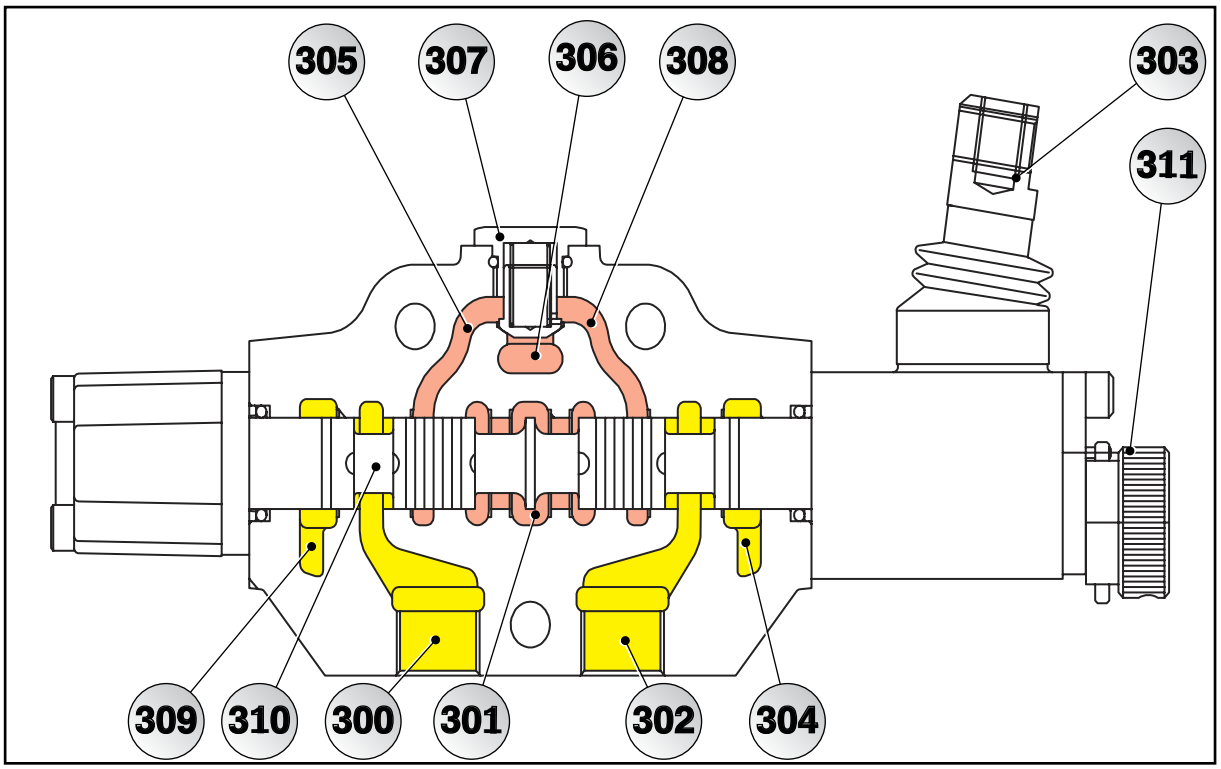


Fig. 7.183

300 - User
301 - Towards the power lift
302 - User
303 - Lever (remote control)
304 - Discharge
305 - Feed chambers
306 - Oil arriving from the flow divider
307 - Retainer
308 - Feed chambers
309 - Discharge
310 - Stem
311 - Valve for single/double-action conversion

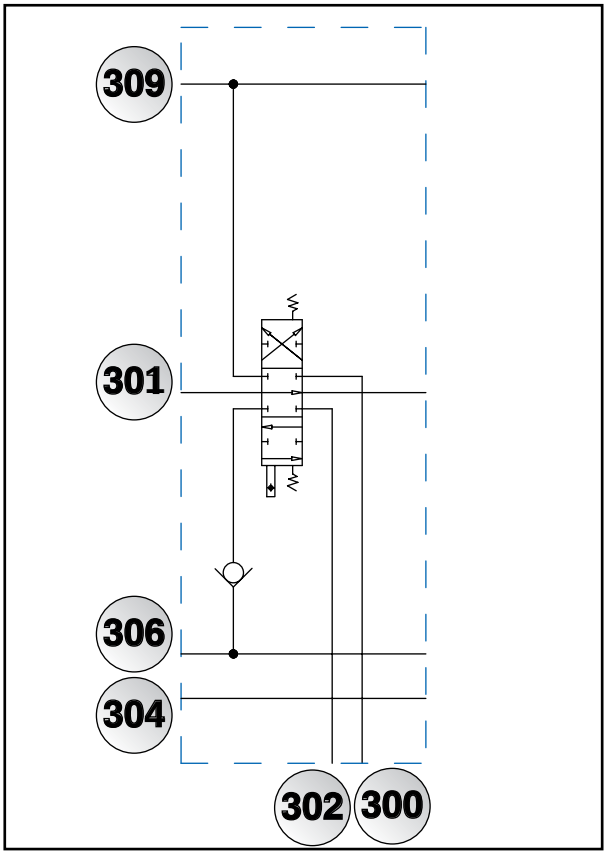


Fig. 7.184

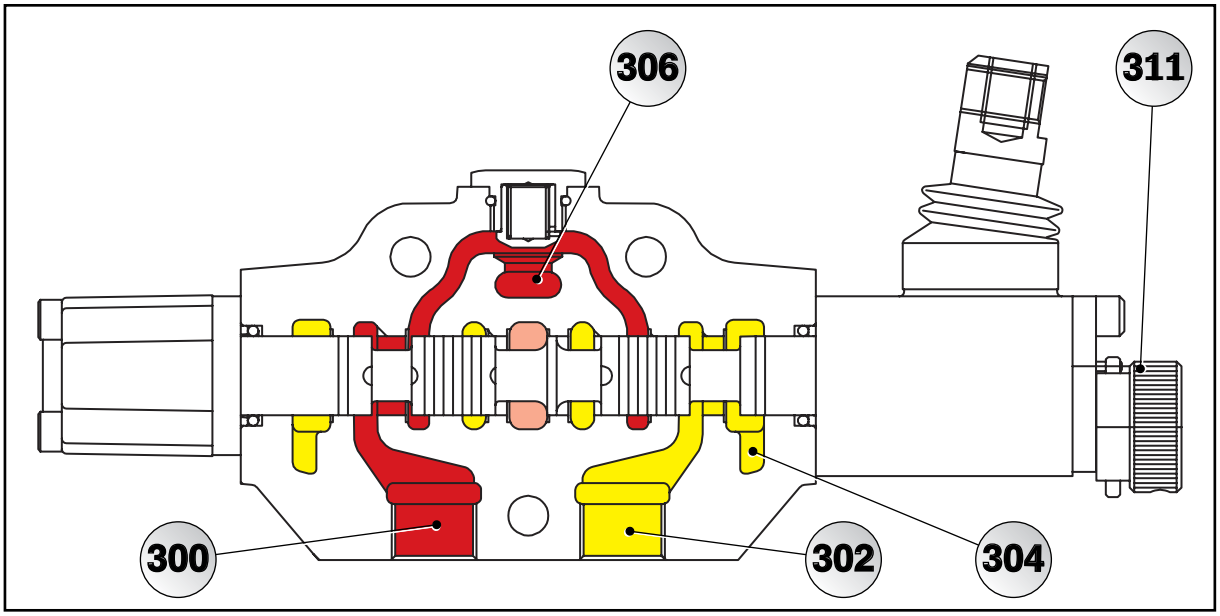


Fig. 7.185

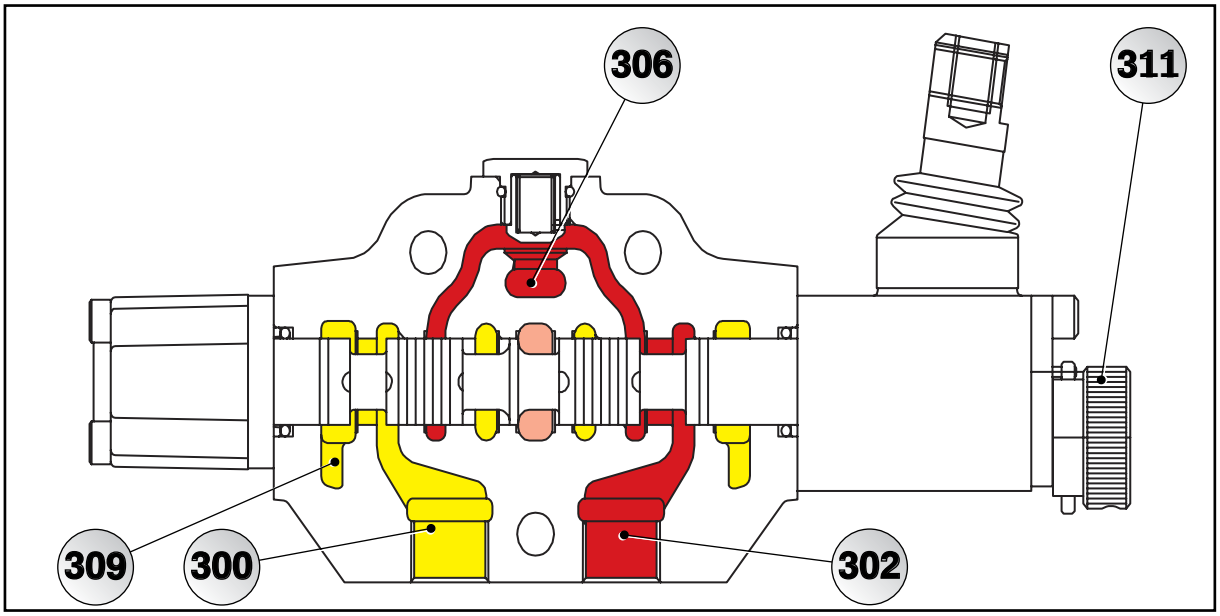


Fig. 7.186

Description of operation

Oil from the pump flows into chamber (306) and into the continuity race (301) at the same time.

When the stem is on hold, oil from the pump through the chamber (306) displaces the non return valve (307) and reaches chambers (305) and (308), that have no outlet. Oil passes through the continuity race (301) in order to supply the following control valves or the hydraulic power lift.

If the stem is shifted to the left, oil from the chamber (306) may flow on to hole (302) to supply the external ram, while oil returning from the hole (300) via the duct (309) goes to the outlet.

If the stem is shifted to the right, oil from chamber (306) may flow on to hole (300) to supply the other side of the external ram.

Oil returning from hole (302) through duct (304), flows to the discharge outlet.

When the lever is no longer operated, the stem is always returned to the neutral position by a spring.

To obtain single-acting operation, turn the knob (311) in order to connect the user (300). With its outlet (309), the user that supplies the single-acting ram is (302), while user (300) must be plugged.

6.3.6 Floating control valve

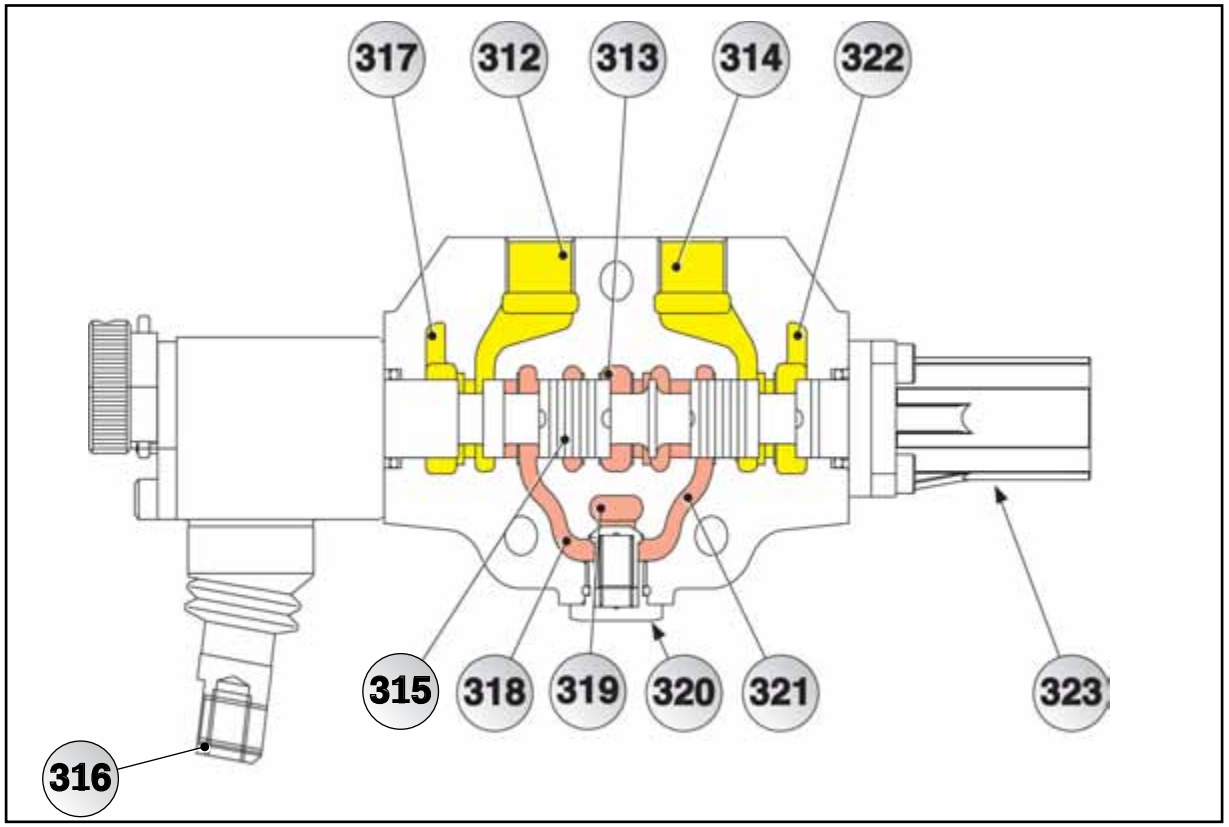


Fig. 7.187

312 - User
313 - Towards the power lift
314 - User
315 - Stem
316 - Lever (remote control)
317 - Discharge
318 - Feed chambers
319 - Oil flowing in from pump
320 - Retainer
321 - Feed chambers
322 - Discharge
323 - Ball/spring unit

Description of operation

Unlike the standard single and double-acting control valve, this control valve has a further stem position towards the right, where the floating position is obtained. In this position the stem (315) is mechanically locked by the balls (323), which seat in the relative race.

In these conditions, oil from the pump (319) through the continuity duct proceeds towards the following control valves or the hydraulic power lift, while the two supply holes (312) and (314) both communicate with outlets (322) and (317). Single or double-acting operation is achieved in the normal way, as described for the standard control valve.

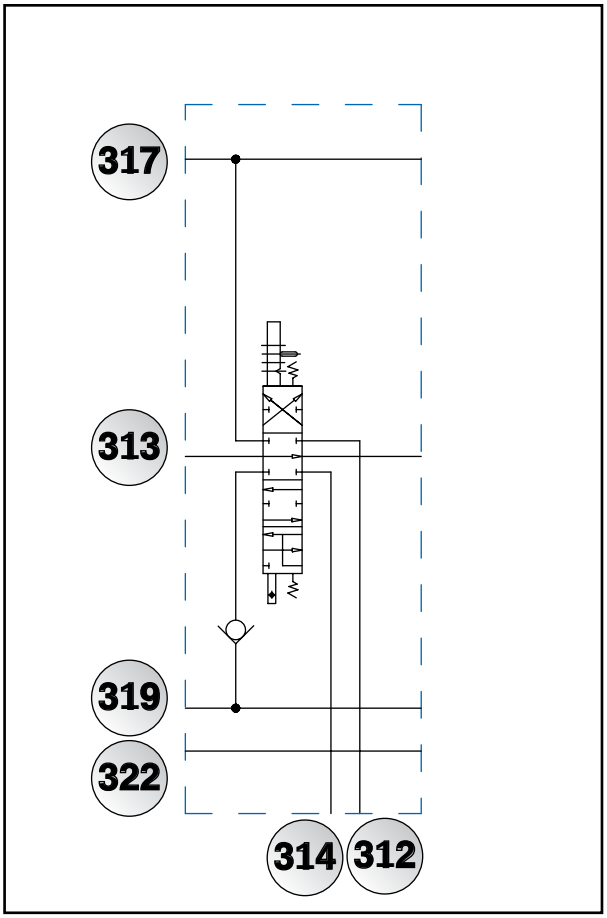


Fig. 7.188

6.3.7 Control valve with automatic release (kick-out)

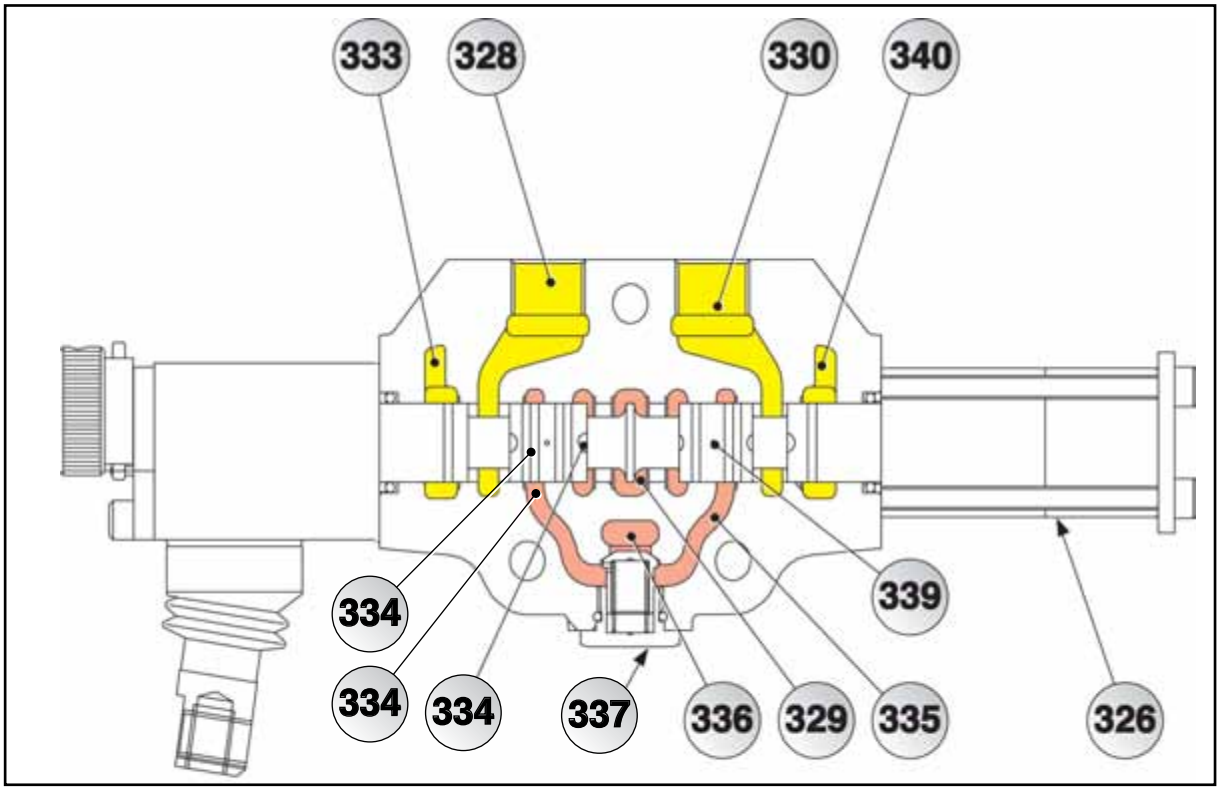


Fig. 7.189

326 - Pump and plunger assembly
328 - User
329 - Towards the power lift
330 - User
331 - Stem
332 - Lever (remote control)
333 - Discharge
334 - Holes
335 - Feed chamber
336 - Oil flowing in from pump
337 - Retainer
338 - Feed chamber
339 - Holes
340 - Discharge

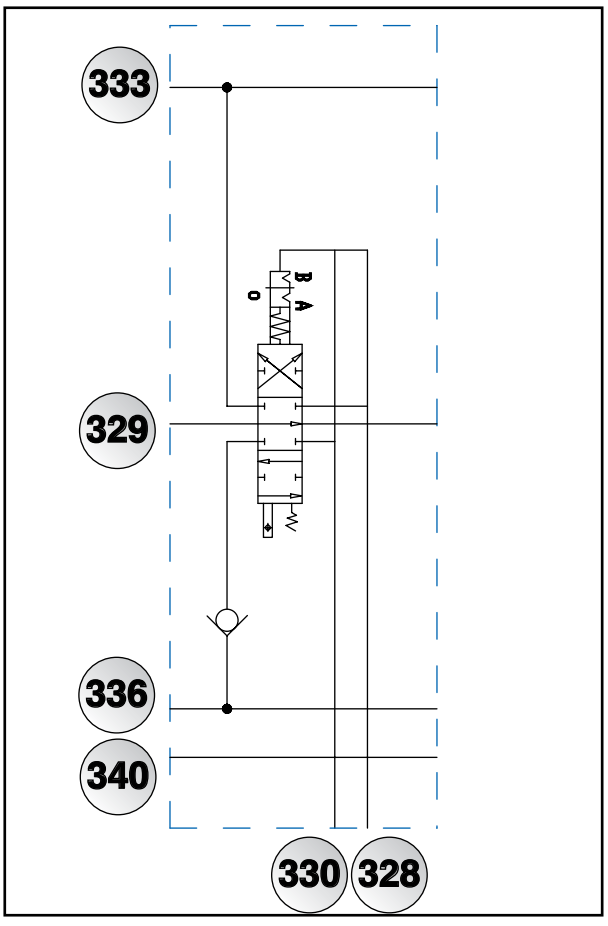


Fig. 7.190

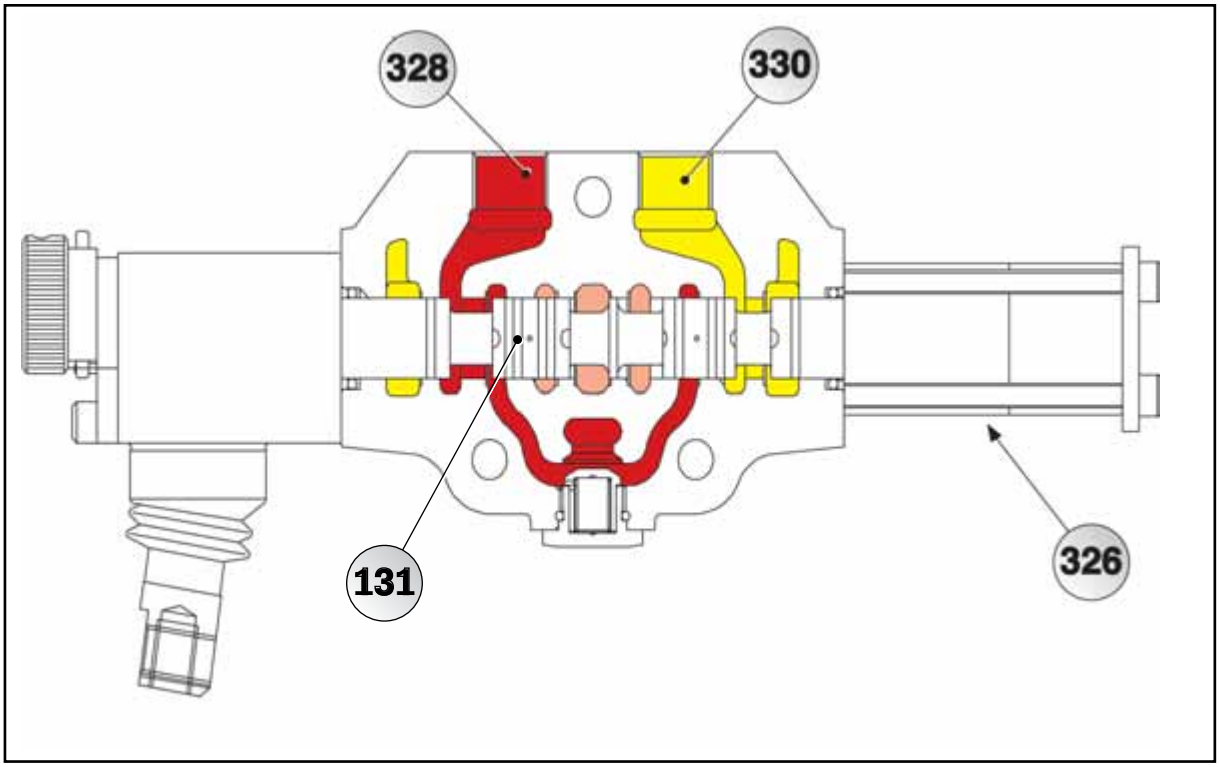


Fig. 7.191

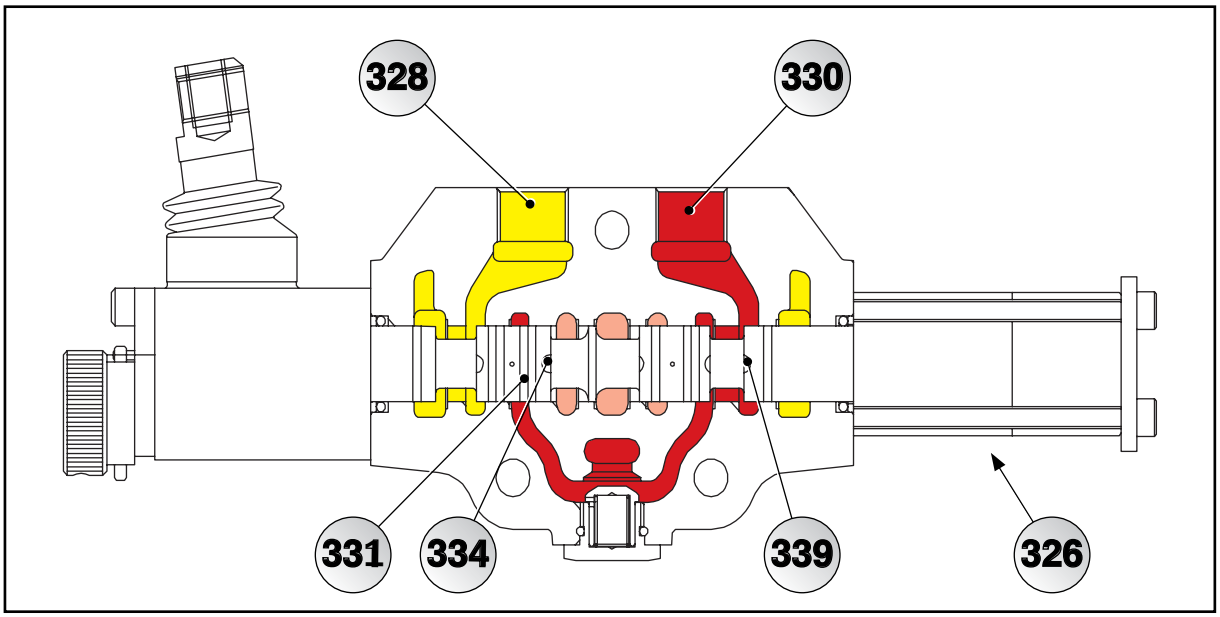


Fig. 7.192

Description of operation

Unlike the standard single and double-acting control valve, this one can lock the control lever to supply the outlets (328) and (330), and automatic return to the neutral position when the external ram is at end of travel.

The stem (331) is locked thanks to the action of the plunger (326).

When the external ram is at end of travel, the pressure increase shifts the stem (331) to the neutral position through holes (334) and (339).

6.3.8 Interface plate (with mechanical power lift)

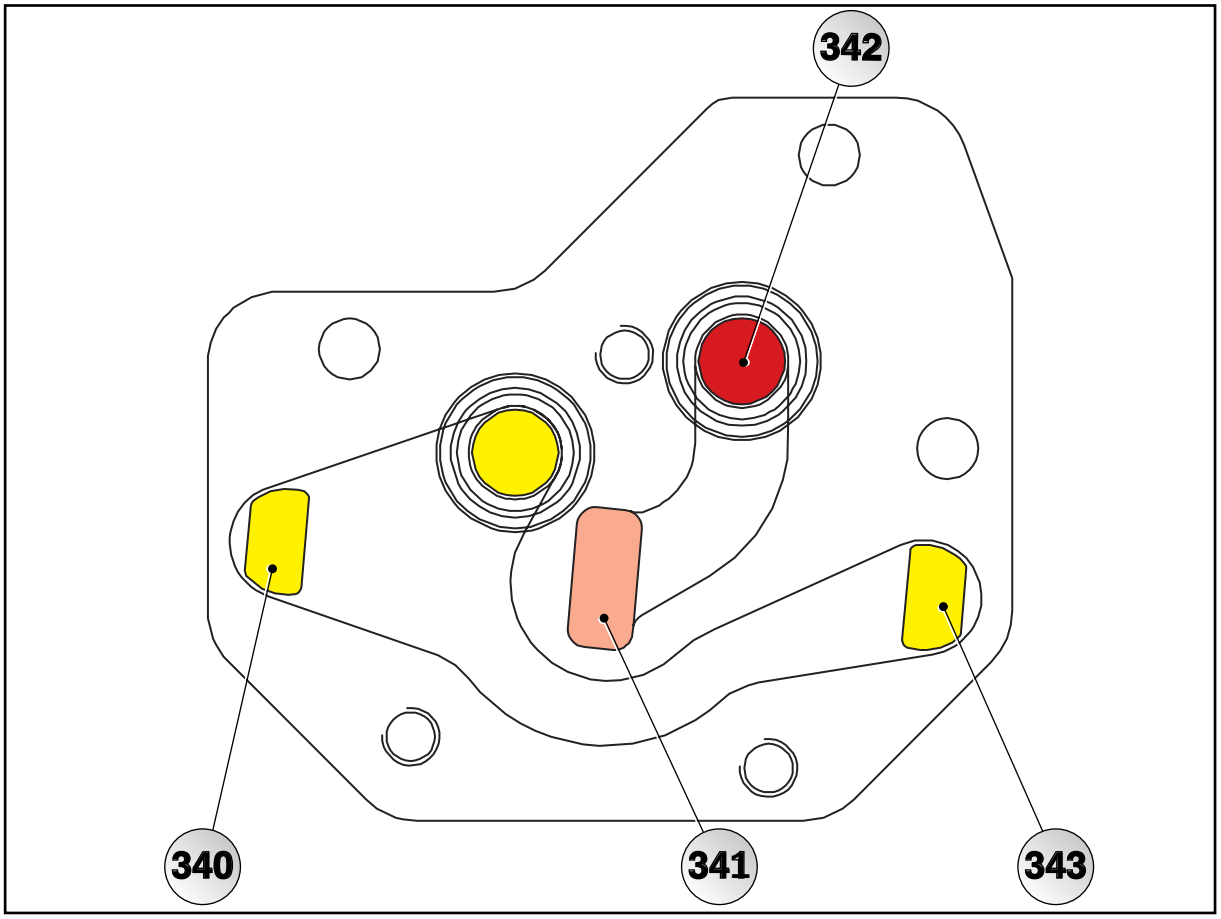


Fig. 7.193

Oil flows from the auxiliary control valve unit through the continuity chamber (341) and proceeds towards the control valve of the hydraulic power lift through the chamber (342). The oil of the auxiliary control valve users is outlet through chambers (340) and (343).

342 - Towards the power lift
341 - Continuity (oil arriving from the control valves)
340 - Discharge

6.3.9 Interface plate (with electronic power lift)

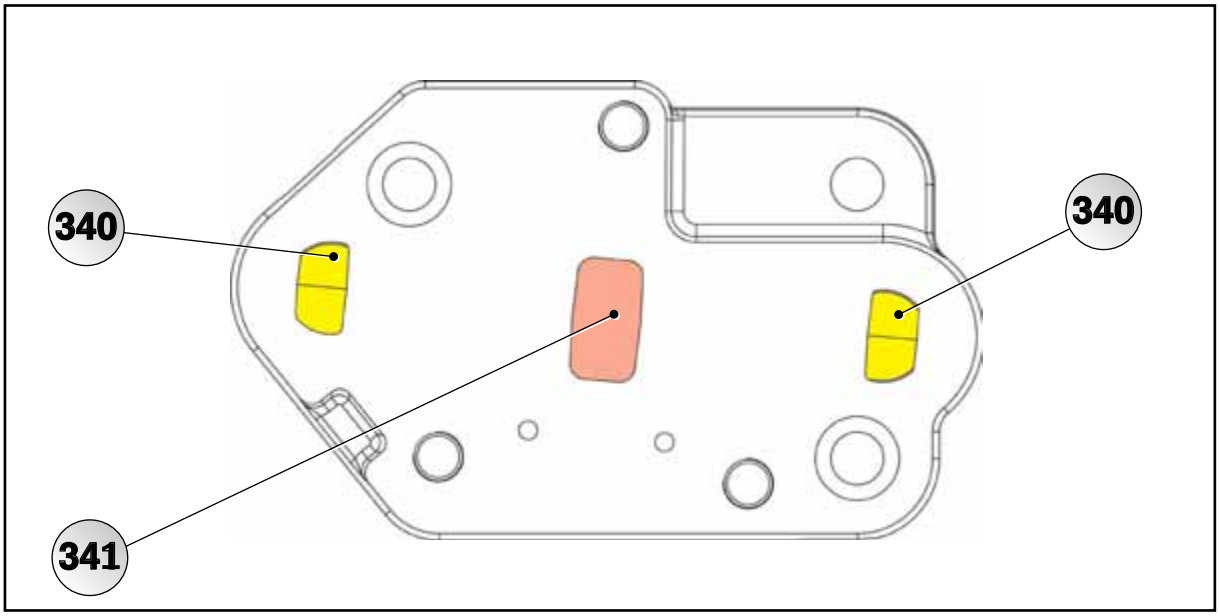


Fig. 7.194

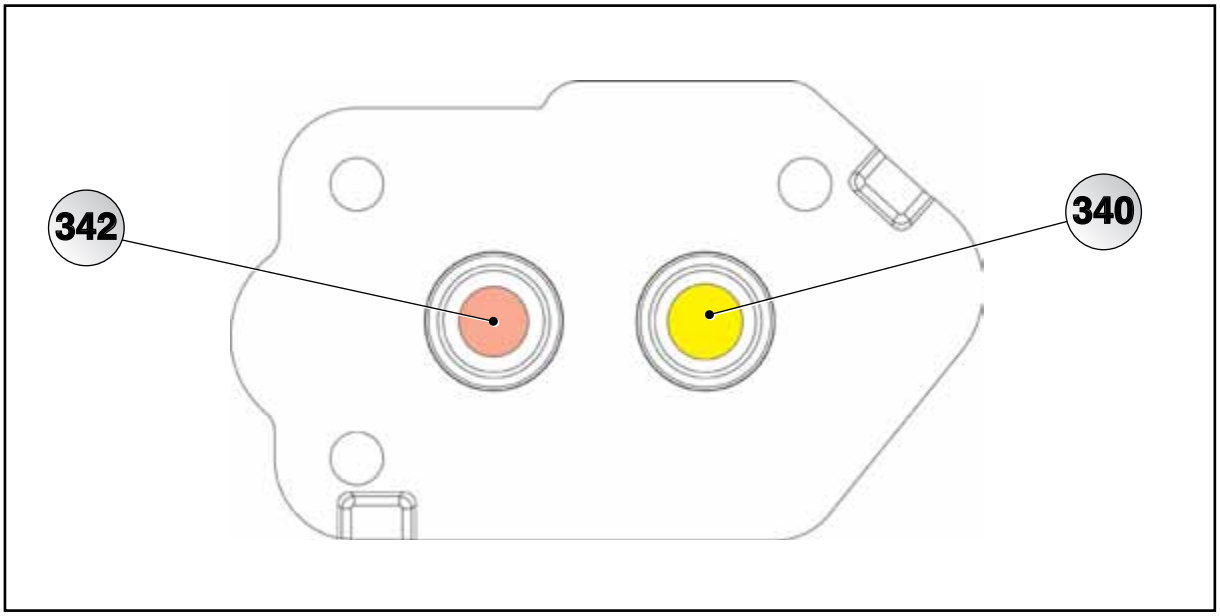


Fig. 7.195

Oil flows from the auxiliary control valve unit through the continuity chamber (341) and proceeds towards the control valve of the hydraulic power lift through the chamber (342). The oil of the auxiliary control valve users is outlet through the chambers (340).

342 - Towards the power lift

341 - Continuity (oil arriving from the control valves)

340 - Discharge

6.3.10 Monoblock for auxiliary control valve unit

The auxiliary control valves can be installed in a single block (400) and can have different configurations, with up to two elements per block. The oil flows into the body of the two control valves through an inlet block (401), which houses a calibration valve (402). Once the 190 bar maximum pressure has been exceeded, the valve opens the communication with the outlet, thus relieving the pressure of the oil flowing towards the two control valves built into the enbloc unit.

The control valves in the monoblock function in the same way as described for the single application in the previous pages, the only difference being that the control head can point either downwards or upwards, depending on the configuration of the machine.

300 - Oil flowing in from pump
301 - Continuity chamber (towards control valves)
303 - Discharge
402 - Maximum valve
401 - Monoblock inlet unit
400 - Monoblock unit
404 - Standard valve unit
405 - Kick out control valve unit
406 - Floating control valve unit

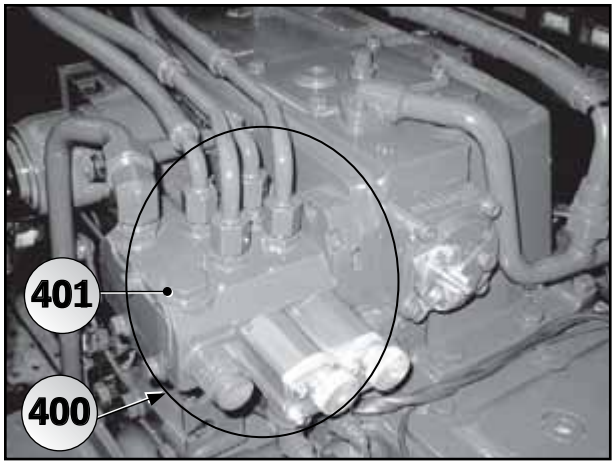


Fig. 7.196

Floating + Standard

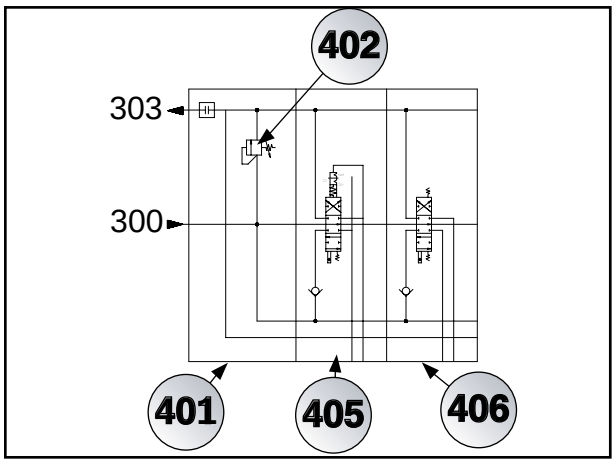


Fig. 7.197

Kick-out + Floating

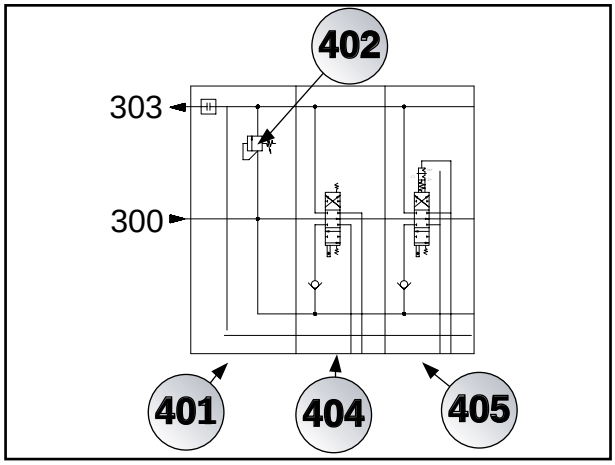


Fig. 7.198

Standard + Kick-out

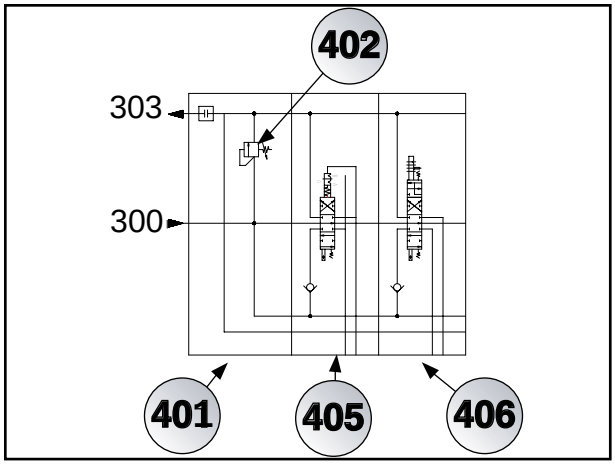


Fig. 7.199

6.3.10.1 Inlet plate

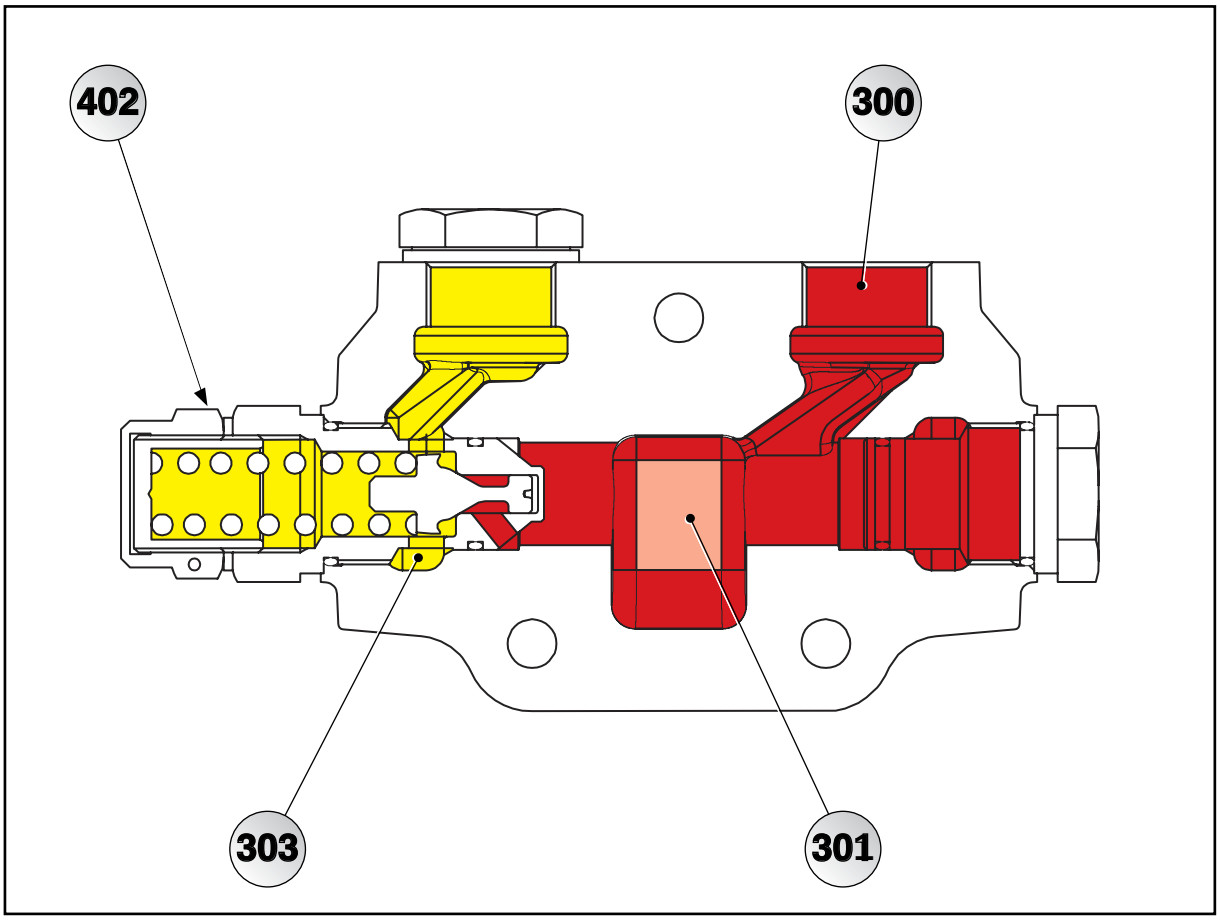


Fig. 7.200

Oil from the high flow pump enters the monoblock unit of the auxiliary control valves through the aforementioned inlet part. Oil enters through the chamber (300) and, through chamber (301), provides a continuous flow towards the power lift and the other control valves installed in series. The maximum valve (402) opens the flow towards the outlet (303) once an 190 bar pressure has been exceeded.

6.3.11 Standard control valve for monoblock (E-Line version)

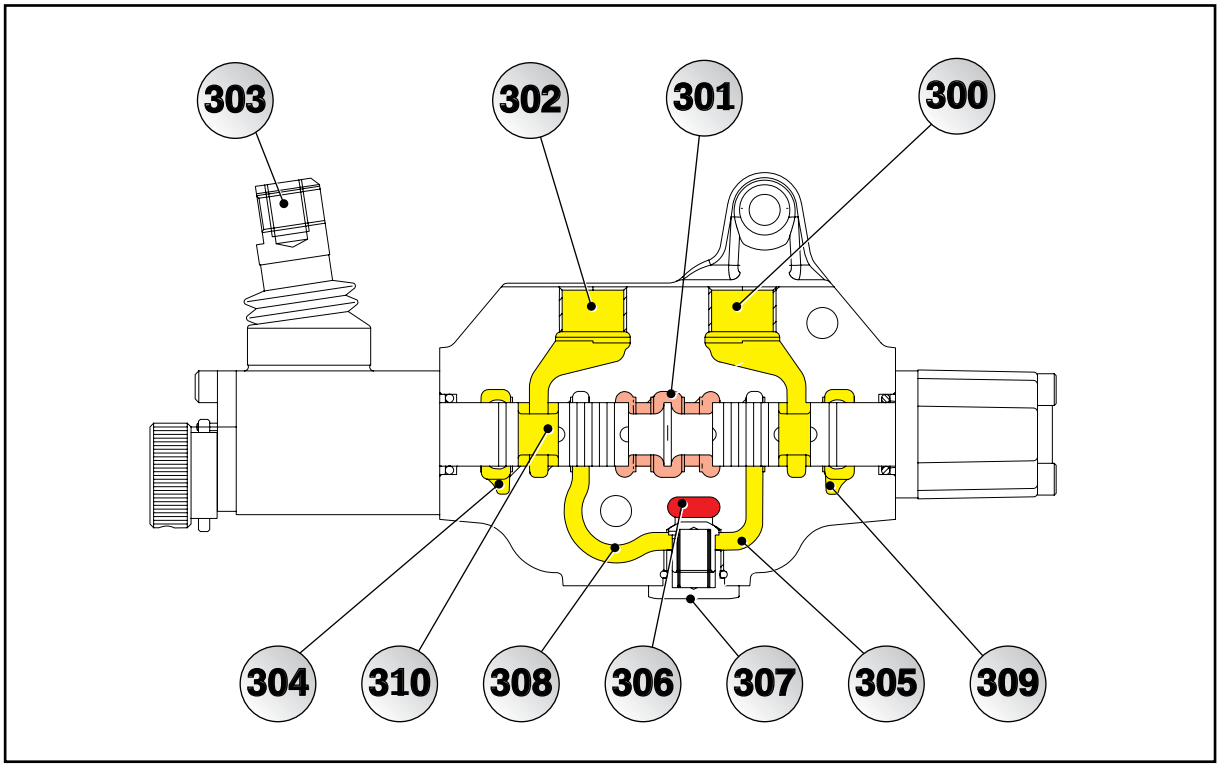


Fig. 7.201

300 - User
301 - Towards the power lift
302 - User
303 - Lever (remote control)
304 - Discharge
305 - Feed chambers
306 - Oil arriving from the inlet plate
307 - Retainer
308 - Feed chambers
309 - Discharge
310 - Stem

Note: operation of the standard control valve indicated above with the control head pointing downwards does not change: the oil flow is the same as that described.

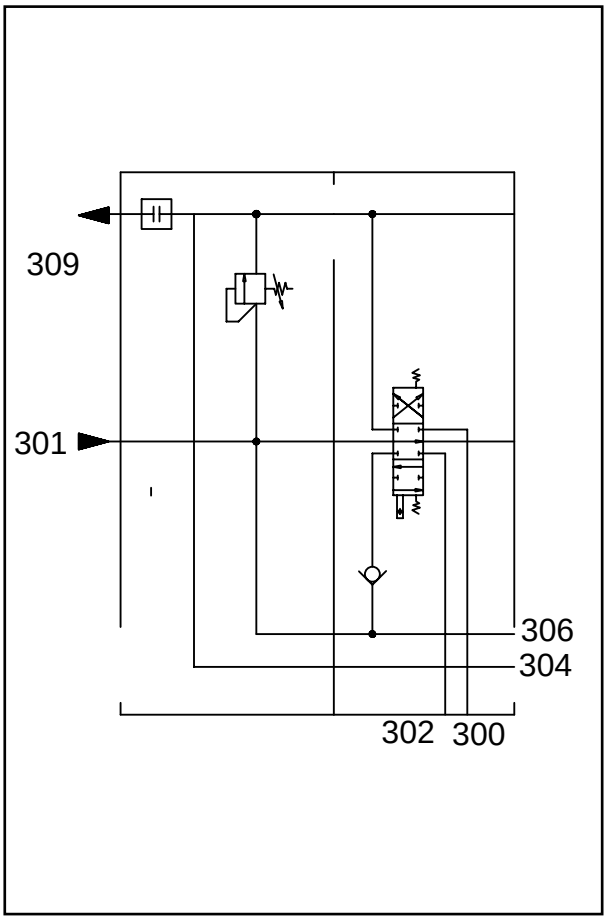


Fig. 7.202

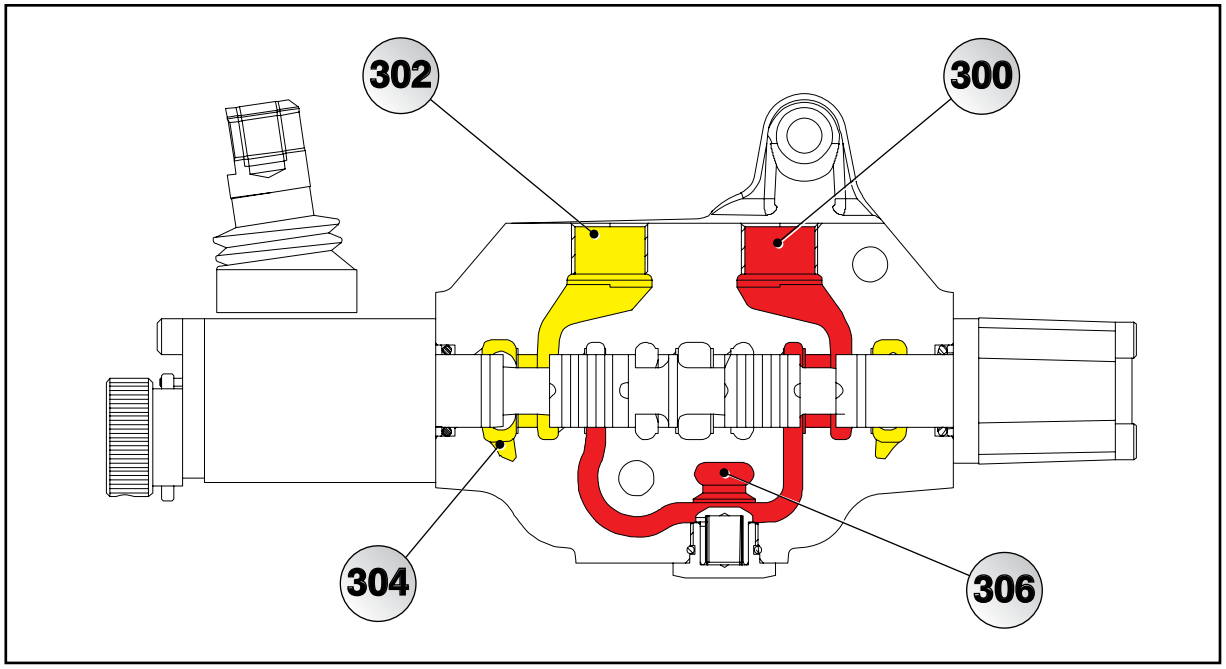


Fig. 7.203

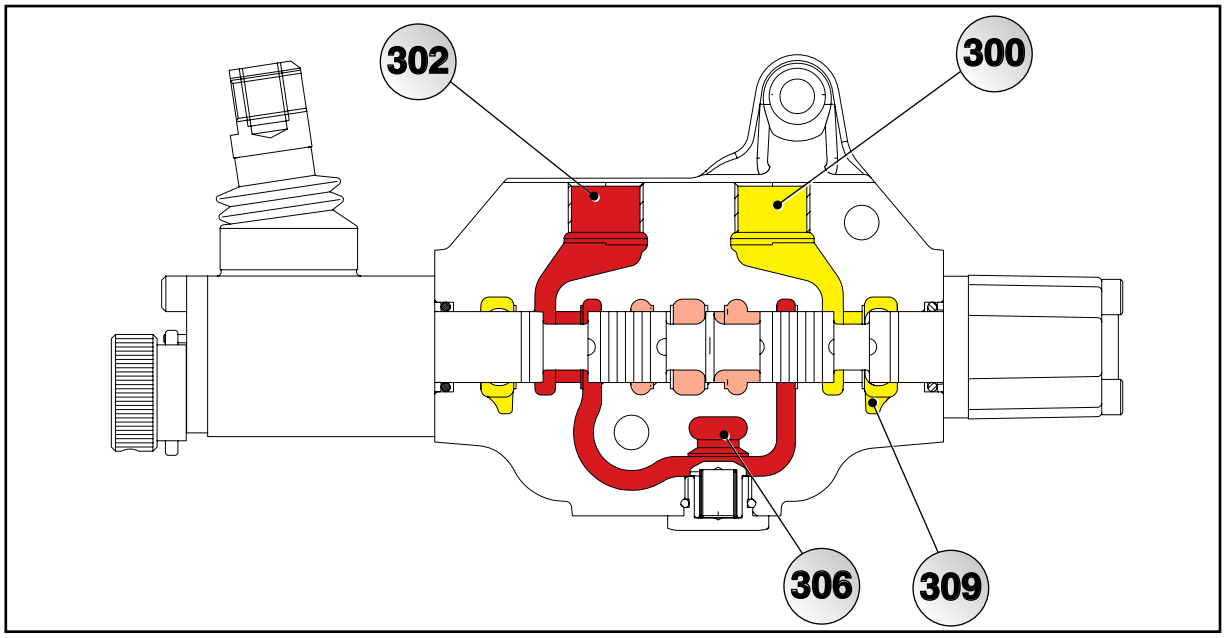


Fig. 7.204

Description of operation

Oil from the pump flows into chamber (306) and into the continuity race (301) at the same time.

When the stem is on hold, oil from the pump through the chamber (306) displaces the non return valve (307) and reaches chambers (305) and (308), that have no outlet. Oil passes through the continuity race (301) in order to supply the following control valves or the hydraulic power lift.

If the stem is shifted to the left, oil from the chamber (306) may flow on to hole (302) to supply the external ram, while oil returning from the hole (300) via the duct (309) goes to the outlet.

If the stem is shifted to the right, oil from chamber (306) may flow on to hole (300) to supply the other side of the external ram.

Oil returning from hole (302) through duct (304), flows to the discharge outlet.

When the lever is no longer operated, the stem is always returned to the neutral position by a spring.

6.3.11.1 Standard inlet plate for monoblock (E-Line version)

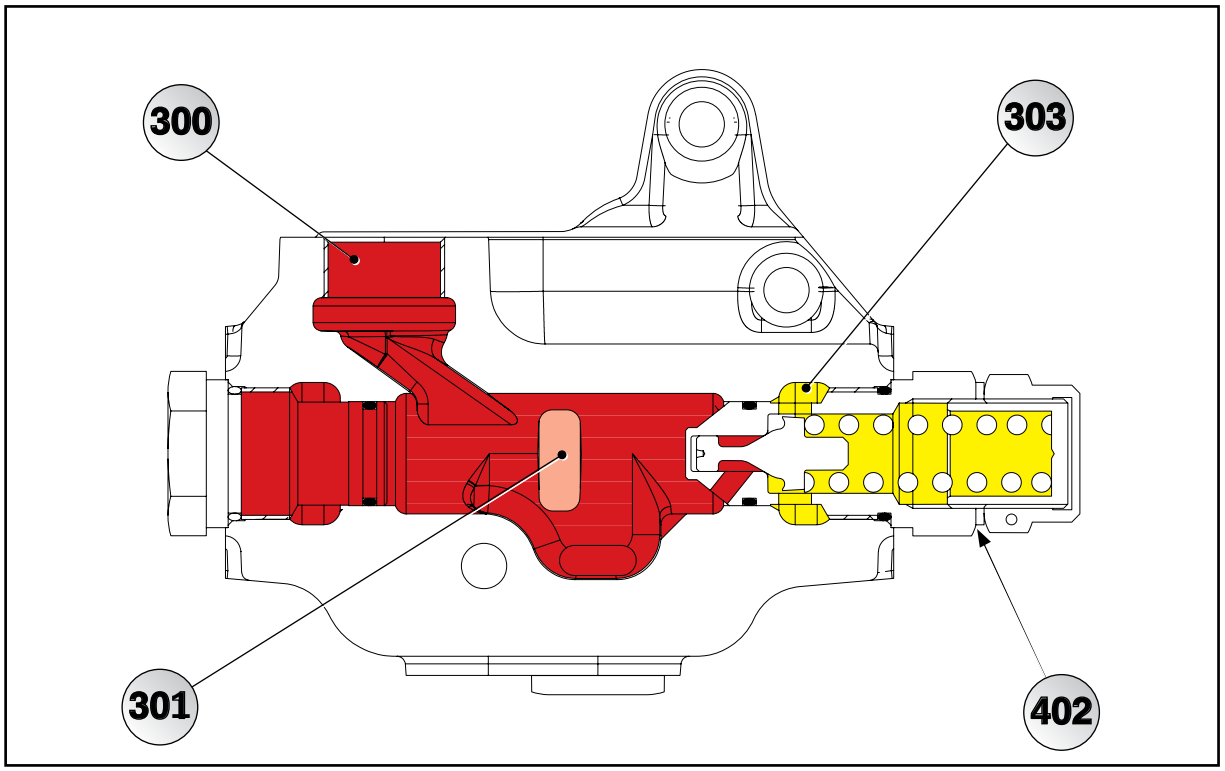


Fig. 7.205

Oil from the high flow pump enters the monoblock unit of the auxiliary control valves through the aforementioned inlet part. Oil enters through the chamber (300) and, through chamber (301), provides a continuous flow towards the power lift and the other control valves installed in series. The maximum valve (402) opens the flow towards the outlet (303) once an 190 bar pressure has been exceeded.

6.4 Electrohydraulic flow selector (Speed Five and Power Shuttle version)

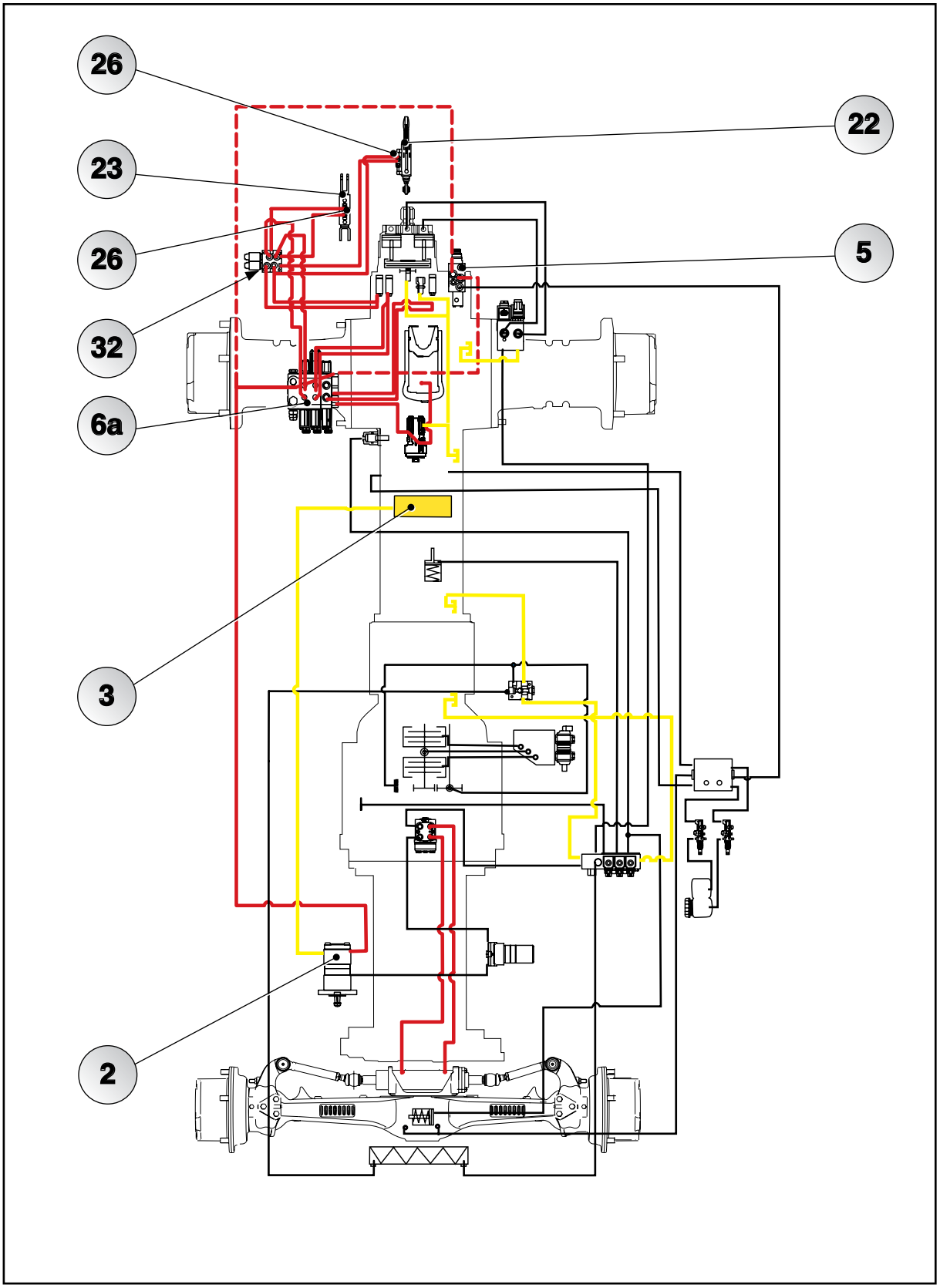


Fig. 7.206

2 - High flow pump
3 - High flow suction filter
5 - Trailer brake valve
6a - Auxiliary control valve supplying the selector (32)
22 - Hydraulic top link
23 - Vertical hydraulic lift rod
26 - Shut-off valves
32 - Electro-hydraulic flow selector
- high pressure
- discharge/inlet

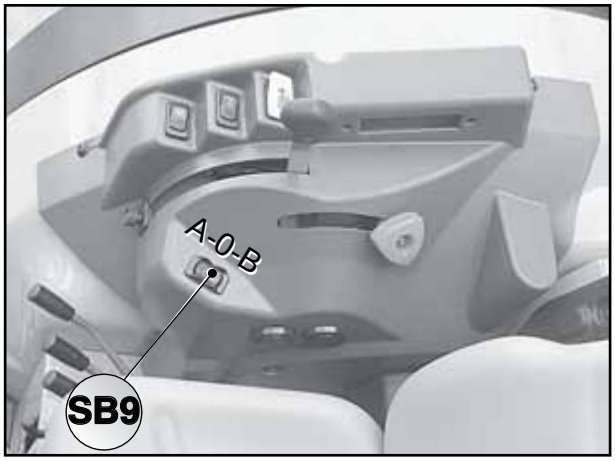


Fig. 7.207

6.4.1 General description

The electrohydraulic flow selector, combined with an auxiliary control valve, supplies with oil to external hydraulic rams, such as the top link and leveling rod.

The selector circuit comprises: a casing (32) and two solenoid valves (YV10 and YV11 Fig.7.208).

It is installed on the right rear side of the gearbox housing. The functions of the selector are activated by the operator by means of switch (SB9 Fig.7.207) . The switch has three positions: **A - 0 - B**.

Pos. 0 : in this position, the control valve lever (6a Fig.7.206) supplies the rear quick couplings that operate the external rams.

Pos.A : in this position, the control valve lever supplies the top link (22 Fig.7.209).

Pos.B : in this position, the control valve lever supplies the levelling rod (23 Fig.7.209).

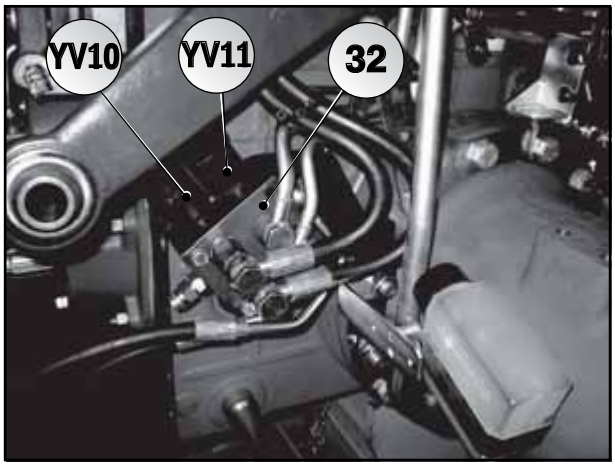


Fig. 7.208

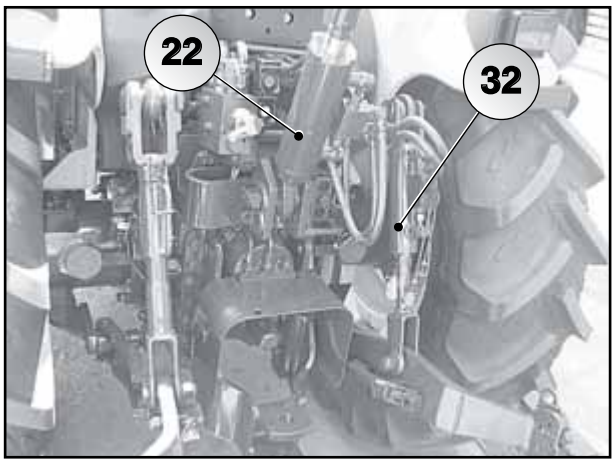


Fig. 7.209

6.4.2 Main components

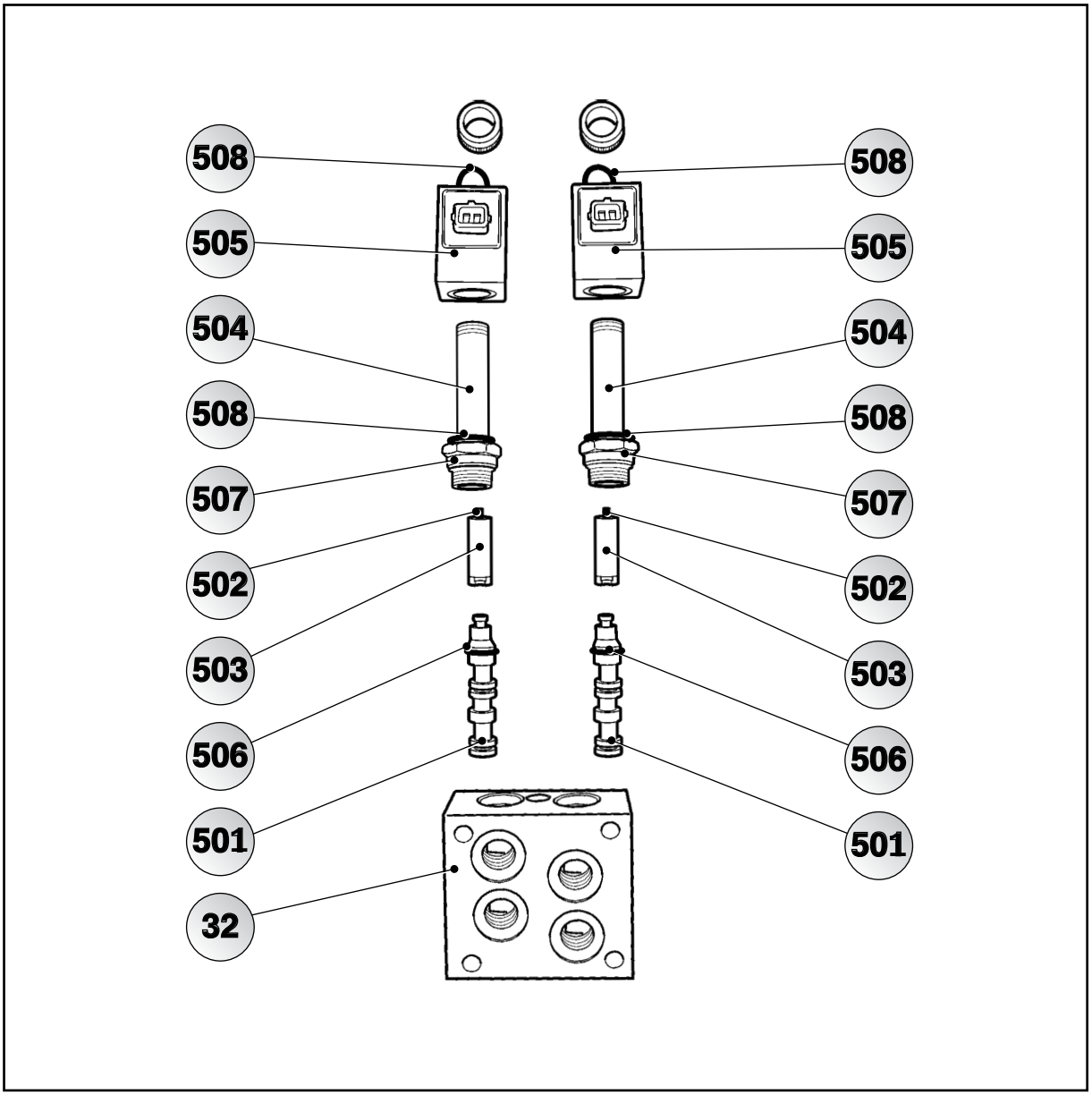


Fig. 7.210

32 - Flow selector housing
501 - Plunger
502 - Spring
503 - Mobile core
504 - Sleeve
505 - Solenoid valve coil
506 - Circlip
507 - “O-ring” seal
508 - “O-ring” seal

Selector's hydraulic connections

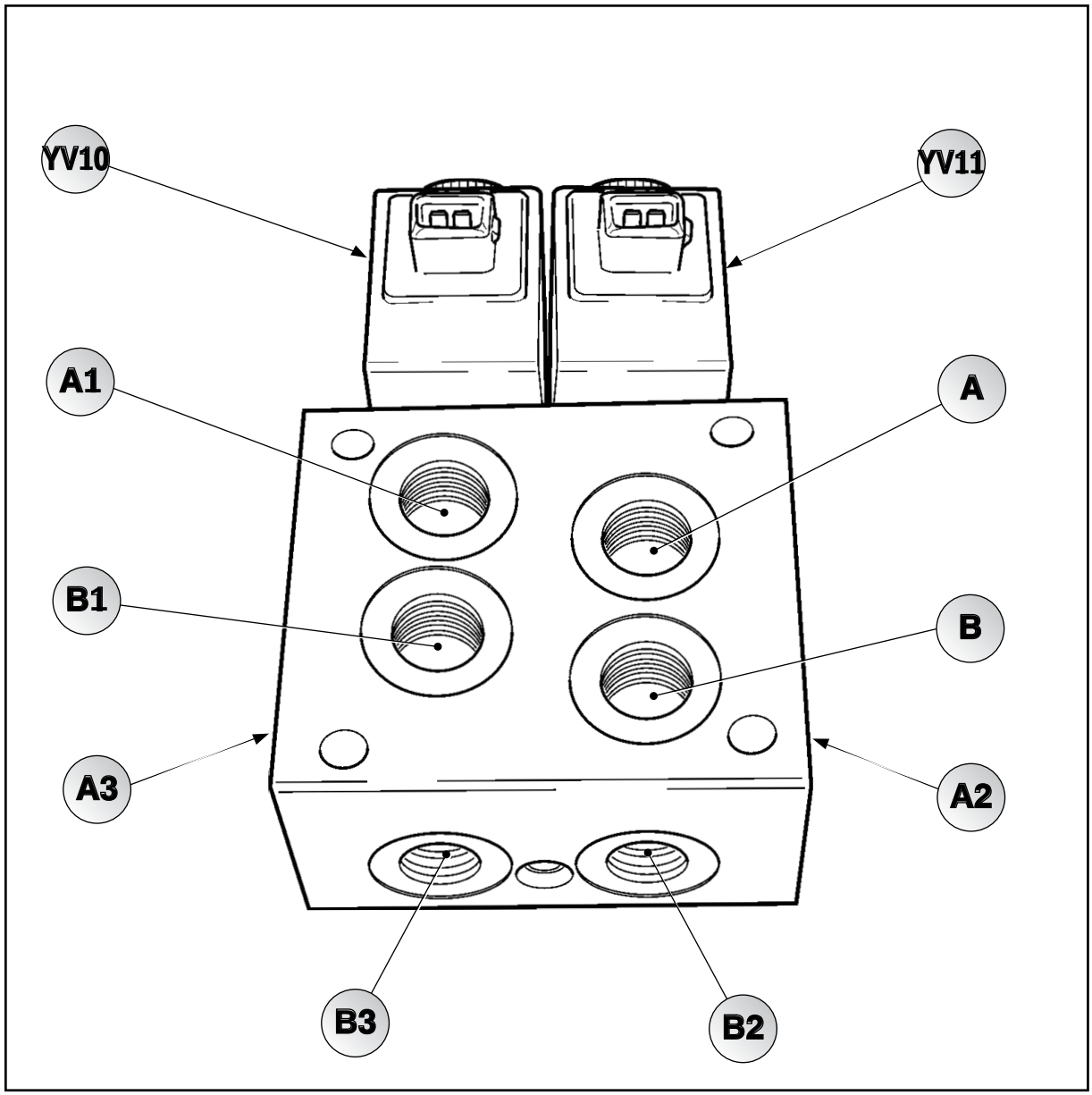


Fig. 7.211

A/B - Oil supply from control valve
A1/B1 - Oil supply to external ram
A2/B2 - Oil supply to leveling rod
A2/B3 - Oil supply to top link

6.4.3 Description of operation

6.4.3.1 External ram oil supply phase

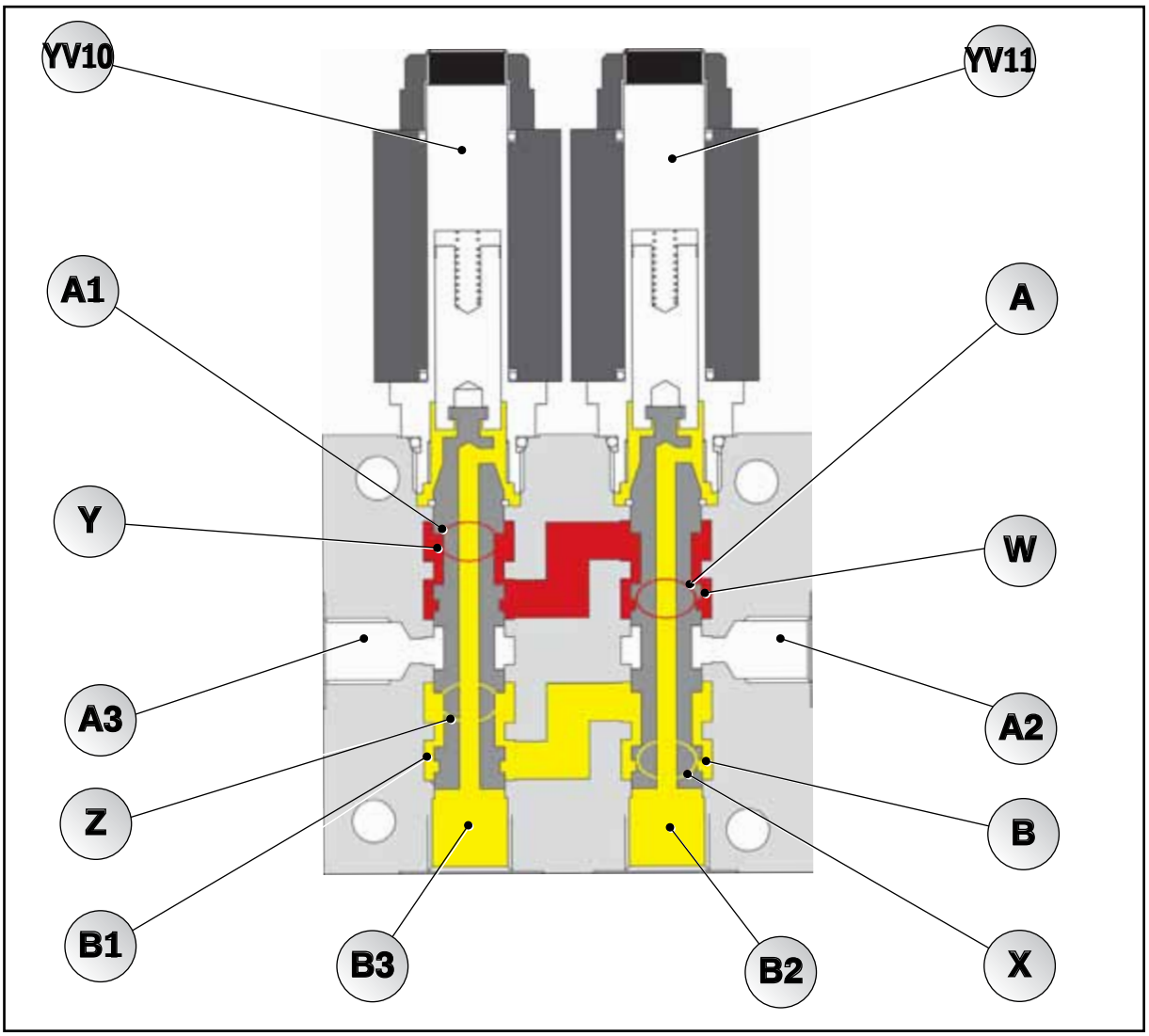


Fig. 7.212

Control switch (SB9 Fig.7.206) in position (0), solenoid valves de-energized.

Oil from the control valve (6a Fig.7.208) enters hole (A) and flows through the internal ducts to hole (A1) or (B1) so as to supply the external ram. Oil returning from hole (B1) or (A1) flows through the internal ducts, reaches hole (B) or (A) and proceeds towards the outlet. In this phase the whole pump flow passes freely through the flow selector and feeds the external ram.

A-B Oil flowing in from the mechanical control valve

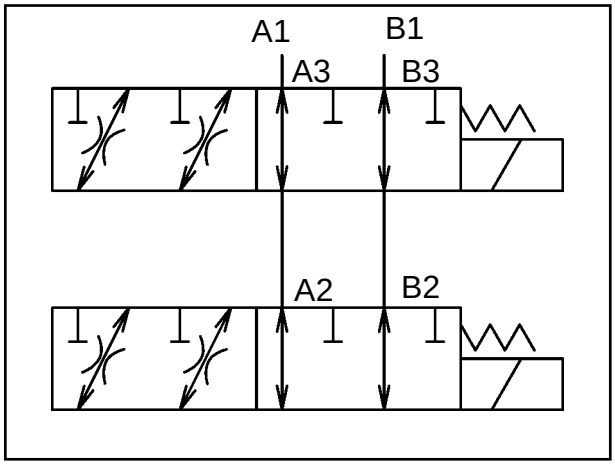


Fig. 7.213

6.4.3.2 Phase with oil supply to top link ram

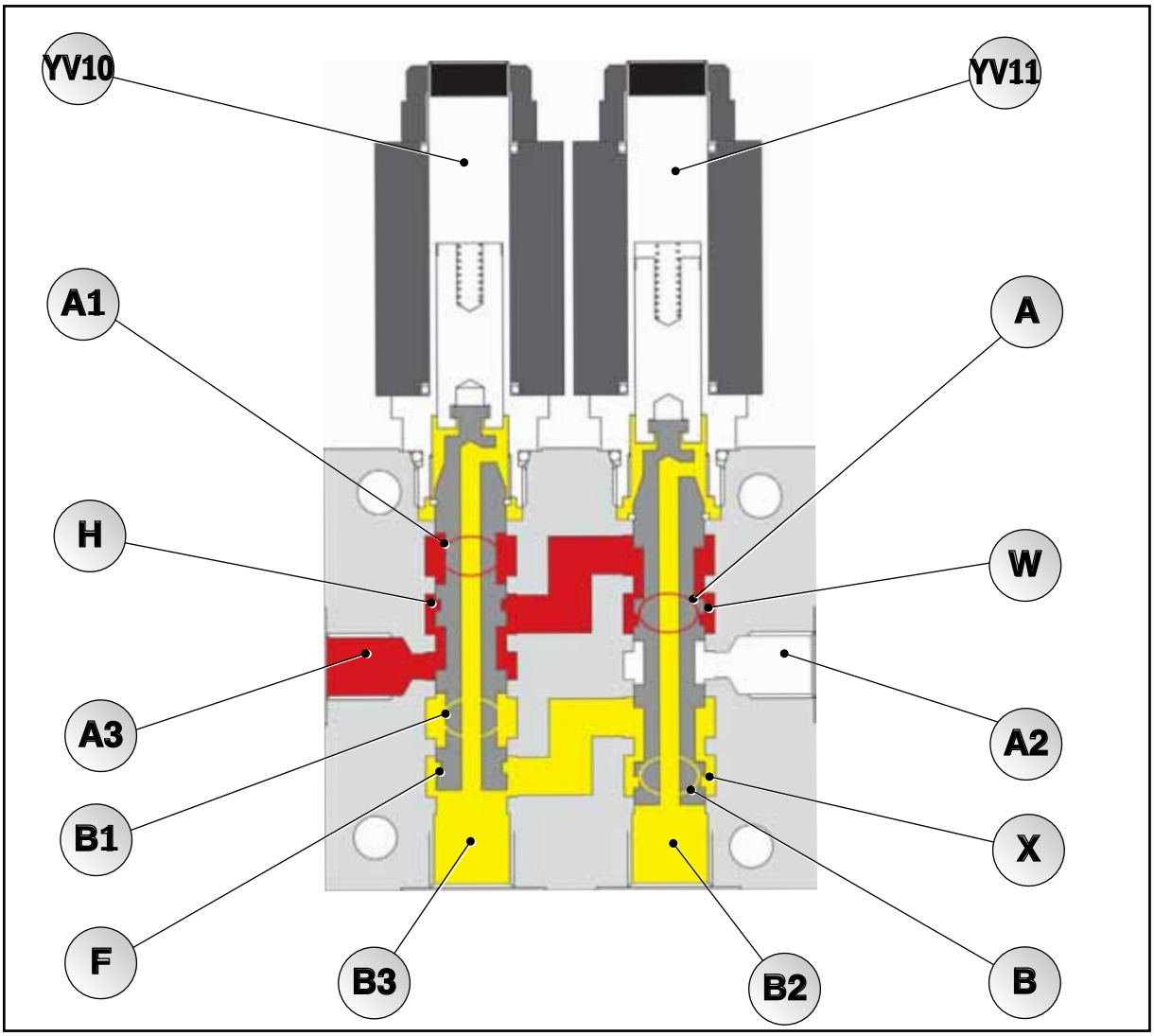


Fig. 7.214

Control switch (SB9 7.207) in position (A), solenoid valve (YV10) energized.

Oil from the control valve (6a 7.206) enters hole (A) or (B) and flows through the internal ducts to hole (A3) or (B3) so as to supply the top link (22 Fig.7.209). Oil returning from hole (B3) or (A3) flows through the internal ducts, reaches hole (B) or (A) and towards the outlet. In this phase the pump flow does not pass freely through the flow selector owing to the throttles inside the housing itself. This allows the top link to move more slowly and be adjusted more accurately.

6.4.3.3 Phase with oil supply to leveling ram

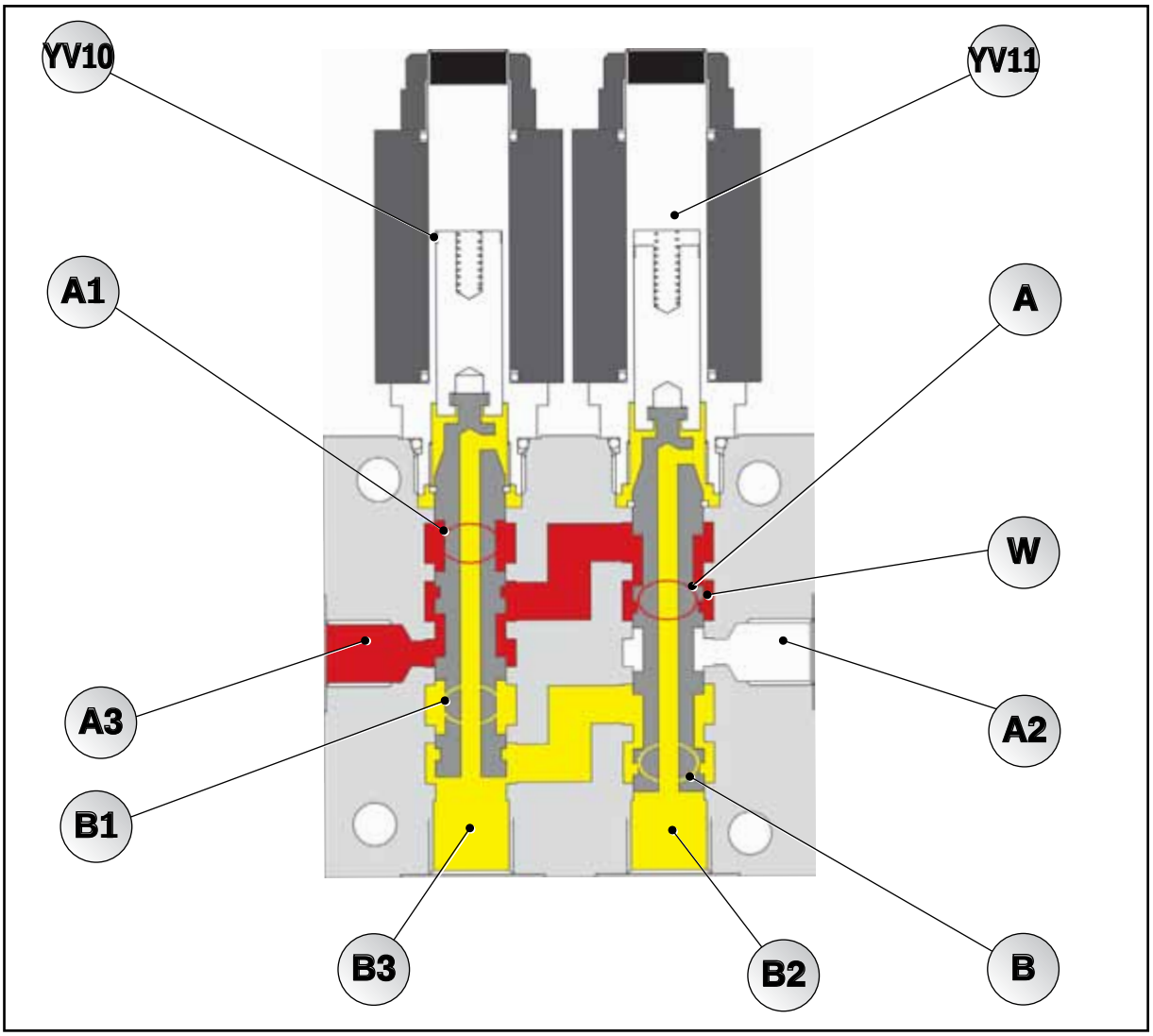


Fig. 7.215

Control switch (SB9 7.207) in position (B), solenoid valve (YV11) energized.

Oil from the control valve (6a) enters hole (A) or (B) and flows through the internal ducts to hole (A2) or (B2) so as to supply the levelling rod (23 Fig.7.209). Oil returning from hole (B2) or (A2) flows through the internal ducts, reaches hole (B) or (A) and flows towards the outlet. In this phase the pump flow does not pass freely through the flow selector owing to the throttles inside the housing itself. This slows the movement of the rod and allows it to be adjusted more accurately.

6.5 Mechanical power lift supply system

6.5.1 Main components

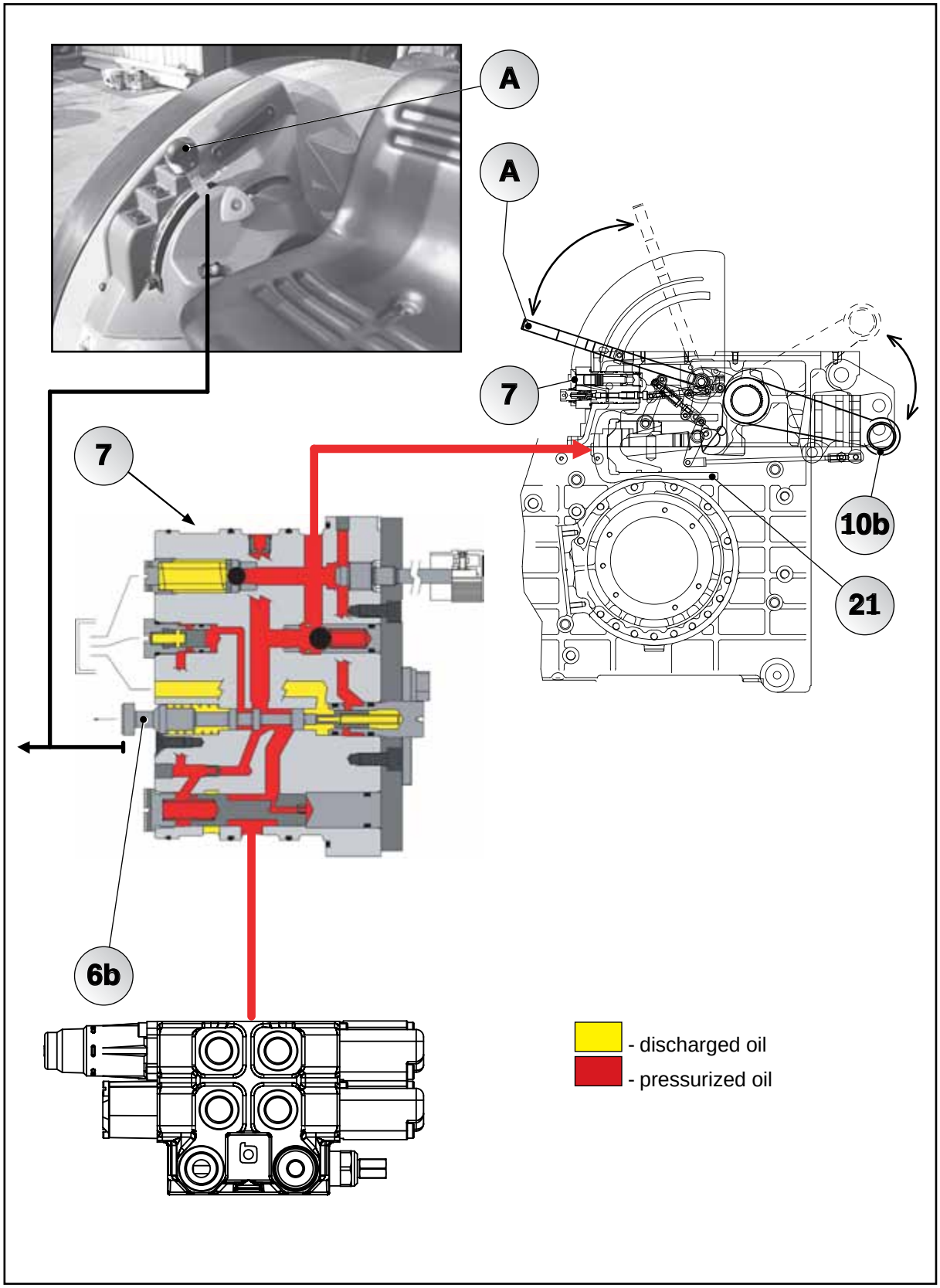


Fig. 7.216

6.5.2 Description of operation

The mechanical hydraulic power lift is supplied with fluid by the high pressure circuit. Oil flows from the pump (2 Fig.7.218) to the trailer brake valve (5) if installed, by way of priority. The oil passes through the auxiliary control valve unit (6) and, via the closing plate, reaches the valve system (7 Fig. 7.218) of the mechanical power lift. Movement of the lever (A Fig.7.216) shifts the stem (6b Fig.7.216) towards the right, thus opening the delivery of pressurized oil to the ram (21). Thus supplied, the internal ram (21 Fig.7.218) is shifted towards the right (Fig.7.216). The lift links (10b) are connected to the movements of ram (21), through a mechanical linkage system. If the trailer brake valve (5) is not installed, the pump (2) sends the oil straight to the auxiliary control valve unit (6), thus supplying the valve system (7) of the power lift.

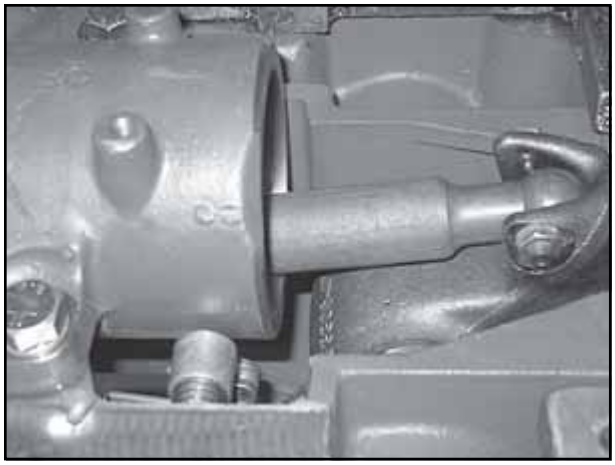


Fig. 7.217

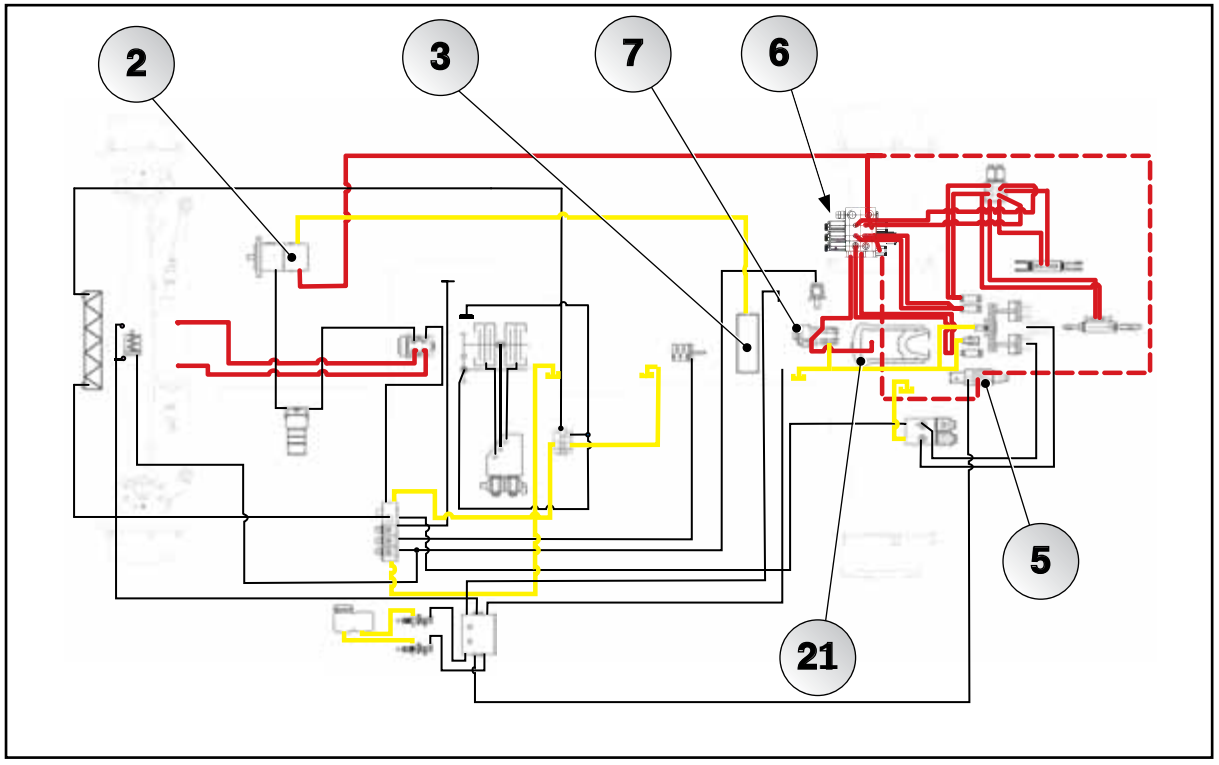


Fig. 7.218

2 - High flow pump
3 - Intake cartridge filter
5 - Hydraulic trailer brake valve
6 - Auxiliary control valve unit
7 - Power lift valve system
21 - Power lift's internal ram

6.6 Triple pump with independent hydraulic circuit (Power Shuttle version)

6.6.1 Main components

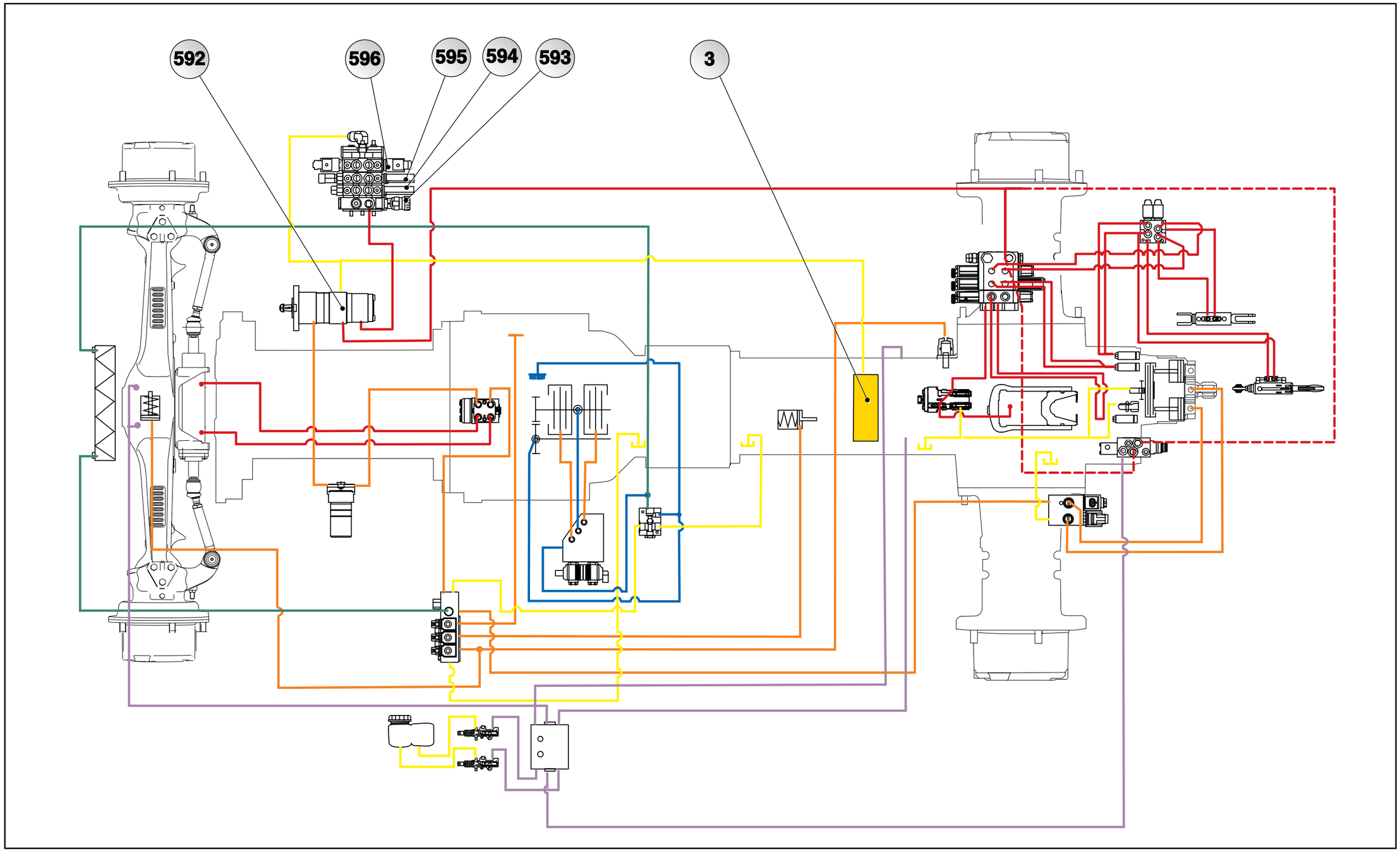


Fig. 7.219

3 - Intake cartridge filter
592 - Supply pump of the front control valves
593 - Flow divider
594 - Control valve for hydraulic motor
595 - Control valve with floating position
596 - Electrically controlled standard control valve

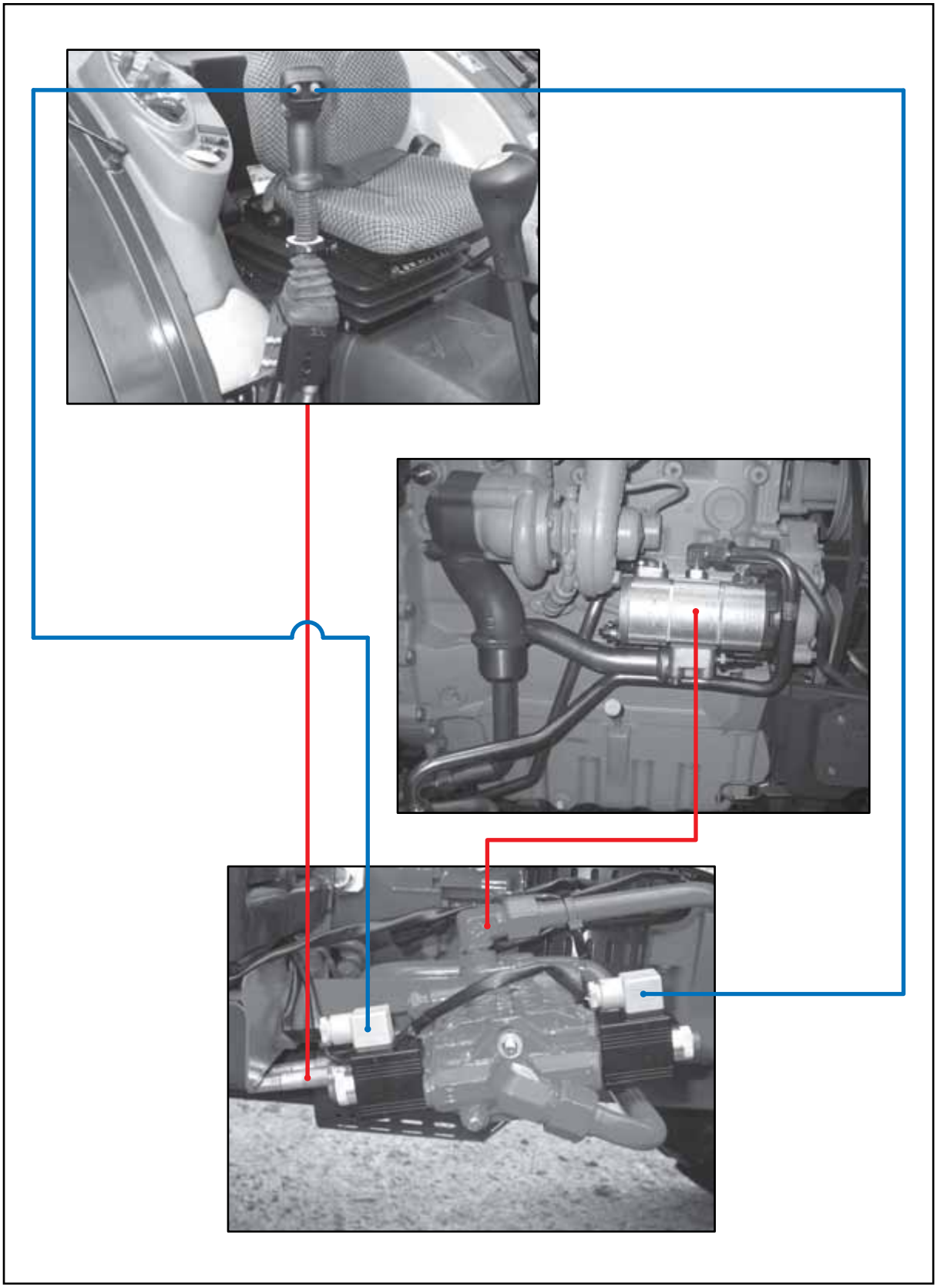


Fig. 7.220

6.6.1.1 Std control valve with electric control (Neutral phase)

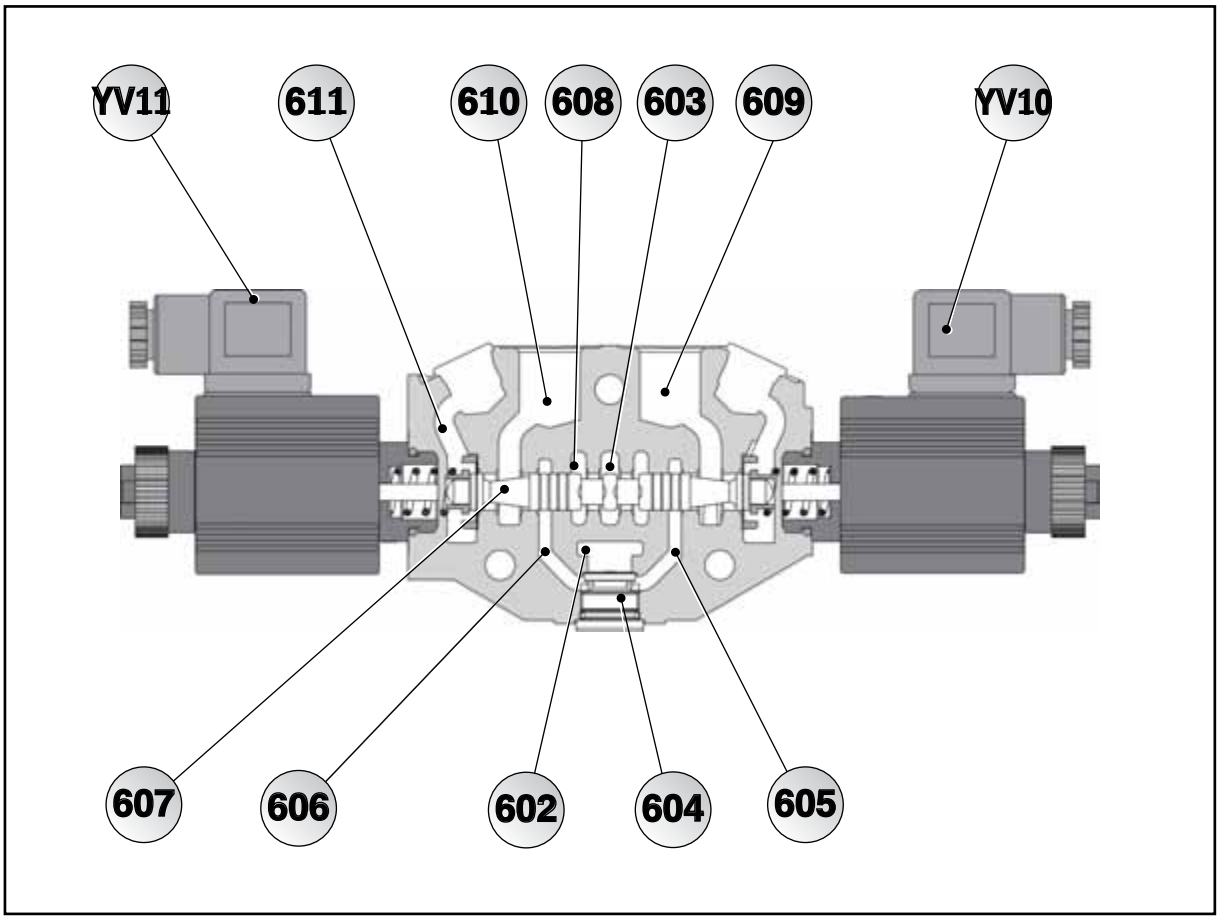


Fig. 7.221

Oil from the pump flows into chambers (602) and (603) at the same time.

When the stem is in neutral position, oil from chamber (602) displaces the non return valve (604) and reaches chambers (605) and (605), that have no outlet. The race in the stem (607) lets oil from chamber (603) flow into chamber (608) and thus to the discharge outlet.

If the stem is shifted to the left, oil from chamber (602) may flow on to hole (609) to supply the external ram. Oil returning from hole (610), through the duct (611), flows to the discharge.

6.6.2 Description of operation

On request a triple pump (592) can be installed, to be coupled to the front control valves (597), which are fed by a separate circuit.

Maximum 3 control valves with flow divider.

1 - Control valve for hydraulic motors, in conjunction with the flow divider.

2 - Control valve with floating position.

3 - Standard control valve, electrically controlled by means of buttons.

The three pumps feed three separate and independent circuits:

1 - Steering circuit and hydraulic facilities of the transmission: 30 l/min with 2200 RPM engine rate, max. steering pressure 160 bar.

2 - Independent circuit for front control valves. 39.6 l/min with 2200 RPM engine rate, max. pressure 185 bar

3 - Power lift and rear control valve circuit: 30 l/min with 2200 RPM engine rate, max. pressure 185 bar

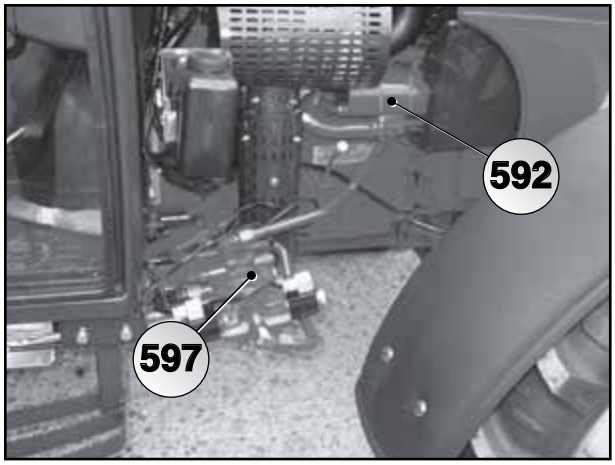


Fig. 7.222

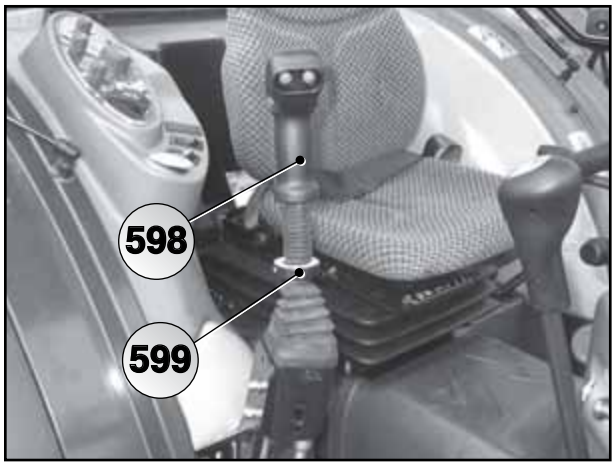


Fig. 7.223

Joystick

The joystick (598) controls the front control valves and is very useful and handy when operating front loaders and other front mounted implements.

The joystick (598) is provided with a stop (599) to lock the lever.

Pull up the stop (599) whenever the joystick has to be used.

After use, press the stop (599) downwards to lock the lever again.

The stop has two coloured marks.

- Green: Stop (599) up - Movements free
- Red: Stop (599) down - Movements locked. The red indicator (B) projects in this position.

Joystick functions

The figure shows the operating positions of the joystick:

1 - Lowering of 1st control valve
2 - Lifting of 1st control valve
3 - 2nd control valve in float position
4 - Lowering of 2nd control valve
5 - Lifting of 2nd control valve

⚠	**Attention:** The lift and front control valve circuits should not be used continuously at the same time: it is advisable to use the two circuits at intervals.

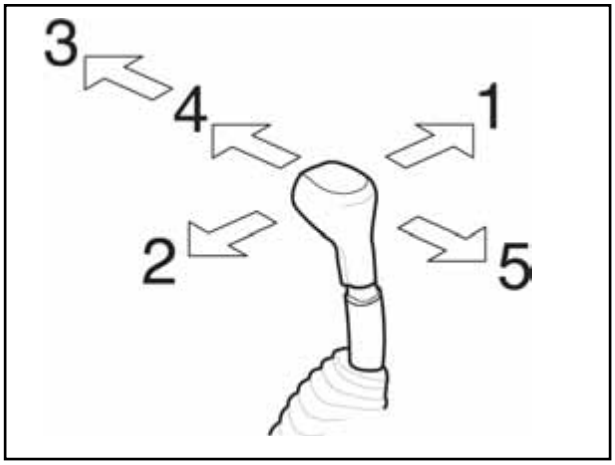


Fig. 7.224

Buttons controlling the third front electric control valve

The joystick (598) has two buttons (SB09) for operating an electrically controlled front control valve.

The lever is provided with a safety switch (4) to override the electric control.

Press the safety switch button (4) to activate the buttons (SB09): the light in the button remains on to indicate that the system is operating.

Press the safety switch button (4) to disable the buttons (SB09): the button light goes out.

The control valve for hydraulic motors is coupled to a flow divider that allows the flow to the hydraulic motor to be regulated. The flow in excess feeds the downstream control valves.

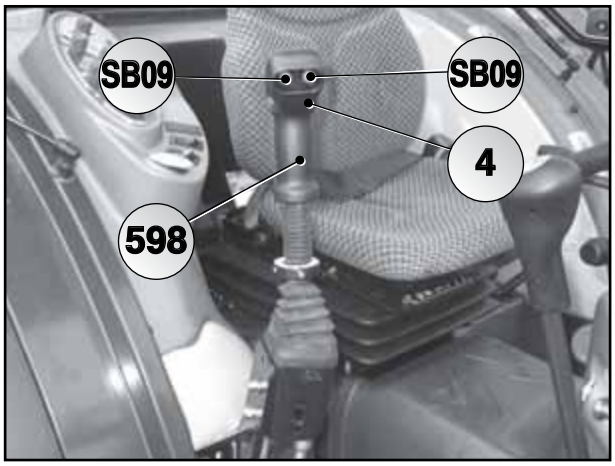


Fig. 7.225

Flow divider

The 1st control valve for hydraulic motors is coupled to a flow divider (593) that allows the flow to the hydraulic motor to be regulated.

Knob turned clockwise: less flow to the hydraulic motor.

Knob turned anti-clockwise: more flow to the hydraulic motor.

The excess flow may be used by the other control valves.

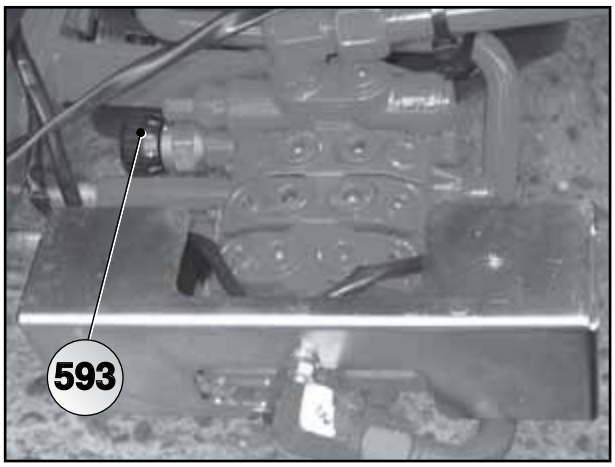


Fig. 7.226

6.6.3 Adjustments

Foreword

The control lever of the front control valves (joystick 598 7.227) will not normally need to be periodically adjusted as there are no parts liable to appreciable wear.

However, adjustments are essential after a general overhaul or when the controls behave in a faulty way, such as reacting in delay to the manual commands.

It is not particularly difficult to adjust the joystick (598) and no particular tools are required. However, these adjustments must be carried out with particular care, so it is advisable to have them done by specialized personnel.

Before beginning the operations described below, make sure that the entire hydraulic circuit operates perfectly, particularly the valve system.

Fig. 7.227

Adjustments

Connect the control cables (600-601 7.228) of the respective control valves. Pull the stop upwards (599 Fig. 7.223) to release the control lever (598) then lengthen or shorten the cables (600-600) until the stop (599) drops freely to the locked position.

Note: these adjustments must be carried out whenever the valve system is overhauled or when the control valves operate in a faulty way that cannot be ascribed to the hydraulic circuit.

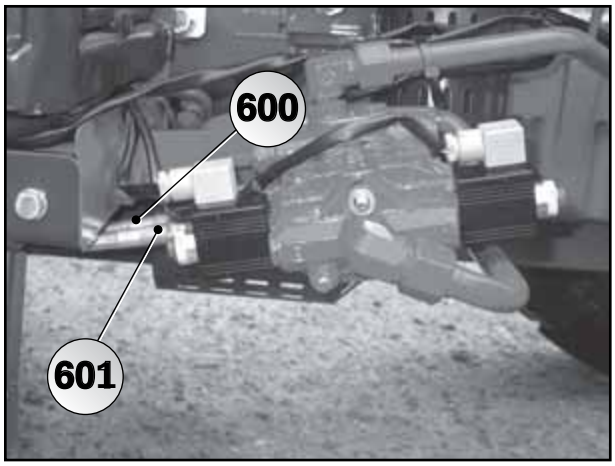


Fig. 7.228

Section 7 : Operating pressure tests

Index

7.1 Introduction.....7-200

7.2 Operating pressure tests for the low flow circuit.....7-201

7.3 High flow pressure test.....7-206

7.1 Introduction

The operating pressure test must be conducted whenever faults are encountered or when the tractor is generally overhauled.

Remember that a low setting for the maximum valves in the circuit could make the hydraulic clutch assemblies slip or prevent the steering system, auxiliary control valves or power lift from operating in a fully efficient way.

On the other hand, an excessively high valve pressure setting could stress all the components in question and, in the case of the valve that controls the lubricating pressure, cause all the transmission retention rings to break.

At the end of the tests, use the relative adjusters to ensure that the valve settings are correct.

Note: the hydraulic tests must be conducted with the engine at a rate of about 1200 RPM, with oil at a temperature between 30/40 °C, using the necessary special tools and a set of pressure gauges.

	Attention: Do not begin work until the pressure in the hydraulic circuit has dropped to zero.

	Attention: Splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.

	Attention: Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

	Attention: Take care to avoid burns when working with boiling oil. Never heat oil to temperatures exceeding 190°C as the oil or its vapours could suddenly catch fire.

7.2 Operating pressure tests for the low flow circuit

Steering cylinder pressure test

Assemble tool **03 IDR REX** with adapter **122 IDR GL** in the point where the rubber hose and rigid pipe join and apply a 0 to 400 bar pressure gauge. When the steering cylinder reaches end of stroke, the pressure gauge must give a reading between **165** and **175** bar

Fig. 7.229

4WD disengaging pressure test (Spring-on) (F-N Series Speed Five version)

Remove the 4WD's disengaging oil supply union from the servo clutch valve system (8) and assemble tool **02 IDR REX** with adapter 122 IDR GL and a **0** to **60 bar**. pressure gauge applied. When the engine is running and the 4WD is disengaged, the pressure gauge must indicate a value between **18** and **20 bar**.

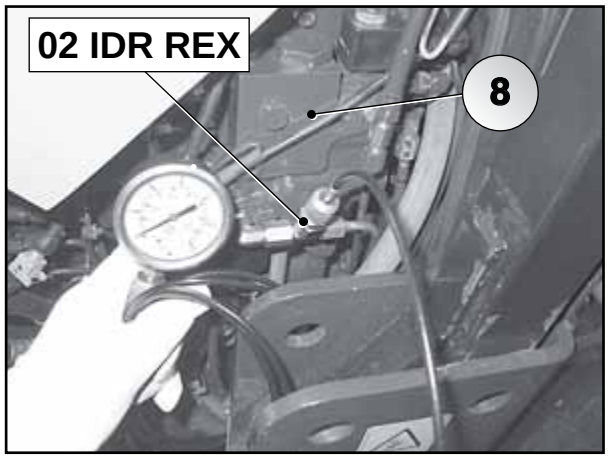


Fig. 7.230

4WD disengaging pressure test (Spring-on) (F-N Series Power Shuttle version)

Remove the cap that protects the quick coupling (141) on the hydraulic power pack (10) and fit on a **0** to **60 bar**. pressure gauge. When the engine is running and the 4WD is disengaged, the pressure gauge must indicate a value between **19 and 21 bar.**

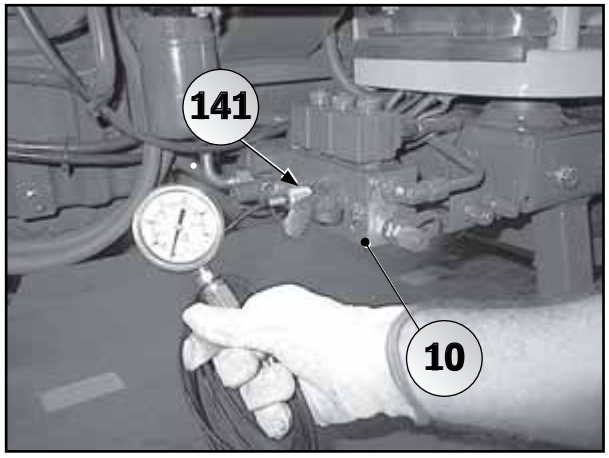


Fig. 7.231

Checking the front and rear differential lock engaging pressure (Speed Five version)

Remove the diff lock supply union from the servo clutch valve system (8) and install tool 125 IDR GL with adapter 122 IDR GL and a 0 to 60 bar pressure gauge applied. When the engine is running and the differential lock engaged, the pressure gauge must indicate a value between **18** and **21 bar**. Proceed in the following way if the pressure measured is less than 18 bar: disconnect the delivery tube of the front or rear differential lock and temporarily plug it. Read the new pressure value. If it is within the tolerated values, the fault will have been temporarily eliminated from the differential. If the pressure still remains below the tolerated value, the tested differential will be at fault.

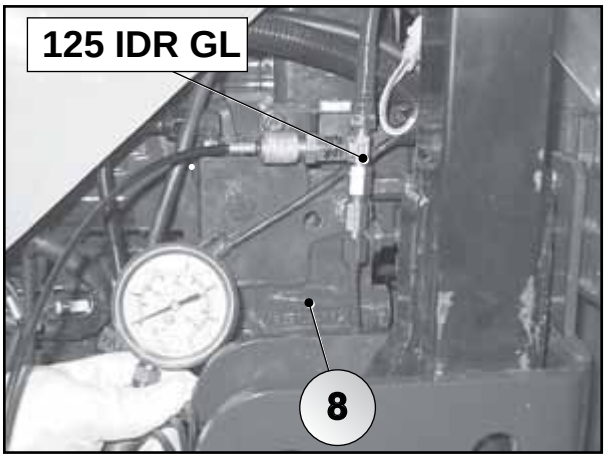


Fig. 7.232

Checking the front and rear differential lock engaging pressure (Power Shuttle version)

Remove the plug that protects the quick coupling (141) on the hydraulic power pack (10) and fit on a 0 to 60 bar pressure gauge. When the engine is running and the differential lock engaged, the pressure gauge must indicate a value between 19 and 21 bar. Proceed in the following way if the pressure measured is less than 19 bar: disconnect the delivery tube of the front or rear differential lock and temporarily plug it. Read the new pressure value. If it is within the tolerated values, the fault will have been temporarily eliminated from the differential. If the pressure still remains below the tolerated value, the tested differential will be at fault.

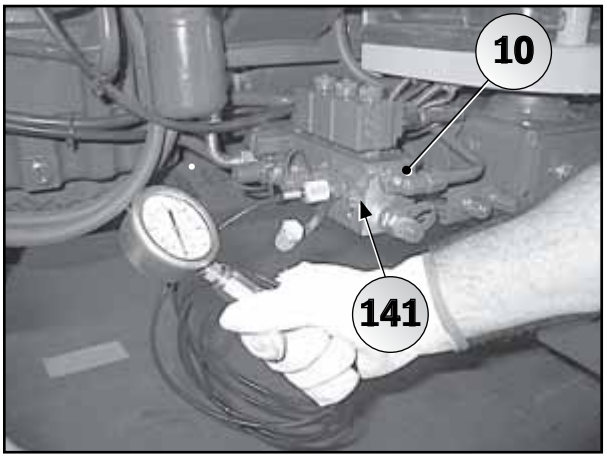


Fig. 7.233

"Power Five" engaging pressure text (Power Shuttle version)

Remove the cap that protects the quick coupling (141) on the hydraulic power pack (10) and fit on a **0 to 60 bar**. pressure gauge. When the engine is running and "Powerfive" is in the fast range, the pressure gauge must indicate a value between **19 and 21 bar.**

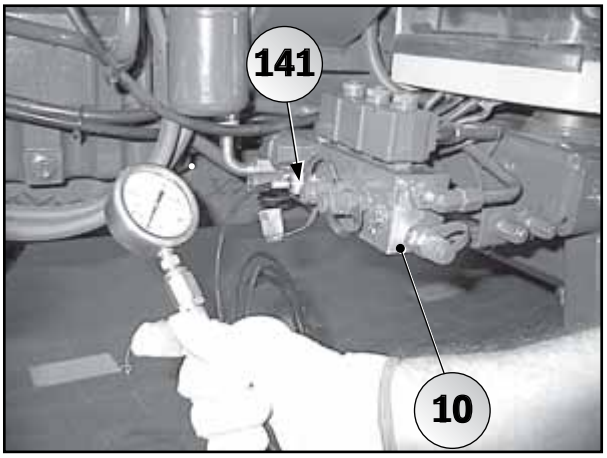


Fig. 7.234

Rear PTO clutch disengaging pressure test (Speed Five version)

Install a **0.60 bar pressure gauge instead of the plug in the position shown in the figure, along with adapter 122 IDR GL.** When the engine is running and the PTO clutch is disengaged, the pressure gauge must indicate a value between **28 and 30 bar.**

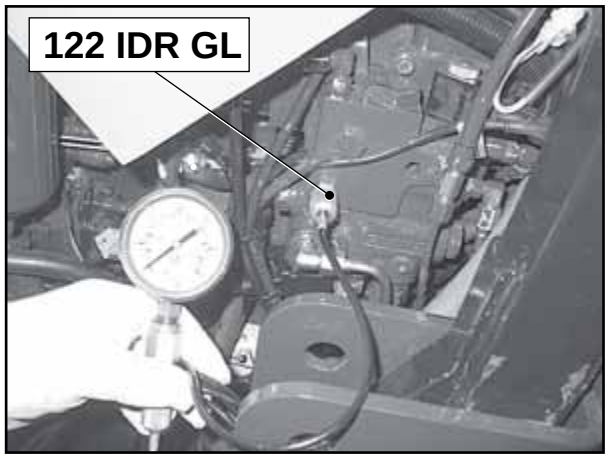


Fig. 7.235

Rear PTO clutch engaging pressure test (Power Shuttle version)

Remove the oil supply union of the P.T.O. clutch from the block (31) and install tool **03 IDR REX** with adapter 122 IDR GL and a 0 to 60 bar pressure gauge applied. When the engine is running and the P.T.O. is engaged, the pressure gauge must indicate a value between **19 and 21 bar.**

Fig. 7.236

Brake engaging pressure test (Power Shuttle version)

Remove the oil supply union of the PTO clutch brake plungers from the rear of the tractor and assemble tool **01 IDR REX** with adapter **122 IDR GL** and apply a 0 to 60 bar pressure gauge. When the engine is running and the P.T.O. is disengaged, the pressure gauge must indicate a value between **19 and21 bar**

Fig. 7.237

Checking the pressure of the low flow circuit's calibration valve (Power Shuttle version)

Remove the cap that protects the quick coupling (141) on the hydraulic power pack (10) and fit on a **0 to 60 bar**. pressure gauge. When the engine is running, the pressure gauge must indicate a value between 19 and 21 bar.

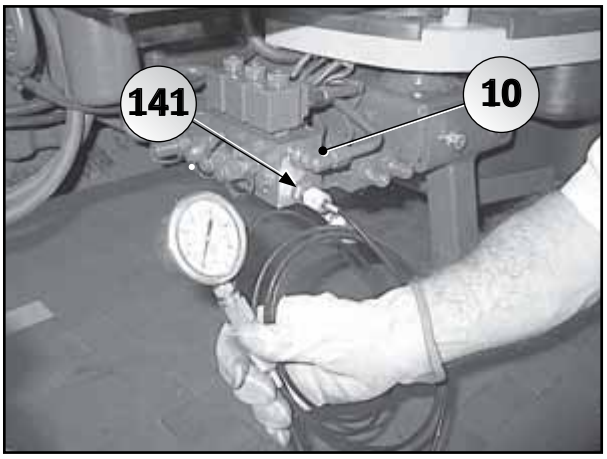


Fig. 7.238

Checking the pressure of the cooling circuit's calibration valve (9.5 bar) (Power Shuttle version)

Remove the connecting pipe (A) from between the hydraulic power pack (10) and the radiator and assemble tool 05 IDR MYT with adapter **122 IDR GL** and a **0 to 25 bar**. pressure gauge applied. Re-connect tube (A) to tool **05 IDR MYT** and measure the pressure value. When the engine is running, it must be between **8.5 and 10.5 bar.**

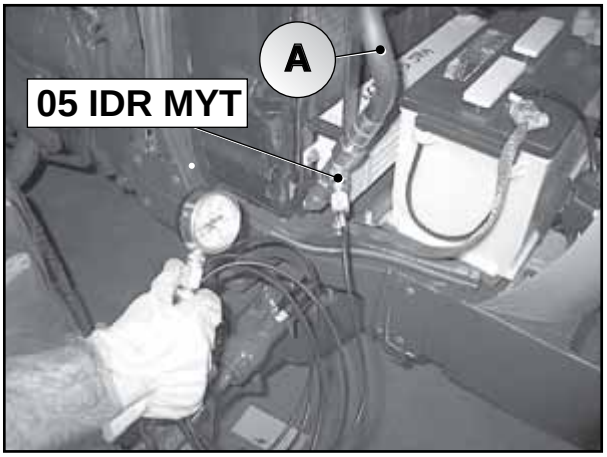


Fig. 7.239

"Power Shuttle" clutch engaging pressure test (secondary clutch)

On the union located on a plate fixed near the hydraulic power pack (10), install tool 125 IDR GL with adapter 122 IDR GL and with a 0 to 60 bar pressure gauge applied.

With the engine running and the gear lever in the neutral position, engage the forward gear and check the pressure gauge reading is between **19 and 21 bar.**

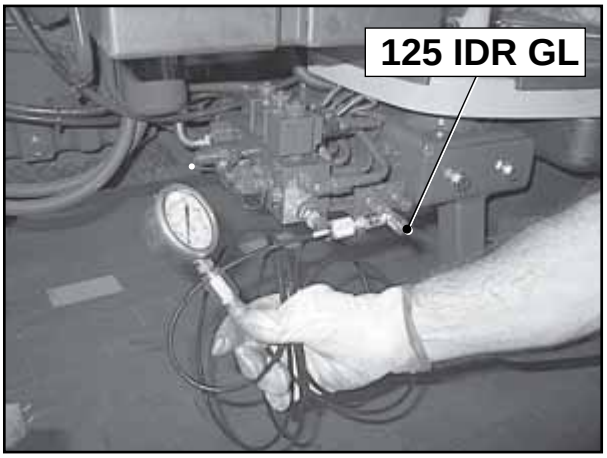


Fig. 7.240

"Power Shuttle" clutch engaging pressure test (main clutch)

Install tool **125 IDR GL** with adapter **122 IDR GL** and a **0 to 60 bar pressure gauge on the union located on a plate fixed near the hydraulic power pack (10).**

With the engine running and the gear lever in the neutral position, engage the reverse gear and check the pressure gauge reading is between **19 and 21 bar.**

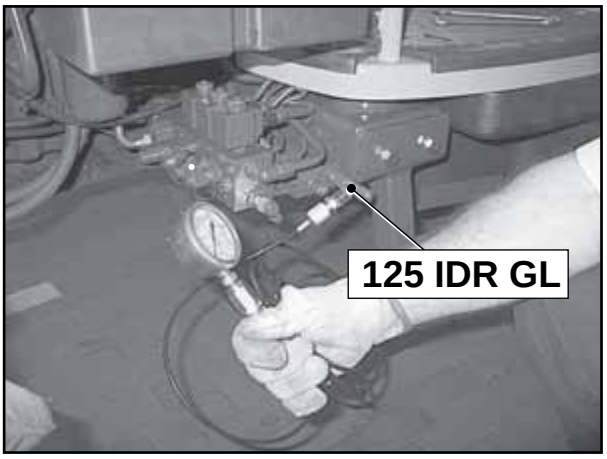


Fig. 7.241

7.3 High flow pressure test

Trailer brake valve pressure test (type for “Italy”) (“Export” type)

Assemble tool **02 IDR MYT** with adapter **122 IDR GL** and a **0 to 400 bar** pressure gauge on the outlet of the quick coupling of the trailer brake valve With the engine running and the pedal brakes latched together and fully depressed, the pressure gauged must be between **130 and 140 bar.**

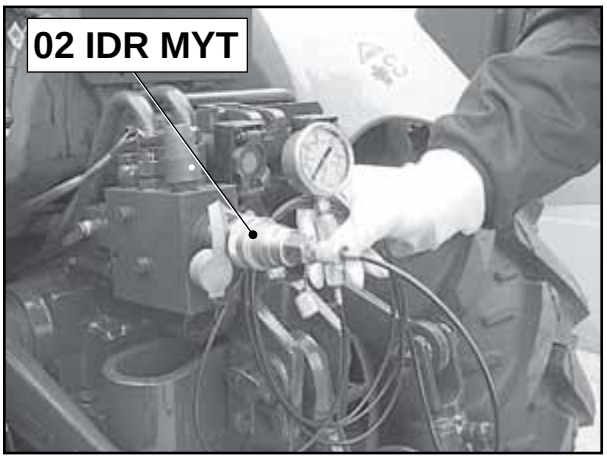


Fig. 7.242

Checking the pressure setting of the calibration valve of the auxiliary control valves

Assemble tool 03 IDR MYT with adapter **122 IDR GL** and a **0 to 400 bar** pressure gauge on the outlet of the quick coupling of one of the auxiliary control valves. Activate the corresponding control lever with the engine running. The pressure gauged must be between **175 and 190 bar.**

Fig. 7.243

Power lift pressure test

To test the power lift’s operating pressure, assemble tool **05 IDR REX** with adapter **122 IDR GL** and a **0 to 400 bar pressure gauge applied.**

With the engine running, raise the implement and gauge the operating pressure.

The maximum pressure tolerated is **185 bar**

Fig. 7.244

Section 8 : Special tools

02 IDR MYT

Union for measurement of trailer brake pressure.

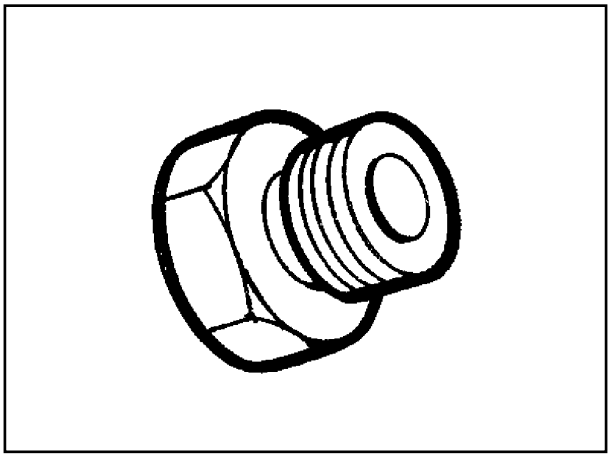


Fig. 7.245

03 IDR MYT

Union for measuring the pressure of auxiliary control valves. To be used with a “male” union for quick couplings.

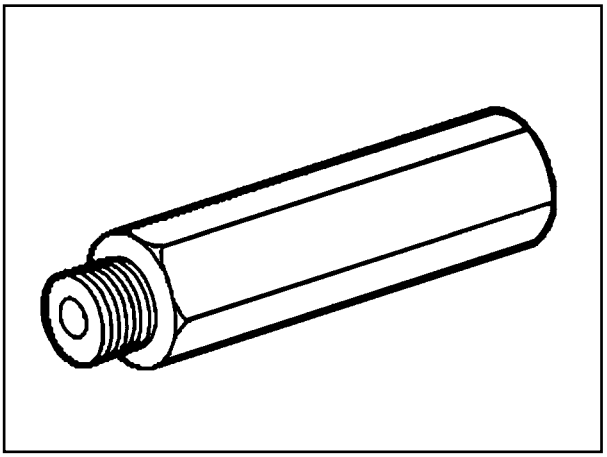


Fig. 7.246

05 IDR MYT

Cooling circuit pressure measuring union

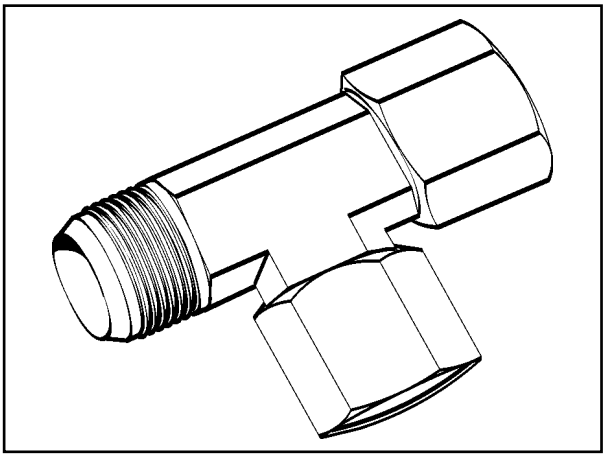


Fig. 7.247

01 IDR REX

Lift pressure measuring union

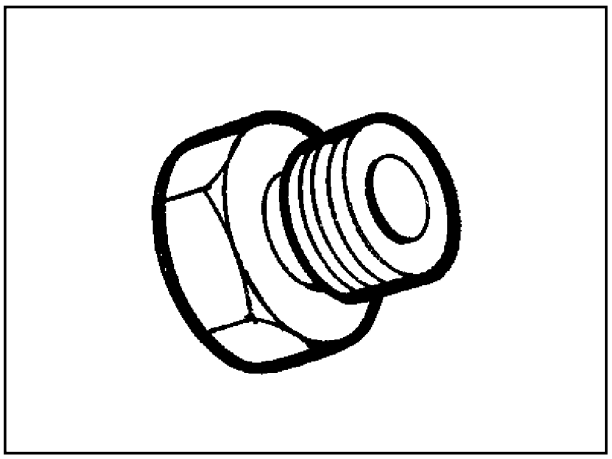


Fig. 7.248

02 IDR REX

4WD engagement pressure measuring union

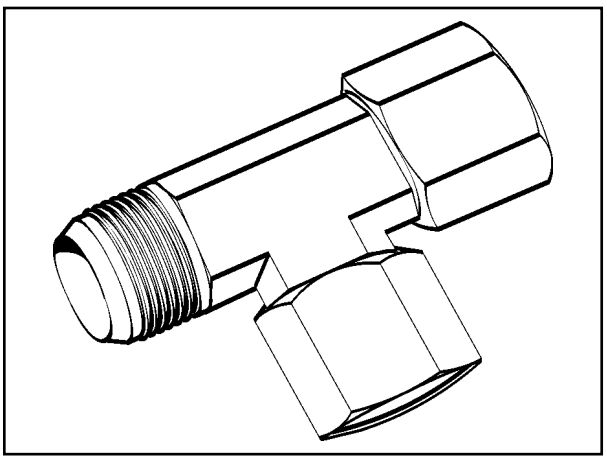


Fig. 7.249

03 IDR REX

Steering circuit pressure measuring union

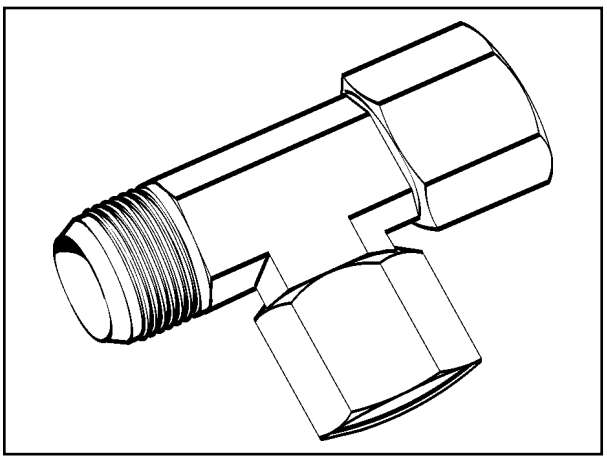


Fig. 7.250

05 IDR REX

Lift pressure measuring union

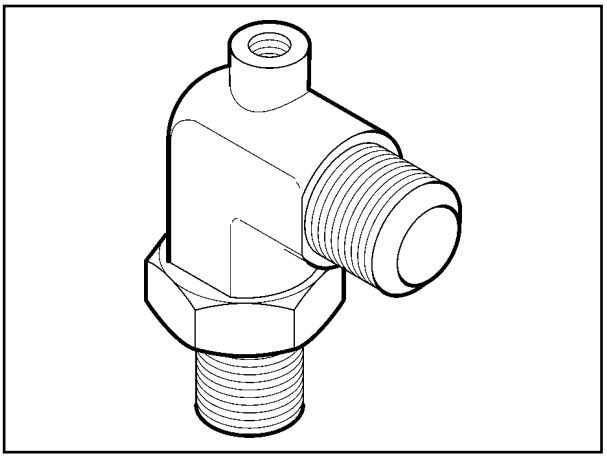


Fig. 7.251

122 IDR GL

Universal adapter union (available from the market)

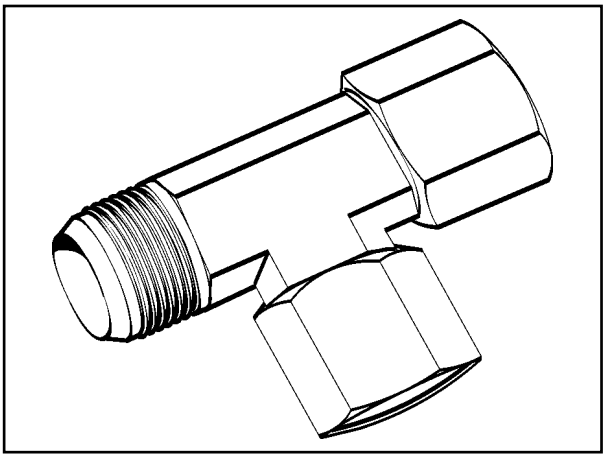


Fig. 7.252

125 IDR GL

Differential lock pressure measuring union.

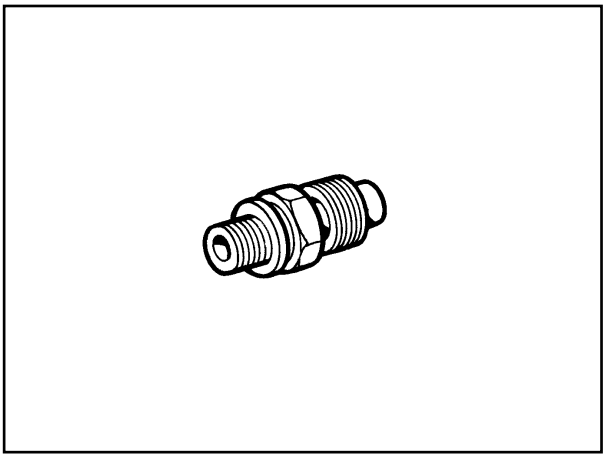


Fig. 7.253

Chapter 8 : Mechanical power lift

Index

Section 1 : Precautions and Safety Recommendations. 8-2

Section 2 : General description 8-3

2.1 Drawing of assembly and main components 8-4
2.2 Hydraulic power lift operating modes 8-7
2.3 Main components of the load sensing valve system 8-12
2.4 Operating phases of the load sensing valve system 8-14

Section 3 : Technical specifications 8-21

3.1 Main technical specifications 8-22
3.2 Driving torques and sealants 8-23

Section 4 : Inspections, adjustments and troubleshooting 8-25

4.1 Hydraulic tests for the load sensing valve system 8-26
4.2 Power lift adjustments 8-30
4.3 Operating pressure tests 8-38
4.4 Troubleshooting 8-39

Section 5 : Special tools 8-39

Section 1 : Precautions and Safety Recommendations.

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: Do not begin work until the pressure in the hydraulic circuit has dropped to zero.
	Attention: Splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.
	Attention: Always comply with the operating instructions supplied by the manufacturer when using adhesive materials or detergents.
	Attention: used oil must be collected and disposed of in compliance with the anti-pollution laws in force.
	Attention: Take care to avoid burns when working with boiling oil. Never heat oil to temperatures exceeding 190°C as the oil or its vapours could suddenly catch fire.
	Attention: lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

Section 2 : General description

Index

2.1 Drawing of assembly and main components 8-4

2.2 Hydraulic power lift operating modes 8-7
2.2.1 Position control 8-7
2.2.2 Draft control 8-8
2.2.3 Mixed position and draft control 8-9
2.2.4 Floating position 8-10

2.3 Main components of the load sensing valve system 8-12

2.4 Operating phases of the load sensing valve system 8-14
2.4.1 Valve system in the Neutral Phase 8-14
2.4.2 Valve system in the lifting phase 8-16
2.4.3 Valve system in the discharge phase 8-18

2.1 Drawing of assembly and main components

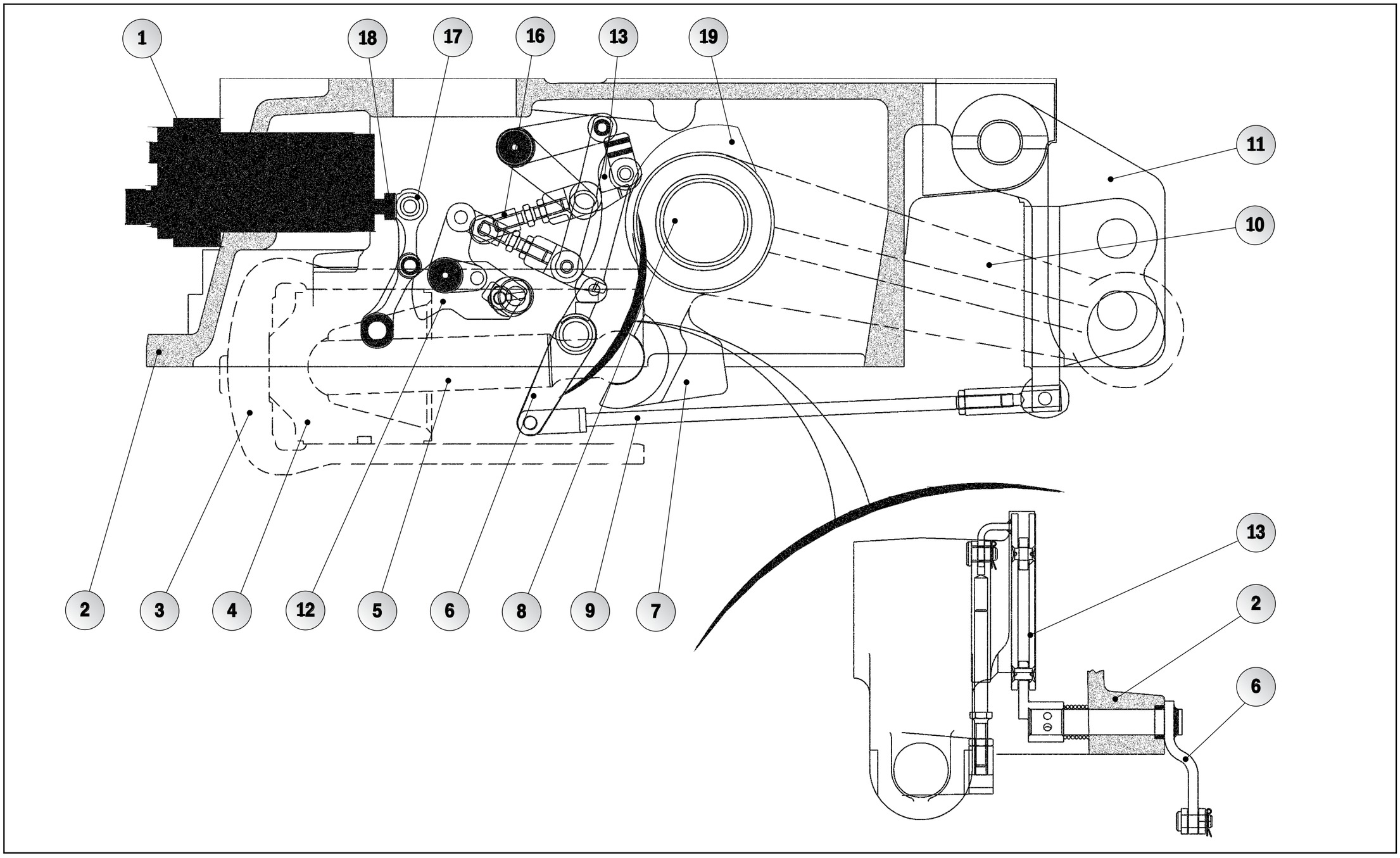


Fig. 8.1

1 - Control valve
2 - Power lift unit
3 - Ram
4 - Piston
5 - Link
6 - Draft control lever
7 - Link bearing shaft lever
8 - Link bearing shaft
9 - Draft control external lever
10 - Lift link
11 - Swinging support
12 - Control cam
13 - Selection guide
14 - Link
15 - Link adjuster screw
16 - Selector fork
17 - Control valve control lever
18 - Control valve activating plunger
19 - Power lift control lever
20 - Position/draft control selector lever

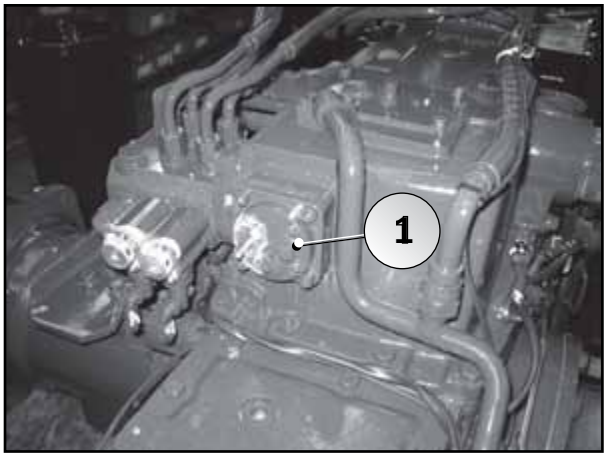


Fig. 8.2

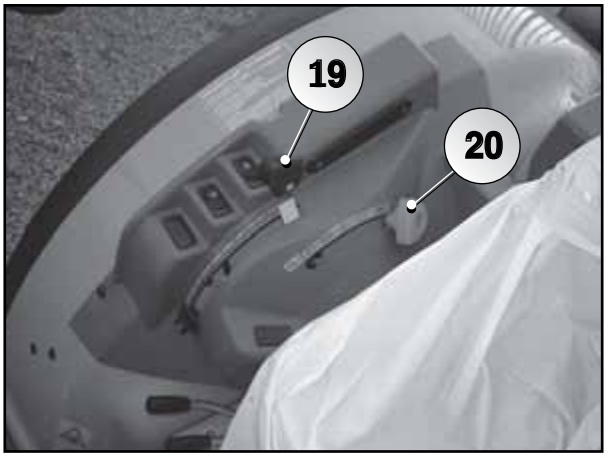


Fig. 8.3

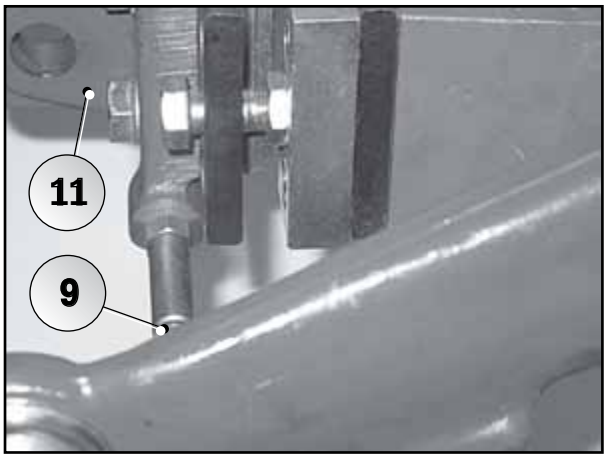


Fig. 8.4

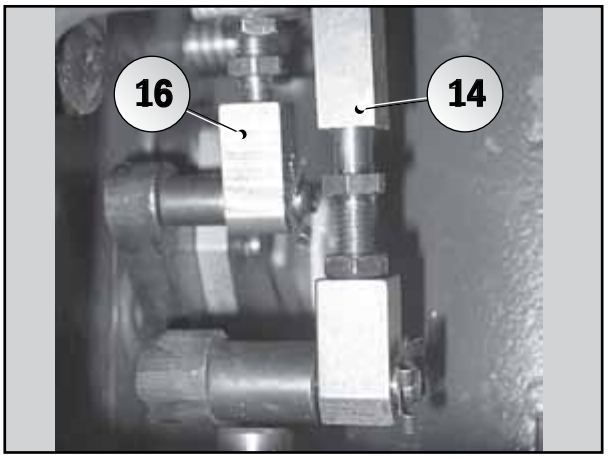


Fig. 8.5

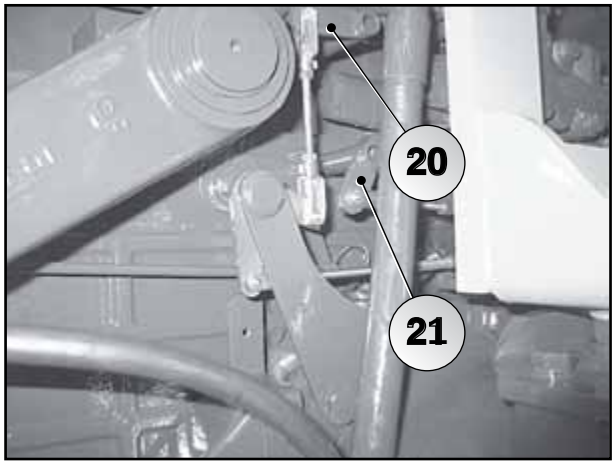


Fig. 8.6

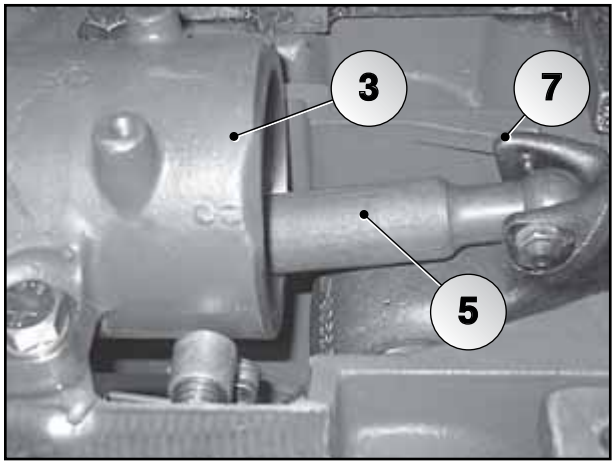


Fig. 8.7

2.2 Hydraulic power lift operating modes

The hydraulic power lift installed in **F-N Series** tractors can have have four operating modes:

- Position control
- Draft control
- Mixed control
- Floating position

Each of these four operating modes must be chosen to suit the type of job and the surface consistency of the soil.

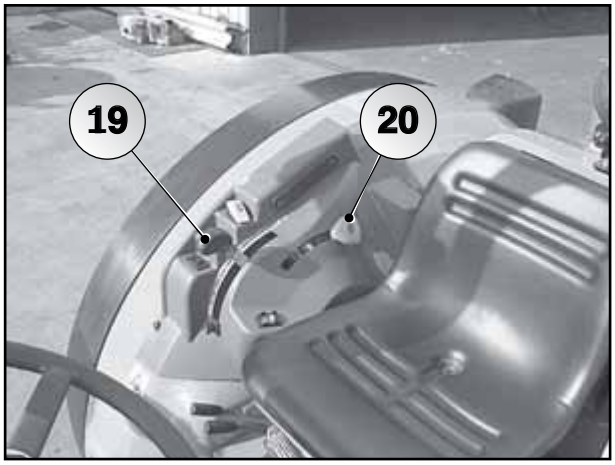


Fig. 8.8

2.2.1 Position control

To work in the position control mode, move knob (20) fully back on the sector and establish the work depth with the lever (19).

The position control mode allows the implement to be set at a determined position at any point between the highest and lowest one, both in and out of the soil, depending on the position to which the control lever is set.

The position control mode allows the implement to be set at a determined position at any point between the highest and lowest one, both in and out of the soil, depending on the position to which the control lever is set.

Lifting link movement in height is proportional to the movement of the control lever.

The depth at which the implement works will not change even if it encounters soil of a different consistency (example: zone d = sandy soil; zone e = compact soil; zone c = clayey soil).

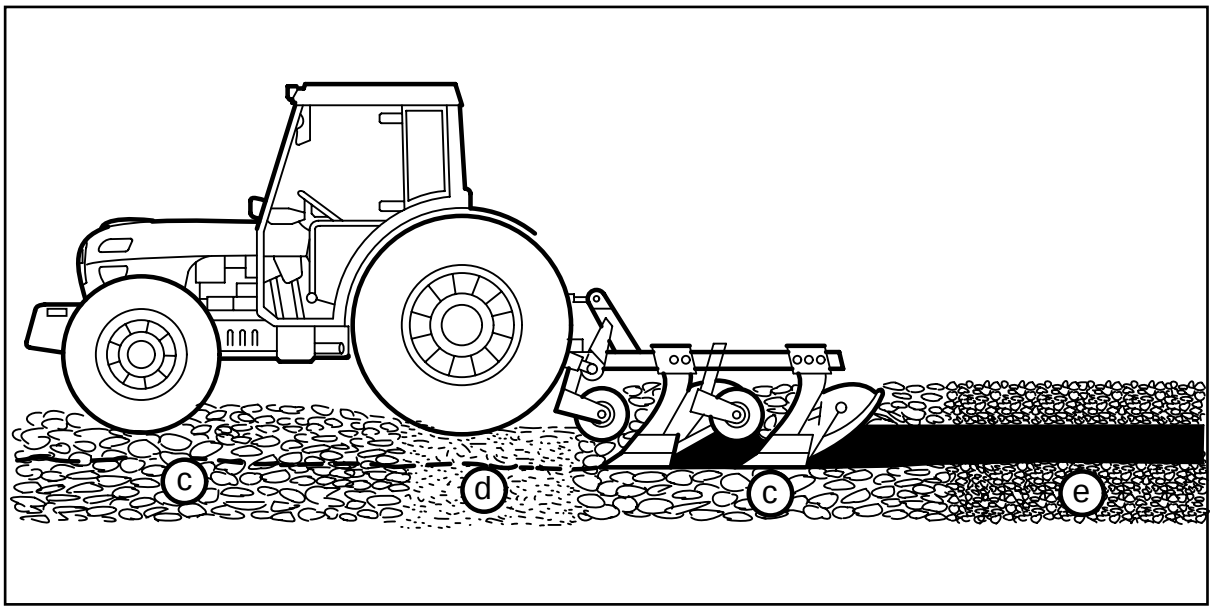


Fig. 8.9

2.2.2 Draft control

To work in the draft control mode, move knob (20) fully forward on the sector and establish the work depth with the lever (19). The draft control mode allows the tractor's lugging power to be maintained at a constant level, automatically varying the work depth of the implement as the soil conditions change.

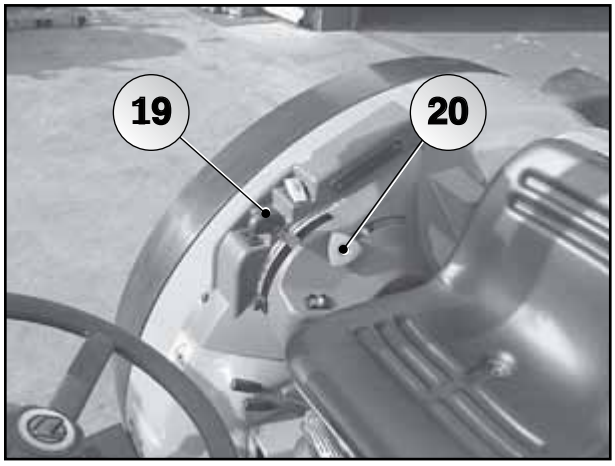


Fig. 8.10

In this operating mode, the depth at which the implement works may change to a considerable degree if it encounters soil of a different consistency (e.g.: zone d = sandy soil; zone e = compact soil), while the depth remains more or less uniform if the soil is homogeneous (zone c = clayey soil), whether the land is flat, or with hollows and hillocks.

Use of the draft control mode is of particular help during work that requires considerable lugging power carried out with mounted implements, since these transfer most of this lugging power to the rear wheels, thus increasing the tractor's wheel grip.

The lever on top of the valve system regulates the sensitivity of the response in draft control mode since it increases or reduces the travel the third point must make in order to change from the neutral phase to the discharge phase.

Maximum sensitivity will be obtained with the lever in the (+) position while the minimum sensitivity is obtained in the (-) position.

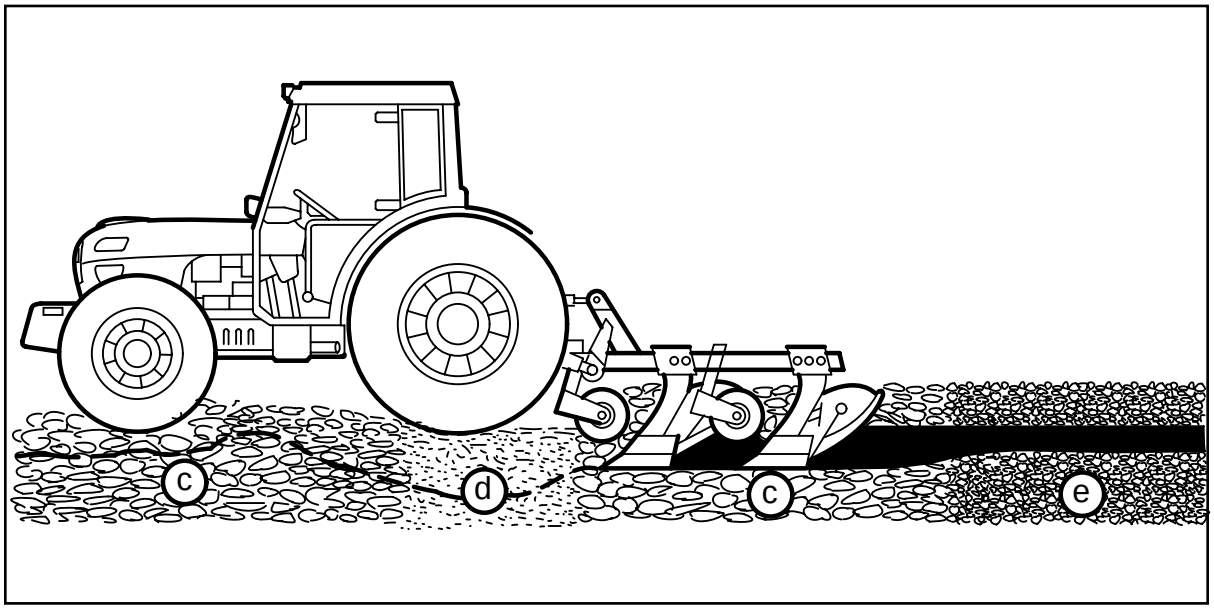


Fig. 8.11

2.2.3 Mixed position and draft control

When work is carried out in the draft control mode on irregular ground, there may be excessive variations to the work depth which are unacceptable for cultivation in that type of soil.

In these conditions, the mixed position-draft control mode should be used. To work in this mode, dig the implement into the soil and establish the required work depth as described for the draft control mode.

Once this depth has been reached, lower lever (19) and gradually move knob (20) up in order to increase the degree of position control. The power lift operates in the draft control mode but meanwhile prevents the implement from digging excessively into softer soil and producing an uneven job.

When the power lift is preset for the mixed position and draft control mode (intermix), the maximum and minimum depths at which the implement works are limited in relation to the mean value (see zone d = sandy soil; zone e = compact soil) since lever movement toward the position control setting reduces the sensitivity of the draft control action and introduces part of position control.

The positions to which the lever can be set are as many as can be obtained in the space that separates the two ends and its vicinity to one end or the other leads to a greater influence being excercised by the position or draft control functions.

During work, the operator must find the best position for the selector lever in order to obtain the best compromise between draft variation and depth.

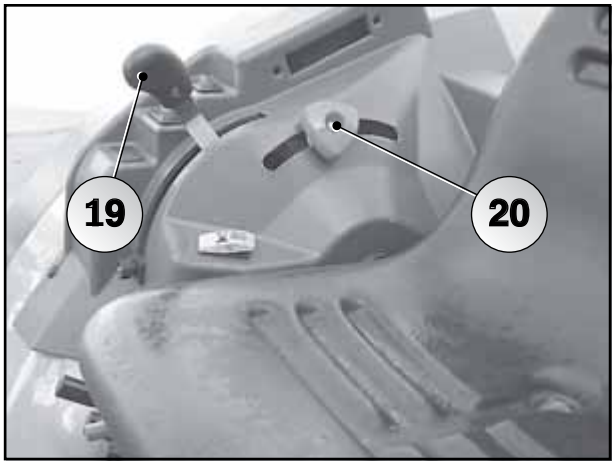


Fig. 8.12

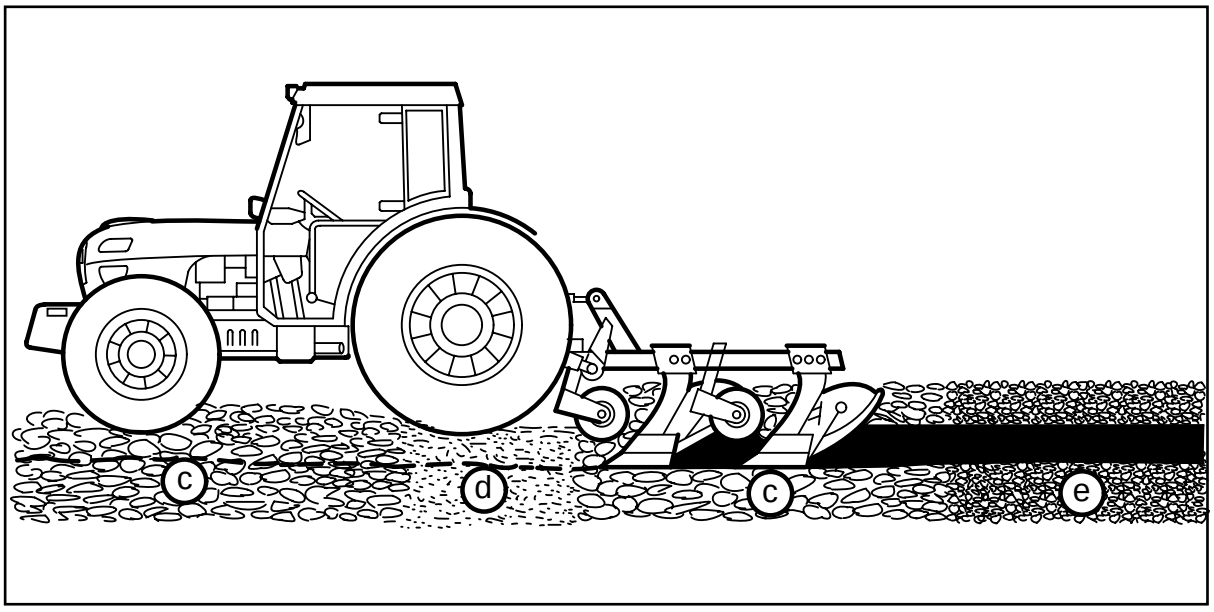


Fig. 8.13

2.2.4 Floating position

To operate in the floating position, move lever (19) completely down on the sector.

The floating position allows the lift links to swing freely.

The floating position is therefore used for all implements that must simply rest on the soil and follow the contours of the ground, or for semi-mounted implements that have specific components with which they rest on the ground.

2.3 Main components of the load sensing valve system

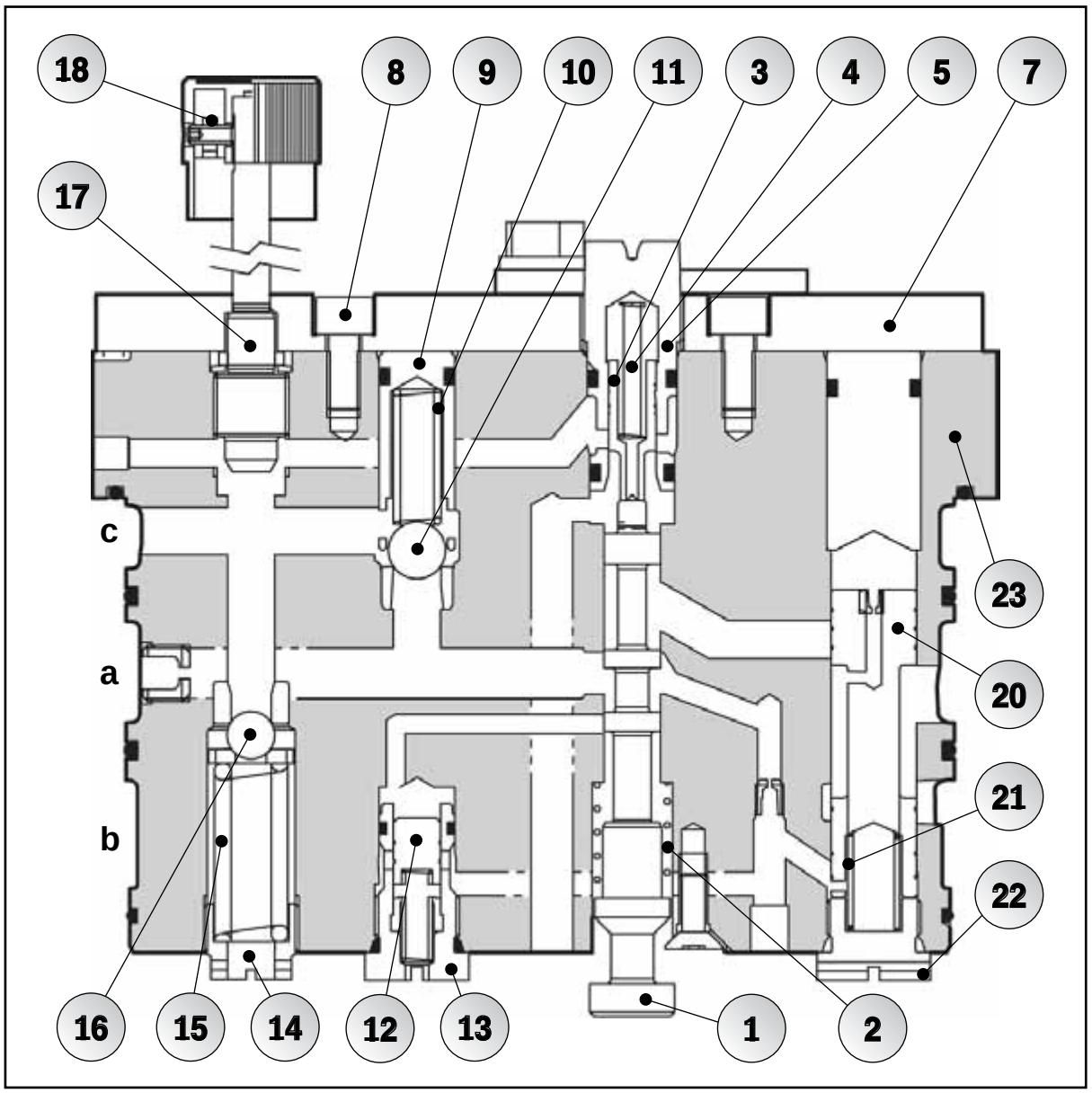


Fig. 8.14

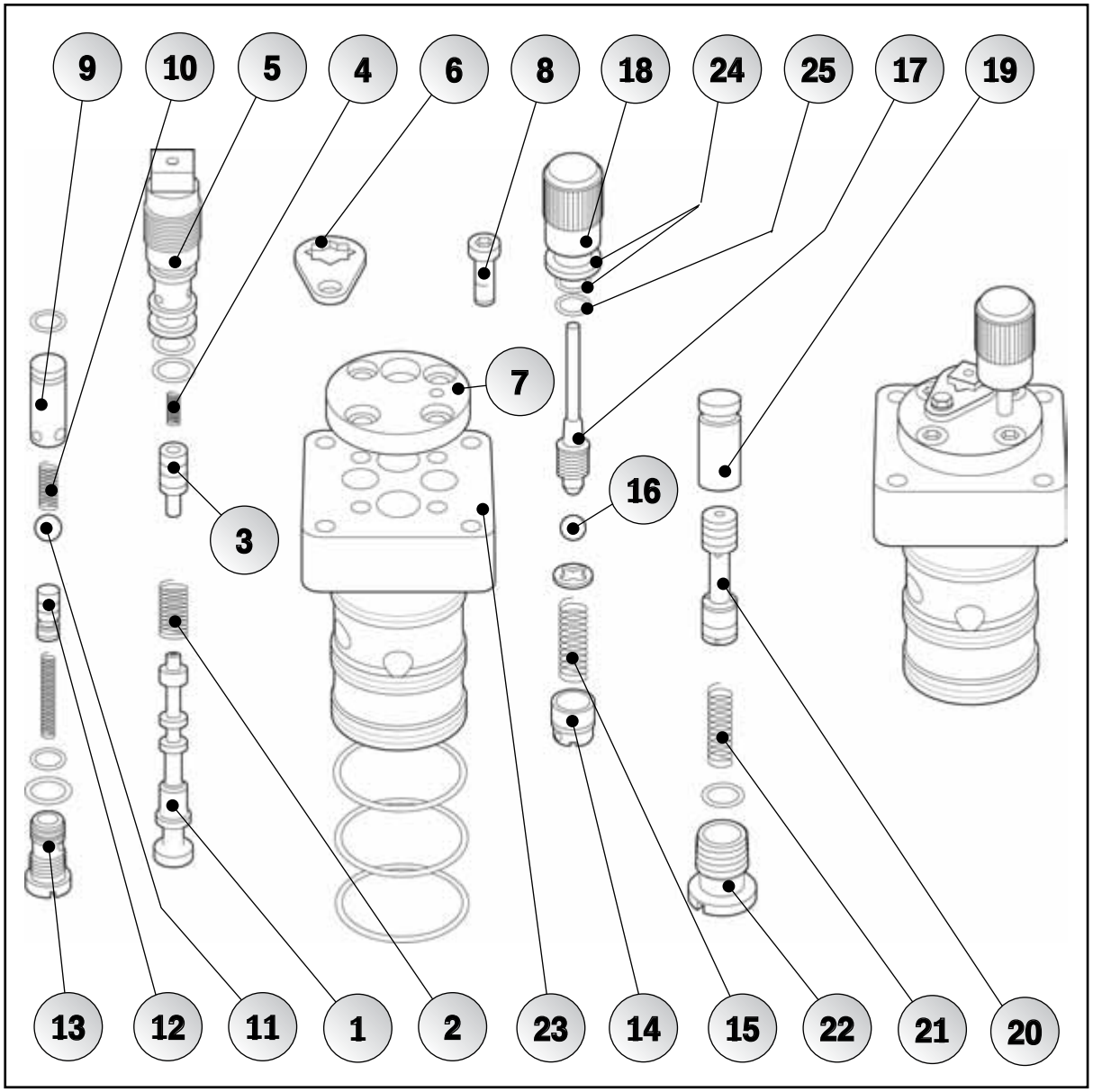


Fig. 8.15

1 - Valve stem
2 - Stem spring
3 - Discharge valve stem
4 - Discharge valve spring
5 - Discharge valve casing
6 - Locking plate
7 - Cover
8 - Screw
9 - Non-return valve plug
10 - Non-return valve ball spring
11 - Non-return valve ball
12 - Pilot valve
13 - Pilot valve casing
14 - Antishock valve adjuster plug
15 - Antishock valve spring
16 - Antishock valve ball
17 - Lowering speed regulator
18 - Down speed regulator knob
19 - Servo valve plug
20 - Servo valve
21 - Servo valve spring
22 - Servo valve plug
23 - Valve system casing
24 - Retention rings
25 - Washer
to - Duct where oil arrives from pump
b - Pump outlet
c - Servo valve pilot duct

2.4 Operating phases of the load sensing valve system

Three phases always occur during power lift operation, regardless of whether it is used in the position control or draft control mode:

- Valve system in the neutral phase
- Valve system in the lifting phase
- Valve system in the discharge phase

To make the descriptions clearer, hese three phases will therefore be illustrated individually. However, remember that the three phases take place without any specific order when the power lift operates, particularly in the draft control and Intermic modes.

2.4.1 Valve system in the Neutral Phase

As soon as the engine starts, the pump (23) draws in oil from the tank (24) and sends it to the circular race (a).

During this phase, the stem (1) is in the intermediate position and the discharge valve is closed, since the valve stem (3) prevents pressurized oil in the channel (r) from flowing to the outlet (l).

Oil from the pump reaches the servo-valve (20) and flows into the chamber (h) through hole (q) where it moves the servo-valve downwards, thus allowing the oil to flow between chambers (a) and (b) and all the pump oil to flow towards the outlet.

The servo-valve can move downwards because, by means of ducts (m) and (g), chamber (i) communicates with chamber (e) of the pilot valve (12), which is in communication with the outlet. The oil in the cylinder (26) communicates with the circular chamber (c) with the antishock valve ball (16) and, through duct (r), with the non-return valve ball (11) and with the discharge valve stem (3).

Oil thus remains in the cylinder, since it is prevented from flowing towards the outlet and constantly communicates with the antishock valve (16).

Neutral phase

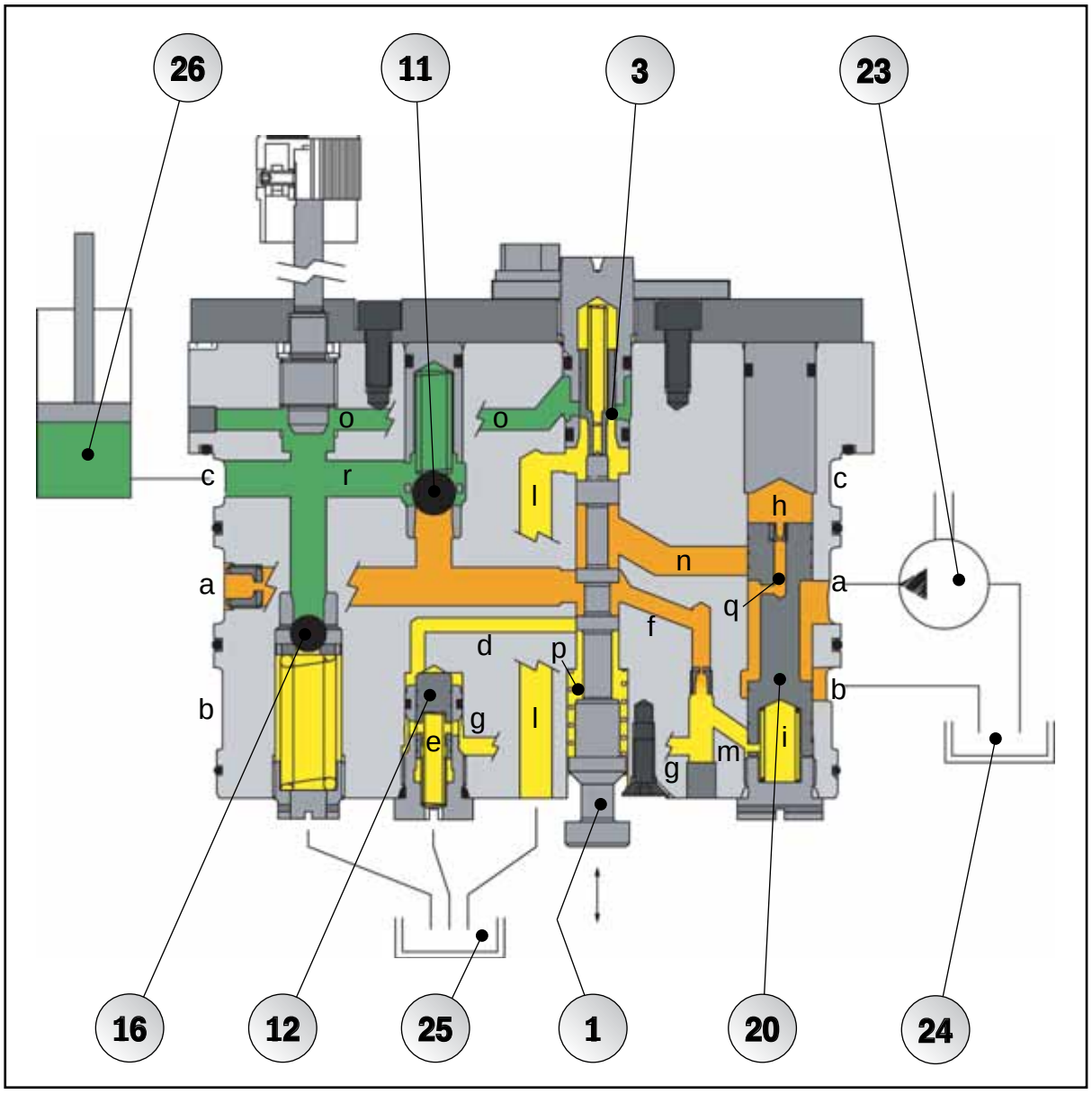


Fig. 8.16

- Oil from the pump
- Static oil
- Discharged oil

2.4.2 Valve system in the lifting phase

Oil from the pump reaches the chamber (i) through the channel (f) and the servo valve (20) moves upwards, shutting off the flow between the circular chamber (a) and the chamber that communicates with the outlet (b).

Lifting phase

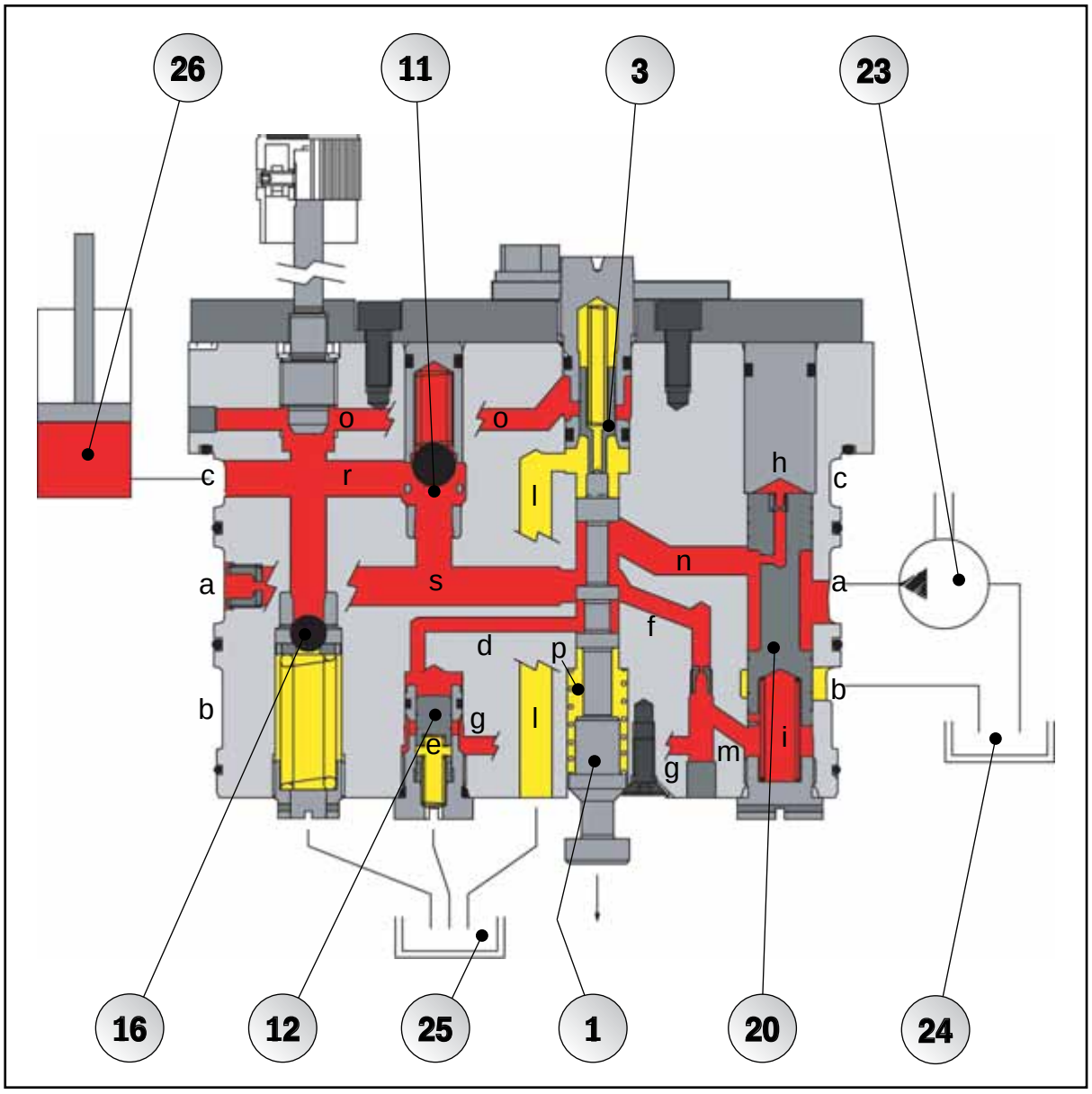


Fig. 8.17

- Pressurized oil
- Discharged oil

2.4.3 Valve system in the discharge phase

In this phase, the stem (1) is pushed fully inside the valve and pushes stem (3) upwards, thus opening the discharge valve.

Oil from the cylinder (26) passes through race (c) and channels (r) and (o) towards the outlet through channel (l).

The flow of oil from channels (r) and (o) is modulated by the lowering speed regulator (17), operated by the knob (18).

Turn the knob clockwise to reduce the lowering speed. Turn it anti-clockwise to increase the speed.

Oil from the pump (23) pushes the servo valve (20) downwards by means of chamber (h), since chamber (i) communicates with the outlet (e) through channel (g).

This allows all the oil from the pump to discharge through circular race (b).

Discharge phase

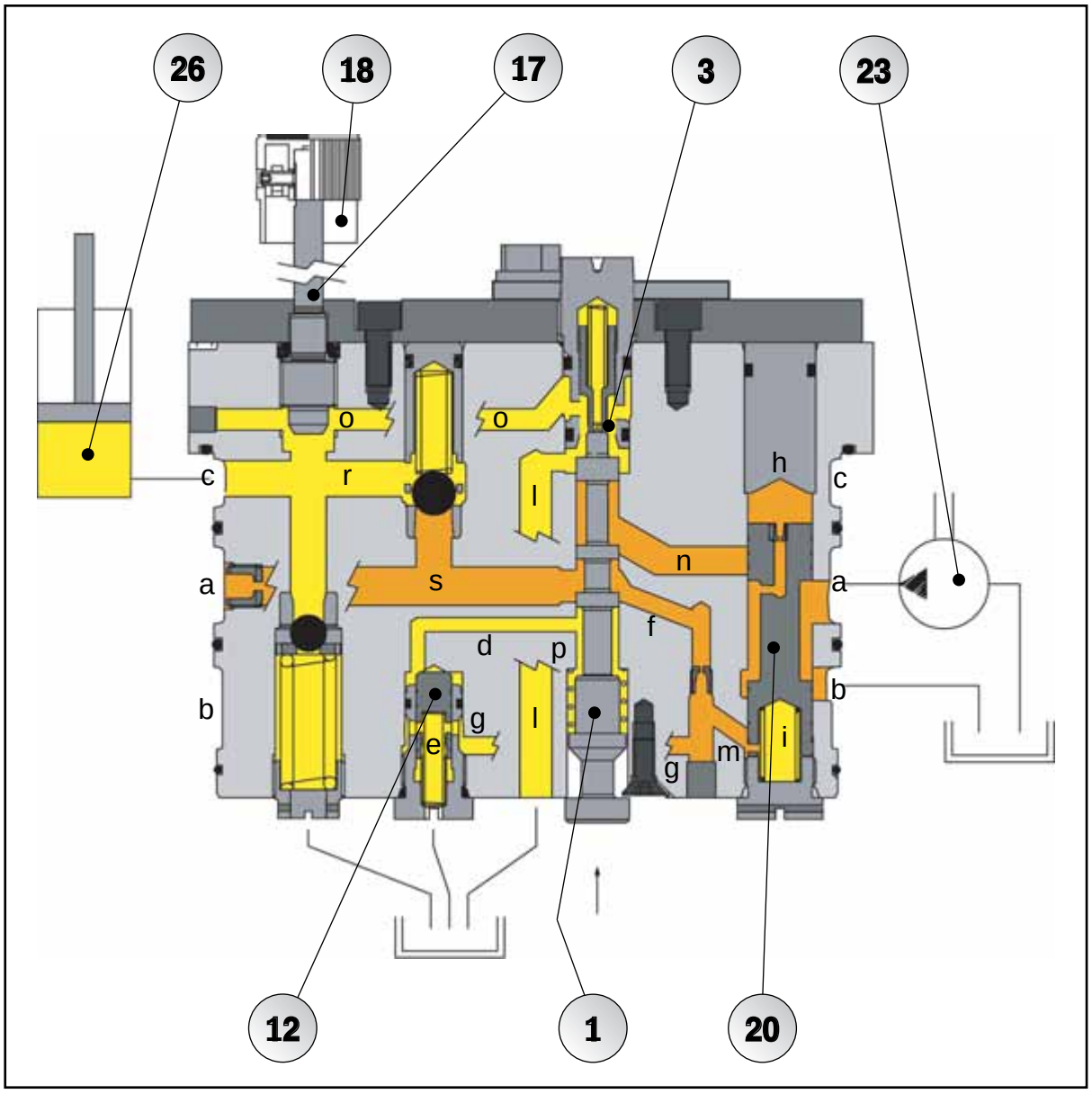


Fig. 8.18

- Oil from the pump
- Discharged oil

Section 3 : Technical specifications

Index

3.1 Main technical specifications 8-22

3.2 Driving torques and sealants 8-23

3.1 Main technical specifications

In this phase (1), the stem is completely shifted downwards and rests against the retention screw (27). This movement opens up the communication between duct (s) and channel (d). Oil from the pump reaches the chamber (t), pushing the piloted valve downwards (12) and shutting off the flow towards the outlet (e) and channel (g).

In this condition, oil coming in from the pump (23) pushes the non return valve ball (11) through channel (s) and reaches channel (r), the circular race (c) and supplies the cylinder (26).

Mechanical hydraulic power lift

Manufacturer	McCormick
Operating modes	position control / draft control / intermix
Hydraulic system	open-center type
Standard cylinder	single-acting
Dimensions	ø 100 x 125 stroke
Swept volume	981 cc
Supplementary cylinders	2 single-acting cylinders
Antishock valve	210 ± 5 bar
Type of Control	hand lever and selector lever
Sensitivity adjustment	lever on control valve

Rated lifting capacity

Capacity	
with 2 supplementary cylinders	4200 kg

3.2 Driving torques and sealants

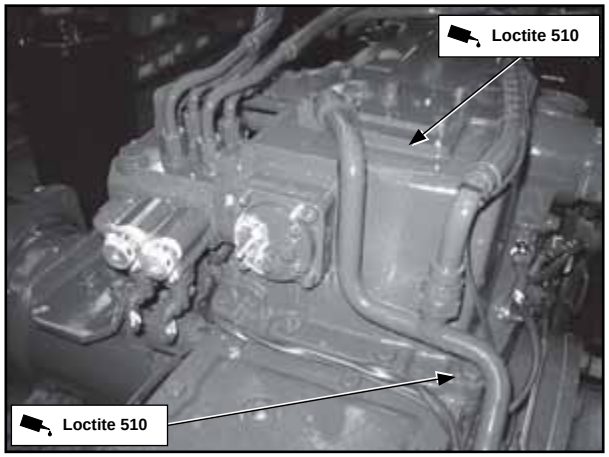


Fig. 8.19

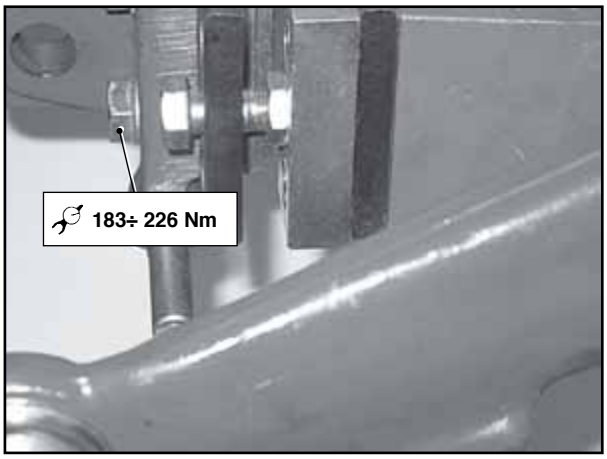


Fig. 8.20

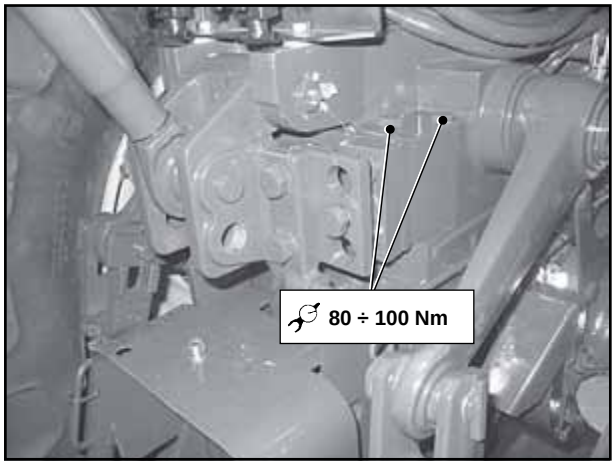


Fig. 8.21

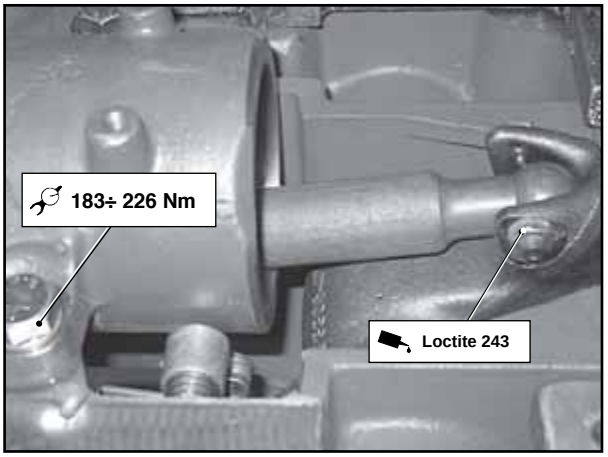


Fig. 8.22

Key

- Driving torque
- Type of sealant

Section 4 : Inspections, adjustments and troubleshooting

Index

4.1 Hydraulic tests for the load sensing valve system 8-26
4.1.1 Check for leaks from the discharge valve 8-26
4.1.2 Inspection and adjustment of the safety valve 8-28
4.1.3 Non-return valve test 8-29
4.1.4 Down speed regulator 8-29

4.2 Power lift adjustments 8-30
4.2.1 Control lever coupling to the power lift's output levers 8-31
4.2.2 Sensitivity adjustment 8-32
4.2.3 Adjustment of the end of travel position of the links in the draft control mode 8-33
4.2.4 Adjustment of the end of travel position of the links in the position control mode 8-34
4.2.5 Draft control adjustment 8-35
4.2.6 Leak test 8-37

4.3 Operating pressure tests 8-38

4.4 Troubleshooting 8-39

4.1 Hydraulic tests for the load sensing valve system

During these tests, the valve system must be made to operate in the various conditions in which it may be called upon to work when the power lift is operating on the tractor.

These tests allow the valves to be calibrated, to make sure that there are no leaks and to establish beforehand whether the assembly operates within the limits for which it was designed and built.

The following tests must be carried out:

- Check for leaks from the discharge valve
- Inspection and adjustment of the safety valve
- Check for leaks from the non-return valve on the user duct

⚠	**Attention:** Do not begin work until the pressure in the hydraulic circuit has dropped to zero.

⚠	**Attention:** Splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.

4.1.1 Check for leaks from the discharge valve

Fit the valve (C) into tool CR-342 (A). Connect the high pressure pump hose to the upper union (B) of the tool (lifting ram duct).

Position a suitable bolt between the base of tool CR-342 and the valve stem, then unscrew the nut of the bolt and lift the stem until its end is about 8 mm away from the lower surface of the body of the valve system.

Operate the pump and make sure that the discharge valve (15) discharges the oil from duct (G). If this fails to occur, turn the valve body clockwise until the valve opens.

Continue to operate the pump and begin to slowly turn the valve body in the anti-clockwise direction to start closing the valve.

Stop this operation as soon as oil stops flowing from duct (I) and the pressure gauge shows that the pressure is increasing (position 1).

Turn the valve unit through 280° in the anti-clockwise direction again. Valve coverage in relation to the discharge holes of its housing will now be 1 mm (position 2). Operate the pump until the pressure reaches 150 bar.

At this stage, the pressure should start to drop very slowly. This this fails to occur, it would be a sign of excessive leaking between the stem (3) and its seat or between the retention rings (21) and the body of the valve system.

The maximum leak tolerated at a pressure of 150 bar and at a temperature of 25-30°C is 3 cc, within 3 minutes.

If this value is reached, disassemble the valve and replace the retention rings, then repeat the test. Replace the discharge valve if the fault persists.

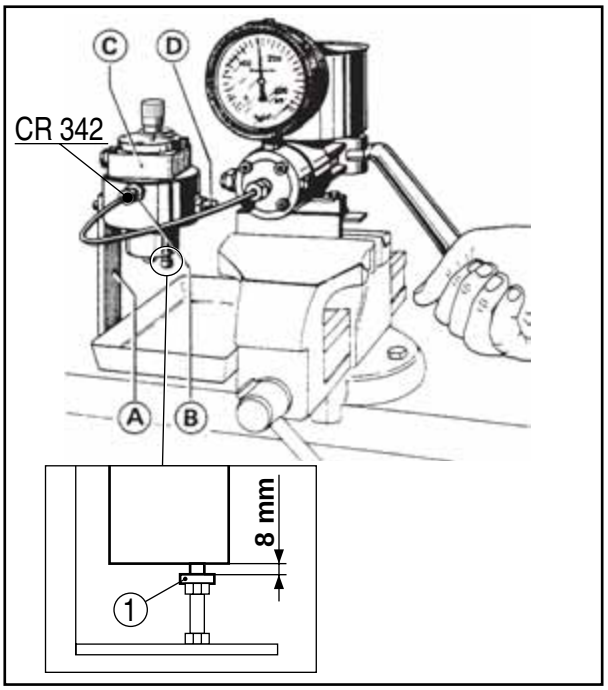


Fig. 8.23

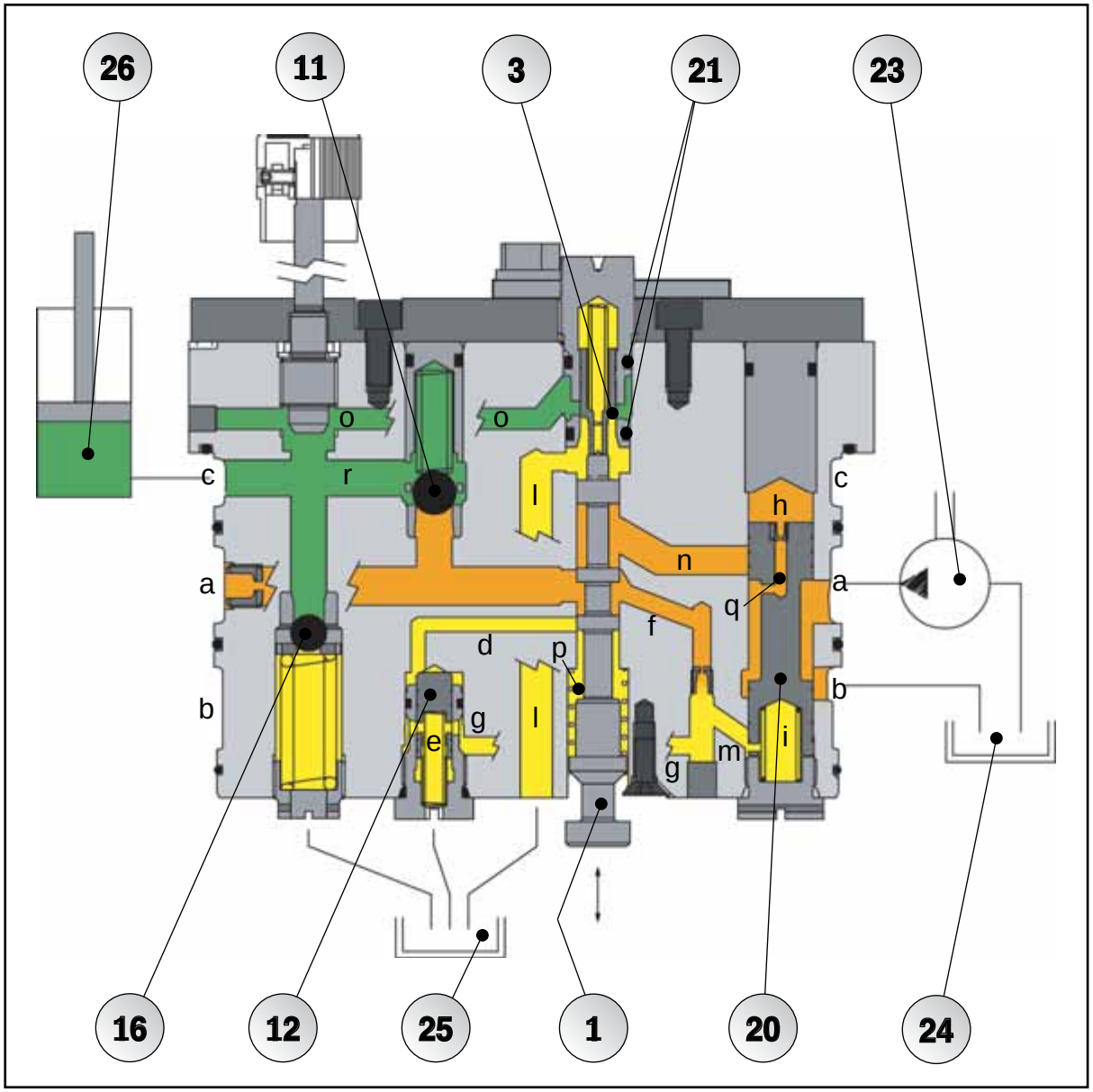


Fig. 8.24

- Oil from the pump
- Static oil
- Discharged oil

4.1.2 Inspection and adjustment of the safety valve

Keep the pump connected to the same tool union and operate it until the cylinder safety valve opens (16 Fig.8.25). It must open at the value of 190 bar.

If this fails to occur, adjust the valve by means of the retention plug of the spring.

Tighten the plug to increase the setting value, slacken it off to decrease the value.

Once the valve has been adjusted, place a graduated test pipe under the valve system and keep the pressure in the circuit at 150 bar.

The maximum leak tolerated in two minutes at an ambient temperature of 25-30°C must not exceed 10 cc. Failing this, check to find out which component is leaking.

Having eliminated the possibility of this being the discharge valve, which has already been checked, check to make sure that the antishock valve (16) is tight by watching to see that no oil flows from its duct.

If necessary, mill its housing to re-create the sharp edge using a 13 mm diameter mill available from the market (e.g. CM 53 SLH 124).

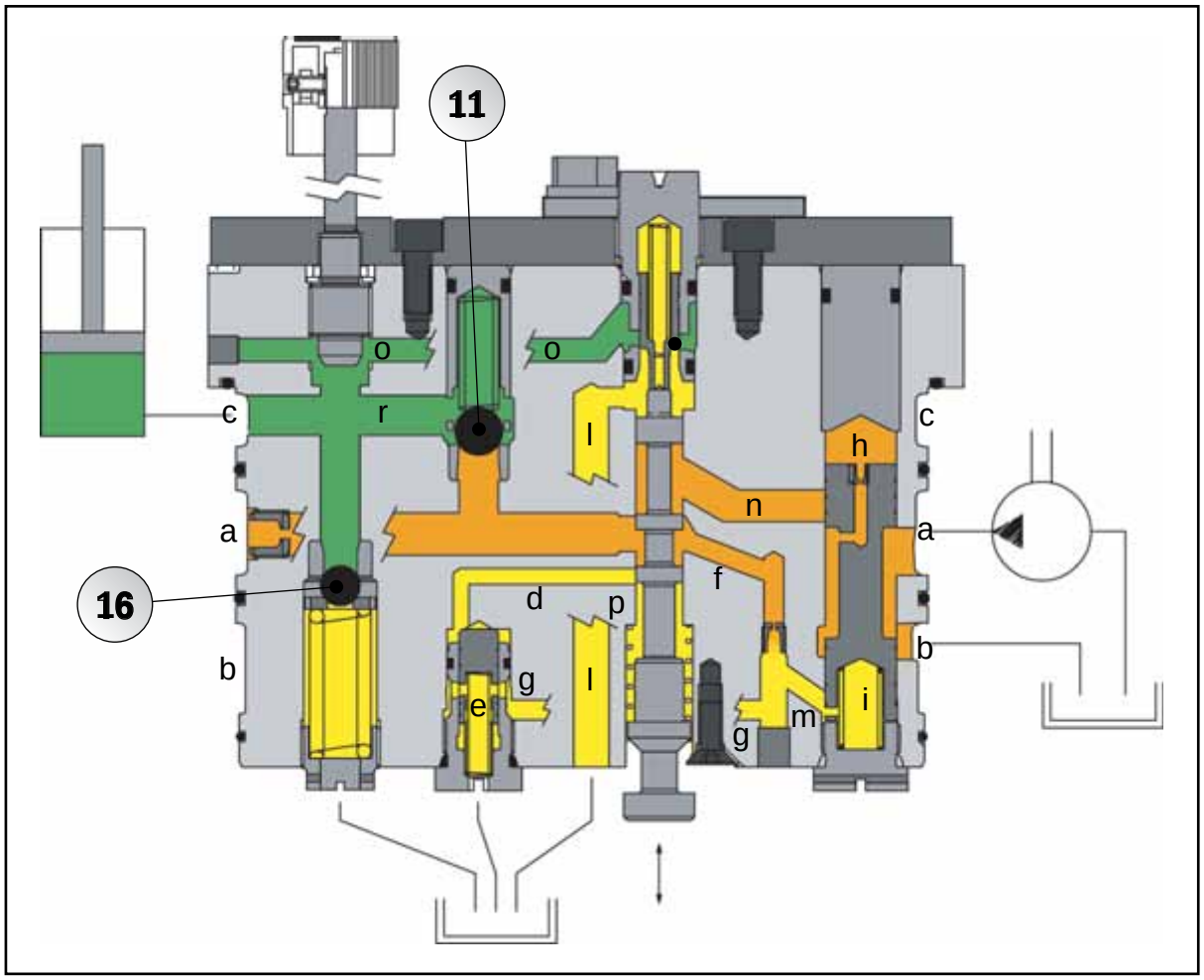


Fig. 8.25

4.1.3 Non-return valve test

Leaking can also be caused by the non-return valve (11).

In this case, oil may flow through duct (e). If necessary, mill its housing to re-create the sharp edge using a 12 mm diameter mill available from the market (e.g. CM 53 SLH 124).

Use an upright drill to mill housings in order to ensure that the mill operates in a perfectly perpendicular way.

The tool must turn between 100-200 RPM at most.

Check the upper and intermediate retention rings of the valve system if the leaks persist.

Note: do not attempt to re-create the seats by tapping on the balls as this would only enlarge them.

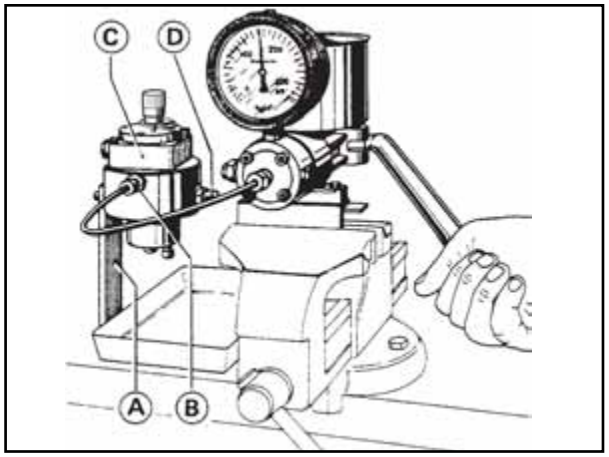


Fig. 8.26

4.1.4 Down speed regulator

How to prepare for assembly.

When the down speed regulator unit is assembled, take great care to ensure that the washer (25) and rings (24) are fitted in the right sequence, as indicated in Fig.8.28.

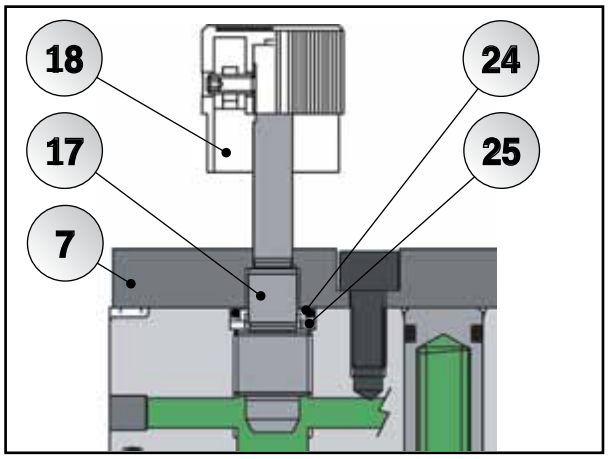


Fig. 8.27

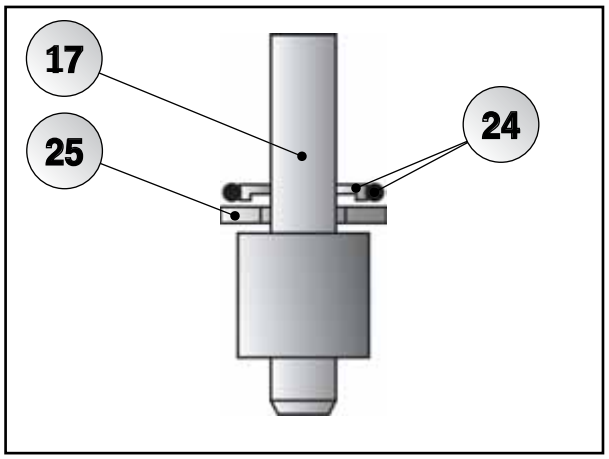


Fig. 8.28

4.2 Power lift adjustments

Foreword

The hydraulic power lift will not normally need to be periodically adjusted as there are no parts liable to appreciable wear.

However, adjustments are essential after a general overhaul or when the power lift controls behave in a faulty way, such as reacting in delay to the manual and automatic commands.

It is not particularly difficult to adjust the hydraulic power lift, neither are special tools equired. However, these adjustments must be carried out with great care, so it is advisable to have them done by specialized personnel.

Before beginning the operations described below, make sure that the entire hydraulic circuit operates perfectly by conducting the hydraulic tests described in the previous chapter if necessary.

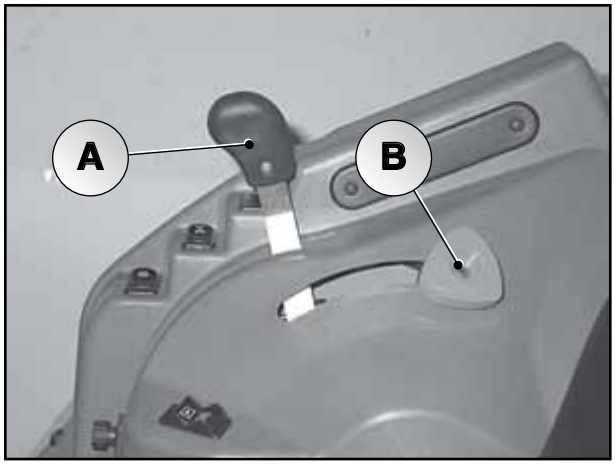


Fig. 8.29

Adjustments

There are 6 adjustments to be made in the following order:

1 - Control lever coupling via links to the power lift's output levers;

2 - Adjustment of the hydraulic valve system's sensitivity;

3 - Adjustment of the end of travel position of the links in the draft control function;

4 - Adjustment of the end of travel position of the links in the position control function;

5 - Draft control adjustment;

6 - Leak test.

Note: these adjustments must be carried out whenever the lifting unit is overhauled or when the power lift operates in a faulty way that cannot be ascribed to the hydraulic circuit.

⚠	**Attention:** before starting the engine, make sure that the screws that fix the valve system to the power lift and the cover screws of the discharge valve are well tightened.

⚠	**Attention:** keep well away of moving parts when the engine is running.

⚠	**Attention:** before loosening the screws of the discharge valve cover, stop the engine and fully lower the power lift links until the pressure in the cylinder has completely discharged.

4.2.1 Control lever coupling to the power lift's output levers

The purpose of this adjustment is to synchronize the movements of the control lever (A) and knob (B) with the two levers (20 and 21) installed on the power lift and, more precisely, ensure that when lever (A) reaches end of travel on the sector, lever (21) is also at end of travel against the stop pin. Likewise for the knob (B). Proceed in the following way to make the adjustments:

- check that the cable supports (24 and 25) are blocked by the bracket (31). If required, screw or unscrew the two nuts (29 and 30 Fig.8.30);
- set the distance between the centers of the holes of the rod (23) at 131 mm (Fig.8.31);
- screw the fork (26) on to the rod (25) until the threaded part of the rod begins to project from the end of the fork and leave it disconnected from the lever (27).
- bring the lever (20) against the top retention pin, and bring all backward the draft and position selector knob (B), that is in position control.
- lengthen or shorten the cable (25) by means of the adjuster (27) until the hole in the fork (26) is coaxial to the hole in the lever (27).
- fit the pin that fixes the fork (26) onto the lever (27).
- screw the fork (28) on to the rod (24) until the threaded part of the rod begins to project from the end of the fork and leave it disconnected from the lever (21).
- bring the lever (21) against the top retention pin, and the lifting-lowering control lever (A) completely up;.
- lengthen or shorten the cable (24) by means of the adjuster screw (26) until the hole in the fork (28) is coaxial to the hole in the lever (21).
- fit the pin that fixes the fork (28) onto the lever (21).

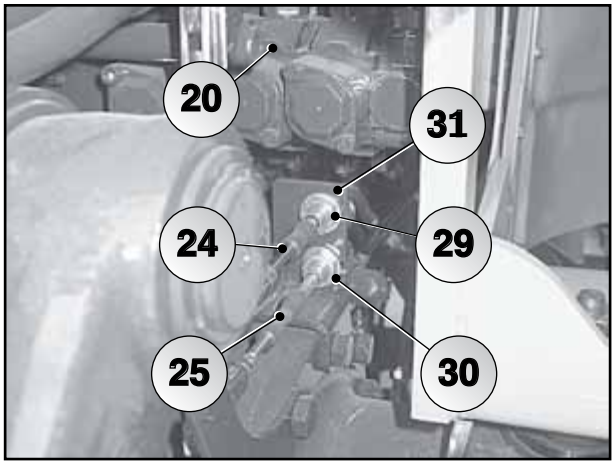


Fig. 8.30

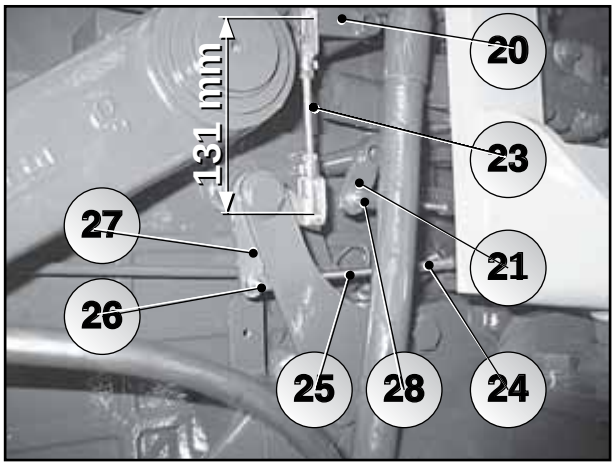


Fig. 8.31

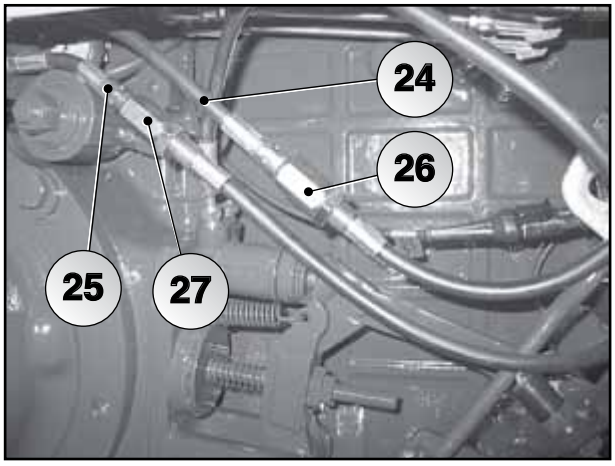


Fig. 8.32

4.2.2 Sensitivity adjustment

To achieve the maximum draft control, it is necessary to obtain the maximum reaction sensitivity from the valve plunger.

⚠	**Attention:** keep well away of moving parts when the engine is running.

1 - Apply a weight of at least 100 kg to the lift links;

2 - Start the engine and accelerate to 1000-1500 RPM. Wait for the transmission oil to reach a temperature of about 20-30°C.

3 - Move the lever (B) to position control, i.e. pushed fully forwards to end of travel.

4 - Move the control lever (A) to about halfway on the sector so that the links reach an intermediate position of their travel.

5 - Remove the nut (E) and the locking plate (6).

6 - Turn the discharge valve unit clockwise (5 Fig.8.34) to find the point at which the valve starts to open. This will be denoted by the appearance of a rhythmic swing from the lift links.

7 - Fix the plate (5) with the screw (E).

8 - Lower the lift links.

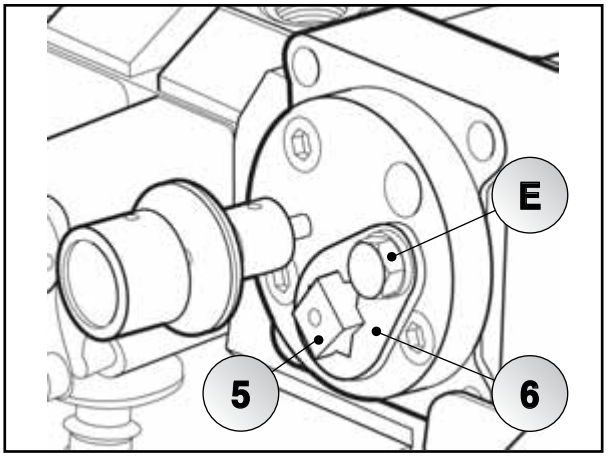


Fig. 8.33

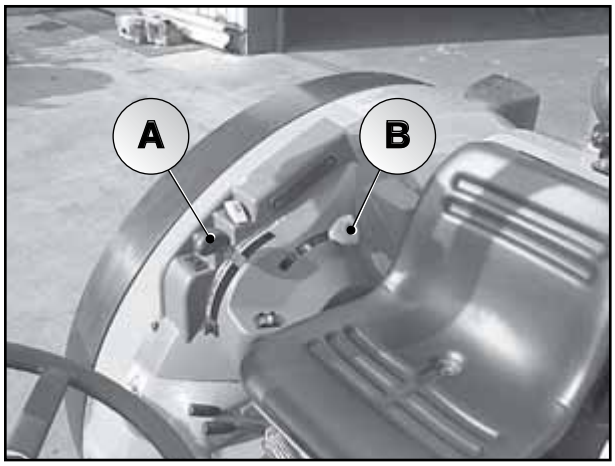


Fig. 8.34

4.2.3 Adjustment of the end of travel position of the links in the draft control mode

The purpose of this adjustment is to stop the lift links with the due play by adjusting the end of stroke device.

Proceed in the following way to make the adjustments:

- Free the lift links from the lower articulated rods.
- Move the lift links fully up by hand (Fig.8.36) so that the lever of the inner link moves to end of travel against the power lift housing. Now make a match mark on both the power lift housing and lift link;
- Start the engine and accelerate to 1000-1500 RPM. Wait for the transmission oil to reach a temperature of at least 20-30 °C.
- Move the mode selector knob (B) to draft control (fully forwards - Fig.8.35);
- Lower the links and apply a weight of no less than 100 kg.
- Move the control lever (A) to the upper part of the sector so that the links reach their maximum lift position.
- The links must stop when the reference mark made on the link is 4-5 mm lower than the one on the power lift housing.
- If the difference in the measurements is more or less than the indicated value, regulate the adjuster screw (H Fig.8.37) of the end of stroke lever through the opening in the upper part of the power lift casing (14 Fig.8.37). Unscrew to advance activation of the end of stroke device, tighten to delay it.

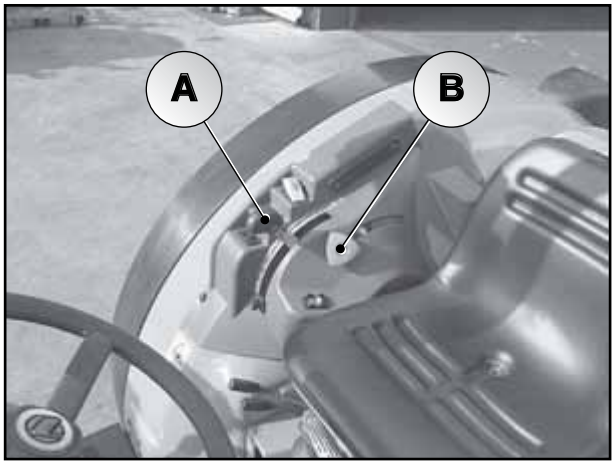


Fig. 8.35

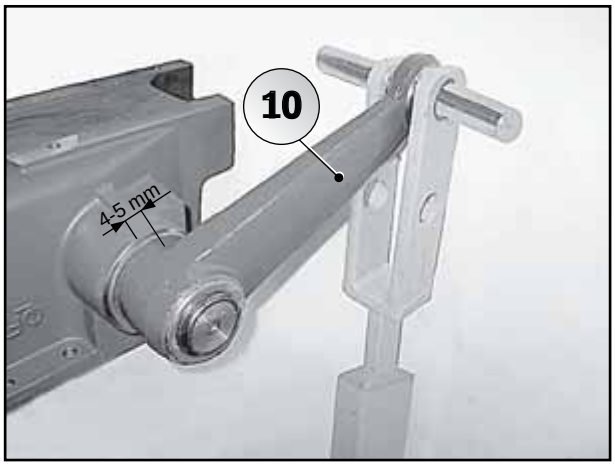


Fig. 8.36

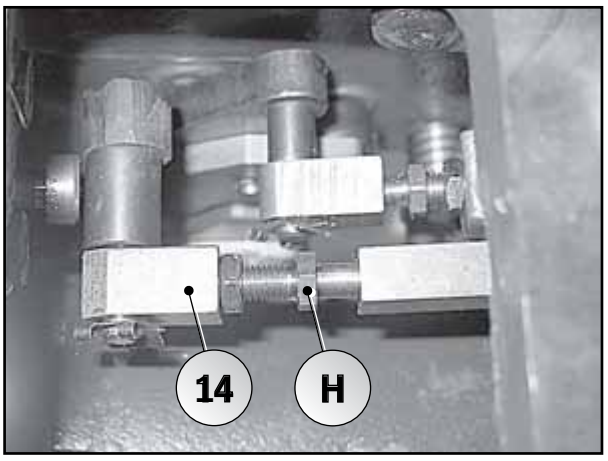


Fig. 8.37

4.2.4 Adjustment of the end of travel position of the links in the position control mode

This adjustment is carried out to ensure that the lifting travel of the links is the same in both the position control and draft control functions through a contemporaneous action of the end of stroke device.

- Keep a 100 kg load applied to the lift inks;
- Start the engine and accelerate to 1000-1500 RPM;
- Move the mode selector knob (B Fig. 8.38) to position control (fully back to end of travel on the sector).
- Move the control lever (A) up to end of travel on the sector. The links must lift and stop in the same position as the previous adjustment: This means that the mark on the link must match the end of travel mark previously made on the casing, 4-5 mm lower than the one made on the power lift casing.
- If the free travel is the same as that of the previous end of travel adjustment in the draft control mode, make sure that link (15) operates at the same time as the lever (14 Fig.8.39).
  To check this, unscrew and lengthen the screw (T) of the link to advance the action of the link limits.
  The links will now lower in a proportional way to screw lengthening.
  Now tighten, and shorten, the same screw by a tiny amount to allow the links to lift again.
  Stop when the last position obtained achieves the same maximum lift as the previous adjustment.
- If the free travel is higher than the indicated value (e.g. 6-7 mm), tighten screw (T) that adjusts the link (15) so that the links lift and bring the free travel to the established value (4-5 mm).

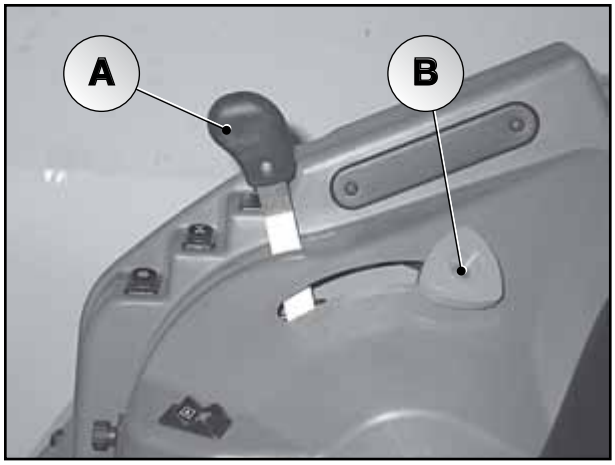


Fig. 8.38

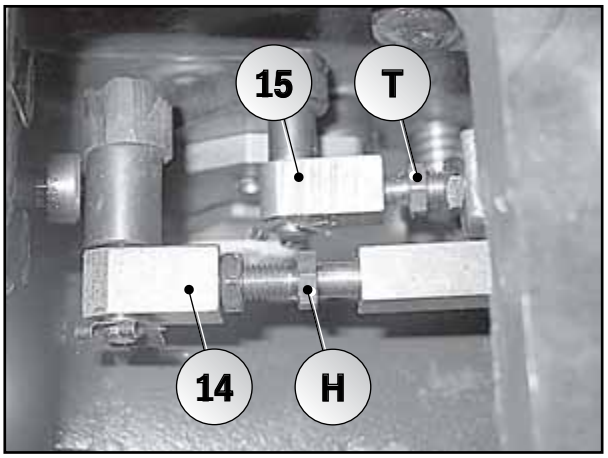


Fig. 8.39

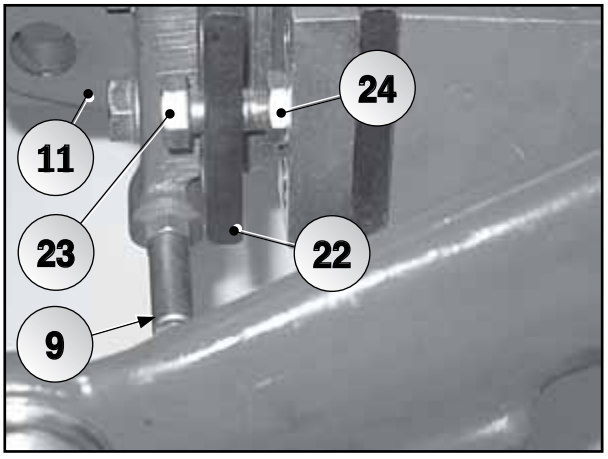


Fig. 8.40

4.2.5 Draft control adjustment

The purpose of this adjustment is to ensure that the swinging support (11 Fig.8.41) makes the exact travel in a synchronized way with full use of the lever (A) on the sector. The adjustment is carried out by means of screw (23) and rod (9 Fig.8.41), by varying the length to the required degree.

- Keep a 100 kg load applied to the lift links and make sure that the load does not touch the ground when the links are fully lowered. Start on the engine and accelerate to a rate between 1300 and 1500 RPM;
- Move the mode selector lever (B) to draft control (fully forwards).
- Move the link lifting control lever (A) fully forwards on the sector.
- Push the swinging support (11) forwards until the spring (22) reaches against the nut (24 Fig.8.41), thus achieving the maximum positive draft.
- The links must remain lowered when the engine is started. When the lever (A) is moved upwards, the links must begin to lift after about 10 mm of lever travel.
- The purpose of this test is to have the draft control exclusion point when the lever is fully forwards and the links are down, thus allowing the implement to dig quickly into the soil when the furrow begins.
- If this condition fails to occur, lengthen rod (9) to advance or shorten to delay the action. Lock the rod's check nut (9) after the adjustments have been made.

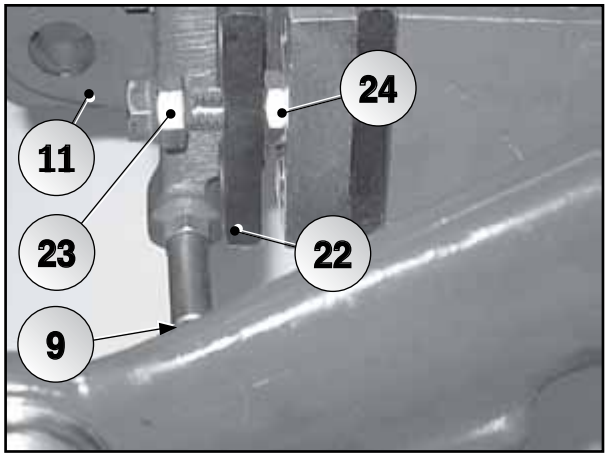


Fig. 8.41

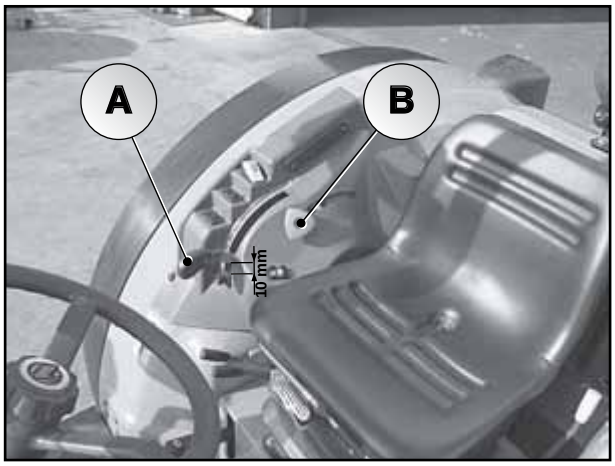


Fig. 8.42

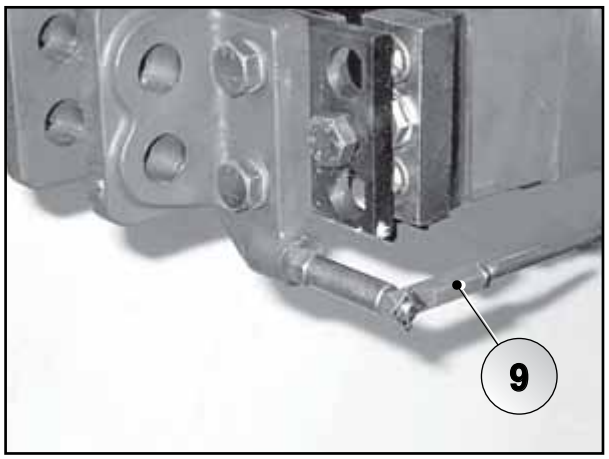


Fig. 8.43

- Move the lever (A) upwards on the sector, to about 10 mm from the end of travel position.

  Unscrew the screw (23) about two turns and, with the aid of a lever, keep the swinging support pulled back against the screw itself.

  Start the engine and begin tightening the screw (1) until the links begin to lift.

  Stop screwing and tighten the nut (24). The purpose of this adjustment is to be certain of the extent to which the links lift with the maximum negative draft.

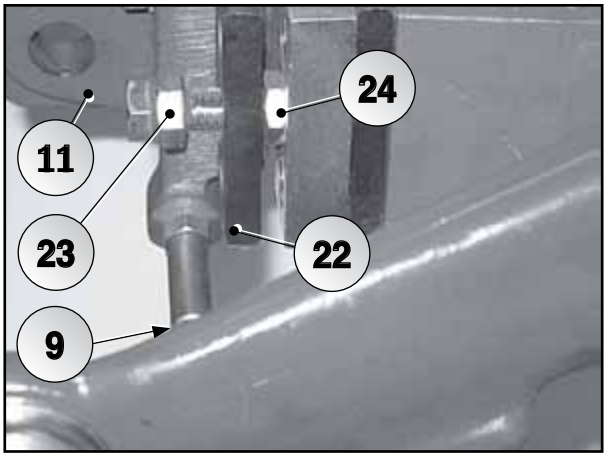


Fig. 8.44

4.2.6 Leak test

Attention: keep well away of moving parts when the engine is running.

1 - Keep a weight on the power lift links and move them fully up.

2 - Make a reference mark between the lift housing and the link with a felt-tip pen (10 Fig.8.47;

3 - Turn the link lowering adjuster lever clockwise (18 Fig.8.46) (fully CLOSED).

4 - Stop the engine and lower the lever (A Fig.8.45). After 5 minutes, the reference mark (Fig.8.47) must still be aligned.

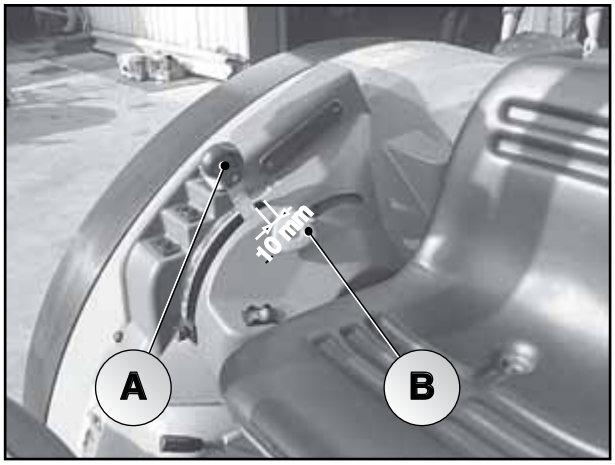


Fig. 8.45

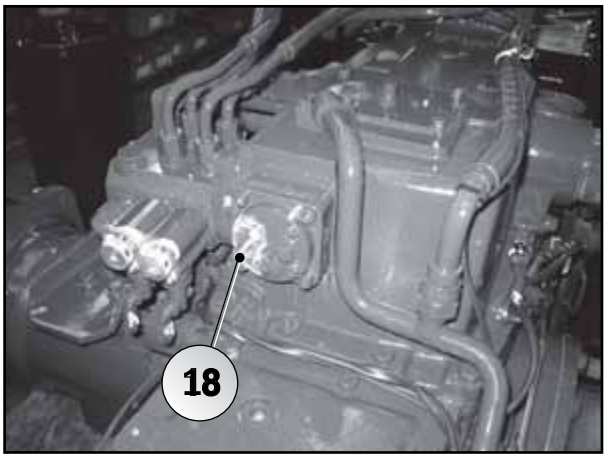


Fig. 8.46

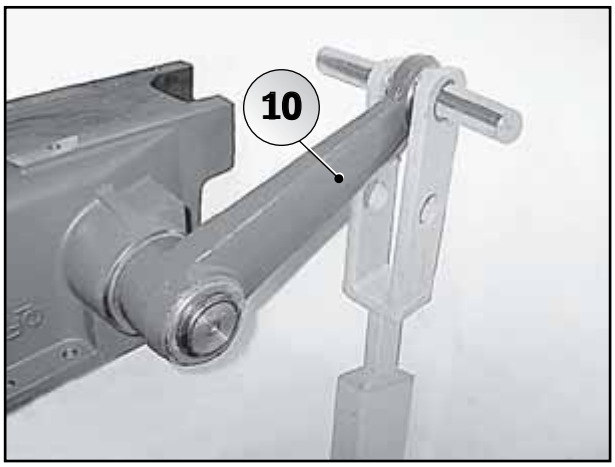


Fig. 8.47

4.3 Operating pressure tests

⚠	**Attention:** Do not begin work until the pressure in the hydraulic circuit has dropped to zero.

⚠	**Attention:** Splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.

Mount tool 05 IDR MYT with adapter 122 IDR GL and with a 0 to 400 bar pressure gauge applied, to check the operating pressure of the lift.

With the engine running, raise the implement and gauge the operating pressure. The maximum pressure tolerated is 180 bar.

Fig. 8.48

4.4 Troubleshooting

FAULTS	PROBABLE CAUSE	REMEDY
The power lift fails to lift in the no-load condition	Servo valve (20 Fig.8.14/8.15) blocked in the open position	Make sure that the valve slides freely and is tight
	The pump fails to deliver oil as it is not primed	Prime the pump by filling it and the suction pipe with transmission oil
The power lift fails to lift the implement or is slow in lifting	Filter on the intake clogged	Disassemble and clean the filter
	Pump inefficient	Replace the pump
	Servo valve not perfectly tight (20 Fig.8.14/8.15)	Check tightness.
	Safety valve (16 Fig.8.14/8.15) with low setting	Check and calibrate the two valves.
	Lower retention ring of the valve housing faulty	Replace the ring
	Leaking discharge valve (13 Fig.8.14/8.15)	Check and overhaul the discharge valve.
	Switch retention rings faulty	Replace the rings.
	Implement too heavy	Change the implement or move the hitch nearer.
The power lift fails to keep the implement in the raised position	Detective seal of the non-return ball (11 Fig.8.14/8.15)	Subject the valve system to hydraulic tests on the bench in order to locate leaks
	Leaking discharge valve (3 Fig.8.14/8.15)	Check and replace the discharge valve if necessary
	Leaking safety valve (16 Fig.8.14/8.15)	Check and overhaul the safety valve
	Upper retention ring of the valve housing faulty	Replace the ring
	Switch retention ring faulty	Replace the ring
	Lifting cylinder piston rings faulty	Replace the ring
	Aluminium plugs that close the machining holes on the power lift’s cover and cylinder	Replace the plugs

Section 5 : Special tools

05 IDR REX

Lift pressure measuring union

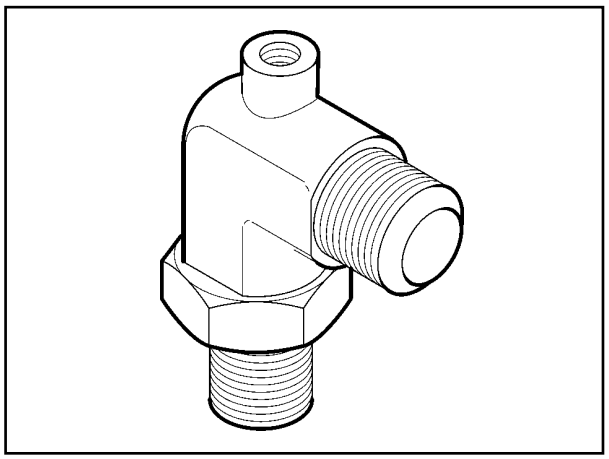


Fig. 8.49

CR 342

Hydraulic power lift controller

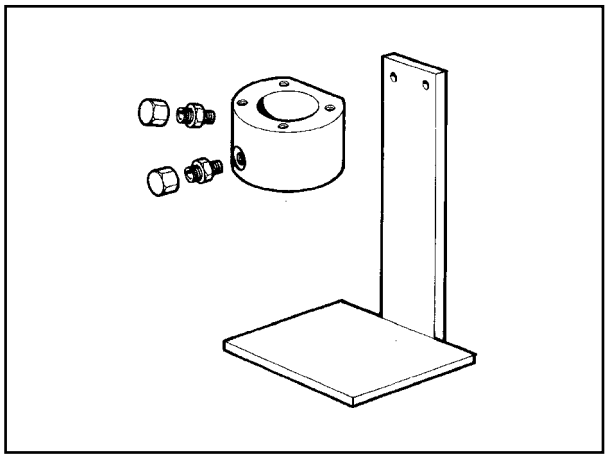


Fig. 8.50

122 IDR GL

Universal adapter union (available from the market)

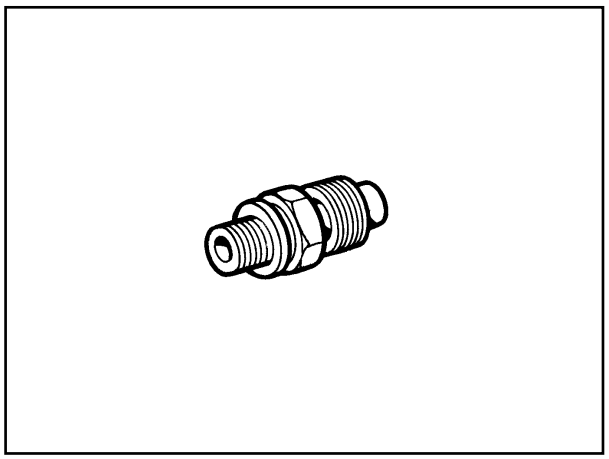


Fig. 8.51

Chapter 9 : Electronic power lift

Index

Section 1 : Precautions and Safety Recommendations. 9-2

Section 2 : General description 9-3

2.1 Introduction 9-4
2.2 Main components 9-5

Section 3 : Technical specifications 9-7

3.1 Main technical specifications 9-8

Section 4 : Hydraulic circuit 9-9

4.1 Main hydraulic circuit and main components 9-10
4.2 Description of operation 9-11
4.3 Antishock valve 9-12
4.4 Control valve 9-13

Section 5 : Electrical system 9-19

5.1 Introduction 9-20
5.2 Wiring diagram 9-21
5.3 Wiring and connector types 9-24
5.4 Connector locations 9-28
5.5 Main electrical/electronic components 9-30
5.6 “Shock Absorber function 9-39

Section 6 : Functionality tests 9-41

6.1 Introduction 9-42
6.2 Rapid operating test 9-43

Section 7 : Check-control and troubleshooting 9-53

7.1 How to diagnose and identify a fault 9-54
7.2 Test instrument 9-55
7.3 Fault code tables 9-56
7.4 Wiring diagram 9-60
7.5 Correspondences between connector terminals 9-62

Section 8 : Hydraulic tests 9-65
8.1 Operating pressure tests 9-66

Section 9 : Special tools 9-67

Section 1 : Precautions and Safety Recommendations.

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

⚠	**Attention:** do not begin work until the pressure in the hydraulic circuit has dropped to zero.
⚠	**Attention:** splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.
⚠	**Attention:** Always comply with the operating instructions supplied by the manufacturer when using adhesive materials or detergents.
⚠	**Attention:** used oil must be collected and disposed of in compliance with the anti-pollution laws in force.
⚠	**Attention:** Take care to avoid burns when working with boiling oil. Never heat oil to temperatures exceeding 190°C as the oil or its vapours could suddenly catch fire.
⚠	**Attention:** lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the units or parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.
⚠	**Attention:** always switch off the charging apparatus before disconnecting the cables.
⚠	**Attention:** : always disconnect the ground cable (-) of the battery before working on the electrical system.
⚠	**Attention:** Always consult the instructions in the operation and maintenance manual when working on the battery.

Section 2 : General description

Index

2.1 Introduction.....9-4

2.2 Main components.....9-5

2.1 Introduction

The electronically controlled power lift can be installed in all the F-N Series Orchard series tractors, as an alternative to the mechanical power lift.

Before going into details, we would like to illustrate the advantages and benefits of the electronic power lift as compared to the conventional type.

The electronic monitoring system does away with the mobile parts between the 3-point hitch, the control panel and valve system. As a consequence, the signals generated by the draft function are instantly converted into an action of the three-point hitch, thus improving the quality of the work.

This ultra-fast reaction allows the implement to adapt to the soil in a more efficient way. Moreover, these signals can be mixed so as to guarantee uniform performances, regardless of the soil conditions. Better adaptation to this increases the lugging power and consequently boosts the efficiency of the machine.

The electronic controls are easy to use and are less tiring to operate when adjustments are required on the job.

The electronic components allow the operator to select more precise values. Moreover, all the controls are grouped together in the same position and are compact.

Electronics are more reliable. There are fewer mechanical parts and this reduces wear, faults and the number of adjustments required (more economical, fewer down times).

The absence of mechanical connections between the controls and power lift does away with overloads, thus the system lasts longer and requires less maintenance.

The sensors (D-E) and controlling valve system (F) are assembled on the outside so they can be easily accessed. This means faster servicing and fewer down times.

The draft sensor (E) is installed on the third point support, in the maximum sensitivity position. This allows the power lift to operate accurately in all conditions.

The electronic control unit (B) compares the signals received from the sensors with the current reference point, i.e. with the settings selected by the operator on the control console (A) in the cab. The lifting or lowering signal is therefore transmitted for the power lift via the wiring to the valve system (F) installed at the end of the group of auxiliary control valves.

This valve system converts the electrical message into a hydraulic lifting or lowering action of the power lift. This procedure is repeated thousands of times per second, so as to keep the performances of the power lift in relation to the operator's commands under constant control.

The autodiagnosis function allows the operator to act fast and surely if the electronic lifting system develops a fault. Active dampening of the vibrations (shock absorber) notably diminishes the stress sustained by the implement and three-point hitch during the transport phase, thus making these mechanical components longer lasting and attentuating the swinging movement made by the front axle. All this makes the tractor totally safe to drive during transporting work. In short, the power lift's electronic control system is fast, precise, reliable and easy to use. This means that the tractor and implement work in close collaboration, providing higher performances and greater efficiency.

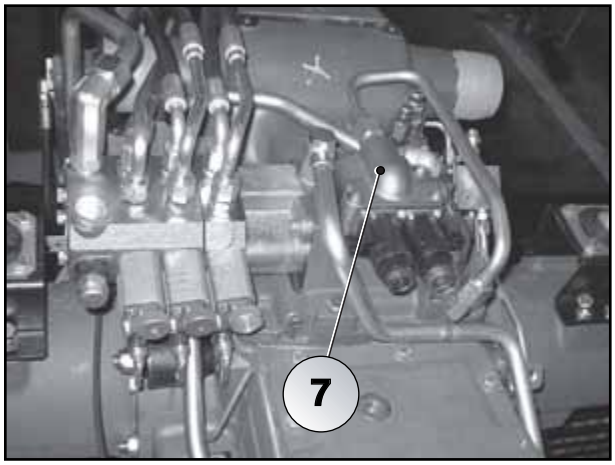


Fig. 9.1

2.2 Main components

The power lift's control system includes five basic components:

A - Control console, located in the cab on the right-hand side.
B - Electronic control unit installed behind the seat, under the rh panel;
C - External buttons installed on the rear mudguards.
D - Position sensor, installed touching a cam assembled on the link bearing shaft.
E - Draft sensor, positioned in the third-point support.
F - Electrohydraulic valve system installed on the auxiliary control valve unit.

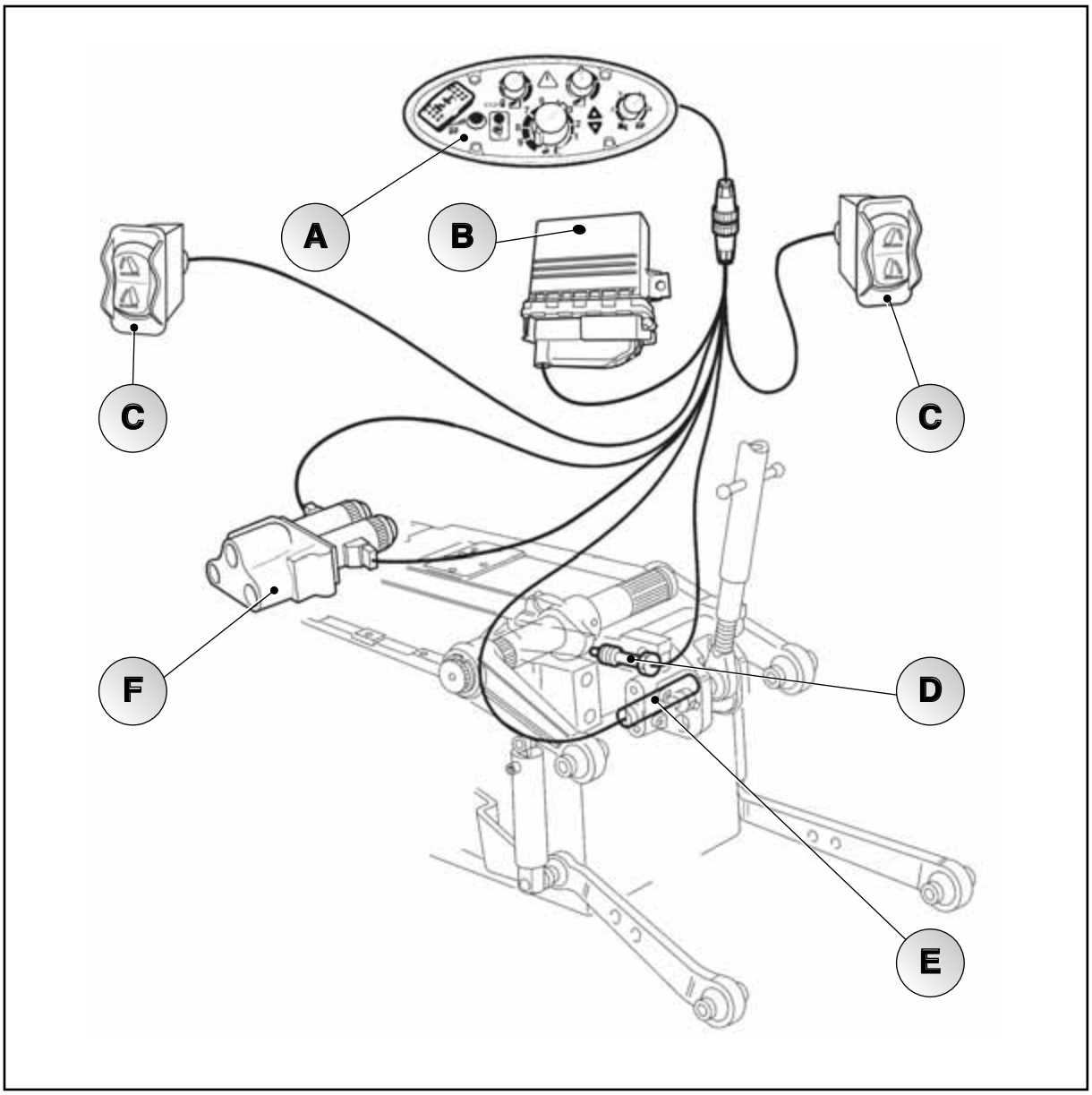


Fig. 9.2

Section 3 : Technical specifications

Index

3.1 Main technical specifications.....9-8

3.1 Main technical specifications

Hydraulic pump

Manufacturer	Bx
Type	with gears
Flow rate with engine at top power rate max.	30 l/min (2200 RPM)

Oil filter

Type	in metal gauze (washable)
Filtering capacity	40 micron

Power lift

Type of operation	Position - Draft - Intermix - Floating
Control	electronic control
Draft control	top link
Draft sensing component	sensor
Operating voltage rating	12 Volts

Internal lifting cylinder

Type	single-acting
Nominal diameter	mm 100
Stroke	mm 125
Swept volume	981 cc
Rated lifting capacity	kg 2600

Electrohydraulic valve system

Manufacturer	Bx
Type	piloted valves
Installation	external
Max. flow rate	63 l.
Maximum valve setting	180 bar
Max. back pressure at outlet	5 bar

Implement hitching device

Type	with 3 points
Class	2a
Type of hitch (on request)	quick

Section 4 : Hydraulic circuit

Index

4.1 Main hydraulic circuit and main components 9-10

4.2 Description of operation 9-11

4.3 Antishock valve 9-12

4.4 Control valve 9-13

4.4.1 Main components of the valve system assembly 9-14
4.4.2 Neutral position 9-15
4.4.3 Lowering position 9-16
4.4.4 Lifting position 9-17

4.1 Main hydraulic circuit and main components

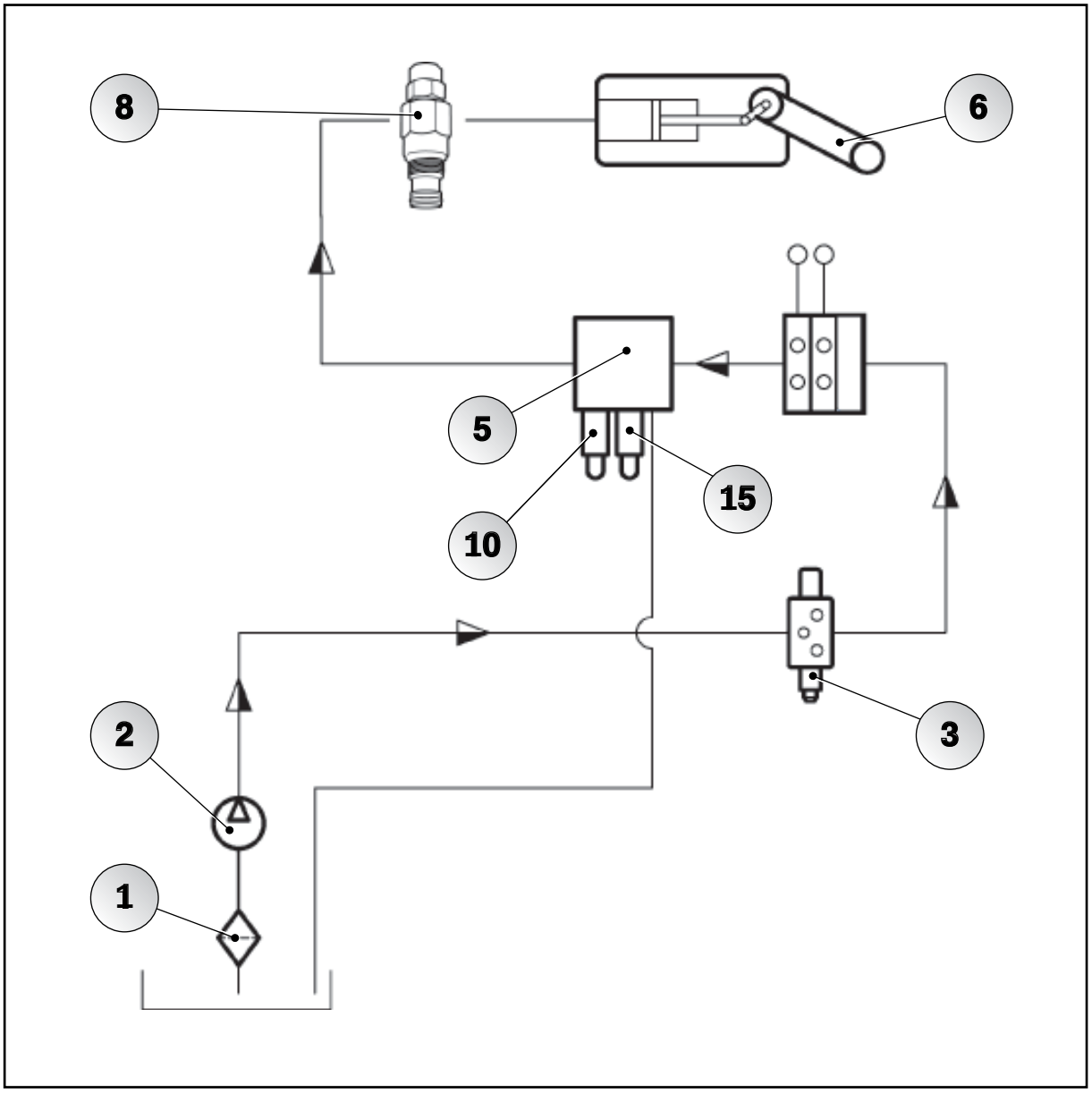


Fig. 9.3

1 - Oil filter
2 - Gear pump
3 - Trailer brake valve
4 - Auxiliary control valves
5 - Power lift valve system
6 - Hydraulic power lift
8 - Antishock valve
10 - Solenoid valve (lowering)
15 - Solenoid valve (lifting)

4.2 Description of operation

Oil from the pump (2 Fig.9.3) is sent by absolute priority to the trailer brake valve (3) and from thence to the auxiliary control valves (4).

When these are not used, the oil supplies the valve system of the electronic power lift (5) and, when required, the power lift (6).

The valve system (5) has two ON/OFF solenoid valves which have two buttons at their ends for operating the valve system's lifting and lowering functions in the manual mode.

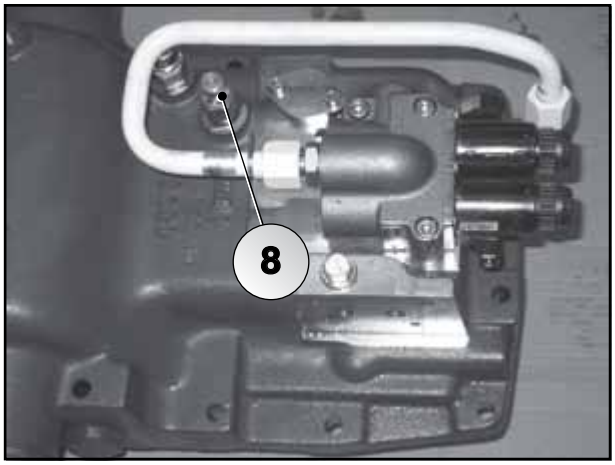


Fig. 9.4

4.3 Antishock valve

The antishock valve (8) with 200 bar setting is constantly in communication with the oil in the cylinders. It's task is to check the maximum pressure created by the jolting implements towed by the power lift.

The valve consists of a spring (21), an adjuster screw (20) and a check nut (19).

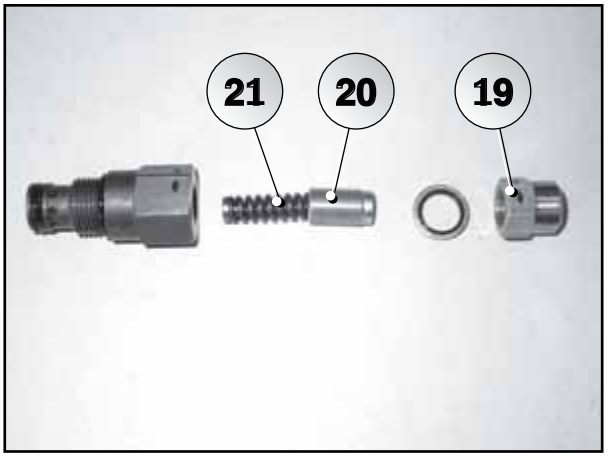


Fig. 9.5

Fig. 9.6

4.4 Control valve

The electrohydraulic valve system (5 Fig.9.7) is installed on the pack of control valves. It is the open center type and, as order of priority, is in series after the trailer brake valve (if installed) and auxiliary control valves, in the high flow circuit.

Its function is to regulate the flow of oil towards the lifting cylinders on the supply and return sides, depending on the signals it receives from the electronic control unit.

Two solenoid valves of the ON/OFF type are installed in the upper part of the valve system: number (15) controls the lifting movement while number (10) controls the lowering movement of the power lift.

There are two buttons at the ends of these solenoid valves. They can be used to operate the lifting and lowering functions of the valve system in the event of faults of an electrical nature.

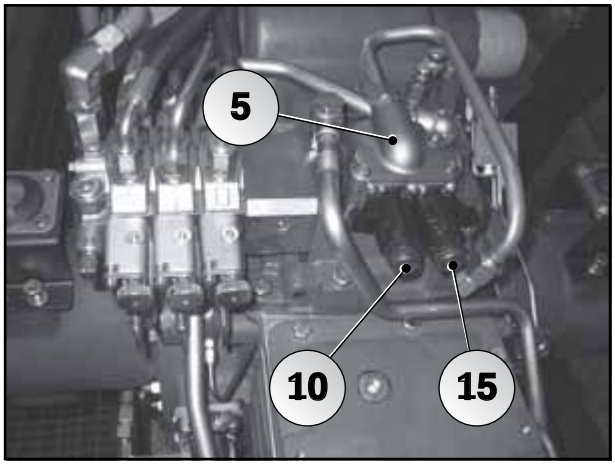


Fig. 9.7

HYDRAULIC DIAGRAM OF THE CONTROL VALVE SYSTEM

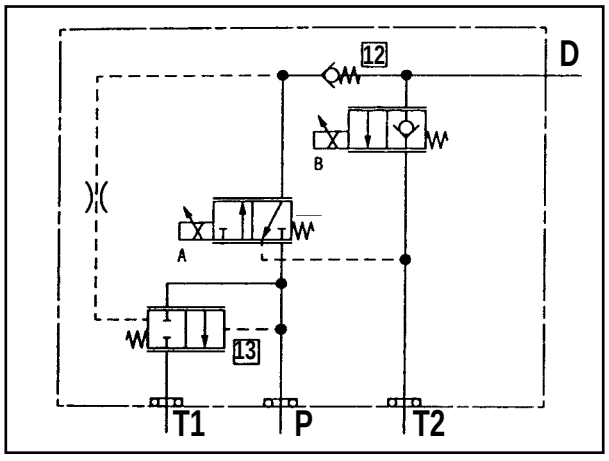


Fig. 9.8

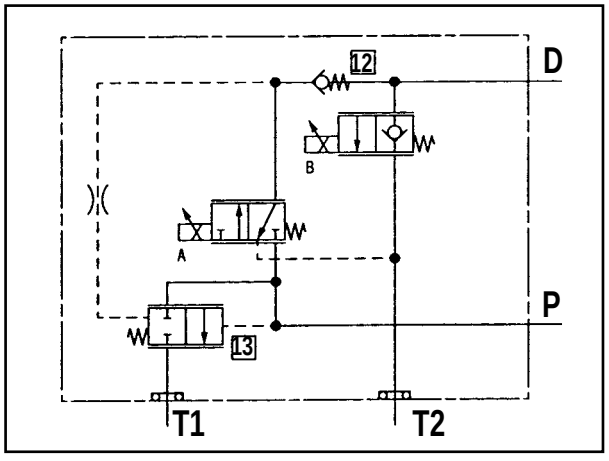


Fig. 9.9

4.4.1 Main components of the valve system assembly

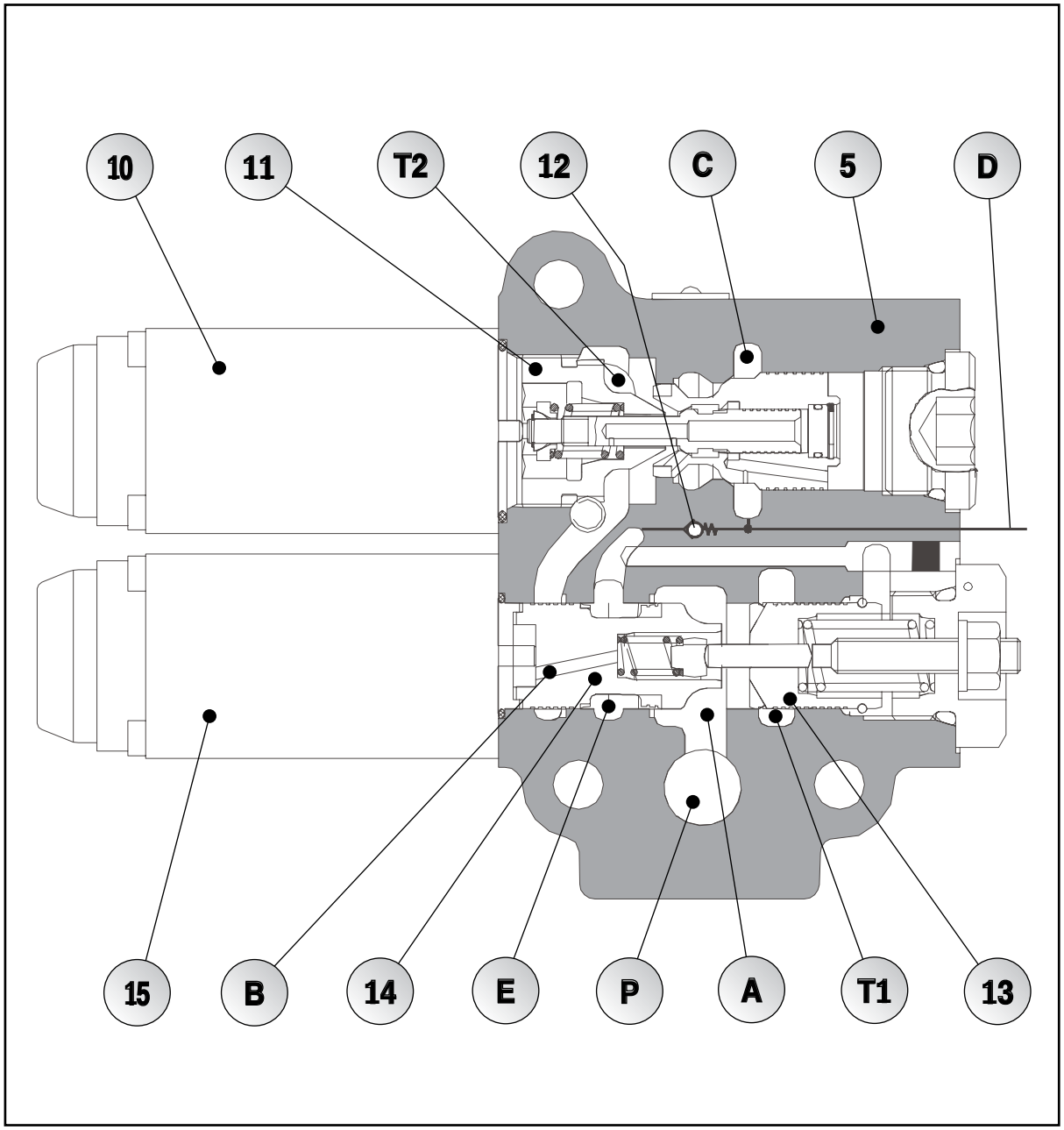


Fig. 9.10

5 - Valve system casing
10 - Lowering solenoid valve
11 - Lowering valve unit
12 - One-way valve (non-return type)
13 - 3-way pressure compensator
14 - Lifting control plunger
15 - Lifting solenoid valve
P - From pump
T1 - Discharge towards casing
T2 - Oil returning to casing
A - Oil inlet chamber
B - Throttle
C - Static oil (from cylinders)
D - Towards cylinders
E - Piloting line

4.4.2 Neutral position

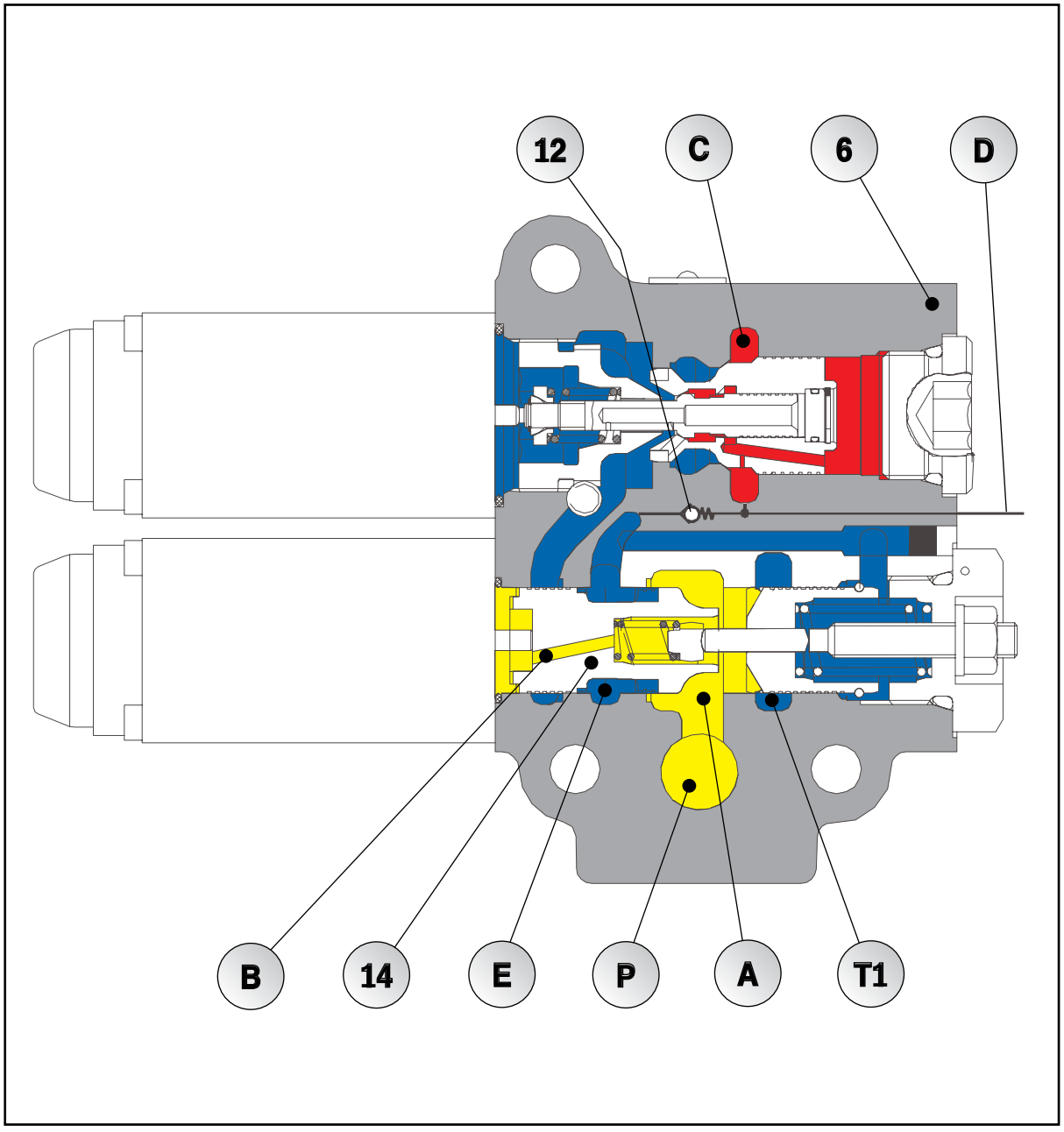


Fig. 9.11

The control valve (5) is in the neutral position when the engine is at a standstill. The moment in which the engine starts, the hydraulic pump supplies the valve system (5) by means of the trailer brake valve (if installed) and the auxiliary control valves. The pressure thus reaches the valve system through hole (P). The flow initially passes through chamber (A) and then enters the plunger (14) through the throttle (B). The remaining oil sent by the pump is discharged towards the casing through duct (T1).

The oil sent to the cylinders remains in the duct (C) in a static condition, since it is blocked by the one-way valve (12).

4.4.3 Lowering position

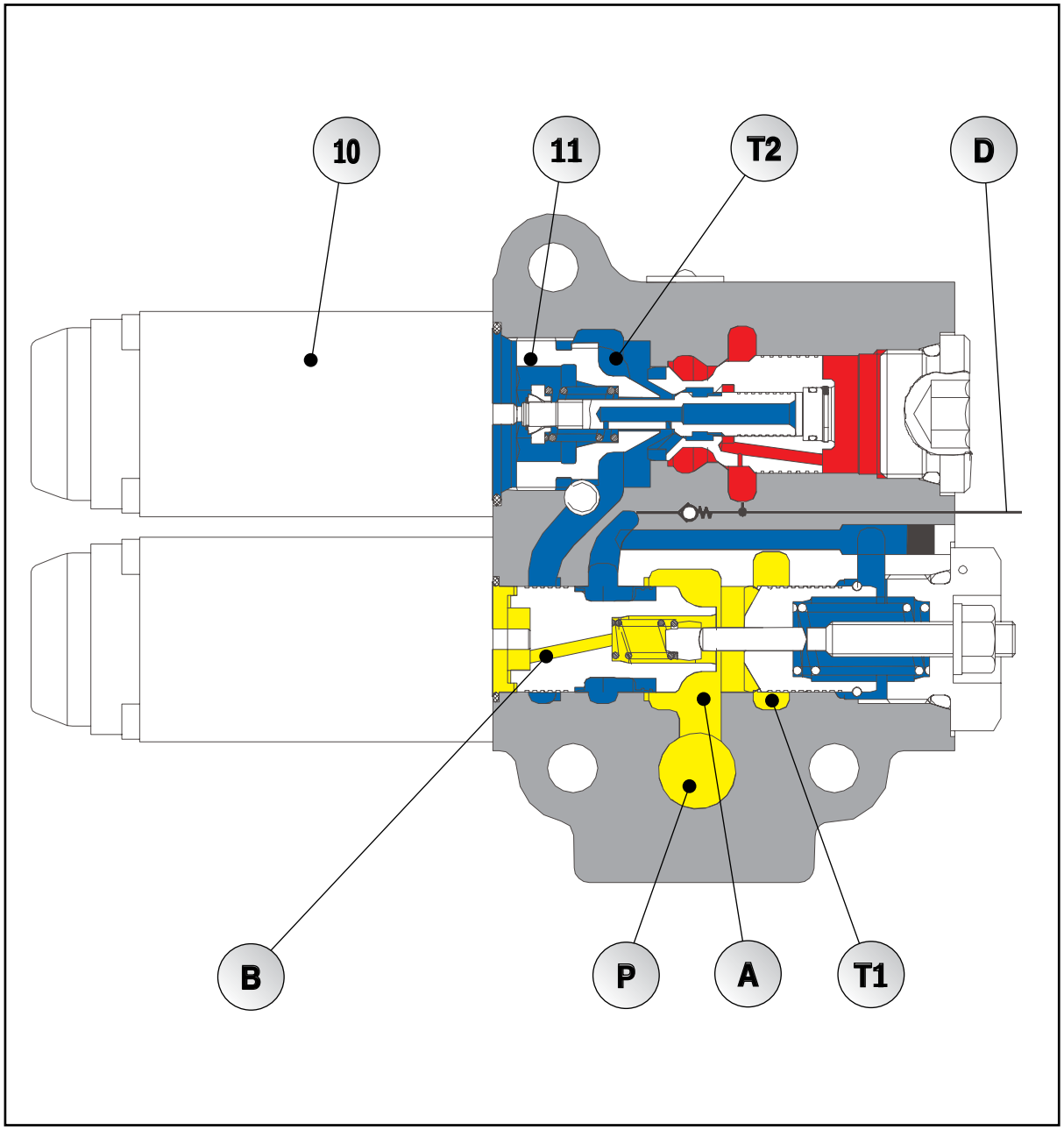


Fig. 9.12

During the power lift's lowering phase, the solenoid valve (10) is energized. This causes the the lowering valve unit to shift towards the right (11), thus allowing channel (D) to communicate with the outlet (T2). The oil in the cylinders thus discharges towards the casing, causing the power lift's links to lower.

Meanwhile, oil from the pump (P) flows into the outlet (T1) towards the casing through chamber (A).

4.4.4 Lifting position

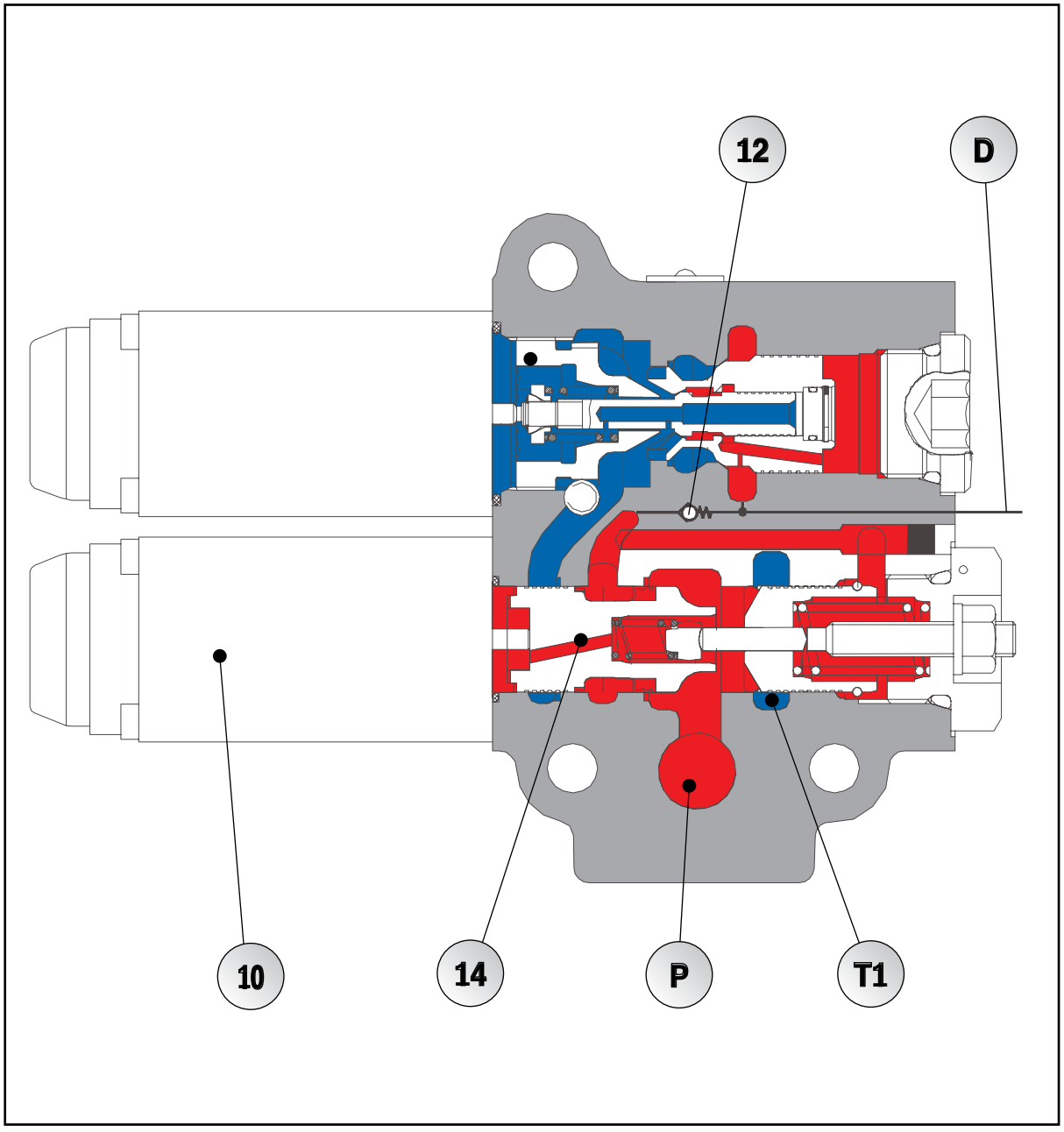


Fig. 9.13

During the lifting phase, the solenoid valve (15) is energized, thus shifting the plunger (14) towards the right and completely shutting off the communication with the discharge duct (T1). Meanwhile, it opens the passage towards channel (D) by means of the one-way valve (12).

Section 5 : Electrical system

Index

5.1 Introduction.....9-20

5.2 Wiring diagram.....9-21

5.3 Wiring and connector types.....9-24
5.3.1 Types of connector.....9-26

5.4 Connector locations.....9-28
5.4.1 Connector locations.....9-29

5.5 Main electrical/electronic components.....9-30
5.5.1 Console.....9-30
5.5.2 Electronic control unit.....9-35
5.5.3 External buttons.....9-36
5.5.4 Sensors.....9-37

5.6 "Shock Absorber function.....9-39

5.1 Introduction

The wiring diagram of the electrical system of the lifting apparatus highlights all the connections and components that form the actual system itself.

It depicts the various components in the form of symbols, as required by the international standardizing of wiring diagrams, as well as all the connection cables.

These latter have ends connected to connectors marked with letters of the alphabet.

These numbers allow the various components to be quickly located when necessary, thus faulty parts can be easily replaced.

Moreover, each connector has a series of numbers that mark each individual connection pin.

These numbers are a great help during tests as they allow the electrician to quickly locate each terminal and make the necessary repairs.

The electronic control unit with the relative connector that links to the system is also shown on the wiring diagram.

When the various tests are conducted, the control unit must be checked as to functionality, but it will not be possible to make any repairs inside.

The control unit must necessarily be replaced if it becomes faulty.

5.2 Wiring diagram

Cable colour chart

The colours of the cables in the wiring lines installed in Powerfarm tractors are shown in the multiple wiring diagrams and electrical correspondence tables according to the following table:

Code	Wire colour
A	Light blue
AN	Light blue black
AG	Light blue yellow
AB	Light blue white
AV	Light blue green
AR	Light blue red
B	White
BR	White red
BN	White black
BL	White blue
BG	White yellow
C	Orange
CB	Orange white
CN	Orange black
CL	Orange blue
G	Yellow
GV	Yellow green
GN	Yellow black
GR	Yellow red
GL	Yellow blue
H	Grey
HM	Grey brown
HR	Grey red
HN	Grey black
HB	Grey white
HL	Grey blue
HV	Grey green
HG	Grey yellow
L	Blue
LB	Blue white
LN	Blue black
LR	Blue red
M	Brown
MB	Brown white
MN	Brown black
MV	Brown green
N	Black
NZ	Black purple
NB	Black white
NR	Black red
R	Red
RG	Red yellow
RN	Red black
RV	Red green
S	Pink
SN	Pink black
SG	Pink yellow
V	Green
VG	Green yellow
VN	Green black
VB	Green white
Z	Purple
ZB	Purple white
ZN	Purple black

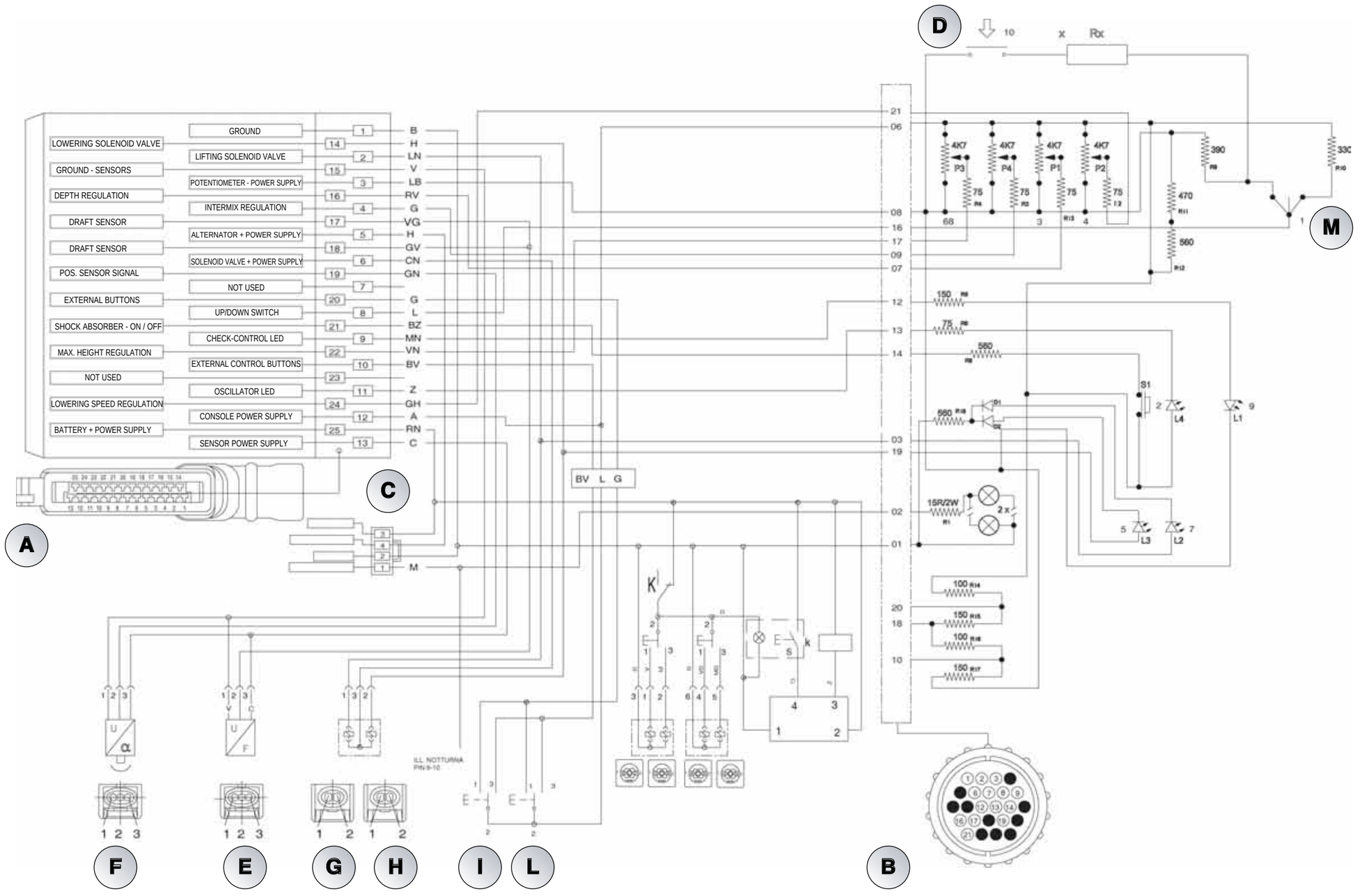

D
10
x
Rx
LOWERING SOLENOID VALVE
GROUND - SENSORS
DEPTH REGULATION
DRAFT SENSOR
DRAFT SENSOR
POS. SENSOR SIGNAL
EXTERNAL BUTTONS
SHOCK ABSORBER - ON / OFF
MAX. HEIGHT REGULATION
NOT USED
LOWERING SPEED REGULATION
BATTERY + POWER SUPPLY
GROUND
LIFTING SOLENOID VALVE
POTENTIOMETER - POWER SUPPLY
INTERMIX REGULATION
ALTERNATOR + POWER SUPPLY
SOLENOID VALVE + POWER SUPPLY
NOT USED
UP/DOWN SWITCH
CHECK-CONTROL LED
EXTERNAL CONTROL BUTTONS
OSCILLATOR LED
CONSOLE POWER SUPPLY
SENSOR POWER SUPPLY
M
BV L G
K
ILL. NOTTURNA
P/N 9-10
4K7
P3
P4
P1
P2
75
390
330
470
560
150
S1
L4
L1
L3
L2
15R/2W
2 x
100
A
B
C
E
F
G
H
I
L
M

Fig. 9.14

1 - Up/down switch (M)
2 - “Shock absorber” engaging button
3 - Work depth selector potentiometer
4 - Down speed potentiometer
5 - Lowering indicator Led
6 - Maximum height limiter potentiometer
7 - Lifting indicator Led
8 - Function selector potentiometer (position-draft-intermix)
9 - Autodiagnosis led
10 - Quick soil engagement button (D)
A - 25-way connector for the electronic control unit
B - 24-way connector for the console
C - 10-way connector for powering the power lift
D - quick soil engagement button
E - 3-way connector for the draft sensor
F - 3-way connector for the position sensor
G - 2-way connector for the lifting solenoid valve
H - 2-way connector for the lowering solenoid valve
I - 3-way connector for the external buttons
L - 3-way connector for the external buttons
M - up/down switch

5.3 Wiring and connector types

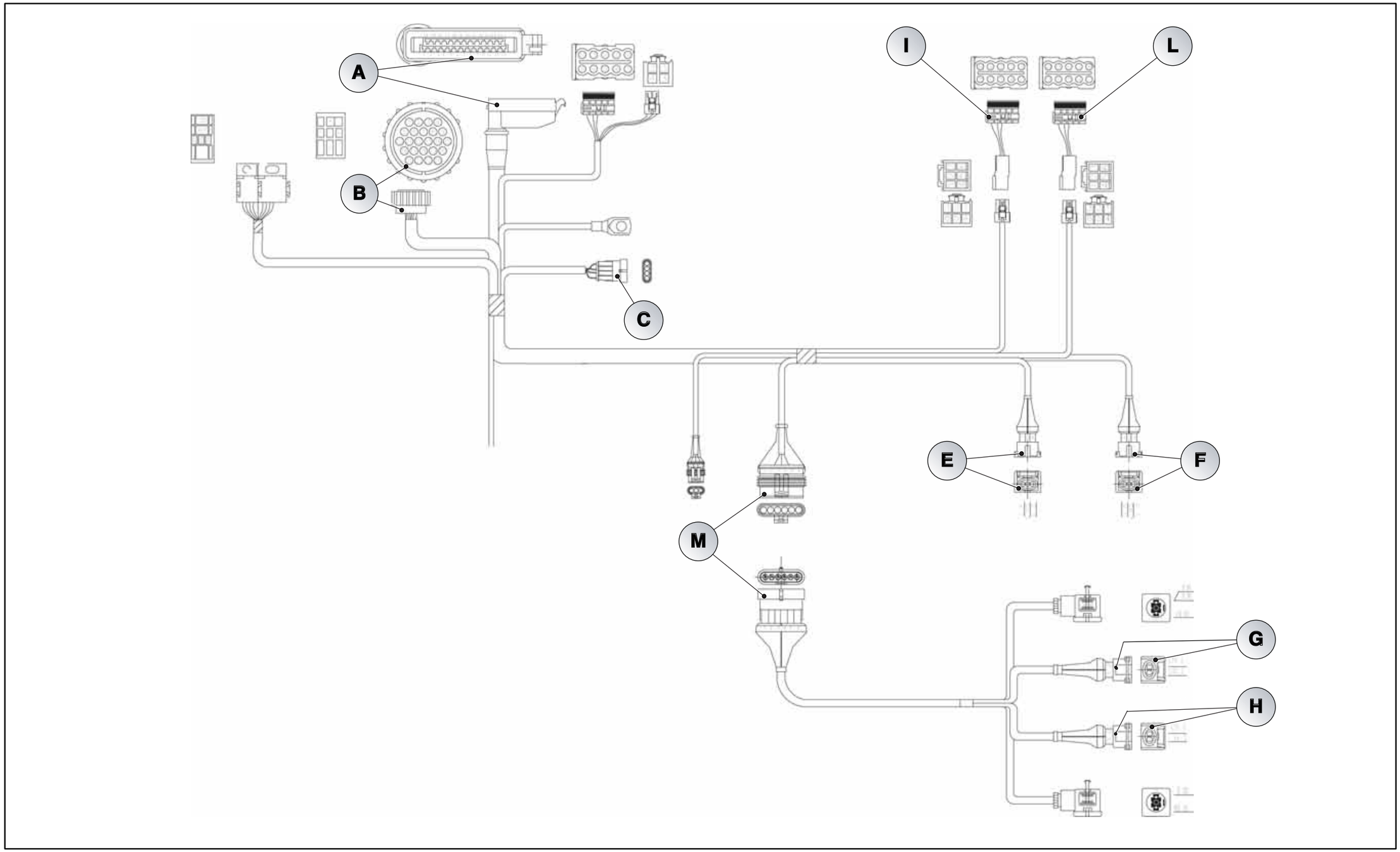


Fig. 9.15

A - 25-way connector for the electronic control unit
B - 24-way connector for the console
C - 10-way connector for powering the power lift
E - 3-way connector for the draft sensor
F - 3-way connector for the position sensor
G - 2-way connector for the lifting control solenoid valve
H - 2-way connector for the lowering control solenoid valve
I - 3-way connector for the external buttons
L - 3-way connector for the external buttons
M - 6-way connector for the lifting and lowering solenoid valves

5.3.1 Types of connector

The two main connectors in the wiring of the electronically controlled power lift are illustrated below.

CONNECTOR FOR ELECTRONIC CONTROL UNIT (A)

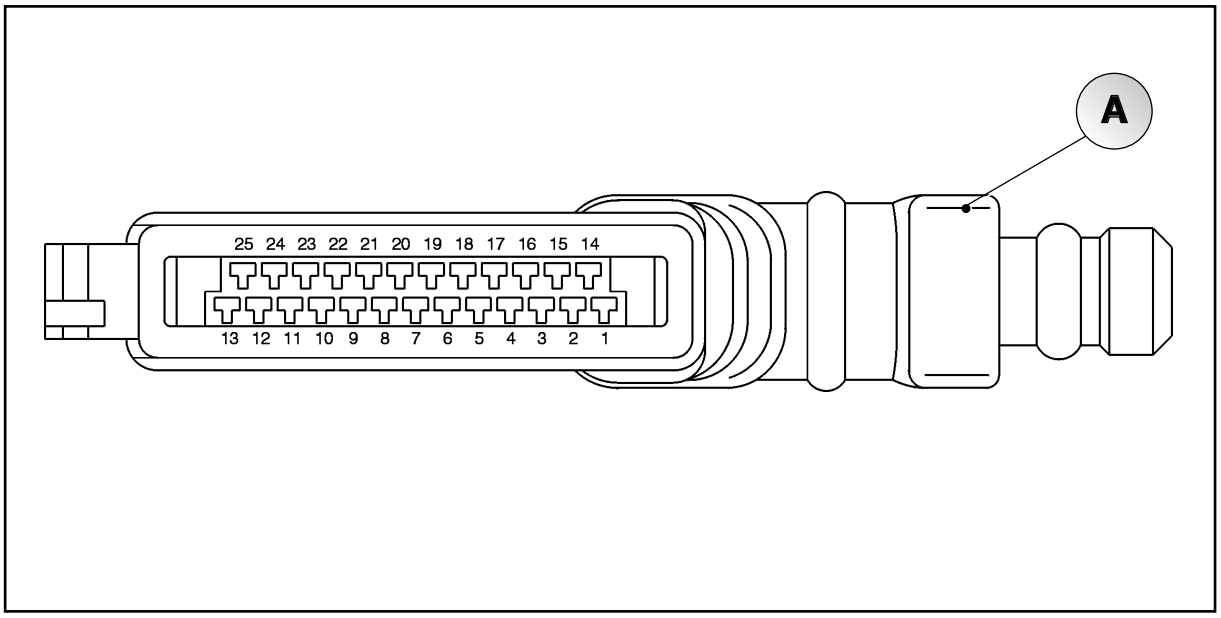


Fig. 9.16

The connector (A Fig.9.16) is the 25-way type. When it is connected to the electronic control unit of the system, it enables communication between the controller itself and the remaining electrical/electronic components in the power lift circuit. Terminals 7 and 23 of the connector (A) are not used.

CONSOLE CONNECTOR (B)

Connector (B) is the 24-way type. It's connected to the console, enables the electronic control unit of the system to communicate with the controls on the console itself. By using it, the operator transmits the signals required for controlling the power lift to the control unit. The terminals used are the ones shown in (Fig.9.17.

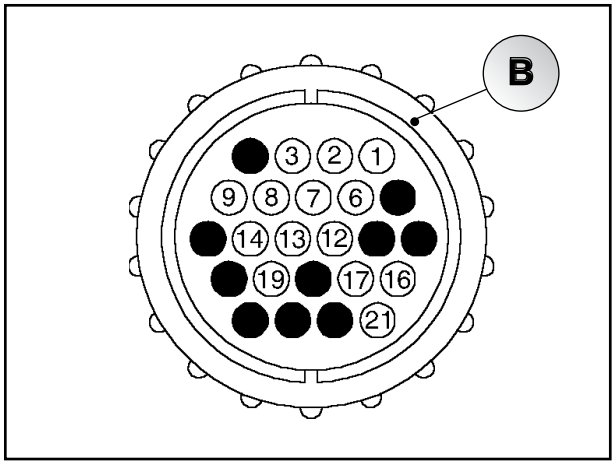


Fig. 9.17

5.4 Connector locations

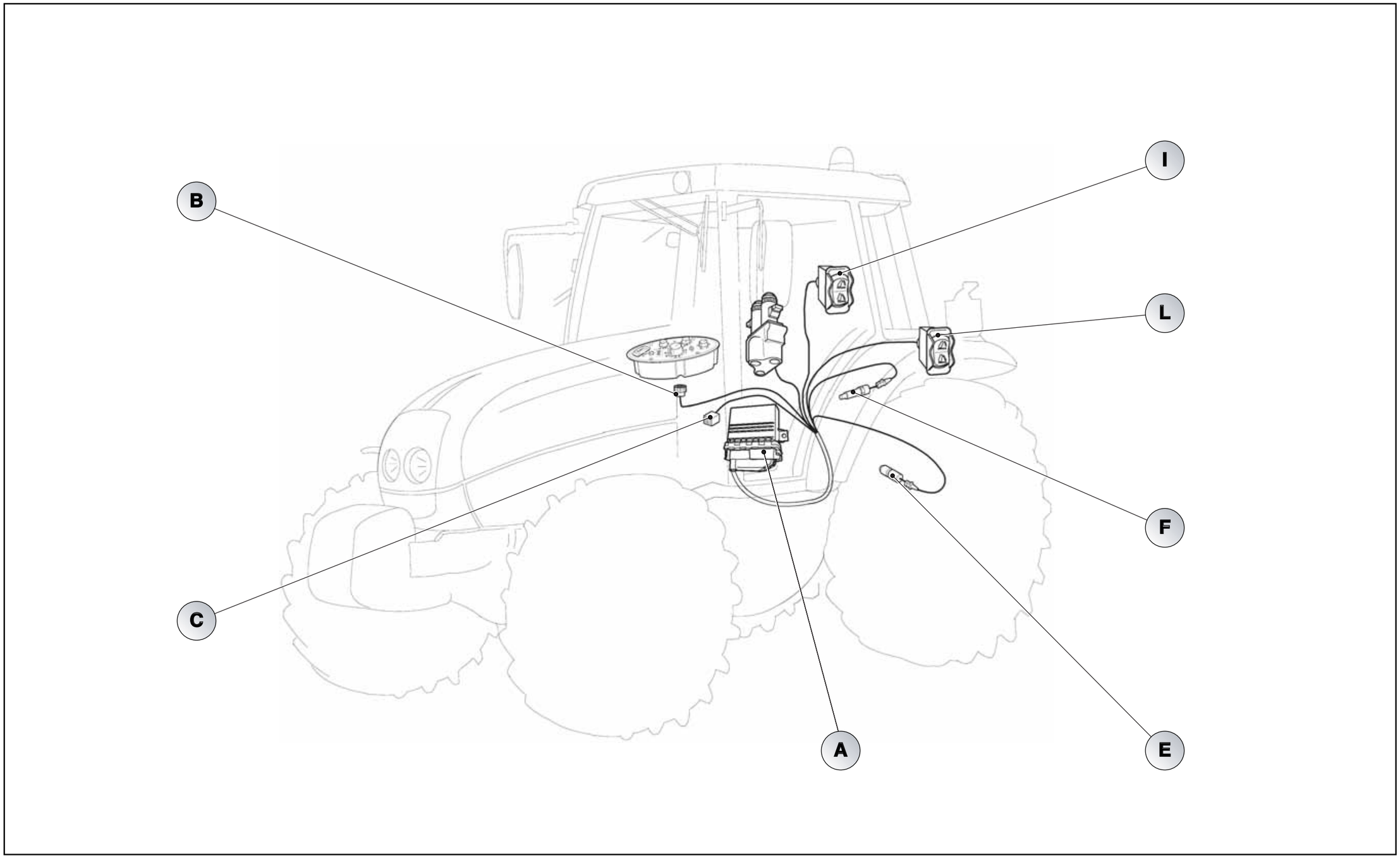


Fig. 9.18

5.4.1 Connector locations

Figure 9.18 alongside highlights the zones of the tractor that house the various connectors of the electronic power lift's electrical system.

A - 25-way connector for the electronic control unit
B - 24-way connector for the console
C - 10-way connector for powering the power lift
E - 3-way connector for the draft sensor
F - 3-way connector for the position sensor
G - 2-way connector for the lifting control solenoid valve
H - 2-way connector for the lowering control solenoid valve
I - 3-way connector for the external buttons
L - 3-way connector for the external buttons

5.5 Main electrical/electronic components

The main characteristics of the electrical/electronic components forming the electronic power lift assembly are analyzed on the following pages.

a - Console
b - Electronic control unit
c - External buttons
d - Position sensor
e - Draft sensor

5.5.1 Console

The console comprises the functions with which the operator can regulate the operating settings of the power lift. By means of the relative buttons and knobs shown in Fig.9.19), the console transmits the signals to the electronic control unit. This latter compares these signals with those transmitted by the sensors.

If the values of the signals are different, the electronic control unit sends its operating signal to the solenoid valves of the valve system thanks to which the power lift links are raised or lowered so that the set value and the value received by the sensors become equal.

These corrections take place in a continuous way when the tractor is on the move. Thes ensures that the quality of the work remains at a constant level.

The console houses a printed circuit.

- **Up/down switch** with 3 positions
  - Lifting - Transport: the fully raised position is established by the limiter (6).
  - Stop - The lift arms are unable to move in any way in the stop position.
  - Lowering - Work position. This depends on the way the controls (8 and 10) are regulated.
- **Button for engaging the "Shock Absorber" in the transport position.**
- **Warning light to indicate that the shock absorber is engaged in the transport position.**
- **Down speed selector:**
  - Turned fully anti-clockwise, does not lower.
  - Turned fully clockwise, maximum lowering rate.
- **Lowering movement indicator light.**
- **Maximum height limiter:**
  - Minimum height, turned in anti-clockwise direction.
  - Maximum height, turned in clockwise direction.
- **Lifting movement indicator light.**
- **Function selector:**
  - Position Control, turned anti-clockwise.
  - Draft Control, turned clockwise.
  - Intermediate pos.: mixed draft and position control ("**INTERMIX**").
- **Electronic power lift "Check Control" indicator light.**
- **Implement work depth/height control:**
  - 9 - Down.
  - 1 - Maximum height from ground.
- **Quick soil engagement button.**
- **Lowering block engaged indicator light.**

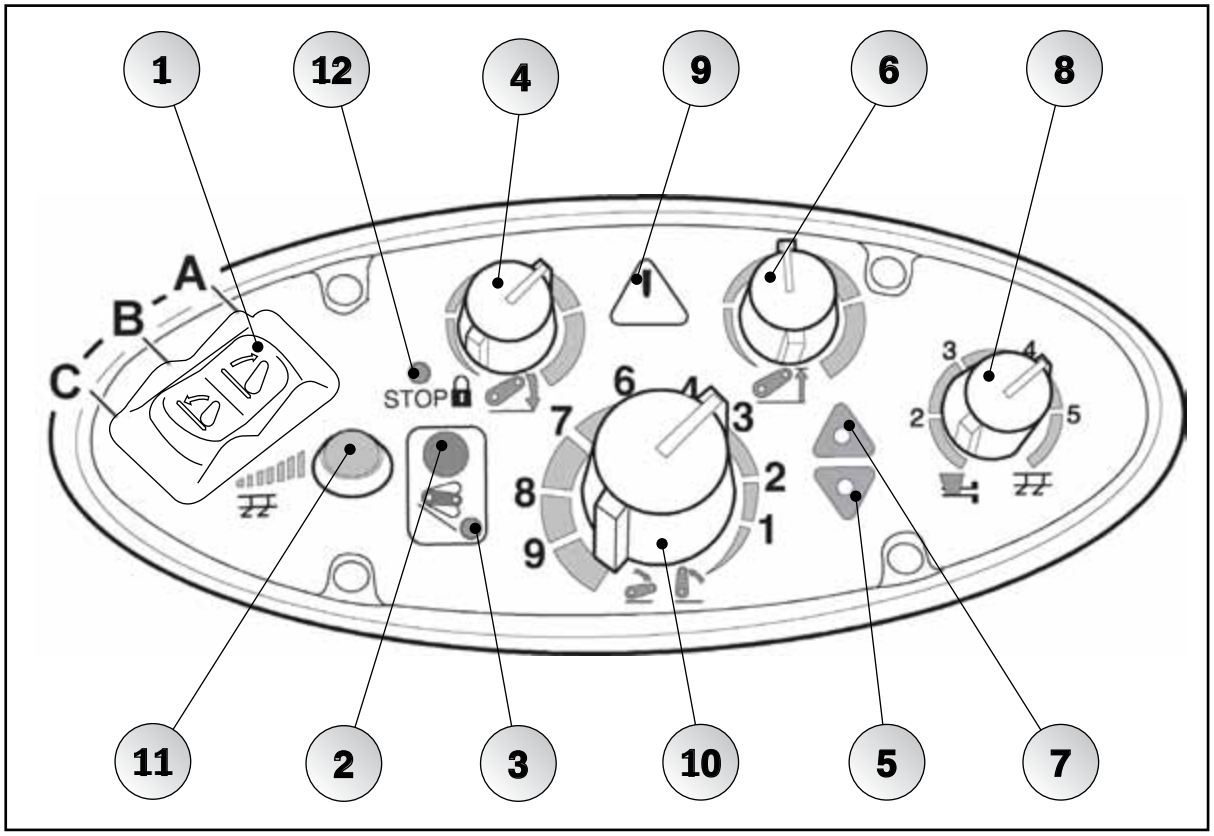


Fig. 9.19

ELECTRIC CIRCUIT

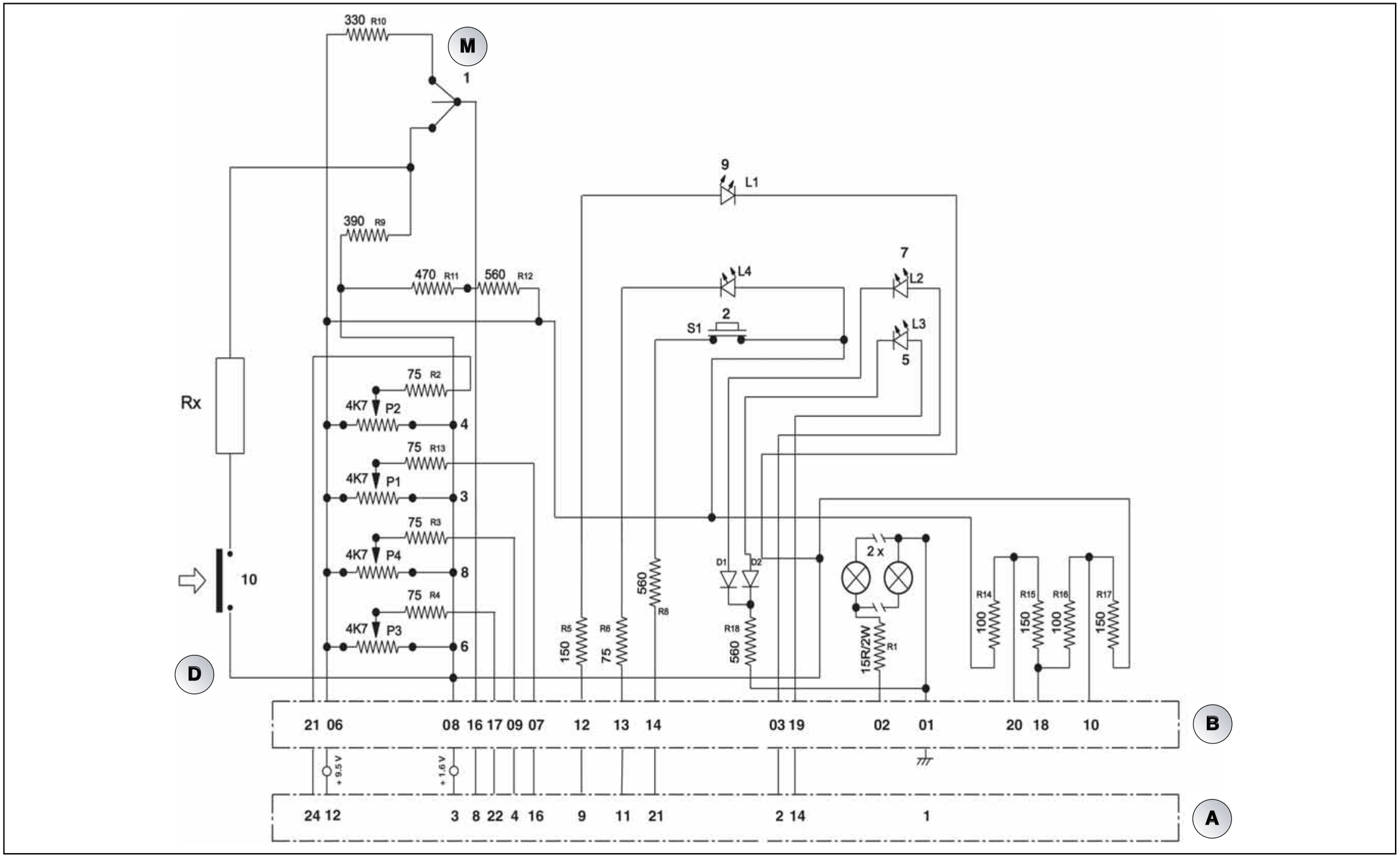


Fig. 9.20

The wiring diagram of the printed circuit in the console is illustrated alongside.

1 - Up/down switch (M)
2 - “Shock absorber” engaging button
3 - Work depth selector potentiometer
4 - Lowering speed selector potentiometer
5 - Lowering indicator Led
6 - Maximum height limiter potentiometer
7 - Lifting indicator Led
8 - Function selector potentiometer (position-draft-intermix)
9 - Autodiagnosis led
10 - Quick soil engagement button (D)
A - Connector for electronic controller
B - Console connector

Removal of the console

Attention: always disconnect the ground cable (-) of the battery before working on the electrical system.

To remove the console from the tractor cab, unscrew the four fixing screws (X) and disconnect the connector (11 Fig.9.22).

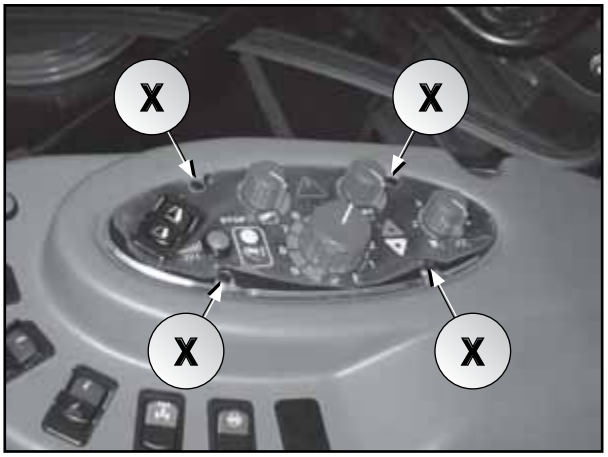


Fig. 9.21

Fig. 9.22

5.5.2 Electronic control unit

The electronic control unit (B) is the “brain” that electronically controls the electronic power lift. The control unit compares the signals from the sensors with the values chosen by the operator by means of the selectors on the console.

When the values transmitted by the sensors and console are different, the control unit activates the solenoid valves of the valve system so as to lift or lower the links until the set values and measured values become the same.

A safety system has been installed to prevent the electronic system from remaining activated after the engine has stopped. In order to operate, the electronic control unit needs two power lines: that of the ignition contactor and that of the alternator. The control unit remains deactivated in the absence of one of these two lines. As a consequence, it will be impossible to use the electronically controlled power lift in any way with the engine at a standstill.

The control unit (B) is installed in the cab on the right-hand side, under the panel (Fig.9.23). To remove it, first disassemble the panel on the right-hand side and loosen the fixing screws (G), then disconnect the connector by means of the metal tab (H).

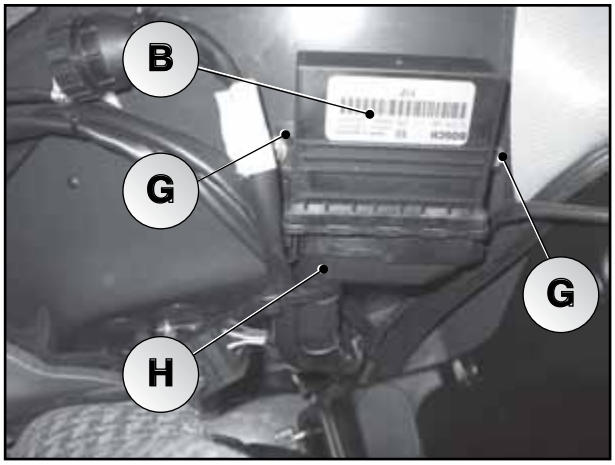


Fig. 9.23

5.5.3 External buttons

The external buttons (C Fig.9.24) are installed on both mudguards. These buttons allow the operator to lift and lower the power lift links from outside the tractor and they operate with the lifting/lowering switch (1 Fig.9.25) in any position.

Their use turns on the indicator light (9 Fig. 9.25) and inhibits access to the power lift from the console. To re-activate the console controls and turn off the indicator light (9), turn the switch (1) to the neutral position B (Fig.9.25).

For safety reasons and to make implements easier for the operator to hitch/unhitch, the lowering speed of the links is 30% less than the maximum speed when the external buttons are used.

Fig. 9.24

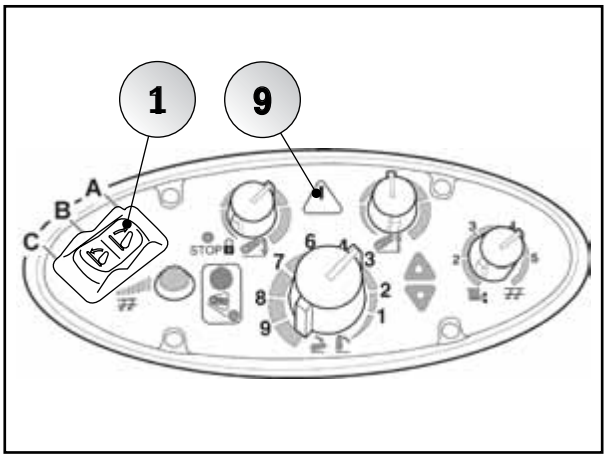


Fig. 9.25

5.5.4 Sensors

The electronic power lift's system is equipped with a group of sensors that allow the central processing unit, formed by the electronic controller (B Fig.9.23) to constantly keep the variations to the system under control.

The information from the group of sensors is essential for managing all the automatic controls of the lifting system, such as control over the position of the links, for instance.

An analysis will now be made of the sensors and their functions, i.e.

D - position sensor
E - draft sensor

Position sensor

The position sensor illustrated in (Fig.9.26) is installed on the cover of the power lift, in contact with a cam assembled on the link bearing shaft (Fig.9.27).

The position sensor operates in the following way: it consists of two internal wingings. One powered primary winding and one secondary winding, where voltage variations are generated by induction by a ferrite plunger that runs between the two windings themselves.

The voltage variations are routed to the output by the sensor on terminal 2 (signal), which requires a 9.5 V power supply generated by the electronic control unit.

The tip of the position sensor houses a ball that acts as a feeler on the cam of the transversal power lift shaft, measuring the variations to the position of the power lift's links depending on the angle at which the cam turns (Fig.9.27).

The third point support must be completely disassembled to regulate the position sensor (Fig.9.27).

Settings: move the lift links to end of upper mechanical travel and tighten the sensor until it locks against the cam of the shaft. Now unscrew the sensor by a 1/2 turn (about 0.75 mm) and tighten the check nut to fix the adjustment.

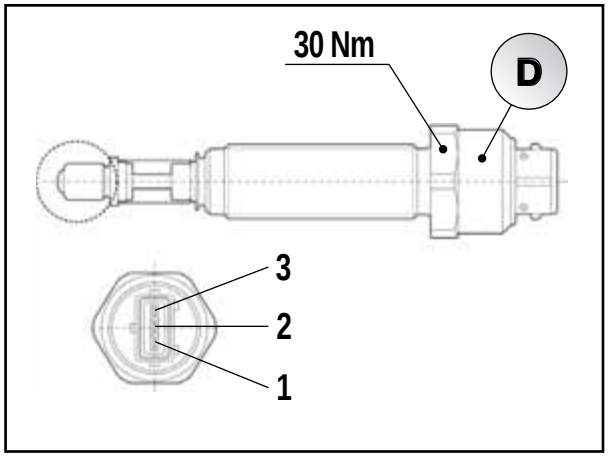


Fig. 9.26

1 - Ground
2 - Signal
3 - Feed
4 - Measuring zone

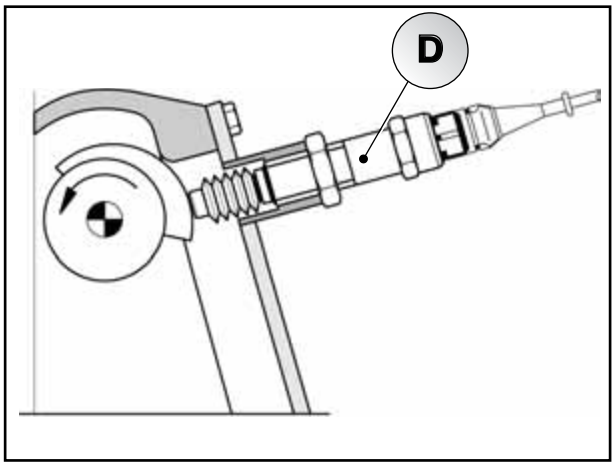


Fig. 9.27

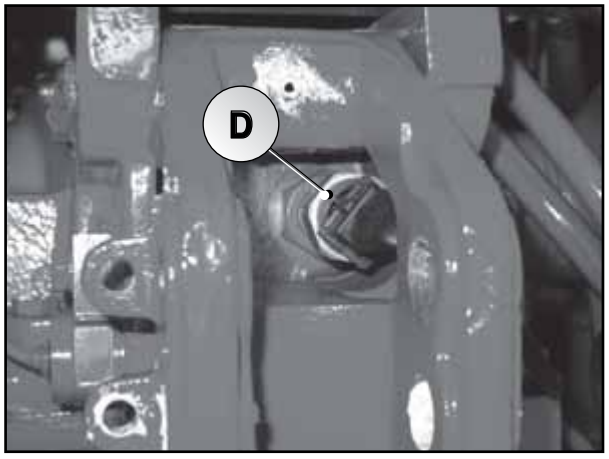


Fig. 9.28

Draft sensor

The draft sensor is installed in the third-point support. The draft sensor operates in the following way: an internal digital electronic circuit generates a magnetic field in the measuring zone. The field is affected by the flexions of the sensor caused by the draft, generating voltage variations on terminal 2 (signal).

9.5 Vdc power is required, and is generated by the electronic control unit. The output signal varies from 25% to 75% of the power supply voltage. When on hold, the sensor generates a signal corresponding to 50% of the power supply voltage on terminal N° 2, meaning an indicative voltage value of 4.7 V ± 0.1.

Assembly: to correctly assemble the draft sensor, consider the rounded part of the stem between the three flat machined surfaces as a reference. In both sensors installed in the hinging points of the lower links, it must point towards the front part of the tractor (Fig.9.31).

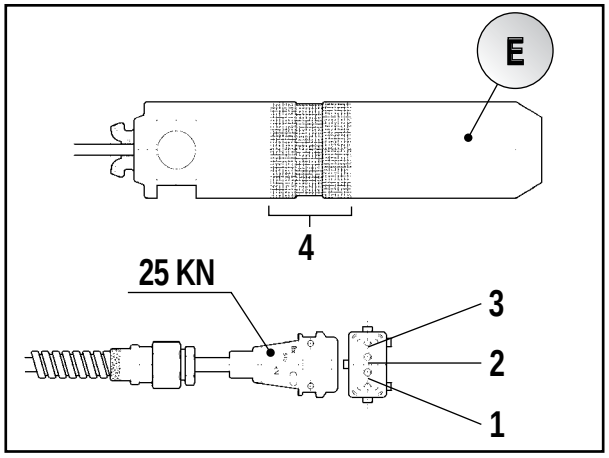


Fig. 9.29

1 - Ground
2 - Signal
3 - Feed
4 - Measuring zone

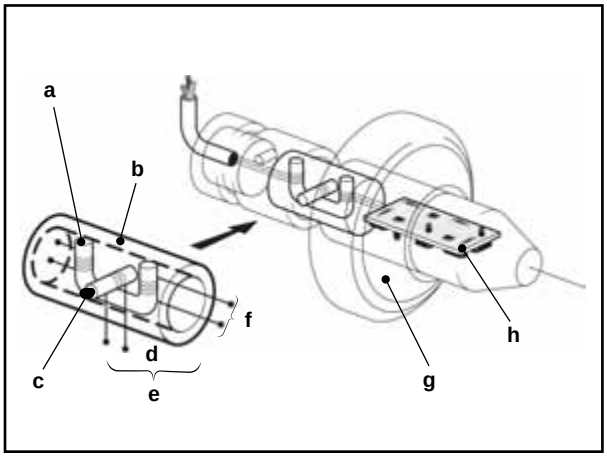


Fig. 9.30

a - Secondary coil
b - Steel cylinder
c - Main coil
d - 10V power supply
e - Sensor
f - Draft signal
g - Wheel
h - Printed circuit

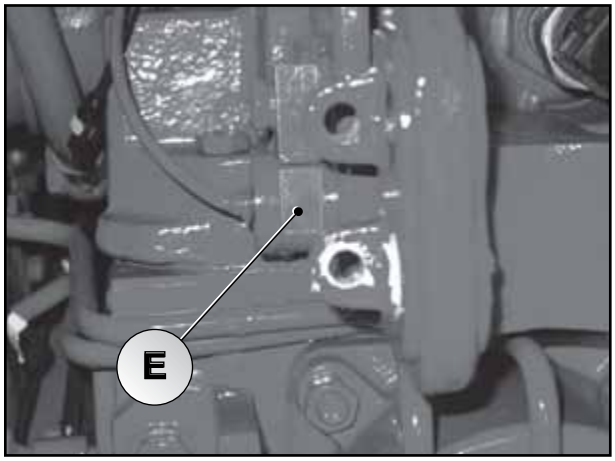


Fig. 9.31

5.6 "Shock Absorber function

The "shock absorber" function achieves a dynamic control of the oscillations to which the implement is subjected during the transport phase. It allows the operator to use the tractor on the roads in a safe and easy way.

The function is activated by means of button (2 Fig.9.33). If the relative indicator light (3 Fig.9.33) in the button comes on, it means that the relative function has been activated.

The moment in which this function is activated, the power lift's links lower by about 4% from their current position until they reach the "mean swining axis" thus, by exclusively moving around this, an 8% maximum swing is obtained. The percentage data refer to a 100% lifting amplitude.

To optimize the dampening effect and, thus, control of the power lift, the lowering solenoid valve is energized so as to open the discharge line to the maximum extent and, thus, achieve the maximum lowering speed.

Note: the "shock absorber" function can only be activated when the switch (1 Fig.9.33) is in lifting position (A).

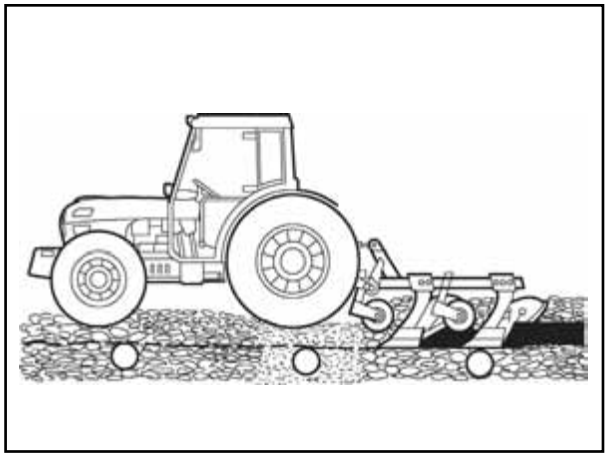


Fig. 9.32

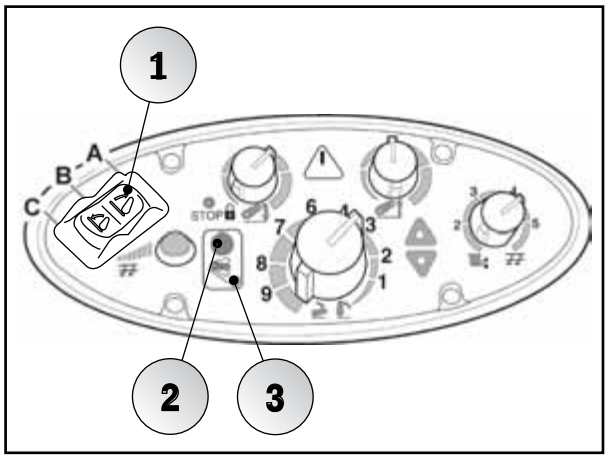


Fig. 9.33

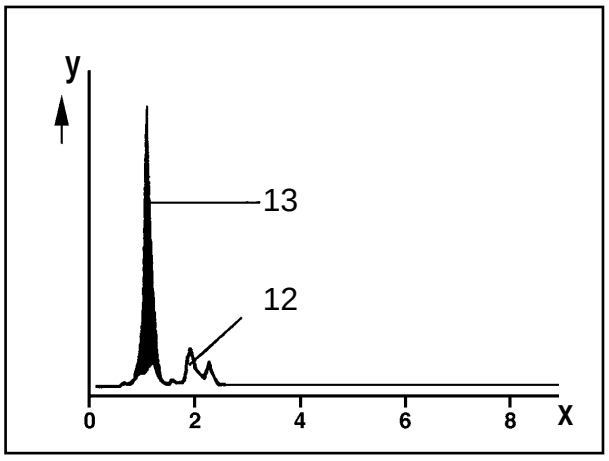


Fig. 9.34

x - Frequency (Hz)
y - Extent of front axle swing
12 - With shock absorber
13 - without shock absorber

Section 6 : Functionality tests

Index

6.1 Introduction.....9-42

6.2 Rapid operating test.....9-43

6.2.1 Up - down switch 9-44
6.2.2 “Position control” inspection (knob 8) 9-46
6.2.3 Draft and intermix test (knob 8) 9-48
6.2.4 Link locking (transport) (Knob 4) 9-49
6.2.5 Shock absorber (button 2) 9-51
6.2.6 Quick soil engagement (button 11).....9-52

6.1 Introduction

This chapter describes two different procedures the technician can use to make sure that the electronic control system of the power lift operates correcxtly and to identify any faults.

There are two procedures:

- rapid operating test
- inspections and repairs with use of the universal tester

6.2 Rapid operating test

This test is conducted on the tractor. No test instruments are required. When he must repair an electronically controlled lifting system, the technician must first make sure whether the fault is of a hydraulic nature or due to a breakdown in the electronic control system.

In these new generation electronic power lifts, electrical faults are signalled by a fault code that flashes on the control panel. Vice versa, if there is no response, the fault is of a hydraulic nature.

Once having established whether the fault is of an electrical or electronic nature, the next thing to do is to find out which component is faulty.

The method described further on can be used to rapidly check all the components in the lifting system.

This method gives the technician precise information he can use to identify the fault and, therefore, direct his efforts to repairing the faulty component.

6.2.1 Up - down switch

6.2.1.1 Test in neutral position (position B)

1 - Set the switch (1) to the neutral position (B).

2 - Start the engine.

3 - No reaction from the lift links.

4 - The links can be controlled with the external buttons.

5 - Check control indicator light on.

6.2.1.2 Test in lifting position (position A)

1 - Position the controls as indicated in (Fig.9.35)

2 - Set the switch (1) to the lifting position (A).

3 - The lift links must rise 23 cm

4 - The lifting indicator light (7) will remain on during the lifting phase.

5 - Turn the depth knob (10) clockwise until position 1 has been reached.

6 - Gradually turn the link lifting adjuster knob (6).

7 - Link ascent must be proportional to knob rotation without swinging movements.

8 - The indicator light (7) must come on during the lifting phase.

9 - The safety valve of the hydraulic circuit must not activate when the links are at the end of upward travel.

10 - The links can be controlled with the external buttons.

The check control indicator light (9) comes on during and after use of the external buttons. Move switch (1) to position (C) to turn it off.

6.2.1.3 Test in lowering position (position C)

1 - Turn the knob (10) in the anti-clockwise direction to position 9 and keep the switch (1) on the lowering option (C).

2 - The links must gradually lower until they are completely down.

3 - The lowering indicator (5) must come on as the links lower and remain on when the links are completely down.

4 - The links can be controlled with the external buttons.

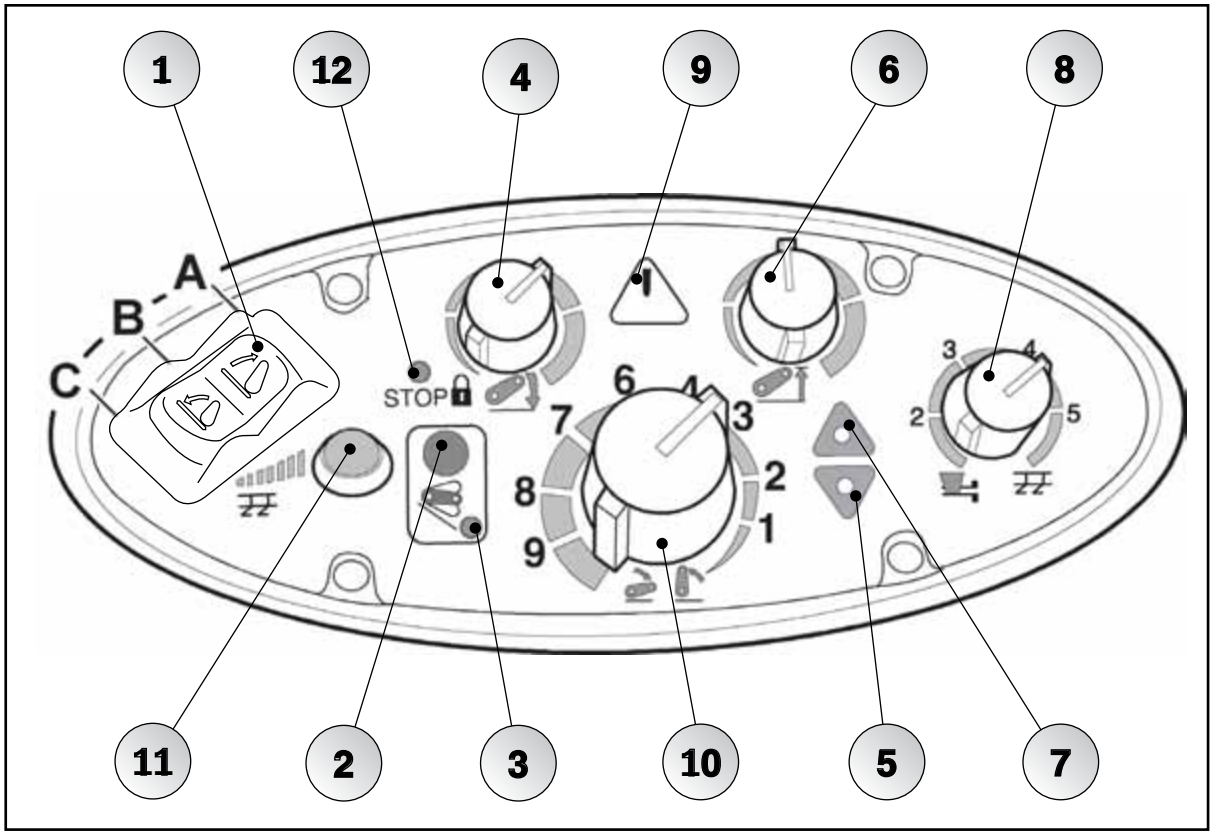


Fig. 9.35

6.2.2 "Position control" inspection (knob 8)

6.2.2.1 Test in lifting position

1 - Position the controls as indicated in (Fig.9.36).

2 - The indicator light (9) must come on when the engine starts.

3 - The links must remain in the lowered position.

4 - Use the switch (1), passing through the neutral position (B) and setting to the lowering position (C).

5 - The indicator light (5) must be on.

6 - Turn the knob (6) to the maximum height position.

7 - Slowly turn knob (10) clockwise until the maximum height indication (1) has been reached.

8 - The indicator light (7) must come on as soon as the 8/8.5 position has been reached

9 - The lift links reach their maximum height in position 1 and at end of upwards travel, the lifting indicator (7) must go out.

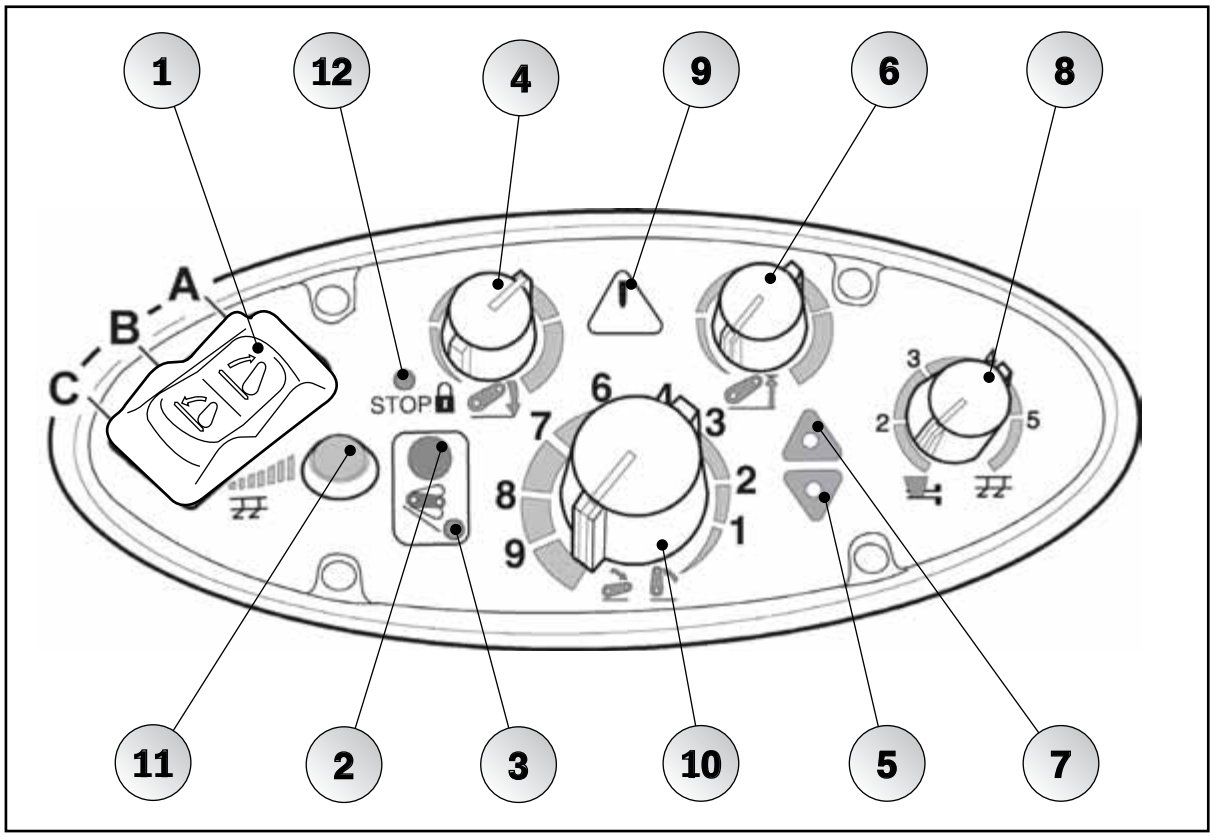


Fig. 9.36

6.2.2.2 Lowering test

1 - Position the controls as indicated in (Fig.9.37).

2 - Turn the knob (10) anti-clockwise.

3 - The indicator light (5) must come on as soon as the 1/1.5 position has been reached

4 - The lift links must reach the down position when the knob is in position 8.5/9.

5 - The indicator light (5) must remain on as from the 8.5/9

6 - Turn the knob (10) clockwise to the maximum link height position.

7 - Turn the knob (4) anti-clockwise to the padlock position ( )

8 - Turn the knob (10) anti-clockwise to position (9). The links must not lower and indicator lights (5 and 7) must be off.

9 - Set the switch (1) to the lowering position (C).

10 - Turn the knob (4) clockwise.

11 - There must be a proportional increase in the link lowering speed with an increase that reaches its maximum when the knob (4) reaches end of travel.

12 - The indicator light (5) must be on.

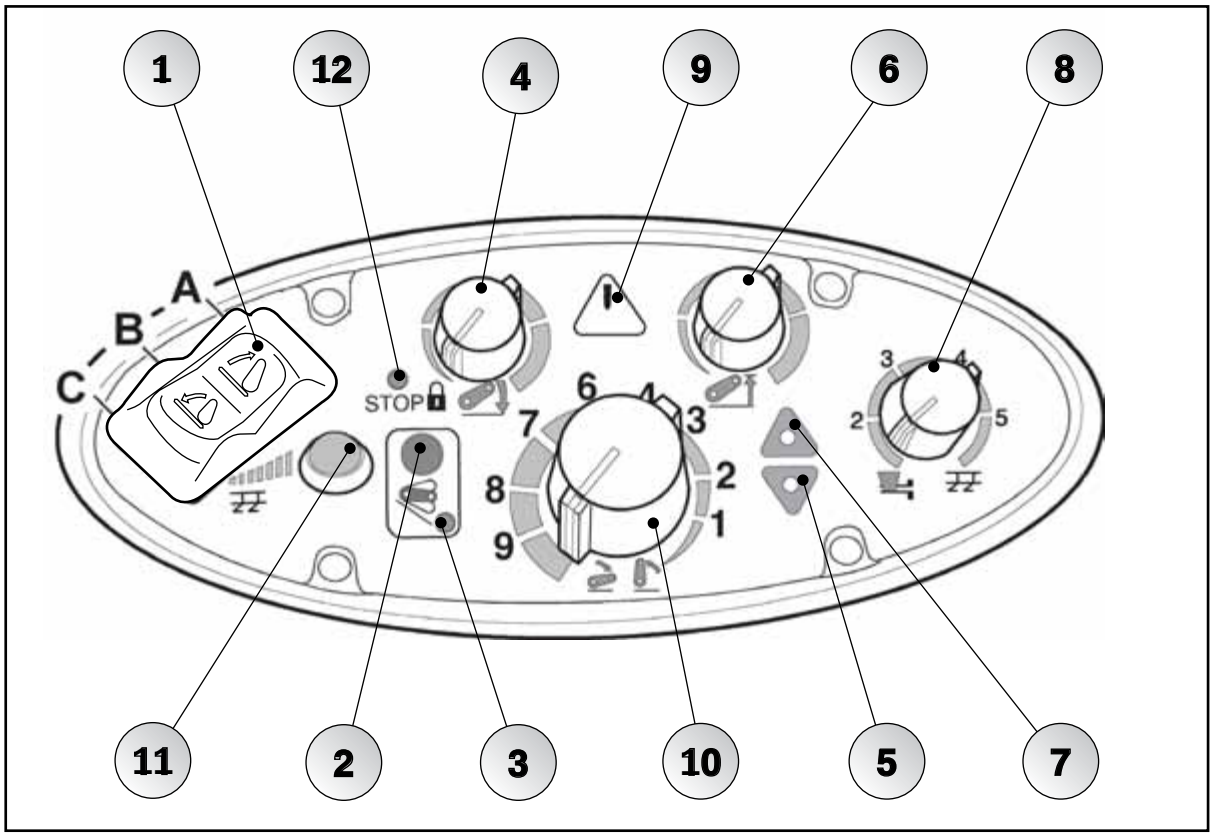


Fig. 9.37

6.2.3 Draft and intermix test (knob 8)

6.2.3.1 Draft test

1 - Position the controls as indicated in (Fig.9.33).

2 - The indicator light (5) must be on.

3 - Turn the knob (10) slowly clockwise.

4 - The indicator light (7) must come on as soon as the position 4.5 has been reached.

5 - The lift links must reach their maximum height position when the knob (10) is in position 3.5.

6 - Turn the knob (10) clockwise to position 1.

6.2.3.2 Lowering test

1 - Turn the depth knob (10) anti-clockwise.

2 - The indicator light (5) must come on and remain on when the knob is in position 4.

3 - The lift links must reach the down position when the knob is in position 4.5.

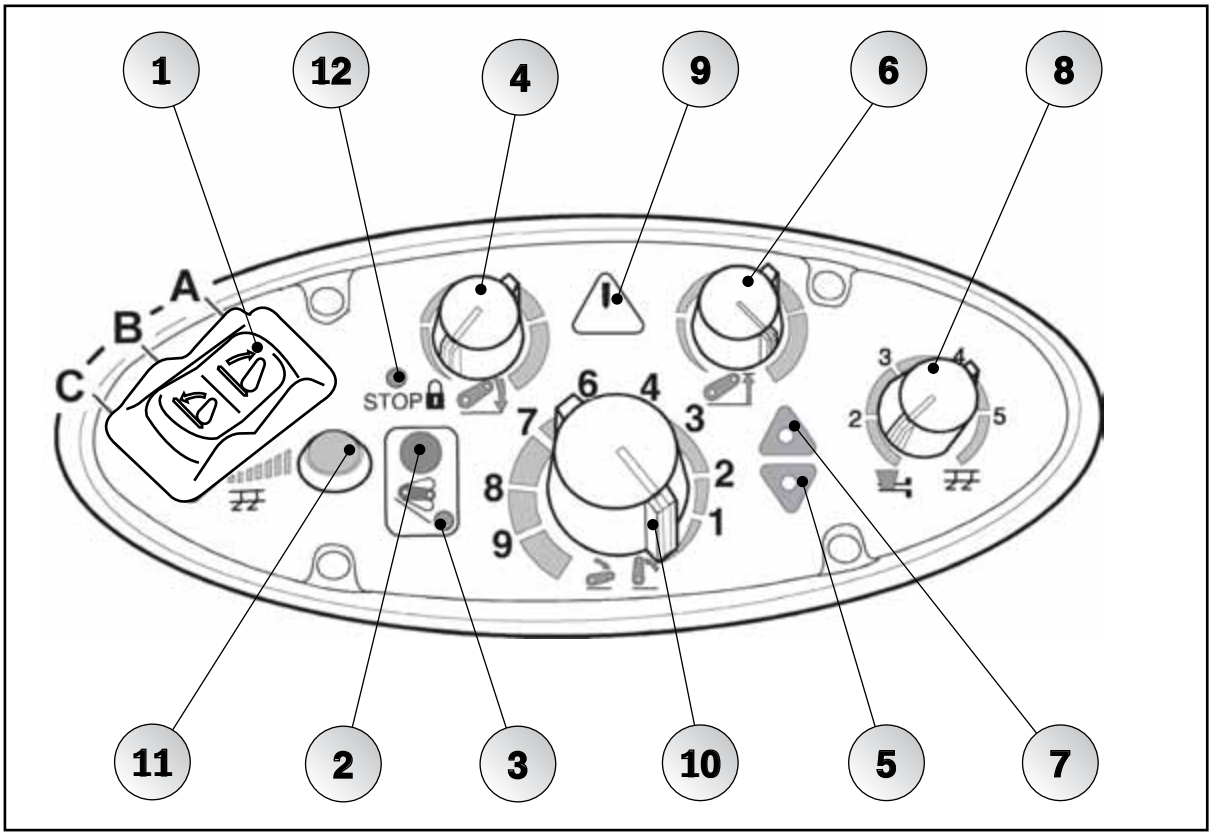


Fig. 9.38

6.2.4 Link locking (transport) (Knob 4)

6.2.4.1 Down speed knob test

1 - Position the controls as indicated in (Fig.9.38).

2 - Make sure that the links are completely down.

3 - Set the knob (4) to the padlock position ( ).

4 - The indicator light (5) must go out.

5 - You must be able to lift the links by means of knob (10) or switch (1).

6 - Set the switch (1) to the lifting position (A). The indicator light (12) must come on.

7 - Turn the knob (6) fully clockwise.

8 - Wait for the links to lift to maximum height.

9 - Keeping the knob (4) on the padlock position (indicator light 12 must remain on), make sure that the links are unable to move in any way when controls (6, 10 and 8) are used.

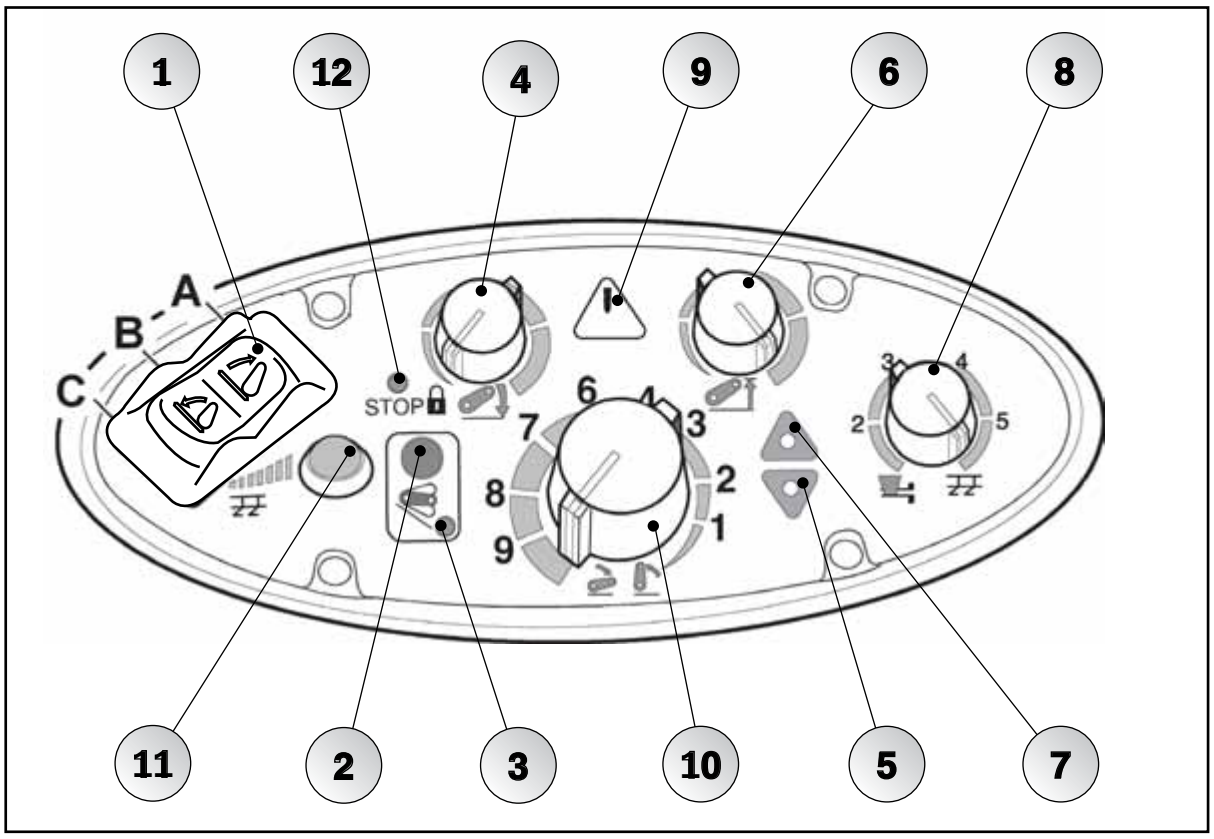


Fig. 9.39

6.2.4.2 "Intermix" test

1 - Position the controls as indicated in (Fig.9.40.

2 - The intermix functionality test is conducted by setting the function selector knob (8) to the various positions (a-b-c-d-e-f Fig.9.39), checking with knob (10) that the lifting control (indicator light (7) on) occurs at the intervals indicated below

At the end of each test, always set the lift links back down by turning knob (10) anti-clockwise.

3 - With increased sensitivity on the draft control, the range of action of knob (10) also tends to increase as mode selector (8) approaches the position control setting.

Knob position (8)	Lifting control intervals of knob (10)
a - (Pure draft)	5 - 4,5
b - (Intermix 5)	5,5 - 5
c - (Intermix 4)	6 - 1
d - (Intermix 3)	7 - 1
e - (Intermix 2)	7,5 - 1
f - (Pure position)	8 - 1

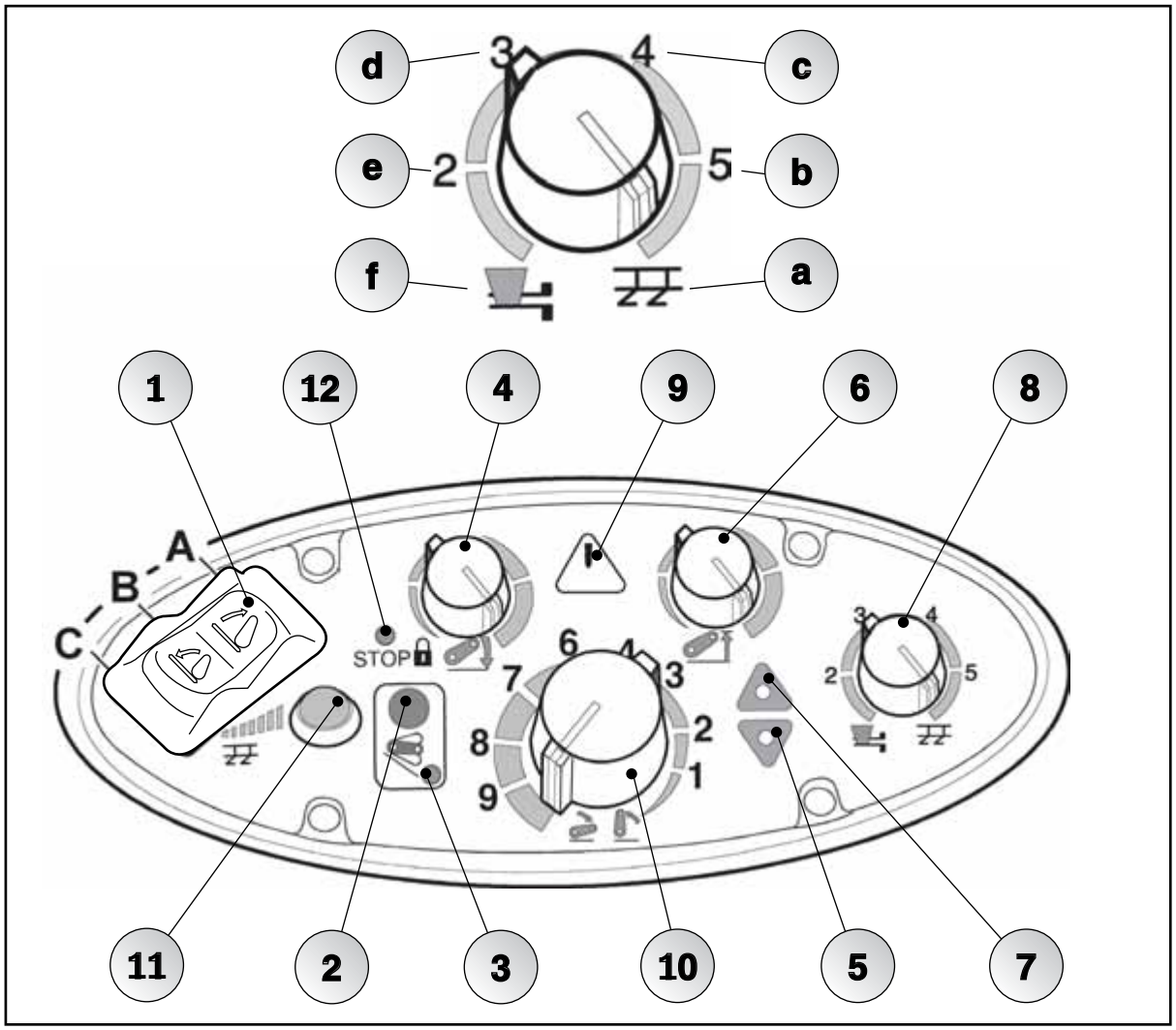


Fig. 9.40

6.2.5 Shock absorber (button 2)

6.2.5.1 "Shock absorber" activation test

1 - Position the controls as indicated in (Fig.9.41).

2 - Turn the knob (6) fully clockwise.

3 - Set the switch (1) to the maximum link lifting position (A).

4 - Press button (2). Indicator light (3) must come on and the links must lower by about 4% of their travel.

5 - Set the switch (1) to position (C): the shock absorber engaged indicator light (3) must go out.

Set the switch (1) back to position (A9). The indicator light (3) must come back on again.

Press button (2) to disengage the "shock absorber".

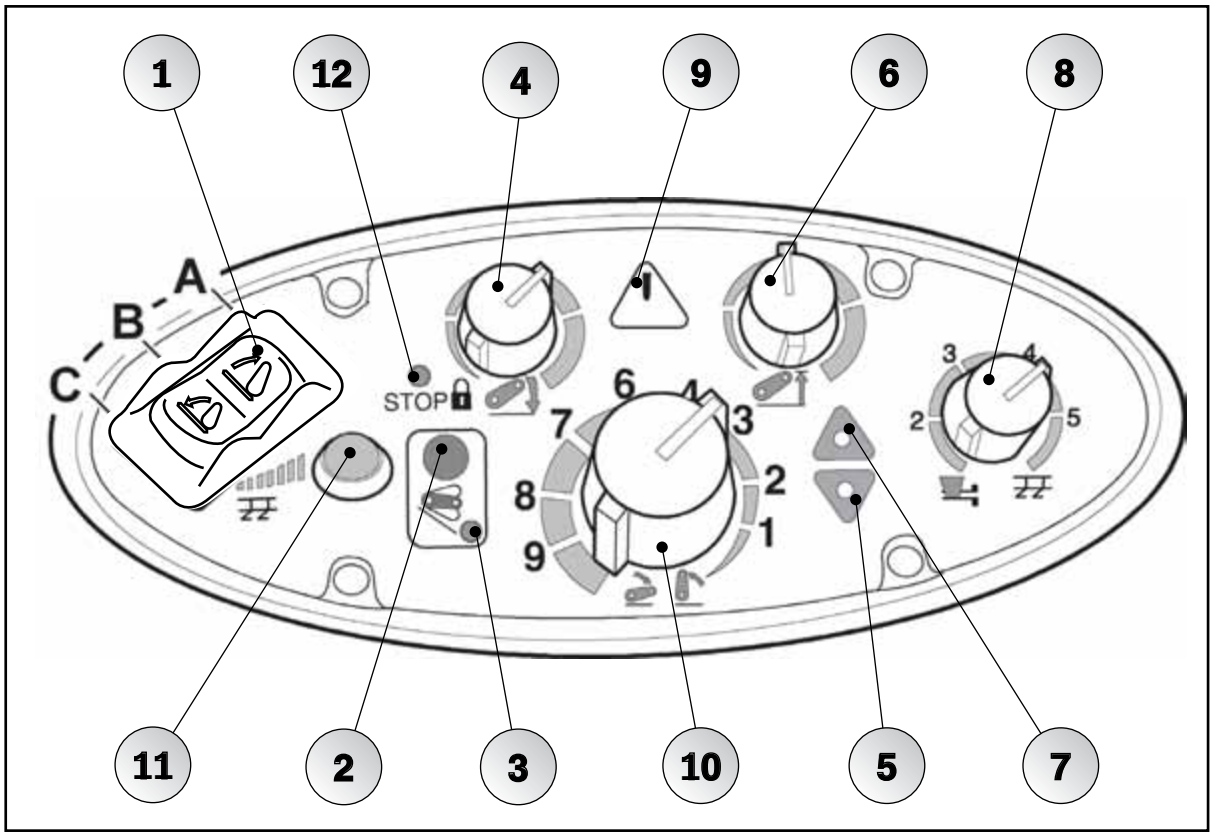


Fig. 9.41

6.2.6 Quick soil engagement (button 11)

6.2.6.1 Button test

1 - Position the controls as indicated in (Fig.9.42).

2 - Set the depth knob (10) to any position between 2 and 10.

3 - Operate button (11) to set to the rapid soil-engagement position.

4 - The links must gradually lower until they are completely down.

5 - The button will automatically return to its hold position when released.

6 - The links must rise to the height established by the previous adjustment of the depth control knob (10).

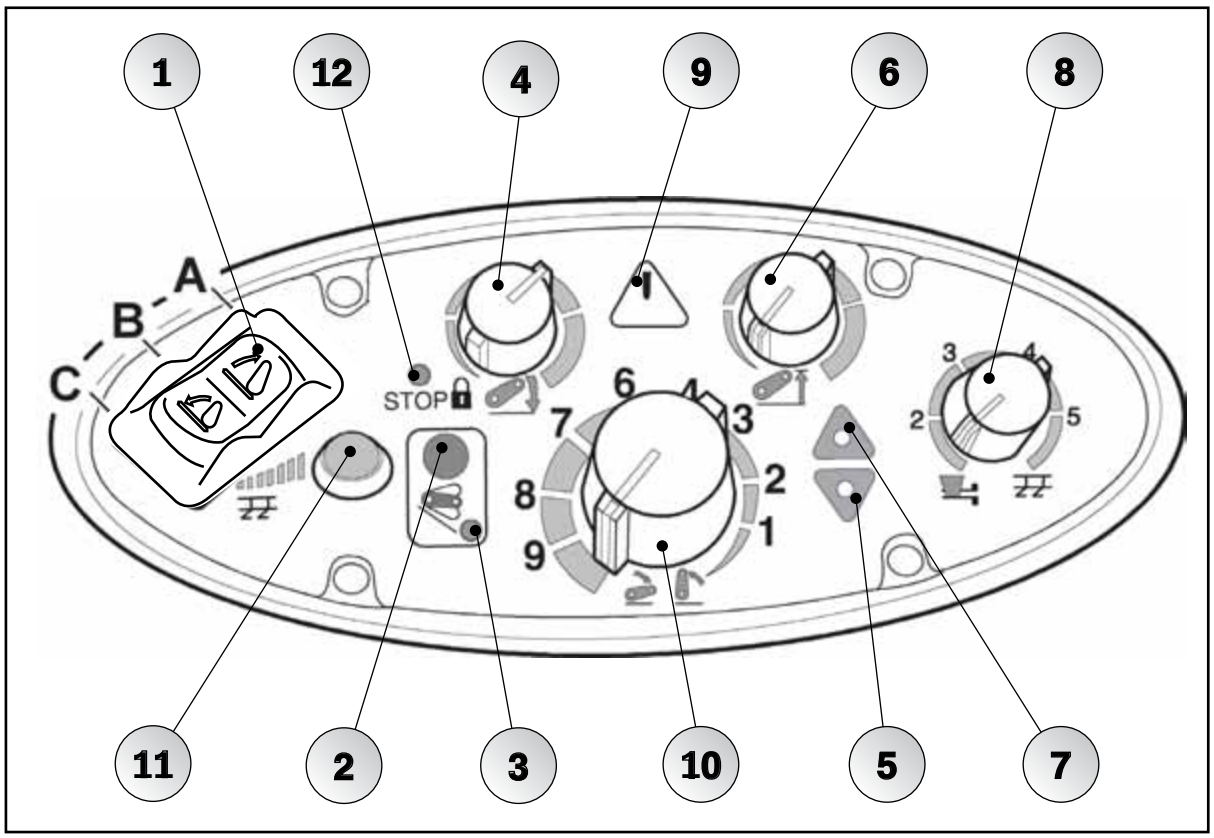


Fig. 9.42

Section 7 : Check-control and troubleshooting

Index

7.1 How to diagnose and identify a fault 9-54

7.2 Test instrument 9-55

7.3 Fault code tables 9-56

7.3.1 Slight fault (long pause + three flashes) 9-56
7.3.2 Medium serious fault (long pause + two flashes) 9-57
7.3.3 Serious fault (long pause + one flash) 9-58

7.4 Wiring diagram 9-60

7.5 Correspondences between connector terminals 9-62

7.1 How to diagnose and identify a fault

The tractors in the F-N Series Orchard series are equipped with a check-control system that allows the operator to identify and locate faults. The operator is warned if faults occur by the system's electronic control unit thanks to the check-control LED (9 Fig.9.43) on the console.

This LED issues a series of flashes with pauses in between. There are two types of pause, depending on the type of indication provided: long (lasting about "2 seconds") and short ("lasting about "1 second").

The code indicated by the LED (9 Fig.9.43) therefore consists of a long pause and a series of flashes that indicate how serious the fault is, a short pause and a series of flashes, indicating the component involved.

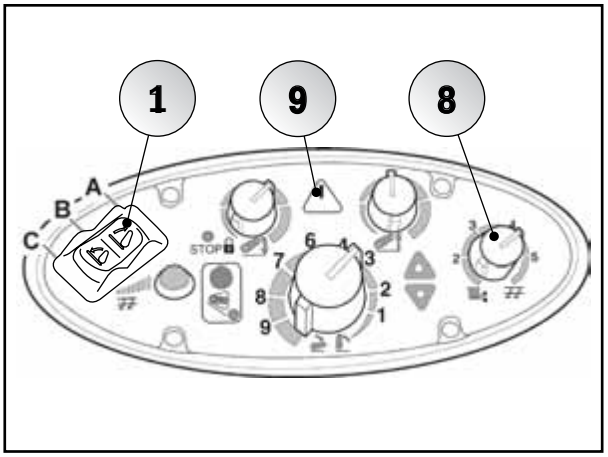
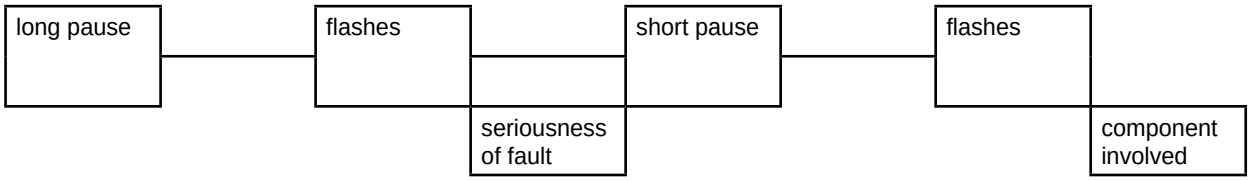


Fig. 9.43



Example: if there is a fault in the cable that transmit signals to the Intermix potentiometer (8 Fig.9.43), the respective error code "-3-6" is indicated by the following pause/ flashes sequence:

long pause —— three flashes —— short pause —— six flashes

Example: The code that indicates how serious the fault is is coded in the following way:

long pause + three flashes = slight fault (table 1)

long pause + two flashes = fault of medium seriousness (table 2)

long pause + one flashes = serious fault (table 3)

The code that indicates the component concerned is coded as shown in the tables on page 9-56-9-58.

The operator must interpret the code by means of the tables on the following pages and then act on the faulty component by conducting a series of electrical tests.

Wuth the aid of a tester and bearing in mind the wiring diagram of the system, the tables with the fault codes and the terminals of the connectors in question, the operator will be able to identify and then repair any faults in the system.

7.2 Test instrument

The instruments required for identifying and, consequently, repairing electrical faults in the electronically controlled power lift are: the wiring diagram, the tables with the fault codes (section 6-3), the tables with the connector terminal correspondences (section 6-5) and a tester (Fig.9.44).

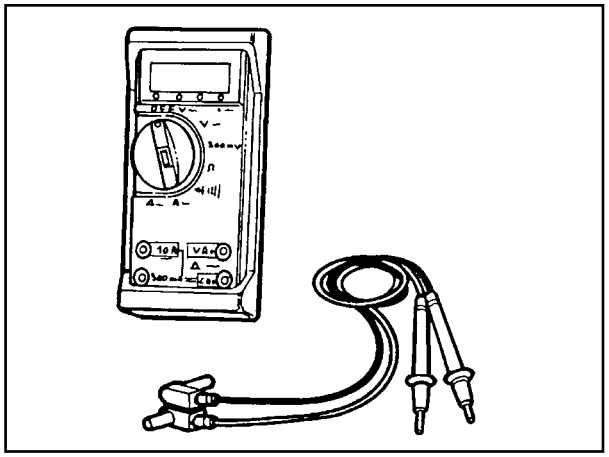


Fig. 9.44

7.3 Fault code tables

This section contains the tables that help the operator to identify faults of an electrical/electronic nature that may occur in the circuit of the electronically controlled power lift. There are three tables, since the “check-control” system installed envisages three categories of faults, identified as described previously:

1 - slight fault

2 - fault of medium seriousness

3 - serious fault

These tables indicate:

- the fault codes issued by the check-control led;
- the electrical/electronic components affected by the fault;
- the connectors and the respective terminals required for checking the fault with a tester;
- a brief description of the fault and the probable reasons that caused it.

7.3.1 Slight fault (long pause + three flashes)

Fault code	Component	Connectors and terminals		Description of fault and reason
3-1	draft sensor	A	E	sensor return signal not OK
		17	2	circuit open or sensor not connected
		18		possible short-circuit or discharge towards ground
				possible overload on terminal 2 of the draft sensor
3-4	down speed potentiometer	A	B	signal from down speed potentiometer not OK
		24	21	circuit open or potentiometer not connected
3-6	intermix potentiometer	A	B	signal from intermix potentiometer not OK
		4	9	circuit open or potentiometer not connected

7.3.2 Medium serious fault (long pause + two flashes)

Fault code	Component	Connectors and terminals		Description of fault and reason
2-1	position sensor	A	F	position sensor return signal not OK
		19	2	circuit open or sensor not connected
				possible short-circuit or discharge towards ground
				sensor position regulation not ok
2-3	work depth potentiometer	A	B	signal from potentiometer not ok
		16	7	circuit open or potentiometer not connected
2-4	maximum height limiter potentiometer	A	B	signal from potentiometer not ok
		22	17	circuit open or potentiometer not connected
2-6	up/down switch	A	B	signal from potentiometer not ok
		8	16	circuit open or potentiometer not connected

7.3.3 Serious fault (long pause + one flash)

Fault code	Component	Connectors and terminals		Description of fault and reason
1-1	lifting solenoid valve	A	G	lifting output phase not OK
		2	1	solenoid circuit defective
				circuit open in solenoid wiring
				solenoid at terminal N°6 of connector A
1-2	lowering position	A	H	lowering output phase not OK
		14	2	solenoid circuit defective
				circuit open in solenoid wiring
				solenoid at terminal N°6 of connector A
1-3	short-circuit		A	the current measured on terminal N° 6 in connector A is too high:
			6	short-circuit between terminals 2 and 6 or between 14 and 6 of connector A (possible short-circuit of solenoid)
1-4	external lifting buttons	A	the L	signal of external buttons not OK or button operation faulty
		10	3	
1-5	external lowering buttons	A	the L	signal of external buttons not OK or button operation faulty
		20	1	
1-6	powering voltage of console	A	B	console powering not OK
		12	6	9.5 V (low) powering or ground not OK

7.4 Wiring diagram

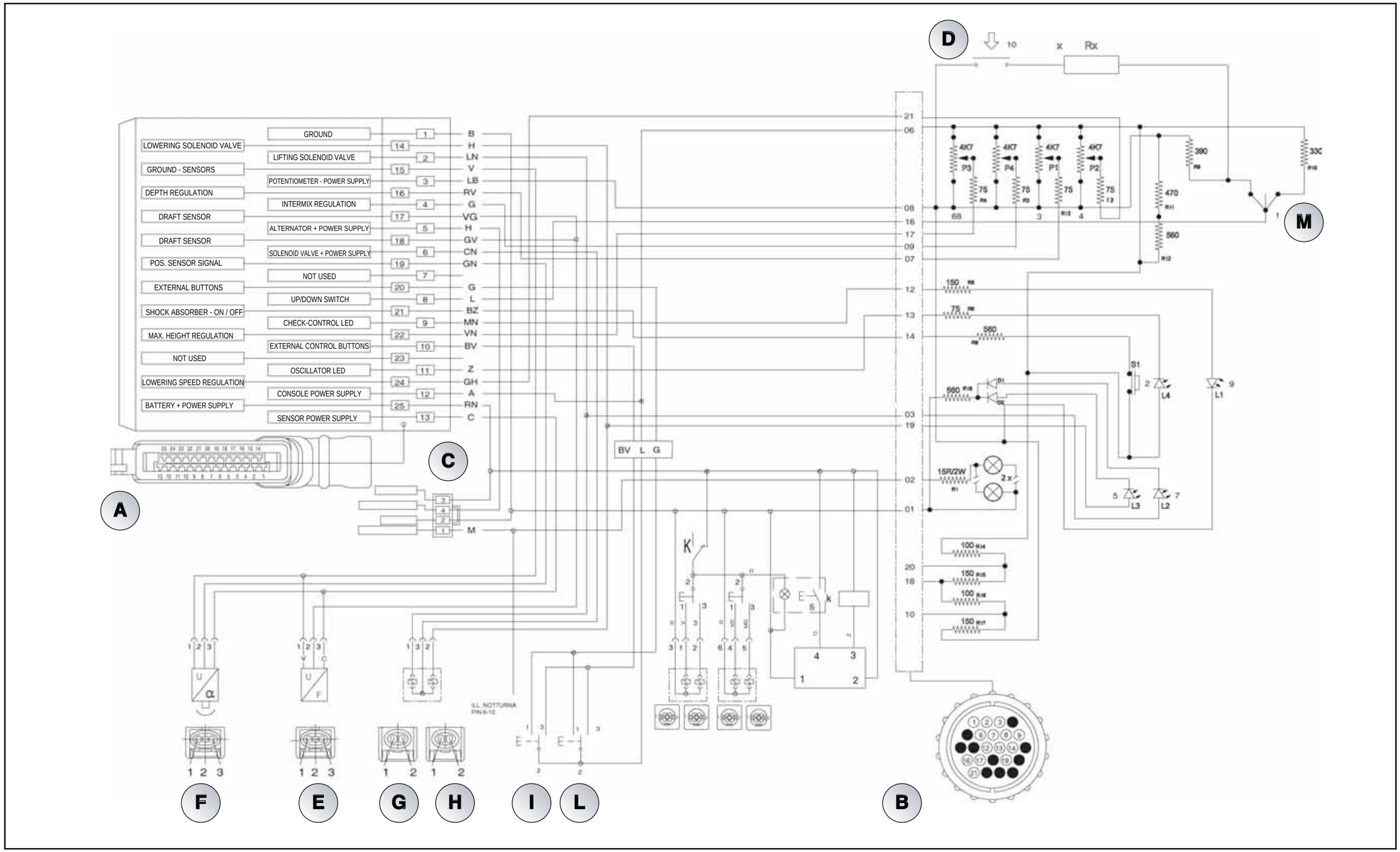


Fig. 9.45

1 - Up/down switch (M)
2 - “Shock absorber” engaging button
3 - Work depth selector potentiometer
4 - Down speed potentiometer
5 - Lowering indicator Led
6 - Maximum height limiter potentiometer
7 - Lifting indicator Led
8 - Function selector potentiometer (position-draft-intermix)
9 - Autodiagnosis led
10 - Quick soil engagement button (D)
A - 25-way connector for the electronic control unit
B - 24-way connector for the console
C - 10-way connector for powering the power lift
D - quick soil engagement button
E - 3-way connector for the draft sensor
F - 3-way connector for the position sensor
G - 2-way connector for the lifting solenoid valve
H - 2-way connector for the lowering solenoid valve
I - 3-way connector for the external buttons
L - 3-way connector for the external buttons
M - up/down switch

7.5 Correspondences between connector terminals

Connector (A)

pin	colour	pin	type of connector	description
1	B	2 and 1	connector C- B	ground
2	LN	1 and 3	connector G - B	console lift sol.v.
3	LB	8	connector B	control console
4	G	9	connector B	control console
5	H	4	connector C	power lift power supply
6	CN	3	connector H - G	up/down sol.v.
7	vacant			
8	L	16	connector B	control console up/down switch
9	MN	12	connector B	control console
10	BV	3	connector I - L	external buttons
11	Z	13	connector B	control console
12	A	6 - 2	connector B - I - L	control console
13	C	3	connector E - F	sensors
14	H	2 - 19	connector H - B	console lowering sol.v.
15	V	1	connector E - F	sensors
16	RV	7	connector B	control console
17	GV	2 - 18	connector E - A	draft sensor
18	GV	2 - 17	connector E - A	draft sensor
19	GN	2	connector F	position sensor
20	G	1	connector I - L	external buttons
21	BZ	14	connector B	control console
22	VN	17	connector B	control console
23	vacant			
24	GH	21	connector B	control console
25	RN	3	connector C	power lift power supply

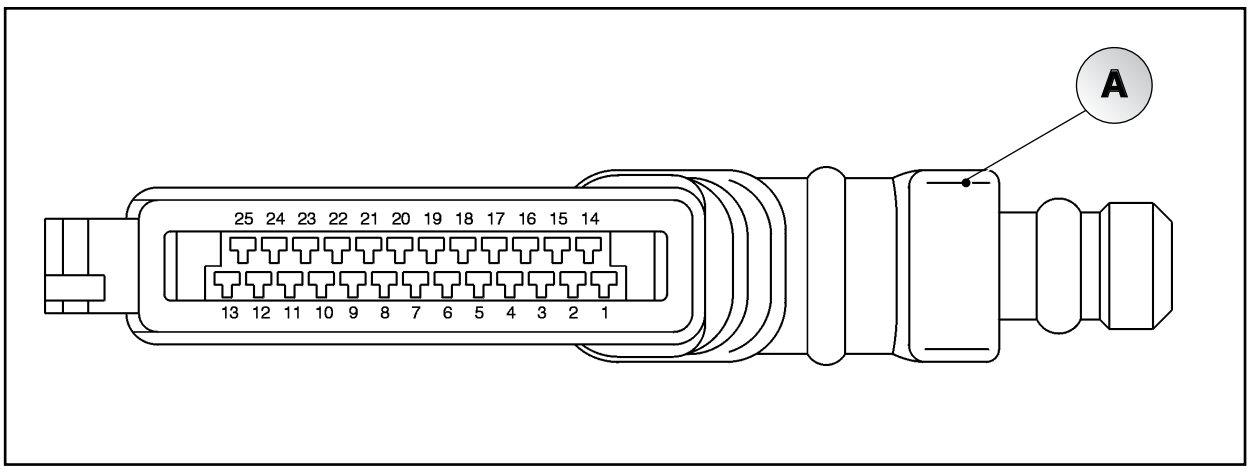


Fig. 9.46

Connector B

pin		pin	type of connector	description
1	B	1 - 2	connector A - C	ground
2	L	1	connector C	console lighting
3	LN	2 -1	connector A - C	lifting solenoid cont.unit
6	A	12 - 2	connector A - I and L	external button cont.unit
7	RV	16	connector A	electronic control unit
8	LB	3	connector A	electronic control unit
9	G	4	connector A	electronic control unit
12	MN	9	connector A	electronic control unit
13	Z	11	connector A	electronic control unit
14	BZ	21	connector A	electronic control unit
16	L	8	connector A - M	up - down switch
17	VN	22	connector A	electronic control unit
19	H	14-2	connector A - H	electronic control unit
21	GH	24	connector A	electronic control unit

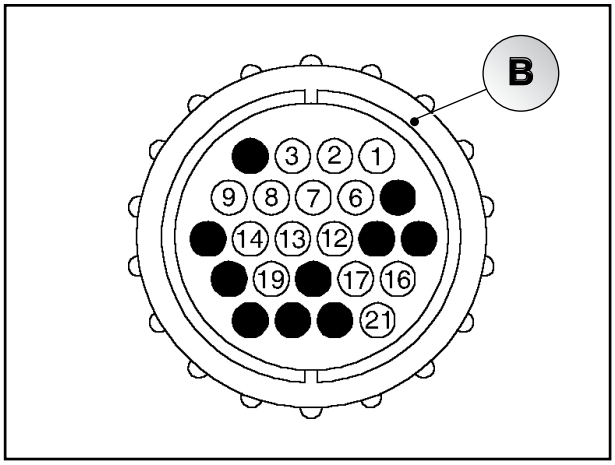


Fig. 9.47

Colour chart

M	Brown	C	Orange
V	Green	A	Light blue
Z	Purple	B	White
N	Black	L	Blue
S	Maroon	G	Yellow
R	Red	H	Grey
D	Pink		

Section 8 : Hydraulic tests

Index

8.1 Operating pressure tests 9-66

8.1 Operating pressure tests

⚠	**Attention:** do not begin work until the pressure in the hydraulic circuit has dropped to zero.

⚠	**Attention:** splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.

To check the operating pressure of the power lift, assemble tool 04 IDR MYT with adapter 122 IDR GL and with a 0 to 400 bar pressure gauge applied, as indicated in (Fig.9.47).

With the engine running, raise the implement and gauge the operating pressure. The maximum pressure tolerated is 180 bar.

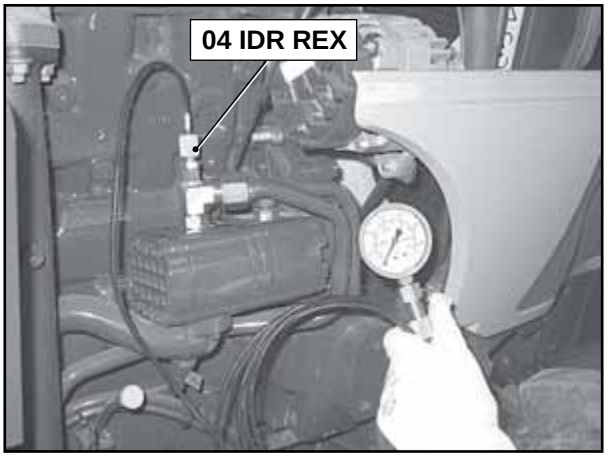


Fig. 9.48

Section 9 : Special tools

04 IDR MYT

Union for measuring the pressure of the steering and lifting circuit.

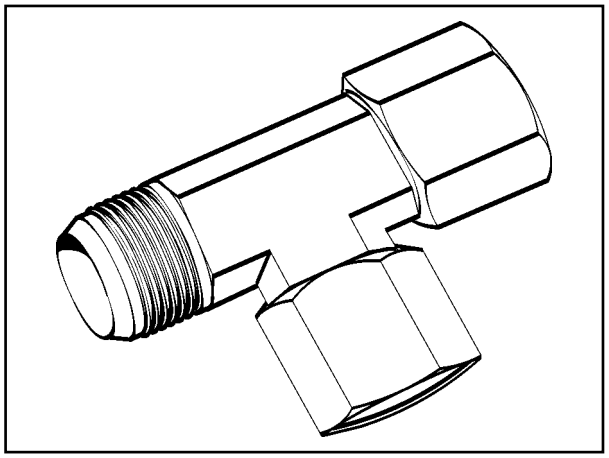


Fig. 9.49

122 IDR GL

Universal adapter union (available from the market)

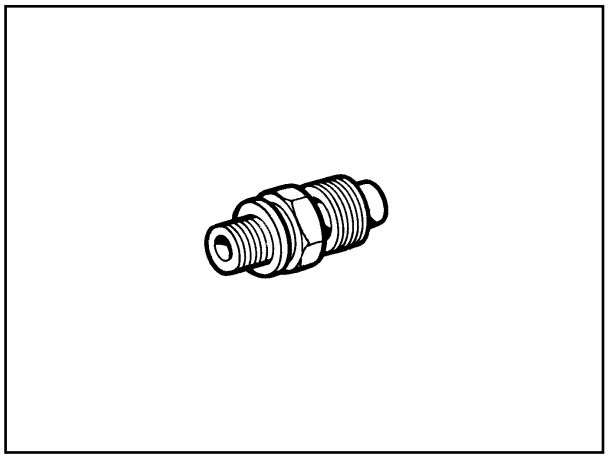


Fig. 9.50

Chapter 10 : Electrical system

Index

Section 1 : Precautions and safety recommendations 10-2

Section 2 : General description 10-3

2.1 Basic concepts 10-4
2.2 Electricity symbols 10-13
2.3 How to read and interpret a functional wiring diagram 10-17

Section 3 : Technical specifications and diagrams 10-19

3.1 Introduction 10-22
3.2 Cable colour chart 10-23
3.3 General location of the wiring 10-24
3.4 Location of connection points 10-26
3.5 NAO KIT cable line 10-30
3.6 F-N Series Speed Five footstep 10-32
3.7 F-N Series Speed Five cab 10-113
3.8 F-N Series Power Shuttle footstep 10-210
3.9 F-N Series Power Shuttle cab 10-303
3.10 F-N Series E-Line footstep 10-413
3.11 F-N Series E-Line cab 10-500

Section 4 : Main components (Speed Five and Power Shuttle versions) 10-605

4.1 Introduction 10-606
4.2 Sensors and potentiometers 10-607
4.3 Solenoid valves 10-619
4.4 Switches and buttons 10-632
4.5 Instrument 10-640

Section 5 : Main components (E-Line version) 10-659

5.1 Introduction 10-660
5.2 Sensors and potentiometers 10-661
5.3 Solenoid valves 10-665
5.4 Switches and buttons 10-667
5.5 Instrument 10-671

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: always consult the instructions in the operation and maintenance manual when working on the battery.
	Attention: Take all the necessary precautions when batteries containing sulphuric acid are installed. If the acid splashes on to the skin or into the eyes, immediately rinse the affected parts under clean running water.
	Attention: When the acid is mixed with water, SLOWLY POUR THE ACID INTO THE WATER, NEVER EVER POUR WATER INTO THE ACID.
	Attention: Explosive gas escapes when batteries are recharged. Work in places where there is good air circulation and keep well away from flames or sparks.
	Attention: always switch off the charging apparatus before disconnecting the cables.
	Attention: keep batteries well out of children's reach.
	Attention: do not smoke when checking or handling batteries.
	Attention: disconnect the negative terminal first. connect the positive terminal first when installing the battery again. Always take great care to check the polarity of the terminals.
	Attention: always disconnect the ground cable (-) of the battery before working on the electrical system.

Section 2 : General description

Index

2.1 Basic concepts 10-4

2.2 Electricity symbols 10-13

2.3 How to read and interpret a functional wiring diagram 10-17

2.1 Basic concepts

Electrical E-Linelogy

This is the term that describes all the practical applications of the electrical phenomena.

Example: industrial and civil systems, process controls, automatisms in general.

Electronics

Branch of engineering that studies how to control electrons for “useful purposes”. Electrons can flow in a vacuum, in a gas, in a liquid solution or in solid materials (semiconductors, conductors, superconductors).

Analog electronics

Part of electronics that deals with all the equipment or systems that manage and process electrical signals without changing their nature.

Example: resistances, sensors, condensers and diodes are typical components of an analog circuit.

Digital electronics

From the English term “Digital” or “Digit” (figure of a numbering system). Part of electronics that deals with all the equipment or systems that use magnitudes in a numerical form, i.e. in numbers, of a particular numbering system.

Example: operational amplifiers, microprocessors, digital sensors and digital displays are typical parts of a digital circuit.

Sensors

Devices that convert a physical magnitude into an electrical signal.

Potentiometers

Components that convert a movement into a voltage variation, using the resistive divider concept.

Electric voltage

The value of the potential energy assumed by the unitary electric charge is called electric potential of a point in space, if located in that point.

The symbol of electric potential is V. Its defining formula is expressed by the ratio:

V=W/Q

between the potential energy value W possessed by a charge Q positioned in the considered point and the value of the charge itself. According to this definition, the unit of measurement of the potential is the joule a coulomb, i.e. the Volt (V).

The meaning of this physical magnitude is very important. The electric potential expresses a measurement of the energy content of a charge positioned in a certain point. There will be a higher energy content if the charge is positioned in points with a higher potential. On the other hand, the energy content will be lower if the points in which the same charge is positioned have a lower potential.

To be more exact, one could say that the energy of an electric charge depends on both the Q value of that charge and on the potential value V in the point in which the charge is to be found. The following relation is used to calculate this energy:

W =Q V

When the electric potentials VA and VB of two different points A and B in space are different from each other, the difference:

UAB = VA - VB

is called potential difference (p.d.) between the two points, or “electric voltage”.

One could say that the voltage between two points represents the quantity of energy yielded by the unitary charge in the passage between the first and second point, or the work accomplished by the same unitary charge in the process of transfer between the same two points.

Voltage is measured by means of a voltmeter

Multiples and submultiples

Kilovolts (Kv) = 1000 v

Volts (V) = 1 v

Millivolts (mv) = 0.001 v

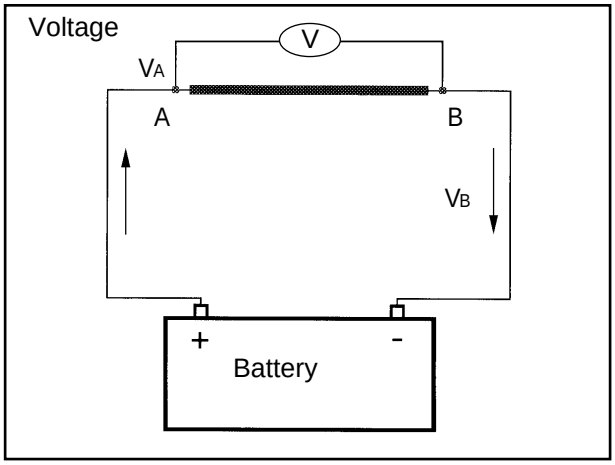


Fig. 10.1

Electric current

An orderly movement of electric charges, however it is produced and through whichever physical medium, is called electric current.

In technical applications, the type of current more generally used is the one caused by the circulation of free electrons throuch conducting materials connected to electric generators.

However it is connected to generators and users, every complex of conductors forms an electric circuit.

Thus defined, the electric circuit contains a current whenever it is closed, i.e. whenever electrical continuity is formed in it amongst all the components with which it is formed. If this continuity is broken, the circuit is known as open and no current can be produced in it.

The migratory movement of the electric charges along a circuit containing current can possess uniform and constant, fade-free characteristics: in this case, the current is called direct current. Variable current is when the electrons do not circulate in a uniform and constant way.

The greater or lesser intensity of an electric current can be completely defined by means of the quantity of electricity that passes through any section of the circuit within one second.

This unit of measurement has been intentionally named ampere and is indicated by the symbol A.

By and large, if any section of the circuit is crossed by a Q coulomb quantity of electricity within Dt seconds, one can say that the circuit is crossed by an electric current whose intensity I, expressed in amperes, is given by the ratio

I =Q/Δt

By measuring the CURRENT, one measures the intensity of a flow of electrons in a determined branch of the electric circuit.

Current is measured with the aid of an amperometer (tester function)

Multiples and submultiples

Kiloampere (KA) = 1000 A

Ampere (A) = 1 A

Milliampere (mA) = 0.001 A

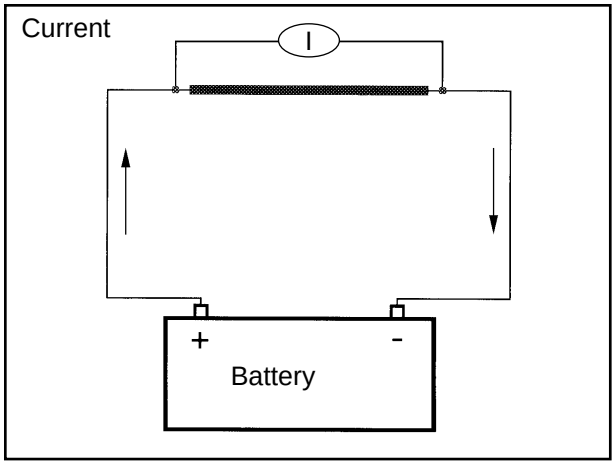


Fig. 10.2

Electric resistance

Different conductor wires offer a different “electric resistances” to the passage of current; the ratio between any voltage value applied to the ends of the wire and the corresponding intensity value of the current that passes through the wire being the electric resistance of each wire in question. Thus, if a metal wire is crossed by a current with intensity I under the action of voltage V, this means that the wire possesses a resistance R expressed by the ratio

R =V/I

If the number of volts that measures voltage V applied to the ends of the conductor in question equals the number of amperes that measures the current I, the value of the ratio between voltage and current will be 1: this means that the conductor in question has unitary electrical resistance. A similar wire with a 1 V voltage applied to its ends is crossed by a 1A current and under a 10V voltage is crossed by a 10A current and so forth.

Each conductor that complies with this condition forms within itself the electrical resistance called unit of measurement of resistance.

The unit of measurement of electrical resistance is therefore represented by the resistance of the conductor that requires 1V at its ends in order to be crossed by a 1A current.

The unit of electrical resistance is called Ohm and is indicated by symbol . Thus:

1 Ohm = 1 volt/ampere ; (1 Ω= 1 V/A)

By saying that a wire has a 10 W electrical resistance, one expresses the fact that that wire requires a 10V voltage at its ends for each ampere of current that crosses it. If that wire must be crossed by 2A, it will require 20V voltage at its ends.

To understand the concept, one can compare resistance to the effort water makes when it flows through a pipe; proportional to the roughness of the internal walls, the section of the pipe and its length.

The electrical resistance does not change as the voltage or current changes but varies as the temperature varies (even only slightly). It should thus be considered as a physical characteristics of the material.

Multiples and submultiples

KiloOhm (K Ω) = 1000Ω;

Ohm (Ω) = 1 Ω;

MilliOhm (mΩ) = 0.001 Ω;

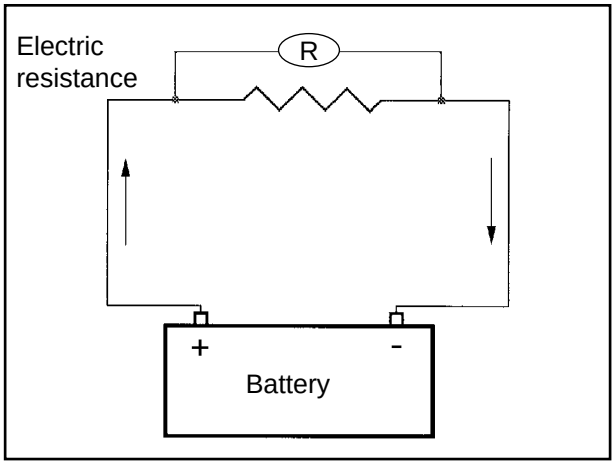


Fig. 10.3

Ohm's Law

Given the resistance R of the conductor, one could say that each time any voltage V is applied to its ends, the conductor will be crossed by a current whose intensity will be expressed by the relation:

I = V/R

Inversely, each time the conductyor with resistance R is crossed by a current with intensity I, there must be a voltage at its ends whose vaue is given by the product:

V = R I

Similarly:

R =V/I

The corresponding relations form Ohm's law, which expresses the basic relation amongst the three magnitudes described previously: Voltage (V), Resistance (R), Current (I).

This allows you to calculate one of the three magnitudes if the other two are known.

Example: Let's consider a series of measurements; maintain a constant resistance value R = 300 , consult the following which gives a first series of current values as the voltage varies:

Table 1R = constant = 300Ω				
Voltage in Volts (V)	3	6	9	12
Current in Milliamperes (mA)	10	20	30	40

Now consult a second series of measurements. Maintain the voltage value constant and calculate the current values as the resistance varies (potentiometer type):

Table 2V = constant = 18V				
Resistance in Ohms (Ω)	300	600	1200	2400
Current in Milliamperes (mA)	60	30	15	7.5

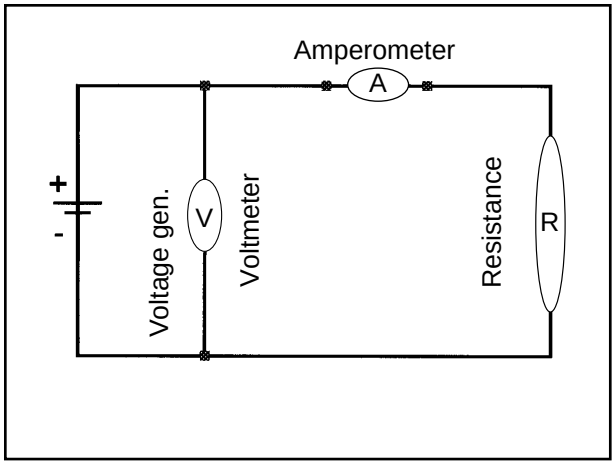


Fig. 10.4

Operating faults in electrical circuits

There are four types of operating faults that may occur in electrical circuits:

1 - excessive resistance in the circuit (high resistance)

2 - broken circuit (open circuit)

3 - grounded circuit

4 - short-circuit

In a simple circuit like the one indicated in (Fig.10.5), there are only three parts in which these operating faults can occur:

1 - before the control switch (A)

2 - between the control switch (A) and the load (B)

3 - after the load (B)

It is easy to mistake the operating fault of a component with that of a circuit. Great care must therefore be taken when the cause of a fault is identified, so as to ensure that it can be correctly and quickly resolved.

Example: a component may not operate before a connector is disconnected and operate after the same connector has been re-connected. The reason for this could be excessive resistance, which created a drop in the voltage supplied to the connector terminals, thus preventing the right amount of current to flow towards the component.

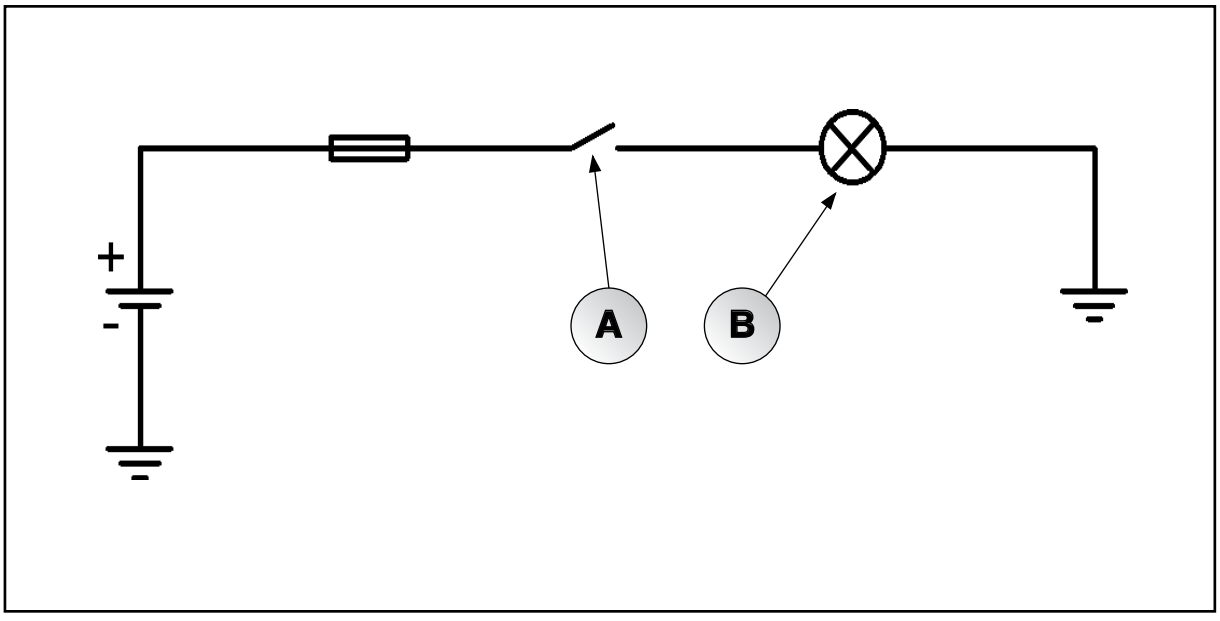


Fig. 10.5

High resistance / Open circuit

A circuit with high resistance could lead to a slow movement, a fluttering light or failure of a component to operate (e.g.: caused by loose, tarnished, dirty or greasy terminals, if the wire diameter is too small, or if the wires have been pulled).

If the circuit is “open”, the component will be unable to operate since the circuit is broken (e.g.: torn wire, disconnected terminals, open protection device on switch).

Proceed as described below to find out where “excessive resistance” or an “open circuit” is located:

- With the control switch (C) “on” and the load (I) connected in the circuit, check to find out whether the voltage is correct in an easily accessible point between (D) and (H).

  If the voltage is low, move towards the current source (A) until you have found the point in which the voltage drop occurs.

  If the voltage is correct, move towards the load (I) and the ground terminal (J) until you have found the point in which the voltage drop occurs.

- Repair the circuit as required.

- Repeat the test procedure after the repairs have been made.

  Note: the example refers to excessive resistance between (D) and (F), and an open circuit between (F) and (G).

A - Battery
B - Fuse
C - Switch
D - Component terminal
E - Circuit resistance
F - Connector of the circuit
G - Connector of the circuit
H - Component terminal
I - Lamp
J - Ground

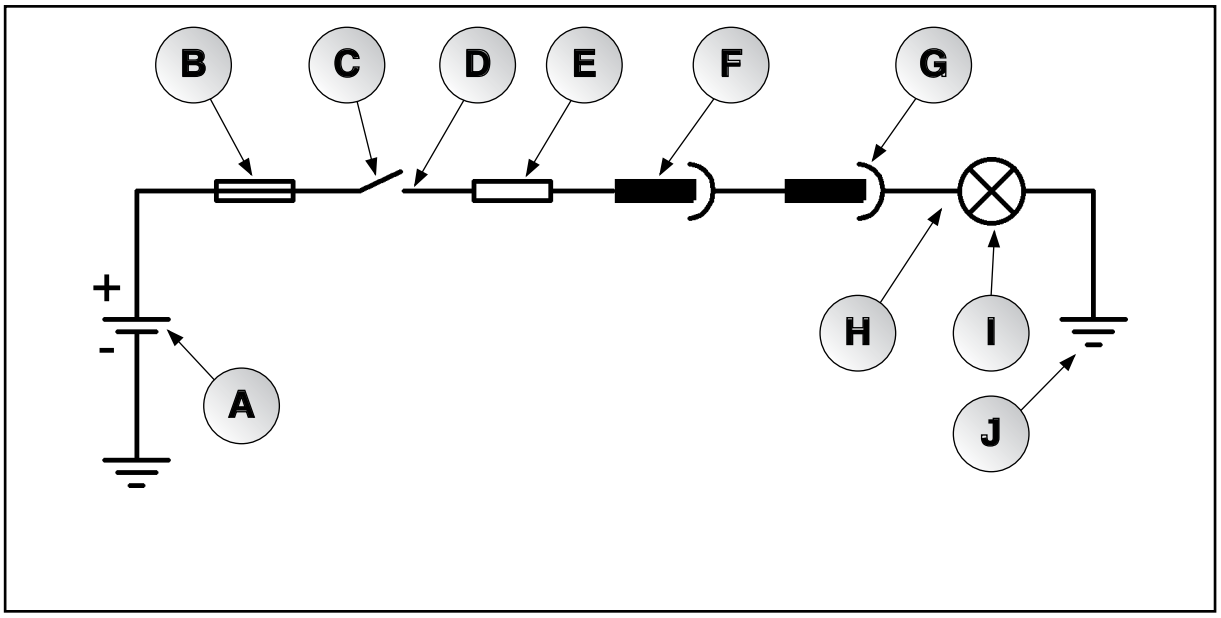


Fig. 10.6

Grounded circuit

A grounded circuit prevents the components from operating and the fuse or automatic switch open (e.g.: the powering wire has a contact towards ground).

Proceed as described below to find out where a “grounded circuit” is located:

- With the control switch (D) off, check to find out whether there is continuity towards ground between (C) and (D).

  If there is no break, then the grounded circuit is between (C) and (D). Eliminate the fault from this part of the circuit.

  If there is a break towards ground between (C) and (D), disconnect the load (H) in point (G), then turn off the control switch (D) and check to find out whether there is a break towards ground between (D) and (F). If there is no break, then the grounded circuit is between (E) and (F). Eliminate the fault from this part of the circuit.

- Repeat the functional test after the repairs have been made.

  Note: there is a ground between (E) and (F) in the example.

A - Battery
B - Fuse terminal
C - Fuse terminal
D - Switch
E - Component terminal
F - Ground circuit
G - Component terminal
H - Lamp

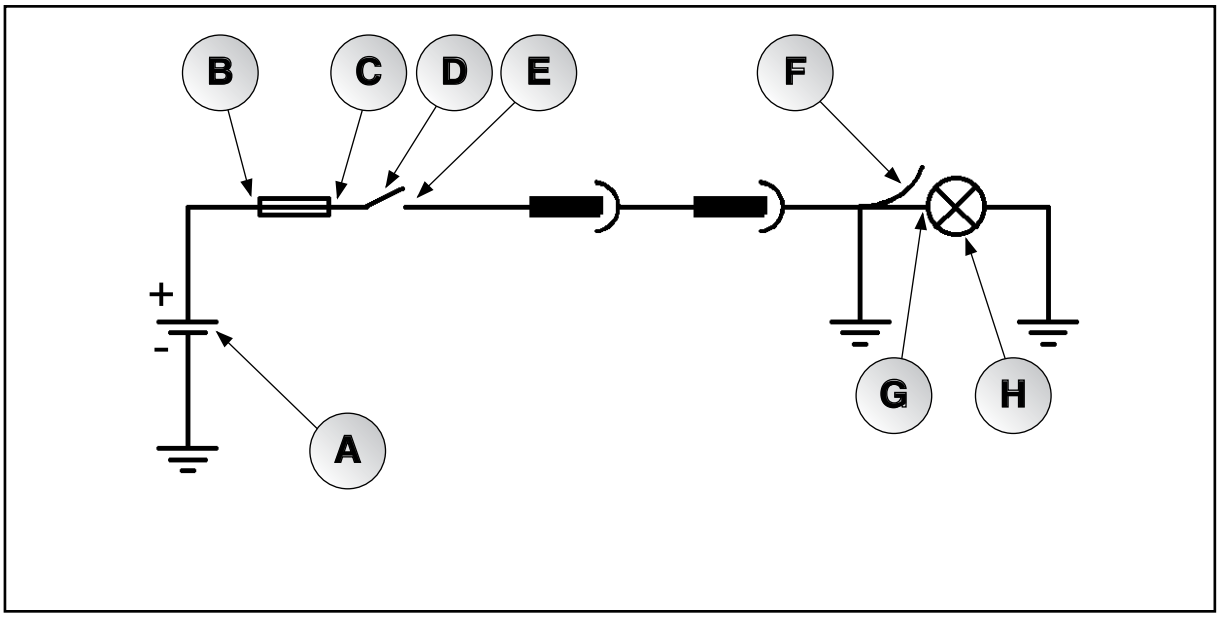


Fig. 10.7

Short-circuit

The thing that usually happens when there is a short-circuit in the electrical system, is that two components operate at the same time when only one switch is operated (e.g.: improper contact between two wires).

There can also be a short-circuit in one component. However, this usually activates the relative protection circuit.

Proceed as described below to find out where a short-circuit is located:

- Use switch (A) to operate the right lamp (B).
- Begin with the control switch (D) of the lamp (I), which should not come on, and disconnect the wire at the terminal (E).
- Following the circuit, disconnect the wire at the connectors (F, G or H) until the supplementary lamp (I) goes out.
- The short-circuit or improper connection will be between the last two points in which the wire was connected. In the example, it is between (F) and (G).
- Repair the circuit in the following way:
  - wires that are not installed within a protective tube: wrap insulating tape around the wire in question, or replace it and wrap with tape as required.
  - Wires that are installed within a protective tube: replace the entire harness if there are hot points in the short-circuited parts of the pre-assembled wiring.
    If no hot points have been detected, install a new wire of an appropriate size between the last two connectors and wrap insulating tape around the wire as required.
- Repeat the functional test after the repairs have been made.

A - Switch
B - Lamp
C - Fuse
D - Switch
E - Component terminal
F - Connector of the circuit
G - Connector of the circuit
H - Component terminal
I - Lamp

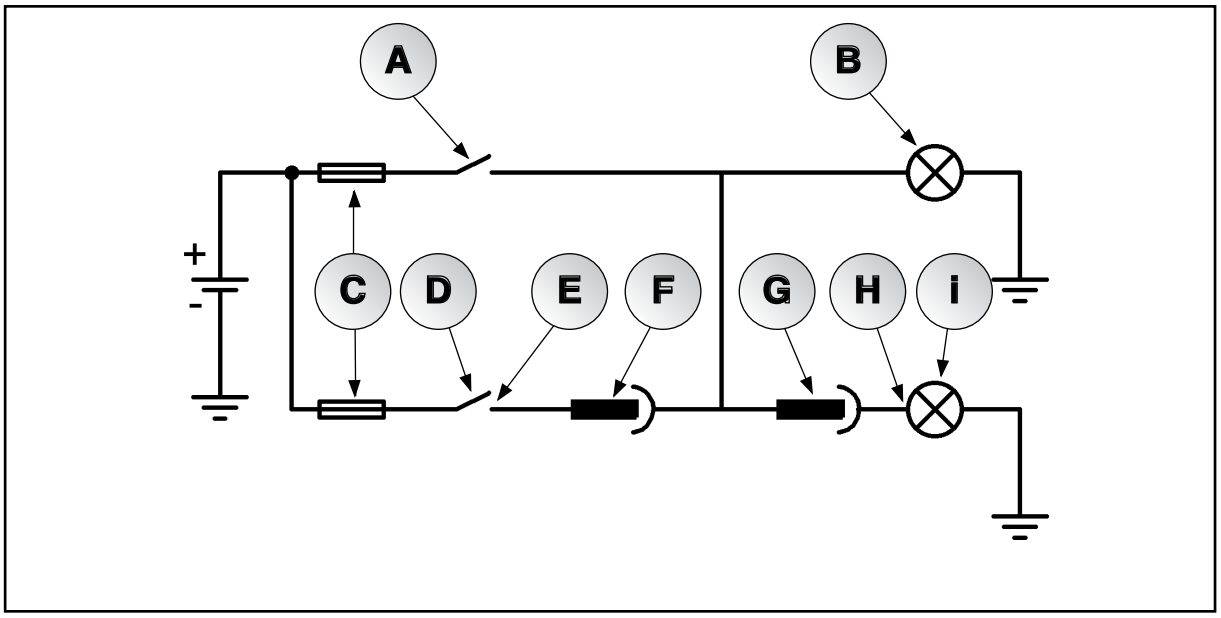
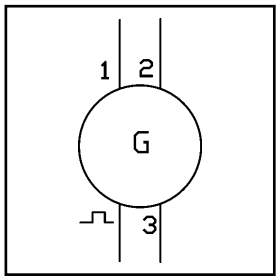
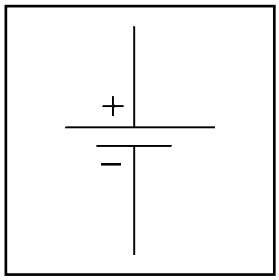
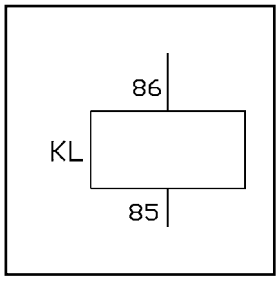
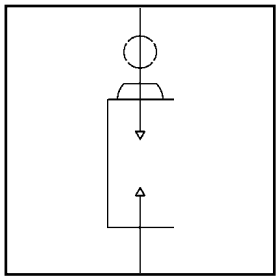
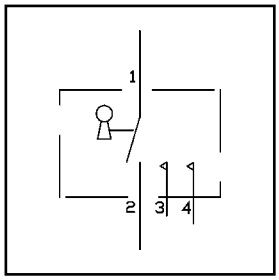
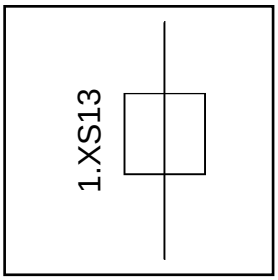
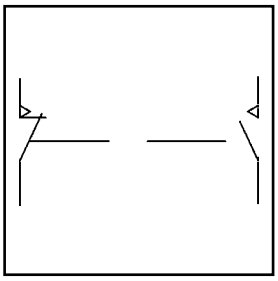
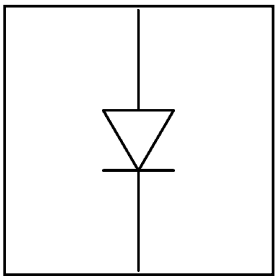
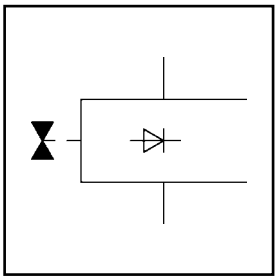
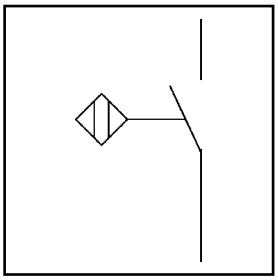


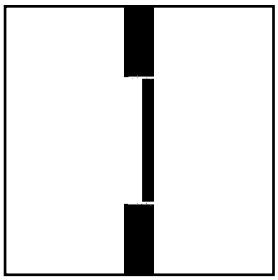
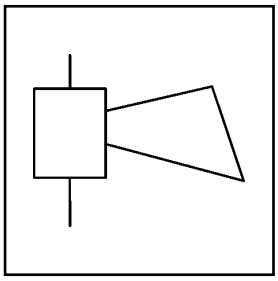
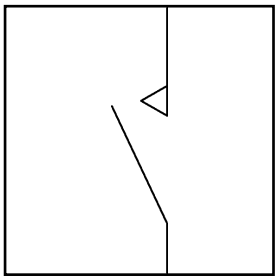
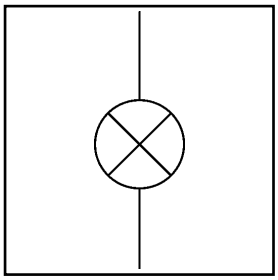
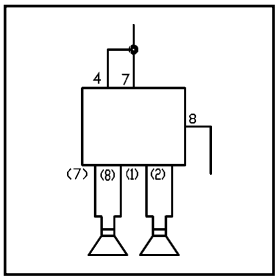
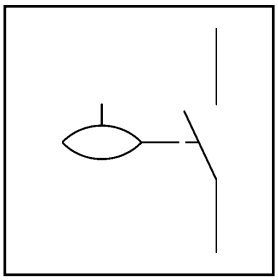
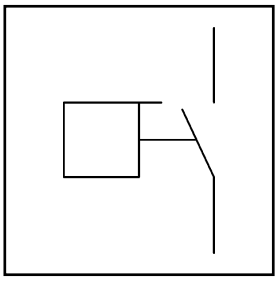
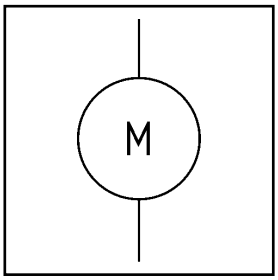
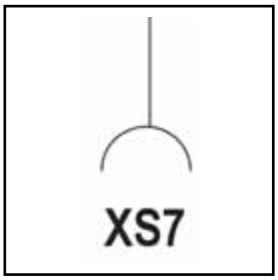
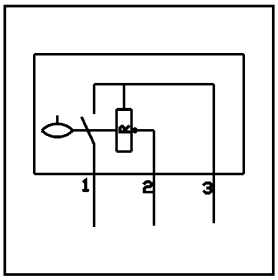
Fig. 10.8

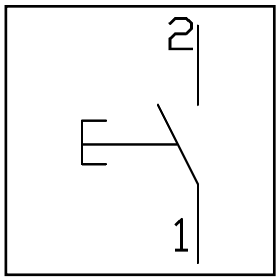
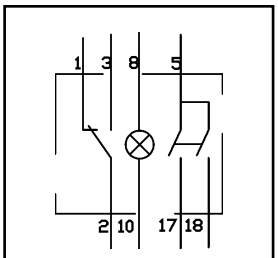
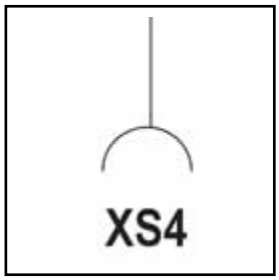
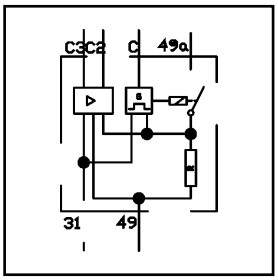
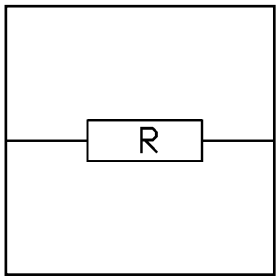
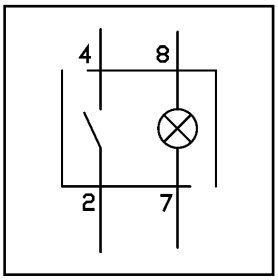
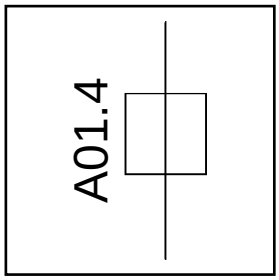
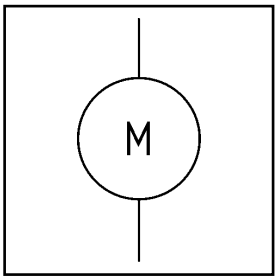
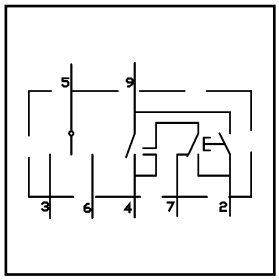
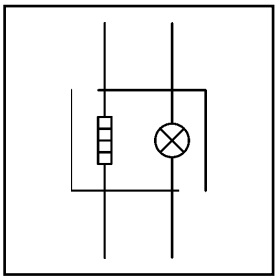
2.2 Electricity symbols

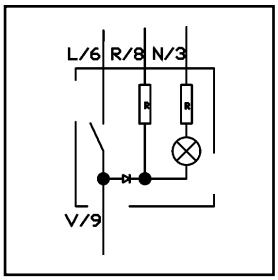
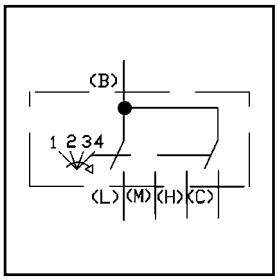
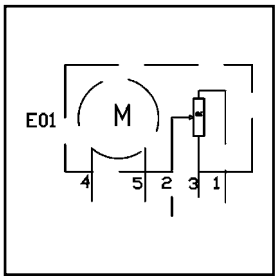
This section illustrates the main symbols used in the general wiring diagrams.

The symbols conform to the criteria established by CEI standards.

Alternator	
Battery	
Relay coil/Relay contact	
Thermostarter	
Ignition switch	
Terminal board connecting wiring lines	
Sensor	
Diode	
Solenoid valve	
Sensor	

Fuse	
Horn	
Switch	
Lamp	
Radio with loud-speakers	
Sensor	
Sensor	
Starter motor	
Trailer power socket	
Sensor	

Button	
Selector	
Electr. power lift connector	
Blinker	
Resistance	
Revolving beacon switch	
Connector for instrument	
Window washer motor	
Selector	
Cigarette lighter	

A/C switch	
A/C fan switch	
A/C temperature regulating and water cock	

2.3 How to read and interpret a functional wiring diagram

An identification letter has been given to each componewnt (electrical device) and to the main connectors (terminal board). A number has been added to the letter to separate and indicate the total number of components within the letter group.

Identification letter	Type	Examples
A	System, sub-assembly, group of parts	Control unit, switch box, transeivers, logic module
B	Transducer for converting non-electric variables into electrical ones and vice versa	Speed sensors, pressure sensors, horns, pressure switches, sensors, detectors, limit value sensors, pulse generators, probes, air flow sensors, oil pressure switches, temperature sensors, ignition-voltage detectors
C	Condenser	Generic condenser
D	Binary device, memory	Digital devices, integrated circuits, pulse counters, magnetic tape recorders
E	Various devices and instruments	Heating devices, air conditioners, lamps, lights, glow plugs, remote control switches
F	Protection device	Releasing devices, devices to protect against polarities, fuses, electrical protection circuits
G	Power supplier, generator	Batteries, generators, alternators, battery chargers
H	Monitor, alarm, indicators	Acoustic alarms, indicator lights, turn indicators, brake indicators, alarm indicators, buzzers
K	Relays	Battery relays, turn indicator relays, electromagnetic switches, ignition relays, blinkers
L	Inductor	Stopping coils, coils, windings
M	Starter motor	Fan motors, starter motors
N	Regulator, amplifier	Regulators (electronic or electromechanical), voltage stabilizers
P	Measuring instrument	Amperometer, check-control connectors, tachymeter, fuel level gauge, pressure gauges, measuring prods, test prods, speed indicators
Q	Operating equipment for power circuits	Normally open microswitches, normally closed microswitches
R	Resistor	Glow plugs, glow plugs with sheathed element, spark plugs, heating resistors, NTC resistors, PTC resistors, potentiometers, regulating resistors
S	Switch	Switches and buttons, switch with universal key, light switch, horn switch, blinker switch
T	Transformer	Ignition coil, ignition transformer
U	Modulator, converter	Direct current transformers
V	Semiconductor, thermionic valves	Transistors, diodes, thermionic valves, rectifiers, semi-conductors, thyristors, Zener diodes
W	Transmission path, conductor, antenna	Antennas, shield components, screened conductors, wiring, conductors, ground wires
X	Terminal, plug, plug and socket connection	Terminal pins, electrical connections, coupler connectors for electrical lines, line connectors, sockets, plugs, terminals, plug and socket connections
Y	Mechanical actuator device	Permanent magnets, injection valves (electromagnetic), clutch assemblies and electromagnetic brakes, bleeder valves, fuel pumps, solenoids, switch valves, ignition valves, locking systems
Z	Electric filter	Anti-jamming filters

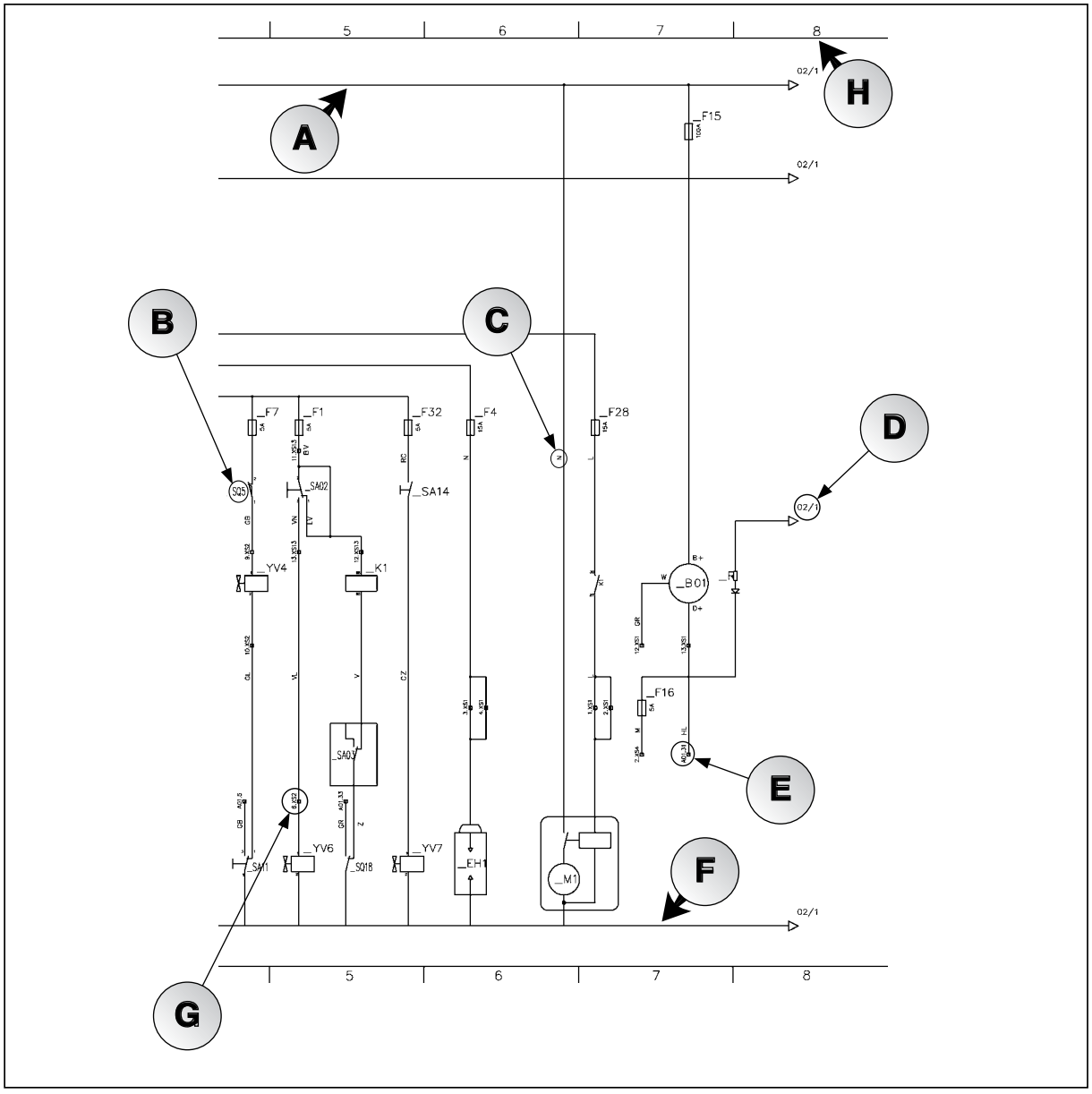


Fig. 10.9

A - Powering line
B - Component identification
C - Cable colour
D - Reference to other sections of the diagram and reference column
E - Reference number of connector and terminal
F - Negative line of battery
G - Reference number of terminal board and terminals
H - Number of reference column

The functional diagram of F-N Series tractors is divided into various parts. Designation of the components is the same as used in the corresponding wiring diagrams. The functional diagram has been prepared in compliance with the criteria established by the CEI standards.

Section 3 : Technical specifications and diagrams

Index

3.1 Introduction.....10-22

3.2 Cable colour chart.....10-23

3.3 General location of the wiring.....10-24

3.4 Location of connection points.....10-26

3.5 NAO KIT cable line.....10-30

3.6 F-N Series Speed Five footstep.....10-32
3.6.1 Technical specifications.....10-32
3.6.2 Main wiring diagram.....10-40
3.6.3 Battery-starter motor line.....10-43
3.6.4 Front engine line (with 3-cylinder engine).....10-49
3.6.5 Front engine line (with 4-cylinder engine).....10-63
3.6.6 Dashboard line.....10-77
3.6.7 Platform line.....10-89
3.6.8 Rear line.....10-99
3.6.9 Headlight extension line.....10-109

3.7 F-N Series Speed Five cab.....10-113
3.7.1 Technical specifications.....10-113
3.7.2 Main wiring diagram.....10-123
3.7.3 Battery-starter motor line.....10-127
3.7.4 Front engine line (with 3-cylinder engine).....10-133
3.7.5 Front engine line (with 4-cylinder engine).....10-147
3.7.6 Dashboard line.....10-161
3.7.7 Platform line.....10-173
3.7.8 Rear line.....10-183
3.7.9 Headlight extension line.....10-193
3.7.10 Roof line.....10-197

3.8 F-N Series Power Shuttle footstep.....10-210
3.8.1 Technical specifications.....10-210
3.8.2 Main wiring diagram 10-218
3.8.3 Battery-starter motor line 10-223
3.8.4 Front engine line (with 3-cylinder engine).....10-229
3.8.5 Front engine line (with 4-cylinder engine).....10-243
3.8.6 Dashboard line 10-257
3.8.7 Platform line.....10-271
3.8.8 Rear line 10-285
3.8.9 Headlight extension line 10-299

3.9 F-N Series Power Shuttle cab.....10-303
3.9.1 Technical specifications.....10-303
3.9.2 Main wiring diagram 10-313
3.9.3 Battery-starter motor line 10-319
3.9.4 Front engine line (with 3-cylinder engine).....10-325
3.9.5 Front engine line (with 4-cylinder engine).....10-339
3.9.6 Dashboard line 10-353
3.9.7 Platform line.....10-367
3.9.8 Rear line 10-381
3.9.9 Headlight extension line 10-395
3.9.10 Roof line 10-399

3.10 F-N Series E-Line footstep.....10-413
3.10.1 Technical specifications.....10-413
3.10.2 Main wiring diagram 10-421
3.10.3 Battery-starter motor line 10-425
3.10.4 Front engine line.....10-429
3.10.5 Dashboard line 10-452
3.10.6 Platform line.....10-470
3.10.7 Rear line 10-484
3.10.8 Headlight extension line 10-495

3.11 F-N Series E-Line cab.....10-500
3.11.1 Technical specifications.....10-500
3.11.2 Main wiring diagram 10-510
3.11.3 Battery-starter motor line 10-515
3.11.4 Front engine line.....10-519
3.11.5 Dashboard line 10-542
3.11.6 Platform line.....10-560
3.11.7 Rear line 10-574
3.11.8 Headlight extension line 10-585
3.11.9 Roof line 10-590

3.1 Introduction

This chapter examines the main characteristics of the wiring lines installed in **F-N Series tractors**.

The information given here will be useful for testing and identifying any faults of an electrical nature that may have occurred in the machine.

The relative constructional diagram is indicated for each wiring line. The position of each connector on the tractor is indicated so that it can be easily and quickly found. Moreover, the relative electrical connections between the Pins have also been indicated. Each connector is identified by the code and numbering used on the machine's main wiring diagram. These numbers are a great help during tests as they allow the electrician to quickly locate each terminal and make the necessary repairs.

Terminals (SP5) for the air filter's vacuum switch				
term.	wire colour	to connector or component	term.	Wire function
1	B	XM (ground)		air filter
2	LG	XS1	10	air filter

Terminal 1 of connector (SP5) with colour (B) corresponds to ground eyelet (XM); terminal 2 of connector (SP5) with colour (LG) corresponds to terminal board (XS1) on pin 10.

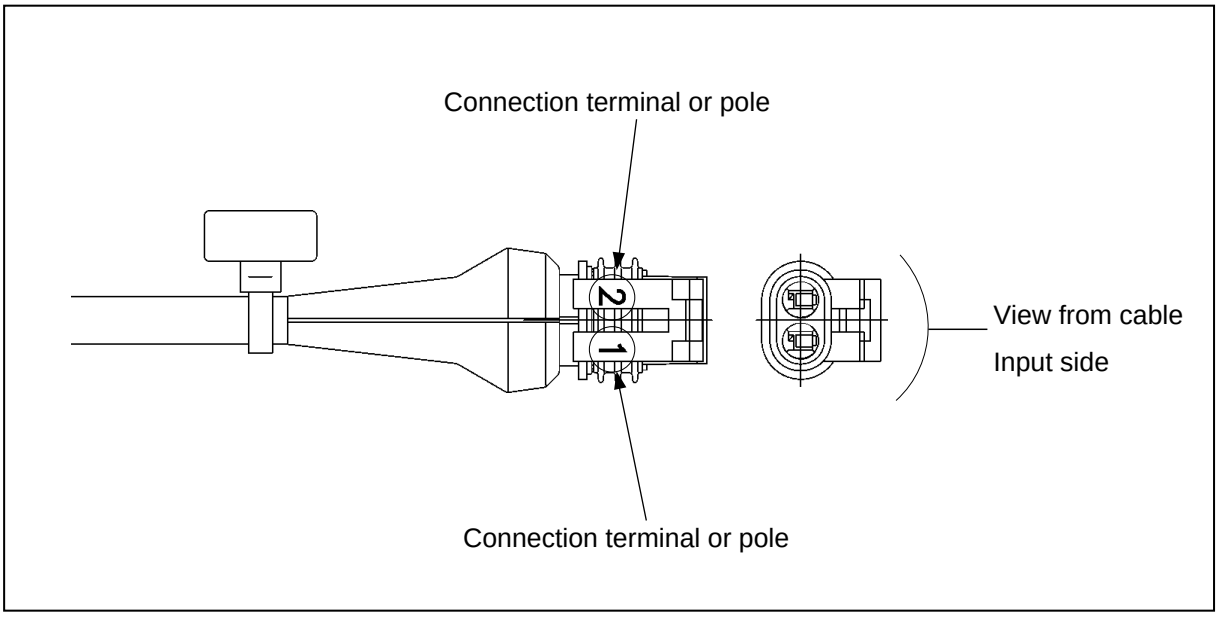


Fig. 10.10

3.2 Cable colour chart

The colours of the cables used in the wiring lines installed in **F-N Series** tractors are indicated in the multiple wiring diagrams and electrical correspondence tables according to the following table.

Code	Wire colour
A	Light blue
AN	Light blue black
AG	Light blue yellow
AB	Light blue white
AV	Light blue green
AR	Light blue red
B	White
BR	White red
BN	White black
BL	White blue
BG	White yellow
C	Orange
CB	Orange white
CN	Orange black
CL	Orange blue
G	Yellow
GV	Yellow green
GN	Yellow black
GR	Yellow red
GL	Yellow blue
H	Grey
HM	Grey brown
HR	Grey red
HN	Grey black
HB	Grey white
HL	Grey blue
HV	Grey green
HG	Grey yellow
L	Blue
LB	Blue white
LN	Blue black
LR	Blue red
M	Brown
MB	Brown white
MN	Brown black
MV	Brown green
N	Black
NZ	Black purple
NB	Black white
NR	Black red
R	Red
RG	Red yellow
RN	Red black
RV	Red green
S	Pink
SN	Pink black
SG	Pink yellow
V	Green
VG	Green yellow
VN	Green black
VB	Green white
Z	Purple
ZB	Purple white
ZN	Purple black

3.3 General location of the wiring

The electrical system of **F-N Series footstep version** tractors mainly consists of 5 wiring lines, while in the **F-N Series cab version** tractors, there is also a cab roof line.

The wiring lines and positioned in the tractor in a logical way so that the assemblies can be split.

The wiring lines are named in accordance with the location of the main components they supply:

A - Battery-starter motor line
B - Front engine line
C - Dashboard line
E - Platform line
P - Rear line
G - Roof line
H - Headlight extension line

F-N Series footstep version tractor

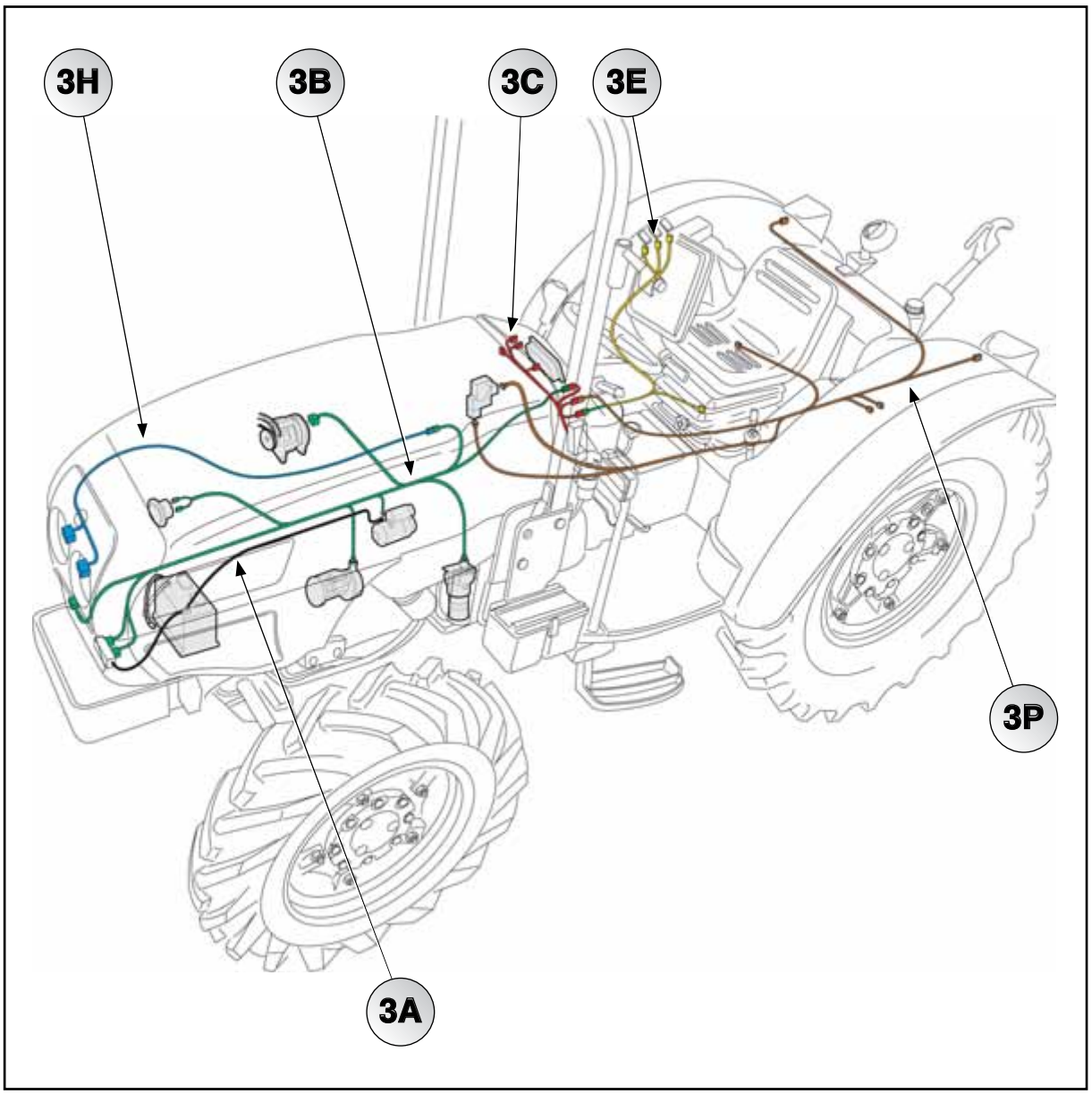


Fig. 10.11

F-N Series cab version tractor

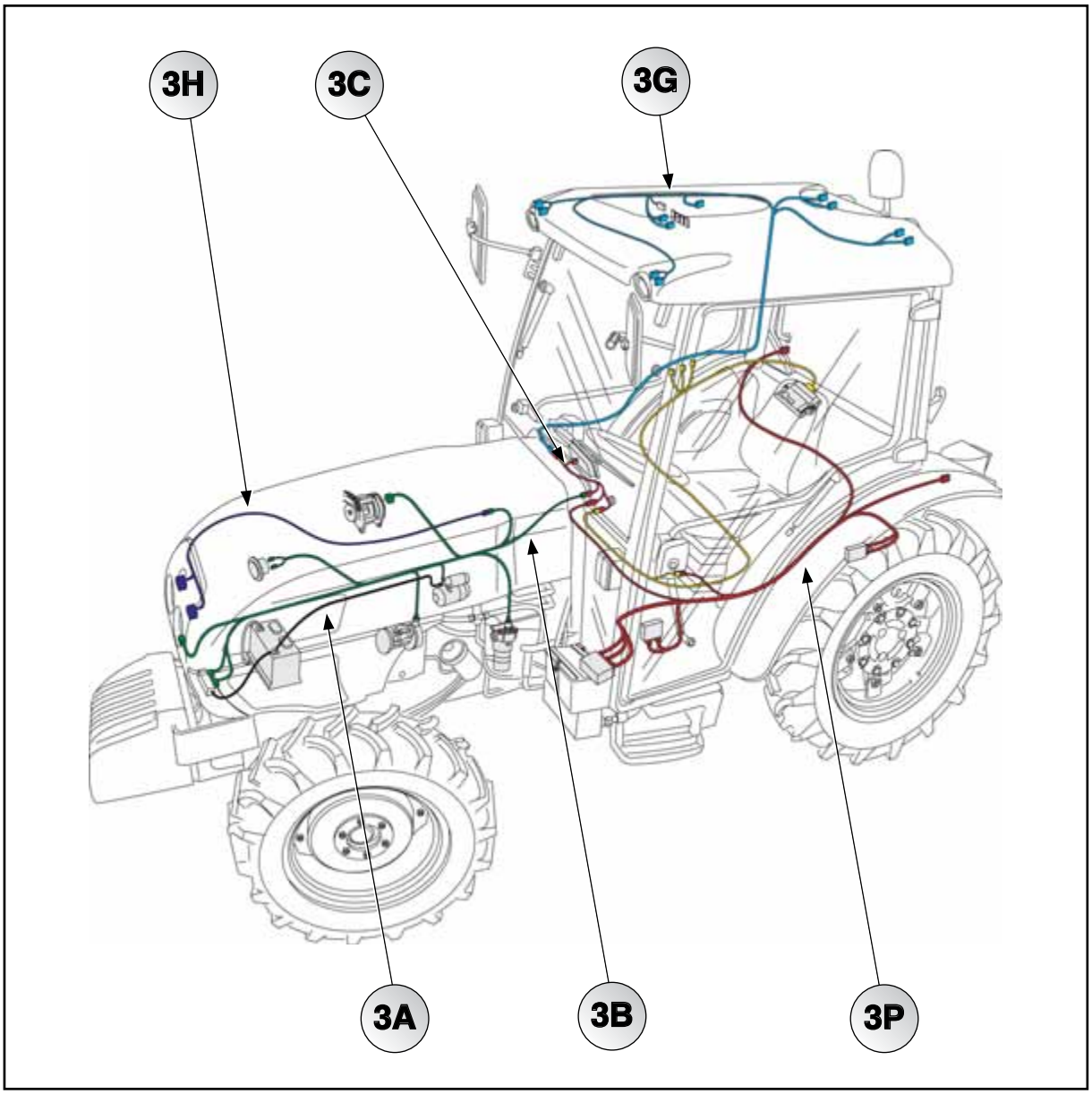


Fig. 10.12

3.4 Location of connection points

The following figures illustrate the connection points between the various wiring lines installed, depending on the tractor version.

Speed Five and E-Line footstep versions

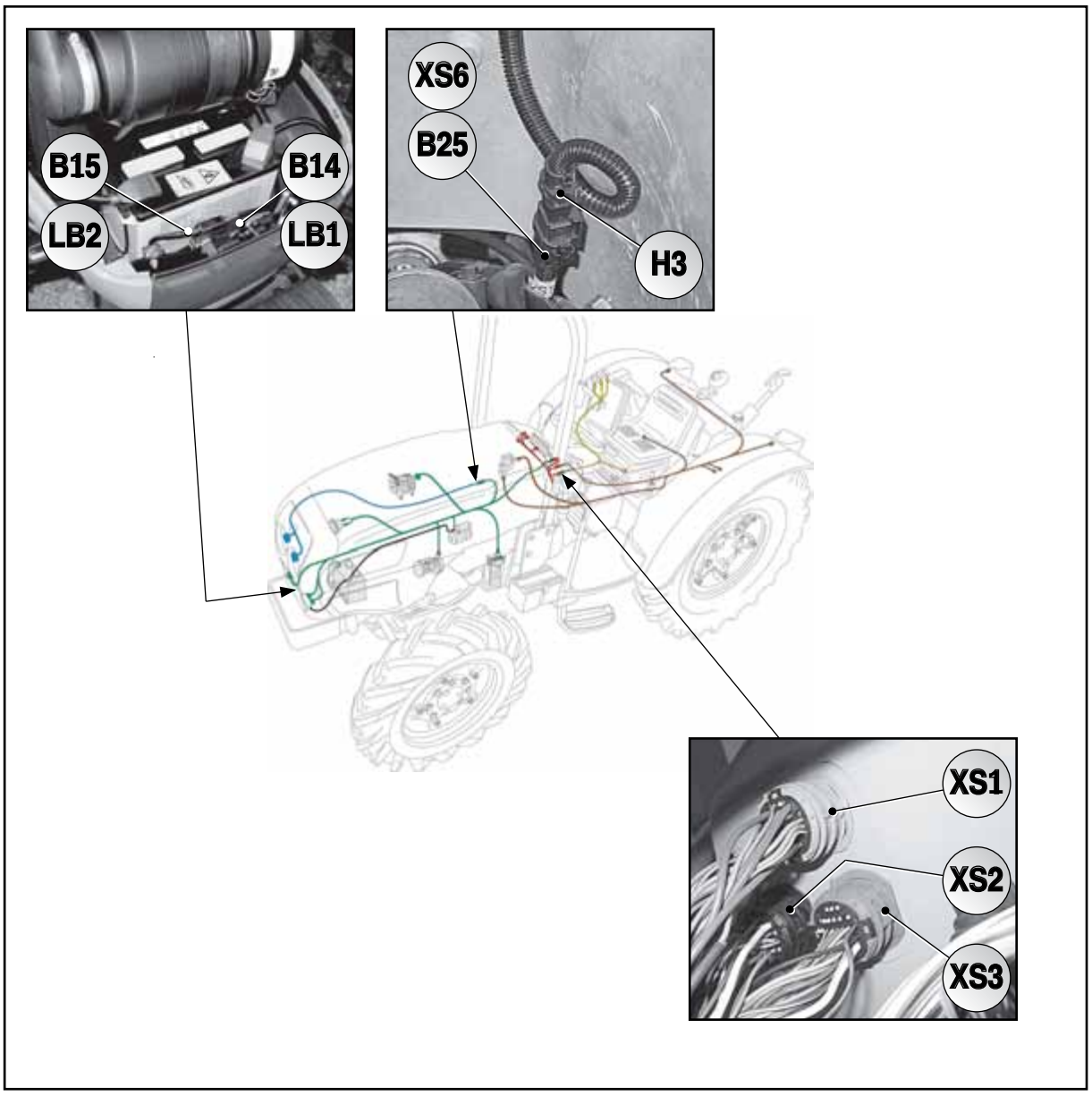


Fig. 10.13

a - Front line / battery line junction (B14/B15)
b - Dashboard line / front line junction (XS1)
- Dashboard line/rear line junction (XS2)
- Dashboard line / platform line junction (XS3)
c - Front line / headlight line junction (B25/H3)

Power Shuttle footstep version tractors

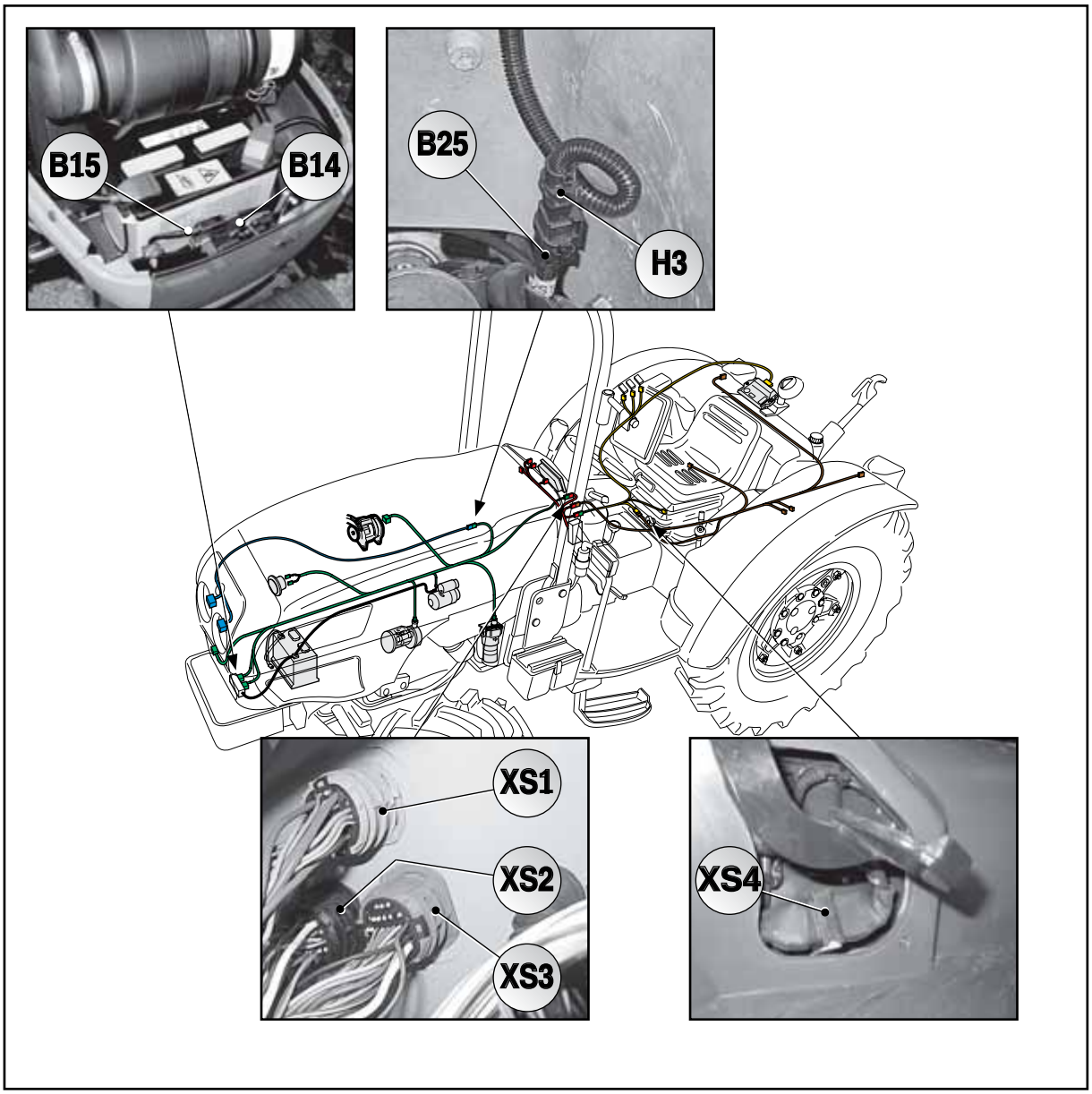


Fig. 10.14

a - Front line / battery line junction (B14/B15)
b - Dashboard line / front line junction (XS1)
- Dashboard line/rear line junction (XS2)
- Dashboard line / platform line junction (XS3)
c - Platform line / rear line junction (XS4)
d - Front line / headlight line junction (B25/H3)

Speed Five and E-Line cab version tractors

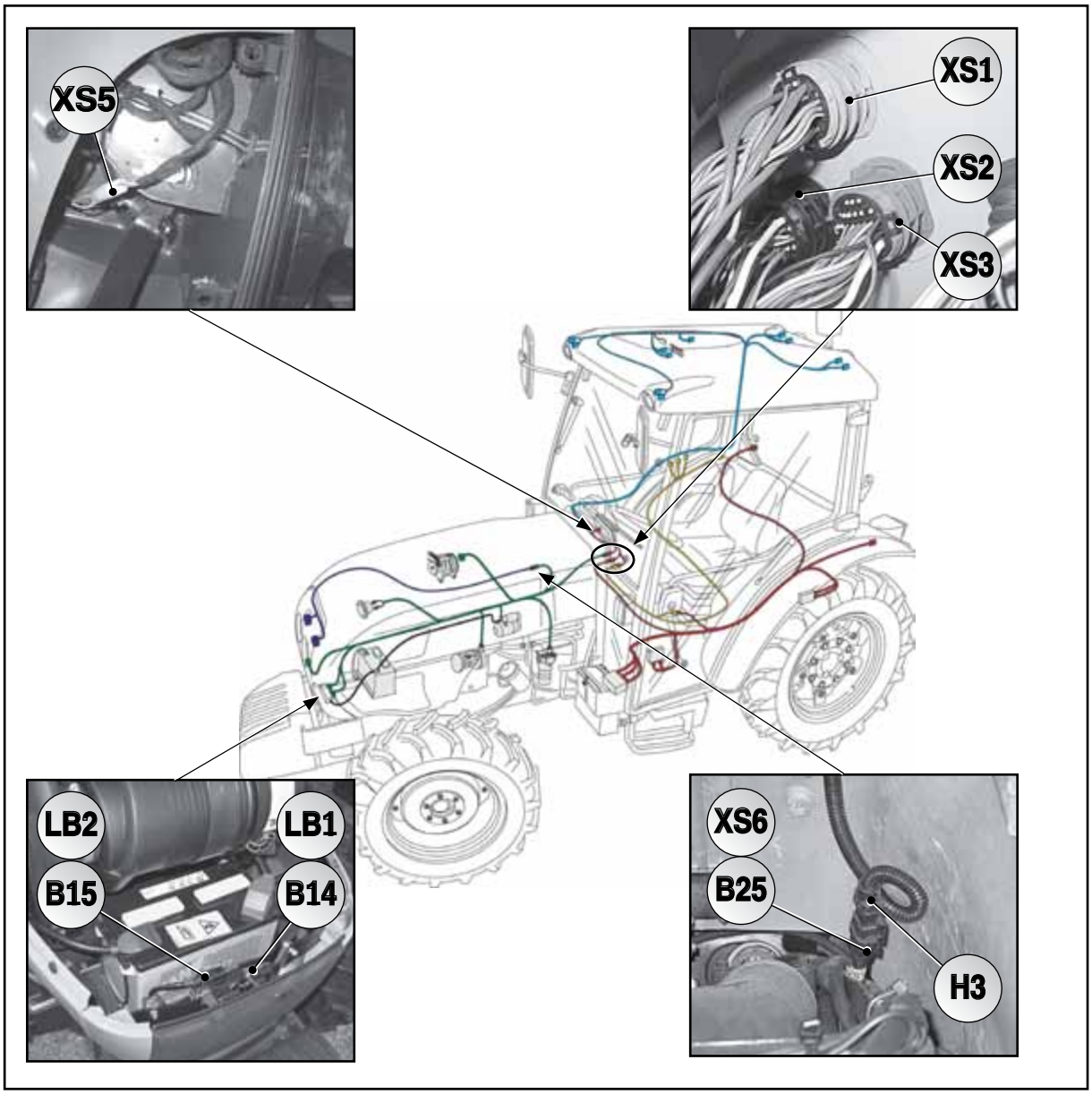


Fig. 10.15

a - Dashboard line/roof line junction (XS5)
b - Front line / battery line junction (B14/B15 Speed Five versions; LB1/LB2 E-Line versions)
c - Front line / headlight extension line junction (B25-XS6-H3)
d - Dashboard line / front line junction (XS1)
- Dashboard line/rear line junction (XS2)
- Dashboard line / platform line junction (XS3)

Power Shuttle cab version tractors

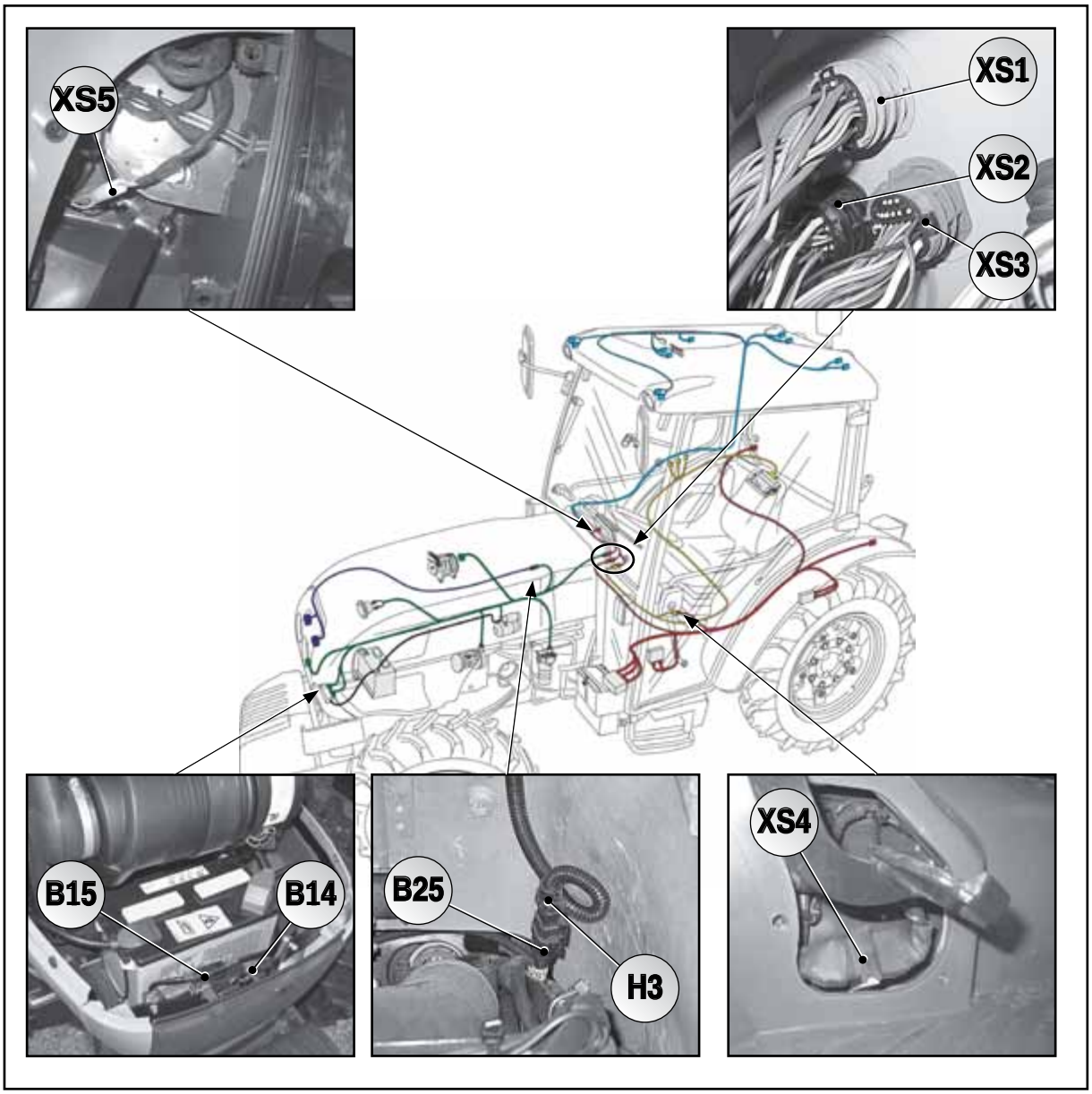


Fig. 10.16

a - Dashboard line/roof line junction (XS5)
b - Front line / battery line junction (B14/B15)
c - Front line / headlight line junction (B25/H3)
d - Platform line / rear line junction (XS4)
e - Dashboard line / front line junction (XS1)
- Dashboard line/rear line junction (XS2)
- Dashboard line / platform line junction (XS3)

3.5 NAO KIT cable line

This line is used for connecting the light switch in tractors for the NAO market. Thanks to connection to a dedicated box (K4) that houses mini-relays, the light switch functions vary in compliance with the standards in force in NAO markets.

The mini-relay box is installed under the dashboard cover, near the instrument.

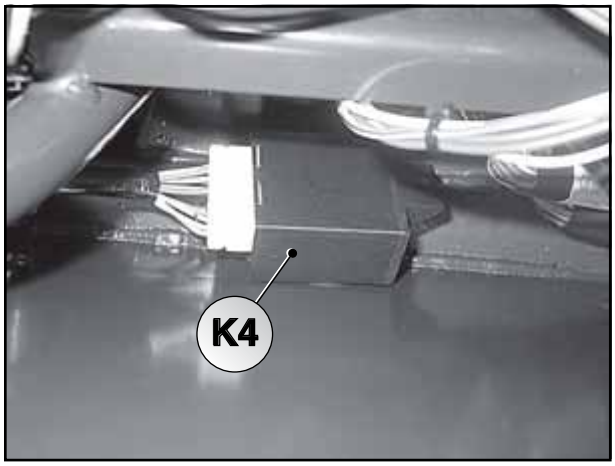


Fig. 10.17

Mini-relay connections

	K1	K4
B	1	ground
	2	not used
BN	3	blinker signal
	4	not used
LR	5	key-positive (+12V)
V	6	Rh turn indicator (light switch)
G	7	lh turn indicator (light switch)
G	8	hazard light switch (lh)
G	9	lh turn indicators
	10	not used
GR	11	lh suppl. headlight
V	12	hazard light switch (rh)
V	13	rh turn indicators
	14	not used
VR	15	rh suppl. headlight
	16	not used
	17	not used
	18	not used
	19	not used
	20	not used

Wiring

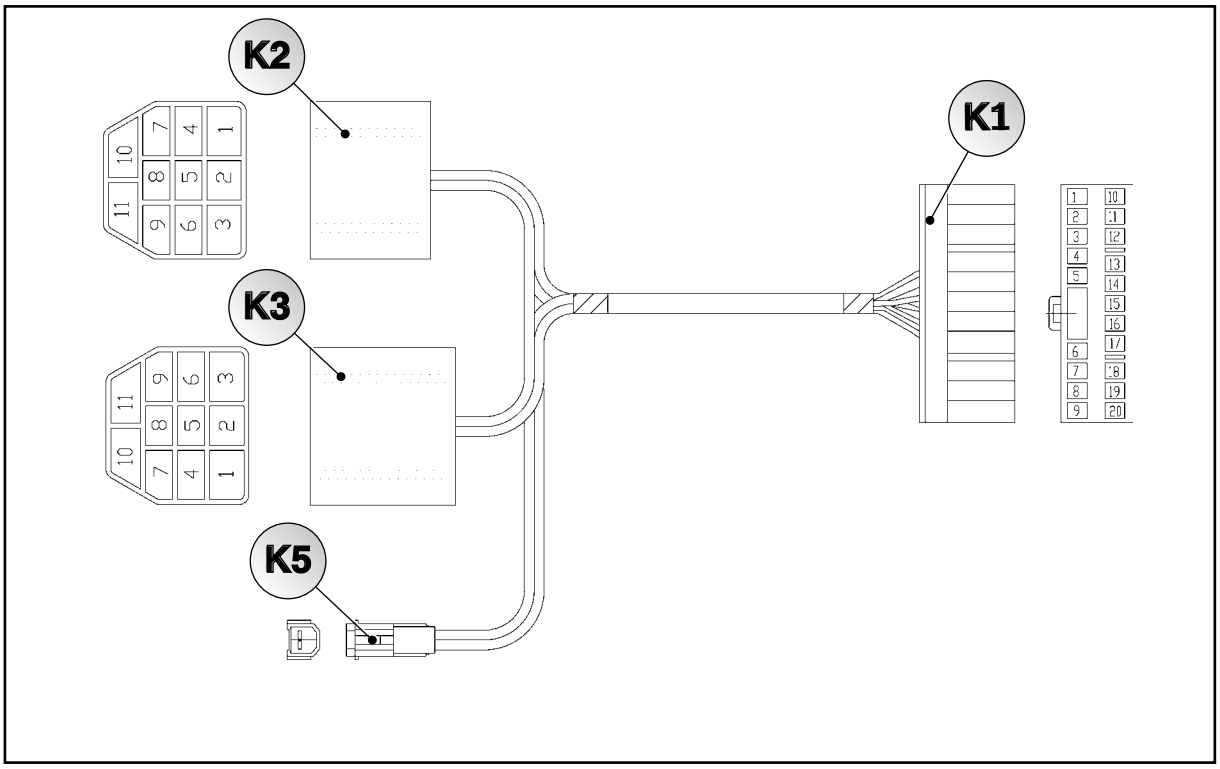


Fig. 10.18

K1 - Connector for the mini-relay box (K4) connections
K2-K3 - Connector for the dashboard line and light switch
XS5 - Connector for NAO supplementary indicators

Multiple wiring diagram

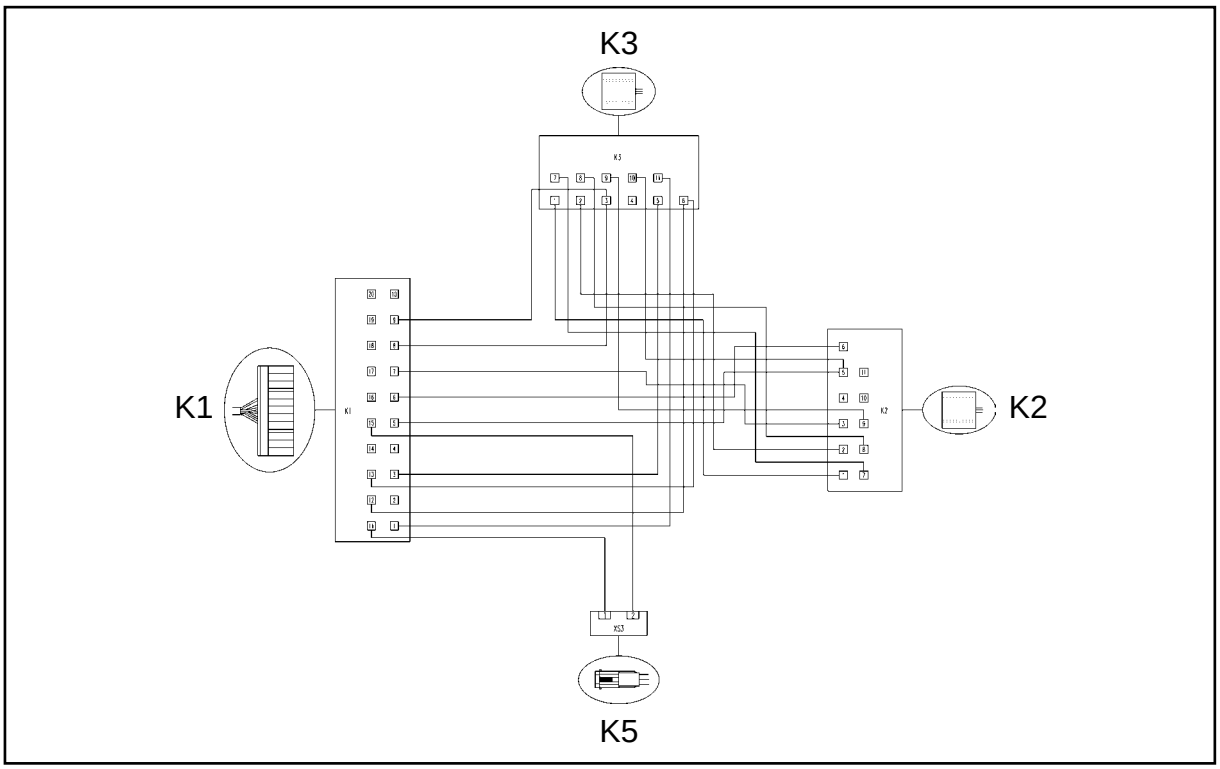


Fig. 10.19

3.6 F-N Series Speed Five footstep

3.6.1 Technical specifications

3.6.1.1 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
gen.	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Alternator

Make	Ix
Type	Threephase
Voltage	14 V
Current	65 A

Starter motor

Manufacturer	Ix - Dsx
Type	Solenoidal
Maximum power	2.8 kW
Type of engagement	Automatic pinion engagement by means of electro-magnet.

Solenoid valves

Manufacturer	Srx Dx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 Ω ±5%

Sensors

Manufacturer	Jx/Stx
Type	Inductive

Instrument

Make	Jx

3.6.1.2 Relays and fuse holders

The electrical system of **F-N Series** tractors is protected against short-circuits and excessive power draw by means of fuses. The number of fuses installed in the electrical system depends on the components and functions that need protecting.

The fuses are installed in two dedicated boxes:

Z - front fuse box (Fig.10.20) installed at the front, near the battery that powers the system. It contains a further fuse (FU5) that protects the preheater relay.

B - main fuse box (Fig.10.21) installed on the left-hand side of the dashboard cover.

Note: before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

There are 11 relays installed in **F-N Series Speed Five footstep** tractors, of which 10 are installed in the front fuse box (B), just under the protection fuses (Fig.10.21) and 1 is installed at the front, near the fuse box (Z).

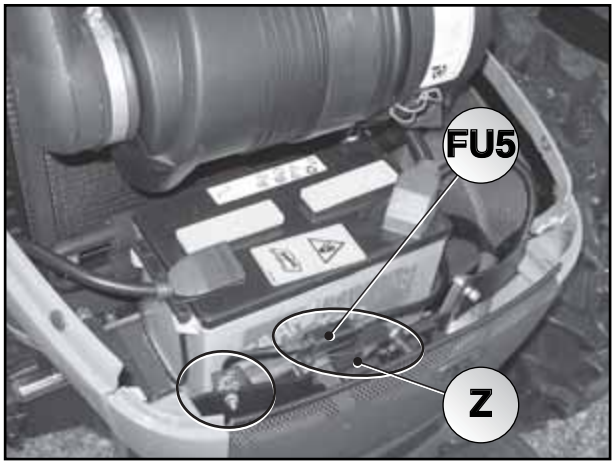


Fig. 10.20

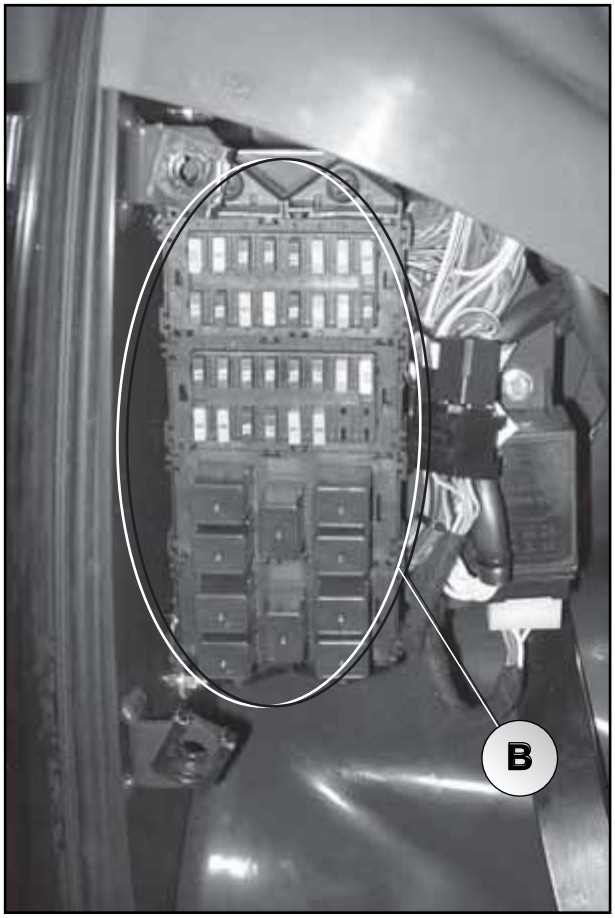


Fig. 10.21

Z- Front fuse box

The front fuses are installed in the “battery-starter motor line” wiring. They are connected by means of the positive terminal (A1) to the battery (GB1) on the one side and on the other side, to the front engine line, by means of connectors (B14 and B15) (Fig.10.22).

Turn the ignition key to the 2nd position to activate the power relay (K16), which transmits the signal for preheating the plate in contact with the glow plugs. The relay (K16) cuts out the electrical signal after 5 seconds in this position have elapsed. The relative indicator light (A Fig.10.23) on the display of the instrument goes out, indicating that the tractor engine can now be started.

The front fuses have the following functions and ampere ratings (Fig.10.24):

Fuse	Circuits protected	Amp.
FU1	Primary	60
FU2	Alternator primary	70
FU3	Primary	60
FU4	Primary	60

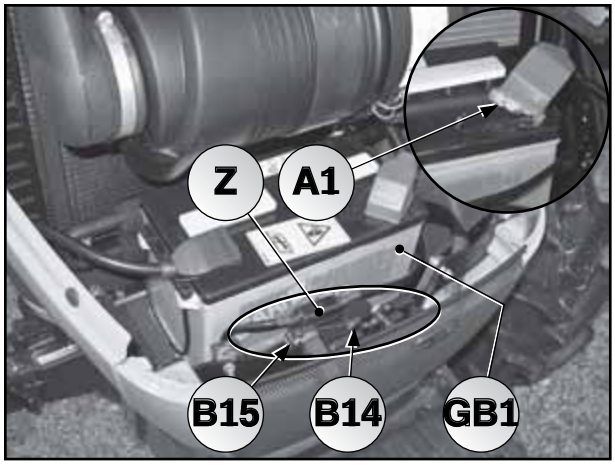


Fig. 10.22

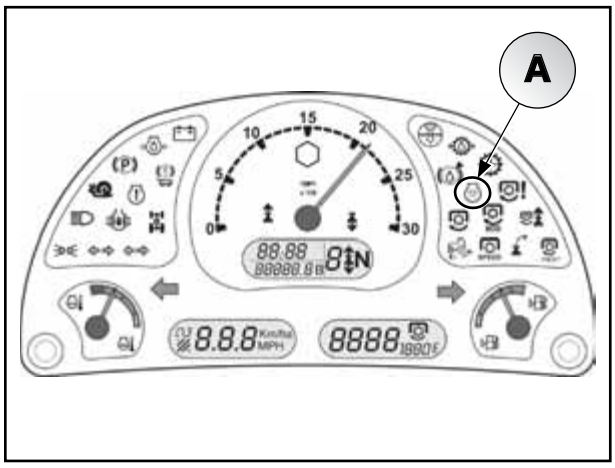


Fig. 10.23

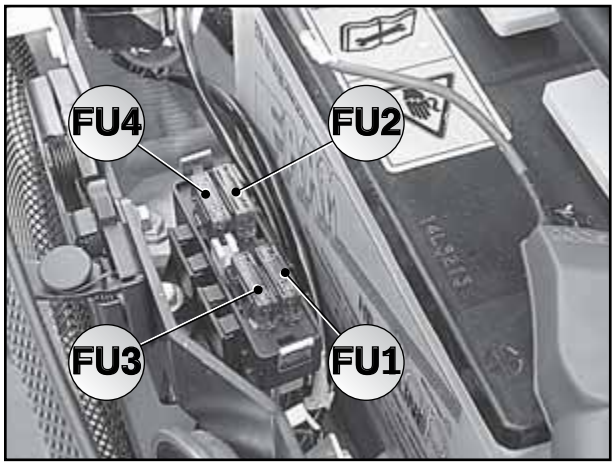


Fig. 10.24

The front line is also fitted with a further fuse (FU5 Fig.10.25) for protecting the glow plug pre-heater system.

Fuse	Circuits protected	Amp.
FU5	Glow plugs	50

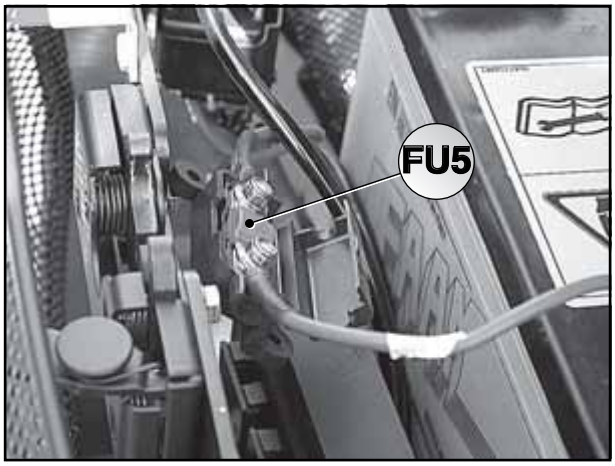


Fig. 10.25

B - Main fuse box

The main fuses are installed in the dashboard wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
F1	Rear PTO	7.5
F2	Auxiliary relays	5
F5	Key-activated Instrument	5
F6	Fuel pump	7.5
F7	4WD solenoid valve	5
F8	Brake light switch	7.5
F9	Diff lock solenoid valve	7.5
F10	Dipped beams	15
F11	Driving beams	15
F12	Blinker	10
F13	Lh side lights	7.5
F14	Rh side lights	7.5
F15	Light switch	10
F16	Electronic power lift (Indicator D+)	5
F17	Electronic power lift (Key-activated positive)	5
F18	Diff lock and brake light controls	15
F20	Starter motor	15
F21	Rear field lights	7.5
F22	Instrument and buzzer power	5
F24	Flow selector (A-B)	5
F25	Auxiliary socket (key-activated power)	15
F26	Auxiliary socket (key-activated power)	20
F27	Horn + revolving beacon	15
F29	Cab	5
F30	Pneumatic seat	15
F36	Emergency switch	15
F39	NAO KIT positive	7.5

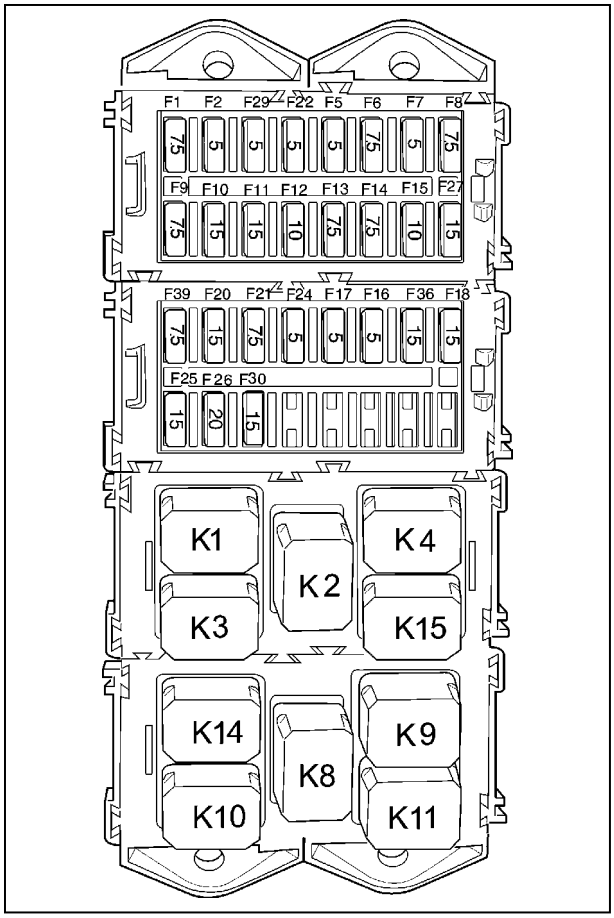


Fig. 10.26

Relays	Function
K1	Immobiliser relay
K2	Relay for socket + pneumatic seat
K3	Field light relay
K4	Brake light and instrument relay
K8	Differential lock relay
K9	Driving beam relay
K10	Dipped beam relay
K11	Headlight relay
K14	Relay for diff lock release + rear brake lights
K15	Start-inhibiting relay for engaged rear PTO
K16	Power relay (glow plug preheater) (Fig.10.27).

Fig. 10.27

identification of the components in the functional diagram

Code	Description	Part	Col.
A01	Instrument	4	3
B01	Alternator	1	7
D01	Blinker	2	4
EH1	Glow plugs	1	7
EL2	Footstep revolving beacon light	4	5
EL9	Platform rear field light	4	6
EL13	License plate light	2	5
EL14	Rh headlight	1	8
EL15	Lh headlight	1	8
F1	Front PTO/safety fuse	1	4
F2	Auxiliary relay fuse	1	1
F3	Cab auxiliary relay fuse	1	2
F5	Key-activated fuse for instrument	4	1
F6	Injection-fuel pump fuse	1	2
F7	4WD fuse	1	5
F8	Brake light indicator fuse	2	3
F9	Diff lock fuse	2	3
F10	Dipped beam fuse	1	7
F11	Driving beam fuse	1	7
F12	Blinker fuse	2	4
F13	Side light fuse	2	6
F14	Side light fuse	2	6
F15	General side light fuse	2	6
F16	El. power lift fuse (alternator D+ positive)	1	1
F17	El. power lift fuse (key-activated positive)	1	1
F18	Fuse for diff lock controls and brake lights	2	1
F20	Starter motor fuse	1	7
F21	Rear field light fuse	4	2
F22	Fuse for instrument and buzzer power	4	2
F24	A-B control valve fuse	1	5
F25	Auxiliary socket fuse 25A	4	4
F26	Auxiliary socket fuse 25A	4	6
F27	Fuse for horn, rotating beacon	4	3
F30	Pneumatic seat fuse	4	2
F36	Emergency switch fuse (hazard)	2	1
F39	NAO control unit fuse	2	5
FU1	Link-box primary fuse	1	1
FU2	Link-box alternator primary fuse	1	1
FU3	Link-box primary fuse	2	3
FU4	Link-box primary fuse	4	6
FU5	Glow plug fuse (steering wheel midival)	1	1
GB1	Battery	1	1
HA1	Horn	4	5
HA2	Alarm buzzer	4	5
HL1	Rh front turn indicator	2	5
HL2	Rh rear turn indicator	2	5
HL3	Lh front turn indicator	2	5
HL4	Lh rear turn indicator	2	5
HL5	Rh front side light	2	6
HL6	Rh rear side light	2	6
HL7	Lh front side light	2	6
HL8	Lh rear side light	2	6
HL9	Rh brake light indicator	2	3
HL10	Lh brake light indicator	2	4
HL11	Supplementary rh turn indicator (NAO)	2	8
HL12	Supplementary lh turn indicator (NAO)	2	8
K1	Starter motor power relay	1-1	6-4
K2	Power relay for auxiliary socket - pneumatic seat	4-1	2-2
K3	Relay for side lights, brake lights	2-1	3-2
K4	Relay for fuel injection - field light - instrument	4-1	1-2
K8	Diff lock power relay	2-2	2-1
K9	Driving beam power relay	1-2	7-6
K10	Dipped beam power relay	1-2	6-6
K11	Headlight power relay	1-1	6-3
K14	Power relay for diff lock release, brake light indicators	2-2	2-1
K15	Rear PTO safety power relay	1-1	4-3
K16	Glow plug power relay	1-1	6-5
M1	Starter motor	1	6
M5	Pneumatic seat actuator	4	3
M10	Fuel pump motor	1	7
SA00	Main contact key switch	1	1
SA01	Light switch selector	2	5
SA08	Platform revolving beacon commutator	4	1
SA09	Hazard light switch	2	4
SA11	4WD commutator	1	5
SA15	Side lights and dipped beams commutator	2	7
SB08	Differential lock button	2	1
SB09	Auxiliary control valve button	1	5

SL1	Fuel level sensor	4	7
SL2	Brake fluid level sensor	4	7
SL3	Supplementary fuel tank level sensor	4	8
SP2	Hydraulic trailer brake pressure switch	4	5
SP3	Gearbox oil intake vacuum switch	4	6
SP4	Engine oil pressure switch	4	4
SP5	Air intake circuit vacuum switch	4	4
SP8	Brake pump pressure switch (brake-diff lock)	2	1
SQ4	Hand brake lever microswitch	4	7
SQ6	540 rear PTO microswitch	4	6
SQ7	750-1000 rear PTO microswitch	4	6
SQ8	Synchronized rear PTO microswitch	4	5
SQ18	PTO engaged microswitch	1	3
SQ19	Safety microswitch on gearshift lever	1	4
SR1	Ground speed sensor	4	5
SR5	Rear PTO rate sensor	4	5
ST6	Engine water temperature sensor	4	4
ST7	Fuel enrichment jet sensor	1	8
YA1	Fuel injection pump solenoid	1	8
YA2	Fuel enrichment jet solenoid	1	7
YV3	Diff lock solenoid valve	2	2
YV4	4WD solenoid valve	1	4
YV10	Auxiliary control valve solenoid valve A	1	4
YV11	Auxiliary control valve solenoid valve B	1	5

Term.boards

XS0	7-pin trailer socket terminal board
XS1	Front wiring line terminal board
XS2	Rear wiring line terminal board
XS3	Platform wiring line terminal board
XS5	Roof wiring line terminal board
XS7	Auxiliary socket terminal board

References to functional diagram

1 - Cab version only
2 - Four-wheel drive indicator
3 - Independent PTO indicator
4 - Glow plug ind.light
5 - Driving beam ind.light
6 - Rate gyroscope
7 - Alternator indicator light
8 - Differential lock indicator
9 - NAO plant (+12V)
11 - Glow plug ind.light
12 - Four-wheel drive
13 - Differential lock
14 - Rear independent PTO
15 - Driving beams
16 - Side lights
17 - Lh turn ind.
18 - Rh turn ind.
19 - 1st trailer direction ind.
20 - 2nd trailer direction ind.
21 - Engine rate ind. from alternator (W)
22 - Alternator indicator light

3.6.2 Main wiring diagram

Part 1

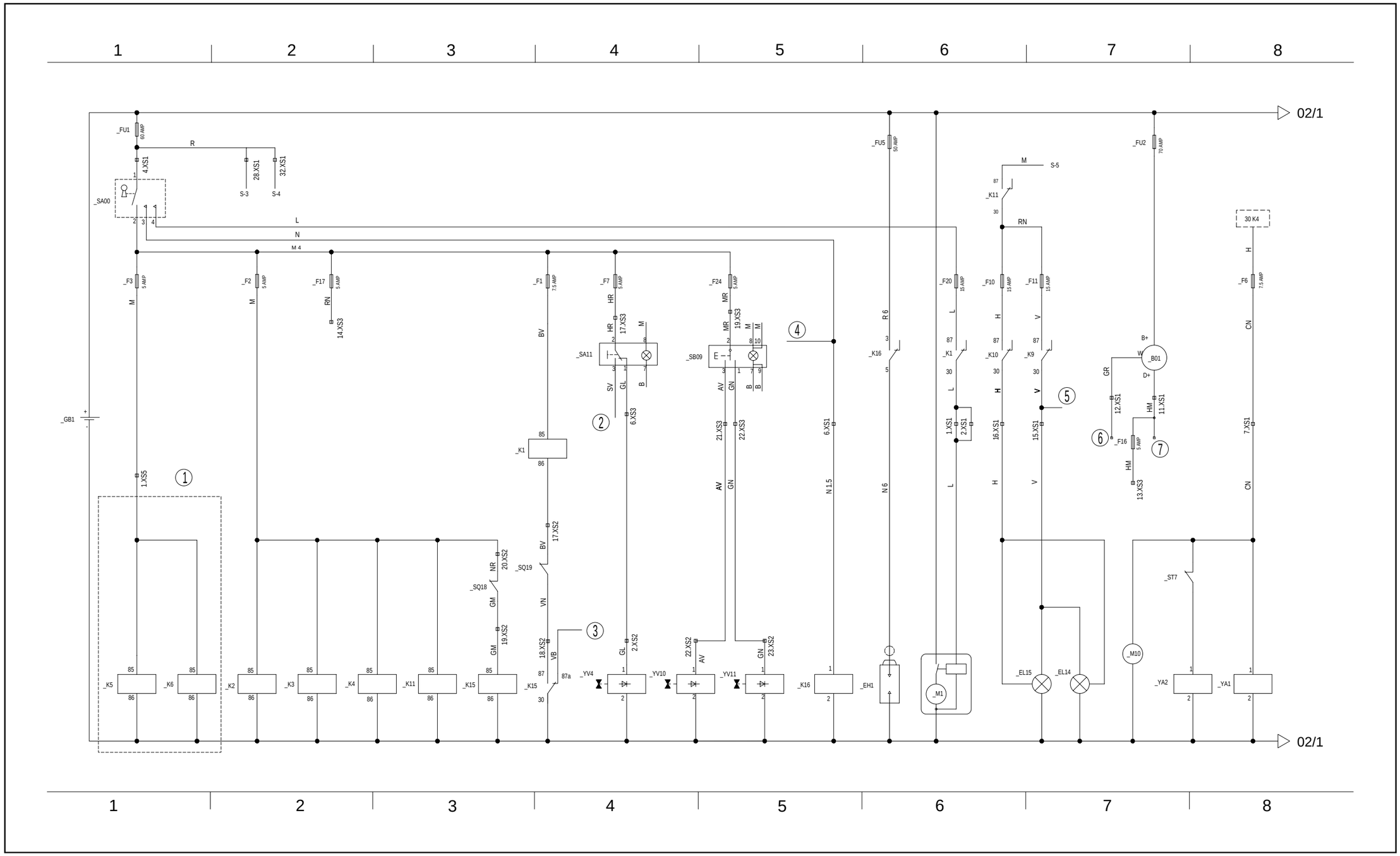


Fig. 10.28

Part 2

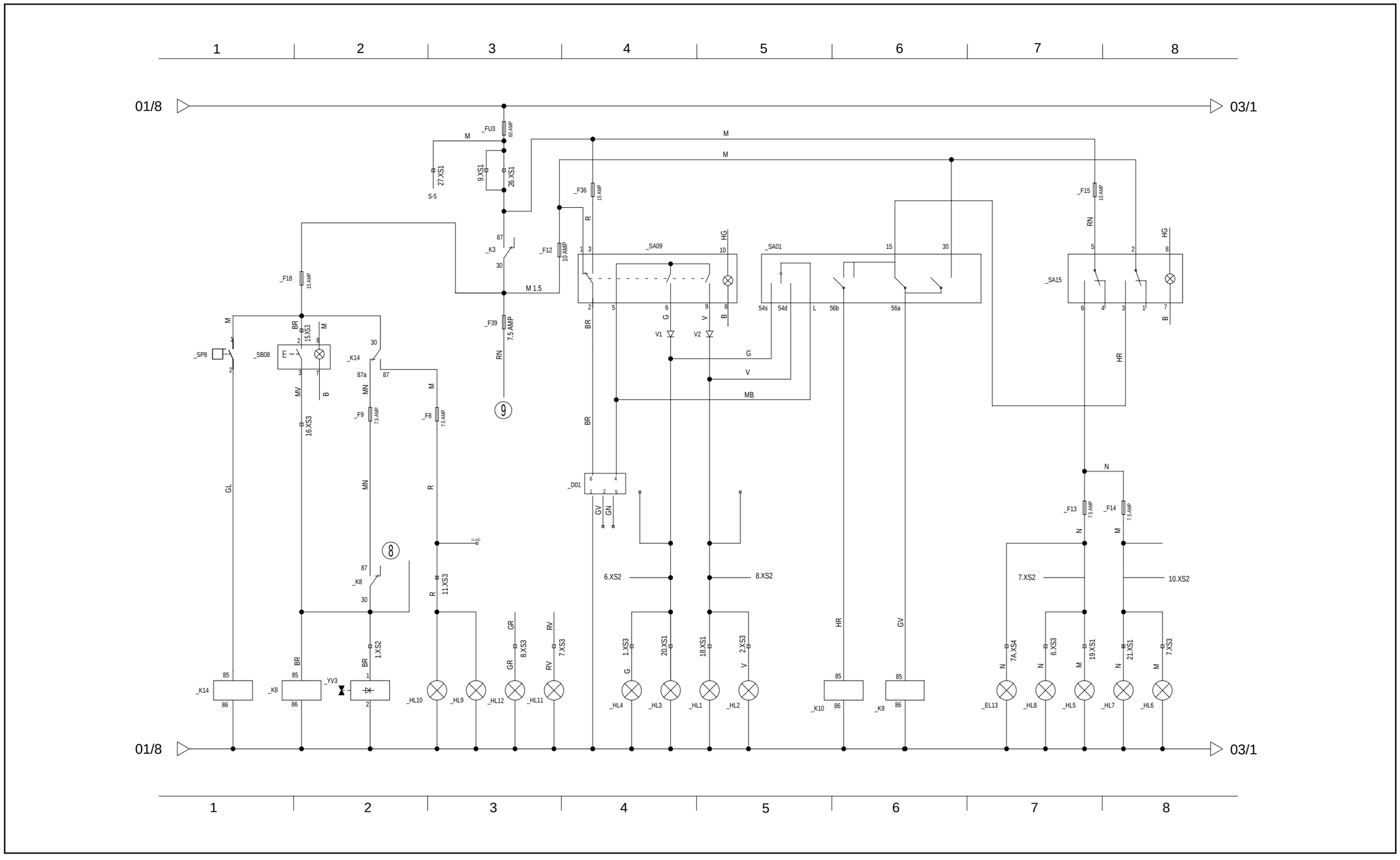


Fig. 10.29

Part 3

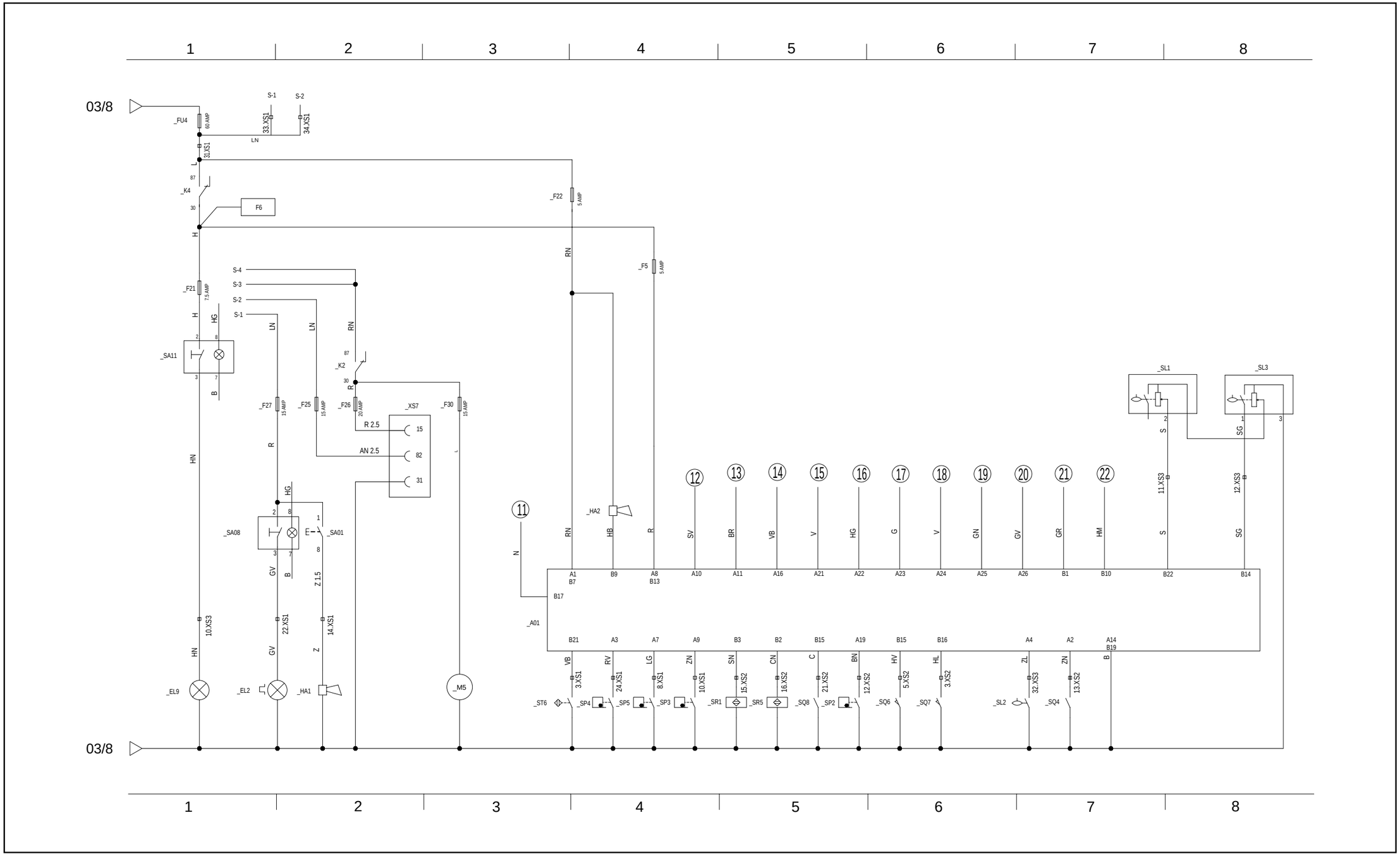


Fig. 10.30

3.6.3 Battery-starter motor line

3.6.3.1 General description

This line is very important for the functionality of the electrical system of the entire tractor. It connects the positive battery pole to the starter motor (M1 Fig.10.31), thus allowing the entire electrical system to be powered, as the ignition switch is connected to the battery.

Connection to the front fuse box is made on the positive battery terminal (Fig.10.32). These fuses protect the tractor's electrical system against short circuits and excessive power draw.

The positive battery terminal is also connected to power fuse (FU5), which protects the preheater relay (K1&) from short-circuits (Fig.10.33).

Battery (GB1) is installed in the front, between the radiator and headlights (Fig.10.33).

⚠	**Attention:** comply with the safety instructions !

⚠	**Attention:** disconnect the ground wire (-) from the battery.

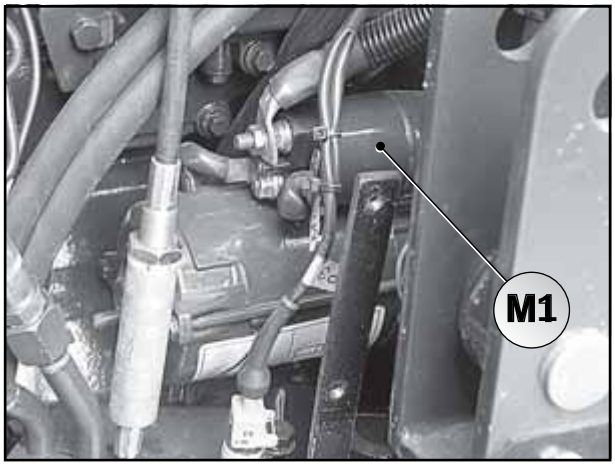


Fig. 10.31

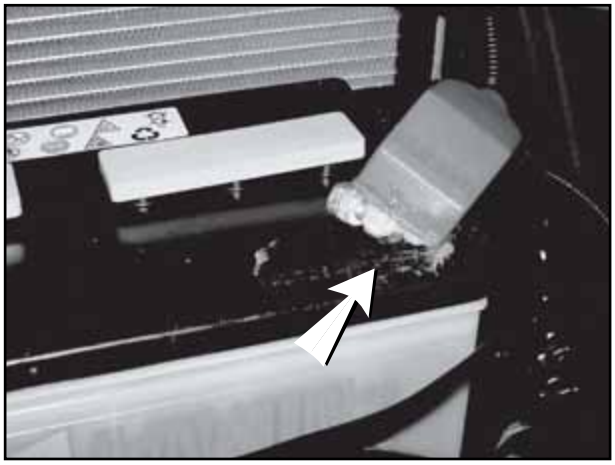


Fig. 10.32

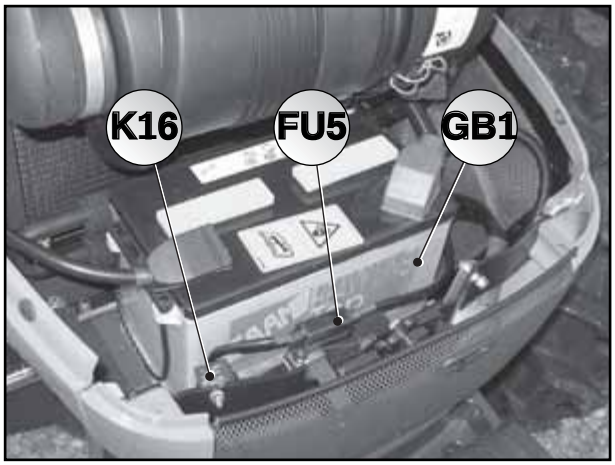


Fig. 10.33

3.6.3.2 Wiring

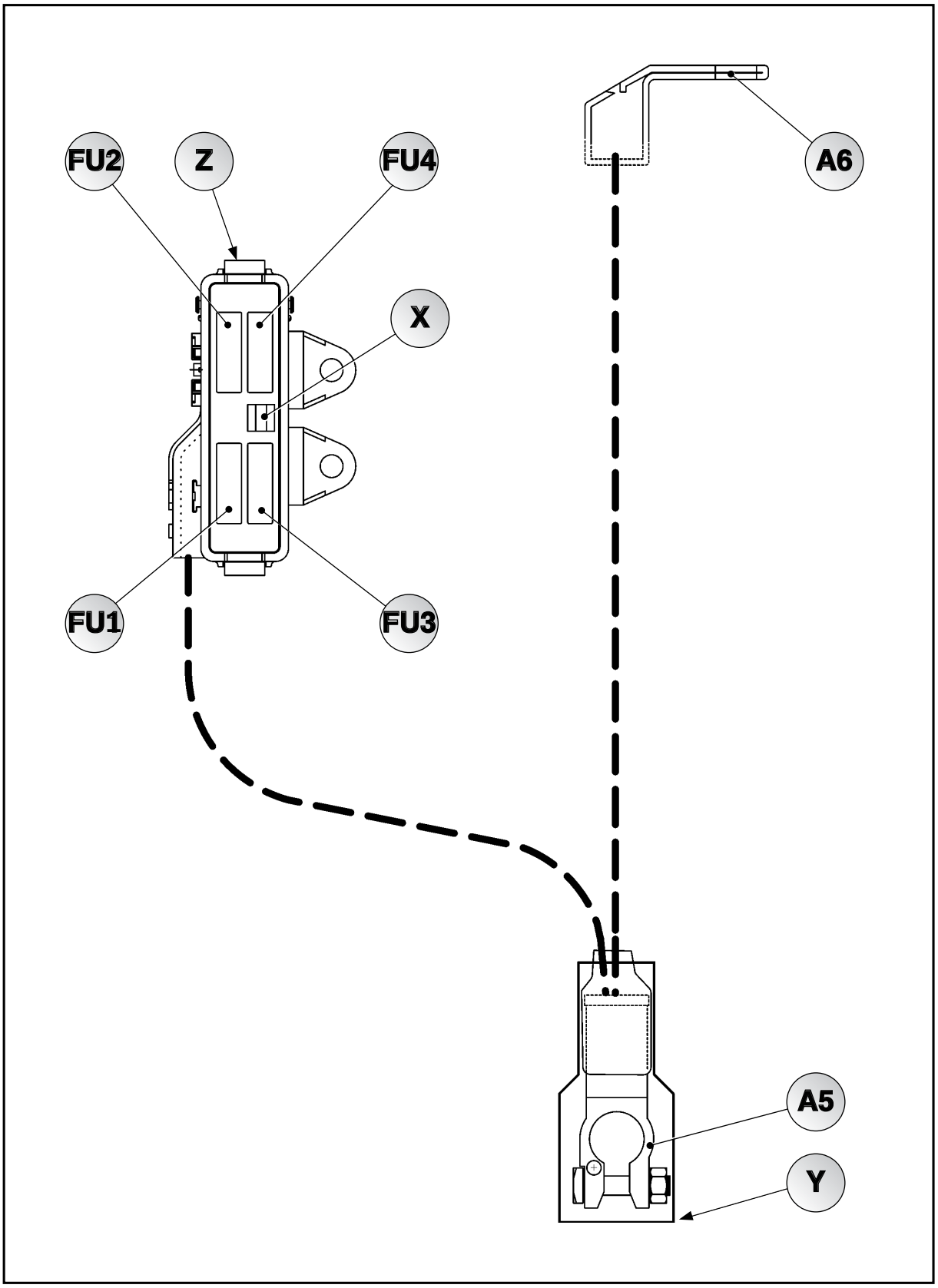


Fig. 10.34

Z - Front fuse box
Y - Insulating cap
X - Pincers for removing fuses
FU1 - 60 Amp. fuse
FU2 - 70 Amp. fuse
FU3 - 60 Amp. fuse
FU4 - 60 Amp. fuse
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal

3.6.3.3 Connector locations

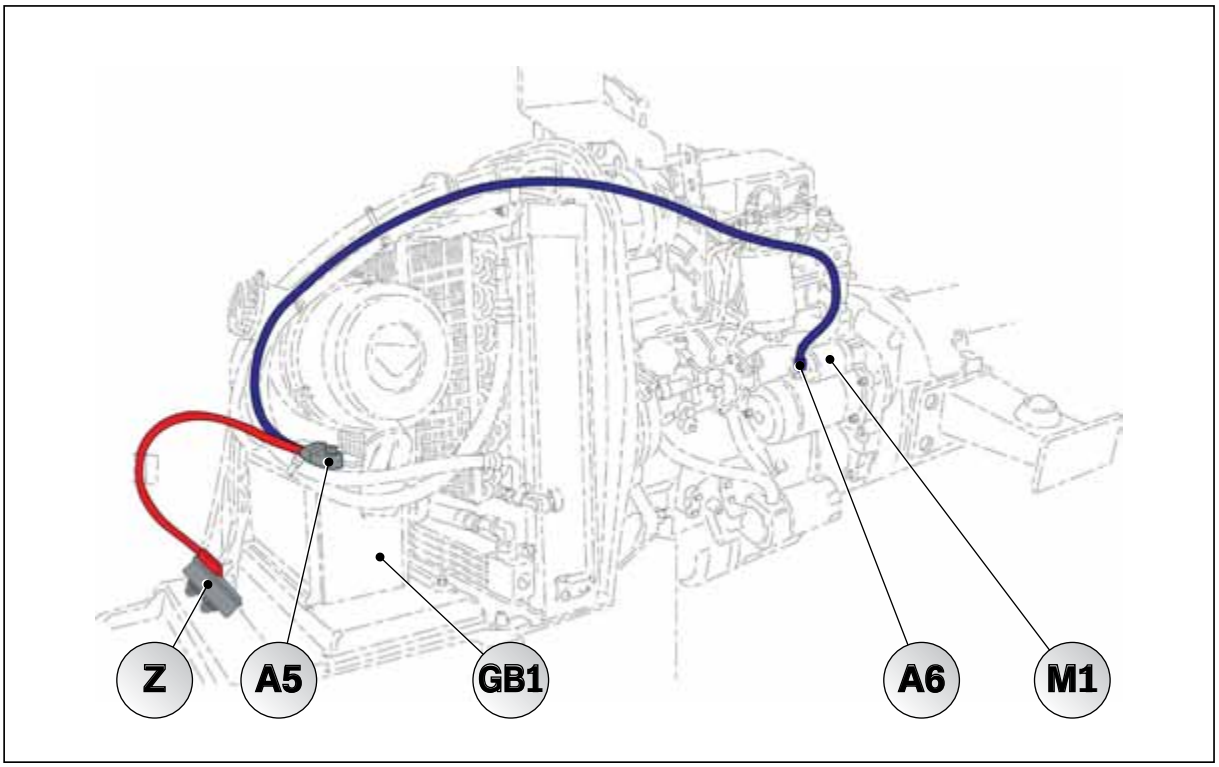


Fig. 10.35

GB1 - Battery
M1 - Starter motor
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal
Z - Front fuse box

The front fuse box (Z) is installed in front of the battery (GB1).

The four fuses inside are important since they protect the tractor's entire electrical system from short-circuits and excessive power draw.

Before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it. (Fig.10.36).

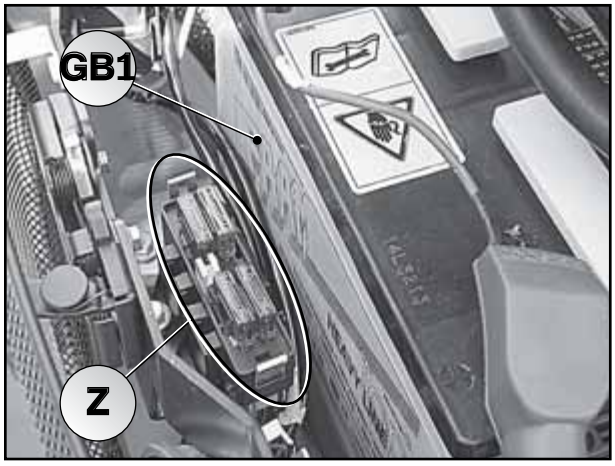


Fig. 10.36

3.6.3.4 Connector identification

Terminal (A6) for starter motor connection

term.	wire colour	To con. or comp.	term.
A	N	M1	

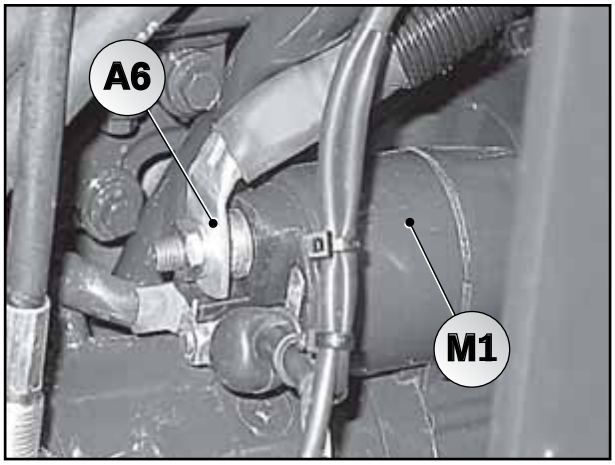


Fig. 10.37

Eyelet (A5) connection to the battery's positive terminal allows the remaining part of the tractor's electrical system to be powered.

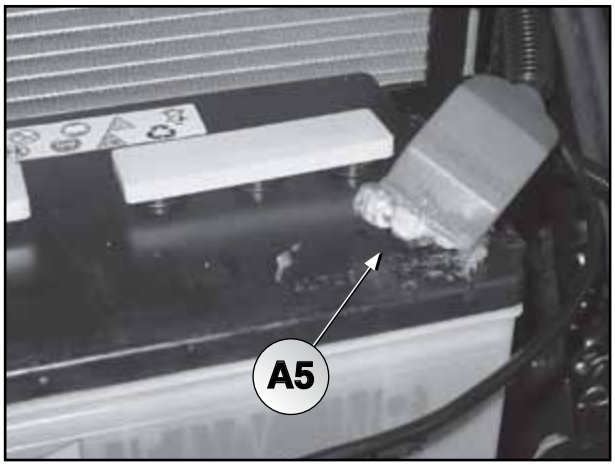


Fig. 10.38

3.6.4 Front engine line (with 3-cylinder engine)

3.6.4.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.39), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.40) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.40) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.41) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.42) installed under the bonnet.

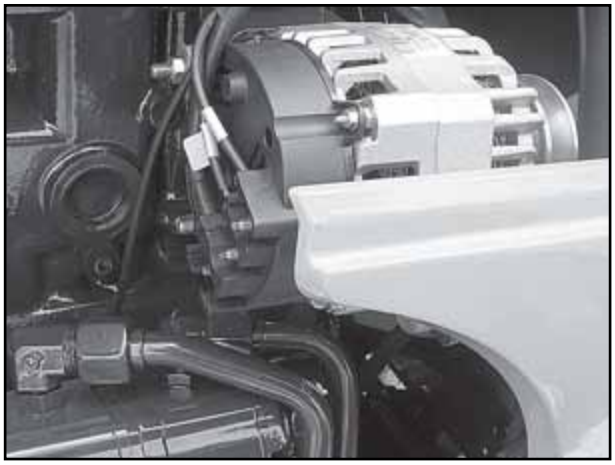


Fig. 10.39

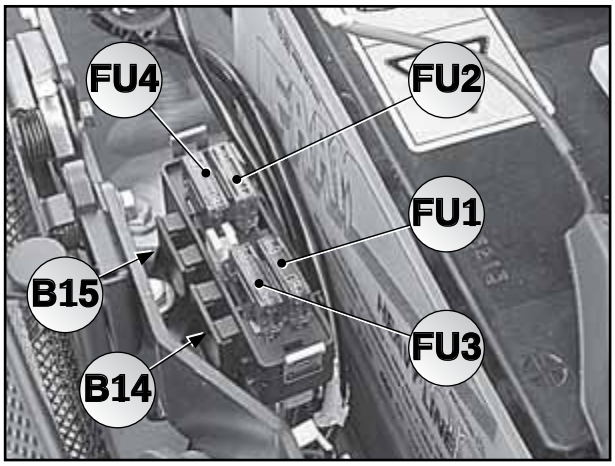


Fig. 10.40

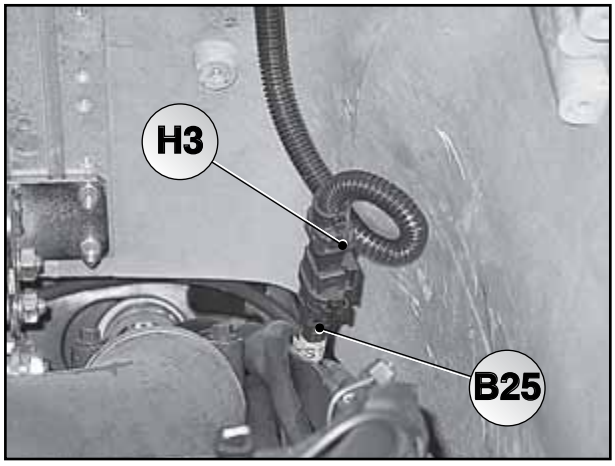


Fig. 10.42

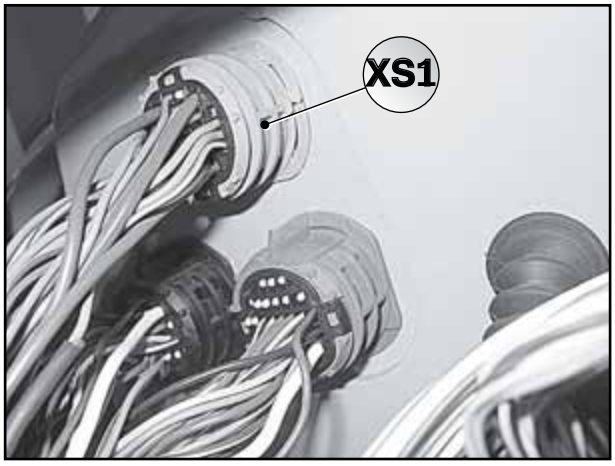


Fig. 10.41

3.6.4.2 Wiring (version with 3-cylinder engine)

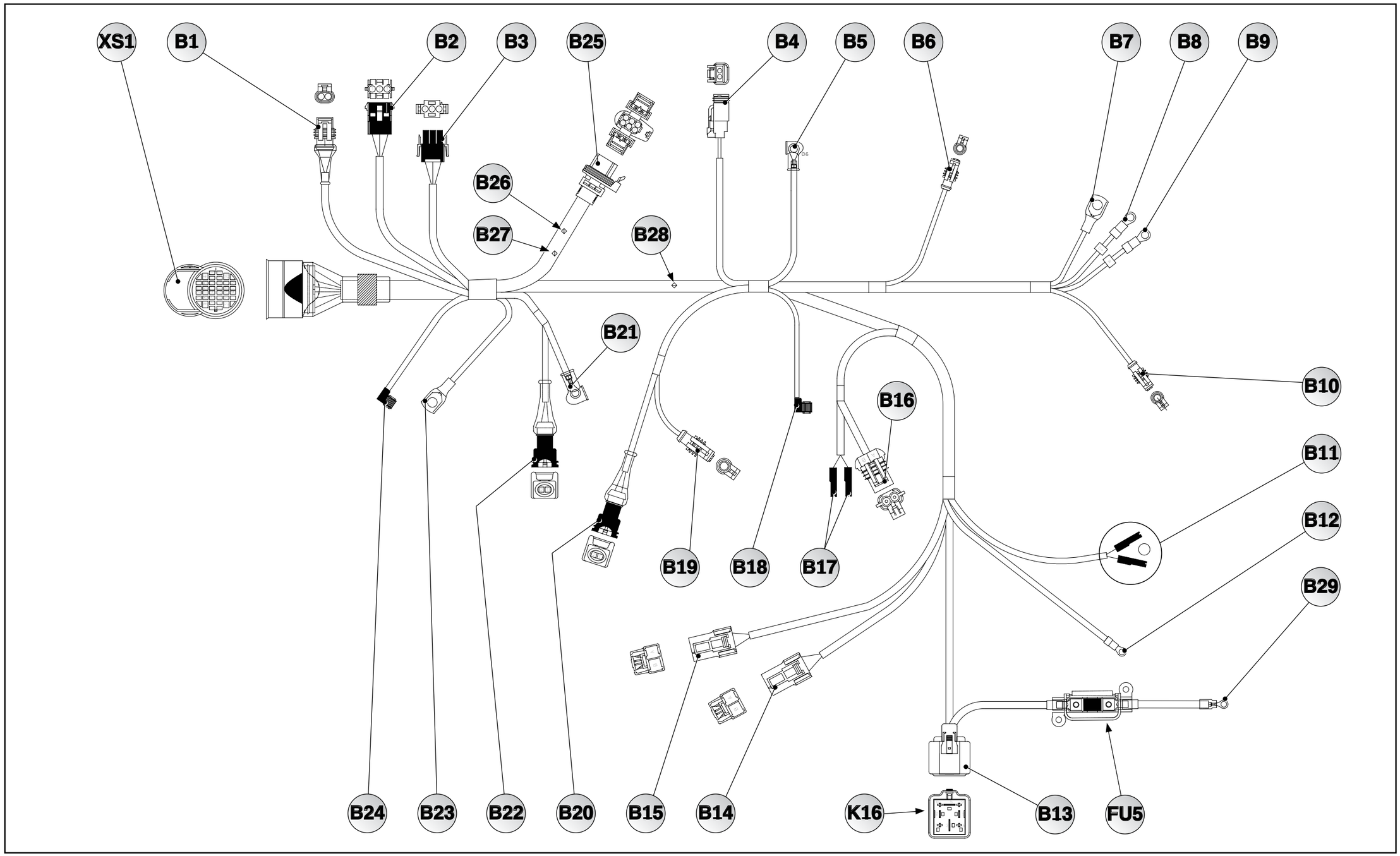


Fig. 10.43

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26 - Junction
B27 - Junction
B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.6.4.3 Connector locations

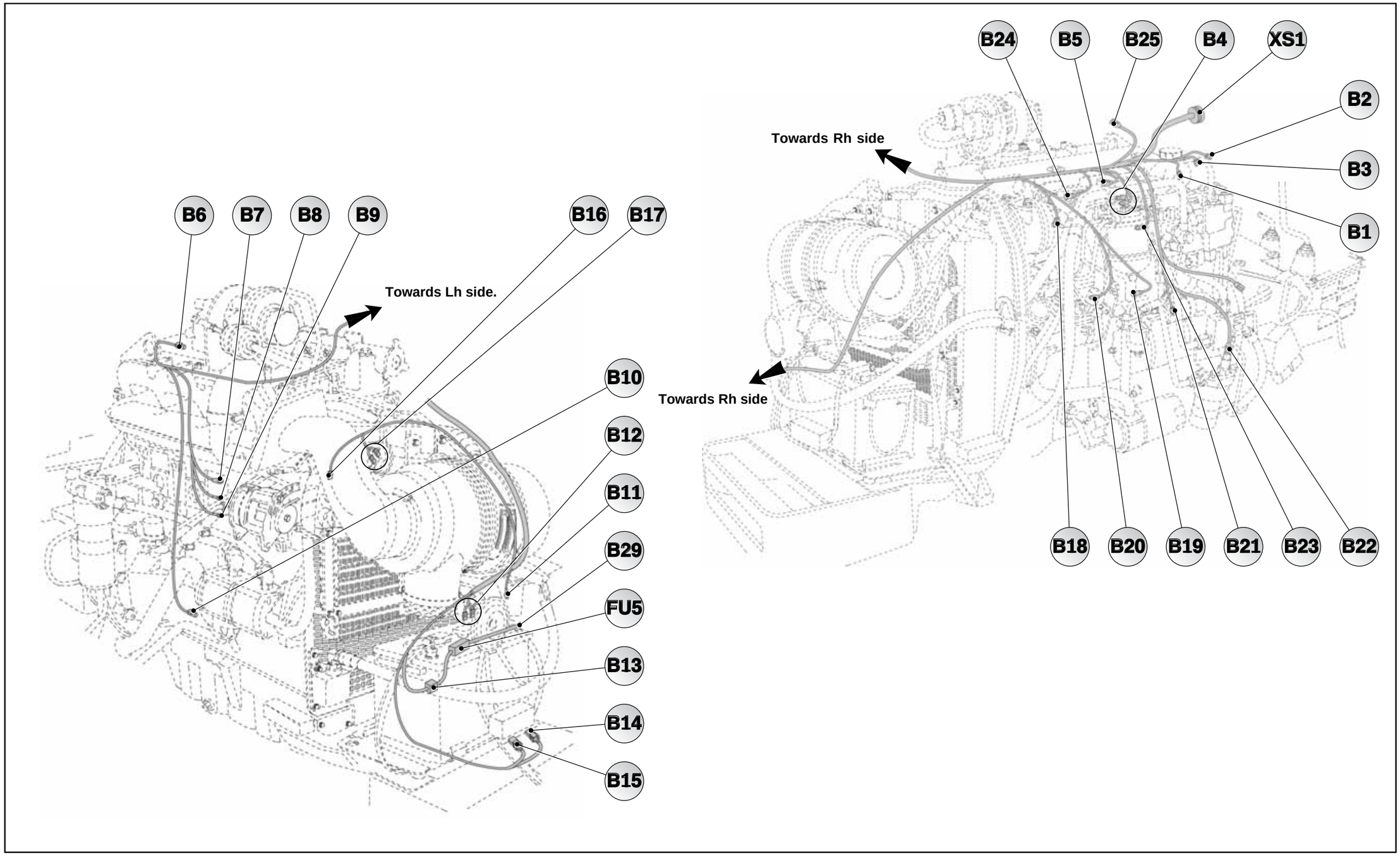


Fig. 10.44

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.6.4.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

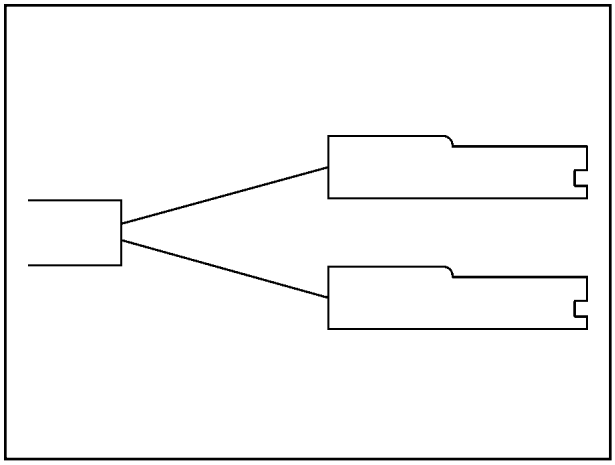


Fig. 10.45

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

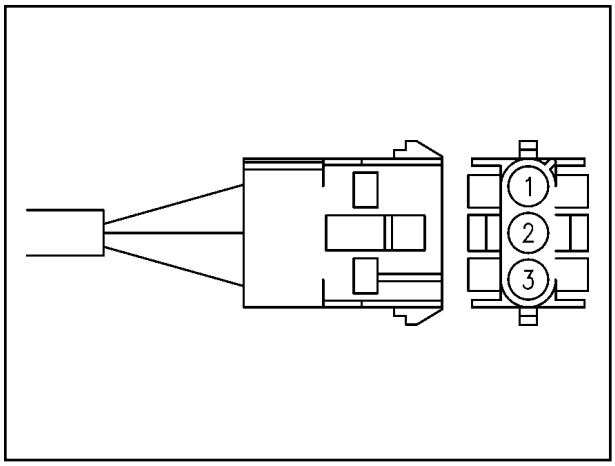


Fig. 10.46

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

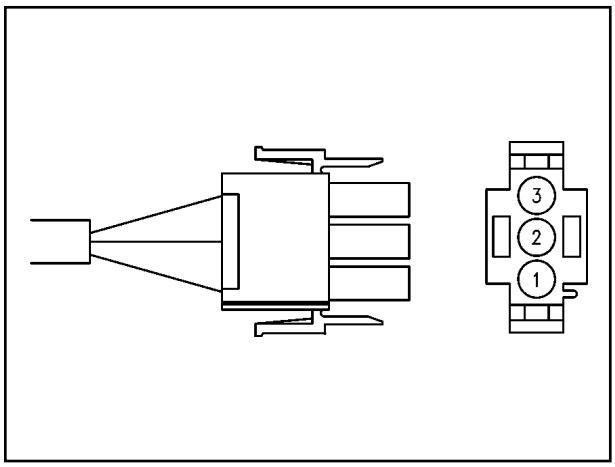


Fig. 10.47

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

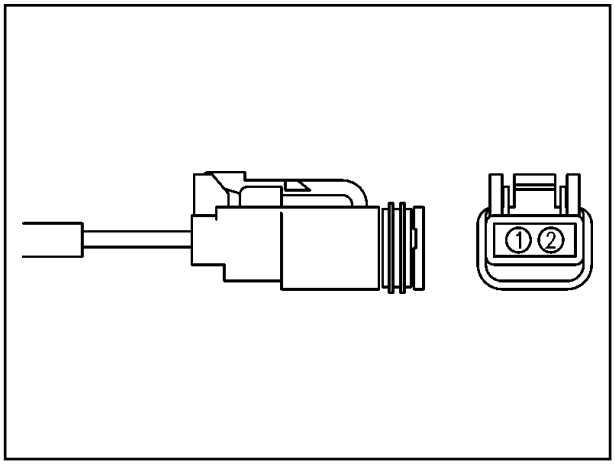


Fig. 10.48

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

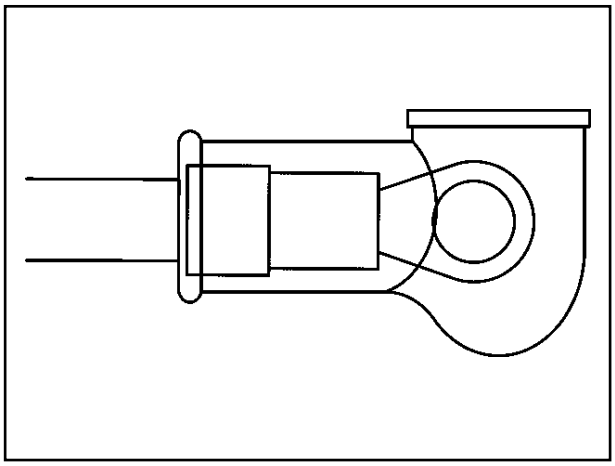


Fig. 10.49

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

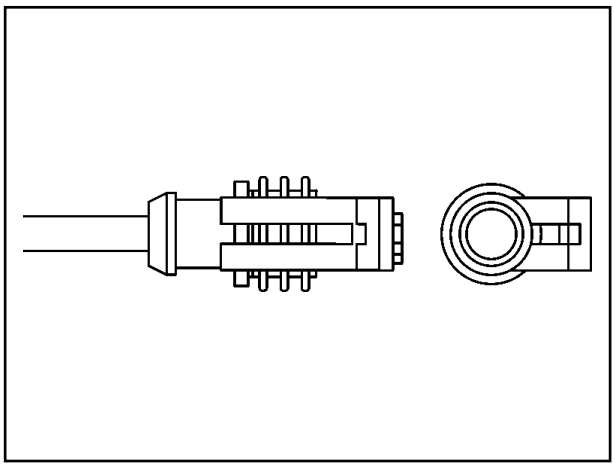


Fig. 10.50

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

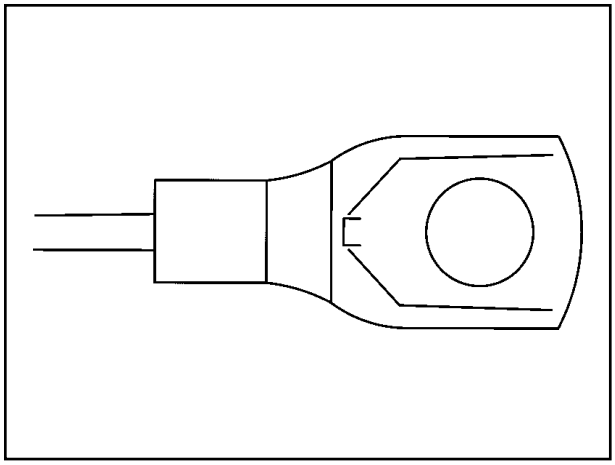


Fig. 10.51

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

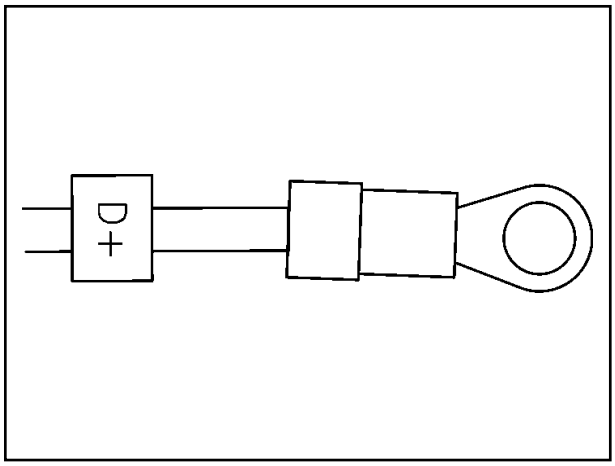


Fig. 10.52

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

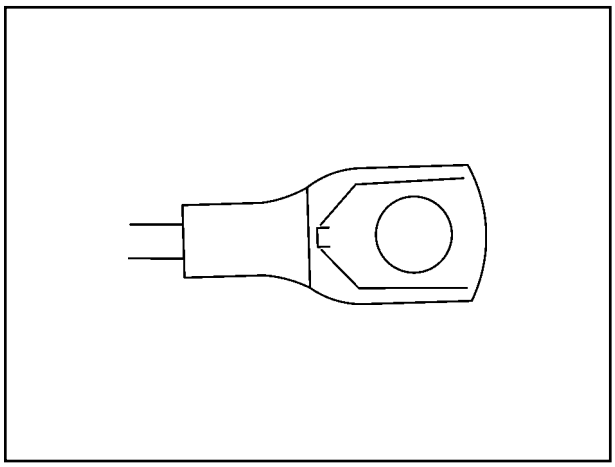


Fig. 10.53

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

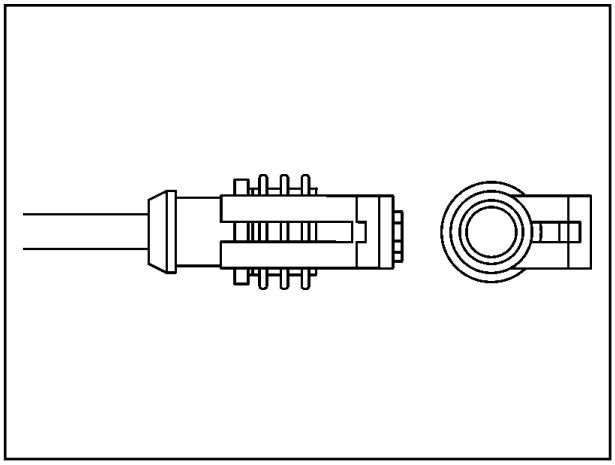


Fig. 10.54

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

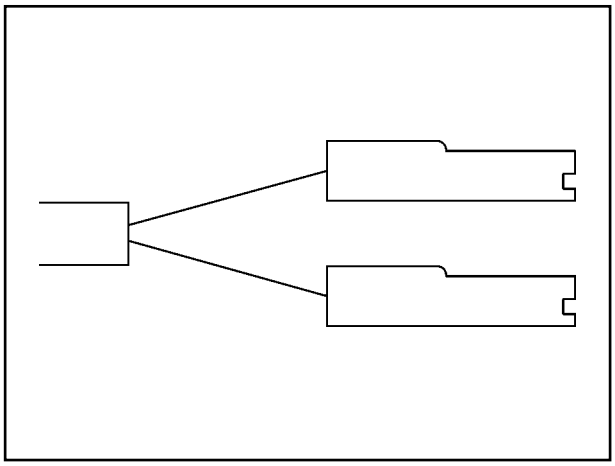


Fig. 10.55

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

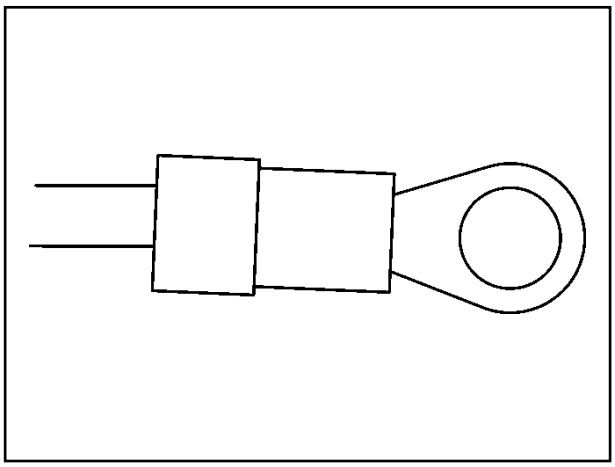


Fig. 10.56

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

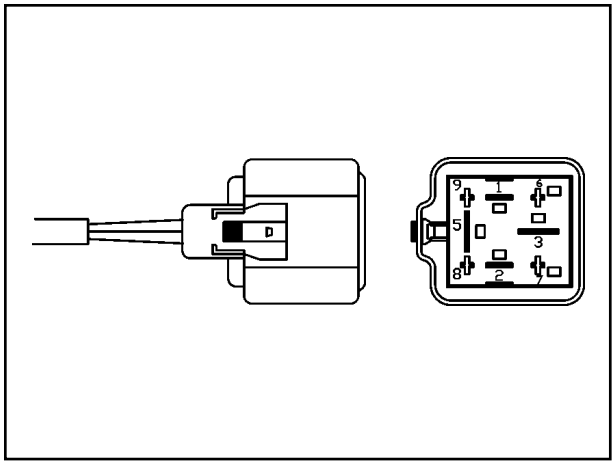


Fig. 10.57

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

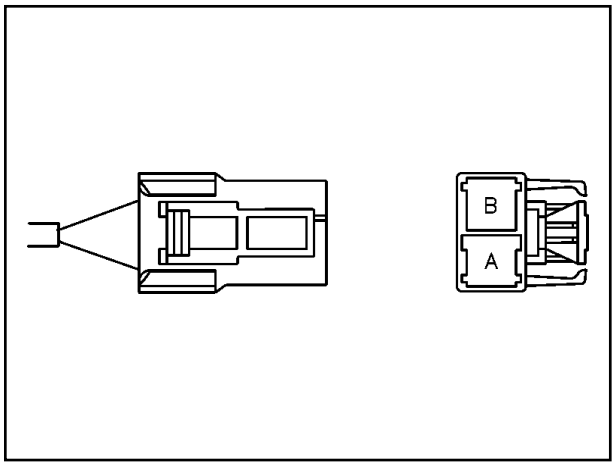


Fig. 10.58

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

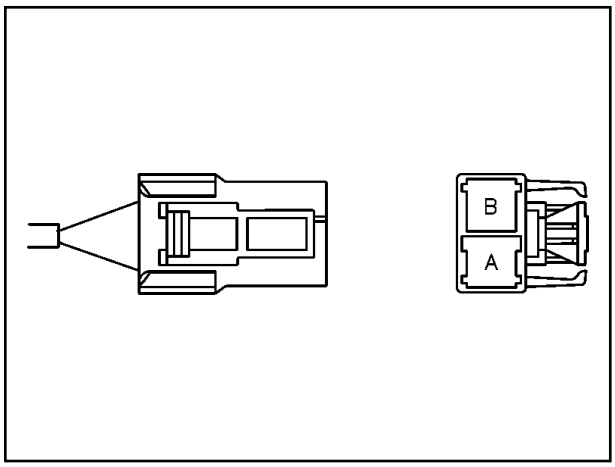


Fig. 10.59

Connector (B16) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

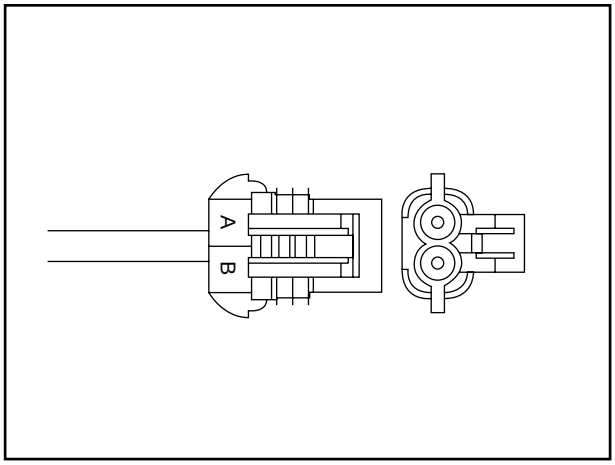


Fig. 10.60

Faston terminals (B17) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

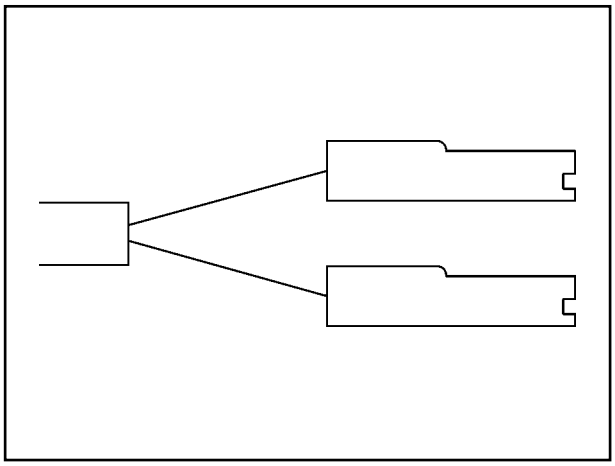


Fig. 10.61

Terminal (B18) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

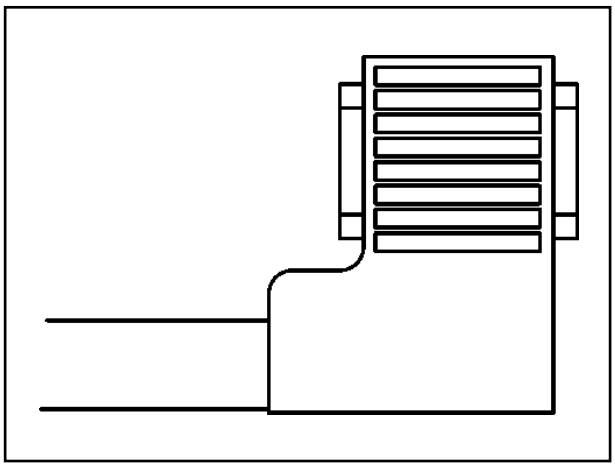


Fig. 10.62

Connector (B19) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

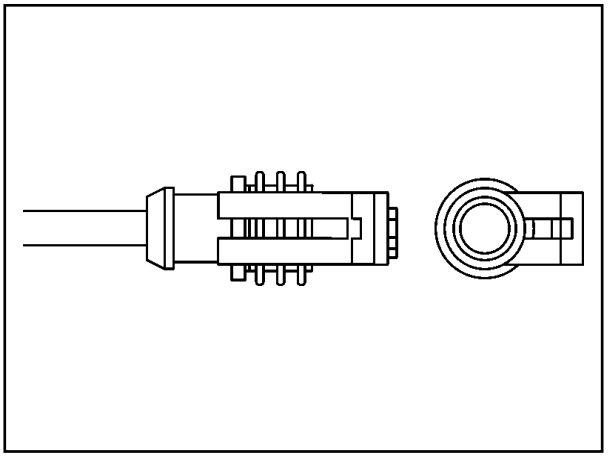


Fig. 10.63

Terminal (B20) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

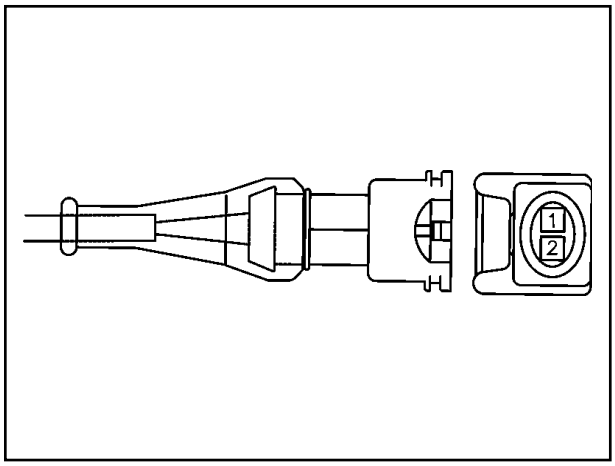


Fig. 10.64

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

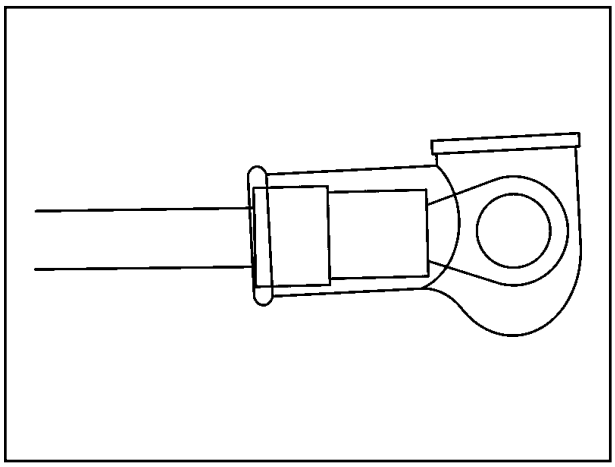


Fig. 10.65

Connector (B22) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

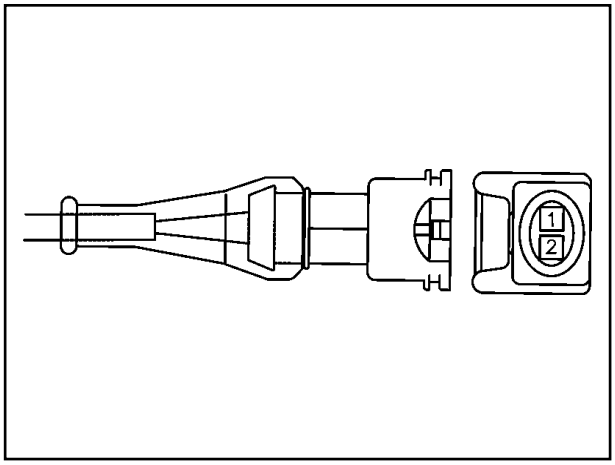


Fig. 10.66

Grounding eyelet (B23)

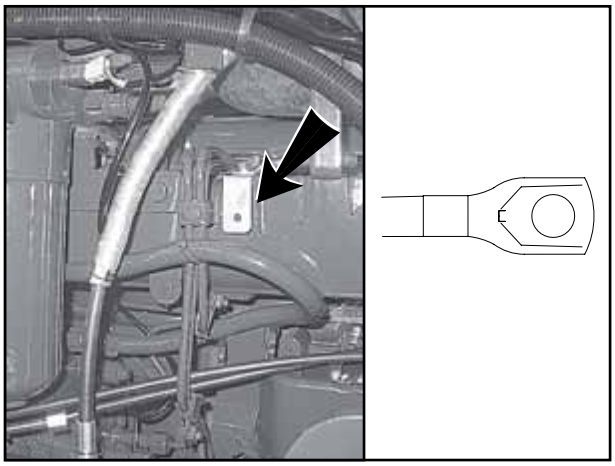


Fig. 10.67

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

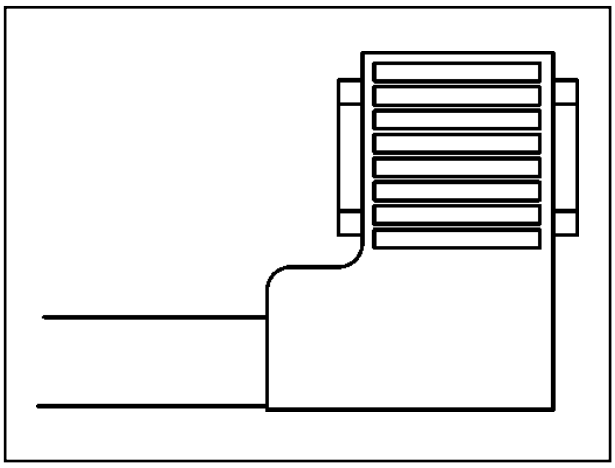


Fig. 10.68

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

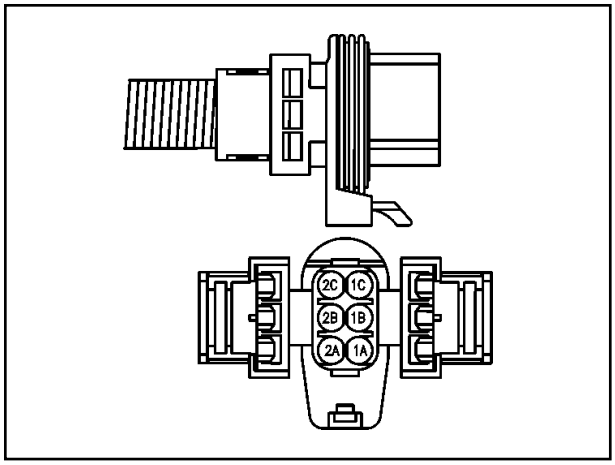


Fig. 10.69

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13		not used	
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29		not used	
30		not used	
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

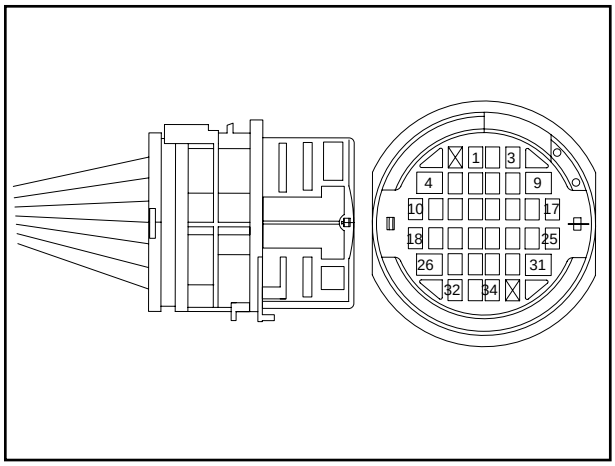


Fig. 10.70

3.6.5 Front engine line (with 4-cylinder engine)

3.6.5.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.71), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.72) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.72) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.73) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.74) installed under the bonnet.

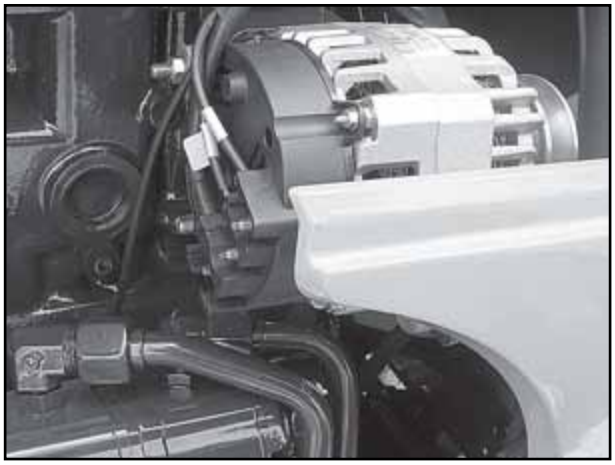


Fig. 10.71

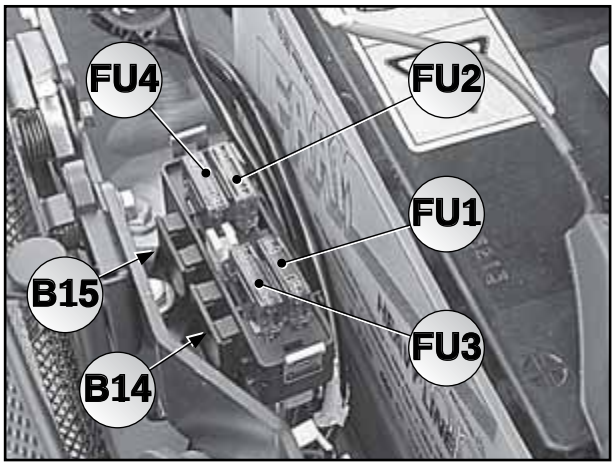


Fig. 10.72

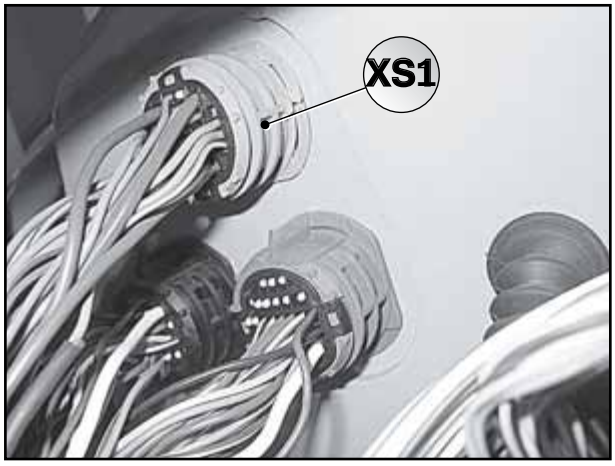


Fig. 10.73

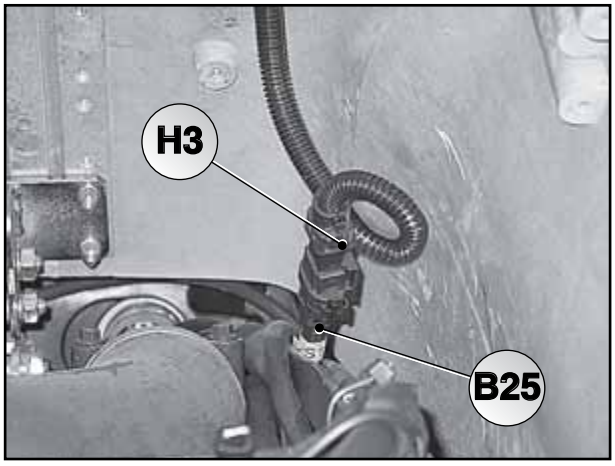


Fig. 10.74

3.6.5.2 Wiring (version with 4-cylinder engine)

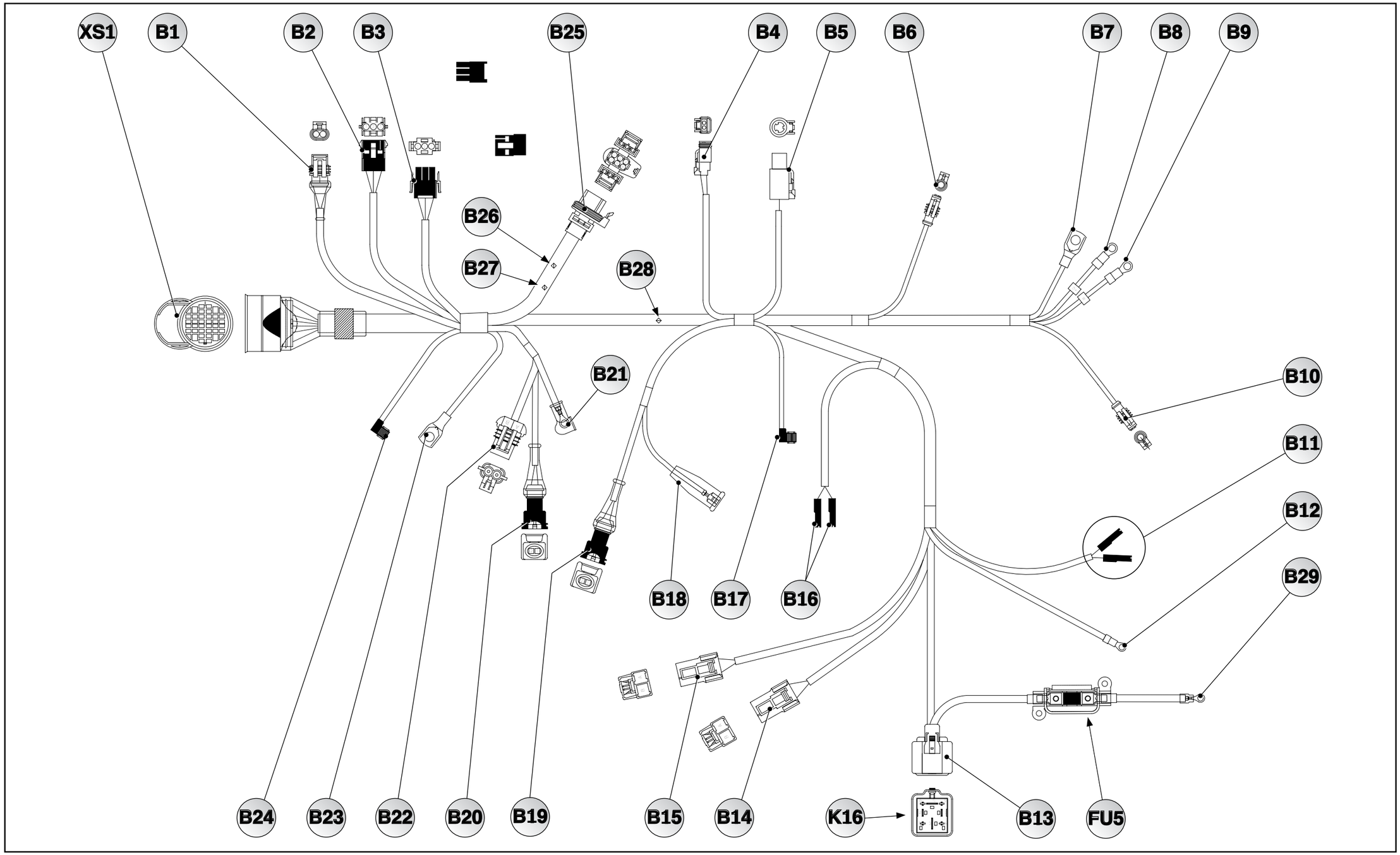


Fig. 10.75

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26 - Junction
B27 - Junction
B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.6.5.3 Connector locations

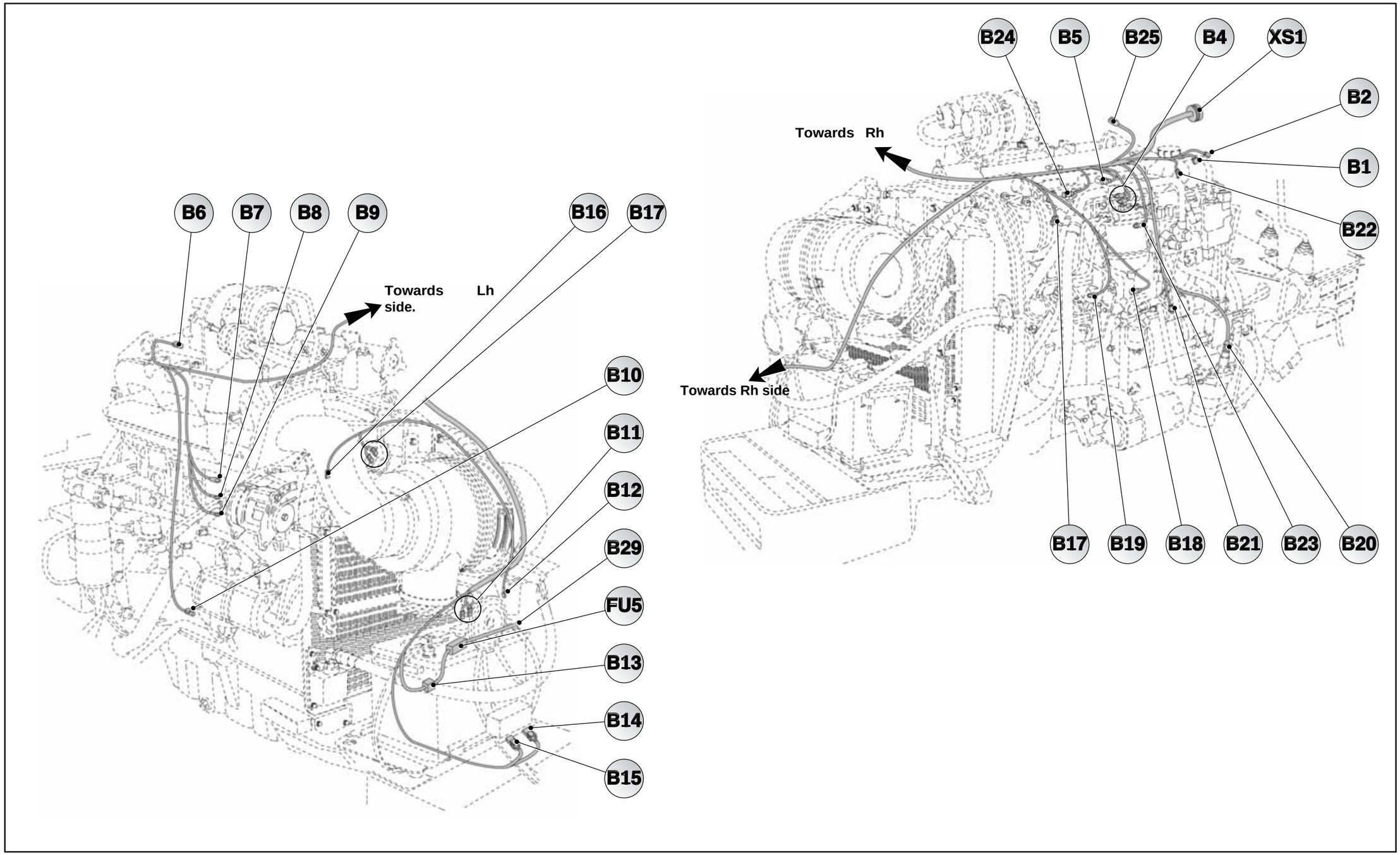


Fig. 10.76

Towards Lh side

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26 - Junction
B27 - Junction
B28 - Junction
B29 - Loop terminal
XS1 - Terminal board for front line/dashboard connection

3.6.5.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

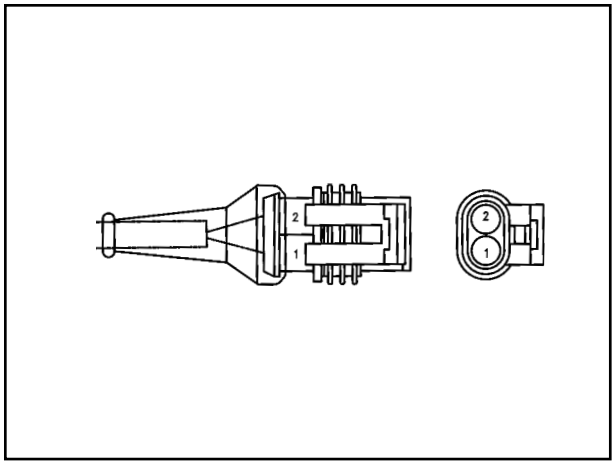


Fig. 10.77

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

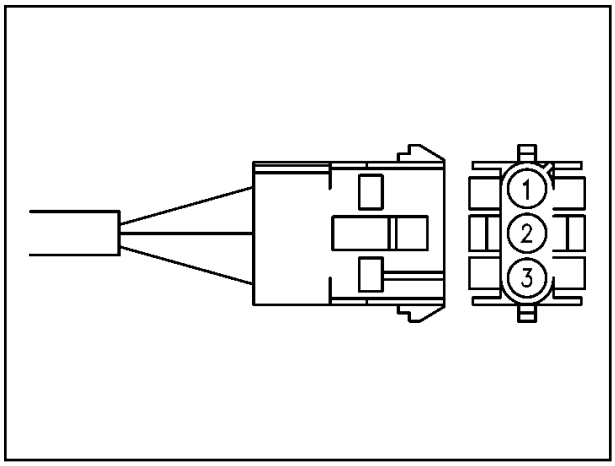


Fig. 10.78

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

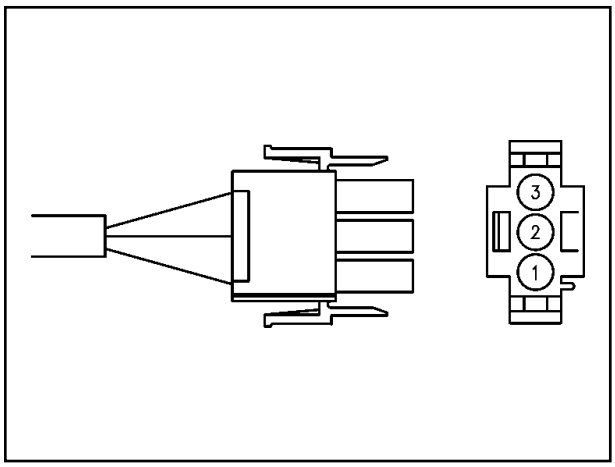


Fig. 10.79

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

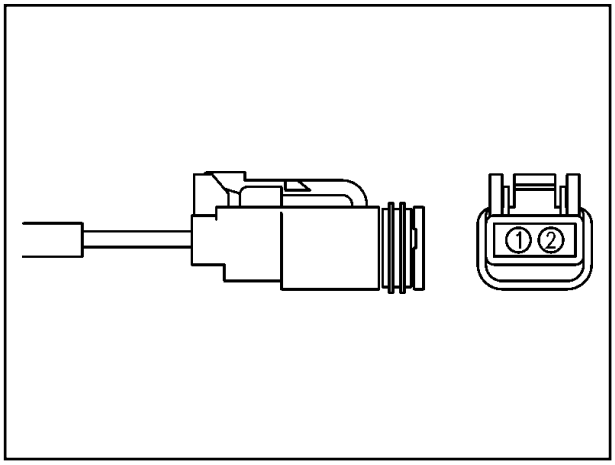


Fig. 10.80

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

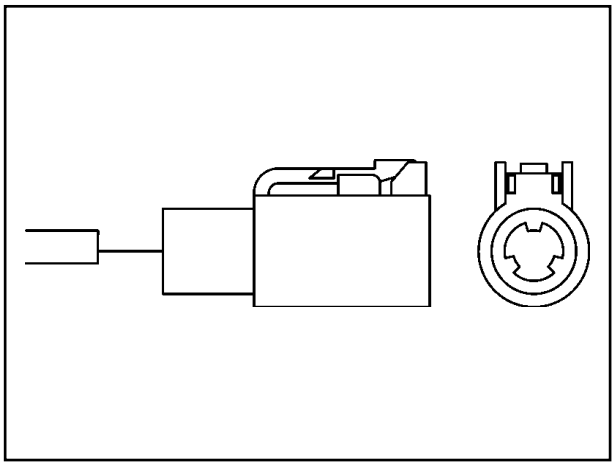


Fig. 10.81

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

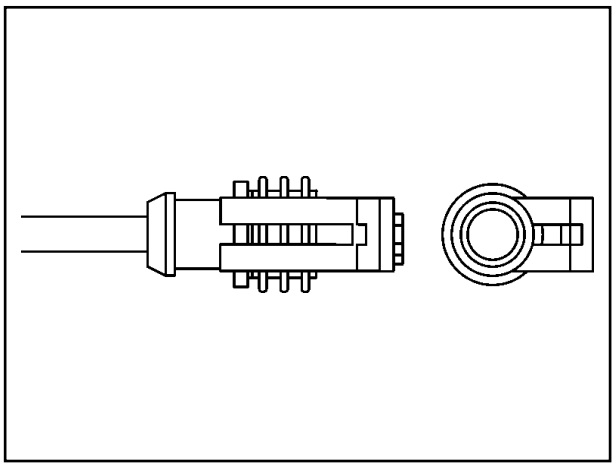


Fig. 10.82

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

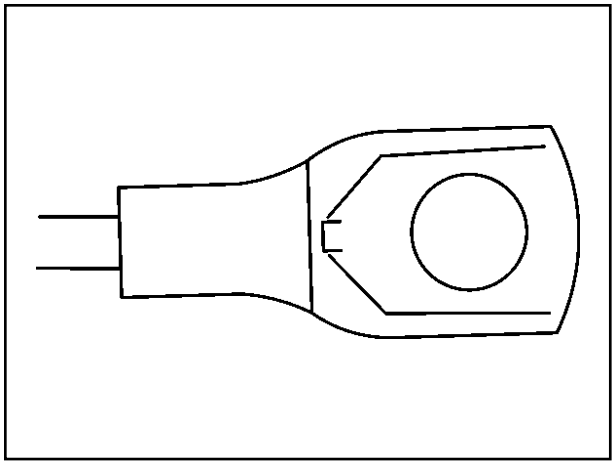


Fig. 10.83

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

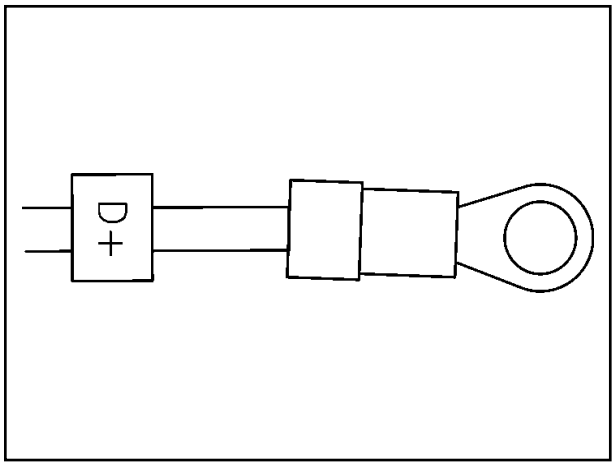


Fig. 10.84

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

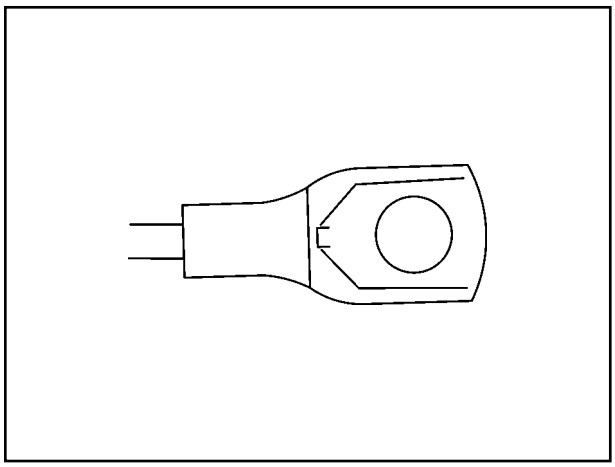


Fig. 10.85

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

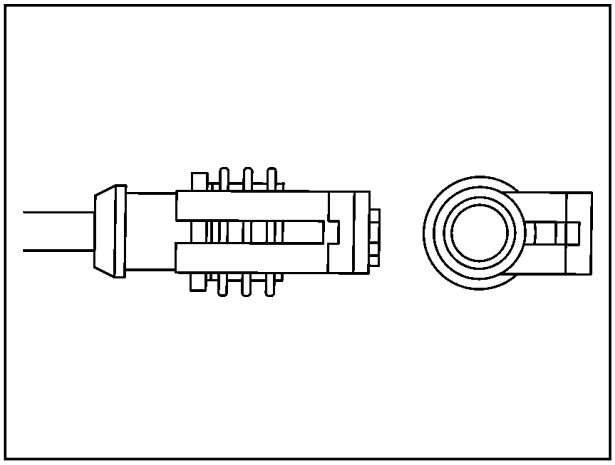


Fig. 10.86

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

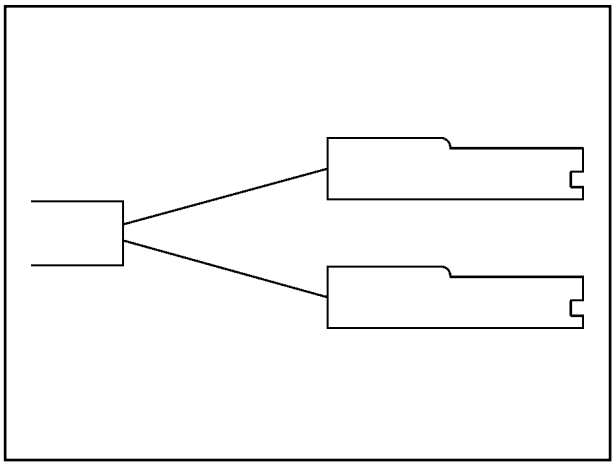


Fig. 10.87

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

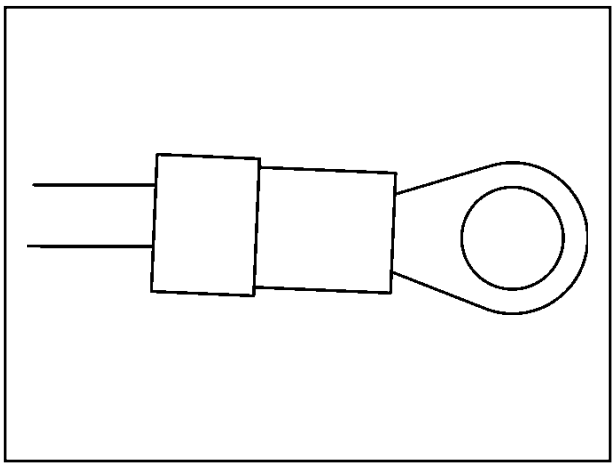


Fig. 10.88

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

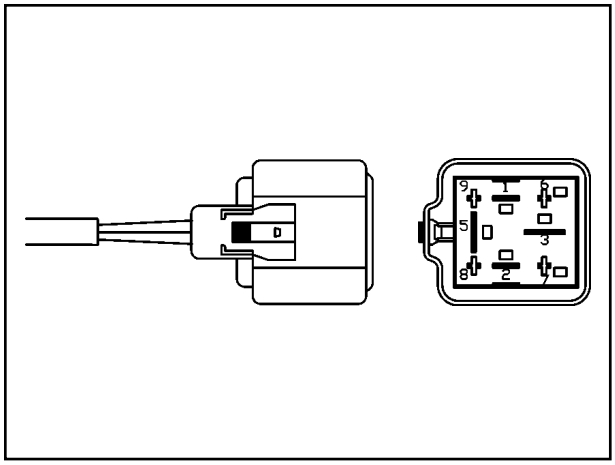


Fig. 10.89

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

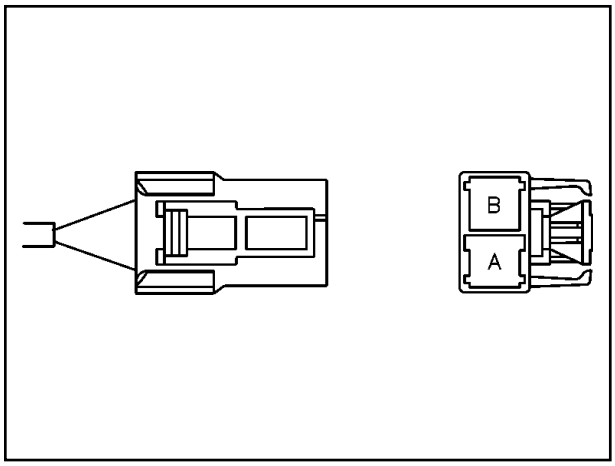


Fig. 10.90

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

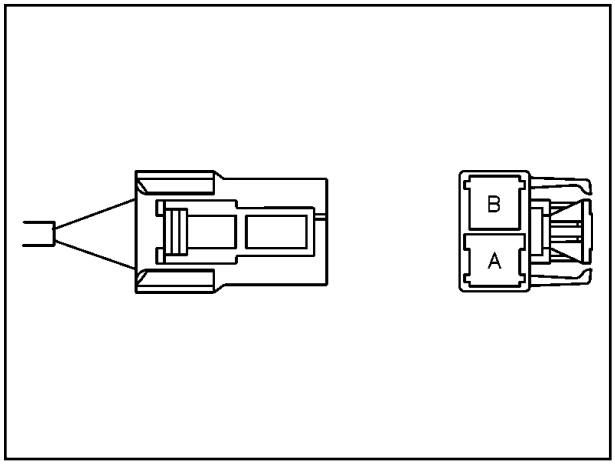


Fig. 10.91

Faston terminals (B16) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

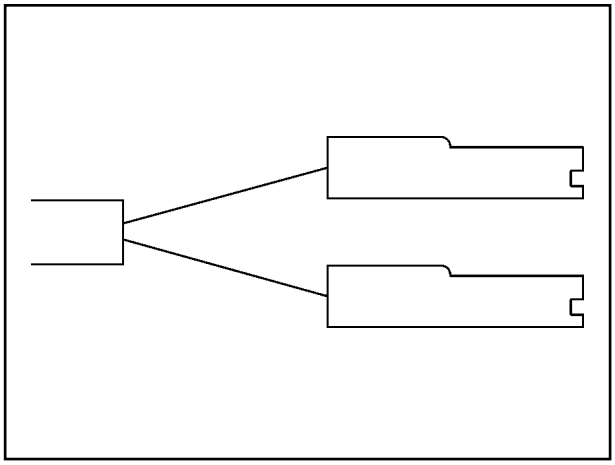


Fig. 10.92

Terminal (B17) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

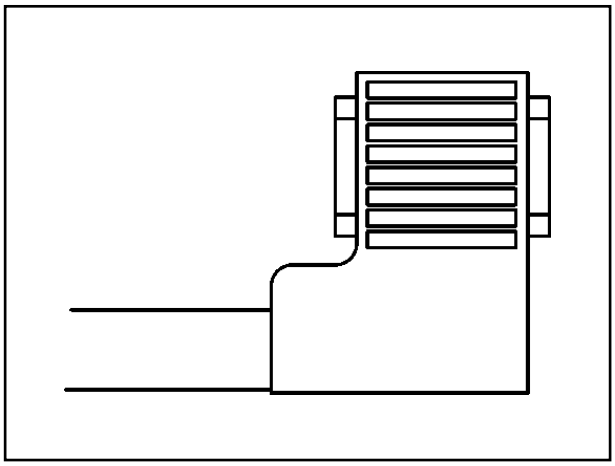


Fig. 10.93

Connector (B18) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

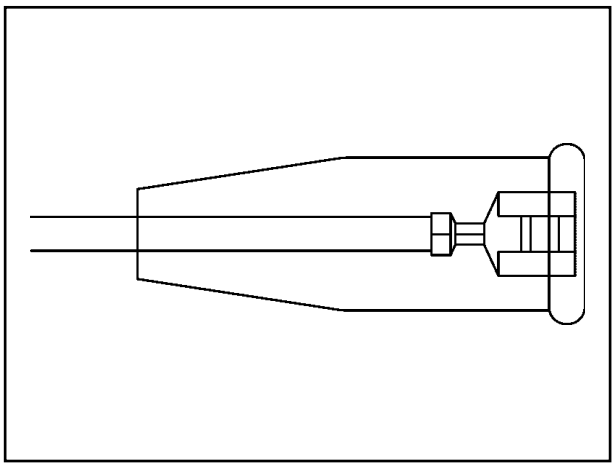


Fig. 10.94

Terminal (B19) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

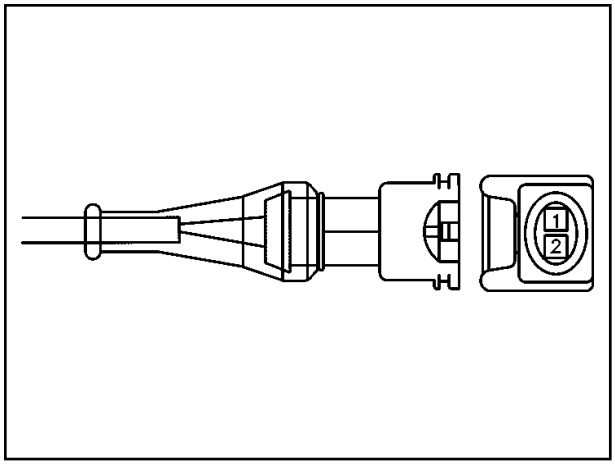


Fig. 10.95

Connector (B20) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

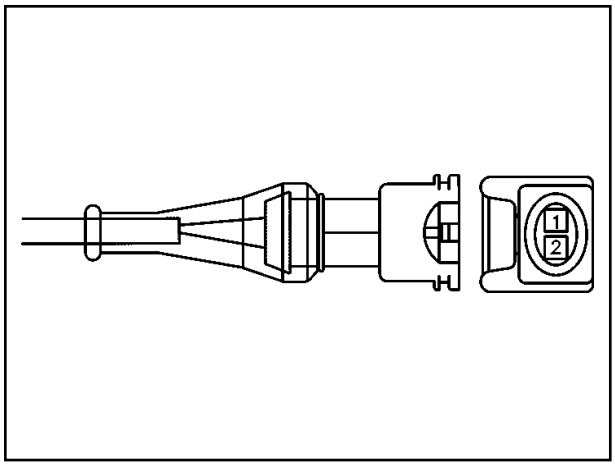


Fig. 10.96

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

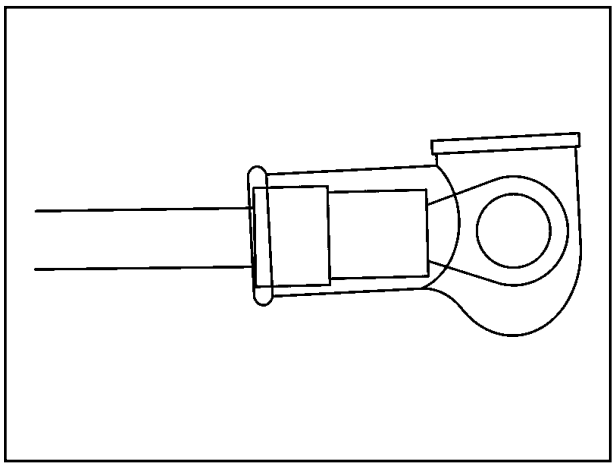


Fig. 10.97

Connector (B22) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

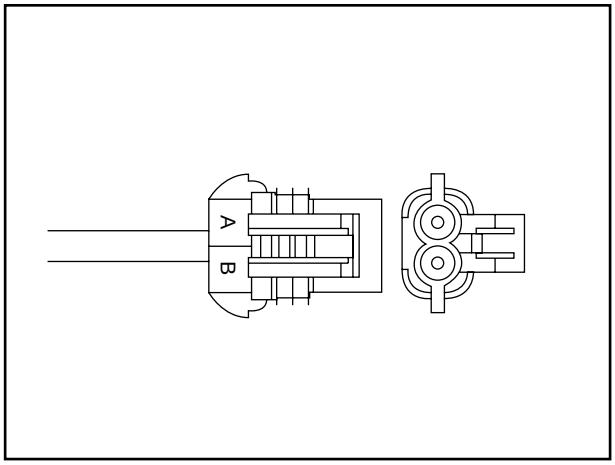


Fig. 10.98

Grounding eyelet (B23)

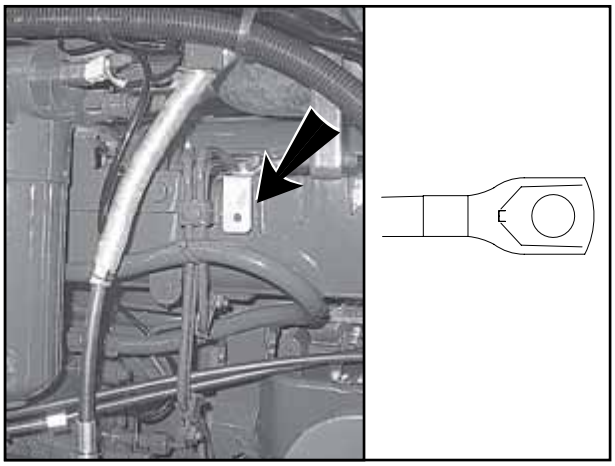


Fig. 10.99

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

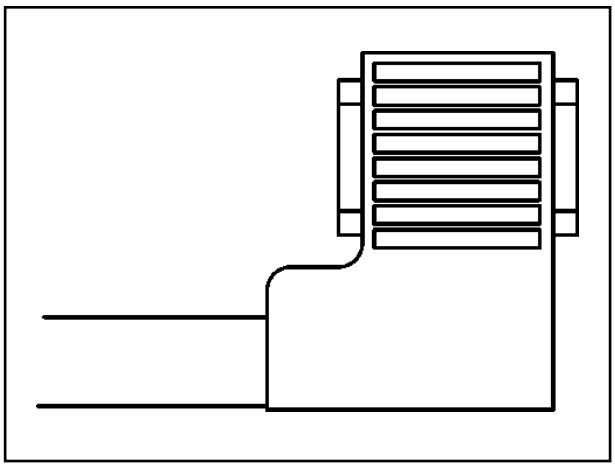


Fig. 10.100

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

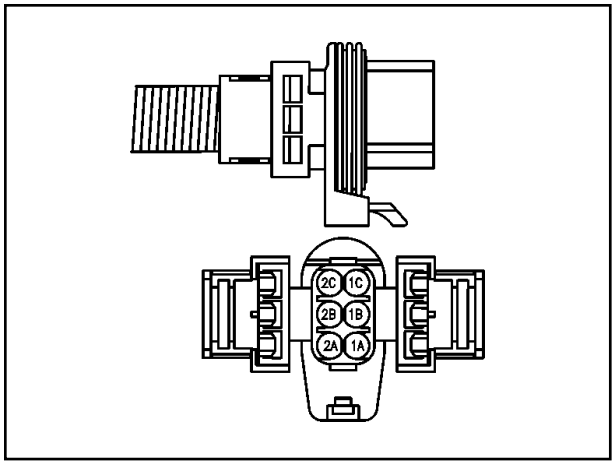


Fig. 10.101

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13		not used	
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29		not used	
30		not used	
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

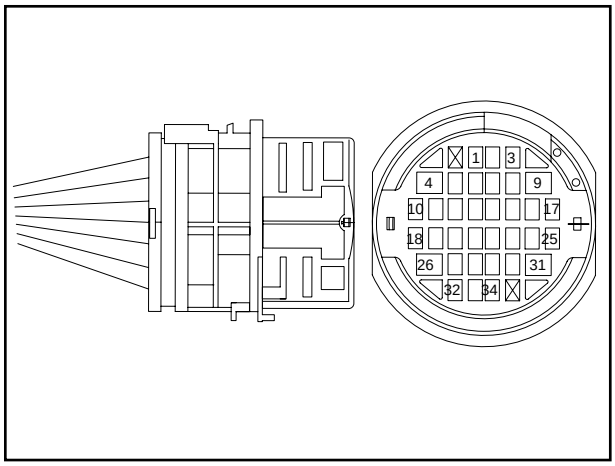


Fig. 10.102

3.6.6 Dashboard line

3.6.6.1 General description

The dashboard line powers the controls installed in front of the driver (Fig.10.103), such as the switches that control the headlights, the light switch lever, etc. It also connects with the fuses that protect the tractor's entire electrical system (Fig.10.104).

The dashboard line is connected to the front engine line via connection to the terminal boards (XS1), to the rear line via terminal boards (XS2) and to the platform line by means of the terminal boards (XS3)(Fig.10.105) in each wiring line.

Fig. 10.103

Fig. 10.104

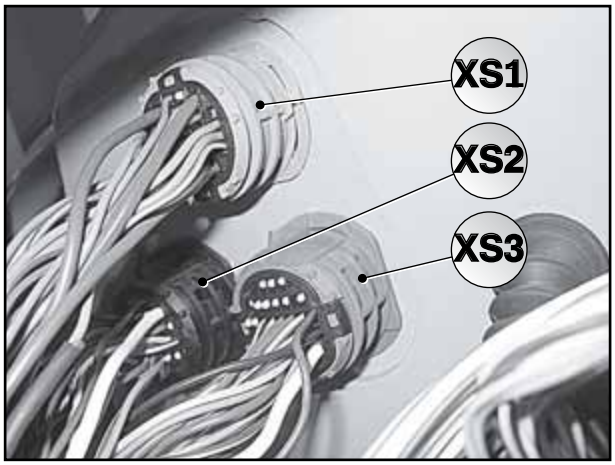


Fig. 10.105

3.6.6.2 Wiring

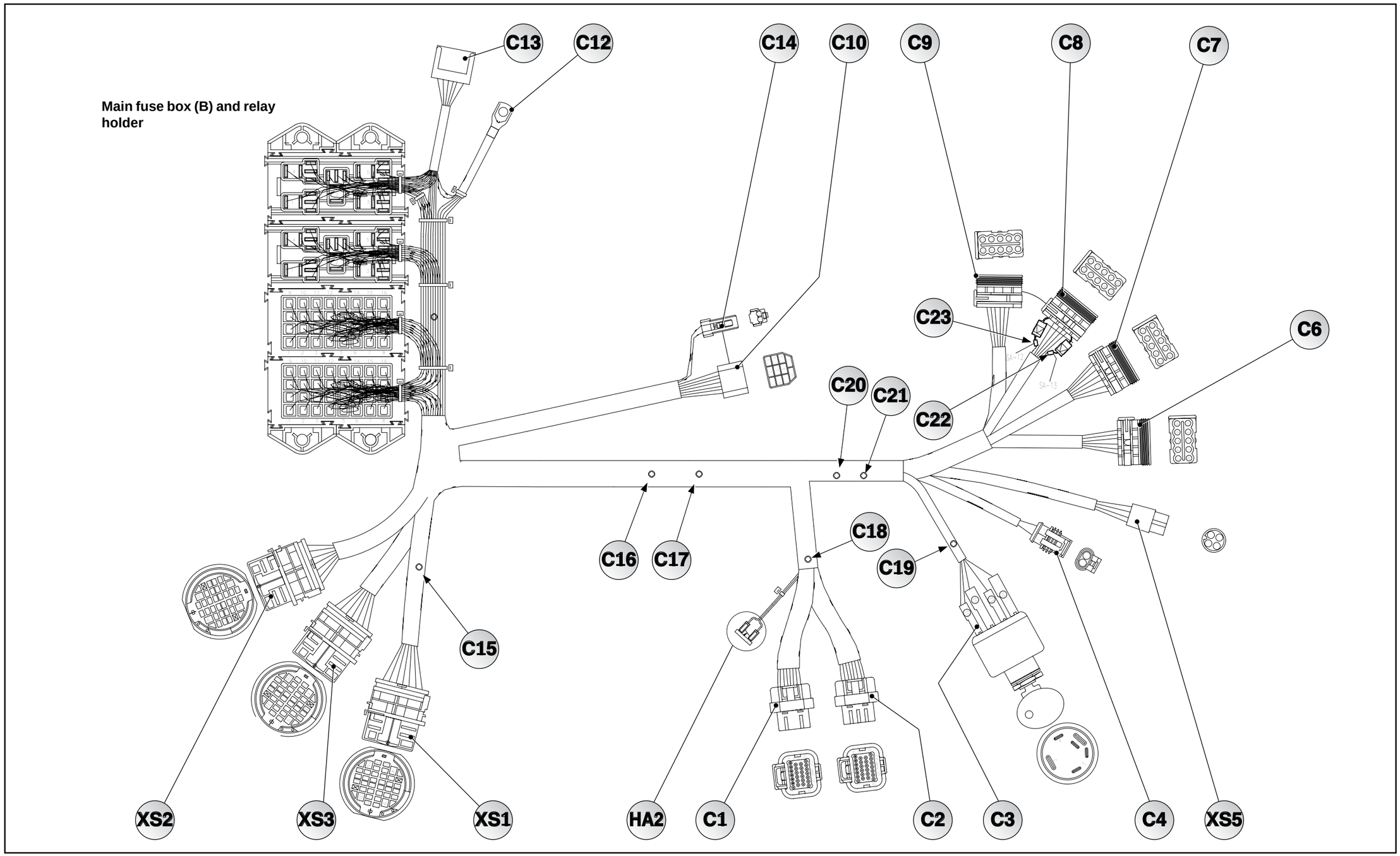


Fig. 10.106

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C6 - Connector for revolving beacon switch
C7 - Connector for field light switch
C8 - Connector for emergency switch
C9 - Connector for side lights switch
C10 - Connector for light switch
C11 - Connector for light switch
C12 - Grounding eyelet
C13 - Connector for blinker
C14-C26 - Junctions
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
B - Main relay and fuse box

3.6.6.3 Connector locations

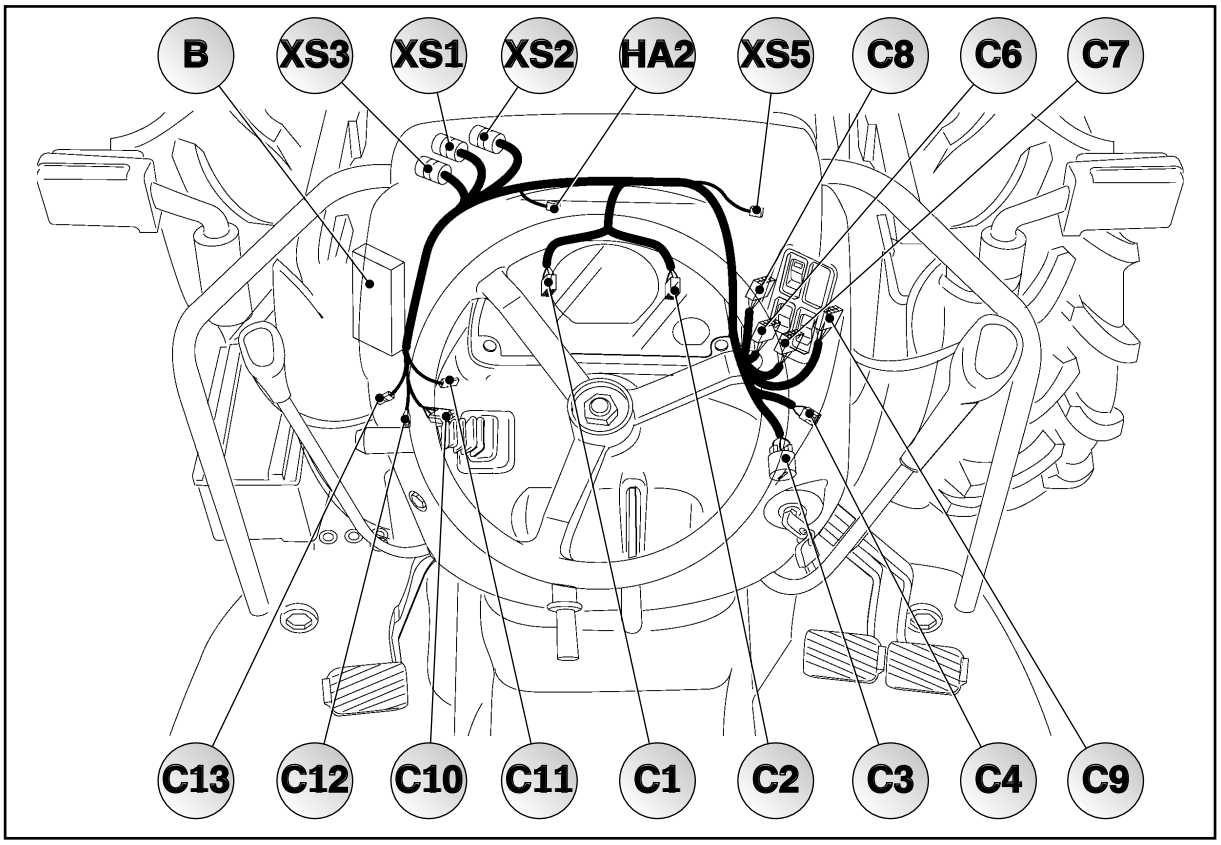


Fig. 10.107

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C6 - Connector for revolving beacon switch
C7 - Connector for field light switch
C8 - Connector for emergency switch
C9 - Connector for side lights switch
C10 - Connector for light switch
C11 - Connector for light switch
C12 - Grounding eyelet
C13 - Connector for blinker
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
B - Main relay and fuse box

3.6.6.4 Connector identification

Connector (C1) for instrument

term.	wire colour	To con. or comp.	term.
1	RN	C18 (junction)	
2	ZN	XS2	13
3	RV	XS1	5
4	ZL	XS3	32
5	not used		
6	not used		
7	LG	XS1	8
8	R	F5	5A
9	ZH	C17 (junction)	
10	SV	XS3	5
11	BR	K8	3
12		not used	
13		not used	
14	B	C24 (junction)	
15	C	XS2	21
16	VB	K15	4
17		not used	
18		not used	
19	BN	XS2	12
20		not used	
21	V	K9	5
22	HG	C21 (junction)	
23	G	C22 (junction)	
24	V	C23 (junction)	
25	GN	C13	5
26	GV	C13	2

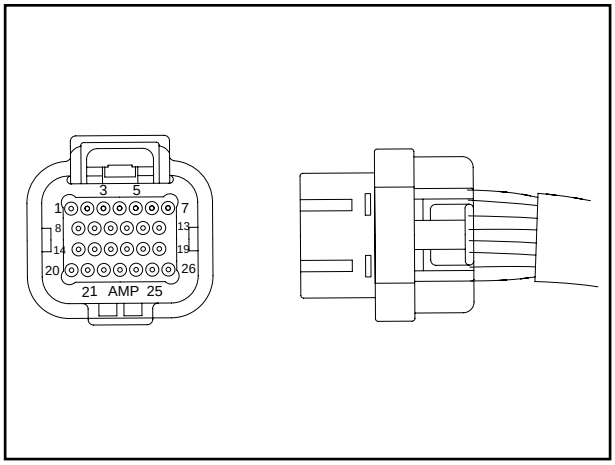


Fig. 10.108

Connector (C2) for instrument

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12
2	CN	XS2	16
3	SN	XS2	15
4	not used		
5	not used		
6	not used		
7	RN	C18 (junction)	
8	not used		
9	HB	HA2	-
10	HM	F16	6
11	not used		
12	not used		
13	R	F5	5A
14	SG	XS3	11
15	HV	XS2	5
16	HL	XS2	3
17	N	C3	3
18	not used		
19	B	C24 (junction)	
20	not used		
21	VB	XS1	3
22	S	XS3	12
23	not used		
24	not used		
25	not used		
26	not used		

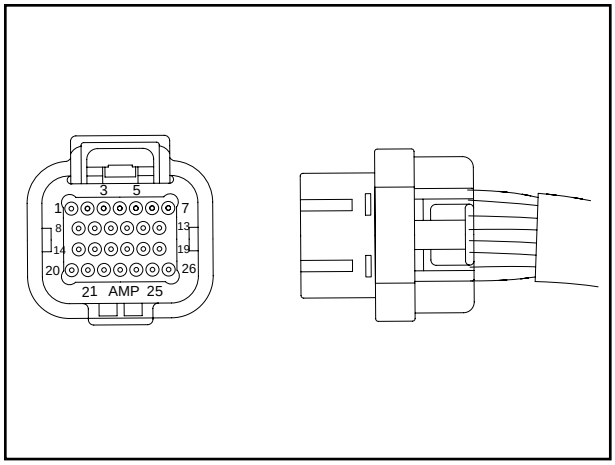


Fig. 10.109

Ignition switch faston terminals (C3)

term.	wire colour	To con. or comp.	term.
1	R	XS1	4
2	M	C19 (junction)	
3	N-N	XS1-C2	6-17
4	L	F20	2

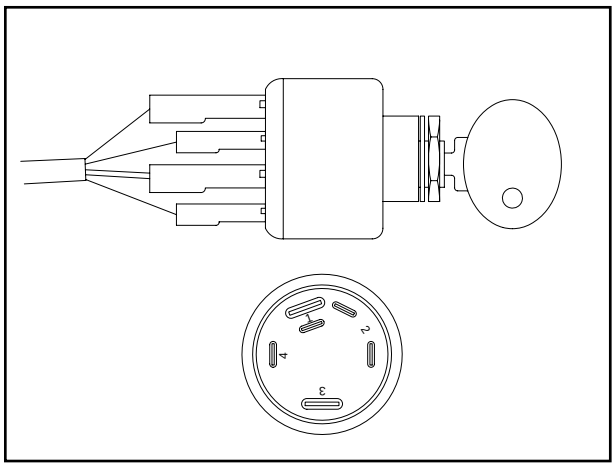


Fig. 10.110

Brake oil pressure sensor connector (C4)

term.	wire colour	To con. or comp.	term.
1	M	K14	3
2	GL	K14	2

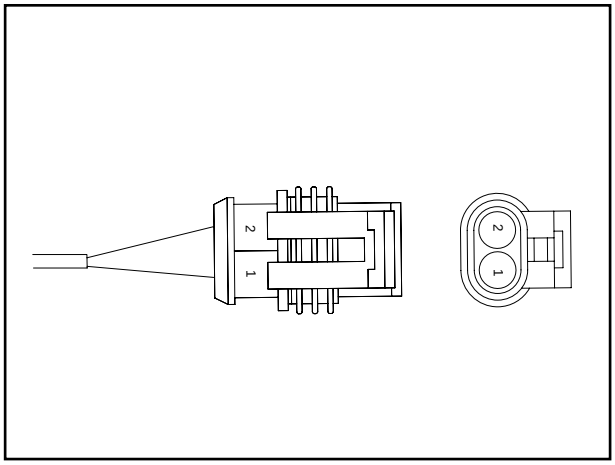


Fig. 10.111

Revolving beacon switch connector (C6)

term.	wire colour	To con. or comp.	term.
1	not used		
2	R	F27	16A
3	GV	C26 (junction)	
4	not used		
5	not used		
6	not used		
7	B	C24 (junction)	
8	HG	C21 (junction)	
9	B	C24 (junction)	
10	GV	C26 (junction)	

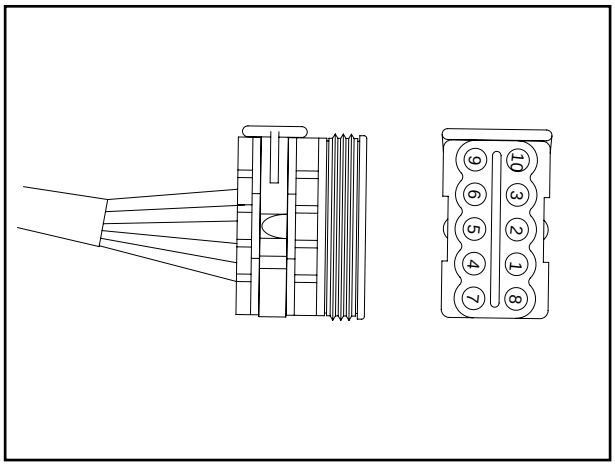


Fig. 10.112

Connector (C7) for field light switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	H	F21	3
3	HN	C25 (junction)	
4	not used		
5	not used		
6	not used		
7	B	C24 (junction)	
8	HG	C20 (junction)	
9	B	C24 (junction)	
10	HN	C25 (junction)	

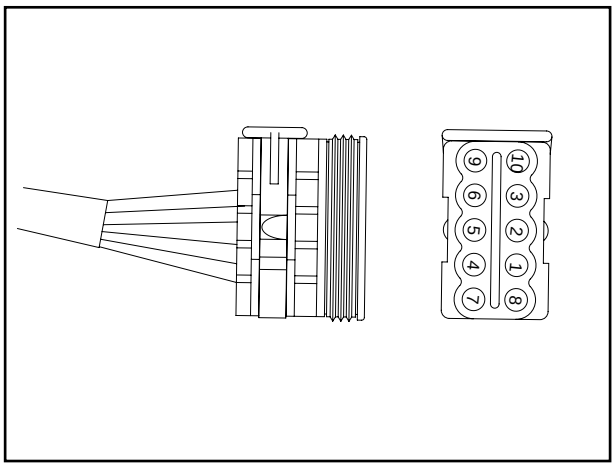


Fig. 10.113

Connector (C8) for emergency switch

term.	wire colour	To con. or comp.	term.
1	M	C24 (junction)	
2	BR	F12	12A
3	R	F36	7A
4	not used		
5	MB	C13	4
6	G	C22 (diode)	
7	not used		
8	B	C24 (junction)	
9	V	C23 (diode)	
10	HG	C20 (junction)	

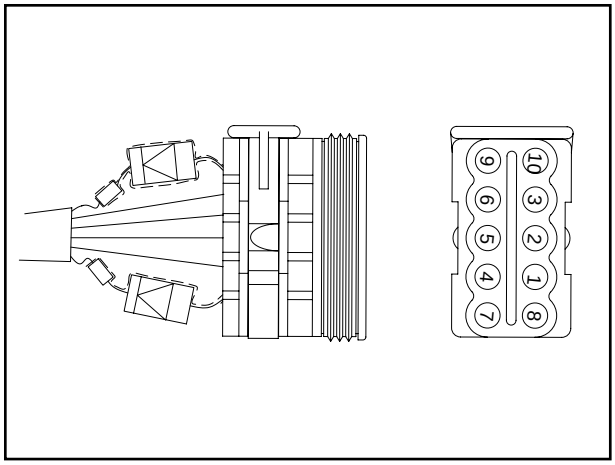


Fig. 10.114

Connector (C9) for side lights switch

term.	wire colour	To con. or comp.	term.
1		not used	
2	M	C14 (junction)	
3	HN	C10	4
4		not used	
5	RN	F15	15A
6	N	C16 (junction)	
7	B	C24 (junction)	
8	HG	C21 (junction)	
9	B	C24 (junction)	
10	N	C16 (junction)	

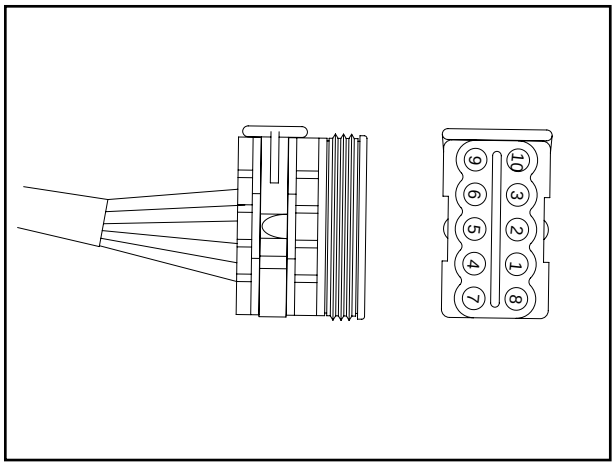


Fig. 10.115

Connector (C10) for light switch

term.	wire colour	To con. or comp.	term.
1	R	F27	16A
2	GV	K9	2
3	G	XS1-XS3-XS2-C22 (junction)	20-1-6
4	ZN	C9	3
5	MB	C13	4
6	V	XS2-XS3-XS1-C23 (junction)	8-2-18
7	HR	K10	2
8	Z	XS1	14
9	M	C14 (junction)	
10	RN	F39	1A
11	B	C12 (ground)	

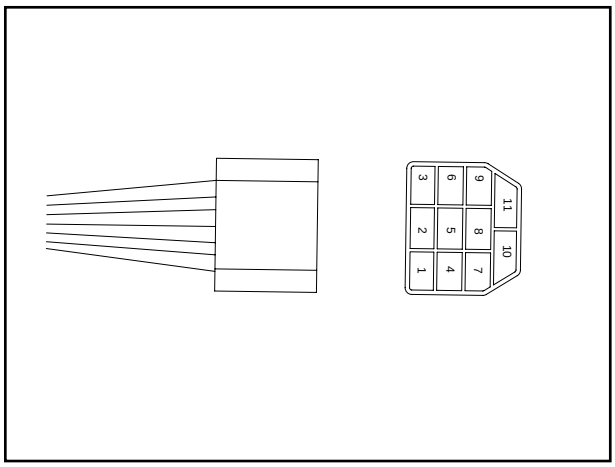


Fig. 10.116

Connector (C11) for light switch

term.	wire colour	To con. or comp.	term.
1	GR	XS3	8
2	RV	XS3	7

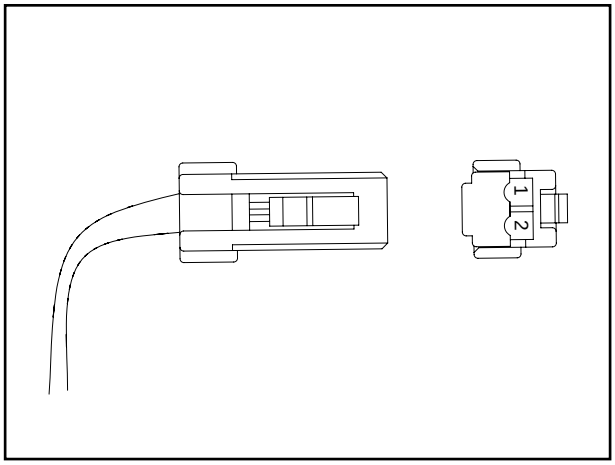


Fig. 10.117

Grounding eyelet (C12)

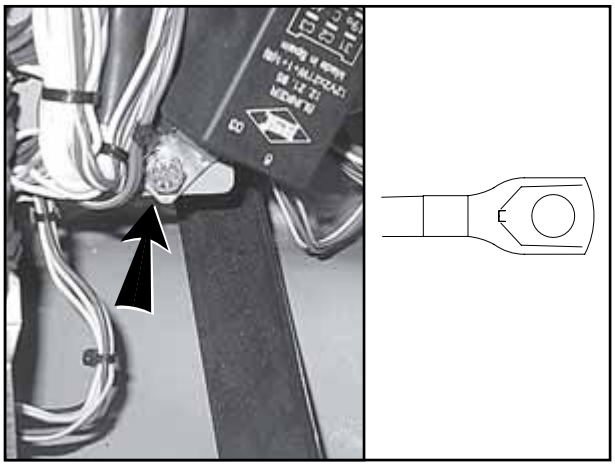


Fig. 10.118

Blinker connector (C13)

term.	wire colour	To con. or comp.	term.
1	B	C12 (ground)	
2	GV	C1	26
3	not used		
4	MB-MB	C10-C8	5-5
5	GN	C1	25
6	BR	F12	12

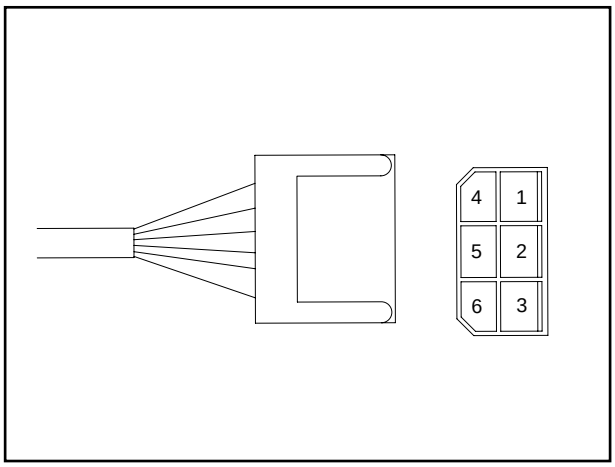


Fig. 10.119

Connector (HA2) for horn (buzzer)

term.	wire colour	To con. or comp.	term.
-	HB	C2	9
+	RN	F22	4A

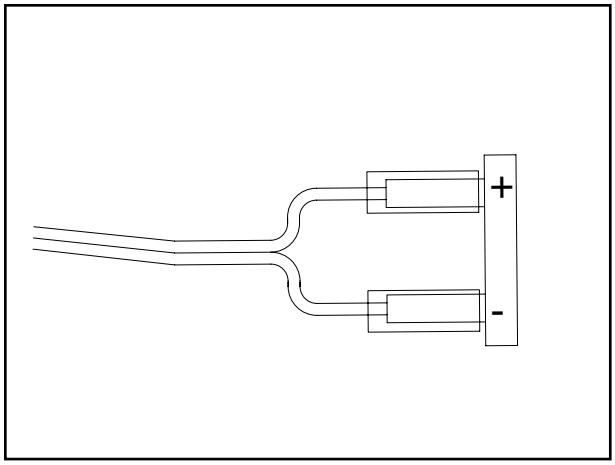


Fig. 10.120

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	K1	5
2	L	K1	5
3	VB	C2	21
4	R	C3	1
5	RV	C1	3
6	N	C3	3
7	CN	F6	6A
8	LG	C1	7
9	M	K4	3
10	ZH	C17 (junction)	
11	HM	F16	6A
12	GR	C2	1
13		not used	
14	Z	C10	8
15	V	K9	5
16	H	K10	5
17	GM	XS5	2
18	V	C10	6
19	M	C20 (junction)	
20	G	C10	3
21	N	C21 (junction)	
22	GV	C26 (junction)	
23		not used	
24	ZH	C17 (junction)	
25		not used	
26	M	C15 (junction)	
27	M	K11	3
28	R	K2	5
29		not used	
30		not used	
31	L	K3	3
32	R	K2	5
33	LB	F25	9
34	LN	F27	16

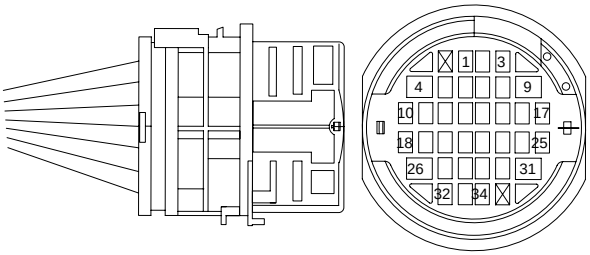


Fig. 10.121

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	K8	3
2	GL	XS3	6
3	HL	C2	16
4	B	C12 (ground)	
5	HV	C2	15
6	G	C10	3
7	M	C20 (junction)	
8	V	C10	6
9		not used	
10	N	C21 (junction)	
11	R	F8	8A
12	BN	C1	19
13	ZN	C1	2
14		not used	
15	SN	C2	3
16	CN	C2	2
17	BV	K1	1
18	VN	K15	5
19	GM	K15	2
20	NR	F2	2
21	C	C1	15
22	AV	XS3	21
23	GN	XS3	22
24		not used	
25		not used	
26		not used	
27		not used	
28		not used	
29		not used	
30		not used	
31		not used	
32		not used	
33		not used	
34		not used	

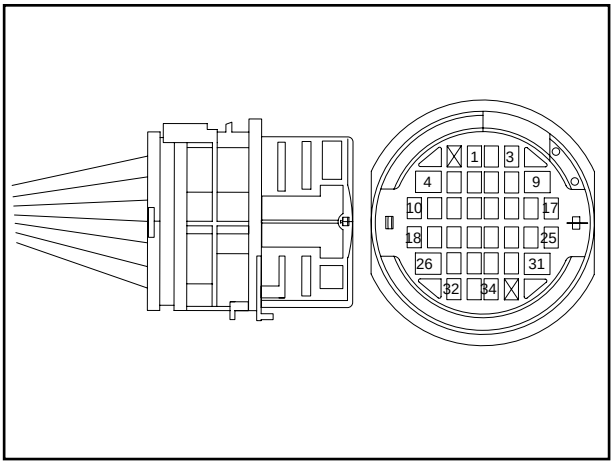


Fig. 10.122

Terminal board (XS3) for platform/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	G	C10	3
2	V	C10	6
3	N	C21 (junction)	
4		not used	
5	SV	C1	10
6	GL	XS2	2
7	RV	C11	2
8	GR	C11	1
9		not used	
10	HN	C25 (junction)	
11	SG	C2	14
12	S	C2	22
13	HM	F16	6
14	RN	F17	5
15	BR	K8	2
16	MV	F18	8A
17	HR	F7	7
18		not used	
19	MR	F24	4
20	R	F8	8A
21	AV	XS2	22
22	GN	XS2	23
23	AN	F25	9A
24		not used	
25		not used	
26	B	C12 (ground)	
27		not used	
28	M	C20 (junction)	
29		not used	
30		not used	
31	R	F26	10A
32	ZL	C1	4
33	RN	F30	11A
34		not used	

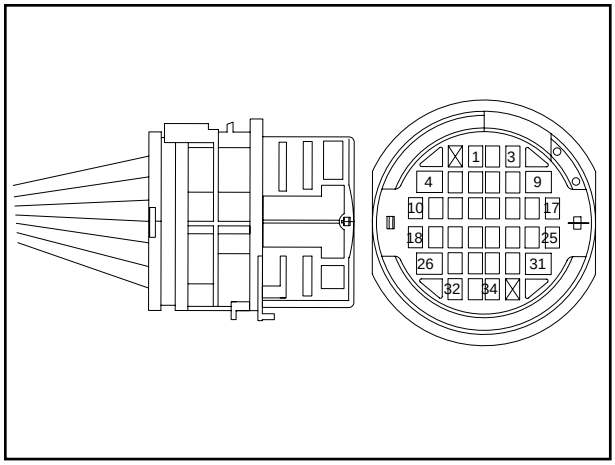


Fig. 10.123

Terminal board (XS5) for roof/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	M	F29	3
2	GM	XS1	17
3	B	C12 (ground)	
4	HG	C21 (junction)	

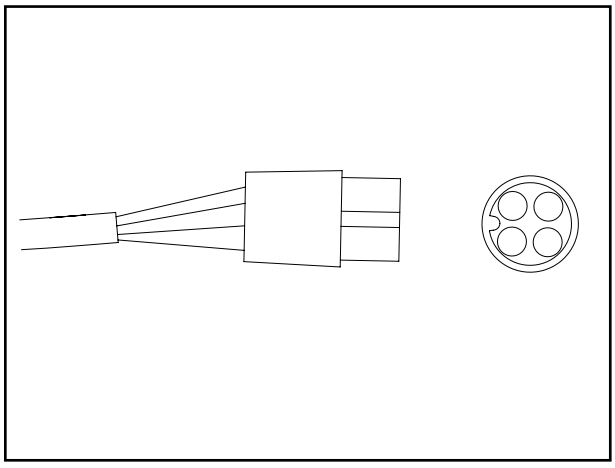


Fig. 10.124

3.6.7 Platform line

3.6.7.1 General description

The platform line connects the controls on the right-hand side of the platform, such as the switches and buttons for engaging/disengaging the 4WD and diff lock (Fig.10.125). It also connects the rear lights and auxiliary power socket.

It is connected to the dashboard line, by means of the connection between the terminal boards (XS3) (Fig.10.126) in each wiring line.

Fig. 10.125

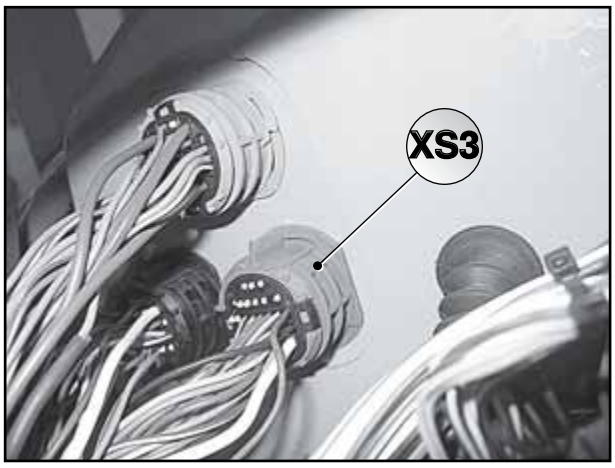


Fig. 10.126

3.6.7.2 Wiring

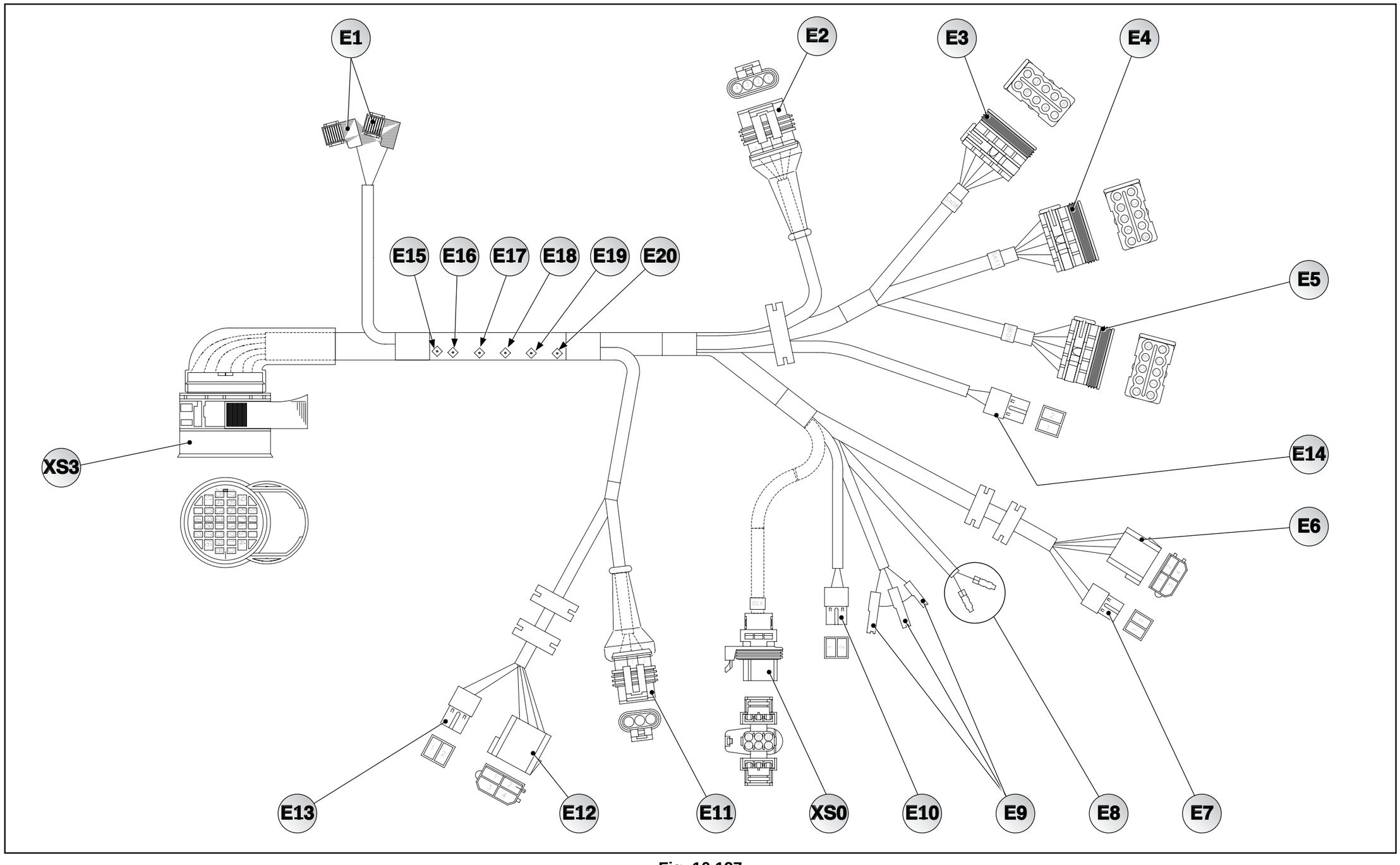


Fig. 10.127

E1 - Terminals for brake oil level sensor
E2 - Connector (not used)
E3 - Connector for differential lock button
E4 - Connector for 4WD engagement/disengagement switch
E5 - Connector for control button of auxiliary control valves (A-B)
E6 - Connector for rh rear field light
E7 - Connector for rh rear field light
E8 - Terminal for field light
E9 - Faston terminals for auxiliary power socket in cab
E10 - Connector for licence plate light
E11 - Fuel level sensor connector
E12 - Connector for lh rear field light
E13 - Connector for lh rear field light
E14 - Pneumatic seat connector
E15-E20 - Junctions
XS0 - Terminal board for trailer socket connection
XS3 - Terminal board for platform/dashboard cable line connection

3.6.7.3 Connector locations

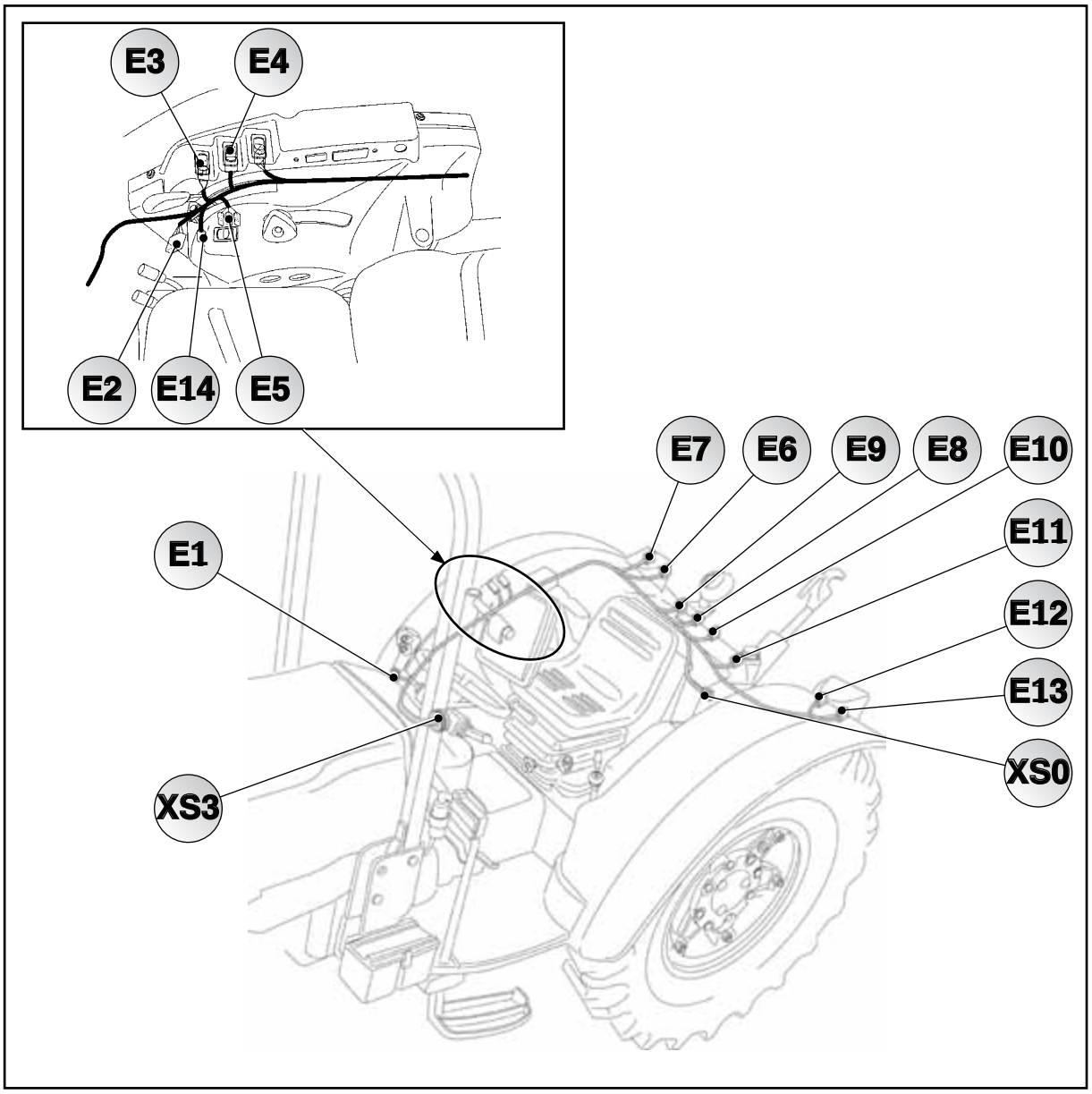


Fig. 10.128

3.6.7.4 Connector identification

Terminals (E1) for brake oil level sensor

term.	wire colour	To con. or comp.	term.
1	ZL	XS3	32
2	B	E17 (junction)	

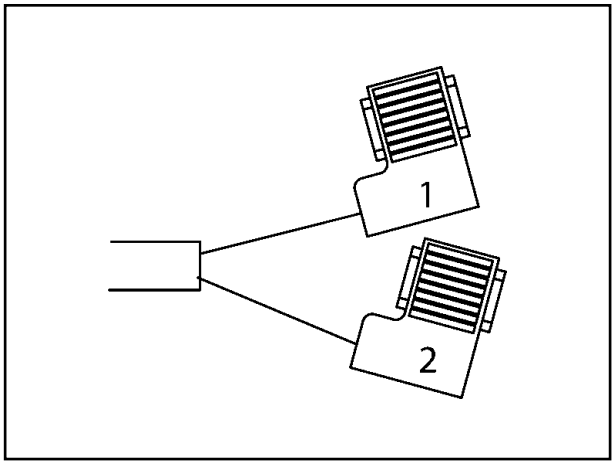


Fig. 10.129

Connector (E2) (not used)

term.	wire colour	To con. or comp.	term.
1	M	E16 (junction)	
2	B	E17 (junction)	
3	RN	XS3	14
4	HM	XS3	13

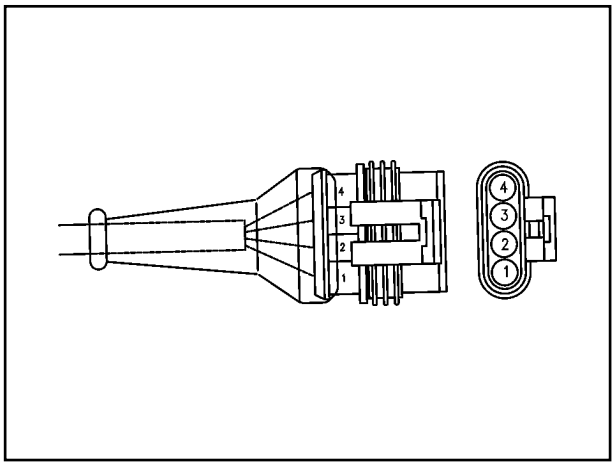


Fig. 10.130

Connector (E3) for differential lock button

term.	wire colour	To con. or comp.	term.
1		not used	
2	BR	XS3	15
3	MV	XS3	16
4		not used	
5		not used	
6		not used	
7	B	E17 (junction)	
8	M	E16 (junction)	
9		not used	
10		not used	

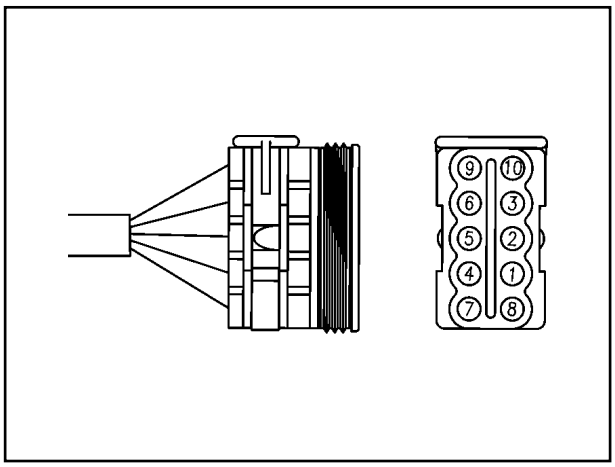


Fig. 10.131

Connector (E4) for 4WD engagement/disengagement switch

term.	wire colour	To con. or comp.	term.
1	GL	XS3	6
2	HR	XS3	17
3	SV	XS3	5
4		not used	
5		not used	
6		not used	
7	B	E17 (junction)	
8	M	E16 (junction)	
9		not used	
10		not used	

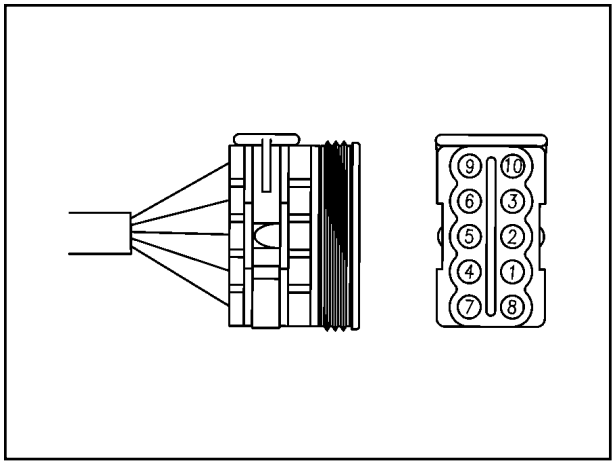


Fig. 10.132

Connector (E5) for control button of auxiliary control valves (A-B)

term.	wire colour	To con. or comp.	term.
1	GN	XS3	22
2	MR	XS3	19
3	AV	XS3	21
4		not used	
5		not used	
6		not used	
7	B	E17 (junction)	
8	M	E16 (junction)	
9	B	E17 (junction)	
10	M	E16 (junction)	

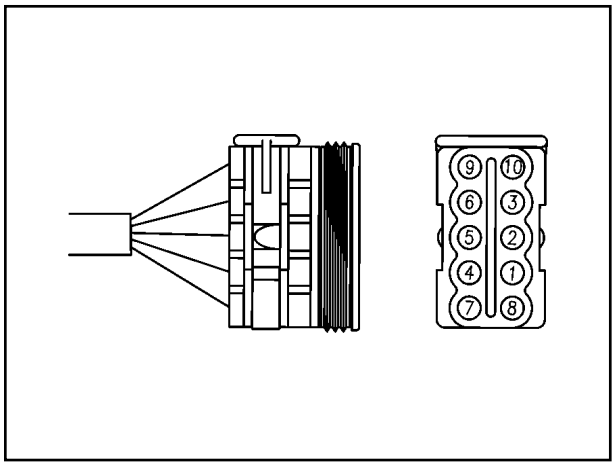


Fig. 10.133

Connector (E6) for rh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E7-E17 (junction)	1
2	V	E20 (junction)	
3	R	E18 (junction)	
4	M	E16 (junction)	

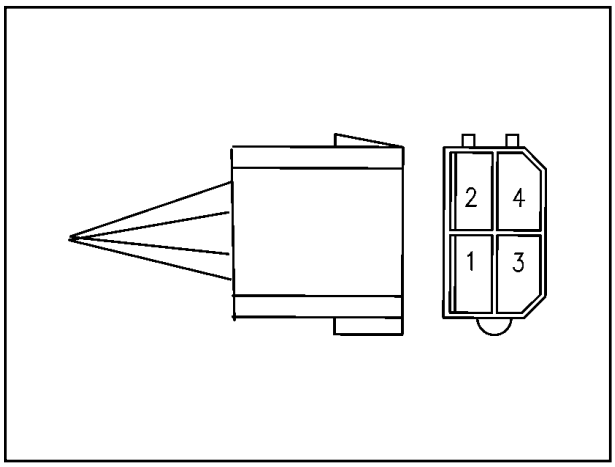


Fig. 10.134

Connector (E7) for rh rear field light

term.	wire colour	To con. or comp.	term.
1	B	E6	1
2	RV	XS3	7

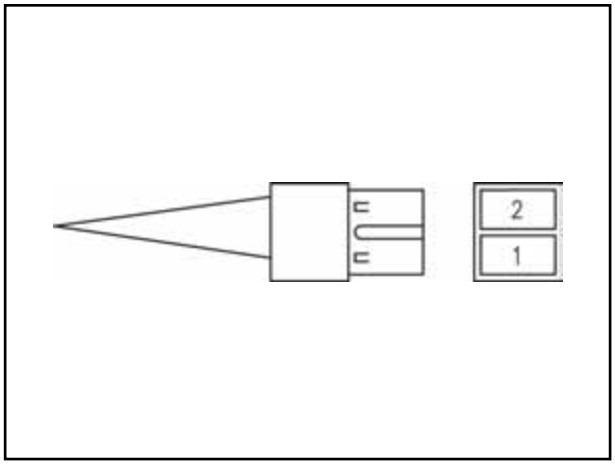


Fig. 10.135

Terminal (E8) for field light

term.	wire colour	To con. or comp.	term.
1	HN	XS3	10
2	B	E17 (junction)	

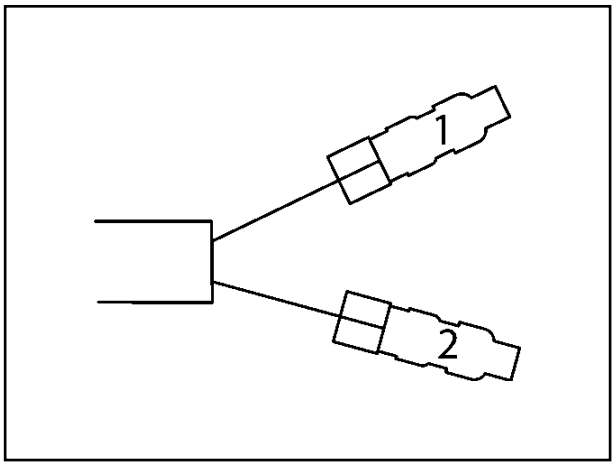


Fig. 10.136

Faston terminals (E9) for auxiliary power socket in cab

term.	wire colour	To con. or comp.	term.
1	R	XS3	31
2	B	E17 (junction)	
3	AN	XS3	23

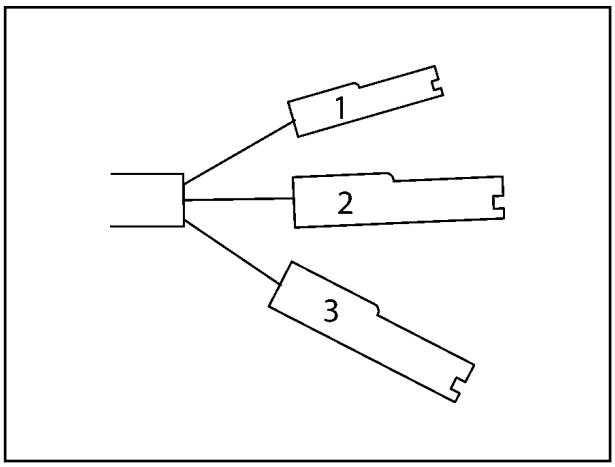


Fig. 10.137

Connector (E10) for licence plate light

term.	wire colour	To con. or comp.	term.
1	N	E15 (junction)	
2	B	E17 (junction)	

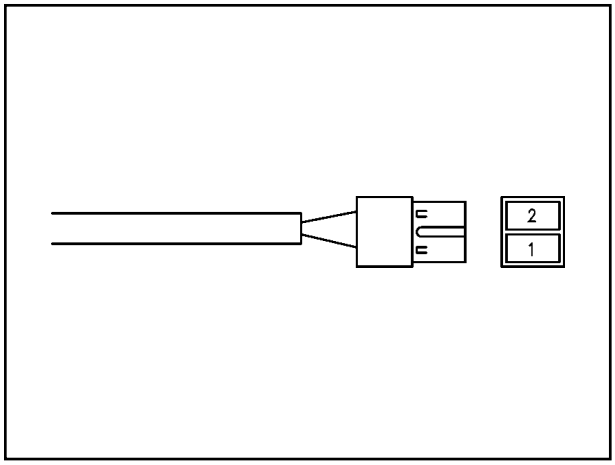


Fig. 10.138

Fuel level sensor connector (E11)

term.	wire colour	To con. or comp.	term.
1	SG	XS3	11
2	S	XS3	12
3	B	E17 (junction)	

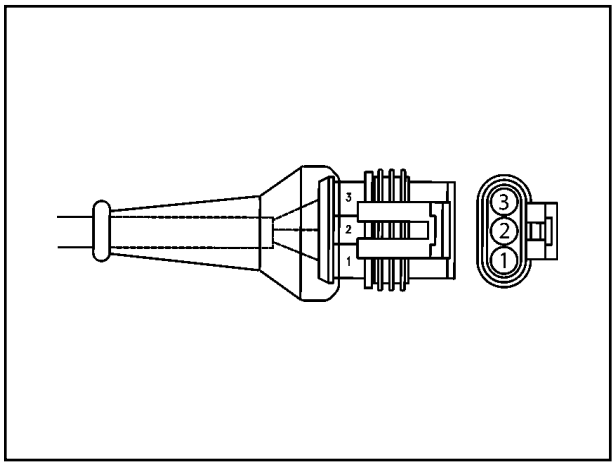


Fig. 10.139

Connector (E12) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E13-E17 (junction)	1
2	G	E19 (junction)	
3	R	E18 (junction)	
4	N	E15 (junction)	

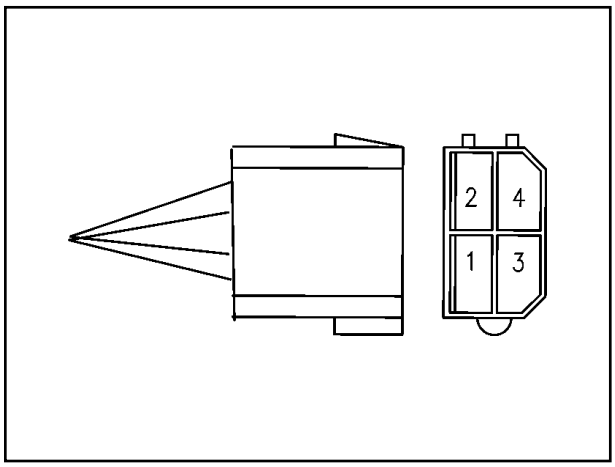


Fig. 10.140

Connector (E13) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B	E12	1
2	GR	XS3	8

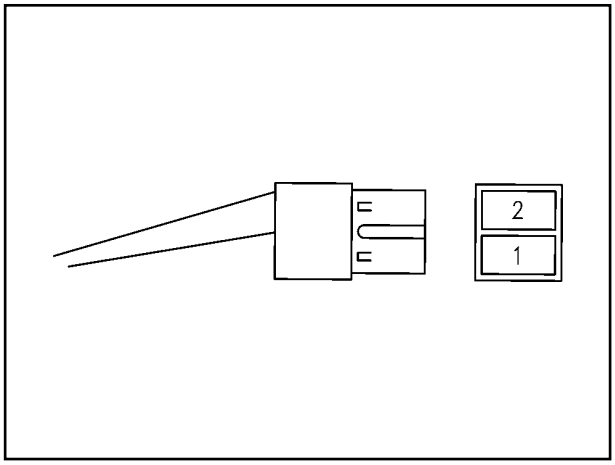


Fig. 10.141

Pneumatic seat connector (E14)

term.	wire colour	To con. or comp.	term.
1	RN	XS3	33
2	B	E17 (junction)	

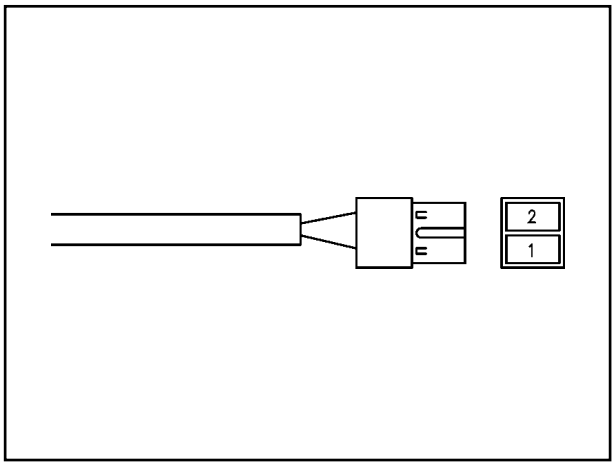


Fig. 10.142

Terminal board (XS0) for trailer socket connection

term.	wire colour	To con. or comp.	term.
1A	N	E15 (junction)	
1B	M	E16 (junction)	
1C	R	E18 (junction)	
2A	G	E19 (junction)	
2B	V	E20 (junction)	
2C	B	E17 (junction)	

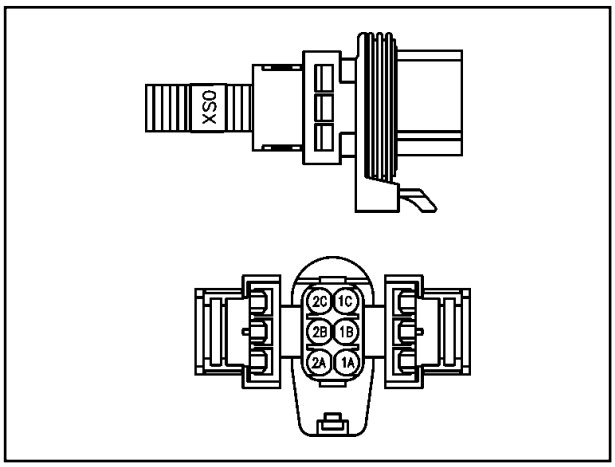


Fig. 10.143

Terminal board (XS3) for platform/dashboard wiring connection

term.	wire colour	To con. or comp.	term.
1	G	E19 (junction)	
2	V	E20 (junction)	
3	N	E15 (junction)	
4		not used	
5	SV	E4	3
6	GL	E4	1
7	RV	E7	2
8	GR	E13	2
9		not used	
10	HN	E8	1
11	SG	E11	1
12	S	E11	2
13	HM	E2	4
14	RN	E2	3
15	BR	E3	2
16	MV	E3	3
17	HR	E4	2
18		not used	
19	MR	E5	2
20	R	E18 (junction)	
21	AV	E5	3
22	GN	E5	1
23	AN	E9	3
24		not used	
25		not used	
26	B	E17 (junction)	
27		not used	
28	M	E16 (junction)	
29		not used	
30		not used	
31	R	E9	1
32	ZL	E1	1
33	RN	E14	1
34		not used	

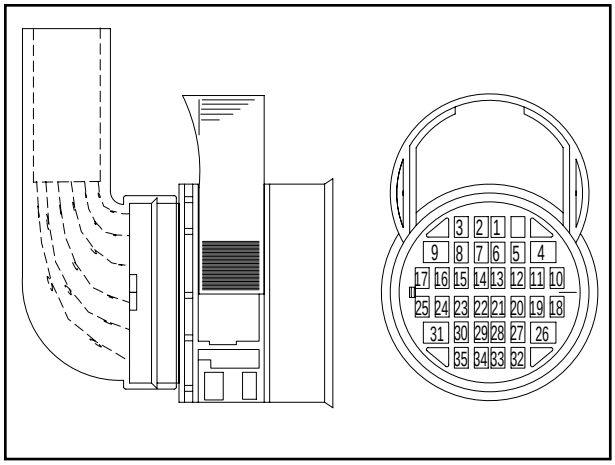


Fig. 10.144

3.6.8 Rear line

3.6.8.1 General description

The rear line powers the components installed on the transmission casing and hydraulic power packs, such as the sensor that detects the rear PTO rate (SR5 Fig.10.145) and the solenoid valves in the servo clutch valve system (8 Fig.10.146) for controlling users like the differential lock and four-wheel drive.

The rear line is connected to the dashboard line via connections between the terminal boards (XS2 Fig.10.147).

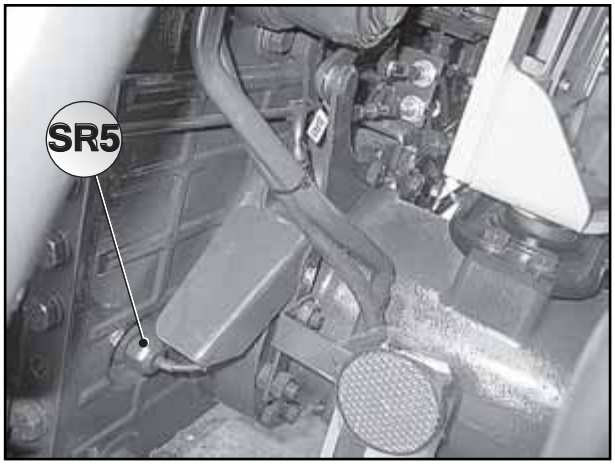


Fig. 10.145

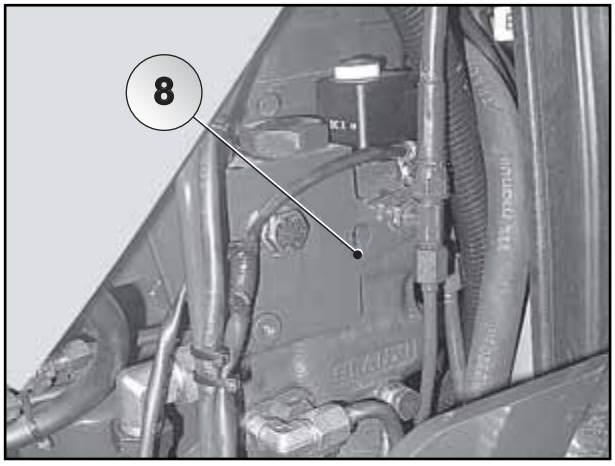


Fig. 10.146

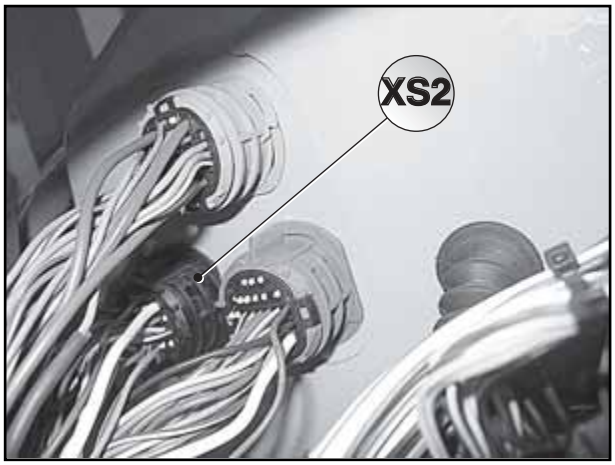


Fig. 10.147

3.6.8.2 Wiring

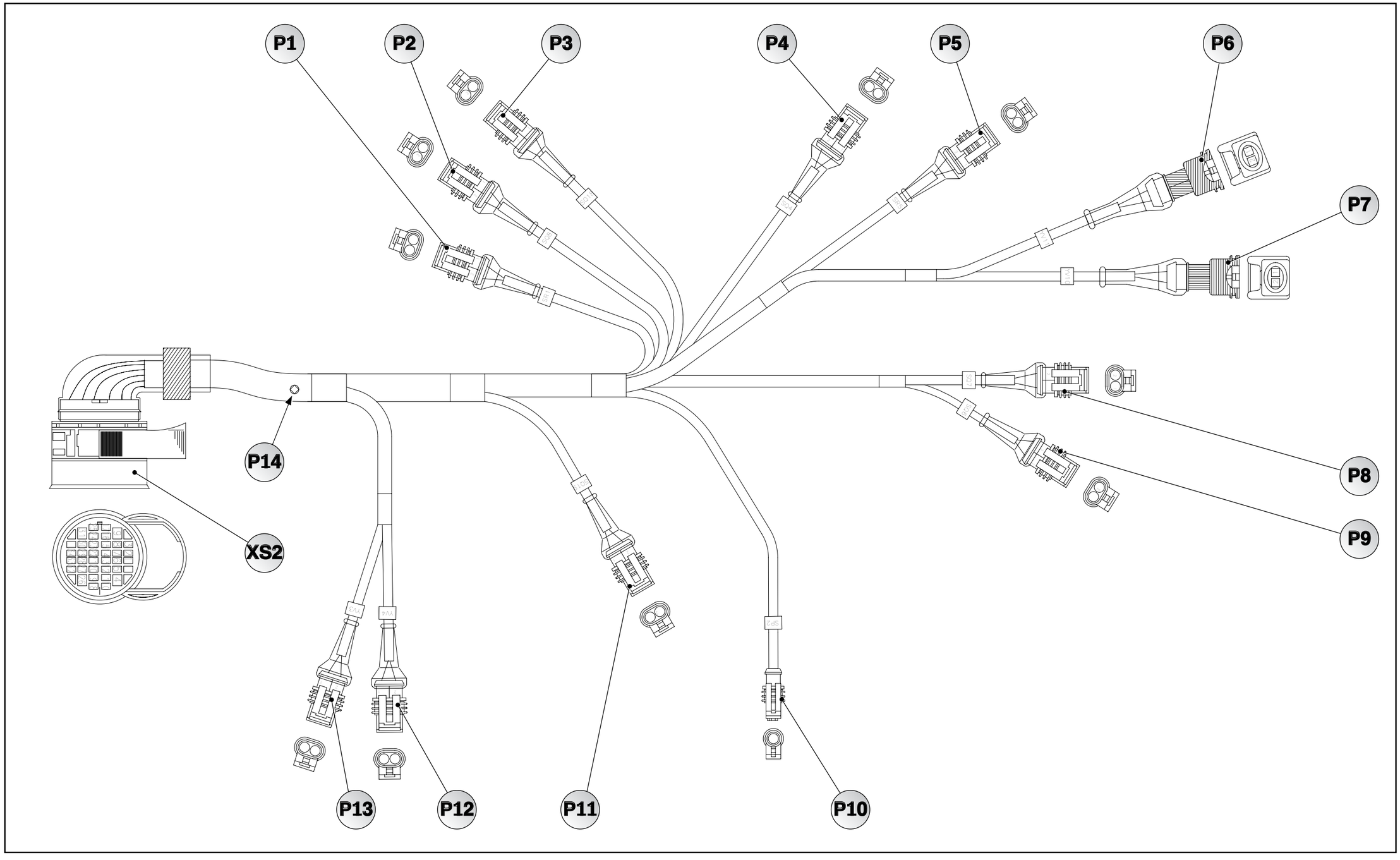


Fig. 10.148

P1 - Connector for ground speed sensor
P2 - Connector for proportional rear PTO microswitch
P3 - Connector for independent rear PTO microswitch
P4 - Connector for parking brake hand lever microswitch
P5 - Connector for rear PTO RPM sensor
P6 - Connector for solenoid valve (YV11) of auxiliary control valve B
P7 - Connector for solenoid valve (YV10) of auxiliary control valve A
P8 - Connector for fast rear PTO microswitch
P9 - Connector for slow rear PTO microswitch
P10 - Trailer brake pressure switch connector
P11 - Connector for ignition enabling microswitch
P12 - Connector for 4WD solenoid valve
P13 - Connector for differential lock solenoid valve
P14 - Junction
XS2 - Terminal board for rear line/dashboard connection

3.6.8.3 Connector locations

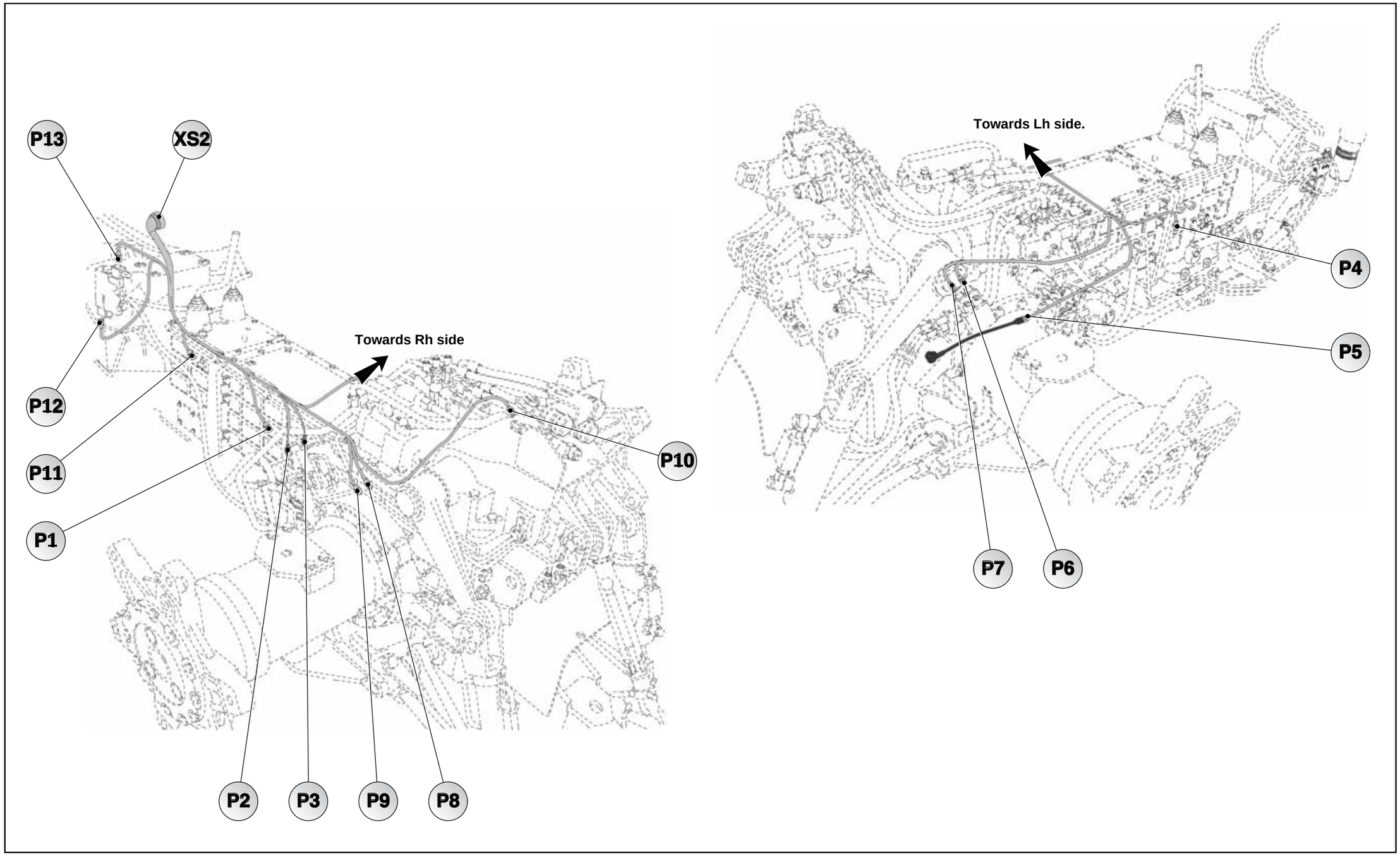


Fig. 10.149

P1 - Connector for ground speed sensor
P2 - Connector for proportional rear PTO microswitch
P3 - Connector for independent rear PTO microswitch
P4 - Connector for parking brake hand lever microswitch
P5 - Connector for rear PTO RPM sensor
P6 - Connector for solenoid valve (YV11) of auxiliary control valve B
P7 - Connector for solenoid valve (YV10) of auxiliary control valve A
P8 - Connector for fast rear PTO microswitch
P9 - Connector for slow rear PTO microswitch
P10 - Trailer brake pressure switch connector
P11 - Connector for ignition enabling microswitch
P12 - Connector for 4WD solenoid valve
P13 - Connector for differential lock solenoid valve
XS2 - Terminal board for rear line/dashboard connection

3.6.8.4 Connector identification

Connector (P1) for ground speed sensor

term.	wire colour	To con. or comp.	term.
1	SN	XS2	15
2	B	P14 (junction)	

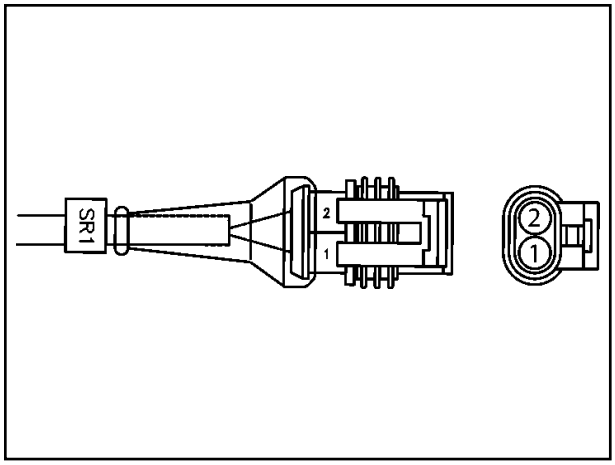


Fig. 10.150

Connector (P2) for proportional rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	C	XS2	21
2	B	P14 (junction)	

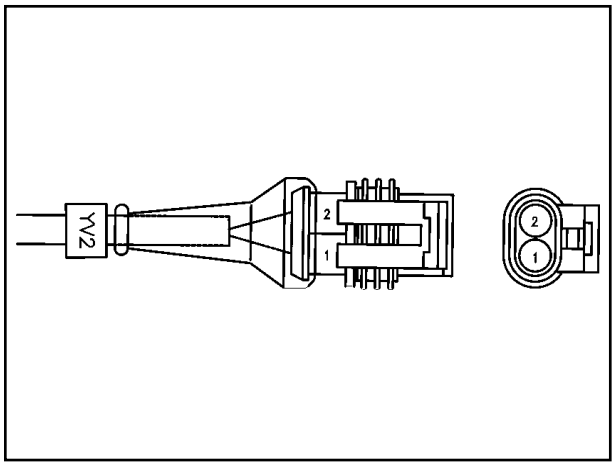


Fig. 10.151

Connector (P3) for independent rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	GM	XS2	19
2	NR	XS2	20

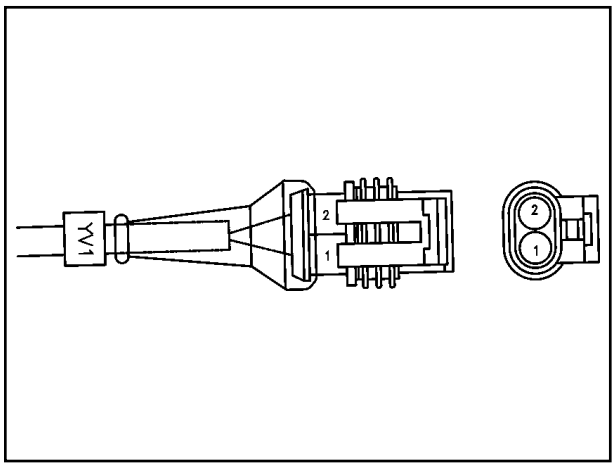


Fig. 10.152

Connector (P4) for parking brake lever microswitch

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	ZN	XS2	13

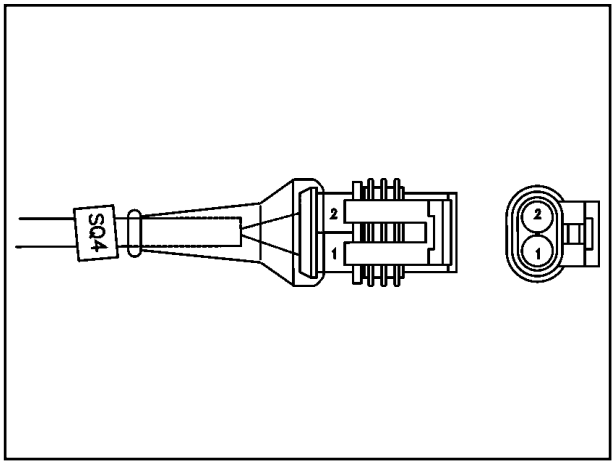


Fig. 10.153

Connector (P5) for rear PTO RPM sensor

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	CN	XS2	16

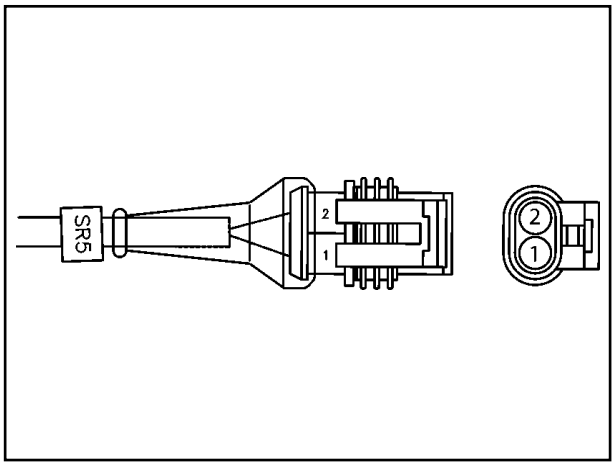


Fig. 10.154

Connector (P6) for solenoid valve (YV11) of auxiliary control valve B

term.	wire colour	To con. or comp.	term.
1	GN	XS2	23
2	B	P14 (junction)	

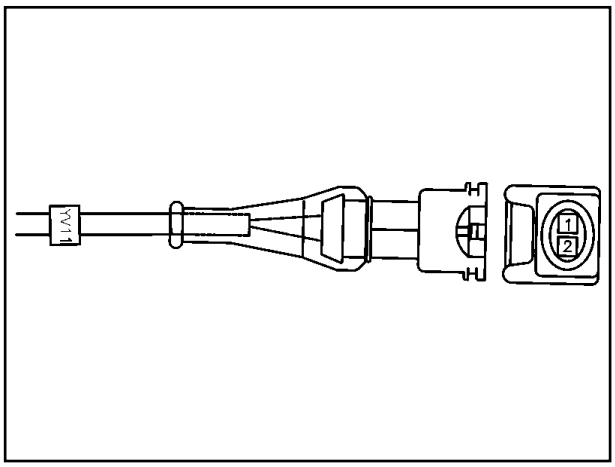


Fig. 10.155

Connector (P7) for solenoid valve (YV10) of auxiliary control valve A

term.	wire colour	To con. or comp.	term.
1	AV	XS2	22
2	B	P14 (junction)	

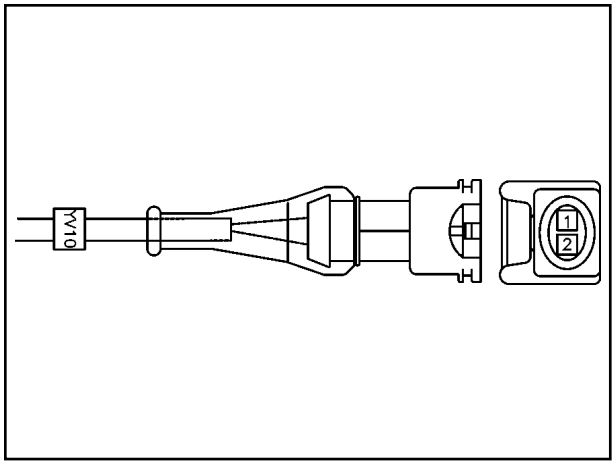


Fig. 10.156

Connector (P8) for fast rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	HL	XS2	3

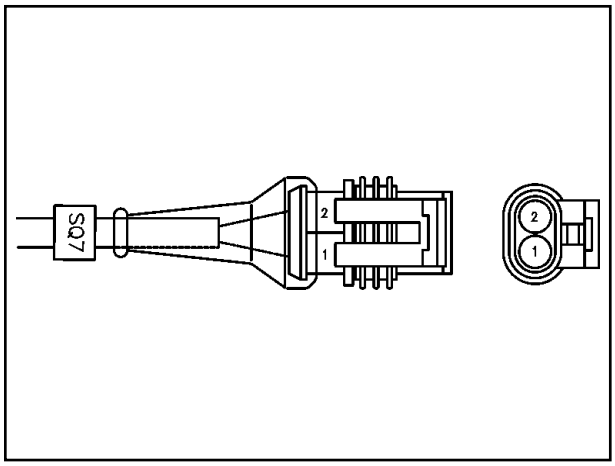


Fig. 10.157

Connector (P9) for slow rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	HV	XS2	5

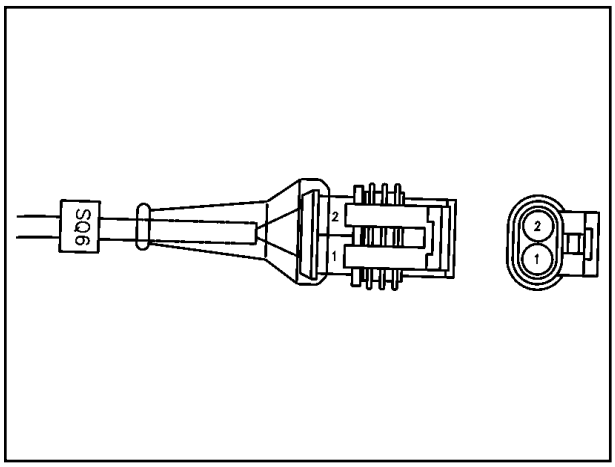


Fig. 10.158

Trailer brake pressure switch connector (P10)

term.	wire colour	To con. or comp.	term.
1	BN	XS2	12

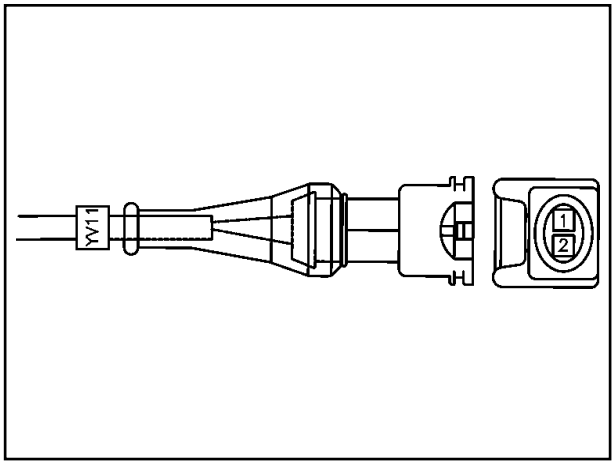


Fig. 10.159

Connector (P11) for ignition enabling microswitch

term.	wire colour	To con. or comp.	term.
1	BV	XS2	17
2	VN	XS2	18

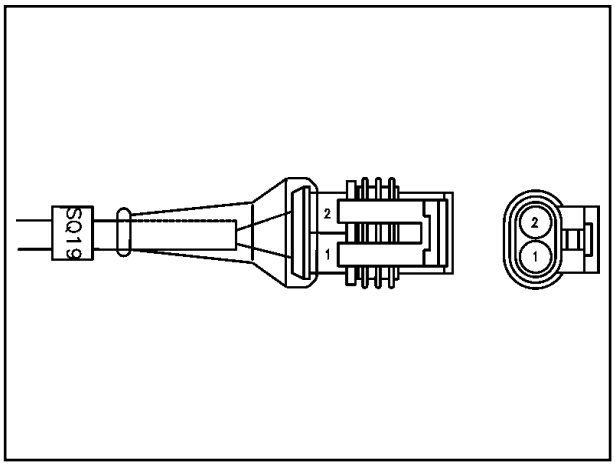


Fig. 10.160

Connector (P12) for 4WD solenoid valve

term.	wire colour	To con. or comp.	term.
1	GL	XS2	2
2	B	P14 (junction)	

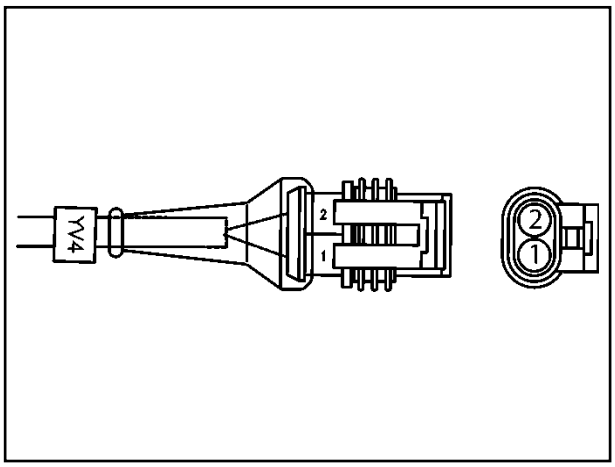


Fig. 10.161

Connector (P13) for differential lock solenoid valve

term.	wire colour	To con. or comp.	term.
1	BR	XS2	1
2	B	P14 (junction)	

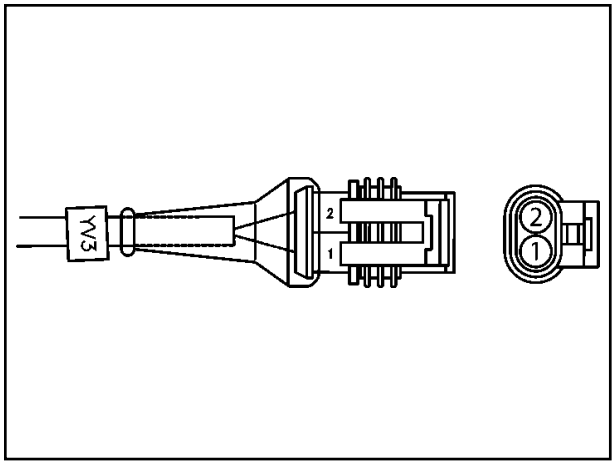


Fig. 10.162

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	P13	1
2	GL	P12	1
3	HL	P8	2
4	B	P14 (junction)	
5	HV	P9	2
6		not used	
7		not used	
8		not used	
9		not used	
10		not used	
11		not used	
12	BN	P10	1
13	ZN	P4	2
14		not used	
15	SN	P1	1
16	CN	P5	2
17	BV	P11	1
18	VN	P11	2
19	GM	P3	1
20	NR	P3	2
21	C	P2	1
22	AV	P7	1
23	GN	P6	1
24		not used	
25		not used	
26		not used	
27		not used	
28		not used	
29		not used	
30		not used	
31		not used	
32		not used	
33		not used	
34		not used	

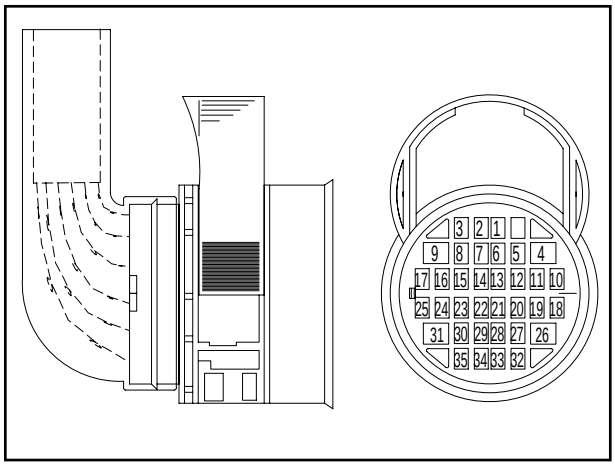


Fig. 10.163

3.6.9 Headlight extension line

3.6.9.1 General description

The headlight extension line powers the lamps installed at the front of the tractor's bonnet (Fig.10.164).

The headlight extsneion line is connected to the engine's front line by means of connectors (H3 and B25)(Fig.10.165).

Fig. 10.164

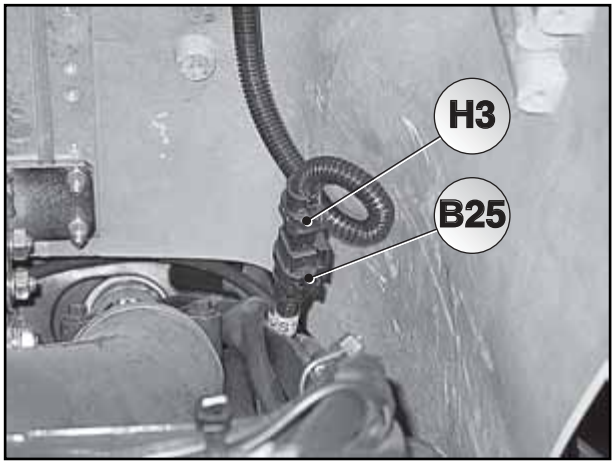


Fig. 10.165

3.6.9.2 Wiring

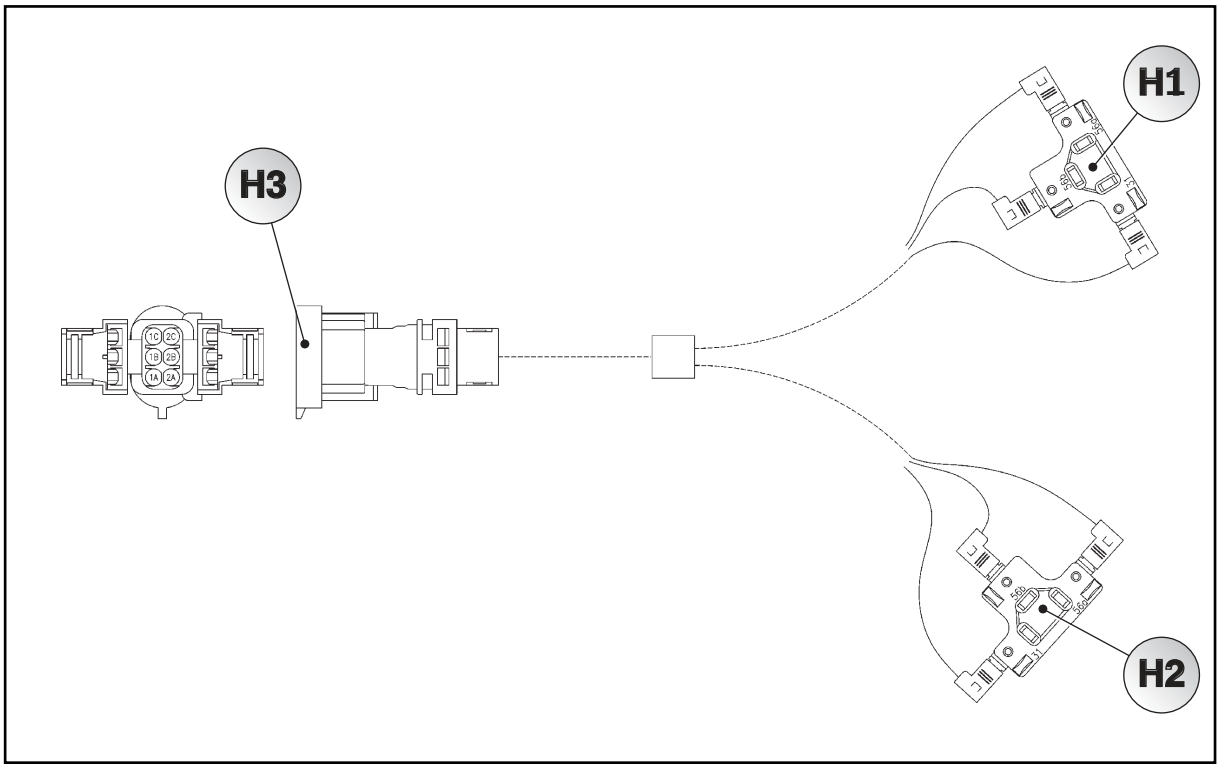


Fig. 10.166

H1 - Lh headlight connector
H2 - Rh headlight connector
H3 - Connector for connecting to the front line

3.6.9.3 Connector locations

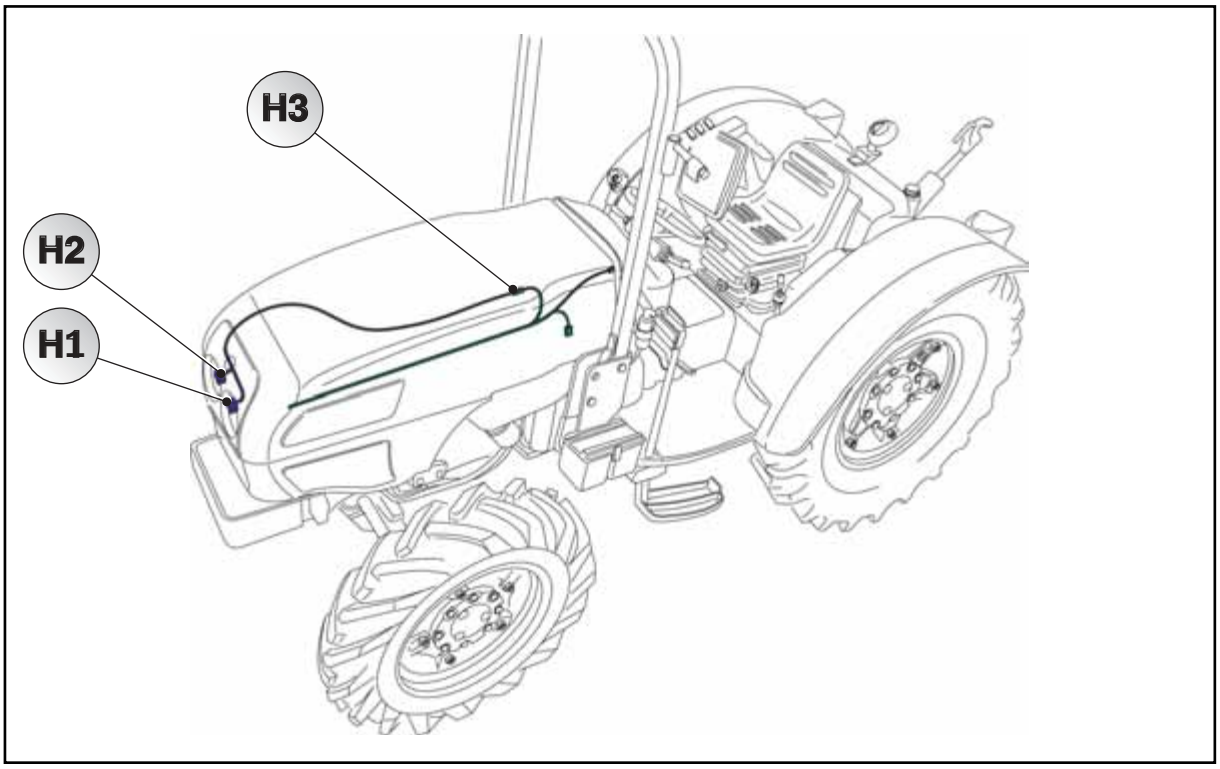


Fig. 10.167

3.6.9.4 Connector identification

Lh headlight connector (H1)

term.	wire colour	To con. or comp.	term.
1	B	H3	2C
2	H	H3	2B
3	V	H3	1A

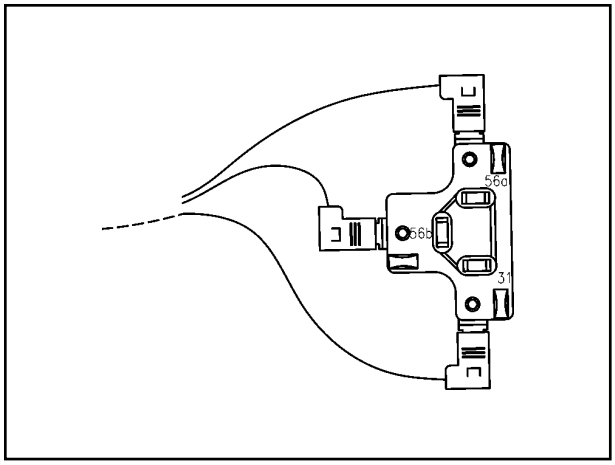


Fig. 10.168

Rh headlight connector (H2)

term.	wire colour	To con. or comp.	term.
1	B	H3	1C
2	HN	H3	2A
3	VN	H3	1B

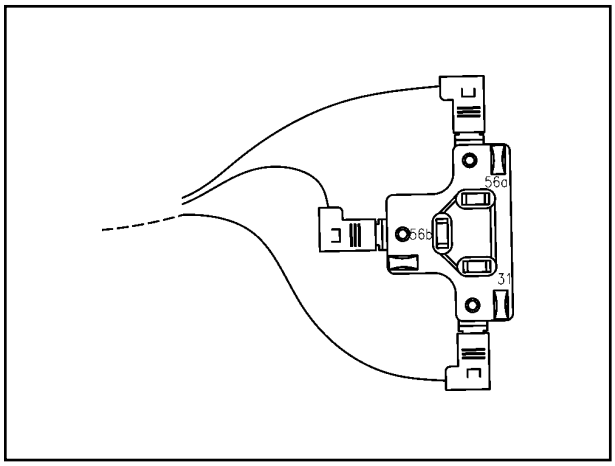


Fig. 10.169

Connector (H3) for front line connection

term.	wire colour	To con. or comp.	term.
1A	V	H1	3
1B	VN	H2	3
1C	B	H2	1
2A	HN	H2	2
2B	H	H1	2
2C	B	H1	1

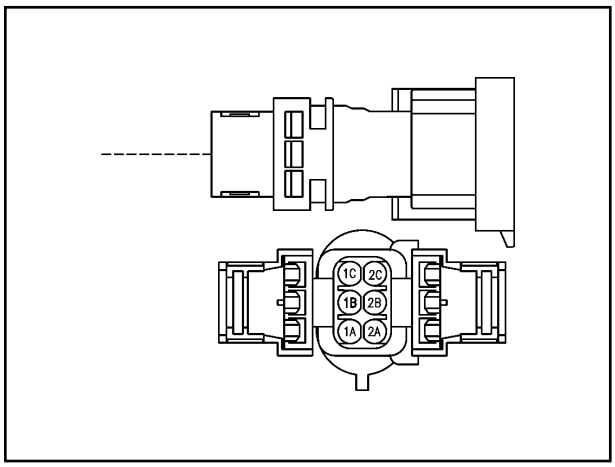


Fig. 10.170

3.7 F-N Series Speed Five cab

3.7.1 Technical specifications

3.7.1.1 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
Voltage	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Alternator

Make	Ix
Type	Threephase
Voltage	14 V
Current	85 A

Starter motor

Manufacturer	Ix - Dsx
Type	Solenoidal
Maximum power	2.8 kW
Type of engagement	Automatic pinion engagement by means of electro-magnet.

Solenoid valves

Manufacturer	Srx Dx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 Ω ±5%

Sensors

Manufacturer	Jx/Stx
Type	Inductive

Instrument

Make	Dgx

3.7.1.2 Relays and fuse holders

The electrical system of **F-N Series** tractors is protected against short-circuits and excessive power draw by means of fuses. The number of fuses installed in the electrical system depends on the components and functions that need protecting.

The fuses are installed in two dedicated boxes:

Z - front fuse box (Fig.10.171) installed at the front, near the battery that powers the system. It contains a further fuse (FU5) that protects the preheater relay.

B - main fuse box (Fig.10.173) installed on the left-hand side of the dashboard cover.

Y - cab fuse box (Fig.10.172), in the cab on the roof, on the right-hand side of the covering, upper zone.

Note: before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

The cab version of **F-N Series Speed Five cab** is fitted with a fuse (FU6 Fig.10.177) on the line that connects the roof facilities and the alternator, so as to protect the cab power.

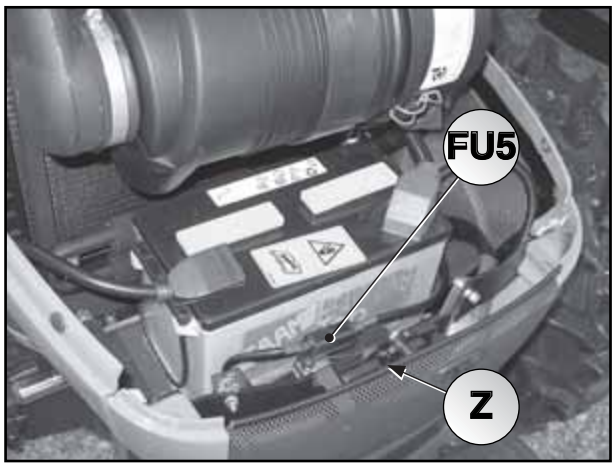


Fig. 10.171

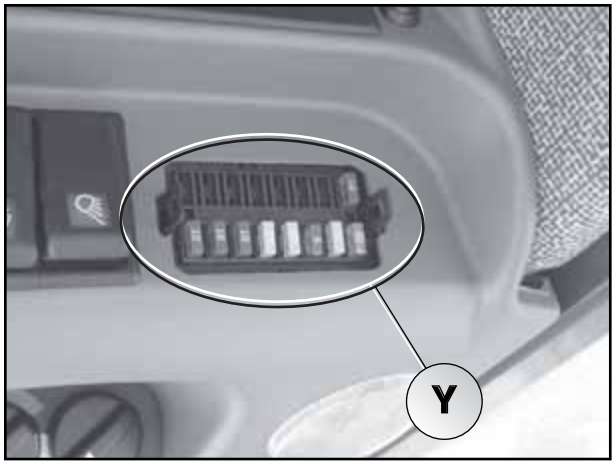


Fig. 10.172

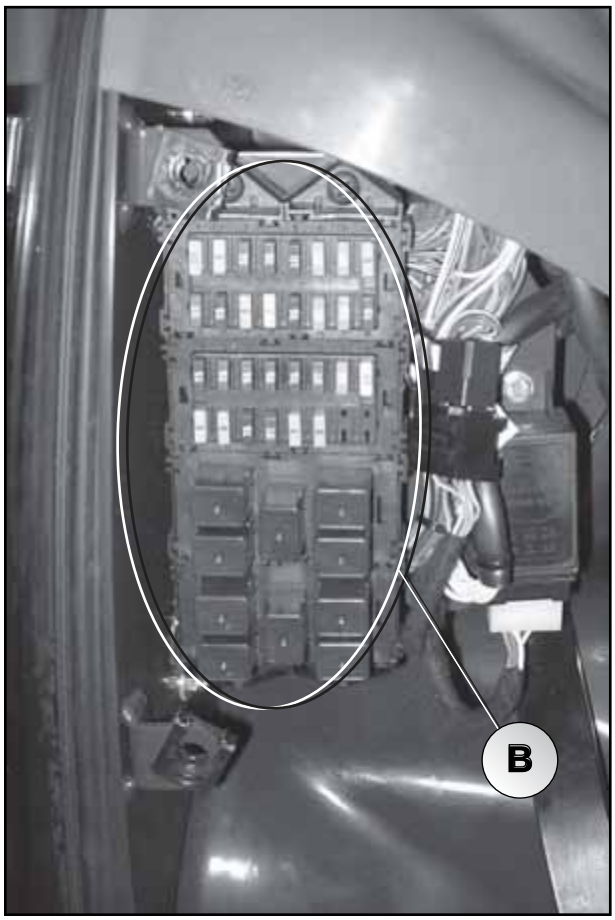


Fig. 10.173

Z- Front fuse box

The front fuses are installed in the “battery-starter motor line” wiring. They are connected by means of the positive terminal (A1) to the battery (GB1) on the one side and on the other side, to the front engine line, by means of connectors (B14 and B15) (Fig.10.174).

The front line is also fitted with a further fuse (FU5 Fig.10.175) for protecting the glow plug pre-heater system.

Turn the ignition key to the 2nd position to activate the power relay (K16), which transmits the signal for preheating the plate in contact with the glow plugs. The relay (K16) cuts out the electrical signal after 5 seconds in this position have elapsed. The relative indicator light (A Fig.10.176) on the display of the instrument goes out, indicating that the tractor engine can now be started.

The front fuses have the following functions and ampere ratings (Fig.10.174):

Fuse	Circuits protected	Amp.
FU1	Primary	60
FU2	Alternator primary	70
FU3	Primary	60
FU4	Primary	60
FU5	Glow plugs (Fig.10.175)	50

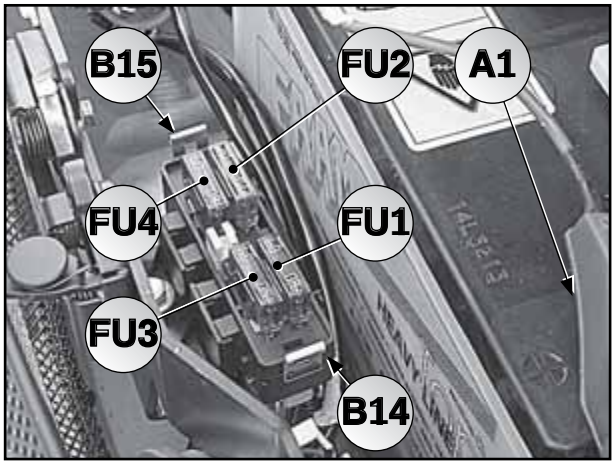


Fig. 10.174

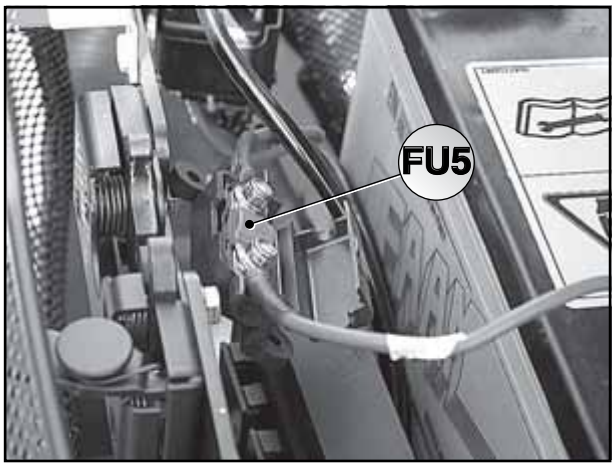


Fig. 10.175

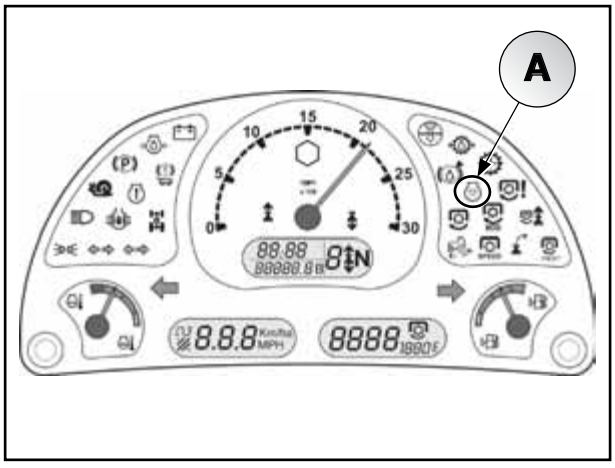


Fig. 10.176

Fuse (FU6 Fig.10.177) is installed between the roof facility line and the power from the alternator. It is installed under the bonnet and protects the services in the cab roof wiring

Fuse	Circuits protected	Amp.
FU6	Cab roof line power	50

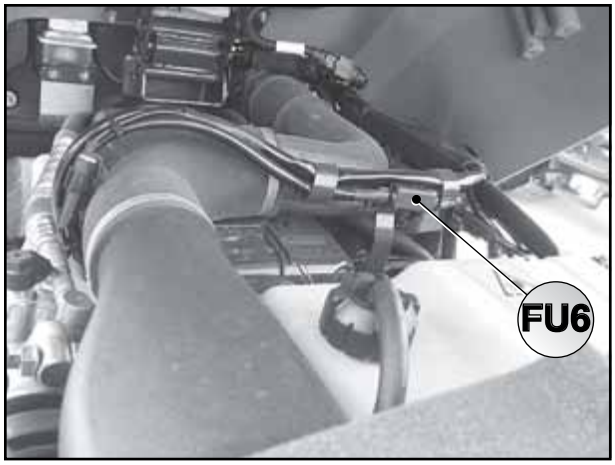


Fig. 10.177

B - Main fuse box

The main fuses are installed in the dashboard wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
F1	Rear PTO	7.5
F2	Auxiliary relays	5
F5	Key-activated Instrument	5
F6	Fuel pump	7.5
F7	4WD solenoid valve	5
F8	Brake light switch	7.5
F9	Diff lock solenoid valve	7.5
F10	Dipped beams	15
F11	Driving beams	15
F12	Blinker	10
F13	Lh side lights	7.5
F14	Rh side lights	7.5
F15	Light switch	10
F16	Electronic power lift (Indicator D+)	5
F17	Electronic power lift (Key-activated positive)	5
F18	Diff lock and brake light controls	15
F20	Starter motor	15
F21	Rear field lights	7.5
F22	Instrument and buzzer power	5
F24	Flow selector (A-B)	5
F25	Auxiliary socket (key-activated power)	15
F26	Auxiliary socket (key-activated power)	20
F27	Horn + revolving beacon	15
F29	Cab	5
F30	Pneumatic seat	15
F36	Emergency switch	15
F39	NAO KIT positive	7.5

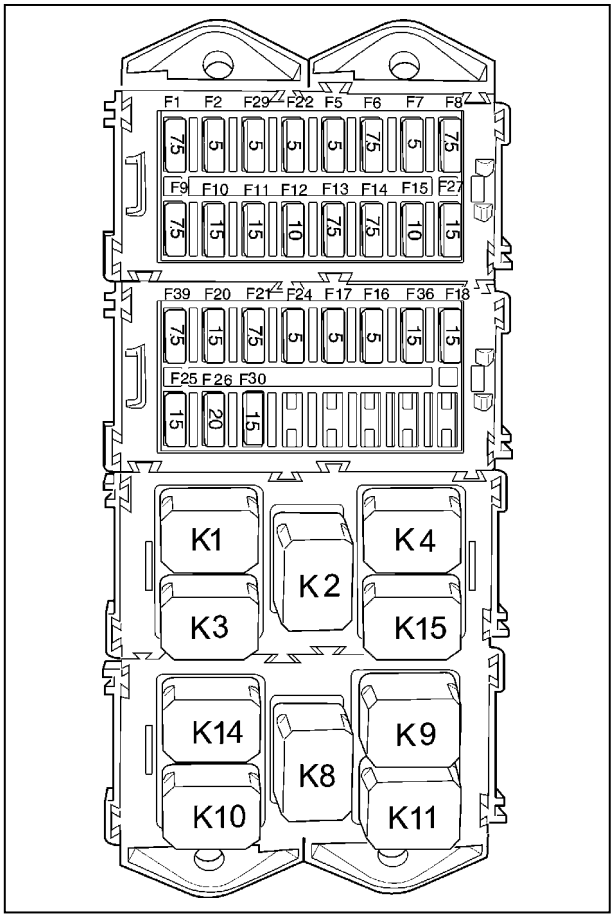


Fig. 10.178

Y - Cab fuse box

The fuses for the “cab” services are installed in the roof wiring line (Fig.10.179) and have the following functions and ampere ratings:

F3	Key-activated Instrument	15
F4	Ac pressure switch, compressor, radio	20
F23	Revolving beacon	15
F28	Window washer	10
F32	Optional	5
F33	Rear window wiper	10
F34	Front field lights	15
F35	Rear field light	10
F40	Windscreen wiper	10

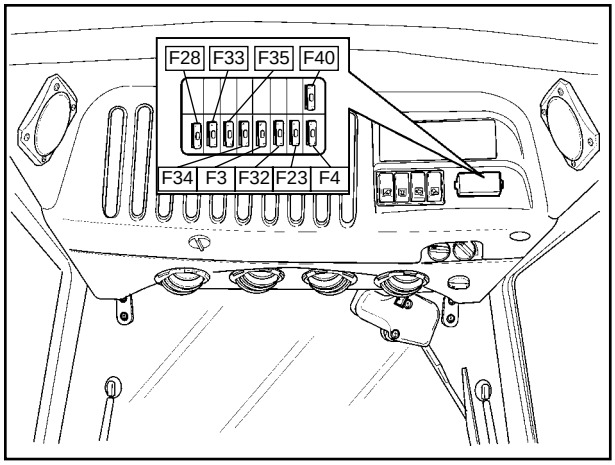


Fig. 10.179

There are 15 relays installed in **F-N Series Speed Five cab version** tractors, of which 10 are installed in the front fuse box (B), just under the protection fuses (Fig.10.180), 1 is installed at the front, near the fuse box (Z)(Fig.10.182) and another 4 are installed in the roof wiring line (Fig.10.181).

Relays	Function
K1	Immobiliser relay
K2	Relay for socket + pneumatic seat
K3	Field light relay
K4	Brake light and instrument relay
K8	Differential lock relay
K9	Driving beam relay
K10	Dipped beam relay
K11	Headlight relay
K14	Relay for diff lock release + rear brake lights
K15	Start-inhibiting relay for engaged rear PTO
K16	Power relay (glow plug preheater) (Fig.10.182).

Another 4 relays are installed in the cab roof wiring line, in the rh side behind the lining, near to the protection fuses (Fig.10.181)

Relays	Function
K5	AC compressor/key-activated positive relay
K6	Relay for roof auxiliaries
K17	Front field light relay
K18	Rear field light relay

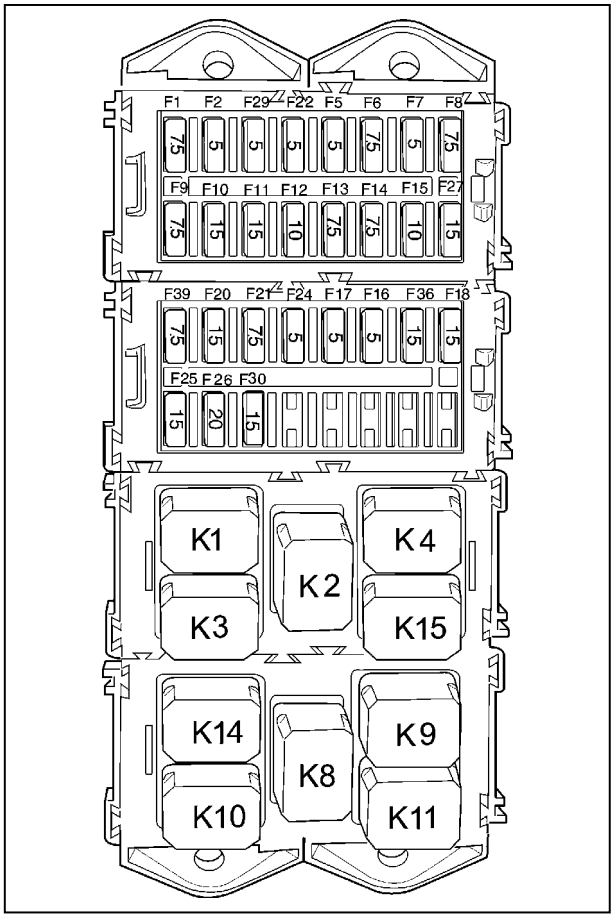


Fig. 10.180

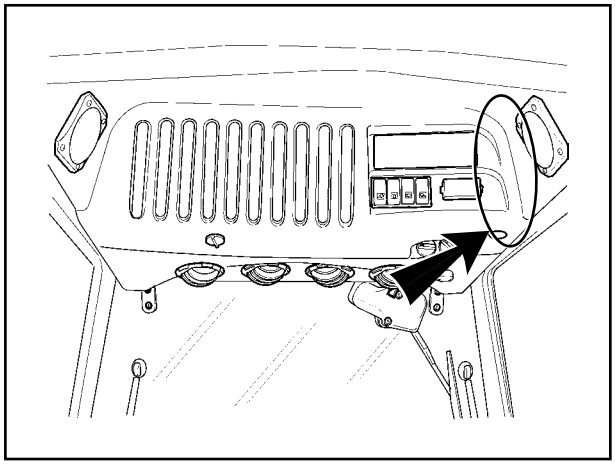


Fig. 10.181

Fig. 10.182

identification of the components in the functional diagram

Code	Description	Part	Col.
A01	Instrument	4	3
A02	Radio	3	4
B01	Alternator	1	7
B02	Lh loudspeaker	3	4
B03	Rh loudspeaker	3	4
D01	Blinker	2	4
EH1	Glow plugs	1	6
EL1	Cab ceiling light	3	4
EL2	Footstep revolving beacon light	4	2
EL3	Cab rotating beacon	3	3
EL4	Lh front field light	3	7
EL5	Rh front field light	3	7
EL6	Lh rear field light	3	7
EL7	Rh rear field light	3	8
EL9	Platform rear field light	4	1
EL13	License plate light	2	7
EL14	Rh headlight	1	7
EL15	Lh headlight	1	7
F1	Front PTO/safety fuse	1	4
F2	Auxiliary relay fuse	1	2
F3	Cab auxiliary relay fuse	1	1
F4	Air conditioning fuse	3	2
F5	Key-activated fuse for instrument	4	4
F6	Injection-fuel pump fuse	1	8
F7	4WD fuse	1	4
F8	Brake light indicator fuse	2	3
F9	Diff lock fuse	2	2
F10	Dipped beam fuse	1	6
F11	Driving beam fuse	1	7
F12	Blinker fuse	2	3
F13	Side light fuse	2	7
F14	Side light fuse	2	8
F15	General side light fuse	2	7
F16	El. power lift fuse (alternator D+ positive)	1	7
F17	El. power lift fuse (key-activated positive)	1	2
F18	Fuse for diff lock controls and brake lights	2	2
F20	Starter motor fuse	1	6
F21	Rear field light fuse	4	1
F22	Fuse for instrument and buzzer power	4	4
F23	Fuse for ceiling light-cab's rotating beacon	3	3
F24	A-B control valve fuse	1	5
F25	Auxiliary socket fuse 25A	4	2
F26	Auxiliary socket fuse 25A	4	2
F27	Fuse for horn, rotating beacon	4	2
F28	Fuse for field light/windscreen wiper-washer controls	3	4
F29	Windscreen wiper fuse	3	4
F30	Pneumatic seat fuse	4	3
F31	Window washer reservoir fuse	3	5
F32	Radio fuse	3	4
F33	Rear window wiper fuse	3	5
F34	Cab's front field light fuse	3	7
F35	Cab's rear field light fuse	3	7
F36	Emergency switch fuse (hazard)	2	4
F39	NAO control unit fuse	2	3
FU1	Link-box primary fuse	1	1
FU2	Link-box alternator primary fuse	1	7
FU3	Link-box primary fuse	2	3
FU4	Link-box primary fuse	4	1
FU5	Glow plug fuse (steering wheel midival)	1	6
FU6	Cab power fuse (steering wheel midival)	3	2
GB1	Battery	1	1
HA1	Horn	4	2
HA2	Alarm buzzer	4	4
HL1	Rh front turn indicator	2	5
HL2	Rh rear turn indicator	2	5
HL3	Lh front turn indicator	2	4
HL4	Lh rear turn indicator	2	4
HL5	Rh front side light	2	7
HL6	Rh rear side light	2	8
HL7	Lh front side light	2	8
HL8	Lh rear side light	2	7
HL9	Rh brake light indicator	2	3
HL10	Lh brake light indicator	2	3
HL11	Supplementary rh turn indicator (NAO)	2	3
HL12	Supplementary lh turn indicator (NAO)	2	3
K1	Starter motor power relay	1-1	6-4
K2	Power relay for auxiliary socket - pneumatic seat	4-1	2-2
K3	Relay for side lights, brake lights	2-1	3-2

K4	Relay for fuel injection - field light - instrument	4-1	1-2
K5	Air conditioning power relay	3-1	2-1
K6	Roof auxiliary power relay	3-1	4-1
K8	Diff lock power relay	2-2	2-1
K9	Driving beam power relay	1-2	7-6
K10	Dipped beam power relay	1-2	6-6
K11	Headlight power relay	1-1	6-3
K14	Power relay for diff lock release, brake light indicators	2-2	2-1
K15	Rear PTO safety power relay	1-1	4-3
K16	Glow plug power relay	1-1	6-5
K17	Cab front field light power relay	3-3	7-6
K18	Cab rear field light power relay	3-3	7-6
M1	Starter motor	1	6
M2	Windscreen wiper motor	3	4
M3	Rear window wiper motor	3	5
M4	Rear window washer pump	3	5
M5	Pneumatic seat actuator	4	3
M6	Electric fan in cab	3	2
M8	Rear window washer pump	3	5
M9	Air conditioning compressor	3	2
M10	Fuel pump motor	1	7
R01	Air conditioning electric fan resistor	3	1
SA00	Main contact key switch	1	1
SA01	Light switch selector	2	5
SA04	Cab front field light selector	3	6
SA05	Cab rear field light selector	3	6
SA08	Platform revolving beacon commutator	4	1
SA09	Hazard light switch	2	4
SA10	Cab rotating beacon commutator	3	3
SA11	4WD commutator	1-4	4-1
SA13	A/C electric fan commutator	3	1
SA15	Side lights and dipped beams commutator	2	7
SB06	Window washer button	3	5
SB08	Differential lock button	2	1
SB09	Auxiliary control valve button	1	5
SL1	Fuel level sensor	4	7
SL2	Brake fluid level sensor	4	7
SL3	Supplementary fuel tank level sensor	4	8
SP1	A/C dehydrator filter pressure switch	3	2
SP2	Hydraulic trailer brake pressure switch	4	5
SP3	Gearbox oil intake vacuum switch	4	4
SP4	Engine oil pressure switch	4	4
SP5	Air intake circuit vacuum switch	4	4
SP8	Brake pump pressure switch (brake-diff lock)	2	1
SQ4	Hand brake lever microswitch	4	7
SQ6	540 rear PTO microswitch	4	6
SQ7	750-1000 rear PTO microswitch	4	6
SQ8	Synchronized rear PTO microswitch	4	5
SQ18	PTO engaged microswitch	1	3
SQ19	Safety microswitch on gearshift lever	1	4
SR1	Ground speed sensor	4	5
SR5	Rear PTO rate sensor	4	5
ST6	Engine water temperature sensor	4	4
ST7	Fuel enrichment jet sensor	1	8
YA1	Fuel injection pump solenoid	1	8
YA2	Fuel enrichment jet solenoid	1	7
YV3	Diff lock solenoid valve	2	2
YV4	4WD solenoid valve	1	4
YV10	Auxiliary control valve solenoid valve A	1	4
YV11	Auxiliary control valve solenoid valve B	1	5

Term.boards

XS0	7-pin trailer socket terminal board
XS1	Front wiring line terminal board
XS2	Rear wiring line terminal board
XS3	Platform wiring line terminal board
XS5	Roof wiring line terminal board
XS7	Auxiliary socket terminal board

References to functional diagram

1 - Cab version only
2 - Four-wheel drive indicator
3 - Independent PTO indicator
4 - Glow plug ind.light
5 - Driving beam ind.light
6 - Rate gyroscope
7 - Alternator indicator light
8 - Differential lock indicator
9 - NAO plant (+12V)
11 - Glow plug ind.light
12 - Four-wheel drive
13 - Differential lock
14 - Rear independent PTO
15 - Driving beams
16 - Side lights
17 - Lh turn ind.
18 - Rh turn ind.
19 - 1st trailer direction ind.
20 - 2nd trailer direction ind.
21 - Engine rate ind. from alternator (W)
22 - Alternator indicator light

3.7.2 Main wiring diagram

Part 1

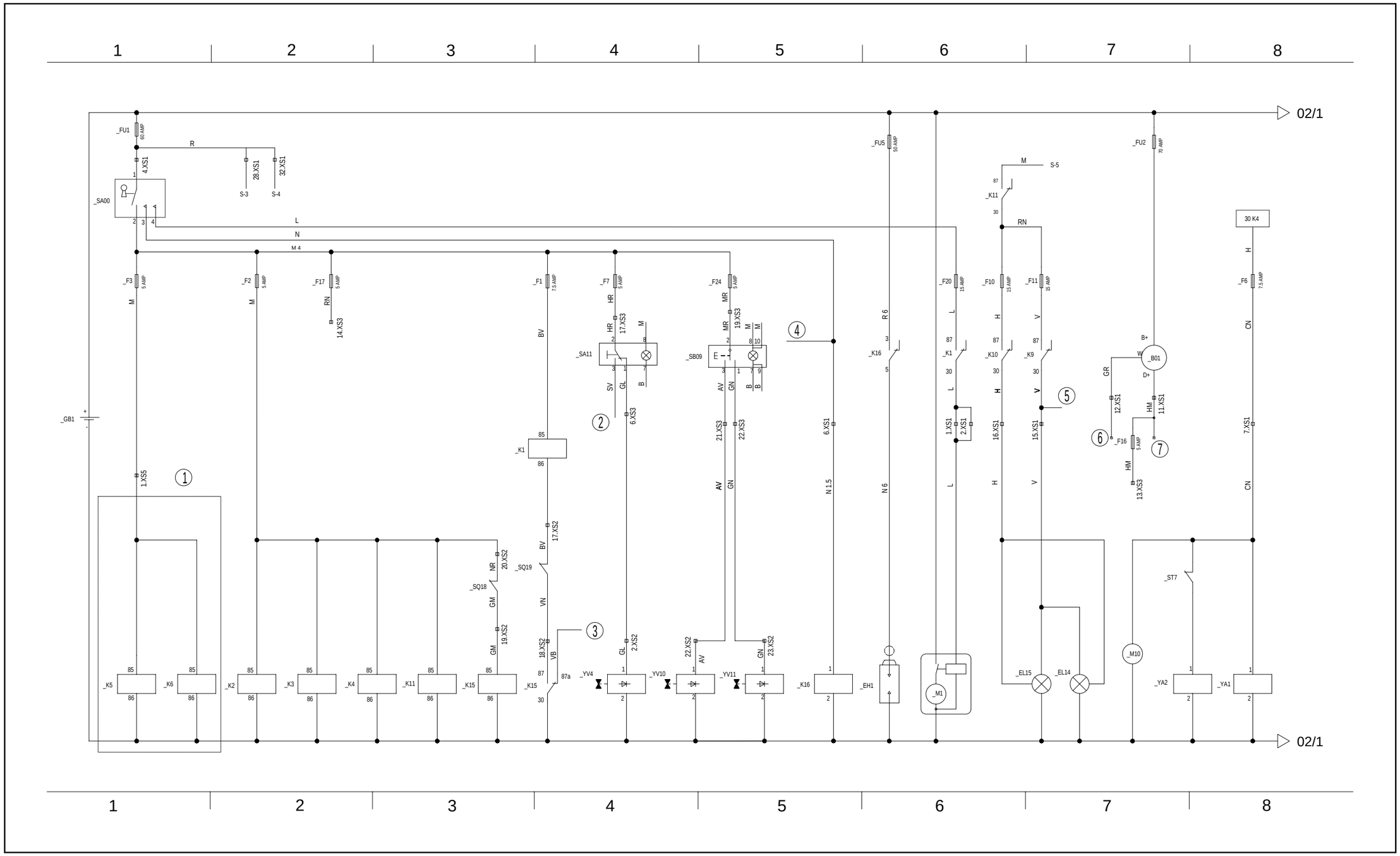


Fig. 10.183

Part 2

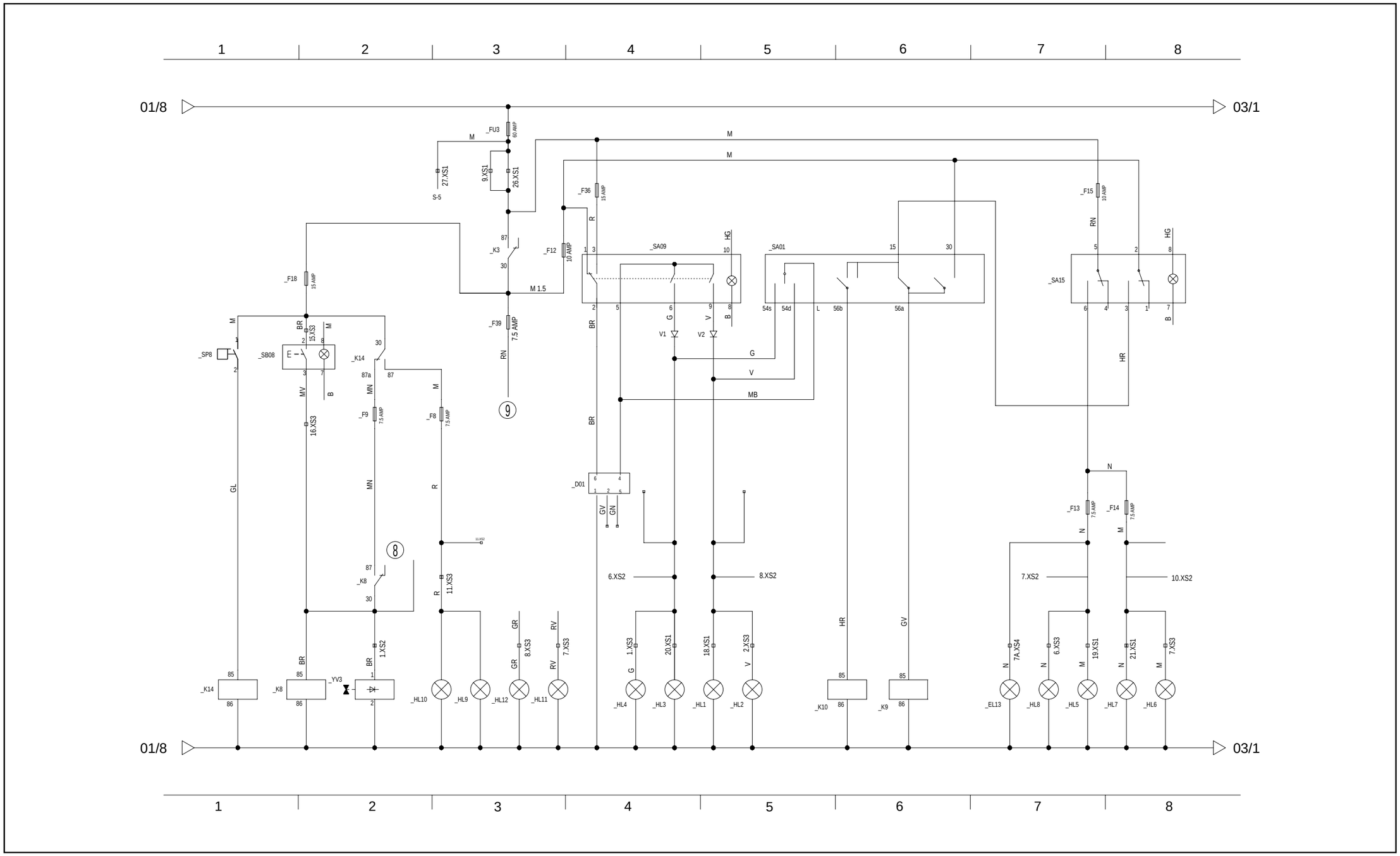


Fig. 10.184

Part 3

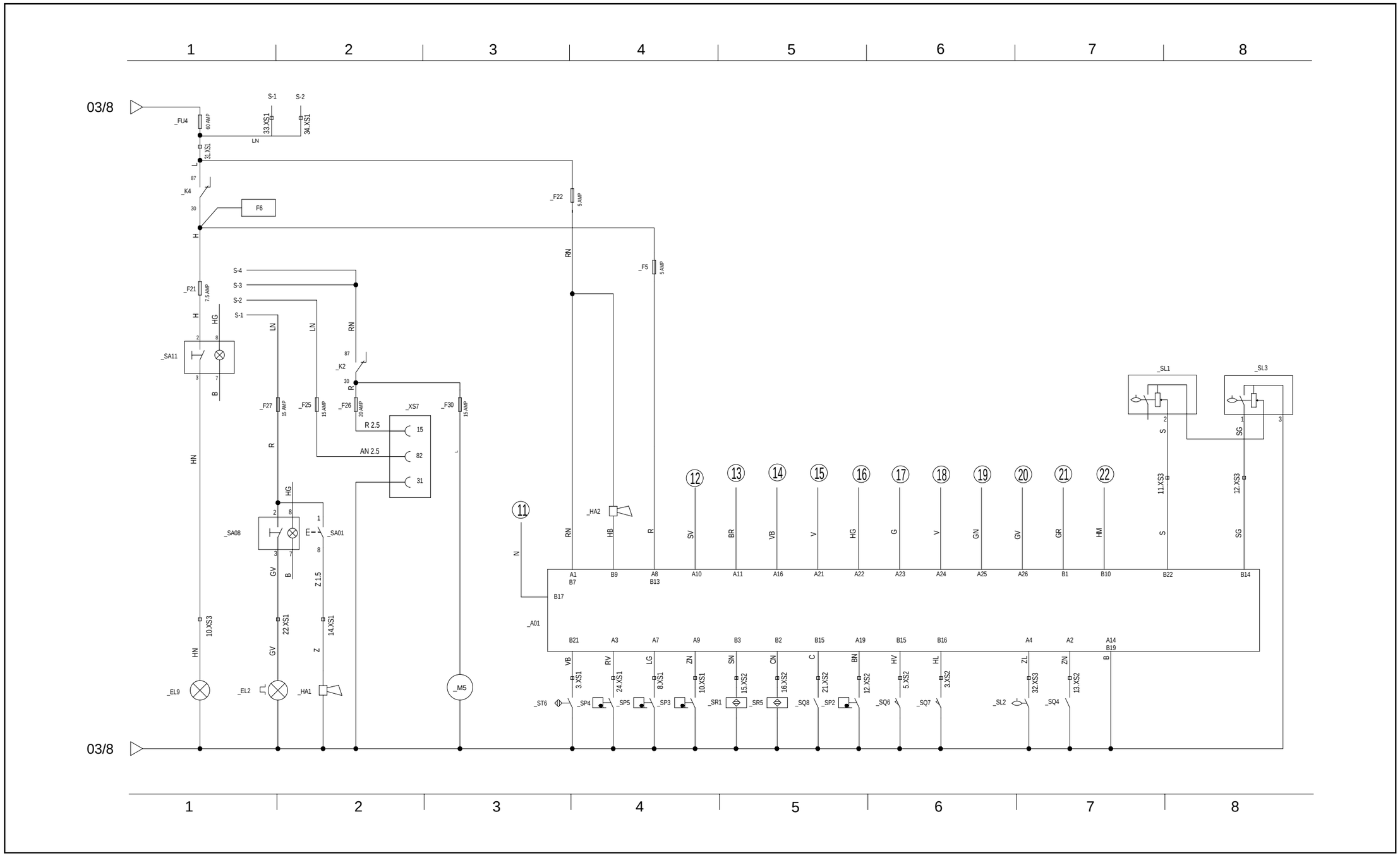


Fig. 10.185

Part 4

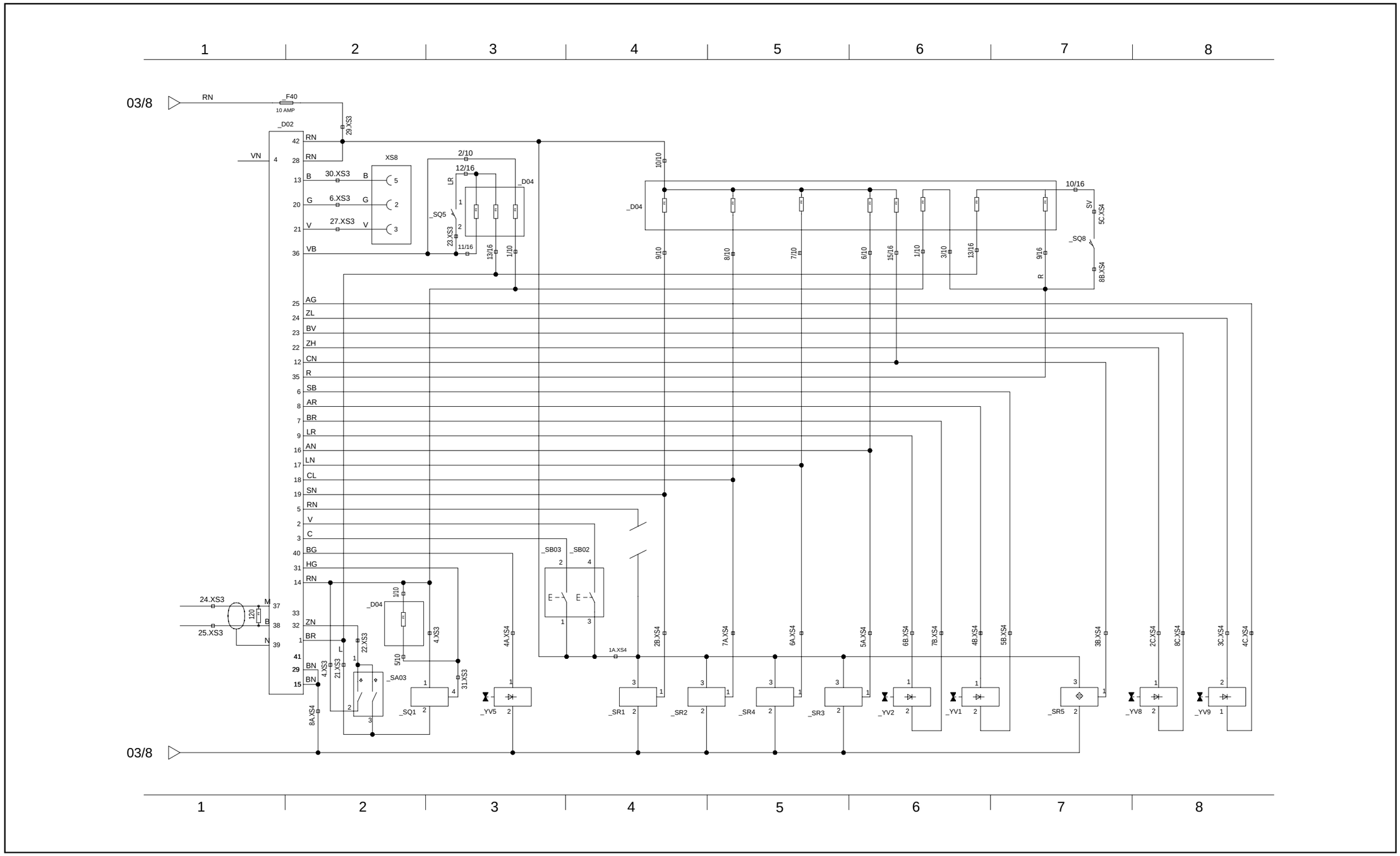


Fig. 10.186

3.7.3 Battery-starter motor line

3.7.3.1 General description

This line is very important for the functionality of the electrical system of the entire tractor. It connects the positive battery pole to the starter motor (M1 Fig.10.187), thus allowing the entire electrical system to be powered, as the ignition switch is connected to the battery.

Connection to the front fuse box is made on the positive battery terminal (Fig.10.188). These fuses protect the tractor's electrical system against short circuits and excessive power draw.

The positive battery terminal is also connected to power fuse (FU5), which protects the preheater relay (K1&) from short-circuits (Fig.10.189).

Battery (GB1) is installed in the front, between the radiator and headlights (Fig.10.189).

⚠	**Attention:** comply with the safety instructions !

⚠	**Attention:** disconnect the ground wire (-) from the battery.

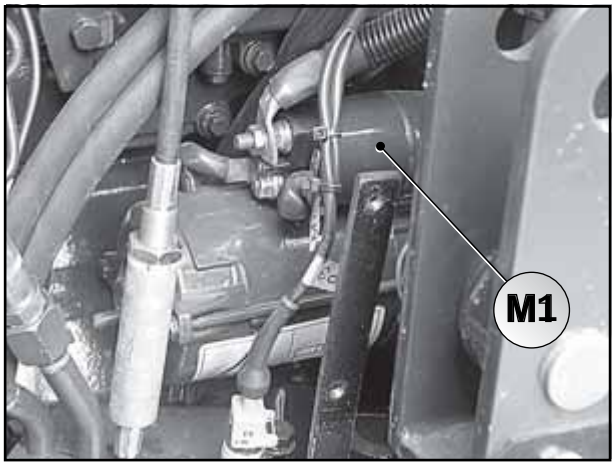


Fig. 10.187

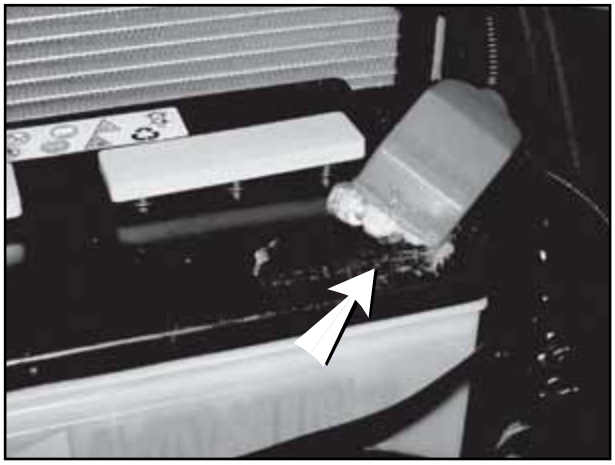


Fig. 10.188

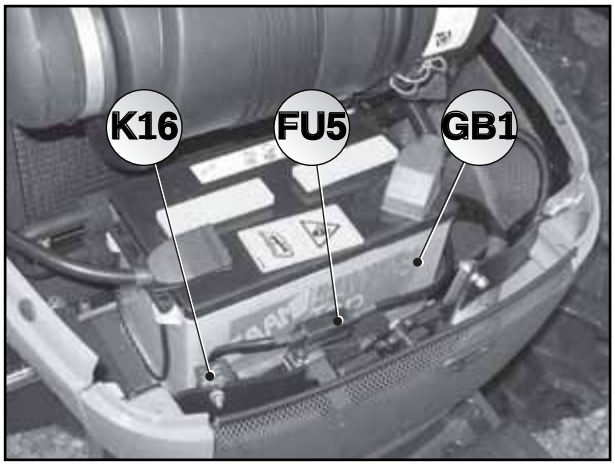


Fig. 10.189

3.7.3.2 Wiring

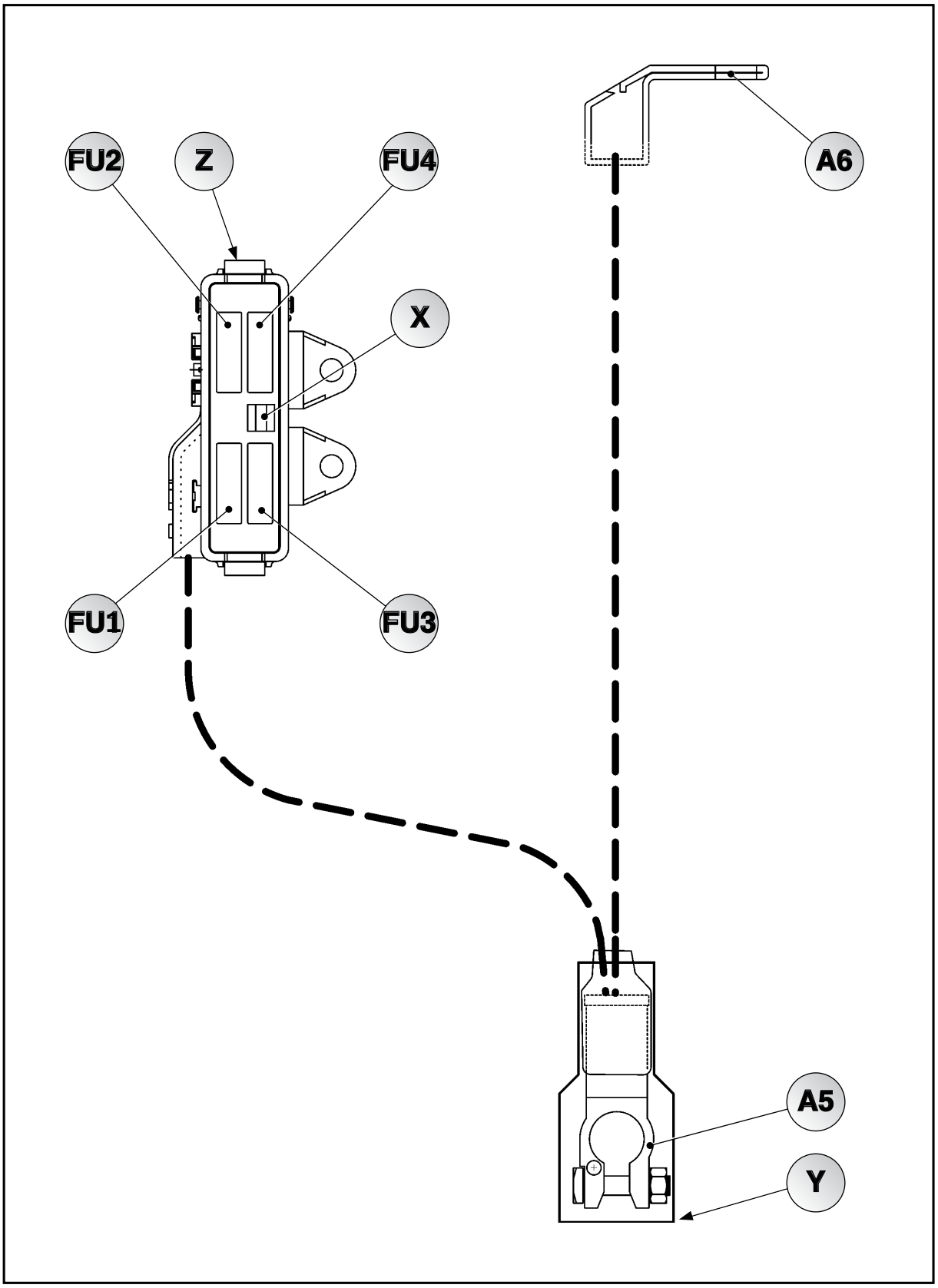


Fig. 10.190

Z - Front fuse box
Y - Insulating cap
X - Pincers for removing fuses
FU1 - 60 Amp. fuse
FU2 - 70 Amp. fuse
FU3 - 60 Amp. fuse
FU4 - 60 Amp. fuse
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal

3.7.3.3 Connector locations

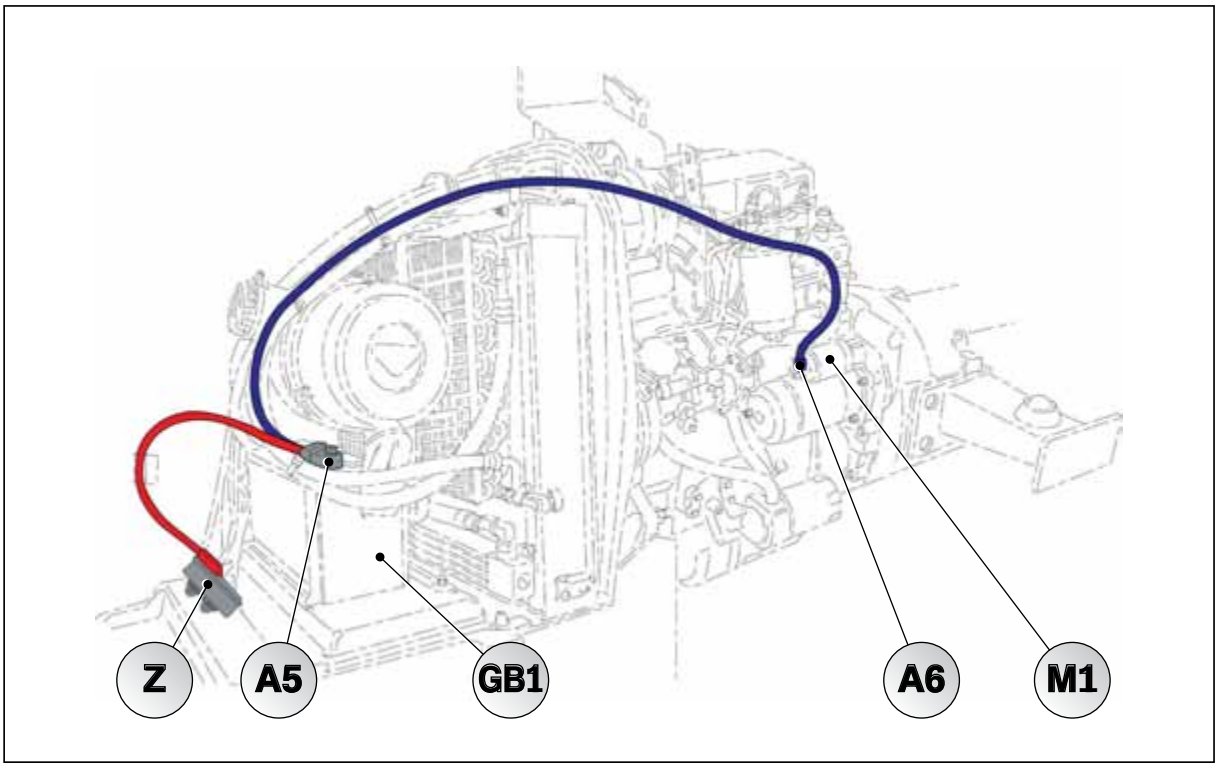


Fig. 10.191

GB1 - Battery
M1 - Starter motor
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal
Z - Front fuse box

The front fuse box (Z) is installed in front of the battery (GB1).

The four fuses inside are important since they protect the tractor's entire electrical system from short-circuits and excessive power draw.

Before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it. (Fig.10.192).

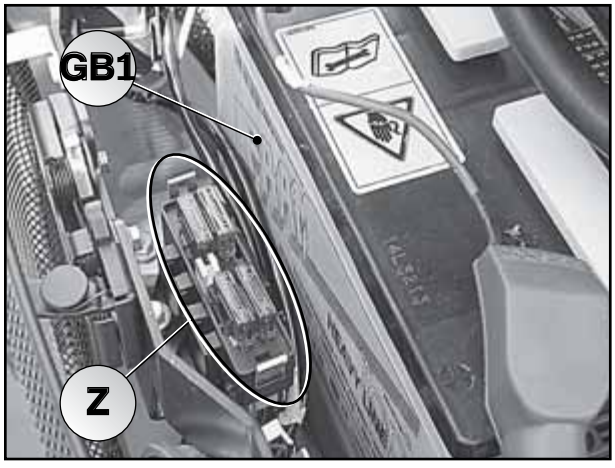


Fig. 10.192

3.7.3.4 Connector identification

Terminal (A6) for starter motor connection

term.	wire colour	To con. or comp.	term.
A	N	M1	

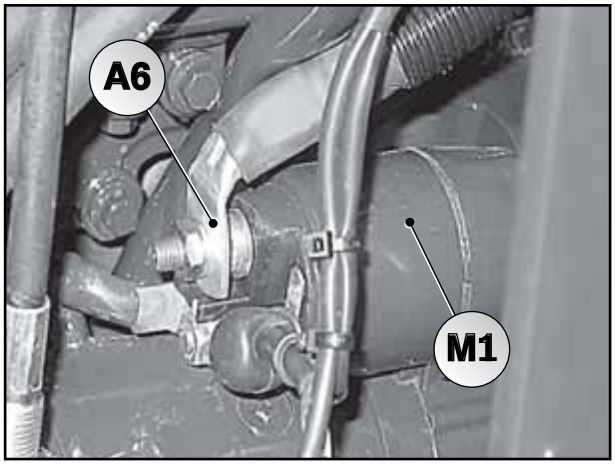


Fig. 10.193

Eyelet (A5) connection to the battery's positive terminal allows the remaining part of the tractor's electrical system to be powered.

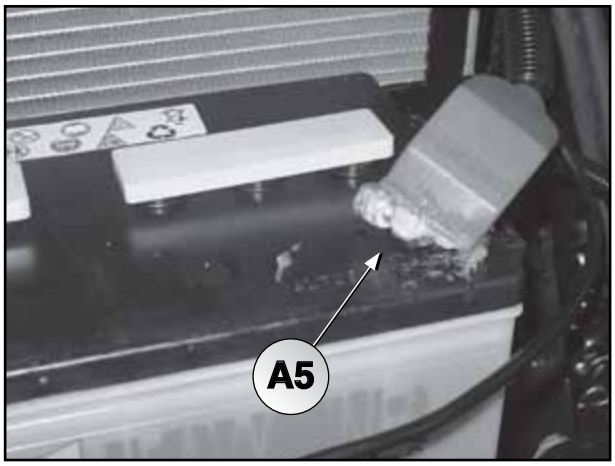


Fig. 10.194

3.7.4 Front engine line (with 3-cylinder engine)

3.7.4.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.195), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.196) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.196) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.197) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.198) installed under the bonnet.

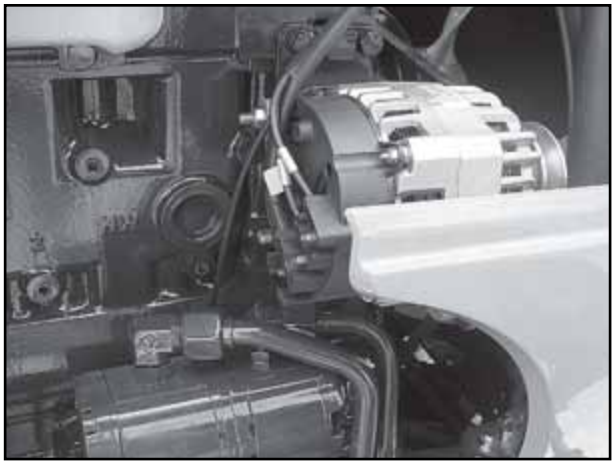


Fig. 10.195

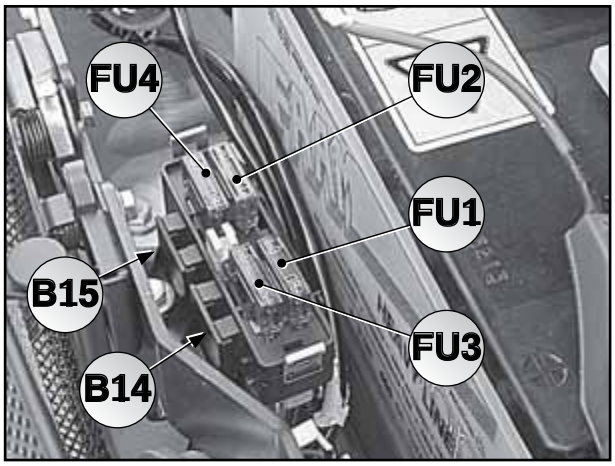


Fig. 10.196

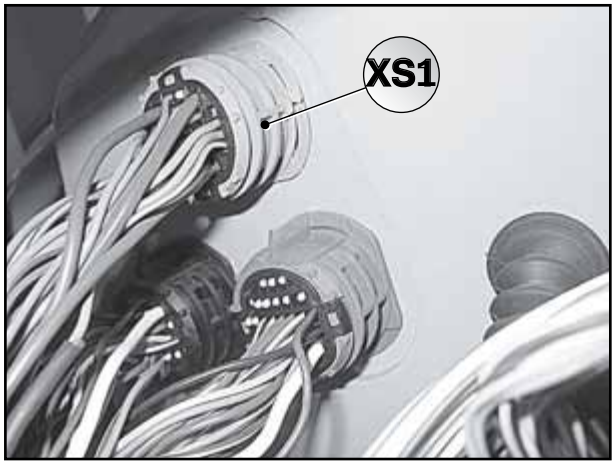


Fig. 10.197

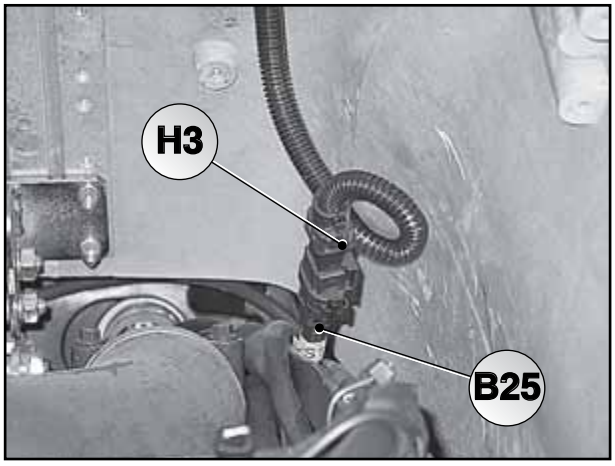


Fig. 10.198

3.7.4.2 Wiring (version with 3-cylinder engine)

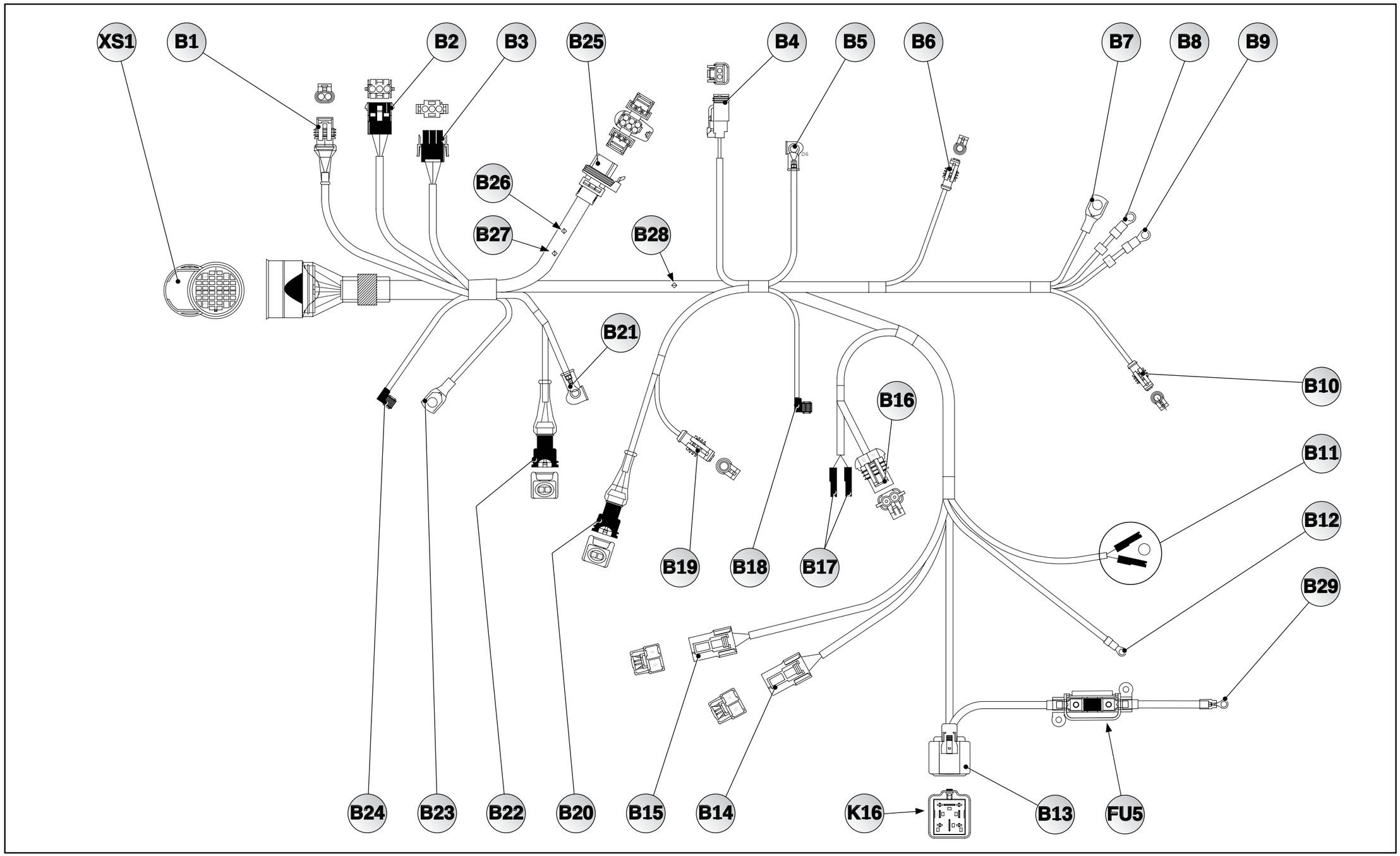


Fig. 10.199

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26-B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.7.4.3 Connector locations

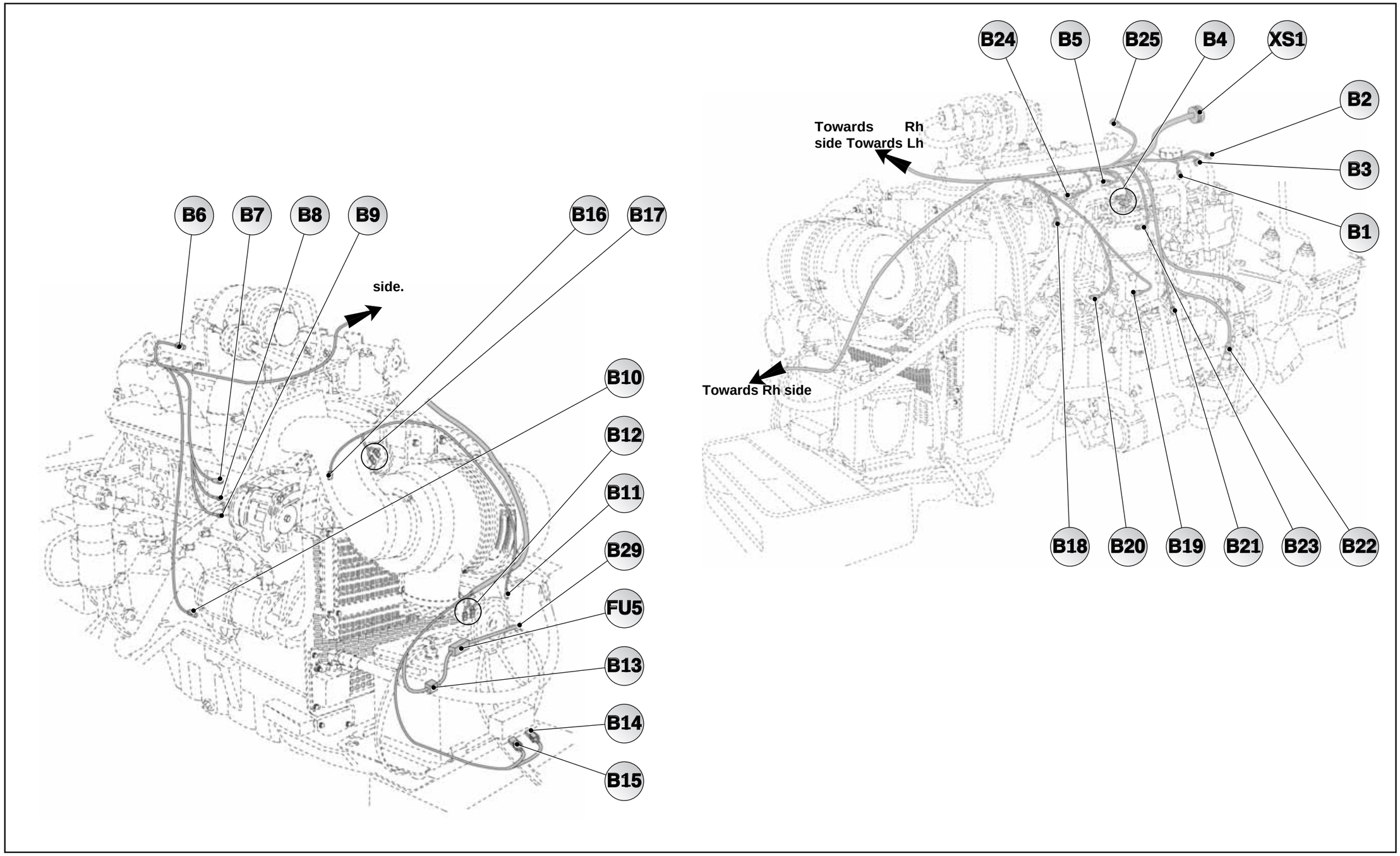


Fig. 10.200

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.7.4.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

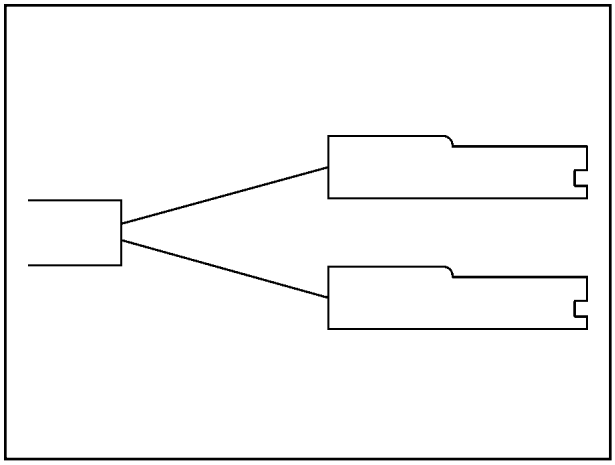


Fig. 10.201

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

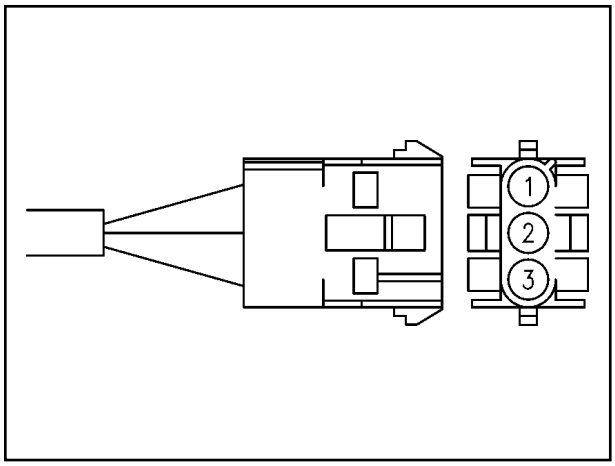


Fig. 10.202

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

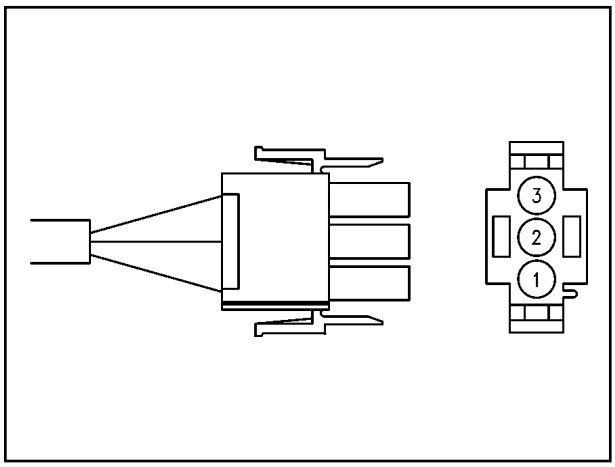


Fig. 10.203

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

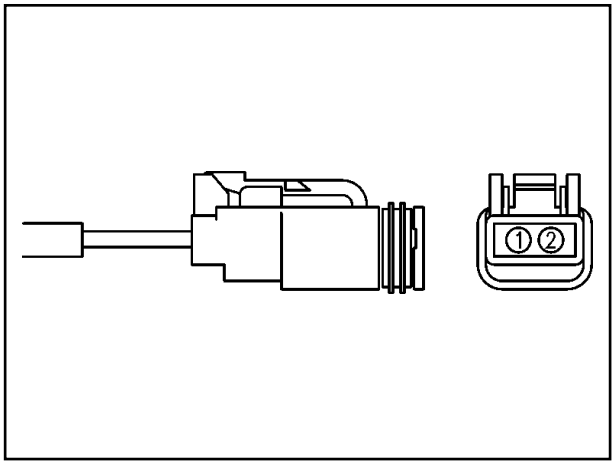


Fig. 10.204

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

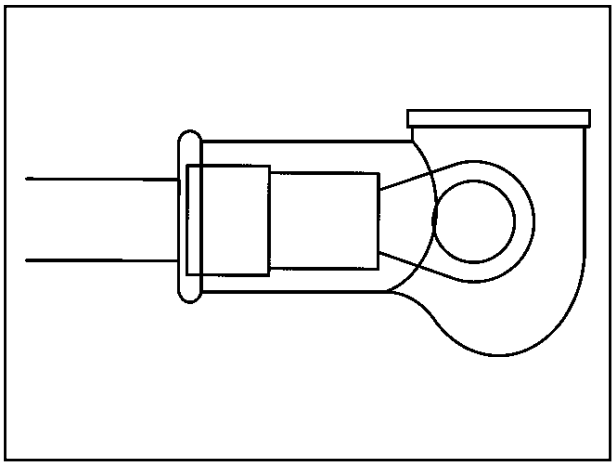


Fig. 10.205

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

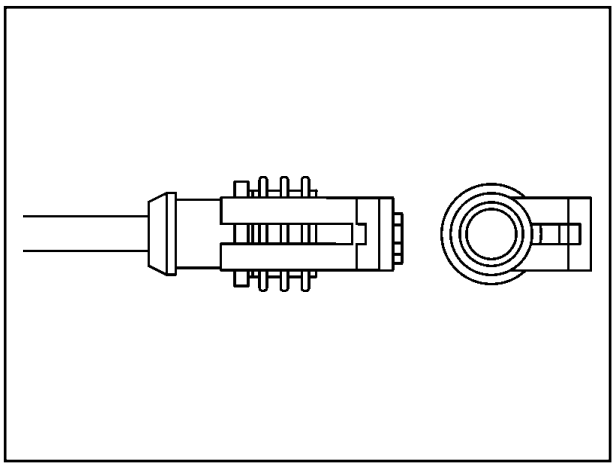


Fig. 10.206

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

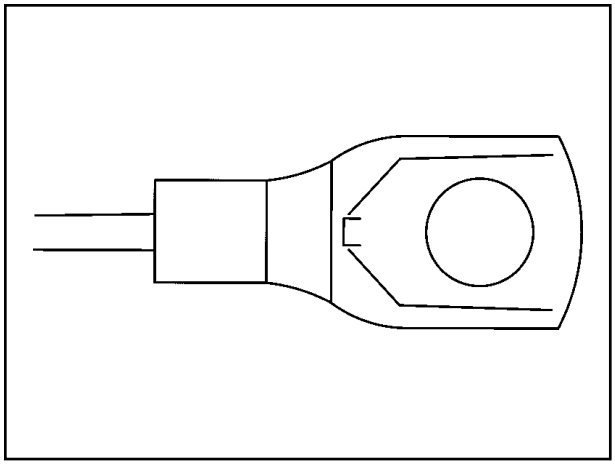


Fig. 10.207

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

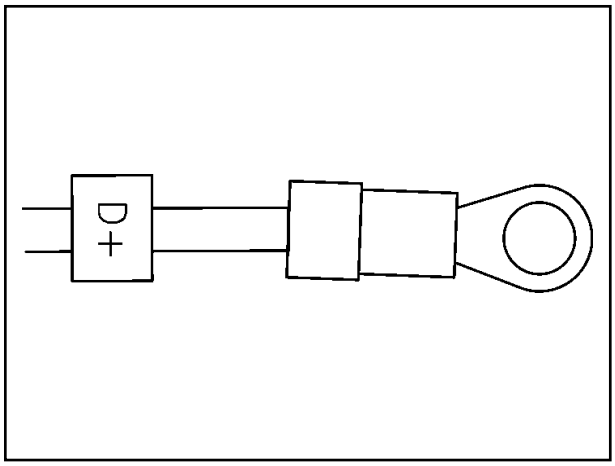


Fig. 10.208

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

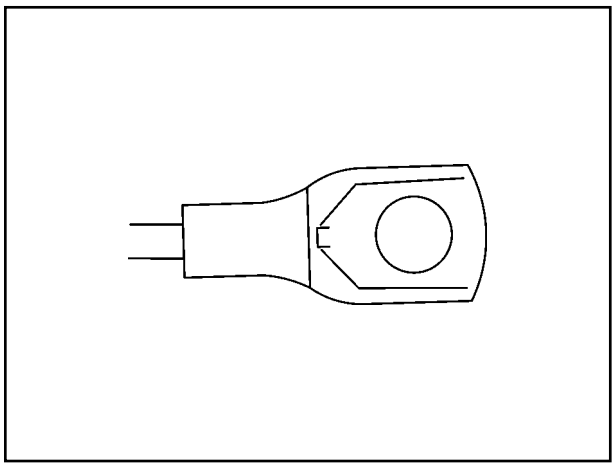


Fig. 10.209

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

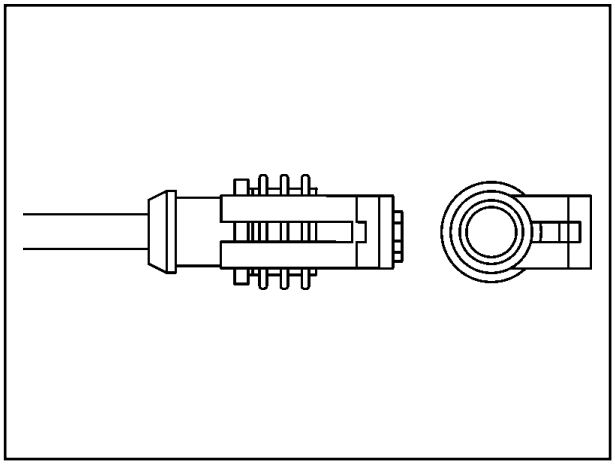


Fig. 10.210

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

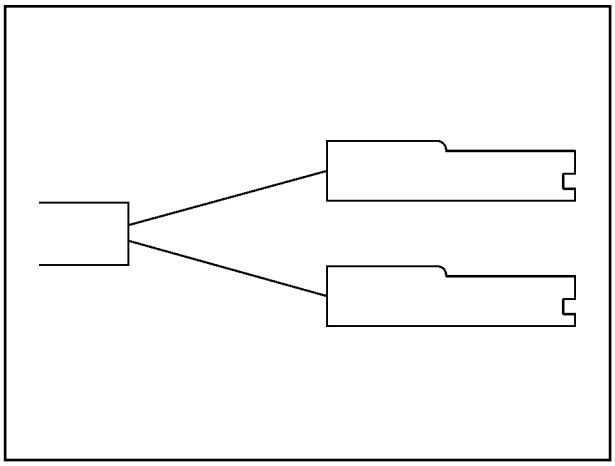


Fig. 10.211

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

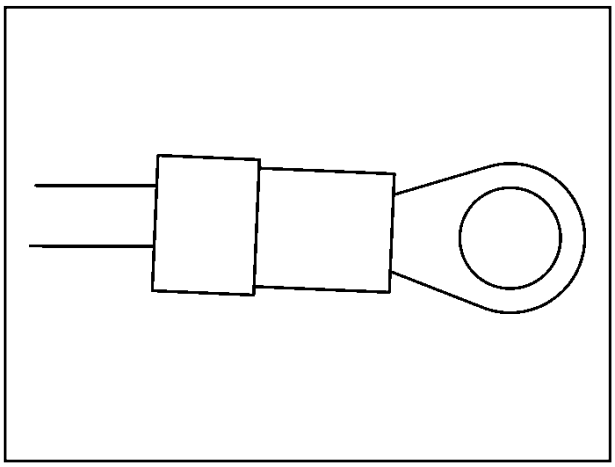


Fig. 10.212

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

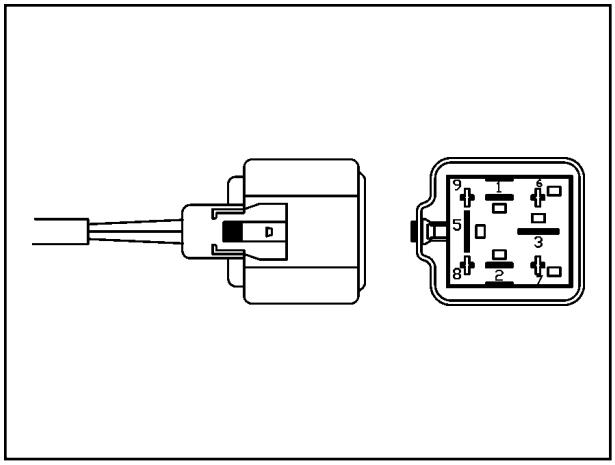


Fig. 10.213

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

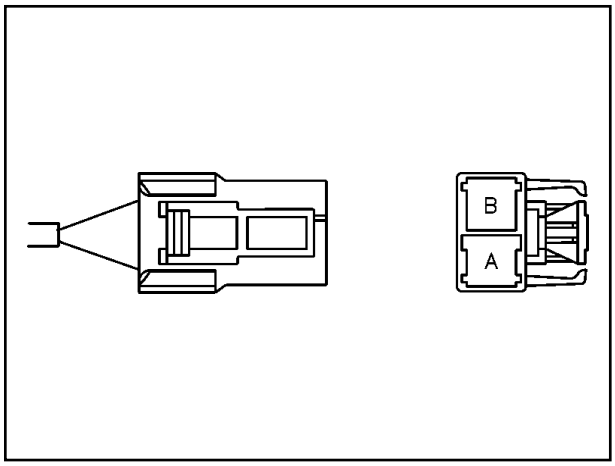


Fig. 10.214

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

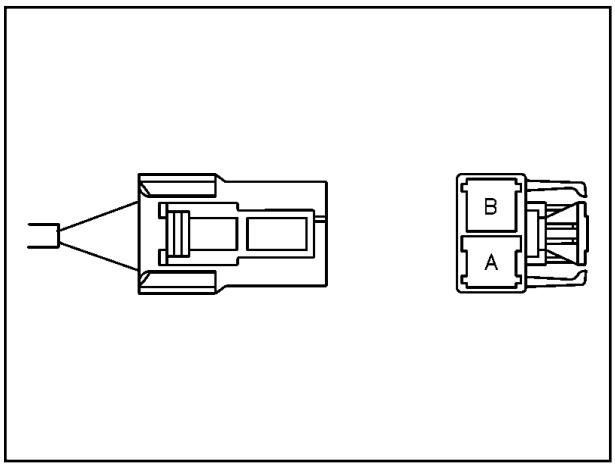


Fig. 10.215

Connector (B16) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

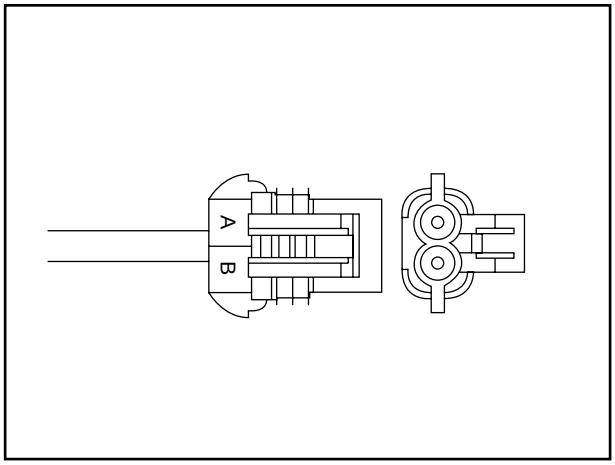


Fig. 10.216

Faston terminals (B17) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

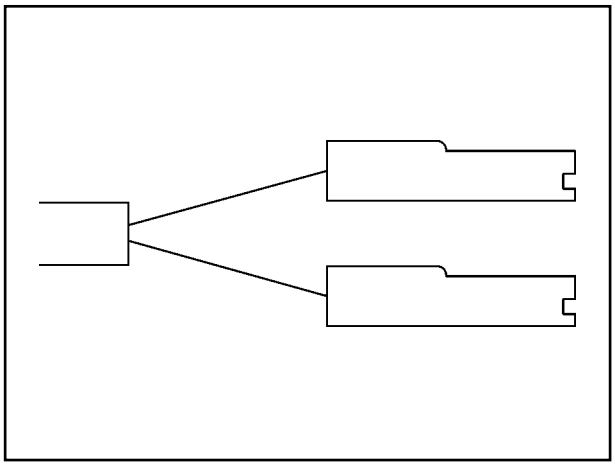


Fig. 10.217

Terminal (B18) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

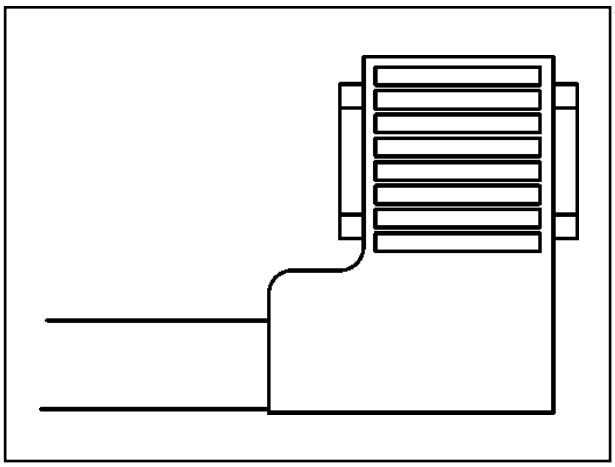


Fig. 10.218

Connector (B19) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

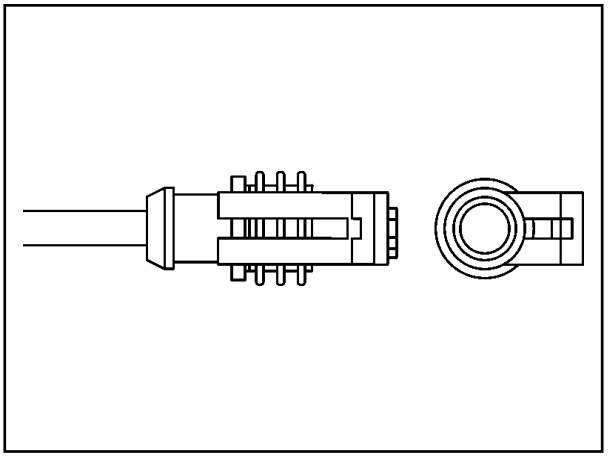


Fig. 10.219

Terminal (B20) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

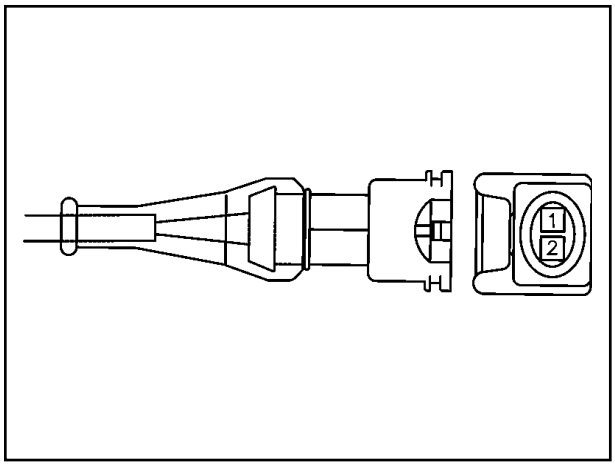


Fig. 10.220

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

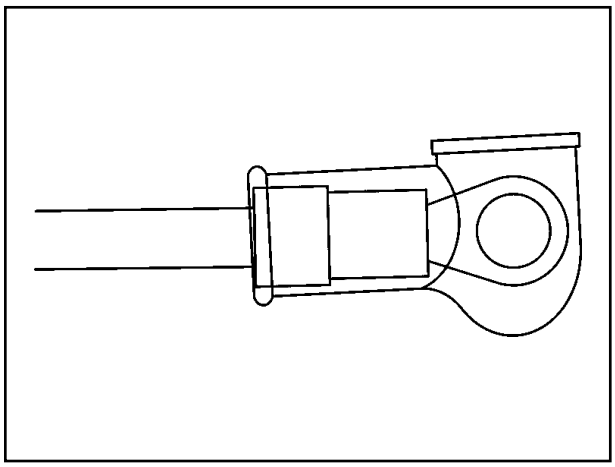


Fig. 10.221

Connector (B22) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

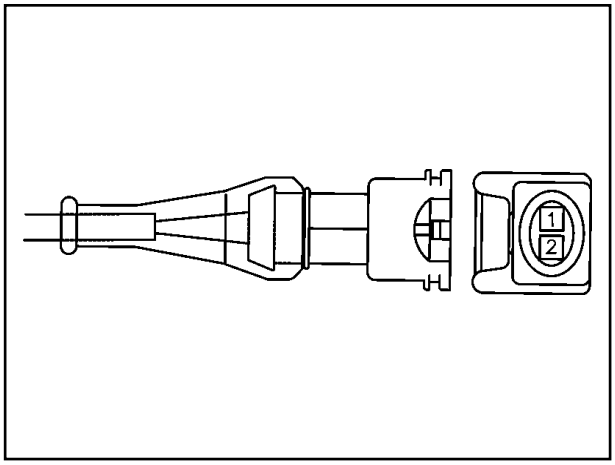


Fig. 10.222

Grounding eyelet (B23)

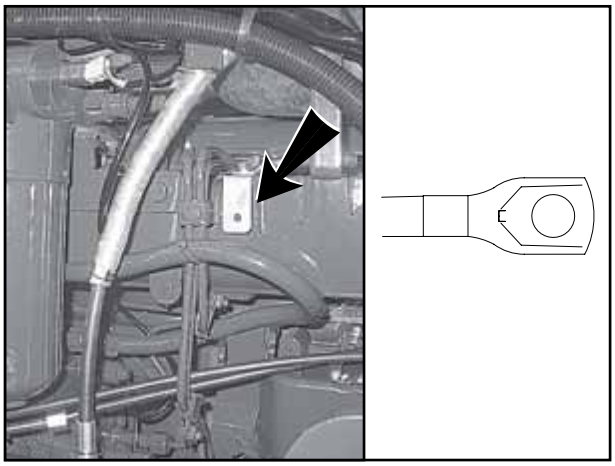


Fig. 10.223

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

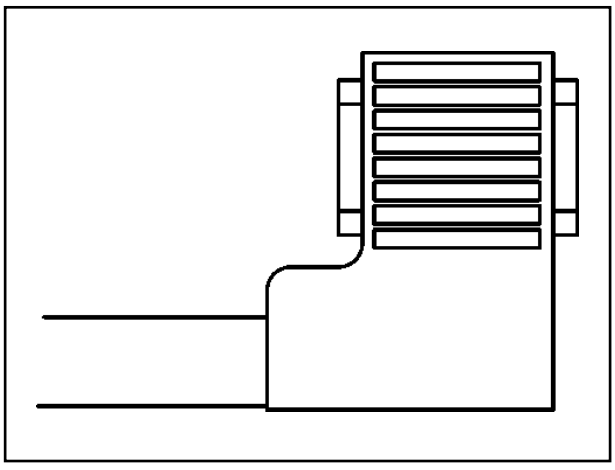


Fig. 10.224

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

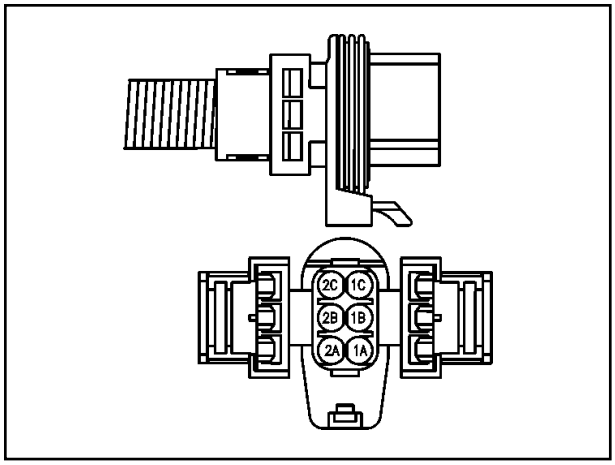


Fig. 10.225

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13	not used		
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29		not used	
30		not used	
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

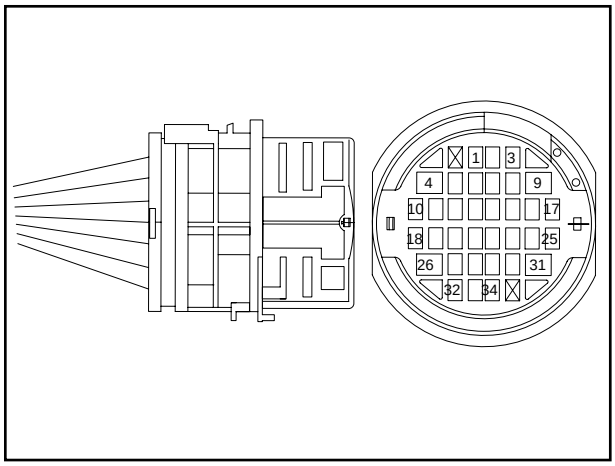


Fig. 10.226

3.7.5 Front engine line (with 4-cylinder engine)

3.7.5.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.227), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.228) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.228) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.229) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.230) installed under the bonnet.

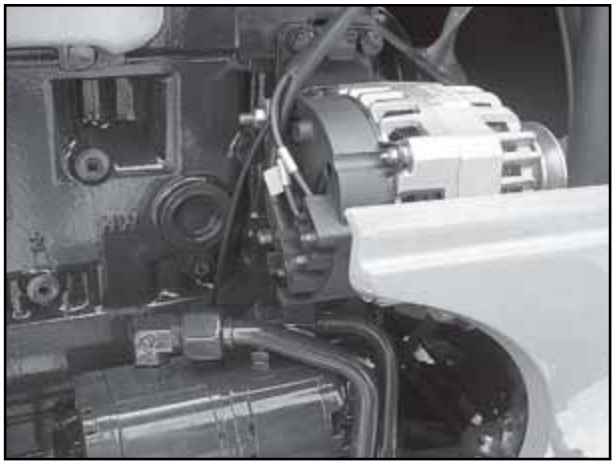


Fig. 10.227

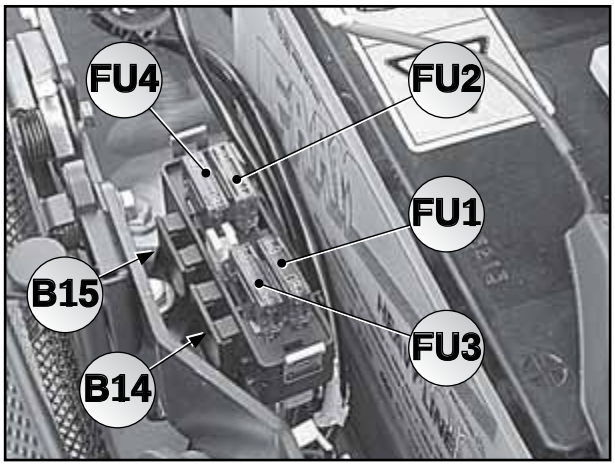


Fig. 10.228

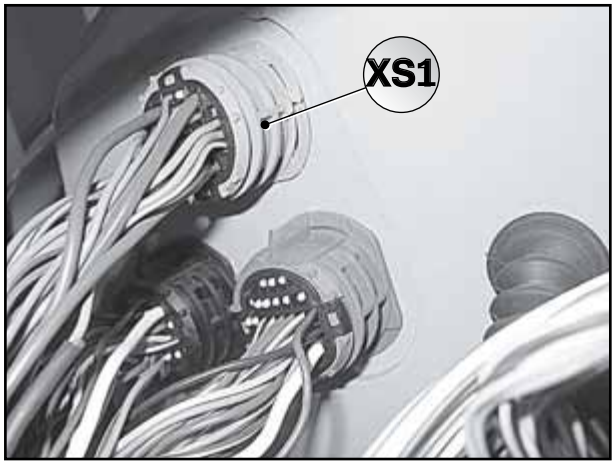


Fig. 10.229

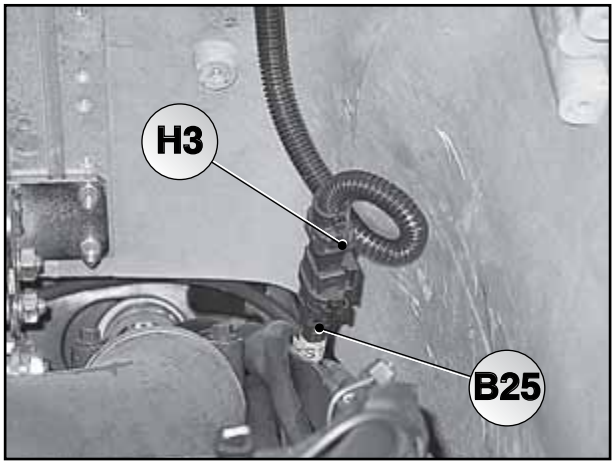


Fig. 10.230

3.7.5.2 Wiring (version with 4-cylinder engine)

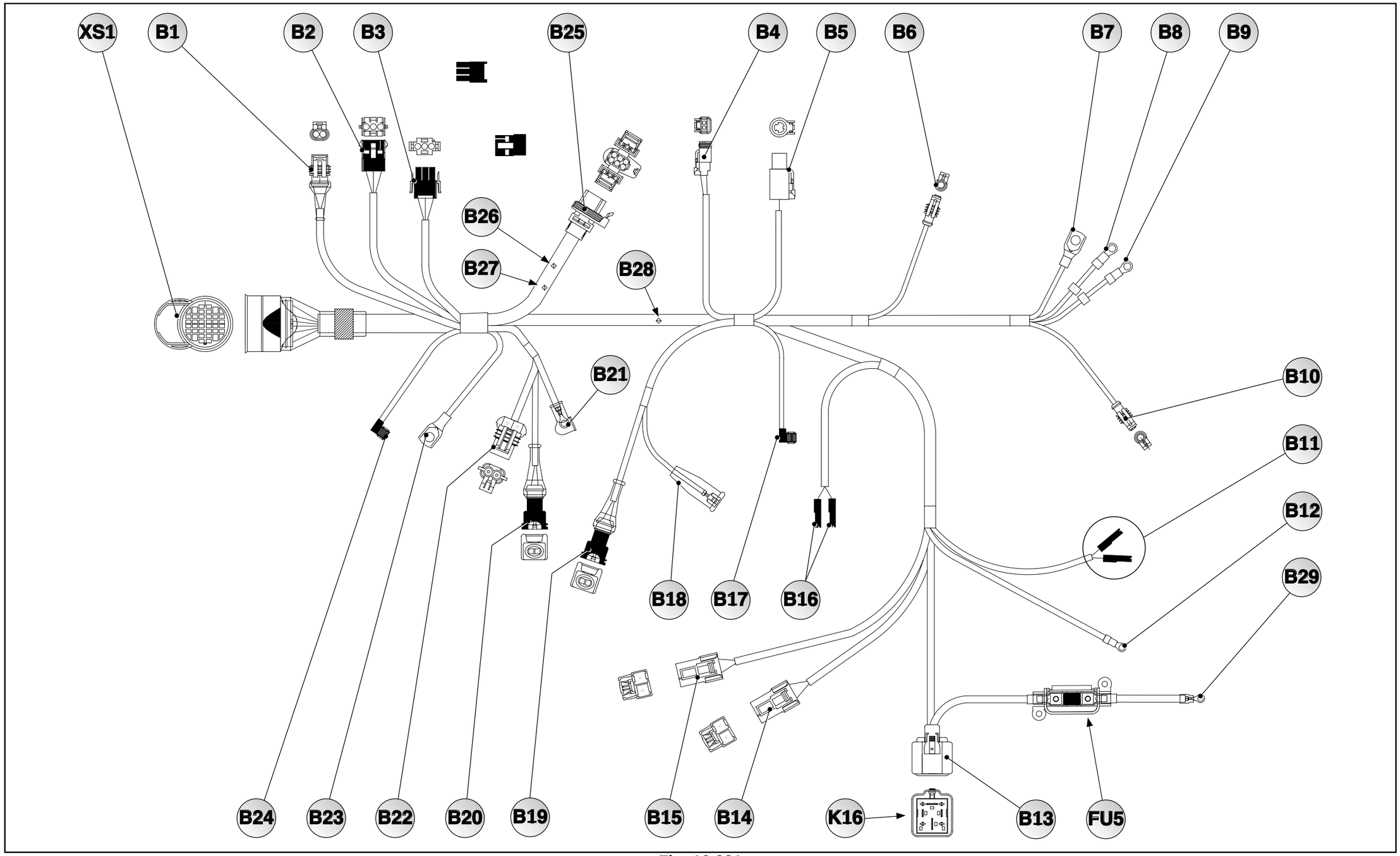


Fig. 10.231

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26-B28 - Junctions
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.7.5.3 Connector locations

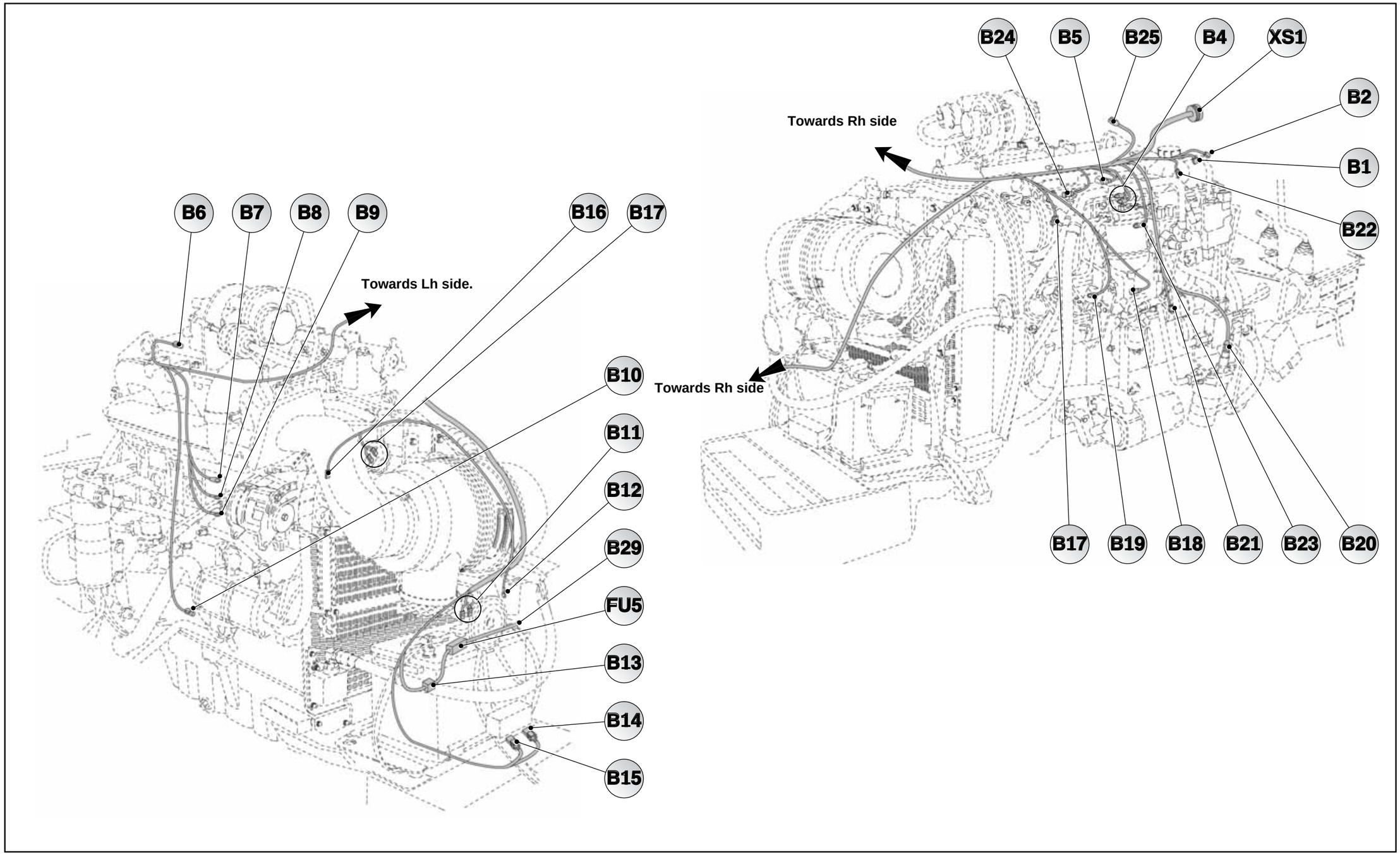


Fig. 10.232

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
XS1 - Terminal board for front line/dashboard connection

3.7.5.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

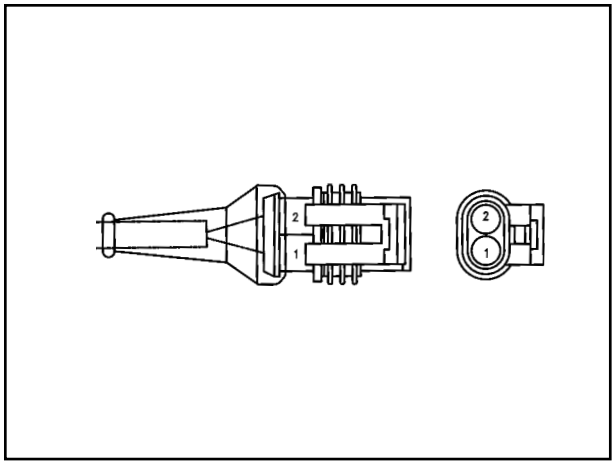


Fig. 10.233

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

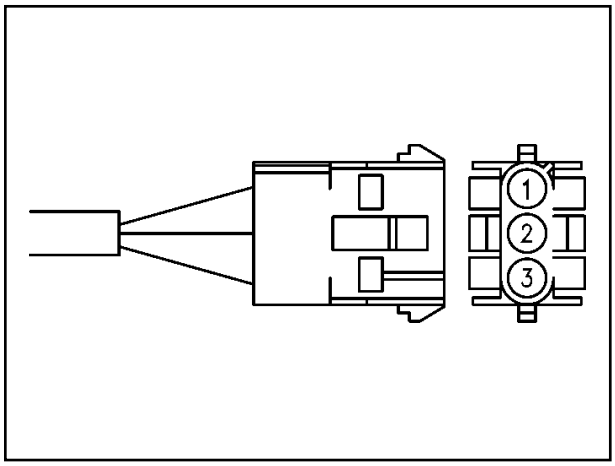


Fig. 10.234

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

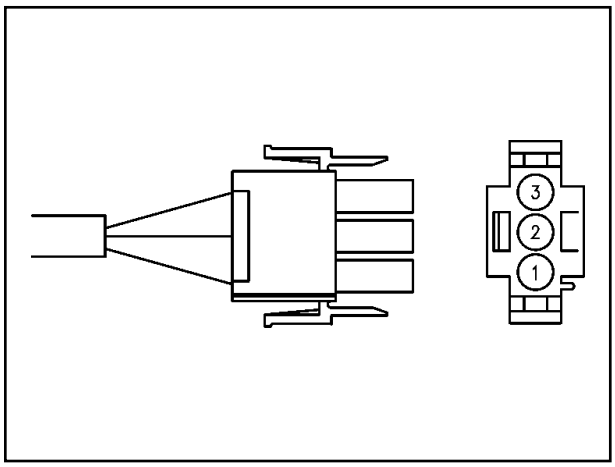


Fig. 10.235

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

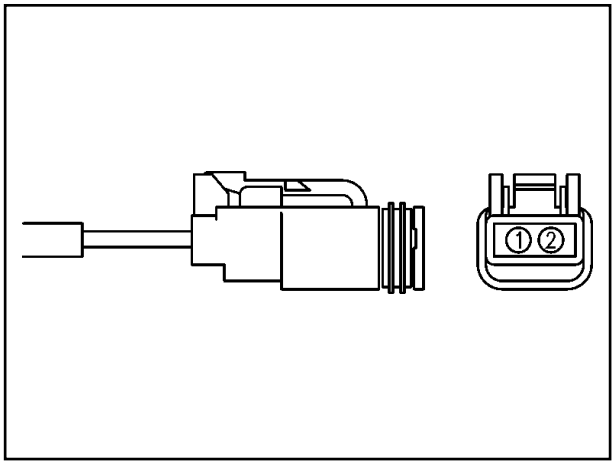


Fig. 10.236

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

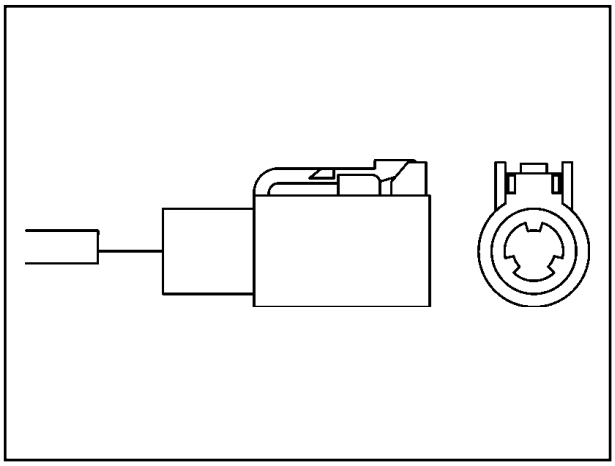


Fig. 10.237

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

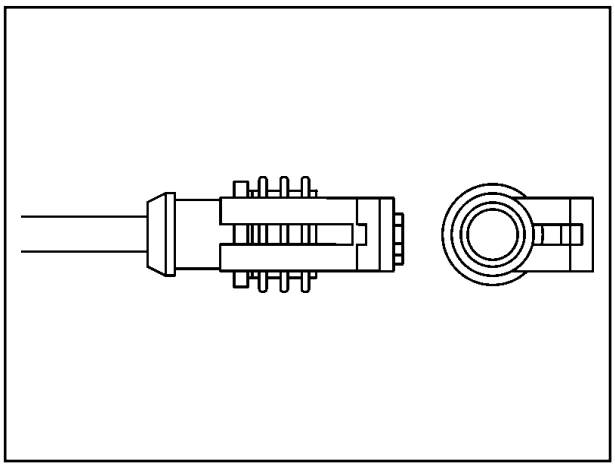


Fig. 10.238

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

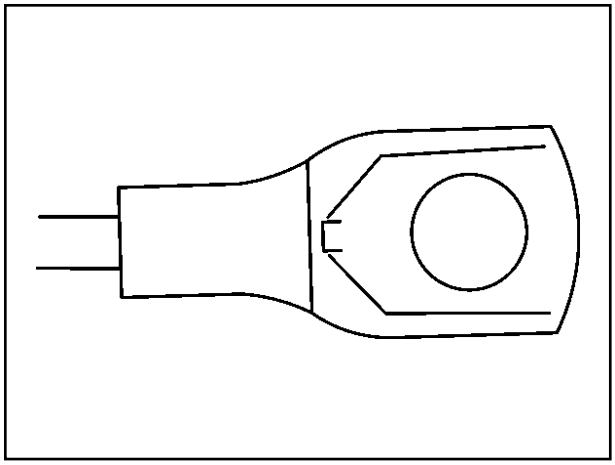


Fig. 10.239

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

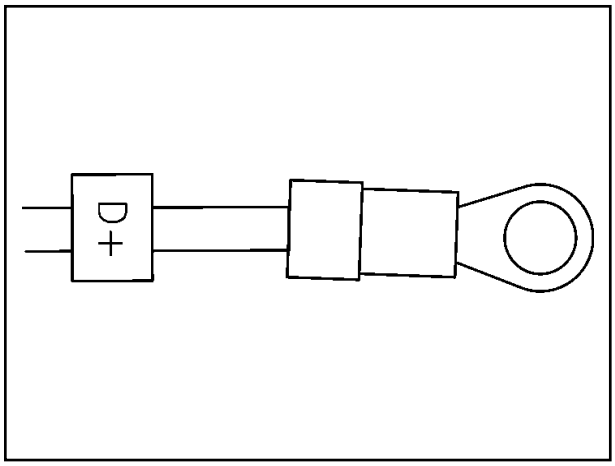


Fig. 10.240

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

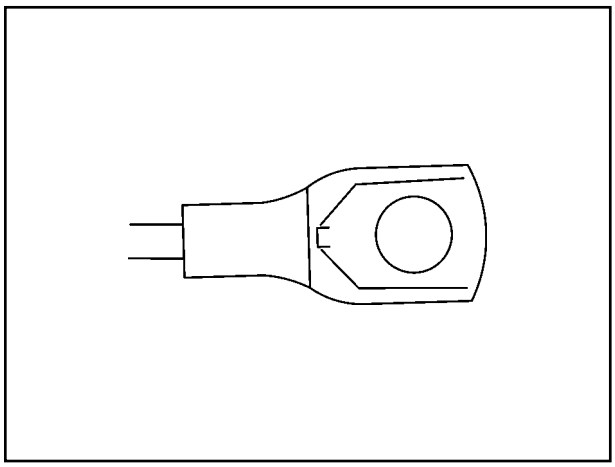


Fig. 10.241

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

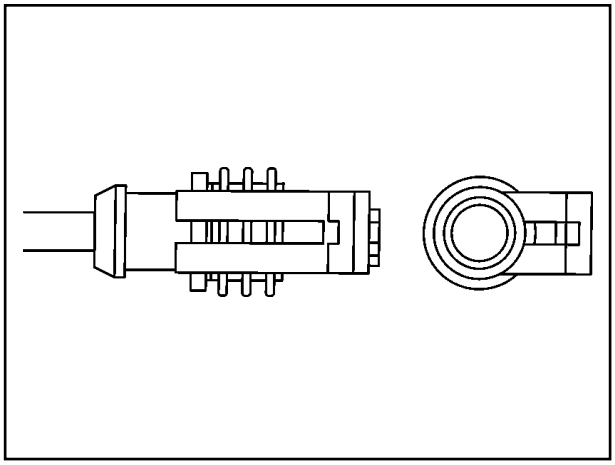


Fig. 10.242

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

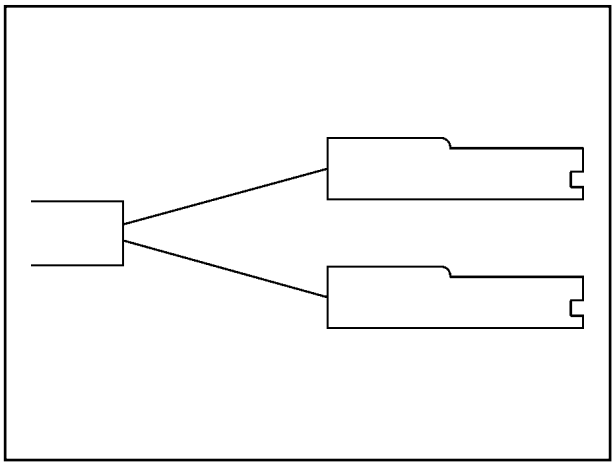


Fig. 10.243

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

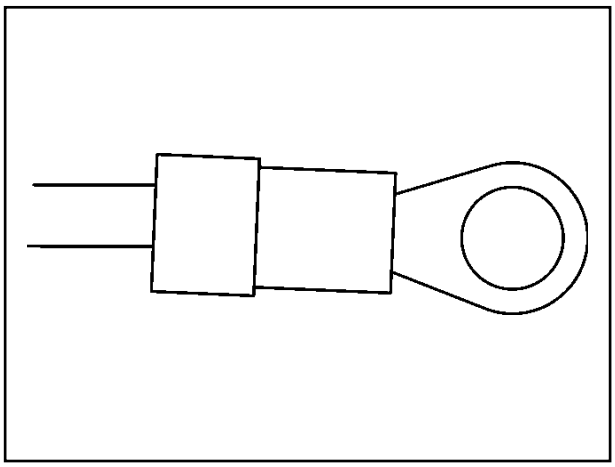


Fig. 10.244

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

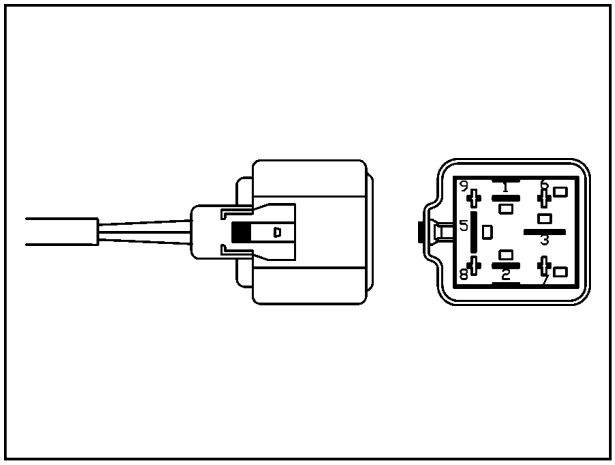


Fig. 10.245

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

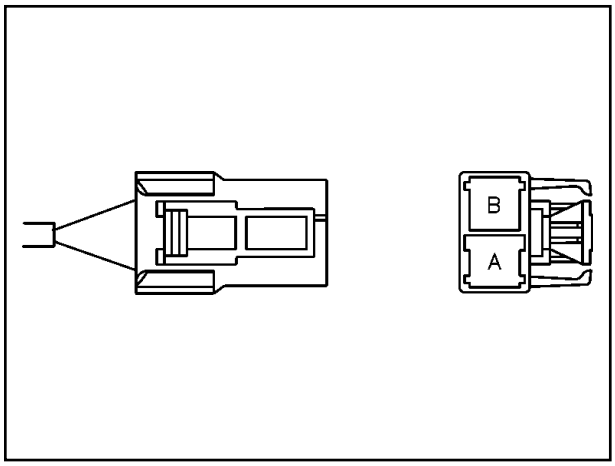


Fig. 10.246

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

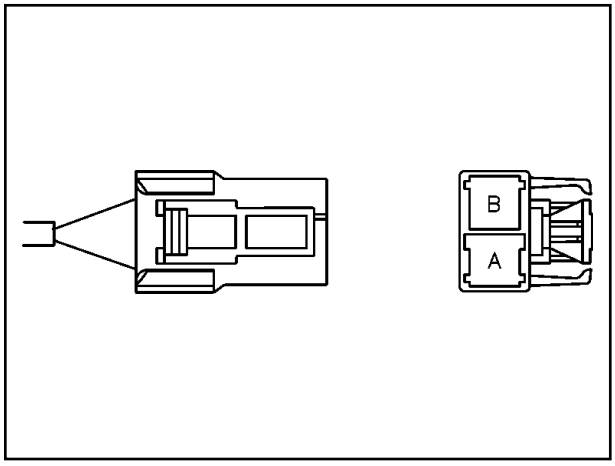


Fig. 10.247

Faston terminals (B16) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

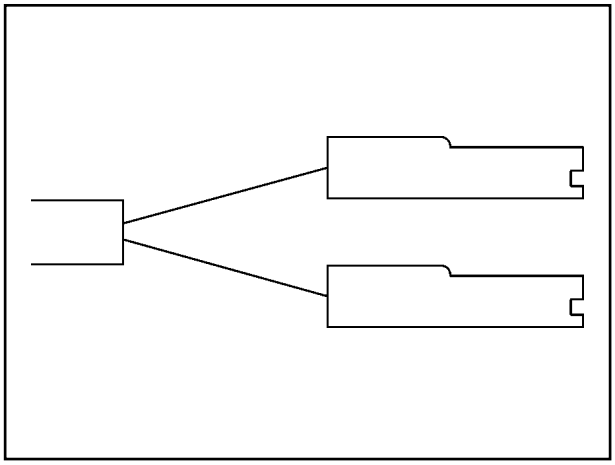


Fig. 10.248

Terminal (B17) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

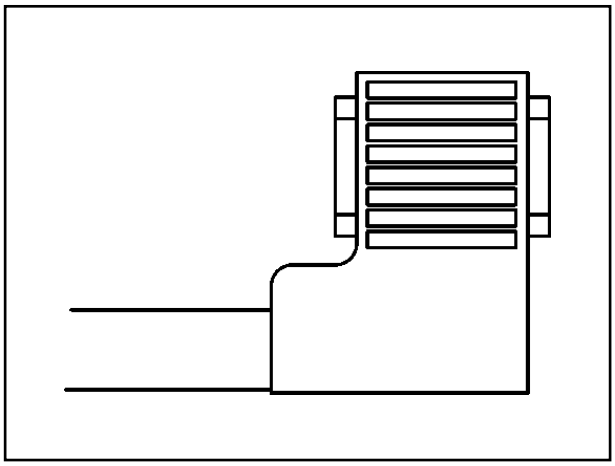


Fig. 10.249

Connector (B18) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

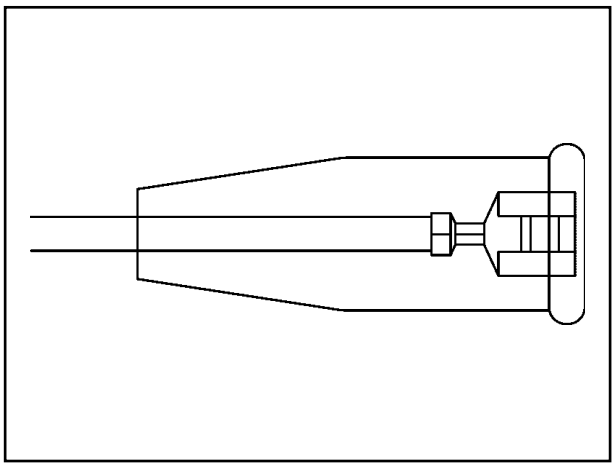


Fig. 10.250

Terminal (B19) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

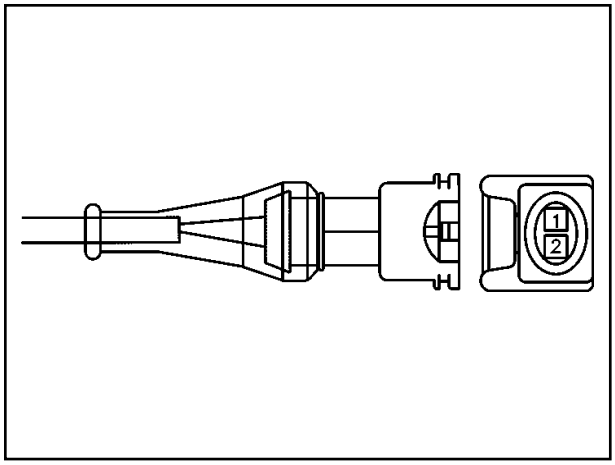


Fig. 10.251

Connector (B20) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

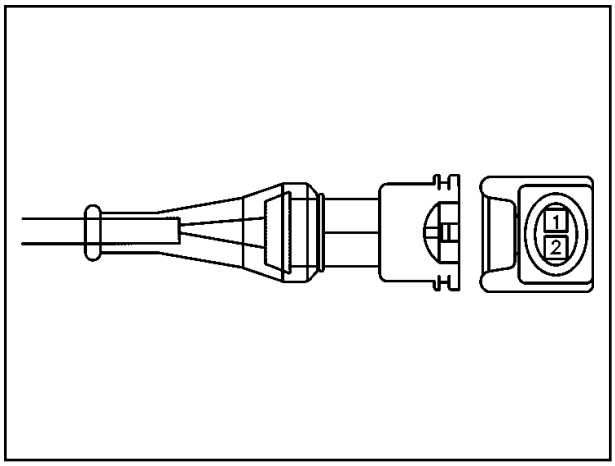


Fig. 10.252

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

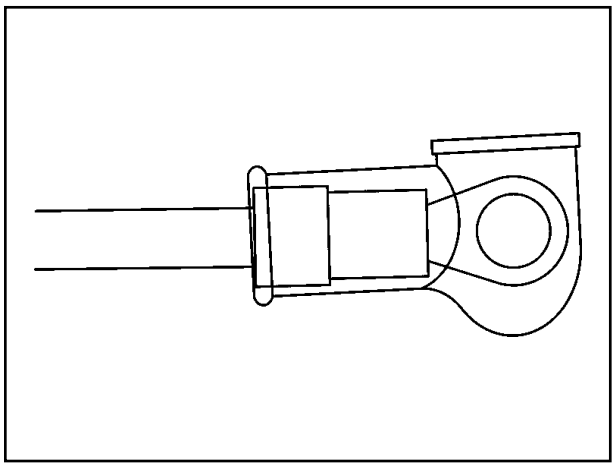


Fig. 10.253

Connector (B22) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

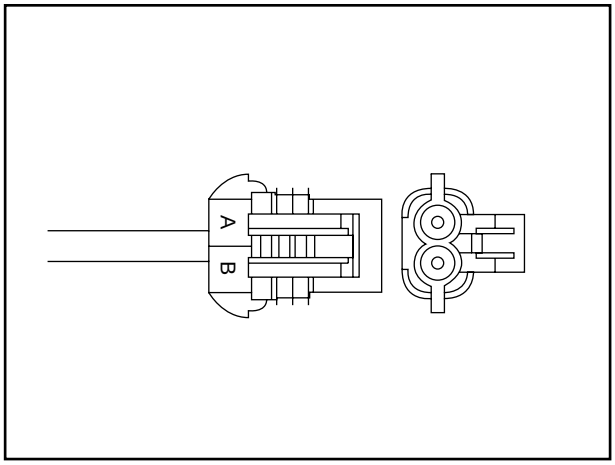


Fig. 10.254

Grounding eyelet (B23)

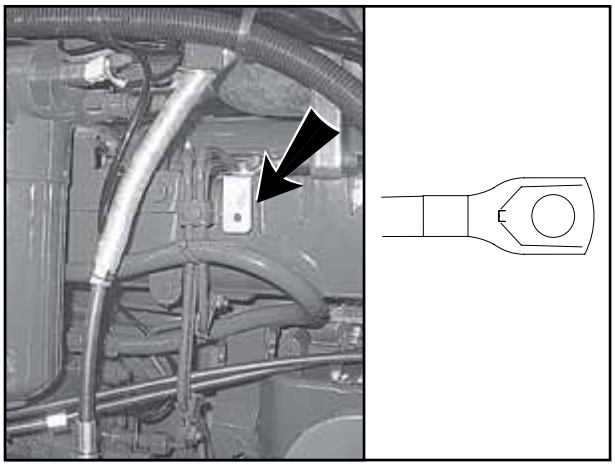


Fig. 10.255

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

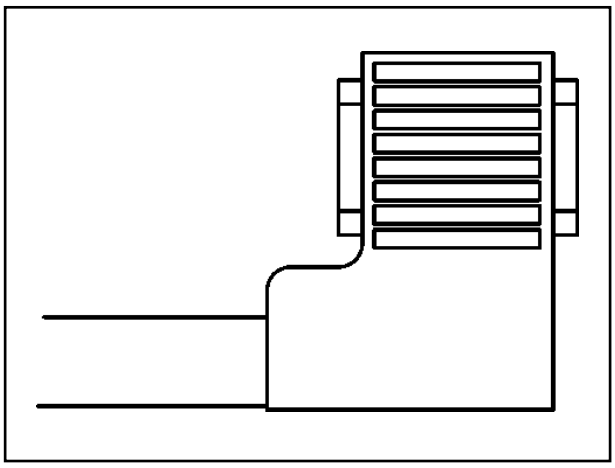


Fig. 10.256

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

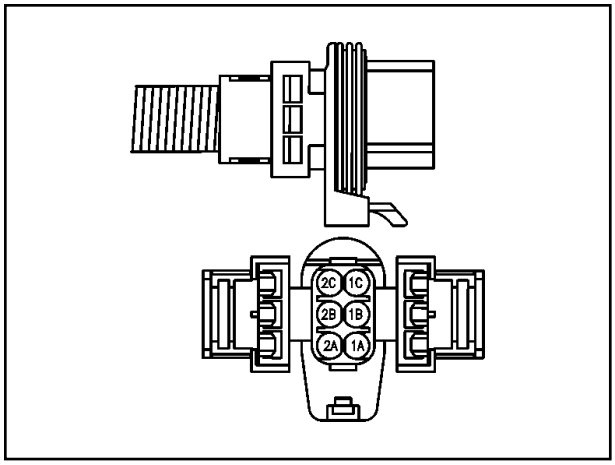


Fig. 10.257

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13		not used	
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29		not used	
30		not used	
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

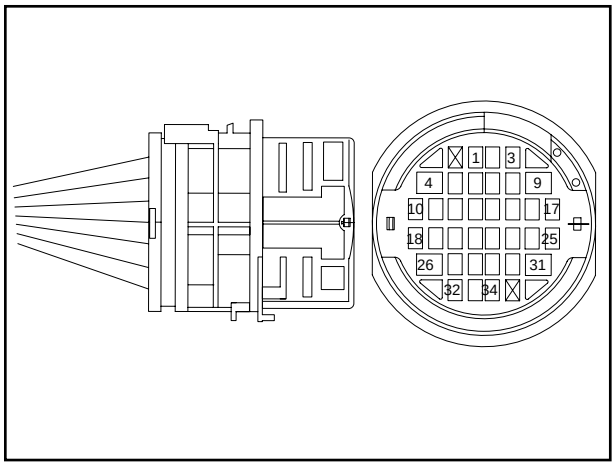


Fig. 10.258

3.7.6 Dashboard line

3.7.6.1 General description

The dashboard line powers the controls installed in front of the driver (Fig.10.259), such as the switches that control the headlights, the light switch lever, etc. It also connects with the fuses that protect the tractor's entire electrical system (Fig.10.261).

The dashboard line is connected to the front engine line via connection to the terminal boards (XS1), to the rear line via terminal boards (XS2), 0to the platform line by means of the terminal boards (XS3)(Fig.10.262) and to the roof line by means of the terminal boards (XS5) (Fig.10.261) in each wiring line.

Fig. 10.259

Fig. 10.260

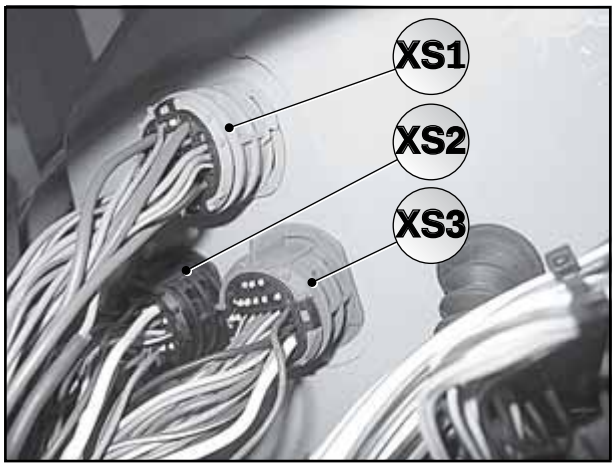


Fig. 10.262

Fig. 10.261

3.7.6.2 Wiring

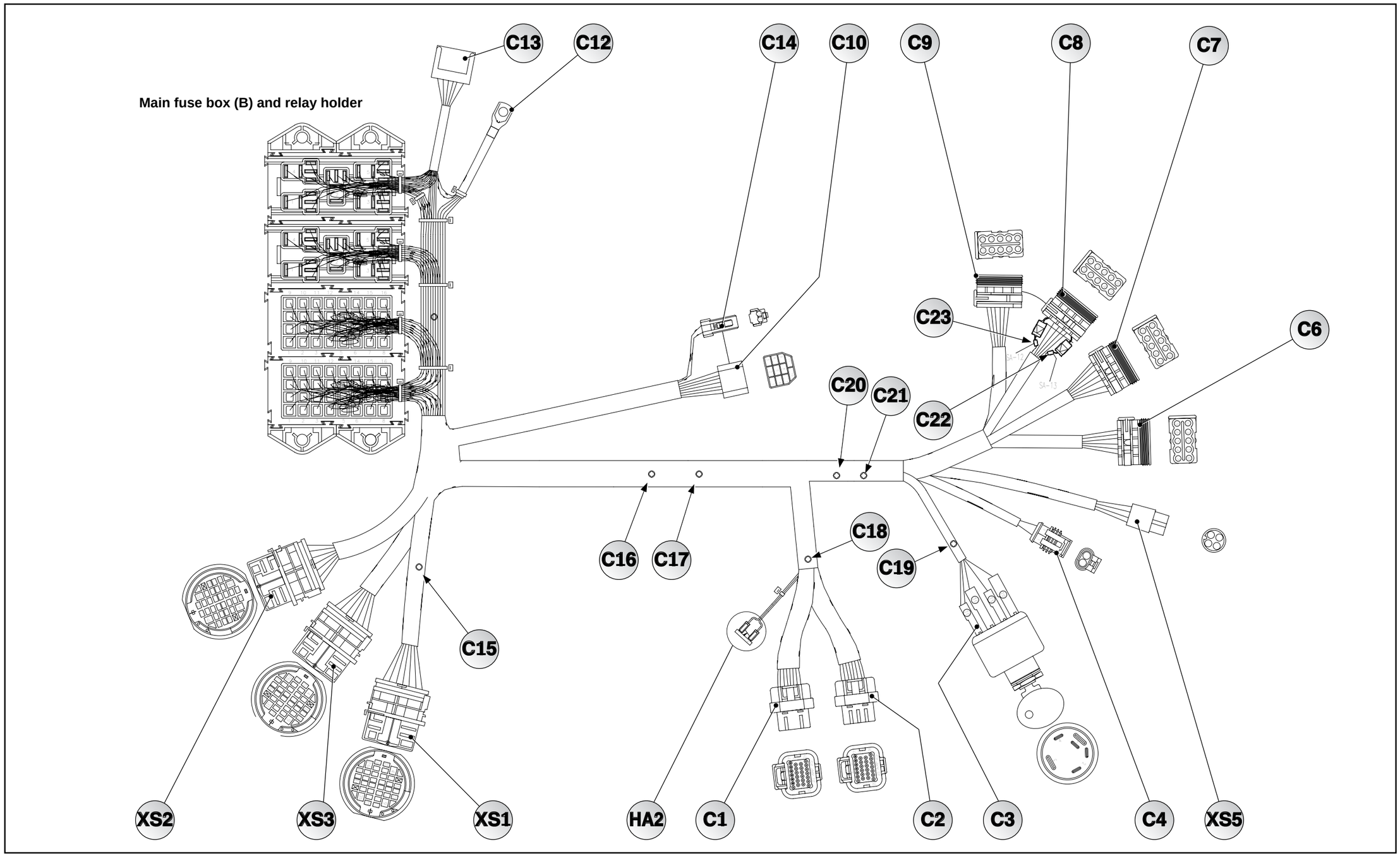


Fig. 10.263

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C6 - Connector for revolving beacon switch
C7 - Connector for field light switch
C8 - Connector for emergency switch
C9 - Connector for side lights switch
C10 - Connector for light switch
C11 - Connector for light switch
C12 - Grounding eyelet
C13 - Connector for blinker
C14-C26 - Junctions
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
B - Main relay and fuse box

3.7.6.3 Connector locations

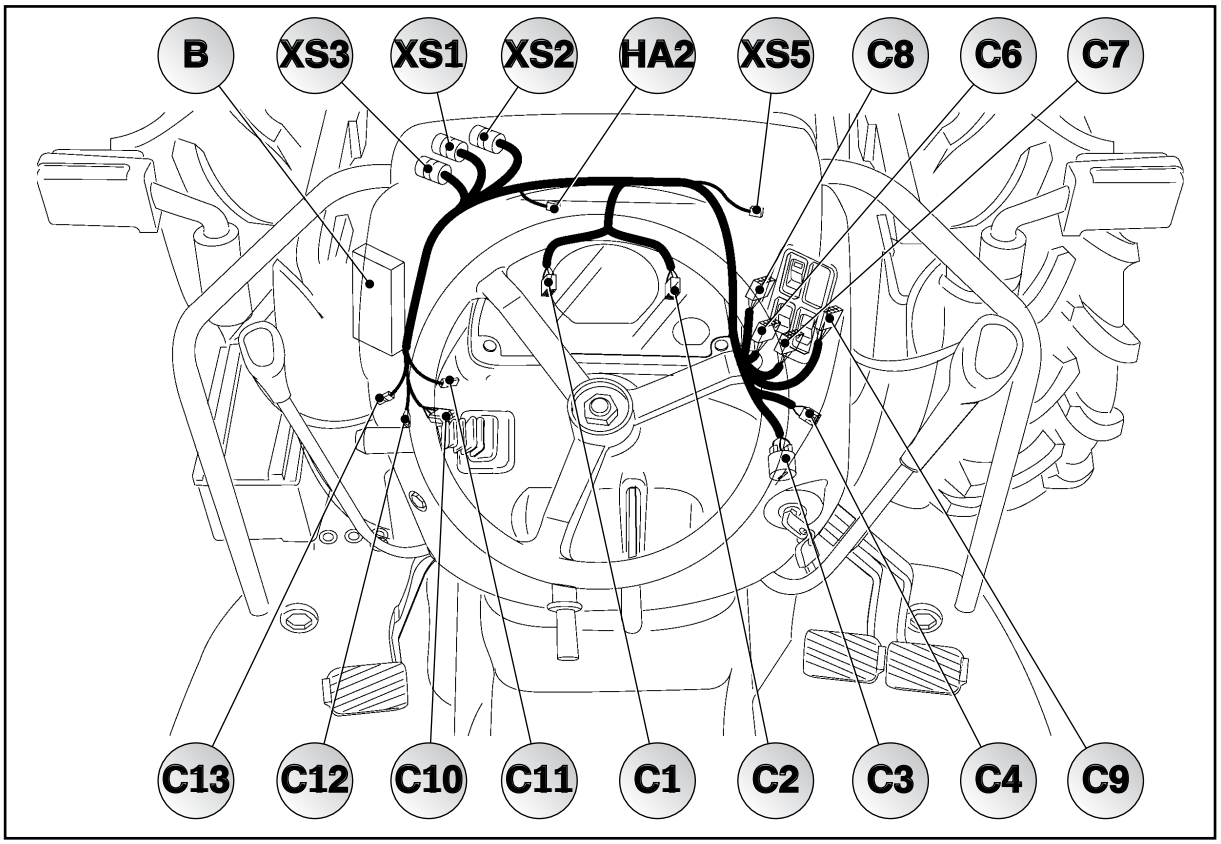


Fig. 10.264

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C6 - Connector for revolving beacon switch
C7 - Connector for field light switch
C8 - Connector for emergency switch
C9 - Connector for side lights switch
C10 - Connector for light switch
C11 - Connector for light switch
C12 - Grounding eyelet
C13 - Connector for blinker
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
B - Main relay and fuse box

3.7.6.4 Connector identification

Connector (C1) for instrument

term.	wire colour	To con. or comp.	term.
1	RN	C18 (junction)	
2	ZN	XS2	13
3	RV	XS1	5
4	ZL	XS3	32
5		not used	
6		not used	
7	LG	XS1	8
8	R	F5	5A
9	ZH	C17 (junction)	
10	SV	XS3	5
11	BR	K8	3
12		not used	
13		not used	
14	B	C24 (junction)	
15	C	XS2	21
16	VB	K15	4
17		not used	
18		not used	
19	BN	XS2	12
20		not used	
21	V	K9	5
22	HG	C21 (junction)	
23	G	C22 (junction)	
24	V	C23 (junction)	
25	GN	C13	5
26	GV	C13	2

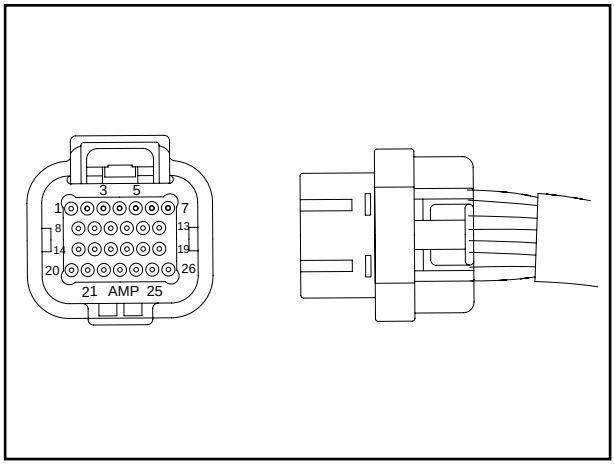


Fig. 10.265

Connector (C2) for instrument

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12
2	CN	XS2	16
3	SN	XS2	15
4		not used	
5		not used	
6		not used	
7	RN	C18 (junction)	
8		not used	
9	HB	HA2	-
10	HM	F16	6
11		not used	
12		not used	
13	R	F5	5A
14	SG	XS3	11
15	HV	XS2	5
16	HL	XS2	3
17	N	C3	3
18		not used	
19	B	C24 (junction)	
20		not used	
21	VB	XS1	3
22	S	XS3	12
23		not used	
24		not used	
25		not used	
26		not used	

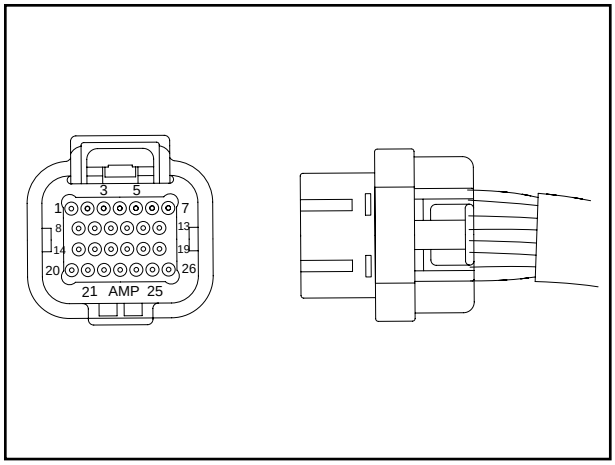


Fig. 10.266

Ignition switch faston terminals (C3)

term.	wire colour	To con. or comp.	term.
1	R	XS1	4
2	M	C19 (junction)	
3	N-N	XS1-C2	6-17
4	L	F20	2

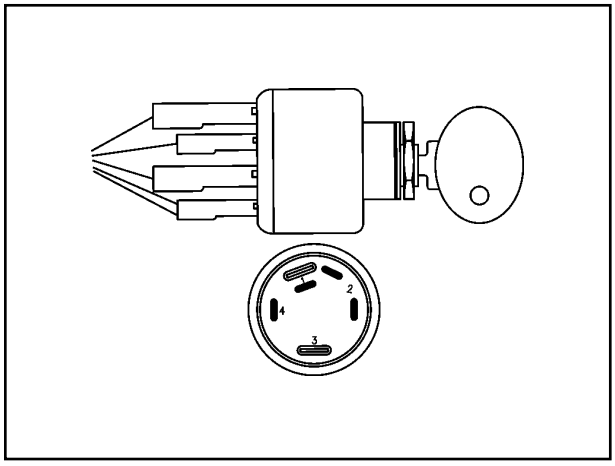


Fig. 10.267

Brake oil pressure sensor connector (C4)

term.	wire colour	To con. or comp.	term.
1	M	K14	3
2	GL	K14	2

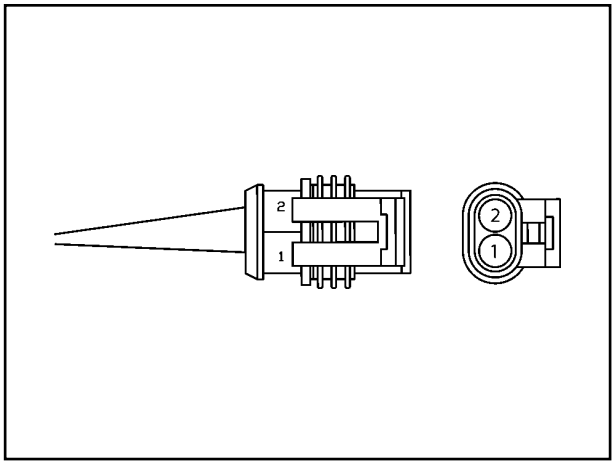


Fig. 10.268

Revolving beacon switch connector (C6)

term.	wire colour	To con. or comp.	term.
1		not used	
2	R	F27	16A
3	GV	C26 (junction)	
4		not used	
5		not used	
6		not used	
7	B	C24 (junction)	
8	HG	C21 (junction)	
9	B	C24 (junction)	
10	GV	C26 (junction)	

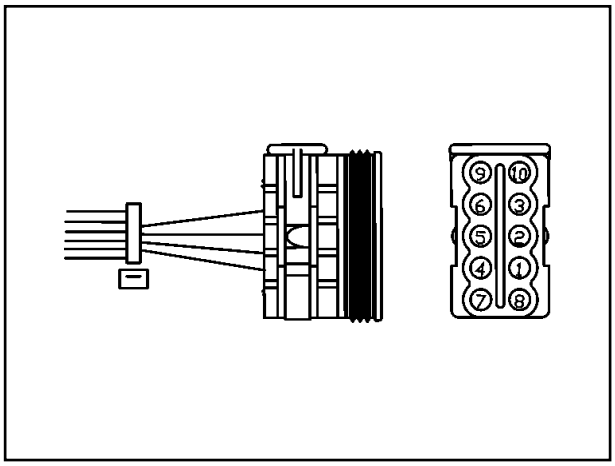


Fig. 10.269

Connector (C7) for field light switch

term.	wire colour	To con. or comp.	term.
1		not used	
2	H	F21	3
3	HN	C25 (junction)	
4		not used	
5		not used	
6		not used	
7	B	C24 (junction)	
8	HG	C20 (junction)	
9	B	C24 (junction)	
10	HN	C25 (junction)	

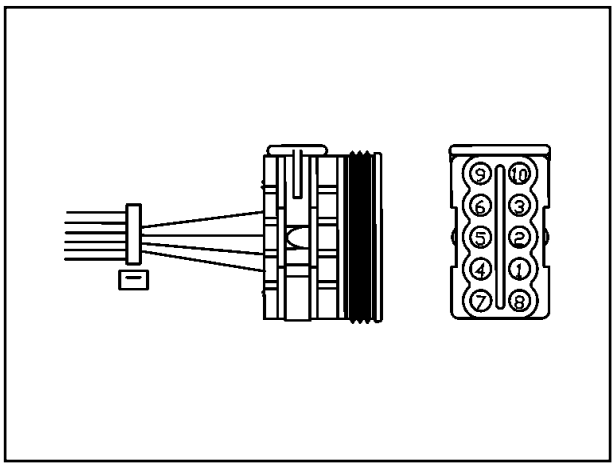


Fig. 10.270

Connector (C8) for emergency switch

term.	wire colour	To con. or comp.	term.
1	M	C24 (junction)	
2	BR	F12	12A
3	R	F36	7A
4		not used	
5	MB	C13	4
6	G	C22 (diode)	
7		not used	
8	B	C24 (junction)	
9	V	C23 (diode)	
10	HG	C20 (junction)	

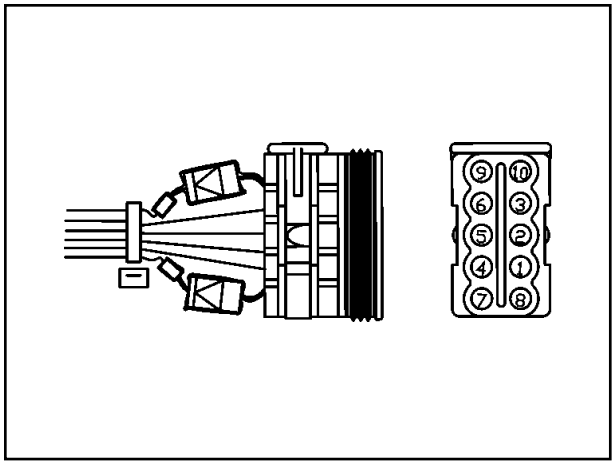


Fig. 10.271

Connector (C9) for side lights switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	C14 (junction)	
3	HN	C10	4
4	not used		
5	RN	F15	15A
6	N	C16 (junction)	
7	B	C24 (junction)	
8	HG	C21 (junction)	
9	B	C24 (junction)	
10	N	C16 (junction)	

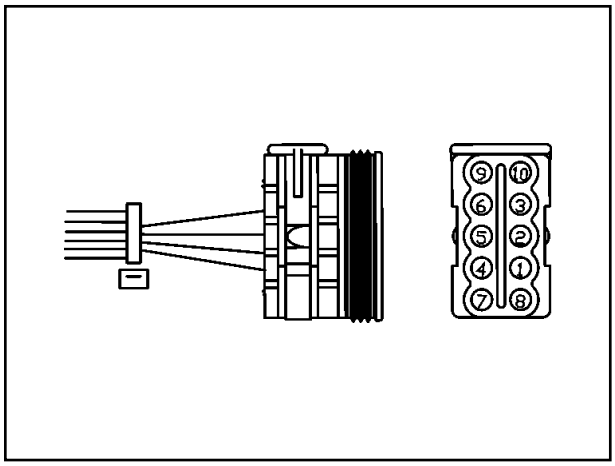


Fig. 10.272

Connector (C10) for light switch

term.	wire colour	To con. or comp.	term.
1	R	F27	16A
2	GV	K9	2
3	G	XS1-XS3-XS2-C22 (junction)	20-1-6
4	ZN	C9	3
5	MB	C13	4
6	V	XS2-XS3-XS1-C23 (junction)	8-2-18
7	HR	K10	2
8	Z	XS1	14
9	M	C14 (junction)	
10	RN	F39	1A
11	B	C12 (ground)	

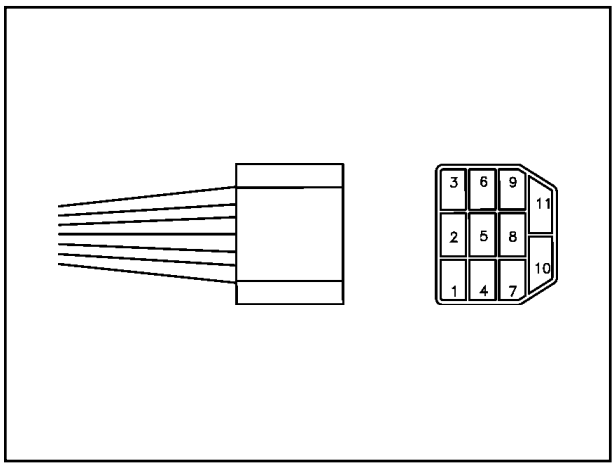


Fig. 10.273

Connector (C11) for light switch

term.	wire colour	To con. or comp.	term.
1	GR	XS3	8
2	RV	XS3	7

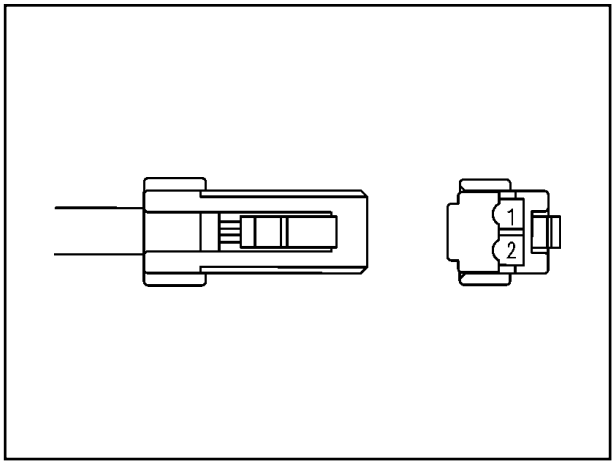


Fig. 10.274

Grounding eyelet (C12)

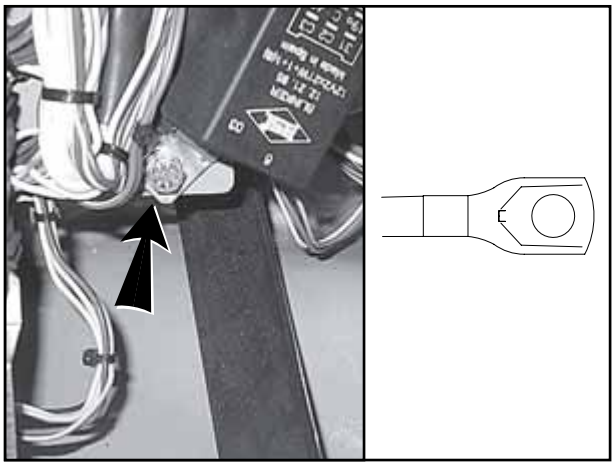


Fig. 10.275

Blinker connector (C13)

term.	wire colour	To con. or comp.	term.
1	B	C12 (ground)	
2	GV	C1	26
3	not used		
4	MB-MB	C10-C8	5-5
5	GN	C1	25
6	BR	F12	12

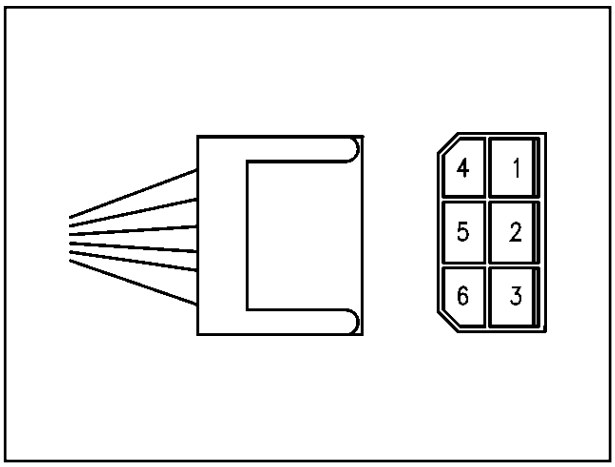


Fig. 10.276

Connector (HA2) for horn (buzzer)

term.	wire colour	To con. or comp.	term.
-	HB	C2	9
+	RN	F22	4A

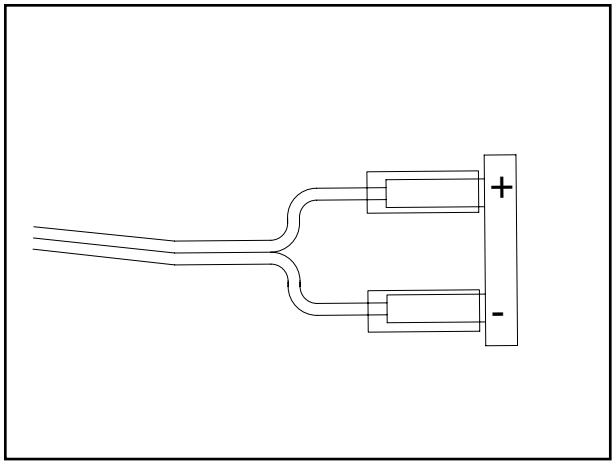


Fig. 10.277

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	K1	5
2	L	K1	5
3	VB	C2	21
4	R	C3	1
5	RV	C1	3
6	N	C3	3
7	CN	F6	6A
8	LG	C1	7
9	M	K4	3
10	ZH	C17 (junction)	
11	HM	F16	6A
12	GR	C2	1
13	not used		
14	Z	C10	8
15	V	K9	5
16	H	K10	5
17	GM	XS5	2
18	V	C10	6
19	M	C20 (junction)	
20	G	C10	3
21	N	C21 (junction)	
22	GV	C26 (junction)	
23	not used		
24	ZH	C17 (junction)	
25	not used		
26	M	C15 (junction)	
27	M	K11	3
28	R	K2	5
29	not used		
30	not used		
31	L	K3	3
32	R	K2	5
33	LB	F25	9
34	LN	F27	16

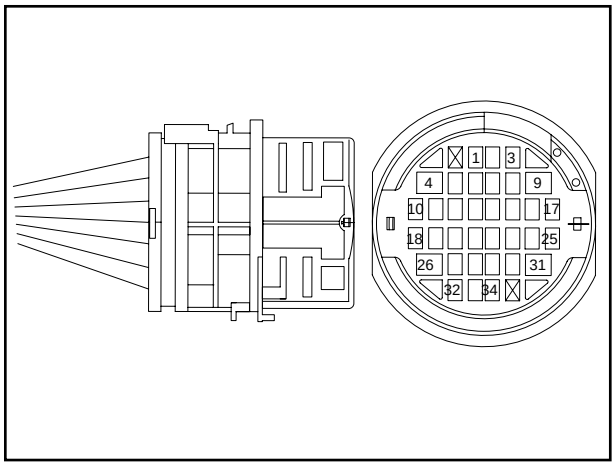


Fig. 10.278

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	K8	3
2	GL	XS3	6
3	HL	C2	16
4	B	C12 (ground)	
5	HV	C2	15
6	G	C10	3
7	M	C20 (junction)	
8	V	C10	6
9	not used		
10	N	C21 (junction)	
11	R	F8	8A
12	BN	C1	19
13	ZN	C1	2
14	not used		
15	SN	C2	3
16	CN	C2	2
17	BV	K1	1
18	VN	K15	5
19	GM	K15	2
20	NR	F2	2
21	C	C1	15
22	AV	XS3	21
23	GN	XS3	22
24	not used		
25	not used		
26	not used		
27	not used		
28	not used		
29	not used		
30	not used		
31	not used		
32	not used		
33	not used		
34	not used		

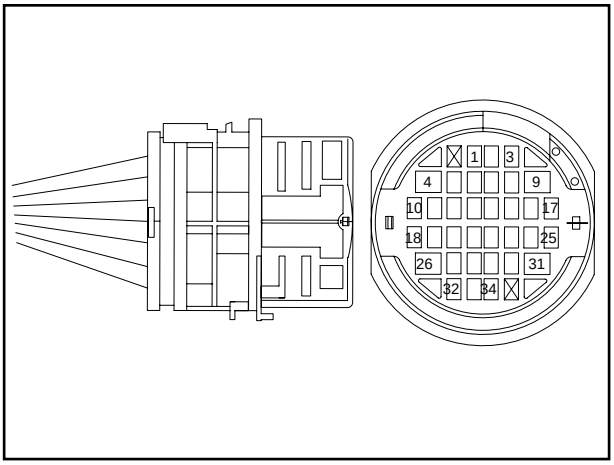


Fig. 10.279

Terminal board (XS3) for platform/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	G	C10	3
2	V	C10	6
3	N	C21 (junction)	
4	not used		
5	SV	C1	10
6	GL	XS2	2
7	RV	C11	2
8	GR	C11	1
9	not used		
10	HN	C25 (junction)	
11	SG	C2	14
12	S	C2	22
13	HM	F16	6
14	RN	F17	5
15	BR	K8	2
16	MV	F18	8A
17	HR	F7	7
18	not used		
19	MR	F24	4
20	R	F8	8A
21	AV	XS2	22
22	GN	XS2	23
23	AN	F25	9A
24	not used		
25	not used		
26	B	C12 (ground)	
27	not used		
28	M	C20 (junction)	
29	not used		
30	not used		
31	R	F26	10A
32	ZL	C1	4
33	RN	F30	11A
34	not used		

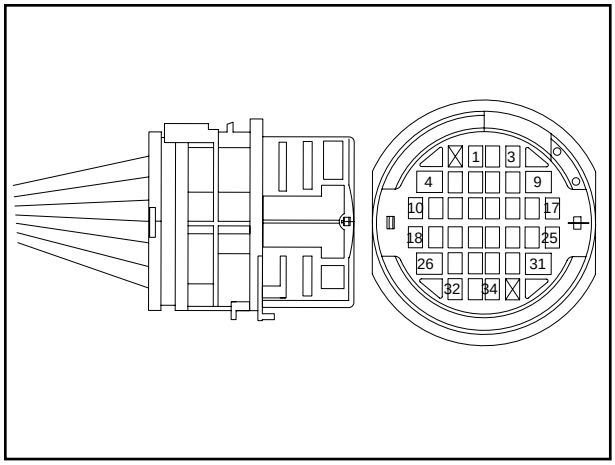


Fig. 10.280

Terminal board (XS5) for roof/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	M	F29	3
2	GM	XS1	17
3	B	C12 (ground)	
4	HG	C21 (junction)	

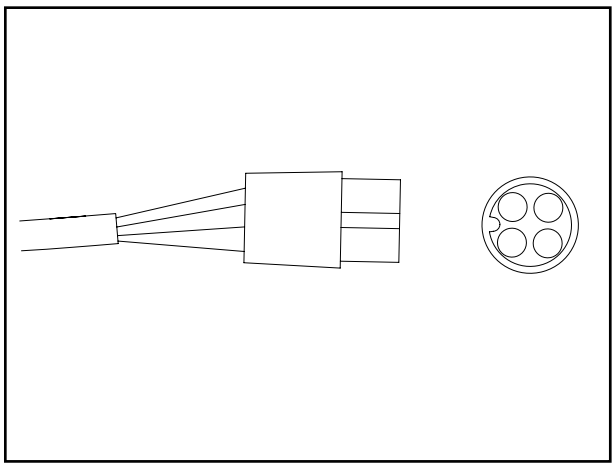


Fig. 10.281

3.7.7 Platform line

3.7.7.1 General description

The platform line connects the controls on the right-hand side of the platform, such as the switches and buttons for engaging/disengaging the 4WD and diff lock (Fig.10.282). It also connects the rear lights and auxiliary power socket.

It is connected to the dashboard line, by means of the connection between the terminal boards (XS3) (Fig.10.283) in each wiring line.

Fig. 10.282

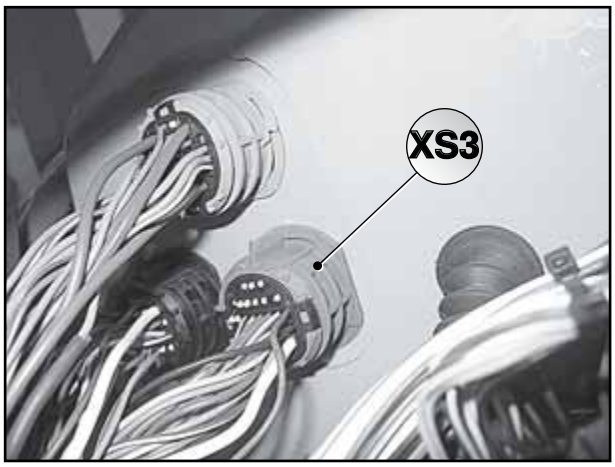


Fig. 10.283

3.7.7.2 Wiring

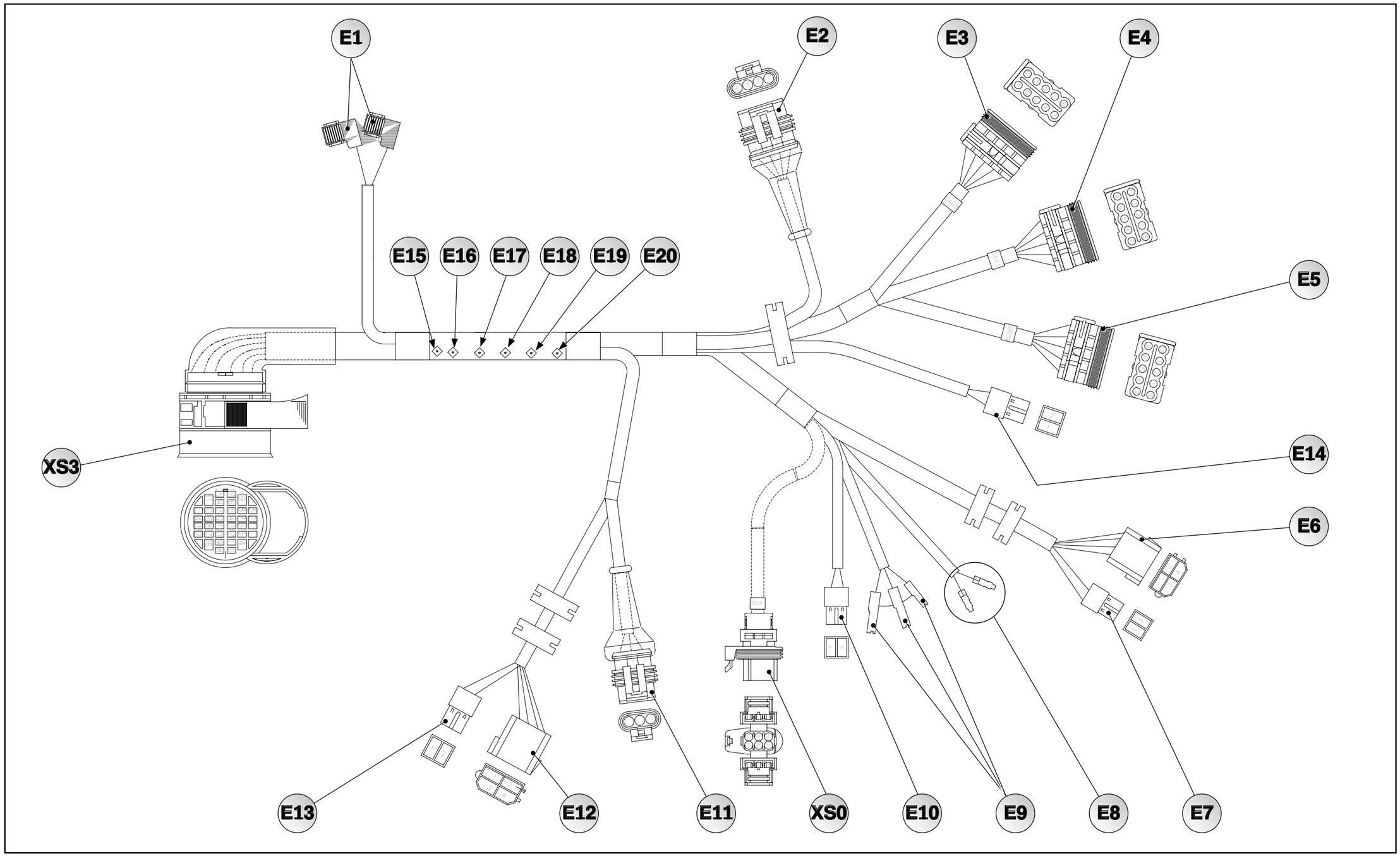


Fig. 10.284

E1 - Terminals for brake oil level sensor
E2 - Connector (not used)
E3 - Connector for differential lock button
E4 - Connector for 4WD engagement/disengagement switch
E5 - Connector for control button of auxiliary control valves (A-B)
E6 - Connector for rh rear field light
E7 - Connector for rh rear field light
E8 - Terminal for field light
E9 - Faston terminals for auxiliary power socket in cab
E10 - Connector for licence plate light
E11 - Fuel level sensor connector
E12 - Connector for lh rear field light
E13 - Connector for lh rear field light
E14 - Pneumatic seat connector
E15-E20 - Junctions
XS0 - Terminal board for trailer socket connection
XS3 - Terminal board for platform/dashboard cable line connection

3.7.7.3 Connector locations

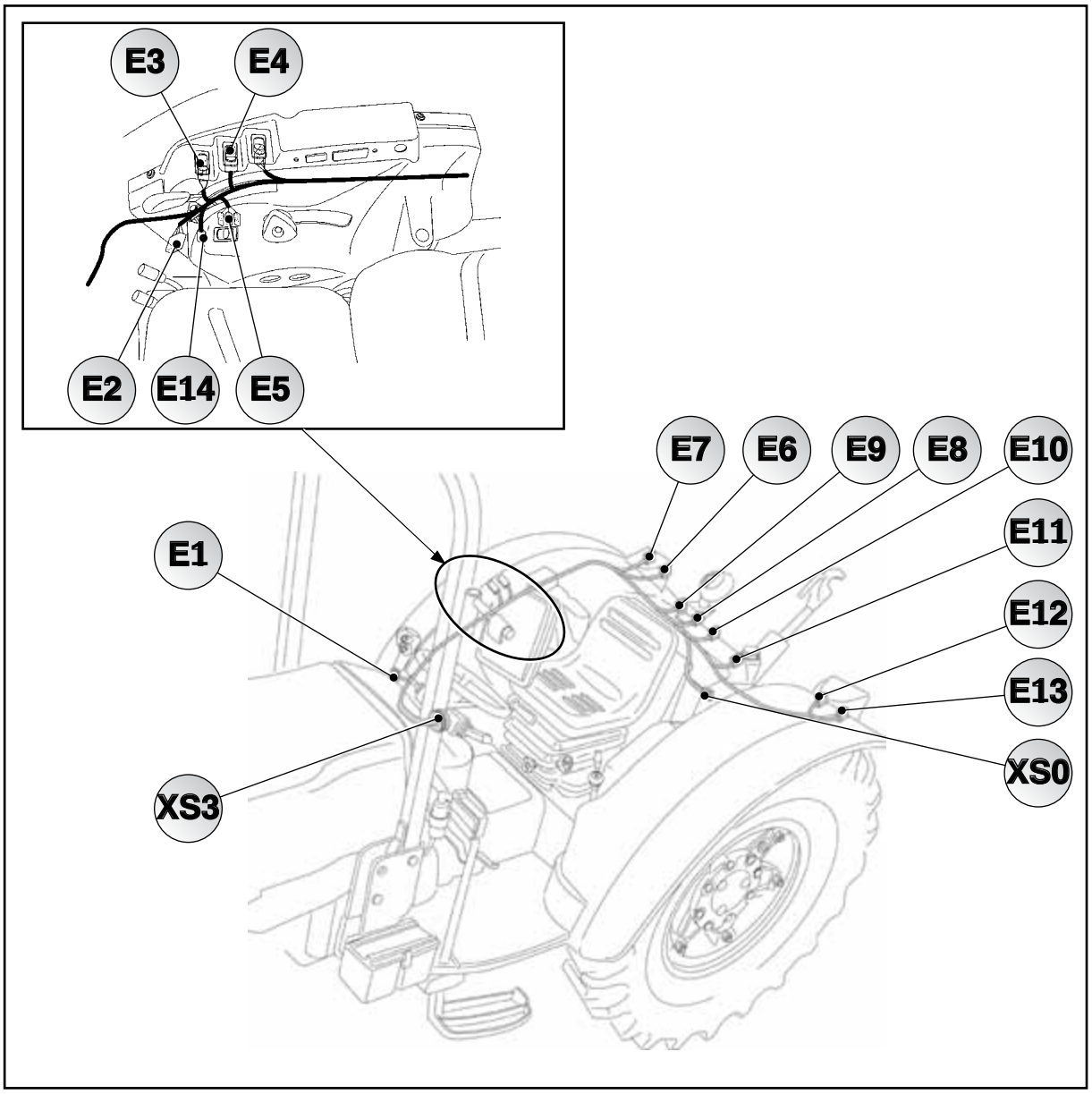


Fig. 10.285

3.7.7.4 Connector identification

Terminals (E1) for brake oil level sensor

term.	wire colour	To con. or comp.	term.
1	ZL	XS3	32
2	B	E17 (junction)	

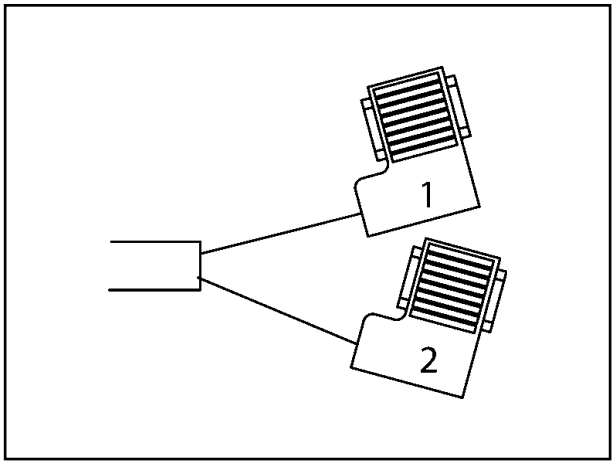


Fig. 10.286

Connector (E2) (not used)

term.	wire colour	To con. or comp.	term.
1	M	E16 (junction)	
2	B	E17 (junction)	
3	RN	XS3	14
4	HM	XS3	13

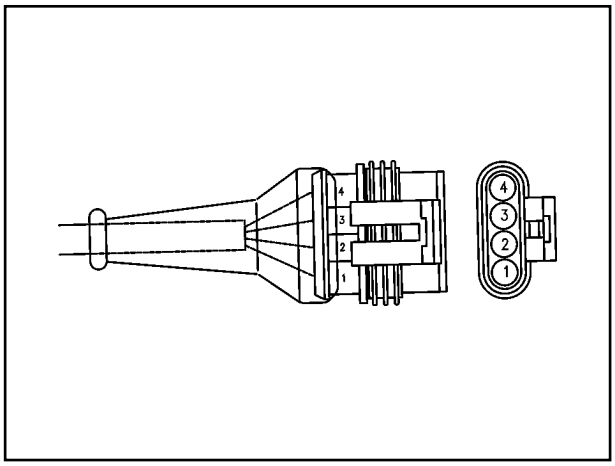


Fig. 10.287

Connector (E3) for differential lock button

term.	wire colour	To con. or comp.	term.
1	not used		
2	BR	XS3	15
3	MV	XS3	16
4	not used		
5	not used		
6	not used		
7	B	E17 (junction)	
8	M	E16 (junction)	
9	not used		
10	not used		

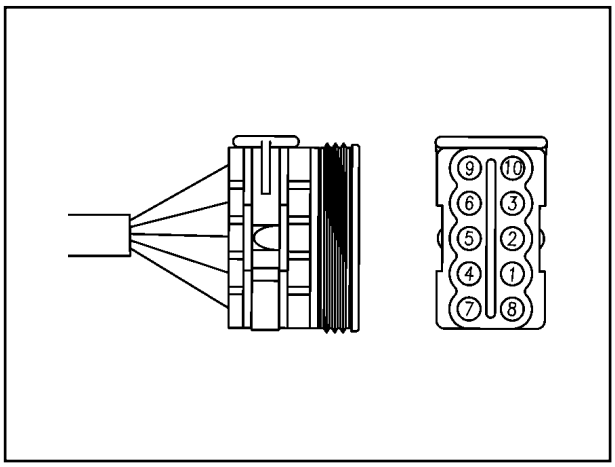


Fig. 10.288

Connector (E4) for 4WD engagement/disengagement switch

term.	wire colour	To con. or comp.	term.
1	GL	XS3	6
2	HR	XS3	17
3	SV	XS3	5
4	not used		
5	not used		
6	not used		
7	B	E17 (junction)	
8	M	E16 (junction)	
9	not used		
10	not used		

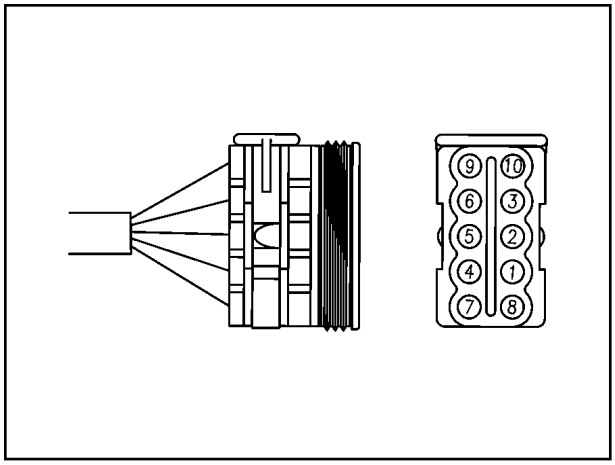


Fig. 10.289

Connector (E5) for control button of auxiliary control valves (A-B)

term.	wire colour	To con. or comp.	term.
1	GN	XS3	22
2	MR	XS3	19
3	AV	XS3	21
4	not used		
5	not used		
6	not used		
7	B	E17 (junction)	
8	M	E16 (junction)	
9	B	E17 (junction)	
10	M	E16 (junction)	

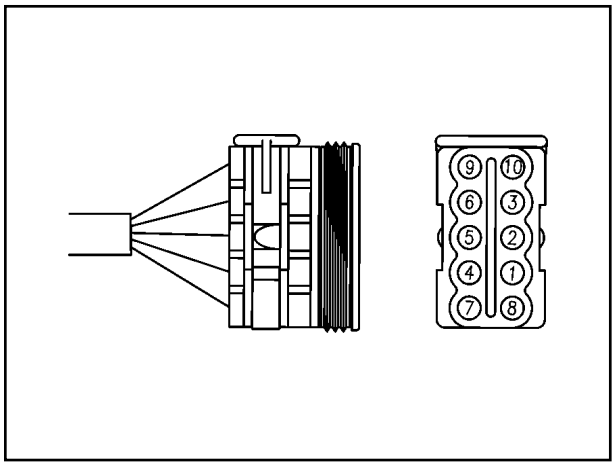


Fig. 10.290

Connector (E6) for rh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E7-E17 (junction)	1
2	V	E20 (junction)	
3	R	E18 (junction)	
4	M	E16 (junction)	

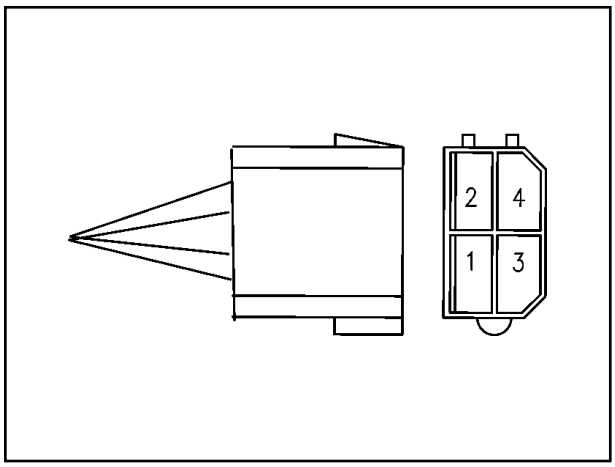


Fig. 10.291

Connector (E7) for rh rear field light

term.	wire colour	To con. or comp.	term.
1	B	E6	1
2	RV	XS3	7

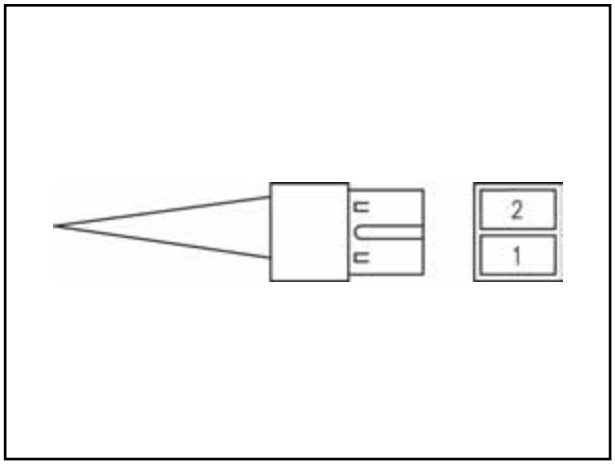


Fig. 10.292

Terminal (E8) for field light

term.	wire colour	To con. or comp.	term.
1	HN	XS3	10
2	B	E17 (junction)	

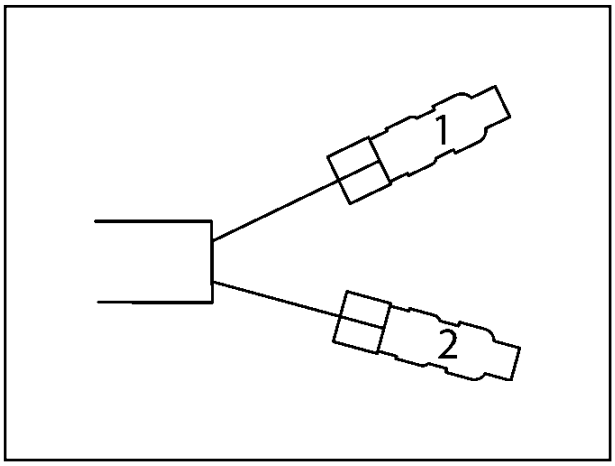


Fig. 10.293

Faston terminals (E9) for auxiliary power socket in cab

term.	wire colour	To con. or comp.	term.
1	R	XS3	31
2	B	E17 (junction)	
3	AN	XS3	23

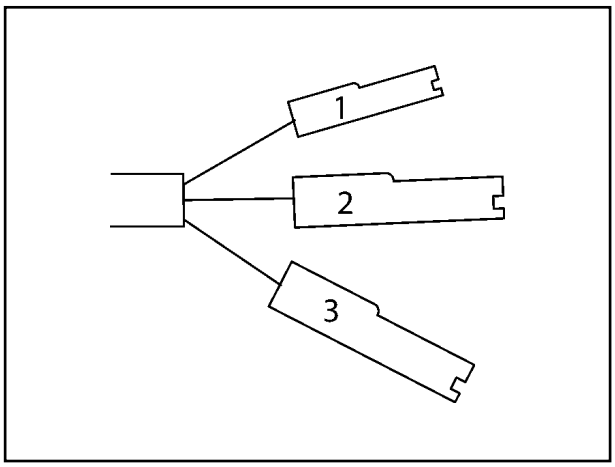


Fig. 10.294

Connector (E10) for licence plate light

term.	wire colour	To con. or comp.	term.
1	N	E15 (junction)	
2	B	E17 (junction)	

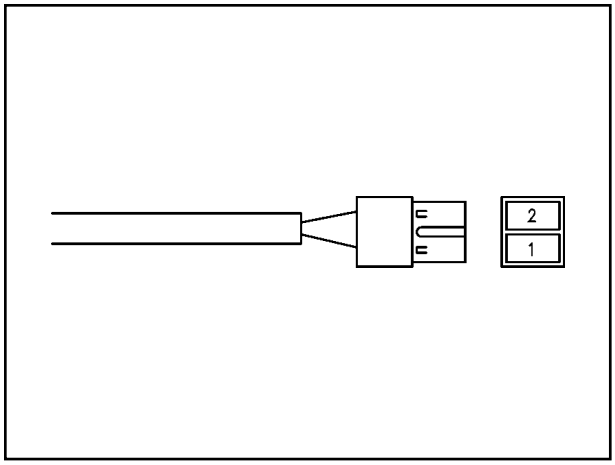


Fig. 10.295

Fuel level sensor connector (E11)

term.	wire colour	To con. or comp.	term.
1	SG	XS3	11
2	S	XS3	12
3	B	E17 (junction)	

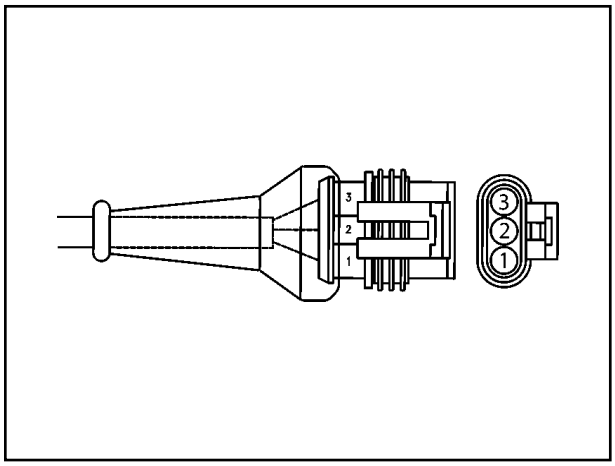


Fig. 10.296

Connector (E12) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E13-E17 (junction)	1
2	G	E19 (junction)	
3	R	E18 (junction)	
4	N	E15 (junction)	

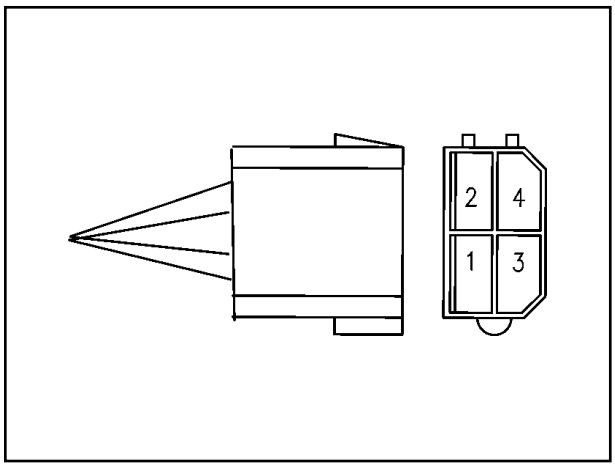


Fig. 10.297

Connector (E13) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B	E12	1
2	GR	XS3	8

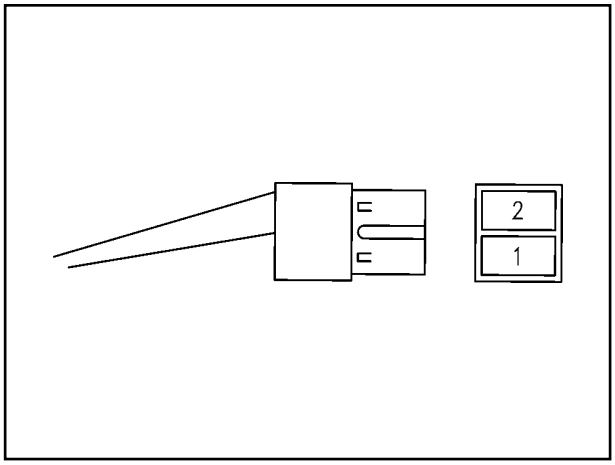


Fig. 10.298

Pneumatic seat connector (E14)

term.	wire colour	To con. or comp.	term.
1	RN	XS3	33
2	B	E17 (junction)	

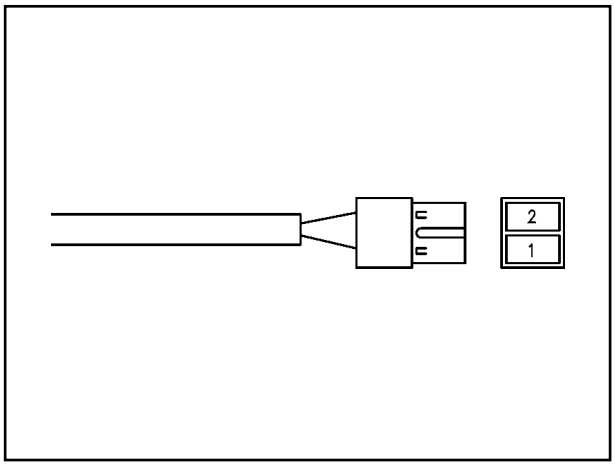


Fig. 10.299

Terminal board (XS0) for trailer socket connection

term.	wire colour	To con. or comp.	term.
1A	N	E15 (junction)	
1B	M	E16 (junction)	
1C	R	E18 (junction)	
2A	G	E19 (junction)	
2B	V	E20 (junction)	
2C	B	E17 (junction)	

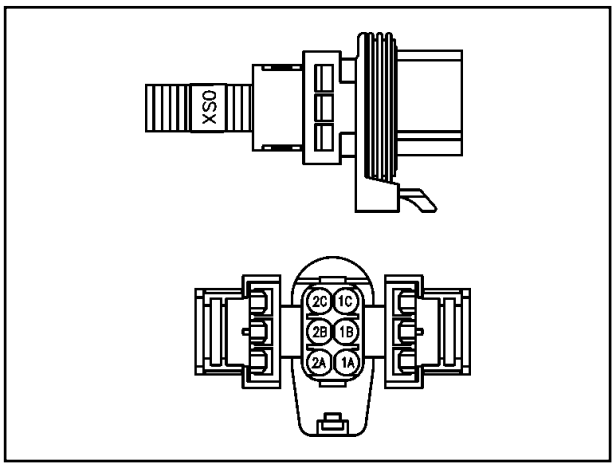


Fig. 10.300

Terminal board (XS3) for platform/dashboard wiring connection

term.	wire colour	To con. or comp.	term.
1	G	E19 (junction)	
2	V	E20 (junction)	
3	N	E15 (junction)	
4	not used		
5	SV	E4	3
6	GL	E4	1
7	RV	E7	2
8	GR	E13	2
9	not used		
10	HN	E8	1
11	SG	E11	1
12	S	E11	2
13	HM	E2	4
14	RN	E2	3
15	BR	E3	2
16	MV	E3	3
17	HR	E4	2
18	not used		
19	MR	E5	2
20	R	E18 (junction)	
21	AV	E5	3
22	GN	E5	1
23	AN	E9	3
24	not used		
25	not used		
26	B	E17 (junction)	
27	not used		
28	M	E16 (junction)	
29	not used		
30	not used		
31	R	E9	1
32	ZL	E1	1
33	RN	E14	1
34	not used		

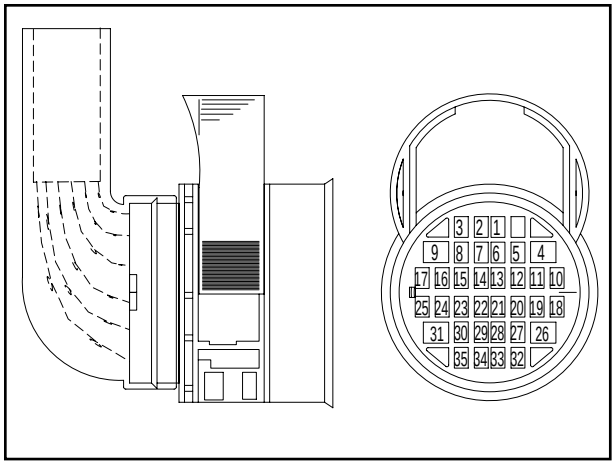


Fig. 10.301

3.7.8 Rear line

3.7.8.1 General description

The rear line powers the components installed on the transmission casing and hydraulic power packs, such as the sensor that detects the rear PTO rate (SR5 Fig.10.302) and the solenoid valves in the servo clutch valve system (8 Fig.10.303) for controlling users like the differential lock and four-wheel drive.

The rear line is connected to the dashboard line via connections between the terminal boards (XS2 Fig.10.304).

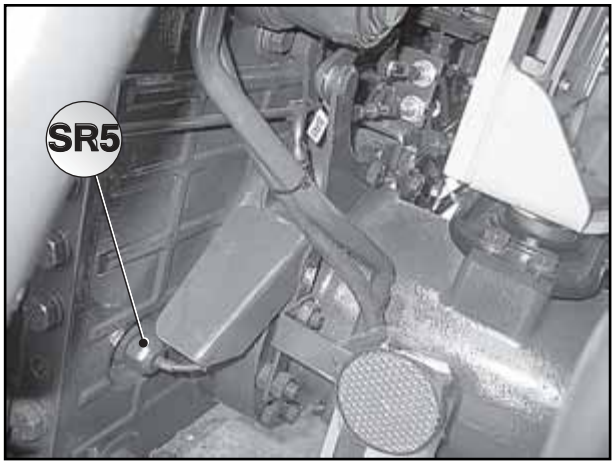


Fig. 10.302

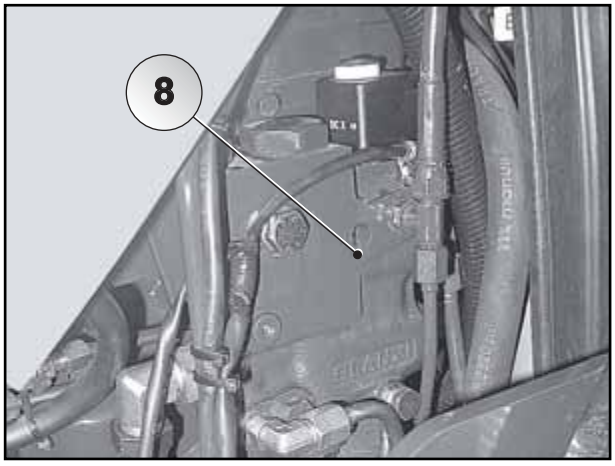


Fig. 10.303

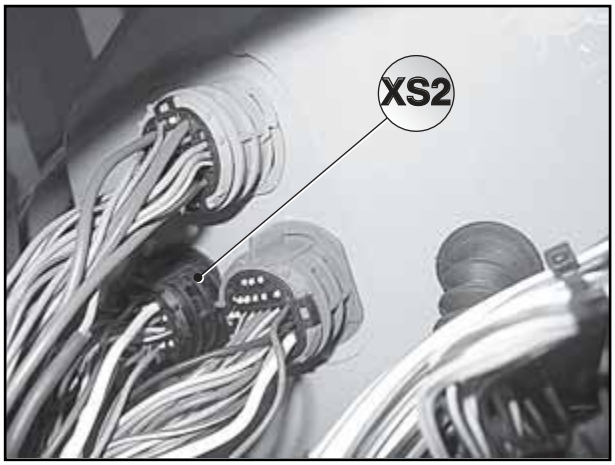


Fig. 10.304

3.7.8.2 Wiring

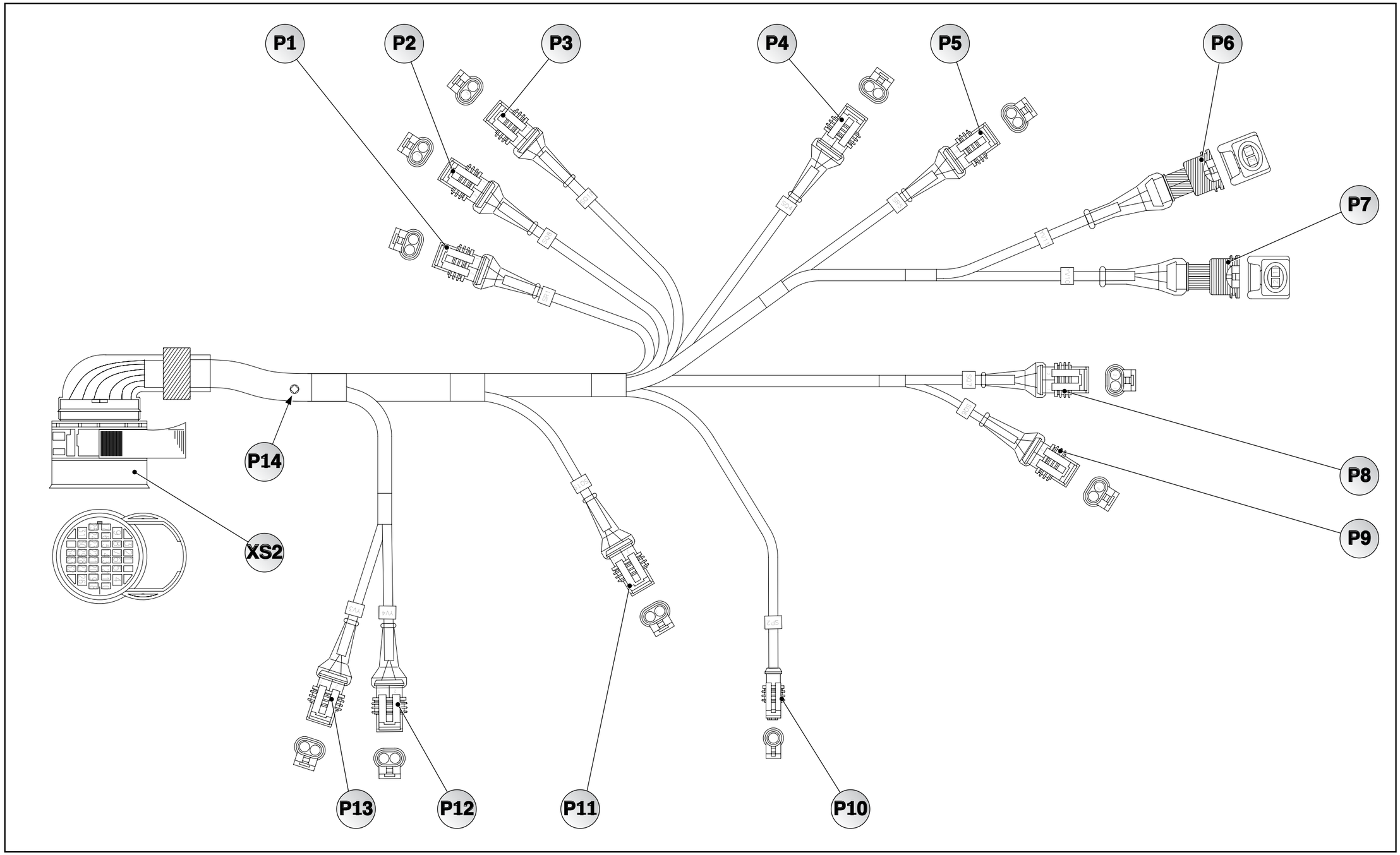


Fig. 10.305

P1 - Connector for ground speed sensor
P2 - Connector for proportional rear PTO microswitch
P3 - Connector for independent rear PTO microswitch
P4 - Connector for parking brake hand lever microswitch
P5 - Connector for rear PTO RPM sensor
P6 - Connector for solenoid valve (YV11) of auxiliary control valve B
P7 - Connector for solenoid valve (YV10) of auxiliary control valve A
P8 - Connector for fast rear PTO microswitch
P9 - Connector for slow rear PTO microswitch
P10 - Trailer brake pressure switch connector
P11 - Connector for ignition enabling microswitch
P12 - Connector for 4WD solenoid valve
P13 - Connector for differential lock solenoid valve
P14 - Junction
XS2 - Terminal board for rear line/dashboard connection

3.7.8.3 Connector locations

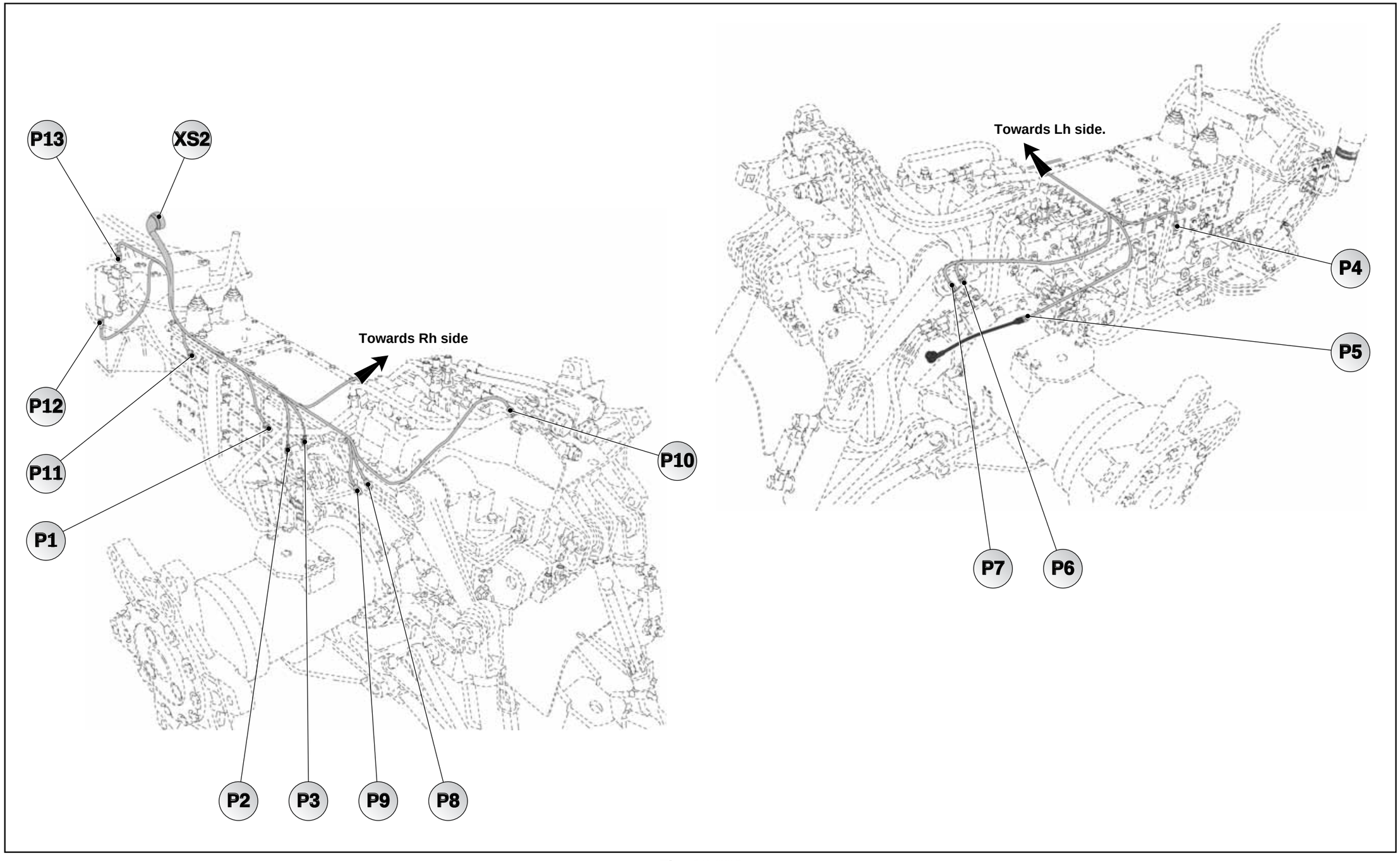


Fig. 10.306

P1 - Connector for ground speed sensor
P2 - Connector for proportional rear PTO microswitch
P3 - Connector for independent rear PTO microswitch
P4 - Connector for parking brake hand lever microswitch
P5 - Connector for rear PTO RPM sensor
P6 - Connector for solenoid valve (YV11) of auxiliary control valve B
P7 - Connector for solenoid valve (YV10) of auxiliary control valve A
P8 - Connector for fast rear PTO microswitch
P9 - Connector for slow rear PTO microswitch
P10 - Trailer brake pressure switch connector
P11 - Connector for ignition enabling microswitch
P12 - Connector for 4WD solenoid valve
P13 - Connector for differential lock solenoid valve
XS2 - Terminal board for rear line/dashboard connection

3.7.8.4 Connector identification

Connector (P1) for ground speed sensor

term.	wire colour	To con. or comp.	term.
1	SN	XS2	15
2	B	P14 (junction)	

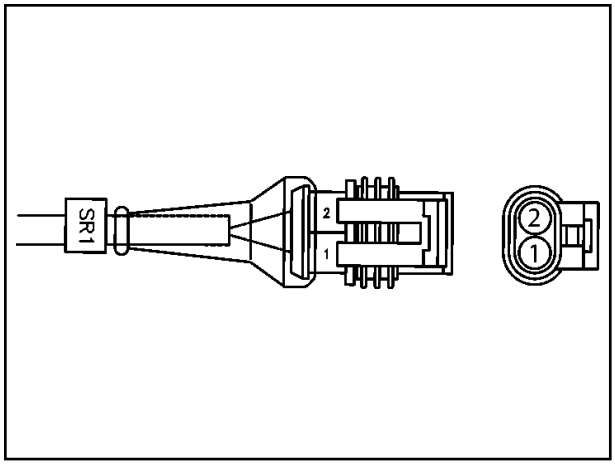


Fig. 10.307

Connector (P2) for proportional rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	C	XS2	21
2	B	P14 (junction)	

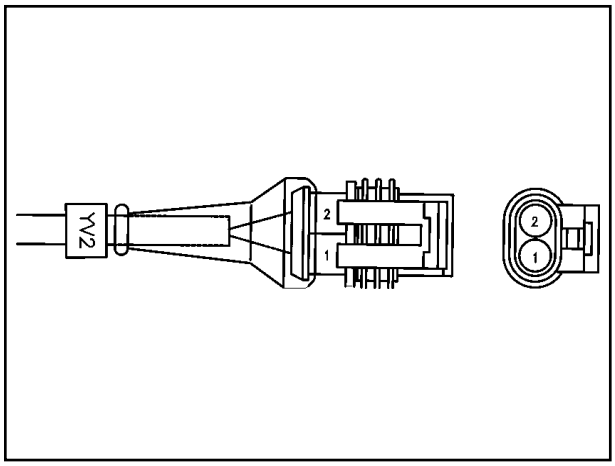


Fig. 10.308

Connector (P3) for independent rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	GM	XS2	19
2	NR	XS2	20

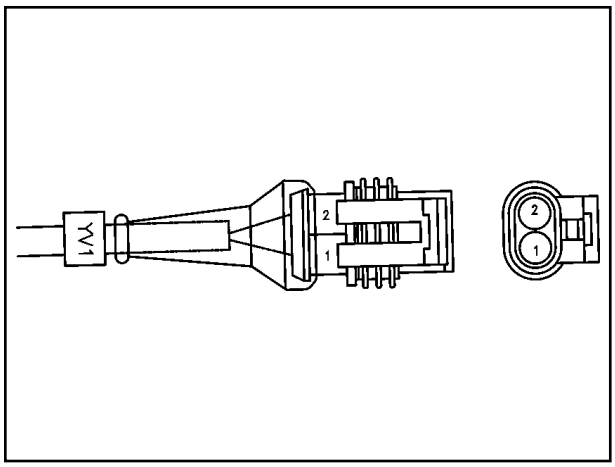


Fig. 10.309

Connector (P4) for parking brake lever microswitch

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	ZN	XS2	13

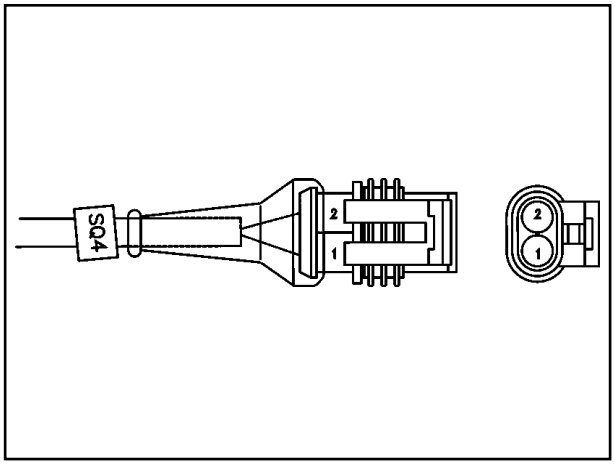


Fig. 10.310

Connector (P5) for rear PTO RPM sensor

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	CN	XS2	16

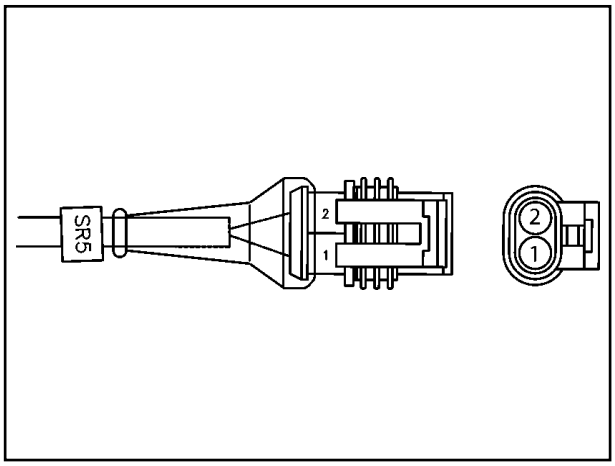


Fig. 10.311

Connector (P6) for solenoid valve (YV11) of auxiliary control valve B

term.	wire colour	To con. or comp.	term.
1	GN	XS2	23
2	B	P14 (junction)	

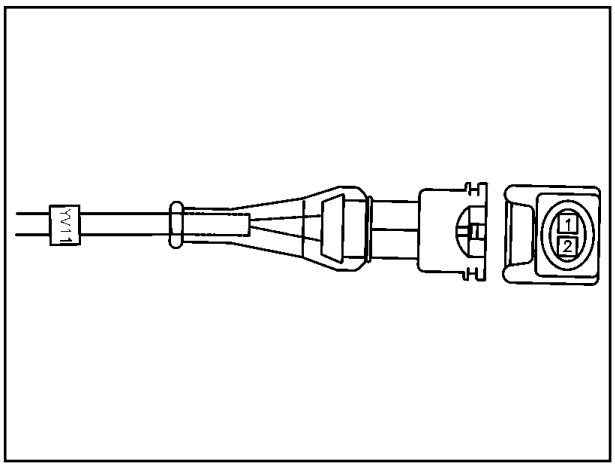


Fig. 10.312

Connector (P7) for solenoid valve (YV10) of auxiliary control valve A

term.	wire colour	To con. or comp.	term.
1	AV	XS2	22
2	B	P14 (junction)	

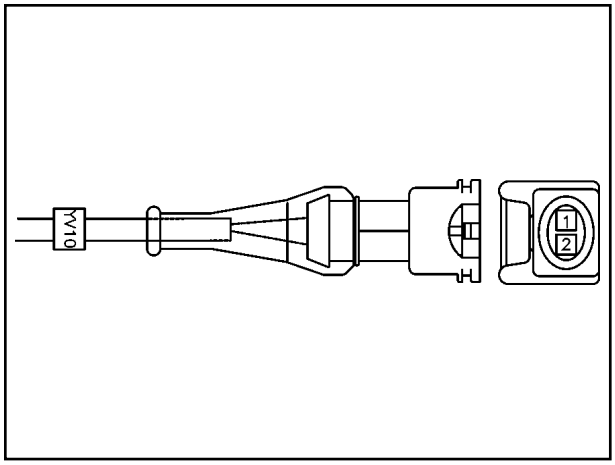


Fig. 10.313

Connector (P8) for fast rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	HL	XS2	3

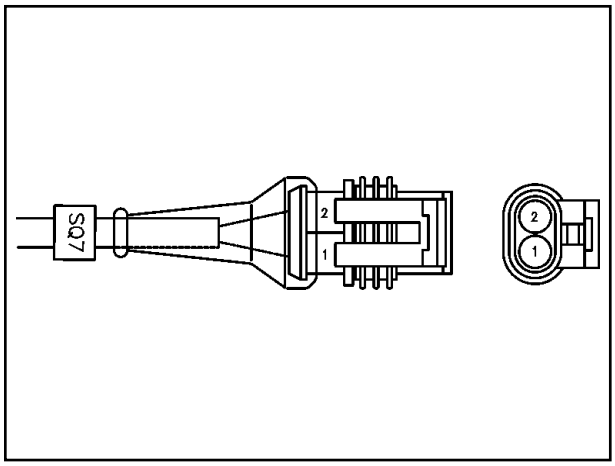


Fig. 10.314

Connector (P9) for slow rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P14 (junction)	
2	HV	XS2	5

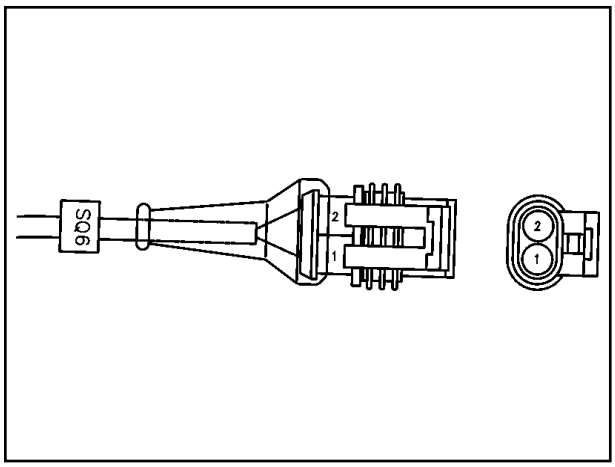


Fig. 10.315

Trailer brake pressure switch connector (P10)

term.	wire colour	To con. or comp.	term.
1	BN	XS2	12

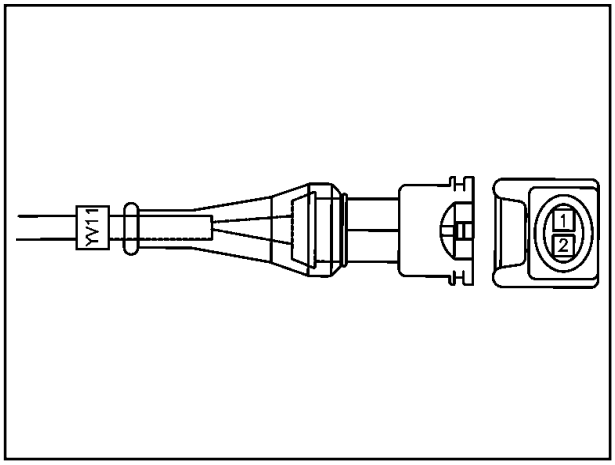


Fig. 10.316

Connector (P11) for ignition enabling microswitch

term.	wire colour	To con. or comp.	term.
1	BV	XS2	17
2	VN	XS2	18

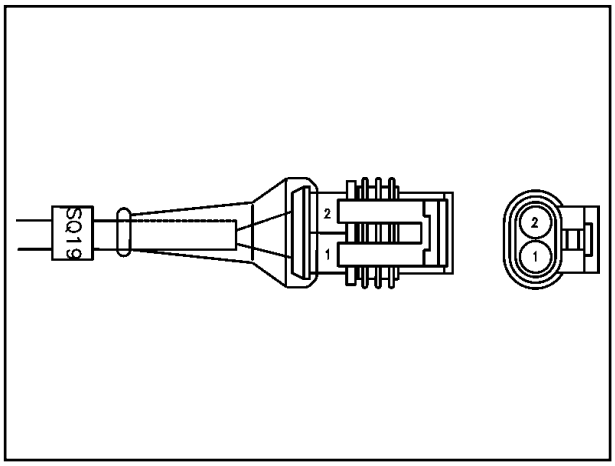


Fig. 10.317

Connector (P12) for 4WD solenoid valve

term.	wire colour	To con. or comp.	term.
1	GL	XS2	2
2	B	P14 (junction)	

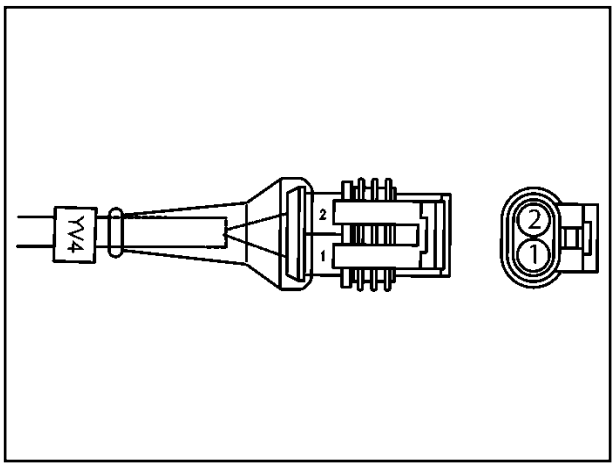


Fig. 10.318

Connector (P13) for differential lock solenoid valve

term.	wire colour	To con. or comp.	term.
1	BR	XS2	1
2	B	P14 (junction)	

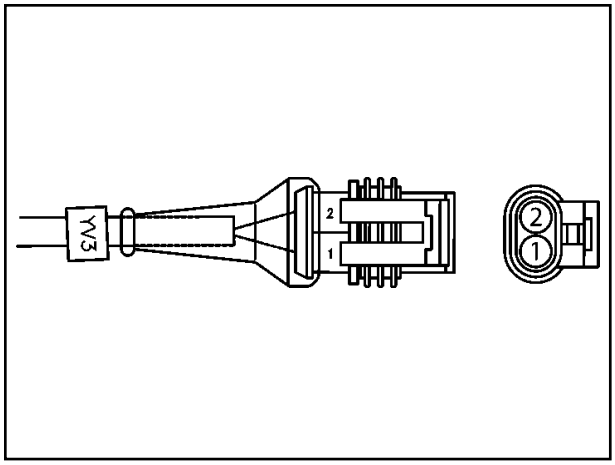


Fig. 10.319

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	P13	1
2	GL	P12	1
3	HL	P8	2
4	B	P14 (junction)	
5	HV	P9	2
6	not used		
7	not used		
8	not used		
9	not used		
10	not used		
11	not used		
12	BN	P10	1
13	ZN	P4	2
14	not used		
15	SN	P1	1
16	CN	P5	2
17	BV	P11	1
18	VN	P11	2
19	GM	P3	1
20	NR	P3	2
21	C	P2	1
22	AV	P7	1
23	GN	P6	1
24	not used		
25	not used		
26	not used		
27	not used		
28	not used		
29	not used		
30	not used		
31	not used		
32	not used		
33	not used		
34	not used		

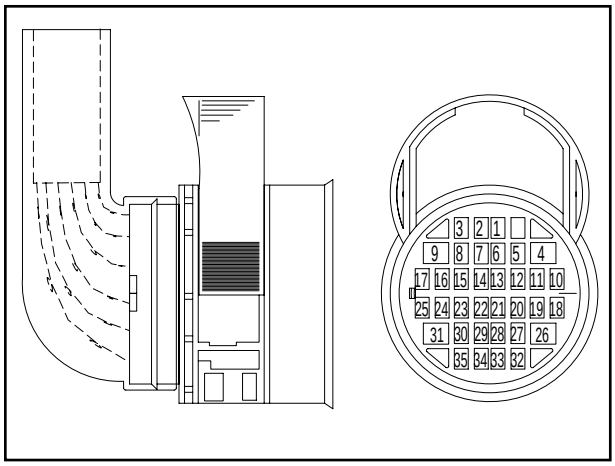


Fig. 10.320

3.7.9 Headlight extension line

3.7.9.1 General description

The headlight extension line powers the lamps installed at the front of the tractor's bonnet (Fig.10.321).

The headlight extsneion line is connected to the engine's front line by means of connectors (H3 and B25)(Fig.10.322).

Fig. 10.321

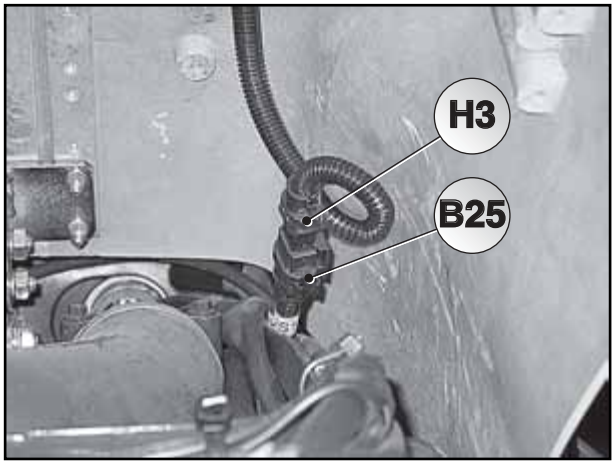


Fig. 10.322

3.7.9.2 Wiring

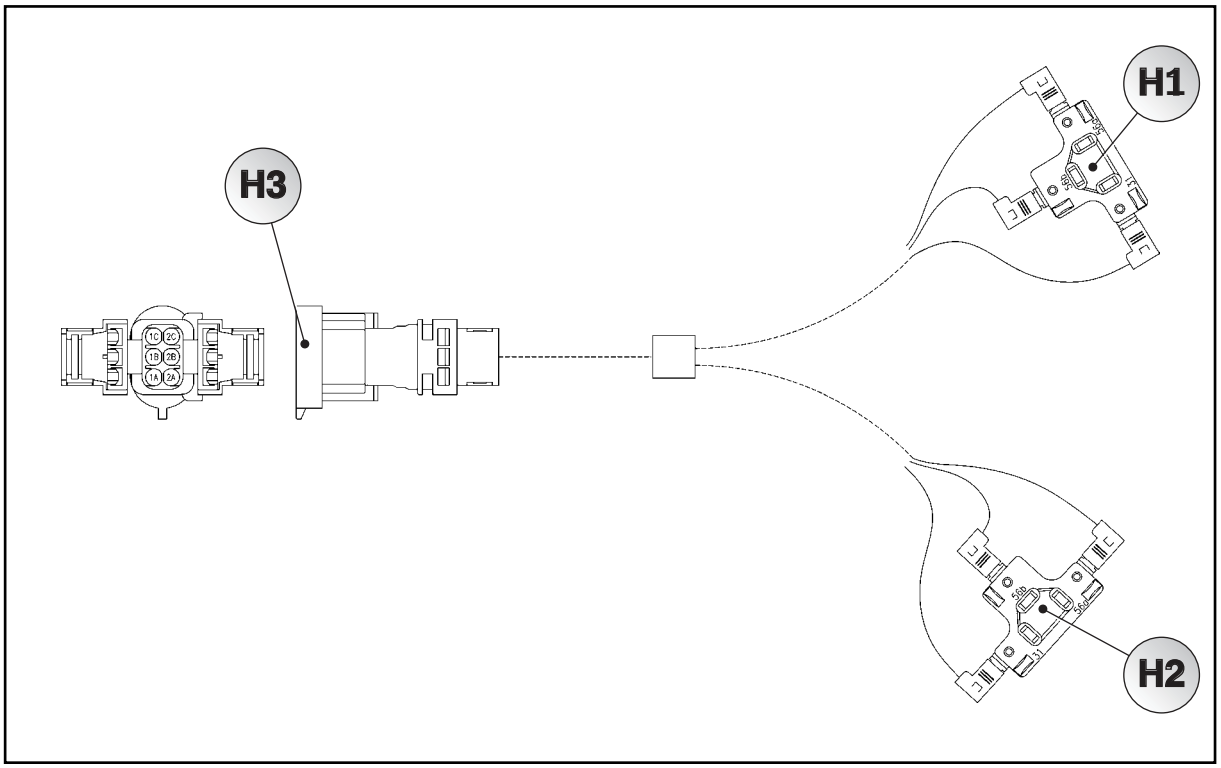


Fig. 10.323

H1 - Lh headlight connector
H2 - Rh headlight connector
H3 - Connector for connecting to the front line

3.7.9.3 Connector locations

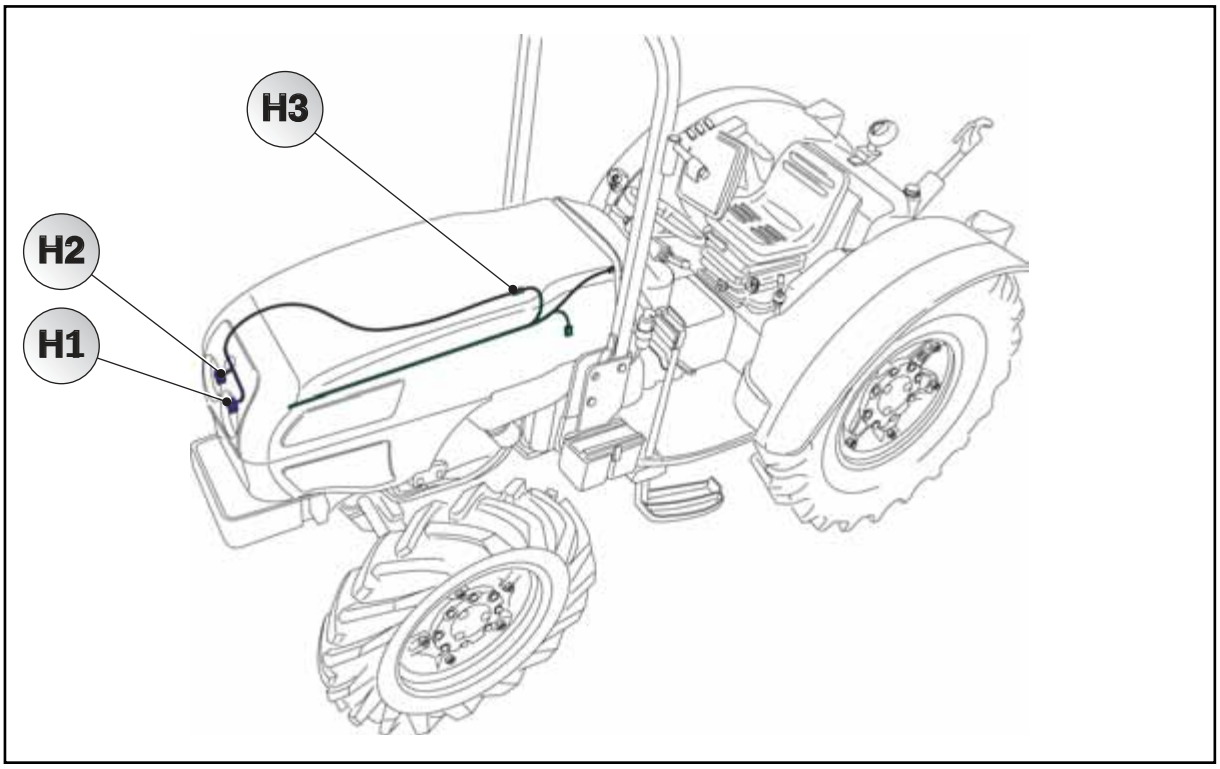


Fig. 10.324

3.7.9.4 Connector identification

Lh headlight connector (H1)

term.	wire colour	To con. or comp.	term.
1	B	H3	2C
2	H	H3	2B
3	V	H3	1A

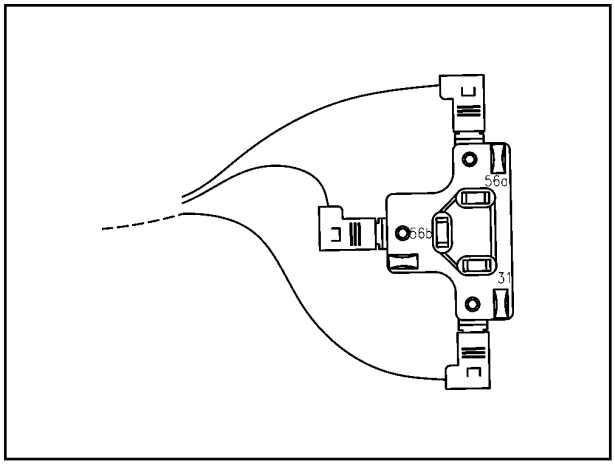


Fig. 10.325

Rh headlight connector (H2)

term.	wire colour	To con. or comp.	term.
1	B	H3	1C
2	HN	H3	2A
3	VN	H3	1B

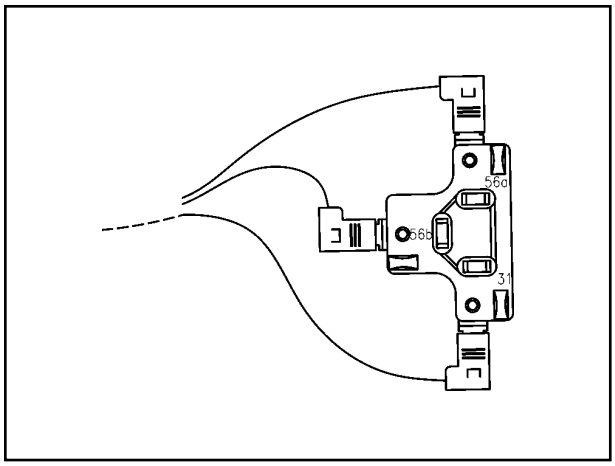


Fig. 10.326

Connector (H3) for front line connection

term.	wire colour	To con. or comp.	term.
1A	V	H1	3
1B	VN	H2	3
1C	B	H2	1
2A	HN	H2	2
2B	H	H1	2
2C	B	H1	1

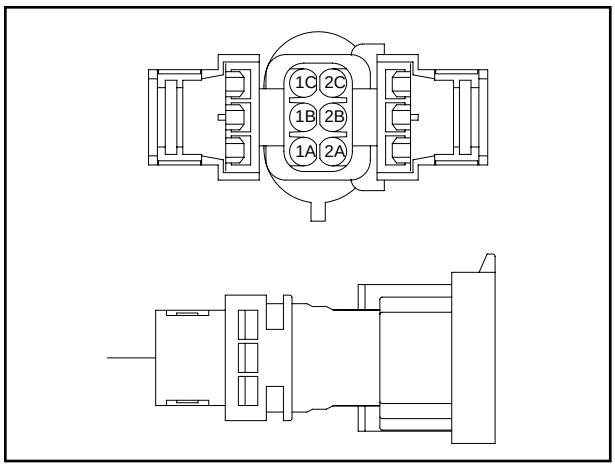


Fig. 10.327

3.7.10 Roof line

3.7.10.1 General description

The roof wiring line powers the components installed on the cab roof. The air conditioning system is installed in the rear part of the roof and is connected to the system by this wiring line. The field light switches, windowscreen wiper switches, etc., are also powered by this line.

The services in the cab are protected against short-circuits and excessive power draw by the power fuse (FU6 Fig.10.329), installed in the roof powering line.

The cab roof line is connected to the dashboard line via the terminal boards (XS5) (Fig.10.330).

Fig. 10.328

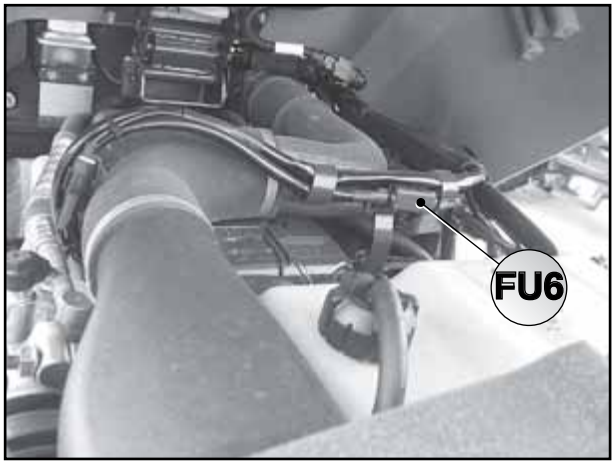


Fig. 10.329

Fig. 10.330

3.7.10.2 Wiring

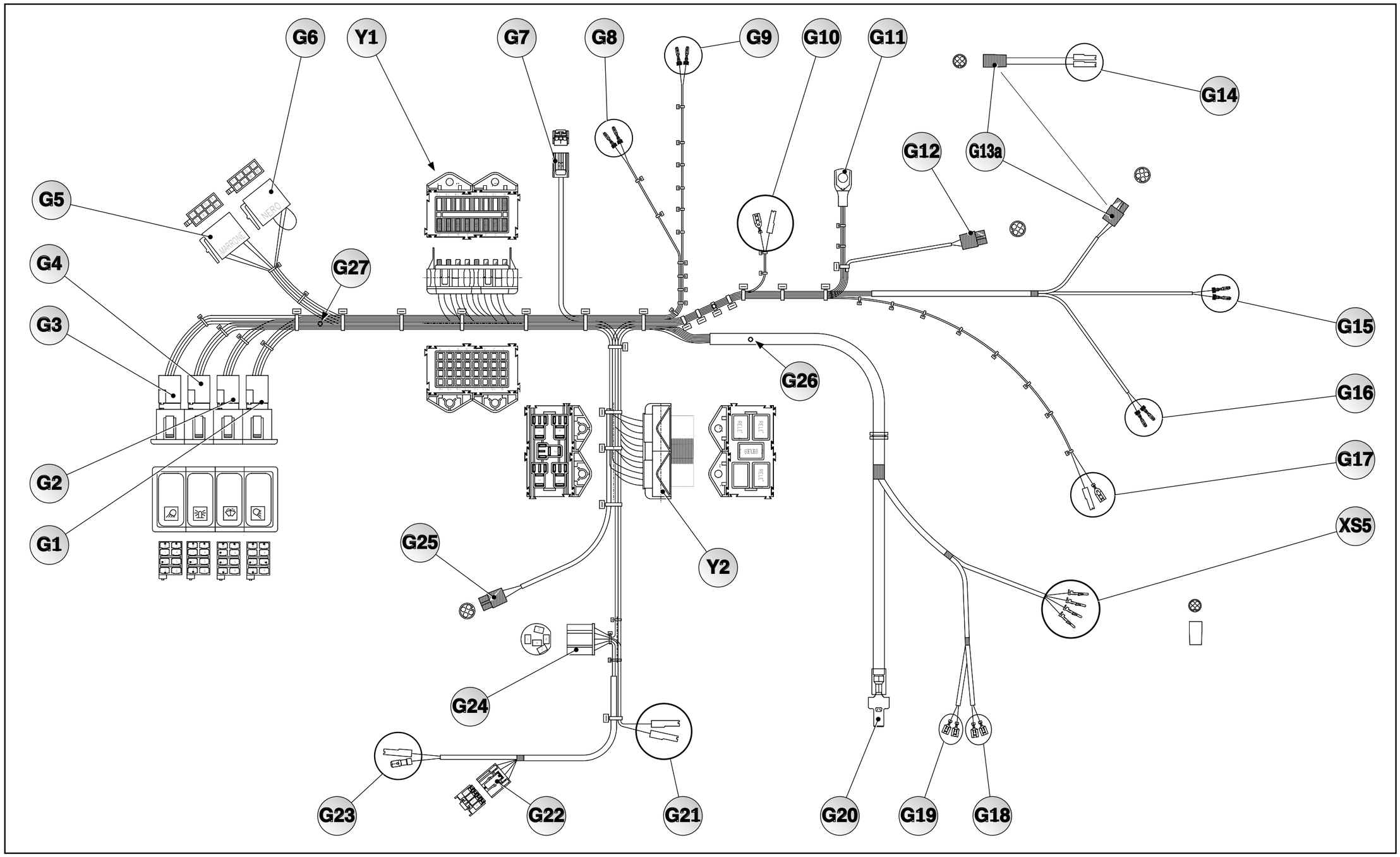


Fig. 10.331

G1 - Connector for rear light switch
G2 - Connector for windscreen wiper switch
G3 - Connector for revolving beacon switch
G4 - Connector for headlight switch
G5 - Radio connector (brown)
G6 - Radio connector (black)
G7 - Ceiling light connector
G8 - Terminals for rh front field light connection
G9 - Terminals for lh front field light connection
G10 - Terminals for rh loud-speaker
G11 - Grounding eyelet
G12 - Connector for rear window wiper
G13 - Connector for revolving beacon brace
G13a - Connector for revolving beacon brace
G14 - Terminals for connecting the revolving beacon
G15 - Terminal for rear field light connection
G16 - Terminal for rear field light connection
G17 - Terminals for lh loud-speaker
G18 - Windscreen washer terminals
G19 - Rear window washer terminals
G20 - Terminal for alternator connection (direct powering)
G21 - Terminals for AC system
G22 - Connector for AC system
G23 - Terminals for AC system
G24 - Connector for AC system fan
G25 - Connector for windscreen wiper
G26/G27 - Junctions
Y1 - Cab fuse box
Y2 - Cab relay box
XS5 - Terminal board for roof line/dashboard connection

3.7.10.3 Connector locations

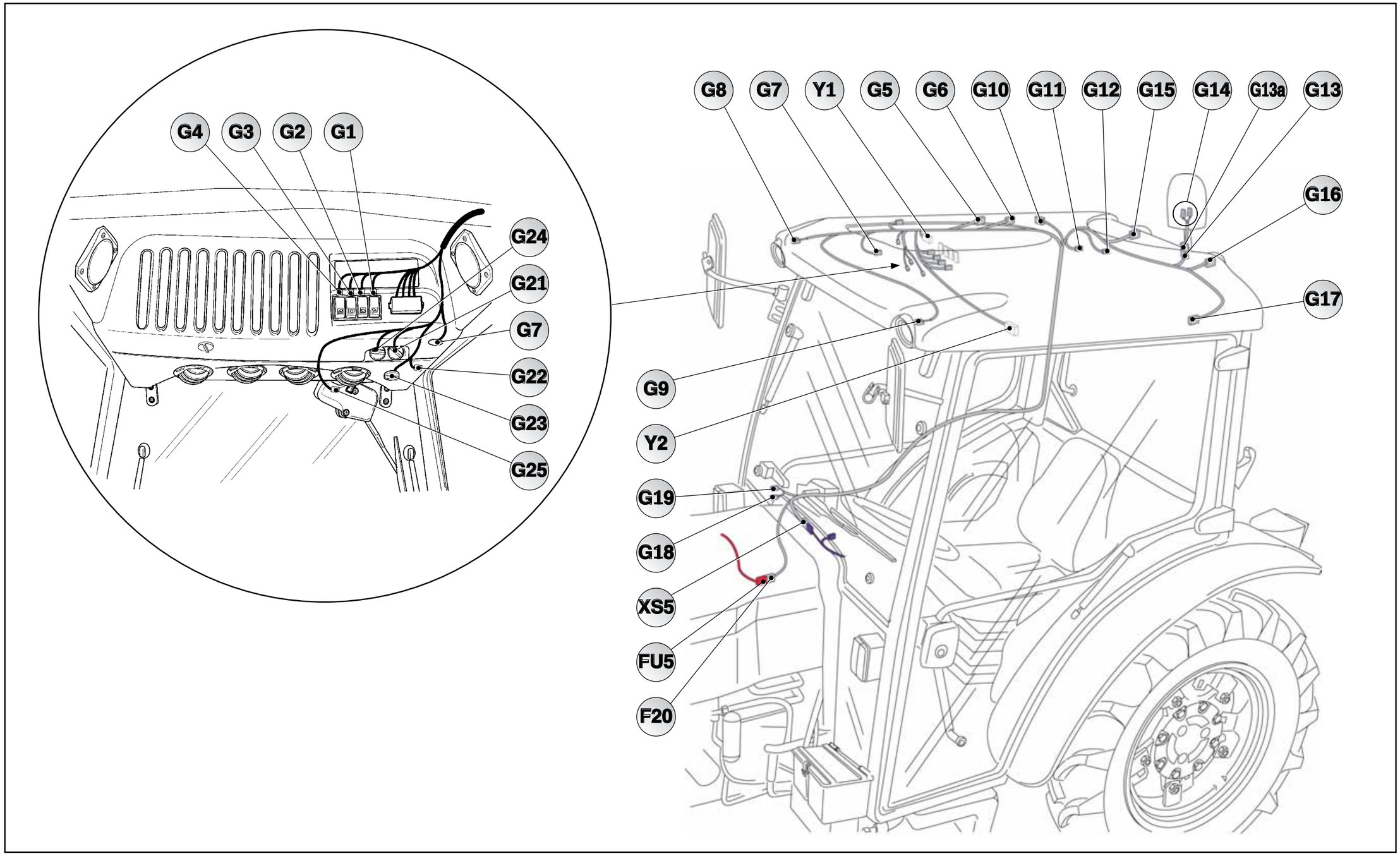


Fig. 10.332

3.7.10.4 Connector identification

Connector (G1) for rear light switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	K6	87
3	MC	K18	86
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

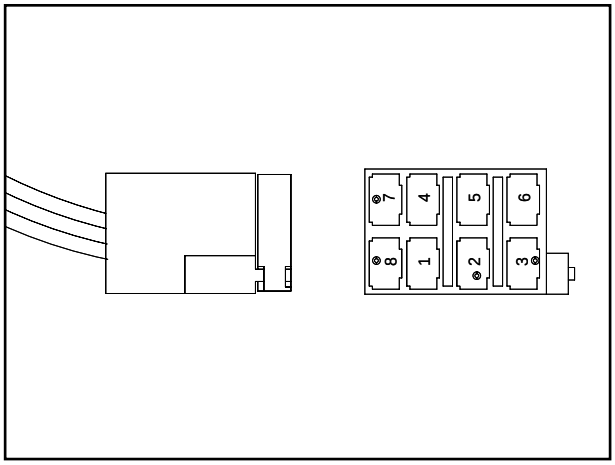


Fig. 10.333

Connector (G2) for windscreen wiper switch

term.	wire colour	To con. or comp.	term.
1	VB	G19	1
2	MR	F28	8A
3	VZ	G18	1
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

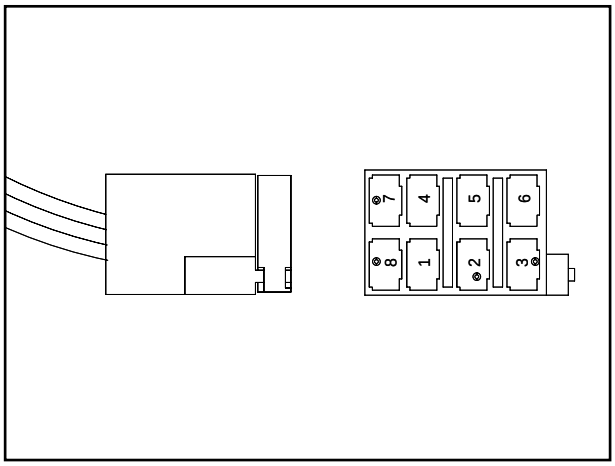


Fig. 10.334

Revolving beacon switch connector (G3)

term.	wire colour	To con. or comp.	term.
1	not used		
2	BR	F23	2A
3	RV	G13	1
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

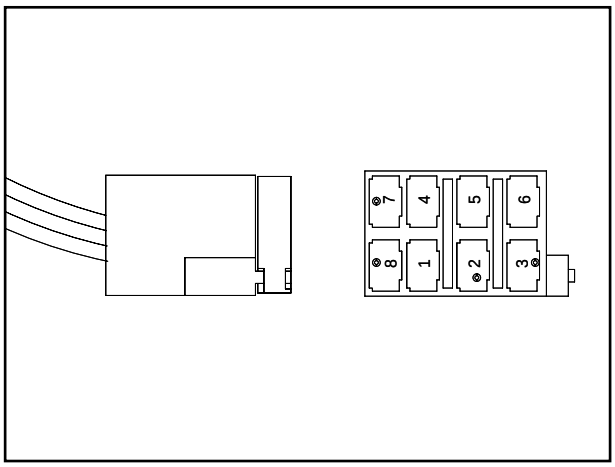


Fig. 10.335

Connector (G4) for headlight switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	K6	87
3	MS	K17	86
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

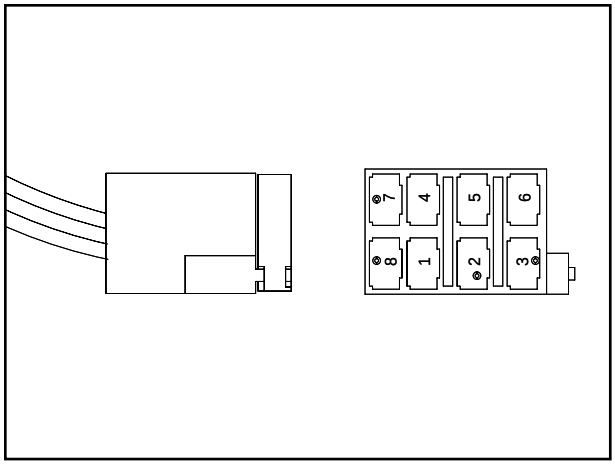


Fig. 10.336

Radio connector (G5) (brown)

term.	wire colour	To con. or comp.	term.
1	G	G10	1
2	GN	G10	2
3	not used		
4	not used		
5	not used		
6	not used		
7	A	G17	1
8	AN	G17	2

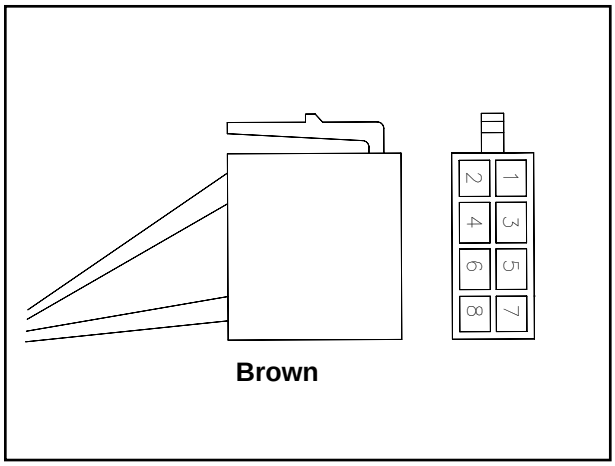


Fig. 10.337

Radio connector (G6) (black)

term.	wire colour	To con. or comp.	term.
1	not used		
2	not used		
3	not used		
4	R	G6	7
5	not used		
6	not used		
7	R-R	G6-F32	4-3A
8	B	G28 (junction)	

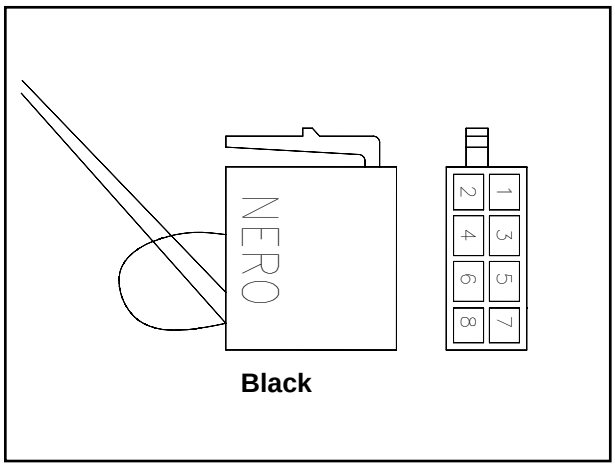


Fig. 10.338

Ceiling light connector (G7)

term.	wire colour	To con. or comp.	term.
1	BR	F23	2A
2	B	G28 (junction)	
3	not used		

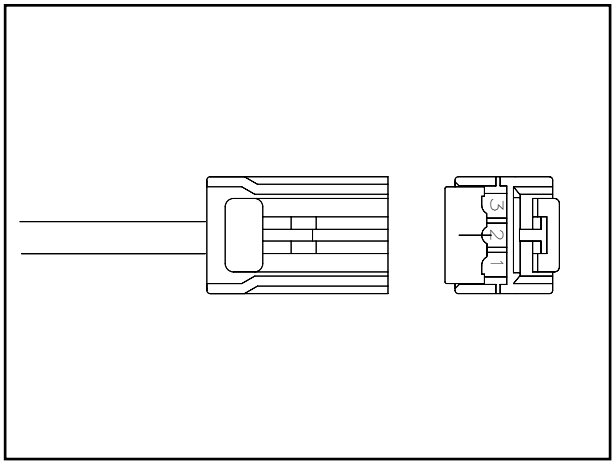


Fig. 10.339

Terminals (G8) for rh front field light connection

term.	wire colour	To con. or comp.	term.
1	LN	K17	87
2	B	G28 (junction)	

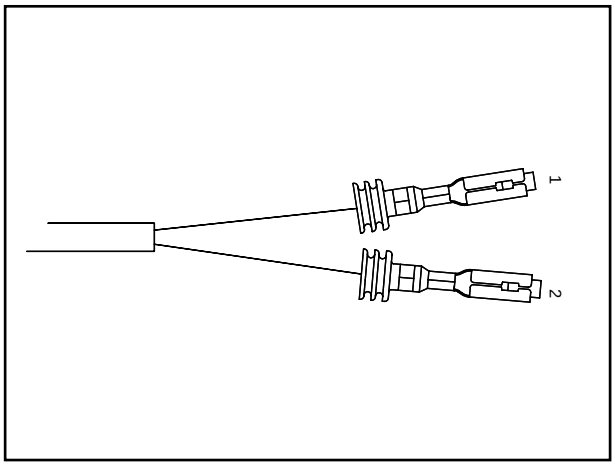


Fig. 10.340

Terminals (G9) for lh front field light connection

term.	wire colour	To con. or comp.	term.
1	LN	K17	87
2	B	G28 (junction)	

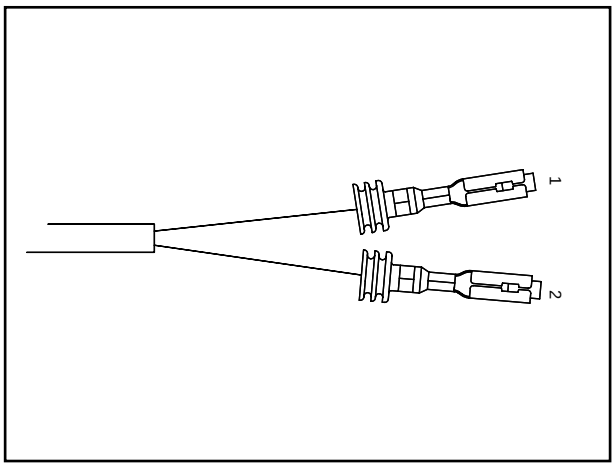


Fig. 10.341

Terminals (G10) for rh loud-speaker

term.	wire colour	To con. or comp.	term.
1	G	G5	1
2	GN	G5	2

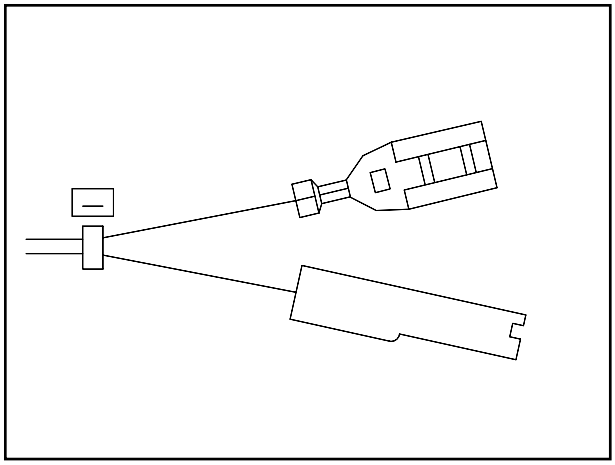


Fig. 10.342

Grounding eyelet (G11)

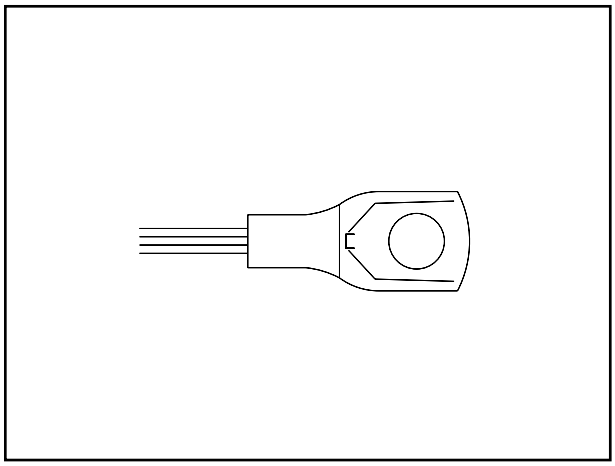


Fig. 10.343

Connector (G12) for rear window wiper

term.	wire colour	To con. or comp.	term.
1	MN	F23	7A
2	B	G11 (ground)	
3	not used		
4	not used		

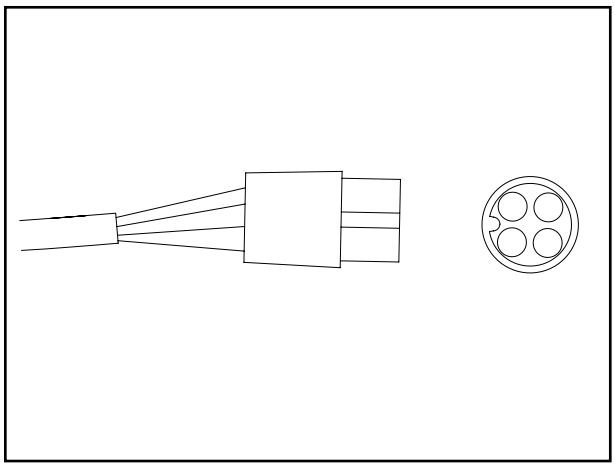


Fig. 10.344

Connector (G13) for revolving beacon brace

term.	wire colour	To con. or comp.	term.
1	RV	G3	3
2	B	G11 (ground)	
3	not used		
4	not used		

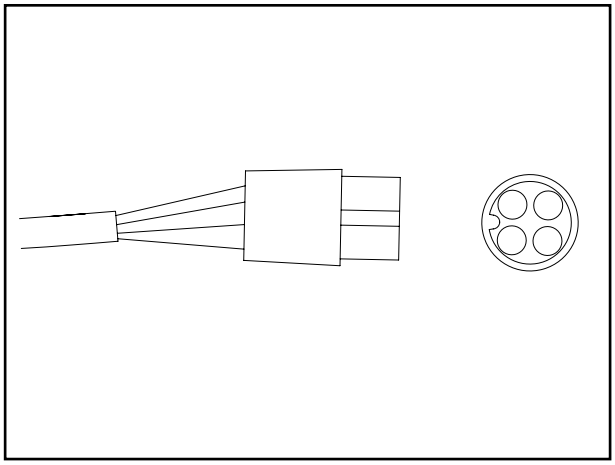


Fig. 10.345

Connector (G13a) for revolving beacon brace

term.	wire colour	To con. or comp.	term.
1	RV	G14	2
2	B	G14	1
3	not used		
4	not used		

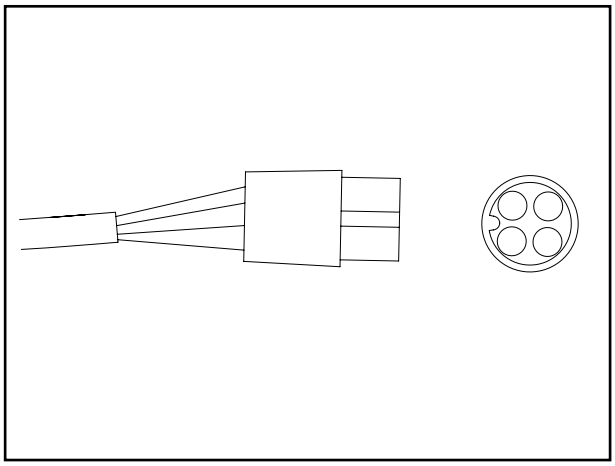


Fig. 10.346

Terminal (G14) for revolving beacon connection

term.	wire colour	To con. or comp.	term.
1	B	G13a	2
2	RV	G13a	1

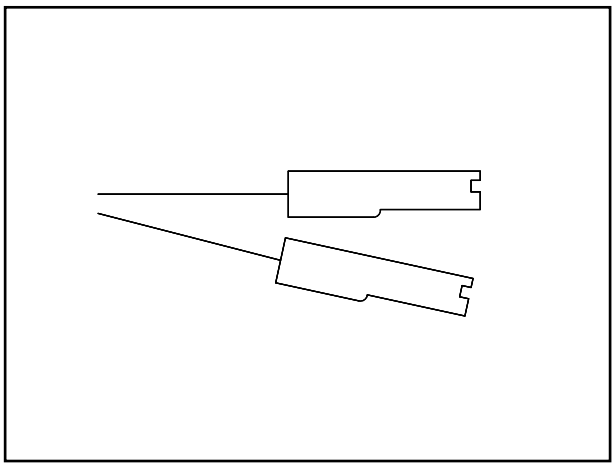


Fig. 10.347

Terminals (G15) for rear field light connection

term.	wire colour	To con. or comp.	term.
1	B	G11 (ground)	
2	AG	K18	87

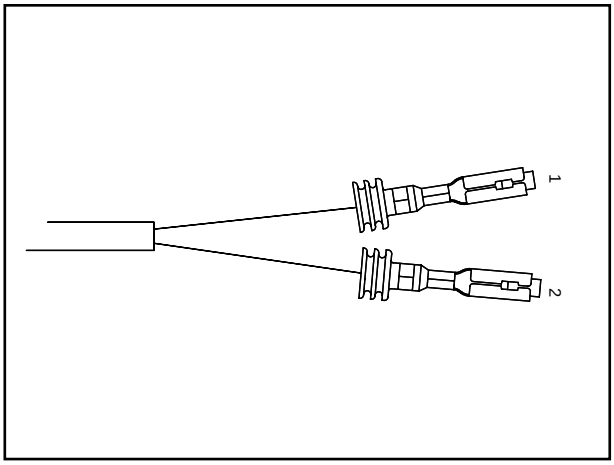


Fig. 10.348

Terminals (G16) for rear field light connection

term.	wire colour	To con. or comp.	term.
1	B	G11 (ground)	
2	AG	K18	87

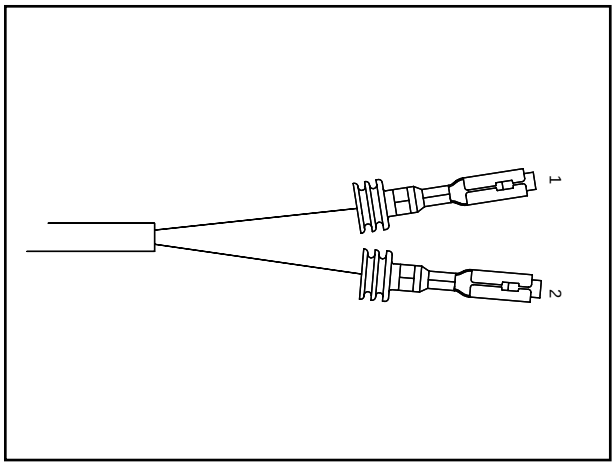


Fig. 10.349

Terminals (G17) for lh loud-speaker

term.	wire colour	To con. or comp.	term.
1	A	G5	7
2	AN	G5	8

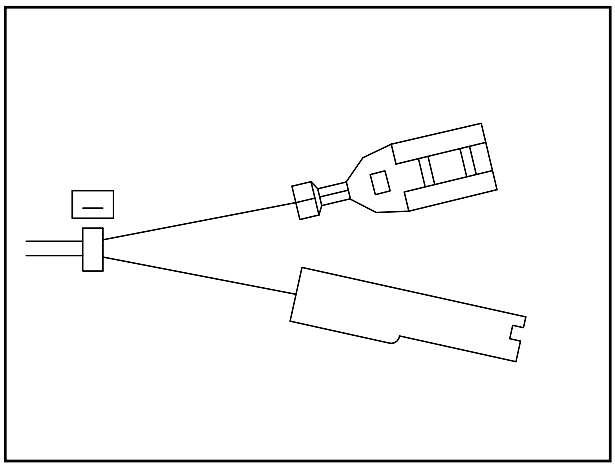


Fig. 10.350

Windscreen washer terminals (G18)

term.	wire colour	To con. or comp.	term.
1	VZ	G2	3
2	B-B	G19-XS5	2-4

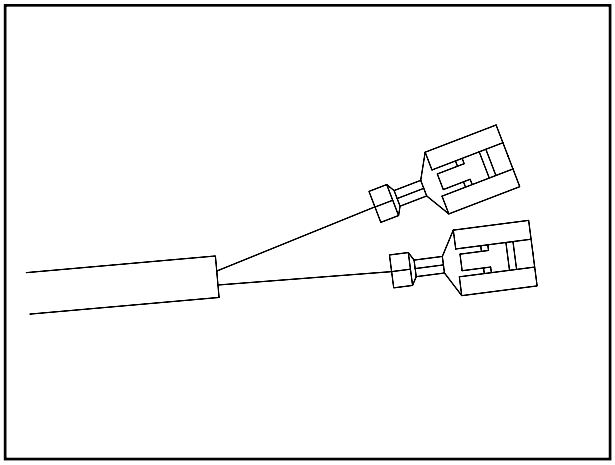


Fig. 10.351

Rear window washer terminals (G19)

term.	wire colour	To con. or comp.	term.
1	VB	G2	1
2	B	G18	2

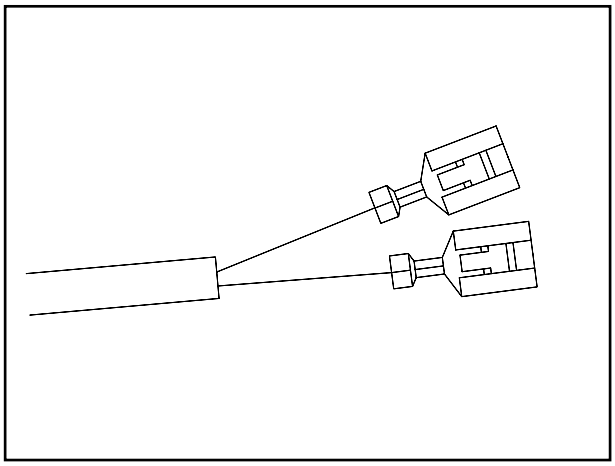


Fig. 10.352

Terminal (G20) for alternator connection (direct powering)

term.	wire colour	To con. or comp.	term.
1	R	G26 (junction)	

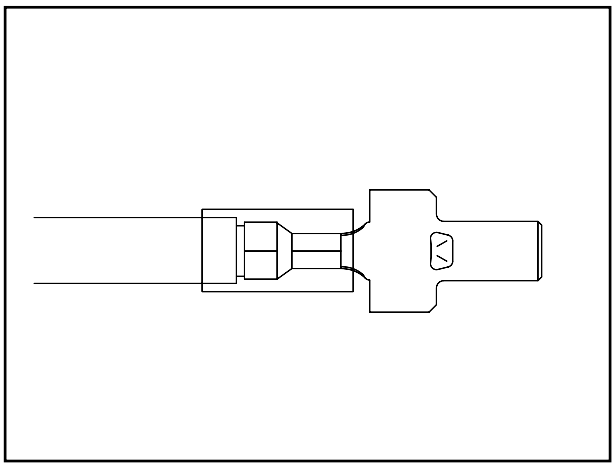


Fig. 10.353

Terminals (G21) for AC system

term.	wire colour	To con. or comp.	term.
1	GM	XS5	2
2	G	G24	1

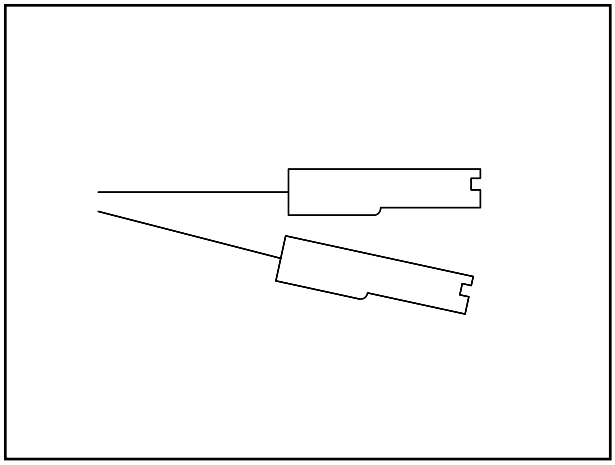


Fig. 10.354

Connector (G22) for AC system

term.	wire colour	To con. or comp.	term.
1	R-N	G24-G23	4-1
2	B	G24	3
3	S	G24	2
4	not used		

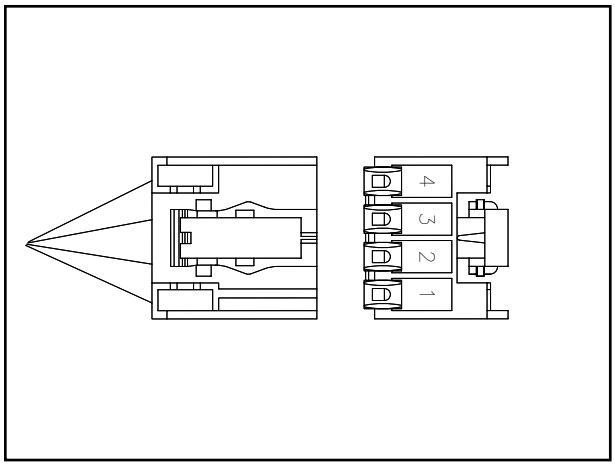


Fig. 10.355

Terminals (G23) for AC system

term.	wire colour	To con. or comp.	term.
1	N	G22	1
2	B	G28 (junction)	

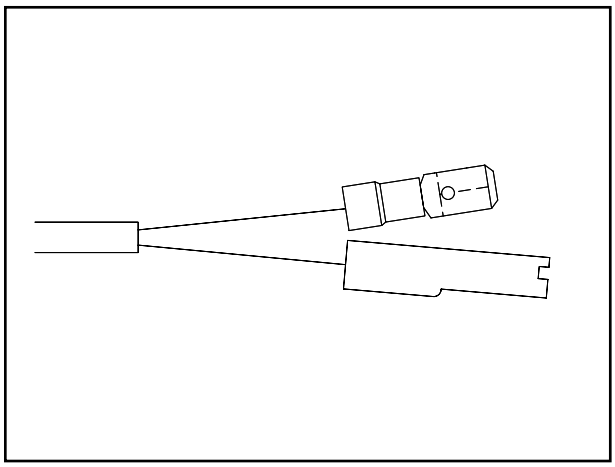


Fig. 10.356

Connector (G24) for AC system fan

term.	wire colour	To con. or comp.	term.
1	G	G21	2
2	S	G22	3
3	B	G22	2
4	R	G22	1
+	C	K5	87

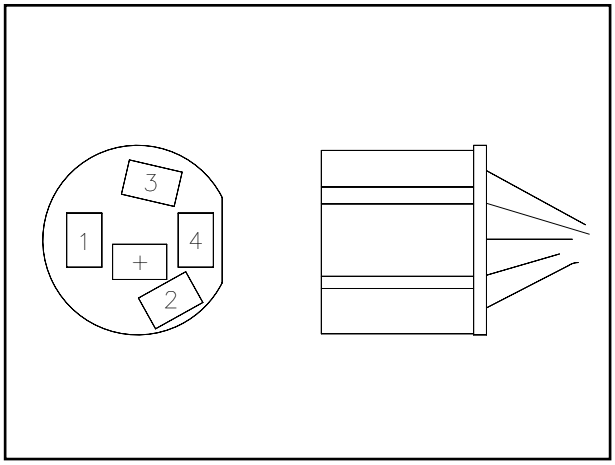


Fig. 10.357

Connector (G25) for windscreen wiper

term.	wire colour	To con. or comp.	term.
1	MB	F40	9A
2	B	G28 (junction)	
3	not used		
4	not used		

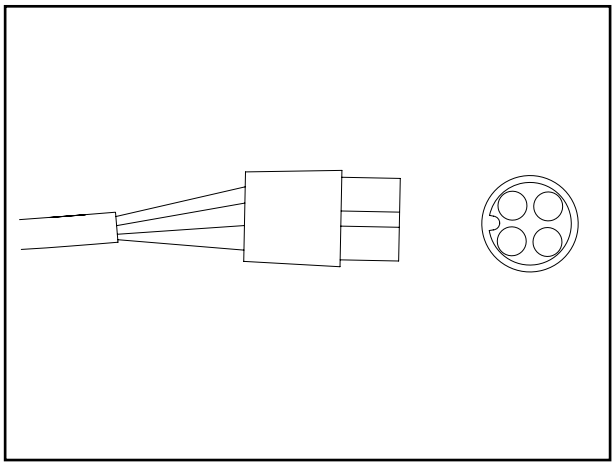


Fig. 10.358

Terminal board (XS5) for roof/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	M	K5	86
2	GM	G21	1
3	HG	G27 (junction)	
4	B	G18	2

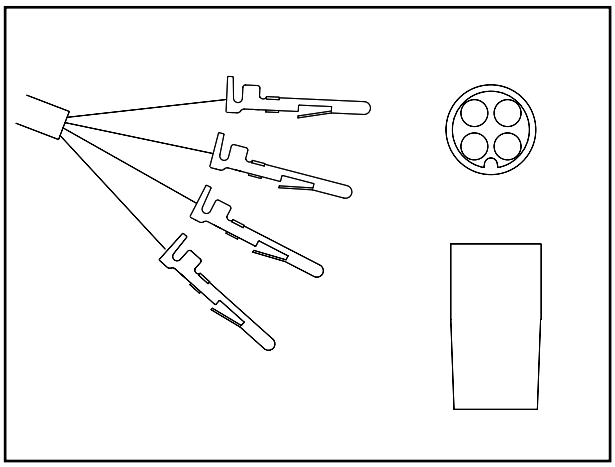


Fig. 10.359

3.8 F-N Series Power Shuttle footstep

3.8.1 Technical specifications

3.8.1.1 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
Voltage	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Alternator

Make	Ix
Type	Threephase
Voltage	14 V
Current	65 A

Starter motor

Manufacturer	Ix - Dsx
Type	Solenoidal
Maximum power	3 kW
Type of engagement	Automatic pinion engagement by means of electro-magnet.

Solenoid valves

Manufacturer	Srx Dx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 Ω ±5%
Type	Proportional valves
Voltage	12 V
Model	With 2 positions and 3 ways

Sensors

Manufacturer	Jx/Stx
Type	Inductive

Manufacturer	Hx
Type	Hall type

Electronic control unit

Make	Srx Dx

Instrument

Make	Jx

3.8.1.2 Relays and fuse holders

The electrical system of **F-N Series** tractors is protected against short-circuits and excessive power draw by means of fuses. The number of fuses installed in the electrical system depends on the components and functions that need protecting.

The fuses are installed in two dedicated boxes:

Z - front fuse box (Fig.10.360) installed at the front, near the battery that powers the system. It contains a further fuse (FU5) that protects the preheater relay.

B - main fuse box (Fig.10.361) installed on the left-hand side of the dashboard cover.

Note: before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

There are 11 relays installed in **F-N Series Power Shuttle footstep version** tractors, of which 10 are installed in the front fuse box (B), just under the protection fuses (Fig.10.361) and 1 is installed at the front, near the fuse box (Z).

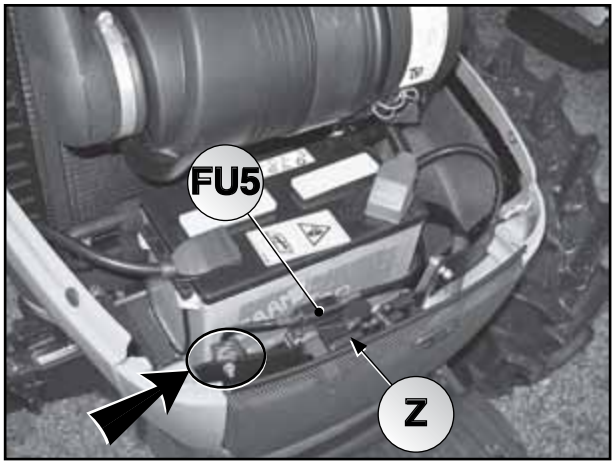


Fig. 10.360

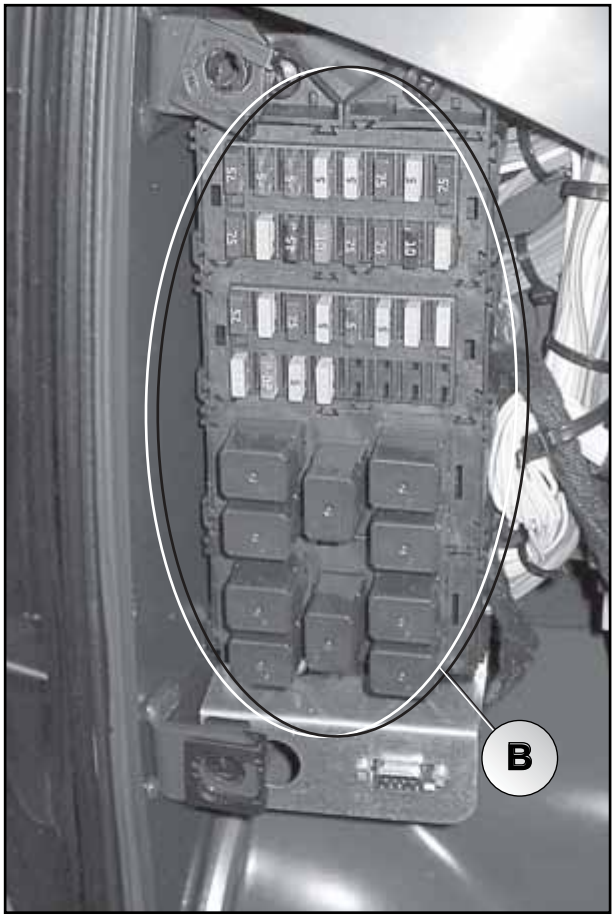


Fig. 10.361

Z- Front fuse box

The front fuses are installed in the “battery-starter motor line” wiring. They are connected by means of the positive terminal (A1) to the battery (GB1) on the one side and on the other side, to the front engine line, by means of connectors (B14 and B15) (Fig.10.362).

Turn the ignition key to the 2nd position to activate the power relay (K16), which transmits the signal for preheating the plate in contact with the glow plugs. The relay (K16) cuts out the electrical signal after 5 seconds in this position have elapsed. The relative indicator light (A Fig.10.363) on the display of the instrument goes out, indicating that the tractor engine can now be started.

The front fuses have the following functions and ampere ratings (Fig.10.364):

Fuse	Circuits protected	Amp.
FU1	Primary	60
FU2	Alternator primary	70
FU3	Primary	60
FU4	Primary	60

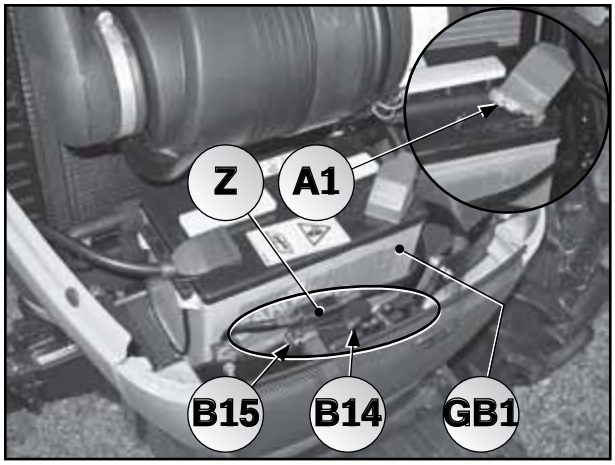


Fig. 10.362

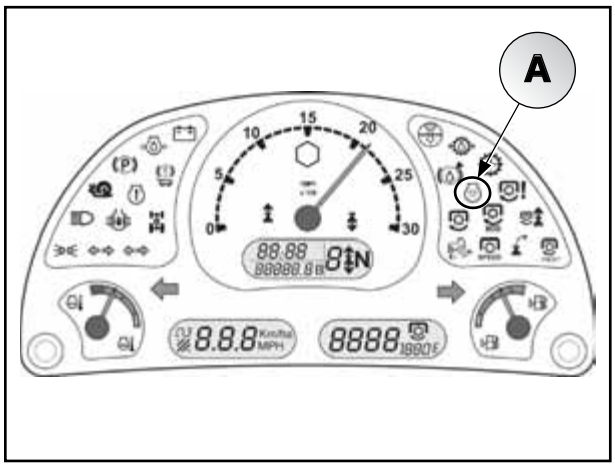


Fig. 10.363

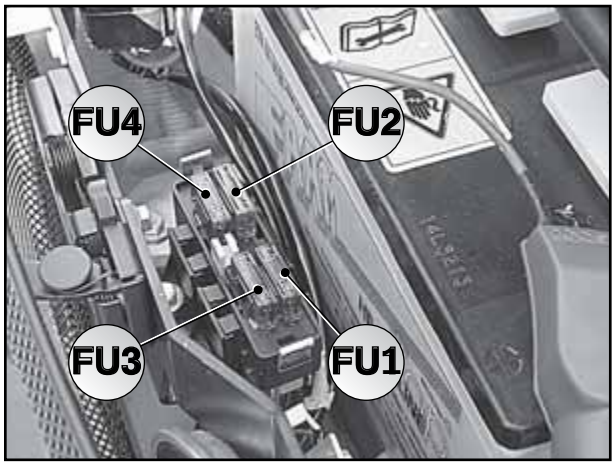


Fig. 10.364

The front line is also fitted with a further fuse (FU5 Fig.10.365) for protecting the glow plug pre-heater system.

Fuse	Circuits protected	Amp.
FU5	Glow plugs	50

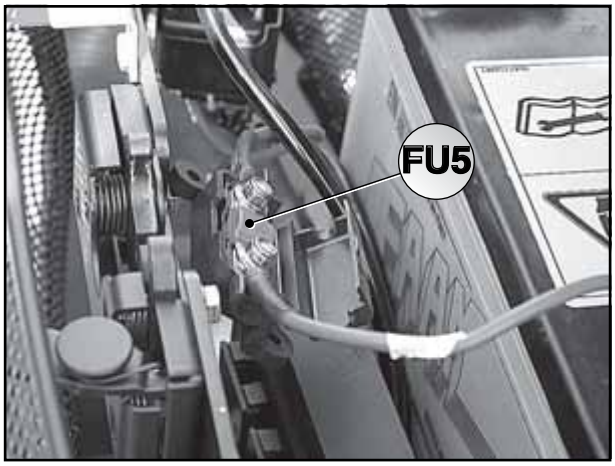


Fig. 10.365

B - Main fuse box

The main fuses are installed in the dashboard wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
F1	Rear PTO	7.5
F2	Auxiliary relays	5
F5	Key-activated Instrument	5
F6	Fuel pump	7.5
F7	4WD solenoid valve	5
F8	Brake light switch	7.5
F9	Diff lock solenoid valve	7.5
F10	Dipped beams	15
F11	Driving beams	15
F12	Blinker	10
F13	Lh side lights	7.5
F14	Rh side lights	7.5
F15	Light switch	10
F16	Electronic power lift (Indicator D+)	5
F17	Electronic power lift (Key-activated positive)	5
F18	Diff lock and brake light controls	15
F20	Starter motor	15
F21	Rear field lights	7.5
F22	Instrument and buzzer power	5
F24	Flow selector (A-B)	5
F25	Auxiliary socket (key-activated power)	15
F26	Auxiliary socket (key-activated power)	20
F27	Horn + revolving beacon	15
F29	Cab	5
F30	Pneumatic seat	15
F36	Emergency switch	15
F39	NAO KIT positive	7.5

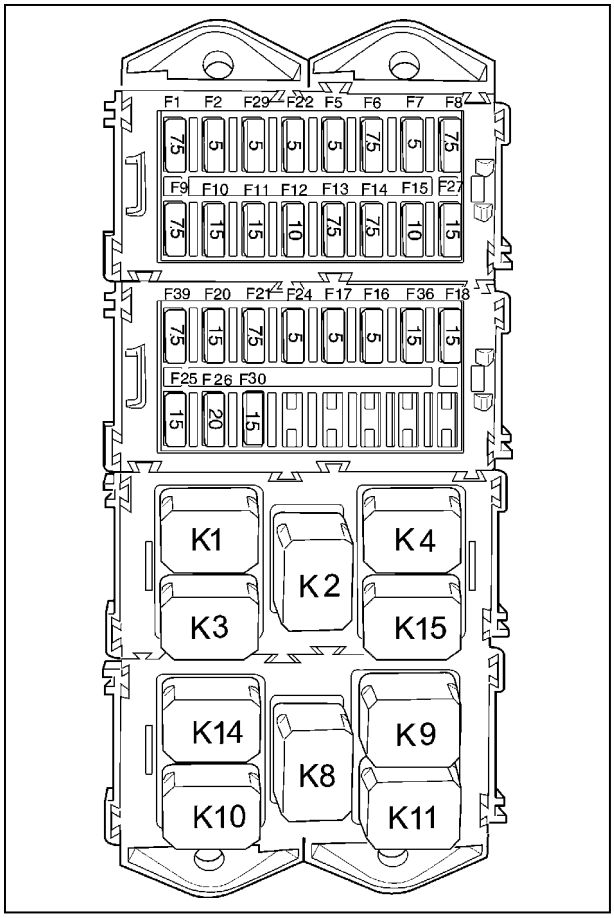


Fig. 10.366

Relays	Function
K1	Immobiliser relay
K2	Relay for socket + pneumatic seat
K3	Field light relay
K4	Brake light and instrument relay
K8	Differential lock relay
K9	Driving beam relay
K10	Dipped beam relay
K11	Headlight relay
K14	Relay for diff lock release + rear brake lights
K15	Start-inhibiting relay for engaged rear PTO
K16	Power relay (glow plug preheater) (Fig.10.367).

Fig. 10.367

identification of the components in the functional diagram

Code	Description	Part	Col.
A01	Instrument	3	4
B01	Alternator	1	7
D01	Blinker	2	4
D02	Electronic controller for gearbox management	3	1
D04	Resistive circuit board	4	4
D04	Resistive circuit board	4	3
D04	Resistive circuit board	4	2
EH1	Glow plugs	1	5
EL2	Footstep revolving beacon light	3	2
EL9	Footstep tractor's rear field light	3	1
EL13	License plate light	2	6
EL14	Rh headlight	1	7
EL15	Lh headlight	1	6
F1	Front PTO/safety fuse	1	3
F2	Auxiliary relay fuse	1	1
F3	Cab auxiliary relay fuse	1	3
F5	Key-activated fuse for instrument	3	4
F6	Injection-fuel pump fuse	1	8
F7	4WD fuse	1	4
F8	Brake light indicator fuse	2	3
F9	Diff lock fuse	2	2
F10	Dipped beam fuse	1	6
F11	Driving beam fuse	1	6
F12	Blinker fuse	2	4
F13	Side light fuse	2	7
F14	Side light fuse	2	7
F15	General side light fuse	2	7
F16	El. power lift fuse (alternator D+ positive)	1	7
F17	El. power lift fuse (key-activated positive)	1	2
F18	Fuse for diff lock controls and brake lights	2	2
F20	Starter motor fuse	1	6
F21	Rear field light fuse	3	1
F22	Fuse for instrument and buzzer power	3	6
F24	A-B control valve fuse	1	5
F25	Auxiliary socket fuse 25A	3	2
F26	Auxiliary socket fuse 25A	3	2
F27	Fuse for horn, rotating beacon	3	2
F30	Pneumatic seat fuse	3	3
F36	Emergency switch fuse (hazard)	2	4
F39	NAO control unit fuse	2	3
F40	Windscreen wiper fuse	4	1
FU1	Link-box primary fuse	1	1
FU2	Link-box alternator primary fuse	1	7
FU3	Link-box primary fuse	2	3
FU4	Link-box primary fuse	3	1
FU5	Glow plug fuse (steering wheel midival)	1	5
GB1	Battery	1	1
HA1	Horn	3	2
HA2	Alarm buzzer	3	4
HL1	Rh front turn indicator	2	5
HL2	Rh rear turn indicator	2	5
HL3	Lh front turn indicator	2	4
HL4	Lh rear turn indicator	2	4
HL5	Rh front side light	2	7
HL6	Rh rear side light	2	8
HL7	Lh front side light	2	7
HL8	Lh rear side light	2	7
HL9	Rh brake light indicator	2	3
HL10	Lh brake light indicator	2	2
HL11	Supplementary rh turn indicator (NAO)	2	3
HL12	Supplementary lh turn indicator (NAO)	2	3
K1	Starter motor power relay	1-1	6-4
K2	Power relay for auxiliary socket - pneumatic seat	3-1	2-1
K3	Relay for side lights, brake lights	2-1	3-2
K4	Relay for fuel injection - field light - instrument	3-1	1-2
K8	Diff lock power relay	2-2	2-1
K9	Driving beam power relay	1-2	6-6
K10	Dipped beam power relay	1-2	6-6
K11	Headlight power relay	1-1	6-6
K14	Power relay for diff lock release, brake light indicators	2-2	2-1
K15	Rear PTO safety power relay	1-1	4-3
K16	Glow plug power relay	1-1	5-5
M1	Starter motor	1	6
M5	Pneumatic seat actuator	3	3
M10	Fuel pump motor	1	7
SA00	Main contact key switch	1	1
SA01	Light switch selector	2-3	5-2
SA02	Independent PTO selector	1	3
SA03	Reverse shuttle selector	4-1	2-4

SA07	Platform rear field light selector	3	1
SA08	Platform revolving beacon commutator	3	2
SA09	Hazard light switch	2	4
SA11	4WD commutator	1	4
SA15	Side lights and dipped beams commutator	2	7
SB02	Speedshift button (gearshift lever)	4	4
SB03	Clutch button (gearshift lever)	4	3
SB08	Differential lock button	2	1
SB09	Auxiliary control valve button	1	5
SL1	Fuel level sensor	3	7
SL2	Brake fluid level sensor	3	6
SL3	Supplementary fuel tank level sensor	3	7
SP2	Hydraulic trailer brake pressure switch	3	6
SP3	Gearbox oil intake vacuum switch	3	5
SP4	Engine oil pressure switch	3	4
SP5	Air intake circuit vacuum switch	3	4
SP8	Brake pump pressure switch (brake-diff lock)	2	1
SQ1	Clutch pedal position sensor	4	2
SQ4	Hand brake lever microswitch	3	6
SQ5	Park-lock engaging microswitch	4	3
SQ6	540 rear PTO microswitch	3	6
SQ7	750-1000 rear PTO microswitch	3	6
SQ8	Synchronized rear PTO microswitch	4	7
SQ19	Safety microswitch on gearshift lever	1	4
SR1	Ground speed sensor	4	4
SR2	Engine rate sensor	4	4
SR3	Lh C1 speed sensor (trishift system)	4	5
SR4	Rh C2 speed sensor (trishift system)	4	5
SR5	Rear PTO rate sensor	4	7
ST6	Engine water temperature sensor	3	4
ST7	Fuel enrichment jet sensor	1	7
YA1	Fuel injection pump solenoid	1	8
YA2	Fuel enrichment jet solenoid	1	7
YV1	Forward drive solenoid valve (UNDER)	4	6
YV2	Reverse drive solenoid valve (OVER)	4	6
YV3	Diff lock solenoid valve	2	2
YV4	4WD solenoid valve	1	4
YV5	Speedshift solenoid valve	4	3
YV8	Rear P.T.O. brake solenoid valve	4	8
YV9	Rear P.T.O. brake solenoid valve	4	8
YV10	Auxiliary control valve solenoid valve A	1	4
YV11	Auxiliary control valve solenoid valve B	1	5

Term.boards

XS0	7-pin trailer socket terminal board
XS1	Front wiring line terminal board
XS2	Rear wiring line terminal board
XS3	Platform wiring line terminal board
XS5	Roof wiring line terminal board
XS7	Auxiliary socket terminal board
XS8	Can bus serial socket terminal board

References to functional diagram

1 - Cab version only
2 - Four-wheel drive indicator
3 - Glow plug ind.light
4 - Driving beam ind.light
5 - Differential lock indicator
6 - Control lighting
7 - Glow plug ind.light
8 - Alternator indicator light
9 - Four-wheel drive
11 - Driving beams
12 - Side lights
13 - Lh turn ind.
14 - Rh turn ind.
15 - Rh turn ind.
16 - 2nd trailer direction ind.

3.8.2 Main wiring diagram

Part 1

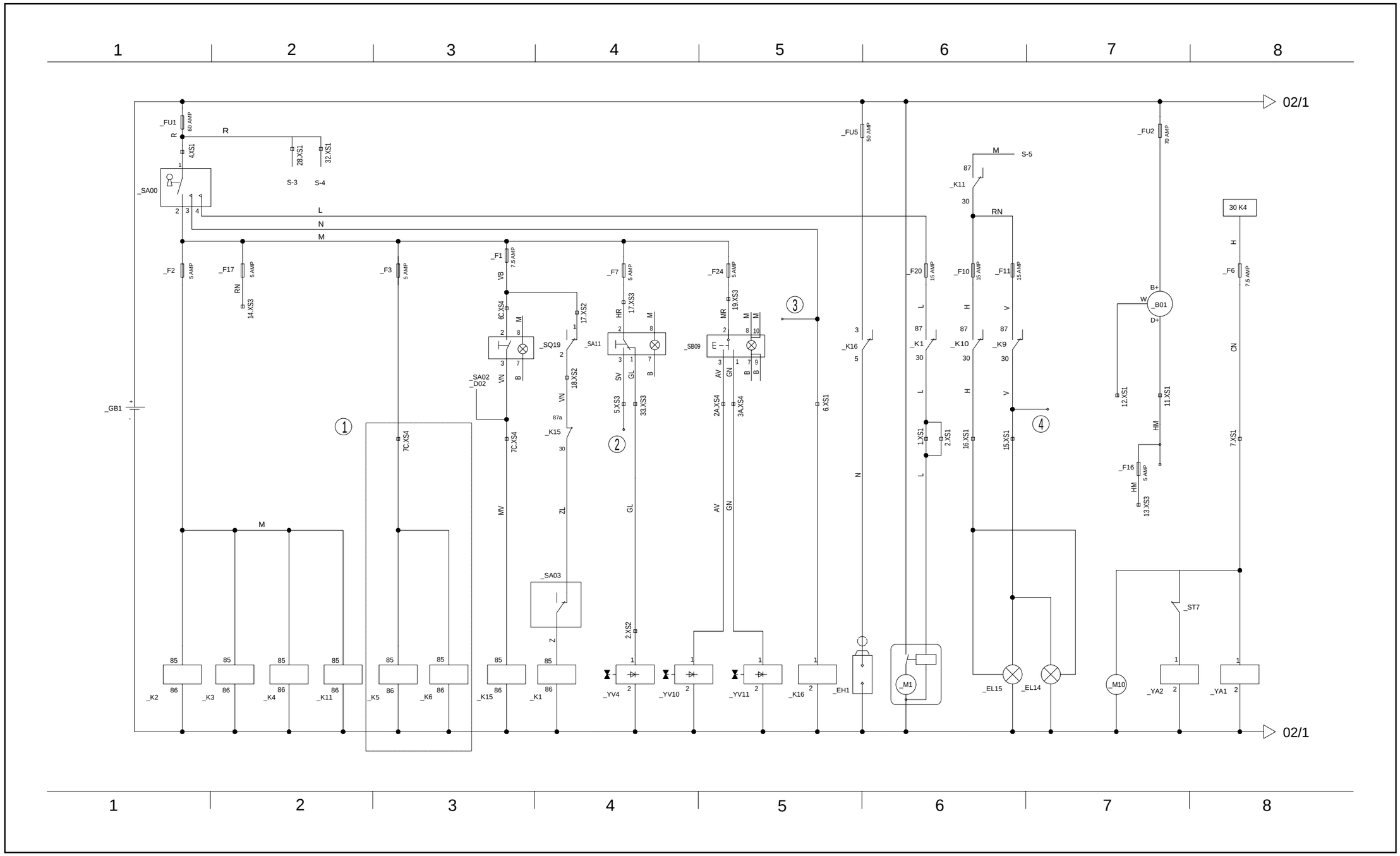


Fig. 10.368

Part 2

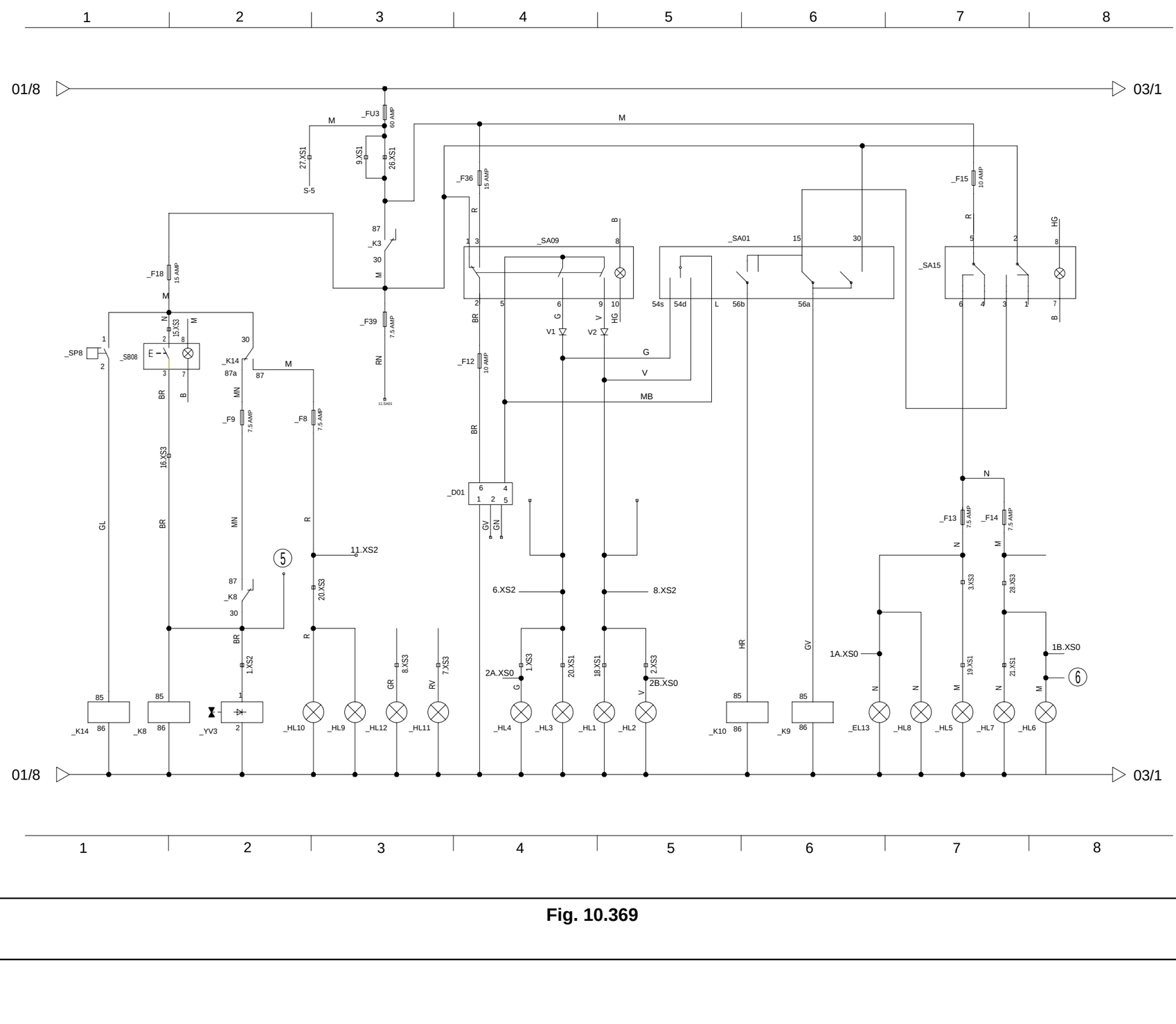


Fig. 10.369

Part 3

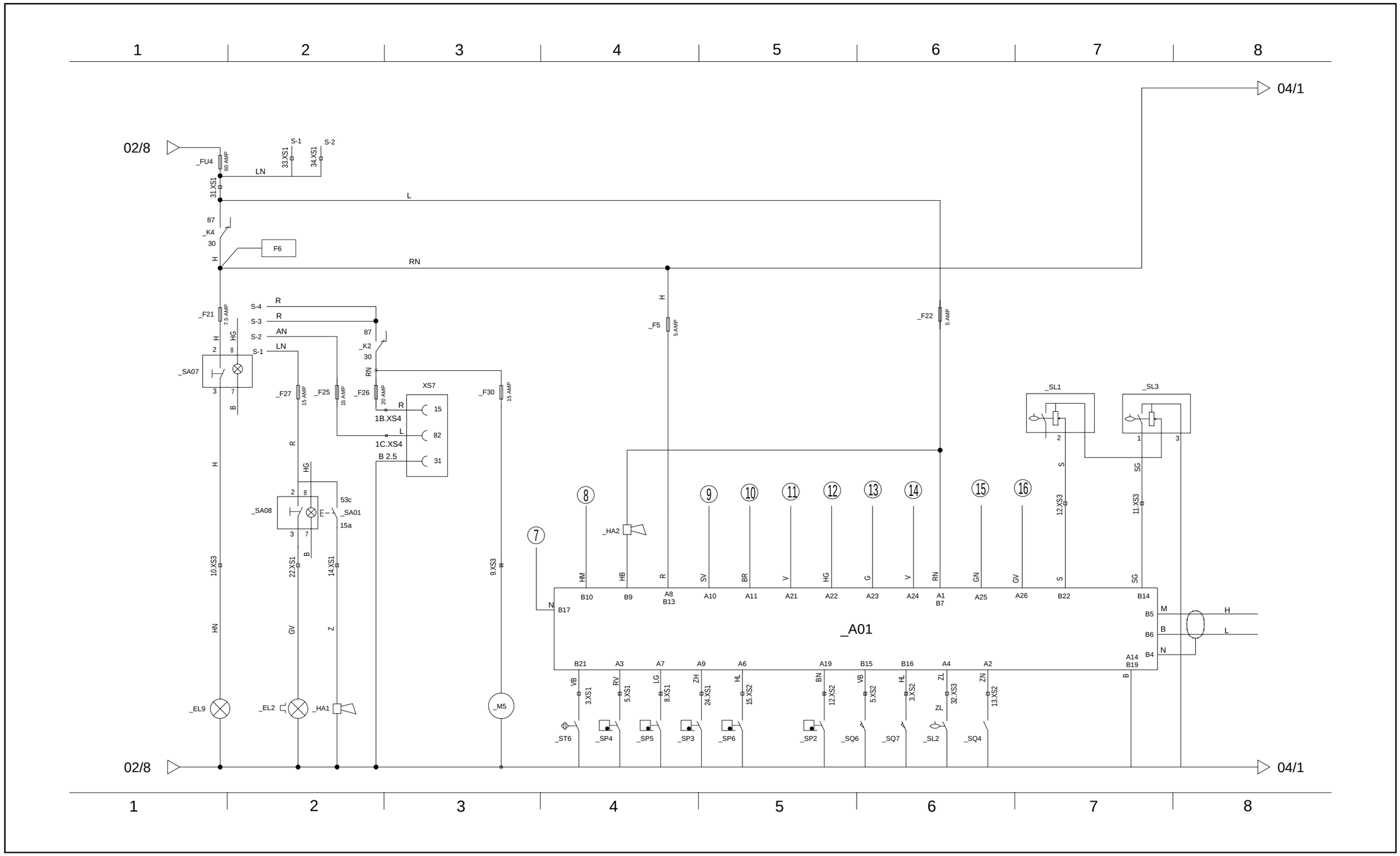


Fig. 10.370

Part 4

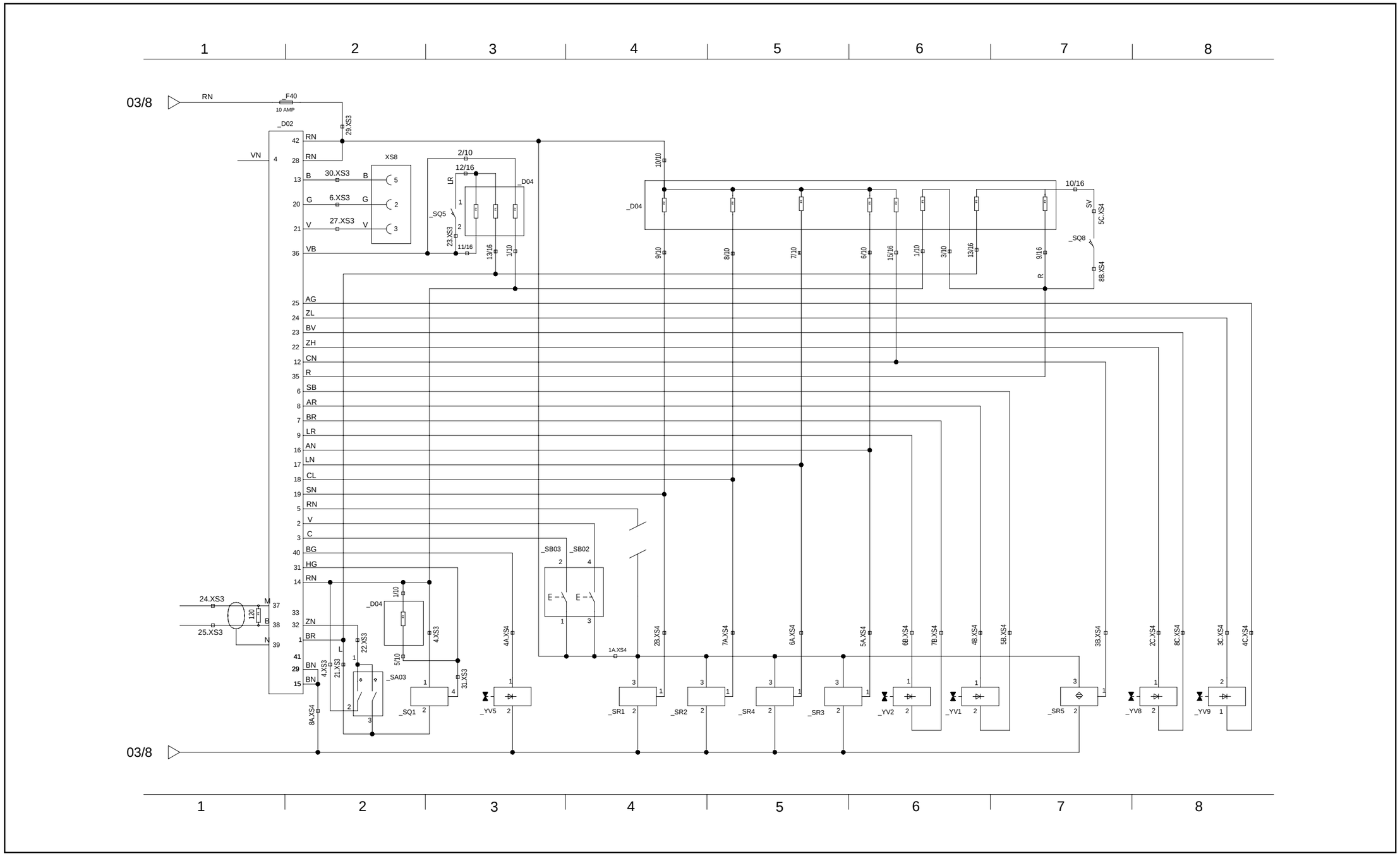


Fig. 10.371

3.8.3 Battery-starter motor line

3.8.3.1 General description

This line is very important for the functionality of the electrical system of the entire tractor. It connects the positive battery pole to the starter motor (M1 Fig.10.372), thus allowing the entire electrical system to be powered, as the ignition switch is connected to the battery.

Connection to the front fuse box is made on the positive battery terminal (Fig.10.373). These fuses protect the tractor's electrical system against short circuits and excessive power draw.

The positive battery terminal is also connected to power fuse (FU5), which protects the preheater relay (K1&) from short-circuits (Fig.10.374).

Battery (GB1) is installed in the front, between the radiator and headlights (Fig.10.374).

⚠	**Attention:** comply with the safety instructions !

⚠	**Attention:** disconnect the ground wire (-) from the battery.

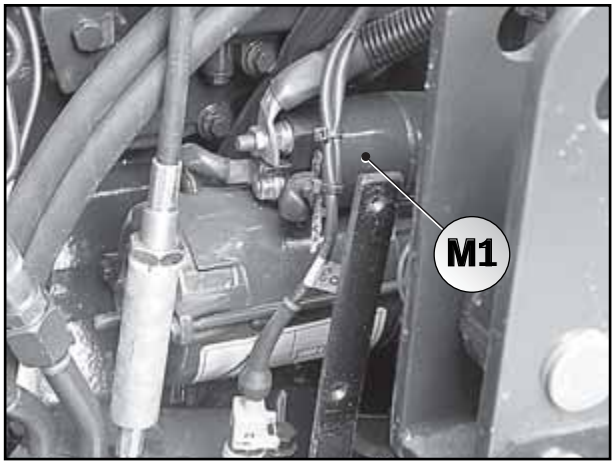


Fig. 10.372

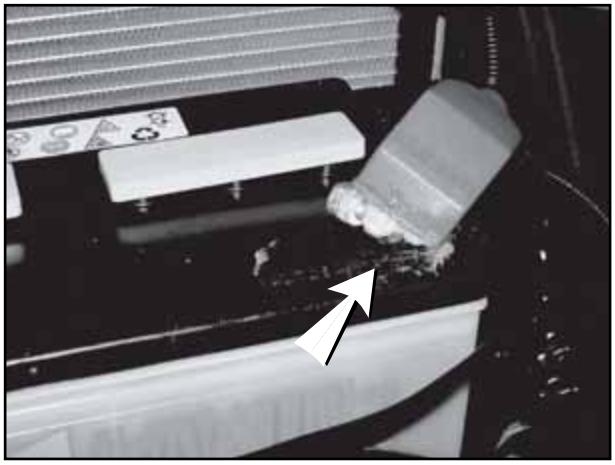


Fig. 10.373

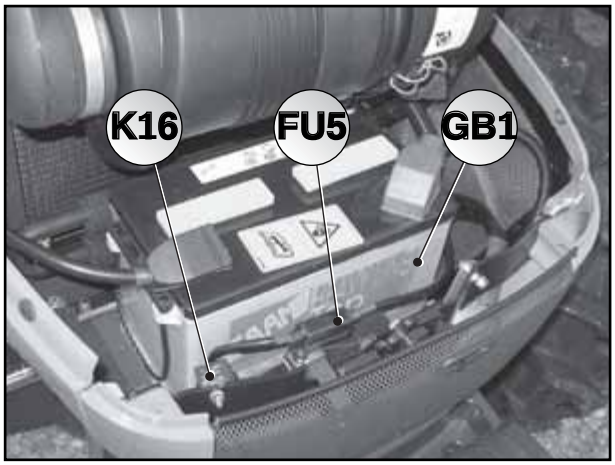


Fig. 10.374

3.8.3.2 Wiring

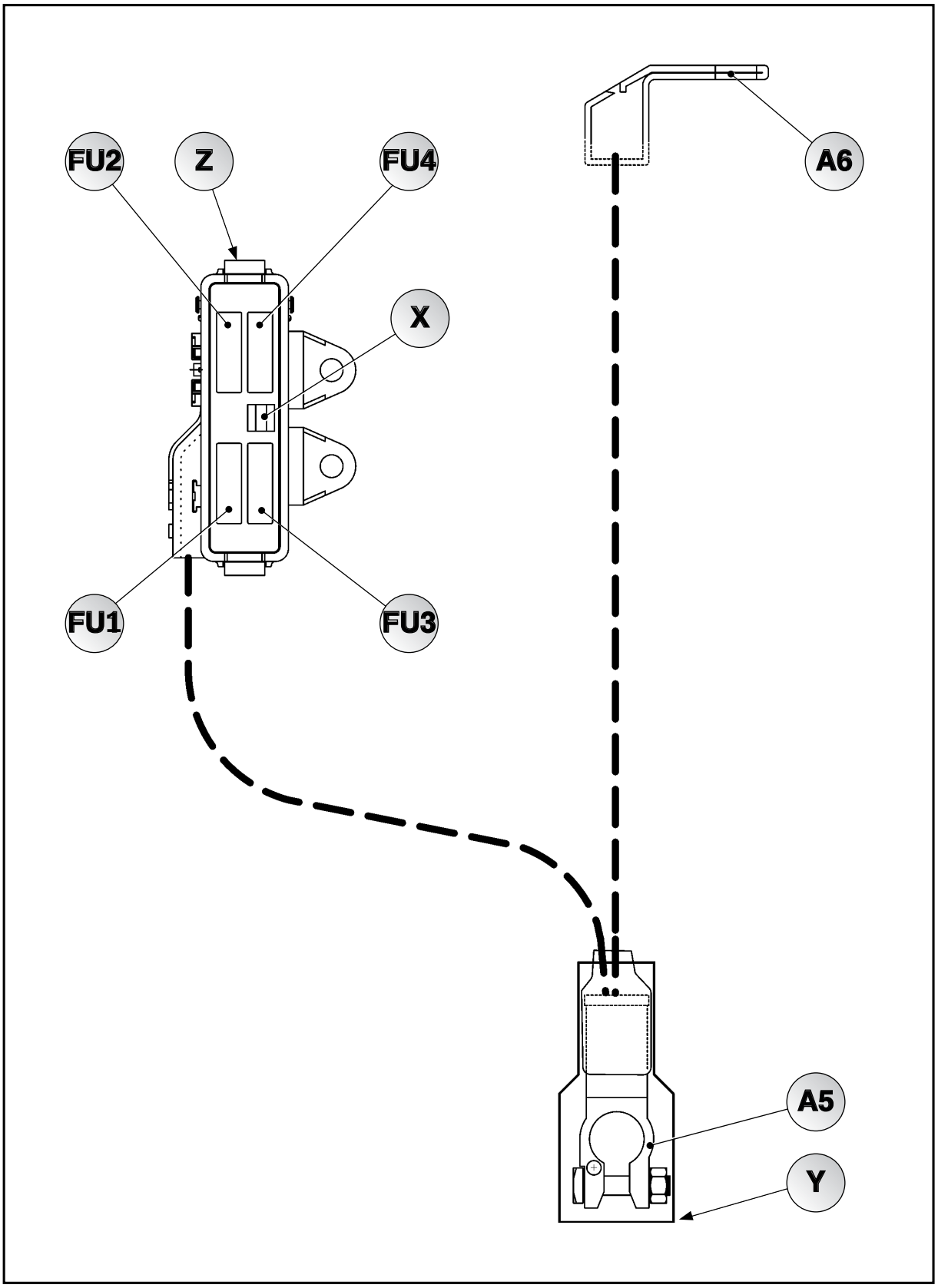


Fig. 10.375

Z - Front fuse box
Y - Insulating cap
X - Pincers for removing fuses
FU1 - 60 Amp. fuse
FU2 - 70 Amp. fuse
FU3 - 60 Amp. fuse
FU4 - 60 Amp. fuse
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal

3.8.3.3 Connector locations

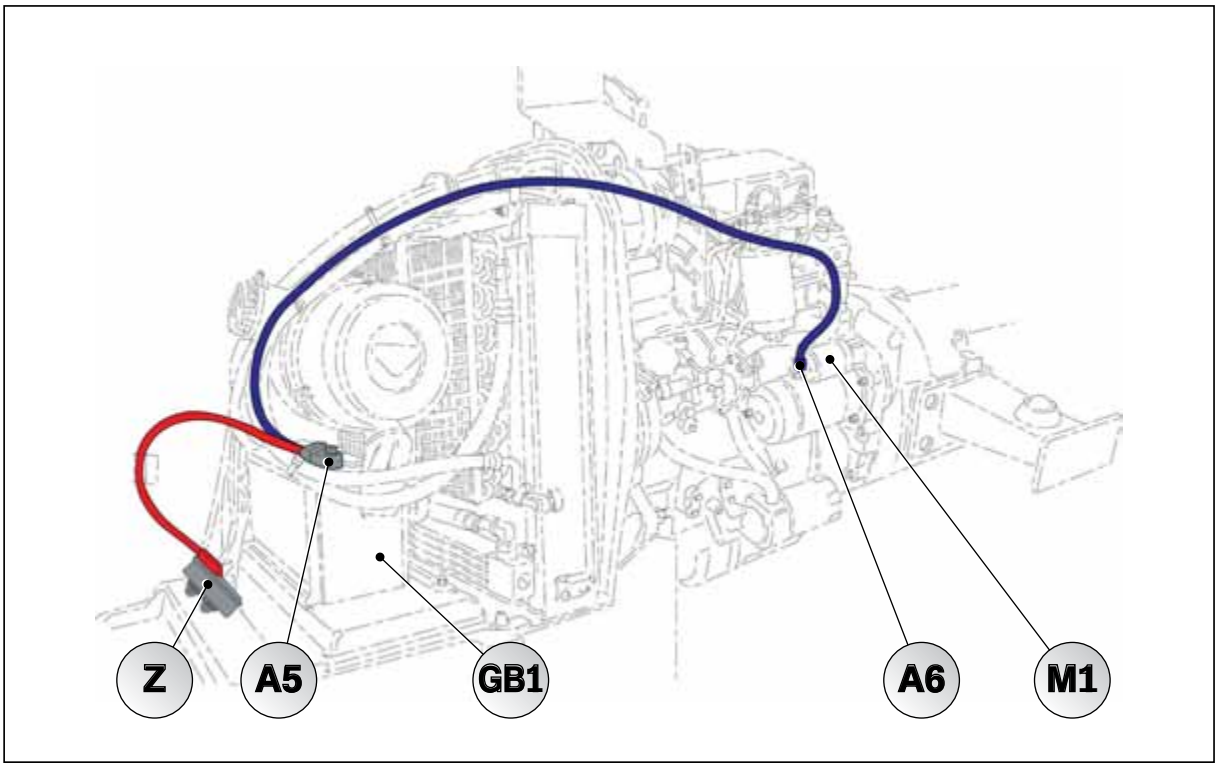


Fig. 10.376

GB1 - Battery
M1 - Starter motor
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal
Z - Front fuse box

The front fuse box (Z) is installed in front of the battery (GB1).

The four fuses inside are important since they protect the tractor's entire electrical system from short-circuits and excessive power draw.

Before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it. (Fig.10.377).

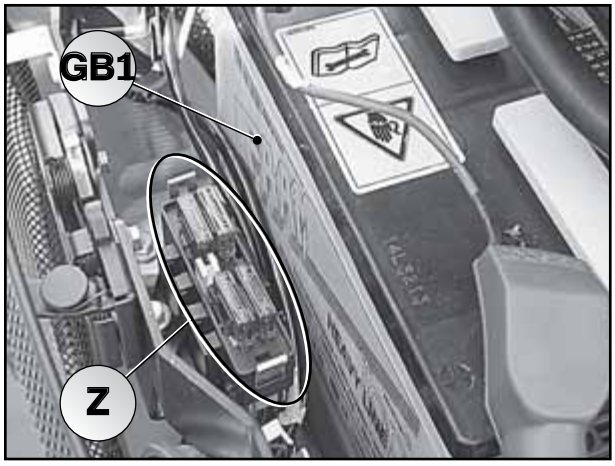


Fig. 10.377

3.8.3.4 Connector identification

Terminal (A6) for starter motor connection

term.	wire colour	To con. or comp.	term.
A	N	M1	

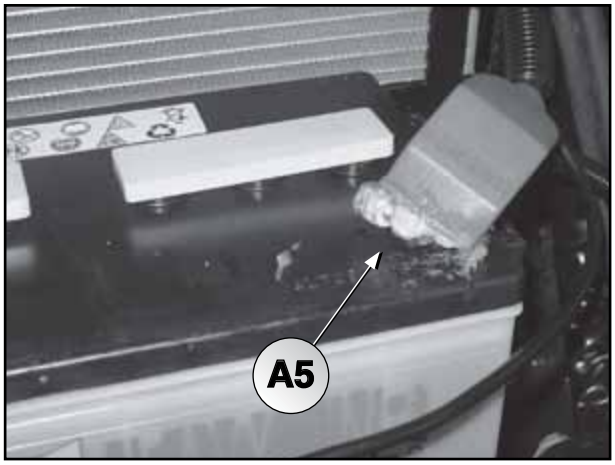


Fig. 10.378

Eyelet (A5) connection to the battery's positive terminal allows the remaining part of the tractor's electrical system to be powered.

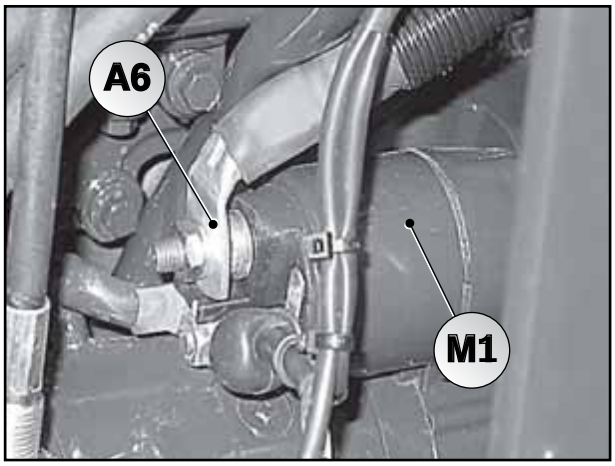


Fig. 10.379

3.8.4 Front engine line (with 3-cylinder engine)

3.8.4.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.380), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.381) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.381) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.382) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.383) installed under the bonnet.

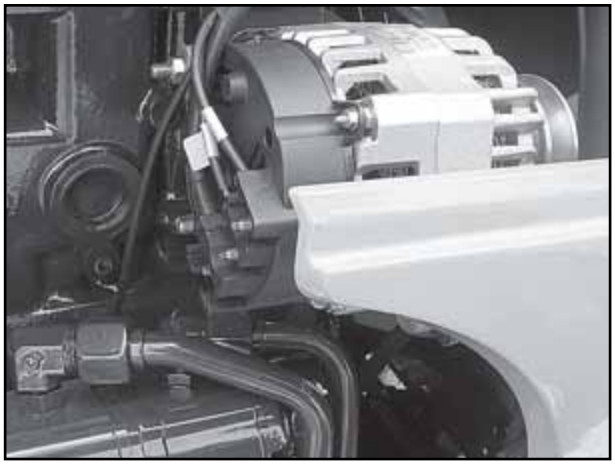


Fig. 10.380

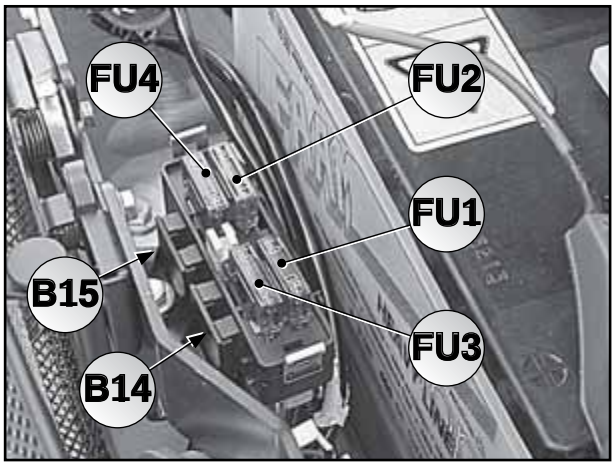


Fig. 10.381

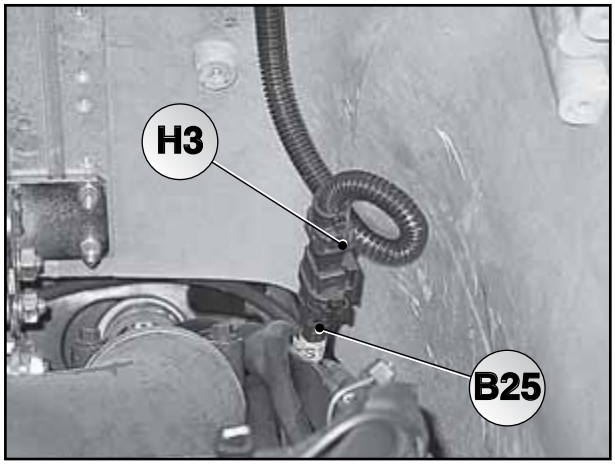


Fig. 10.383

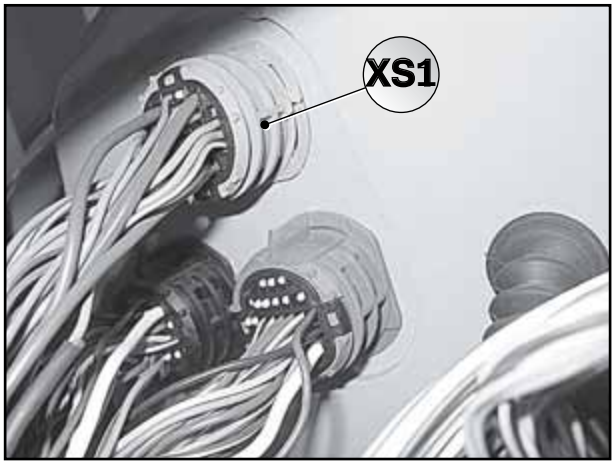


Fig. 10.382

3.8.4.2 Wiring (version with 3-cylinder engine)

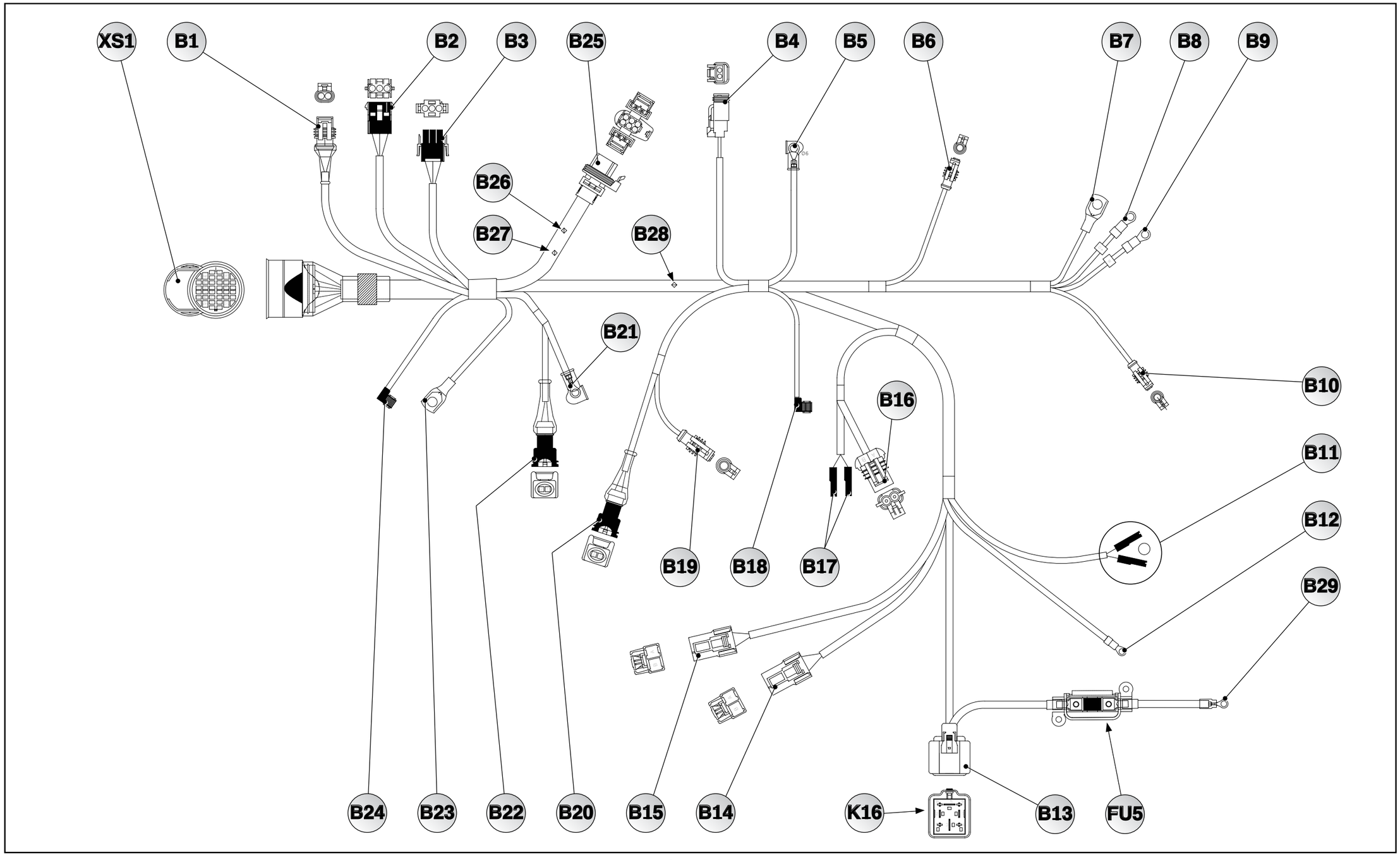


Fig. 10.384

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26-B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.8.4.3 Connector locations

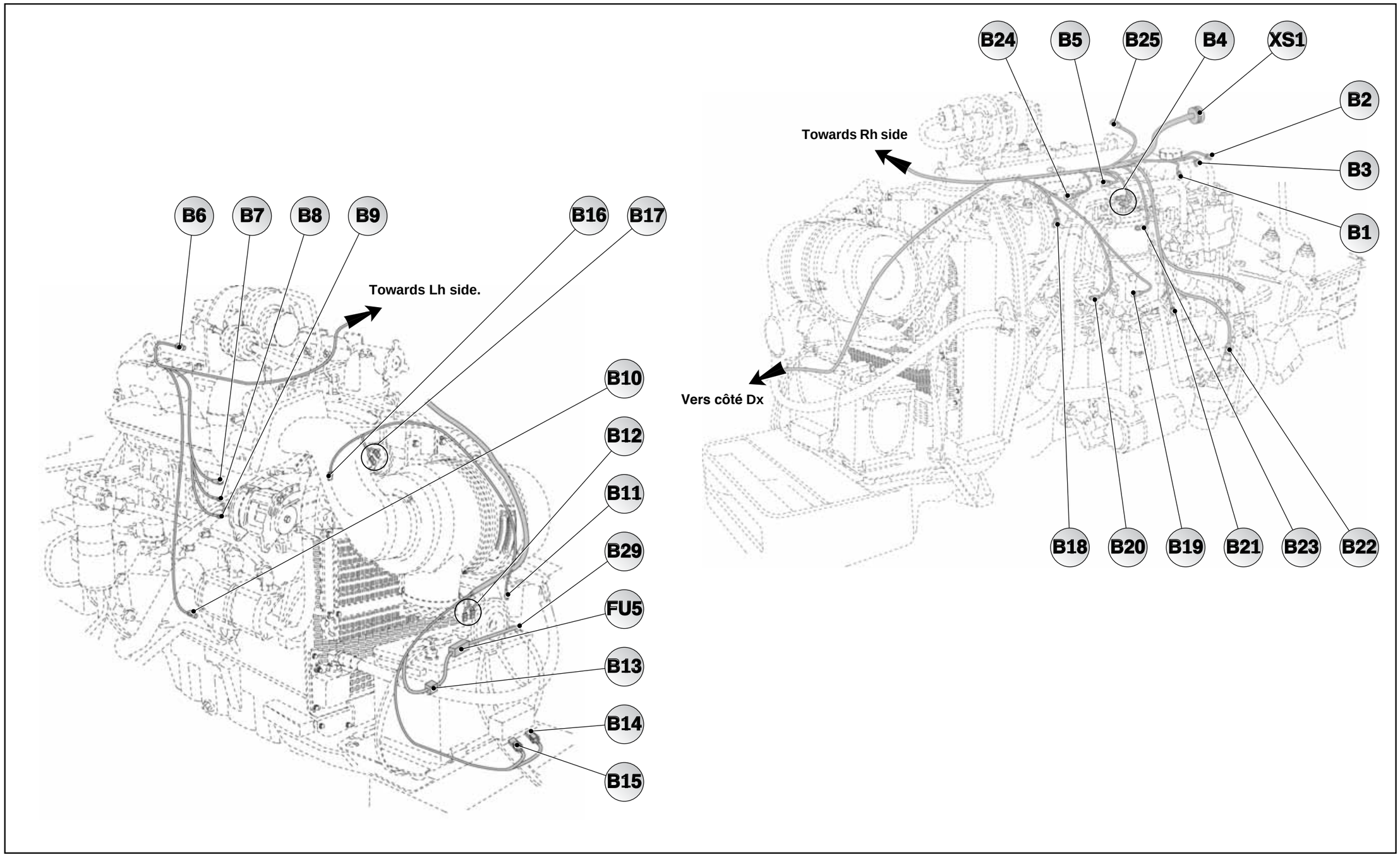


Fig. 10.385

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.8.4.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

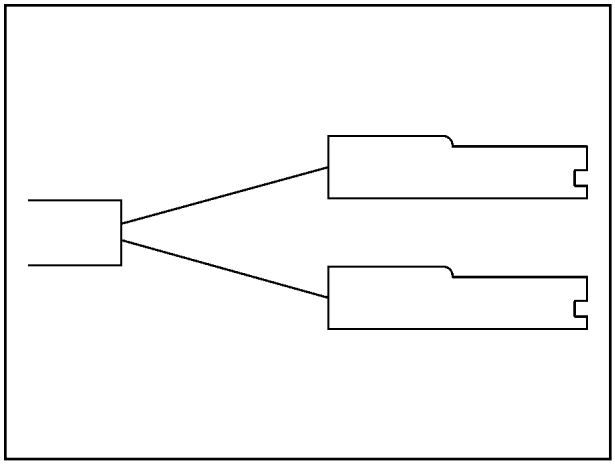


Fig. 10.386

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

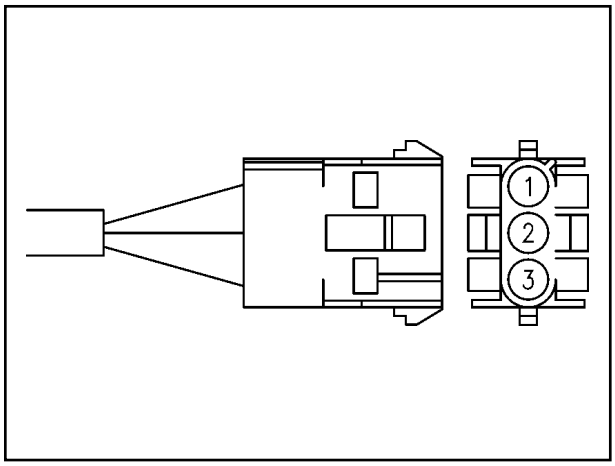


Fig. 10.387

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

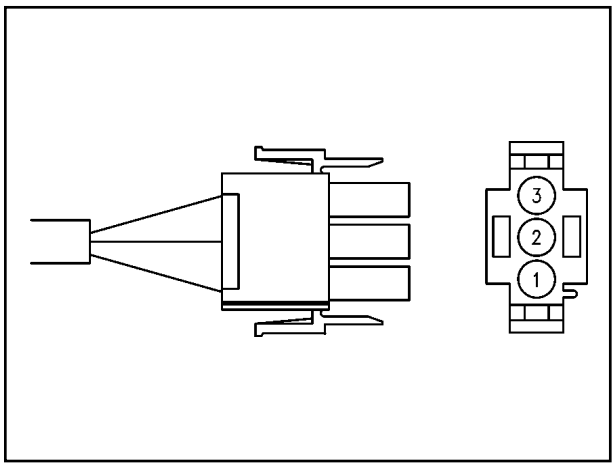


Fig. 10.388

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

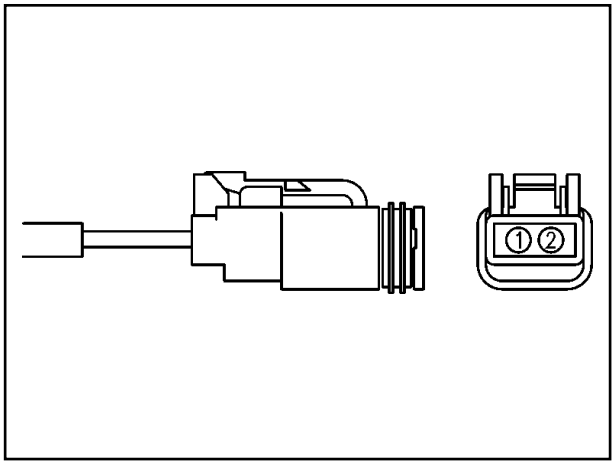


Fig. 10.389

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

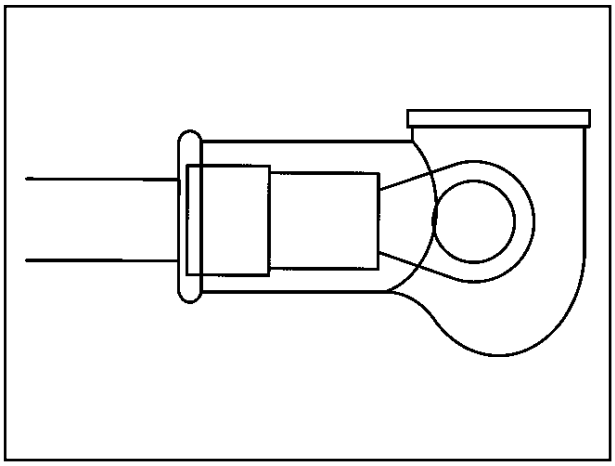


Fig. 10.390

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

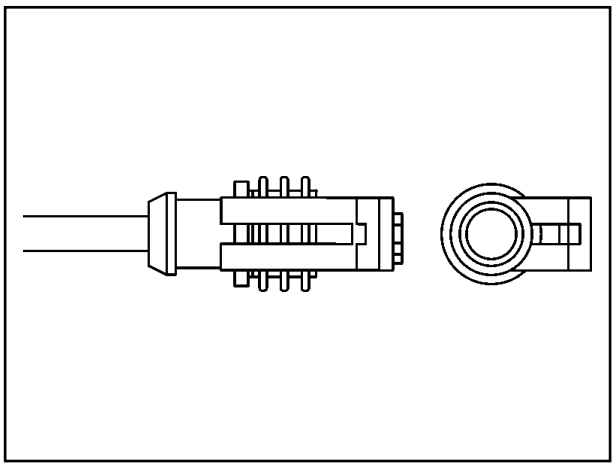


Fig. 10.391

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

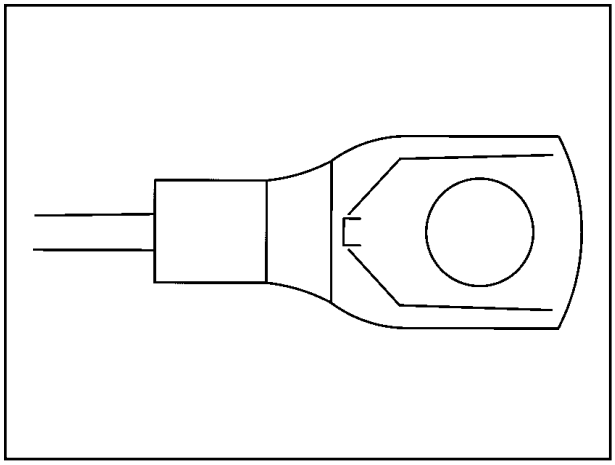


Fig. 10.392

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

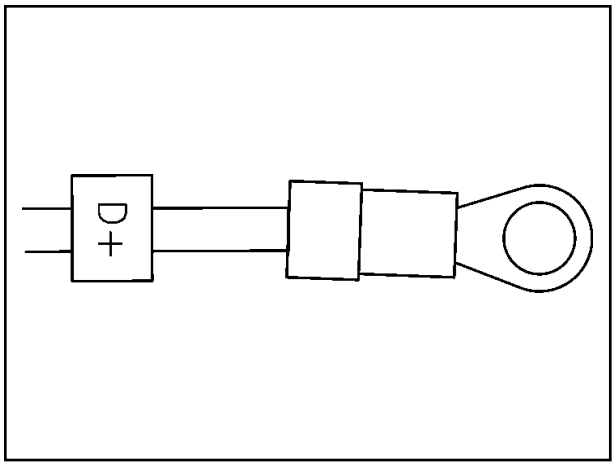


Fig. 10.393

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

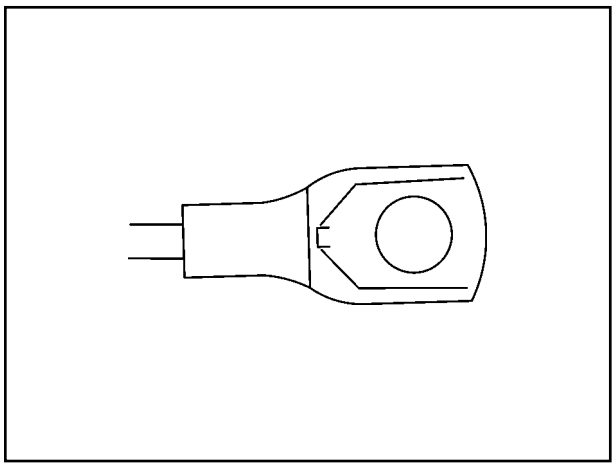


Fig. 10.394

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

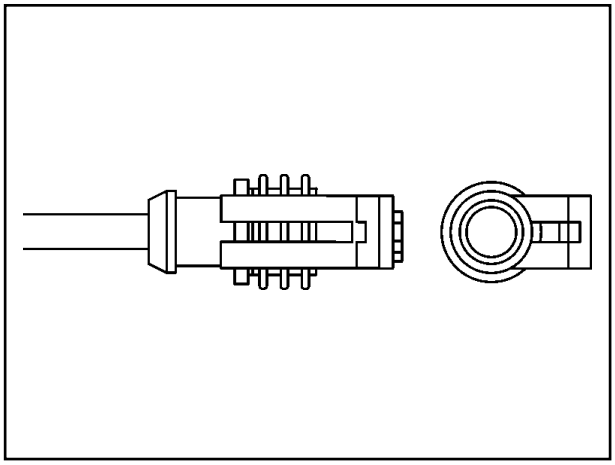


Fig. 10.395

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

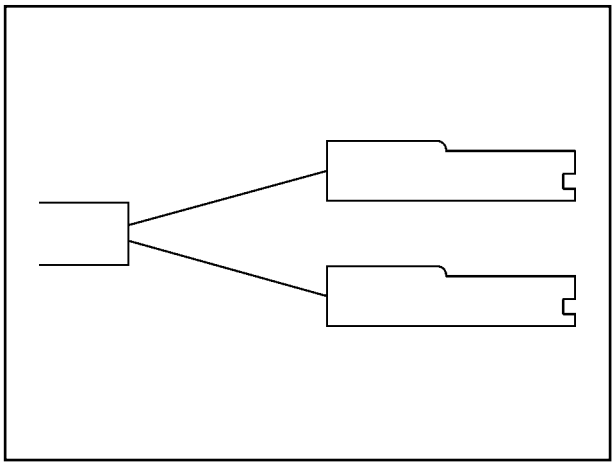


Fig. 10.396

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

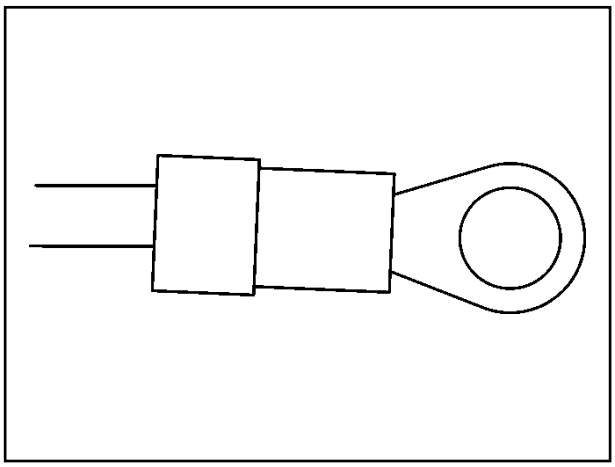


Fig. 10.397

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

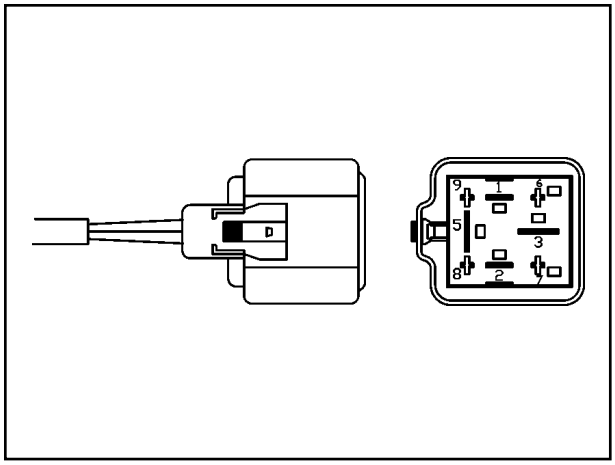


Fig. 10.398

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

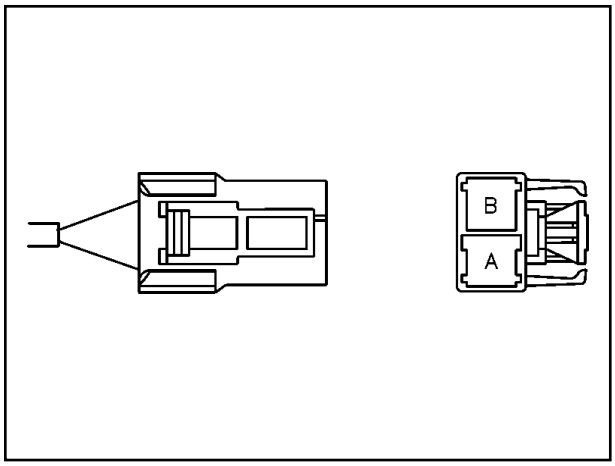


Fig. 10.399

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

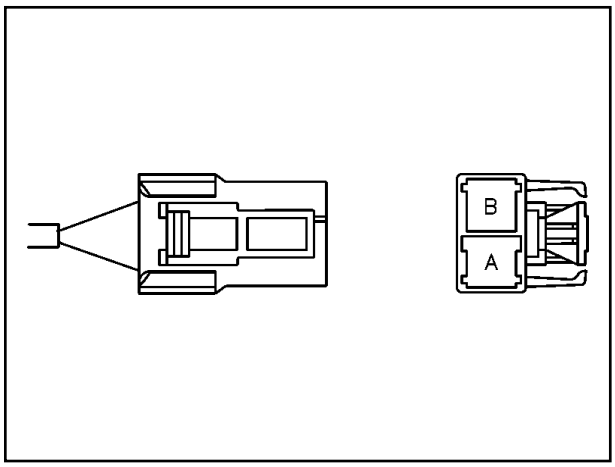


Fig. 10.400

Connector (B16) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

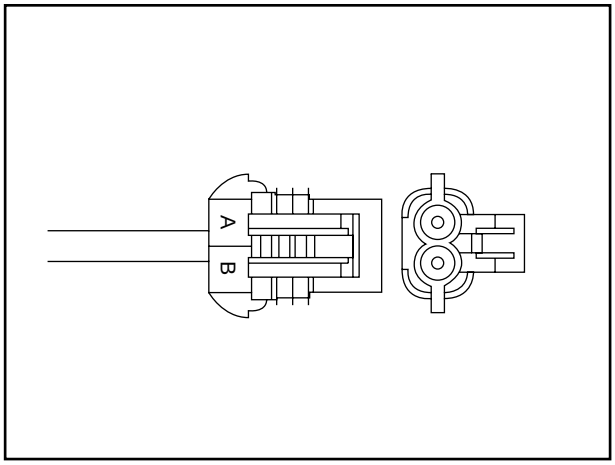


Fig. 10.401

Faston terminals (B17) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

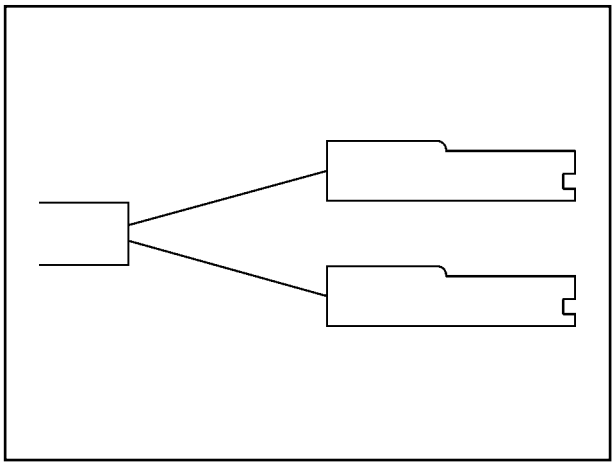


Fig. 10.402

Terminal (B18) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

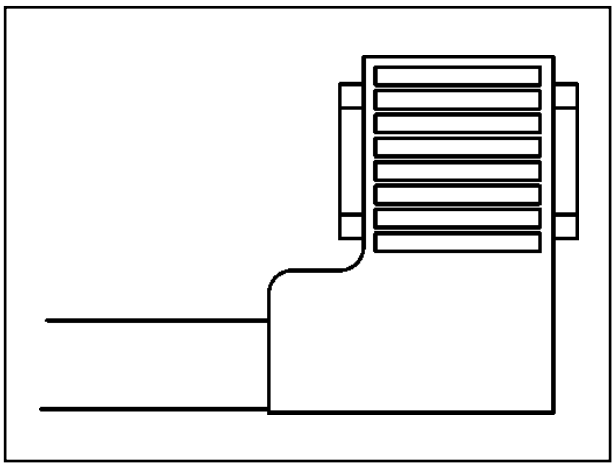


Fig. 10.403

Connector (B19) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

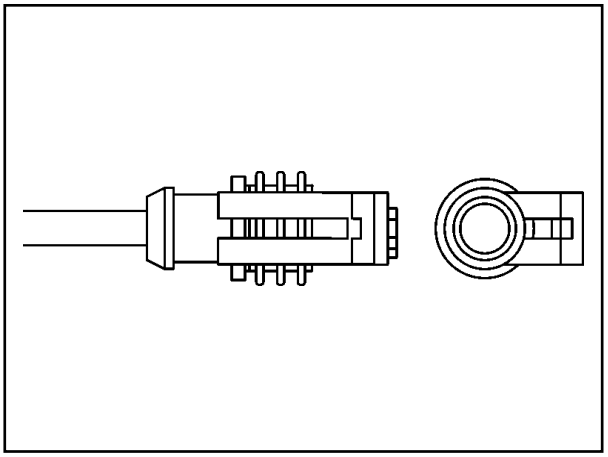


Fig. 10.404

Terminal (B20) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

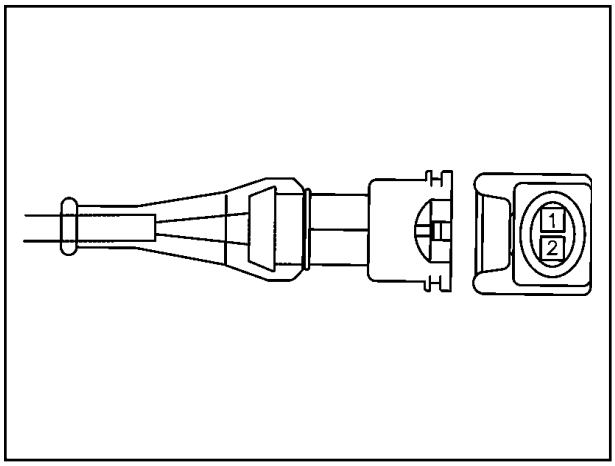


Fig. 10.405

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

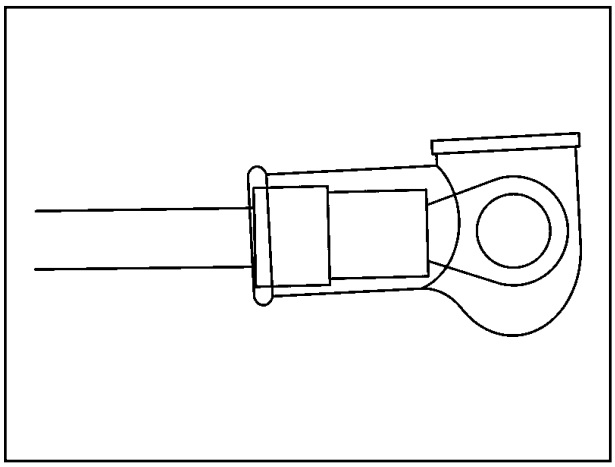


Fig. 10.406

Connector (B22) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

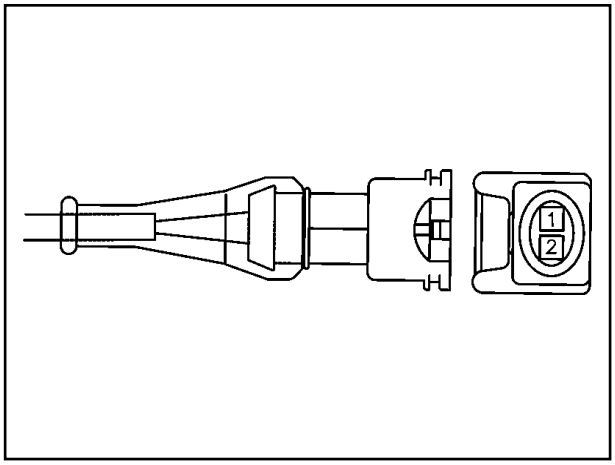


Fig. 10.407

Grounding eyelet (B23)

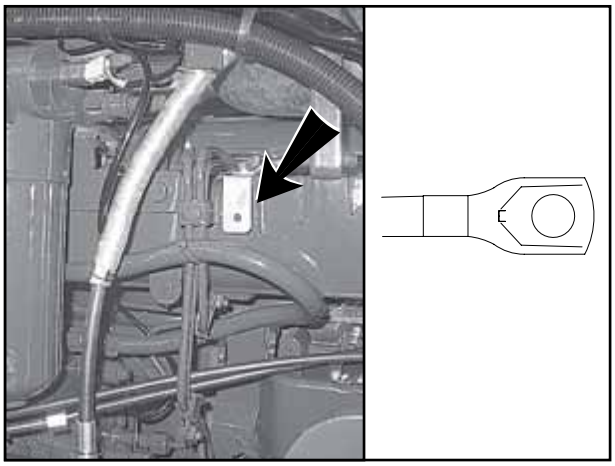


Fig. 10.408

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

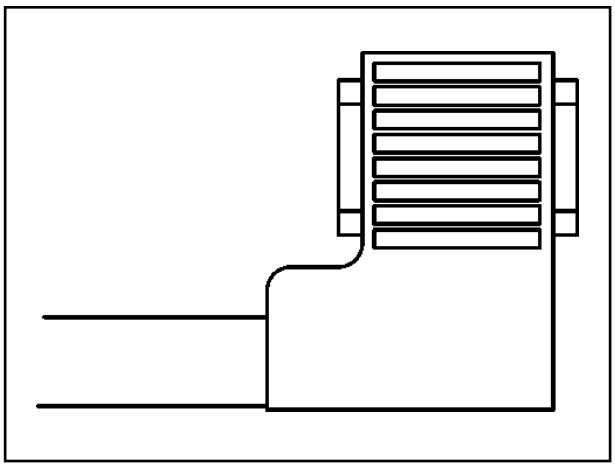


Fig. 10.409

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

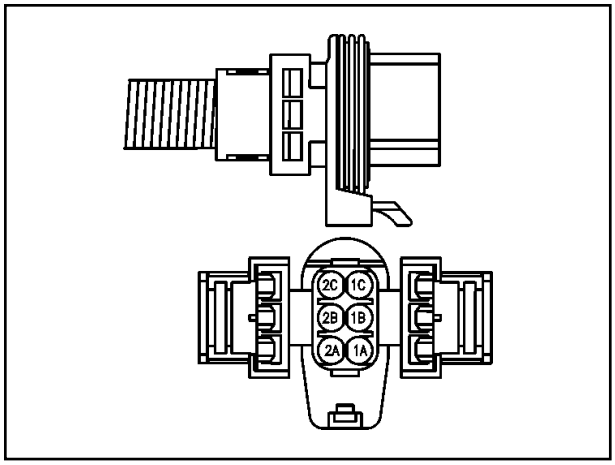


Fig. 10.410

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13	not used		
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29	not used		
30	not used		
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

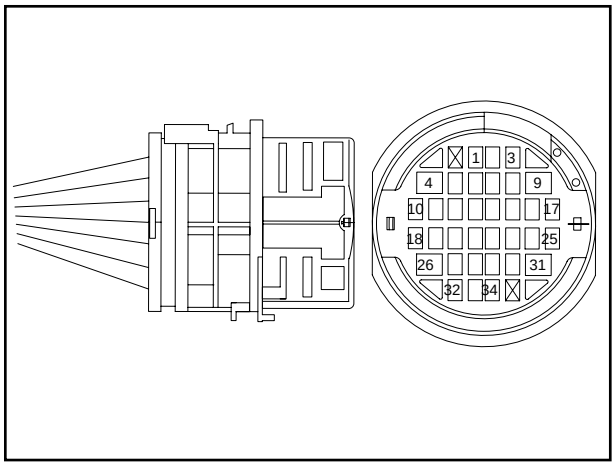


Fig. 10.411

3.8.5 Front engine line (with 4-cylinder engine)

3.8.5.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.412), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.413) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.413) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.414) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.415) installed under the bonnet.

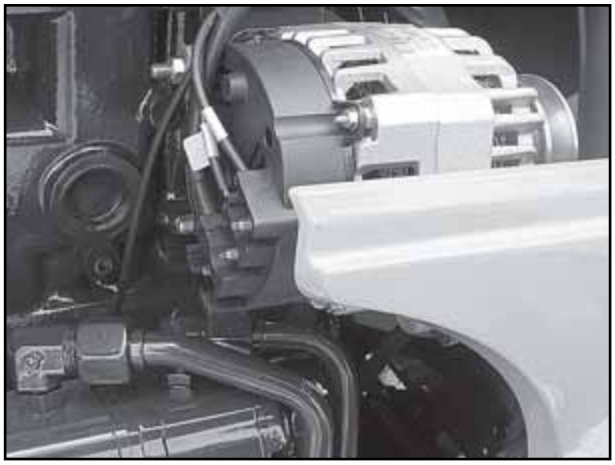


Fig. 10.412

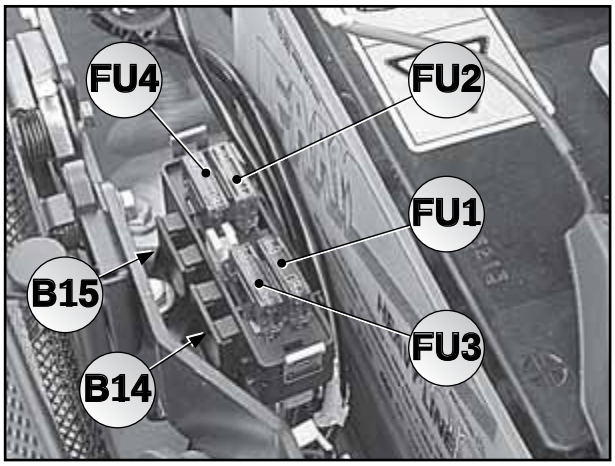


Fig. 10.413

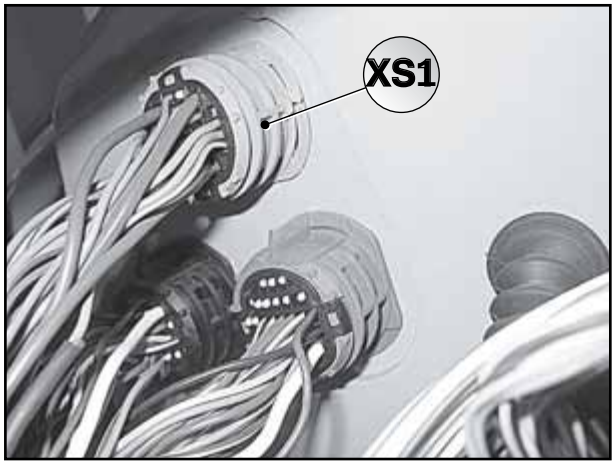


Fig. 10.414

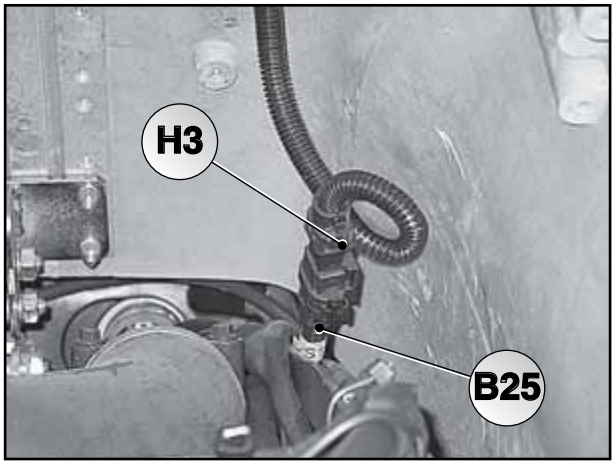


Fig. 10.415

3.8.5.2 Wiring (version with 4-cylinder engine)

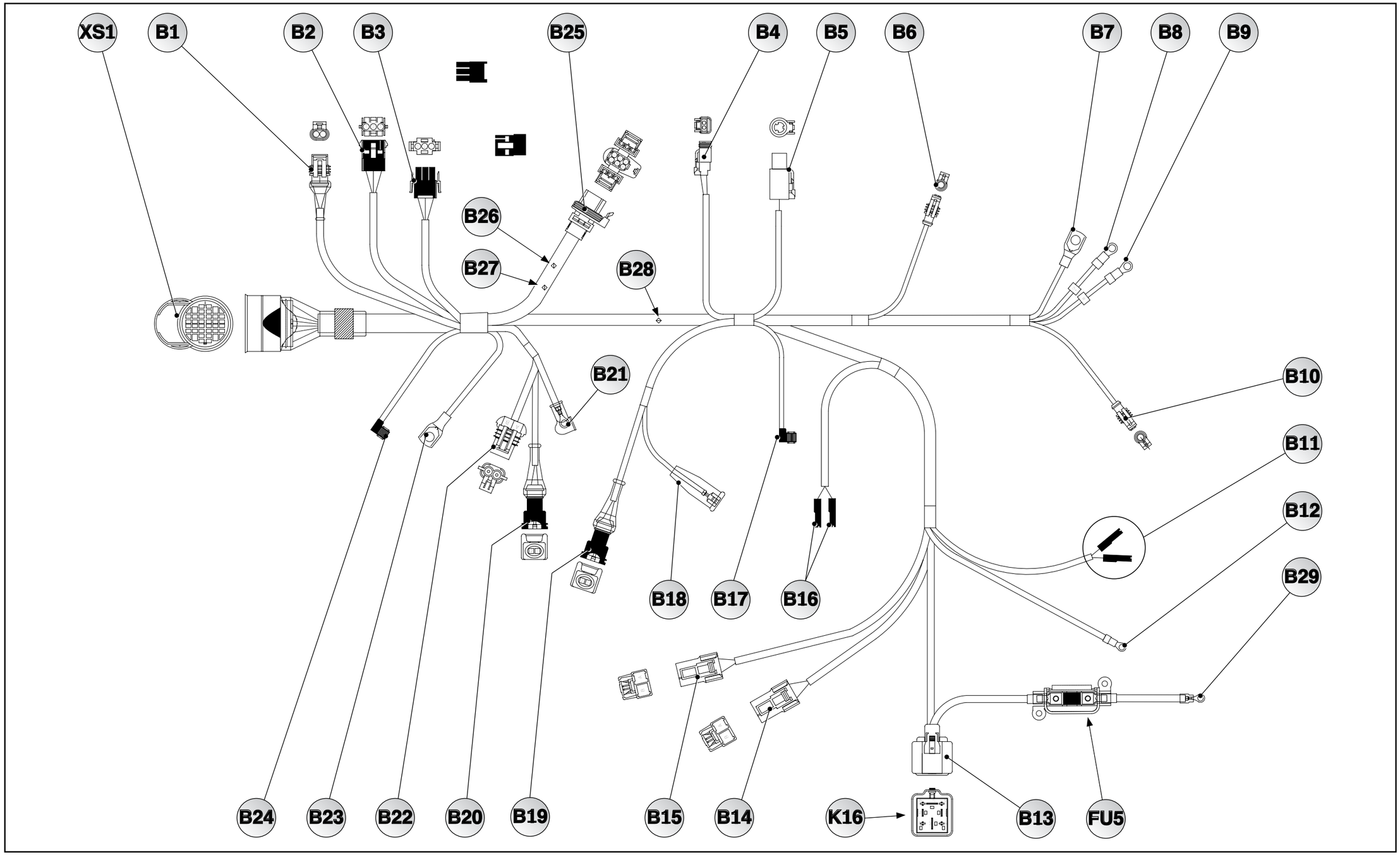


Fig. 10.416

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26-B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.8.5.3 Connector locations

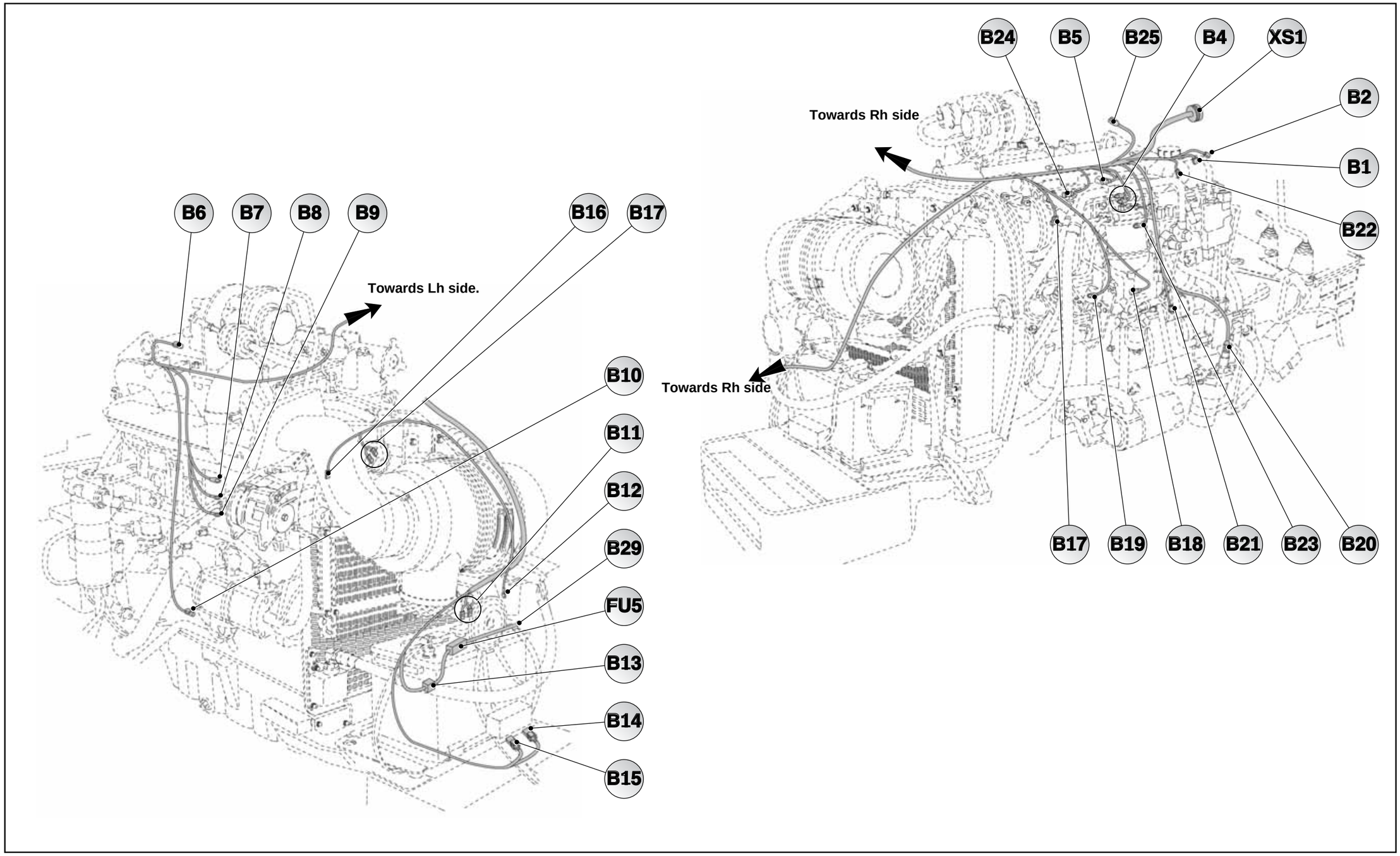


Fig. 10.417

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
XS1 - Terminal board for front line/dashboard connection

3.8.5.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

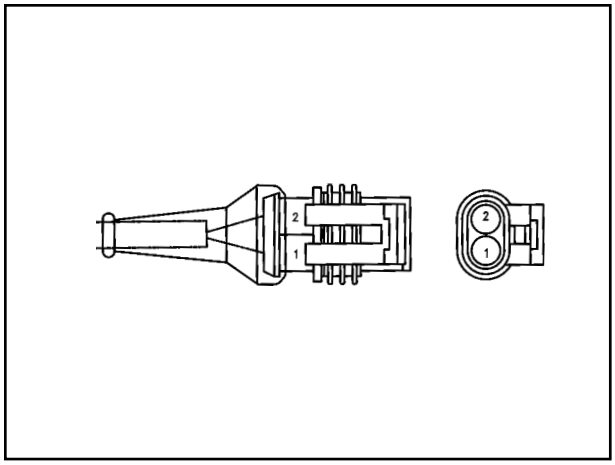


Fig. 10.418

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

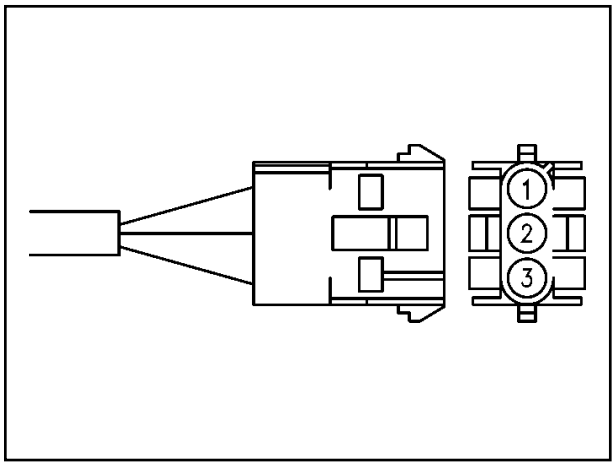


Fig. 10.419

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

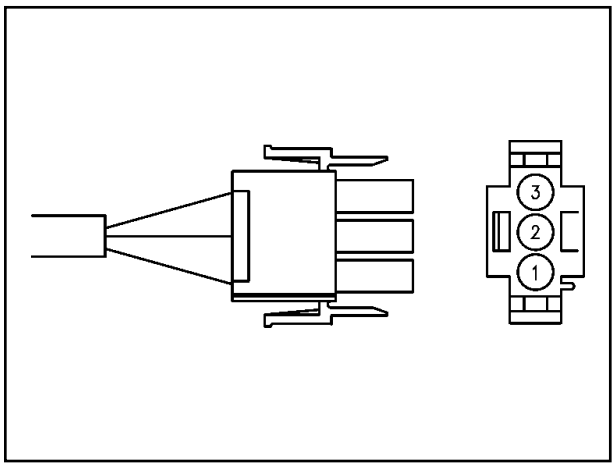


Fig. 10.420

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

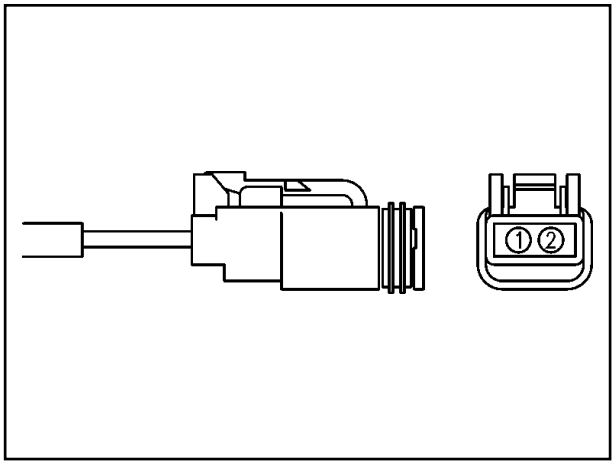


Fig. 10.421

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

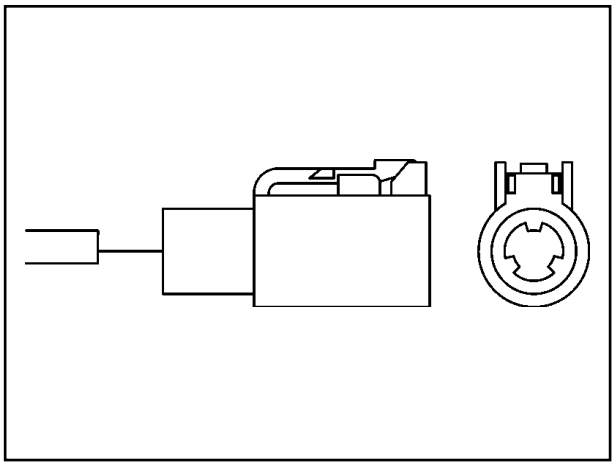


Fig. 10.422

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

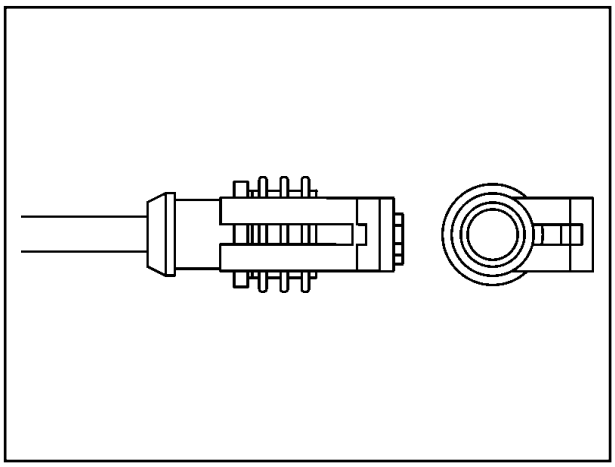


Fig. 10.423

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

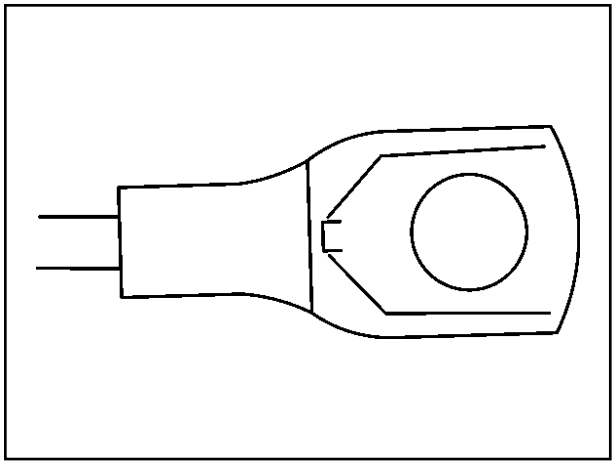


Fig. 10.424

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

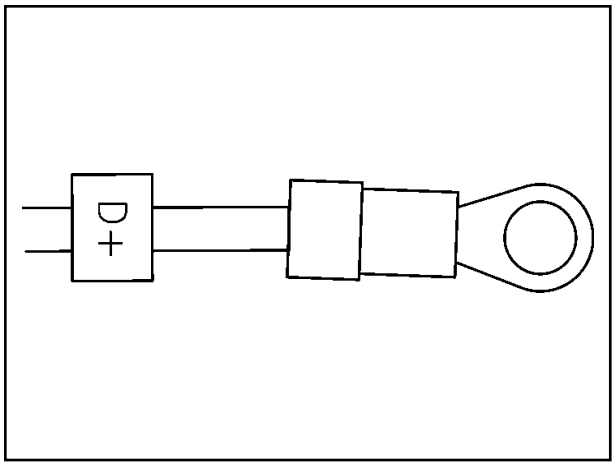


Fig. 10.425

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

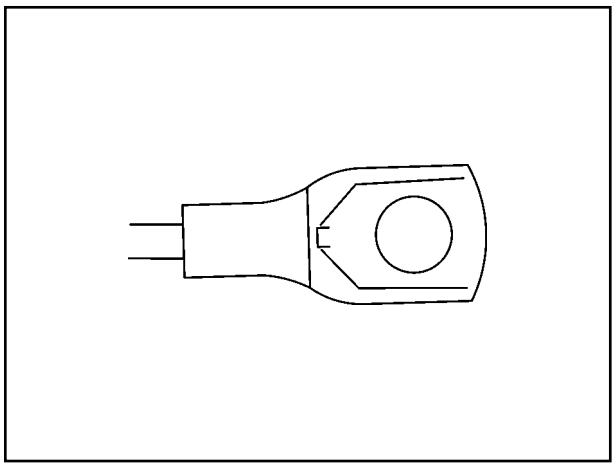


Fig. 10.426

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

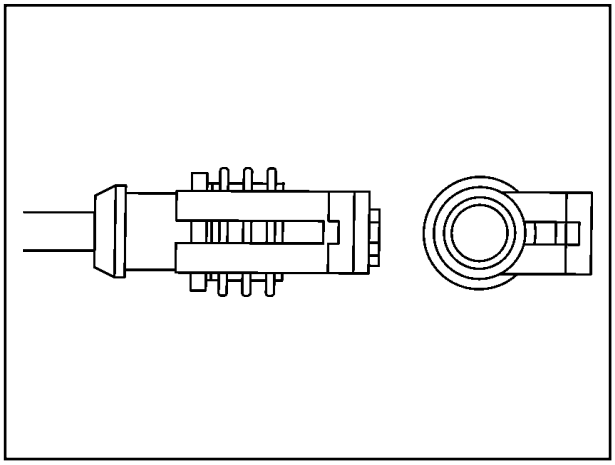


Fig. 10.427

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

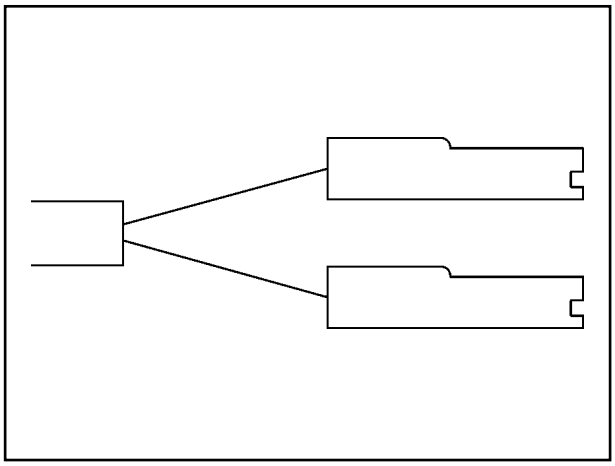


Fig. 10.428

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

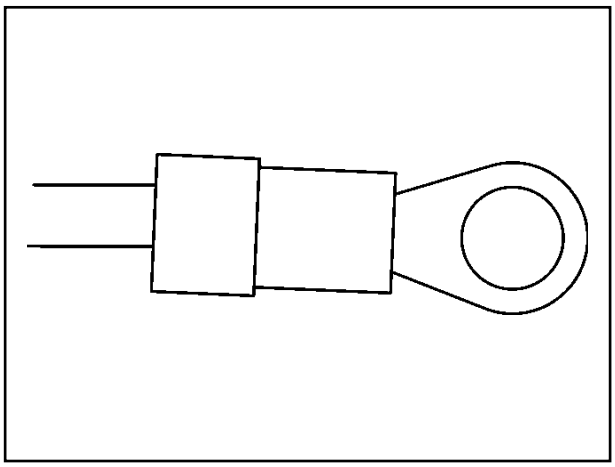


Fig. 10.429

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

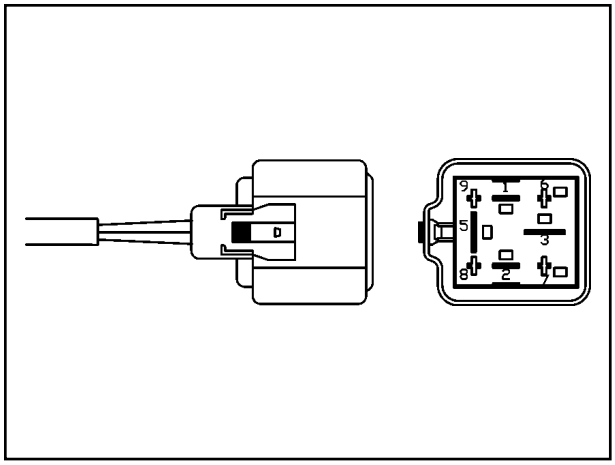


Fig. 10.430

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

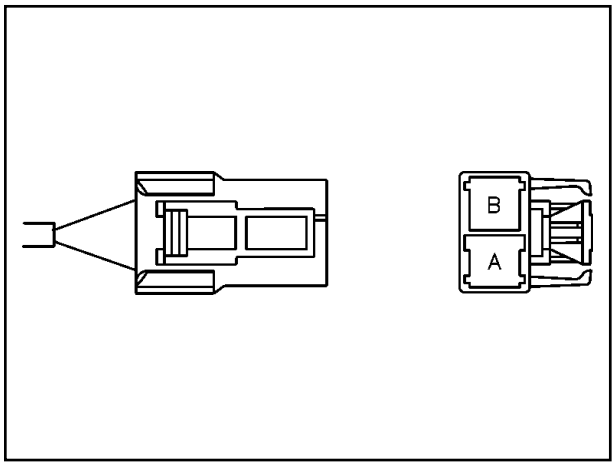


Fig. 10.431

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

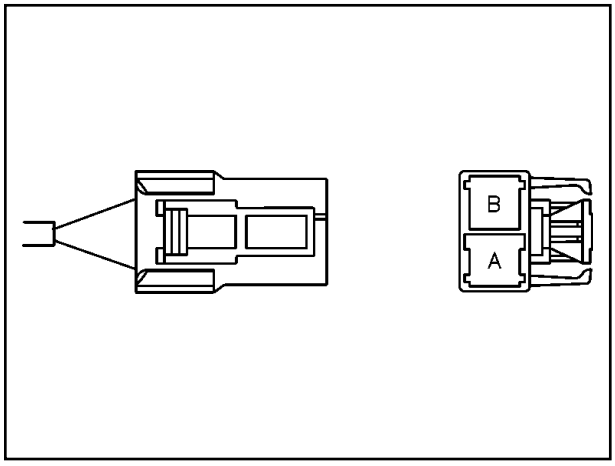


Fig. 10.432

Faston terminals (B16) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

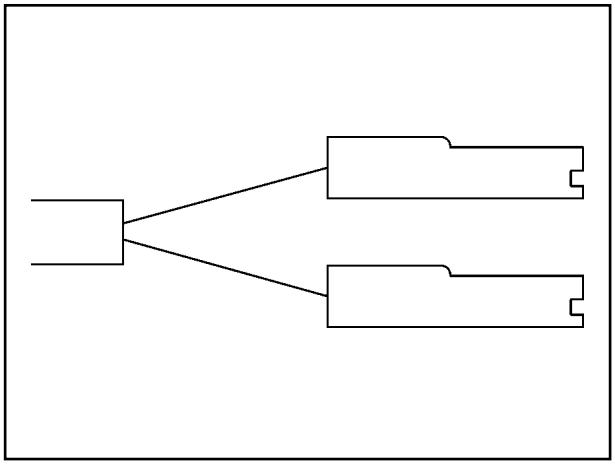


Fig. 10.433

Terminal (B17) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

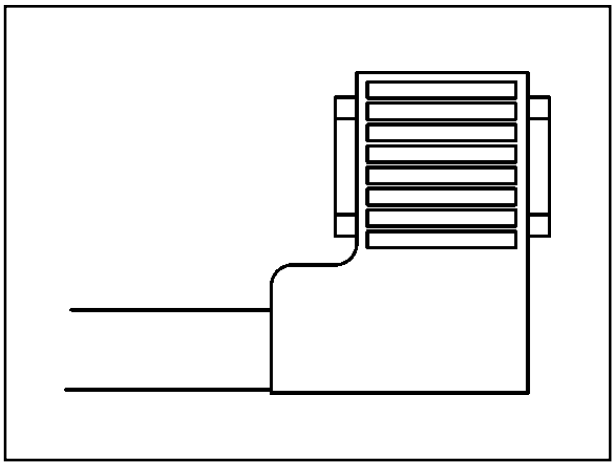


Fig. 10.434

Connector (B18) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

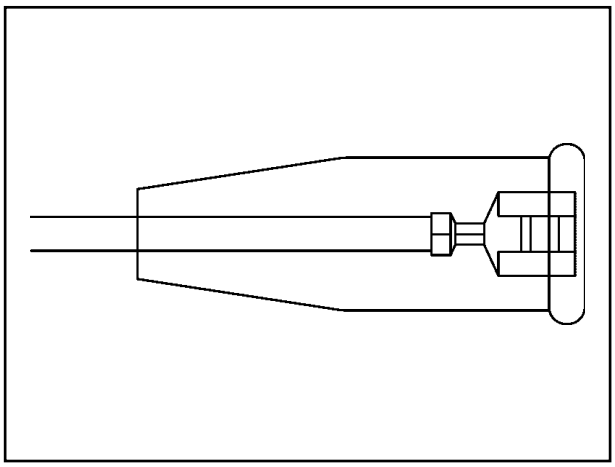


Fig. 10.435

Terminal (B19) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

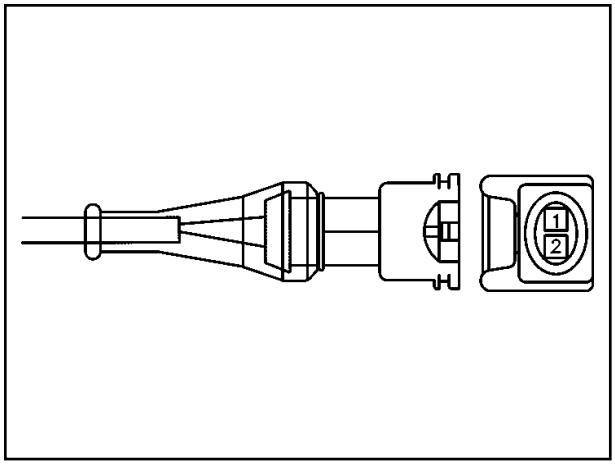


Fig. 10.436

Connector (B20) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

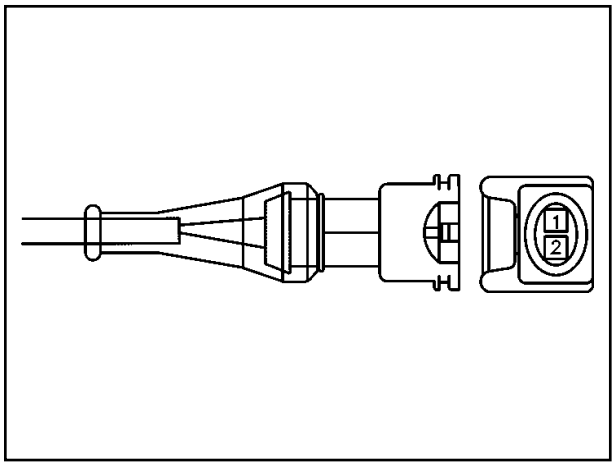


Fig. 10.437

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

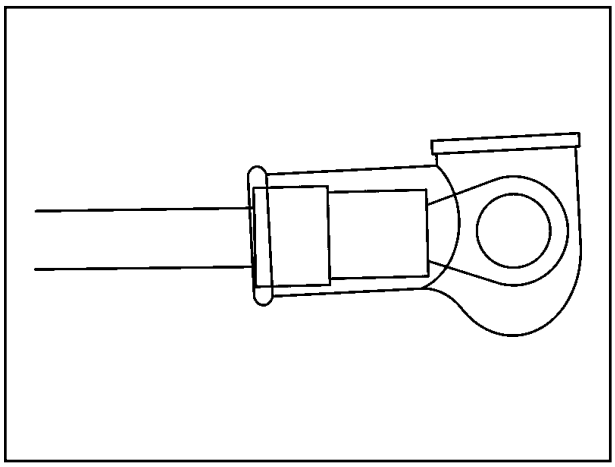


Fig. 10.438

Connector (B22) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

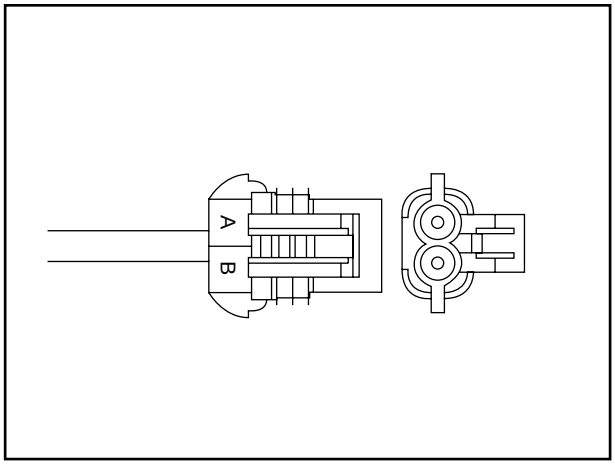


Fig. 10.439

Grounding eyelet (B23)

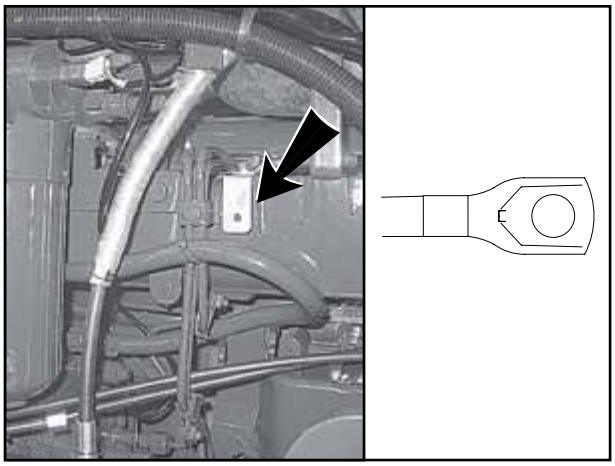


Fig. 10.440

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

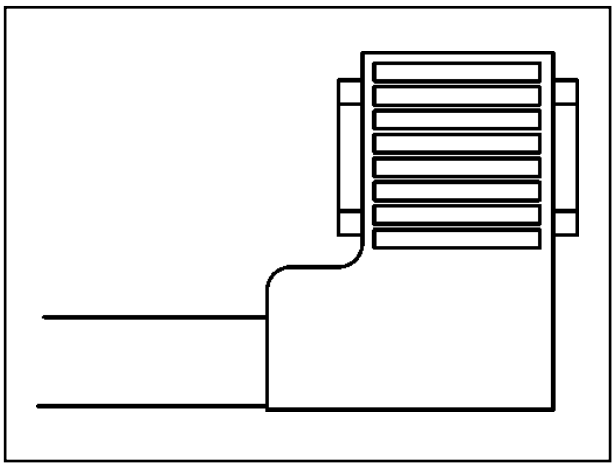


Fig. 10.441

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

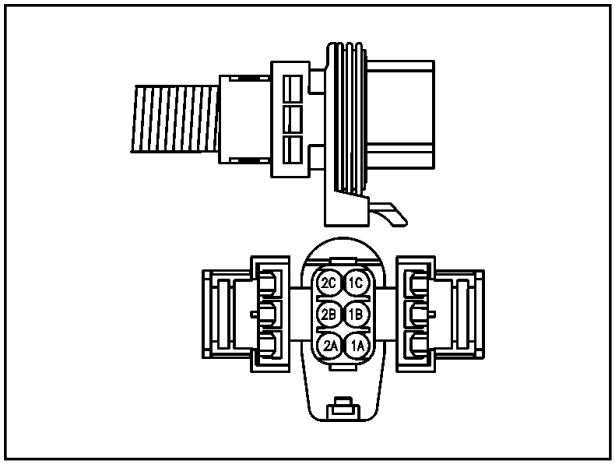


Fig. 10.442

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13	not used		
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29	not used		
30	not used		
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

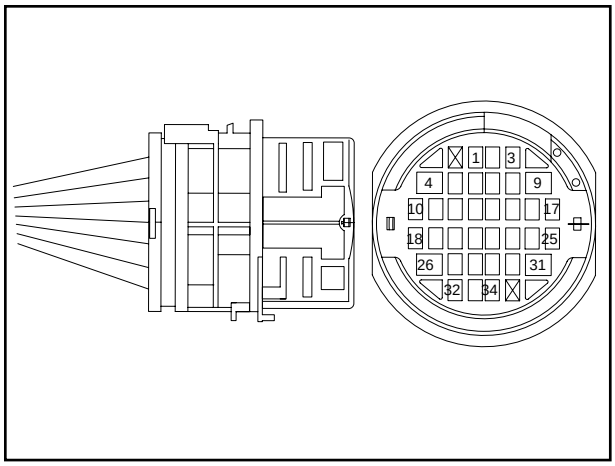


Fig. 10.443

3.8.6 Dashboard line

3.8.6.1 General description

The dashboard line powers the controls installed in front of the driver (Fig.10.444), such as the switches that control the headlights, the light switch lever, etc. It also connects with the fuses that protect the tractor's entire electrical system (Fig.10.445).

The dashboard line is connected to the front engine line via connection to the terminal boards (XS1), to the rear line via terminal boards (XS2) and to the platform line by means of the terminal boards (XS3)(Fig.10.446) in each wiring line.

Fig. 10.444

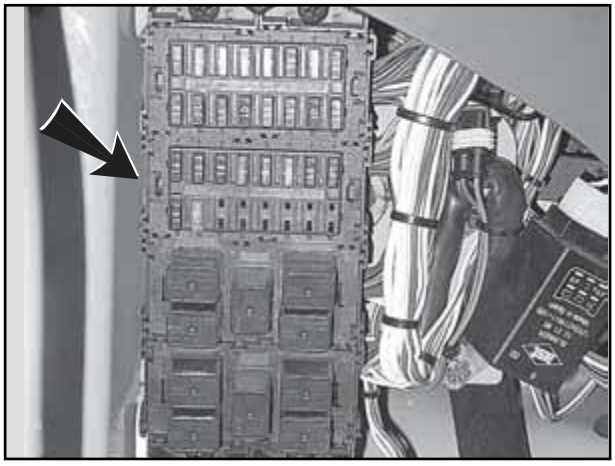


Fig. 10.445

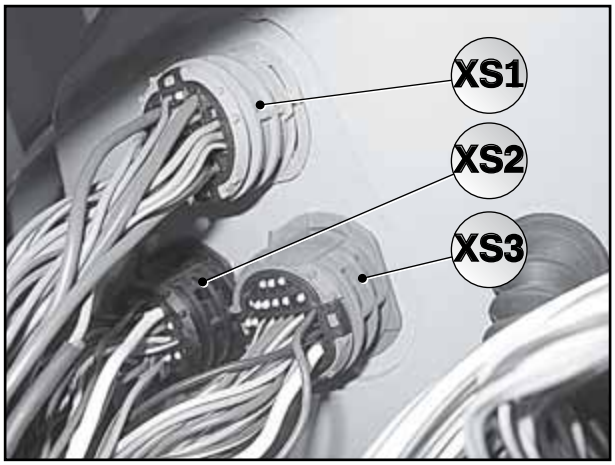


Fig. 10.446

3.8.6.2 Wiring

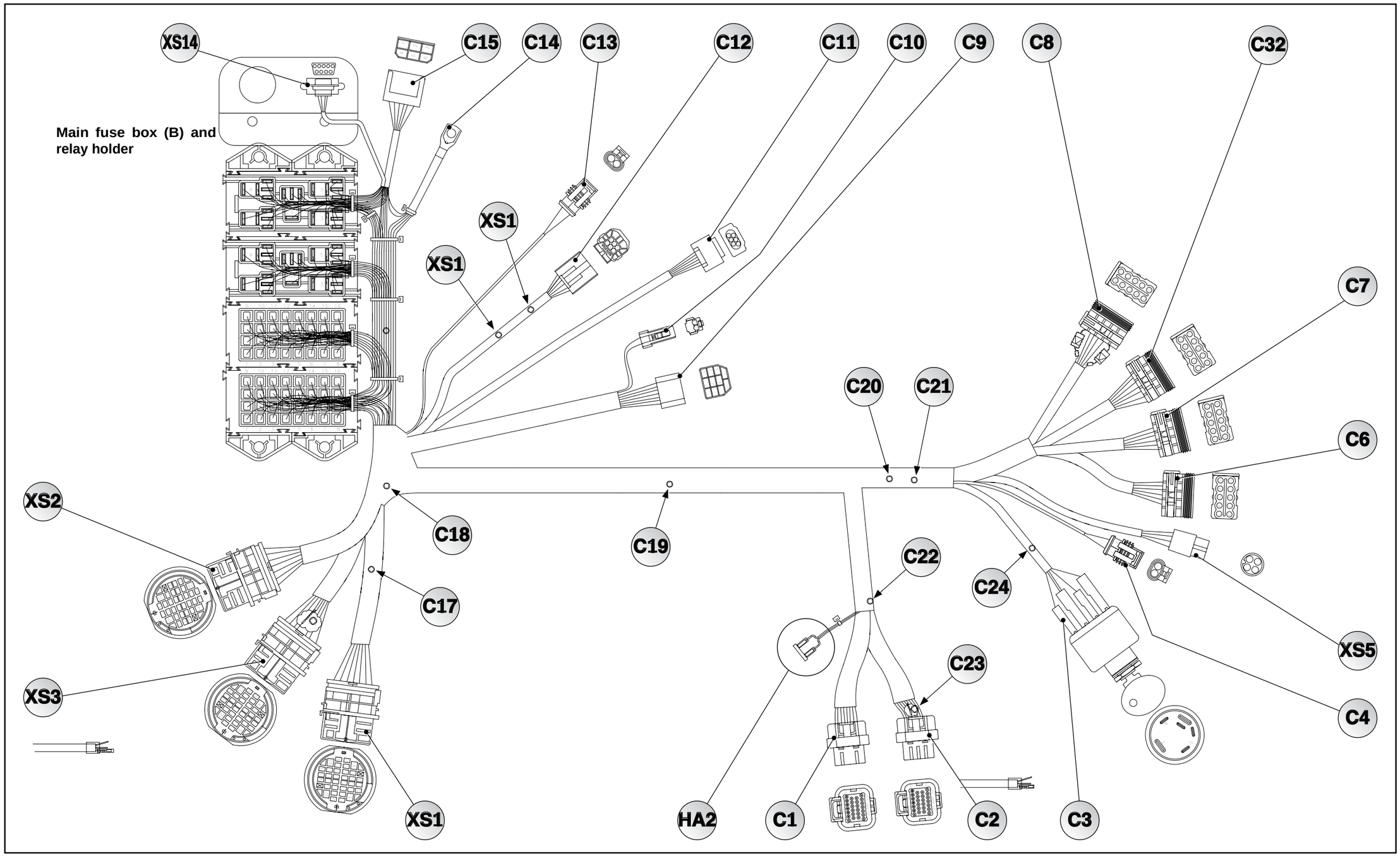


Fig. 10.447

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C5 - Connector for connecting the roof line
C6 - Connector for side lights switch
C7 - Connector for revolving beacon switch
C8 - Connector for emergency switch
C9 - Connector for light switch
C10 - Connector for light switch
C11 - Connector for clutch pedal potentiometer
C12 - Connector for reverse shuttle lever connection
C13 - Connector for Park Lock engaging microswitch
C14 - Grounding eyelet
C15 - Connector for blinker
C16-C31 - Junctions
C32 - Connector for field light switch
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
XS14 - Serial socket for connection to PC

3.8.6.3 Connector locations

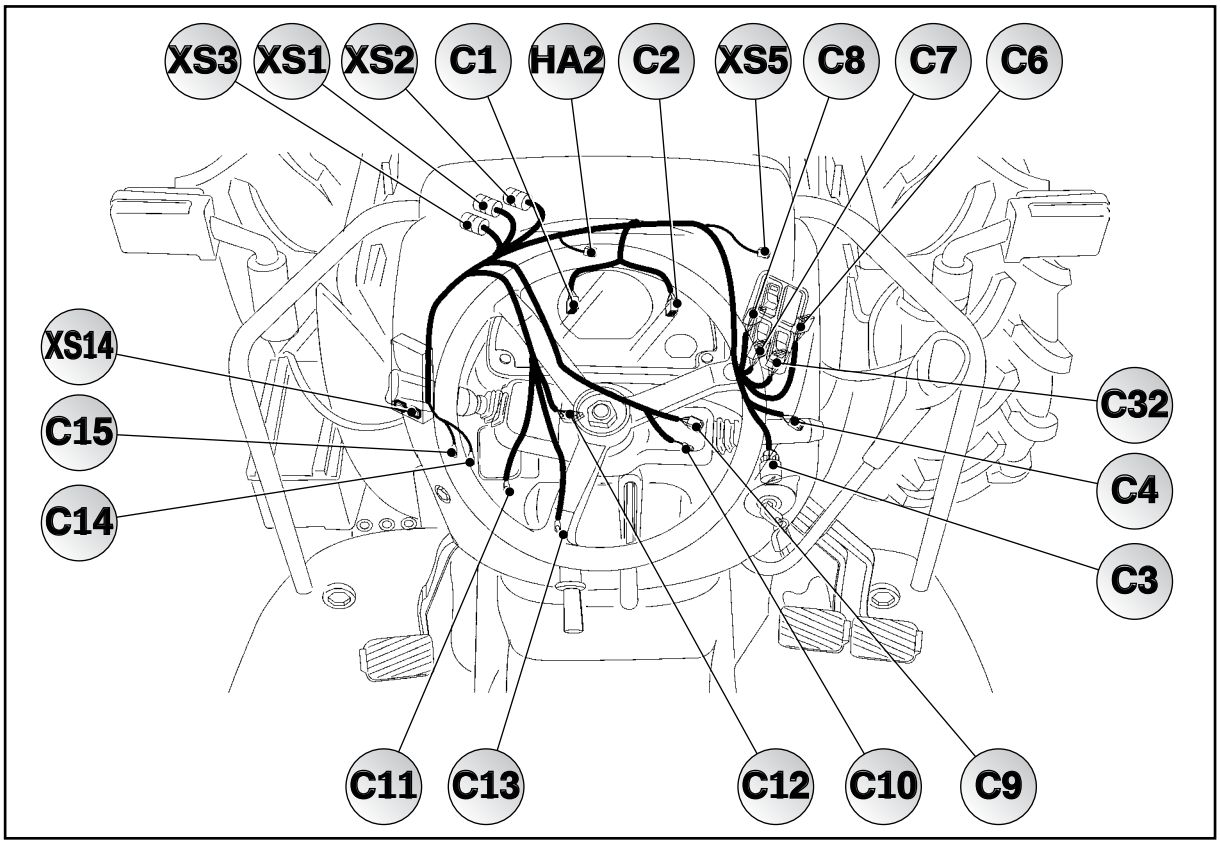


Fig. 10.448

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C5 - Connector for connecting the roof line
C6 - Connector for side lights switch
C7 - Connector for revolving beacon switch
C8 - Connector for emergency switch
C9 - Connector for light switch
C10 - Connector for light switch
C11 - Connector for clutch pedal potentiometer
C12 - Connector for reverse shuttle lever connection
C13 - Connector for Park Lock engaging microswitch
C14 - Grounding eyelet
C15 - Connector for blinker
C32 - Connector for field light switch
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
XS14 - Serial socket for connection to PC

3.8.6.4 Connector identification

Connector (C1) for instrument

term.	wire colour	To con. or comp.	term.
1	RN	C22 (junction)	
2	ZN	XS2	13
3	RV	XS1	5
4	ZL	XS3	32
5	not used		
6	HL	XS2	15
7	LG	XS1	8
8	R	F5	5A
9	ZH	XS1	24
10	SV	XS3	5
11	BR	K8	3
12	not used		
13	not used		
14	B	C19 (junction)	
15	not used		
16	not used		
17	not used		
18	not used		
19	BN	XS2	12
20	not used		
21	V	K9	5
22	HG	C21 (junction)	
23	G	C25 (junction)	
24	V	C26 (junction)	
25	GN	C15	5
26	GV	C15	2

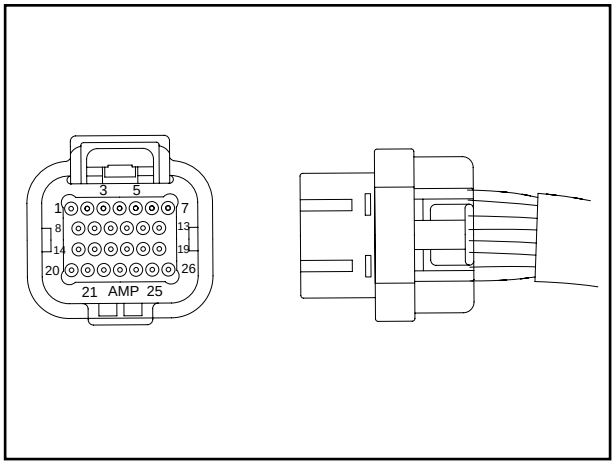


Fig. 10.449

Connector (C2) for instrument

term.	wire colour	To con. or comp.	term.
1	not used		
2	not used		
3	not used		
4	N	C23 (junction)	
5	M	XS3	24
6	B	XS3	25
7	RN	C22 (junction)	
8	not used		
9	HB	HA2	-
10	HM	F16	6
11	not used		
12	not used		
13	R	F5	5A
14	SG	XS3	11
15	VB	XS2	5
16	HL	XS2	3
17	N	C3	3
18	not used		
19	B	C24 (junction)	
20	not used		
21	VB	XS1	3
22	S	XS3	12
23	not used		
24	not used		
25	not used		
26	not used		

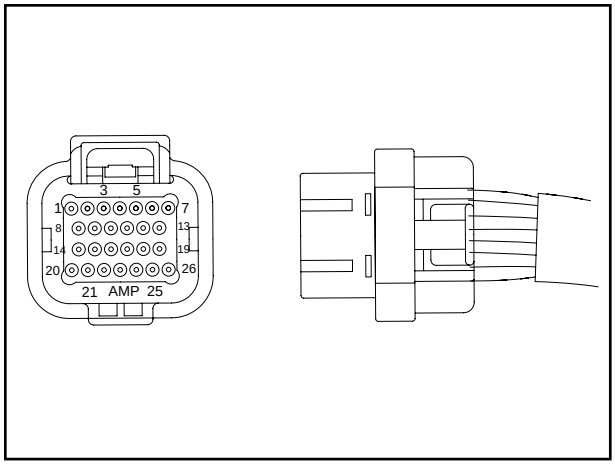


Fig. 10.450

Ignition switch faston terminals (C3)

term.	wire colour	To con. or comp.	term.
1	R	XS1	4
2	M	C24 (junction)	
3	N-N	XS1-C2	6-17
4	L	F20	2

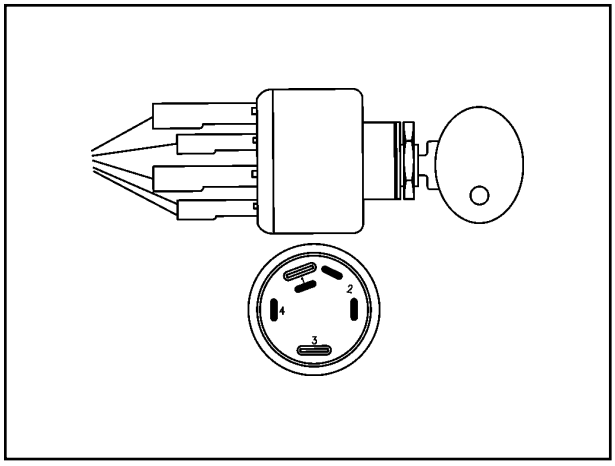


Fig. 10.451

Brake oil pressure sensor connector (C4)

term.	wire colour	To con. or comp.	term.
1	M	K3	3
2	GL	K3	2

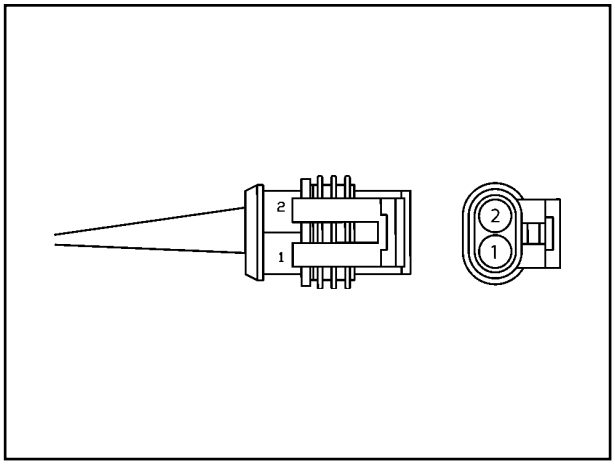


Fig. 10.452

Connector (C6) for side lights switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	C29 (junction)	
3	HR	C9	4
4	not used		
5	RN	F15	15A
6	N	C18 (junction)	
7	B	C19 (junction)	
8	HG	C21 (junction)	
9	B	C19 (junction)	
10	N	C18 (junction)	

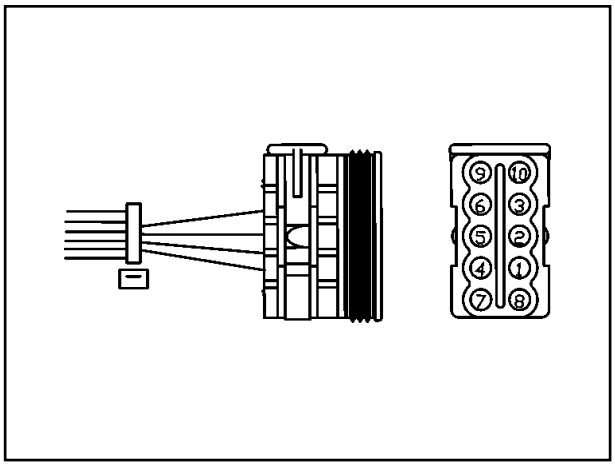


Fig. 10.453

Revolving beacon switch connector (C7)

term.	wire colour	To con. or comp.	term.
1	not used		
2	R	F27	16A
3	GV	C30 (junction)	
4	not used		
5	not used		
6	not used		
7	B	C19 (junction)	
8	HG	C21 (junction)	
9	B	C19 (junction)	
10	GV	C30 (junction)	

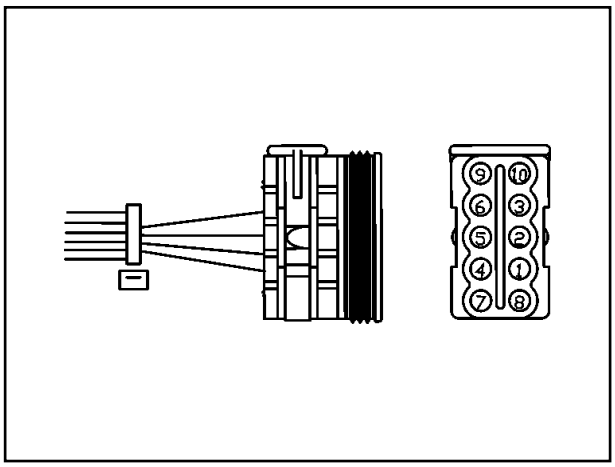


Fig. 10.454

Connector (C8) for emergency switch

term.	wire colour	To con. or comp.	term.
1	M	C29 (junction)	
2	BR	F12	12A
3	R	F36	7A
4	not used		
5	MB	C15	4
6	G (diode)	C25 (junction)	
7	not used		
8	B	C19 (junction)	
9	V (diode)	C26 (junction)	
10	HG	C20 (junction)	

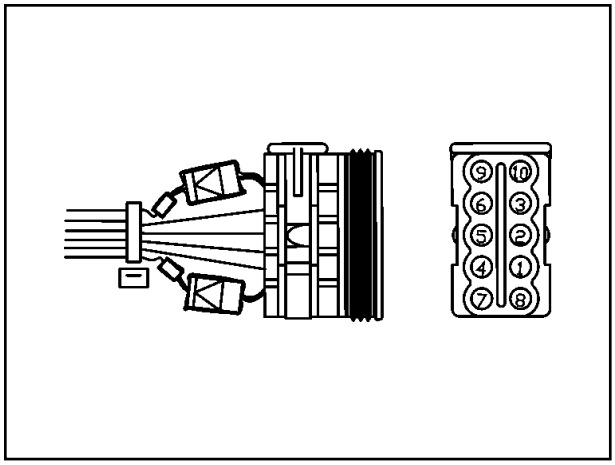


Fig. 10.455

Connector (C9) for light switch

term.	wire colour	To con. or comp.	term.
1	R	F27	16A
2	GV	K9	2
3	G	XS1-XS2-XS3-C25 (junction)	20-6-1
4	HR	C6	3
5	MB	C15	4
6	V	XS2-XS3-XS1-C26 (junction)	8-2-18
7	HR	K10	2
8	Z	XS1	14
9	M	C29 (junction)	
10	RN	F39	1A
11	B	C14 (ground)	

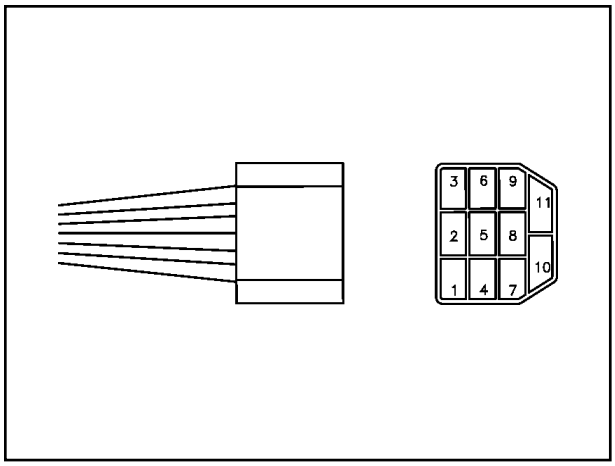


Fig. 10.456

Connector (C10) for light switch

term.	wire colour	To con. or comp.	term.
1	GR	XS3	8
2	RV	XS3	7

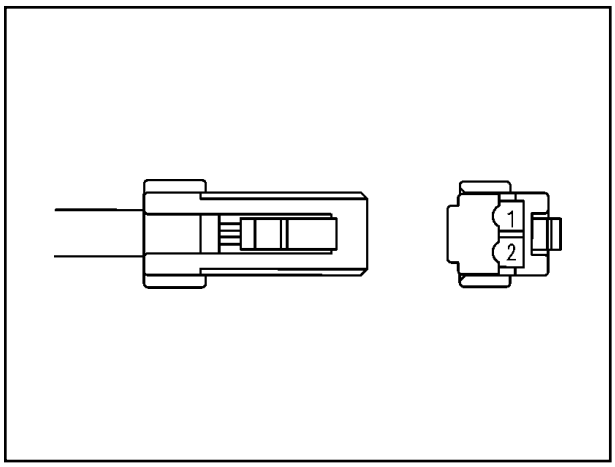


Fig. 10.457

Clutch pedal potentiometer connector (C11)

term.	wire colour	To con. or comp.	term.
1	RN	C27 (junction)	
2	BR	C28 (junction)	
3	not used		
4	HG	XS3	31
5	not used		
6	not used		

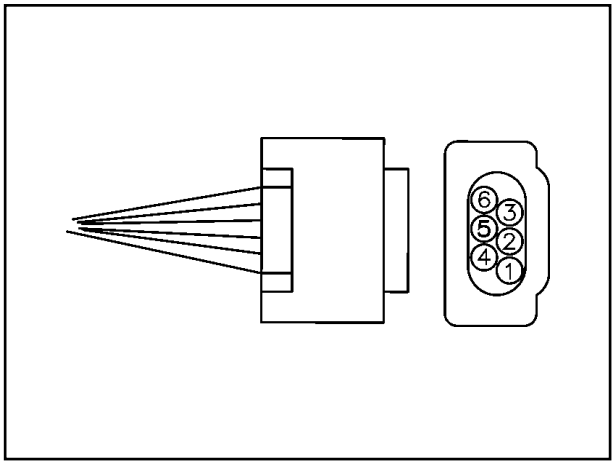


Fig. 10.458

Reverse shuttle lever connector (C12)

term.	wire colour	To con. or comp.	term.
1	ZN	XS3	22
2	RN	C27 (junction)	
3	BR	C28 (junction)	
4	ZL	K15	3
5	Z	K1	2
6	not used		

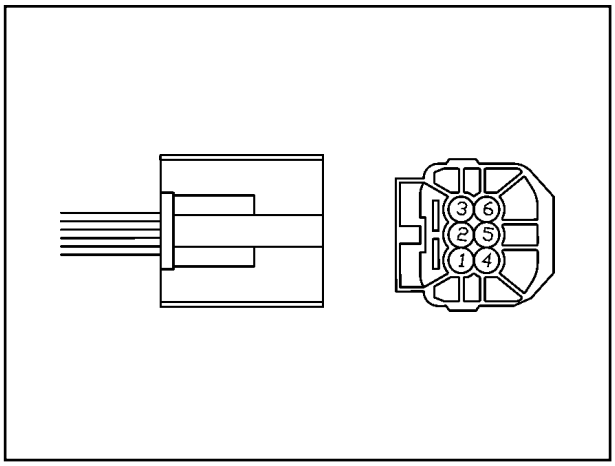


Fig. 10.459

Blinker connector (C13)

term.	wire colour	To con. or comp.	term.
1	LR	XS3	18
2	VB	XS3	23

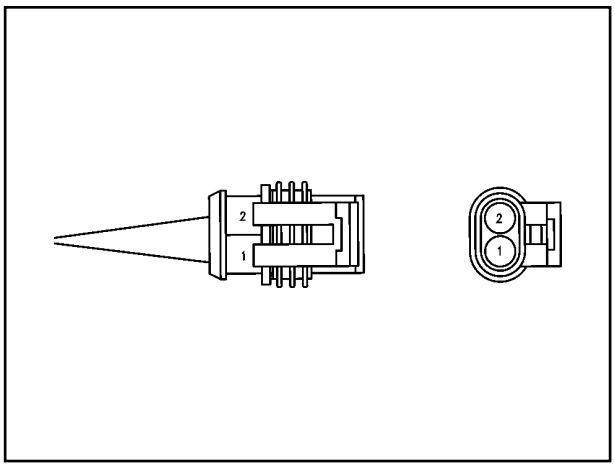


Fig. 10.460

Grounding eyelet (C14)

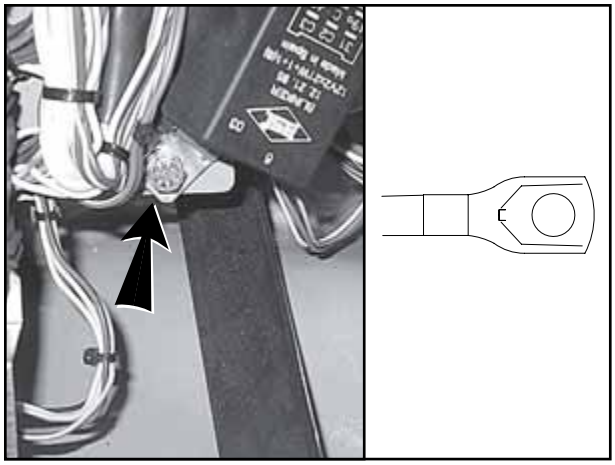


Fig. 10.461

Blinker connector (C15)

term.	wire colour	To con. or comp.	term.
1	B	C14 (ground)	
2	GV	C1	26
3	not used		
4	MB-MB	C9-C8	5-5
5	GN	C1	25
6	BR	F12	12

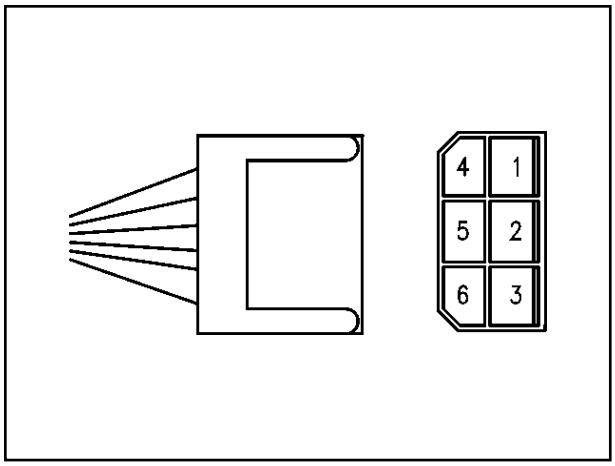


Fig. 10.462

Connector (C32) for field light switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	H	F21	3
3	HN	C31 (junction)	
4	not used		
5	not used		
6	not used		
7	B	C19 (junction)	
8	HG	C20 (junction)	
9	B	C19 (junction)	
10	HN	C31 (junction)	

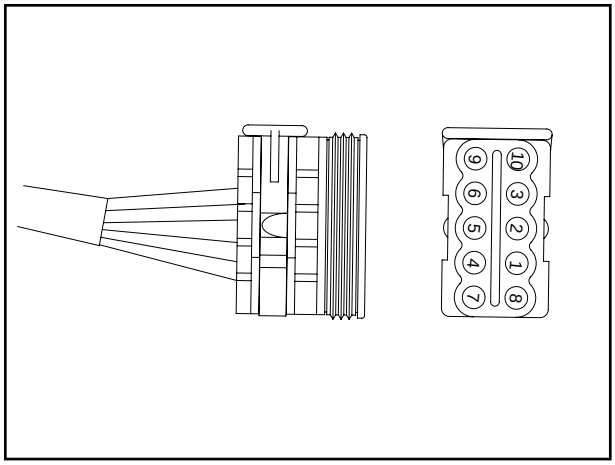


Fig. 10.463

Connector (HA2) for horn (buzzer)

term.	wire colour	To con. or comp.	term.
-	HB	C2	9
+	RN	F22	4A

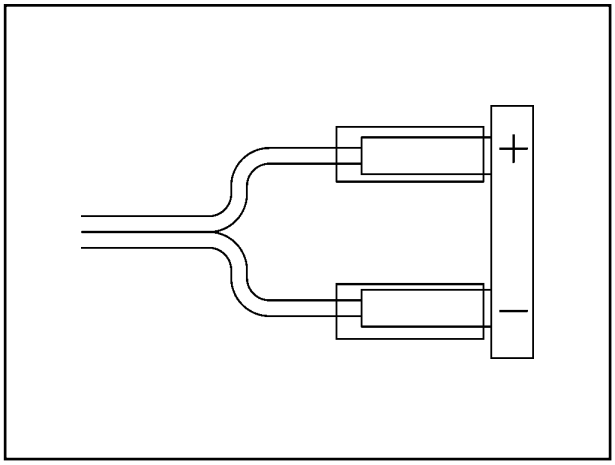


Fig. 10.464

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	K1	5
2	L	K1	5
3	VB	C2	21
4	R	C3	1
5	RV	C1	3
6	N	C3	3
7	CN	F6	6A
8	LG	C1	7
9	M	K3	3
10	not used		
11	HM	F16	6A
12	not used		
13	not used		
14	Z	C9	8
15	V	K3	5
16	H	K10	5
17	GM	XS5	2
18	V	C9	6
19	M	C20 (junction)	
20	G	C9	3
21	N	C21 (junction)	
22	GV	C30 (junction)	
23	BN	XS2	30
24	ZH	C1	9
25	not used		
26	M	C17 (junction)	
27	M	K11	3
28	R	K2	5
29	not used		
30	not used		
31	L	K4	3
32	R	K2	5
33	LB	F25	9
34	LN	F27	16

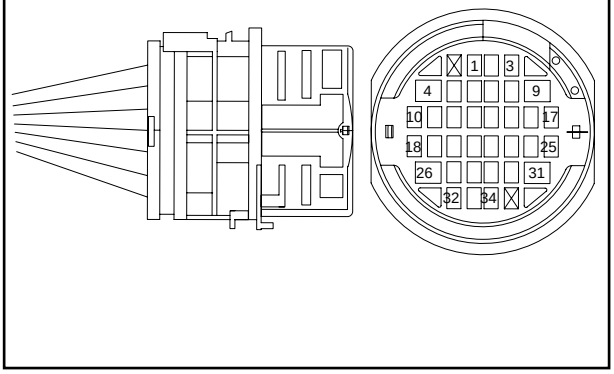


Fig. 10.465

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	K8	3
2	GL	XS3	33
3	HL	C2	16
4	B	C14 (ground)	
5	VB	C2	15
6	G	C9	3
7	M	C20 (junction)	
8	V	C9	6
9	R	F26	10A
10	N	C21 (junction)	
11	R	F8	8A
12	BN	C1	19
13	ZN	C1	2
14	BV	F1	1
15	HL	C2	6
16	MV	K15	2
17	BV	F1	1
18	VN	K15	4
19	not used		
20	not used		
21	not used		
22	not used		
23	not used		
24	not used		
25	not used		
26	not used		
27	not used		
28	not used		
29	not used		
30	BN	XS1	23
31	AN	F25	9A
32	not used		
33	not used		
34	not used		

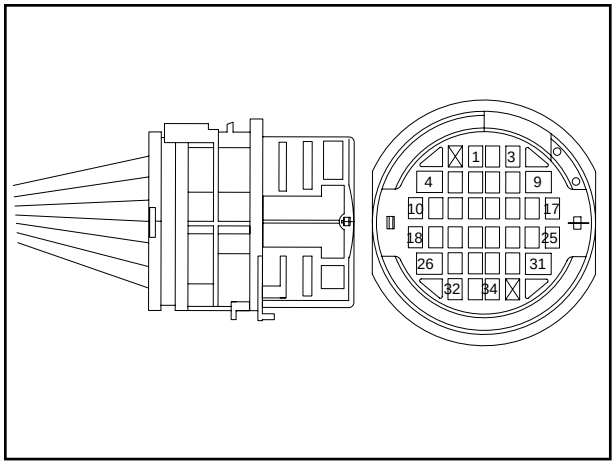


Fig. 10.466

Terminal board (XS3) for platform/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	G	C9	3
2	V	C9	6
3	N	C21 (junction)	
4	ZB	C27 (junction)	
5	SV	C1	10
6	G	XS14	2
7	RV	C10	2
8	GR	C10	1
9	RN	F30	12A
10	GR	C31 (junction)	
11	SG	C2	14
12	S	C2	22
13	HM	F16	6
14	RN	F17	5
15	BR	K8	2
16	SN	F18	8A
17	HR	F7	7
18	LR	C13	1
19	MR	F24	4
20	R	F8	8A
21	L	C28 (junction)	
22	ZN	C12	1
23	VB	C13	2
24	M	C2	5
25	B	C2	6
26	B	C14 (ground)	
27	V	XS14	3
28	M	C20 (junction)	
29	RN	F29	3A
30	B	XS14	5
31	HG	C11	4
32	ZL	C1	4
33	GL	XS2	2
34	N	C16 (junction)	

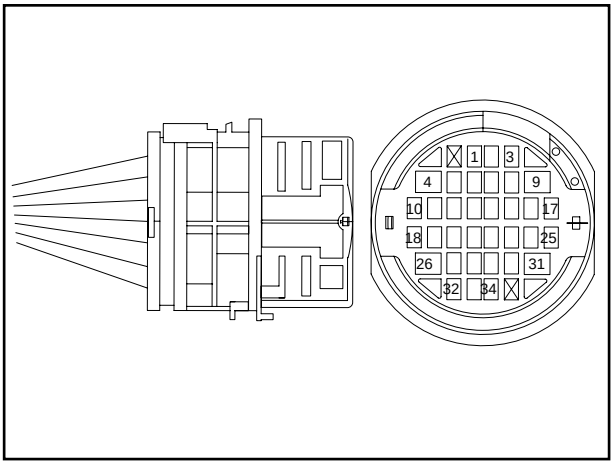


Fig. 10.467

Terminal board (XS5) for roof/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	M	F3	11
2	GM	XS1	17
3	B	C14 (ground)	
4	HG	C21 (junction)	

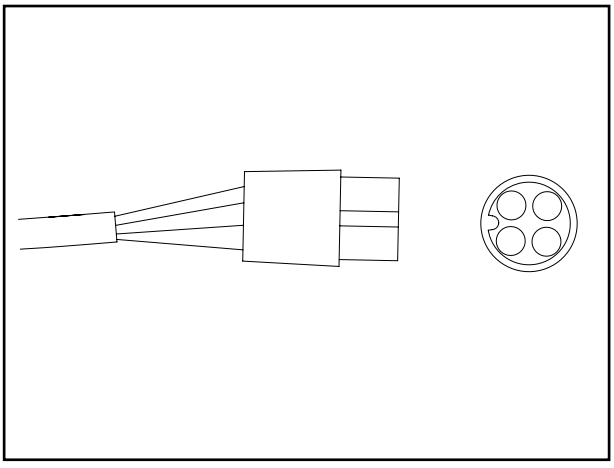


Fig. 10.468

3.8.7 Platform line

3.8.7.1 General description

The platform line connects the controls on the right-hand side of the platform, such as the switches and buttons for engaging/disengaging the 4WD and diff lock (Fig.10.469). It also connects the rear lights and auxiliary power socket.

It is connected to the dashboard line, by means of the connection between the terminal boards (XS3) (Fig.10.470) and to the rear line, by means of the connections between the terminal boards (XS4) (Fig.10.471) in each wiring line.

Fig. 10.469

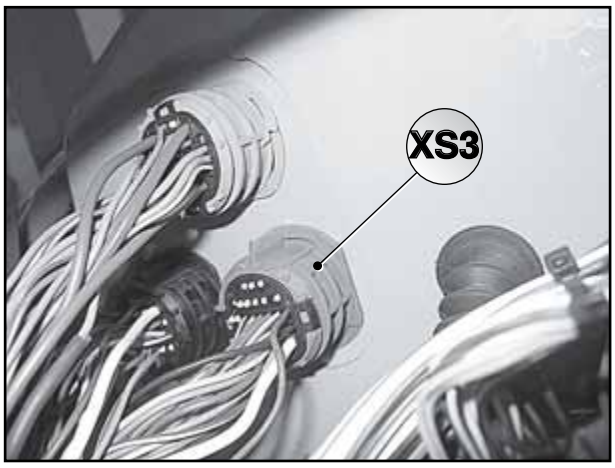


Fig. 10.470

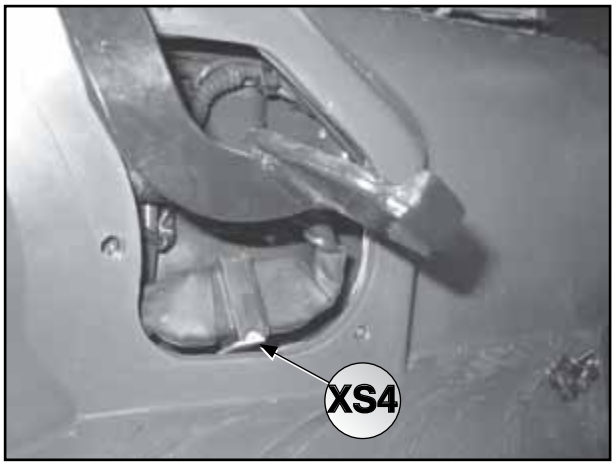


Fig. 10.471

3.8.7.2 Wiring

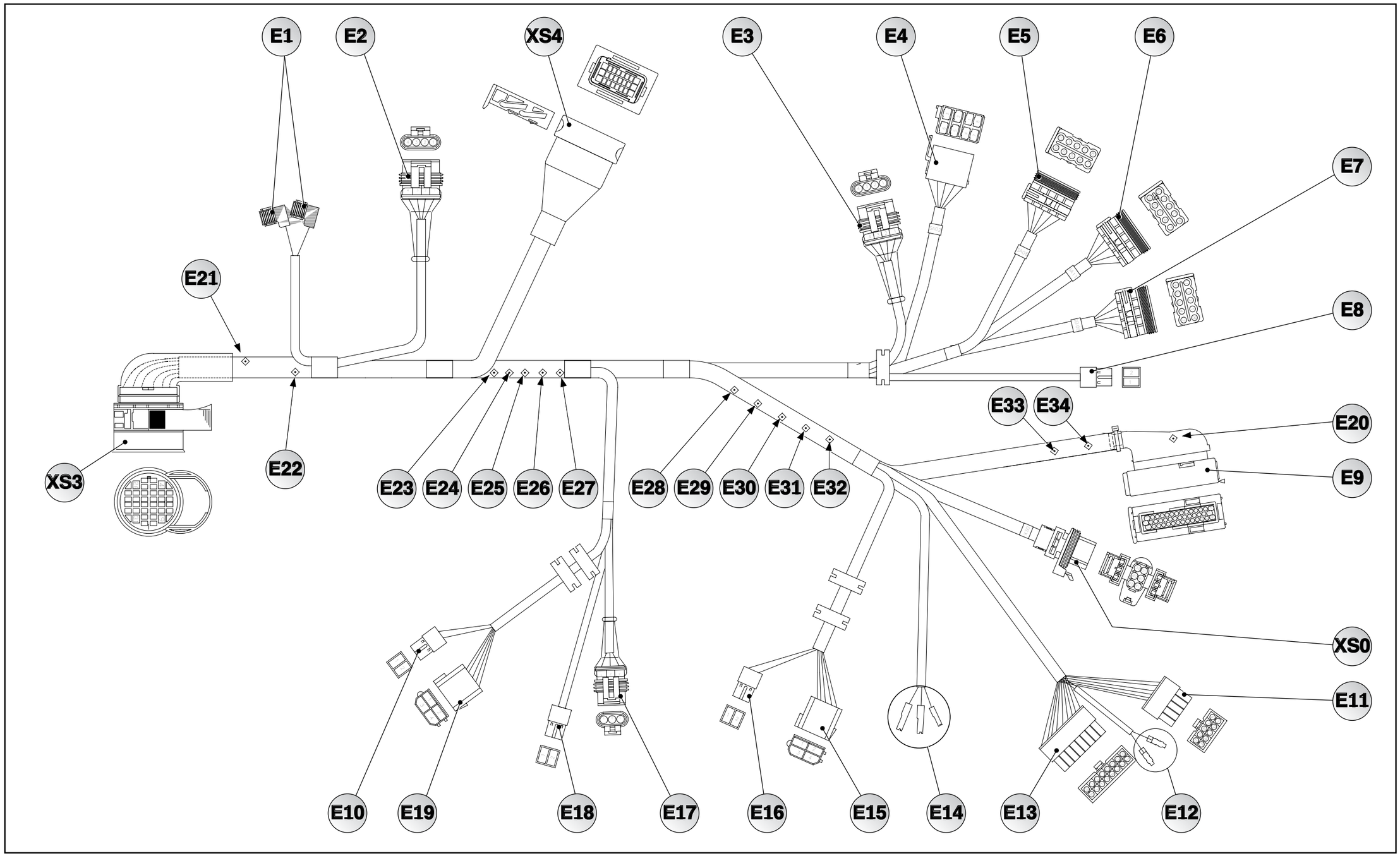


Fig. 10.472

E1 - Terminals for brake oil level sensor
E2 - Connector for Powerfive and Declutch button (gearshift lever)
E3 - Connector (not used)
E4 - Connector for rear PTO switch
E5 - Connector for differential lock button
E6 - Connector for 4WD engagement/disengagement switch
E7 - Connector for control button of auxiliary control valves (A-B)
E8 - Pneumatic seat connector
E9 - Electronic control unit connector
E10 - Connector for lh rear field light
E11 - Connector for resistive kit
E12 - Connector for resistive kit
E13 - Connector for resistive kit
E14 - Faston terminals for auxiliary power socket
E15 - Connector for rh external rear field light
E16 - Connector for rh external rear field light
E17 - Connector for fuel level sensor
E18 - Connector for licence plate light
E19 - Connector for lh rear field light
E20-E34 - Junctions
XS0 - Terminal board for trailer socket connection
XS3 - Terminal board for platform/dashboard cable line connection
XS4 - Terminal board for platform/rear line cable connection

3.8.7.3 Connector locations

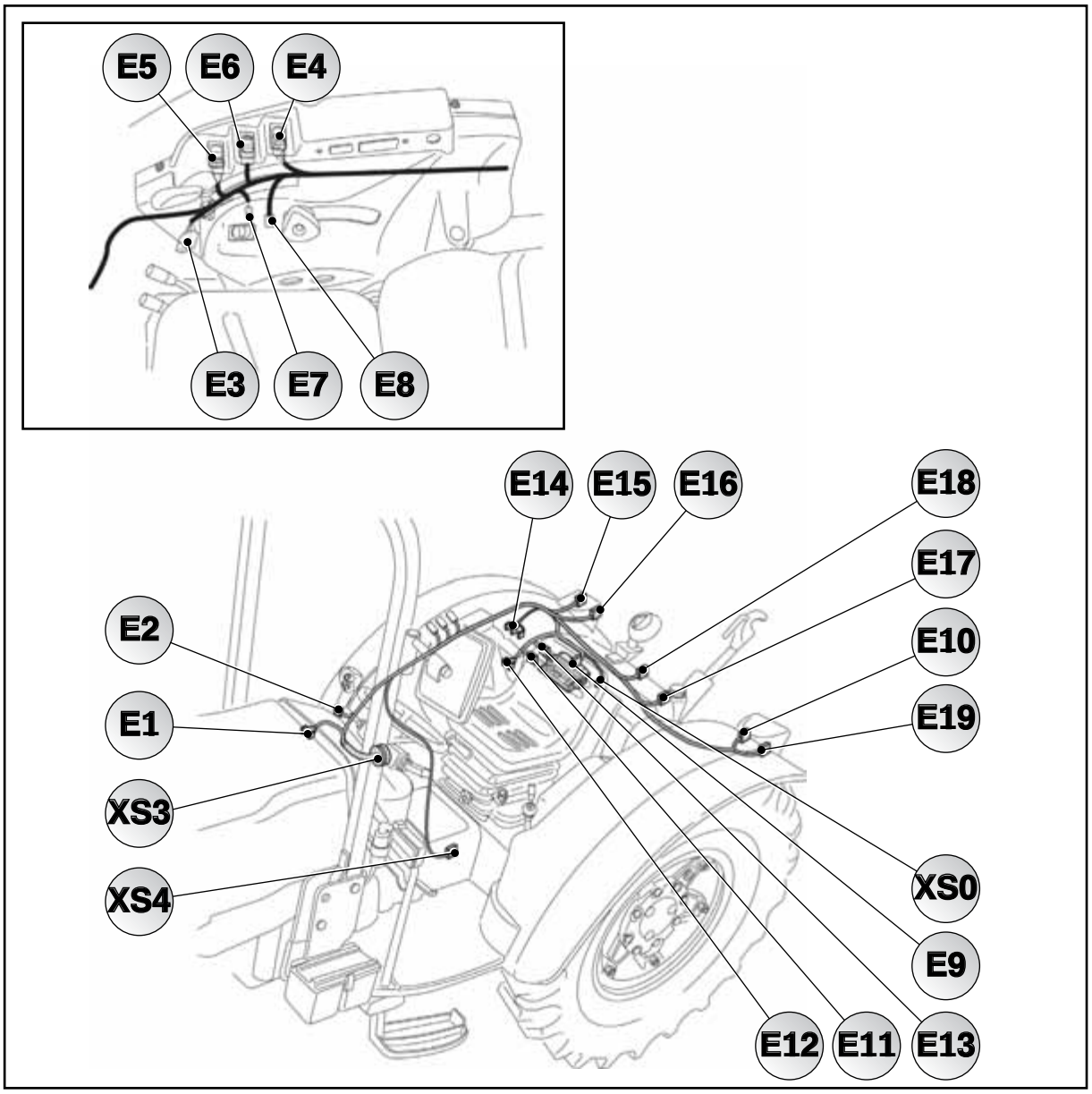


Fig. 10.473

3.8.7.4 Connector identification

Terminals (E1) for brake oil level sensor

term.	wire colour	To con. or comp.	term.
1	ZL	XS3	32
2	B	E22 (junction)	

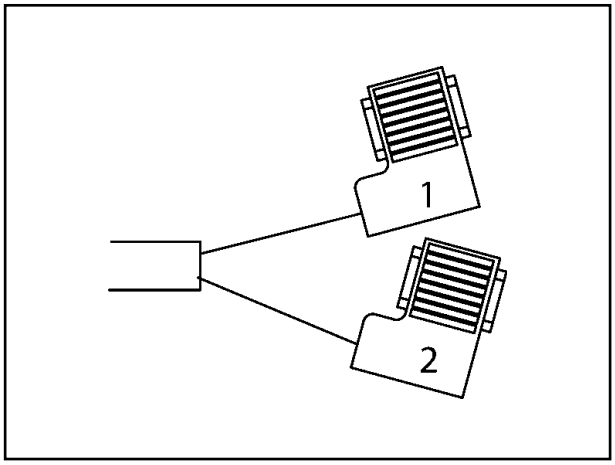


Fig. 10.474

Connector (E2) for Powerfive and Declutch button (gearshift lever)

term.	wire colour	To con. or comp.	term.
1	RN	E29 (junction)	
2	C	E9	3
3	RN	E29 (junction)	
4	V	E9	2

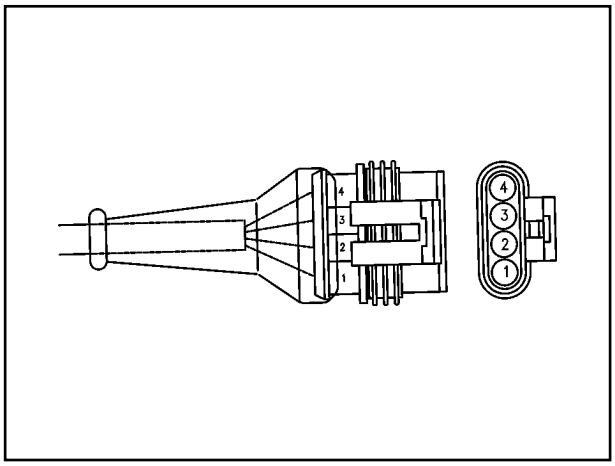


Fig. 10.475

Connector (E3) not used

term.	wire colour	To con. or comp.	term.
1	M	E23 (junction)	
2	B	E22 (junction)	
3	RN	XS3	14
4	HM	XS3	13

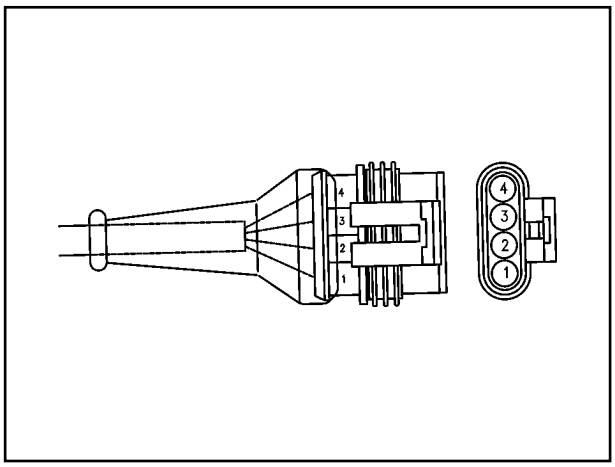


Fig. 10.476

Connector (E4) for rear PTO switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	VB	XS4	C6
3	VN-VN	XS4-E9	C7-4
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	

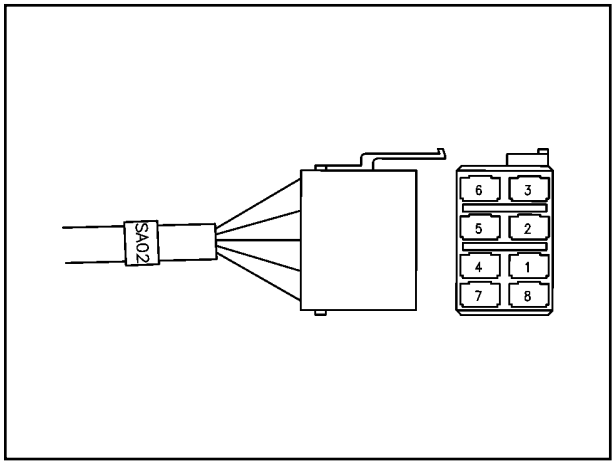


Fig. 10.477

Connector (E5) for differential lock button

term.	wire colour	To con. or comp.	term.
1	not used		
2	BR	XS3	16
3	MV	XS3	15
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	
9	not used		
10	not used		

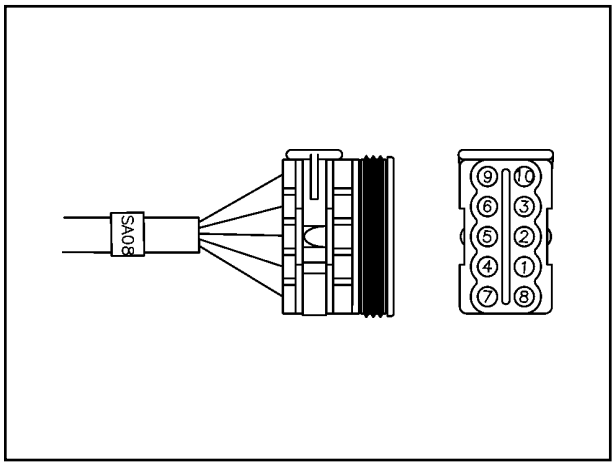


Fig. 10.478

Connector (E6) for 4WD engagement/disengagement switch

term.	wire colour	To con. or comp.	term.
1	GL	XS3	33
2	HR	XS3	17
3	SV	XS3	5
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	
9	not used		
10	not used		

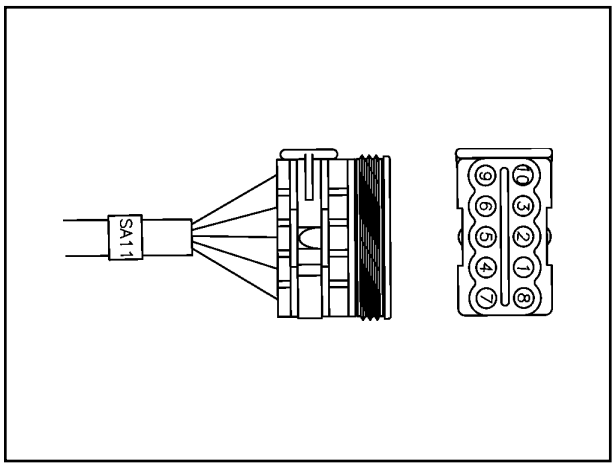


Fig. 10.479

Connector (E7) for control button of auxiliary control valves (A-B)

term.	wire colour	To con. or comp.	term.
1	GN	XS3	A3
2	MR	XS3	19
3	AV	XS3	A2
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	
9	B	E22 (junction)	
10	M	E23 (junction)	

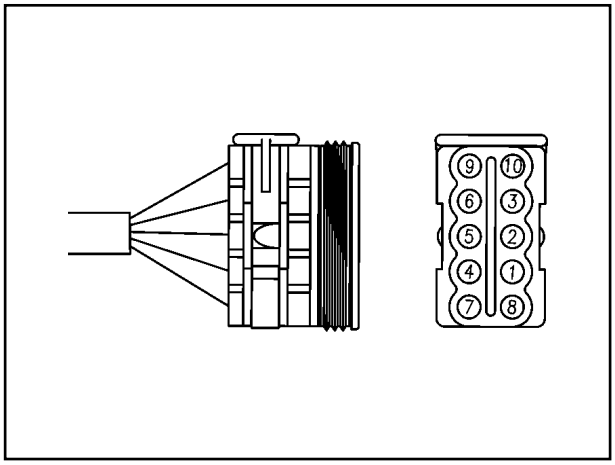


Fig. 10.480

Pneumatic seat connector (E8)

term.	wire colour	To con. or comp.	term.
1	RN	XS3	9
2	B	E22 (junction)	

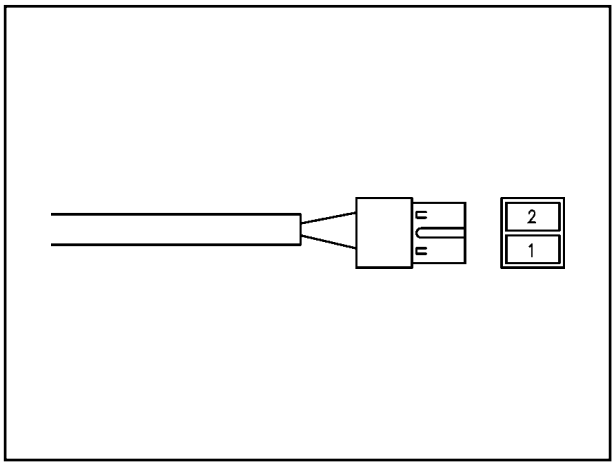


Fig. 10.481

Electronic controller connector (E9)

term.	wire colour	To con. or comp.	term.
1	BR	E29 (junction)	
2	V	E2	4
3	C	E2	2
4	VN	E4	3
5	RN	E29 (junction)	
6	SB	XS4	B5
7	BR	XS4	B7
8	AR	XS4	B4
9	LR	XS4	B6
10	not used		
11	not used		
12	CN	E31 (junction)	
13	B	XS3	30
14	RN	E30 (junction)	
15	BN	E28 (junction)	
16	AN	E34 (junction)	
17	LN	E34 (junction)	
18	CL	E33 (junction)	
19	SN	E33 (junction)	
20	G	XS3	6
21	V	XS3	27
22	ZH	XS4	C2
23	BV	XS4	C8
24	ZL	XS4	C3
25	AG	XS4	C4
26	not used		
27	not used		
28	RN	E29 (junction)	
29	BN	E29 (junction)	
30	not used		
31	HG	E30 (junction)	
32	ZN	XS3	22
33	not used		
34	not used		
35	R	E32 (junction)	
36	VB	E32 (junction)	
37	M	XS3	24
38	B	XS3	25
39	N	E20 (junction)	
40	BG	XS4	A4
41	not used		
42	RN	E29 (junction)	

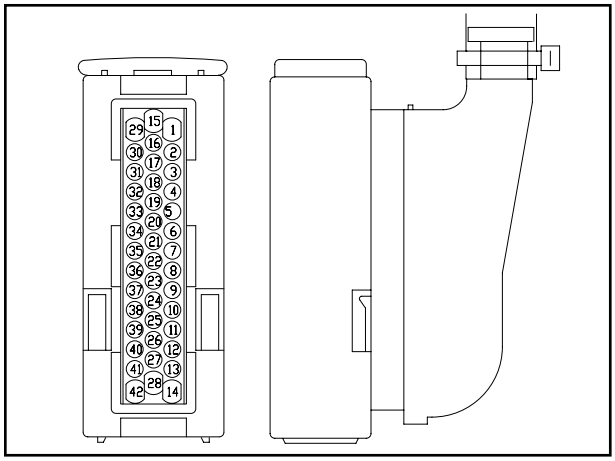


Fig. 10.482

Connector (E10) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B	E19	1
2	GR	XS3	8

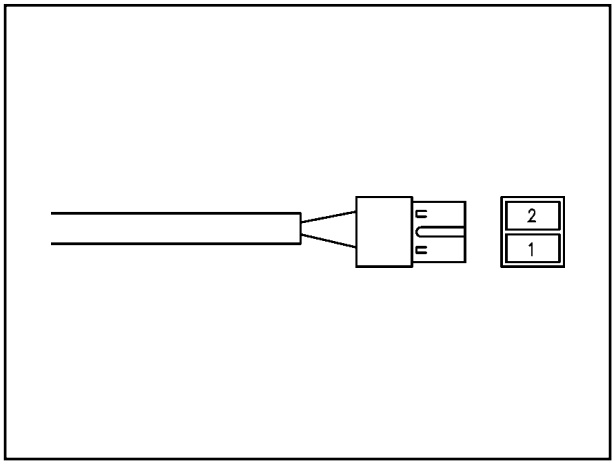


Fig. 10.483

Connector (E11) for resistive kit

term.	wire colour	To con. or comp.	term.
1	RN	E30 (junction)	
2	VB	E32 (junction)	
3	R	E32 (junction)	
4	not used		
5	HG	E30 (junction)	
6	AN	E34 (junction)	
7	LN	E34 (junction)	
8	CL	E33 (junction)	
9	SN	E33 (junction)	
10	NR	E29 (junction)	

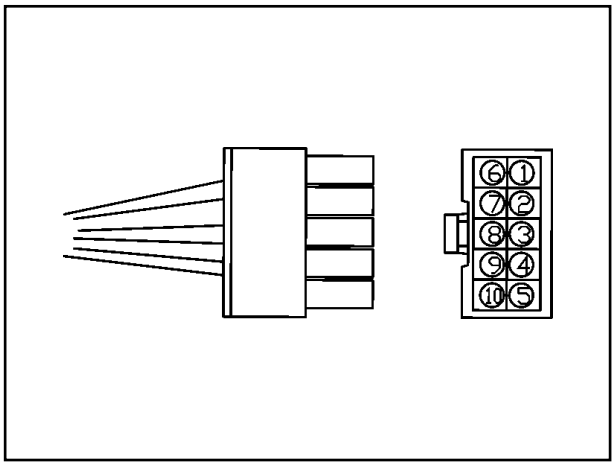


Fig. 10.484

Connector (E12) for resistive kit

term.	wire colour	To con. or comp.	term.
1	HN	XS3	10
2	B	E22 (junction)	

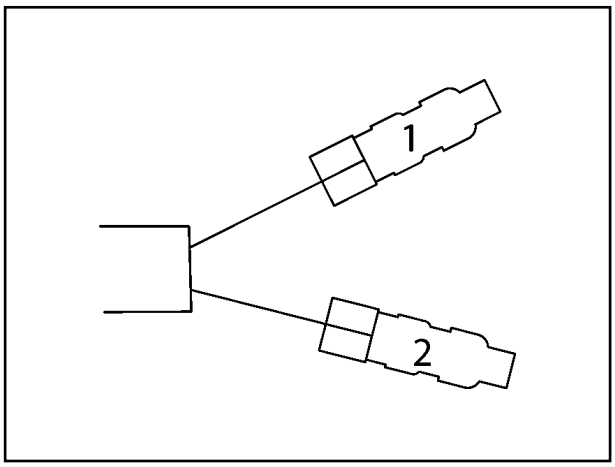


Fig. 10.485

Connector (E13) for resistive kit

term.	wire colour	To con. or comp.	term.
1	not used		
2	not used		
3	not used		
4	not used		
5	not used		
6	not used		
7	not used		
8	not used		
9	R	E32 (junction)	
10	SV	XS4	C5
11	VB	E32 (junction)	
12	LR	XS3	18
13	BR	E29 (junction)	
14	not used		
15	CN	E31 (junction)	
16	not used		

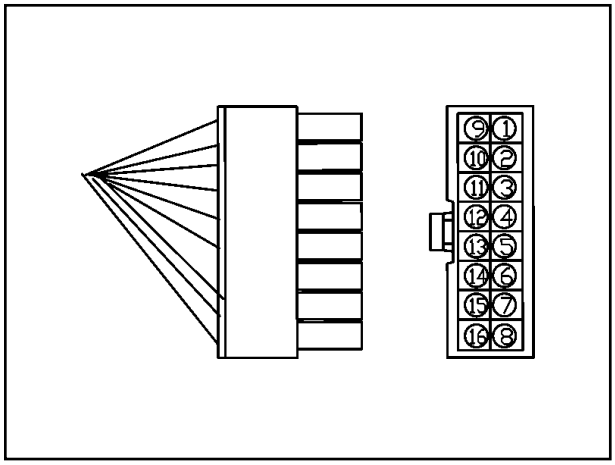


Fig. 10.486

Faston terminals (E14) for auxiliary power socket

term.	wire colour	To con. or comp.	term.
1	L	XS4	C1
2	B	E22 (junction)	
3	R	XS4	B1

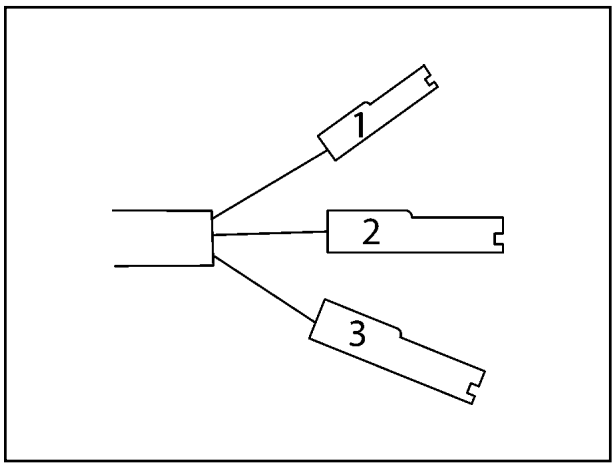


Fig. 10.487

Connector (E15) for rh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E7-E17 (junction)	1
2	V	E20 (junction)	
3	R	E18 (junction)	
4	M	E16 (junction)	

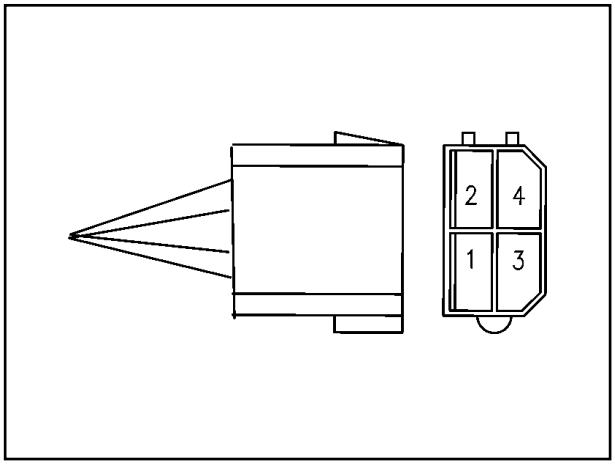


Fig. 10.488

Connector (E16) for rh external rear field light

term.	wire colour	To con. or comp.	term.
1	B	E15	1
2	RV	XS3	7

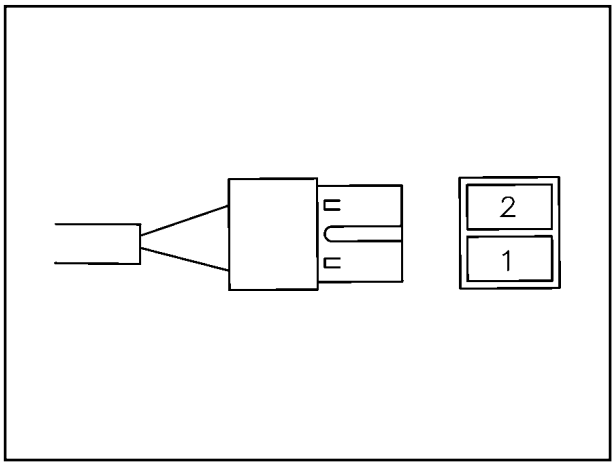


Fig. 10.489

Fuel level sensor connector (E17)

term.	wire colour	To con. or comp.	term.
1	SG	XS3	11
2	S	XS3	12
3	B	E22 (junction)	

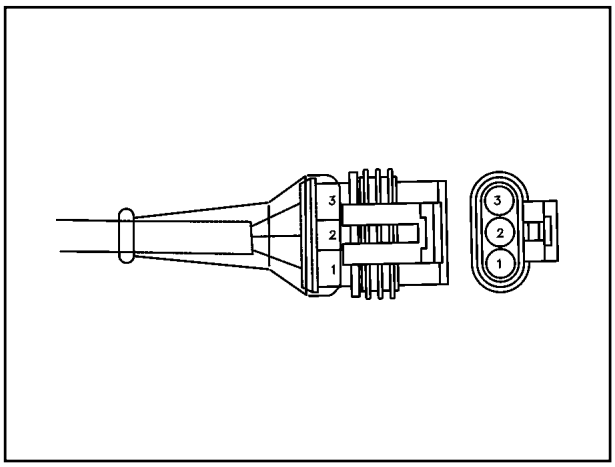


Fig. 10.490

Connector (E18) for licence plate light

term.	wire colour	To con. or comp.	term.
1	N	E24 (junction)	
2	B	E22 (junction)	

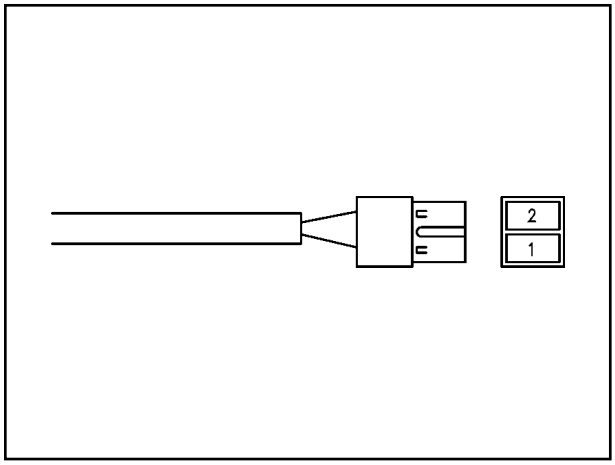


Fig. 10.491

Connector (E19) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E10-E22 (junction)	1
2	G	E26 (junction)	
3	R	E27 (junction)	
4	N	E24 (junction)	

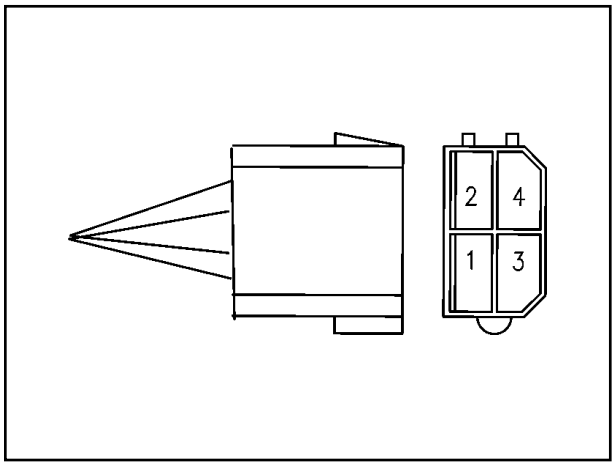


Fig. 10.492

Terminal board (XS0) for trailer socket connection

term.	wire colour	To con. or comp.	term.
1A	N	E24 (junction)	
1B	M	E23 (junction)	
1C	R	E27 (junction)	
2A	G	E26 (junction)	
2B	V	E25 (junction)	
2C	B	E22 (junction)	

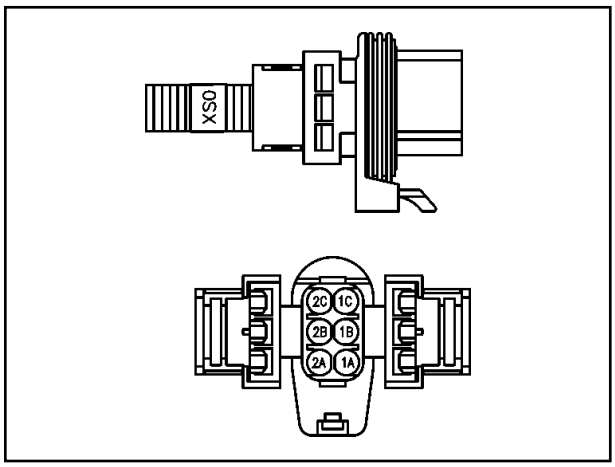


Fig. 10.493

Terminal board (XS3) for platform/dashboard wiring connection

term.	wire colour	To con. or comp.	term.
1	G	E26 (junction)	
2	V	E25 (junction)	
3	N	E24 (junction)	
4	RN	E30 (junction)	
5	SV	E6	3
6	G	E9	20
7	RV	E10	2
8	GR	E10	2
9	RN	E8	1
10	HN	I3	1
11	SG	E17	1
12	S	E17	2
13	HM	E3	4
14	RN	E3	3
15	BR	E5	3
16	MV	E5	2
17	HR	E6	2
18	LR	E13	4
19	MR	E7	2
20	R	E27 (junction)	
21	L	E29 (junction)	
22	ZN	E9	12
23	VB	E32 (junction)	
24	M	E9	37
25	B	E9	38
26	B	E22 (junction)	
27	V	E9	21
28	M	E23 (junction)	
29	RN	E29 (junction)	
30	B	E9	13
31	HG	E30 (junction)	
32	ZL	E1	1
33	GL	E6	1
34	N	E21 (junction)	

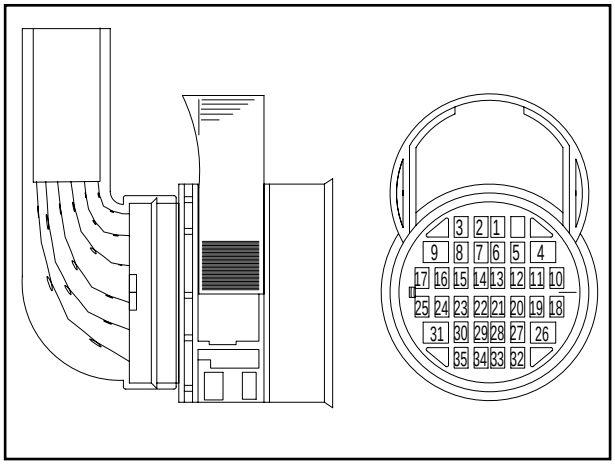


Fig. 10.494

Terminal board (XS4) for platform/rear wiring line connection

term.	wire colour	To con. or comp.	term.
A1	RN	E29 (junction)	
A2	AV	E7	3
A3	GN	E7	1
A4	BG	E9	40
A5	AN	E34 (junction)	
A6	LN	E34 (junction)	
A7	CL	E33 (junction)	
A8	BN	E28 (junction)	
B1	R	E14	3
B2	SN	E33 (junction)	
B3	CN	E31 (junction)	
B4	AR	E9	8
B5	SB	E9	6
B6	LR	E9	9
B7	BR	E9	7
B8	R	E32 (junction)	
C1	L	E14	1
C2	ZH	E9	22
C3	ZL	E9	24
C4	AG	E9	25
C5	SV	E13	10
C6	VB	E4	2
C7	VN	E4	3
C8	VB	E9	23

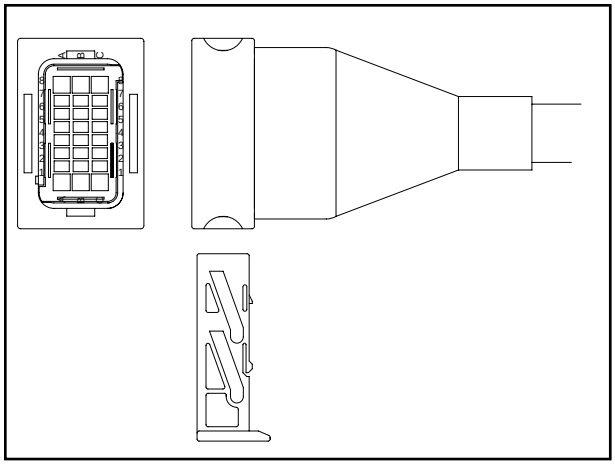


Fig. 10.495

3.8.8 Rear line

3.8.8.1 General description

The rear line powers the components installed on the transmission casing and hydraulic power packs, such as the sensor that detects the rear PTO rate (SR5 Fig.10.496) and the solenoid valves in the hydraulic power pack (10 Fig.10.497) for controlling users like the differential lock and four-wheel drive.

The rear line is connected to the dashboard line via connections between the terminal boards (XS2 Fig.10.499) and to the platform line by means of the terminal boards (XS4) (Fig.10.498)

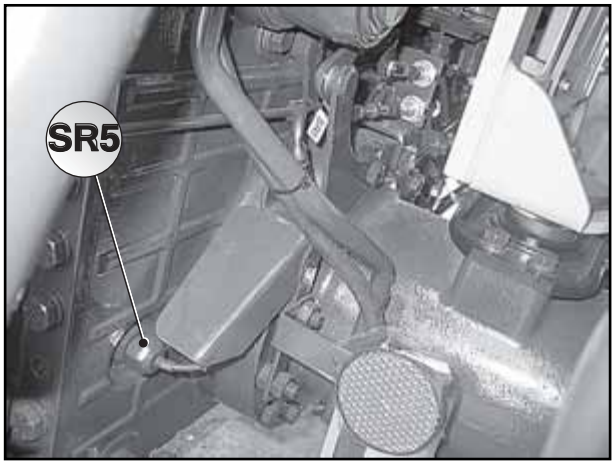


Fig. 10.496

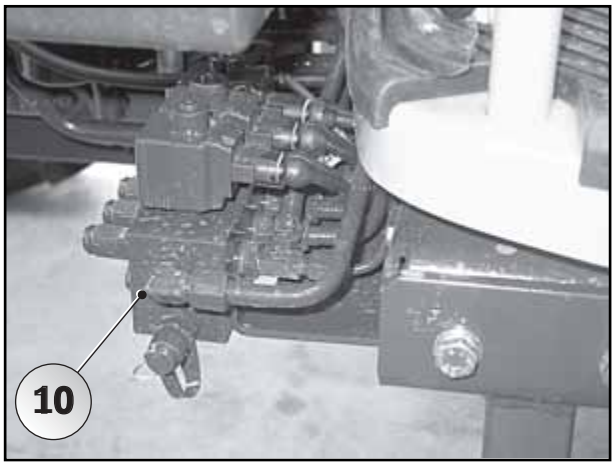


Fig. 10.497

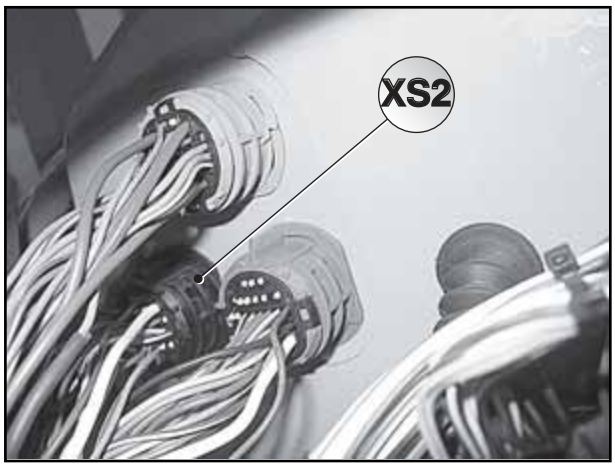


Fig. 10.499

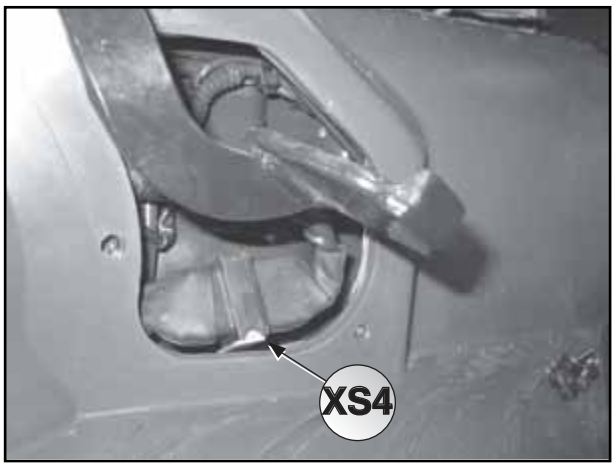


Fig. 10.498

3.8.8.2 Wiring

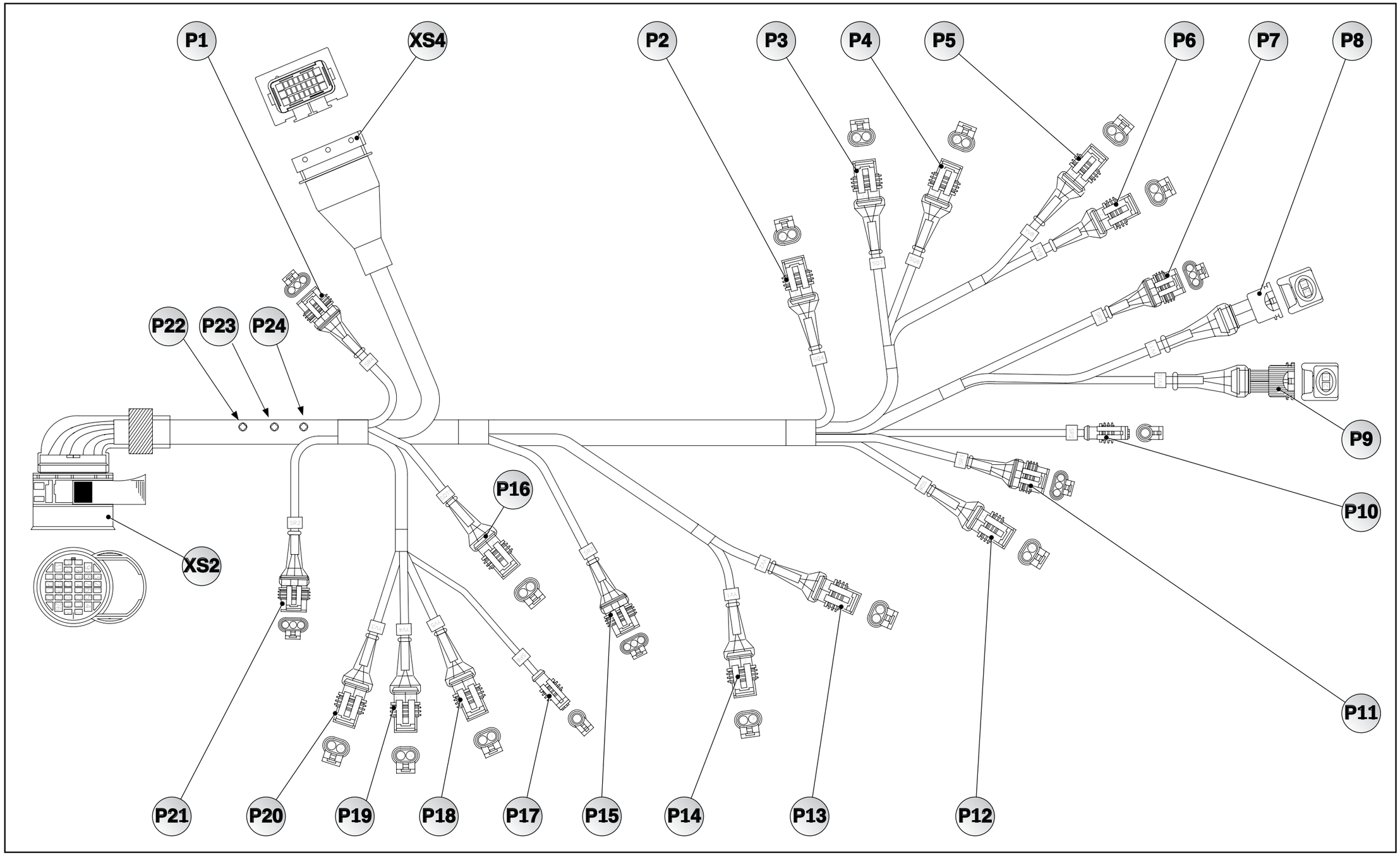


Fig. 10.500

P1 - Connector for rh sensor (Deltashift system)
P2 - Connector for parking brake hand lever microswitch
P3 - Connector for fast rear PTO microswitch
P4 - Connector for slow rear PTO microswitch
P5 - Connector for solenoid valve of rear PTO brake
P6 - Connector for solenoid valve of rear PTO clutch
P7 - Connector for rear PTO RPM sensor
P8 - Connector for solenoid valve (YV11) of auxiliary control valve B
P9 - Connector for solenoid valve (YV10) of auxiliary control valve A
P10 - Trailer brake pressure switch connector
P11 - Connector for ground speed sensor
P12 - Connector for proportional rear PTO microswitch
P13 - Connector (YV2) for secondary clutch solenoid valve
P14 - Connector (YV1) for main clutch solenoid valve
P15 - Connector for lh sensor (Deltashift system)
P16 - Connector for ignition enabling microswitch
P17 - Connector for pressure switch (14 bar)
P18 - Connector for “Power Five” solenoid valve
P19 - Connector for 4WD solenoid valve
P20 - Connector for differential lock solenoid valve
P21 - Connector for engine rate sensor
P22-P24 - Junctions
XS2 - Terminal board for rear line/dashboard connection
XS4 - Terminal board for platform line/rear line connection

3.8.8.3 Connector locations

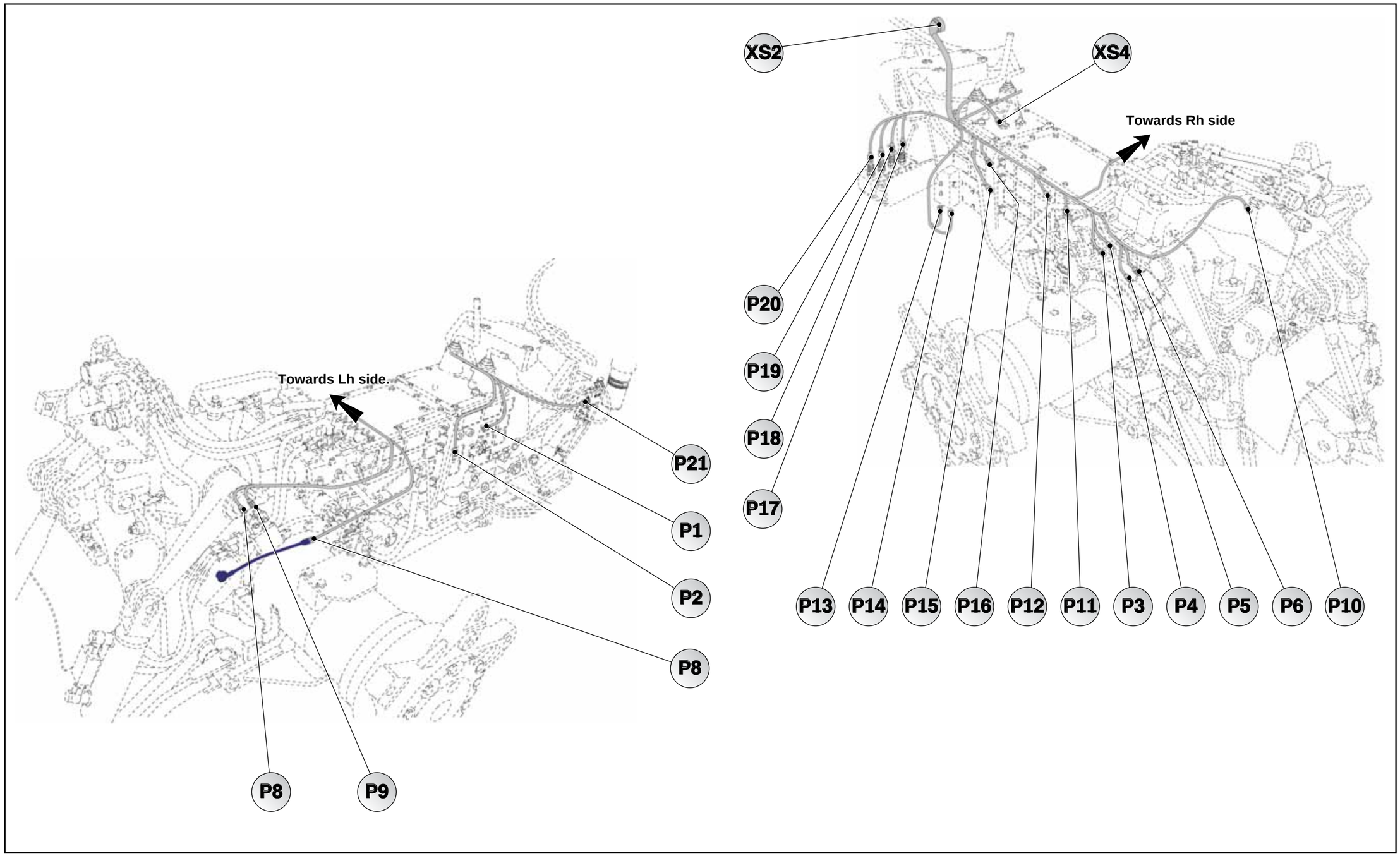


Fig. 10.501

P1 - Connector for rh sensor (Deltashift system)
P2 - Connector for parking brake hand lever microswitch
P3 - Connector for fast rear PTO microswitch
P4 - Connector for slow rear PTO microswitch
P5 - Connector for solenoid valve of rear PTO brake
P6 - Connector for solenoid valve of rear PTO clutch
P7 - Connector for rear PTO RPM sensor
P8 - Connector for solenoid valve (YV11) of auxiliary control valve B
P9 - Connector for solenoid valve (YV10) of auxiliary control valve A
P10 - Trailer brake pressure switch connector
P11 - Connector for ground speed sensor
P12 - Connector for proportional rear PTO microswitch
P13 - Connector (YV2) for secondary clutch solenoid valve
P14 - Connector (YV1) for main clutch solenoid valve
P15 - Connector for lh sensor (Deltashift system)
P16 - Connector for ignition enabling microswitch
P17 - Connector for pressure switch (14 bar)
P18 - Connector for “Power Five” solenoid valve
P19 - Connector for 4WD solenoid valve
P20 - Connector for differential lock solenoid valve
P21 - Connector for engine rate sensor
XS2 - Terminal board for rear line/dashboard connection
XS4 - Terminal board for platform line/rear line connection

3.8.8.4 Connector identification

Connector (P1) for rh sensor (Deltashift system)

term.	wire colour	To con. or comp.	term.
1	LN	XS4	A6
2	BN	P23 (junction)	
3	RN	P22 (junction)	

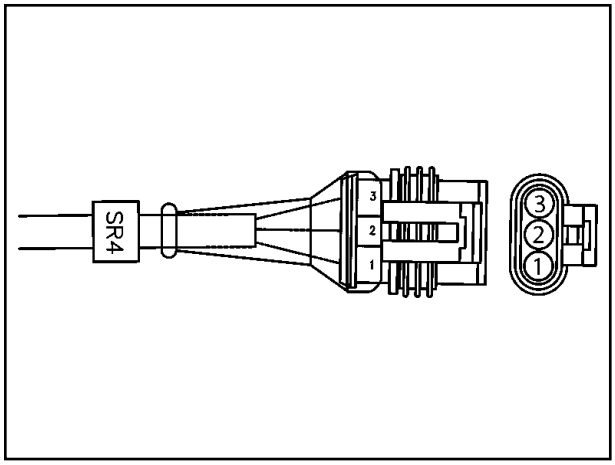


Fig. 10.502

Connector (P2) for parking brake lever microswitch

term.	wire colour	To con. or comp.	term.
1	ZN	XS2	13
2	B	P24 (junction)	

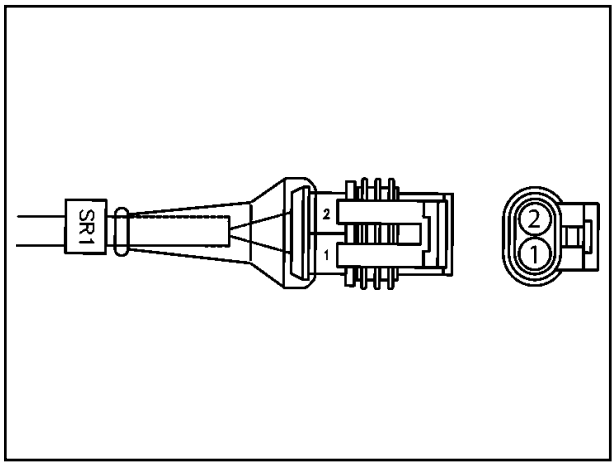


Fig. 10.503

Connector (P3) for fast rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P24 (junction)	
2	HL	XS2	3

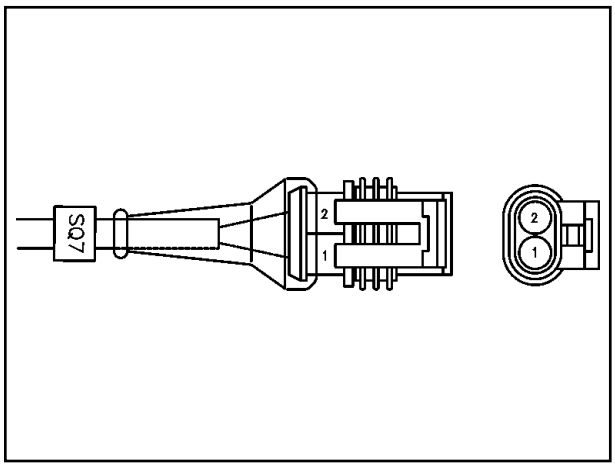


Fig. 10.504

Connector (P4) for slow rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P24 (junction)	
2	VB	XS2	5

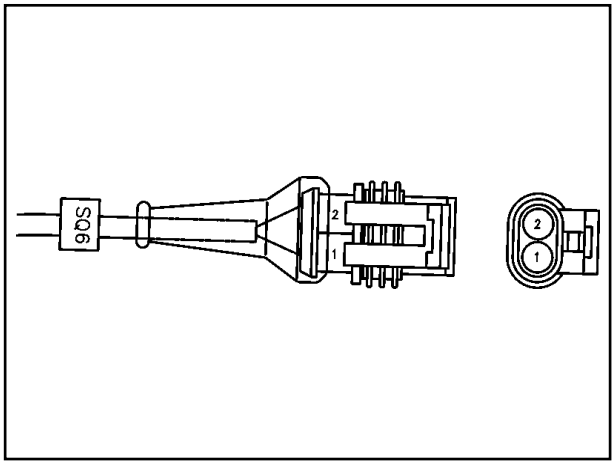


Fig. 10.505

Connector (P5) for solenoid valve of rear PTO brake

term.	wire colour	To con. or comp.	term.
1	ZH	XS4	C2
2	BV	XS4	C8

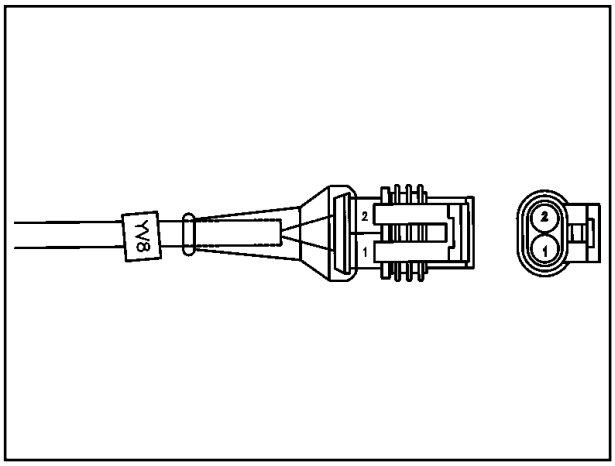


Fig. 10.506

Connector (P6) for rear PTO clutch solenoid valve

term.	wire colour	To con. or comp.	term.
1	AG	XS4	C4
2	ZL	XS4	C3

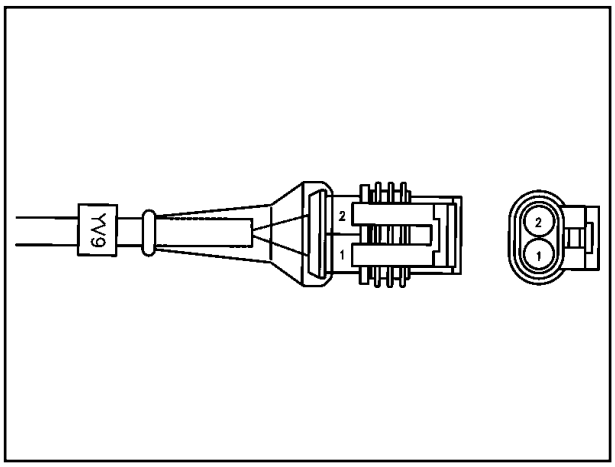


Fig. 10.507

Connector (P7) for rear PTO RPM sensor

term.	wire colour	To con. or comp.	term.
1	CN	XS4	B3
2	BN	P23 (junction)	
2	RN	P22 (junction)	

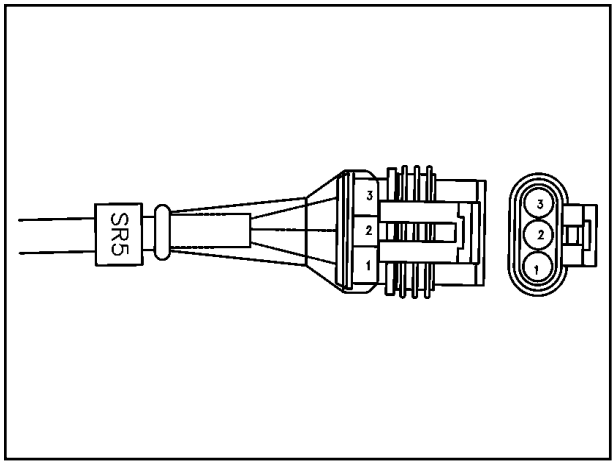


Fig. 10.508

Connector (P8) for solenoid valve (YV11) of auxiliary control valve B

term.	wire colour	To con. or comp.	term.
1	GN	XS2	A3
2	B	P24 (junction)	

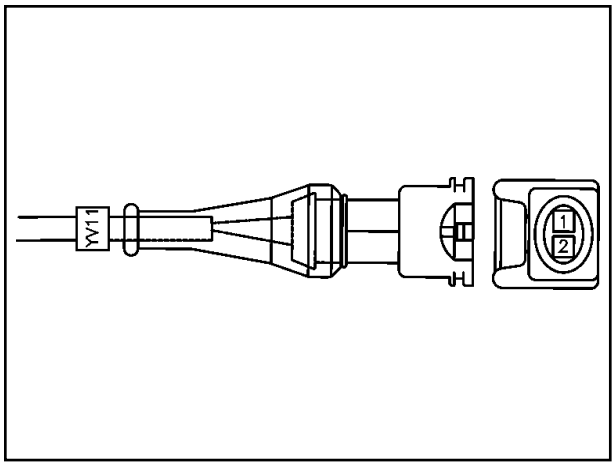


Fig. 10.509

Connector (P9) for solenoid valve (YV10) of auxiliary control valve A

term.	wire colour	To con. or comp.	term.
1	AV	XS4	A2
2	B	P24 (junction)	

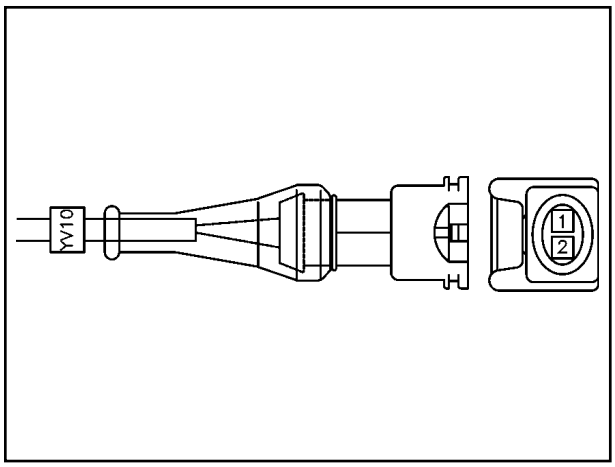


Fig. 10.510

Trailer brake pressure switch connector (P10)

term.	wire colour	To con. or comp.	term.
1	BN	XS2	12

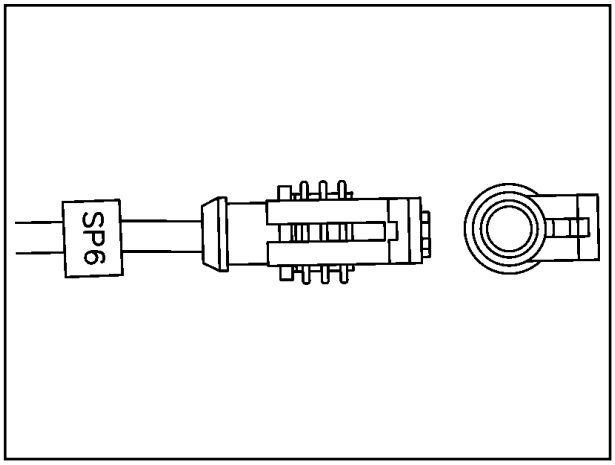


Fig. 10.511

Connector (P11) for ground speed sensor

term.	wire colour	To con. or comp.	term.
1	SN	XS4	B2
2	BN	P23 (junction)	
3	RN	P22 (junction)	

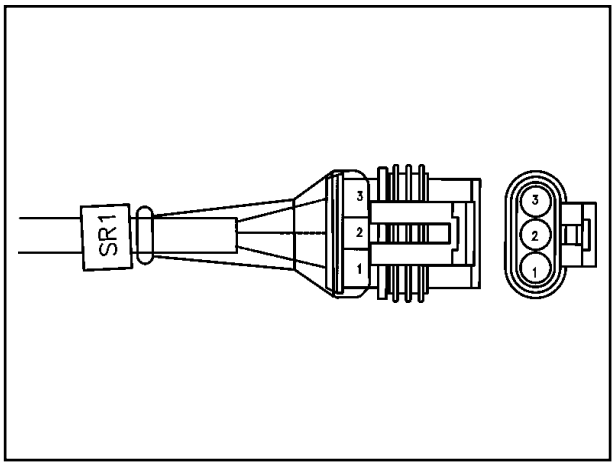


Fig. 10.512

Connector (P12) for proportional rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	SV	XS4	C5
2	R	XS4	B8

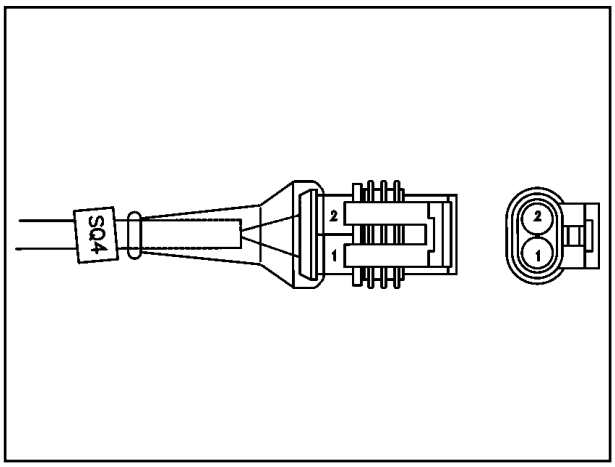


Fig. 10.513

Connector (P13) for secondary clutch solenoid valve (YV2)

term.	wire colour	To con. or comp.	term.
1	LR	XS4	B6
2	BR	XS4	B7

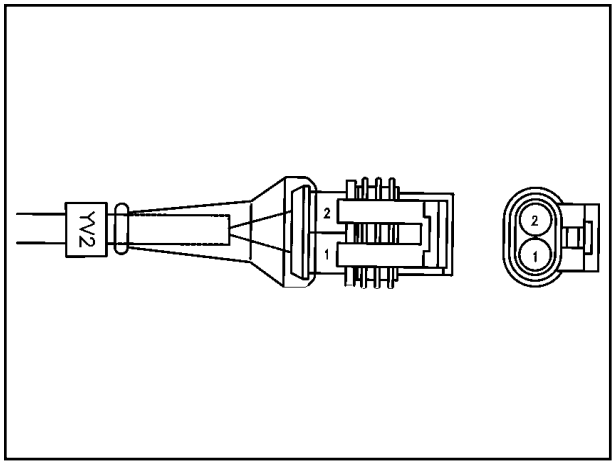


Fig. 10.514

Connector (P14) for main clutch solenoid valve (YV1)

term.	wire colour	To con. or comp.	term.
1	AR	XS4	B4
2	SB	XS4	B5

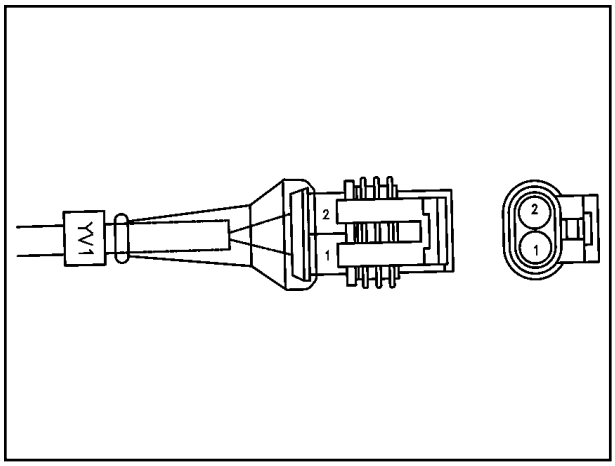


Fig. 10.515

Connector (P15) for rh sensor (Deltashift system)

term.	wire colour	To con. or comp.	term.
1	AN	XS4	A5
2	BN	P23 (junction)	
3	RN	P22 (junction)	

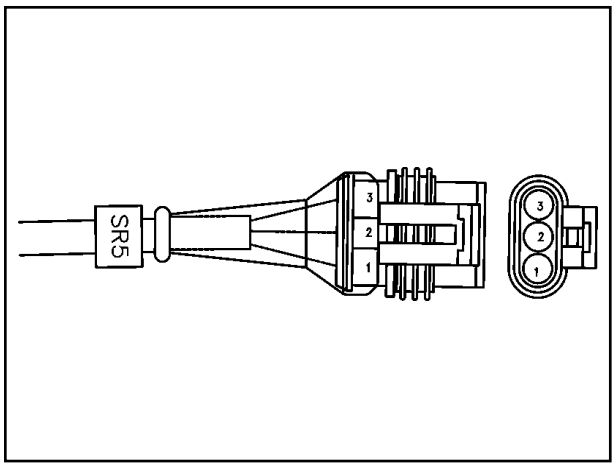


Fig. 10.516

Connector (P16) for ignition enabling microswitch

term.	wire colour	To con. or comp.	term.
1	BV	XS2	17
2	VN	XS2	18

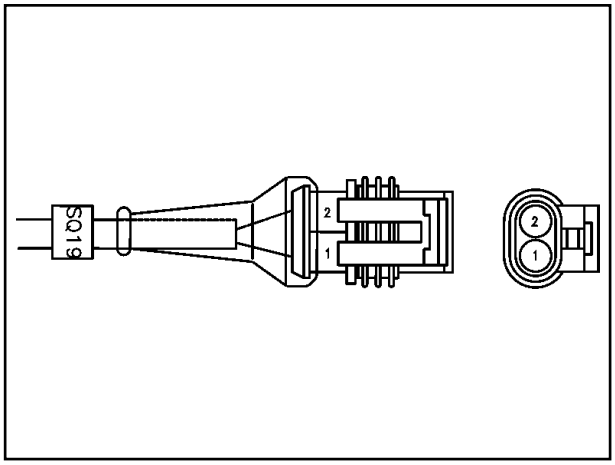


Fig. 10.517

Connector (P17) for ignition enabling microswitch

term.	wire colour	To con. or comp.	term.
1	HL	XS2	15

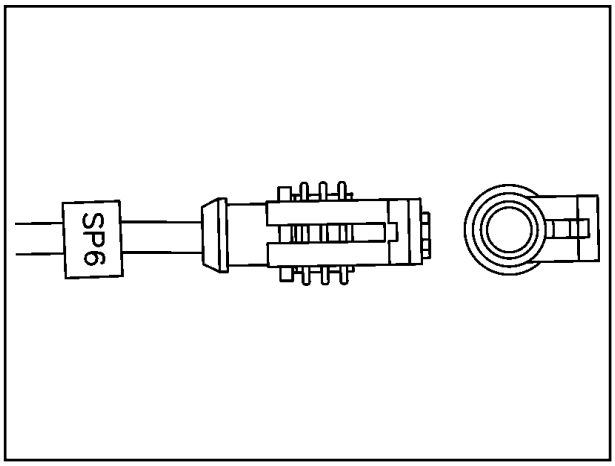


Fig. 10.518

Connector (P18) for “Power Five” solenoid valve

term.	wire colour	To con. or comp.	term.
1	BG	XS4	A4
2	BN	P23 (junction)	

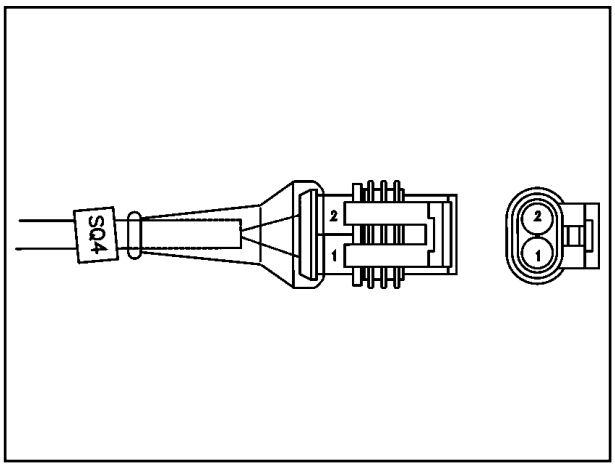


Fig. 10.519

Connector (P19) for 4WD solenoid valve

term.	wire colour	To con. or comp.	term.
1	GL	XS2	2
2	B	P24 (junction)	

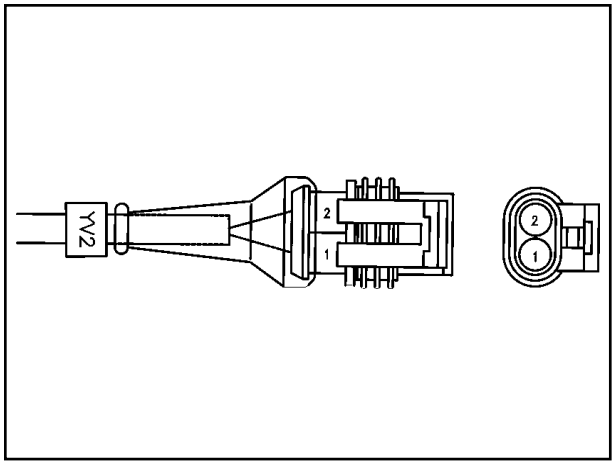


Fig. 10.520

Connector (P20) for differential lock solenoid valve

term.	wire colour	To con. or comp.	term.
1	BR	XS2	1
2	B	P24 (junction)	

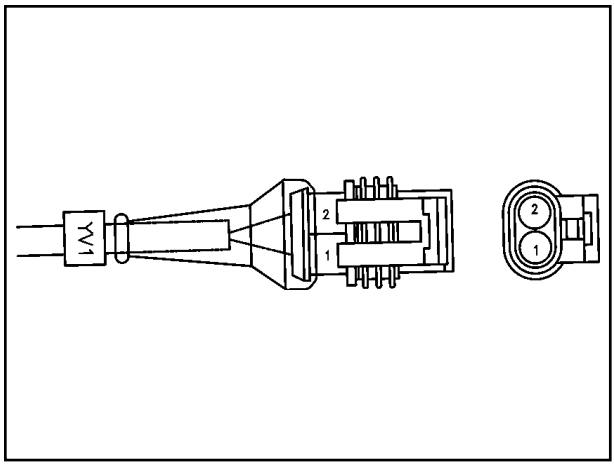


Fig. 10.521

Connector (P21) for engine rate sensor

term.	wire colour	To con. or comp.	term.
1	CL	XS4	A7
2	BN	P23 (junction)	
3	RN	P22 (junction)	

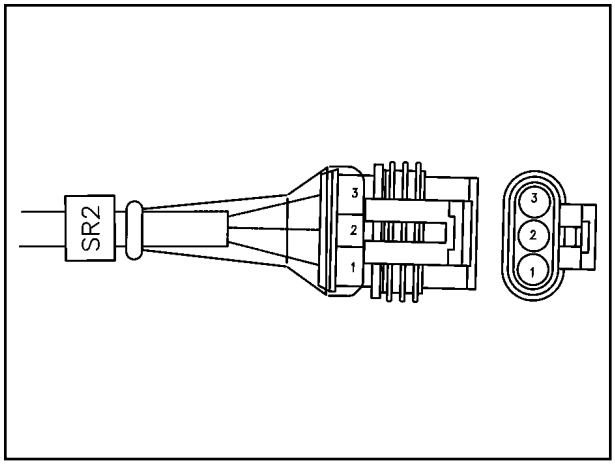


Fig. 10.522

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	P20	1
2	GL	P19	1
3	HL	P3	2
4	B	P24 (junction)	
5	VB	P4	2
6	not used		
7	not used		
8	not used		
9	R	XS4	B1
10	not used		
11	not used		
12	BN	P10	1
13	ZN	P2	1
14	BV	XS4	C6
15	SN	P17	1
16	CN	XS4	C7
17	BV	P16	1
18	VN	P16	2
19	not used		
20	not used		
21	not used		
22	not used		
23	not used		
24	not used		
25	not used		
26	not used		
27	not used		
28	not used		
29	not used		
30	BN	P23 (junction)	
31	AN	XS4	C1
32	not used		
33	not used		
34	not used		

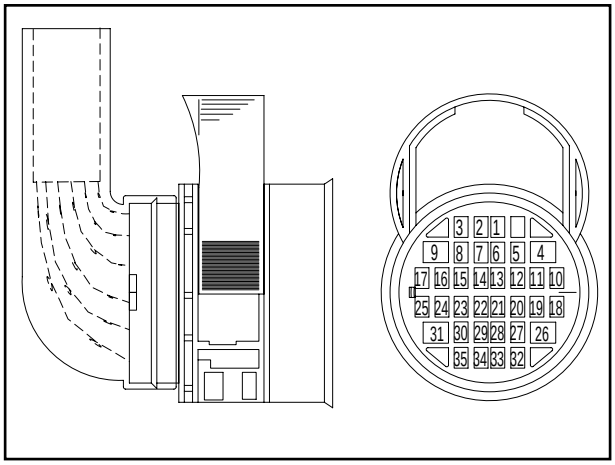


Fig. 10.523

Terminal board (XS4) for platform/rear wiring line connection

term.	wire colour	To con. or comp.	term.
A1	RN	P22 (junction)	1
A2	AV	P9	1
A3	GN	P8	1
A4	BG	P18	1
A5	AN	P15	1
A6	LN	P1	1
A7	CL	P21	1
A8	BN	P23 (junction)	
B1	R	XS2	9
B2	SN	P11	1
B3	CN	P7	1
B4	AR	P14	1
B5	SB	P14	2
B6	LR	P13	1
B7	BR	P13	2
B8	R	P12	2
C1	AN	XS2	31
C2	ZH	P5	1
C3	ZL	P6	2
C4	AG	P6	1
C5	SV	P12	1
C6	BV	XS2	14
C7	MV	XS2	16
C8	BV	P5	2

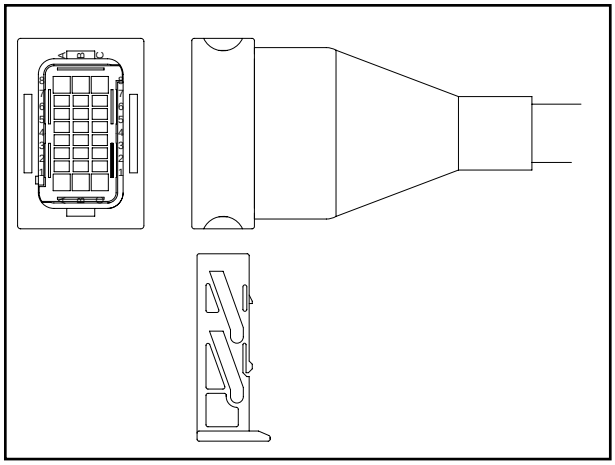


Fig. 10.524

3.8.9 Headlight extension line

3.8.9.1 General description

The headlight extension line powers the lamps installed at the front of the tractor's bonnet (Fig.10.525).

The headlight extsneion line is connected to the engine's front line by means of connectors (H3 and B25)(Fig.10.526).

Fig. 10.525

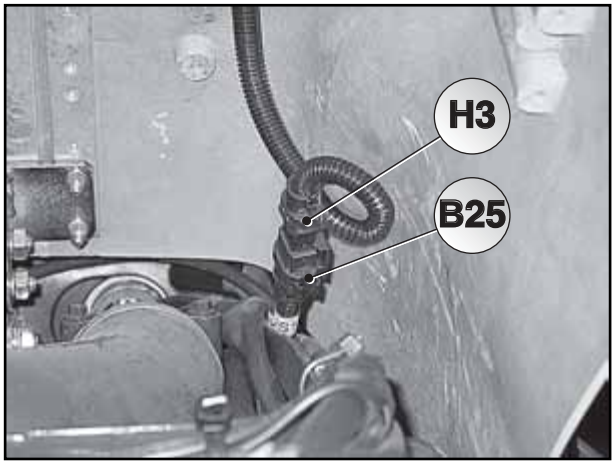


Fig. 10.526

3.8.9.2 Wiring

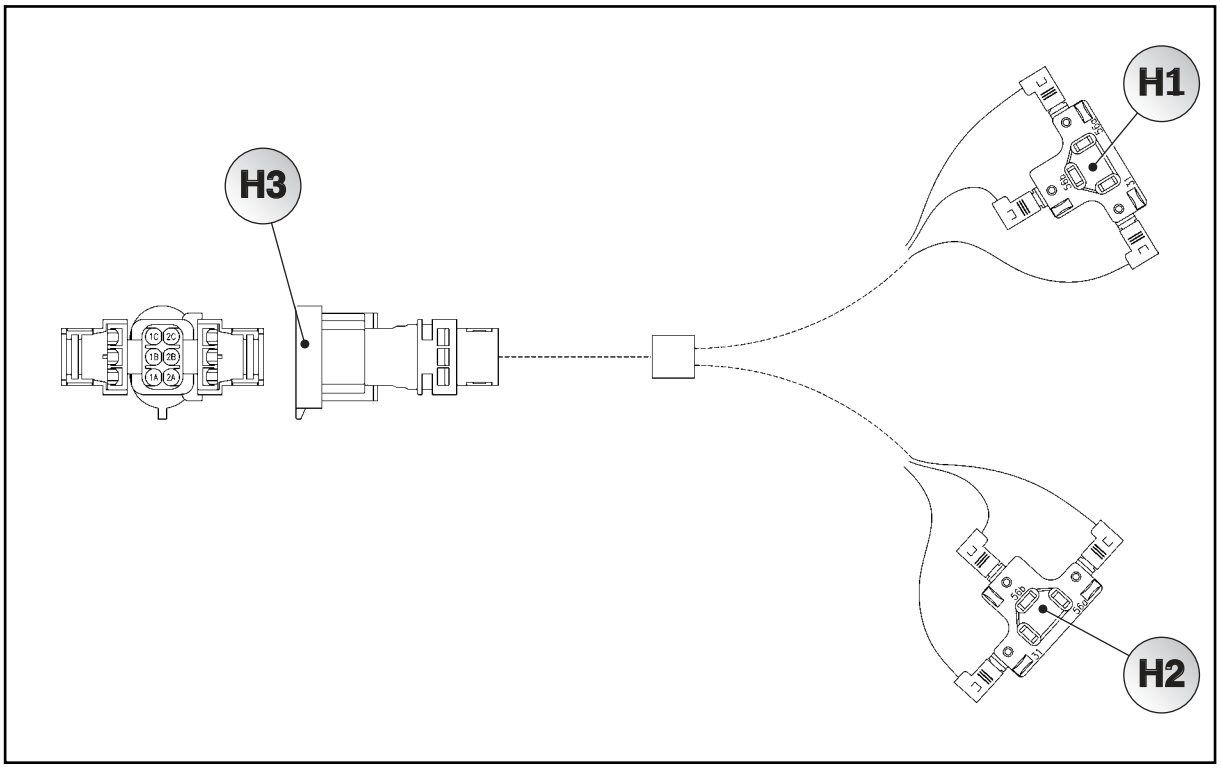


Fig. 10.527

H1 - Lh headlight connector
H2 - Rh headlight connector
H3 - Connector for connecting to the front line

3.8.9.3 Connector locations

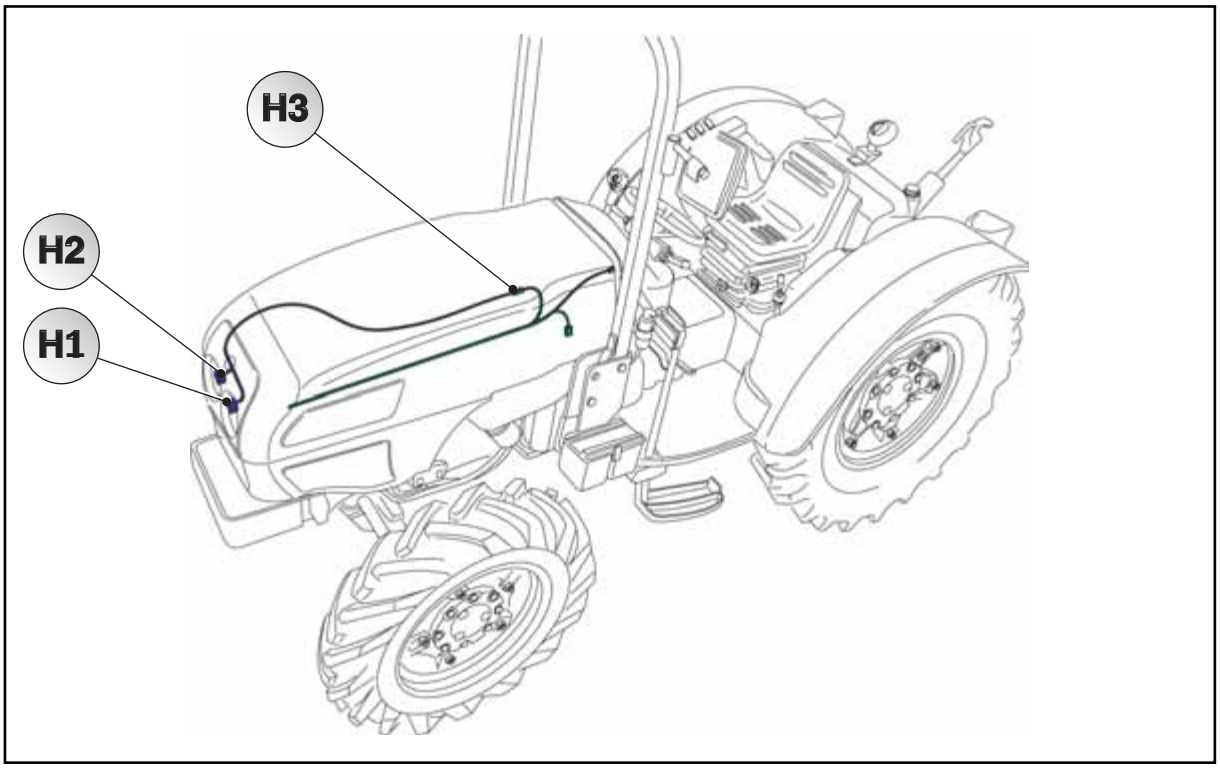


Fig. 10.528

3.8.9.4 Connector identification

Lh headlight connector (H1)

term.	wire colour	To con. or comp.	term.
1	B	H3	2C
2	H	H3	2B
3	V	H3	1A

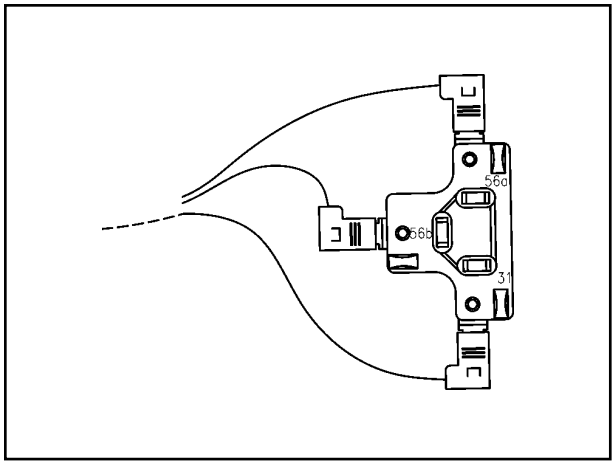


Fig. 10.529

Rh headlight connector (H2)

term.	wire colour	To con. or comp.	term.
1	B	H3	1C
2	HN	H3	2A
3	VN	H3	1B

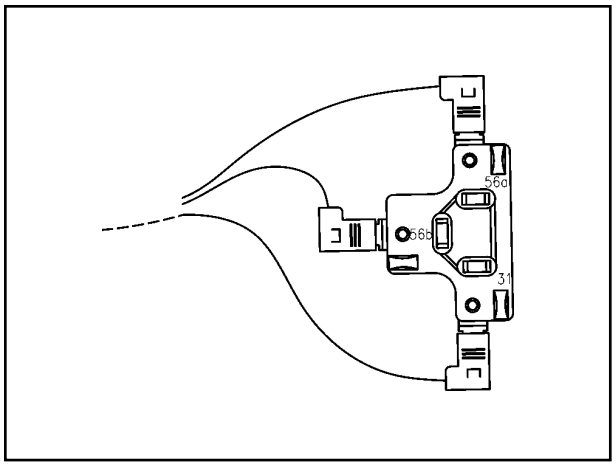


Fig. 10.530

Connector (H3) for front line connection

term.	wire colour	To con. or comp.	term.
1A	V	H1	3
1B	VN	H2	3
1C	B	H2	1
2A	HN	H2	2
2B	H	H1	2
2C	B	H1	1

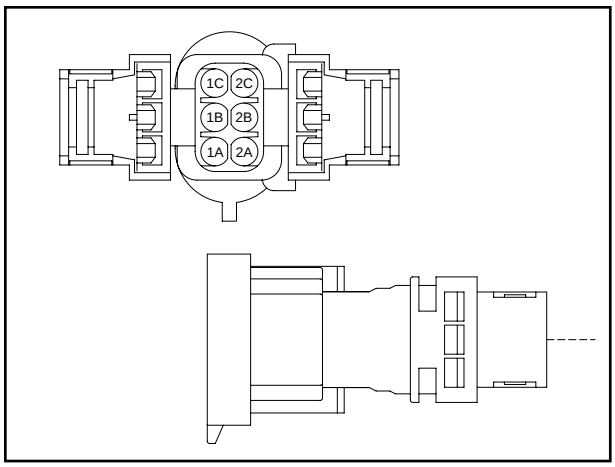


Fig. 10.531

3.9 F-N Series Power Shuttle cab

3.9.1 Technical specifications

3.9.1.1 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
Voltage	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Alternator

Make	Ix
Type	Threephase
Voltage	14 V
Current	85 A

Starter motor

Manufacturer	Ix - Dsx
Type	Solenoidal
Maximum power	3 kW
Type of engagement	Automatic pinion engagement by means of electro-magnet.

Solenoid valves

Manufacturer	Srx Dx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 Ω ±5%
Type	Proportional valves
Voltage	12 V
Model	With 2 positions and 3 ways

Sensors

Manufacturer	Jx/Stx
Type	Inductive

Manufacturer	Hx
Type	Hall type

Electronic control unit

Make	Srx Dx

Instrument

Make	Dgx

3.9.1.2 Relays and fuse holders

The electrical system of **F-N Series** tractors is protected against short-circuits and excessive power draw by means of fuses. The number of fuses installed in the electrical system depends on the components and functions that need protecting.

The fuses are installed in two dedicated boxes:

Z - front fuse box (Fig.10.532) installed at the front, near the battery that powers the system. It contains a further fuse (FU5) that protects the preheater relay.

B - main fuse box (Fig.10.533) installed on the left-hand side of the dashboard cover.

Y - cab fuse box (Fig.10.534), in the cab on the roof, on the right-hand side of the covering, upper zone.

Note: before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

The cab version of **F-N Series Speed Power Shuttle cab** is fitted with a fuse (FU6 Fig.10.177) on the line that connects the roof facilities and the alternator, so as to protect the cab power.

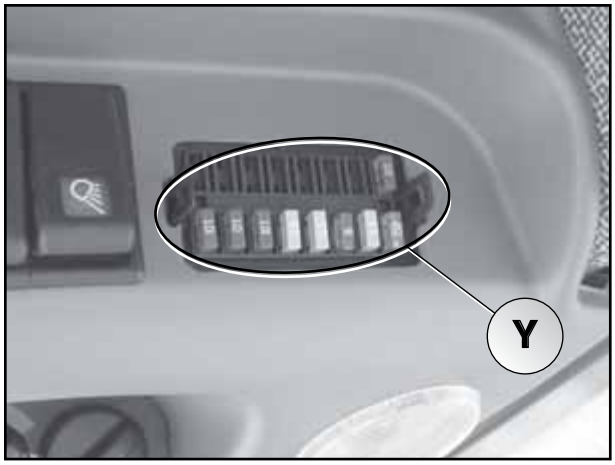


Fig. 10.533

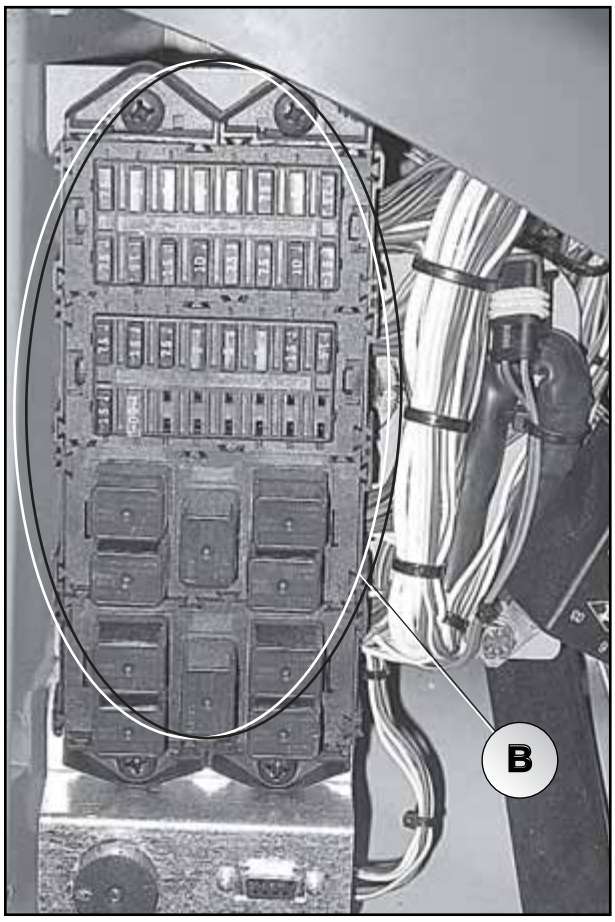


Fig. 10.534

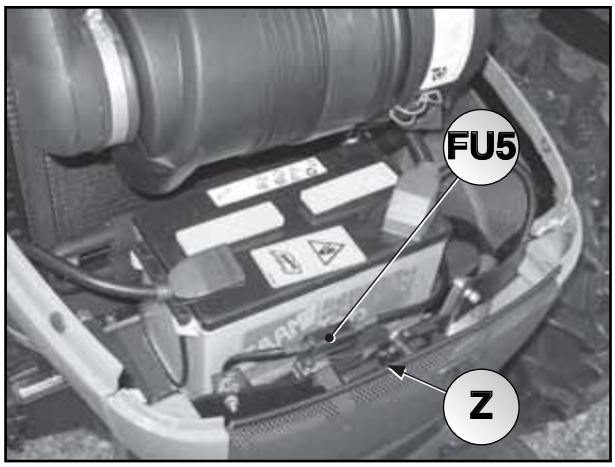


Fig. 10.532

Z- Front fuse box

The front fuses are installed in the “battery-starter motor line” wiring. They are connected by means of the positive terminal (A1) to the battery (GB1) on the one side and on the other side, to the front engine line, by means of connectors (B14 and B15) (Fig.10.535).

The front line is also fitted with a further fuse (FU5 Fig.10.536) for protecting the glow plug pre-heater system.

Turn the ignition key to the 2nd position to activate the power relay (K16), which transmits the signal for preheating the plate in contact with the glow plugs. The relay (K16) cuts out the electrical signal after 5 seconds in this position have elapsed. The relative indicator light (A Fig.10.537) on the display of the instrument goes out, indicating that the tractor engine can now be started.

The front fuses have the following functions and ampere ratings (Fig.10.535):

Fuse	Circuits protected	Amp.
FU1	Primary	60
FU2	Alternator primary	70
FU3	Primary	60
FU4	Primary	60
FU5	Glow plugs (Fig.10.536)	50

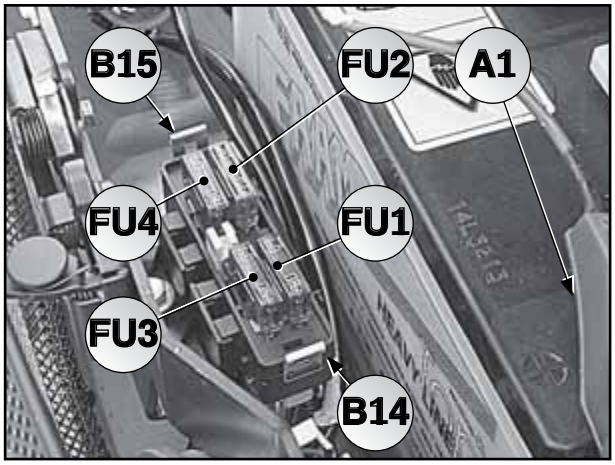


Fig. 10.535

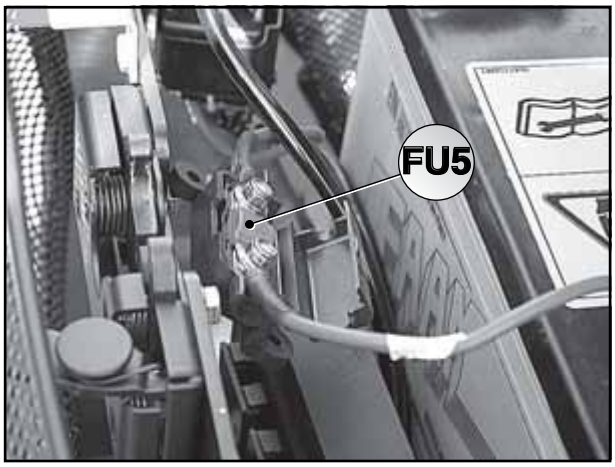


Fig. 10.536

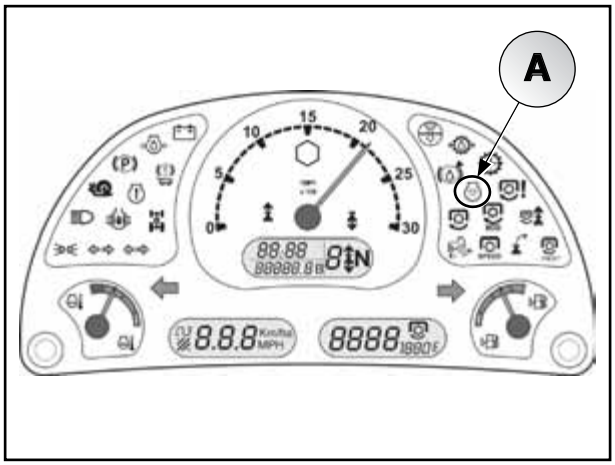


Fig. 10.537

Fuse (FU6 Fig.10.538) is installed between the roof facility line and the power from the alternator. It is installed under the bonnet and protects the services in the cab roof wiring

Fuse	Circuits protected	Amp.
FU6	Cab roof line power	50

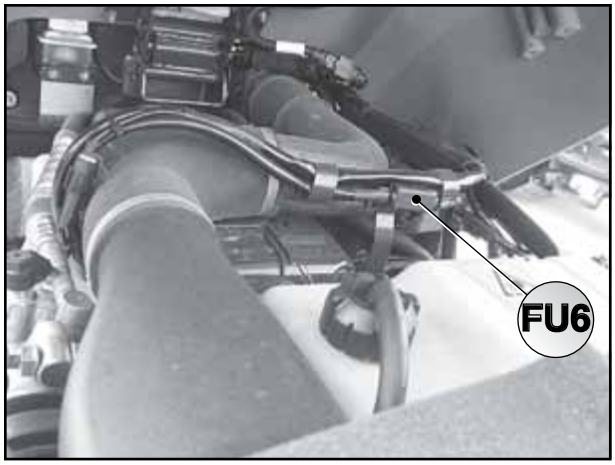


Fig. 10.538

B - Main fuse box

The main fuses are installed in the dashboard wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
F1	Rear PTO	7.5
F2	Auxiliary relays	5
F5	Key-activated Instrument	5
F6	Fuel pump	7.5
F7	4WD solenoid valve	5
F8	Brake light switch	7.5
F9	Diff lock solenoid valve	7.5
F10	Dipped beams	15
F11	Driving beams	15
F12	Blinker	10
F13	Lh side lights	7.5
F14	Rh side lights	7.5
F15	Light switch	10
F16	Electronic power lift (Indicator D+)	5
F17	Electronic power lift (Key-activated positive)	5
F18	Diff lock and brake light controls	15
F20	Starter motor	15
F21	Rear field lights	7.5
F22	Instrument and buzzer power	5
F24	Flow selector (A-B)	5
F25	Auxiliary socket (key-activated power)	15
F26	Auxiliary socket (key-activated power)	20
F27	Horn + revolving beacon	15
F29	Cab	5
F30	Pneumatic seat	15
F36	Emergency switch	15
F39	NAO KIT positive	7.5

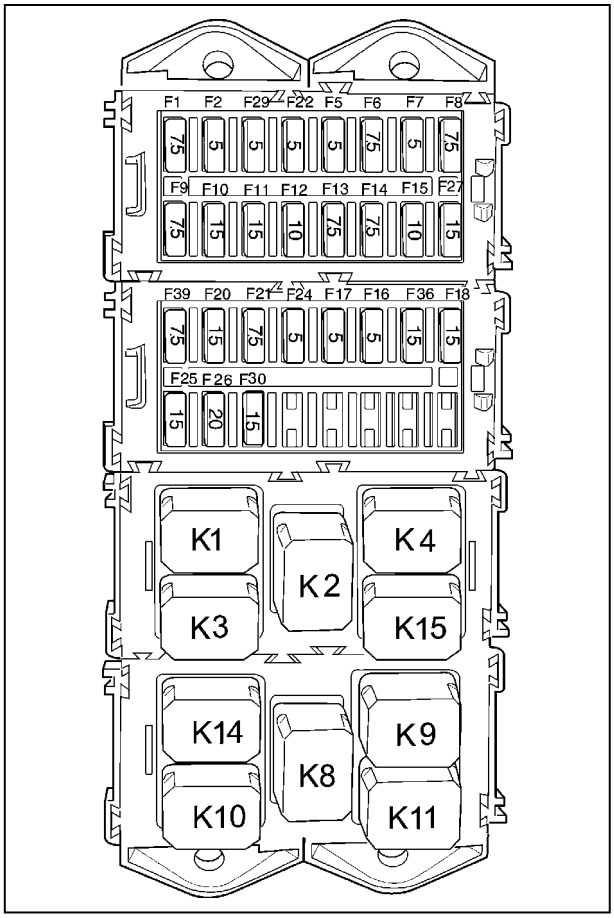


Fig. 10.539

Y - Cab fuse box

The fuses for the “cab” services are installed in the roof wiring line (Fig.10.540) and have the following functions and ampere ratings:

F3	Key-activated Instrument	15
F4	Ac pressure switch, compressor, radio	20
F23	Revolving beacon	15
F28	Window washer	10
F32	Optional	5
F33	Rear window wiper	10
F34	Front field lights	15
F35	Rear field light	10
F40	Windscreen wiper	10

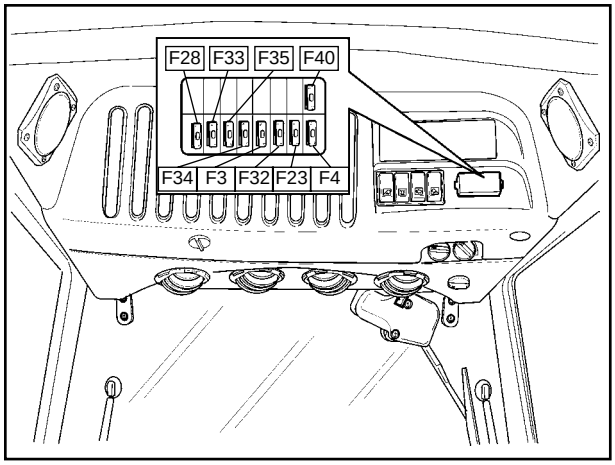


Fig. 10.540

There are 15 relays installed in **F-N Series Power Shuttle cab** tractors, of which 10 are installed in the front fuse box (B), just under the protection fuses (Fig.10.541), 1 is installed at the front, near the fuse box (Z)(Fig.10.543) and another 4 are installed in the roof wiring line (Fig.10.542).

Relays	Function
K1	Immobiliser relay
K2	Relay for socket + pneumatic seat
K3	Field light relay
K4	Brake light and instrument relay
K8	Differential lock relay
K9	Driving beam relay
K10	Dipped beam relay
K11	Headlight relay
K14	Relay for diff lock release + rear brake lights
K15	Start-inhibiting relay for engaged rear PTO
K16	Power relay (glow plug preheater) (Fig.10.543).

Another 4 relays are installed in the cab roof wiring line, in the rh side behind the lining, near to the protection fuses (Fig.10.542)

Relays	Function
K5	AC compressor/key-activated positive relay
K6	Relay for roof auxiliaries
K17	Front field light relay
K18	Rear field light relay

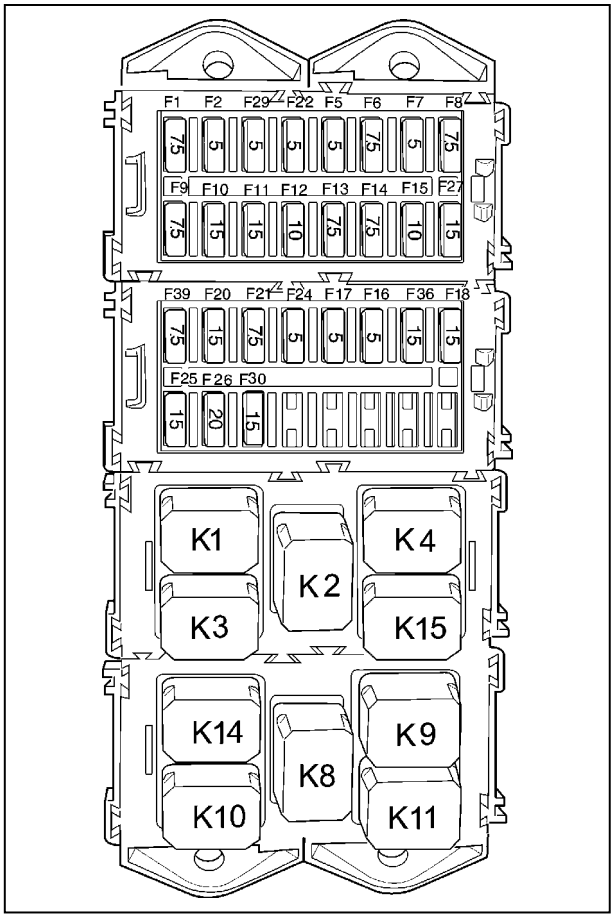


Fig. 10.541

Fig. 10.543

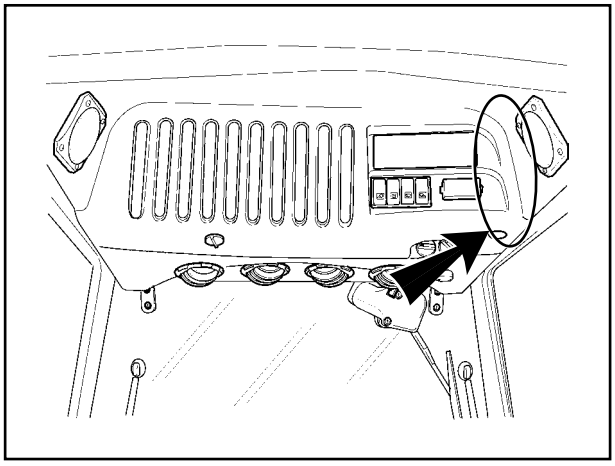


Fig. 10.542

identification of the components in the functional diagram

Code	Description	Part	Col.
A01	Instrument	4	3
A02	Radio	3	4
B01	Alternator	1	7
B02	Lh loudspeaker	3	4
B03	Rh loudspeaker	3	4
D01	Blinker	2	4
EH1	Glow plugs	1	6
EL1	Cab ceiling light	3	4
EL2	Footstep revolving beacon light	4	2
EL3	Cab rotating beacon	3	3
EL4	Lh front field light	3	7
EL5	Rh front field light	3	7
EL6	Lh rear field light	3	7
EL7	Rh rear field light	3	8
EL9	Platform rear field light	4	1
EL13	License plate light	2	7
EL14	Rh headlight	1	7
EL15	Lh headlight	1	7
F1	Front PTO/safety fuse	1	4
F2	Auxiliary relay fuse	1	2
F3	Cab auxiliary relay fuse	1	1
F4	Air conditioning fuse	3	2
F5	Key-activated fuse for instrument	4	4
F6	Injection-fuel pump fuse	1	8
F7	4WD fuse	1	4
F8	Brake light indicator fuse	2	3
F9	Diff lock fuse	2	2
F10	Dipped beam fuse	1	6
F11	Driving beam fuse	1	7
F12	Blinker fuse	2	3
F13	Side light fuse	2	7
F14	Side light fuse	2	8
F15	General side light fuse	2	7
F16	El. power lift fuse (alternator D+ positive)	1	7
F17	El. power lift fuse (key-activated positive)	1	2
F18	Fuse for diff lock controls and brake lights	2	2
F20	Starter motor fuse	1	6
F21	Rear field light fuse	4	1
F22	Fuse for instrument and buzzer power	4	4
F23	Fuse for ceiling light-cab's rotating beacon	3	3
F24	A-B control valve fuse	1	5
F25	Auxiliary socket fuse 25A	4	2
F26	Auxiliary socket fuse 25A	4	2
F27	Fuse for horn, rotating beacon	4	2
F28	Fuse for field light/windscreen wiper-washer controls	3	4
F29	Windscreen wiper fuse	3	4
F30	Pneumatic seat fuse	4	3
F31	Window washer reservoir fuse	3	5
F32	Radio fuse	3	4
F33	Rear window wiper fuse	3	5
F34	Cab's front field light fuse	3	7
F35	Cab's rear field light fuse	3	7
F36	Emergency switch fuse (hazard)	2	4
F39	NAO control unit fuse	2	3
FU1	Link-box primary fuse	1	1
FU2	Link-box alternator primary fuse	1	7
FU3	Link-box primary fuse	2	3
FU4	Link-box primary fuse	4	1
FU5	Glow plug fuse (steering wheel midival)	1	6
FU6	Cab power fuse (steering wheel midival)	3	2
GB1	Battery	1	1
HA1	Horn	4	2
HA2	Alarm buzzer	4	4
HL1	Rh front turn indicator	2	5
HL2	Rh rear turn indicator	2	5
HL3	Lh front turn indicator	2	4
HL4	Lh rear turn indicator	2	4
HL5	Rh front side light	2	7
HL6	Rh rear side light	2	8
HL7	Lh front side light	2	8
HL8	Lh rear side light	2	7
HL9	Rh brake light indicator	2	3
HL10	Lh brake light indicator	2	3
HL11	Supplementary rh turn indicator (NAO)	2	3
HL12	Supplementary lh turn indicator (NAO)	2	3
K1	Starter motor power relay	1-1	6-4
K2	Power relay for auxiliary socket - pneumatic seat	4-1	2-2
K3	Relay for side lights, brake lights	2-1	3-2

K4	Relay for fuel injection - field light - instrument	4-1	1-2
K5	Air conditioning power relay	3-1	2-1
K6	Roof auxiliary power relay	3-1	4-1
K8	Diff lock power relay	2-2	2-1
K9	Driving beam power relay	1-2	7-6
K10	Dipped beam power relay	1-2	6-6
K11	Headlight power relay	1-1	6-3
K14	Power relay for diff lock release, brake light indicators	2-2	2-1
K15	Rear PTO safety power relay	1-1	4-3
K16	Glow plug power relay	1-1	6-5
K17	Cab front field light power relay	3-3	7-6
K18	Cab rear field light power relay	3-3	7-6
M1	Starter motor	1	6
M2	Windscreen wiper motor	3	4
M3	Rear window wiper motor	3	5
M4	Rear window washer pump	3	5
M5	Pneumatic seat actuator	4	3
M6	Electric fan in cab	3	2
M8	Rear window washer pump	3	5
M9	Air conditioning compressor	3	2
M10	Fuel pump motor	1	7
R01	Air conditioning electric fan resistor	3	1
SA00	Main contact key switch	1	1
SA01	Light switch selector	2	5
SA04	Cab front field light selector	3	6
SA05	Cab rear field light selector	3	6
SA08	Platform revolving beacon commutator	4	1
SA09	Hazard light switch	2	4
SA10	Cab rotating beacon commutator	3	3
SA11	4WD commutator	1-4	4-1
SA13	A/C electric fan commutator	3	1
SA15	Side lights and dipped beams commutator	2	7
SB06	Window washer button	3	5
SB08	Differential lock button	2	1
SB09	Auxiliary control valve button	1	5
SL1	Fuel level sensor	4	7
SL2	Brake fluid level sensor	4	7
SL3	Supplementary fuel tank level sensor	4	8
SP1	A/C dehydrator filter pressure switch	3	2
SP2	Hydraulic trailer brake pressure switch	4	5
SP3	Gearbox oil intake vacuum switch	4	4
SP4	Engine oil pressure switch	4	4
SP5	Air intake circuit vacuum switch	4	4
SP8	Brake pump pressure switch (brake-diff lock)	2	1
SQ4	Hand brake lever microswitch	4	7
SQ6	540 rear PTO microswitch	4	6
SQ7	750-1000 rear PTO microswitch	4	6
SQ8	Synchronized rear PTO microswitch	4	5
SQ18	PTO engaged microswitch	1	3
SQ19	Safety microswitch on gearshift lever	1	4
SR1	Ground speed sensor	4	5
SR5	Rear PTO rate sensor	4	5
ST6	Engine water temperature sensor	4	4
ST7	Fuel enrichment jet sensor	1	8
YA1	Fuel injection pump solenoid	1	8
YA2	Fuel enrichment jet solenoid	1	7
YV3	Diff lock solenoid valve	2	2
YV4	4WD solenoid valve	1	4
YV10	Auxiliary control valve solenoid valve A	1	4
YV11	Auxiliary control valve solenoid valve B	1	5

Term.boards

XS0	7-pin trailer socket terminal board
XS1	Front wiring line terminal board
XS2	Rear wiring line terminal board
XS3	Platform wiring line terminal board
XS5	Roof wiring line terminal board
XS7	Auxiliary socket terminal board
XS8	Can bus serial socket terminal board

References to functional diagram

1 - Cab version only
2 - Four-wheel drive indicator
3 - Glow plug ind.light
4 - Driving beam ind.light
5 - Differential lock indicator
6 - Control lighting
7 - Glow plug ind.light
8 - Alternator indicator light
9 - Four-wheel drive
11 - Driving beams
12 - Side lights
13 - Lh turn ind.
14 - Rh turn ind.
15 - Rh turn ind.
16 - 2nd trailer direction ind.

3.9.2 Main wiring diagram
Part 1

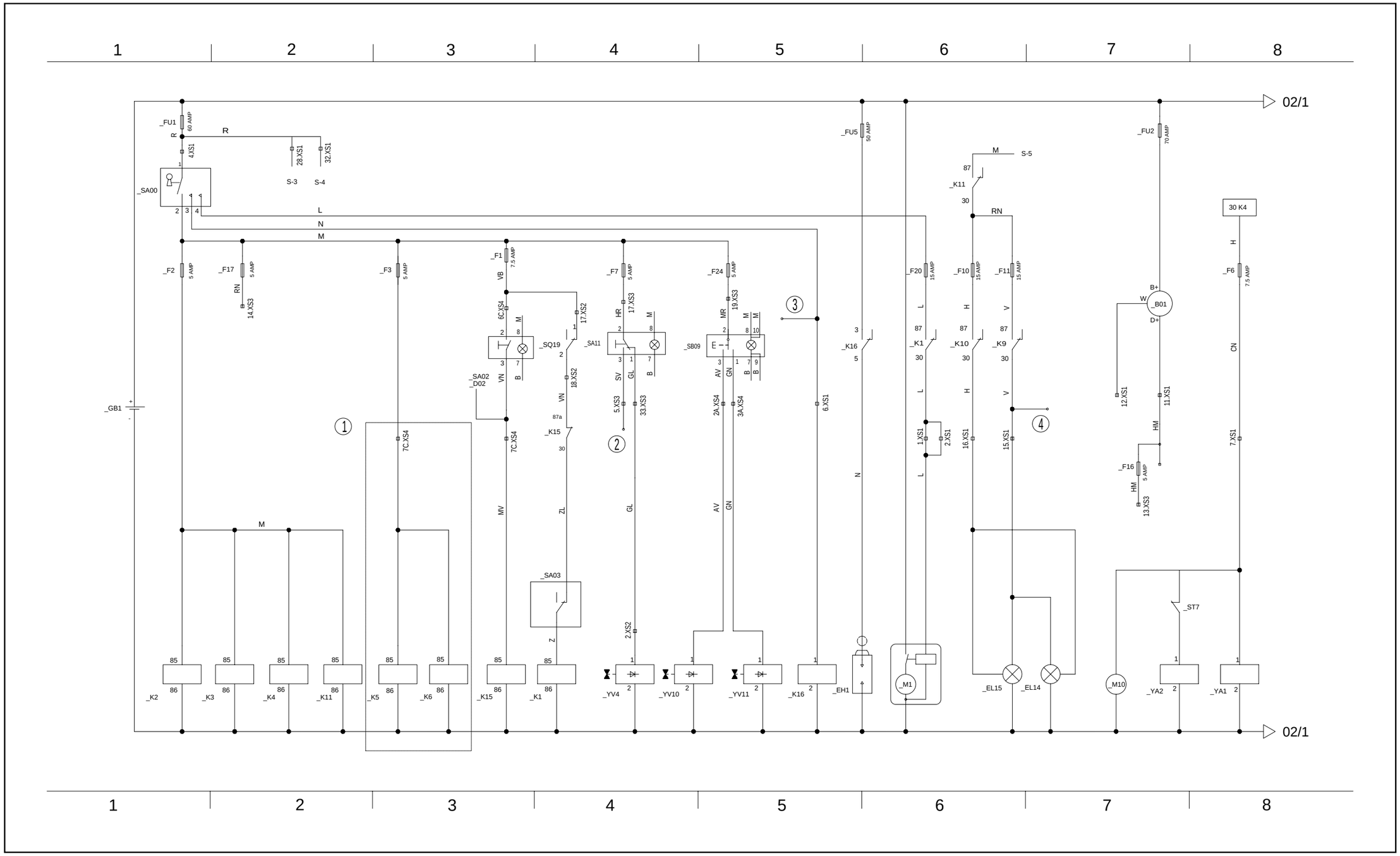


Fig. 10.544

Part 2

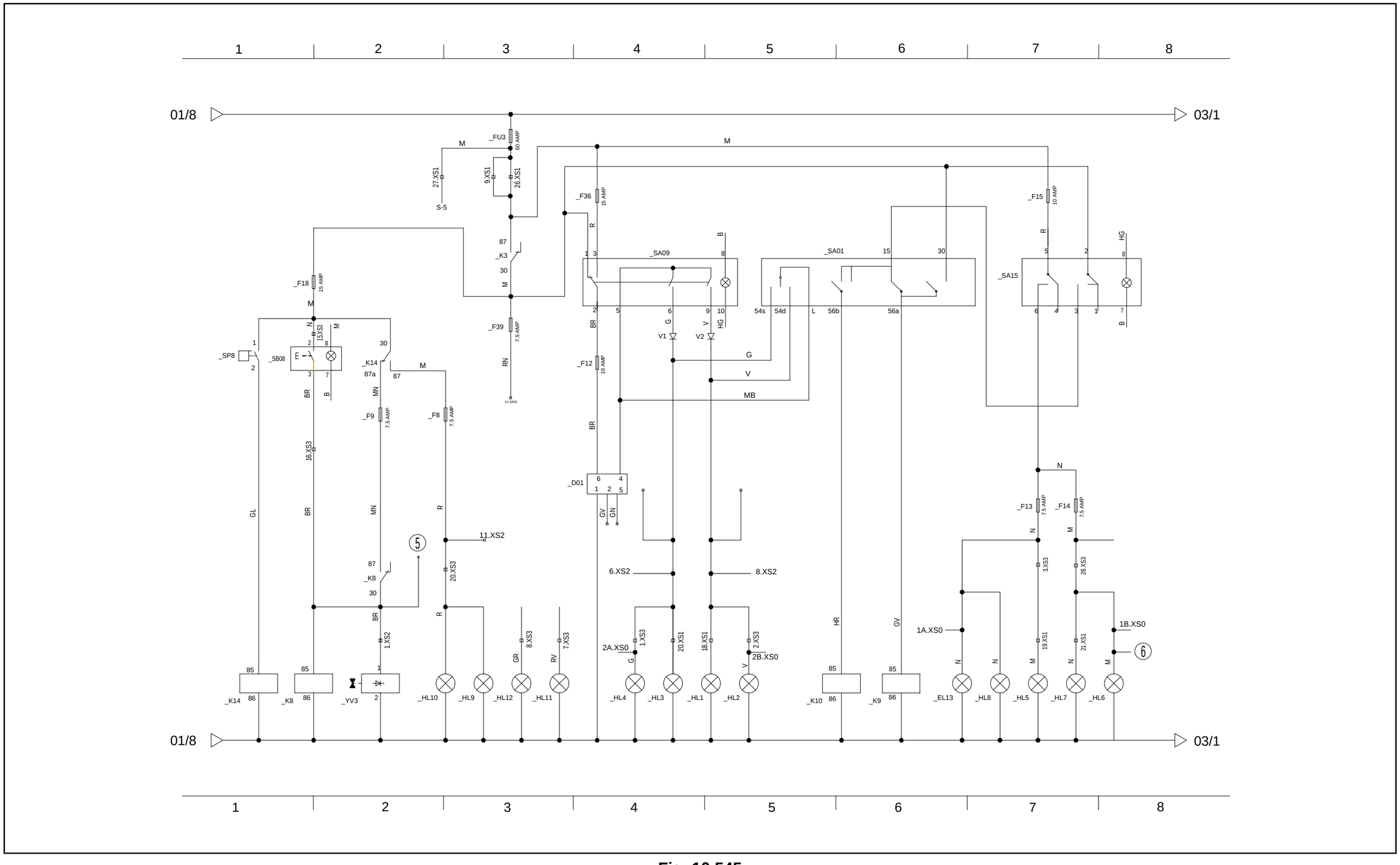


Fig. 10.545

Part 3

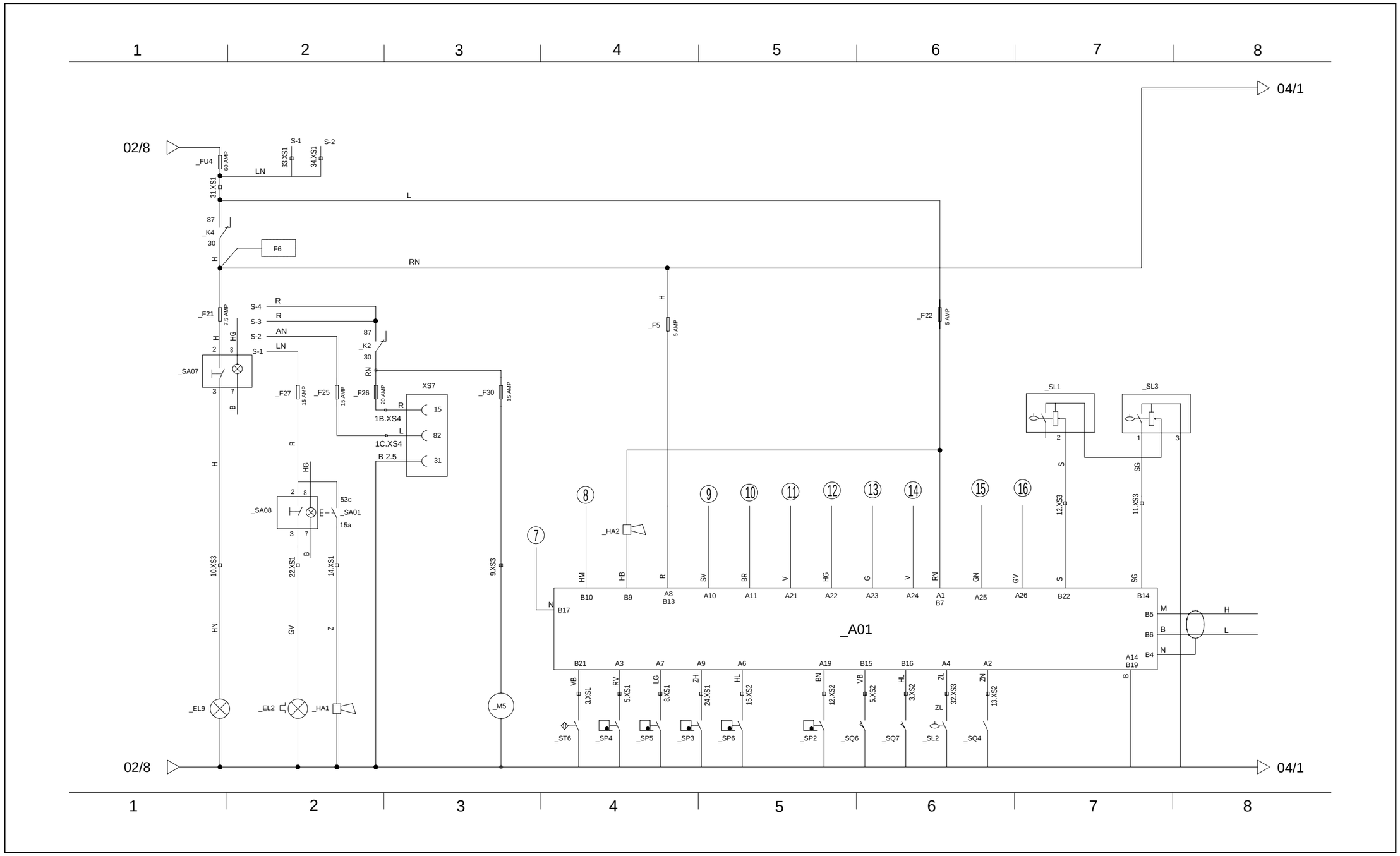


Fig. 10.546

Part 4

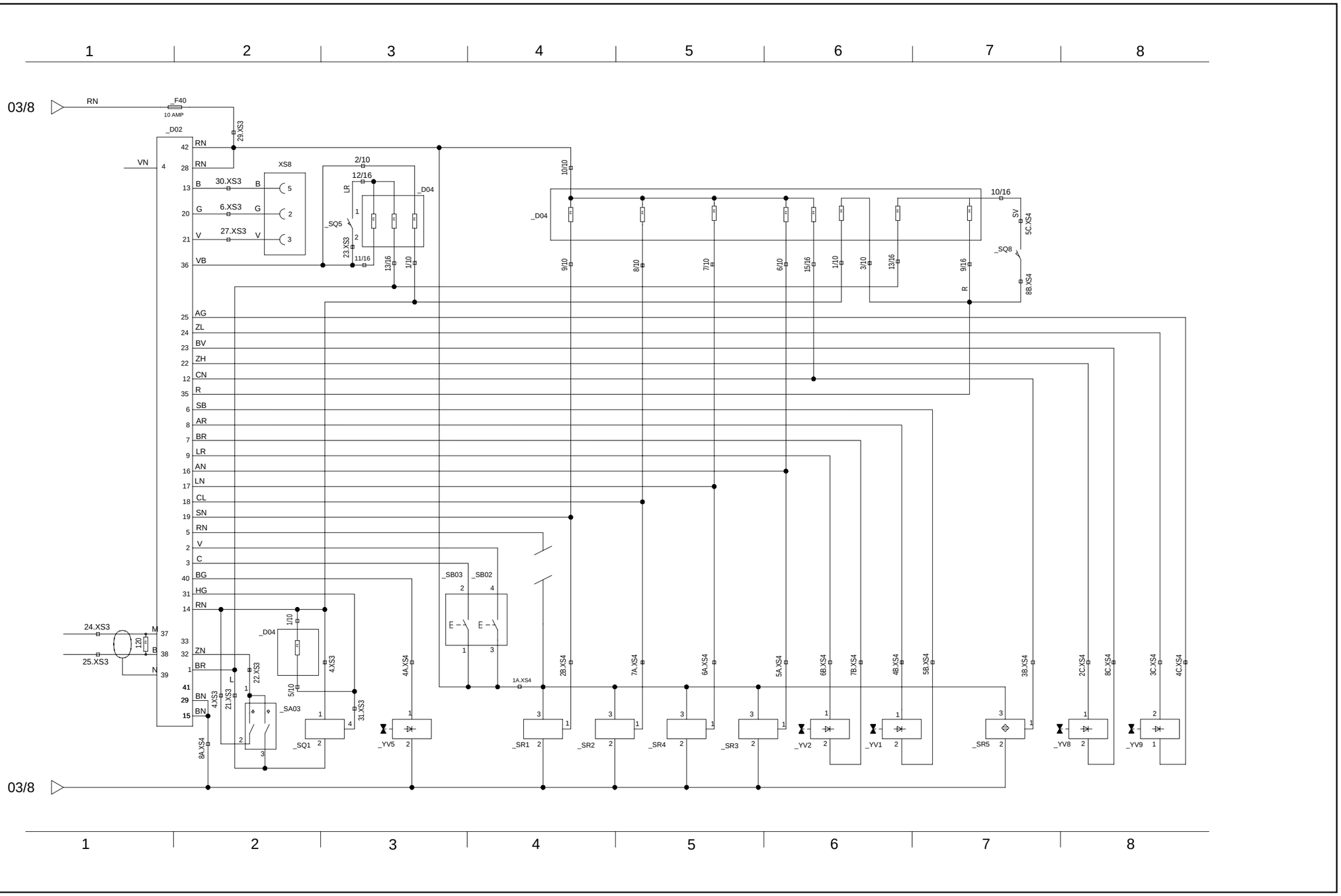


Fig. 10.547

Part 5

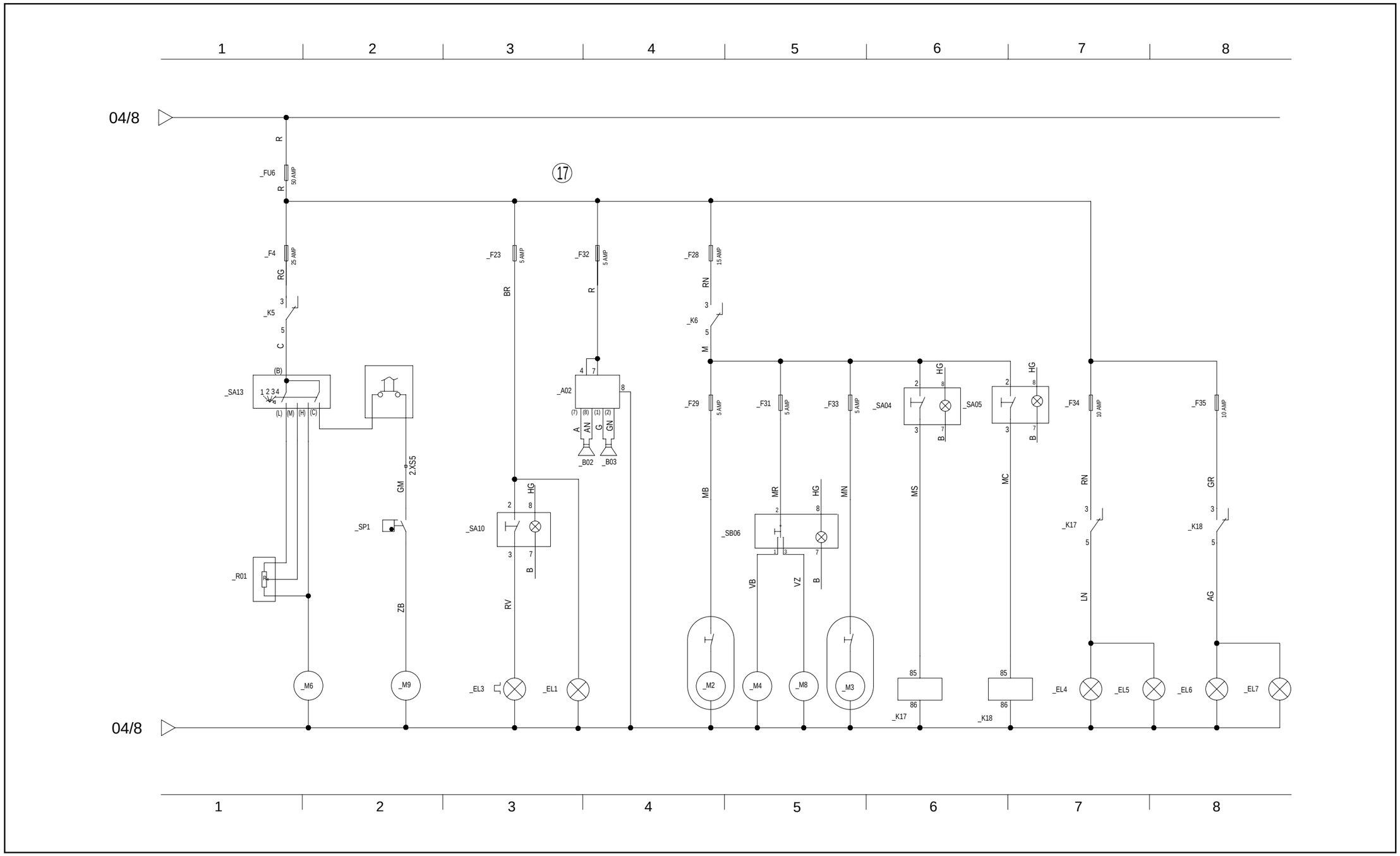


Fig. 10.548

3.9.3 Battery-starter motor line

3.9.3.1 General description

This line is very important for the functionality of the electrical system of the entire tractor. It connects the positive battery pole to the starter motor (M1 Fig.10.372), thus allowing the entire electrical system to be powered, as the ignition switch is connected to the battery.

Connection to the front fuse box is made on the positive battery terminal (Fig.10.550). These fuses protect the tractor's electrical system against short circuits and excessive power draw.

The positive battery terminal is also connected to power fuse (FU5), which protects the preheater relay (K16) from short-circuits (Fig.10.551).

Battery (GB1) is installed in the front, between the radiator and headlights (Fig.10.551).

⚠	**Attention:** comply with the safety instructions !

⚠	**Attention:** disconnect the ground wire (-) from the battery.

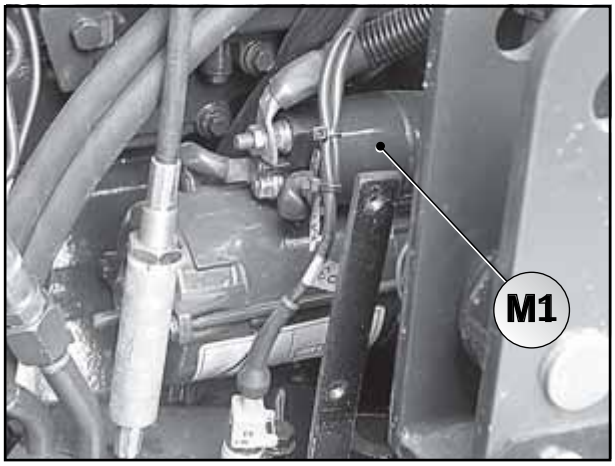


Fig. 10.549

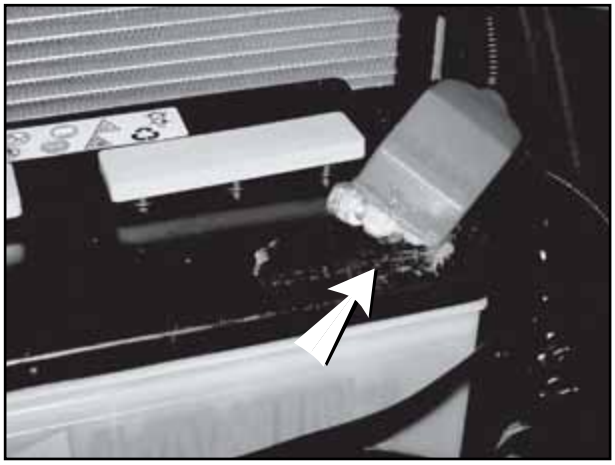


Fig. 10.550

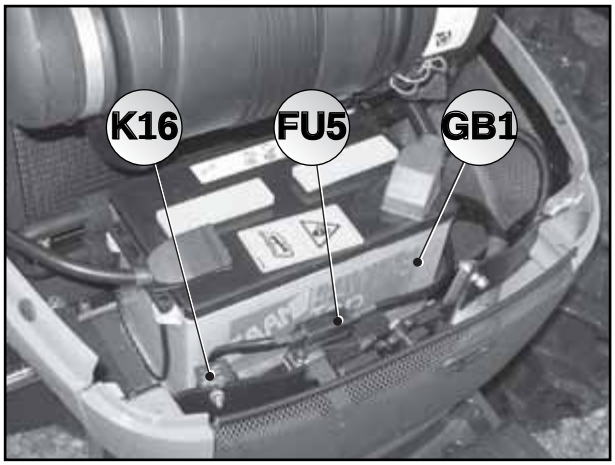


Fig. 10.551

3.9.3.2 Wiring

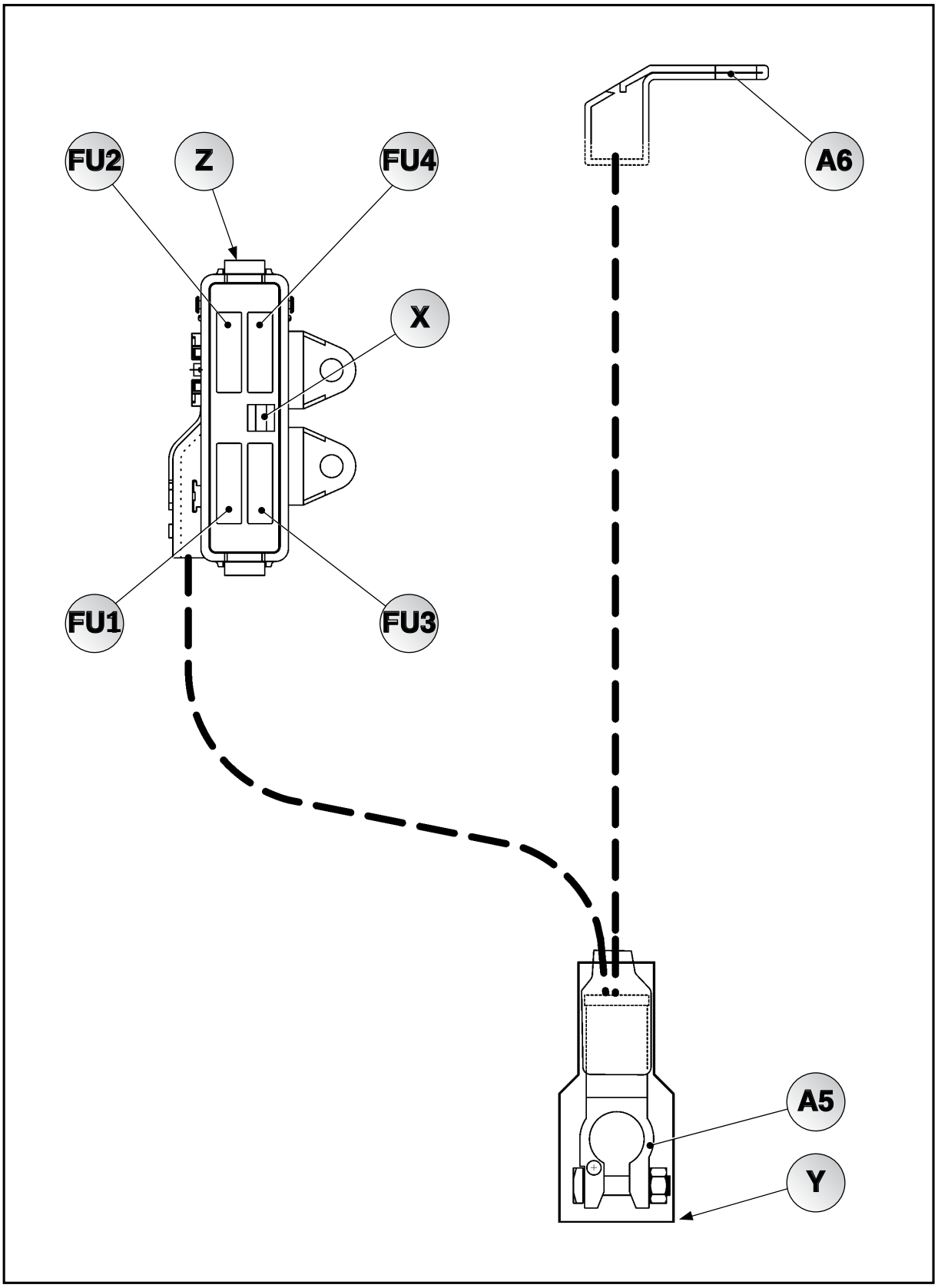


Fig. 10.552

Z - Front fuse box
Y - Insulating cap
X - Pincers for removing fuses
FU1 - 60 Amp. fuse
FU2 - 70 Amp. fuse
FU3 - 60 Amp. fuse
FU4 - 60 Amp. fuse
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal

3.9.3.3 Connector locations

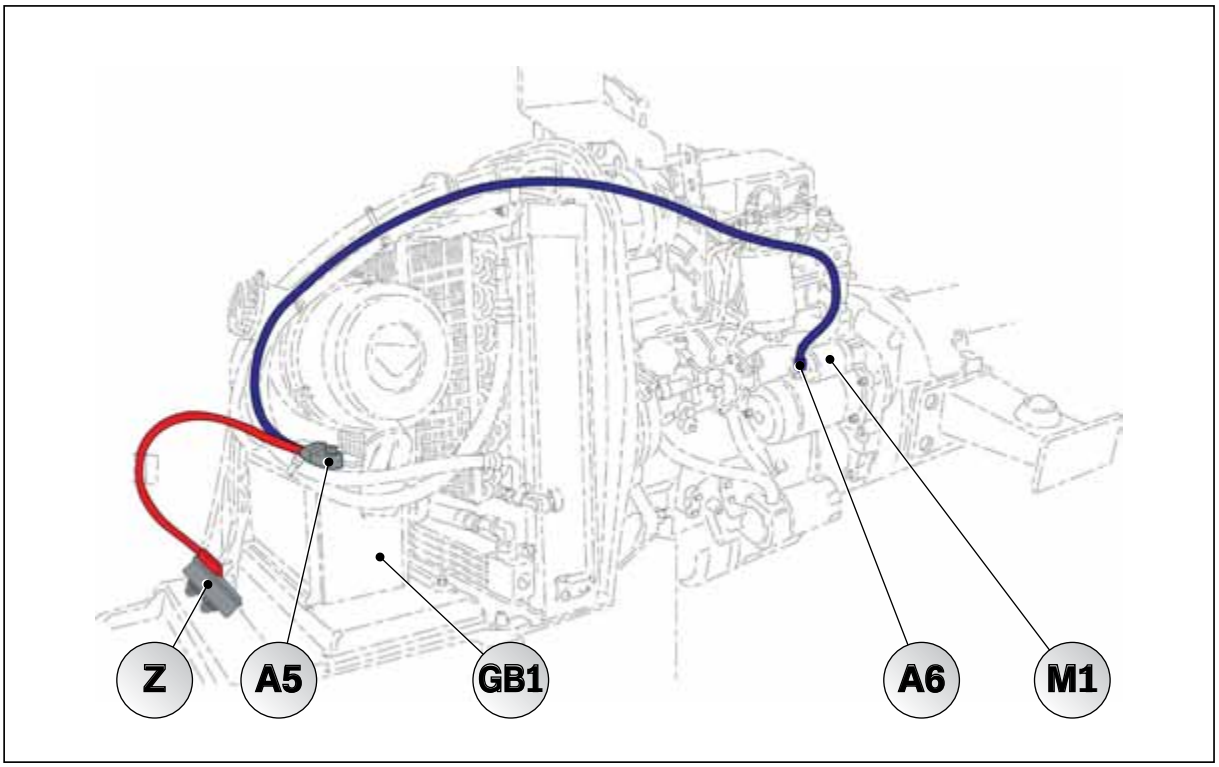


Fig. 10.553

GB1 - Battery
M1 - Starter motor
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal
Z - Front fuse box

The front fuse box (Z) is installed in front of the battery (GB1).

The four fuses inside are important since they protect the tractor's entire electrical system from short-circuits and excessive power draw.

Before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it. (Fig.10.554).

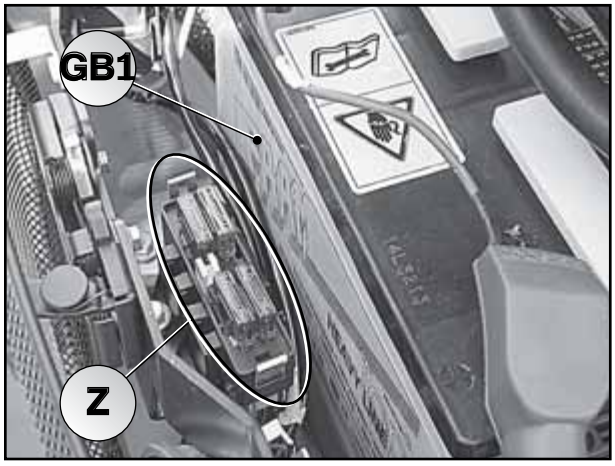


Fig. 10.554

3.9.3.4 Connector identification

Terminal (A6) for starter motor connection

term.	wire colour	To con. or comp.	term.
A	N	M1	

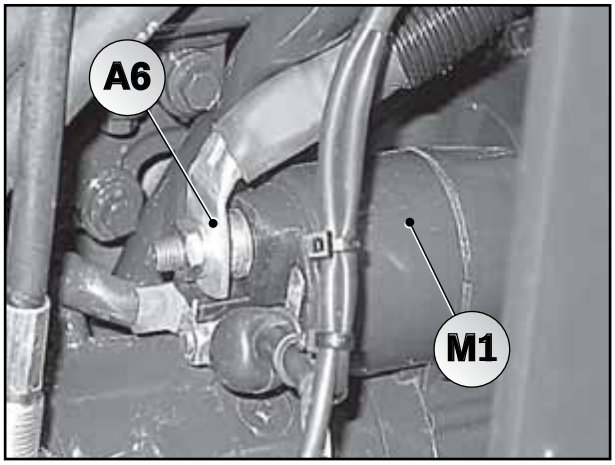


Fig. 10.555

Eyelet (A5) connection to the battery's positive terminal allows the remaining part of the tractor's electrical system to be powered.

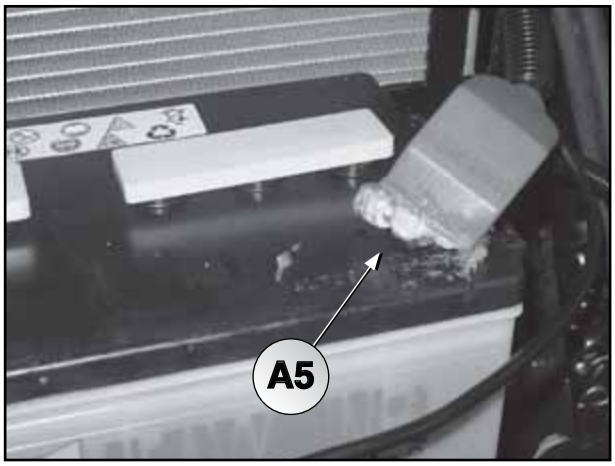


Fig. 10.556

3.9.4 Front engine line (with 3-cylinder engine)

3.9.4.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.557), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.558) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.558) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.559) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.560) installed under the bonnet.

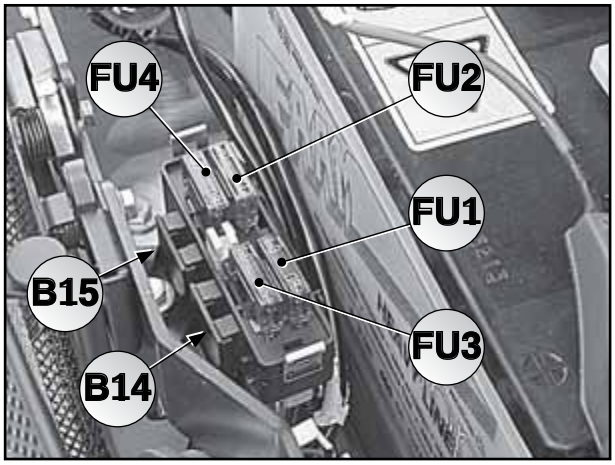


Fig. 10.558

Fig. 10.559

Fig. 10.557

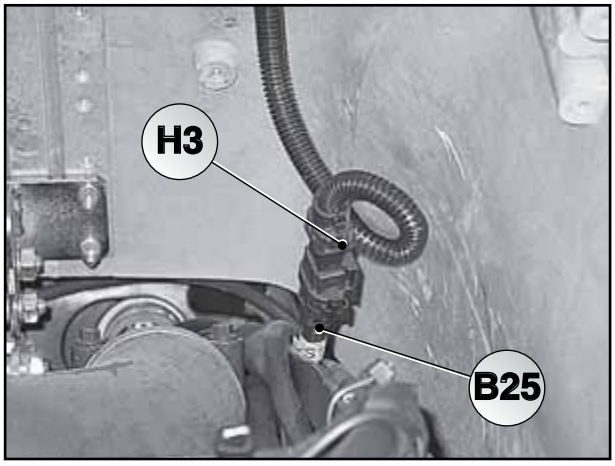


Fig. 10.560

3.9.4.2 Wiring (version with 3-cylinder engine)

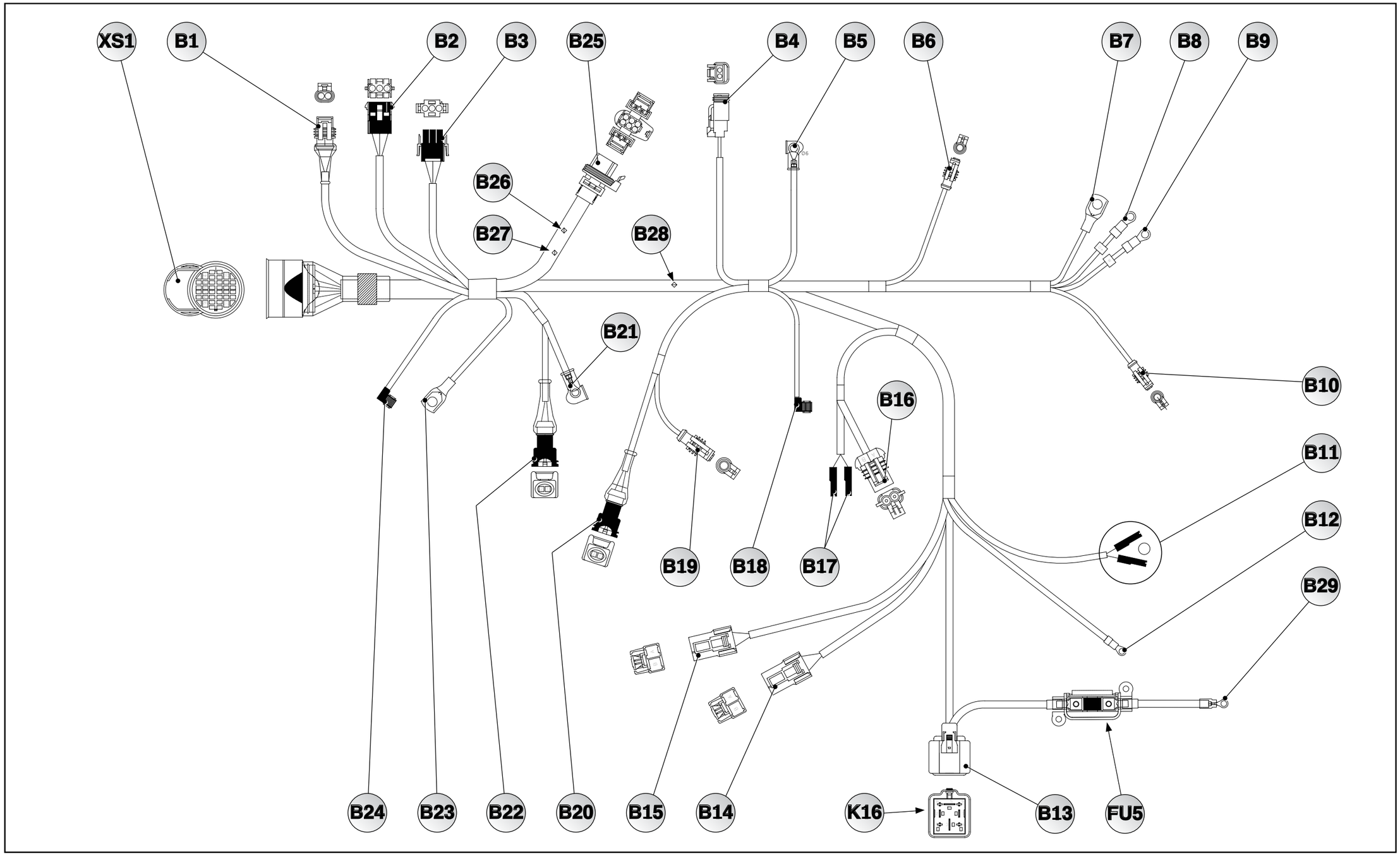


Fig. 10.561

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26-B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.9.4.3 Connector locations

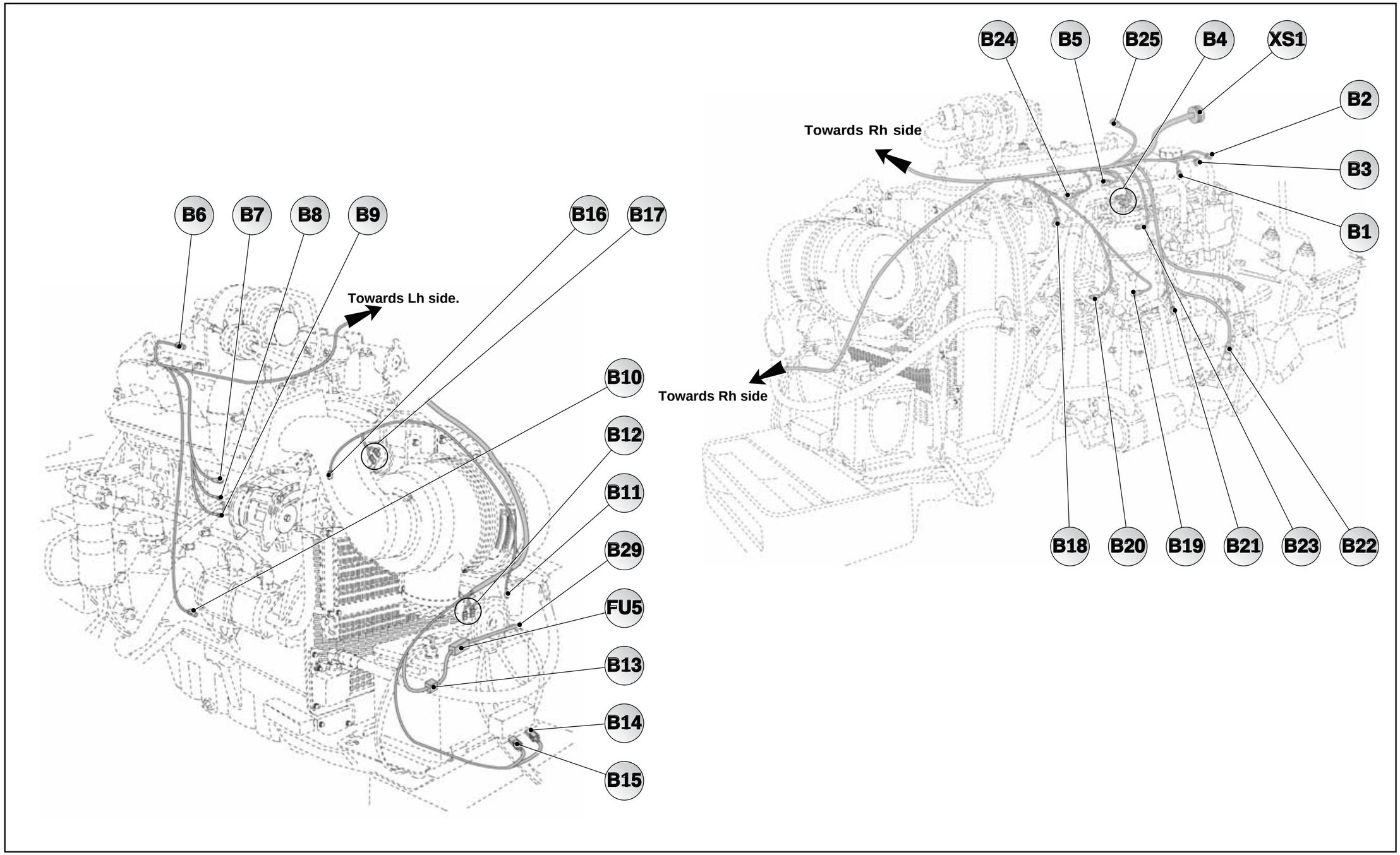


Fig. 10.562

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Connector for air conditioner PWR connection
B17 - Faston terminals for air filter sensor
B18 - Terminal for fuel enrichment jet temperature sensor
B19 - Connector for engine oil pressure switch
B20 - Terminal for fuel injection pump solenoid valve
B21 - Starter motor terminal
B22 - Connector for gearbox oil intake vacuum switch
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.9.4.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

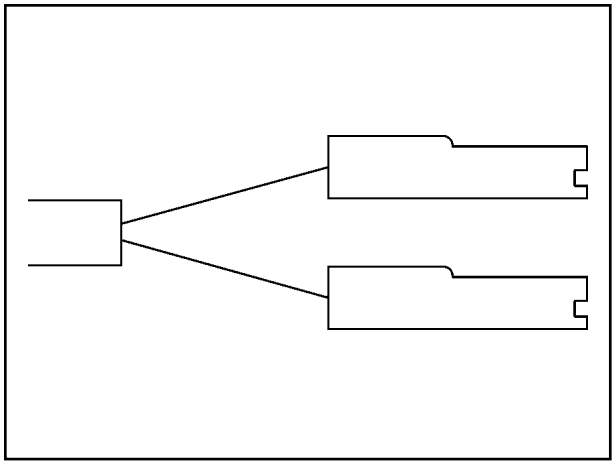


Fig. 10.563

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

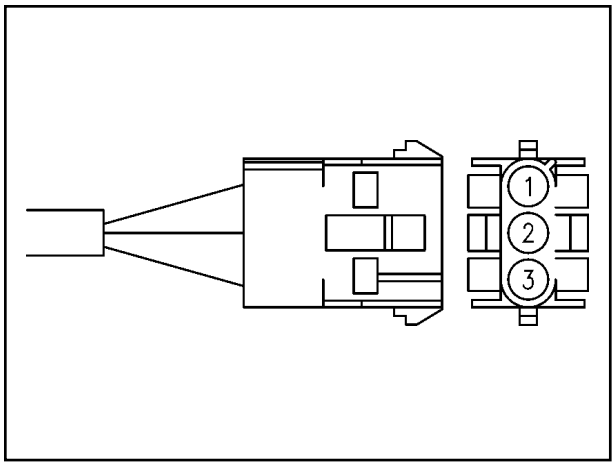


Fig. 10.564

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

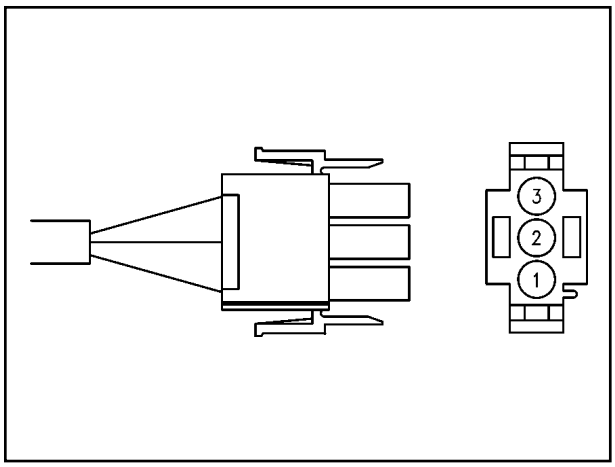


Fig. 10.565

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

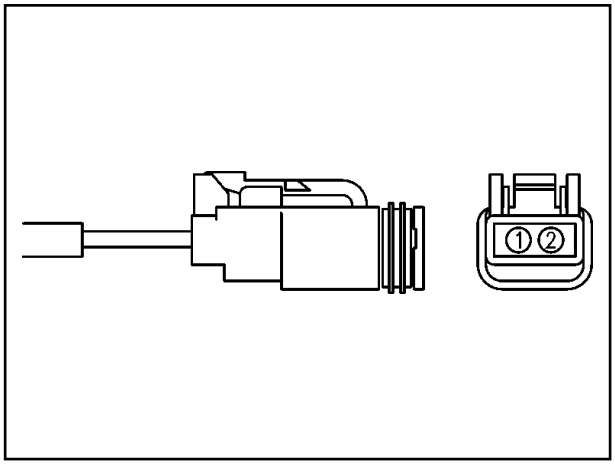


Fig. 10.566

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

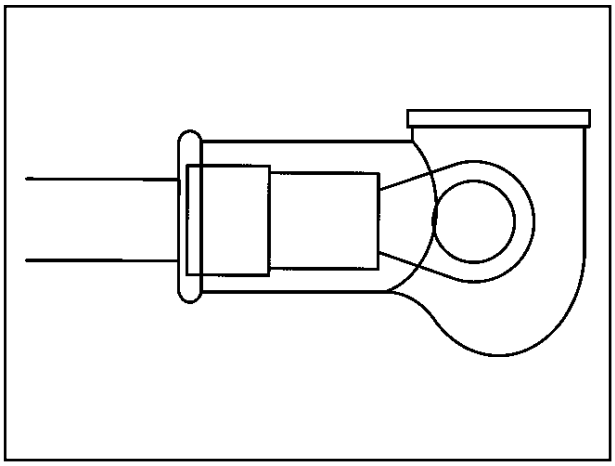


Fig. 10.567

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

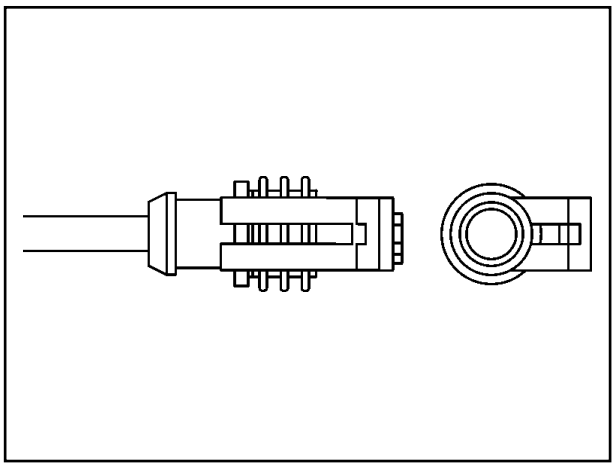


Fig. 10.568

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

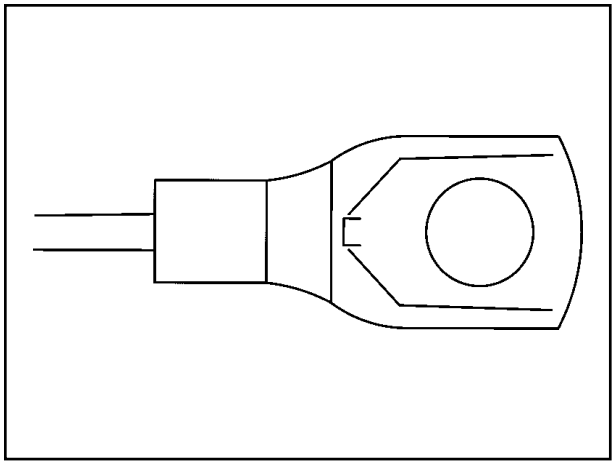


Fig. 10.569

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

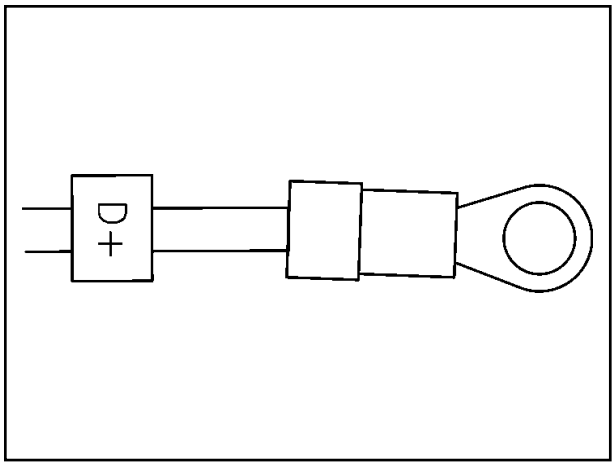


Fig. 10.570

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

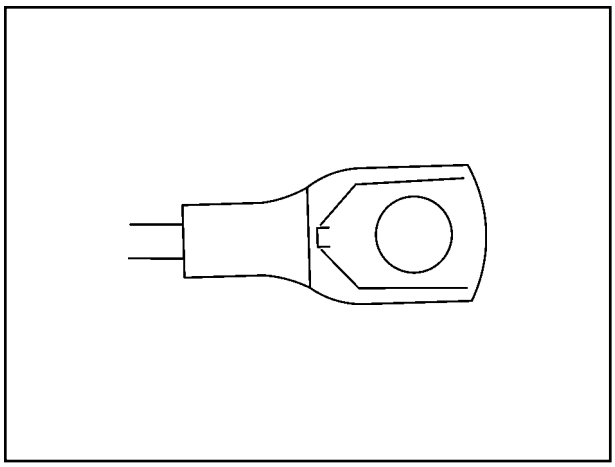


Fig. 10.571

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

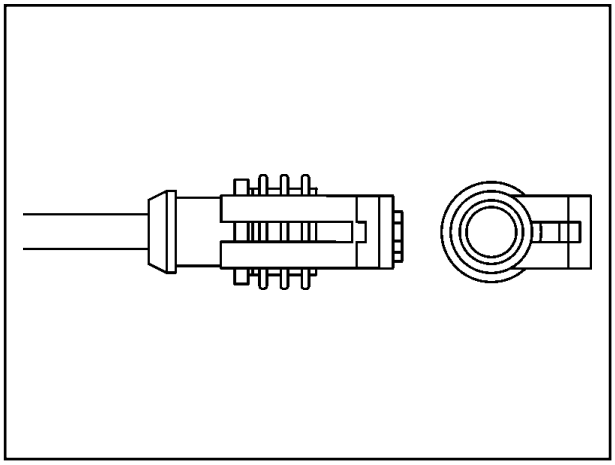


Fig. 10.572

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

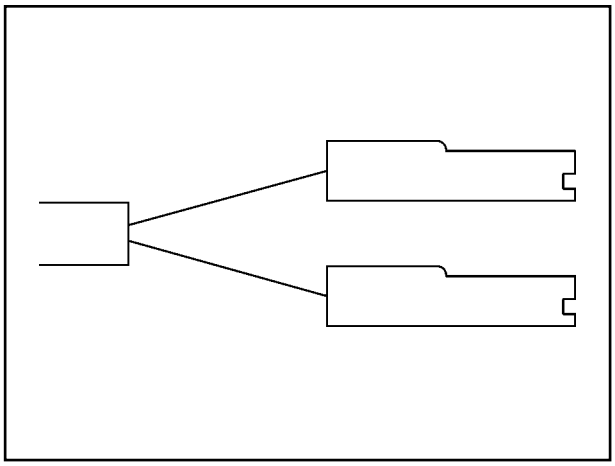


Fig. 10.573

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

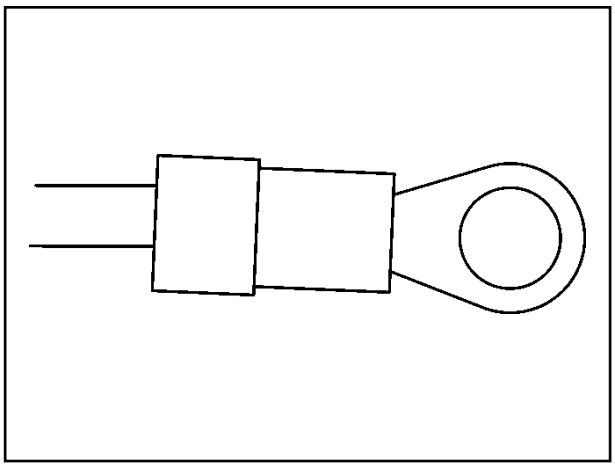


Fig. 10.574

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

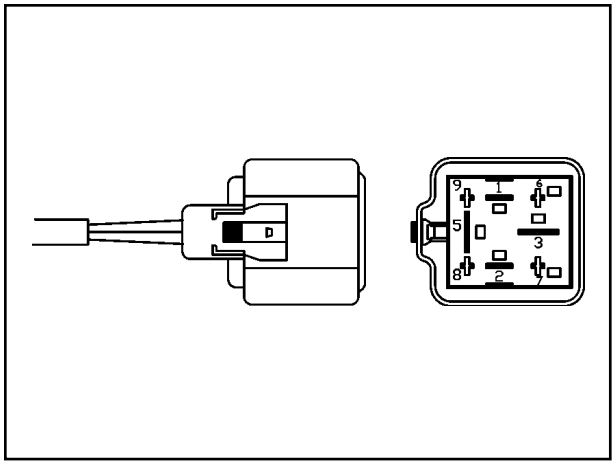


Fig. 10.575

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

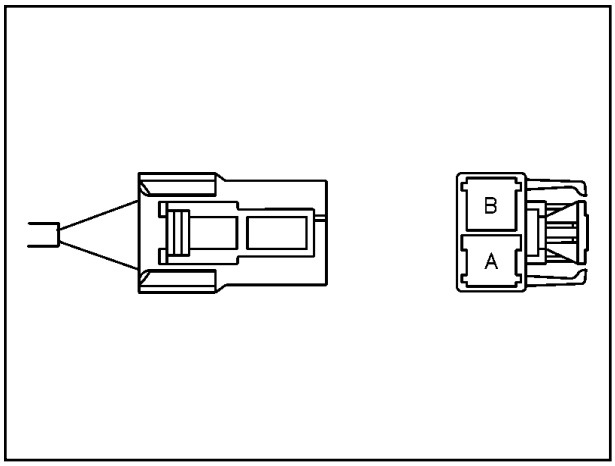


Fig. 10.576

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

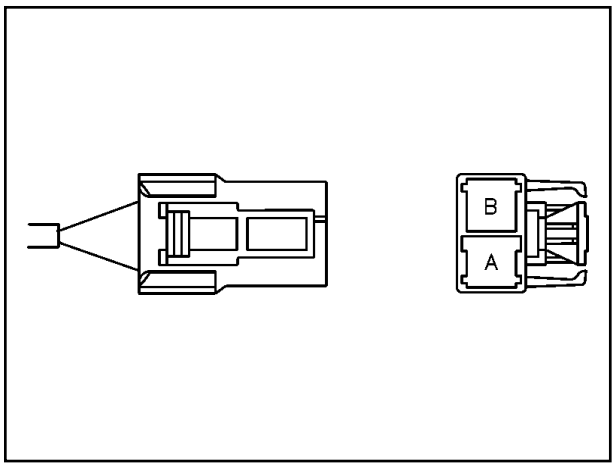


Fig. 10.577

Connector (B16) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

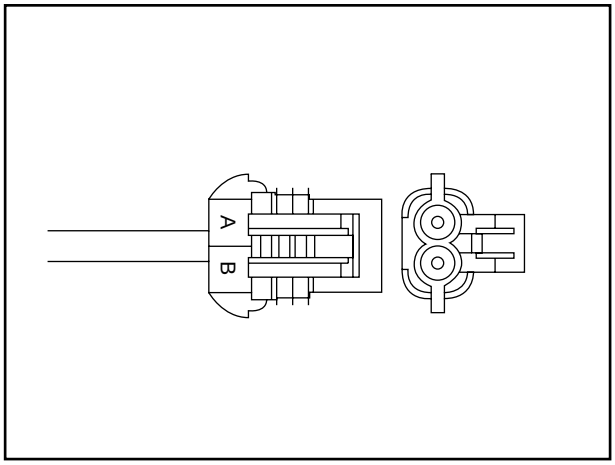


Fig. 10.578

Faston terminals (B17) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

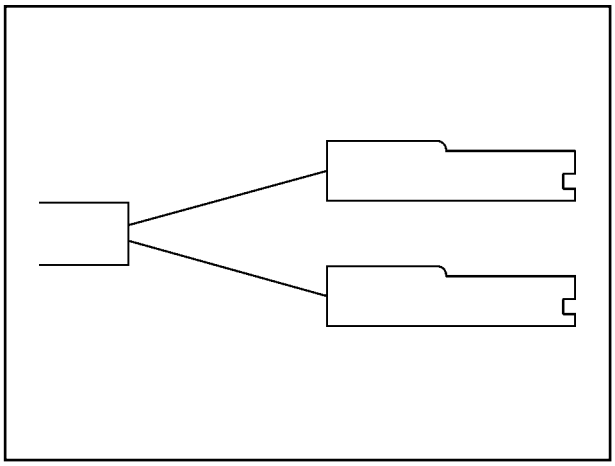


Fig. 10.579

Terminal (B18) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

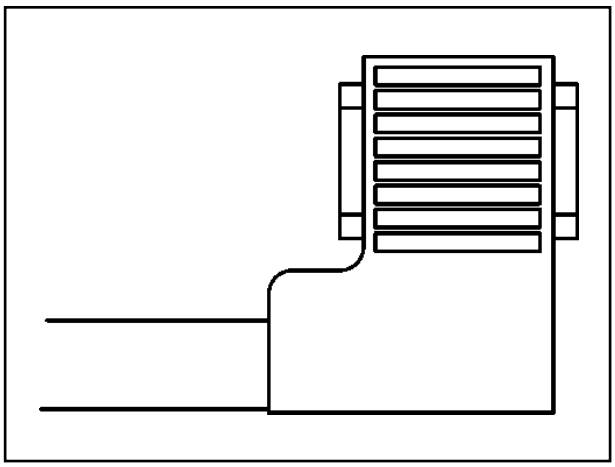


Fig. 10.580

Connector (B19) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

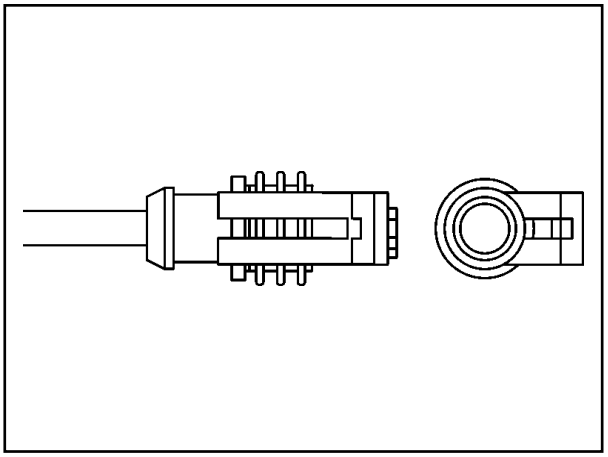


Fig. 10.581

Terminal (B20) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

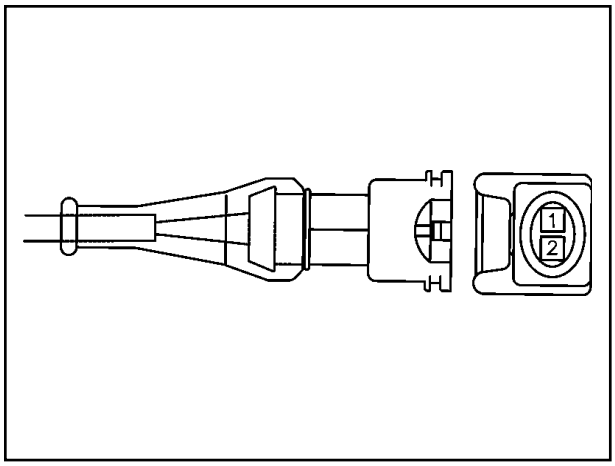


Fig. 10.582

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

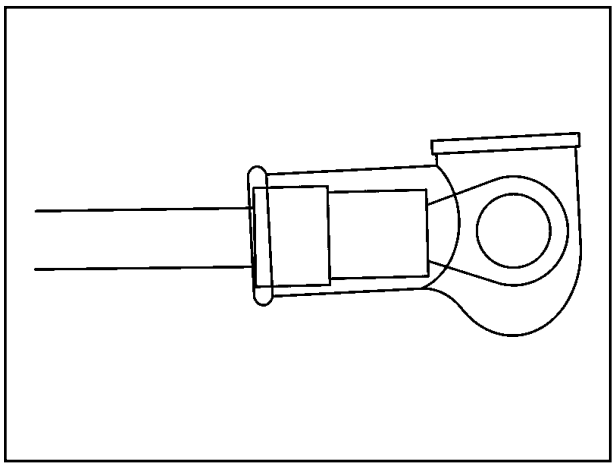


Fig. 10.583

Connector (B22) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

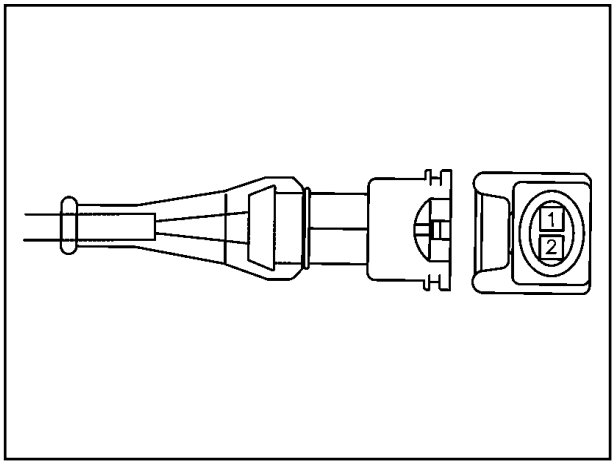


Fig. 10.584

Grounding eyelet (B23)

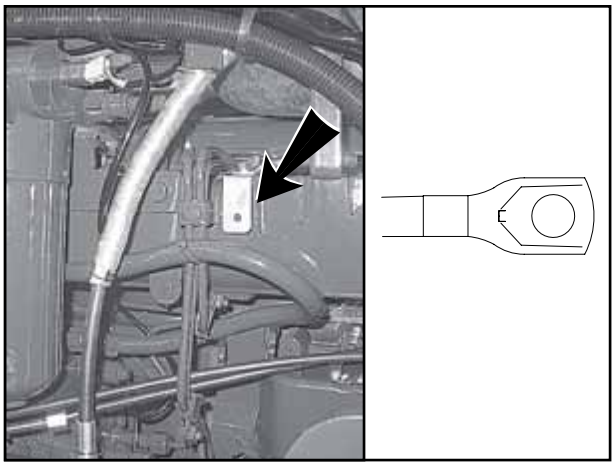


Fig. 10.585

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

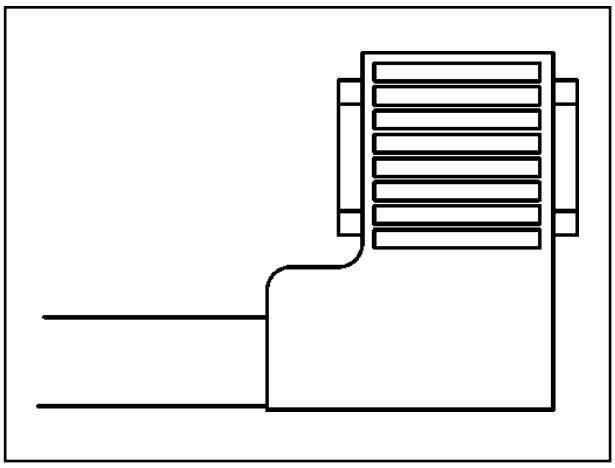


Fig. 10.586

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

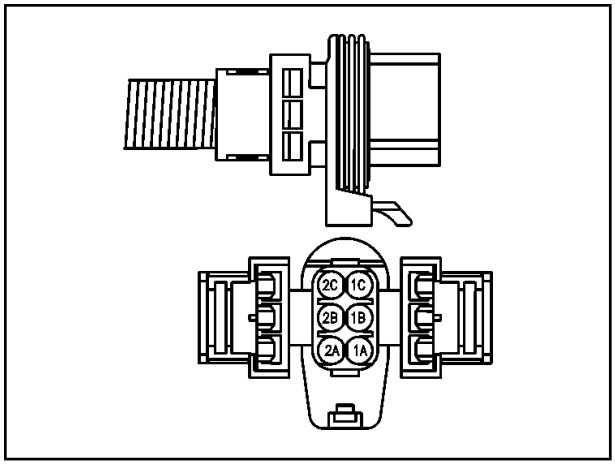


Fig. 10.587

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13	not used		
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29	not used		
30	not used		
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

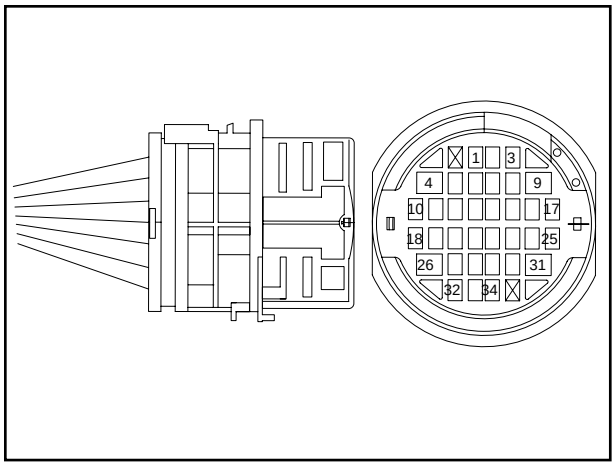


Fig. 10.588

3.9.5 Front engine line (with 4-cylinder engine)

3.9.5.1 General description

The front line installed in **F-N Series Speed Five** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.589), etc.

The four main fuses (FU1, FU2, FU3 and FU4 Fig.10.590) connected to this line by means of the connectors (B14 and B15), protect the system against short-circuits and excessive power draw.

The front line is connected on the one side, to the battery line by means of the connection to the main fuse box (Fig.10.590) and on the other side, to the dashboard line by means of the connections between the terminal boards (XS1 Fig.10.591) installed just under the dashboard lining, between the engine and the platform.

The front line also connects to the headlight extension line by means of connectors (B25 and H3)(Fig.10.592) installed under the bonnet.

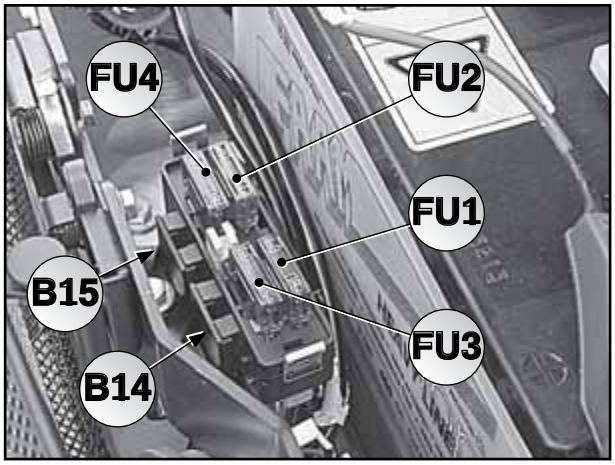


Fig. 10.590

Fig. 10.591

Fig. 10.589

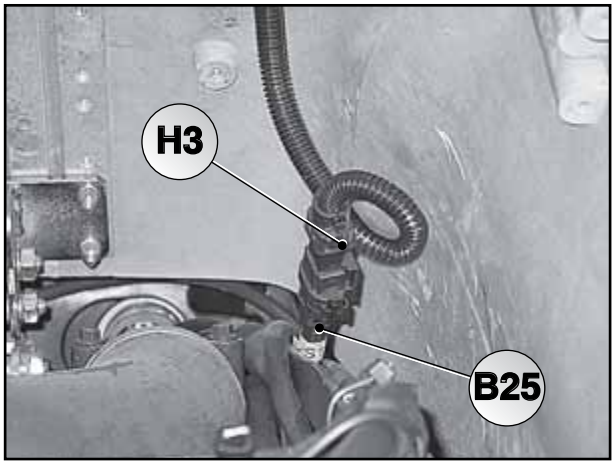


Fig. 10.592

3.9.5.2 Wiring (version with 4-cylinder engine)

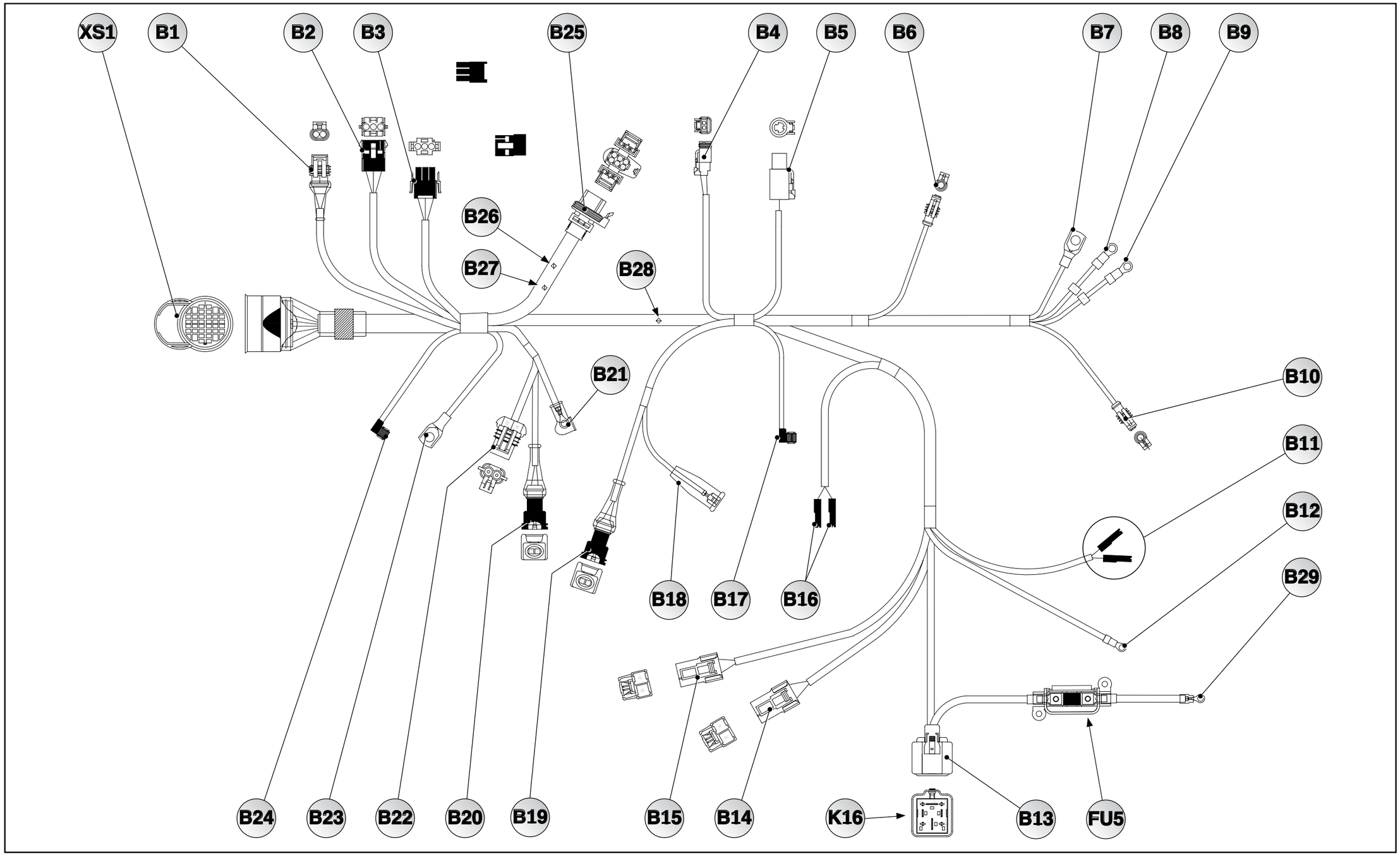


Fig. 10.593

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B26-B28 - Junction
B29 - Loop terminal
FU5 - Fuse to protect the glow plug relay
K16 - Power relay
XS1 - Terminal board for front line/dashboard connection

3.9.5.3 Connector locations

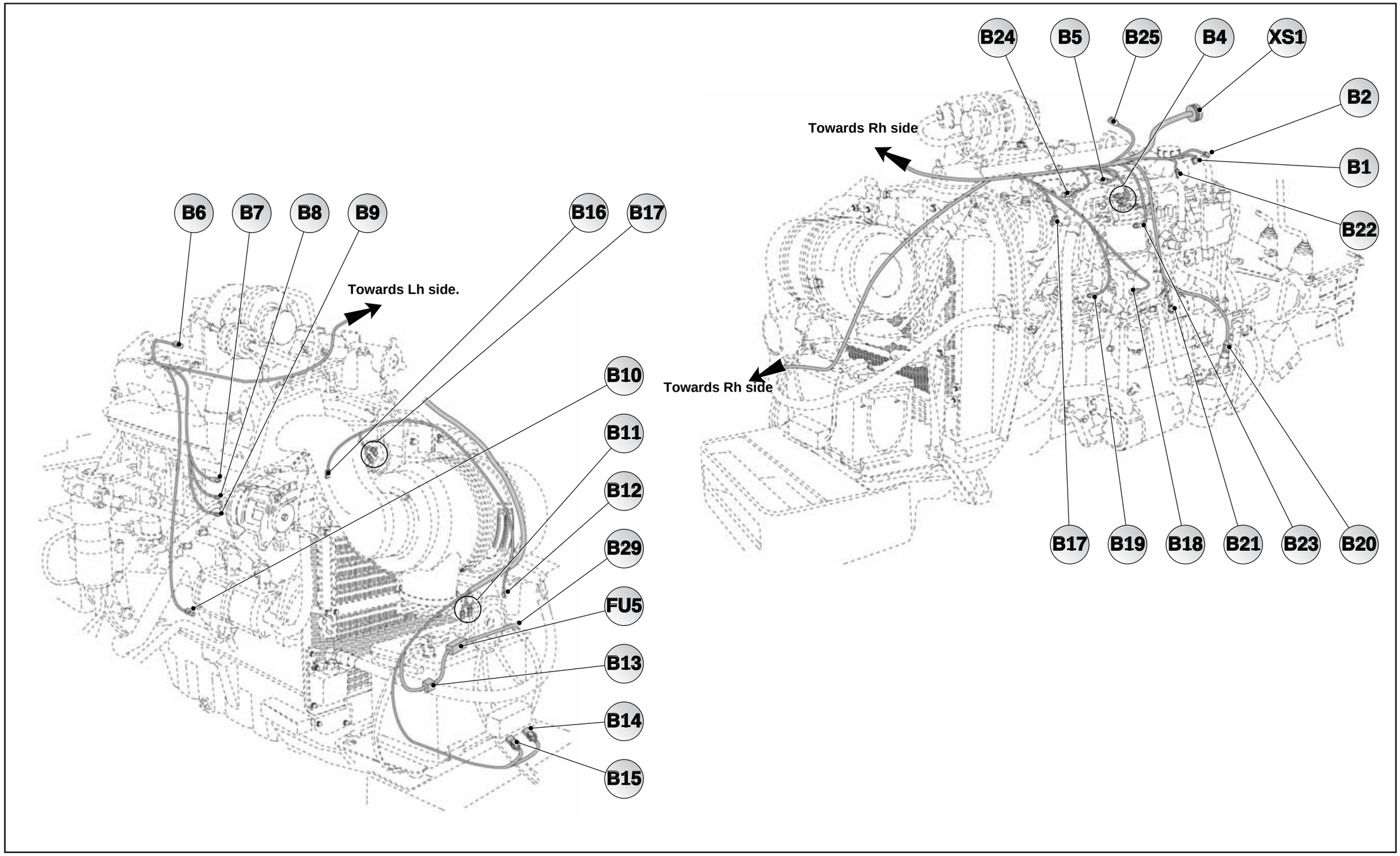


Fig. 10.594

B1 - Connector for revolving beacon
B2 - Connector for sidelights and turn indicators
B3 - Connector for sidelights and turn indicators
B4 - Connector for fuel pump
B5 - Glow plug terminal
B6 - Connector for A/C compressor
B7 - Alternator terminal
B8 - Alternator terminal
B9 - Alternator terminal
B10 - Connector for gearbox oil pressure switch
B11 - Faston terminals for horn
B12 - Loop terminal
B13 - Connector for glow plug relay connection (K16)
B14 - Connector for front fuse connection
B15 - Connector for front fuse connection
B16 - Faston terminals for air filter sensor
B17 - Terminal for fuel enrichment jet temperature sensor
B18 - Connector for engine oil pressure switch
B19 - Terminal for fuel injection pump solenoid valve
B20 - Connector for gearbox oil intake vacuum switch
B21 - Starter motor terminal
B22 - Connector for air conditioner PWR connection
B23 - Grounding eyelet
B24 - Terminal for engine coolant temperature sensor
B25 - Connector for headlights
B29 - Loop terminal
XS1 - Terminal board for front line/dashboard connection

3.9.5.4 Connector identification

Connector (B1) for revolving beacon

term.	wire colour	To con. or comp.	term.
1	GV	XS1	22
2	B	B23 (ground)	

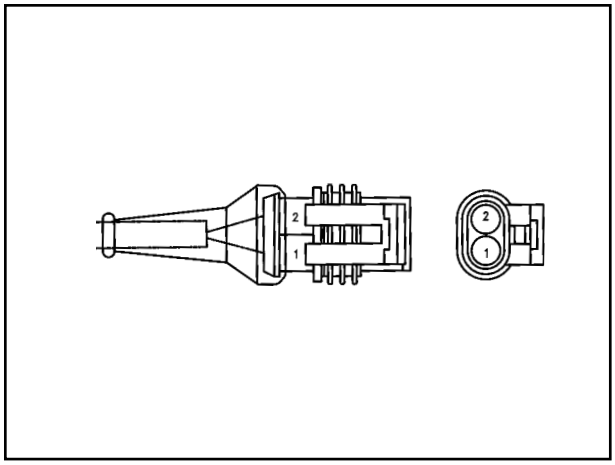


Fig. 10.595

Connector (B2) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	M	XS1	19
2	V	XS1	18
3	B	B23 (ground)	

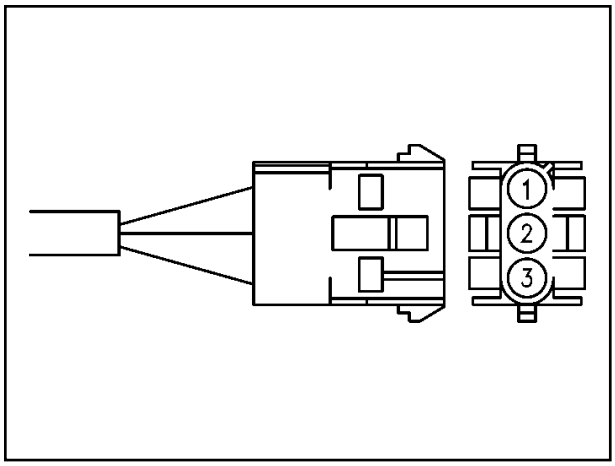


Fig. 10.596

Connector (B3) for sidelights and turn indicators

term.	wire colour	To con. or comp.	term.
1	N	XS1	21
2	G	XS1	20
3	B	B23 (ground)	

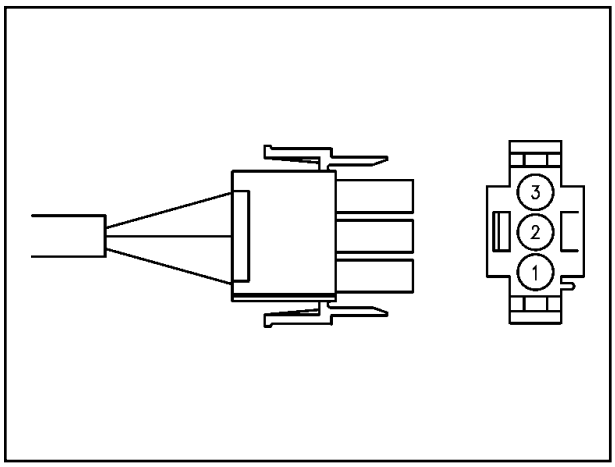


Fig. 10.597

Connector (B4) for fuel pump connection

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

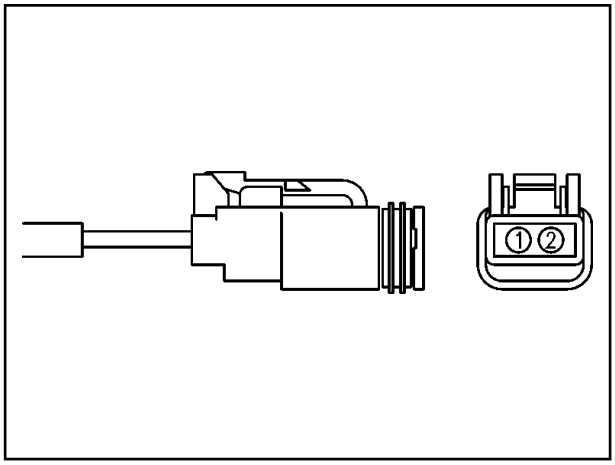


Fig. 10.598

Terminal (B5) for glow plugs

term.	wire colour	To con. or comp.	term.
1	N	B13	5

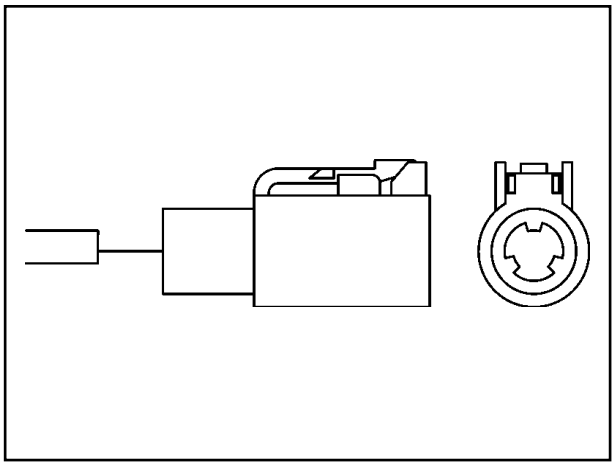


Fig. 10.599

Connector (B6) for A/C compressor

term.	wire colour	To con. or comp.	term.
1	ZB	B16	A

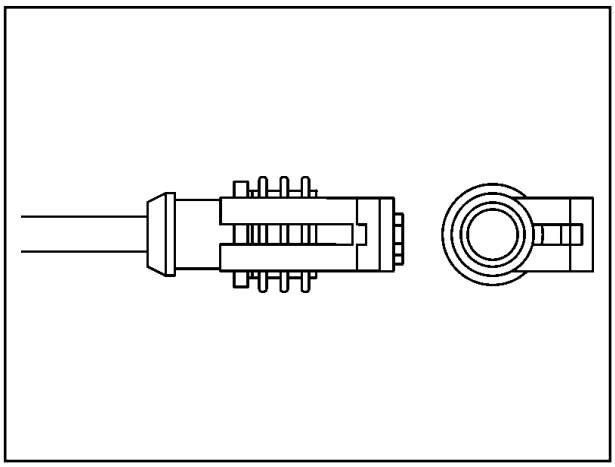


Fig. 10.600

Alternator terminal (B7)

term.	wire colour	To con. or comp.	term.
1	N	B15	B

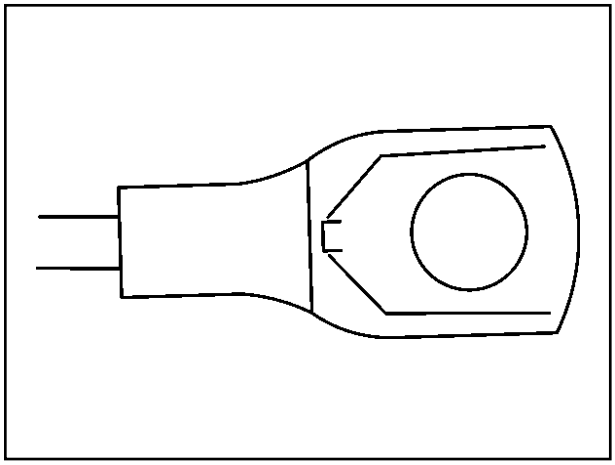


Fig. 10.601

Alternator terminal (B8)

term.	wire colour	To con. or comp.	term.
1	HM	XS1	11

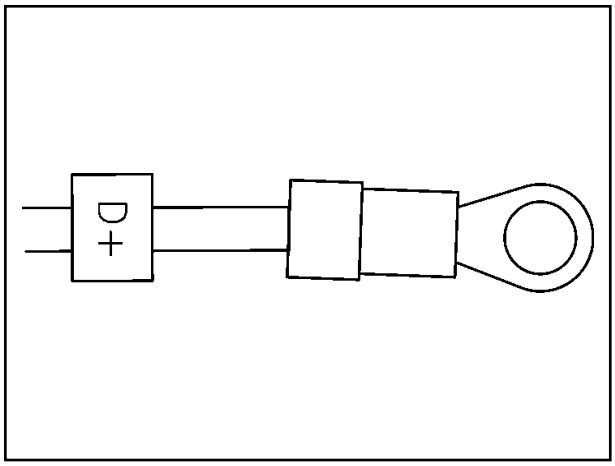


Fig. 10.602

Alternator terminal (B9)

term.	wire colour	To con. or comp.	term.
1	GR	XS1	12

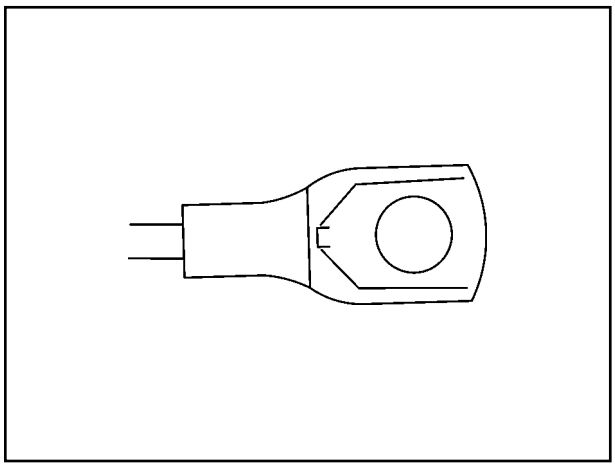


Fig. 10.603

Connector (B10) for gearbox oil pressure switch

term.	wire colour	To con. or comp.	term.
1	ZN	XS1	10

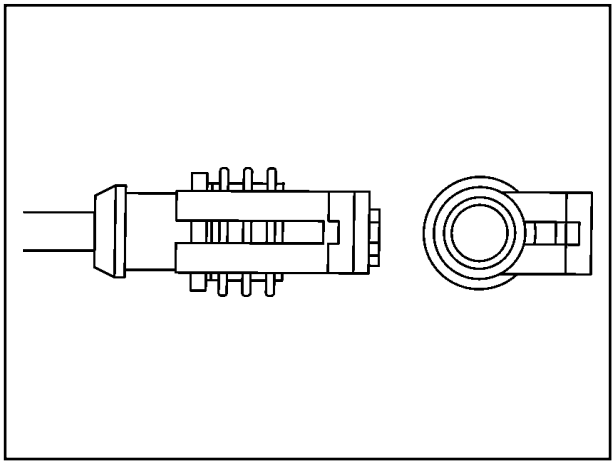


Fig. 10.604

Faston terminals (B11) for horn

term.	wire colour	To con. or comp.	term.
1	Z	XS1	14
2	B	B23 (ground)	

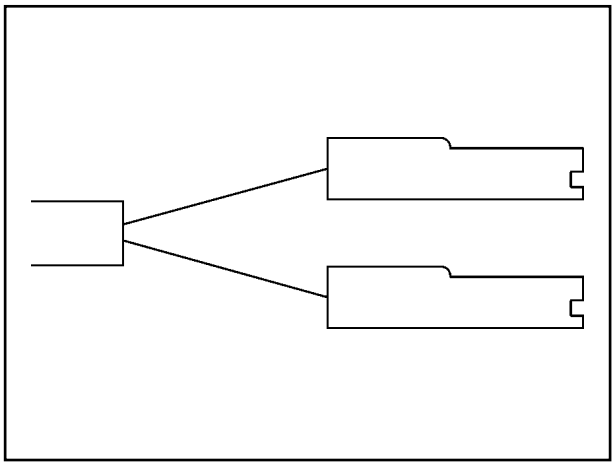


Fig. 10.605

Loop terminal (B12)

term.	wire colour	To con. or comp.	term.
1	BN-BN	XS1-XS1	23-25

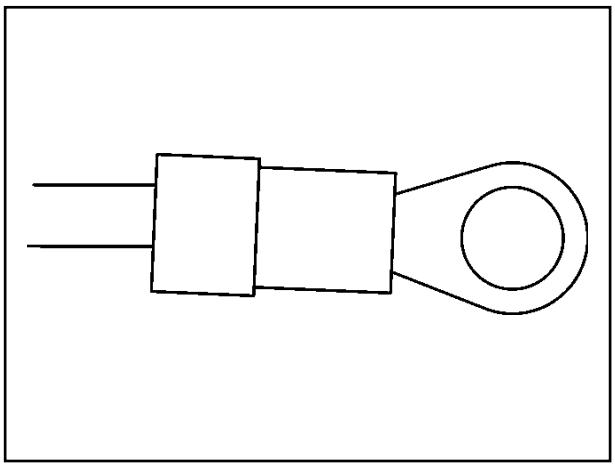


Fig. 10.606

Connector (B13) for glow plug relay connection (K16)

term.	wire colour	To con. or comp.	term.
1	B	B23 (ground)	
2	N	XS1	6
3	GR	FU5	
4	not used		
5	N	B5	1

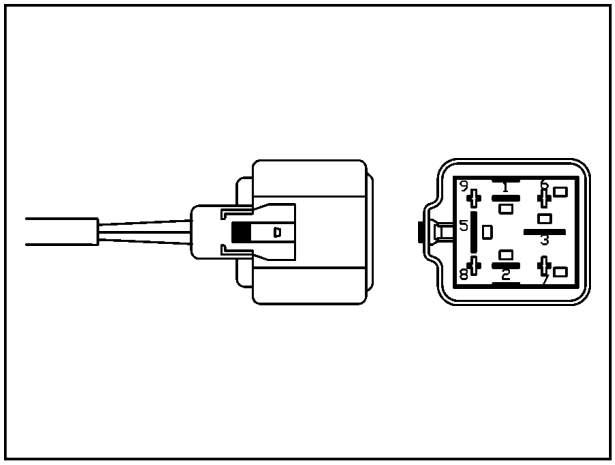


Fig. 10.607

Connector (B14) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	L-LN-LN	XS1-XS1-XS1	31-33-34
B	M-M-M	XS1-XS1-XS1	9-26-27

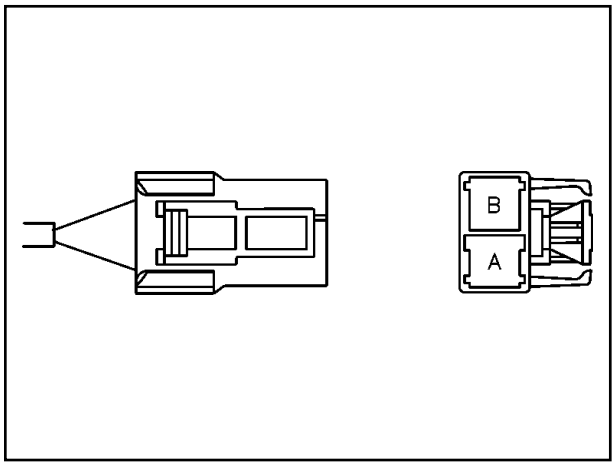


Fig. 10.608

Connector (B15) for front fuse connection

term.	wire colour	To con. or comp.	term.
A	R-R-R	XS1-XS1-XS1	4-28-32
B	N	B7	1

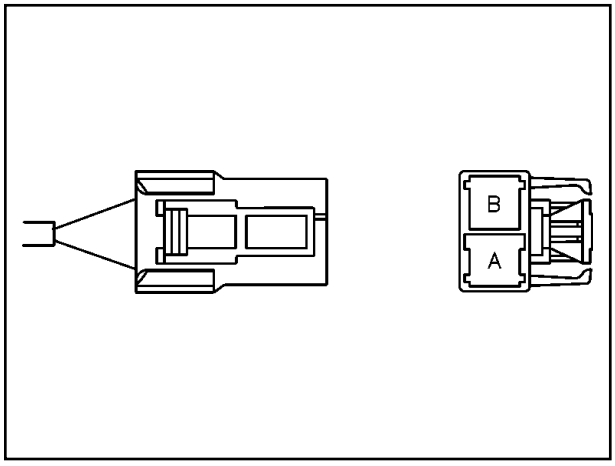


Fig. 10.609

Faston terminals (B16) for air filter sensor

term.	wire colour	To con. or comp.	term.
1	LG	XS1	8
2	B	B23 (ground)	

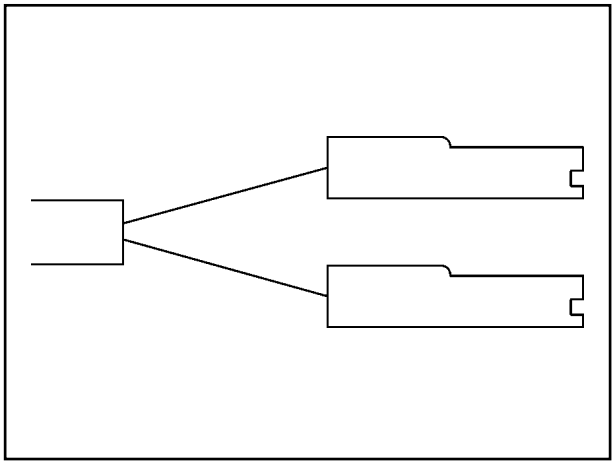


Fig. 10.610

Terminal (B17) for fuel enrichment jet temperature sensor

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	

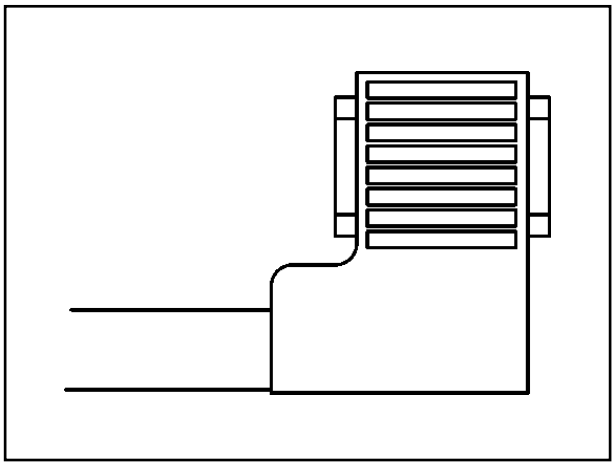


Fig. 10.611

Connector (B18) for engine oil pressure switch

term.	wire colour	To con. or comp.	term.
1	RV	XS1	5

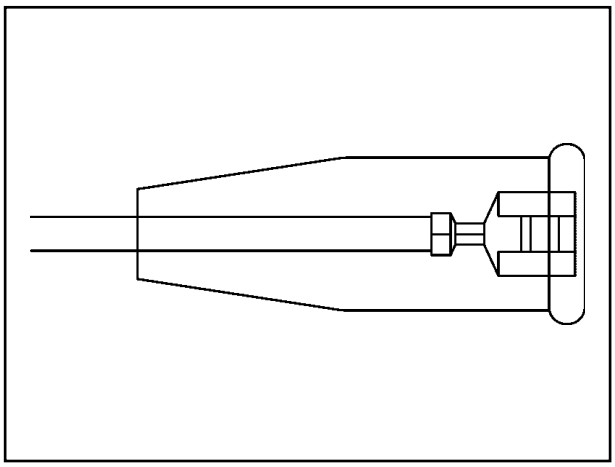


Fig. 10.612

Terminal (B19) for fuel injection pump solenoid

term.	wire colour	To con. or comp.	term.
1	CN	B28 (junction)	
2	B	B23 (ground)	

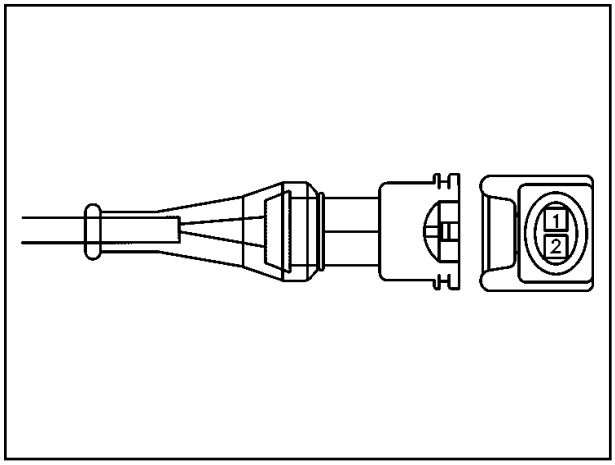


Fig. 10.613

Connector (B20) for gearbox oil intake vacuum switch

term.	wire colour	To con. or comp.	term.
1	ZH	XS1	24
2	B	B23 (ground)	

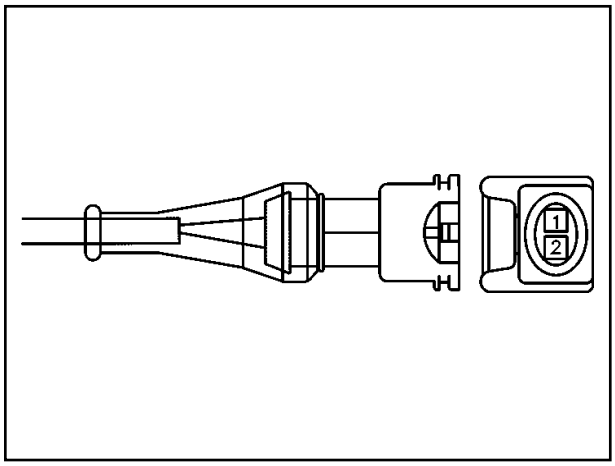


Fig. 10.614

Starter motor terminal (B21)

term.	wire colour	To con. or comp.	term.
1	L-L	XS1-XS1	1-2

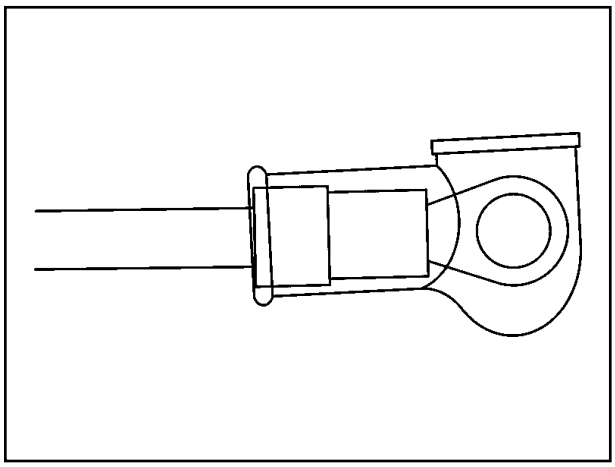


Fig. 10.615

Connector (B22) for air conditioner PWR connection

term.	wire colour	To con. or comp.	term.
1	ZB	B6	1
2	GM	XS1	17

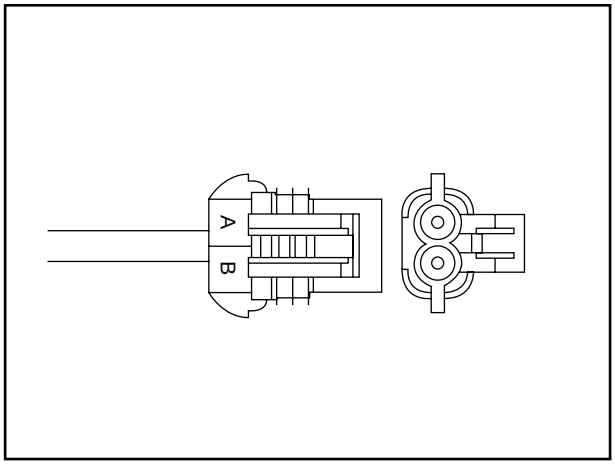


Fig. 10.616

Grounding eyelet (B23)

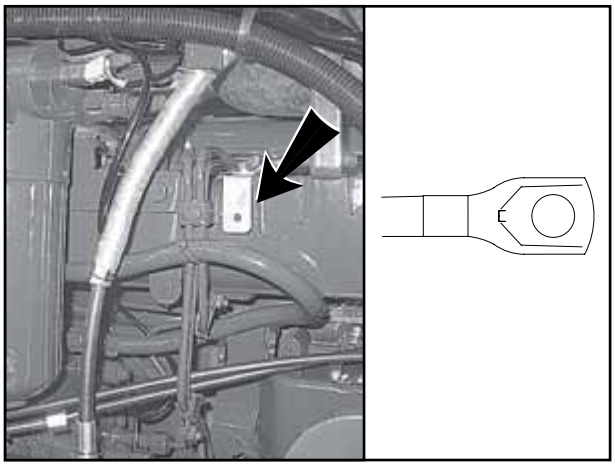


Fig. 10.617

Terminal (B24) for engine coolant temperature sensor

term.	wire colour	To con. or comp.	term.
1	VB	XS1	3

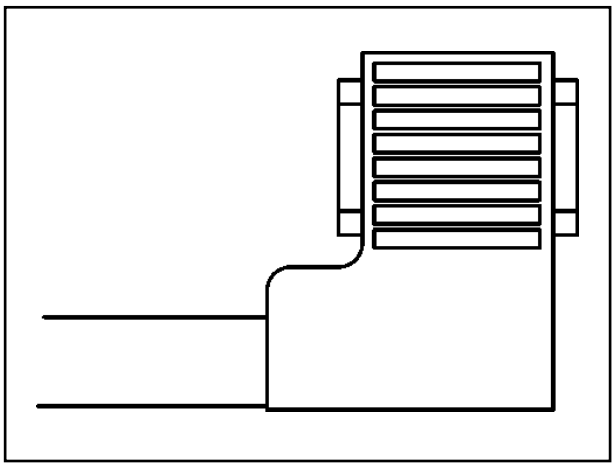


Fig. 10.618

Connector (B25) for headlight connection

term.	wire colour	To con. or comp.	term.
1A	V	B26 (junction)	
1B	VN	B26 (junction)	
1C	B	B23 (ground)	
2A	HN	B27 (junction)	
2B	H	B27 (junction)	
2C	B	B23 (ground)	

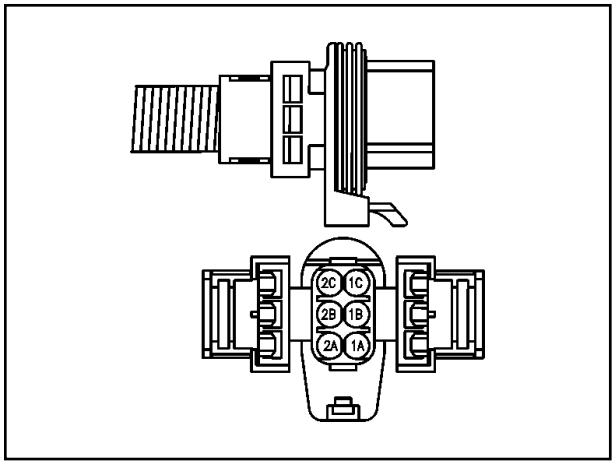


Fig. 10.619

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	B21	1
2	L	B21	1
3	VB	B24	1
4	R	B15	A
5	RV	B19	1
6	N	B13	2
7	CN	B28 (junction)	
8	LG	B17	1
9	M	B14	B
10	ZN	B10	1
11	HM	B8	1
12	GR	B9	1
13	not used		
14	Z	B11	1
15	V	B26 (junction)	
16	H	B27 (junction)	
17	GM	B16	B
18	V	B2	2
19	M	B2	1
20	G	B3	2
21	N	B3	1
22	GV	B1	1
23	BN	B12	1
24	ZH	B22	1
25	BN	B12	1
26	M	B14	B
27	M	B14	B
28	R	B15	A
29	not used		
30	not used		
31	L	B14	A
32	R	B15	A
33	LN	B14	A
34	LN	B14	A

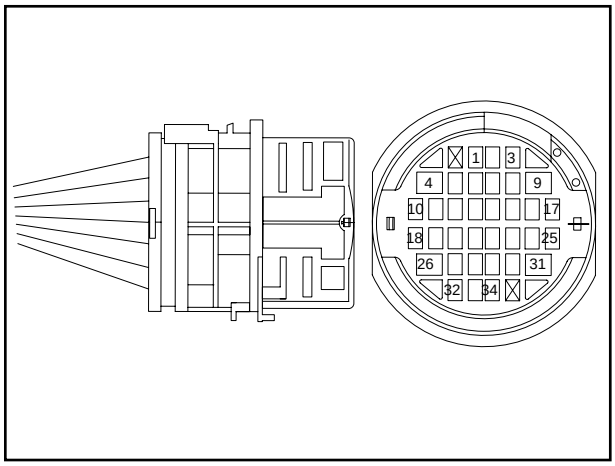


Fig. 10.620

3.9.6 Dashboard line

3.9.6.1 General description

The dashboard line powers the controls installed in front of the driver (Fig.10.621), such as the switches that control the headlights, the light switch lever, etc. It also connects with the fuses that protect the tractor's entire electrical system (Fig.10.622).

The dashboard line is connected to the front engine line via connection to the terminal boards (XS1), to the rear line via terminal boards (XS2), 0to the platform line by means of the terminal boards (XS3)(Fig.10.624) and to the roof line by means of the terminal boards (XS5) (Fig.10.623) in each wiring line.

Fig. 10.621

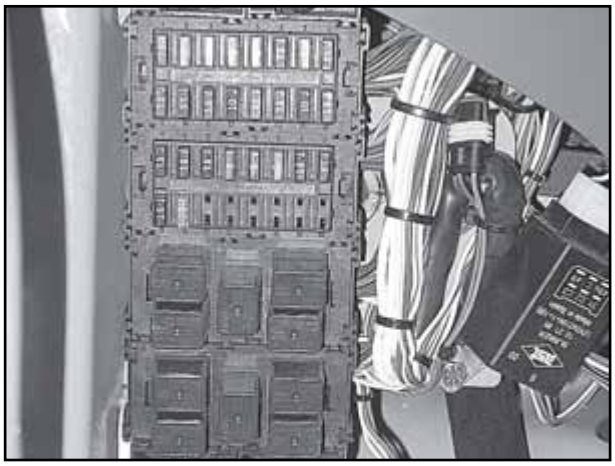


Fig. 10.622

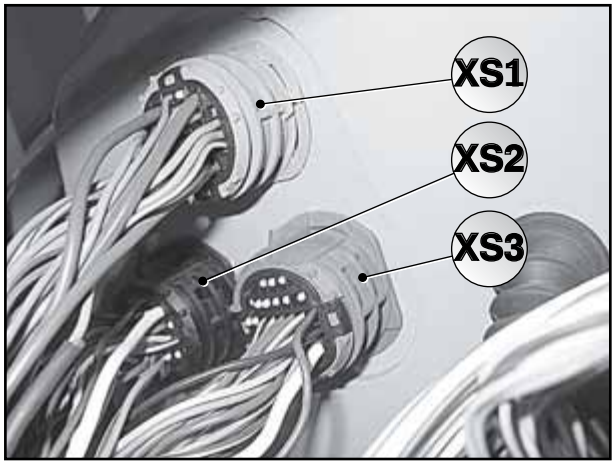


Fig. 10.624

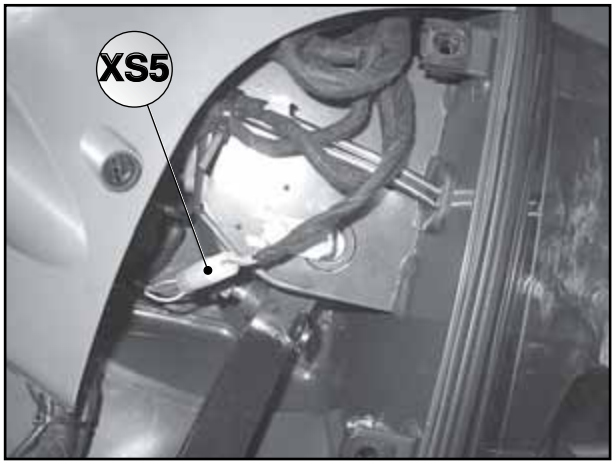


Fig. 10.623

3.9.6.2 Wiring

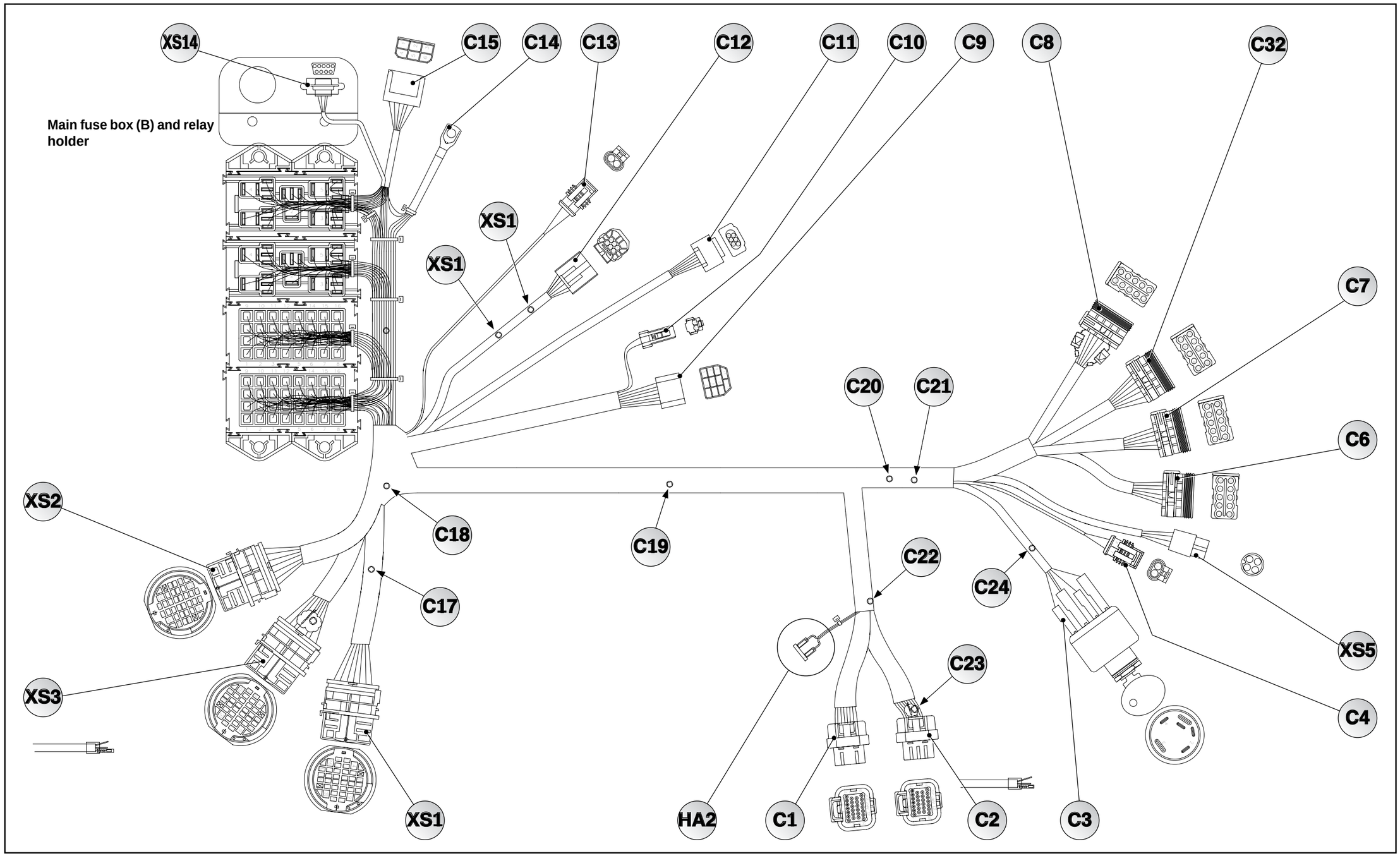


Fig. 10.625

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C5 - Connector for connecting the roof line
C6 - Connector for side lights switch
C7 - Connector for revolving beacon switch
C8 - Connector for emergency switch
C9 - Connector for light switch
C10 - Connector for light switch
C11 - Connector for clutch pedal potentiometer
C12 - Connector for reverse shuttle lever connection
C13 - Connector for Park Lock engaging microswitch
C14 - Grounding eyelet
C15 - Connector for blinker
C16-C31 - Junctions
C32 - Connector for field light switch
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
XS14 - Serial socket for connection to PC

3.9.6.3 Connector locations

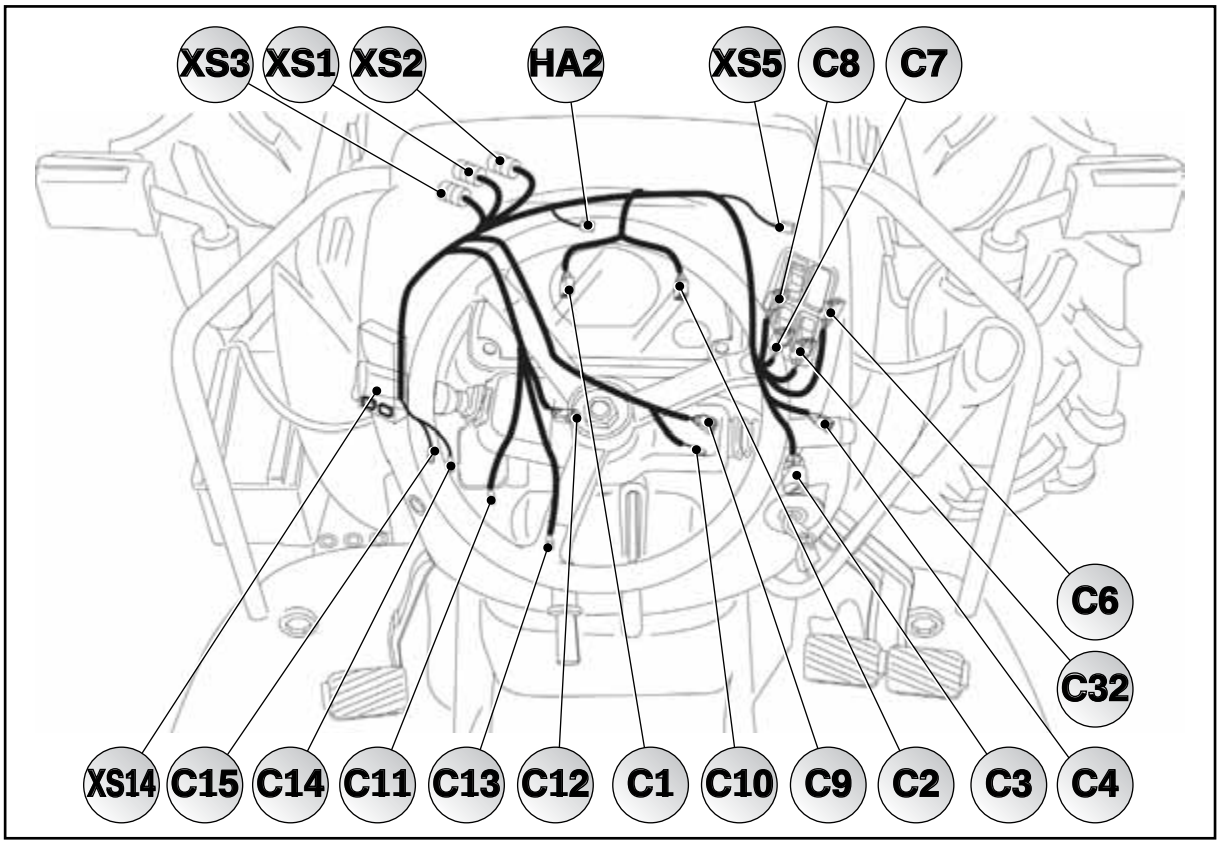


Fig. 10.626

C1 - Connector for instrument
C2 - Connector for instrument
C3 - Faston terminals for ignition switch
C4 - Connector for brake oil pressure sensor
C5 - Connector for connecting the roof line
C6 - Connector for side lights switch
C7 - Connector for revolving beacon switch
C8 - Connector for emergency switch
C9 - Connector for light switch
C10 - Connector for light switch
C11 - Connector for clutch pedal potentiometer
C12 - Connector for reverse shuttle lever connection
C13 - Connector for Park Lock engaging microswitch
C14 - Grounding eyelet
C15 - Connector for blinker
C32 - Connector for field light switch
HA2 - Connector for horn (alarm buzzer)
XS1 - Terminal board for front line/dashboard connection
XS2 - Terminal board for rear line/dashboard connection
XS3 - Terminal board for platform line/dashboard connection
XS5 - Terminal board for roof/dashboard line connection
XS14 - Serial socket for connection to PC

3.9.6.4 Connector identification

Connector (C1) for instrument

term.	wire colour	To con. or comp.	term.
1	RN	C22 (junction)	
2	ZN	XS2	13
3	RV	XS1	5
4	ZL	XS3	32
5	not used		
6	HL	XS2	15
7	LG	XS1	8
8	R	F5	5A
9	ZH	XS1	24
10	SV	XS3	5
11	BR	K8	3
12	not used		
13	not used		
14	B	C19 (junction)	
15	not used		
16	not used		
17	not used		
18	not used		
19	BN	XS2	12
20	not used		
21	V	K9	5
22	HG	C21 (junction)	
23	G	C25 (junction)	
24	V	C26 (junction)	
25	GN	C15	5
26	GV	C15	2

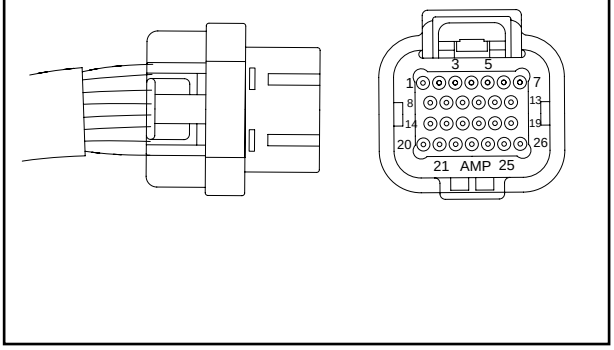


Fig. 10.627

Connector (C2) for instrument

term.	wire colour	To con. or comp.	term.
1	not used		
2	not used		
3	not used		
4	N	C23 (junction)	
5	M	XS3	24
6	B	XS3	25
7	RN	C22 (junction)	
8	not used		
9	HB	HA2	-
10	HM	F16	6
11	not used		
12	not used		
13	R	F5	5A
14	SG	XS3	11
15	VB	XS2	5
16	HL	XS2	3
17	N	C3	3
18	not used		
19	B	C24 (junction)	
20	not used		
21	VB	XS1	3
22	S	XS3	12
23	not used		
24	not used		
25	not used		
26	not used		

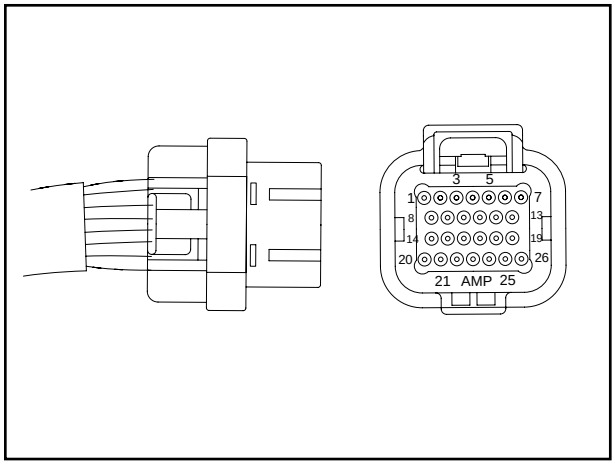


Fig. 10.628

Ignition switch faston terminals (C3)

term.	wire colour	To con. or comp.	term.
1	R	XS1	4
2	M	C24 (junction)	
3	N-N	XS1-C2	6-17
4	L	F20	2

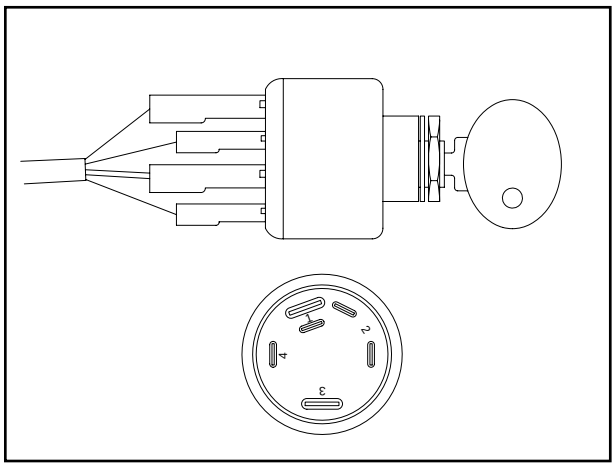


Fig. 10.629

Brake oil pressure sensor connector (C4)

term.	wire colour	To con. or comp.	term.
1	M	K3	3
2	GL	K3	2

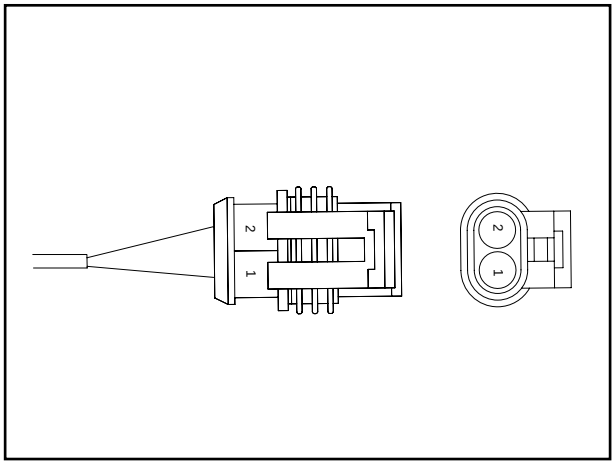


Fig. 10.630

Connector (C6) for side lights switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	C29 (junction)	
3	HR	C9	4
4	not used		
5	RN	F15	15A
6	N	C18 (junction)	
7	B	C19 (junction)	
8	HG	C21 (junction)	
9	B	C19 (junction)	
10	N	C18 (junction)	

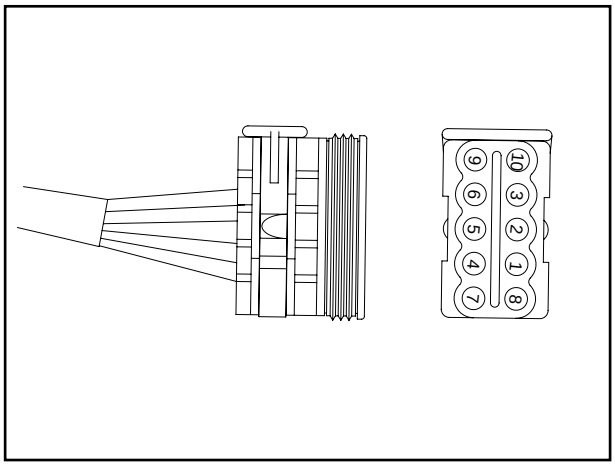


Fig. 10.631

Revolving beacon switch connector (C7)

term.	wire colour	To con. or comp.	term.
1	not used		
2	R	F27	16A
3	GV	C30 (junction)	
4	not used		
5	not used		
6	not used		
7	B	C19 (junction)	
8	HG	C21 (junction)	
9	B	C19 (junction)	
10	GV	C30 (junction)	

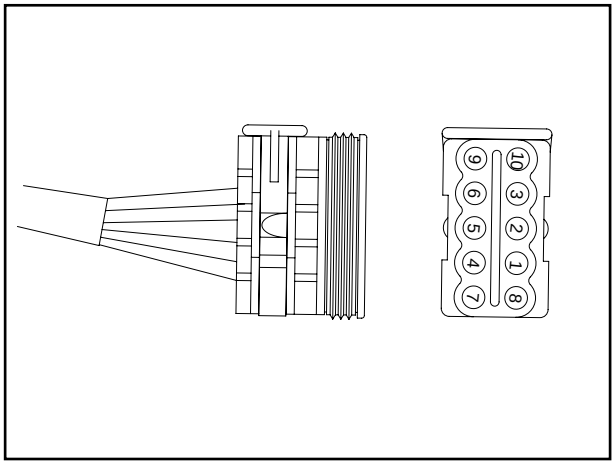


Fig. 10.632

Connector (C8) for emergency switch

term.	wire colour	To con. or comp.	term.
1	M	C29 (junction)	
2	BR	F12	12A
3	R	F36	7A
4	not used		
5	MB	C15	4
6	G (diode)	C25 (junction)	
7	not used		
8	B	C19 (junction)	
9	V (diode)	C26 (junction)	
10	HG	C20 (junction)	

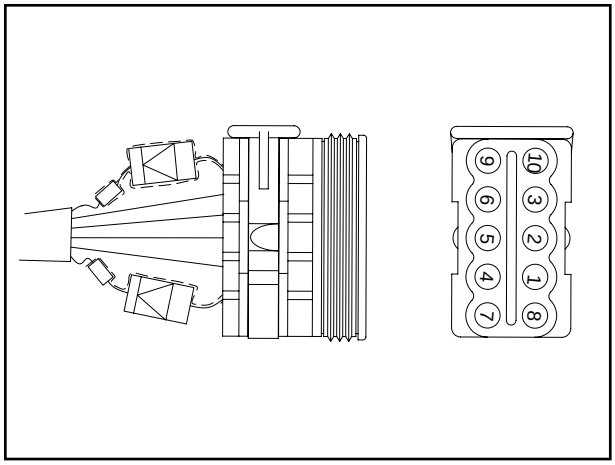


Fig. 10.633

Connector (C9) for light switch

term.	wire colour	To con. or comp.	term.
1	R	F27	16A
2	GV	K9	2
3	G	XS1-XS2-XS3-C25 (junction)	20-6-1
4	HR	C6	3
5	MB	C15	4
6	V	XS2-XS3-XS1-C26 (junction)	8-2-18
7	HR	K10	2
8	Z	XS1	14
9	M	C29 (junction)	
10	RN	F39	1A
11	B	C14 (ground)	

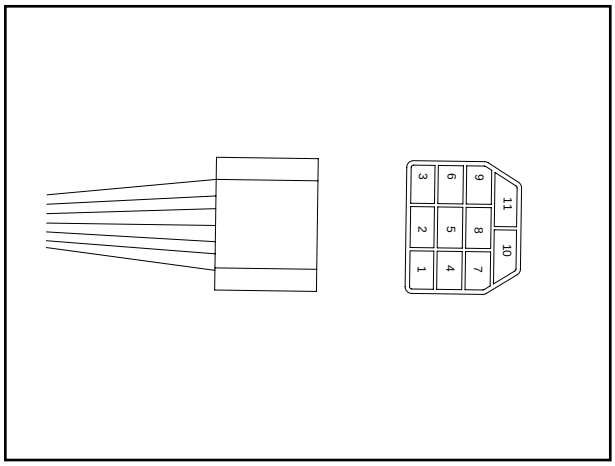


Fig. 10.634

Connector (C10) for light switch

term.	wire colour	To con. or comp.	term.
1	GR	XS3	8
2	RV	XS3	7

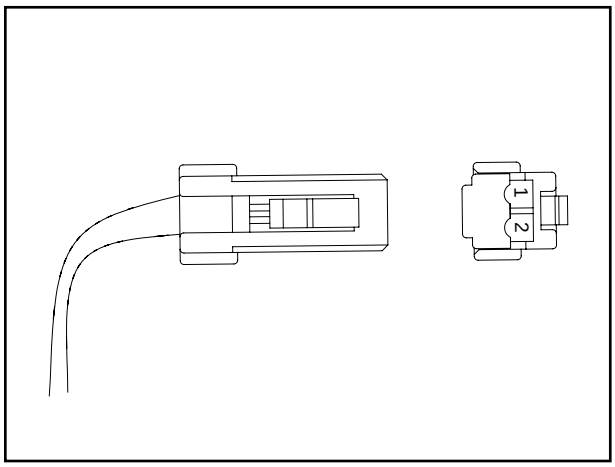


Fig. 10.635

Clutch pedal potentiometer connector (C11)

term.	wire colour	To con. or comp.	term.
1	RN	C27 (junction)	
2	BR	C28 (junction)	
3	not used		
4	HG	XS3	31
5	not used		
6	not used		

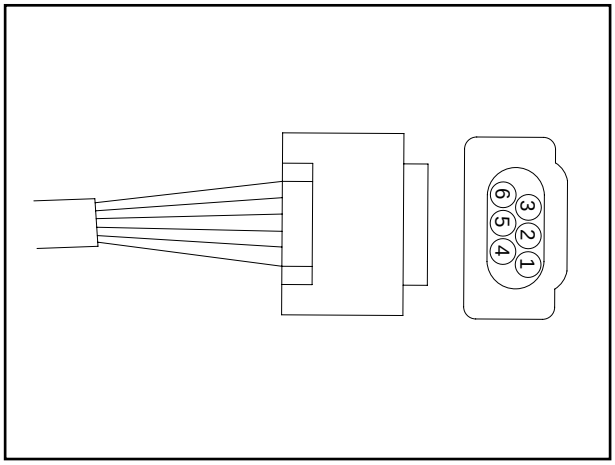


Fig. 10.636

Reverse shuttle lever connector (C12)

term.	wire colour	To con. or comp.	term.
1	ZN	XS3	22
2	RN	C27 (junction)	
3	BR	C28 (junction)	
4	ZL	K15	3
5	Z	K1	2
6	not used		

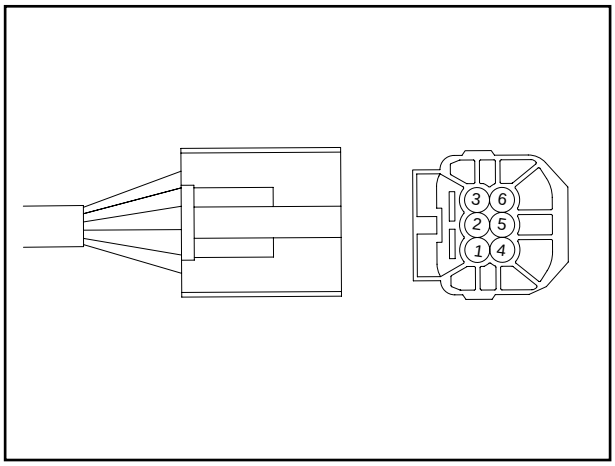


Fig. 10.637

Blinker connector (C13)

term.	wire colour	To con. or comp.	term.
1	LR	XS3	18
2	VB	XS3	23

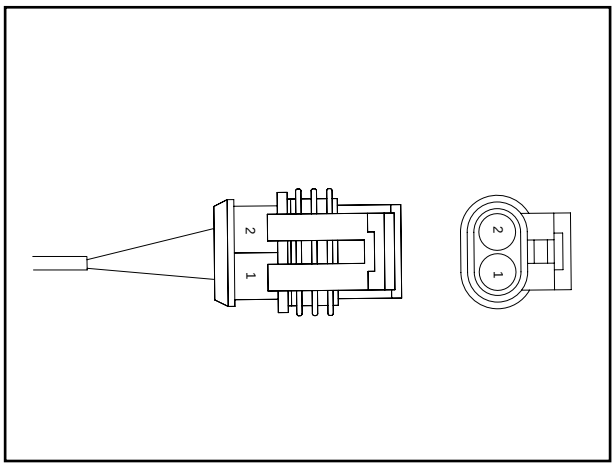


Fig. 10.638

Grounding eyelet (C14)

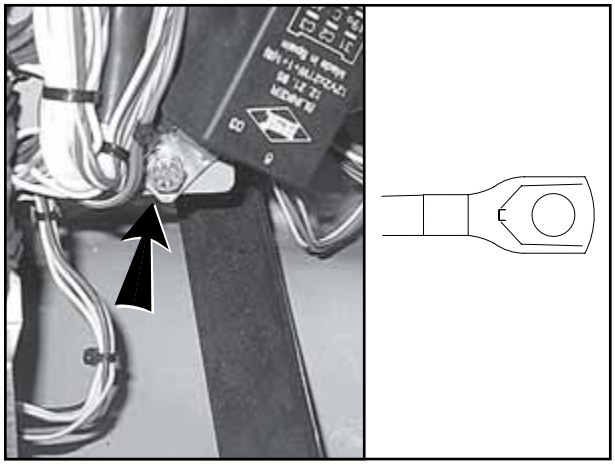


Fig. 10.639

Blinker connector (C15)

term.	wire colour	To con. or comp.	term.
1	B	C14 (ground)	
2	GV	C1	26
3	not used		
4	MB-MB	C9-C8	5-5
5	GN	C1	25
6	BR	F12	12

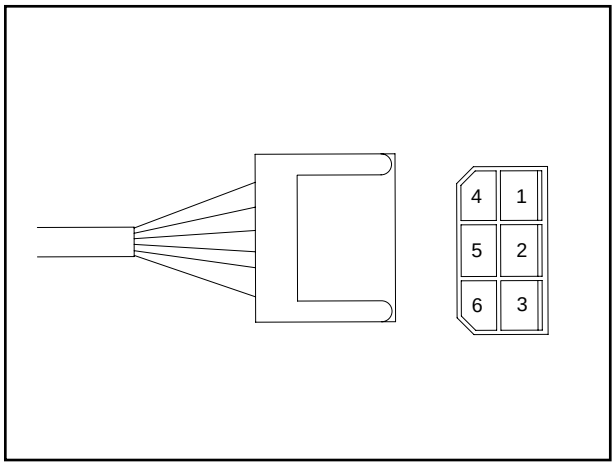


Fig. 10.640

Connector (C32) for field light switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	H	F21	3
3	HN	C31 (junction)	
4	not used		
5	not used		
6	not used		
7	B	C19 (junction)	
8	HG	C20 (junction)	
9	B	C19 (junction)	
10	HN	C31 (junction)	

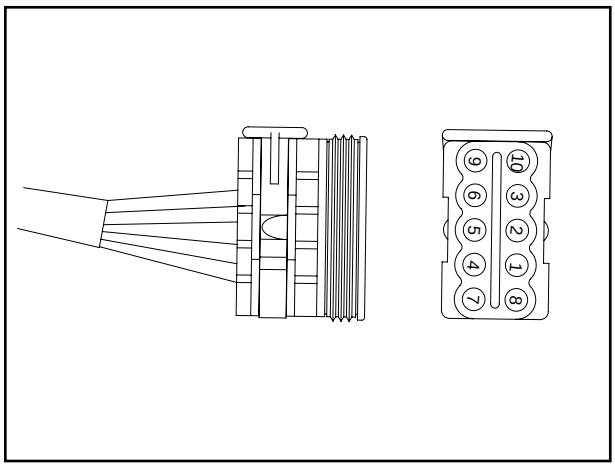


Fig. 10.641

Connector (HA2) for horn (buzzer)

term.	wire colour	To con. or comp.	term.
-	HB	C2	9
+	RN	F22	4A

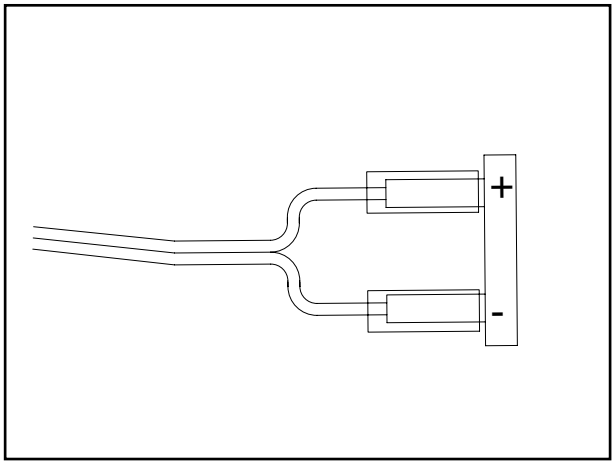


Fig. 10.642

Terminal board (XS1) for front line/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	L	K1	5
2	L	K1	5
3	VB	C2	21
4	R	C3	1
5	RV	C1	3
6	N	C3	3
7	CN	F6	6A
8	LG	C1	7
9	M	K3	3
10	not used		
11	HM	F16	6A
12	not used		
13	not used		
14	Z	C9	8
15	V	K3	5
16	H	K10	5
17	GM	XS5	2
18	V	C9	6
19	M	C20 (junction)	
20	G	C9	3
21	N	C21 (junction)	
22	GV	C30 (junction)	
23	BN	XS2	30
24	ZH	C1	9
25	not used		
26	M	C17 (junction)	
27	M	K11	3
28	R	K2	5
29	not used		
30	not used		
31	L	K4	3
32	R	K2	5
33	LB	F25	9
34	LN	F27	16

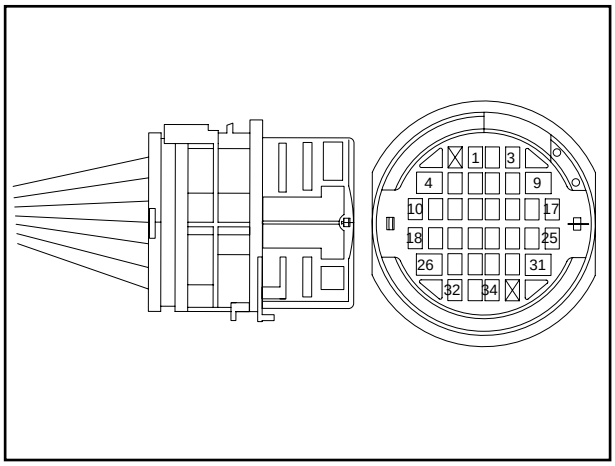


Fig. 10.643

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	K8	3
2	GL	XS3	33
3	HL	C2	16
4	B	C14 (ground)	
5	VB	C2	15
6	G	C9	3
7	M	C20 (junction)	
8	V	C9	6
9	R	F26	10A
10	N	C21 (junction)	
11	R	F8	8A
12	BN	C1	19
13	ZN	C1	2
14	BV	F1	1
15	HL	C2	6
16	MV	K15	2
17	BV	F1	1
18	VN	K15	4
19	not used		
20	not used		
21	not used		
22	not used		
23	not used		
24	not used		
25	not used		
26	not used		
27	not used		
28	not used		
29	not used		
30	BN	XS1	23
31	AN	F25	9A
32	not used		
33	not used		
34	not used		

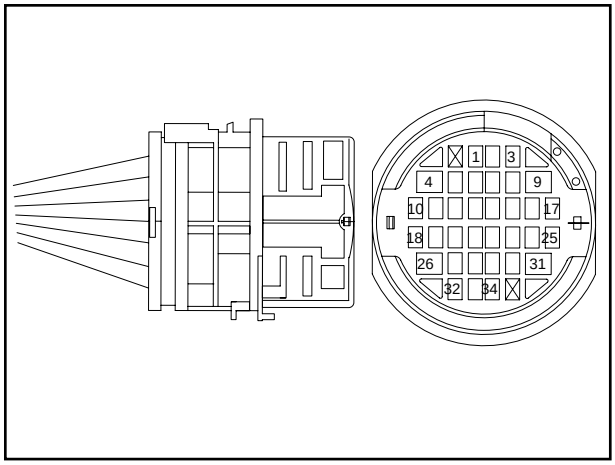


Fig. 10.644

Terminal board (XS3) for platform/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	G	C9	3
2	V	C9	6
3	N	C21 (junction)	
4	ZB	C27 (junction)	
5	SV	C1	10
6	G	XS14	2
7	RV	C10	2
8	GR	C10	1
9	RN	F30	12A
10	HN	C31 (junction)	
11	SG	C2	14
12	S	C2	22
13	HM	F16	6
14	RN	F17	5
15	BR	K8	2
16	SN	F18	8A
17	HR	F7	7
18	LR	C13	1
19	MR	F24	4
20	R	F8	8A
21	L	C28 (junction)	
22	ZN	C12	1
23	VB	C13	2
24	M	C2	5
25	B	C2	6
26	B	C14 (ground)	
27	V	XS14	3
28	M	C20 (junction)	
29	RN	F29	3A
30	B	XS14	5
31	HG	C11	4
32	ZL	C1	4
33	GL	XS2	2
34	N	C16 (junction)	

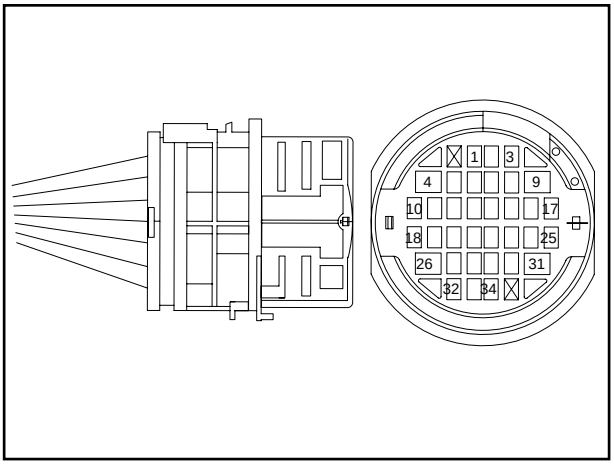


Fig. 10.645

Terminal board (XS5) for roof/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	M	F3	11
2	GM	XS1	17
3	B	C14 (ground)	
4	HG	C21 (junction)	

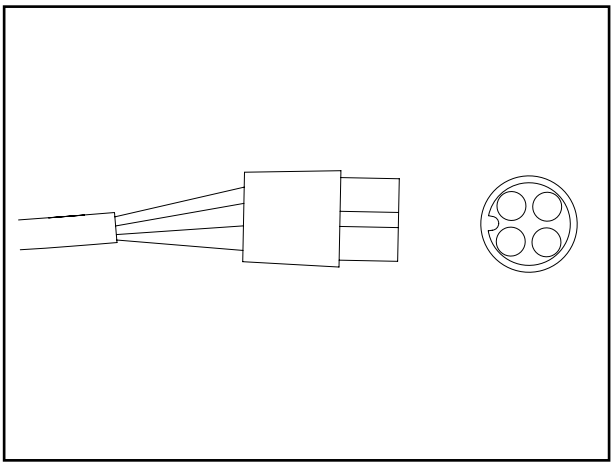


Fig. 10.646

3.9.7 Platform line

3.9.7.1 General description

The platform line connects the controls on the right-hand side of the platform, such as the switches and buttons for engaging/disengaging the 4WD and diff lock (Fig.10.647). It also connects the rear lights and auxiliary power socket.

It is connected to the dashboard line, by means of the connection between the terminal boards (XS3) (Fig.10.648) and to the rear line, by means of the connections between the terminal boards (XS4) (Fig.10.649) in each wiring line.

Fig. 10.647

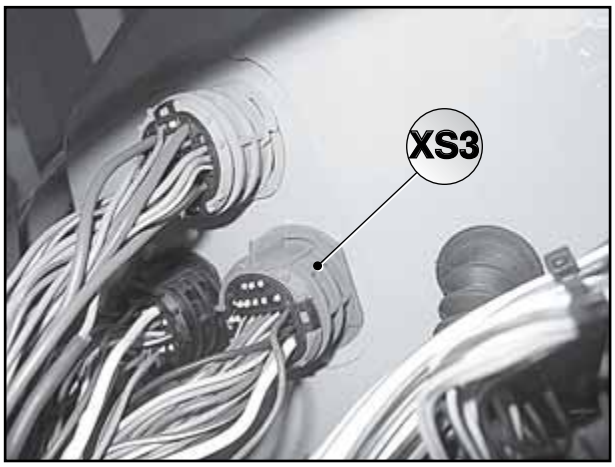


Fig. 10.648

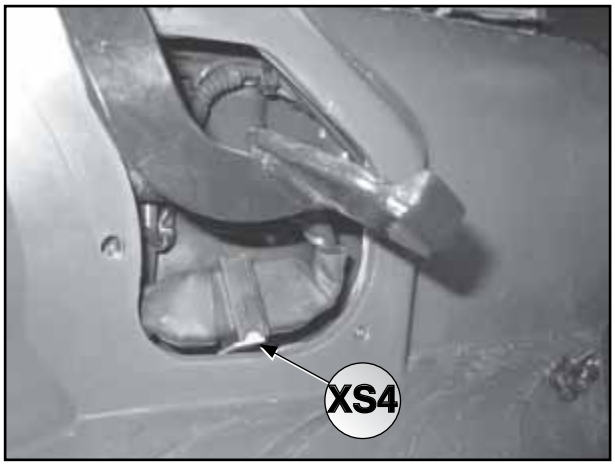


Fig. 10.649

3.9.7.2 Wiring

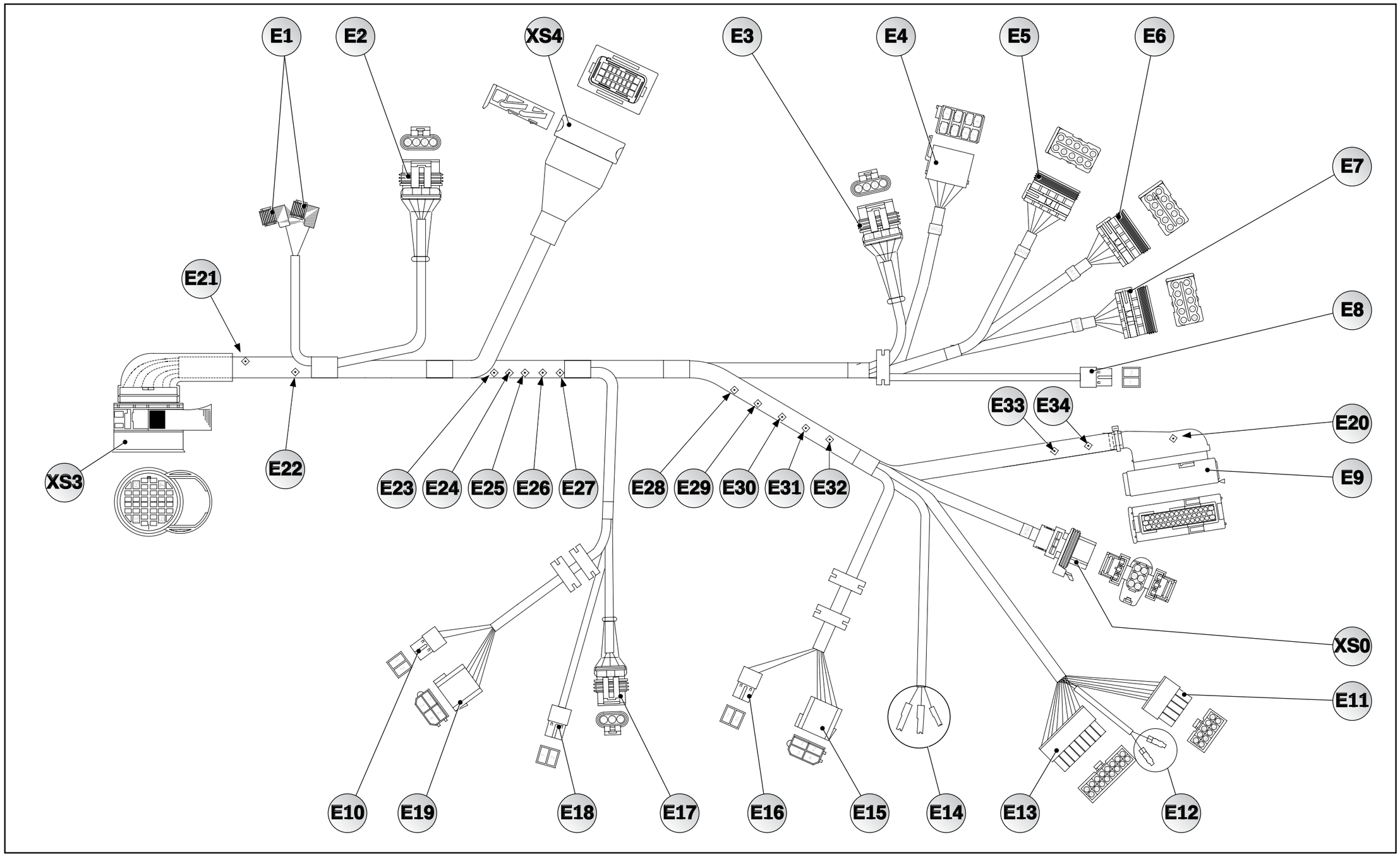


Fig. 10.650

E1 - Terminals for brake oil level sensor
E2 - Connector for Powerfive and Declutch button (gearshift lever)
E3 - Connector (not used)
E4 - Connector for rear PTO switch
E5 - Connector for differential lock button
E6 - Connector for 4WD engagement/disengagement switch
E7 - Connector for control button of auxiliary control valves (A-B)
E8 - Pneumatic seat connector
E9 - Electronic control unit connector
E10 - Connector for lh rear field light
E11 - Connector for resistive kit
E12 - Connector for resistive kit
E13 - Connector for resistive kit
E14 - Faston terminals for auxiliary power socket
E15 - Connector for rh external rear field light
E16 - Connector for rh external rear field light
E17 - Connector for fuel level sensor
E18 - Connector for licence plate light
E19 - Connector for lh rear field light
E20-E34 - Junctions
XS0 - Terminal board for trailer socket connection
XS3 - Terminal board for platform/dashboard cable line connection
XS4 - Terminal board for platform/rear line cable connection

3.9.7.3 Connector locations

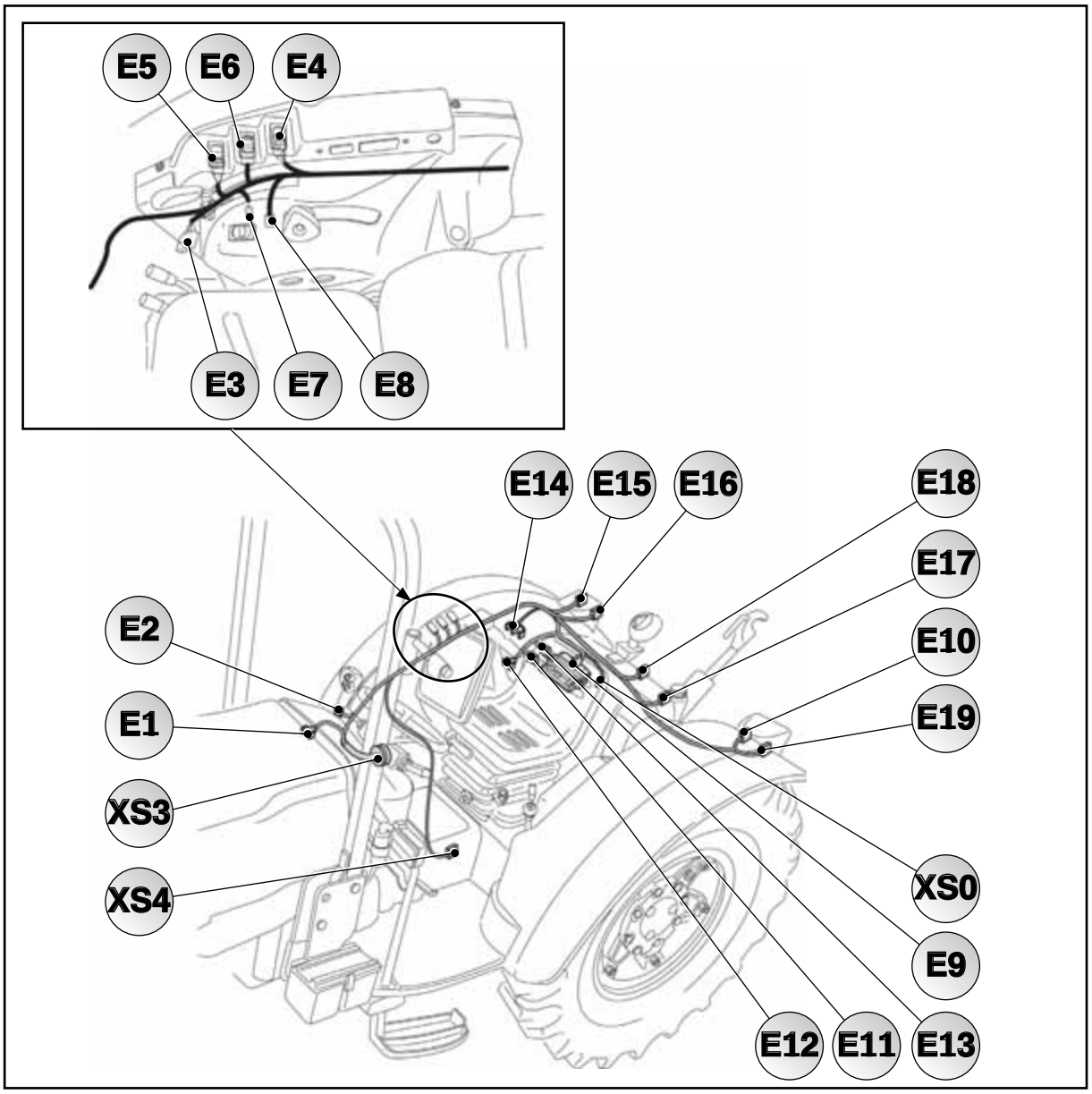


Fig. 10.651

3.9.7.4 Connector identification

Terminals (E1) for brake oil level sensor

term.	wire colour	To con. or comp.	term.
1	ZL	XS3	32
2	B	E22 (junction)	

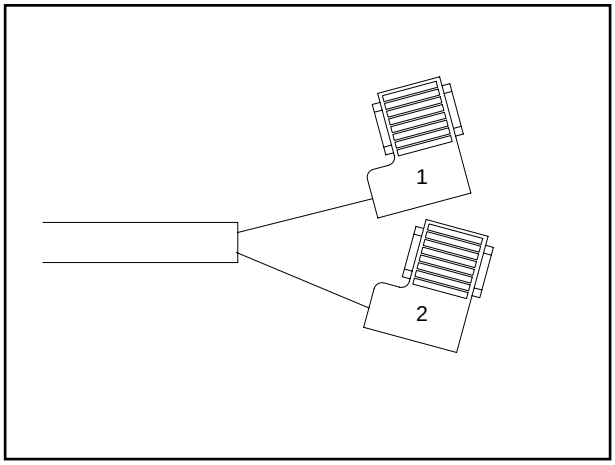


Fig. 10.652

Connector (E2) for Powerfive and Declutch button (gearshift lever)

term.	wire colour	To con. or comp.	term.
1	RN	E29 (junction)	
2	C	E9	3
3	RN	E29 (junction)	
4	V	E9	2

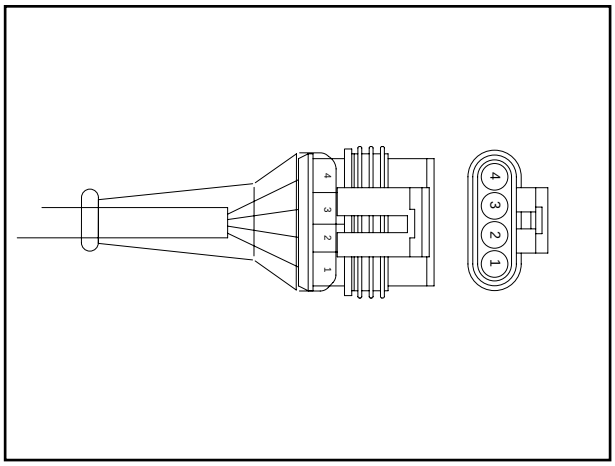


Fig. 10.653

Connector (E3) not used

term.	wire colour	To con. or comp.	term.
1	M	E23 (junction)	
2	B	E22 (junction)	
3	RN	XS3	14
4	HM	XS3	13

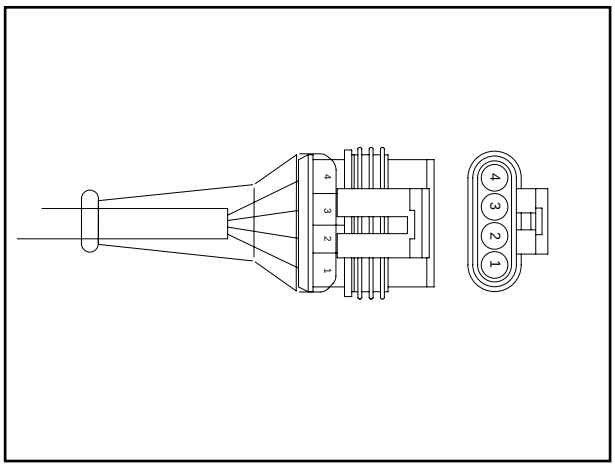


Fig. 10.654

Connector (E4) for rear PTO switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	VB	XS4	C6
3	VN-VN	XS4-E9	C7-4
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	

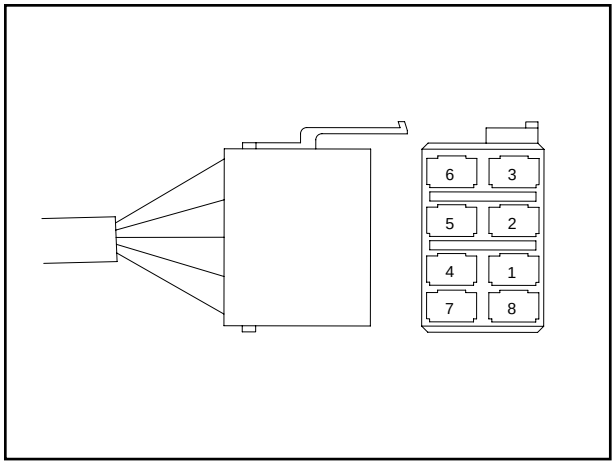


Fig. 10.655

Connector (E5) for differential lock button

term.	wire colour	To con. or comp.	term.
1	not used		
2	BR	XS3	16
3	MV	XS3	15
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	
9	not used		
10	not used		

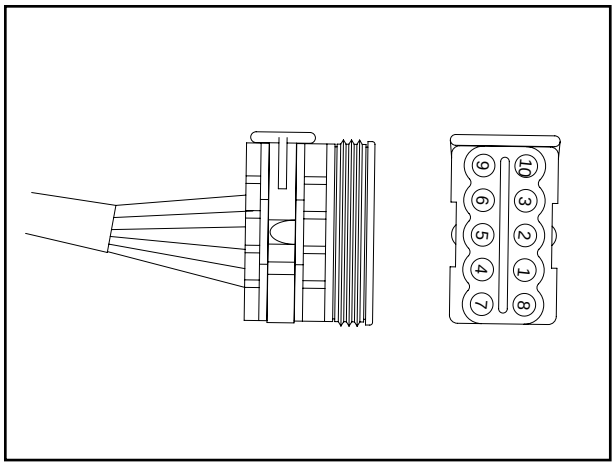


Fig. 10.656

Connector (E6) for 4WD engagement/disengagement switch

term.	wire colour	To con. or comp.	term.
1	GL	XS3	33
2	HR	XS3	17
3	SV	XS3	5
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	
9	not used		
10	not used		

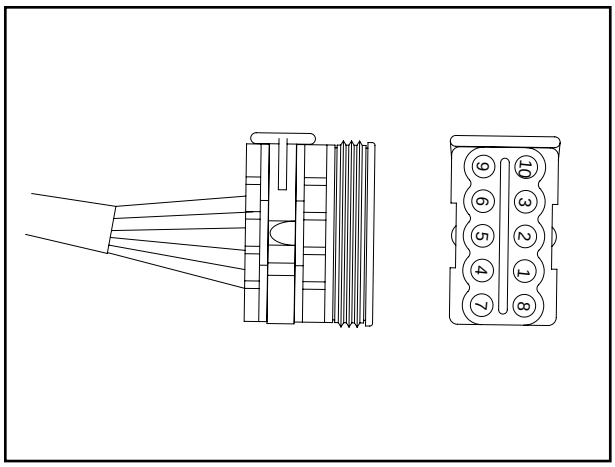


Fig. 10.657

Connector (E7) for control button of auxiliary control valves (A-B)

term.	wire colour	To con. or comp.	term.
1	GN	XS3	A3
2	MR	XS3	19
3	AV	XS3	A2
4	not used		
5	not used		
6	not used		
7	B	E22 (junction)	
8	M	E23 (junction)	
9	B	E22 (junction)	
10	M	E23 (junction)	

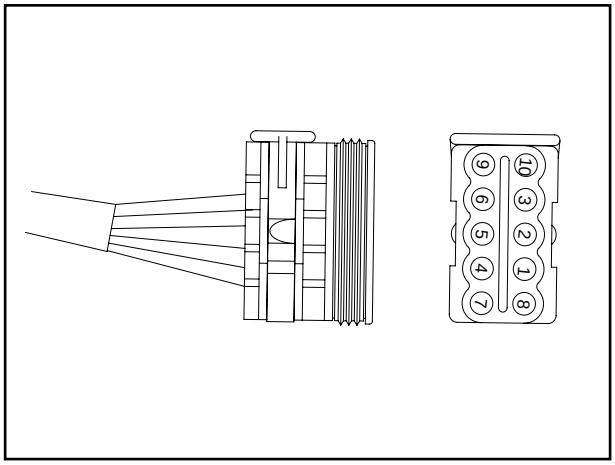


Fig. 10.658

Pneumatic seat connector (E8)

term.	wire colour	To con. or comp.	term.
1	RN	XS3	9
2	B	E22 (junction)	

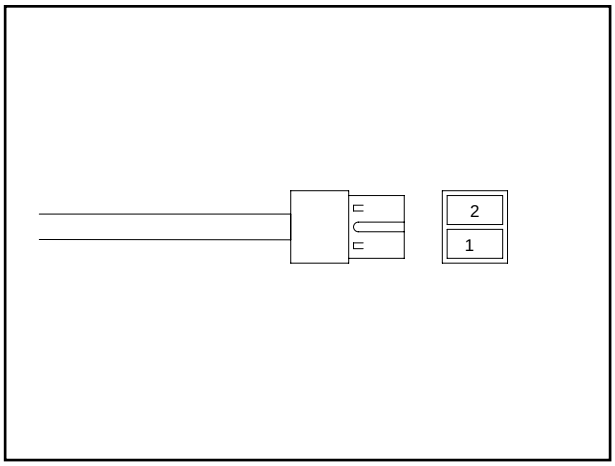


Fig. 10.659

Electronic controller connector (E9)

term.	wire colour	To con. or comp.	term.
1	BR	E29 (junction)	
2	V	E2	4
3	C	E2	2
4	VN	E4	3
5	RN	E29 (junction)	
6	SB	XS4	B5
7	BR	XS4	B7
8	AR	XS4	B4
9	LR	XS4	B6
10	not used		
11	not used		
12	CN	E31 (junction)	
13	B	XS3	30
14	RN	E30 (junction)	
15	BN	E28 (junction)	
16	AN	E34 (junction)	
17	LN	E34 (junction)	
18	CL	E33 (junction)	
19	SN	E33 (junction)	
20	G	XS3	6
21	V	XS3	27
22	ZH	XS4	C2
23	BV	XS4	C8
24	ZL	XS4	C3
25	AG	XS4	C4
26	not used		
27	not used		
28	RN	E29 (junction)	
29	BN	E29 (junction)	
30	not used		
31	HG	E30 (junction)	
32	ZN	XS3	22
33	not used		
34	not used		
35	R	E32 (junction)	
36	VB	E32 (junction)	
37	M	XS3	24
38	B	XS3	25
39	N	E20 (junction)	
40	BG	XS4	A4
41	not used		
42	RN	E29 (junction)	

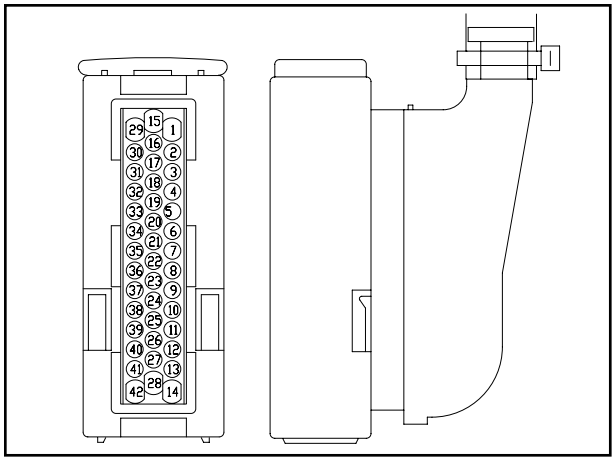


Fig. 10.660

Connector (E10) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B	E19	1
2	GR	XS3	8

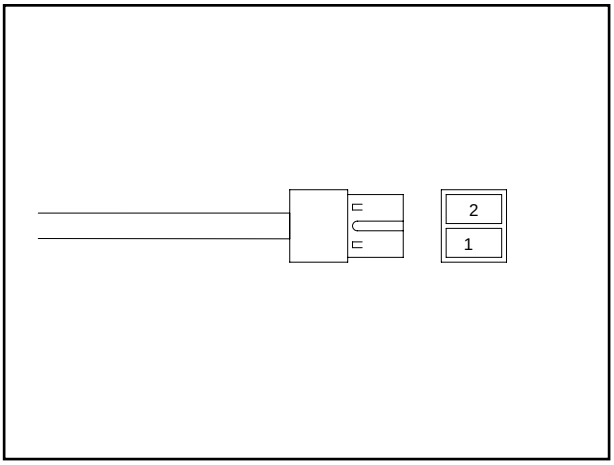


Fig. 10.661

Connector (E11) for resistive kit

term.	wire colour	To con. or comp.	term.
1	RN	E30 (junction)	
2	VB	E32 (junction)	
3	R	E32 (junction)	
4	not used		
5	HG	E30 (junction)	
6	AN	E34 (junction)	
7	LN	E34 (junction)	
8	CL	E33 (junction)	
9	SN	E33 (junction)	
10	NR	E29 (junction)	

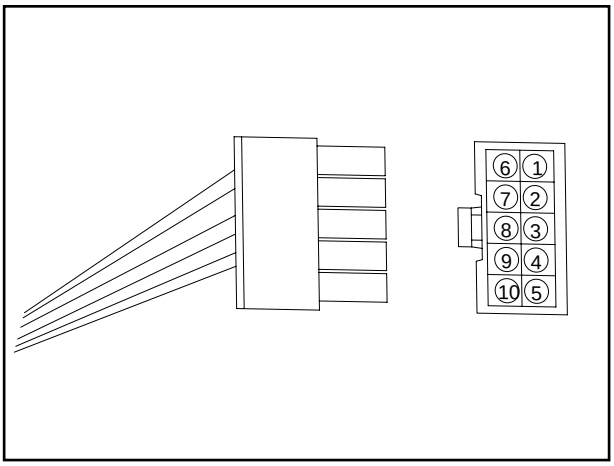


Fig. 10.662

Connector (E12) for resistive kit

term.	wire colour	To con. or comp.	term.
1	HN	XS3	10
2	B	E22 (junction)	

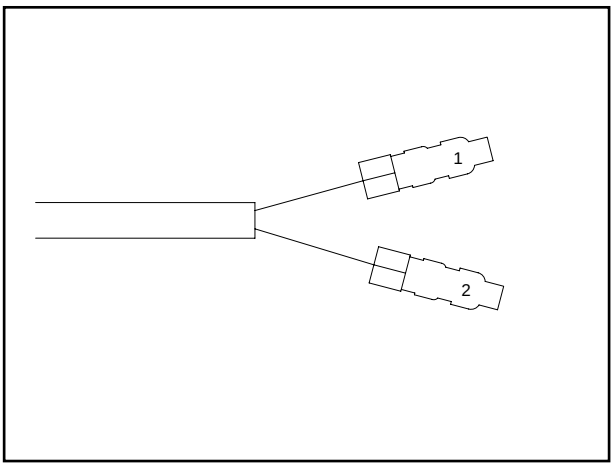


Fig. 10.663

Connector (E13) for resistive kit

term.	wire colour	To con. or comp.	term.
1	not used		
2	not used		
3	not used		
4	not used		
5	not used		
6	not used		
7	not used		
8	not used		
9	R	E32 (junction)	
10	SV	XS4	C5
11	VB	E32 (junction)	
12	LR	XS3	18
13	BR	E29 (junction)	
14	not used		
15	CN	E31 (junction)	
16	not used		

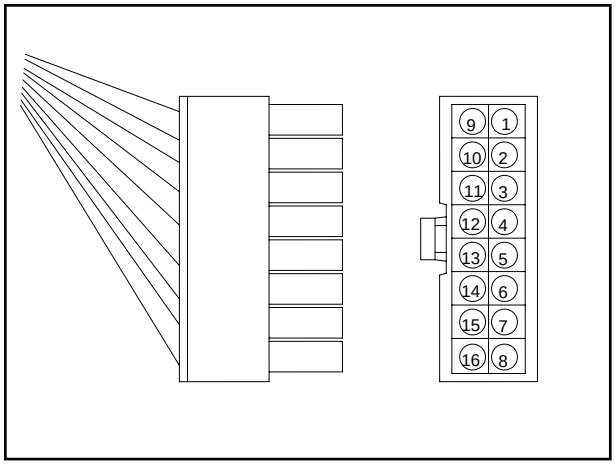


Fig. 10.664

Faston terminals (E14) for auxiliary power socket

term.	wire colour	To con. or comp.	term.
1	L	XS4	C1
2	B	E22 (junction)	
3	R	XS4	B1

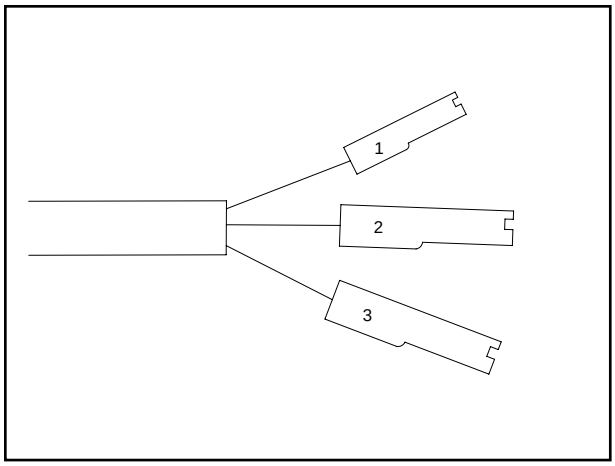


Fig. 10.665

Connector (E15) for rh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E7-E17 (junction)	1
2	V	E20 (junction)	
3	R	E18 (junction)	
4	M	E16 (junction)	

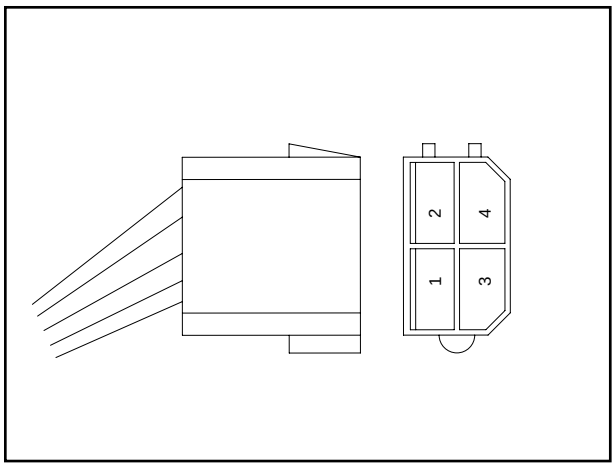


Fig. 10.666

Connector (E16) for rh external rear field light

term.	wire colour	To con. or comp.	term.
1	B	E15	1
2	RV	XS3	7

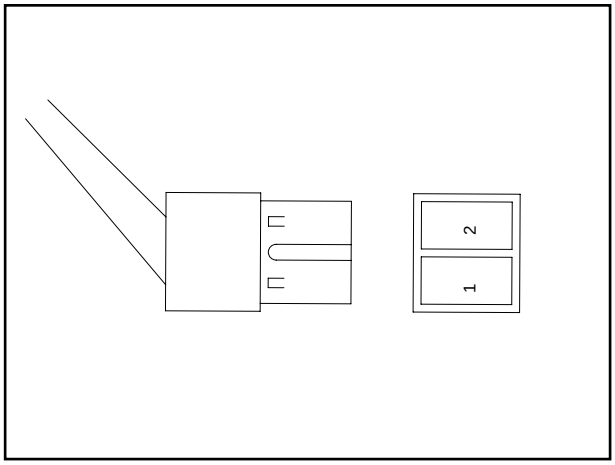


Fig. 10.667

Fuel level sensor connector (E17)

term.	wire colour	To con. or comp.	term.
1	SG	XS3	11
2	S	XS3	12
3	B	E22 (junction)	

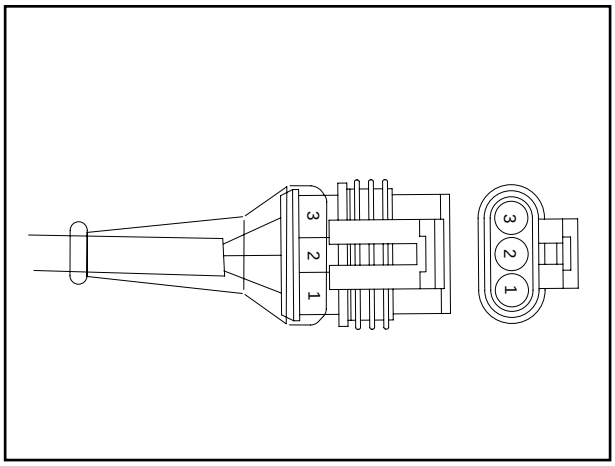


Fig. 10.668

Connector (E18) for licence plate light

term.	wire colour	To con. or comp.	term.
1	N	E24 (junction)	
2	B	E22 (junction)	

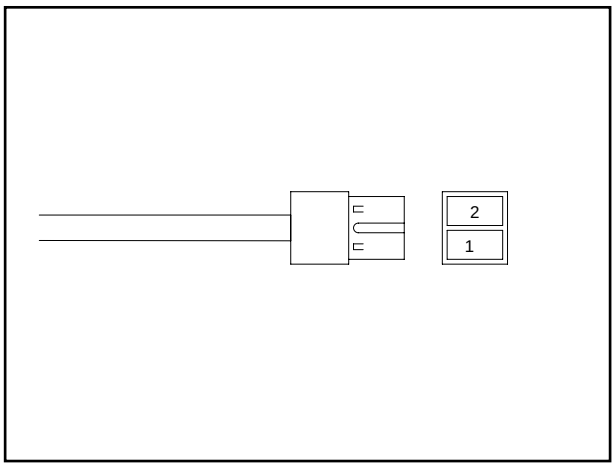


Fig. 10.669

Connector (E19) for lh rear field light

term.	wire colour	To con. or comp.	term.
1	B-B	E10-E22 (junction)	1
2	G	E26 (junction)	
3	R	E27 (junction)	
4	N	E24 (junction)	

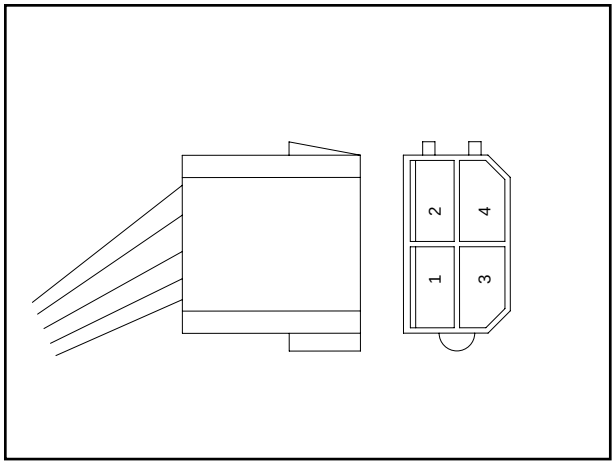


Fig. 10.670

Terminal board (XS0) for trailer socket connection

term.	wire colour	To con. or comp.	term.
1A	N	E24 (junction)	
1B	M	E23 (junction)	
1C	R	E27 (junction)	
2A	G	E26 (junction)	
2B	V	E25 (junction)	
2C	B	E22 (junction)	

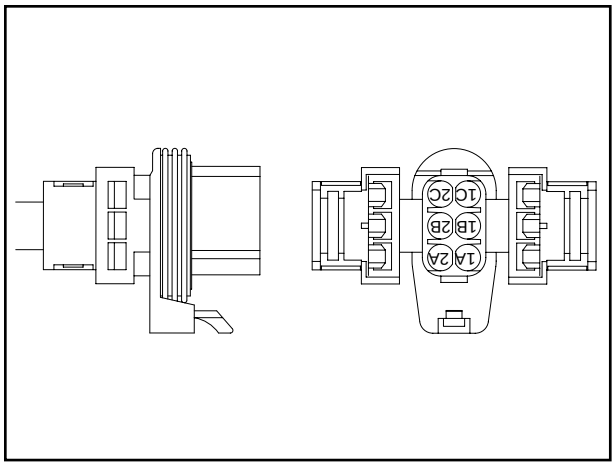


Fig. 10.671

Terminal board (XS3) for platform/dashboard wiring connection

term.	wire colour	To con. or comp.	term.
1	G	E26 (junction)	
2	V	E25 (junction)	
3	N	E24 (junction)	
4	RN	E30 (junction)	
5	SV	E6	3
6	G	E9	20
7	RV	E10	2
8	GR	E10	2
9	RN	E8	1
10	HN	I3	1
11	SG	E17	1
12	S	E17	2
13	HM	E3	4
14	RN	E3	3
15	BR	E5	3
16	MV	E5	2
17	HR	E6	2
18	LR	E13	4
19	MR	E7	2
20	R	E27 (junction)	
21	L	E29 (junction)	
22	ZN	E9	12
23	VB	E32 (junction)	
24	M	E9	37
25	B	E9	38
26	B	E22 (junction)	
27	V	E9	21
28	M	E23 (junction)	
29	RN	E29 (junction)	
30	B	E9	13
31	HG	E30 (junction)	
32	ZL	E1	1
33	GL	E6	1
34	N	E21 (junction)	

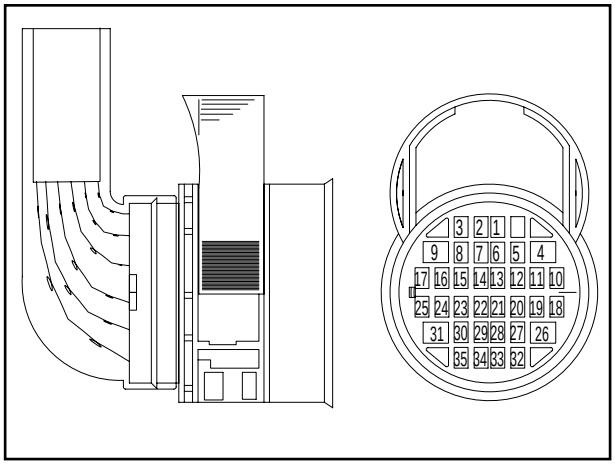


Fig. 10.672

Terminal board (XS4) for platform/rear wiring line connection

term.	wire colour	To con. or comp.	term.
A1	RN	E29 (junction)	
A2	AV	E7	3
A3	GN	E7	1
A4	BG	E9	40
A5	AN	E34 (junction)	
A6	LN	E34 (junction)	
A7	CL	E33 (junction)	
A8	BN	E28 (junction)	
B1	R	E14	3
B2	SN	E33 (junction)	
B3	CN	E31 (junction)	
B4	AR	E9	8
B5	SB	E9	6
B6	LR	E9	9
B7	BR	E9	7
B8	R	E32 (junction)	
C1	L	E14	1
C2	ZH	E9	22
C3	ZL	E9	24
C4	AG	E9	25
C5	SV	E13	10
C6	VB	E4	2
C7	VN	E4	3
C8	VB	E9	23

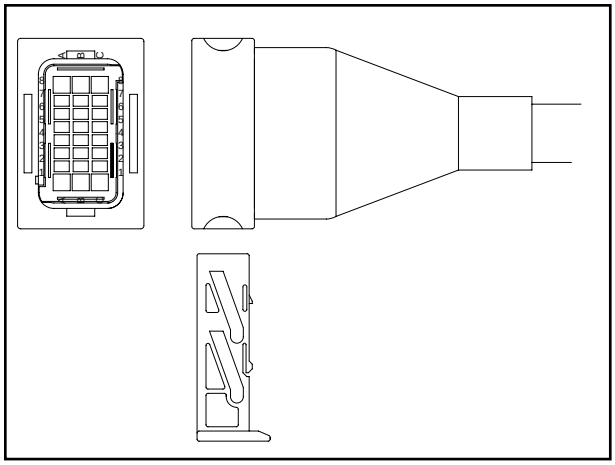


Fig. 10.673

3.9.8 Rear line

3.9.8.1 General description

The rear line powers the components installed on the transmission casing and hydraulic power packs, such as the sensor that detects the rear PTO rate (SR5 Fig.10.674) and the solenoid valves in the hydraulic power pack (10 Fig.10.675) for controlling users like the differential lock and four-wheel drive.

The rear line is connected to the dashboard line via connections between the terminal boards (XS2 Fig.10.677) and to the platform line by means of the terminal boards (XS4) (Fig.10.676)

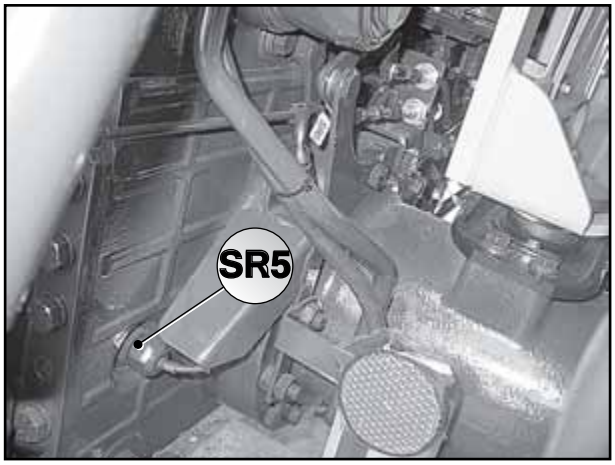


Fig. 10.674

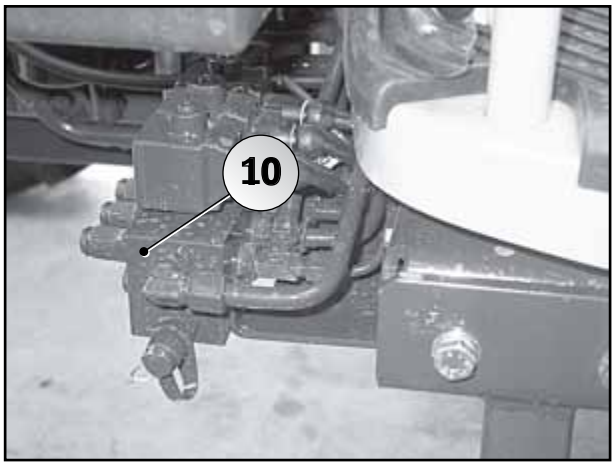


Fig. 10.675

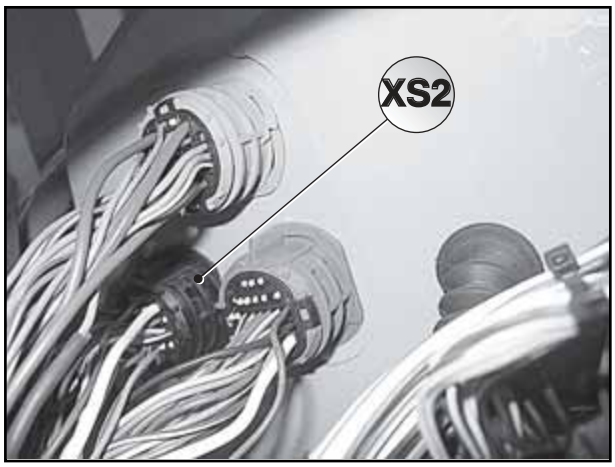


Fig. 10.677

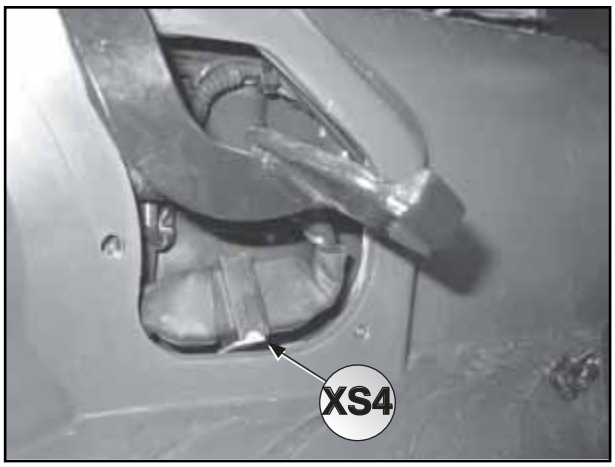


Fig. 10.676

3.9.8.2 Wiring

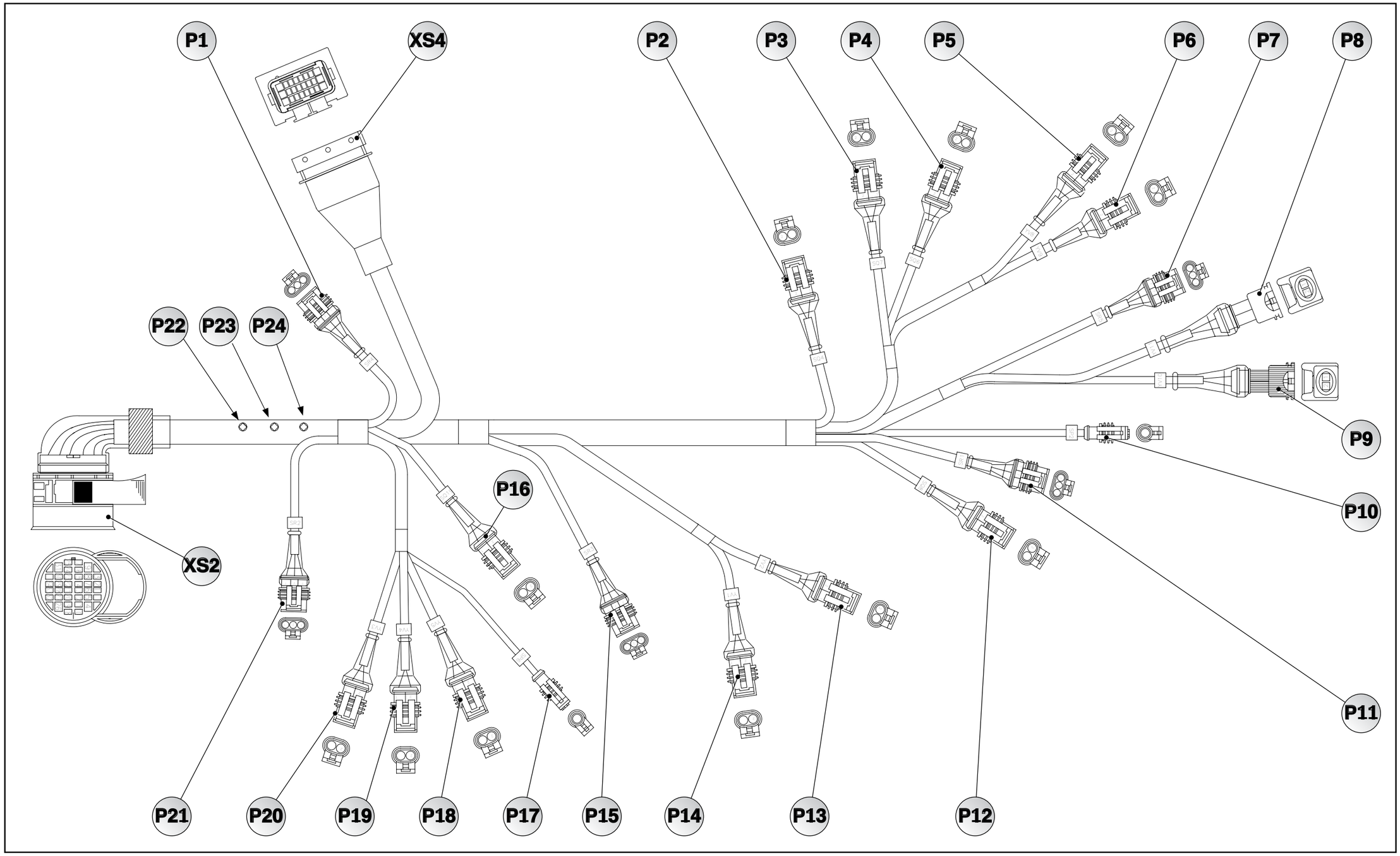


Fig. 10.678

P1 - Connector for rh sensor (Deltashift system)
P2 - Connector for parking brake hand lever microswitch
P3 - Connector for fast rear PTO microswitch
P4 - Connector for slow rear PTO microswitch
P5 - Connector for solenoid valve of rear PTO brake
P6 - Connector for solenoid valve of rear PTO clutch
P7 - Connector for rear PTO RPM sensor
P8 - Connector for solenoid valve (YV11) of auxiliary control valve B
P9 - Connector for solenoid valve (YV10) of auxiliary control valve A
P10 - Trailer brake pressure switch connector
P11 - Connector for ground speed sensor
P12 - Connector for proportional rear PTO microswitch
P13 - Connector (YV2) for secondary clutch solenoid valve
P14 - Connector (YV1) for main clutch solenoid valve
P15 - Connector for lh sensor (Deltashift system)
P16 - Connector for ignition enabling microswitch
P17 - Connector for pressure switch (14 bar)
P18 - Connector for “Power Five” solenoid valve
P19 - Connector for 4WD solenoid valve
P20 - Connector for differential lock solenoid valve
P21 - Connector for engine rate sensor
P22-P24 - Junctions
XS2 - Terminal board for rear line/dashboard connection
XS4 - Terminal board for platform line/rear line connection

3.9.8.3 Connector locations

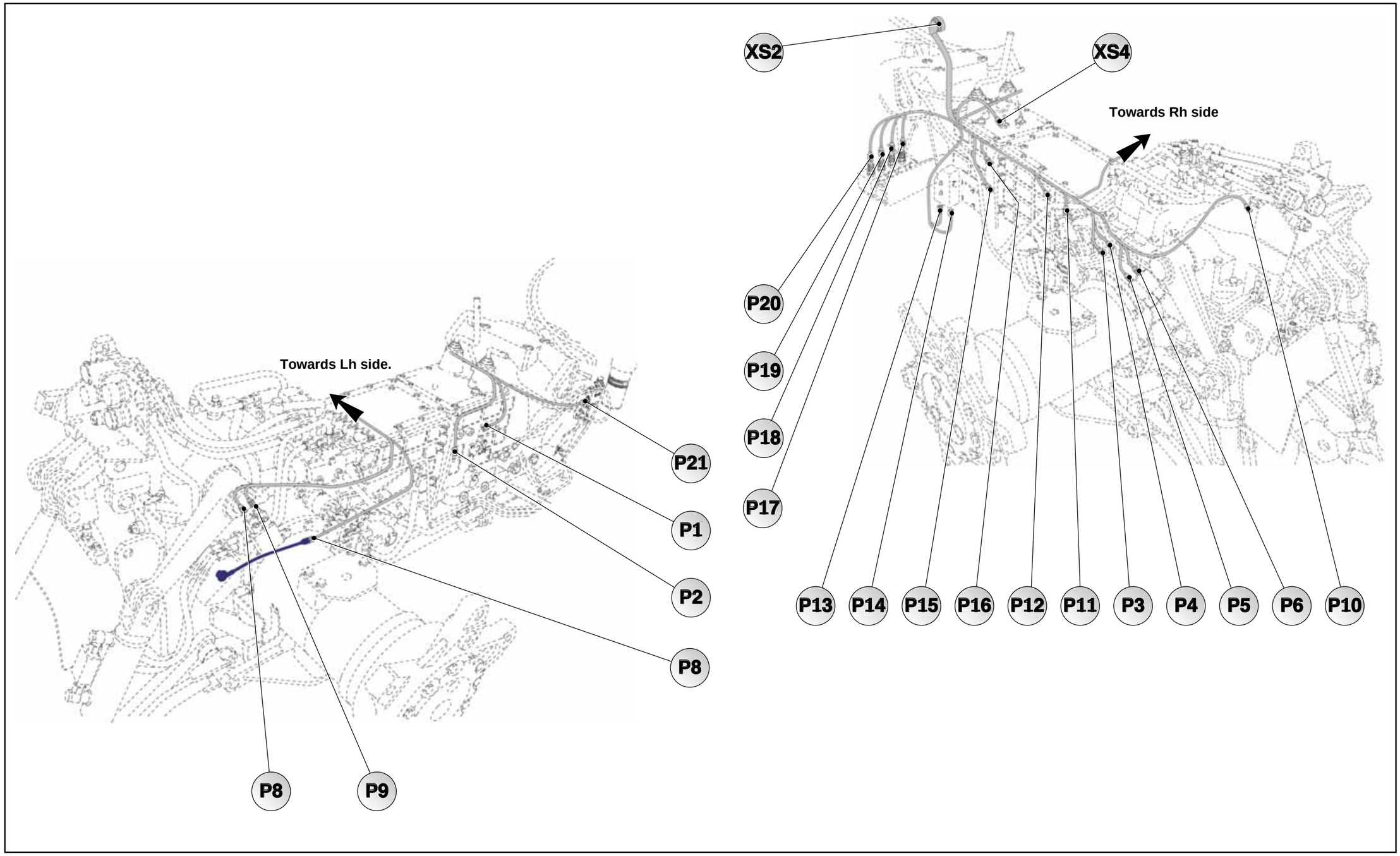


Fig. 10.679

P1 - Connector for rh sensor (Deltashift system)
P2 - Connector for parking brake hand lever microswitch
P3 - Connector for fast rear PTO microswitch
P4 - Connector for slow rear PTO microswitch
P5 - Connector for solenoid valve of rear PTO brake
P6 - Connector for solenoid valve of rear PTO clutch
P7 - Connector for rear PTO RPM sensor
P8 - Connector for solenoid valve (YV11) of auxiliary control valve B
P9 - Connector for solenoid valve (YV10) of auxiliary control valve A
P10 - Trailer brake pressure switch connector
P11 - Connector for ground speed sensor
P12 - Connector for proportional rear PTO microswitch
P13 - Connector (YV2) for secondary clutch solenoid valve
P14 - Connector (YV1) for main clutch solenoid valve
P15 - Connector for lh sensor (Deltashift system)
P16 - Connector for ignition enabling microswitch
P17 - Connector for pressure switch (14 bar)
P18 - Connector for “Power Five” solenoid valve
P19 - Connector for 4WD solenoid valve
P20 - Connector for differential lock solenoid valve
P21 - Connector for engine rate sensor
XS2 - Terminal board for rear line/dashboard connection
XS4 - Terminal board for platform line/rear line connection

3.9.8.4 Connector identification

Connector (P1) for rh sensor (Deltashift system)

term.	wire colour	To con. or comp.	term.
1	LN	XS4	A6
2	BN	P23 (junction)	
3	RN	P22 (junction)	

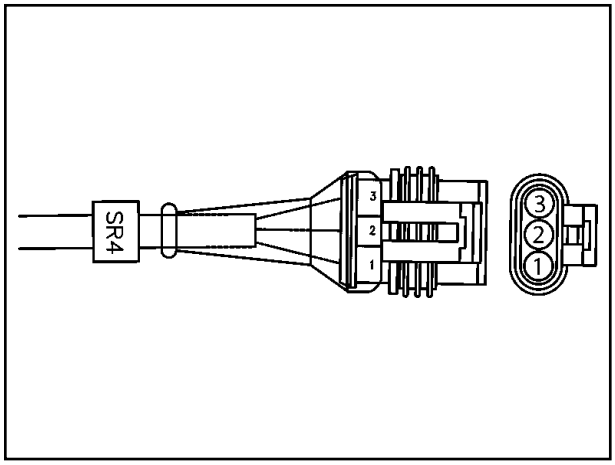


Fig. 10.680

Connector (P2) for parking brake lever microswitch

term.	wire colour	To con. or comp.	term.
1	ZN	XS2	13
2	B	P24 (junction)	

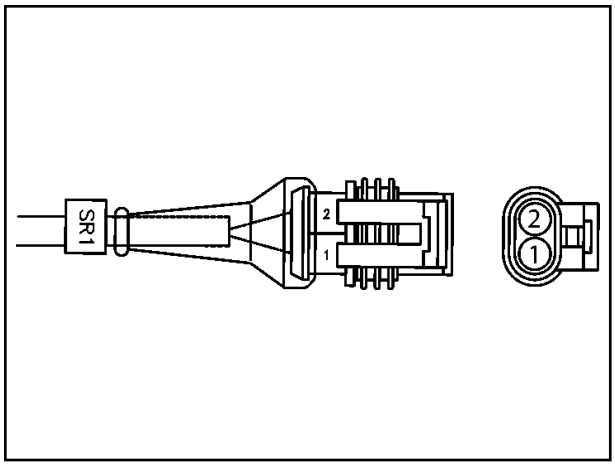


Fig. 10.681

Connector (P3) for fast rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P24 (junction)	
2	HL	XS2	3

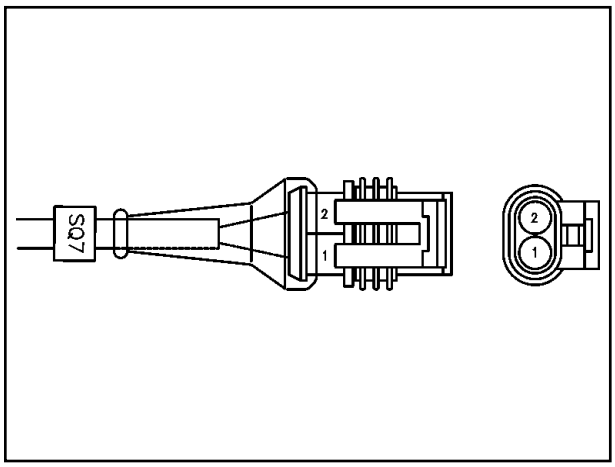


Fig. 10.682

Connector (P4) for slow rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	B	P24 (junction)	
2	VB	XS2	5

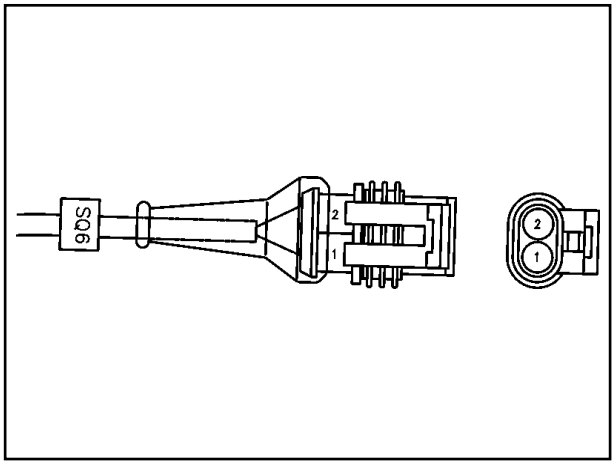


Fig. 10.683

Connector (P5) for solenoid valve of rear PTO brake

term.	wire colour	To con. or comp.	term.
1	ZH	XS4	C2
2	BV	XS4	C8

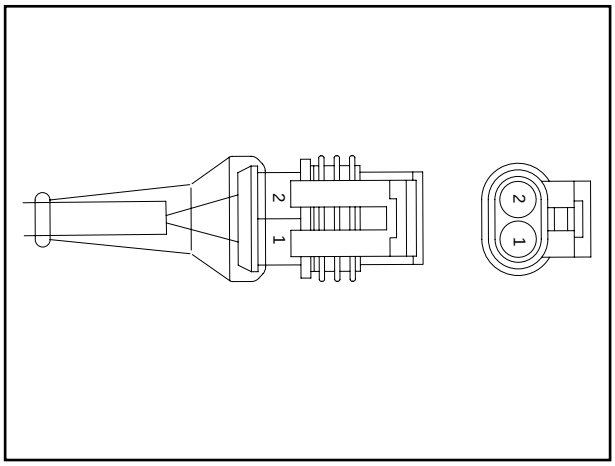


Fig. 10.684

Connector (P6) for rear PTO clutch solenoid valve

term.	wire colour	To con. or comp.	term.
1	AG	XS4	C4
2	ZL	XS4	C3

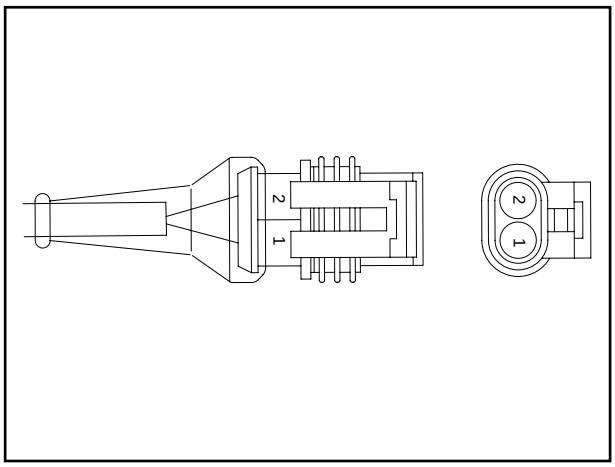


Fig. 10.685

Connector (P7) for rear PTO RPM sensor

term.	wire colour	To con. or comp.	term.
1	CN	XS4	B3
2	BN	P23 (junction)	
2	RN	P22 (junction)	

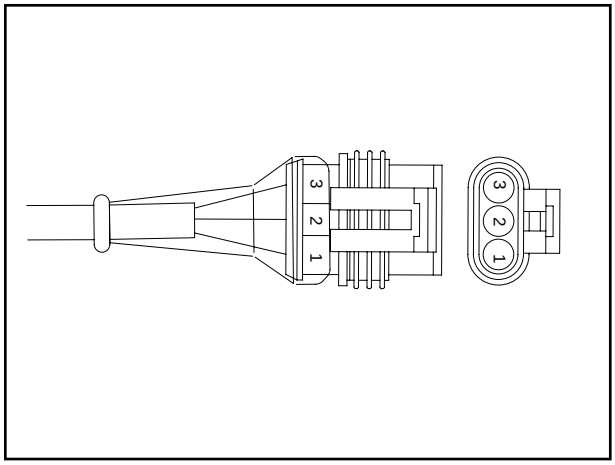


Fig. 10.686

Connector (P8) for solenoid valve (YV11) of auxiliary control valve B

term.	wire colour	To con. or comp.	term.
1	GN	XS2	A3
2	B	P24 (junction)	

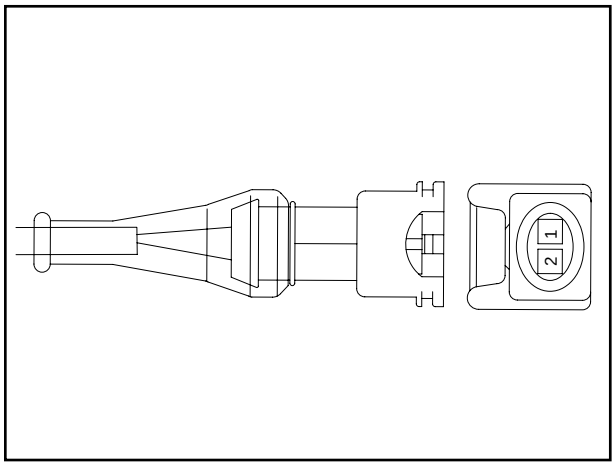


Fig. 10.687

Connector (P9) for solenoid valve (YV10) of auxiliary control valve A

term.	wire colour	To con. or comp.	term.
1	AV	XS4	A2
2	B	P24 (junction)	

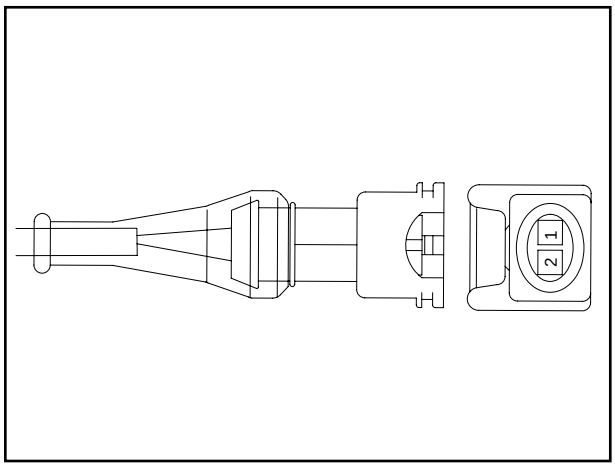


Fig. 10.688

Trailer brake pressure switch connector (P10)

term.	wire colour	To con. or comp.	term.
1	BN	XS2	12

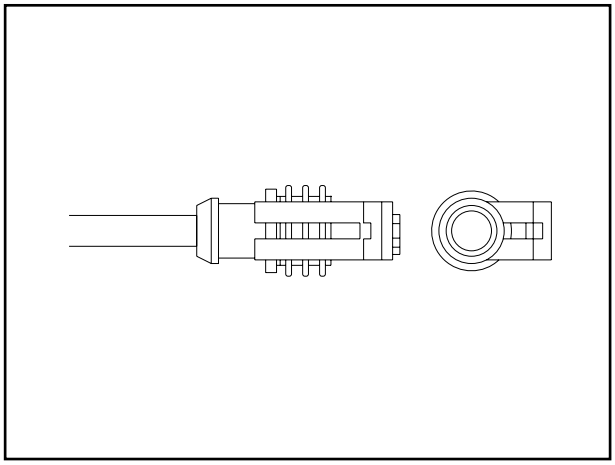


Fig. 10.689

Connector (P11) for ground speed sensor

term.	wire colour	To con. or comp.	term.
1	SN	XS4	B2
2	BN	P23 (junction)	
3	RN	P22 (junction)	

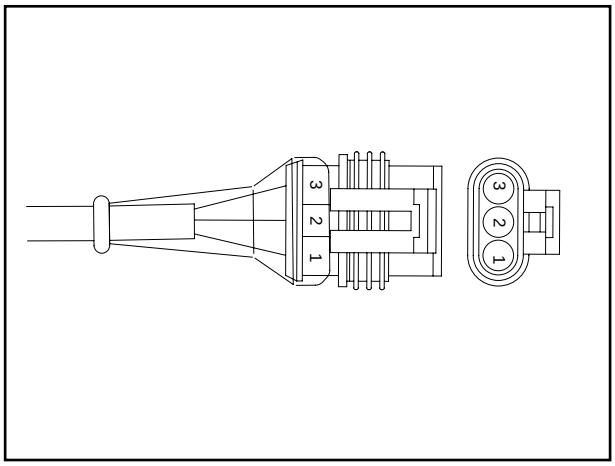


Fig. 10.690

Connector (P12) for proportional rear PTO microswitch

term.	wire colour	To con. or comp.	term.
1	SV	XS4	C5
2	R	XS4	B8

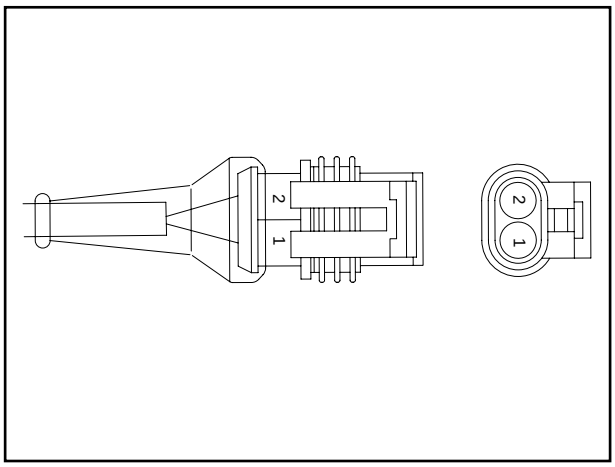


Fig. 10.691

Connector (P13) for secondary clutch solenoid valve (YV2)

term.	wire colour	To con. or comp.	term.
1	LR	XS4	B6
2	BR	XS4	B7

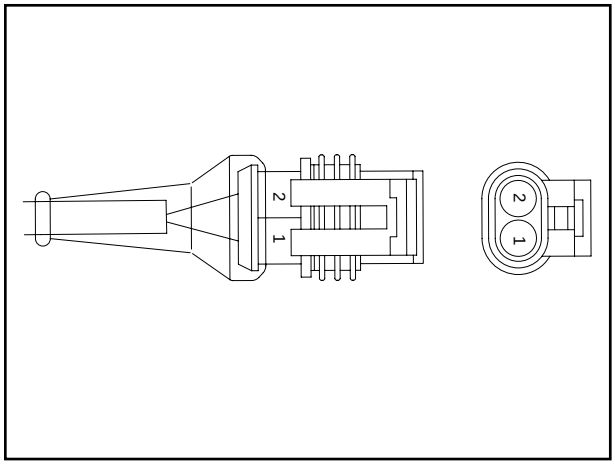


Fig. 10.692

Connector (P14) for main clutch solenoid valve (YV1)

term.	wire colour	To con. or comp.	term.
1	AR	XS4	B4
2	SB	XS4	B5

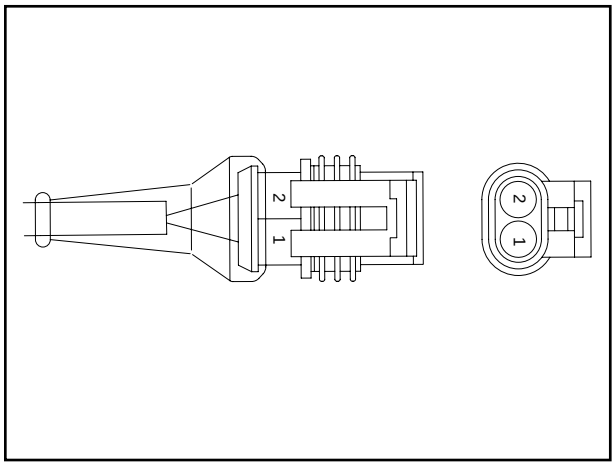


Fig. 10.693

Connector (P15) for rh sensor (Deltashift system)

term.	wire colour	To con. or comp.	term.
1	AN	XS4	A5
2	BN	P23 (junction)	
3	RN	P22 (junction)	

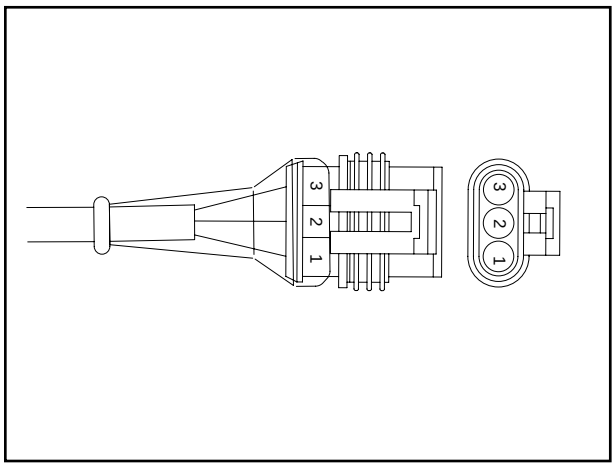


Fig. 10.694

Connector (P16) for ignition enabling microswitch

term.	wire colour	To con. or comp.	term.
1	BV	XS2	17
2	VN	XS2	18

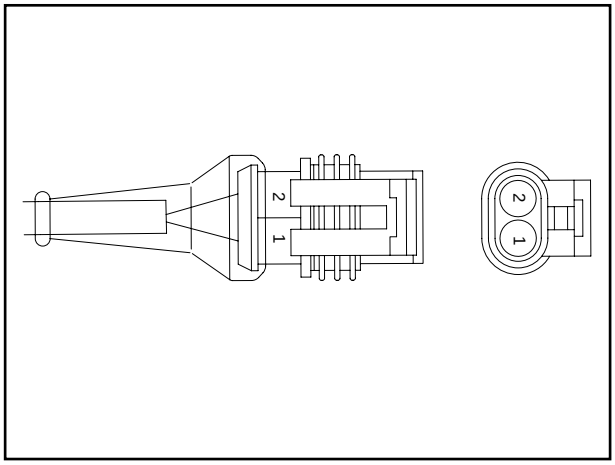


Fig. 10.695

Connector (P17) for ignition enabling microswitch

term.	wire colour	To con. or comp.	term.
1	HL	XS2	15

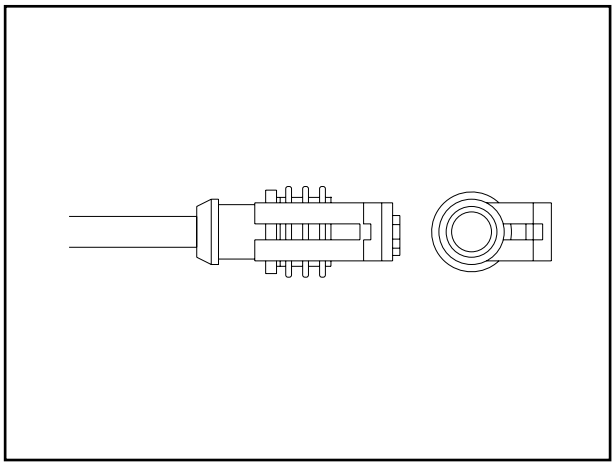


Fig. 10.696

Connector (P18) for “Power Five” solenoid valve

term.	wire colour	To con. or comp.	term.
1	BG	XS4	A4
2	BN	P23 (junction)	

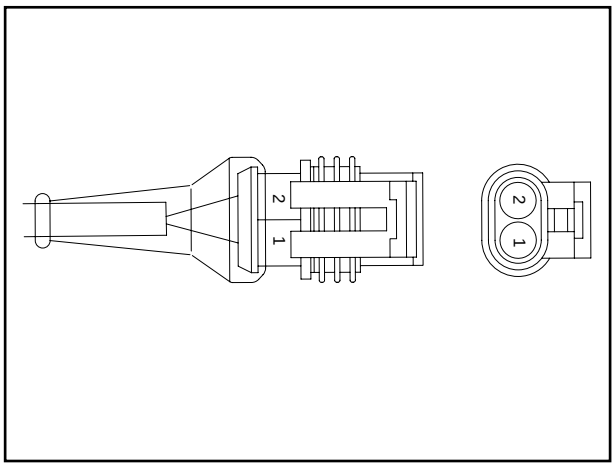


Fig. 10.697

Connector (P19) for 4WD solenoid valve

term.	wire colour	To con. or comp.	term.
1	GL	XS2	2
2	B	P24 (junction)	

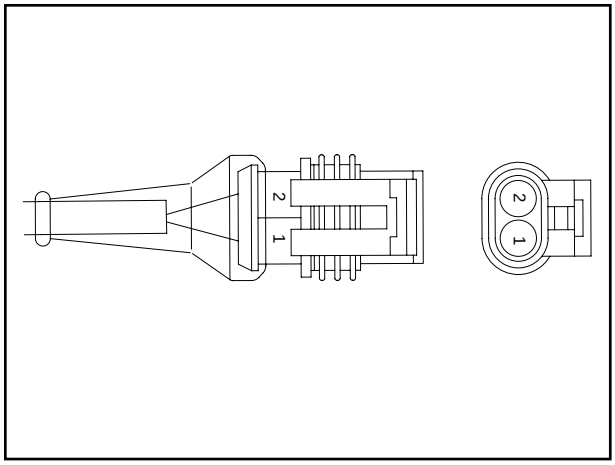


Fig. 10.698

Connector (P20) for differential lock solenoid valve

term.	wire colour	To con. or comp.	term.
1	BR	XS2	1
2	B	P24 (junction)	

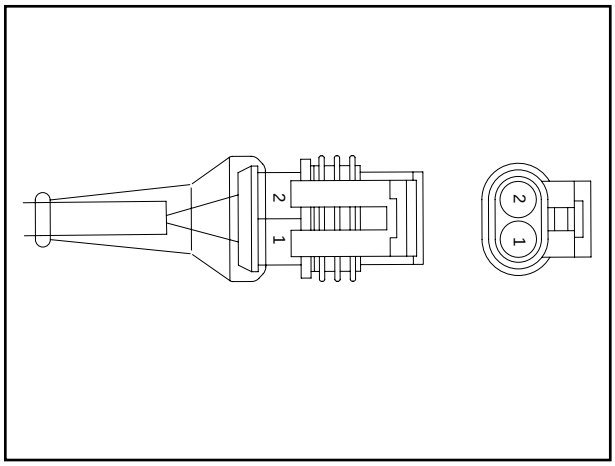


Fig. 10.699

Connector (P21) for engine rate sensor

term.	wire colour	To con. or comp.	term.
1	CL	XS4	A7
2	BN	P23 (junction)	
3	RN	P22 (junction)	

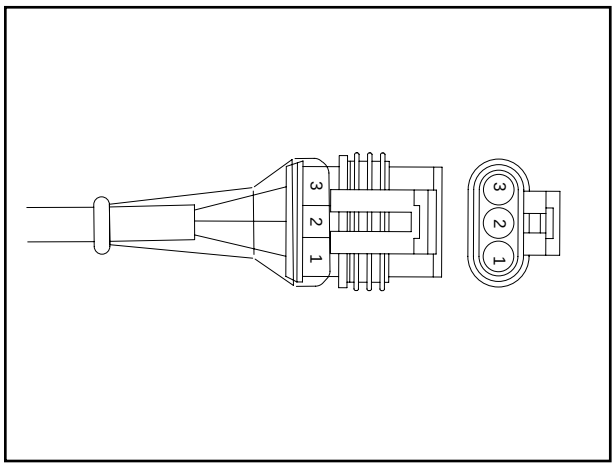


Fig. 10.700

Terminal board (XS2) for rear line/dashboard connection

term.	wire colour	To con. or comp.	term.
1	BR	P20	1
2	GL	P19	1
3	HL	P3	2
4	B	P24 (junction)	
5	VB	P4	2
6	not used		
7	not used		
8	not used		
9	R	XS4	B1
10	not used		
11	not used		
12	BN	P10	1
13	ZN	P2	1
14	BV	XS4	C6
15	SN	P17	1
16	CN	XS4	C7
17	BV	P16	1
18	VN	P16	2
19	not used		
20	not used		
21	not used		
22	not used		
23	not used		
24	not used		
25	not used		
26	not used		
27	not used		
28	not used		
29	not used		
30	BN	P23 (junction)	
31	AN	XS4	C1
32	not used		
33	not used		
34	not used		

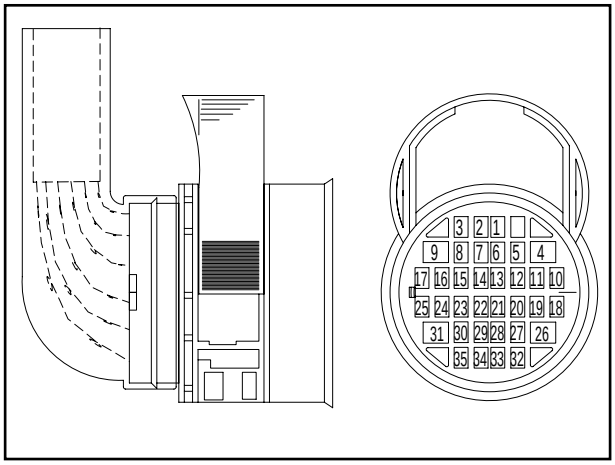


Fig. 10.701

Terminal board (XS4) for platform/rear wiring line connection

term.	wire colour	To con. or comp.	term.
A1	RN	P22 (junction)	1
A2	AV	P9	1
A3	GN	P8	1
A4	BG	P18	1
A5	AN	P15	1
A6	LN	P1	1
A7	CL	P21	1
A8	BN	P23 (junction)	
B1	R	XS2	9
B2	SN	P11	1
B3	CN	P7	1
B4	AR	P14	1
B5	SB	P14	2
B6	LR	P13	1
B7	BR	P13	2
B8	R	P12	2
C1	AN	XS2	31
C2	ZH	P5	1
C3	ZL	P6	2
C4	AG	P6	1
C5	SV	P12	1
C6	BV	XS2	14
C7	MV	XS2	16
C8	BV	P5	2

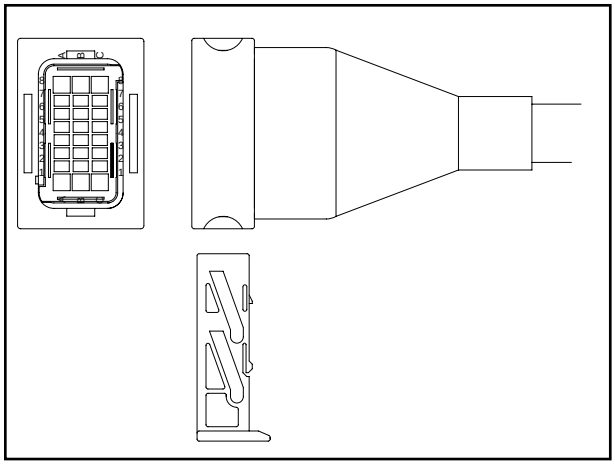


Fig. 10.702

3.9.9 Headlight extension line

3.9.9.1 General description

The headlight extension line powers the lamps installed at the front of the tractor's bonnet (Fig.10.703).

The headlight extsneion line is connected to the engine's front line by means of connectors (H3 and B25)(Fig.10.704).

Fig. 10.703

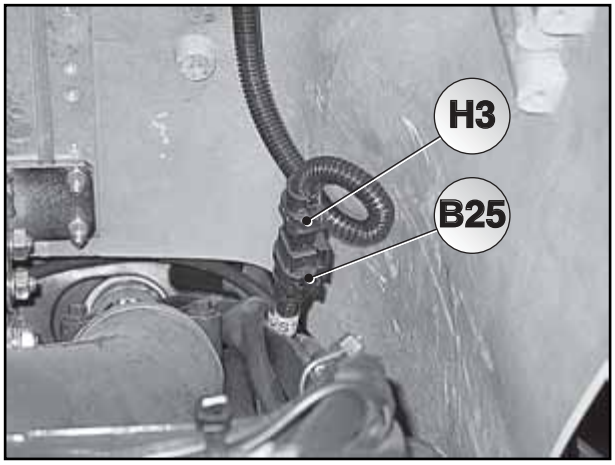


Fig. 10.704

3.9.9.2 Wiring

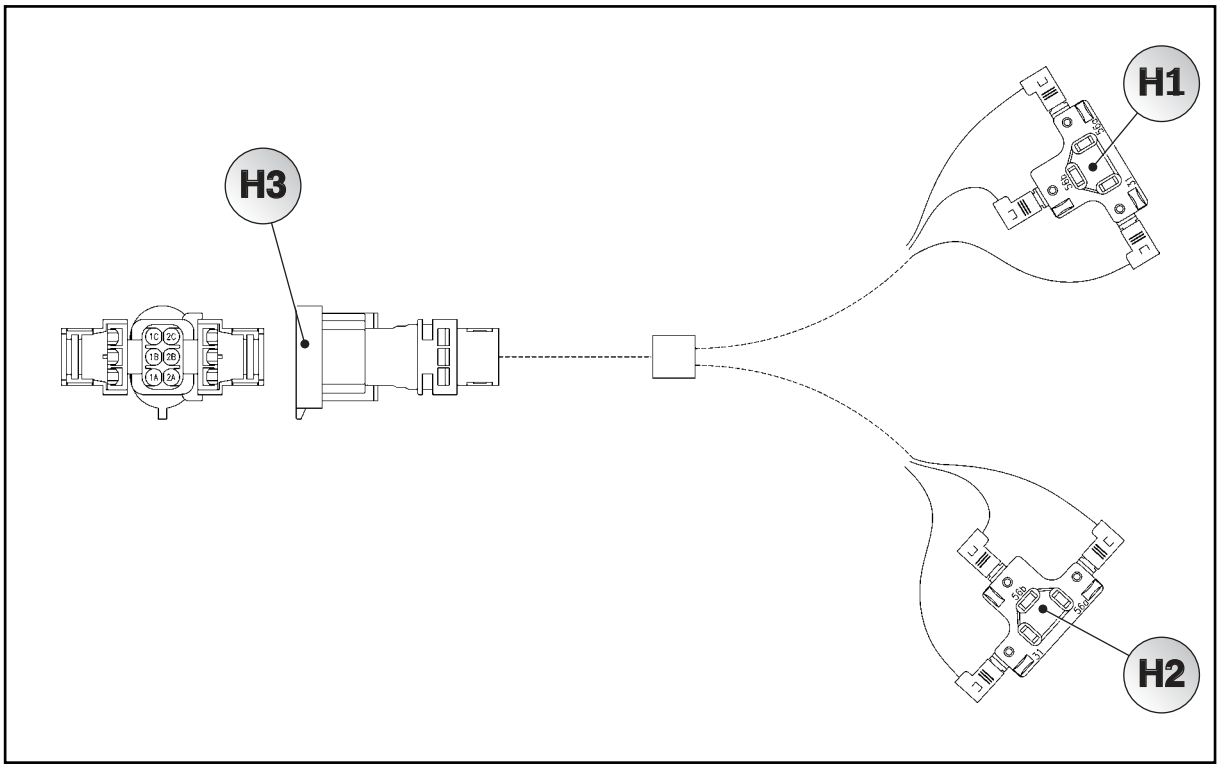


Fig. 10.705

H1 - Lh headlight connector
H2 - Rh headlight connector
H3 - Connector for connecting to the front line

3.9.9.3 Connector locations

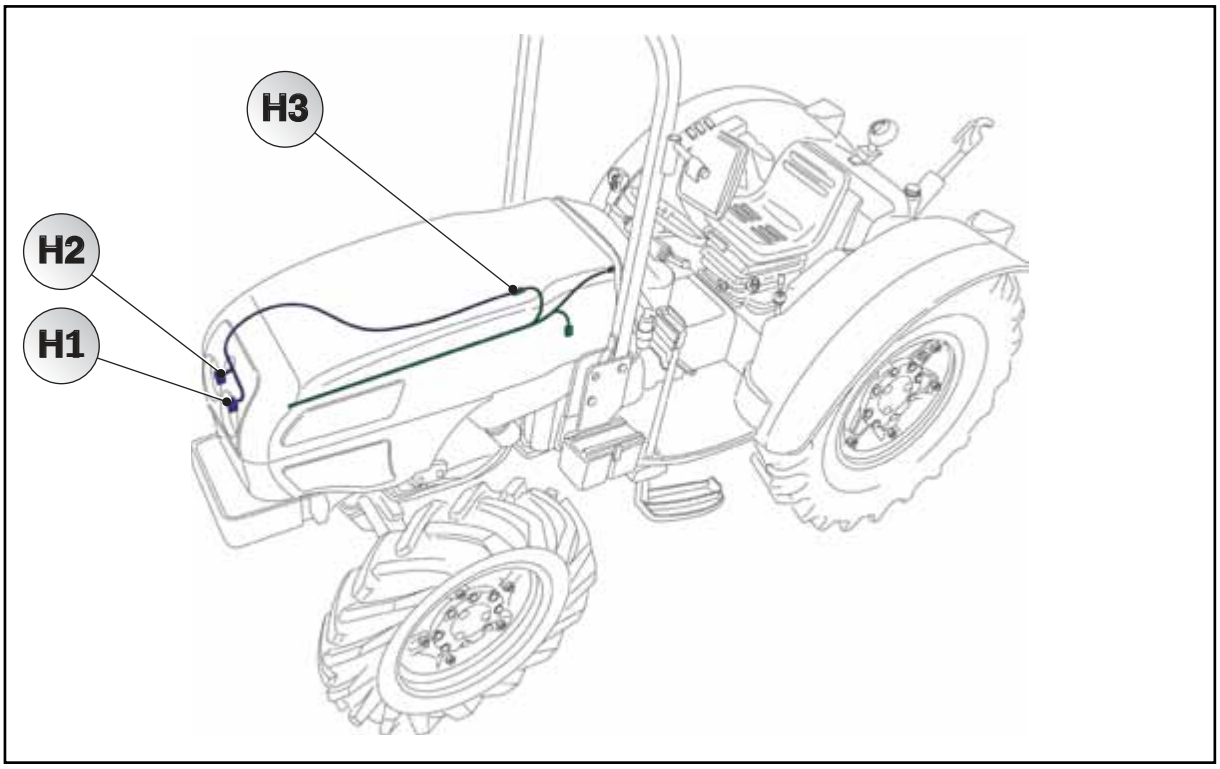


Fig. 10.706

3.9.9.4 Connector identification

Lh headlight connector (H1)

term.	wire colour	To con. or comp.	term.
1	B	H3	2C
2	H	H3	2B
3	V	H3	1A

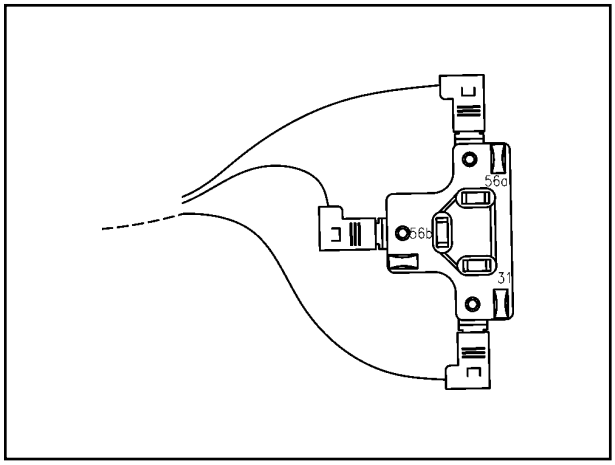


Fig. 10.707

Rh headlight connector (H2)

term.	wire colour	To con. or comp.	term.
1	B	H3	1C
2	HN	H3	2A
3	VN	H3	1B

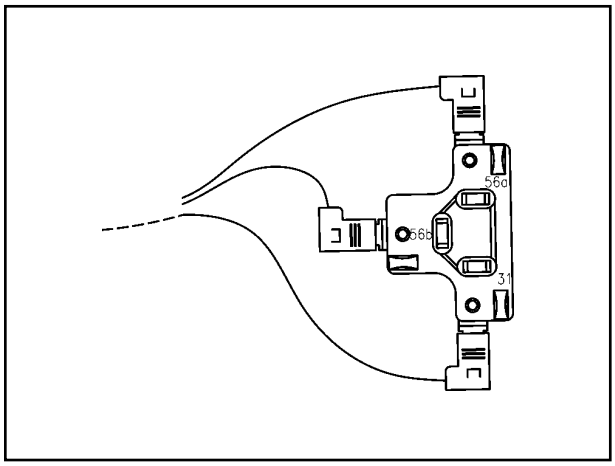


Fig. 10.708

Connector (H3) for front line connection

term.	wire colour	To con. or comp.	term.
1A	V	H1	3
1B	VN	H2	3
1C	B	H2	1
2A	HN	H2	2
2B	H	H1	2
2C	B	H1	1

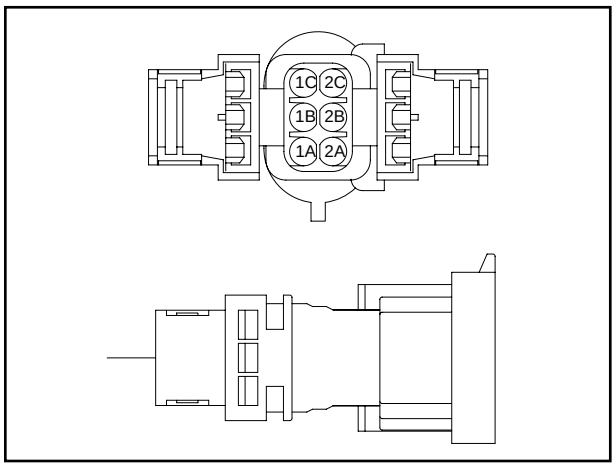


Fig. 10.709

3.9.10 Roof line

3.9.10.1 General description

The roof wiring line powers the components installed on the cab roof. The air conditioning system is installed in the rear part of the roof and is connected to the system by this wiring line. The field light switches, windowscreen wiper switches, etc., are also powered by this line.

The services in the cab are protected against short-circuits and excessive power draw by the power fuse (FU6 Fig.10.711), installed in the roof powering line.

The cab roof line is connected to the dashboard line via the terminal boards (XS5) (Fig.10.712).

Fig. 10.710

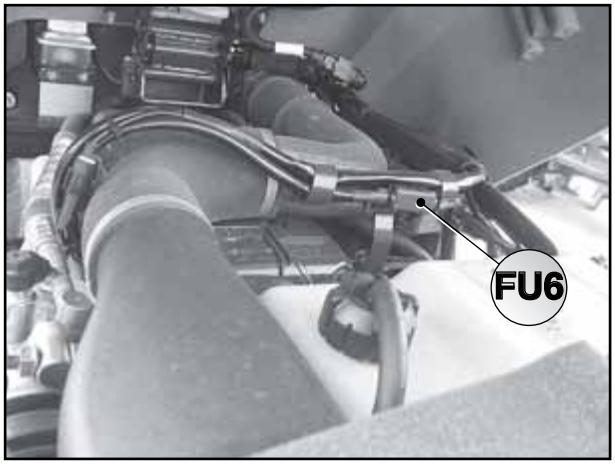


Fig. 10.711

Fig. 10.712

3.9.10.2 Wiring

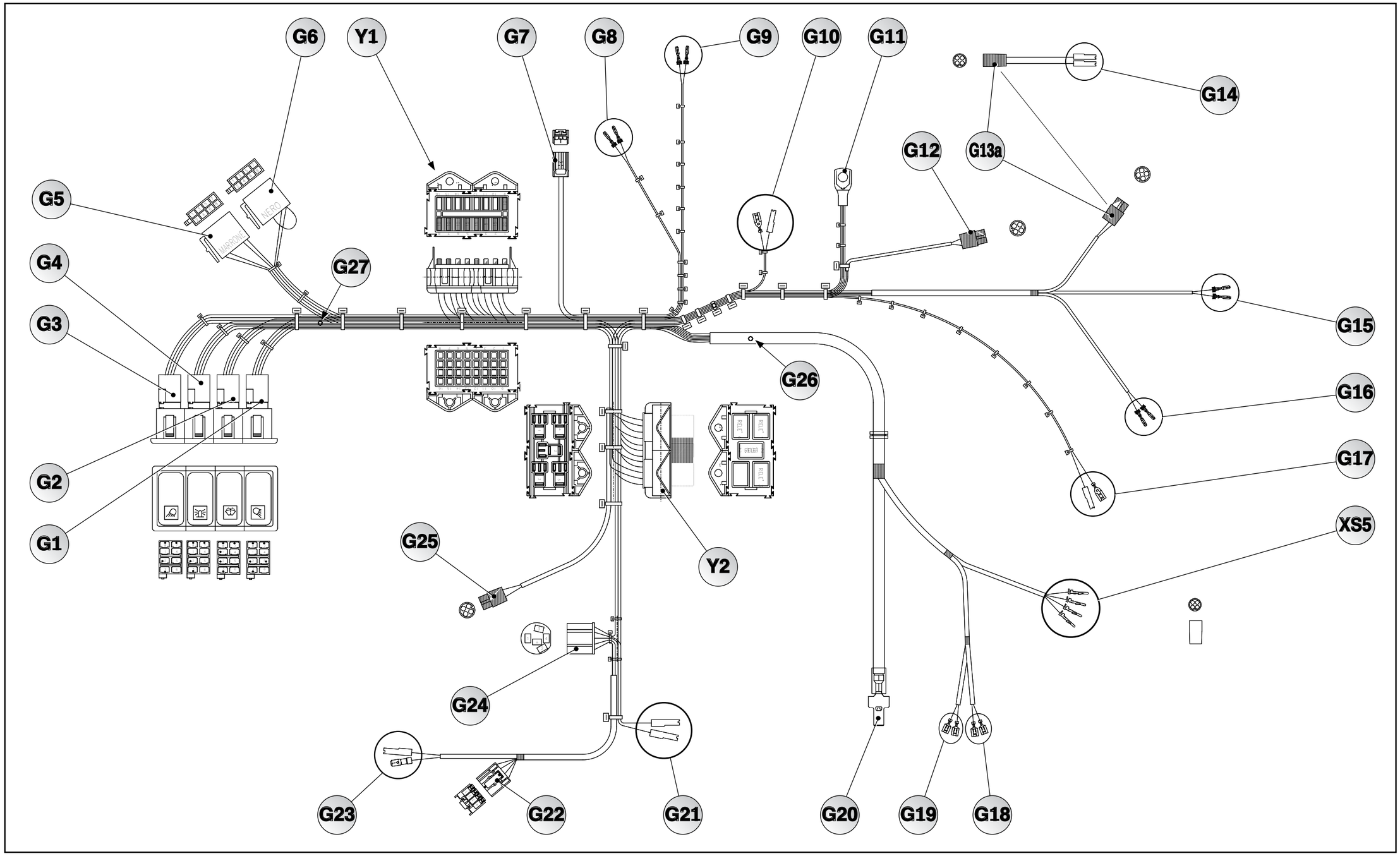


Fig. 10.713

G1 - Connector for rear light switch
G2 - Connector for windscreen wiper switch
G3 - Connector for revolving beacon switch
G4 - Connector for headlight switch
G5 - Radio connector (brown)
G6 - Radio connector (black)
G7 - Ceiling light connector
G8 - Terminals for rh front field light connection
G9 - Terminals for lh front field light connection
G10 - Terminals for rh loud-speaker
G11 - Grounding eyelet
G12 - Connector for rear window wiper
G13 - Connector for revolving beacon brace
G13a - Connector for revolving beacon brace
G14 - Terminals for connecting the revolving beacon
G15 - Terminal for rear field light connection
G16 - Terminal for rear field light connection
G17 - Terminals for lh loud-speaker
G18 - Windscreen washer terminals
G19 - Rear window washer terminals
G20 - Terminal for alternator connection (direct powering)
G21 - Terminals for AC system
G22 - Connector for AC system
G23 - Terminals for AC system
G24 - Connector for AC system fan
G25 - Connector for windscreen wiper
G26/G27 - Junctions
Y1 - Cab fuse box
Y2 - Cab relay box
XS5 - Terminal board for roof line/dashboard connection

3.9.10.3 Connector locations

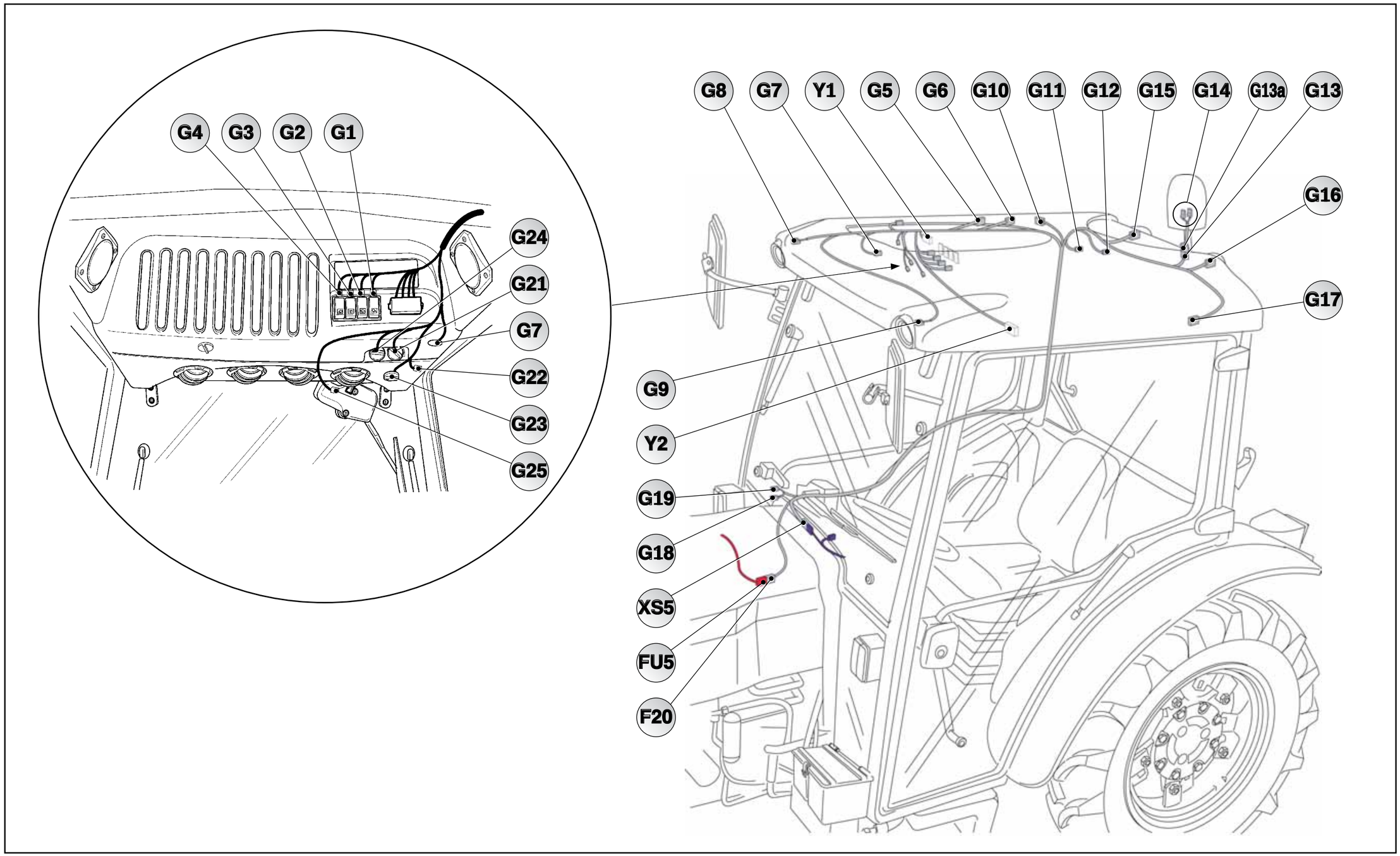


Fig. 10.714

3.9.10.4 Connector identification

Connector (G1) for rear light switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	K6	87
3	MC	K18	86
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

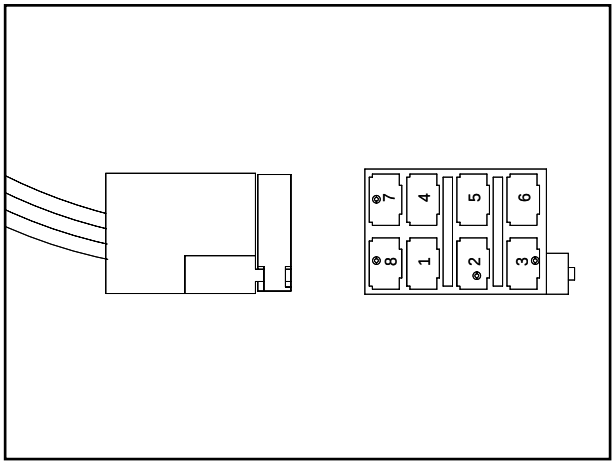


Fig. 10.715

Connector (G2) for windscreen wiper switch

term.	wire colour	To con. or comp.	term.
1	VB	G19	1
2	MR	F28	8A
3	VZ	G18	1
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

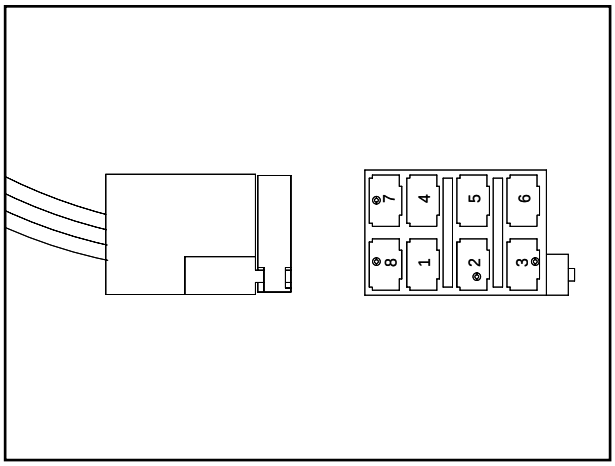


Fig. 10.716

Revolving beacon switch connector (G3)

term.	wire colour	To con. or comp.	term.
1	not used		
2	BR	F23	2A
3	RV	G13	1
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

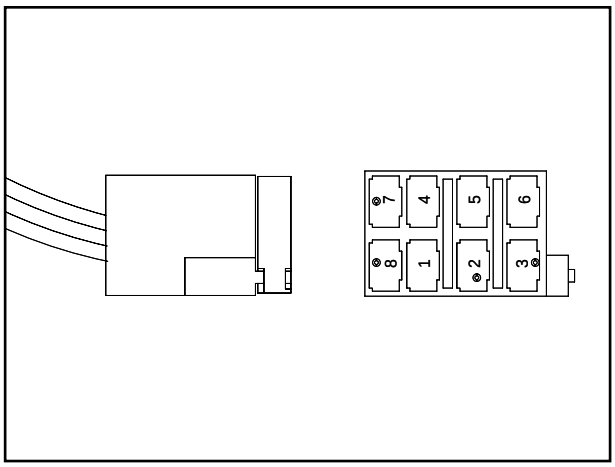


Fig. 10.717

Connector (G4) for headlight switch

term.	wire colour	To con. or comp.	term.
1	not used		
2	M	K6	87
3	MS	K17	86
4	not used		
5	not used		
6	not used		
7	B	G28 (junction)	
8	HG	G27 (junction)	

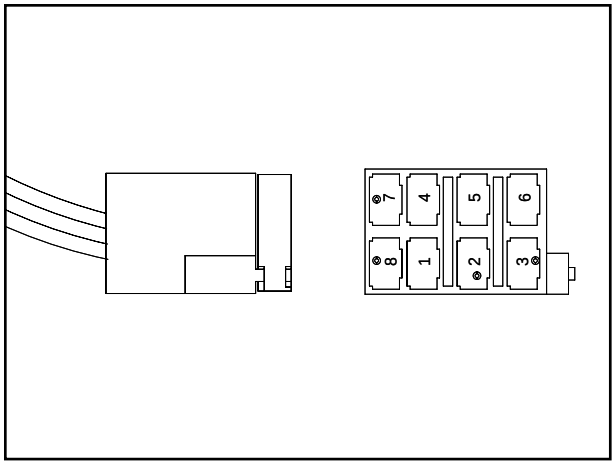


Fig. 10.718

Radio connector (G5) (brown)

term.	wire colour	To con. or comp.	term.
1	G	G10	1
2	GN	G10	2
3	not used		
4	not used		
5	not used		
6	not used		
7	A	G17	1
8	AN	G17	2

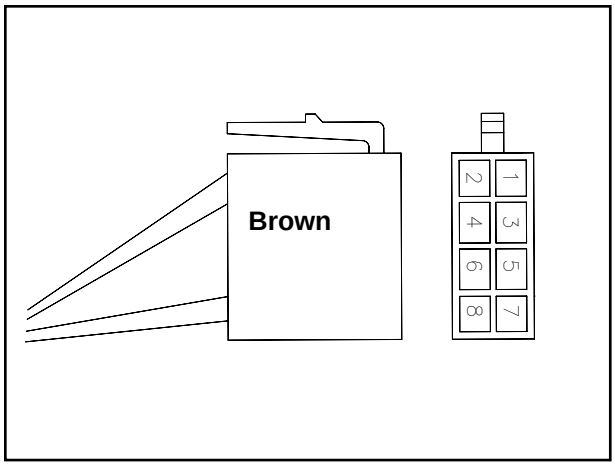


Fig. 10.719

Radio connector (G6) (black)

term.	wire colour	To con. or comp.	term.
1	not used		
2	not used		
3	not used		
4	R	G6	7
5	not used		
6	not used		
7	R-R	G6-F32	4-3A
8	B	G28 (junction)	

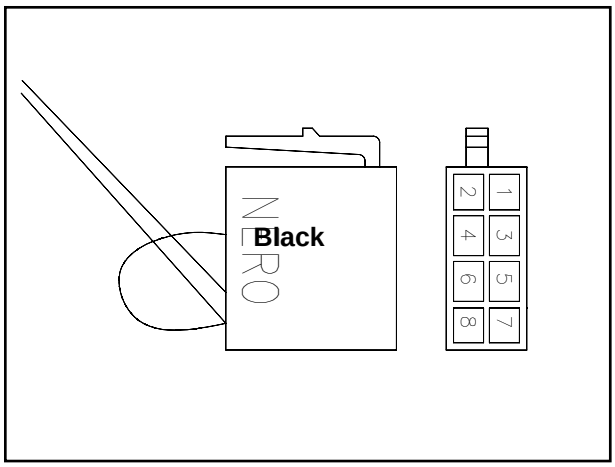


Fig. 10.720

Ceiling light connector (G7)

term.	wire colour	To con. or comp.	term.
1	BR	F23	2A
2	B	G28 (junction)	
3	not used		

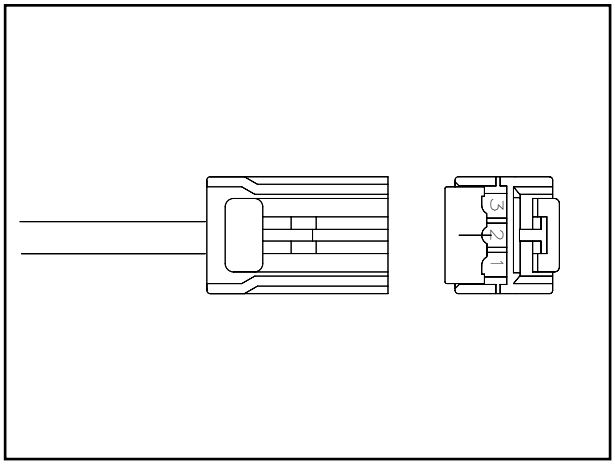


Fig. 10.721

Terminals (G8) for rh front field light connection

term.	wire colour	To con. or comp.	term.
1	LN	K17	87
2	B	G28 (junction)	

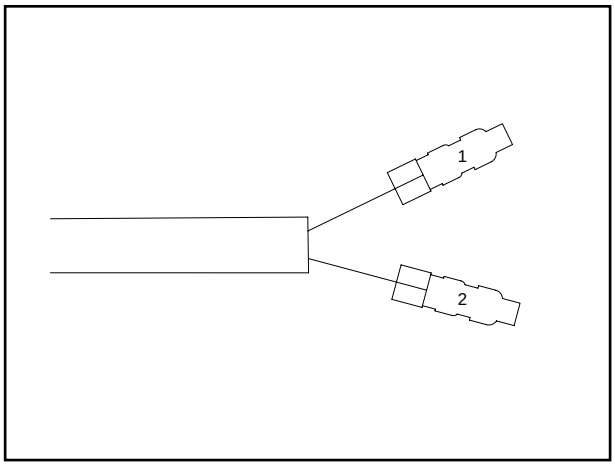


Fig. 10.722

Terminals (G9) for lh front field light connection

term.	wire colour	To con. or comp.	term.
1	LN	K17	87
2	B	G28 (junction)	

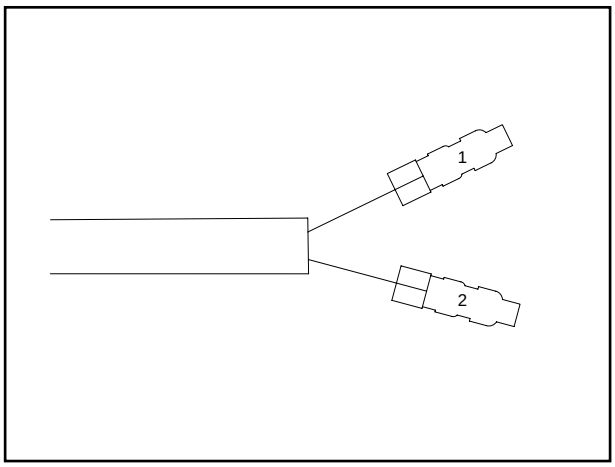


Fig. 10.723

Terminals (G10) for rh loud-speaker

term.	wire colour	To con. or comp.	term.
1	G	G5	1
2	GN	G5	2

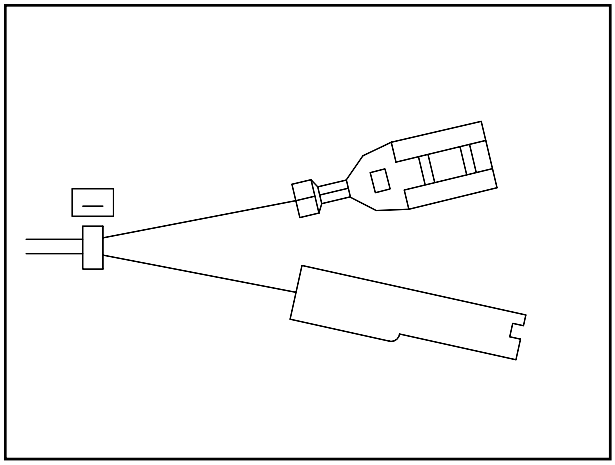


Fig. 10.724

Grounding eyelet (G11)

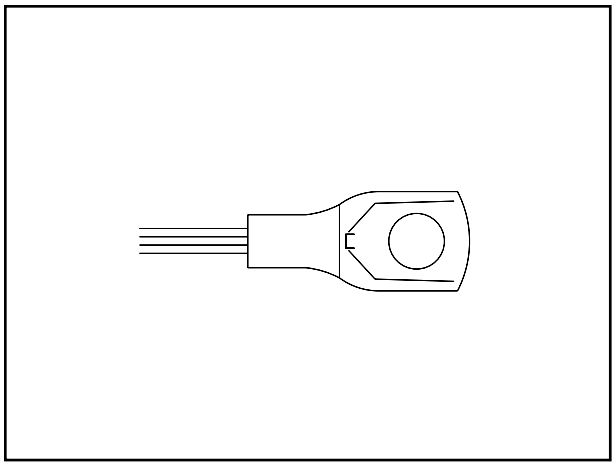


Fig. 10.725

Connector (G12) for rear window wiper

term.	wire colour	To con. or comp.	term.
1	MN	F23	7A
2	B	G11 (ground)	
3	not used		
4	not used		

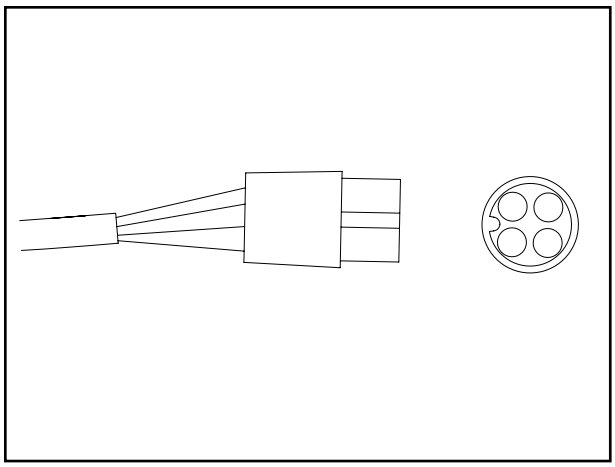


Fig. 10.726

Connector (G13) for revolving beacon brace

term.	wire colour	To con. or comp.	term.
1	RV	G3	3
2	B	G11 (ground)	
3	not used		
4	not used		

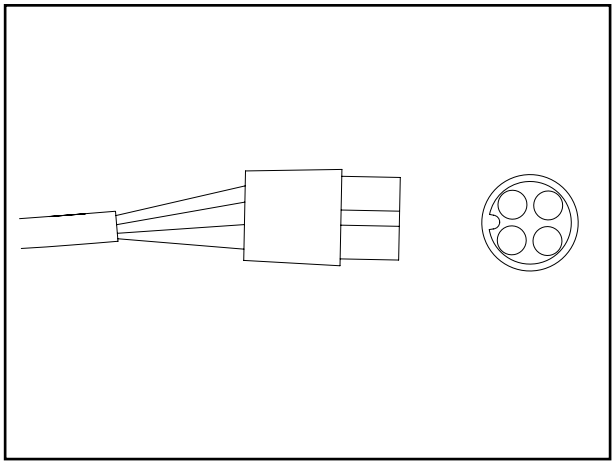


Fig. 10.727

Connector (G13a) for revolving beacon brace

term.	wire colour	To con. or comp.	term.
1	RV	G14	2
2	B	G14	1
3	not used		
4	not used		

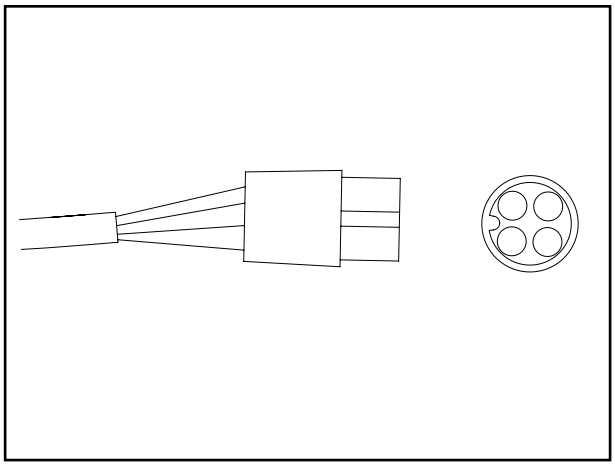


Fig. 10.728

Terminal (G14) for revolving beacon connection

term.	wire colour	To con. or comp.	term.
1	B	G13a	2
2	RV	G13a	1

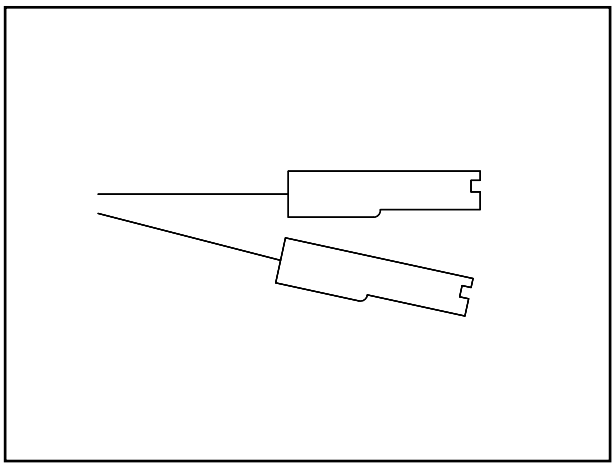


Fig. 10.729

Terminals (G15) for rear field light connection

term.	wire colour	To con. or comp.	term.
1	B	G11 (ground)	
2	AG	K18	87

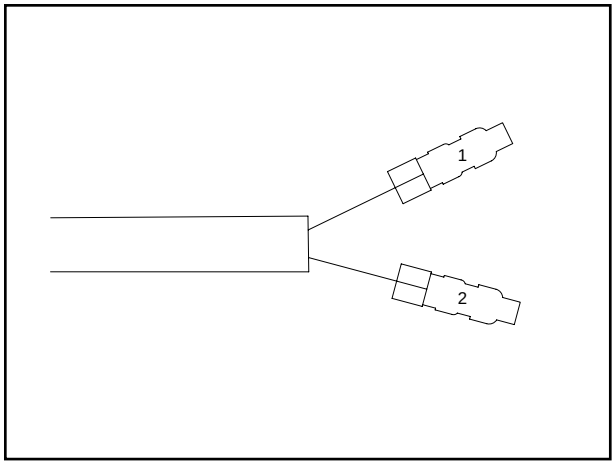


Fig. 10.730

Terminals (G16) for rear field light connection

term.	wire colour	To con. or comp.	term.
1	B	G11 (ground)	
2	AG	K18	87

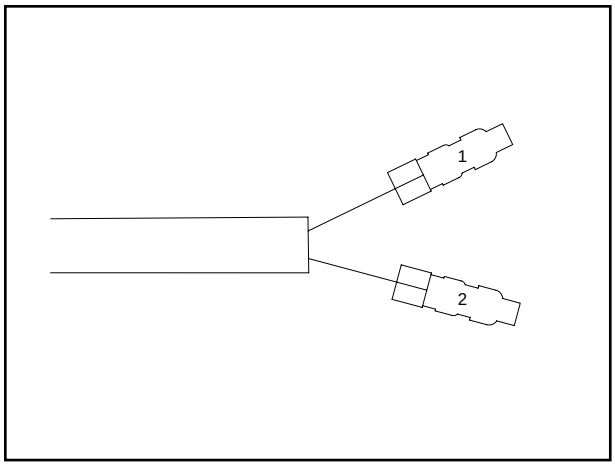


Fig. 10.731

Terminals (G17) for lh loud-speaker

term.	wire colour	To con. or comp.	term.
1	A	G5	7
2	AN	G5	8

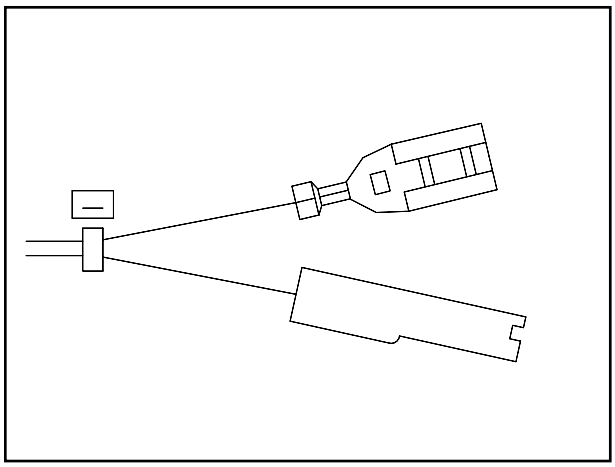


Fig. 10.732

Windscreen washer terminals (G18)

term.	wire colour	To con. or comp.	term.
1	VZ	G2	3
2	B-B	G19-XS5	2-4

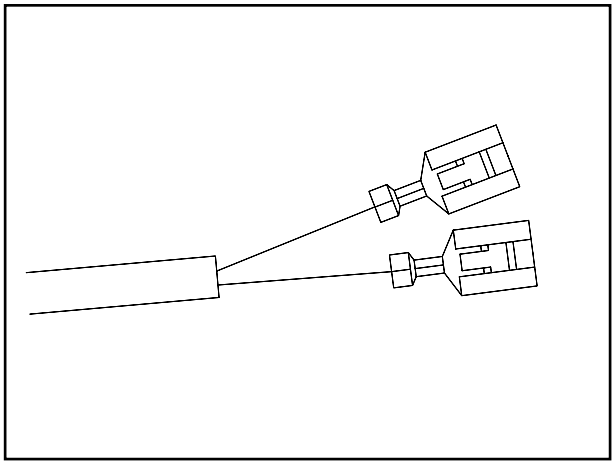


Fig. 10.733

Rear window washer terminals (G19)

term.	wire colour	To con. or comp.	term.
1	VB	G2	1
2	B	G18	2

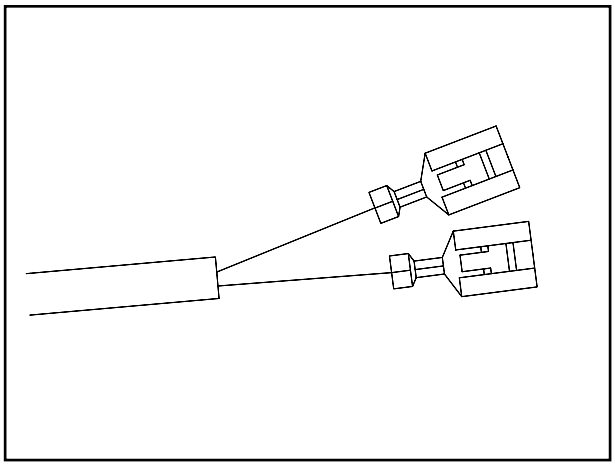


Fig. 10.734

Terminal (G20) for alternator connection (direct powering)

term.	wire colour	To con. or comp.	term.
1	R	G26 (junction)	

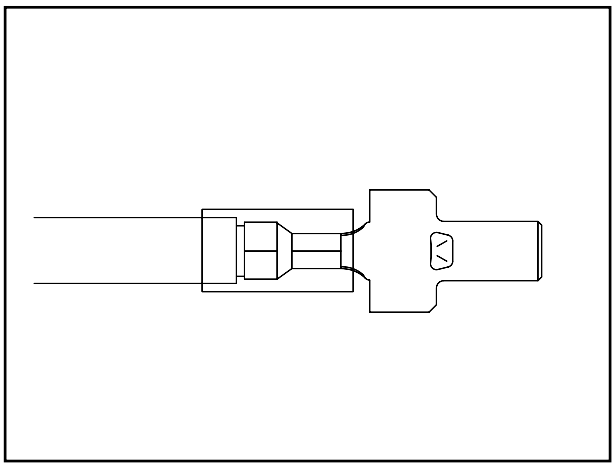


Fig. 10.735

Terminals (G21) for AC system

term.	wire colour	To con. or comp.	term.
1	GM	XS5	2
2	G	G24	1

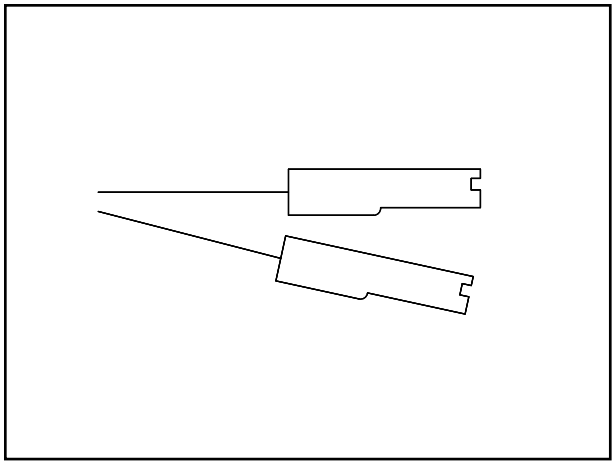


Fig. 10.736

Connector (G22) for AC system

term.	wire colour	To con. or comp.	term.
1	R-N	G24-G23	4-1
2	B	G24	3
3	S	G24	2
4	not used		

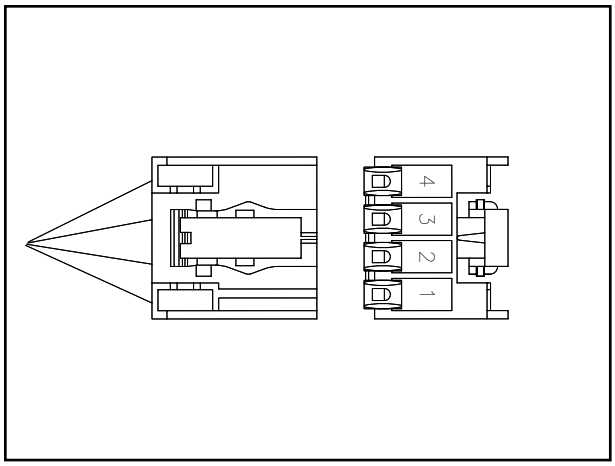


Fig. 10.737

Terminals (G23) for AC system

term.	wire colour	To con. or comp.	term.
1	N	G22	1
2	B	G28 (junction)	

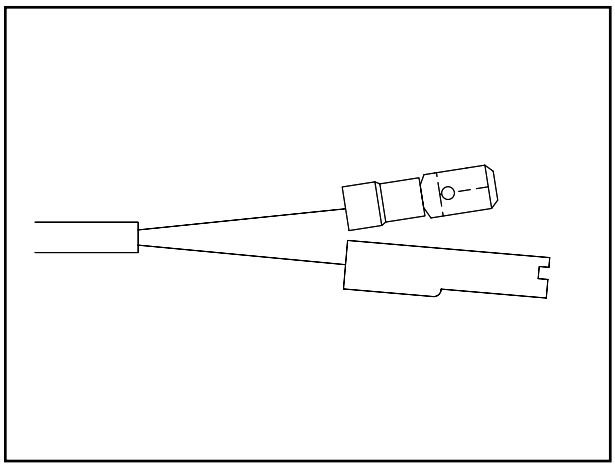


Fig. 10.738

Connector (G24) for AC system fan

term.	wire colour	To con. or comp.	term.
1	G	G21	2
2	S	G22	3
3	B	G22	2
4	R	G22	1
+	C	K5	87

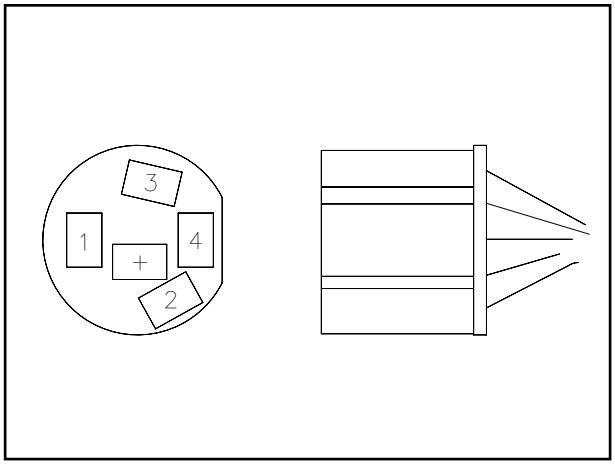


Fig. 10.739

Connector (G25) for windscreen wiper

term.	wire colour	To con. or comp.	term.
1	MB	F40	9A
2	B	G28 (junction)	
3	not used		
4	not used		

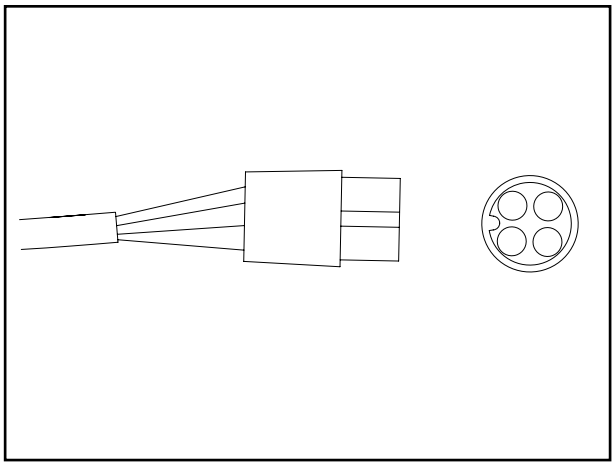


Fig. 10.740

Terminal board (XS5) for roof/dashboard line connection

term.	wire colour	To con. or comp.	term.
1	M	K5	86
2	GM	G21	1
3	HG	G27 (junction)	
4	B	G18	2

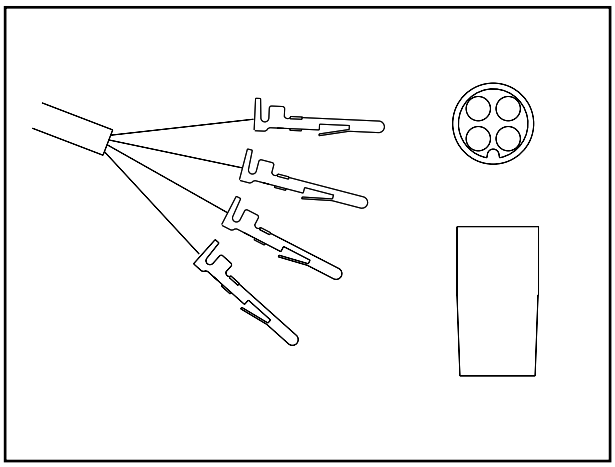


Fig. 10.741

3.10 F-N Series E-Line footstep

3.10.1 Technical specifications

3.10.1.1 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
Voltage	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Alternator

Make	Ix
Type	Threephase
Voltage	14 V
Current	65 A

Starter motor

Manufacturer	Ix - Dsx
Type	Solenoidal
Maximum power	2.8 kW
Type of engagement	Automatic pinion engagement by means of electro-magnet.

Solenoid valves

Manufacturer	Srx Dx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 Ω ±5%

Instrument

Make	Unx

3.10.1.2 Relays and fuse holders

The electrical system of **F-N Series** tractors is protected against short-circuits and excessive power draw by means of fuses. The number of fuses installed in the electrical system depends on the components and functions that need protecting.

The fuses are installed in two dedicated boxes:

Z - front fuse box (Fig.10.742) installed at the front, near the battery that powers the system. It contains a further fuse (F5) that protects the preheater relay.

B - main fuse box (Fig.10.743) installed on the left-hand side of the dashboard cover.

Note: before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

There are 10 relays installed in **F-N Series E-Line footstep version** tractors, of which 9 are installed in the fuse box (B), just under the protection fuses, and one at the front, near the fuse box (Z).

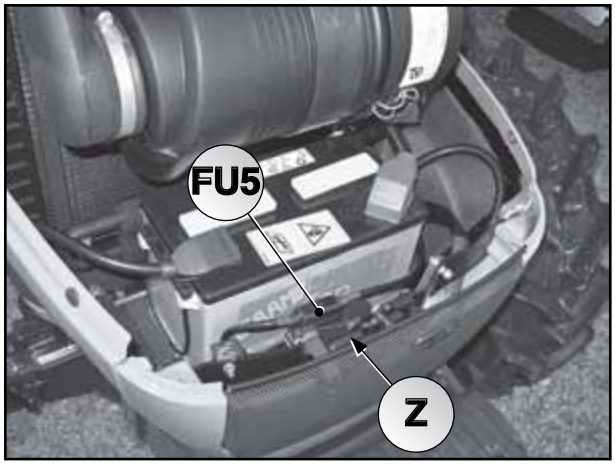


Fig. 10.742

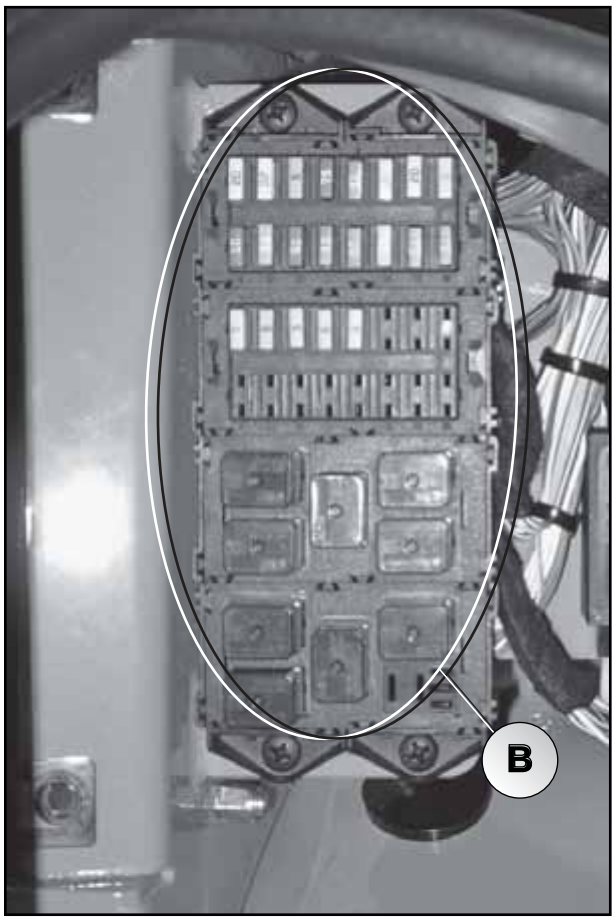


Fig. 10.743

Z- Front fuse box

The front fuses are installed in the “battery-starter motor line” wiring. They are connected by means of the positive terminal (A1) to the battery (G1) on the one side and on the other side, to the front engine line, by means of connectors (LB1 and LB2) (Fig.10.744).

Turn the ignition key to the 2nd position to activate the power relay (K1), which transmits the signal for preheating the plate in contact with the glow plugs. The relay (K1) cuts out the electrical signal after 5 seconds in this position have elapsed.

Note: to reduce the possibility of the relay (K1) burning out to the minimum, it is advisable to wait a few seconds (about 5 sec.) after having turned the ignition key to the 2nd position, before actually starting the tractor.

The front fuses have the following functions and ampere ratings (Fig.10.746):

Fuse	Circuits protected	Amp.
F1	Alternator primary	70
F2	Key-activated user primary	40
F3	Key-activated user primary	50
F4	Battery direct user primary	20
F5	Glow plugs (Fig.10.745)	50

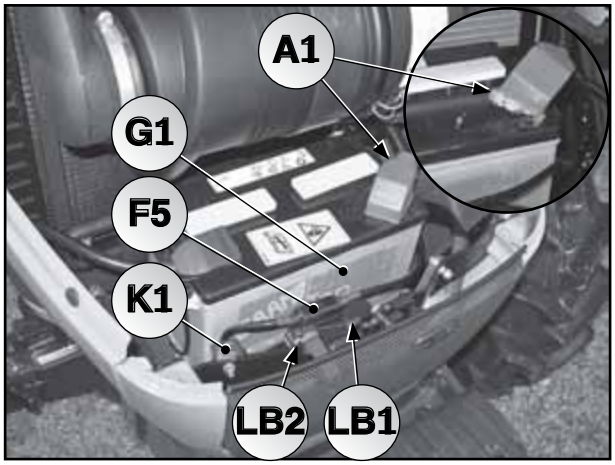


Fig. 10.744

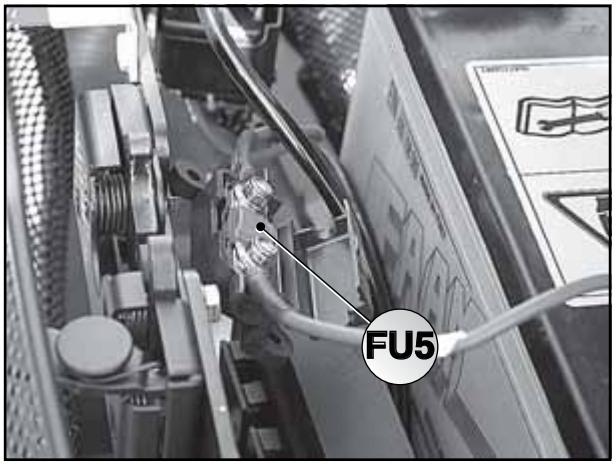


Fig. 10.745

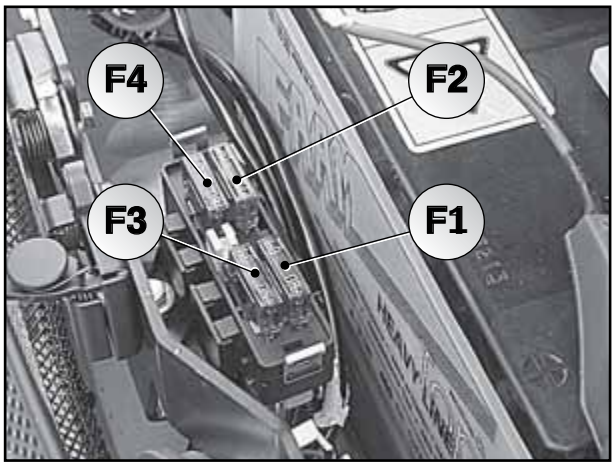


Fig. 10.746

B - Main fuse box

The main fuses are installed in the dashboard wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
FA1	Direct power to ignition key	20
FA2	Key-activated for starter motor	5
FA3	Key-activated for relay coils	7.5
FA4	Key-activated for engine power	7.5
FA5	Direct to platform's rotating beacon	5
FA6	Direct auxiliary socket positive	20
FA7	Key-activated auxiliary socket positive	5
FA8	Key-activated for 4WD solenoid valve	10
FA9	Key-activated for dipped headlights	15
FA10	Key-activated for driving beams	15
FA11	Key-operated rear field light	7.5
FA12	Key-activated for brake lights/diff lock el.	10
FA13	Key-operated turn indicators	10
FA14	Direct to hazard lights	15
FA15	Key-activated horn	7.5
FA16	Key-activated for NAO kit controller	7.5
FB1	Direct to side lights (main)	5
FB2	Direct to side lights (Rh rear and Lh front)	5
FB3	Direct to side lights (Lh rear, Rh front and license plate light)	5
FB4	Direct to instrument powering	3
FB5	Key-activated for instrument powering	3

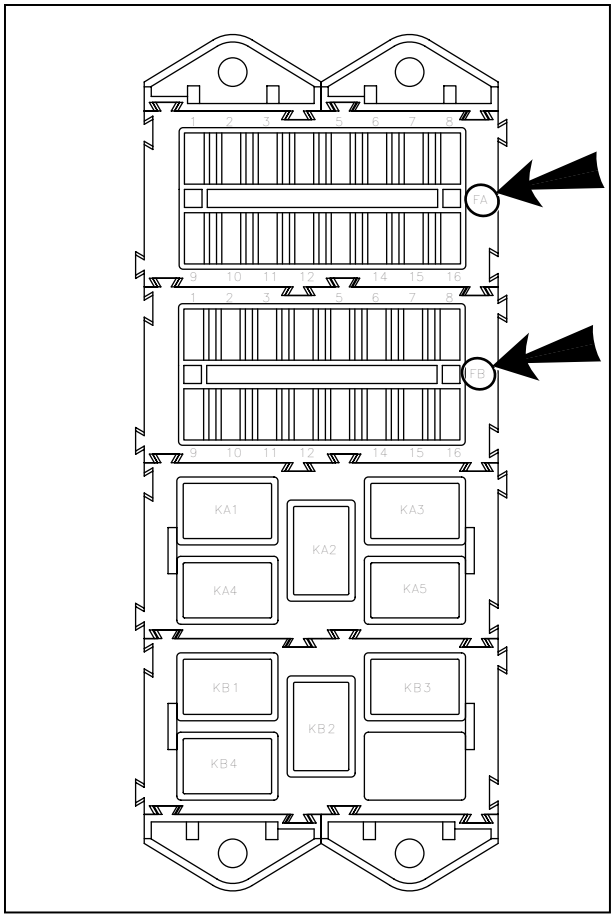


Fig. 10.747

There are 10 relays installed in F-N Series E-Line footstep tractors, of which 9 are installed in the fuse box (B), just under the protection fuses (Fig.10.747) and 1 is installed at the front (Fig. 10.748).

Relays	Function
KA1	Immobiliser relay
KA2	Relay for auxiliary socket + 4WD solenoid valve
KA3	Relay for headlights + rear field lights
KA4	Relay for brake lights, NAO, diff lock el., turn indicators
KA5	Relay 4WD engagement during braking
KB1	Dipped beam relay
KB2	Driving beam relay
KB3	Diff lock self-retaining relay
KB4	Relay for diff lock release + rear brake lights
K1	Power relay (glow plug preheater) (Fig.10.748).

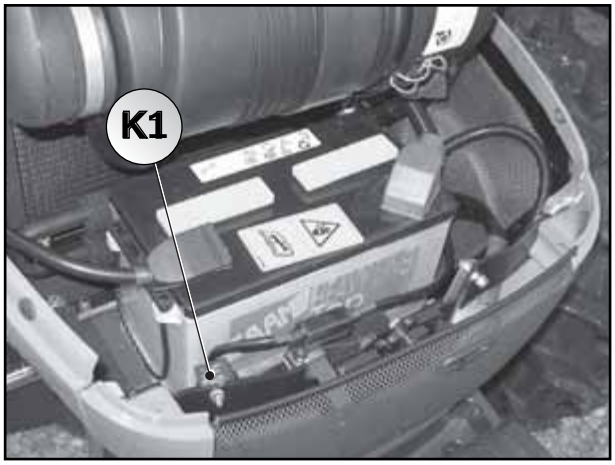


Fig. 10.748

identification of the components in the functional diagram

Code	Description	Part	Col.
FA1	Direct ignition key powering fuse	1	5
FA2	Key-activated starter motor fuse	1	3
FA3	Key-activated relay coil fuse	1	5
FA4	Key-activated engine power fuse	2	6
FA5	Direct fuse for platform's rotating beacon	1	7
FA6	Auxiliary socket positive direct fuse	2	1
FA7	Auxiliary socket positive key-activated fuse	2	1
FA8	Key-activated el. 4WD fuse	2	2
FA9	Key-activated dipped beams fuse	2	4
FA10	Key-activated driving beams fuse	2	4
FA11	Key-activated fuse for rear field light	2	5
FA12	Key-activated fuse for brake lights/el.diff lock	3	1
FA13	Key-activated side lights fuse	3	3
FA14	Direct hazard light fuse	3	3
FA15	Key-activated horn fuse	3	5
FA16	Key-activated NAO control unit fuse	3	5
FB1	Side lights direct fuse (main)	3	6
FB2	Side lights direct fuse (RH rear, LH front)	3	6
FB3	Side lights direct fuse (LH rear,RH front, licence plate light)	3	6
FB4	Instrument power direct fuse	4	1
FB5	Key-activated instrument power fuse	4	2
F1	Alternator link-box fuse	1	3
F2	Key-activated user primary link-box fuse	1	3
F3	Key-activated user primary link-box fuse	1	3
F4	Key-activated battery direct user primary link-box fuse	1	3
F5	Glow plug fuse (steering wheel midival)	1	2
K1	Key-activated relay for glow plugs	1-1	7-2
KA1	Starter motor enabling relay	1-1	7-3
KA2	Key-activated relay for auxiliary socket, 4WD el.	1-2	5-1
KA3	Key-activated relay for headlights, rear field light	1-2	5-4
KA4	Key-activated relay for brake lights, NAO, diff lock el., turn indicators	1-3	5-1
KA5	Relay for engaging 4WD during braking	2-2	2-2
KB1	Dipped beams relay	3-2	4-4
KB2	Driving beams relay	3-2	5-4
KB3	Differential lock self-retaining relay	2-2	8-8
KB4	Relay for brake lights/differential lock	3-3	2-1
S0	Ignition key	1	5
S1	Platform rotating beacon switch	1	7
S2	4WD switch	2	2
S3	Rear field light switch	2	5
S4	Differential lock button	2	7
S5	Emergency switch	3	3
S6	Light switch	3	4
S7	Side lights/dipped beams switch	3	6
SP2	Pressure switch for 4WD engagement during braking	3	2
SP3	7 bar trailer brake pressure switch (braking in progress)	4	2
SP4	Trailer brake pressure switch (brake connected, trailer hitched)	4	2
SP5	Engine oil pressure switch	4	3
SP6	Air filter vacuum switch	4	3
SP7	Gearbox oil vacuum switch	4	3
ST1	Temperature sensor for fuel enrichment jet	2	6
ST2	Engine water temperature sensor	4	7
SL1	Brake fluid level sensor	4	5
SL2	1st tank fuel level sensor	4	5
SL3	2nd (supplementary) tank fuel level sensor	4	6
SQ1	Safety microswitch on gearbox	1	7
SQ2	Independent PTO engaged microswitch	1	7
SQ3	Parking brake engaged microswitch	4	2
SQ4	Synchronized PTO engaged microswitch	4	3
SQ5	Fast PTO engaged microswitch	4	4
SQ6	Lh brake pedal microswitch	2	2
SQ7	Rh brake pedal microswitch	2	2
L1	Platform rotating beacon	1	7
L2	Lh headlight	2	4
L3	Rh headlight	2	4
L4	Platform rear field light	2	5

L5	Lh brake light	3	1
L6	Rh brake light	3	1
L7	LH rear turn indicator light	3	2
L8	LH front turn indicator light	3	3
L9	RH front turn indicator light	3	3
L10	RH rear turn indicator light	3	3
L11	RH rear side light	3	5
L12	LH front side light	3	6
L13	RH front side light	3	6
L14	LH rear side light	3	7
L15	License plate light	3	7
L16	Lh NAO supplementary light	3	7
L17	Rh NAO supplementary light	3	7
Yv1	Fuel injection pump solenoid valve	2	6
Yv2	Fuel enrichment jet solenoid valve	2	6
Yv3	4WD solenoid valve	2	2
Yv4	Diff lock solenoid valve	2	7
EC1	Instrument	4	2
G1	Battery	1	1
G2	Glow plugs	1	1
G3	Alternator	1	4
G4	Blinker	3	3
G5	Horn	3	5
M1	Starter motor	1	2
M2	Fuel pump motor	2	5
D1	NAO protection diode	3	3
D2	NAO protection diode	3	3

Grounds and Terminal boards

XS0	Platform-7-pin socket connector (6-ways)
XS1	Dashboard-front line connector (34-ways)
XS2	Dashboard-rear line connector (34-ways)
XS3	Dashboard-platform line connector (34-ways)
XS5	Roof line circular connector (4 ways)
XS6	Auxiliary 3-pin socket
XS7	Front line-bonnet line connector (6 ways)
XS8	Lh front light connector (3-ways) (socket holder)
XS9	Rh front light connector (3-ways) (plug holder)
XS10	Connector (2-ways) for Nao supplementary lights
XM0	Direct grounding points on parts structure
XM1	Front cable wiring line ground direct battery eyelet)
XM2	Platform cable wiring line ground
XM3	Dashboard wiring line ground (eyelet)
XM5	Rear wiring line ground

References to functional diagram

1 - cab version only
2 - to 7-pin socket
3 - to 7-pin socket
4 - to 7-pin socket
5 - to 7-pin socket
6 - to 7-pin socket
7 - 7-pin socket ground
8 - platform ground
9 - rear ground
10 - dipped beams
11 - driving beams
12 - flash
13 - horn
14 - NAO
15 - glow plugs
16 - starter motor
17 - alternator
18 - auxiliary socket, 4WD solenoid valve
19 - headlights, rear field light
20 - brake lights, NAO, diff lock, turn indicators, front control valve, power lift
21 - air conditioner
22 - roof auxiliary
23 - ignition relay
24 - glow plugs
25 - platform rotating beacon
26 - 3-pin auxiliary socket
27 - 4WD during braking
28 - four-wheel drive
29 - Lh headlight
30 - Rh headlight
31 - platform rear field light
32 - fuel pump
33 - fuel injection pump
34 - fuel enrichment jet
35 - differential lock
36 - differential lock
37 - lh brake light
38 - rh brake light
39 - diff lock release, brake light indicators
40 - lh rear turn indicator
41 - lh front turn indicator
42 - rh front turn indicator
43 - rh rear turn indicator
44 - dipped beams
45 - driving beams
46 - horn
47 - rh rear side light
48 - lh front side light
49 - rh front side light
50 - lh rear side light
51 - license plate light
52 - lh supplementary turn indicator (NAO)
53 - rh supplementary turn indicator (NAO)
54 - hand brake lever
55 - trailer brake oil pressure
56 - synchronized rear PTO
57 - engine oil pressure
58 - air intake circuit
59 - gearbox oil intake
60 - 750 - 1000 RPM rear PTO
61 - brake oil level
62 - fuel level
63 - supplementary tank level
64 - instrument ground
65 - radiator water temperature
66 - hand brake
67 - brake oil level
68 - trailer brake oil pressure
69 - synchronized PTO
70 - low engine oil pressure
71 - air filter clogged
72 - transmission oil filter
73 - fast PTO
74 - battery + (key)
75 - side lights
76 - four-wheel drive
77 - Independent PTO
78 - driving beams
79 - battery charge
80 - fuel level indicator
81 - low fuel level
82 - battery + (battery)
83 - turn indicators
84 - 1st trailer turn indicator
85 - engine water temperature
86 - ground
87 - 2nd trailer turn indicator
88 - differential lock
89 - Engine RPM meter
90 - night lights
107 - cab version only

3.10.2 Main wiring diagram

Part 1

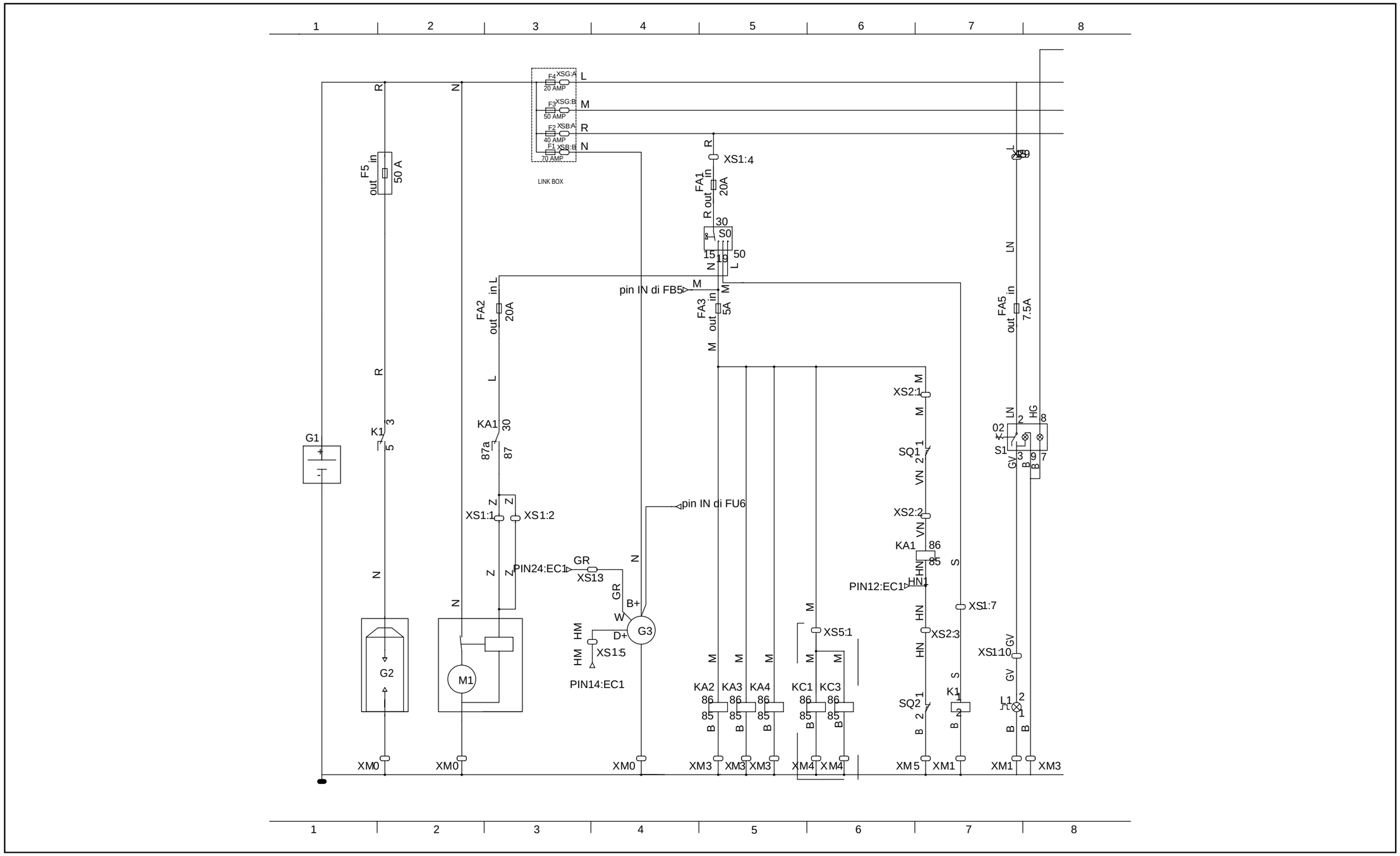


Fig. 10.749

Part 2

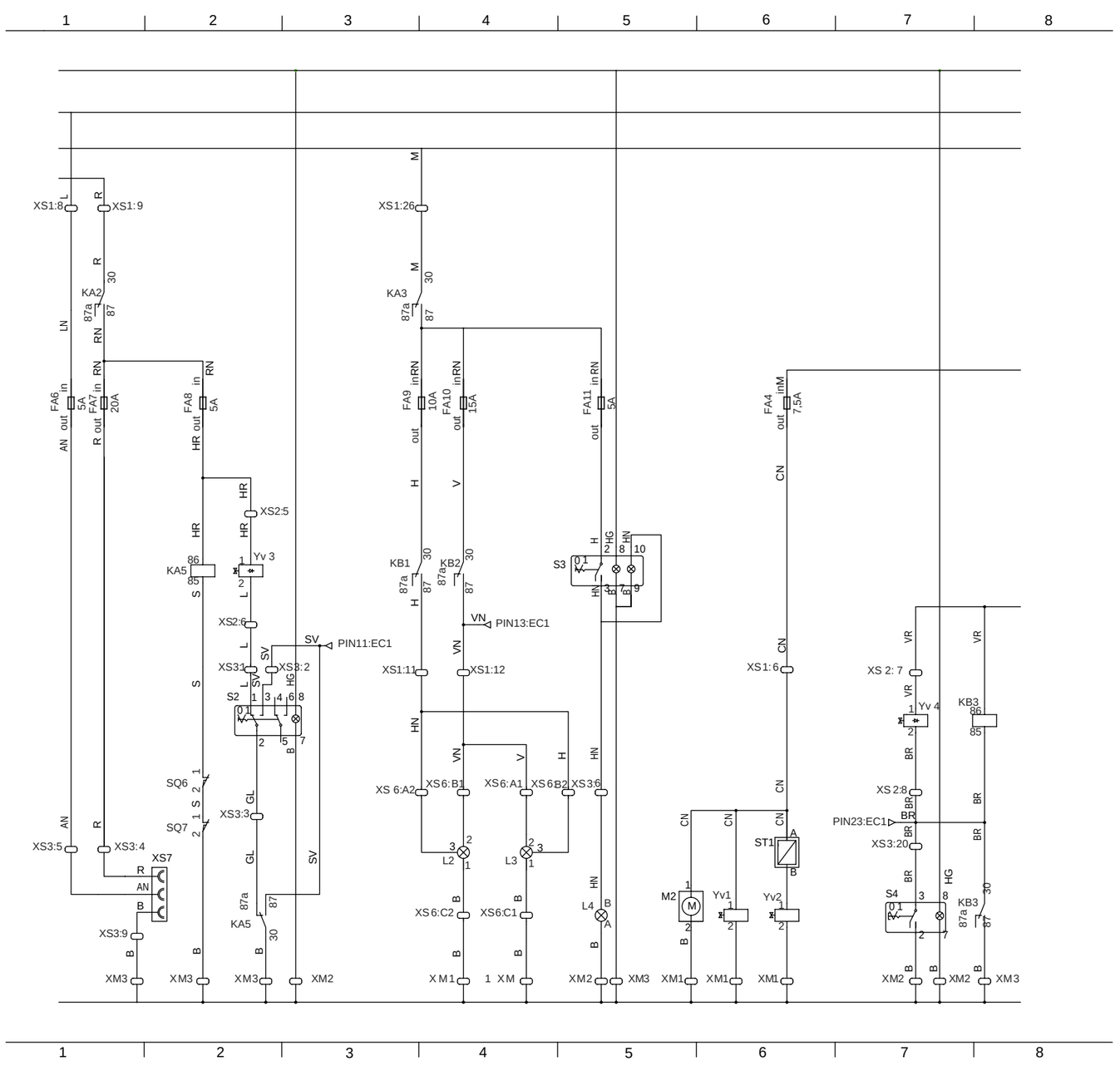


Fig. 10.750

Part 3

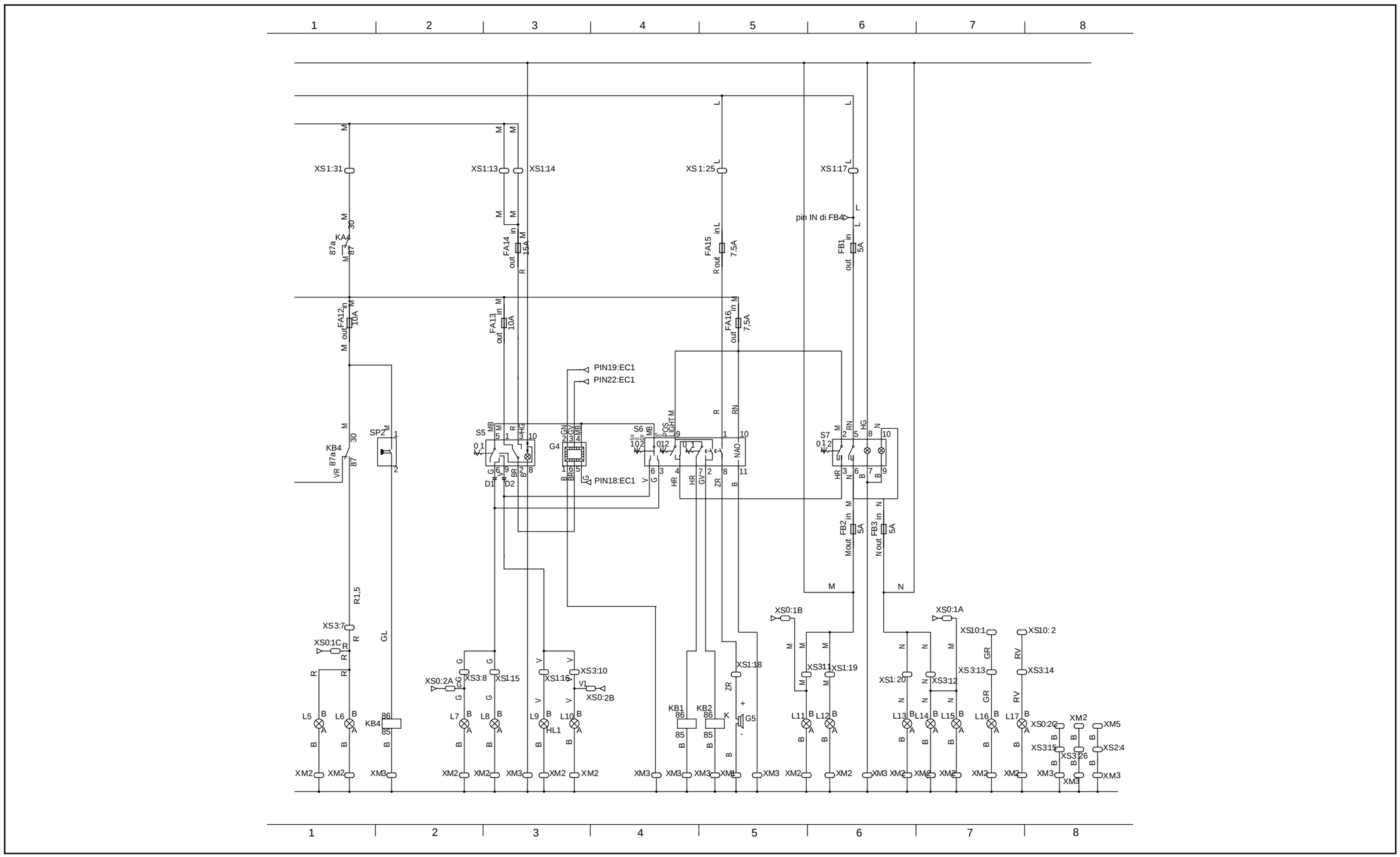


Fig. 10.751

Part 4

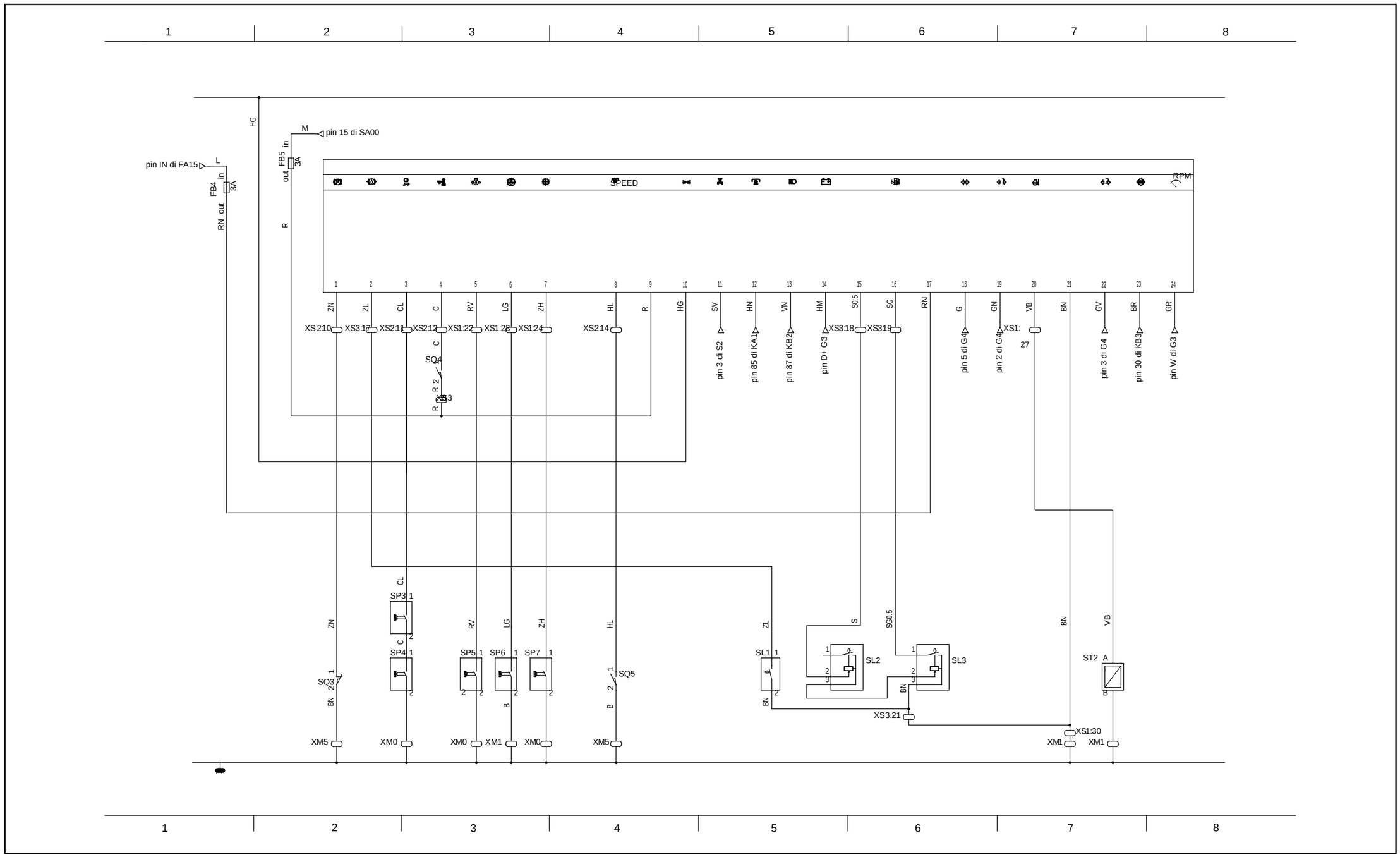


Fig. 10.752

3.10.3 Battery-starter motor line

3.10.3.1 General description

This line is very important for the functionality of the electrical system of the entire tractor. It connects the positive battery pole to the starter motor (M1 Fig.10.753), thus allowing the entire electrical system to be powered, as the ignition switch is connected to the battery.

Connection to the front fuse box is made on the positive battery terminal (Fig.10.754). These fuses protect the tractor's electrical system against short circuits and excessive power draw.

The positive battery terminal is also connected to power fuse (F5), which protects the preheater relay (K1) from short-circuits (Fig.10.755).

Battery (G1) is installed in the front, between the radiator and headlights (Fig.10.755).

⚠	**Attention:** comply with the safety instructions !

⚠	**Attention:** disconnect the ground wire (-) from the battery.

Fig. 10.753

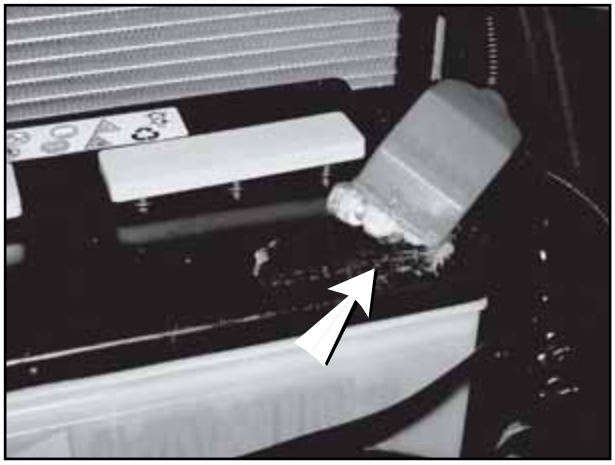


Fig. 10.754

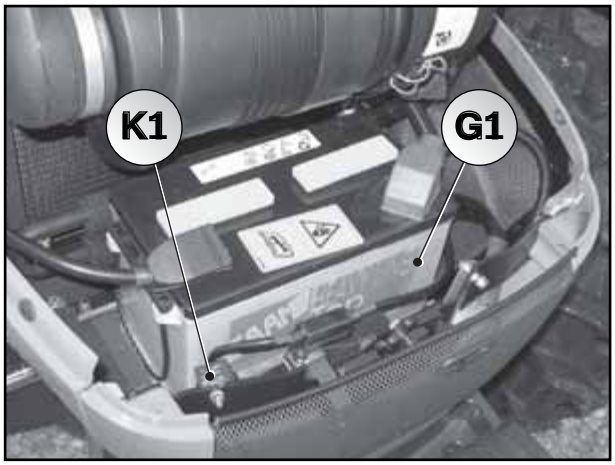


Fig. 10.755

3.10.3.2 Wiring

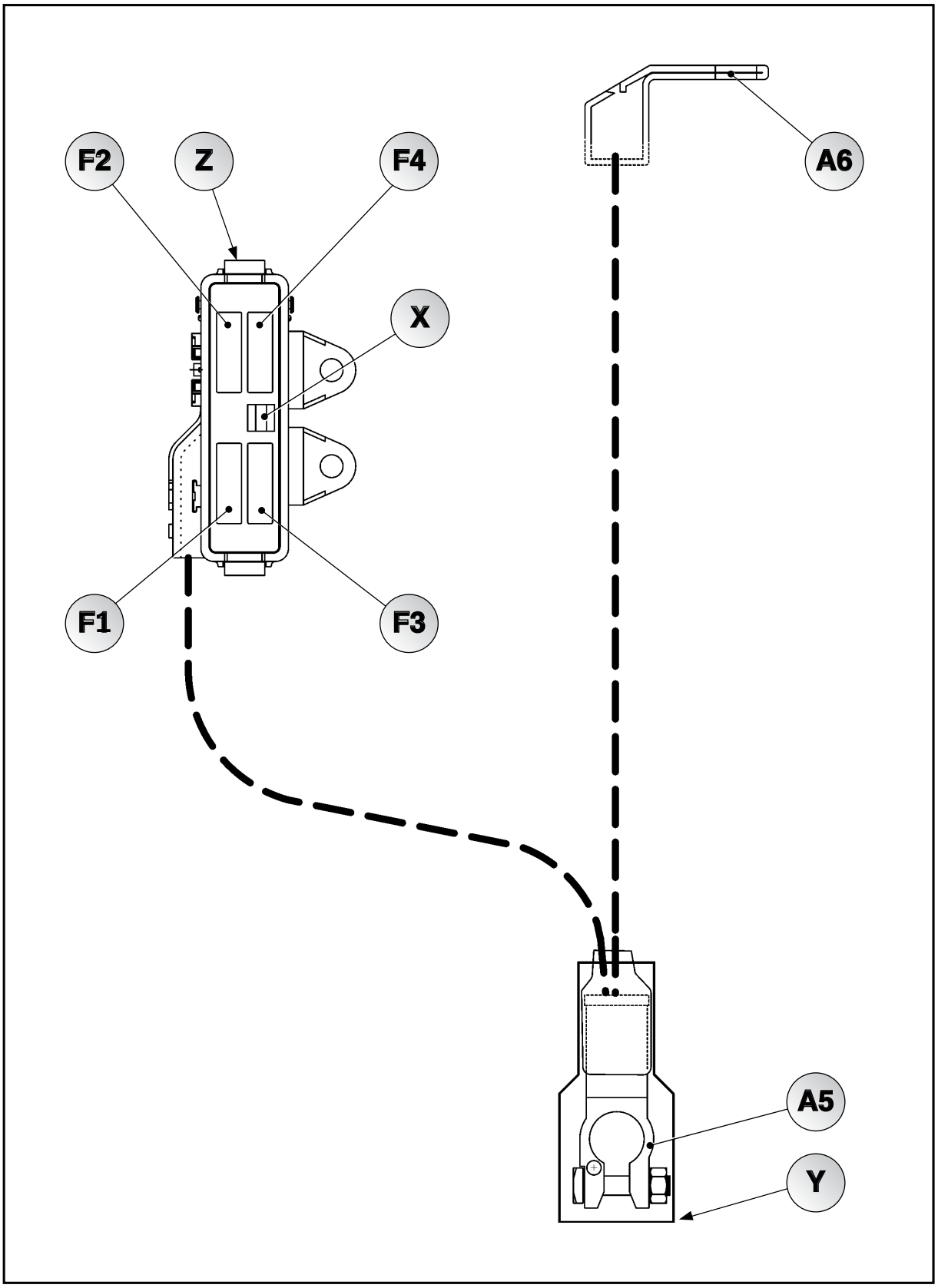


Fig. 10.756

Z - Front fuse box
Y - Insulating cap
X - Pincers for removing fuses
F1 - 70 Amp. fuse
F2 - 40 Amp. fuse
F3 - 50 Amp. fuse
F4 - 20 Amp. fuse
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal

3.10.3.3 Connector locations

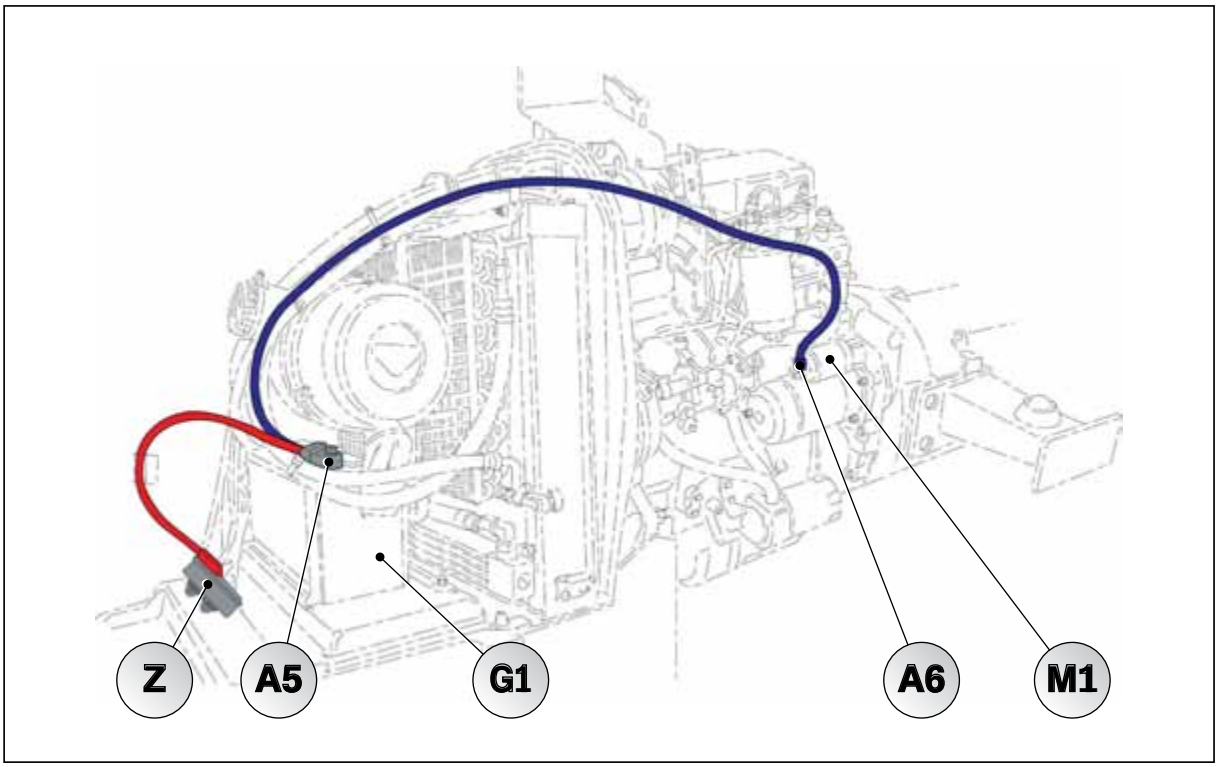


Fig. 10.757

G1 - Battery
M1 - Starter motor
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal
Z - Front fuse box

The front fuse box (Z) is installed in front of the battery (G1)(Fig.10.758).

The four fuses inside are important since they protect the tractor's entire electrical system from short-circuits and excessive power draw.

Before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

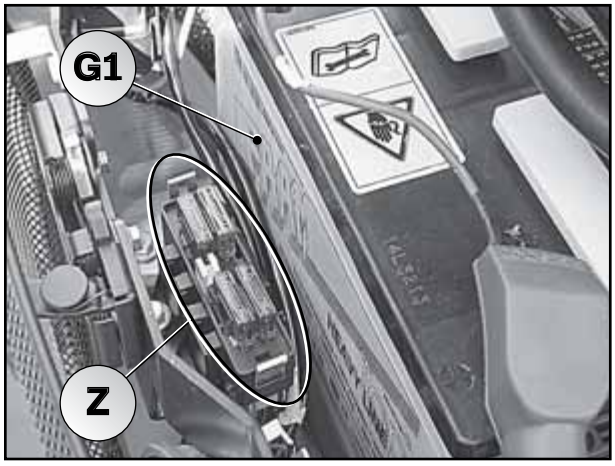


Fig. 10.758

3.10.4 Front engine line

3.10.4.1 General description

The front line installed in **F-N Series E-Line footstep version** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.759), etc.

The four main fuses (F1, F2, F3 and F4 Fig.10.760) connected to this line by means of the connectors (LB1 and LB2), protect the system against short-circuits and excessive power draw.

The front line is connected to the battery line via connection to the main fuse box (Link Box) and on the other side, to the dashboard line via connection to the terminal boards (XS1 Fig.10.761) installed just under the dashboard lining, between the engine and the platform front.

The front line also connects to the headlight extension line by means of the connectors (XS6 Fig.10.762) installed under the bonnet.

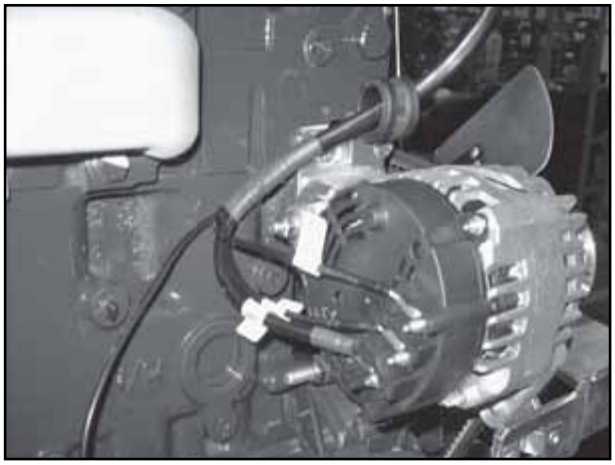


Fig. 10.759

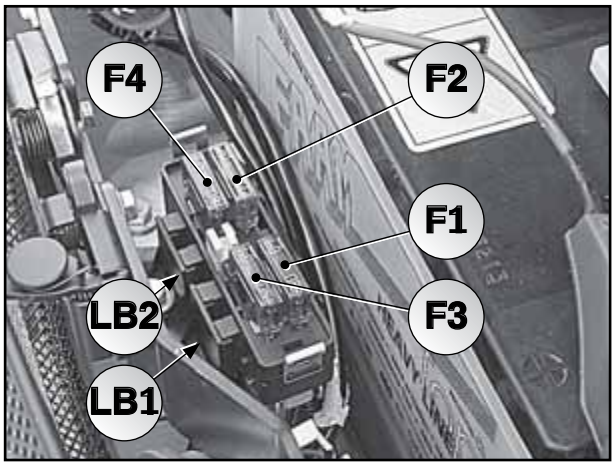


Fig. 10.760

Fig. 10.762

Fig. 10.761

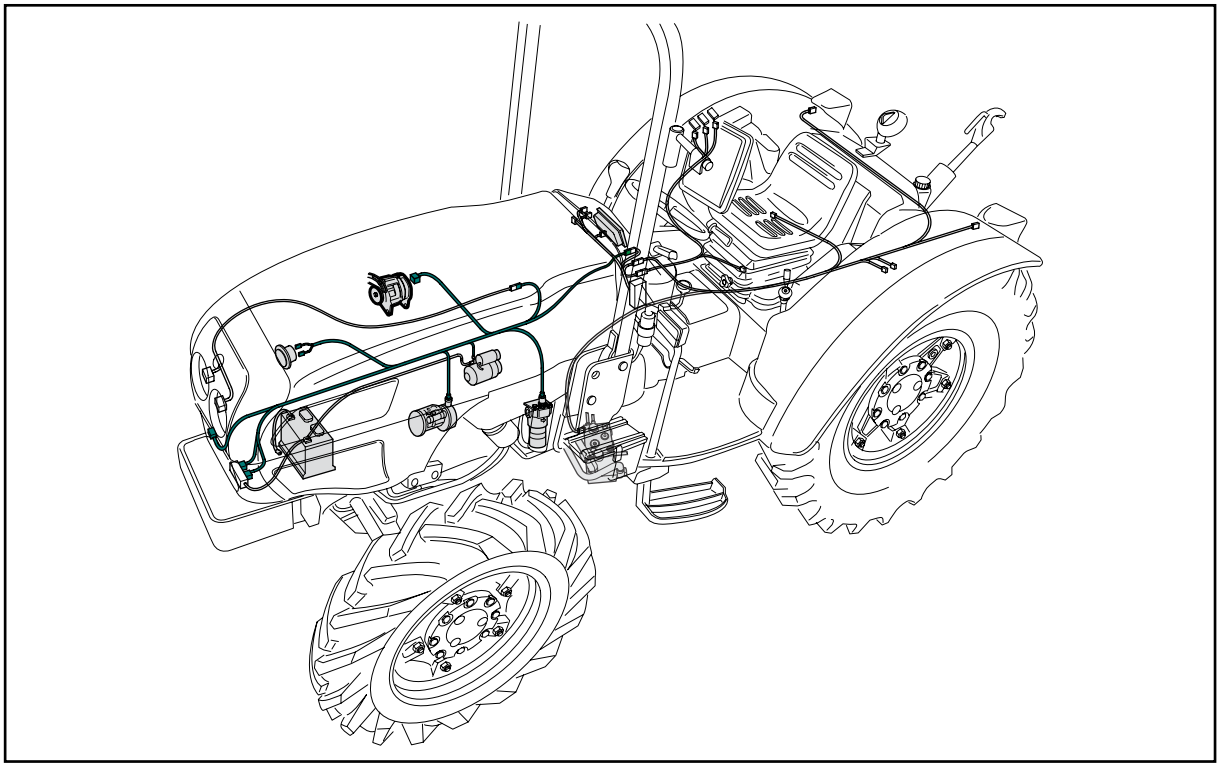


Fig. 10.763

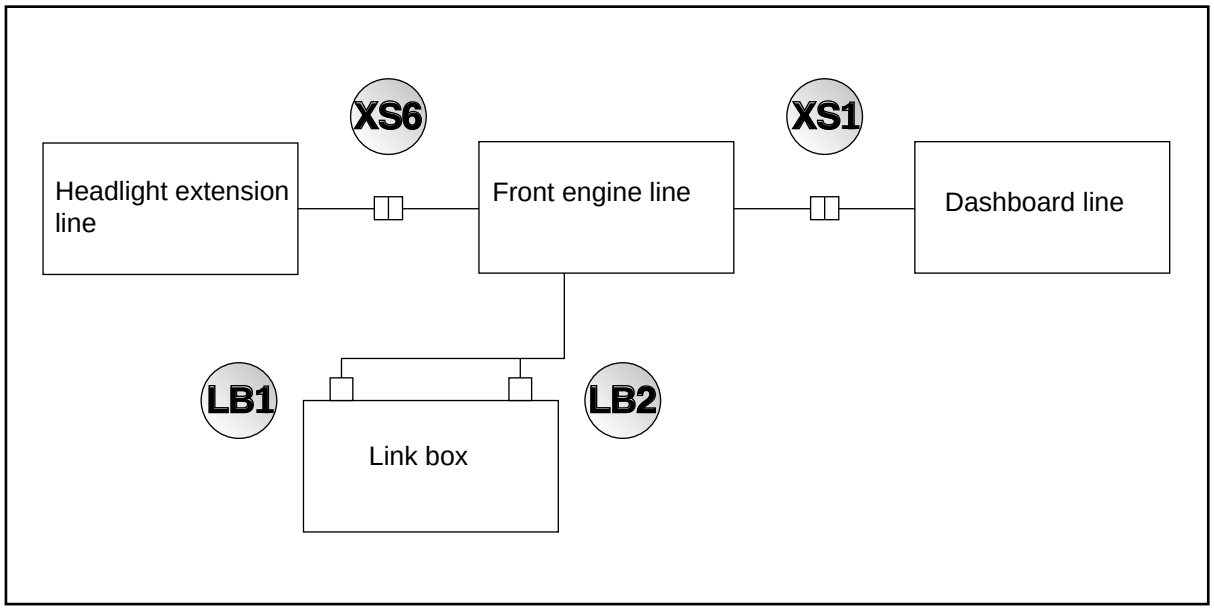


Fig. 10.764

3.10.4.2 Wiring

Wiring (version with 3-cylinder engine)

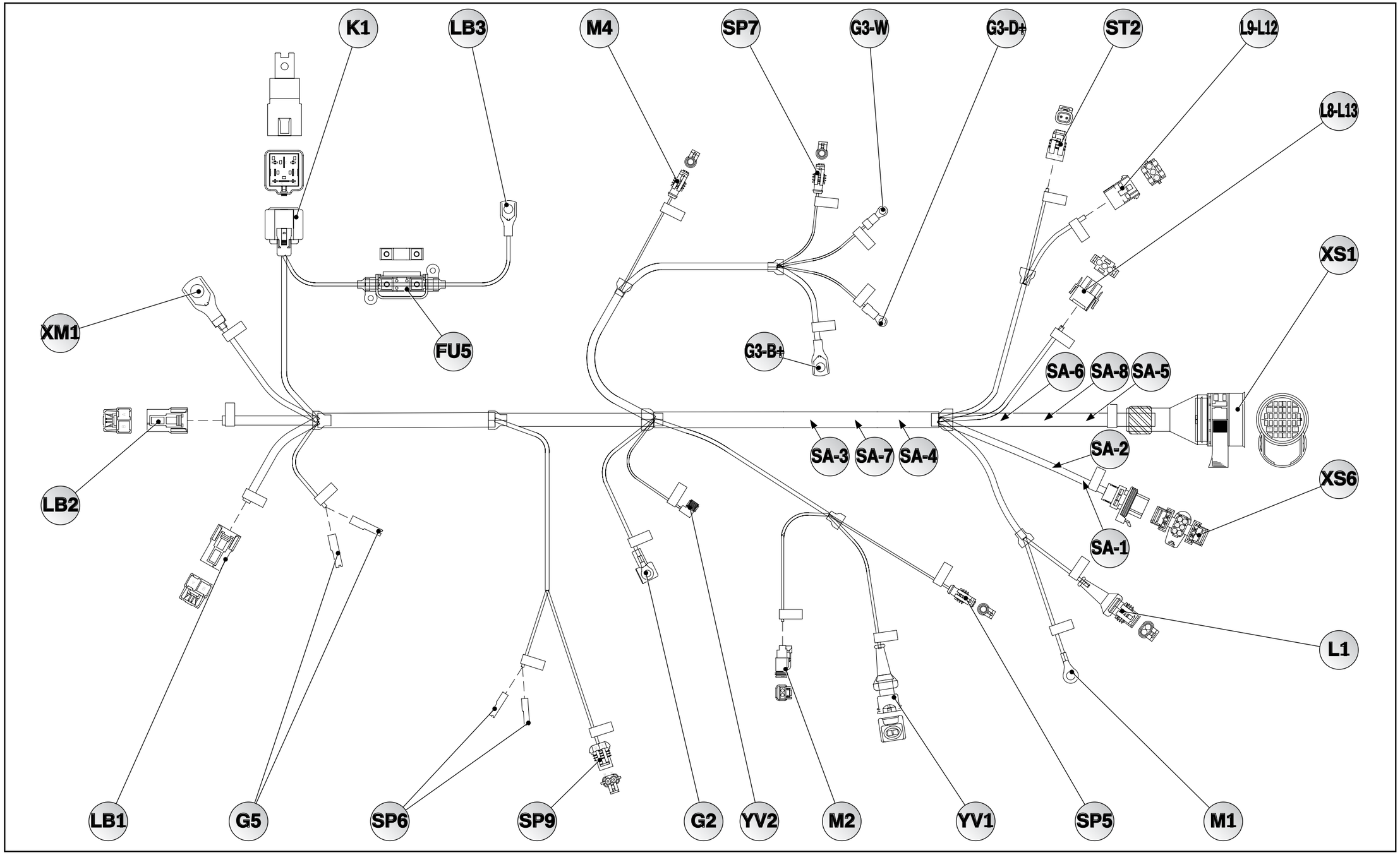


Fig. 10.765

Wiring (version with 4-cylinder engine)

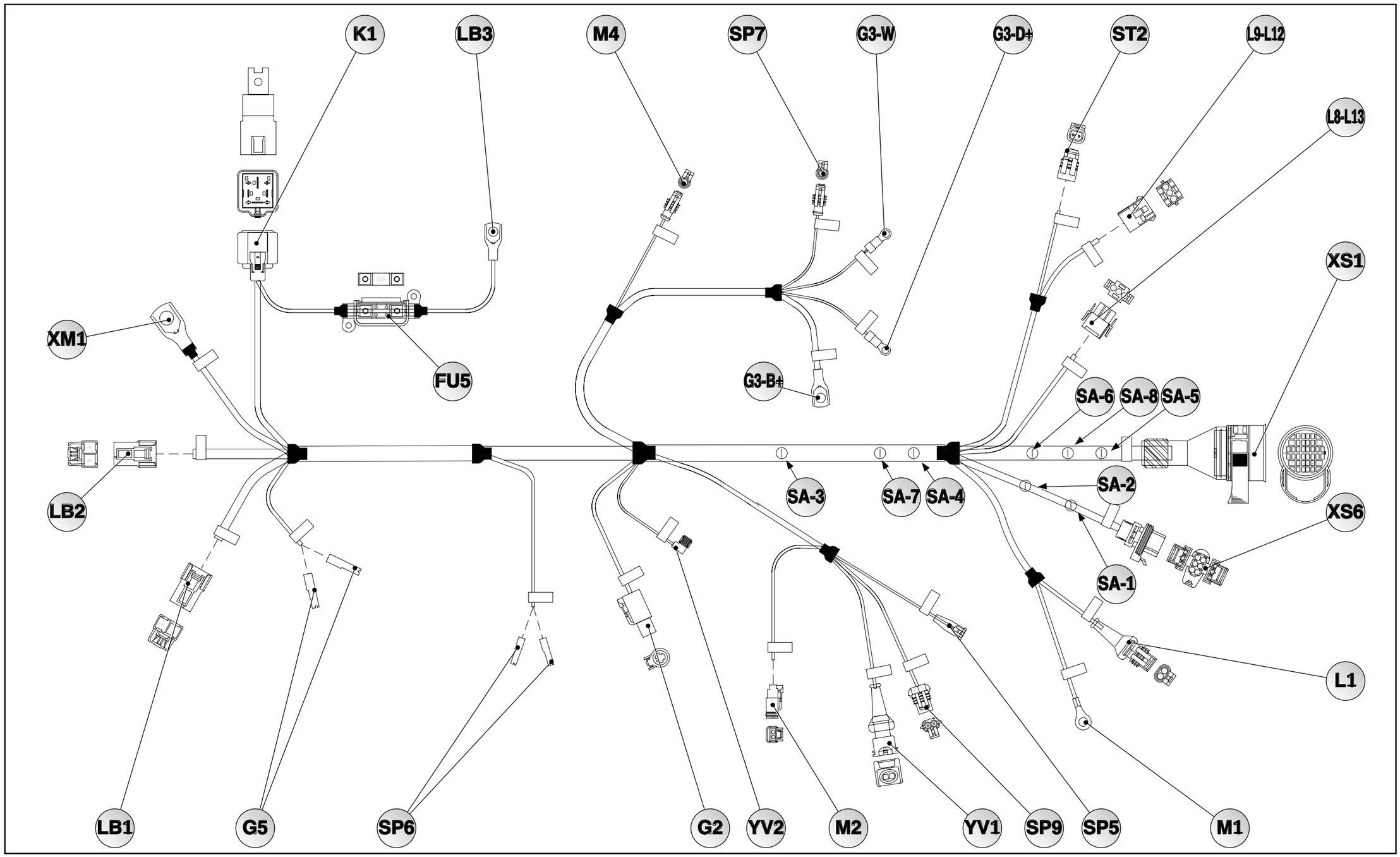


Fig. 10.766

F5 - Fuse to protect the glow plug relay
G2 - Glow plug terminal
G3_B+ - Alternator terminal
G3_D+ - Alternator terminal
G3_W - Alternator terminal
G5 - Faston terminals for horn
K1 - Glow plug relay connector
L1 - Connector for revolving beacon brace
L8_L13 - Connector for lh sidelights and turn indicators
L9_L12 - Connector for sidelights and turn indicators
LB1 - Connector (grey) for front fuses (link box)
LB2 - Connector (blue) for front fuses (link box)
LB3 - Circular terminal for positive battery terminal
M1 - Starter motor terminal
M2 - Connector for fuel pump
M4 - Connector for A/C compressor
SA-1_SA-8 - Junction
SP5 - Connector for engine oil pressure switch
SP6 - Faston terminals for air filter sensor
SP7 - Connector for gearbox oil vacuum switch
SP9 - Connector for A/C filter pressure switch
ST2 - Connector for engine coolant temperature sensor
XM1 - Ground eyelet (direct battery)
XS1 - Terminal board for front line/dashboard connection
XS6 - Connector for bonnet headlight line
YV1 - Terminal for fuel injection pump solenoid valve
YV2 - Terminal for fuel enrichment jet temperature sensor

3.10.4.3 Connector locations

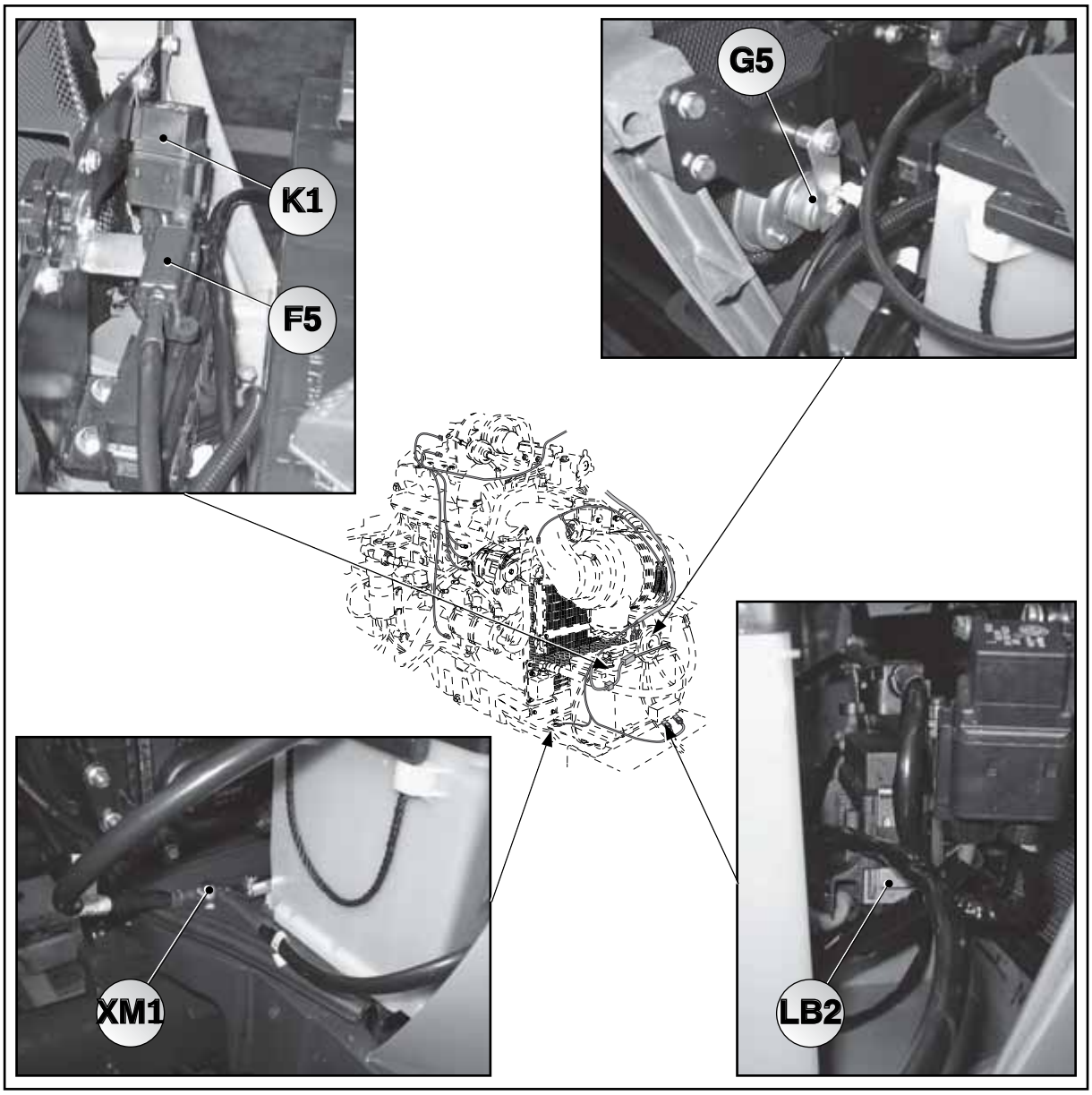


Fig. 10.767

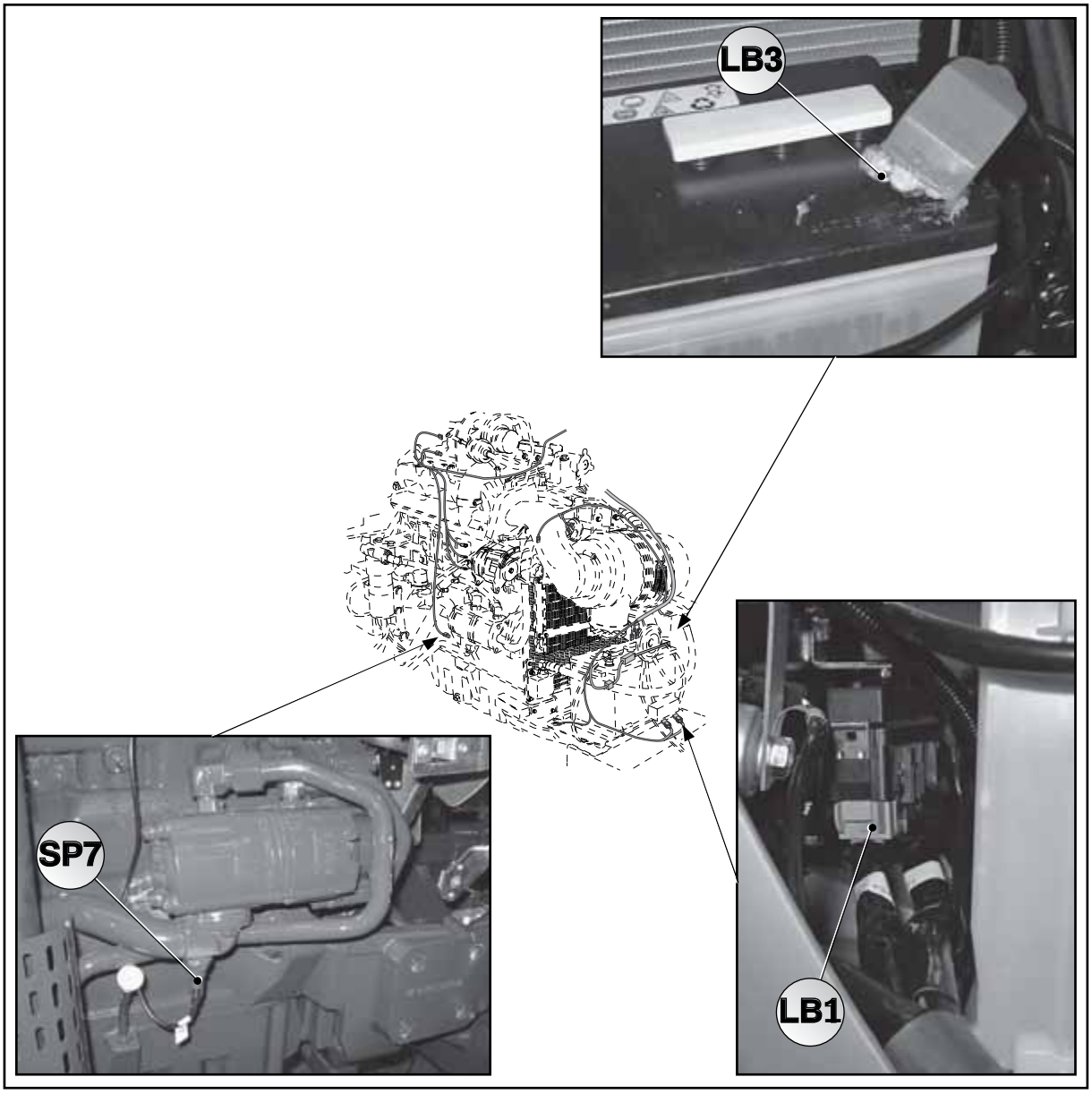


Fig. 10.768

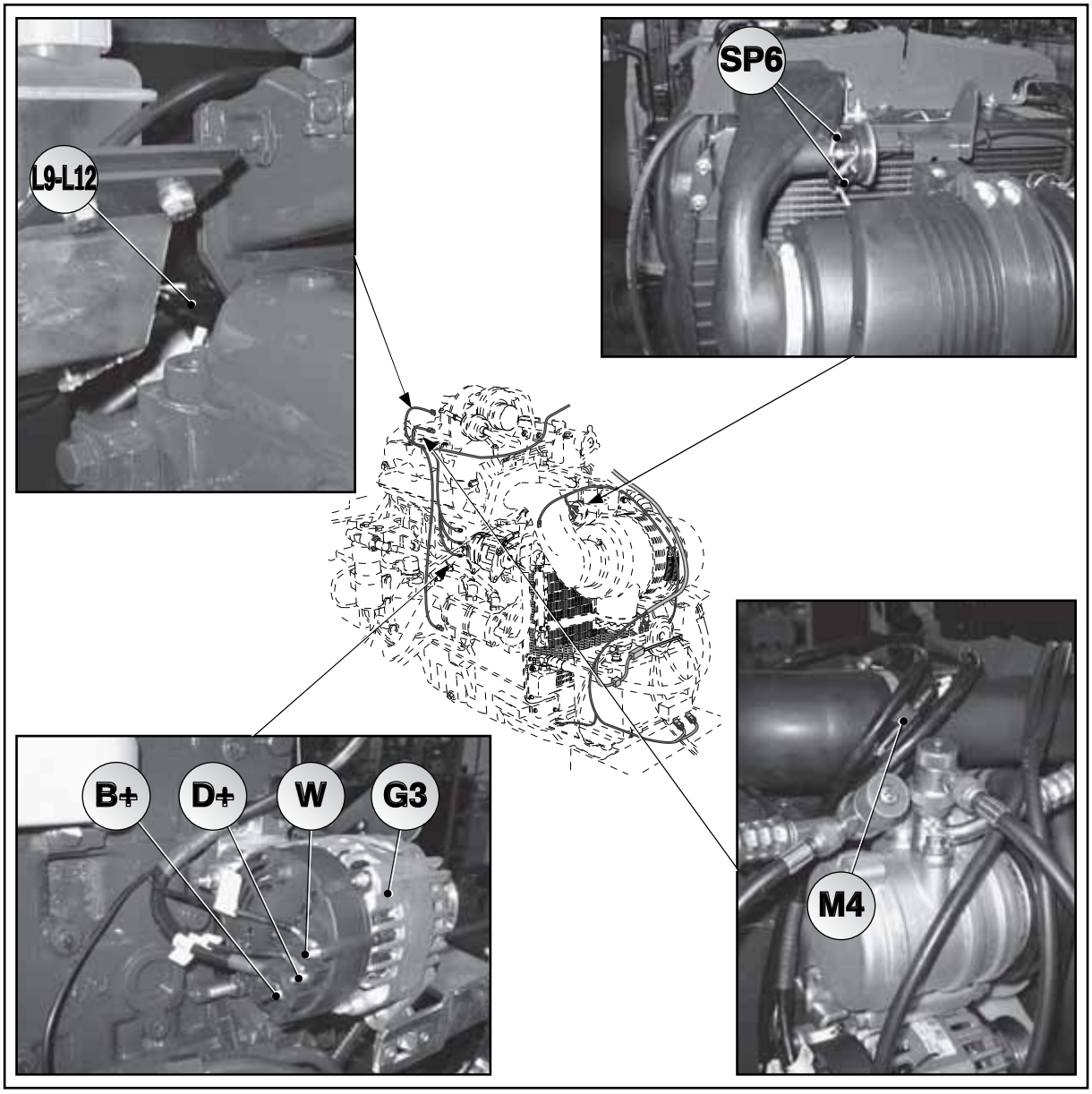


Fig. 10.769

G3_B+ - Alternator terminal
G3_D+ - Alternator terminal
G3_W - Alternator terminal
L9_L12 -Connector for sidelights and turn indicators
M4 - Connector for A/C compressor
SP6 - Faston terminals for air filter sensor

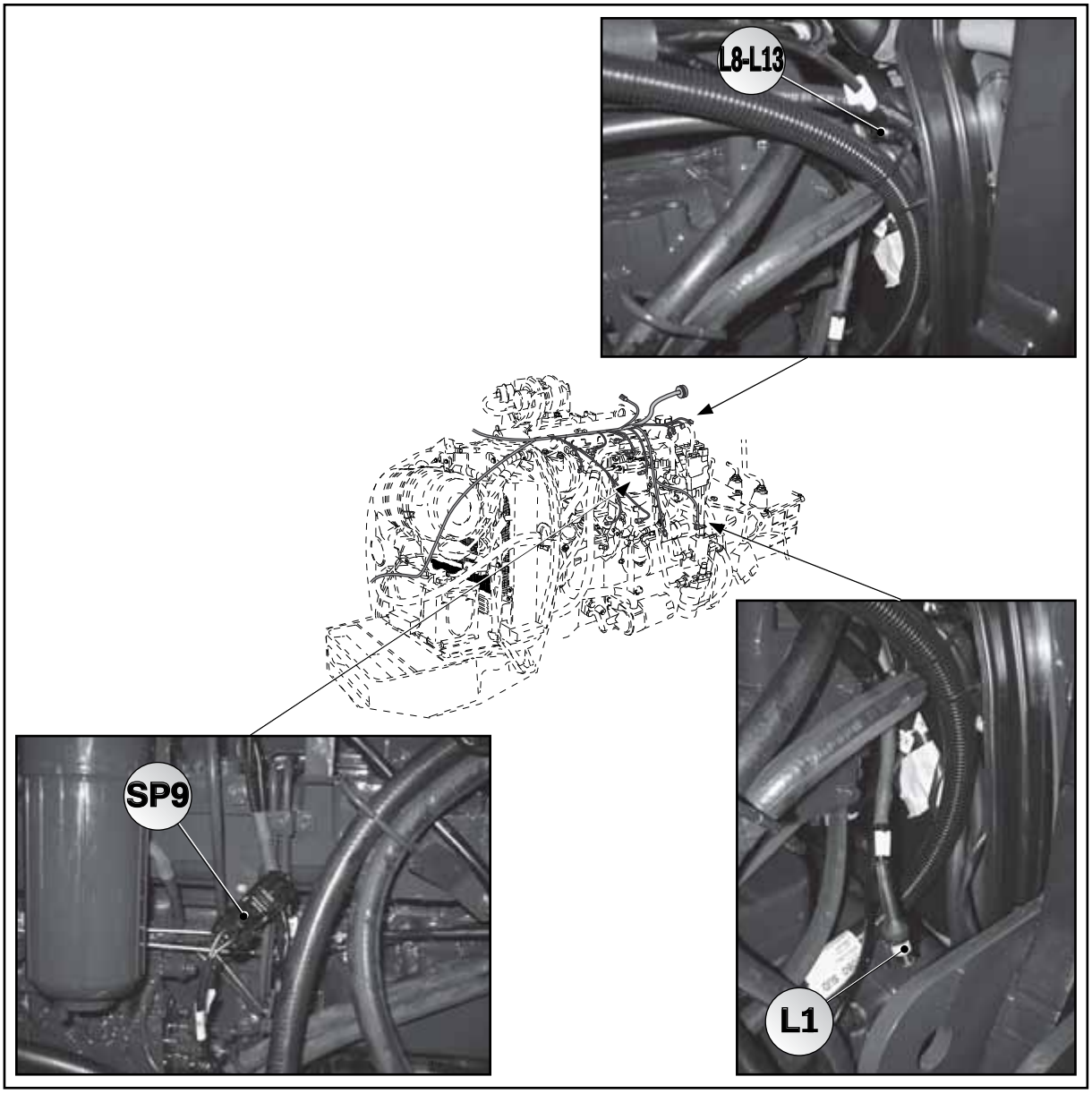


Fig. 10.770

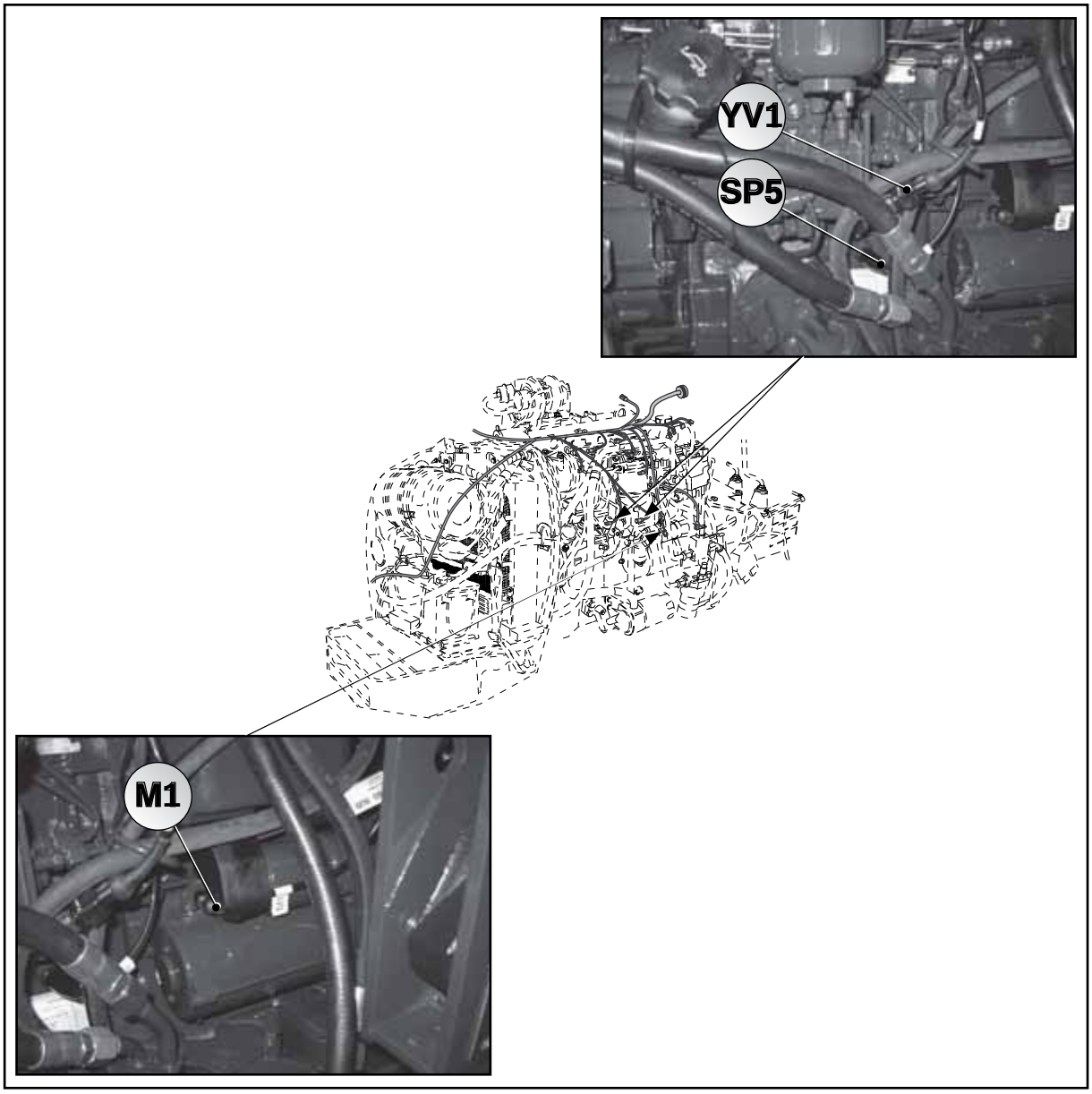


Fig. 10.771

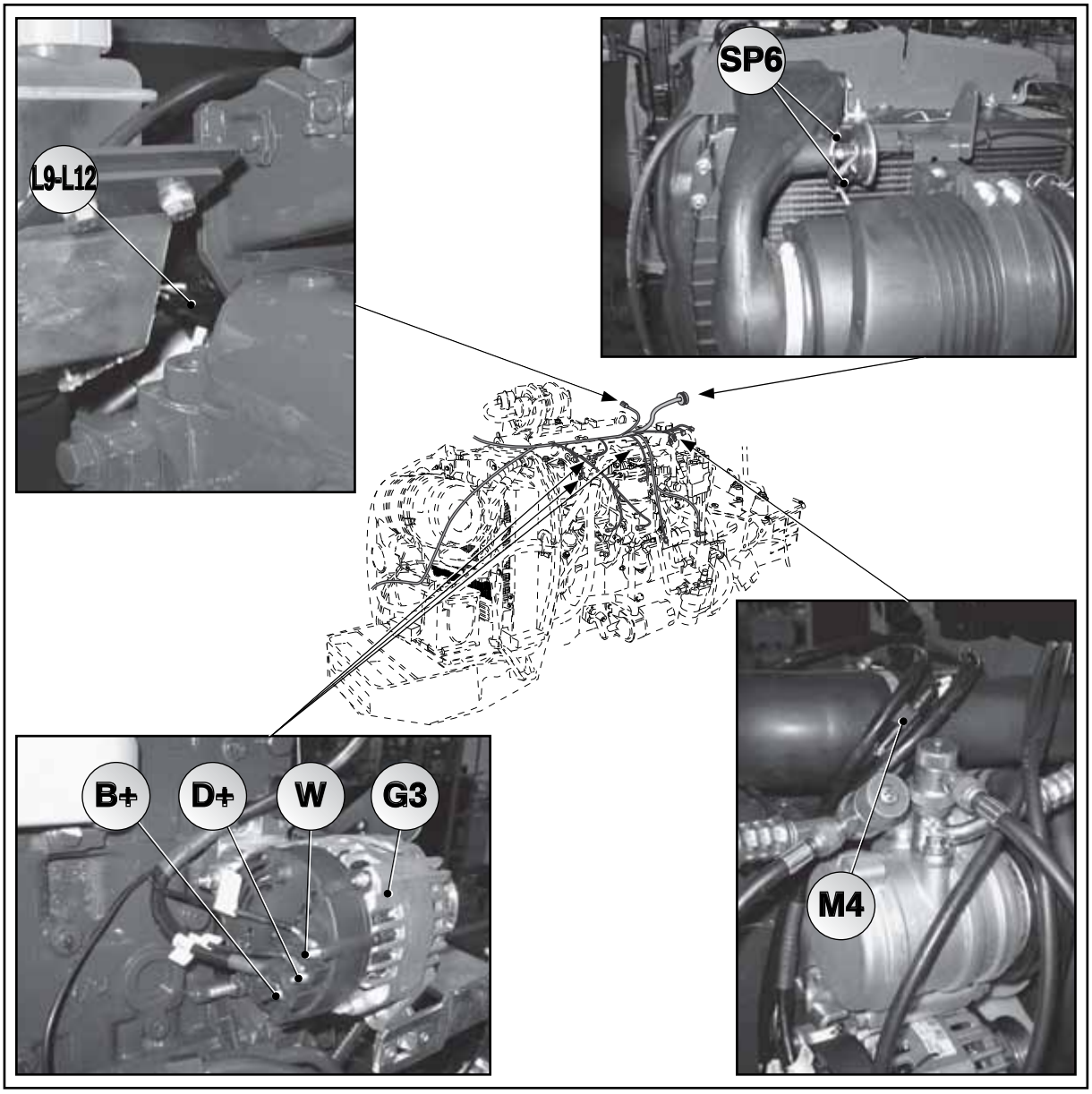


Fig. 10.772

G2 - Glow plug terminal
M2 - Connector for fuel pump
ST2 - Connector for engine coolant temperature sensor
XS1 - Terminal board for front line/dashboard connection
XS6 - Connector for bonnet headlight line
YV2 - Terminal for fuel enrichment jet temperature sensor

3.10.4.4 Connector identification

Terminal (G2) for glow plugs

pin	colour	to con. or comp.	pin	wire function
1	M	K1	5	glow plugs

Fig. 10.773

Alternator terminal (G3_B+)

pin	colour	to con. or comp.	pin	wire function
1	N	LB2	B	

Fig. 10.774

Alternator terminal (G3_D+)

pin	colour	to con. or comp.	pin	wire function
1	HM	XS1	5	

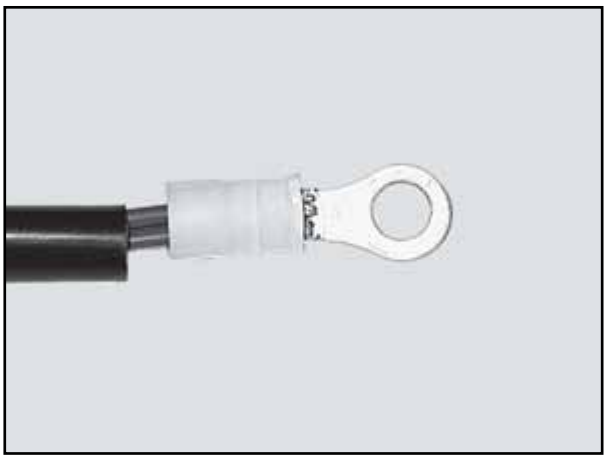


Fig. 10.775

Alternator terminal (G3_W)

pin	colour	to con. or comp.	pin	wire function
1	GR	XS1	3	alternator W

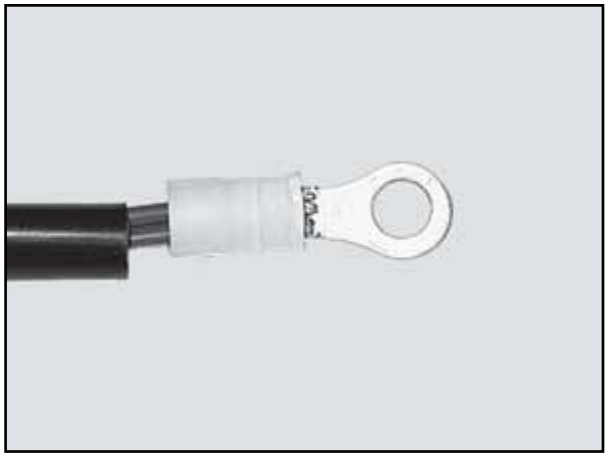


Fig. 10.776

Faston terminals (G5) for horn

pin	colour	to con. or comp.	pin	wire function
1	ZR	XS1	18	horn
2	B	XM1		ground

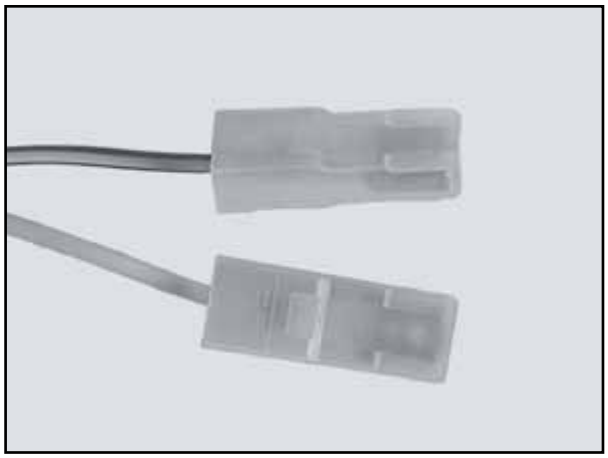


Fig. 10.777

Connector (K1) for glow plug relay

pin	colour	to con. or comp.	pin	wire function
1	B	XM1		ground
2	N	XS1	7	
3	R	F5	1	
4	M	G2	1	glow plugs
5				not used
6				not used
7				not used
8				not used

Fig. 10.778

Connector (L1) for revolving beacon brace

pin	colour	to con. or comp.	pin	wire function
1	GV	XS1	10	revolving beacon
2	B	L9_L12	3	ground

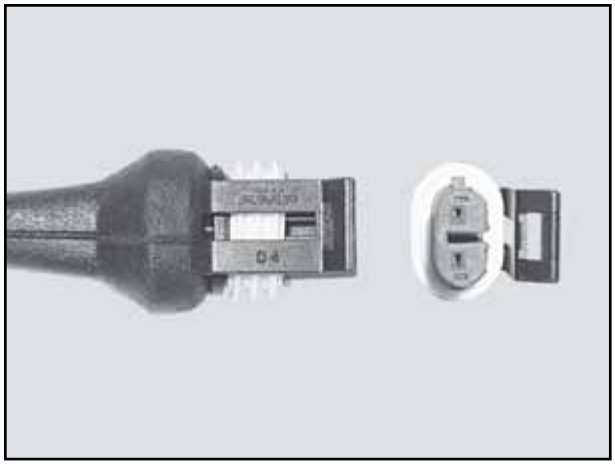


Fig. 10.779

Connector (L8-L123) for lh sidelights and turn indicators

pin	colour	to con. or comp.	pin	wire function
1	N	XS1	20	
2	G	XS1	15	
3	B-B	L9_L13-SA-5	3	junction-ground

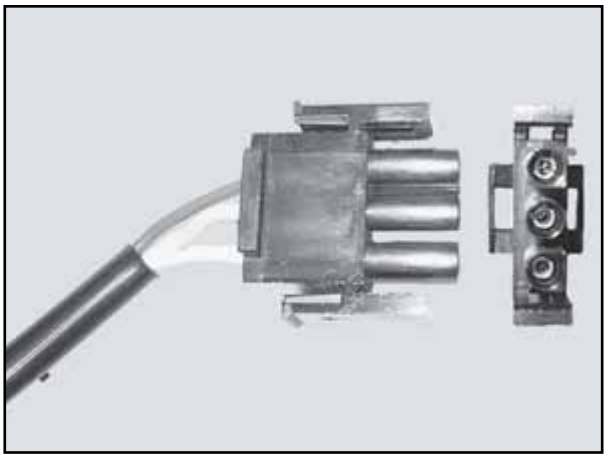


Fig. 10.780

Connector (L9-L12) for rh sidelights and turn indicators

pin	colour	to con. or comp.	pin	wire function
1	M	XS1	19	lh front side light
2	V	XS1	16	rh front turn ind.
3	B-B	L1-L8_L13	2-3	ground

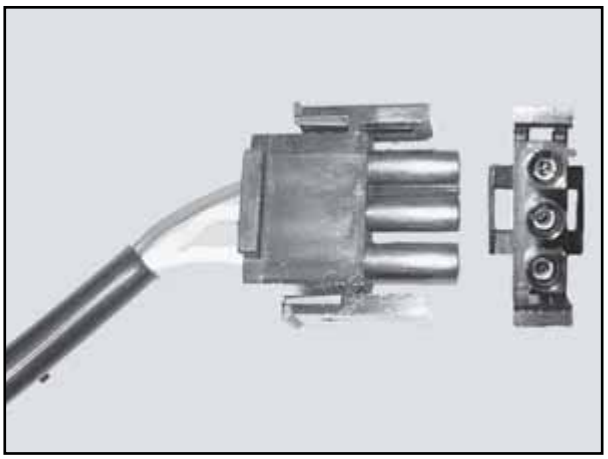


Fig. 10.781

Connector (LB1) (grey) for front fuses (link box)

pin	colour	to con. or comp.	pin	wire function
1	L	SA-7		junction
2	M	SA-6		junction

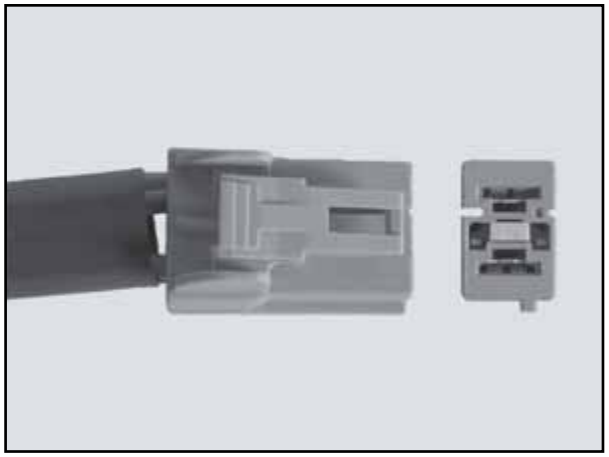


Fig. 10.782

Connector (blue) (LB2) for front fuses (link box)

pin	colour	to con. or comp.	pin	wire function
1	R	SA-4		junction
2	N	G3	1	

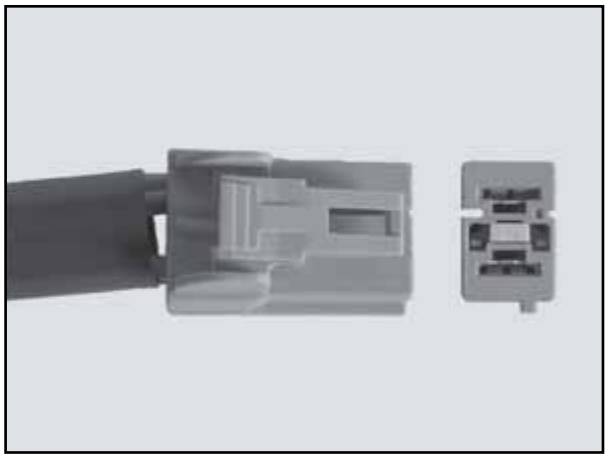


Fig. 10.783

Circular terminal (LB3) for positive battery terminal

pin	colour	to con. or comp.	pin	wire function
1	R	F5	2	glow plug power

Fig. 10.784

Starter motor terminal (M1)

pin	colour	to con. or comp.	pin	wire function
1	Z	SA-8		junction

Fig. 10.785

Connector (M2) for fuel pump connection

pin	colour	to con. or comp.	pin	wire function
1	CN	SA-3		fuel pump junction
2	B	XM1		ground

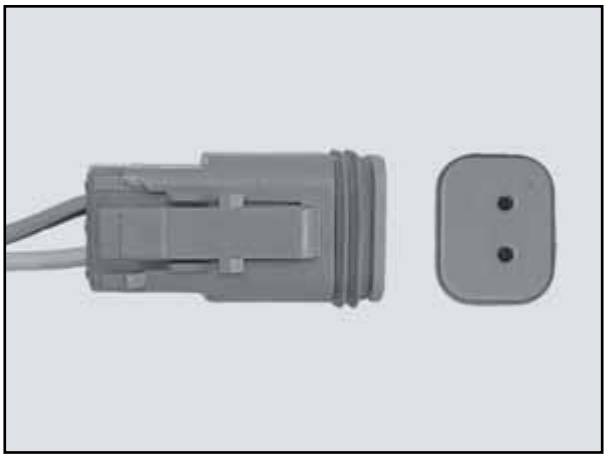


Fig. 10.786

Connector (M4) for A/C compressor

pin	colour	to con. or comp.	pin	wire function
1	ZB	SP9	A	A/C compressor

Fig. 10.787

Connector (SP5) for engine oil pressure switch

pin	colour	to con. or comp.	pin	wire function
1	RV	XS1	22	engine oil pressure

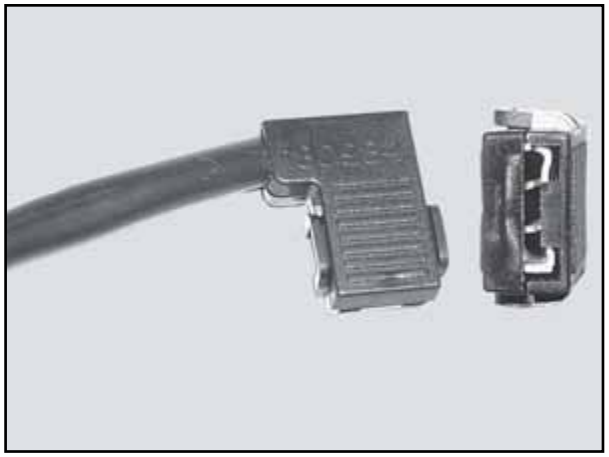


Fig. 10.788

Faston terminals (SP6) for air filter sensor

pin	colour	to con. or comp.	pin	wire function
1	LG	XS1	23	air filter
2	B	XM1		ground

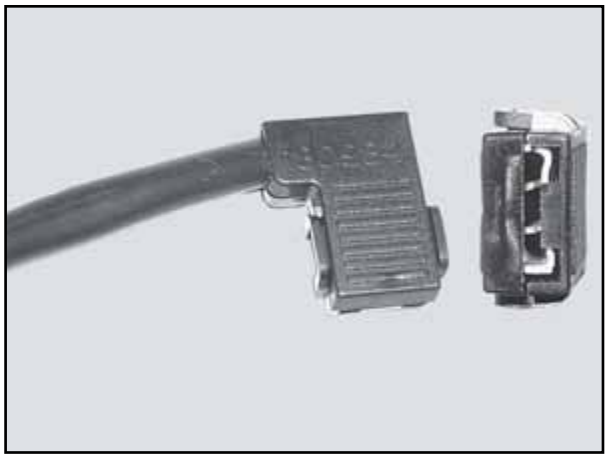


Fig. 10.789

Connector (SP7) for gearbox oil vacuum switch

pin	colour	to con. or comp.	pin	wire function
1	ZH	XS1	24	gearbox oil vacuum switch

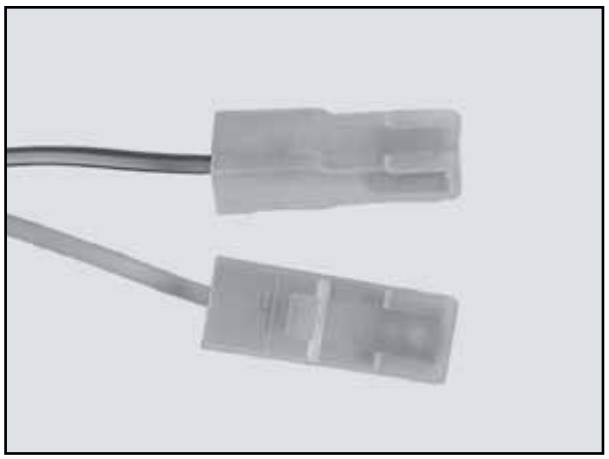


Fig. 10.790

Connector (SP9) for A/C filter pressure switch

pin	colour	to con. or comp.	pin	wire function
1	ZB	M4	1	A/C compressor
2	GM	XS1	28	

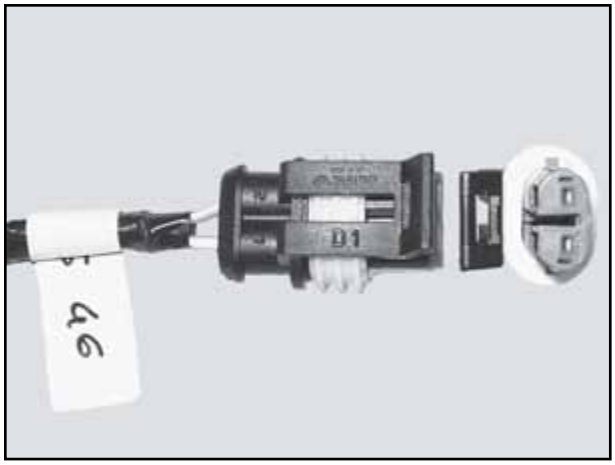


Fig. 10.791

Connector (ST2) for engine coolant temperature sensor

pin	colour	to con. or comp.	pin	wire function
1	BN	SA-5		junction
2	VB	XS1	27	water temperature

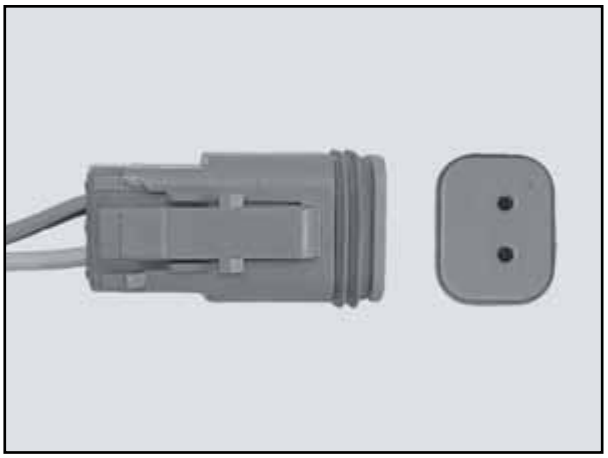


Fig. 10.792

Terminal board (XS1) for front line/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	Z	SA-8		starter motor junction
2	Z	SA-8		starter motor junction
3	GR	G3_W	1	alternator W
4	R	SA-4		junction
5	HM	D3_D+	1	
6	CN	SA-3		junction
7	N	K1	2	
8	L	SA-7		junction
9	R	SA-4		junction
10	GV	L1	1	revolving beacon
11	H	SA-2		junction
12	V	SA-1		junction
13	M	SA-6		junction
14	M	SA-6		junction
15	G	L8_L13	2	lh front turn indicator
16	V	L9_L12	2	rh front turn indicator
17	L	SA-7		junction
18	ZR	G5	1	horn
19	M	L9_L12	1	lh front side light
20	N	L8_L13	1	rh front side light
21				not used
22	RV	SP5	1	engine oil pressure
23	LG	SP6	1	air filter
24	ZH	SP7	1	gearbox oil vacuum switch
25	L	SA-7		junction
26	M	SA-6		junction
27	VB	ST2	A	water temperature
28	GM	SP9	B	A/C filter
29	L	SA-7		junction
30	BN	SA-5		junction
31	M	SA-6		junction
32				not used
33				not used
34				not used

Fig. 10.793

Connector (XS6) for bonnet headlight line connector

pin	colour	to con. or comp.	pin	wire function
A2	V	SA-1		junction
B1	VN	SA-1		junction
C1	B	SA-5		junction
A2	HN	SA-2		junction
B2	H	SA-2		junction
C2	B	SA-5		junction

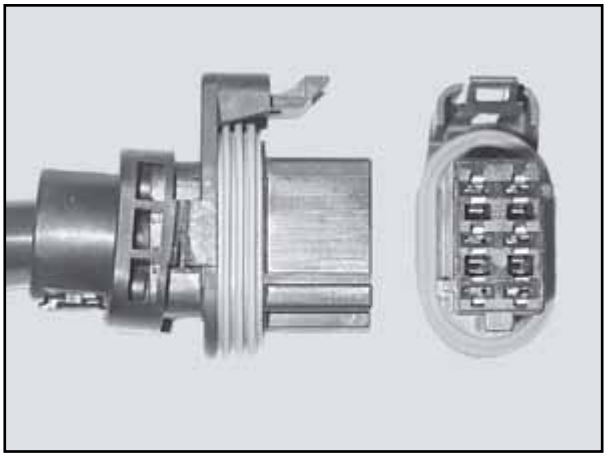


Fig. 10.794

Terminal (YV1) for fuel injection pump solenoid

pin	colour	to con. or comp.	pin	wire function
1	CN	SA-3		fuel pump elec. junction
2	B	SA-5		ground junction

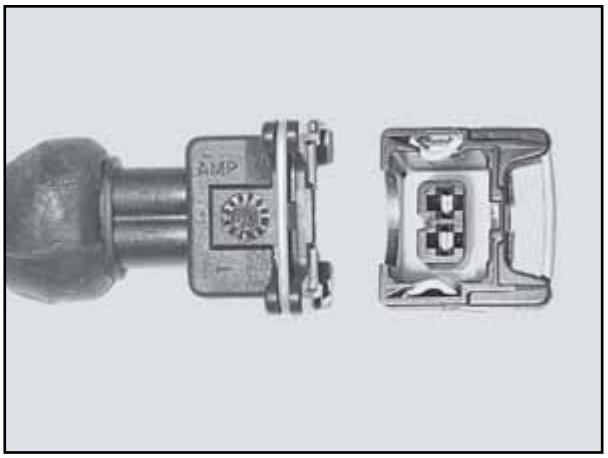


Fig. 10.795

Terminal (YV2) for fuel enrichment jet temperature sensor

pin	colour	to con. or comp.	pin	wire function
1	CN	SA-3		enrichment jet junction

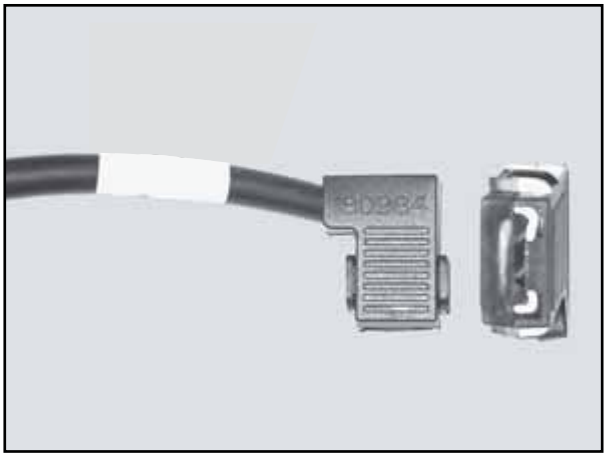


Fig. 10.796

The ground connection is made by means of the eyelet (XM1) fixed to the radiator core, in the front on the rh side, near the battery (G1).

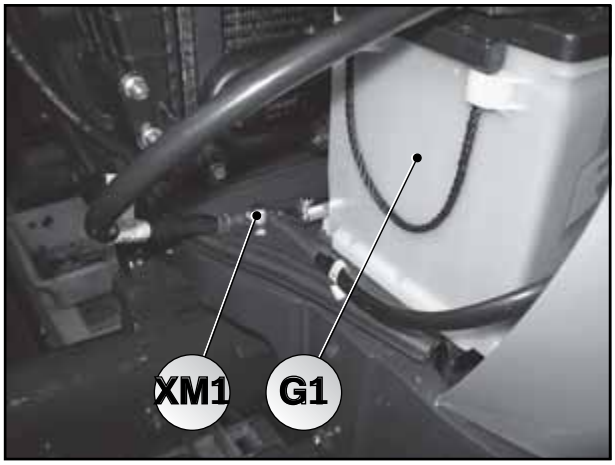


Fig. 10.797

3.10.4.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

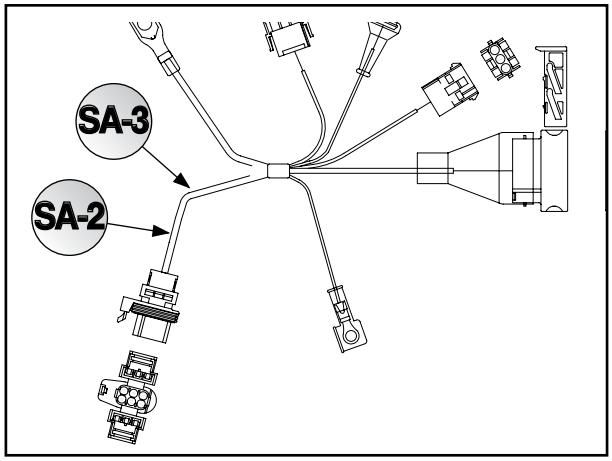


Fig. 10.798

Front engine line solder point tables

SA-1

Colour	Wire function
VN	
V	
V	

SA-2

Colour	Wire function
H	
HN	
H	

SA-3

Colour	Wire function
CN	Fuel pump sol.v.
CN	Rich mixture control
CN	Fuel pump
CN	

SA-4

Colour	Wire function
R	
R	
R	

SA-5

Colour	Wire function
B	
B	
B	
B	
B	
BN	
BN	

SA-6

Colour	Wire function
M	
M	
M	
M	
M	

SA-7

Colour	Wire function
L	
L	
L	
L	
L	

SA-8

Colour	Wire function
Z	Starter motor
Z	Starter motor
Z	

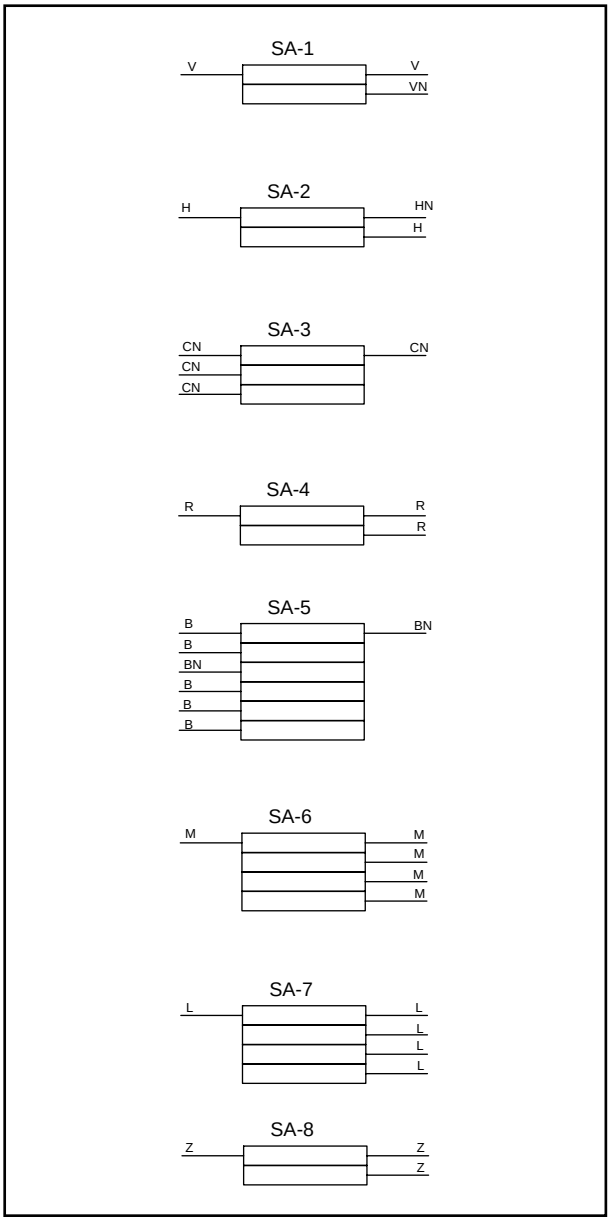


Fig. 10.799

3.10.5 Dashboard line

3.10.5.1 General description

The dashboard line powers the controls installed in front of the driver (Fig.10.800), such as the switches that control the headlights, the light switch lever, etc. It also connects with the fuses that protect the tractor's entire electrical system (Fig.10.801).

The dashboard line is connected to the front engine line via connection to the terminal boards (XS1), to the rear line via terminal boards (XS2) and to the platform line by means of the terminal boards (XS3)(Fig.10.802) in each wiring line.

Fig. 10.800

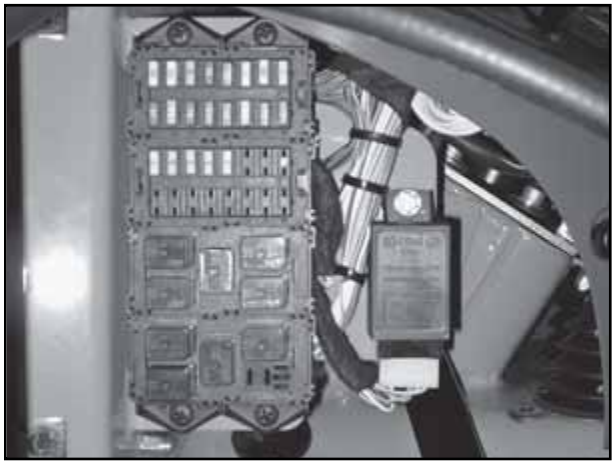


Fig. 10.801

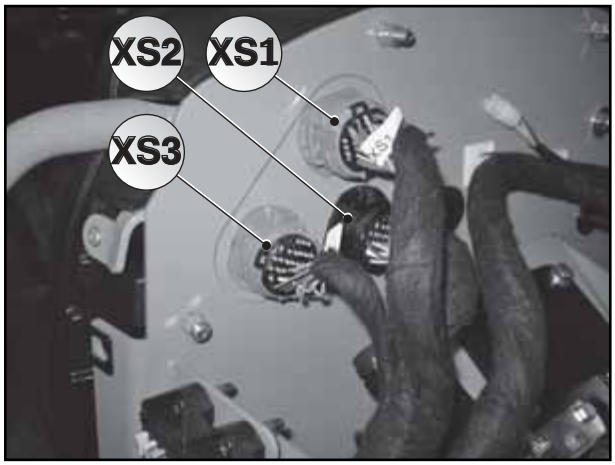


Fig. 10.802

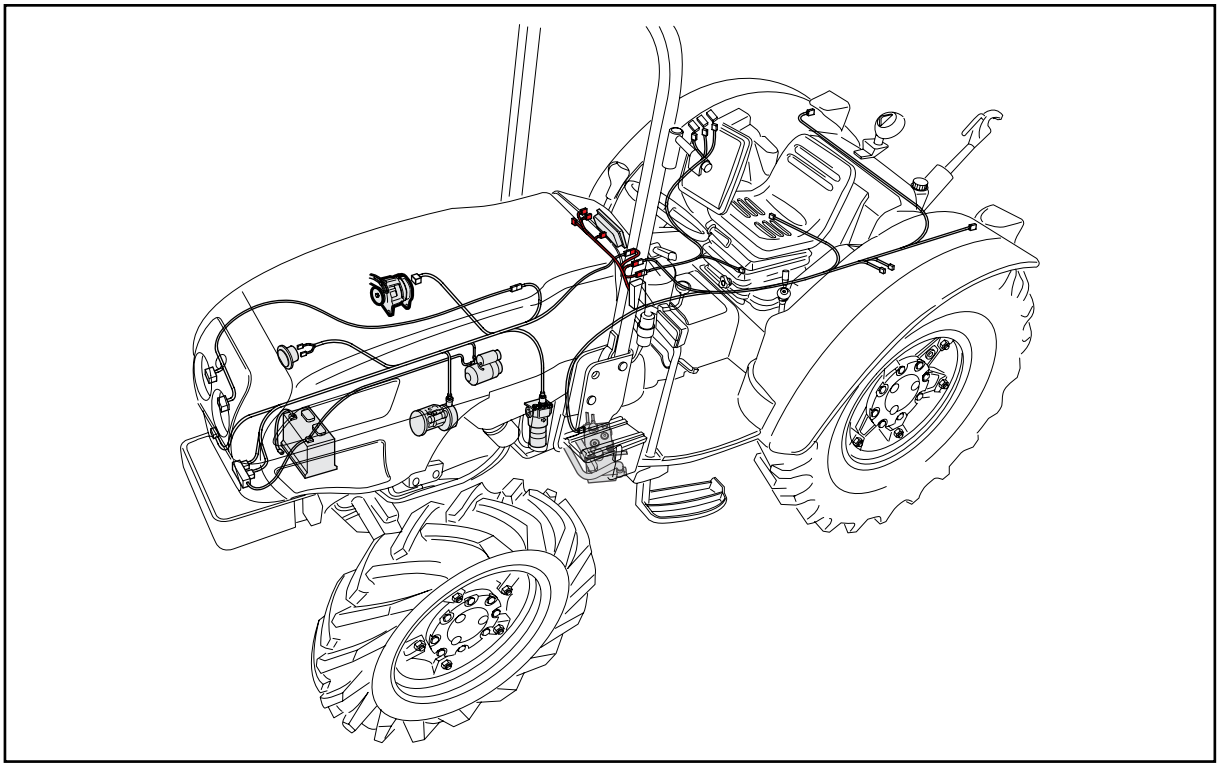


Fig. 10.803

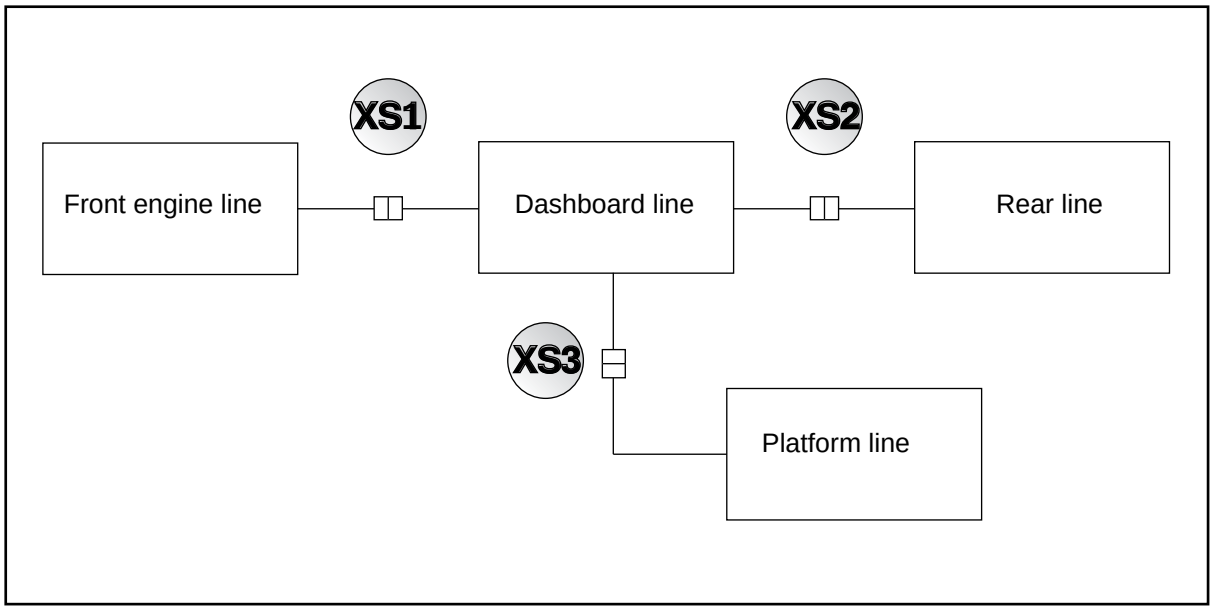


Fig. 10.804

3.10.5.2 Wiring

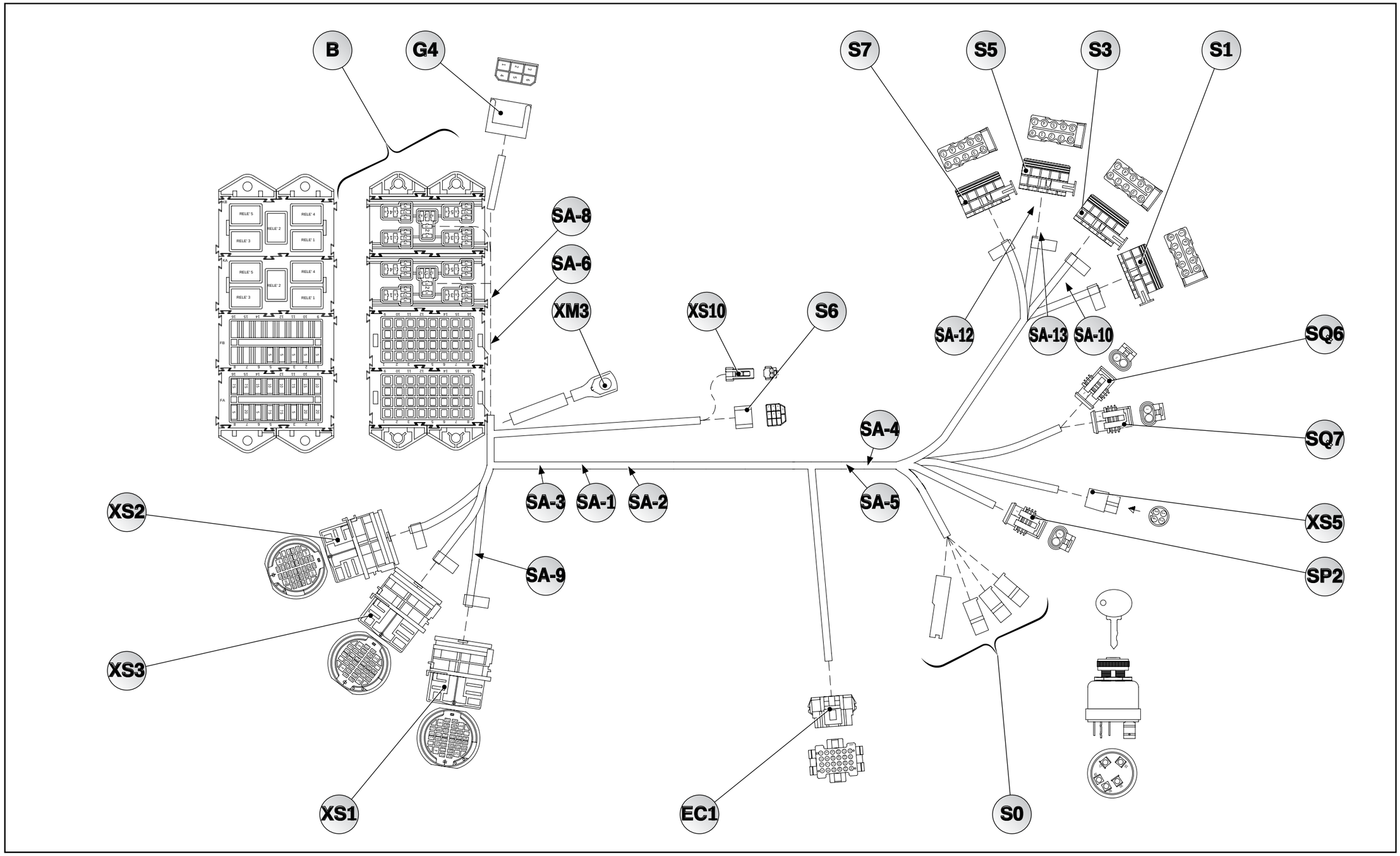


Fig. 10.805

B - Main relay and fuse box
EC1 - Connector for instrument
G4 - Connector for blinker
S0 - Faston terminals for ignition switch
S1 - Connector for revolving beacon switch
S3 - Connector for rear field light switch
S5 - Connector for emergency switch
S6 - Connector for light switch
S7 - Connector for side lights/dipped beams switch
SA-1_SA-10 - Junctions
SA1-12_SA-3 - Diodes
SP2 - Pressure switch for brake lights/diff lock release during braking
SQ6 - Lh brake pedal microswitch
SQ7 - Rh brake pedal microswitch
XM3 - Eyelet for dashboard line ground
XS1 - Terminal board (34-ways) for front line/dashboard line connection
XS2 - Terminal board (34-ways) for rear line/dashboard line connection
XS3 - Terminal board (34-ways) for platform line/dashboard line connection
XS5 - Terminal board (4-ways) for roof/dashboard line connection
XS10 - Connector for NAO supplementary turn indicators

3.10.5.3 Connector locations

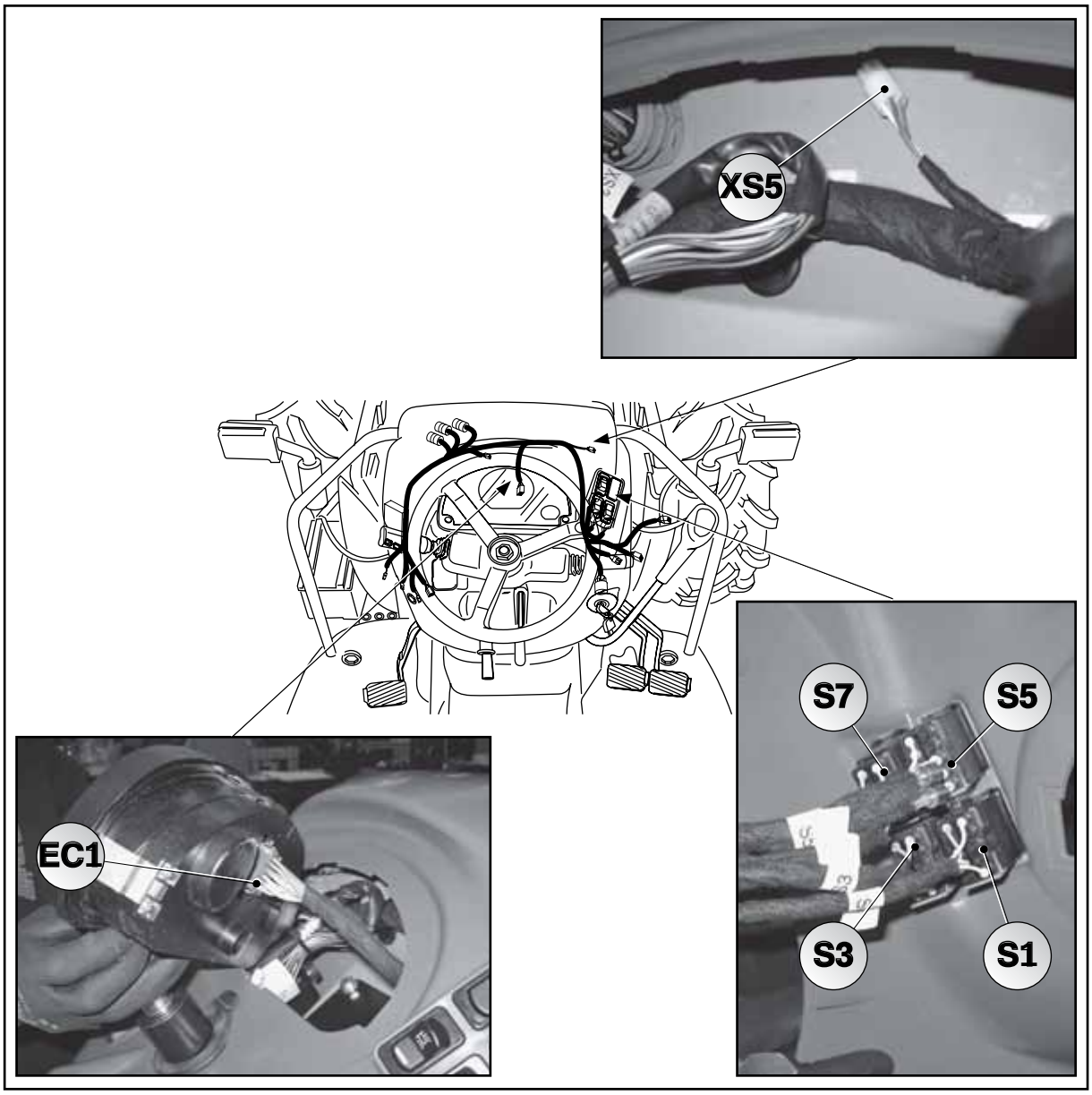


Fig. 10.806

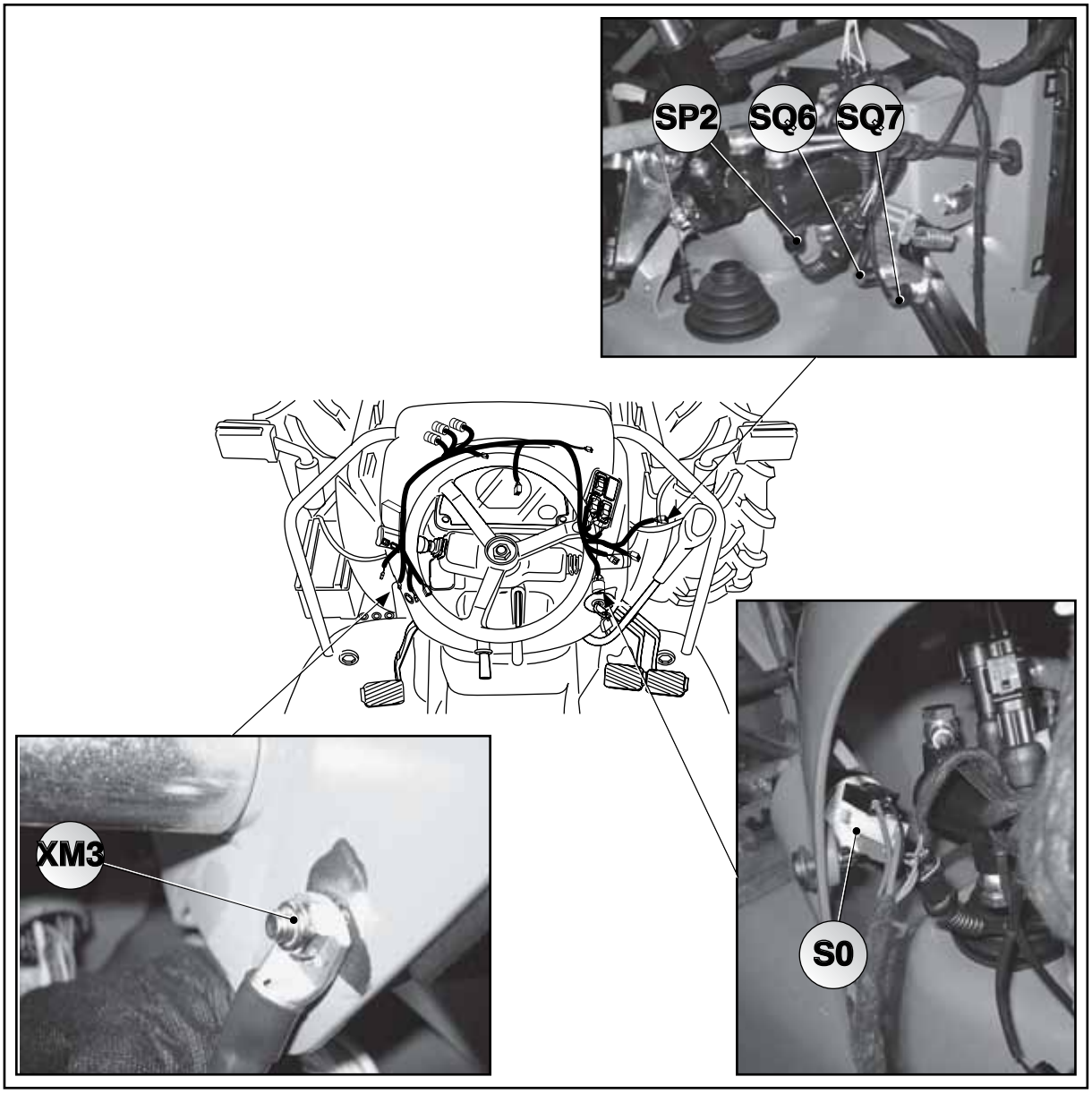


Fig. 10.807

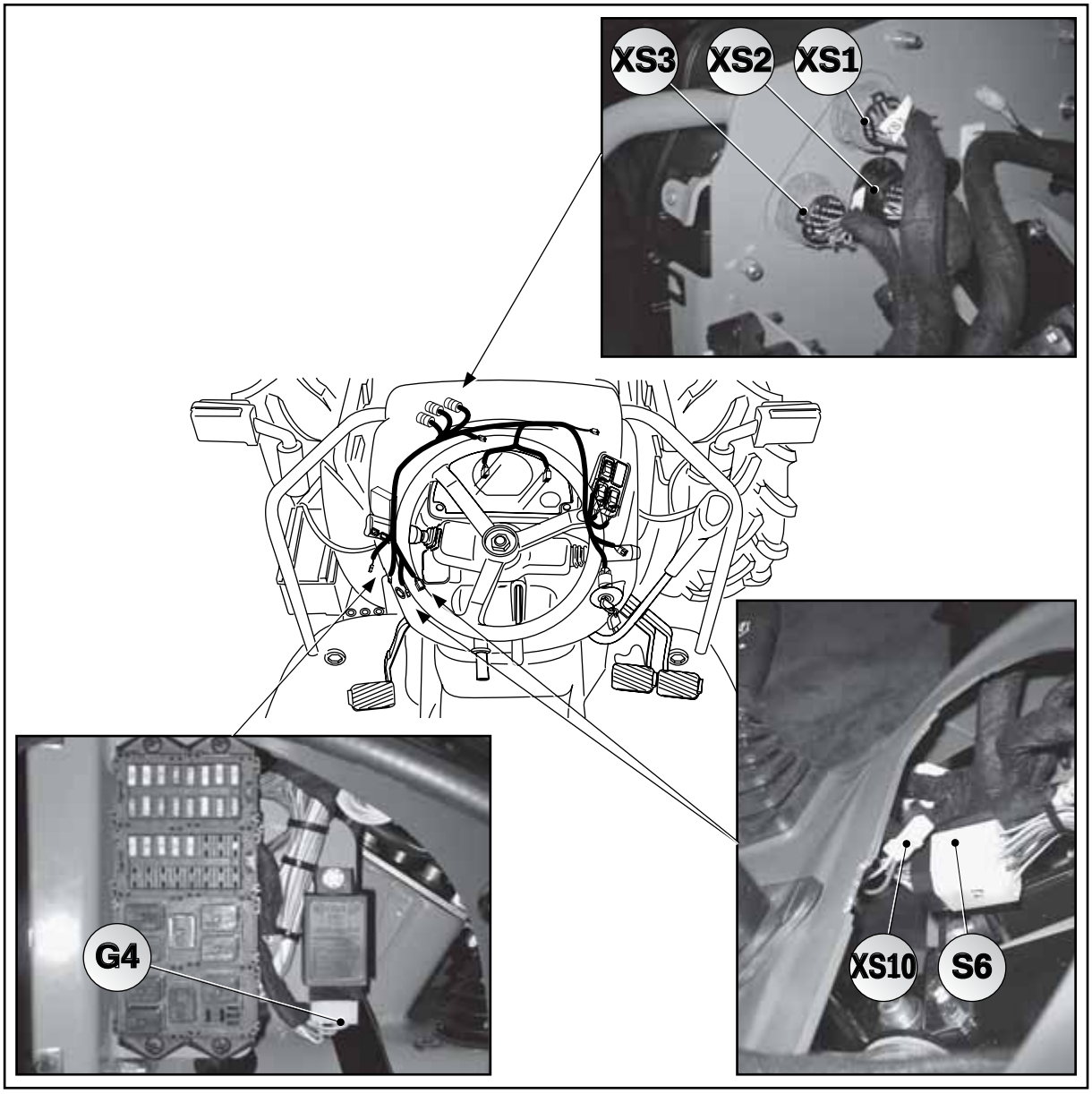


Fig. 10.808

G4 - Connector for blinker
S6 - Connector for light switch
XS1 - Terminal board (34-ways) for front line/dashboard line connection
XS2 - Terminal board (34-ways) for rear line/dashboard line connection
XS3 - Terminal board (34-ways) for platform line/dashboard line connection
XS10 - Connector for NAO supplementary turn indicators

3.10.5.4 Connector identification

Connector (EC1) for instrument connection

pin	colour	to con. or comp.	pin	wire function
1	ZN	XS2	10	hand brake
2	ZL	XS3	17	brake oil level
3	CL	XS2	11	trailer brake oil
4	C	XS2	12	synchronized PTO
5	RV	XS1	22	low engine oil pressure
6	LG	XS1	23	air filter clogged
7	ZH	XS1	24	transmission oil filter
8	HL	XS2	14	fast PTO
9	R	FB5		battery + key
10	HG	SA-5		side light junction
11	SV	KA5	87	four-wheel drive
12	HN	KA1	85	Independent PTO
13	VN	KB2	87	driving beams
14	HM	XS1	5	battery charge
15	S	XS3	18	fuel level
16	SG	XS3	19	fuel indicator
17	RN	FB4		+ 30 instrument
18	G	G4	5	turn indicators
19	GN	G4	2	1st trailer direction
20	VB	XS1	27	water temperature
21	BN	SA-3		battery direct grounding junction
22	GV	G4	3	2nd trailer direction
23	BR	KB3	30	differential lock
24	GR	XS1	3	engine rate

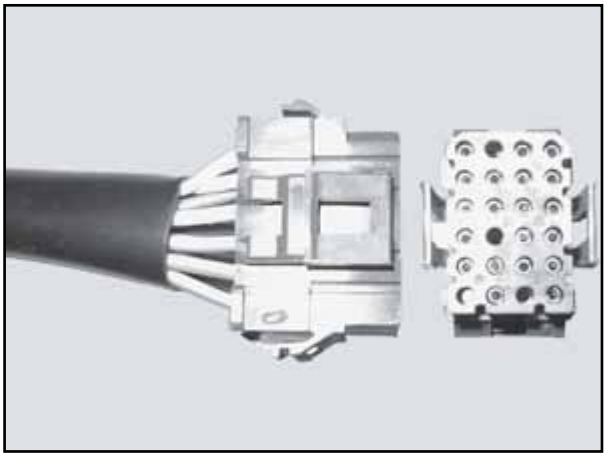


Fig. 10.809

Blinker connector (G4)

pin	colour	to con. or comp.	pin	wire function
1	B	XM3		ground
2	GN	EC1	19	1st trailer direction
3	GV	EC1	22	2nd trailer direction
4	MB-MB	S5-S6	5-5	
5	G	EC1	18	turn indicators
6	BR	S5	2	

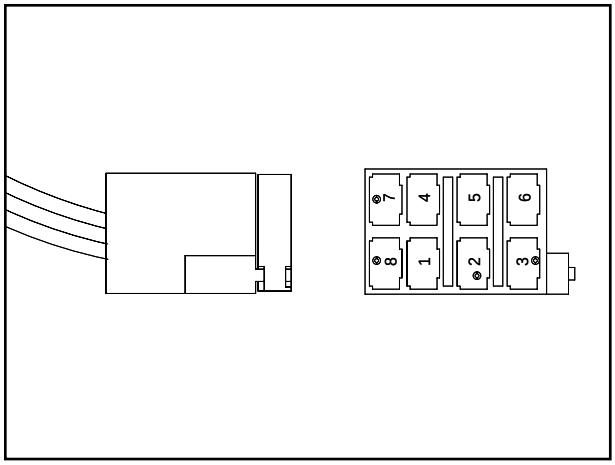


Fig. 10.810

Ignition switch faston terminals (S0)

pin	colour	to con. or comp.	pin	wire function
1	R	FA1		ignition key powering
2	M-M	FB5-FA3		instrument - auxiliary relay power
3	N	XS1	7	
4	L	FA2		against starting

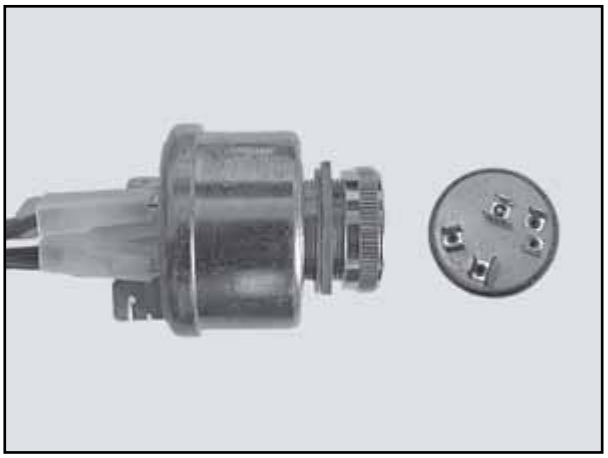


Fig. 10.811

Revolving beacon switch connector (S1)

pin	colour	to con. or comp.	pin	wire function
1				not used
2	LN	FA5		
3	GV	XS1	10	revolving beacon
4				not used
5				not used
6				not used
7	B	SA-2		junction
8	HG	SA-5		junction
9	B	SA-2		junction
10				not used

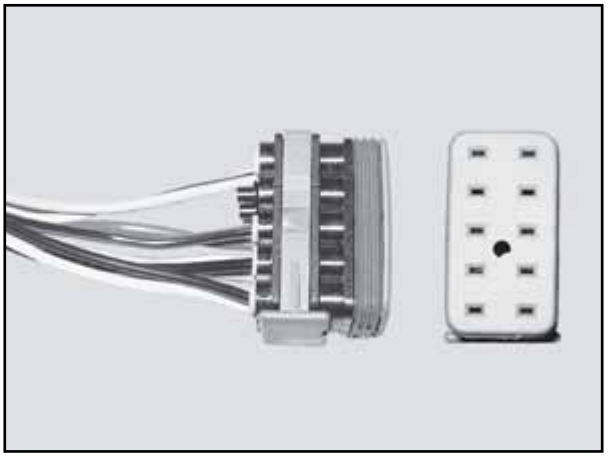


Fig. 10.812

Connector (S3) for rear field light switch

pin	colour	to con. or comp.	pin	wire function
1				not used
2	H	FA11		field light
3	HN	SA-10		junction
4				not used
5				not used
6				not used
7	B	SA-2		junction
8	HG	SA-4		junction
9	B	SA-2		junction
10	HN	SA-10		junction

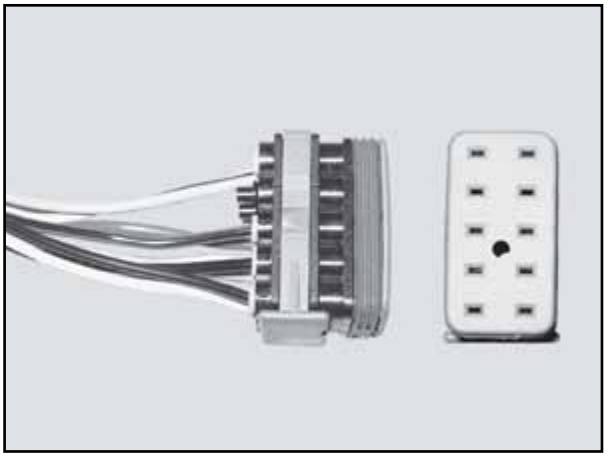


Fig. 10.813

Connector (S5) for emergency switch

pin	colour	to con. or comp.	pin	wire function
1	M	FA13		+ 15 emergency
2	BR	G4		
3	R	FA14		emergency sw.
4				not used
5	MB	G4		
6	G	SA-13		junction
7				not used
8	B	XM3		ground
9	V	SA-12		junction
10	HG	SA-4		junction

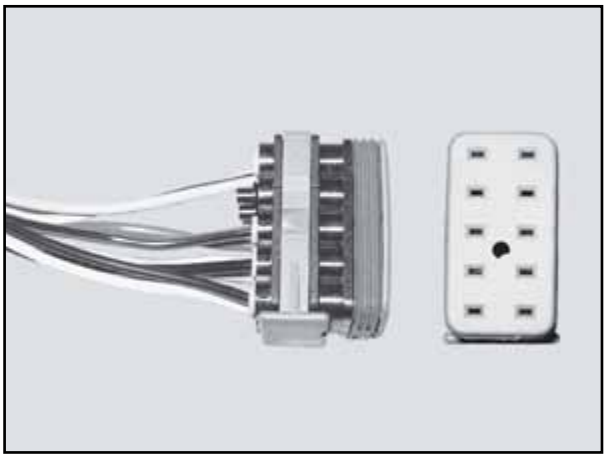


Fig. 10.814

Connector (S6) for light switch

pin	colour	to con. or comp.	pin	wire function
1	R	FA15		horn
2	GV	KB2	86	driving beams
3	G-G-G	XS3-XS1-SA-13	8-15	lh rear - lh front turn ind. junction
4	HR	S7	3	position switch
5	MB	G4	4	
6	V-V-V	XS1-XS3-SA-12	16-10	rh front - lh rear turn ind. junction
7	HR	KB1	86	dipped beams
8	ZR	XS1	18	horn
9	M	FA16		NAO plant
10	RN	FA16		NAO plant
11	B	XM3		ground

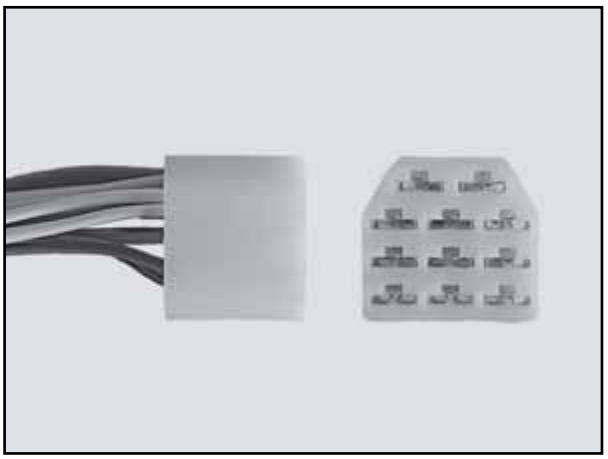


Fig. 10.815

Connector (S7) for side lights/dipped beams switch

pin	colour	to con. or comp.	pin	wire function
1				not used
2	M	FA16		NAO plant
3	HR	S6	4	position switch
4				
5	RN	FB1		light switch
6	N	SA-1		junction
7	B	SA-2		junction
8	HG	SA-5		junction
9	B	SA-2		junction
10	N	SA-1		junction

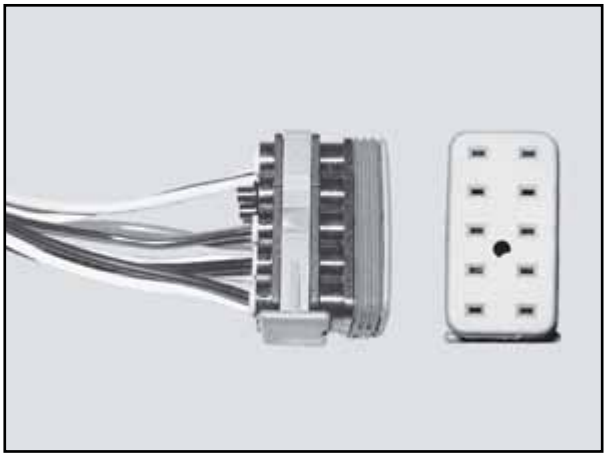


Fig. 10.816

Pressure switch (SP2) for brake lights/diff lock release during braking

pin	colour	to con. or comp.	pin	wire function
1	M	KB4	30	
2	GL	KB4	86	

Fig. 10.817

Lh brake pedal microswitch (SQ6)

pin	colour	to con. or comp.	pin	wire function
1	S	KA5	85	
2	S	SQ6	1	

Fig. 10.818

Rh brake pedal microswitch (SQ7)

pin	colour	to con. or comp.	pin	wire function
1	S	SQ6	2	
2	B	XM3		ground

Fig. 10.819

Terminal board (34-ways) (XS1) for front line/ dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	Z	KA1	87	
2	Z	KA1	87	
3	GR	EC1	24	engine rate
4	R	FA1		ignition key powering
5	HM	EC1	14	battery charge
6	CN	FA4		fuel enrichment device
7	N	S0	3	
8	LN	FA6		25A socket
9	R	KA2	30	
10	GV	S1	3	
11	H	KB1	87	
12	V	KB2	87	
13	M	SA9		junction
14	M	SA9		junction
15	G	S6	3	lh front turn ind.
16	V	S6	6	rh front turn ind.
17	L	FB1		light switch
18	ZR	S6	8	horn
19	M	SA-4		junction
20	M	SA-5		junction
21				not used
22	RV	EC1	5	low engine oil pressure
23	LG	EC1	6	air filter clogged
24	ZH	EC1	7	transmission oil filter
25	L	FA15		horn
26	M	KA3	30	
27	VB	EC1	20	water temperature
28	GM	XS5	2	
29	L	FA5		revolving beacon
30	BN	SA3		battery direct ground
31	M	KA4	30	
32				not used
33				not used
34				not used

Fig. 10.820

Terminal board (34-ways) (XS2) for rear/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	M	SA-8		junction
2	VN	KA1	86	
3	HN	KA1	85	
4	B	XM3		ground
5	HR	KA5	86	
6	L	XS2	1	
7	VR	KB3	86	
8	BR	KB3	30	
9				not used
10	ZN	EC1	1	hand brake
11	CL	EC1	3	trailer brake oil
12	C	EC1	4	synchronized PTO
13	R	FB5		instrument power
14	HL	EC1	8	fast PTO
15				not used
16				not used
17				not used
18				not used
19				not used
20				not used
21				not used
22				not used
23				not used
24				not used
25				not used
26				not used
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.821

Terminal board (34-ways) (XS3) for platform/ dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	L	XS2	6	
2	SV	KA5	87	
3	GL	KA5	87	
4	R	FA7		aux. socket (key-activated)
5	AN	FA6		aux. socket (direct)
6	HN	SA-10		junction
7	R	KB4	87	
8	G	S6	3	lh rear turn ind.
9	B	XM3		ground
10	V	S6	6	lh rear turn ind.
11	M	SA-4		junction
12	N	SA-5		junction
13	GR	XS10	1	
14	RV	XS10	2	
15	B	XM3		ground
16	HG	SA-5		switch lighting junction
17	ZL	EC1	2	brake oil level
18	S	EC1	15	fuel level
19	SG	EC1	16	fuel indicator
20	BR	KB3	85	
21	BN	SA-3		battery direct grounding junction
22				not used
23				not used
24				not used
25				not used
26	B	XM3		ground
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.822

Terminal board (4-ways) (XS5) for roof/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	HG	SA-5		junction
2	GM	XS1	28	
3	B	XM3		ground
4	M	SA-8		junction

Fig. 10.823

Connector (XS10) for NAO supplementary turn indicators

pin	colour	to con. or comp.	pin	wire function
1	GR	XS3	13	
2	RV	XS3	14	

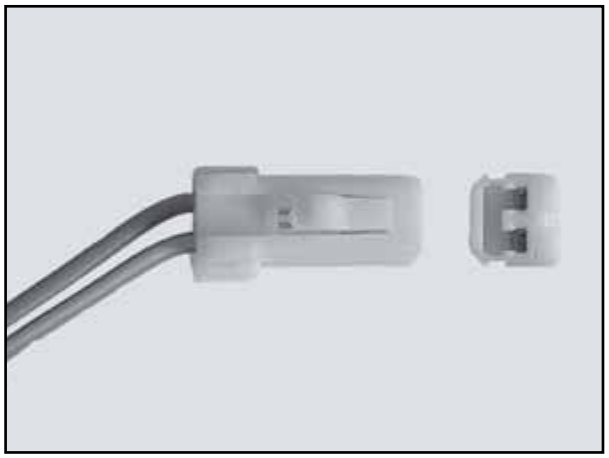


Fig. 10.824

The ground connection is made by means of the eyelet (XM3) fixed to the steering column, just behind the main fuse box (B).

Fig. 10.825

3.10.5.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

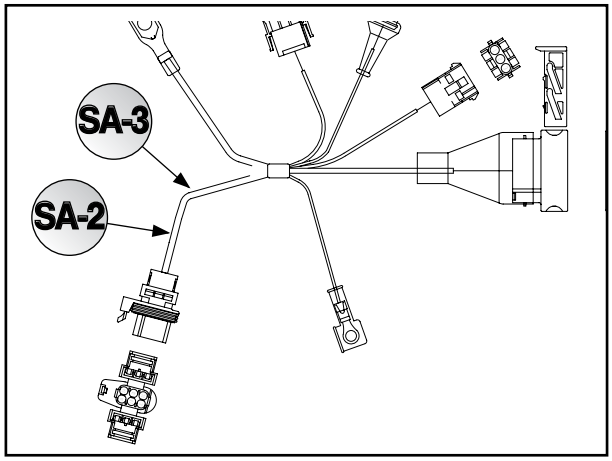


Fig. 10.826

Dashboard line solder point table

SA-1

Colour	Wire function
N	
N	lh side light
N	lh side light
N	

SA-2

Colour	Wire function
B	
B	
B	
B	
B	
B	
B	

SA-3

Colour	Wire function
BN	battery direct ground
BN	battery direct ground
BN	battery direct ground

SA-4

Colour	Wire function
M	
HG	
HG	
M	
M	lh side light

SA-5

Colour	Wire function
N	
HG	switch lighting
HG	
N	rh position
HG	
HG	side lights
N	
HG	

SA-6

Colour	Wire function
M	fuel enrichment jet
M	
M	b.d. +brake light
M	NAO plant
M	+15 emergency

SA-8

Colour	Wire function
M	
M	
M	
M	roof auxiliary
M	
M	

SA-9

Colour	Wire function
M	emergency sw.
M	
M	

SA-10

Colour	Wire function
HN	
HN	
HN	

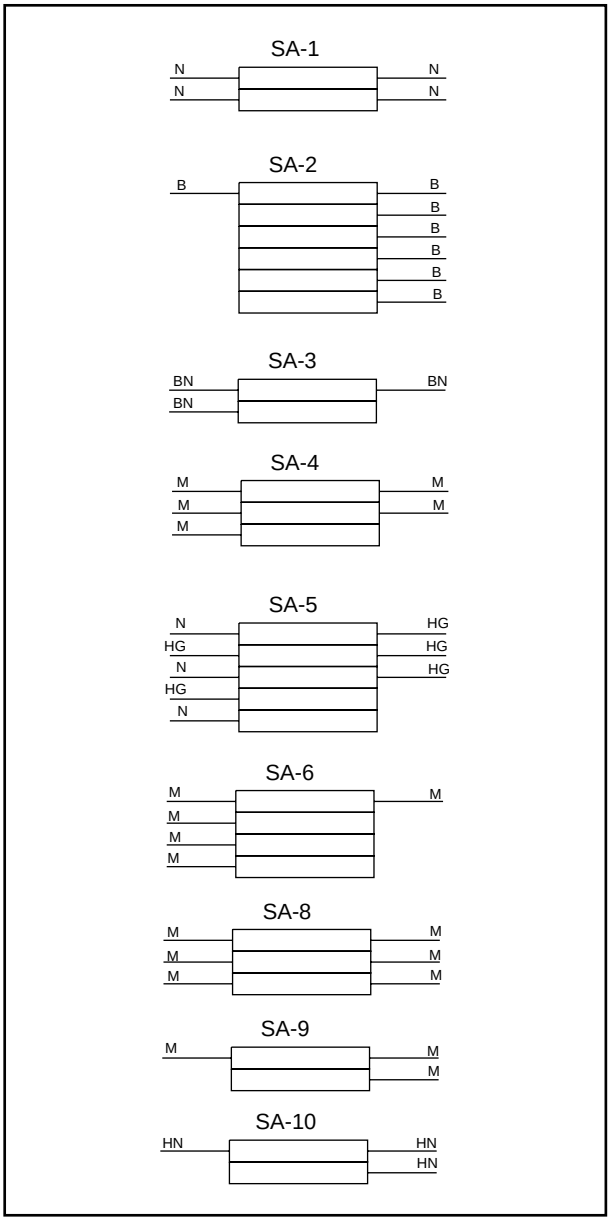


Fig. 10.827

3.10.6 Platform line

3.10.6.1 General description

The platform line connects the controls on the right-hand side of the platform, such as the switches and buttons for engaging/disengaging the 4WD and diff lock (Fig.10.828). It also connects the rear lights and auxiliary power socket.

It is connected to the dashboard line, by means of the connection between the terminal boards (XS3) (Fig.10.829) in each wiring line.

Fig. 10.828

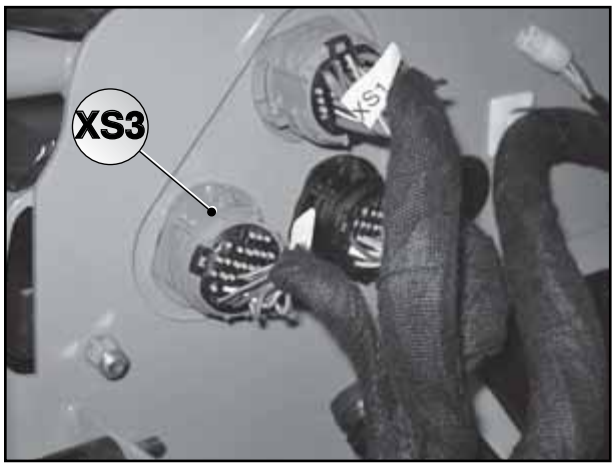


Fig. 10.829

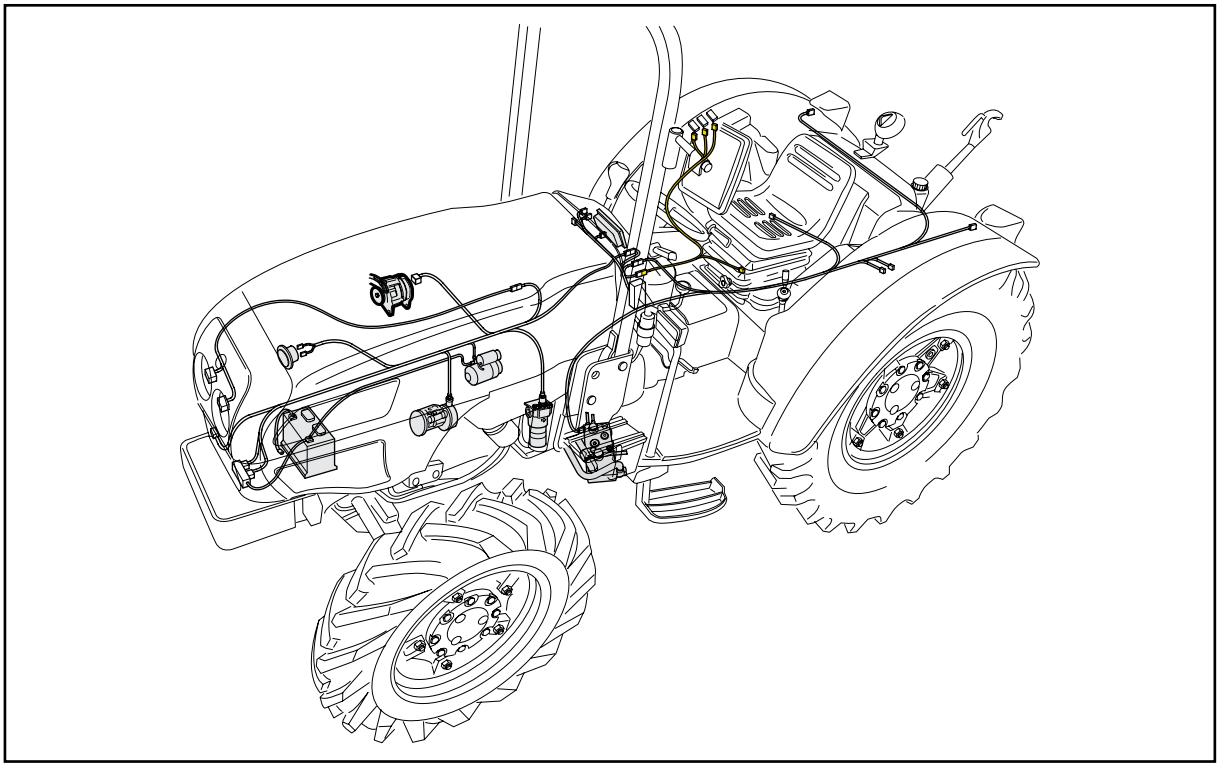


Fig. 10.830

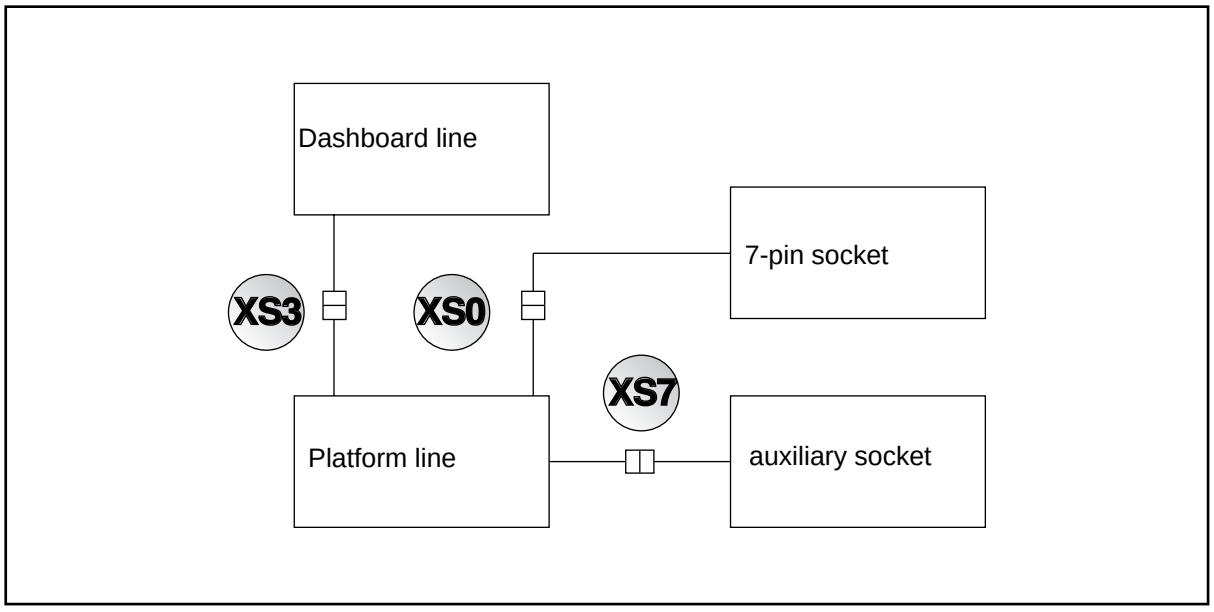


Fig. 10.831

3.10.6.2 Wiring

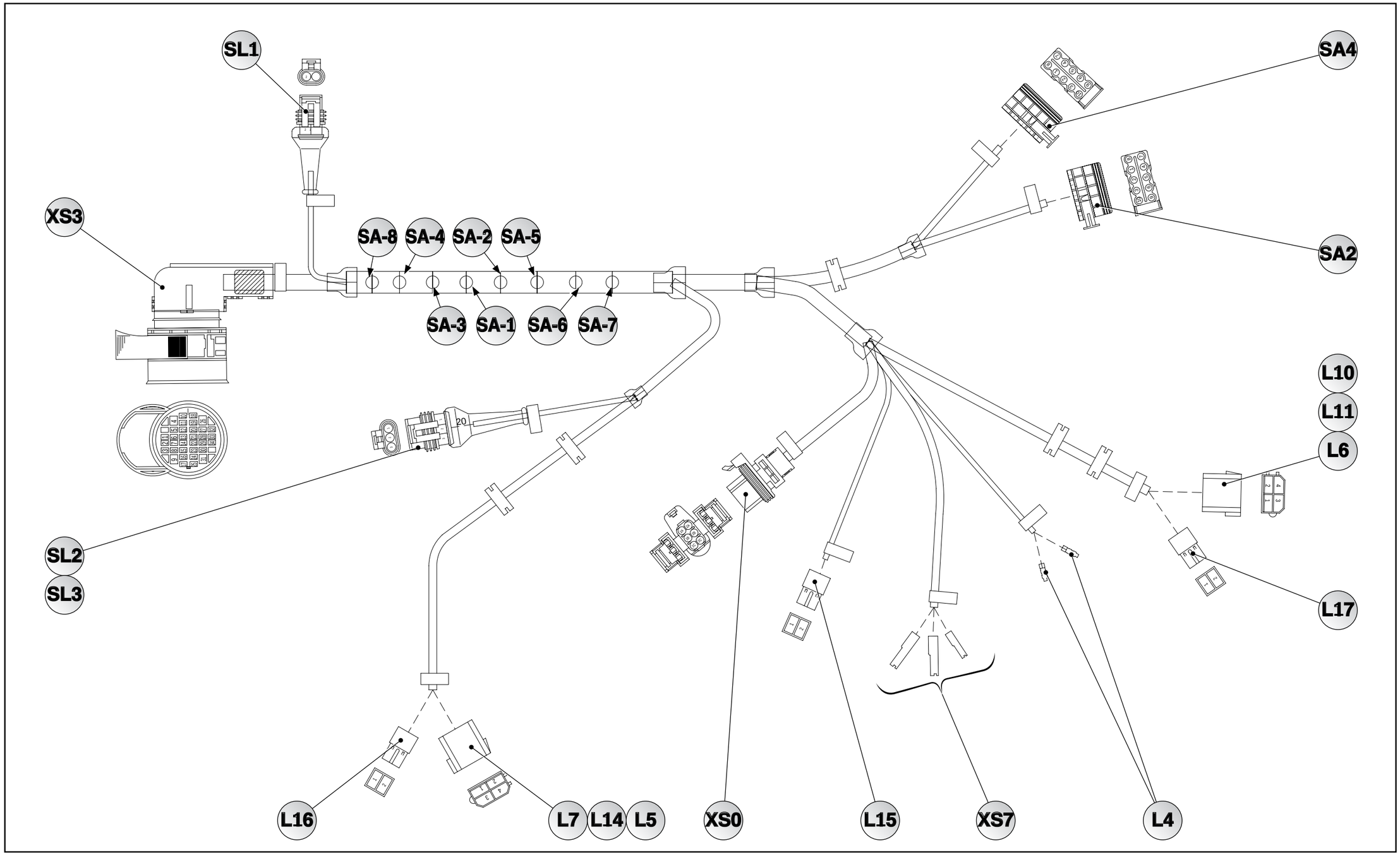


Fig. 10.832

L4 - Terminals for rear platform field light
L5_L7_L14 - Connector for turn ind., side light, lh brake light
L10_L11_L6 - Connector for turn ind., side light, rh brake light
L15 - License plate light connector
L16 - Connector for lh NAO suppl. light
L17 - Connector for rh NAO suppl. light
SA-1/SA-8 - Junctions
SA2 - Connector for 4WD switch
SA4 - Connector for differential lock button
SL1 - Brake oil level sensor connector
SL2_SL3 - Fuel level sensor connector
XS0 - Terminal board for platform-7-pin socket connector (6-ways)
XS3 - Terminal board (34-ways) for platform/dashboard line connection
XS7 - Terminals for auxiliary 3-pin socket

3.10.6.3 Connector locations

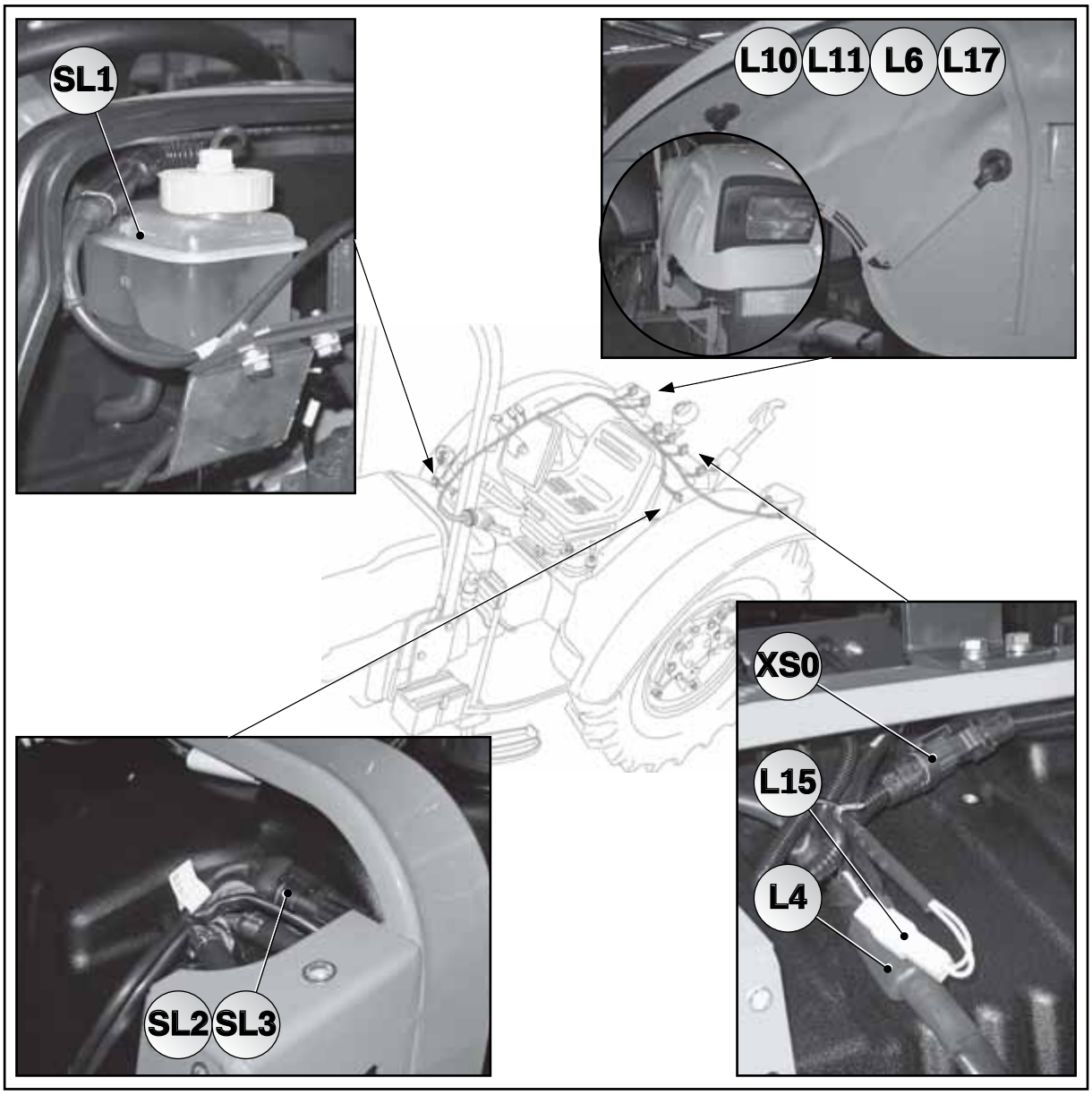


Fig. 10.833

L4 - Terminals for rear platform field light
L15 - License plate light connector
SL1 - Brake oil level sensor connector
SL2_SL3 - Fuel level sensor connector
XS0 - Terminal board for platform-7-pin socket connector (6-ways)

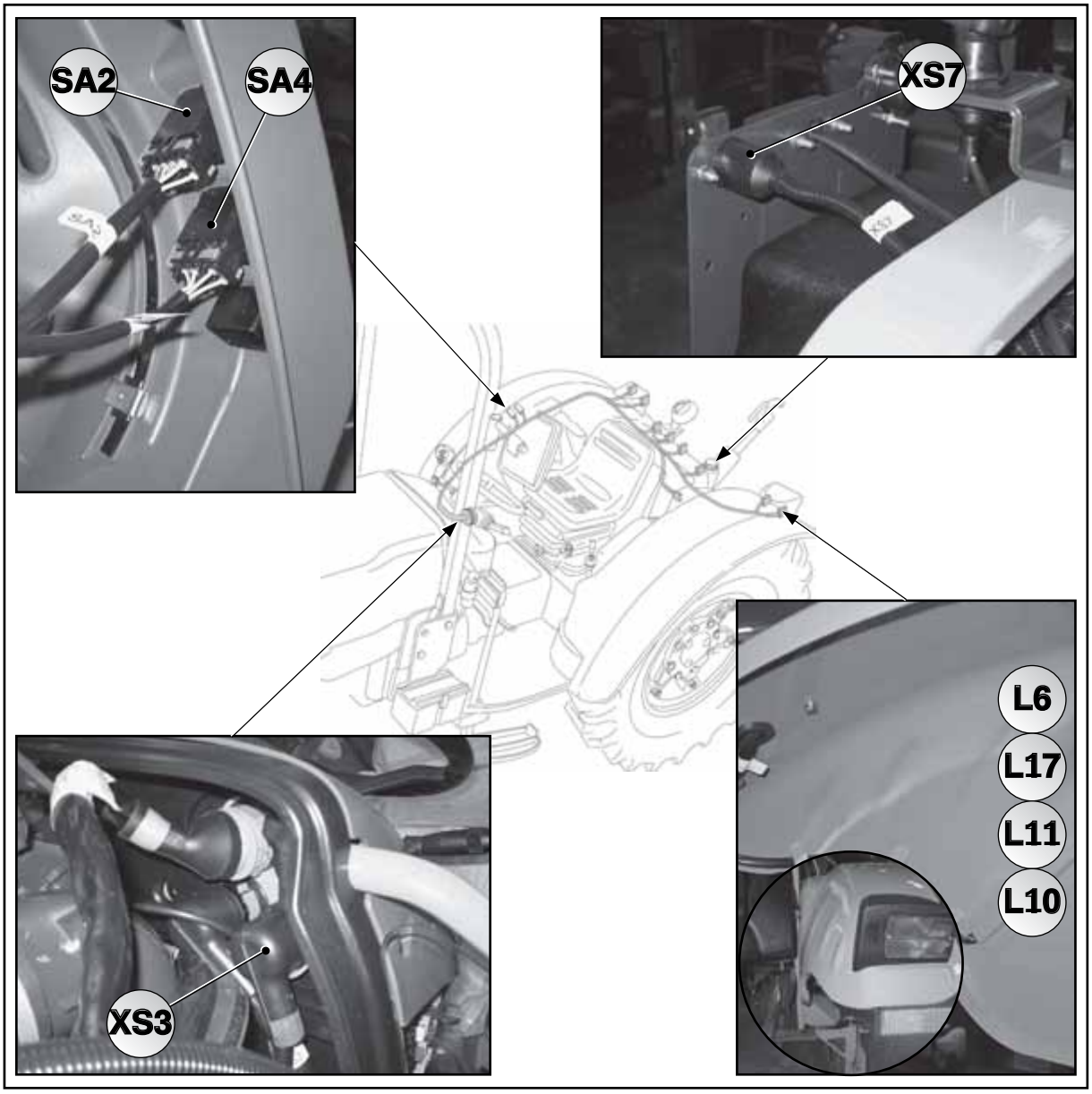


Fig. 10.834

L5_L7_L14 - Connector for turn ind., side light, lh brake light
L16 - Connector for lh NAO suppl. light
SA2 - Connector for 4WD switch
SA4 - Connector for differential lock button
XS3 - Terminal board (34-ways) for platform/dashboard line connection
XS7 - Terminals for auxiliary 3-pin socket

3.10.6.4 Connector identification

Terminals (L4) for rear platform field light

pin	colour	to con. or comp.	pin	wire function
1	HN	XS3	6	field light
2	B	SA-1		junction

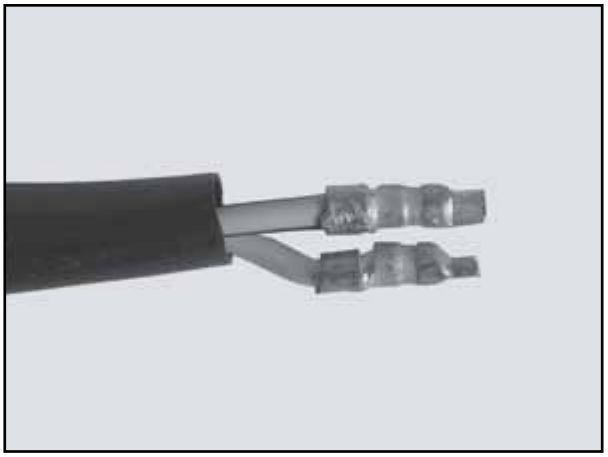


Fig. 10.835

Connector (L5_L7_L14) for turn ind., side light, lh brake light

pin	colour	to con. or comp.	pin	wire function
1	B-B	L16-SA-1	1	junction
2	G	SA-5		lh rear turn ind. junction
3	R	SA-2		lh brake light junction
4	N	SA-4		lh rear side light junction

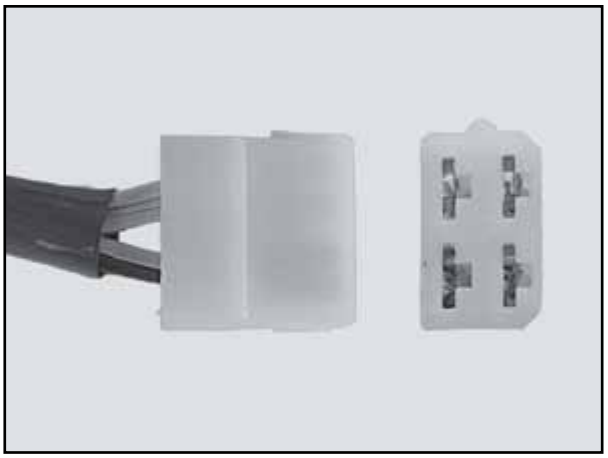


Fig. 10.836

Connector (L10_L11_L6) for turn ind., side light, rh brake light

pin	colour	to con. or comp.	pin	wire function
1	B-B	L17-SA-1	1	junction
2	V	SA-6		rh rear turn ind. junction
3	R	SA-2		rh brake light
4	M	SA-3		rh rear side light junction

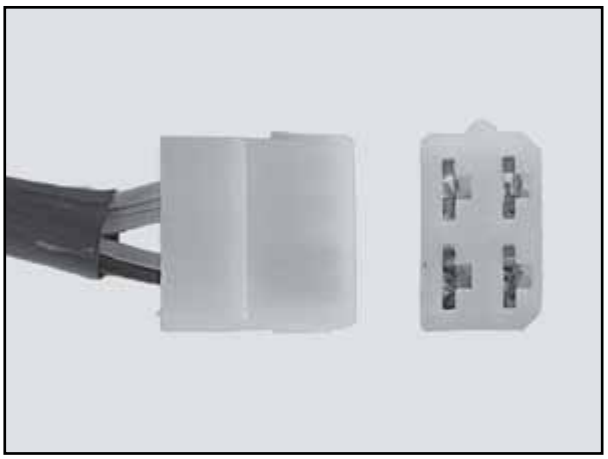


Fig. 10.837

License plate light connector (L15)

pin	colour	to con. or comp.	pin	wire function
1	N	SA-4		licence plate light junction
2	B	SA-1		junction

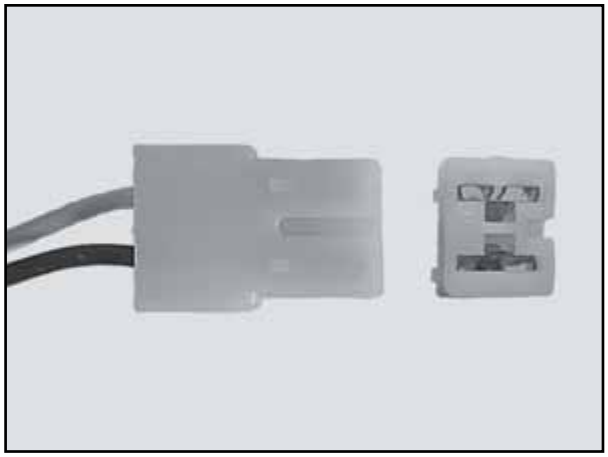


Fig. 10.838

Connector (L16) for lh NAO suppl. light

pin	colour	to con. or comp.	pin	wire function
1	B	L5_L7_L14		
2	GR	XS3		lh NAO

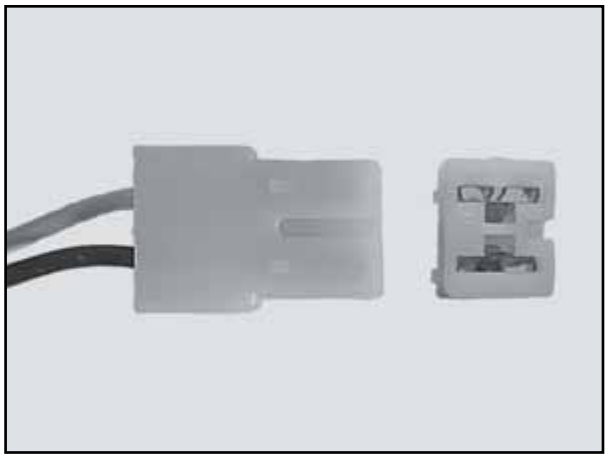


Fig. 10.839

Connector (L17) for rh NAO suppl. light

pin	colour	to con. or comp.	pin	wire function
1	B	L10_L11_L6	1	
2	RV	XS3	14	rh NAO

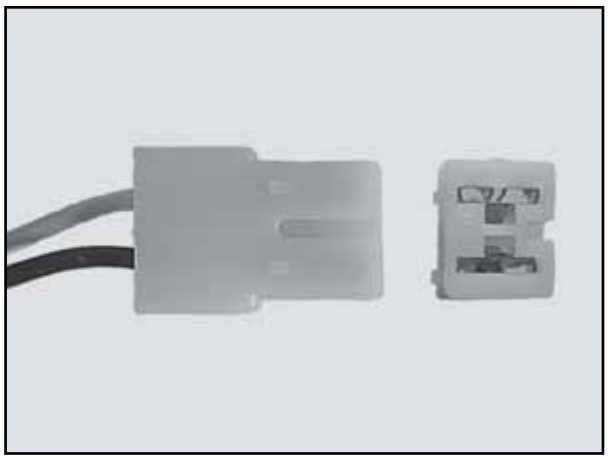


Fig. 10.840

Connector (SA2) for 4WD switch

pin	colour	to con. or comp.	pin	wire function
1	L	XS3	1	4WD sol.v.
2	GL	XS3	3	4WD safety
3	SV	XS3	2	4WD ind.light
4				not used
5				not used
6				not used
7	B	SA-1		
8	HG	SA-7		rh rear side light
9				not used
10				not used

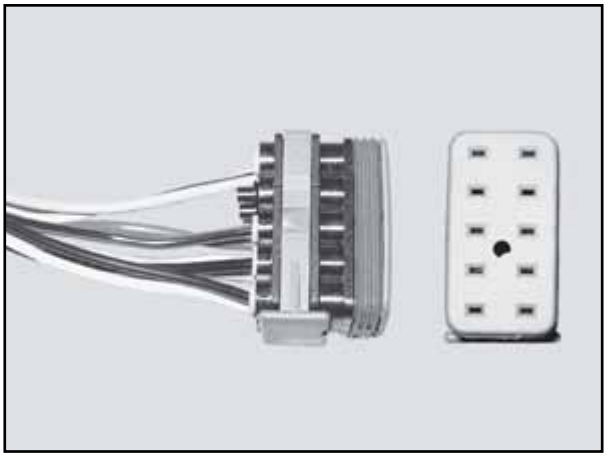


Fig. 10.841

Connector (SA4) for differential lock button

pin	colour	to con. or comp.	pin	wire function
1				not used
2	B	SA-1		junction
3	BR	XS3	20	differential lock
4				not used
5				not used
6				not used
7	B	SA-1		junction
8	HG	SA-7		rh rear side light junction
9				not used
10				not used

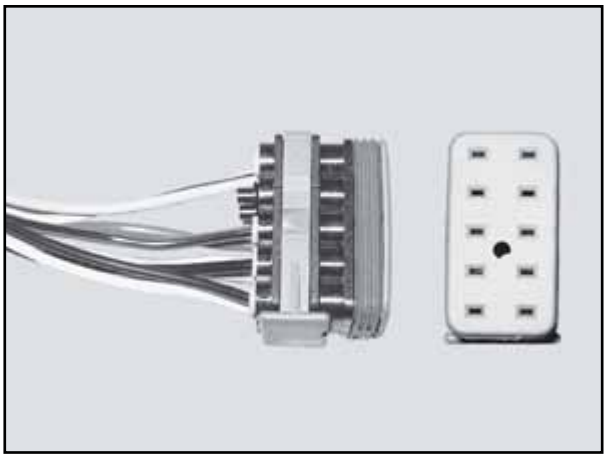


Fig. 10.842

Brake oil level sensor connector (SL1)

pin	colour	to con. or comp.	pin	wire function
1	ZL	XS3	17	brake oil level
2	BN	SA-8		ground junction

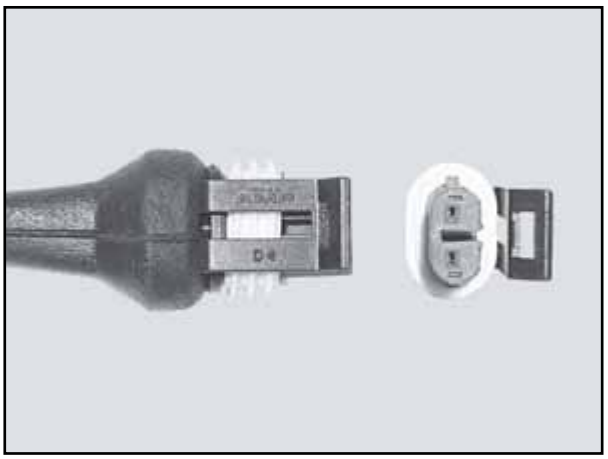


Fig. 10.843

Fuel level sensor connector (SL2_SL3)

pin	colour	to con. or comp.	pin	wire function
1	SG	XS3	19	supplementary tank level
2	S	XS3	18	fuel level
3	BN	SA-8		battery ground junction

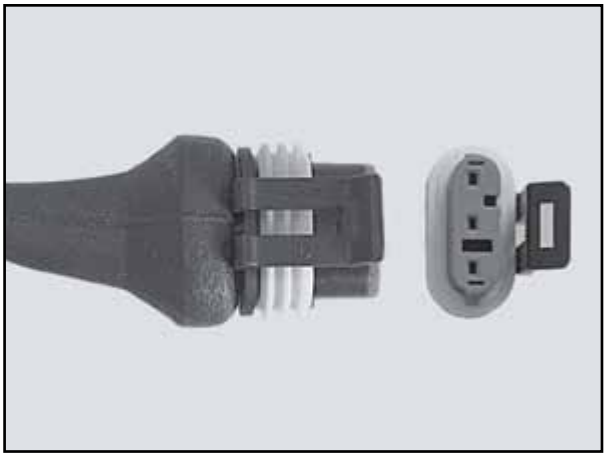


Fig. 10.844

Terminal board (XS0) for platform/7-pin socket connector (6-ways)

pin	colour	to con. or comp.	pin	wire function
A1	N	SA-4		lh rear side light junction
B1	M	SA-3		rh rear side light junction
C1	R	SA-2		brake light junction
A2	G	SA-5		lh rear turn ind. junction
B2	V	SA-6		rh rear turn ind. junction
C2	B	XS3	15	

Fig. 10.845

Terminal board (XS3) (34-ways) for platform/ dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	L	SA2	1	4WD sol.v.
2	SV	SA2	3	4WD ind.light
3	GL	SA2	2	4WD safety
4	R	XS7	1	aux. socket (key-activated)
5	AN	XS7	A	aux. socket (direct)
6	HN	L4	1	field light
7	R	SA-2		brake light junction
8	G	SA-5		lh rear turn ind. junction
9	B	XS7	2	
10	V	SA-6		rh rear turn ind. junction
11	M	SA-3		rh rear side light junction
12	N	SA-4		lh rear side light junction
13	GR	L16	2	lh NAO
14	RV	L17	2	rh NAO
15	B	XS0	C2	
16	HG	SA-7		switch lighting junction
17	ZL	SL1	1	brake oil level
18	S	SL2_SL3	2	fuel level
19	SG	SL2_SL3	1	supplementary tank level
20	BR	SA4	3	diff lock
21	BN	SA-8		battery ground junction
22				not used
23				not used
24				not used
25				not used
26	B	SA-1		junction
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.846

Terminals (XS7) for auxiliary 3-pin socket

pin	colour	to con. or comp.	pin	wire function
1	R	XS3	4	aux. socket (key-activated)
2	B	XS3	9	
3	AN	XS3	5	aux. socket (direct)

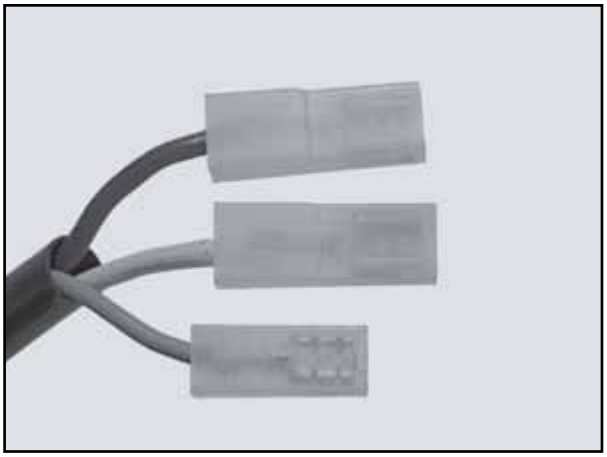


Fig. 10.847

3.10.6.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

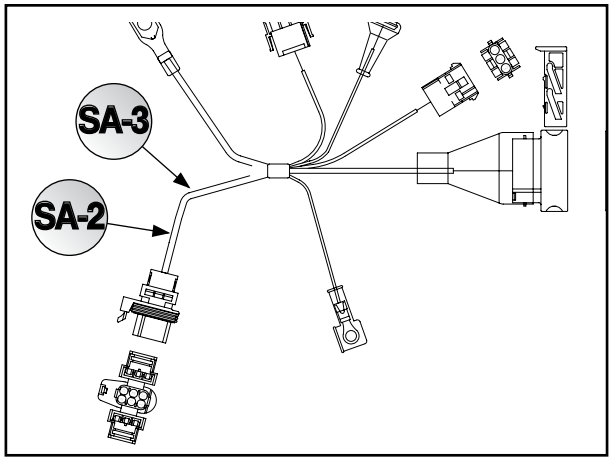


Fig. 10.848

Dashboard line solder point table

SA-1

Colour	Wire function
B	
B	
B	
B	
B	
B	
B	
B	

SA-2

Colour	Wire function
R	brake light
R	brake light
R	lh brake light
R	rh brake light

SA-3

Colour	Wire function
M	rh rear side light
M	rh rear side light
M	rh rear side light

SA-4

Colour	Wire function
N	lh rear side light
N	lh rear side light
N	lh rear side light
N	licence plate light

SA-5

Colour	Wire function
G	lh rear turn ind.
G	lh rear turn ind.
G	lh rear turn ind.

SA-6

Colour	Wire function
V	rh rear turn ind.
V	rh rear turn ind.
V	rh rear turn ind.

SA-7

Colour	Wire function
HG	switch lighting
HG	rh rear side light
HG	rh rear side light

SA-8

Colour	Wire function
BN	battery ground
BN	battery ground
BN	battery ground

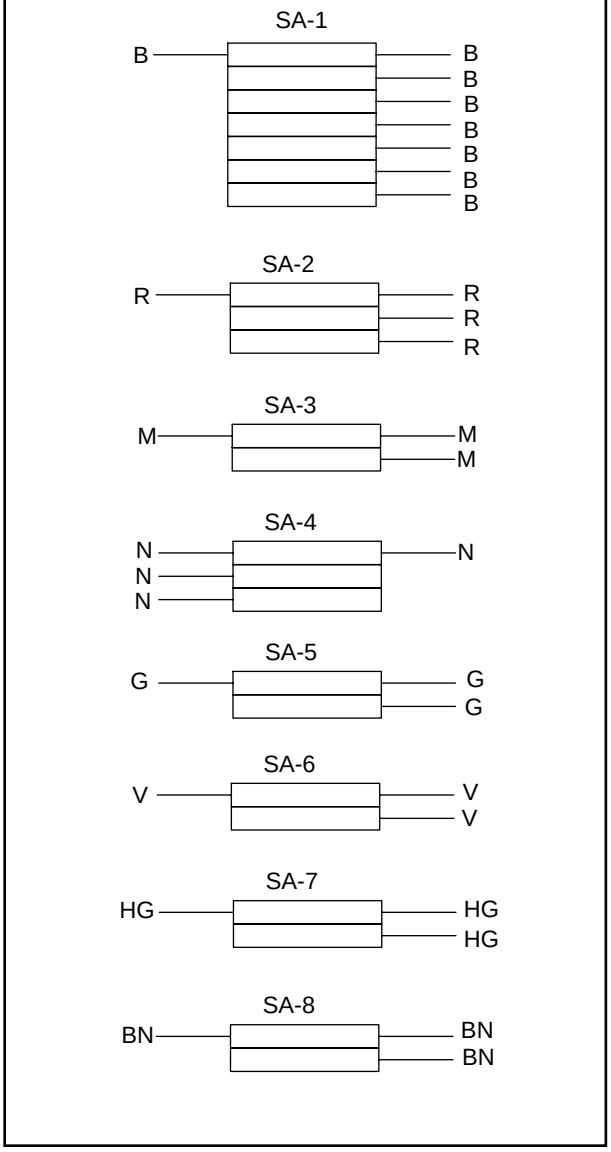


Fig. 10.849

3.10.7 Rear line

3.10.7.1 General description

The rear line powers the components installed on the transmission casing and hydraulic power packs, such as the solenoid valves (YV4) and (YV3)(Fig.10.850 e 10.851) for controlling users like the differential lock and four-wheel drive.

The rear line is connected to the dashboard line via connections between the terminal boards (XS2 Fig.10.852).

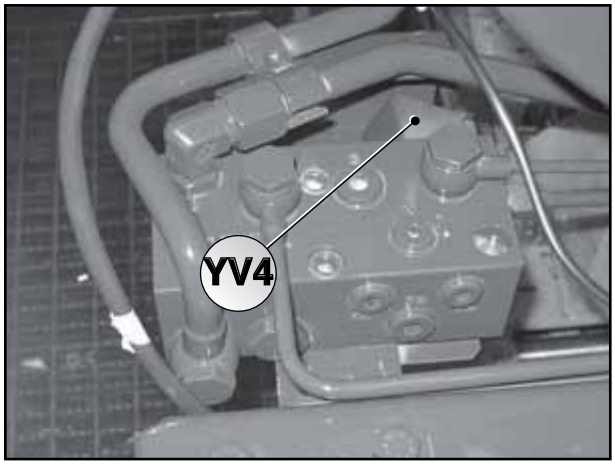


Fig. 10.850

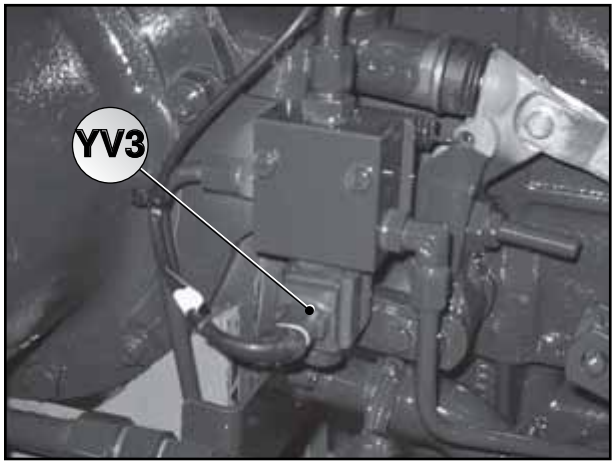


Fig. 10.851

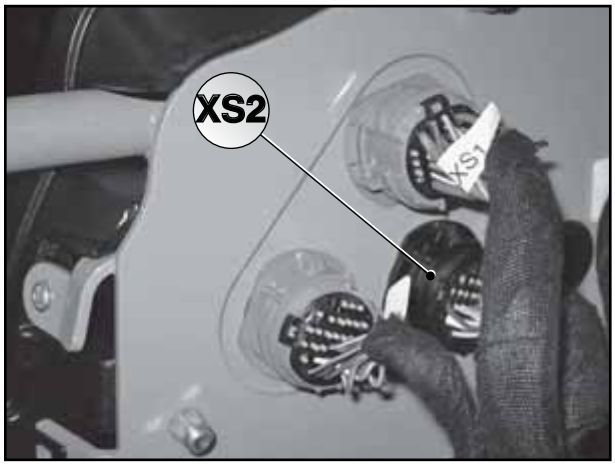


Fig. 10.852

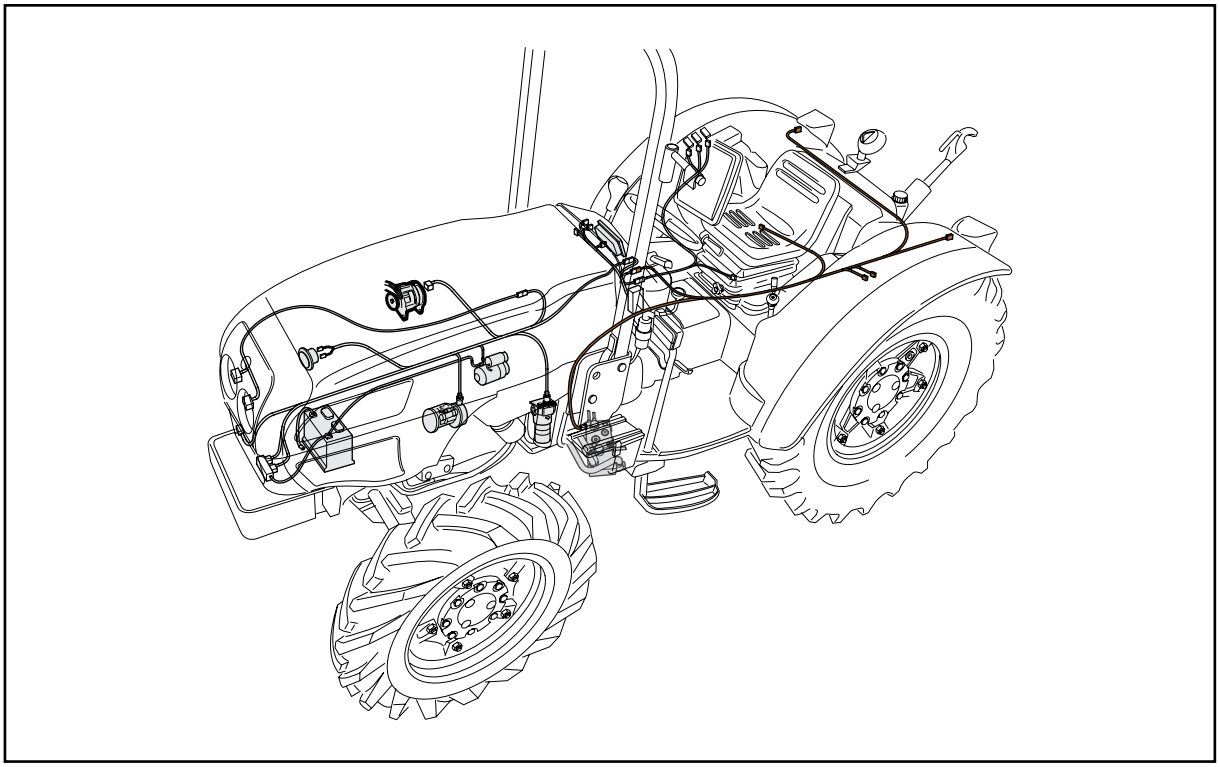


Fig. 10.853

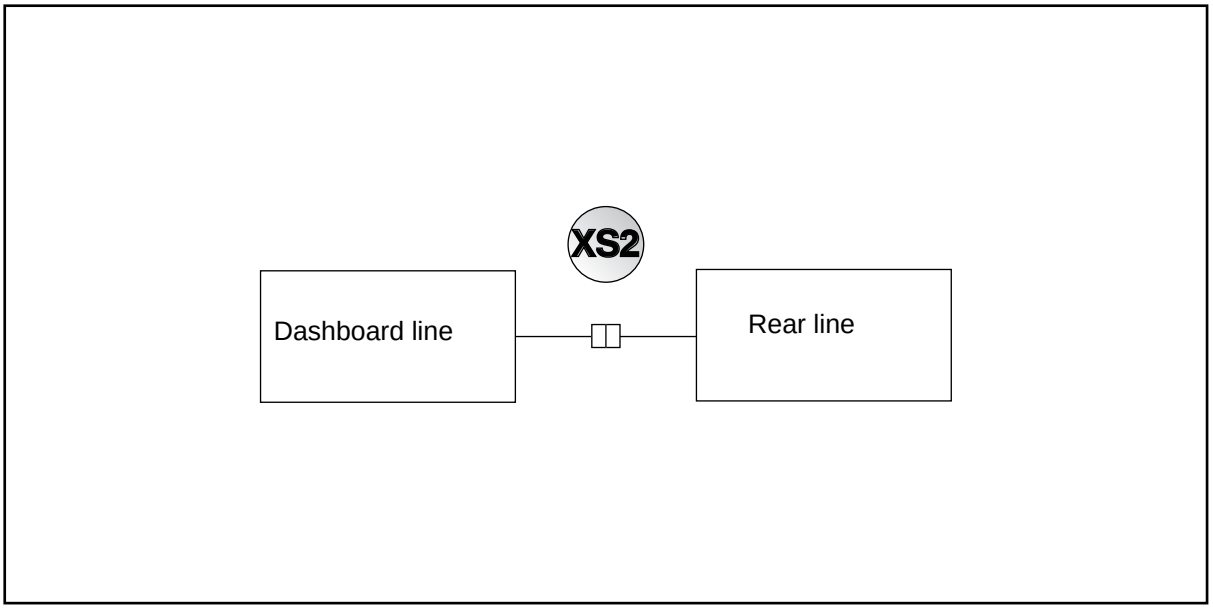


Fig. 10.854

3.10.7.2 Wiring

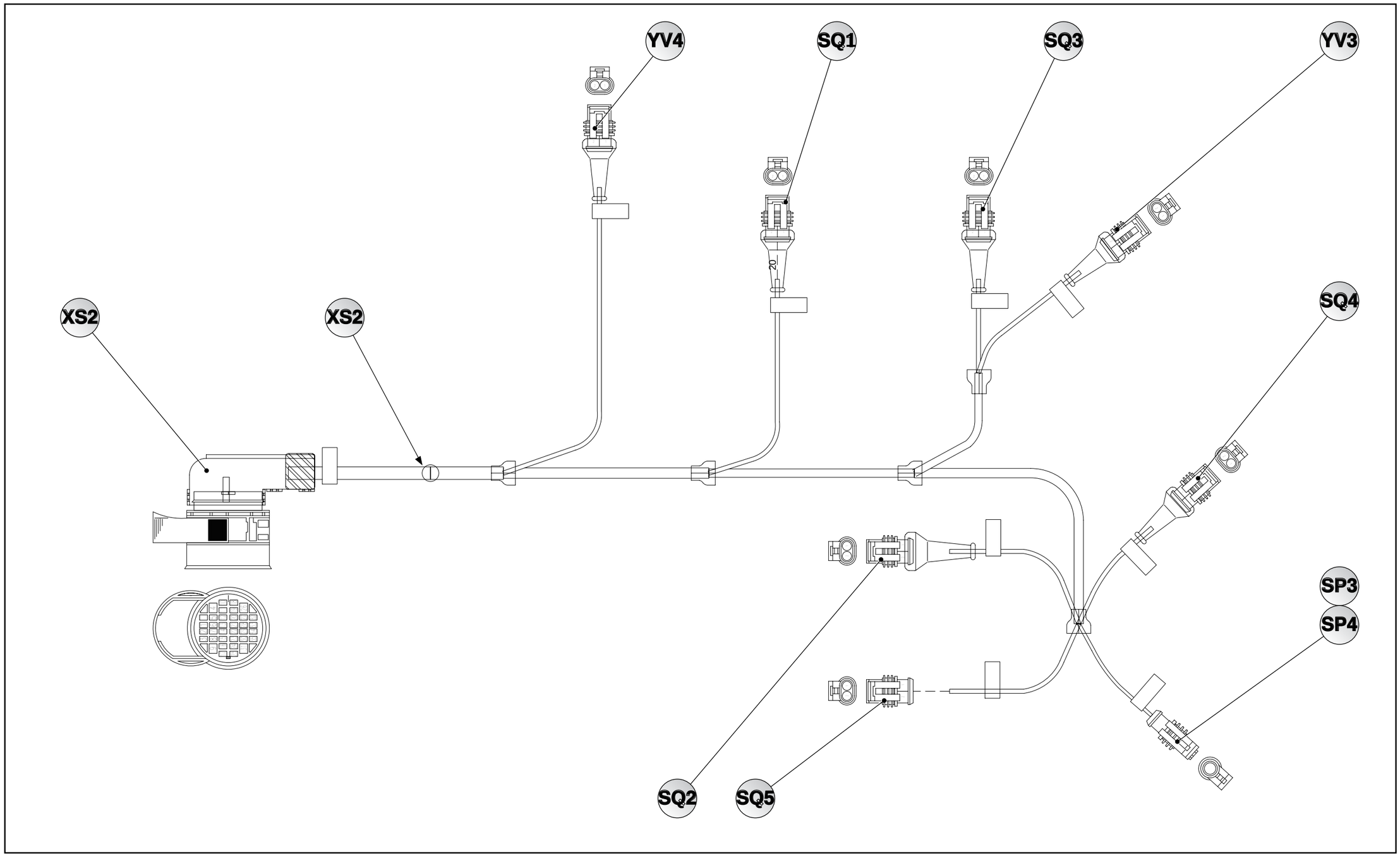


Fig. 10.855

SA-1 - Junction
SP4 - Trailer brake pressure switch connector
SQ1 - Connector for ignition enabling microswitch
SQ2 - Connector for independent rear PTO microswitch
SQ3 - Connector for parking brake hand lever microswitch
SQ4 - Connector for proportional rear PTO microswitch
SQ5 - Connector for fast rear PTO microswitch
YV3 - Connector for 4WD solenoid valve
YV4 - Diff lock solenoid valve connector
XS2 - Terminal board (34-ways) for rear line/dashboard line connection

3.10.7.3 Connector locations

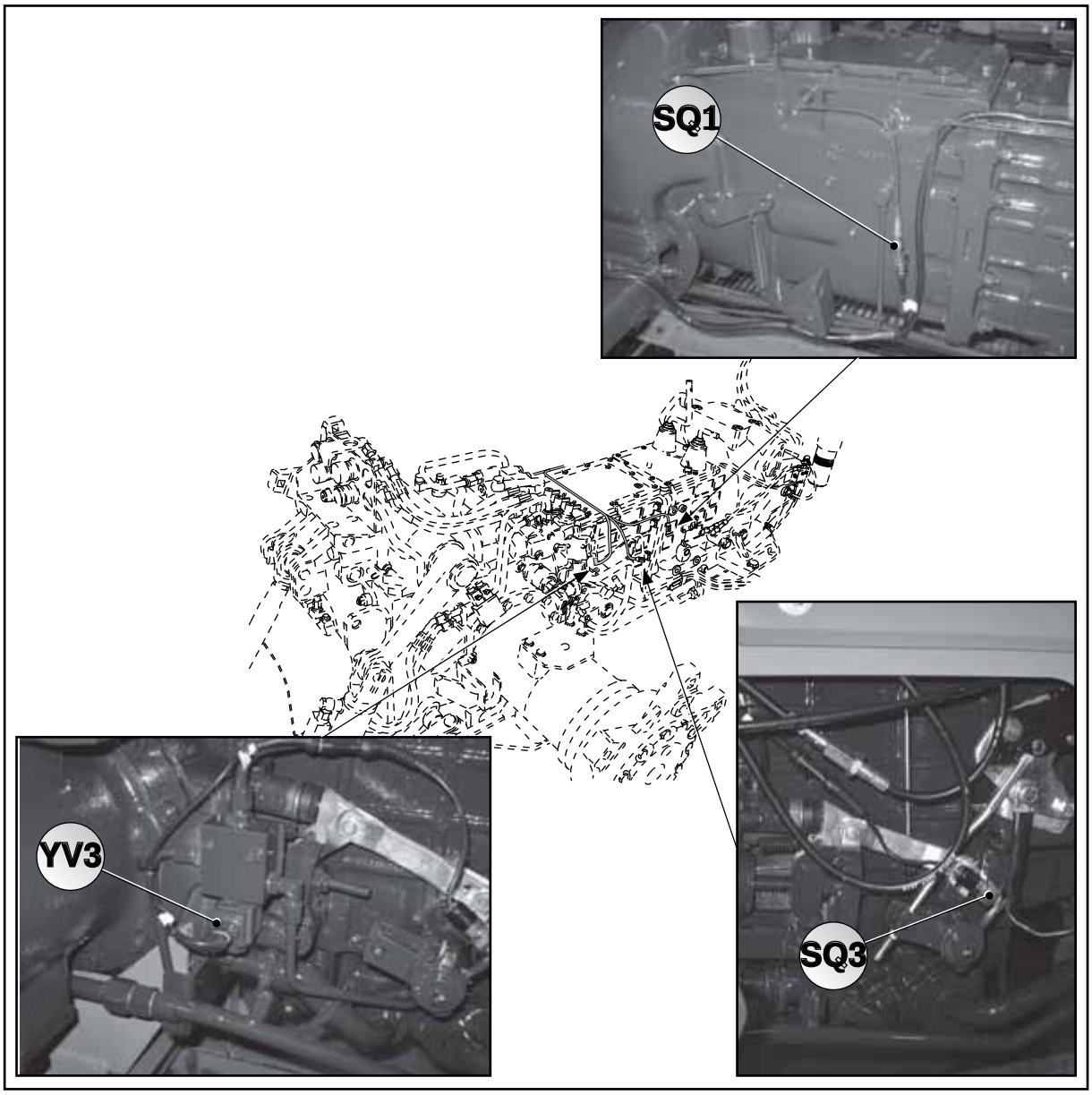


Fig. 10.856

SQ1 - Connector for ignition enabling microswitch
SQ3 - Connector for parking brake hand lever microswitch
YV3 - Connector for 4WD solenoid valve

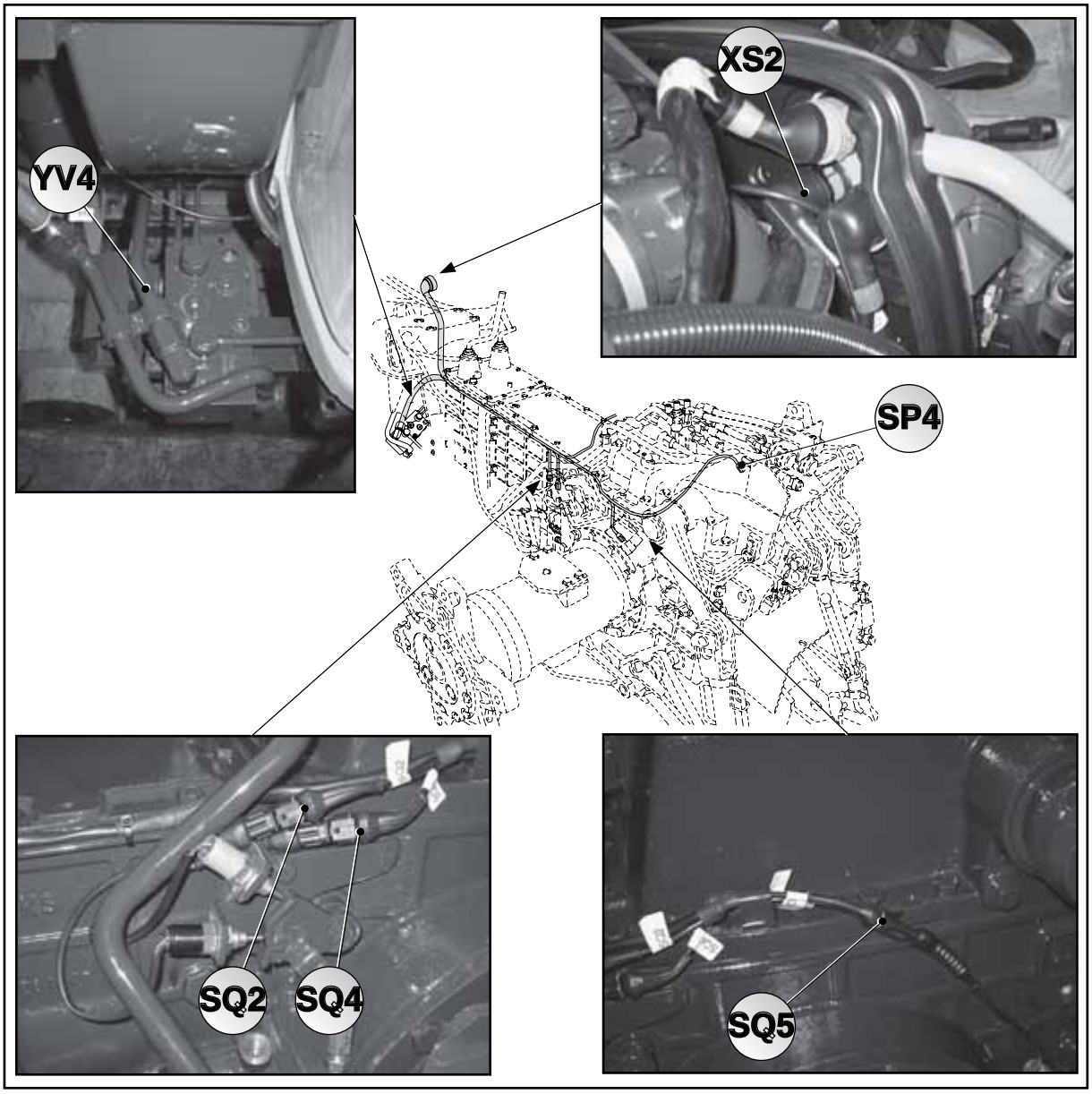


Fig. 10.857

SP4 - Trailer brake pressure switch connector
SQ2 - Connector for independent rear PTO microswitch
SQ4 - Connector for proportional rear PTO microswitch
SQ5 - Connector for fast rear PTO microswitch
YV4 - Diff lock solenoid valve connector
XS2 - Terminal board (34-ways) for rear line/dashboard line connection

3.10.7.4 Connector identification

Trailer brake pressure switch connector (SP4)

pin	colour	to con. or comp.	pin	wire function
1	CL	XS2	11	trailer brake bulb

Fig. 10.858

Connector (SQ1) for ignition enabling microswitch

pin	colour	to con. or comp.	pin	wire function
1	M	XS2	1	gearbox safety
2	VN	XS2	2	gearbox safety

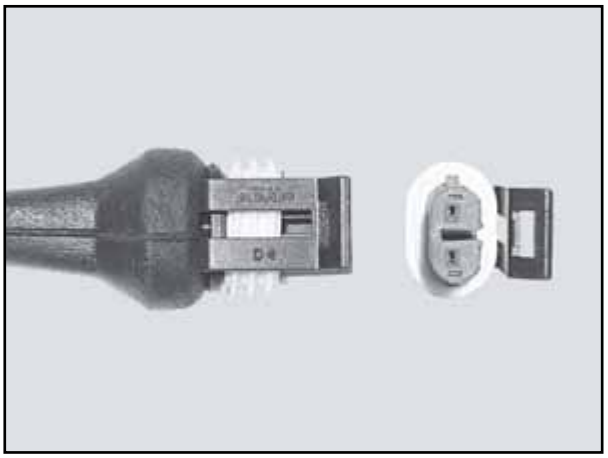


Fig. 10.859

Connector (SQ2) for independent rear PTO microswitch

pin	colour	to con. or comp.	pin	wire function
1	B	SA-1		Independent PTO indicator
2	HL	XS2	14	junction

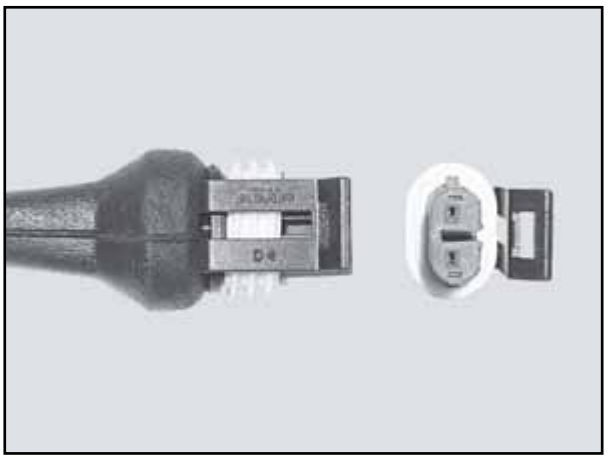


Fig. 10.860

Connector (SQ3) for parking brake lever microswitch

pin	colour	to con. or comp.	pin	wire function
1	B	SA-1		junction
2	ZN	XS2	10	hand brake

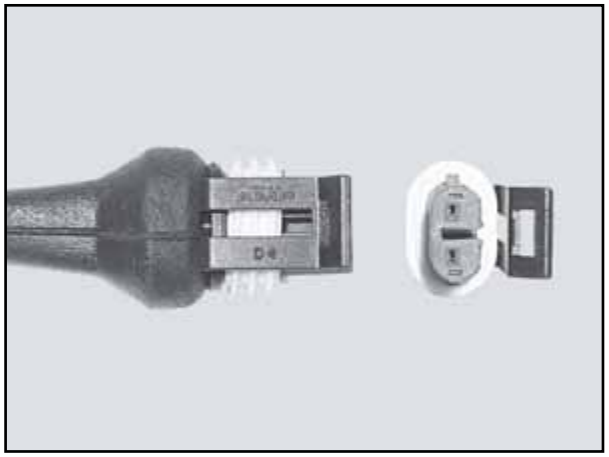


Fig. 10.861

Connector (SQ4) for proportional rear PTO microswitch

pin	colour	to con. or comp.	pin	wire function
1	C	XS2	12	prop. PTO indicator light
2	R	XS2	13	prop. PTO indicator light

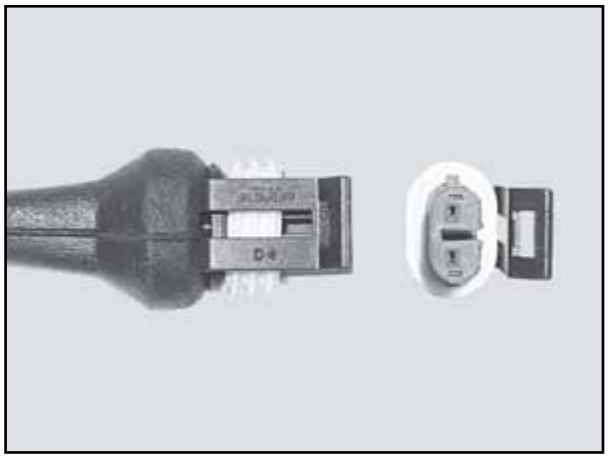


Fig. 10.862

Connector (SQ5) for fast rear PTO microswitch

pin	colour	to con. or comp.	pin	wire function
1	B	SA-1		junction
2	HL	XS2	14	fast PTO indicator light

Fig. 10.863

Connector (YV3) for 4WD solenoid valve

pin	colour	to con. or comp.	pin	wire function
1	HR	XS2	5	4WD solenoid valve
2	L	XS2	6	4WD solenoid valve

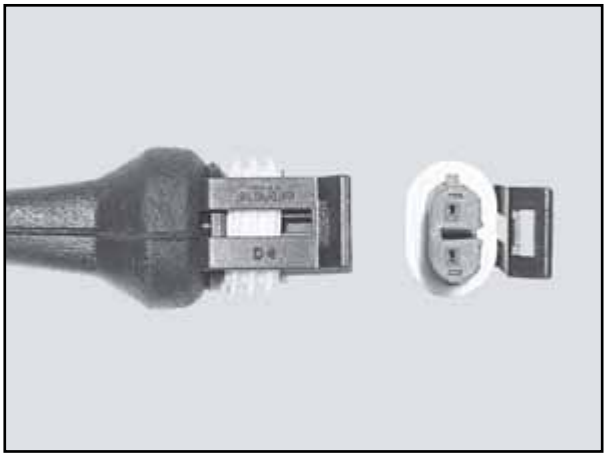


Fig. 10.864

Connector (YV4) for diff. lock solenoid valve

pin	colour	to con. or comp.	pin	wire function
1	VR	XS2	7	diff lock solenoid valve
2	BR	XS2	8	diff lock solenoid valve

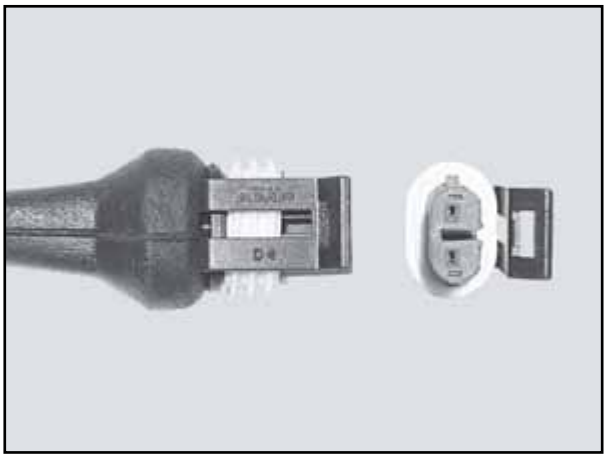


Fig. 10.865

Terminal board (34-ways) (XS2) for rear/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	M	SQ1	1	gearbox safety
2	VN	SQ1	2	gearbox safety
3	HN	SQ2	1	Independent PTO indicator
4	B	SA-1		junction
5	HR	YV3	1	4WD solenoid valve
6	L	YV3	2	4WD solenoid valve
7	VR	YV4	1	diff lock solenoid valve
8	BR	YV4	2	diff lock solenoid valve
9				not used
10	ZN	SQ3	2	hand brake
11	CL	SP4	1	trailer brake bulb
12	C	SQ4	1	prop. PTO indicator light
13	R	SQ4	2	prop. PTO power
14	HL	SQ5	2	fast PTO indicator light
15				not used
16				not used
17				not used
18				not used
19				not used
20				not used
21				not used
22				not used
23				not used
24				not used
25				not used
26				not used
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.866

3.10.7.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

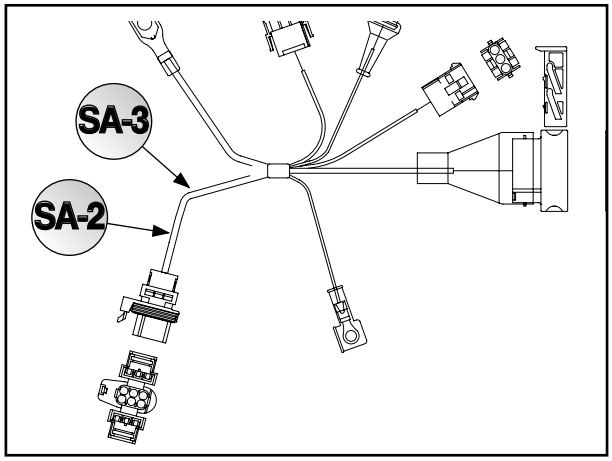


Fig. 10.867

Dashboard line solder point table

SA-1

Colour	Wire function
B	ground
B	ground
B	ground
B	ground

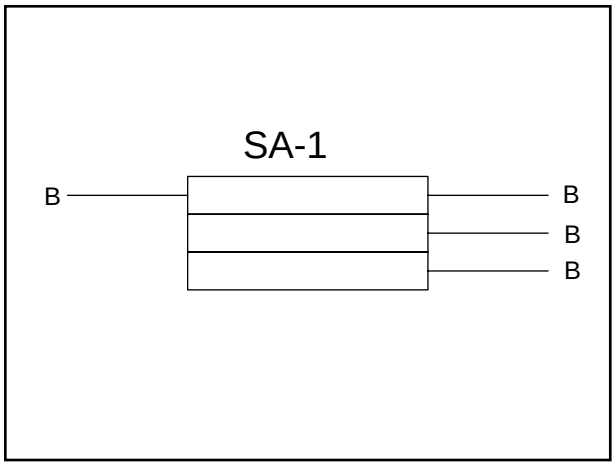


Fig. 10.868

3.10.8 Headlight extension line

3.10.8.1 General description

The headlight extension line powers the lamps installed at the front of the tractor's bonnet (Fig.10.869).

The headlight extension line is connected to the engine's front line by means of the connection between connectors (XS6 Fig.10.870).

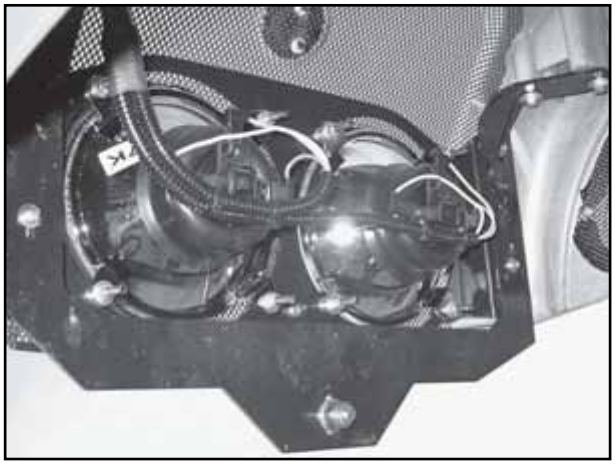


Fig. 10.869

Fig. 10.870

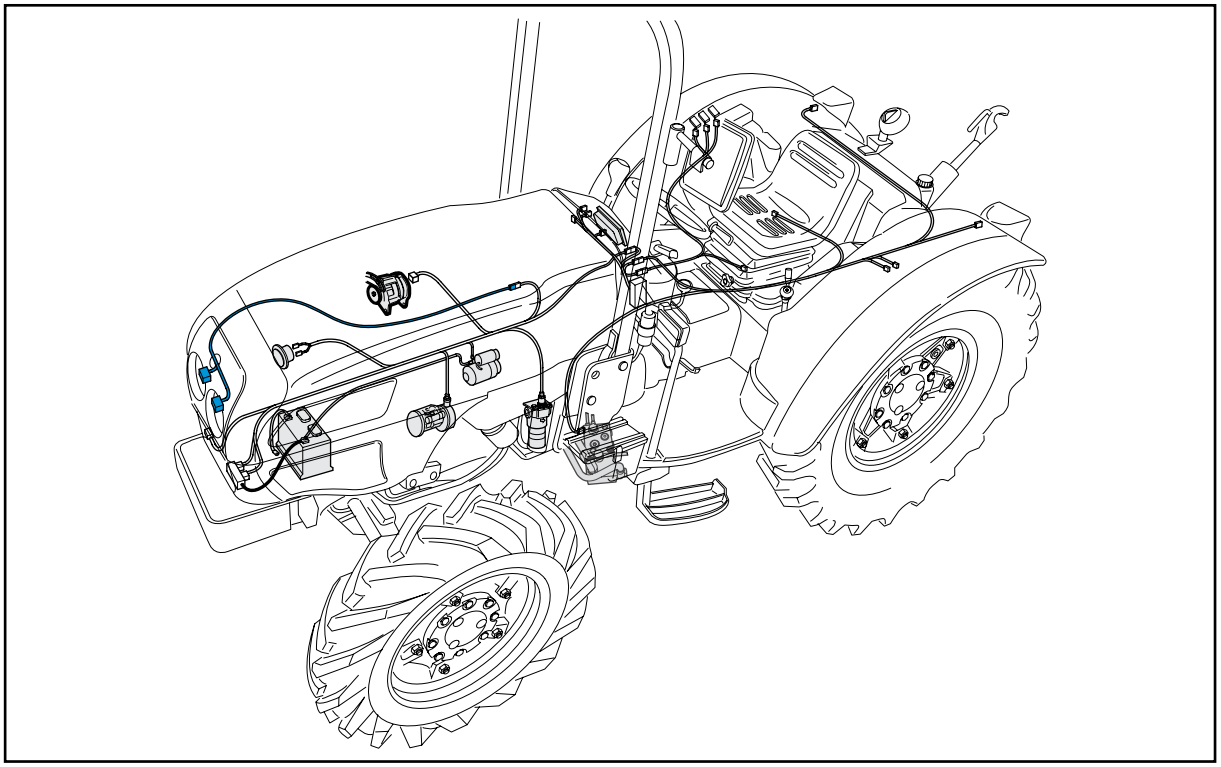


Fig. 10.871

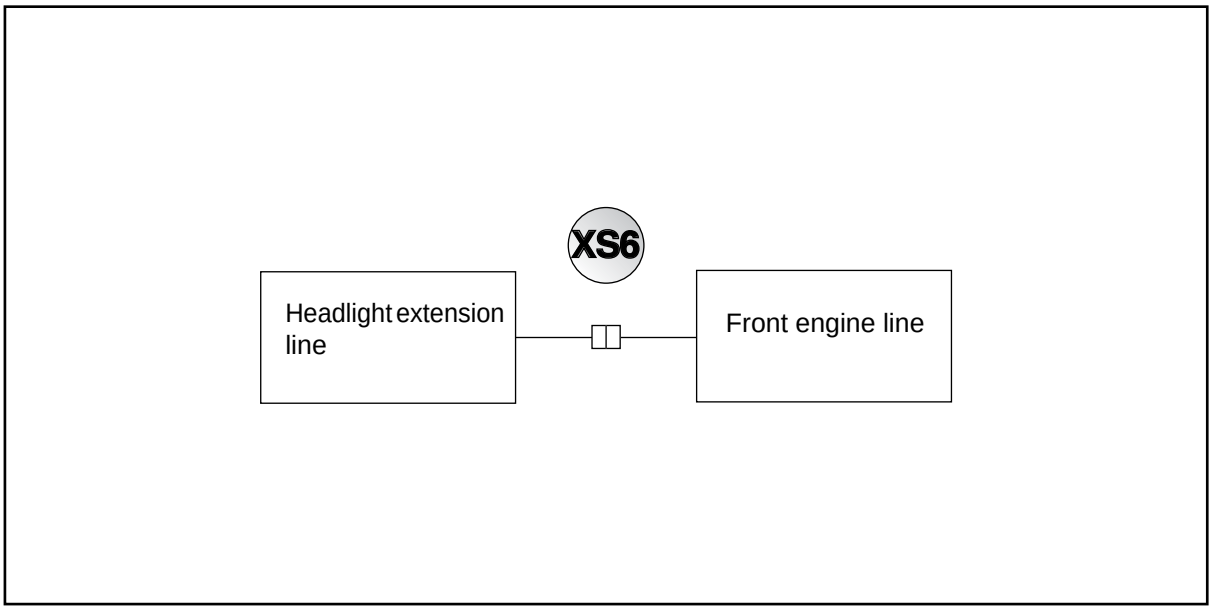


Fig. 10.872

3.10.8.2 Wiring

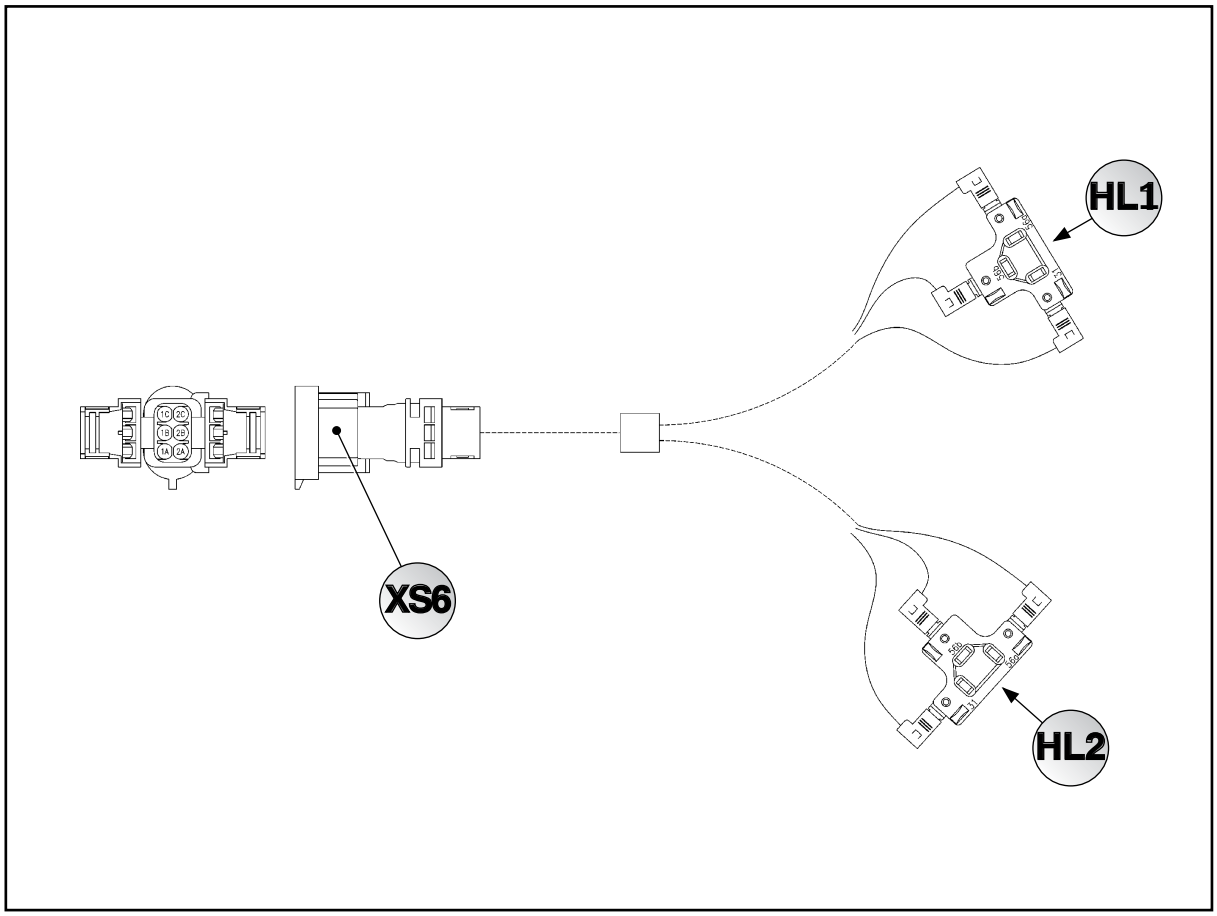


Fig. 10.873

H1 - Lh headlight connector
H2 - Rh headlight connector
XS6 - Connector for connecting to the front line

3.10.8.3 Connector locations

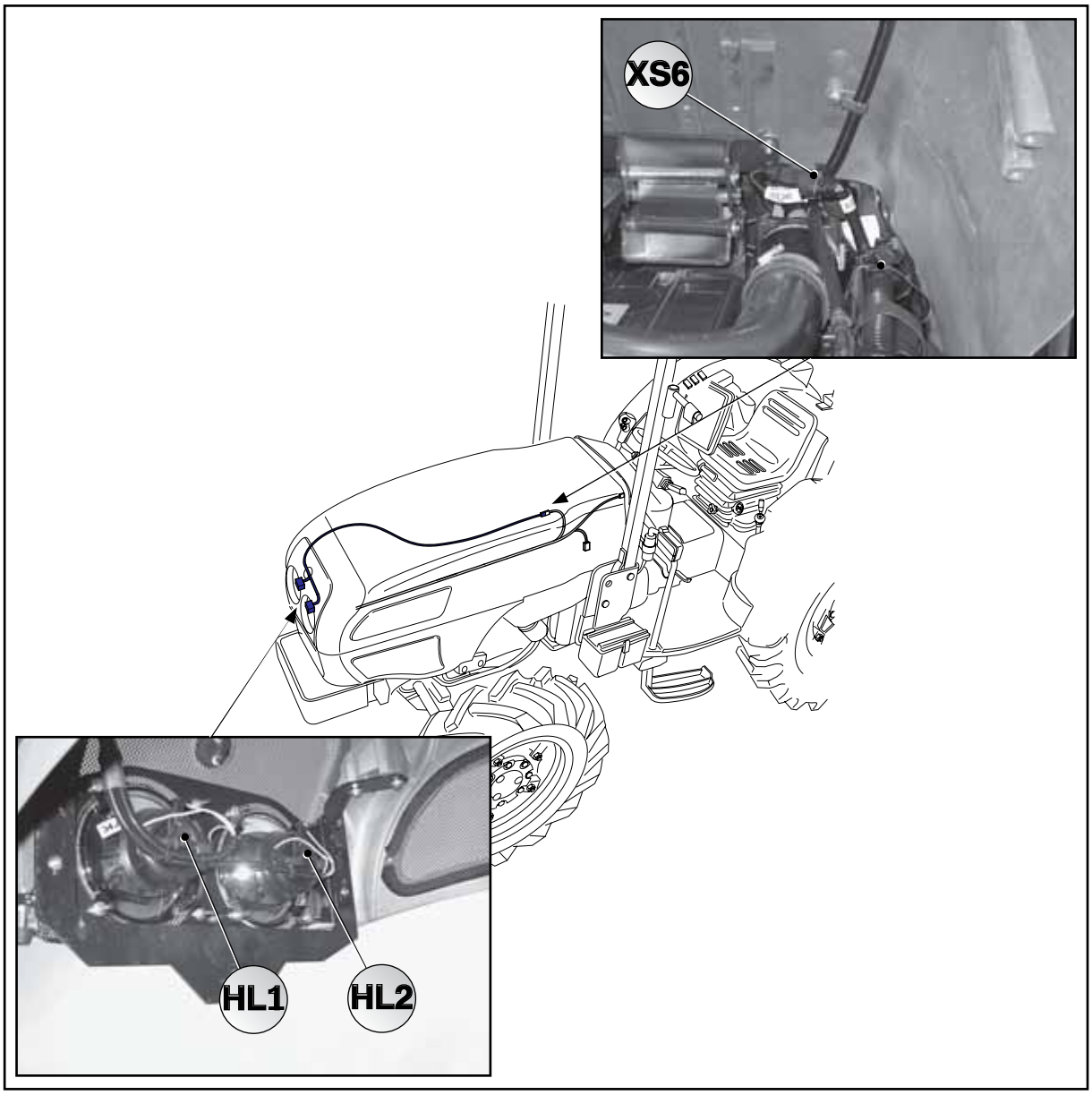


Fig. 10.874

H1 - Lh headlight connector
H2 - Rh headlight connector
XS6 - Connector for connecting to the front line

3.10.8.4 Connector identification

Connector (HL1) for lh front field light connection

pin	colour	to con. or comp.	pin	wire function
1	B	XS6	2C	lh field light ground
2	H	XS6	2B	lh dipped beam
3	V	XS6	1A	lh driving beam

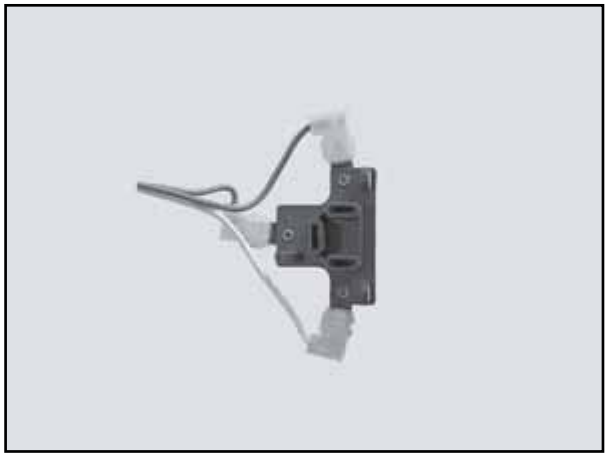


Fig. 10.875

Connector (HL2) for rh front field light connection

pin	colour	to con. or comp.	pin	wire function
1	B	XS6	1C	rh field light ground
2	HN	XS6	2A	rh dipped beam
3	VN	XS6	1B	rh driving beam

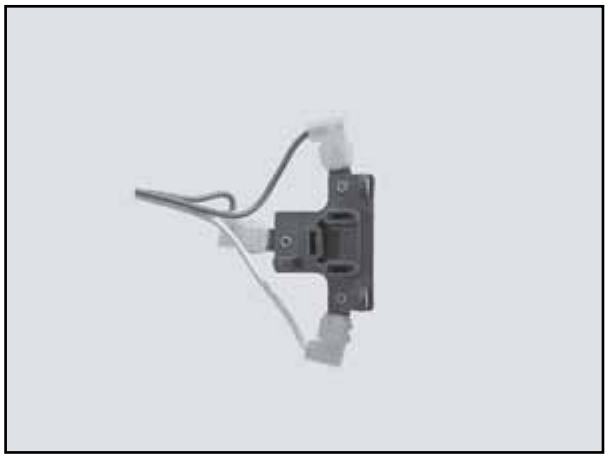


Fig. 10.876

Connector (XS6) for connecting to the front line

pin	colour	to con. or comp.	pin	wire function
1A	V	HL1	3	lh front driving b.
1C	VN	HL2	3	rh front driving b.
1C	B	HL2	1	rh field light ground
2A	HN	HL2	2	rh dipped beam
2B	H	HL1	2	lh dipped beam
2C	B	HL1	1	lh field light ground

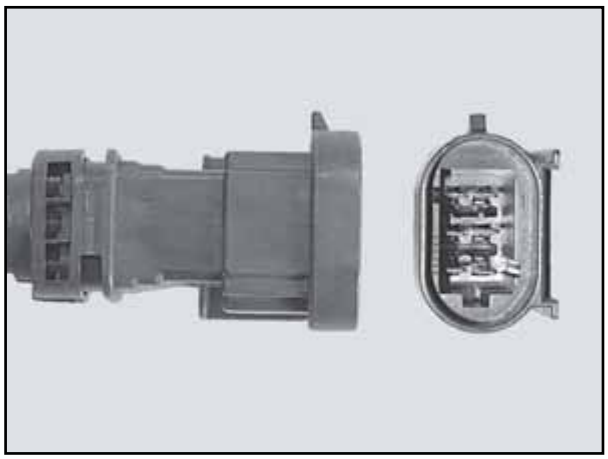


Fig. 10.877

3.11 F-N Series E-Line cab

3.11.1 Technical specifications

3.11.1.1 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
Voltage	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Alternator

Make	Ix
Type	Threephase
Voltage	14 V
Current	85 A

Starter motor

Manufacturer	Ix - Dsx
Type	Solenoidal
Maximum power	2.8 kW
Type of engagement	Automatic pinion engagement by means of electro-magnet.

Solenoid valves

Manufacturer	Srx Dx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 Ω ±5%

Sensors

Manufacturer	Jx/Stx
Type	Inductive

Instrument

Make	Unx

3.11.1.2 Relays and fuse holders

The electrical system of **F-N Series** tractors is protected against short-circuits and excessive power draw by means of fuses. The number of fuses installed in the electrical system depends on the components and functions that need protecting.

The fuses are installed in two dedicated boxes:

Z - front fuse box (Fig.10.878) installed at the front, near the battery that powers the system. It contains a further fuse (F5) that protects the preheater relay.

B - main fuse box (Fig.10.880) installed on the left-hand side of the dashboard cover.

Y - cab fuse box (Fig.10.879), in the cab on the roof, on the right-hand side of the covering, upper zone.

Note: before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

The cab version of **F-N Series E-Line** tractors is fitted with a fuse (F6) on the line that connects the roof facilities and the alternator, so as to protect the cab power.

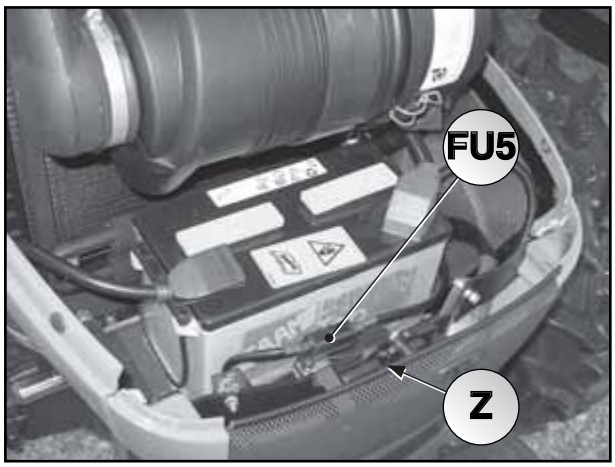


Fig. 10.878

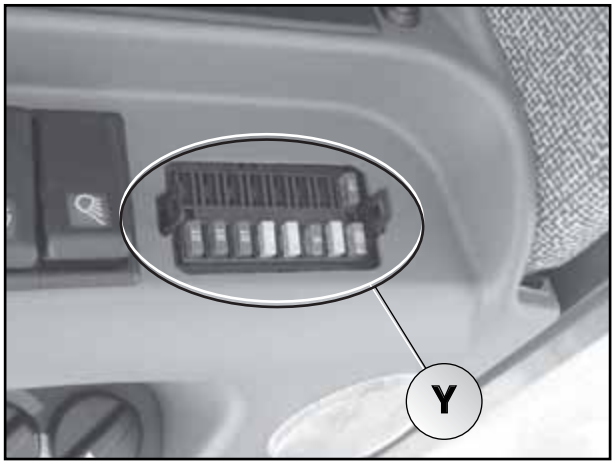


Fig. 10.879

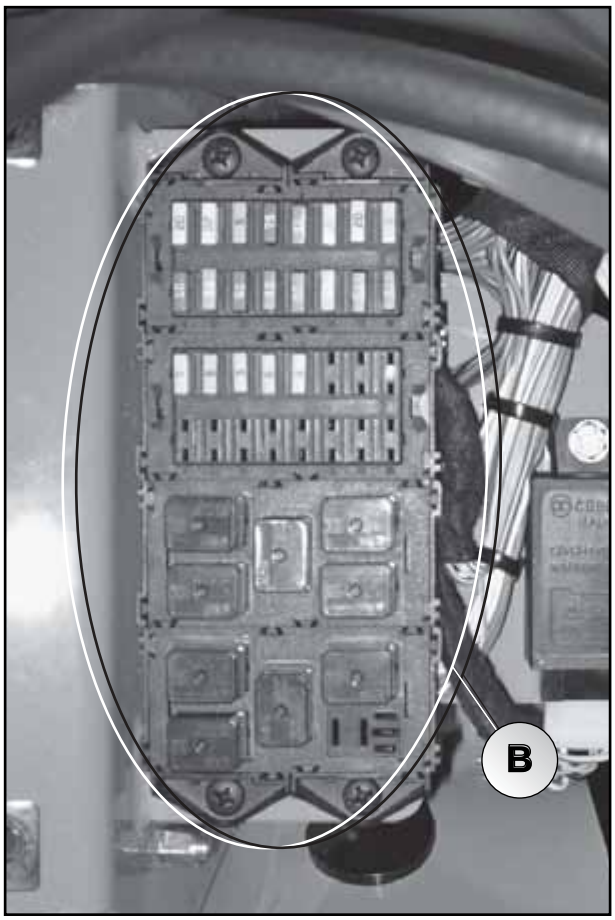


Fig. 10.880

Z- Front fuse box

The front fuses are installed in the “battery-starter motor line” wiring. They are connected by means of the positive terminal (A1) to the battery (G1) on the one side and on the other side, to the front engine line, by means of connectors (LB1 and LB2) (Fig.10.881).

Another fuse (F5) is also installed in the front line, so as to protect the glow plug pre-heater system.

Turn the ignition key to the 2nd position to activate the power relay (K1), which transmits the signal for preheating the plate in contact with the glow plugs. The relay (K1) cuts out the electrical signal after 5 seconds in this position have elapsed.

The fuse (F6) is installed between the roof facility line and the power from the alternator. It is installed under the bonnet and protects the services in the cab roof wiring

Note: to reduce the possibility of the relay (K1) burning out to the minimum, it is advisable to wait a few seconds (about 5 sec.) after having turned the ignition key to the 2nd position, before actually starting the tractor.

The front fuses have the following functions and ampere ratings (Fig.10.881):

Fuse	Circuits protected	Amp.
F1	Alternator primary	70
F2	Key-activated user primary	40
F3	Key-activated user primary	50
F4	Battery direct user primary	20
F5	Glow plugs (Fig.10.882)	50
F6	Cab roof line power (Fig.10.883)	60

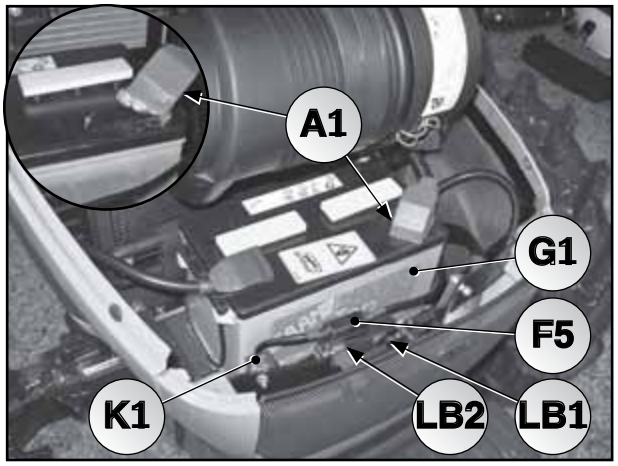


Fig. 10.881

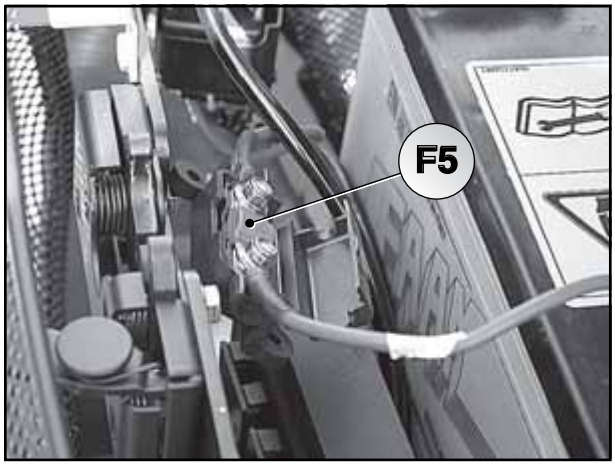


Fig. 10.882

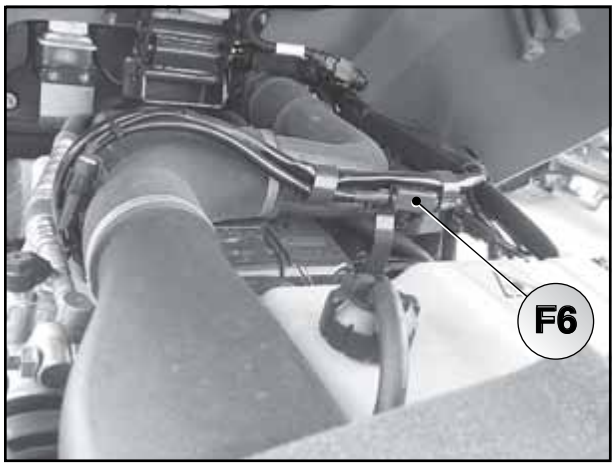


Fig. 10.883

B - Main fuse box

The main fuses are installed in the dashboard wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
FA1	Direct power to ignition key	20
FA2	Key-activated for starter motor	5
FA3	Key-activated for relay coils	7.5
FA4	Key-activated for engine power	7.5
FA5	Direct to platform's rotating beacon	5
FA6	Direct auxiliary socket positive	20
FA7	Key-activated auxiliary socket positive	5
FA8	Key-activated for 4WD solenoid valve	10
FA9	Key-activated for dipped headlights	15
FA10	Key-activated for driving beams	15
FA11	Key-operated rear field light	7.5
FA12	Key-activated for brake lights/diff lock el.	10
FA13	Key-operated turn indicators	10
FA14	Direct to hazard lights	15
FA15	Key-activated horn	7.5
FA16	Key-activated for NAO kit controller	7.5
FB1	Direct to side lights (main)	5
FB2	Direct to side lights (Rh rear and Lh front)	5
FB3	Direct to side lights (Lh rear, Rh front and license plate light)	5
FB4	Direct to instrument powering	3
FB5	Key-activated for instrument powering	3

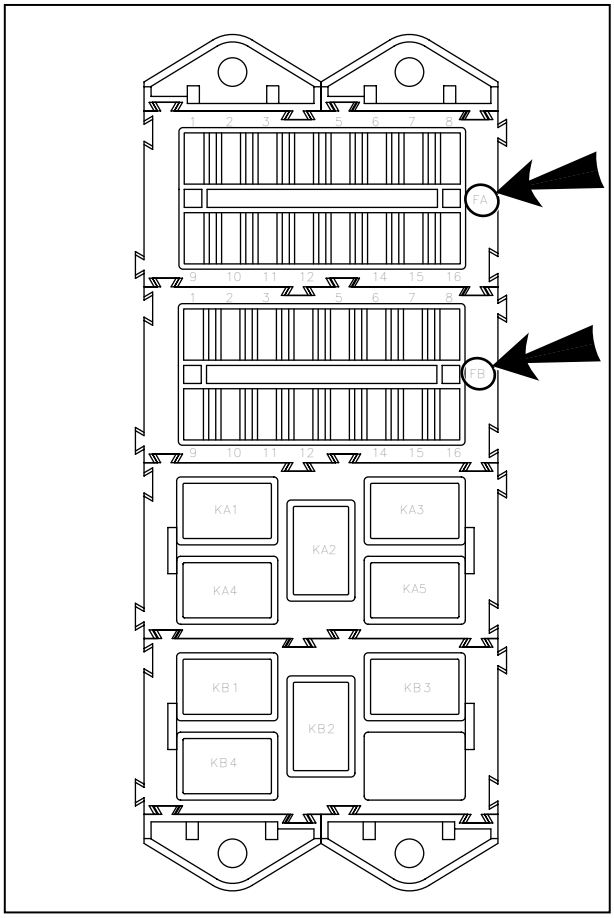


Fig. 10.884

Y - Cab fuse box

The fuses for the “cab” services are installed in the roof wiring line and have the following functions and ampere ratings:

Fuse	Circuits protected	Amp.
FC1	key-activated A/C electric fan	20
FC2	key-activated A/C anti-icing	5
FC3	key-activated A/C compressor	7.5
FC4	direct rotating beacon and ceiling light	10
FC5	direct radio	5
FC6	key-activated radio	5
FC7	key-activated roof auxiliaries	15
FC8	key-activated windscreen wiper	5
FC9	key-activated front/rear window washer	5
FC10	key-activated rear window wiper	5
FC11	key-activated front field lights	10
FC12	key-activated rear field lights	10

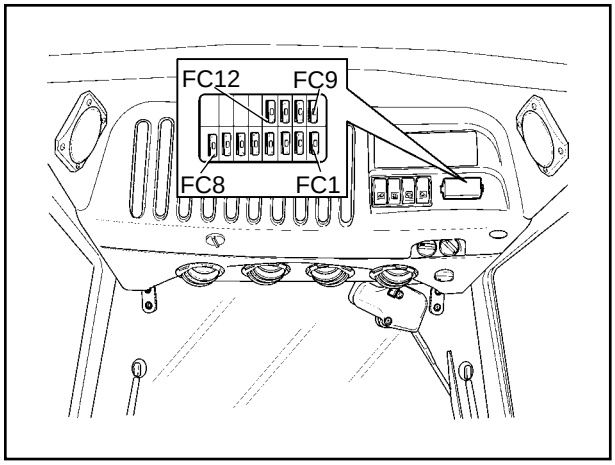


Fig. 10.885

There are 15 relays installed in **F-N Series E-Line cab version** tractors, of which 9 are installed in the fuse box (B), just under the protection fuses, one at the front, near the fuse box (Z) and the other 5 in the roof wiring line.

Relays	Function
KA1	Immobiliser relay
KA2	Relay for auxiliary socket + 4WD solenoid valve
KA3	Relay for headlights + rear field lights
KA4	Relay for brake lights, NAO, diff lock el., turn indicators
KA5	Relay 4WD engagement during braking
KB1	Dipped beam relay
KB2	Driving beam relay
KB3	Diff lock self-retaining relay
KB4	Relay for diff lock release + rear brake lights
K1	Power relay (glow plug preheater) (Fig.10.888).

Another 5 relays are installed in the cab roof wiring line, in the rh side behind the lining, near to the protection fuses (Fig.10.887).

Relays	Function
KC1	Key-activated A/C relay
KC2	A/C compressor release relay
KC3	Key-activated roof auxiliaries relay
KC4	Key-activated front field light relay
KC5	Key-activated rear field light relay

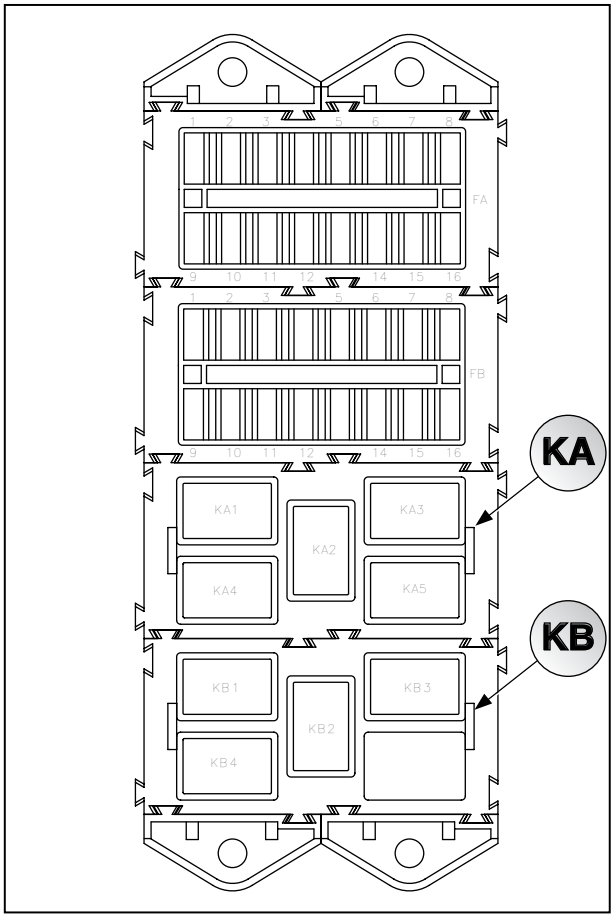


Fig. 10.886

Fig. 10.888

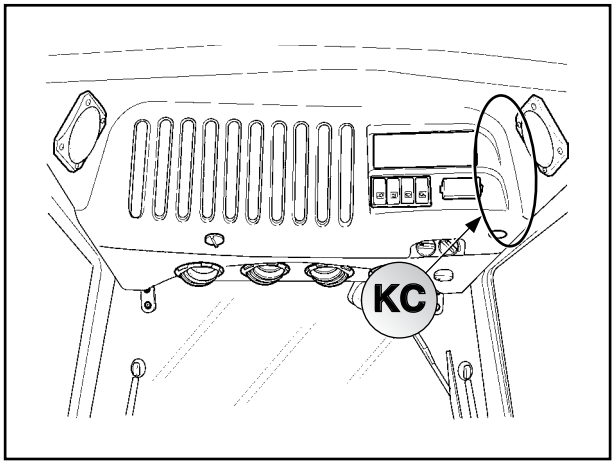


Fig. 10.887

identification of the components in the functional diagram

Code	Description	Part	Col.
FA1	Direct ignition key powering fuse	1	5
FA2	Key-activated starter motor fuse	1	3
FA3	Key-activated relay coil fuse	1	5
FA4	Key-activated engine power fuse	2	6
FA5	Direct fuse for platform's rotating beacon	1	7
FA6	Auxiliary socket positive direct fuse	2	1
FA7	Auxiliary socket positive key-activated fuse	2	1
FA8	Key-activated el. 4WD fuse	2	2
FA9	Key-activated dipped beams fuse	2	4
FA10	Key-activated driving beams fuse	2	4
FA11	Key-activated fuse for rear field light	2	5
FA12	Key-activated fuse for brake lights/el.diff lock	3	1
FA13	Key-activated side lights fuse	3	3
FA14	Direct hazard light fuse	3	3
FA15	Key-activated horn fuse	3	5
FA16	Key-activated NAO control unit fuse	3	5
FB1	Side lights direct fuse (main)	3	6
FB2	Side lights direct fuse (RH rear, LH front)	3	6
FB3	Side lights direct fuse (LH rear,RH front, licence plate light)	3	6
FB4	Instrument power direct fuse	4	1
FB5	Key-activated instrument power fuse	4	2
FC1	Key-activated A/C electric fan fuse	5	1
FC2	Key-activated A/C anti-icing fuse	5	2
FC3	Key-activated A/C compressor fuse	5	3
FC4	Fuse for direct rotating beacon and ceiling light	5	3
FC5	Fuse for direct radio	5	4
FC6	Key-activated radio fuse	5	4
FC7	Key-activated roof line auxiliary fuse	5	4
FC8	Key-activated windscreen wiper fuse	5	4
FC9	Key-activated fuse for front/rear window washer	5	5
FC10	Key-activated rear window wiper fuse	5	6
FC11	Key-activated fuse for front roof field lights	5	7
FC12	Key-activated fuse for rear roof field lights	5	8
F1	Alternator link-box fuse	1	3
F2	Key-activated user primary link-box fuse	1	3
F3	Key-activated user primary link-box fuse	1	3
F4	Key-activated battery direct user primary link-box fuse	1	3
F5	Glow plug fuse (steering wheel midival)	1	2
F6	Roof line fuse (steering wheel midival)	5	1
K1	Key-activated relay for glow plugs	1-1	7-2
KA1	Starter motor enabling relay	1-1	7-3
KA2	Key-activated relay for auxiliary socket, 4WD sol.v.	1-2	5-1
KA3	Key-activated relay for headlights, rear field light	1-2	5-4
KA4	Key-activated relay for brake lights, NAO, diff lock sol.v., turn indicators	1-3	5-1
KA5	Relay for engaging 4WD during braking	2-2	2-2
KB1	Dipped beams relay	3-2	4-4
KB2	Driving beams relay	3-2	5-4
KB3	Differential lock self-retaining relay	2-2	8-8
KB4	Relay for brake lights/differential lock	3-3	2-1
KC1	Key-activated A/C relay	1-5	6-1
KC2	A/C compressor release relay	5-5	2-3
KC3	Key-activated roof auxiliaries relay	1-5	6-4
KC4	Key-activated front field light relay	5-5	6-7
KC5	Key-activated rear field light relay	5-5	7-8
S0	Ignition key	1	5
S1	Platform rotating beacon switch	1	7
S2	4WD switch	2	2
S3	Rear field light switch	2	5
S4	Differential lock button	2	7
S5	Emergency switch	3	3
S6	Light switch	3	4
S7	Side lights/dipped beams switch	3	6
S8	A/C fan selector	5	1

S9	A/C button	5	2
S10	Cab rotating beacon switch	5	3
S11	Windscreen/rear window washer switch	5	5
S12	Front roof field light switch	5	6
S13	Rear roof field light switch	5	7
SP2	Pressure switch for 4WD engagement during braking	3	2
SP3	7 bar trailer brake pressure switch (braking in progress)	4	2
SP4	Trailer brake pressure switch (brake connected, trailer hitched)	4	2
SP5	Engine oil pressure switch	4	3
SP6	Air filter vacuum switch	4	3
SP7	Gearbox oil vacuum switch	4	3
SP9	A/C filter pressure switch	5	3
ST1	Temperature sensor for fuel enrichment jet	2	6
ST2	Engine water temperature sensor	4	7
ST3	A/C anti-icing temperature sensor	5	2
SL1	Brake fluid level sensor	4	5
SL2	1st tank fuel level sensor	4	5
SL3	2nd (supplementary) tank fuel level sensor	4	6
SQ1	Safety microswitch on gearbox	1	7
SQ2	Independent PTO engaged microswitch	1	7
SQ3	Parking brake engaged microswitch	4	2
SQ4	Synchronized PTO engaged microswitch	4	3
SQ5	Fast PTO engaged microswitch	4	4
SQ6	Lh brake pedal microswitch	2	2
SQ7	Rh brake pedal microswitch	2	2
L1	Platform rotating beacon	1	7
L2	Lh headlight	2	4
L3	Rh headlight	2	4
L4	Platform rear field light	2	5
L5	Lh brake light	3	1
L6	Rh brake light	3	1
L7	LH rear turn indicator light	3	2
L8	LH front turn indicator light	3	3
L9	RH front turn indicator light	3	3
L10	RH rear turn indicator light	3	3
L11	RH rear side light	3	5
L12	LH front side light	3	6
L13	RH front side light	3	6
L14	LH rear side light	3	7
L15	License plate light	3	7
L16	Lh NAO supplementary light	3	7
L17	Rh NAO supplementary light	3	7
L18	Cab ceiling light	5	3
L19	Cab rotating beacon	5	3
L20	Lh front roof field light	5	7
L21	Rh front roof field light	5	7
L22	Lh rear roof field light	5	8
L23	Rh rear roof field light	5	8
Yv1	Fuel injection pump solenoid valve	2	6
Yv2	Fuel enrichment jet solenoid valve	2	6
Yv3	4WD solenoid valve	2	2
Yv4	Diff lock solenoid valve	2	7
EC1	Instrument	4	2
G1	Battery	1	1
G2	Glow plugs	1	1
G3	Alternator	1	4
G4	Blinker	3	3
G5	Horn	3	5
G6	Radio	5	4
G7	Lh loudspeaker	5	4
G8	Rh loudspeaker	5	4
M1	Starter motor	1	2
M2	Fuel pump motor	2	5
M3	A/C electric fan	5	1
M4	A/C compressor	5	3
M5	Windscreen wiper	5	4
M6	Rear window washer	5	5
M7	Front windscreen washer	5	5
M8	Rear window wiper	5	6
D1	NAO protection diode	3	3
D2	NAO protection diode	3	3
R1	A/C electric resistance	5	1

Grounds and Terminal boards

XS0	Platform-7-pin socket connector (6-ways)
XS1	Dashboard-front line connector (34-ways)
XS2	Dashboard-rear line connector (34-ways)
XS3	Dashboard-platform line connector (34-ways)
XS5	Roof line circular connector (4 ways)
XS6	Auxiliary 3-pin socket
XS7	Front line-bonnet line connector (6 ways)
XS8	Lh front light connector (3-ways) (socket holder)
XS9	Rh front light connector (3-ways) (plug holder)
XS10	Connector (2-ways) for Nao supplementary lights
XS11	Terminals for cab power connection
XM0	Direct grounding points on parts structure
XM1	Front cable wiring line ground direct battery eyelet)
XM2	Platform cable wiring line ground
XM3	Dashboard wiring line ground (eyelet)
XM5	Rear wiring line ground

References to functional diagram

1 - cab version only
2 - to 7-pin socket
3 - to 7-pin socket
4 - to 7-pin socket
5 - to 7-pin socket
6 - to 7-pin socket
7 - 7-pin socket ground
8 - platform ground
9 - rear ground
10 - dipped beams
11 - driving beams
12 - flash
13 - horn
14 - NAO
15 - glow plugs
16 - starter motor
17 - alternator
18 - auxiliary socket, 4WD solenoid valve
19 - headlights, rear field light
20 - brake lights, NAO, diff lock, turn indicators, front control valve, power lift
21 - air conditioner
22 - roof auxiliary
23 - ignition relay
24 - glow plugs
25 - platform rotating beacon
26 - 3-pin auxiliary socket
27 - 4WD during braking
28 - four-wheel drive
29 - Lh headlight
30 - Rh headlight
31 - platform rear field light
32 - fuel pump
33 - fuel injection pump
34 - fuel enrichment jet
35 - differential lock
36 - differential lock
37 - lh brake light
38 - rh brake light
39 - diff lock release, brake light indicators
40 - lh rear turn indicator
41 - lh front turn indicator
42 - rh front turn indicator
43 - rh rear turn indicator
44 - dipped beams
45 - driving beams
46 - horn
47 - rh rear side light
48 - lh front side light
49 - rh front side light
50 - lh rear side light
51 - license plate light
52 - lh supplementary turn indicator (NAO)

53 - rh supplementary turn indicator (NAO)
54 - hand brake lever
55 - trailer brake oil pressure
56 - synchronized rear PTO
57 - engine oil pressure
58 - air intake circuit
59 - gearbox oil intake
60 - 750 - 1000 RPM rear PTO
61 - brake oil level
62 - fuel level
63 - supplementary tank level
64 - instrument ground
65 - radiator water temperature
66 - hand brake
67 - brake oil level
68 - trailer brake oil pressure
69 - synchronized PTO
70 - low engine oil pressure
71 - air filter clogged
72 - transmission oil filter
73 - fast PTO
74 - battery + (key)
75 - side lights
76 - four-wheel drive
77 - Independent PTO
78 - driving beams
79 - battery charge
80 - fuel level indicator
81 - low fuel level
82 - battery + (battery)
83 - turn indicators
84 - 1st trailer turn indicator
85 - engine water temperature
86 - ground
87 - 2nd trailer turn indicator
88 - differential lock
89 - Engine RPM meter
90 - night lights
91 - electric fan in cab
92 - air conditioning anti-ice thermostat
93 - air conditioner
94 - cab ceiling light
95 - cab rotating beacon
96 - radio
97 - windscreen wiper
98 - rear window washer
99 - windscreen washer
100 - rear window wiper
101 - cab front field lights
102 - cab rear field lights
103 - lh front field light
104 - rh front field light
105 - lh rear field light
106 - rh rear field light
107 - cab version only

3.11.2 Main wiring diagram

Part 1

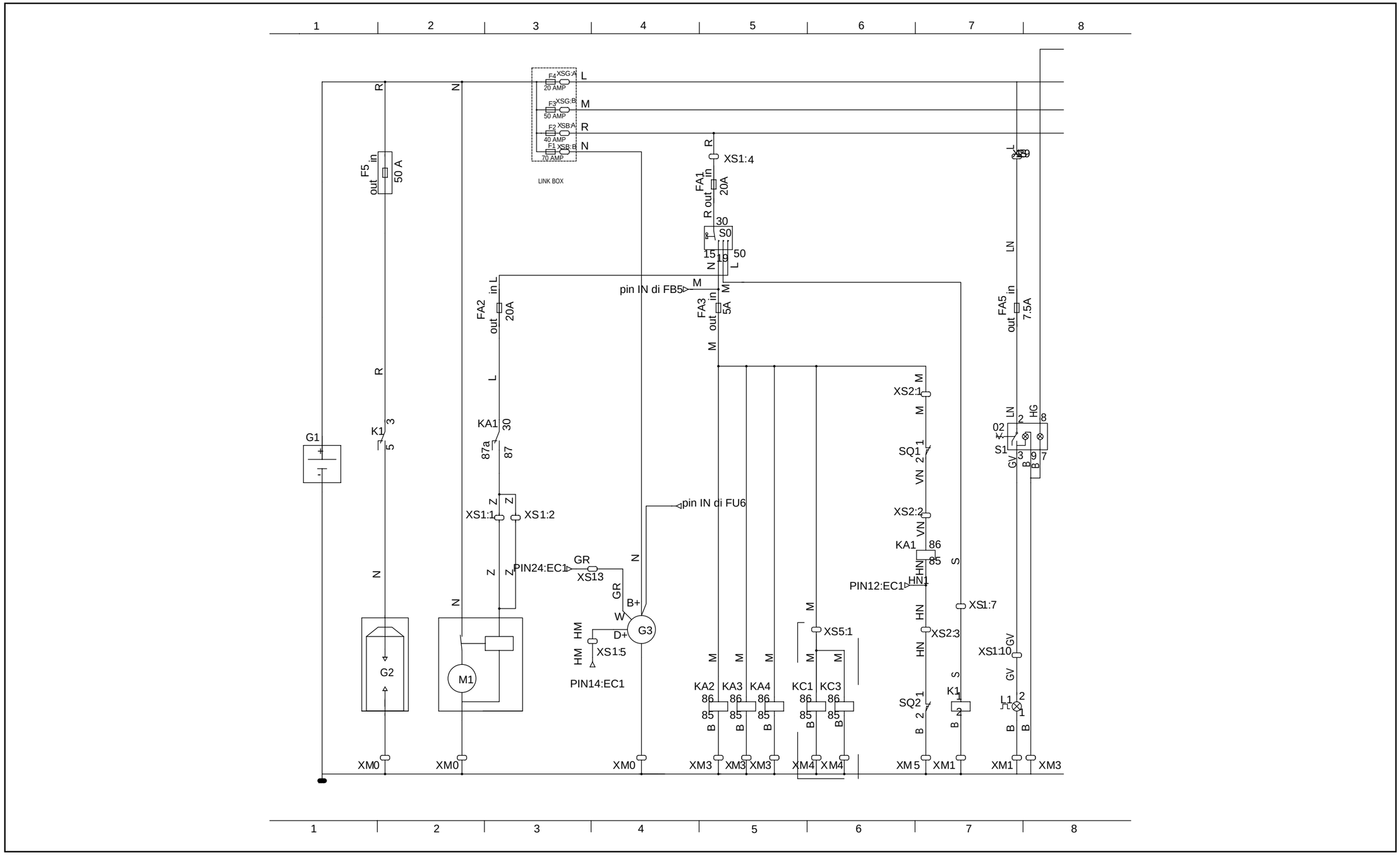


Fig. 10.889

Part 2

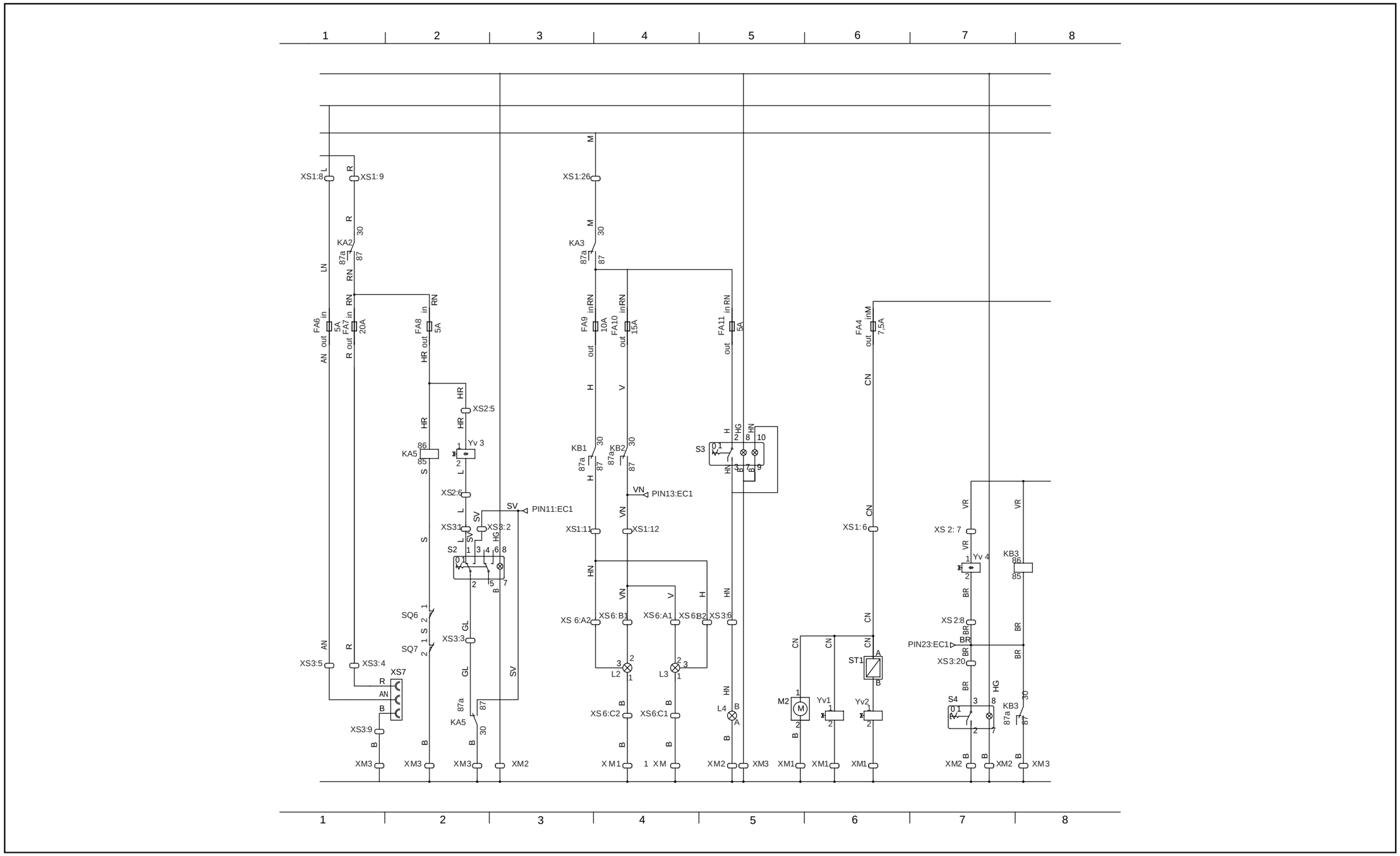


Fig. 10.890

Part 3

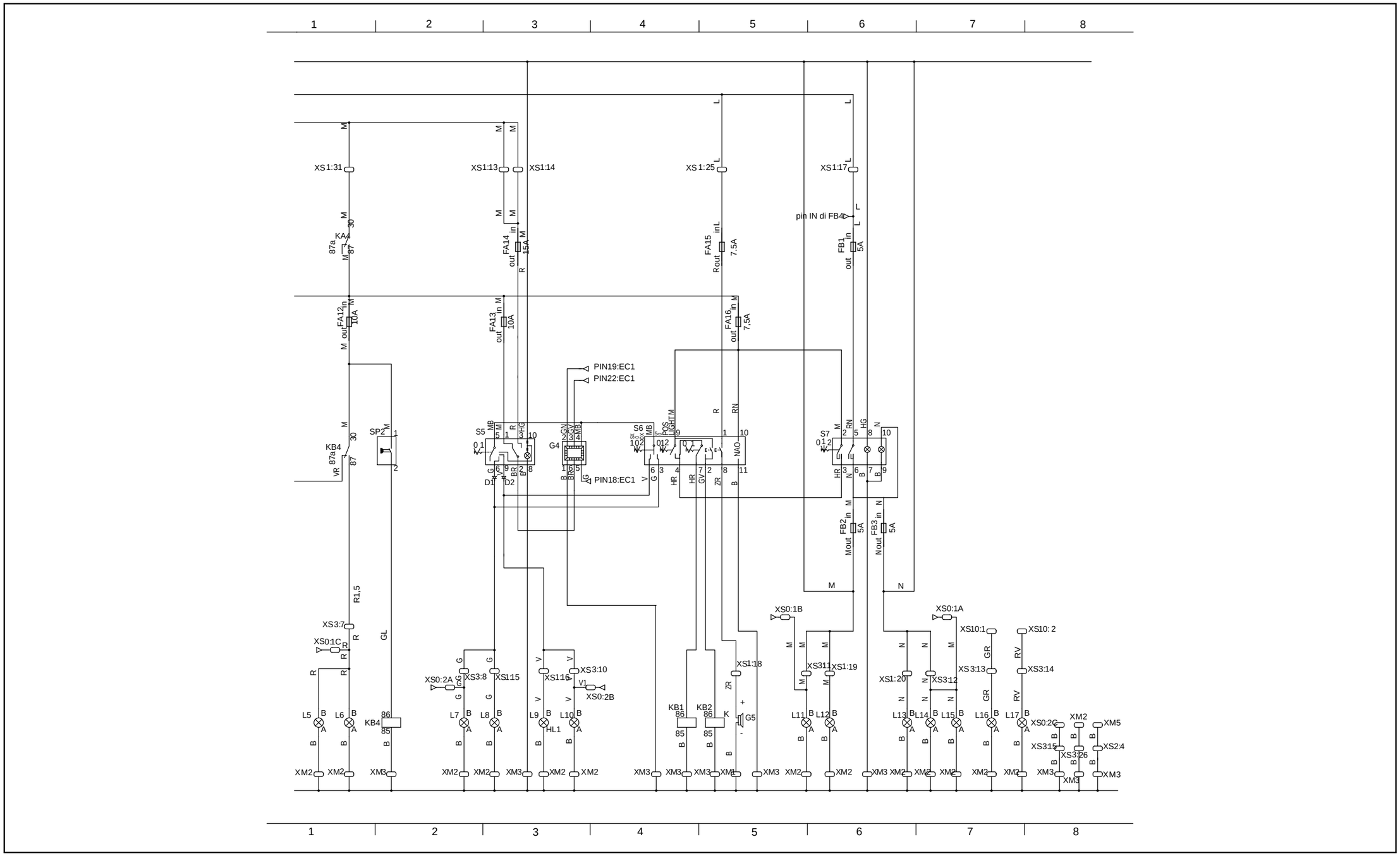


Fig. 10.891

Part 4

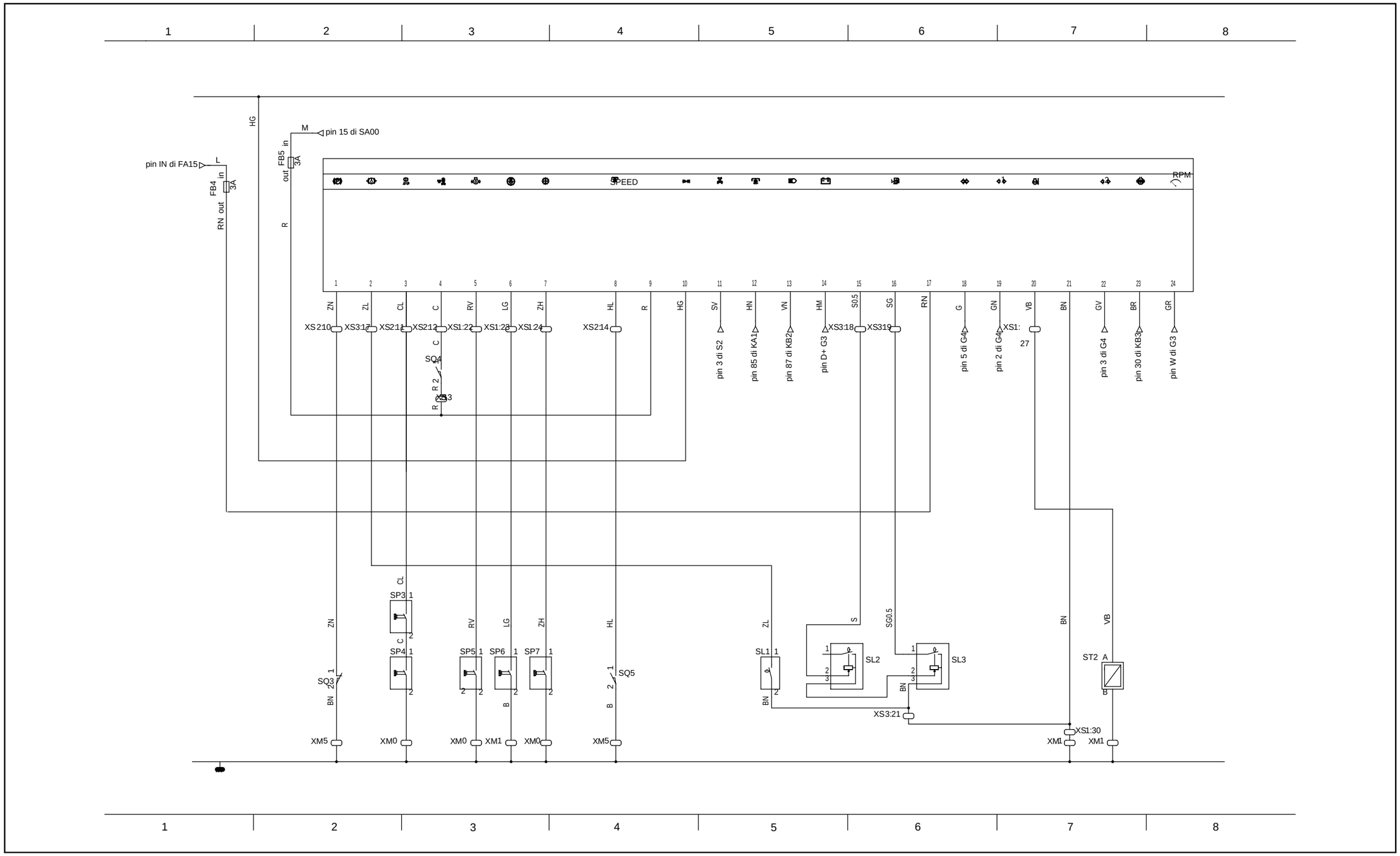


Fig. 10.892

Part 5

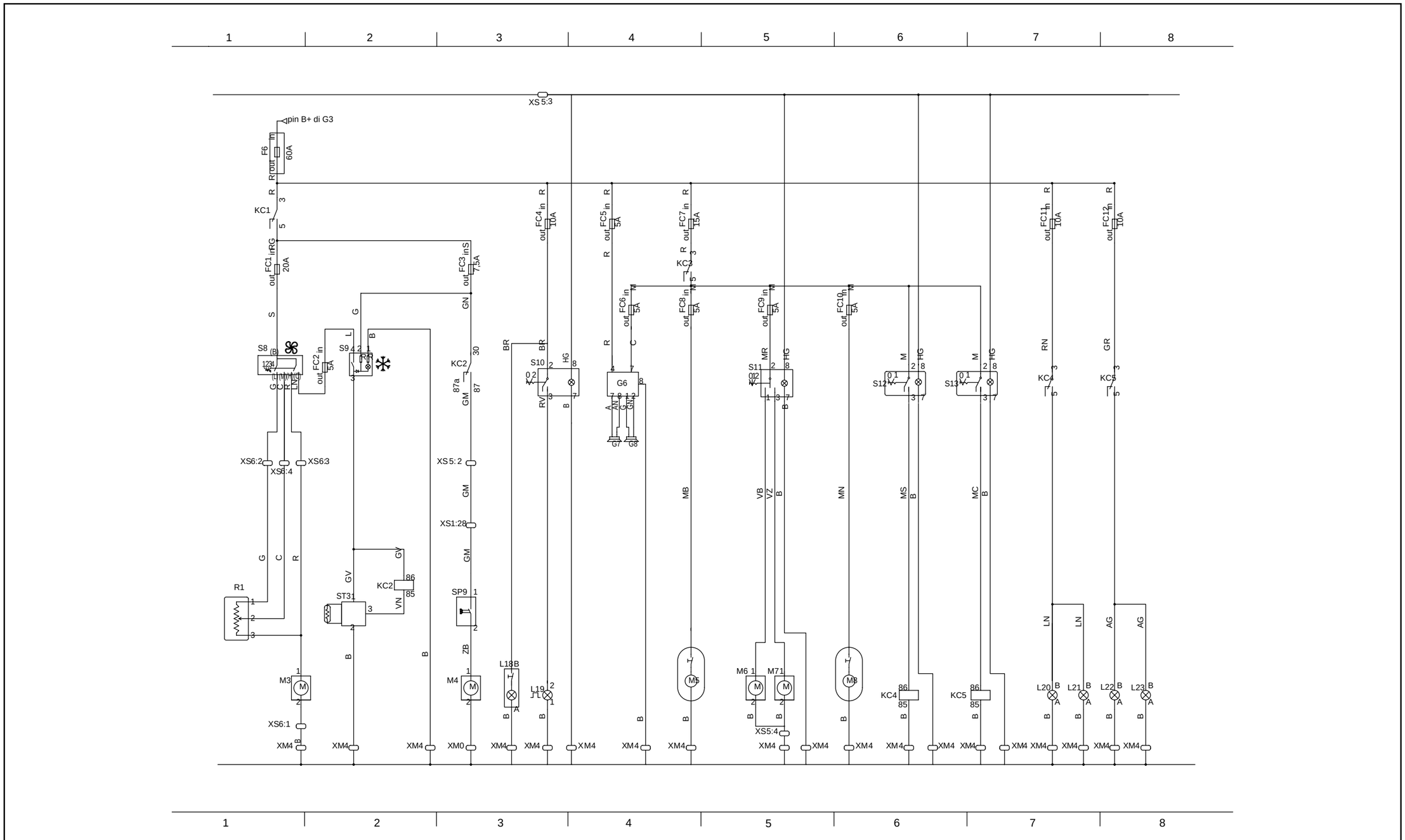


Fig. 10.893

3.11.3 Battery-starter motor line

3.11.3.1 General description

This line is very important for the functionality of the electrical system of the entire tractor. It connects the positive battery pole to the starter motor (M1 Fig.10.894), thus allowing the entire electrical system to be powered, as the ignition switch is connected to the battery.

Connection to the front fuse box is made on the positive battery terminal (Fig.10.895). These fuses protect the tractor's electrical system against short circuits and excessive power draw.

The positive battery terminal is also connected to power fuse (F5), which protects the preheater relay (K1) from short-circuits (Fig.10.896).

Battery (G1) is installed in the front, between the radiator and headlights (Fig.10.896).

⚠	**Attention:** comply with the safety instructions !

⚠	**Attention:** disconnect the ground wire (-) from the battery.

Fig. 10.894

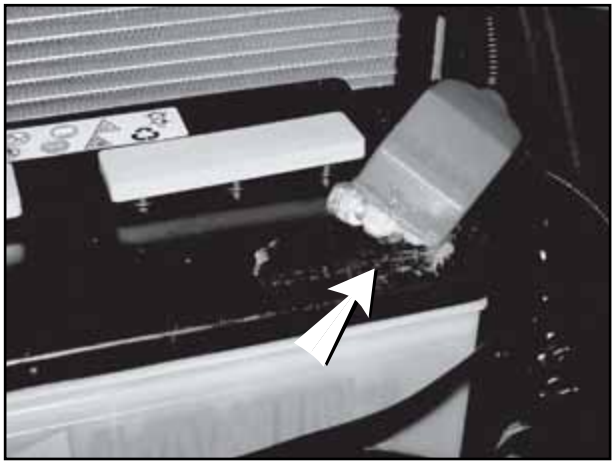


Fig. 10.895

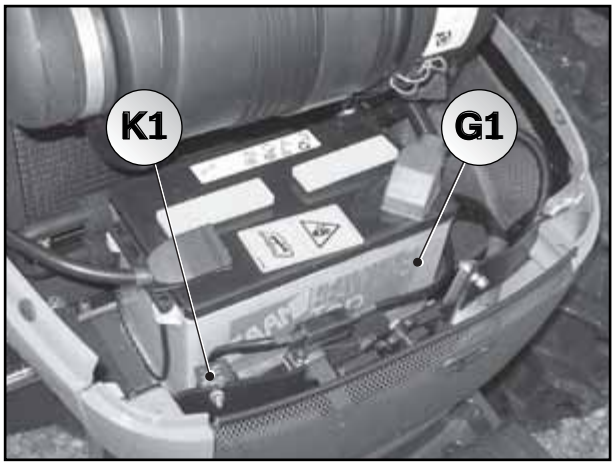


Fig. 10.896

3.11.3.2 Wiring

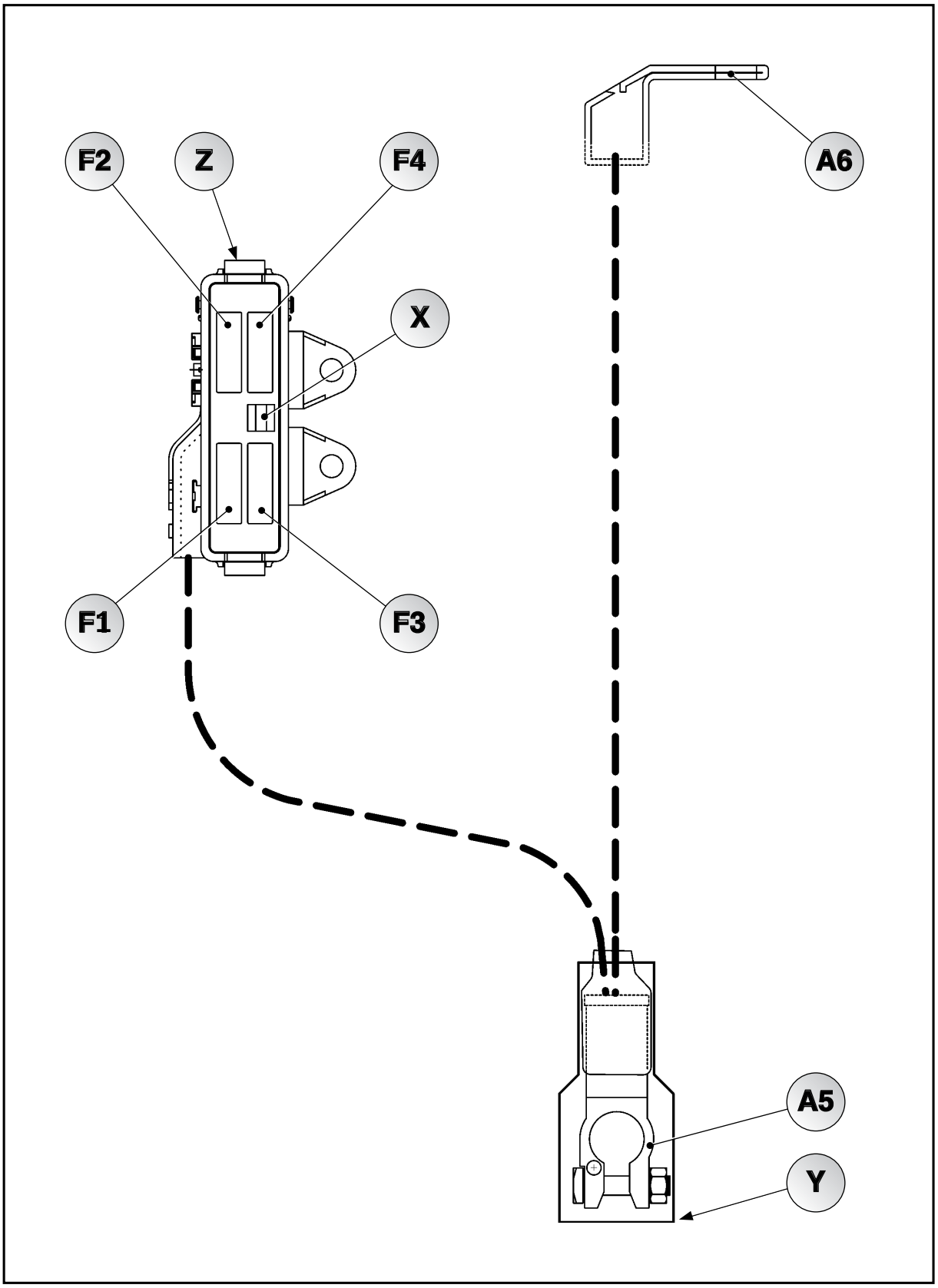


Fig. 10.897

Z - Front fuse box
Y - Insulating cap
X - Pincers for removing fuses
F1 - 70 Amp. fuse
F2 - 40 Amp. fuse
F3 - 50 Amp. fuse
F4 - 20 Amp. fuse
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal

3.11.3.3 Connector locations

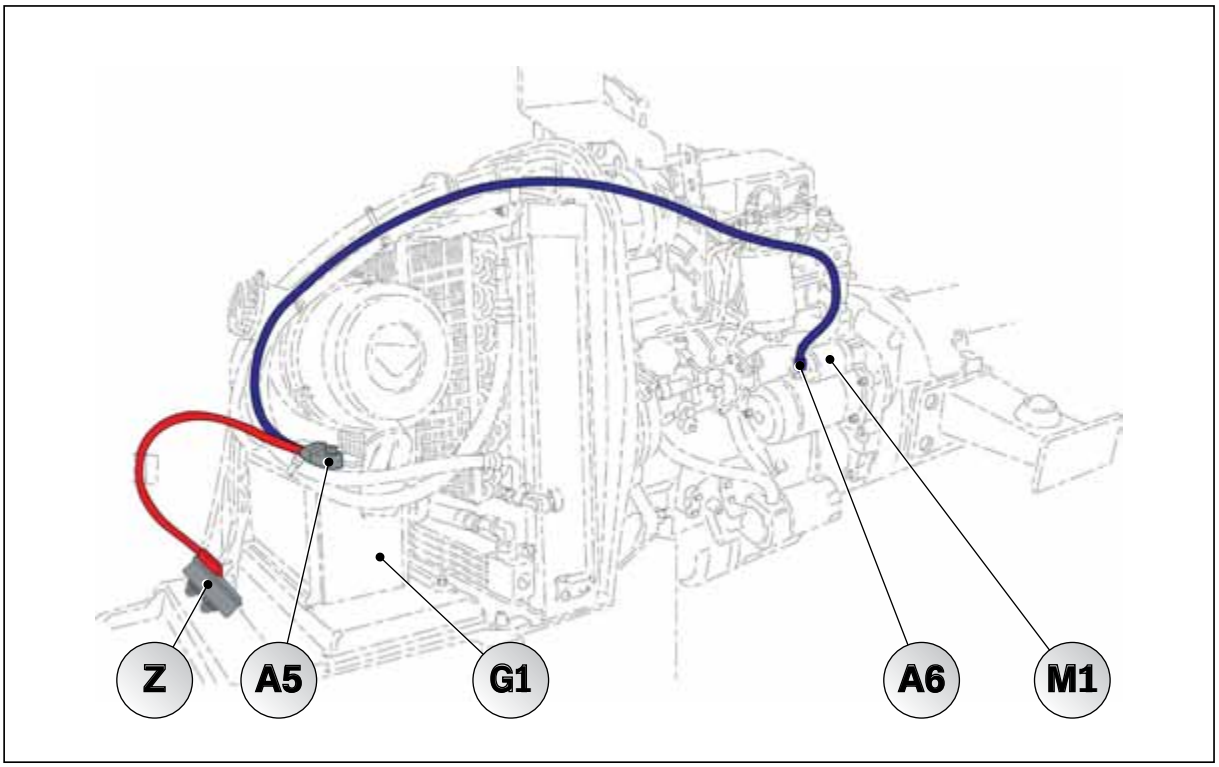


Fig. 10.898

G1 - Battery
M1 - Starter motor
A5 - Eyelet for positive battery terminal
A6 - Starter motor connecting terminal
Z - Front fuse box

The front fuse box (Z) is installed in front of the battery (G1)(Fig.10.899).

The four fuses inside are important since they protect the tractor's entire electrical system from short-circuits and excessive power draw.

Before changing a fuse with another of an equivalent type, first find out what caused the fault and repair it.

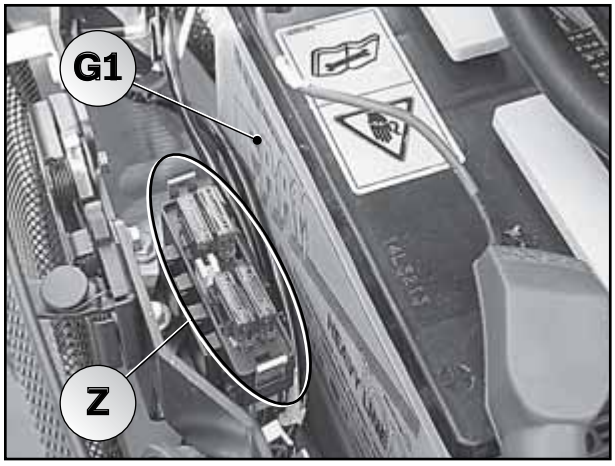


Fig. 10.899

3.11.4 Front engine line

3.11.4.1 General description

The front line installed in **F-N Series E-Line cab version** tractors powers the components in the front part of the tractor (e.g.: the horn, the starter motor), the sensors (e.g.: engine oil pressure), the alternator (Fig.10.900), etc.

The four main fuses (F1, F2, F3 and F4 Fig.10.901) connected to this line by means of the connectors (LB1 and LB2), protect the system against short-circuits and excessive power draw.

The front line is connected to the battery line via connection to the main fuse box (Link Box) and on the other side, to the dashboard line via connection to the terminal boards (XS1 Fig.10.902) installed just under the dashboard lining, between the engine and the platform front.

The front line also connects to the headlight extension line by means of the connectors (XS6 Fig.10.903) installed under the bonnet.

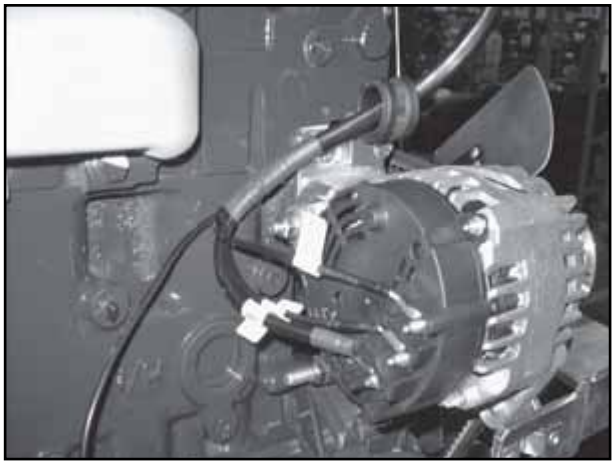


Fig. 10.900

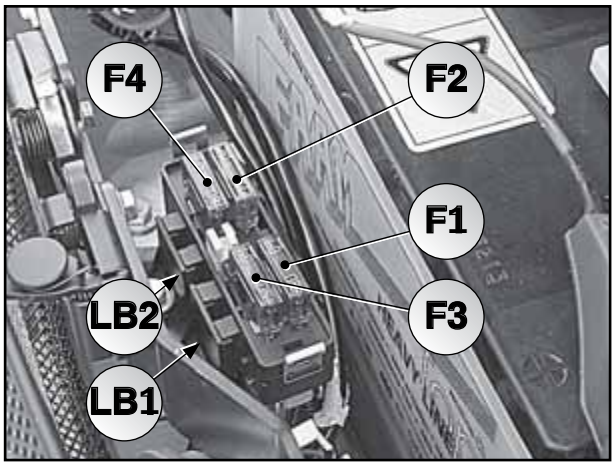


Fig. 10.901

Fig. 10.903

Fig. 10.902

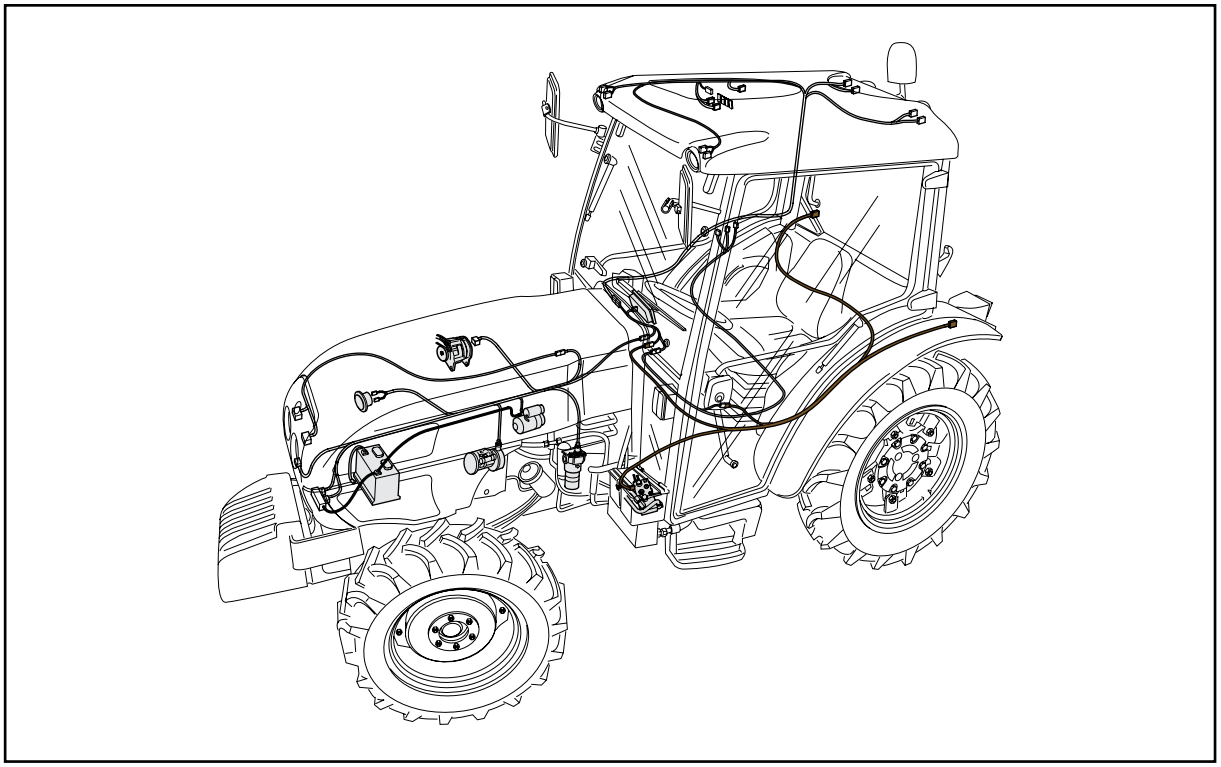


Fig. 10.904

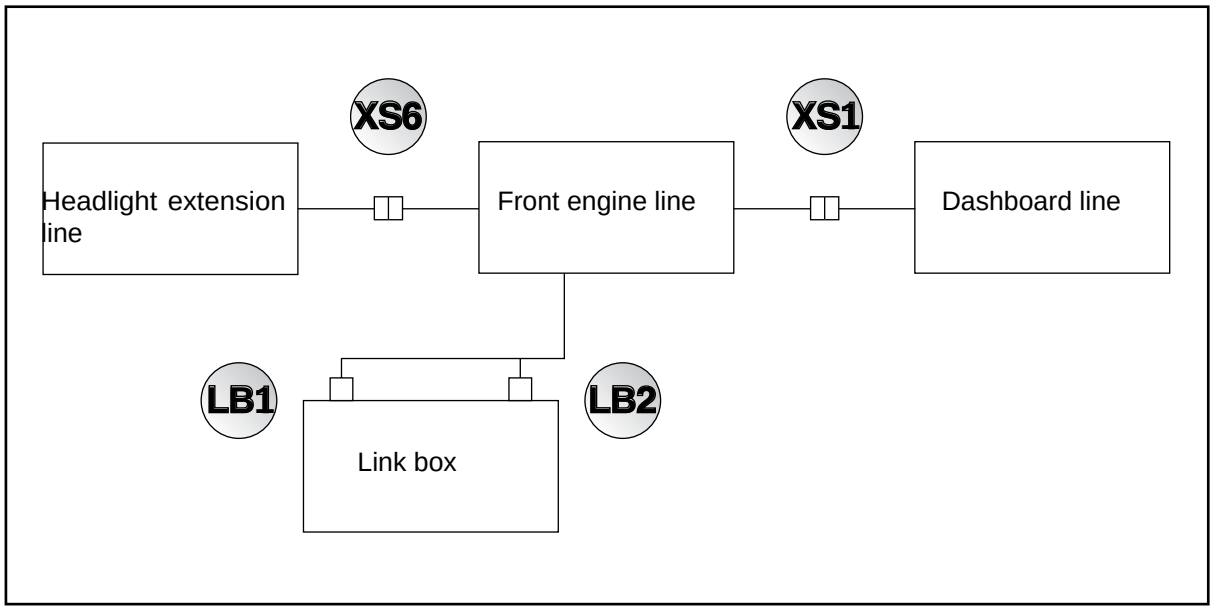


Fig. 10.905

3.11.4.2 Wiring

Wiring (version with 3-cylinder engine)

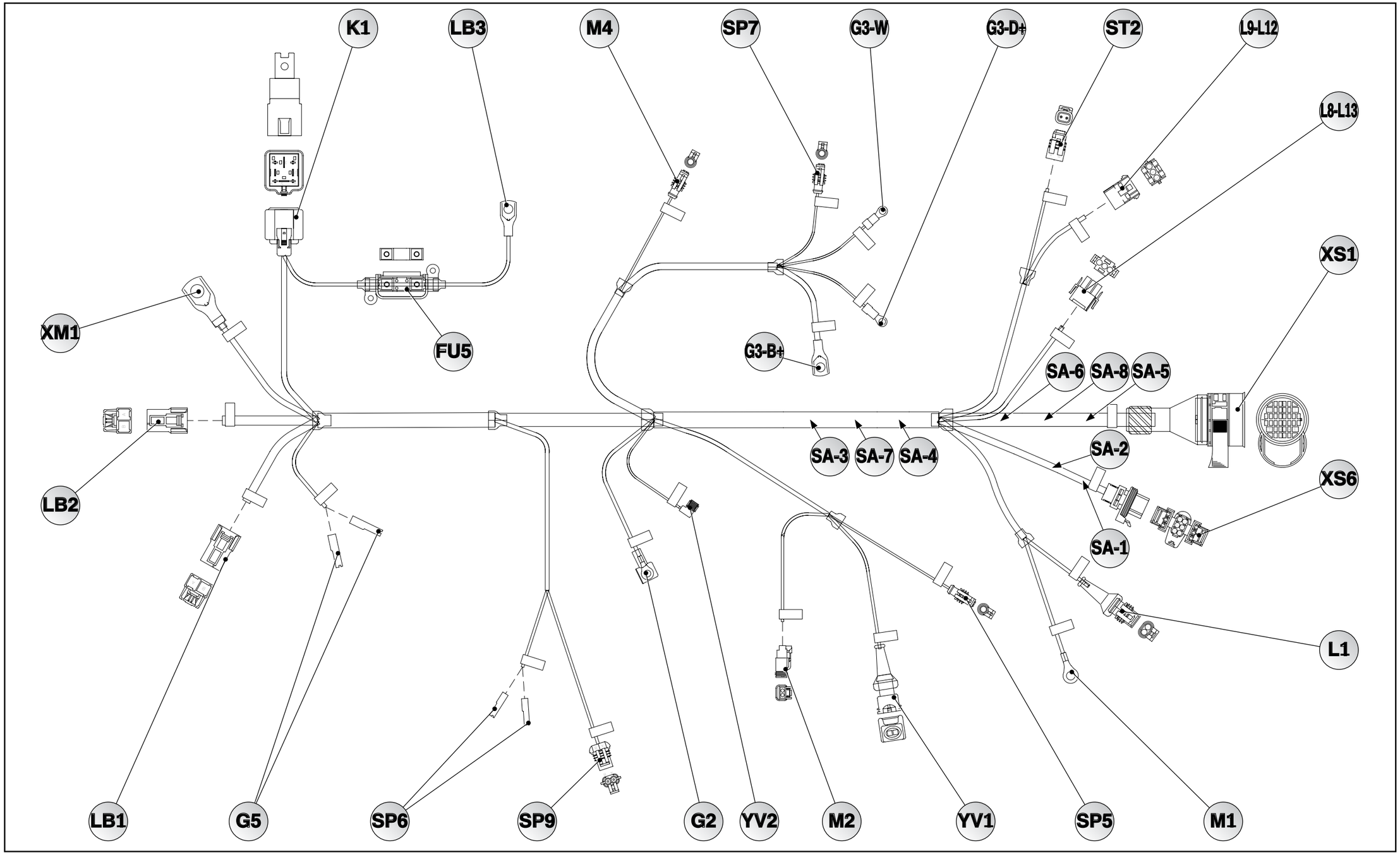


Fig. 10.906

Wiring (version with 4-cylinder engine)

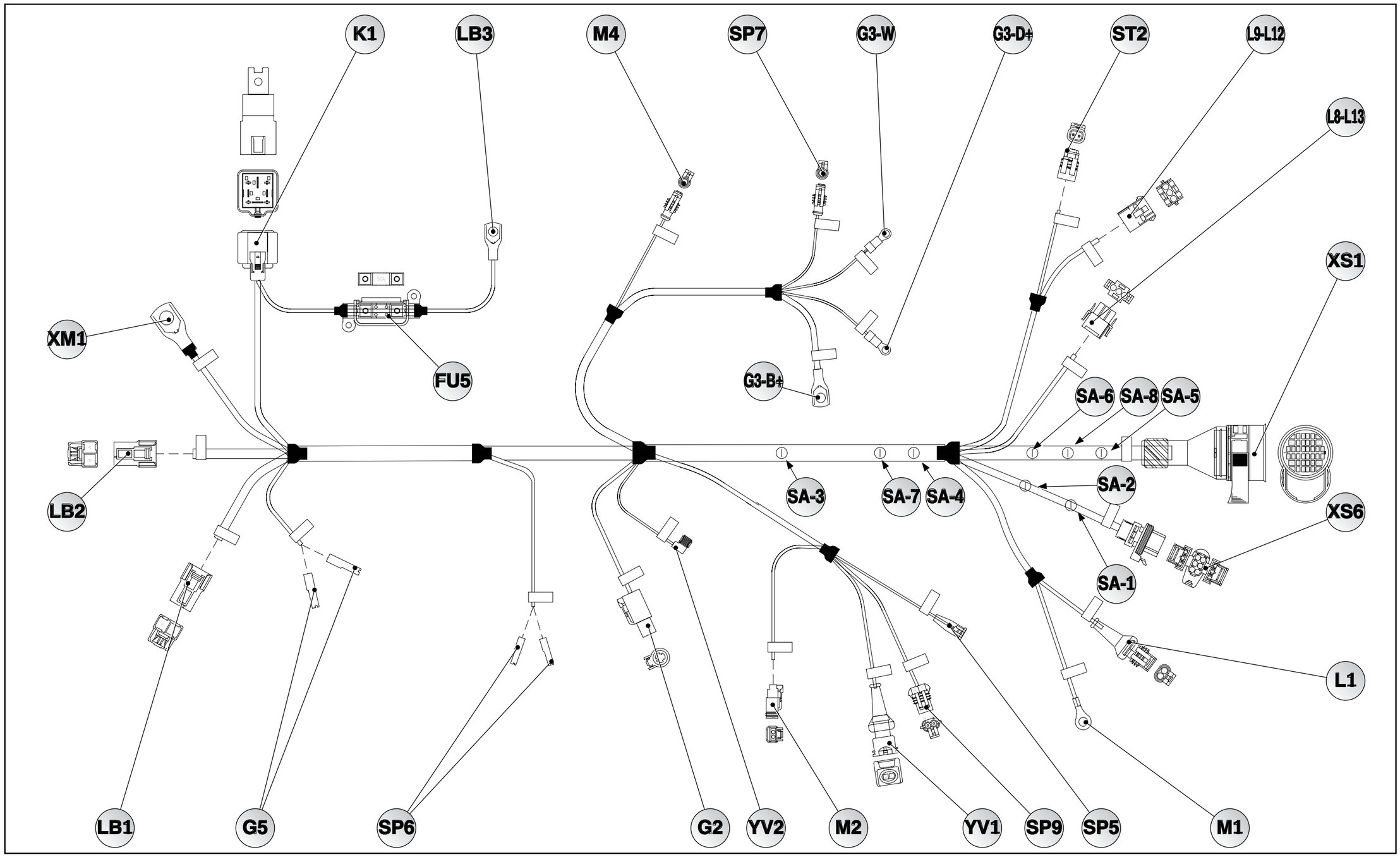


Fig. 10.907

F5 - Fuse to protect the glow plug relay
G2 - Glow plug terminal
G3_B+ - Alternator terminal
G3_D+ - Alternator terminal
G3_W - Alternator terminal
G5 - Faston terminals for horn
K1 - Glow plug relay connector
L1 - Connector for revolving beacon brace
L8_L13 - Connector for lh sidelights and turn indicators
L9_L12 - Connector for sidelights and turn indicators
LB1 - Connector (grey) for front fuses (link box)
LB2 - Connector (blue) for front fuses (link box)
LB3 - Circular terminal for positive battery terminal
M1 - Starter motor terminal
M2 - Connector for fuel pump
M4 - Connector for A/C compressor
SA-1_SA-8 - Junction
SP5 - Connector for engine oil pressure switch
SP6 - Faston terminals for air filter sensor
SP7 - Connector for gearbox oil vacuum switch
SP9 - Connector for A/C filter pressure switch
ST2 - Connector for engine coolant temperature sensor
XM1 - Ground eyelet (direct battery)
XS1 - Terminal board for front line/dashboard connection
XS6 - Connector for bonnet headlight line
YV1 - Terminal for fuel injection pump solenoid valve
YV2 - Terminal for fuel enrichment jet temperature sensor

3.11.4.3 Connector locations

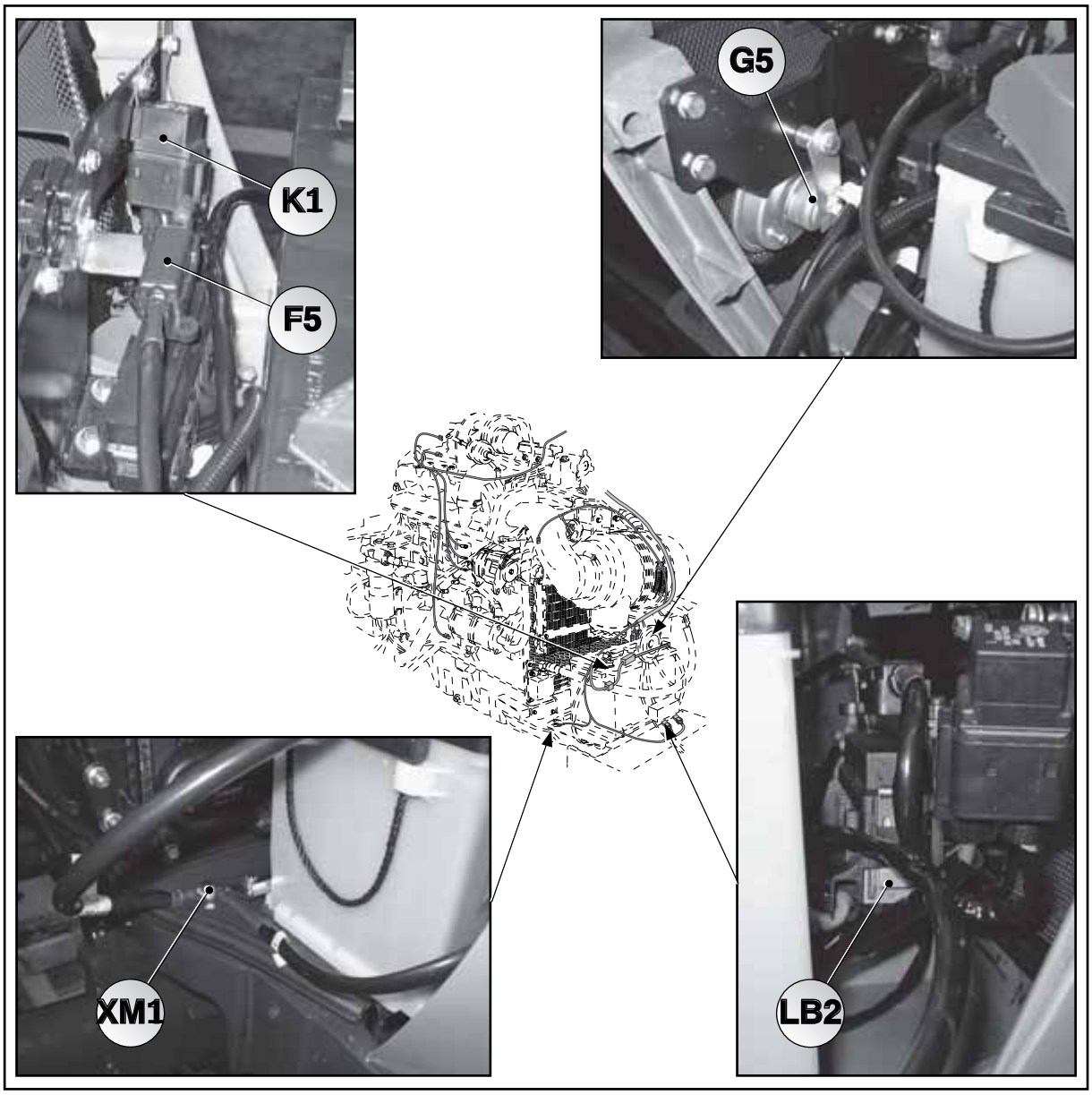


Fig. 10.908

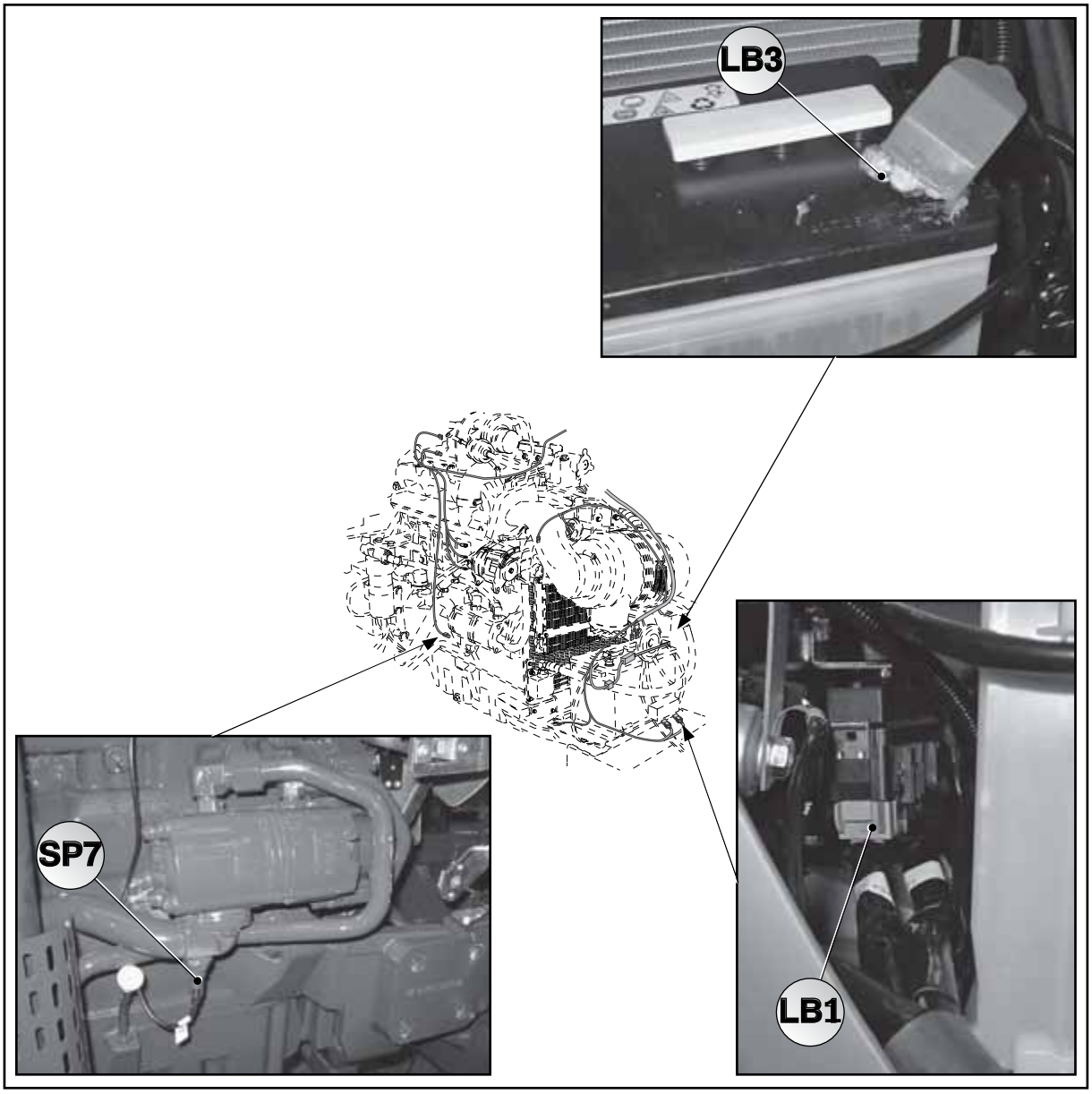


Fig. 10.909

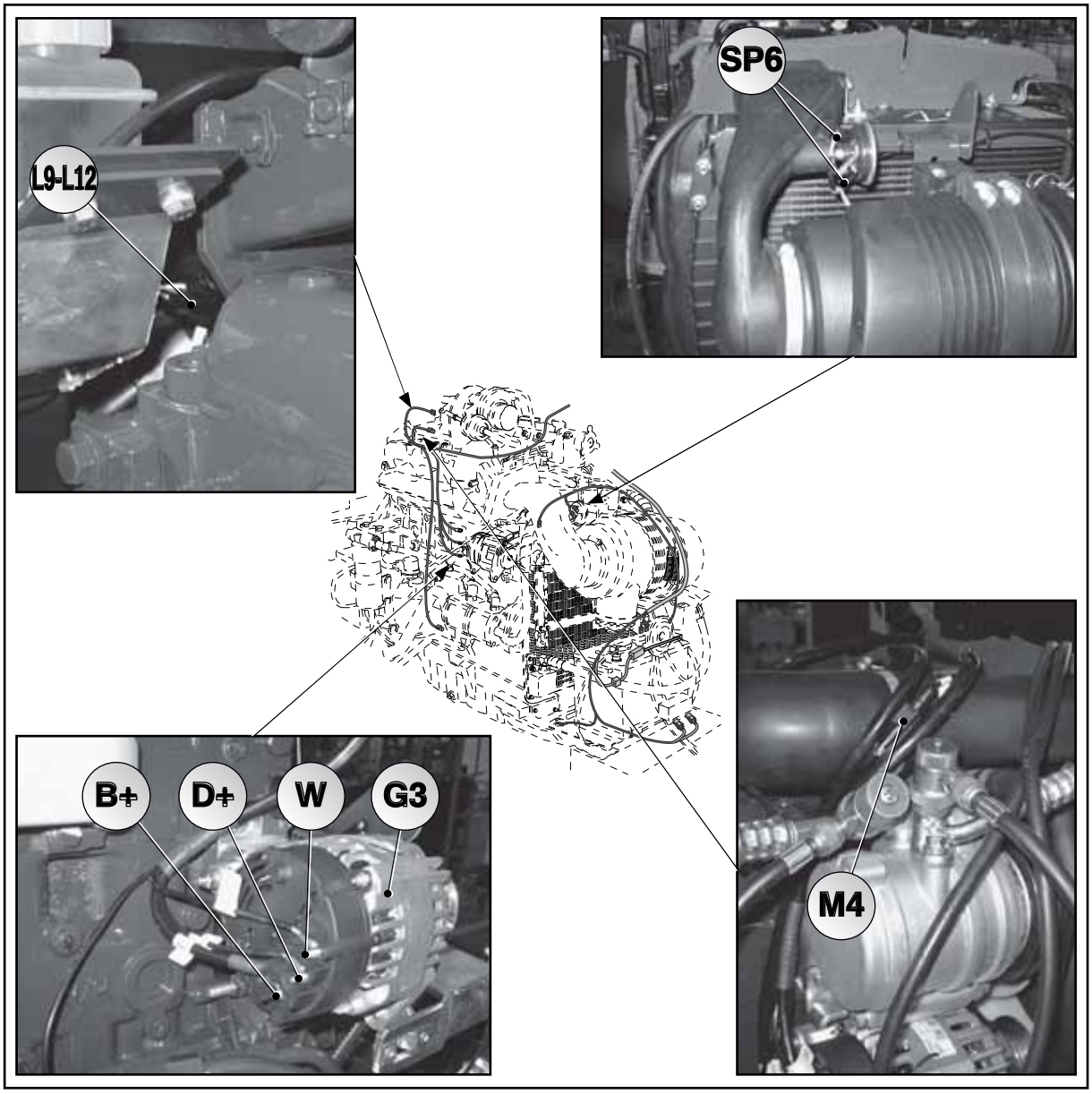


Fig. 10.910

G3_B+ - Alternator terminal
G3_D+ - Alternator terminal
G3_W - Alternator terminal
L9_L12 -Connector for sidelights and turn indicators
M4 - Connector for A/C compressor
SP6 - Faston terminals for air filter sensor

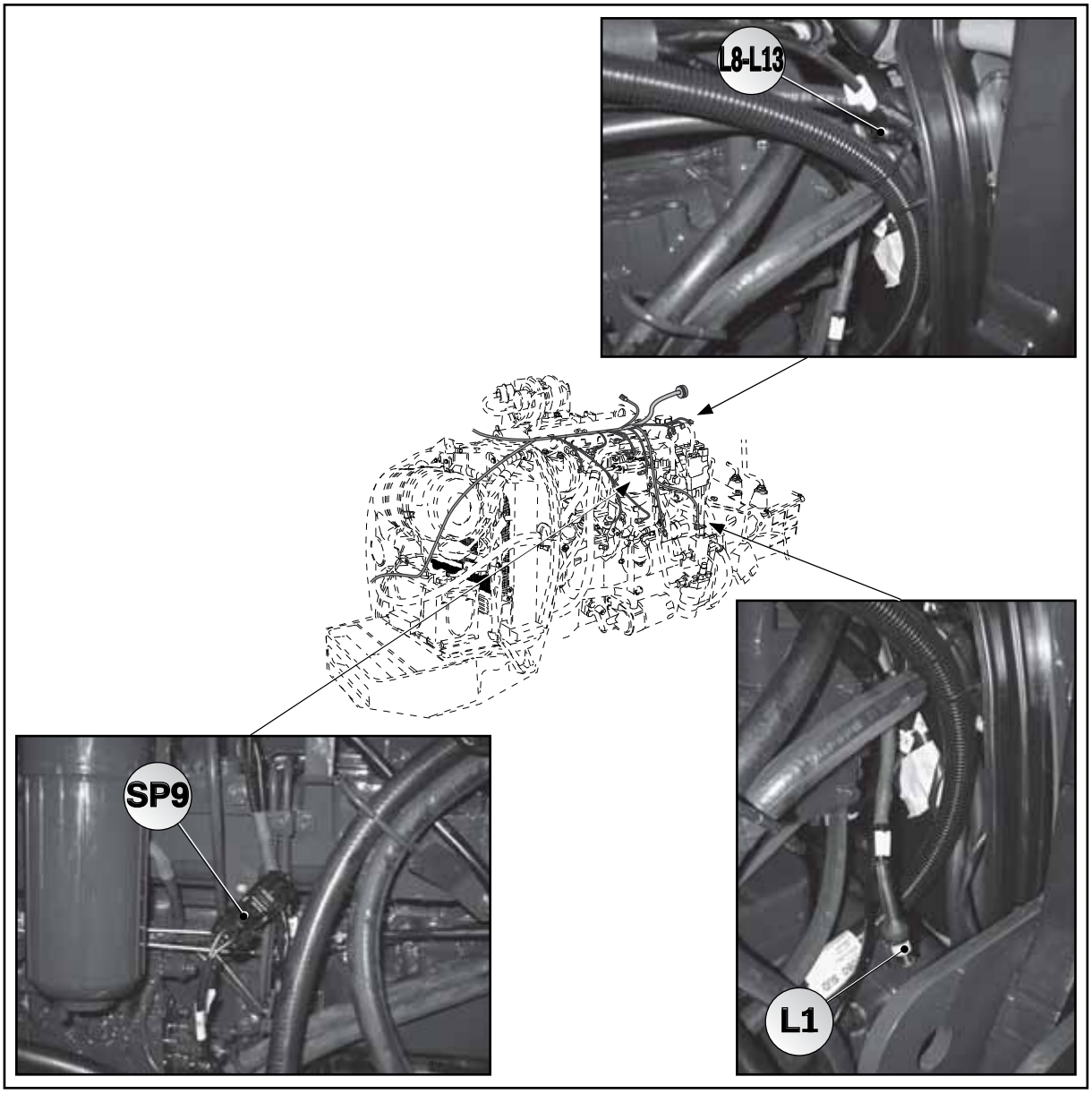


Fig. 10.911

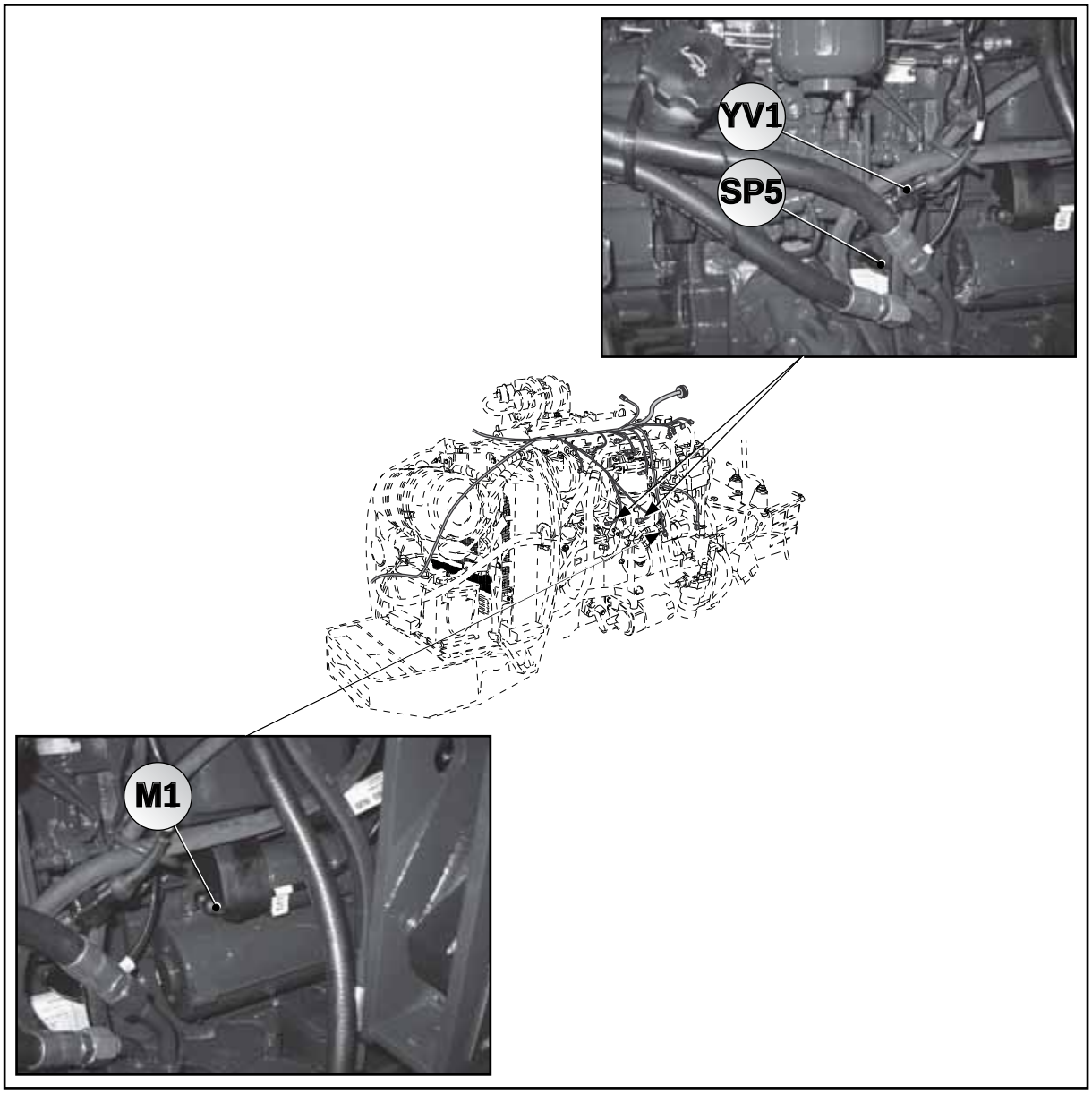


Fig. 10.912

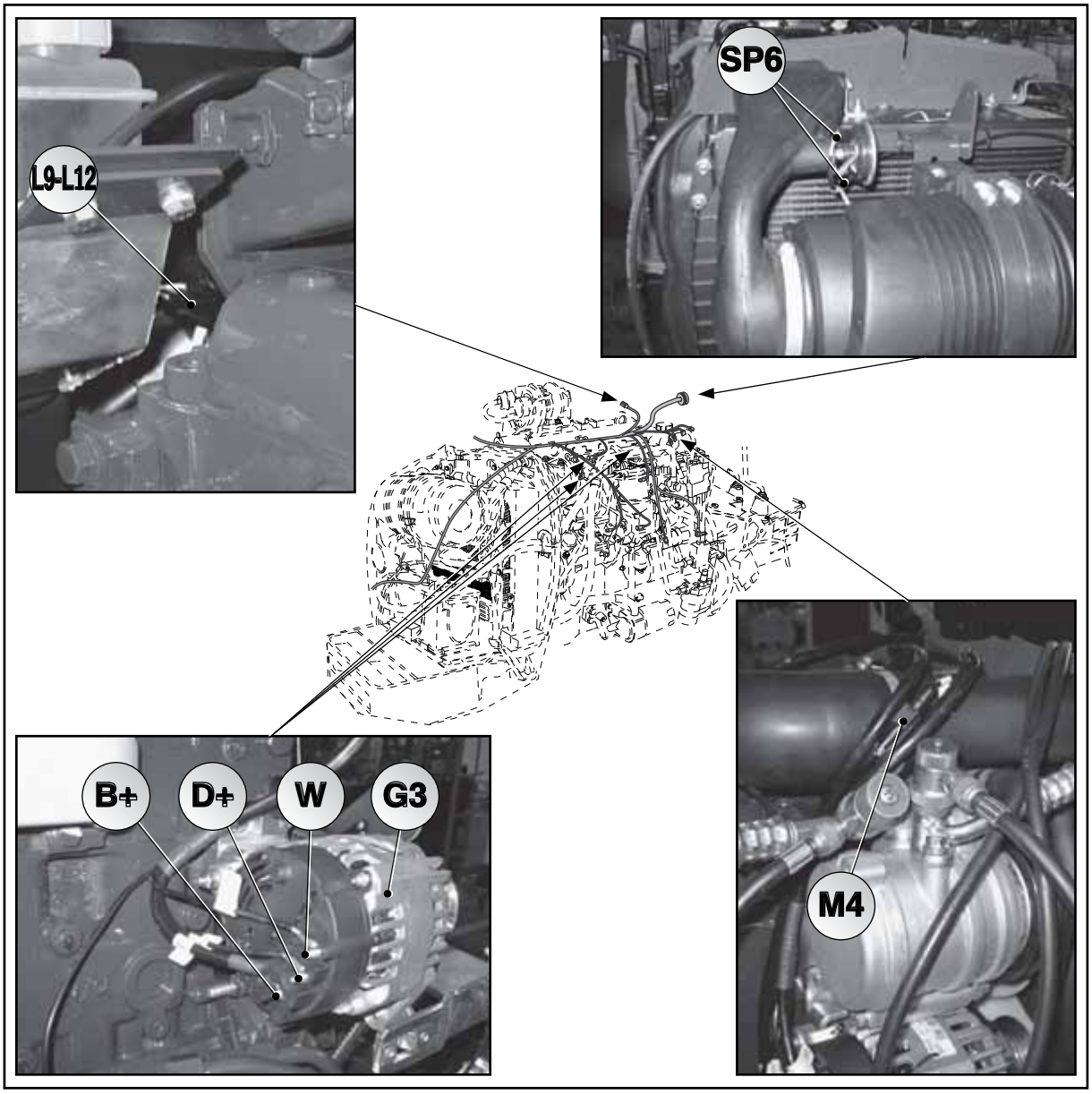


Fig. 10.913

G2 - Glow plug terminal
M2 - Connector for fuel pump
ST2 - Connector for engine coolant temperature sensor
XS1 - Terminal board for front line/dashboard connection
XS6 - Connector for bonnet headlight line
YV2 - Terminal for fuel enrichment jet temperature sensor

3.11.4.4 Connector identification

Terminal (G2) for glow plugs

pin	colour	to con. or comp.	pin	wire function
1	M	K1	5	glow plugs

Fig. 10.914

Alternator terminal (G3_B+)

pin	colour	to con. or comp.	pin	wire function
1	N	LB2	B	

Fig. 10.915

Alternator terminal (G3_D+)

pin	colour	to con. or comp.	pin	wire function
1	HM	XS1	5	

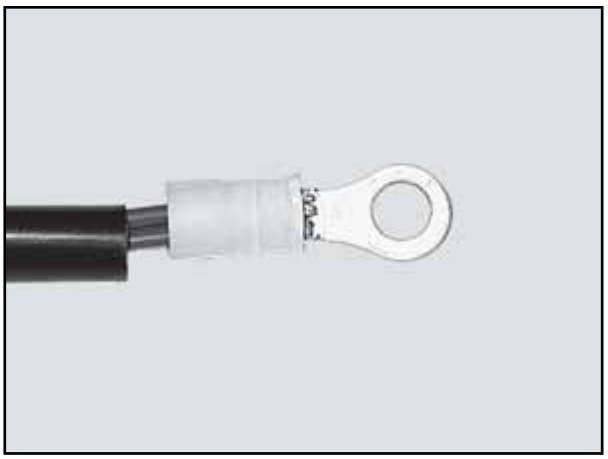


Fig. 10.916

Alternator terminal (G3_W)

pin	colour	to con. or comp.	pin	wire function
1	GR	XS1	3	alternator W

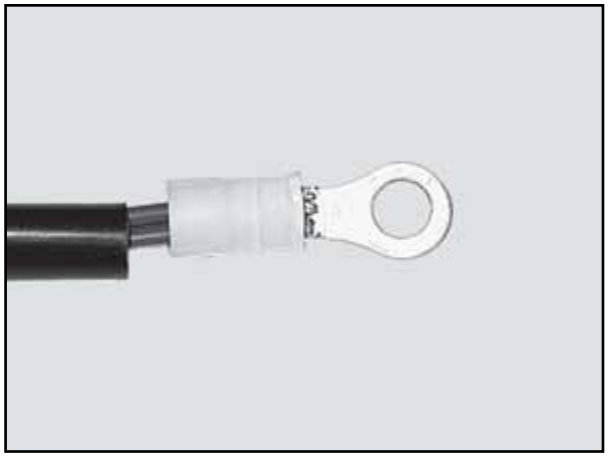


Fig. 10.917

Faston terminals (G5) for horn

pin	colour	to con. or comp.	pin	wire function
1	ZR	XS1	18	horn
2	B	XM1		ground

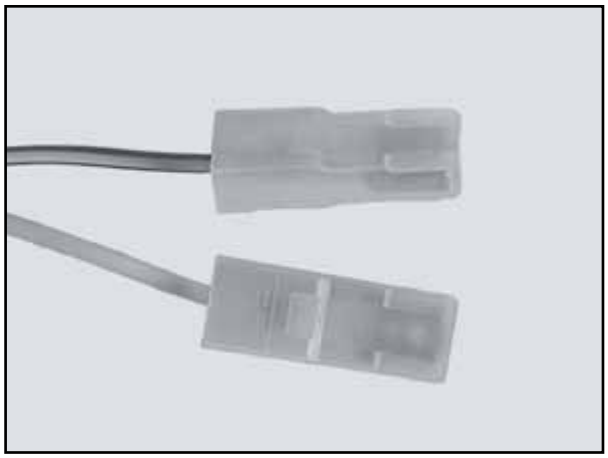


Fig. 10.918

Connector (K1) for glow plug relay

pin	colour	to con. or comp.	pin	wire function
1	B	XM1		ground
2	N	XS1	7	
3	R	F5	1	
4	M	G2	1	glow plugs
5				not used
6				not used
7				not used
8				not used

Fig. 10.919

Connector (L1) for revolving beacon brace

pin	colour	to con. or comp.	pin	wire function
1	GV	XS1	10	revolving beacon
2	B	L9_L12	3	ground

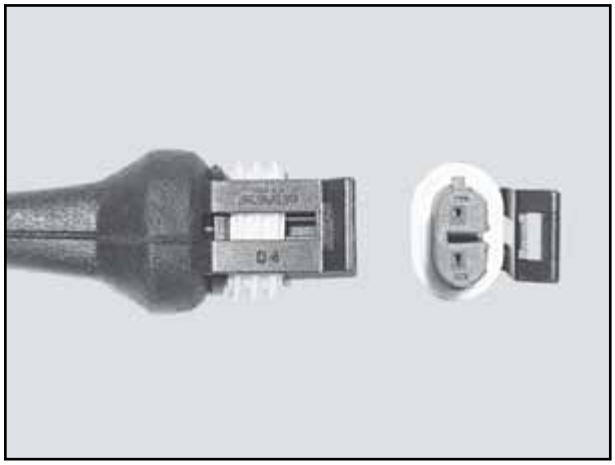


Fig. 10.920

Connector (L8-L123) for lh sidelights and turn indicators

pin	colour	to con. or comp.	pin	wire function
1	N	XS1	20	
2	G	XS1	15	
3	B-B	L9_L13-SA-5	3	junction-ground

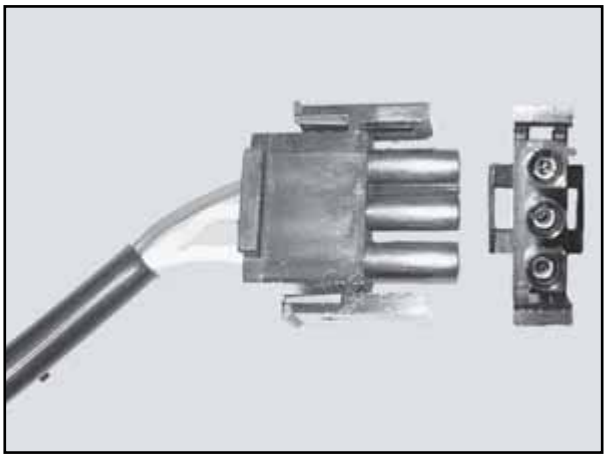


Fig. 10.921

Connector (L9-L12) for rh sidelights and turn indicators

pin	colour	to con. or comp.	pin	wire function
1	M	XS1	19	lh front side light
2	V	XS1	16	rh front turn ind.
3	B-B	L1-L8_L13	2-3	ground

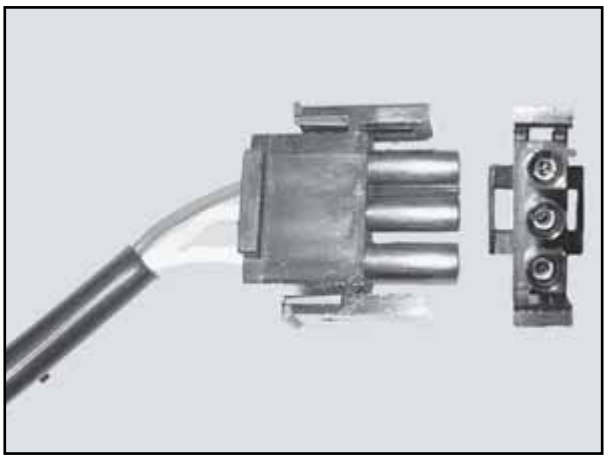


Fig. 10.922

Connector (LB1) (grey) for front fuses (link box)

pin	colour	to con. or comp.	pin	wire function
1	L	SA-7		junction
2	M	SA-6		junction

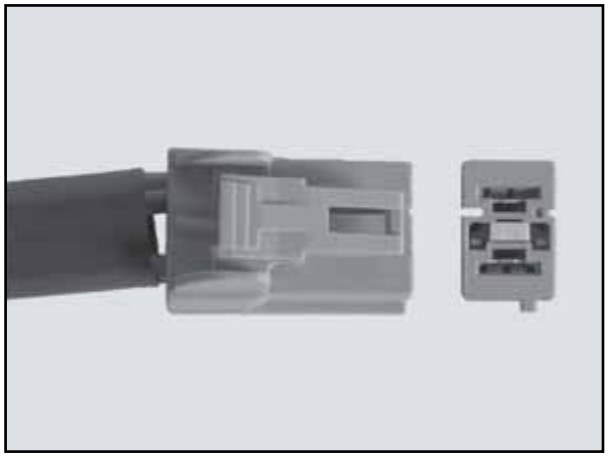


Fig. 10.923

Connector (blue) (LB2) for front fuses (link box)

pin	colour	to con. or comp.	pin	wire function
1	R	SA-4		junction
2	N	G3	1	

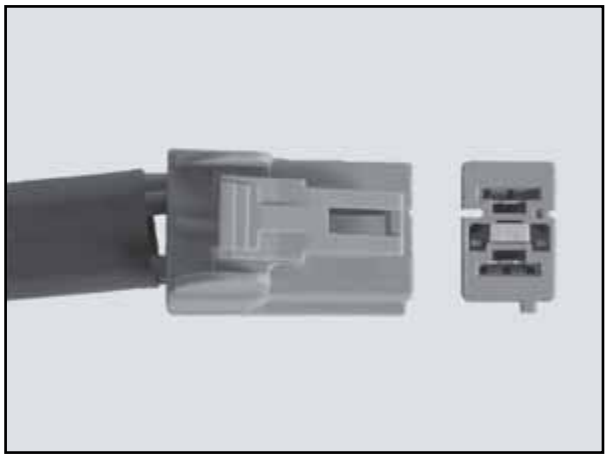


Fig. 10.924

Circular terminal (LB3) for positive battery terminal

pin	colour	to con. or comp.	pin	wire function
1	R	F5	2	glow plug power

Fig. 10.925

Starter motor terminal (M1)

pin	colour	to con. or comp.	pin	wire function
1	Z	SA-8		junction

Fig. 10.926

Connector (M2) for fuel pump connection

pin	colour	to con. or comp.	pin	wire function
1	CN	SA-3		fuel pump junction
2	B	XM1		ground

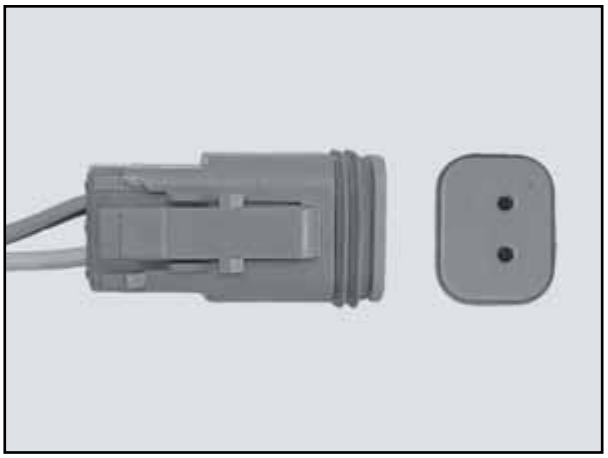


Fig. 10.927

Connector (M4) for A/C compressor

pin	colour	to con. or comp.	pin	wire function
1	ZB	SP9	A	A/C compressor

Fig. 10.928

Connector (SP5) for engine oil pressure switch

pin	colour	to con. or comp.	pin	wire function
1	RV	XS1	22	engine oil pressure

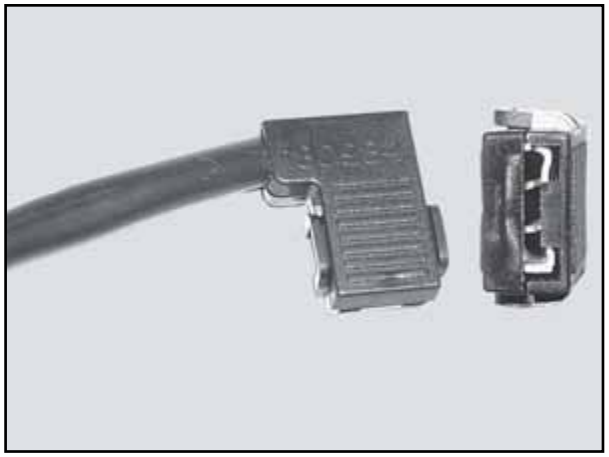


Fig. 10.929

Faston terminals (SP6) for air filter sensor

pin	colour	to con. or comp.	pin	wire function
1	LG	XS1	23	air filter
2	B	XM1		ground

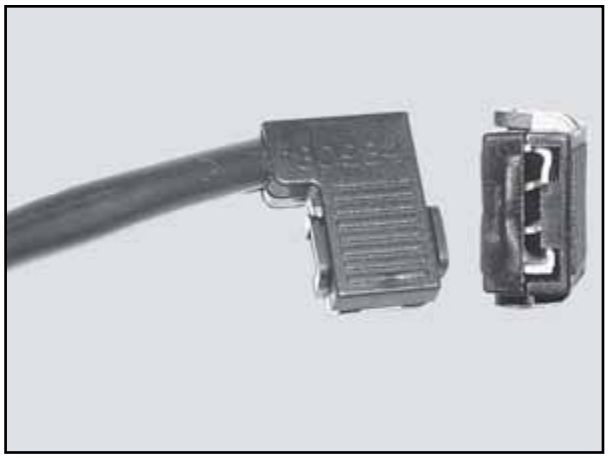


Fig. 10.930

Connector (SP7) for gearbox oil vacuum switch

pin	colour	to con. or comp.	pin	wire function
1	ZH	XS1	24	gearbox oil vacuum switch

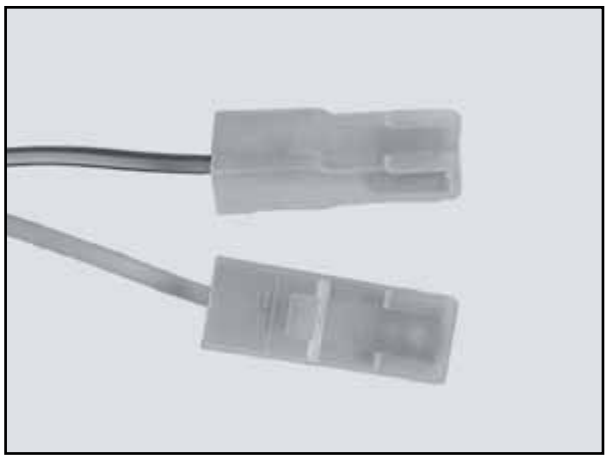


Fig. 10.931

Connector (SP9) for A/C filter pressure switch

pin	colour	to con. or comp.	pin	wire function
1	ZB	M4	1	A/C compressor
2	GM	XS1	28	

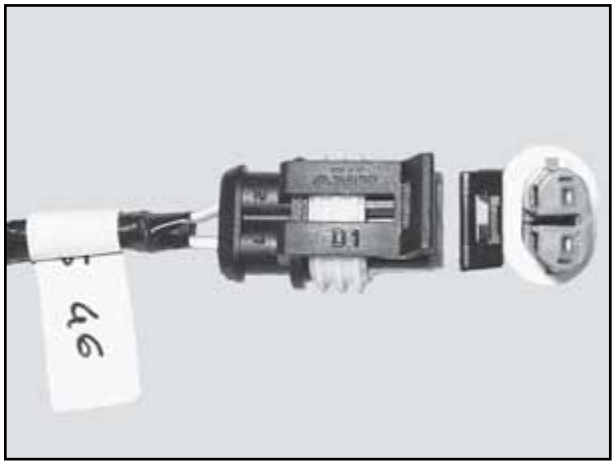


Fig. 10.932

Connector (ST2) for engine coolant temperature sensor

pin	colour	to con. or comp.	pin	wire function
1	BN	SA-5		junction
2	VB	XS1	27	water temperature

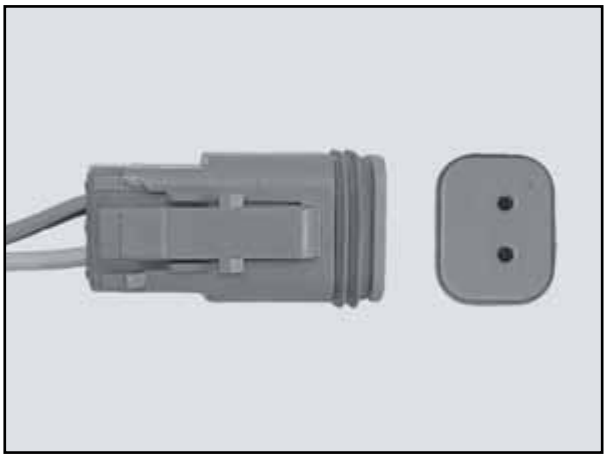


Fig. 10.933

Terminal board (XS1) for front line/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	Z	SA-8		starter motor junction
2	Z	SA-8		starter motor junction
3	GR	G3_W	1	alternator W
4	R	SA-4		junction
5	HM	D3_D+	1	
6	CN	SA-3		junction
7	N	K1	2	
8	L	SA-7		junction
9	R	SA-4		junction
10	GV	L1	1	revolving beacon
11	H	SA-2		junction
12	V	SA-1		junction
13	M	SA-6		junction
14	M	SA-6		junction
15	G	L8_L13	2	lh front turn indicator
16	V	L9_L12	2	rh front turn indicator
17	L	SA-7		junction
18	ZR	G5	1	horn
19	M	L9_L12	1	lh front side light
20	N	L8_L13	1	rh front side light
21				not used
22	RV	SP5	1	engine oil pressure
23	LG	SP6	1	air filter
24	ZH	SP7	1	gearbox oil vacuum switch
25	L	SA-7		junction
26	M	SA-6		junction
27	VB	ST2	A	water temperature
28	GM	SP9	B	A/C filter
29	L	SA-7		junction
30	BN	SA-5		junction
31	M	SA-6		junction
32				not used
33				not used
34				not used

Fig. 10.934

Connector (XS6) for bonnet headlight line connector

pin	colour	to con. or comp.	pin	wire function
A2	V	SA-1		junction
B1	VN	SA-1		junction
C1	B	SA-5		junction
A2	HN	SA-2		junction
B2	H	SA-2		junction
C2	B	SA-5		junction

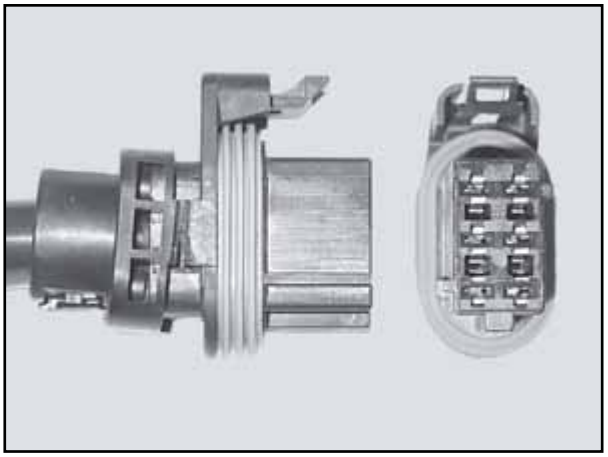


Fig. 10.935

Terminal (YV1) for fuel injection pump solenoid

pin	colour	to con. or comp.	pin	wire function
1	CN	SA-3		fuel pump sol. v.junction
2	B	SA-5		ground junction

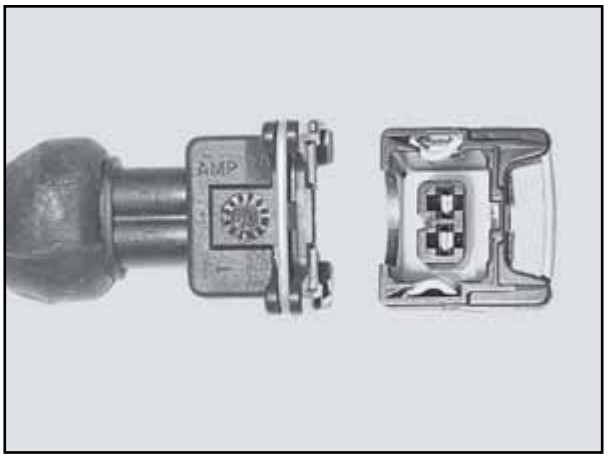


Fig. 10.936

Terminal (YV2) for fuel enrichment jet temperature sensor

pin	colour	to con. or comp.	pin	wire function
1	CN	SA-3		enrichment jet junction

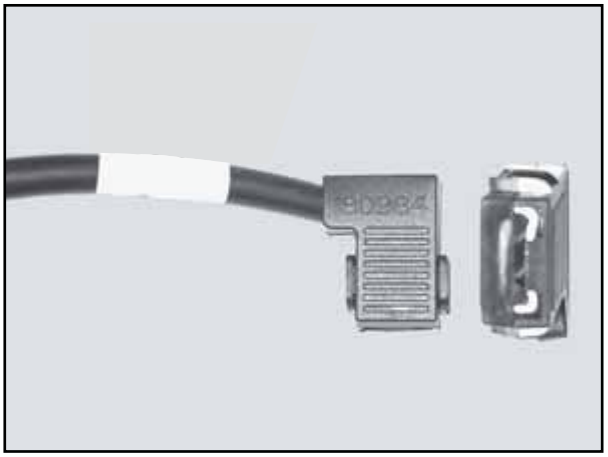


Fig. 10.937

The ground connection is made by means of the eyelet (XM1) fixed to the radiator core, in the front on the rh side, near the battery (G1).

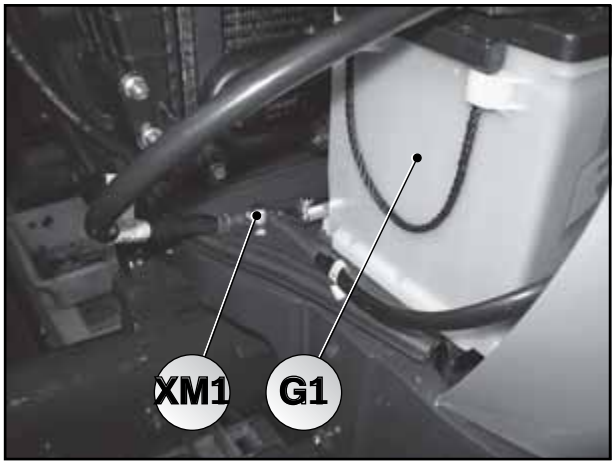


Fig. 10.938

3.11.4.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

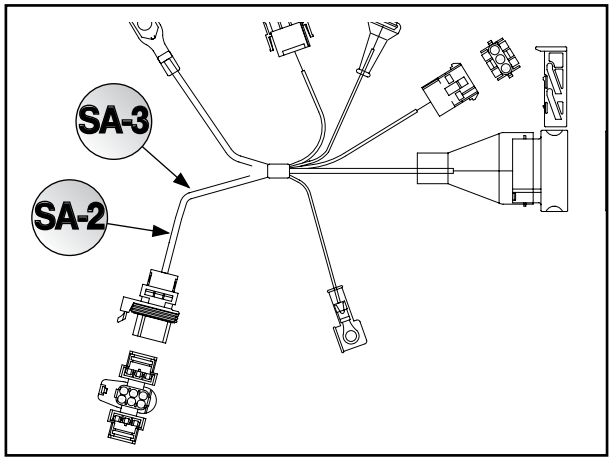


Fig. 10.939

Front engine line solder point tables

SA-1

Colour	Wire function
VN	
V	
V	

SA-2

Colour	Wire function
H	
HN	
H	

SA-3

Colour	Wire function
CN	Fuel pump sol.v.
CN	Rich mixture control
CN	Fuel pump
CN	

SA-4

Colour	Wire function
R	
R	
R	

SA-5

Colour	Wire function
B	
B	
B	
B	
B	
BN	
BN	

SA-6

Colour	Wire function
M	
M	
M	
M	
M	

SA-7

Colour	Wire function
L	
L	
L	
L	
L	

SA-8

Colour	Wire function
Z	Starter motor
Z	Starter motor
Z	

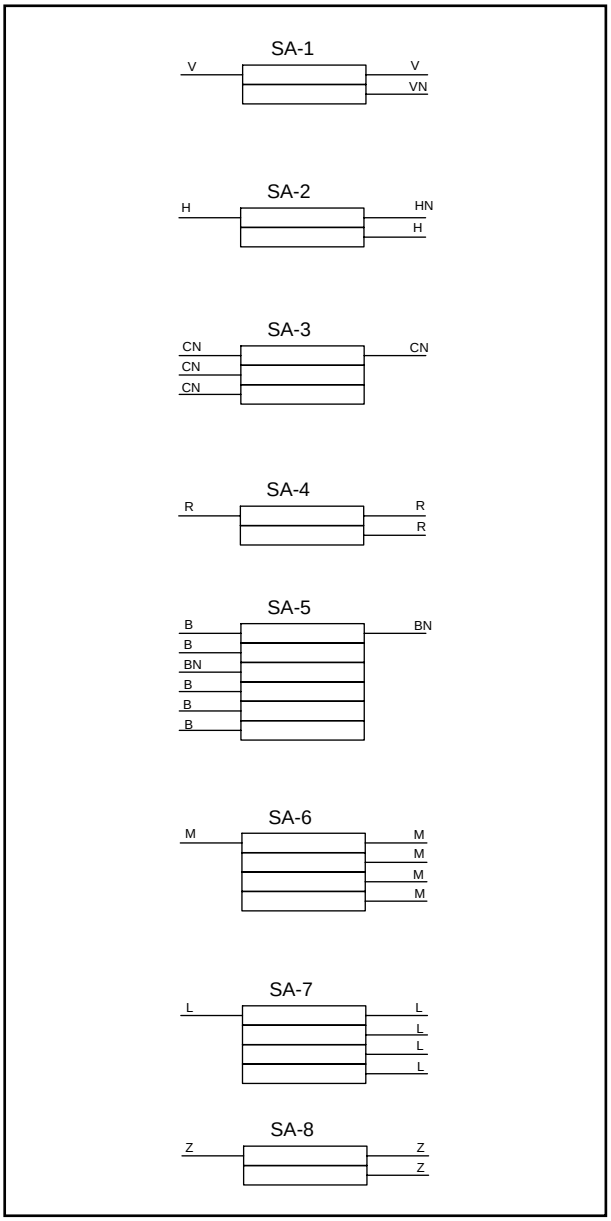


Fig. 10.940

3.11.5 Dashboard line

3.11.5.1 General description

The dashboard line powers the controls installed in front of the driver (Fig.10.941), such as the switches that control the headlights, the light switch lever, etc. It also connects with the fuses that protect the tractor's entire electrical system (Fig.10.942).

The dashboard line is connected to the front engine line via connection to the terminal boards (XS1), to the rear line via terminal boards (XS2) and to the platform line by means of the terminal boards (XS3)(Fig.10.943) in each wiring line.

Fig. 10.941

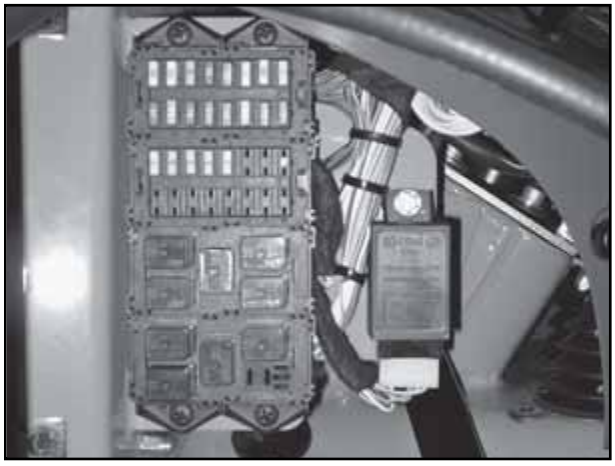


Fig. 10.942

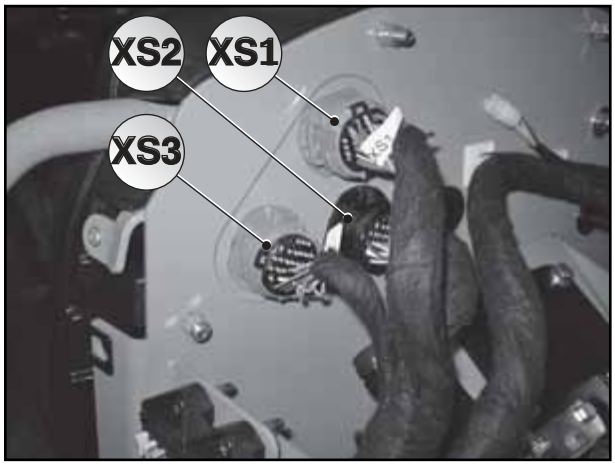


Fig. 10.943

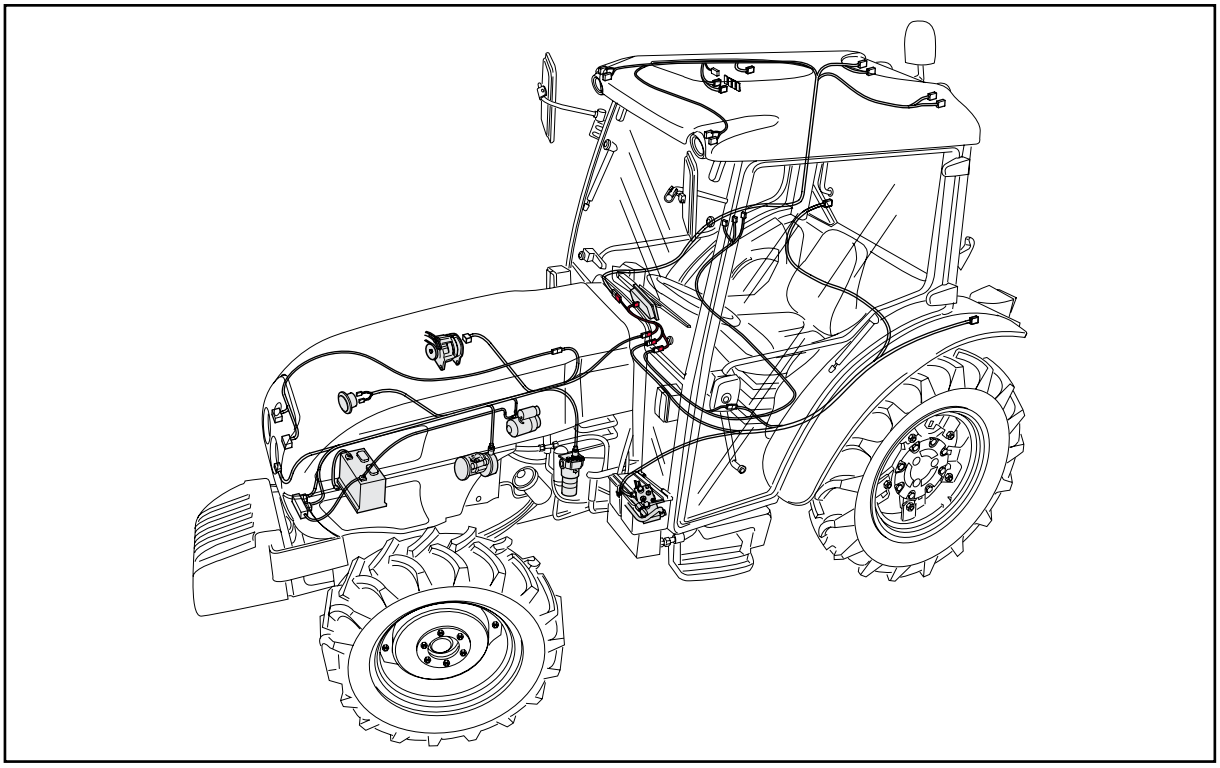


Fig. 10.944

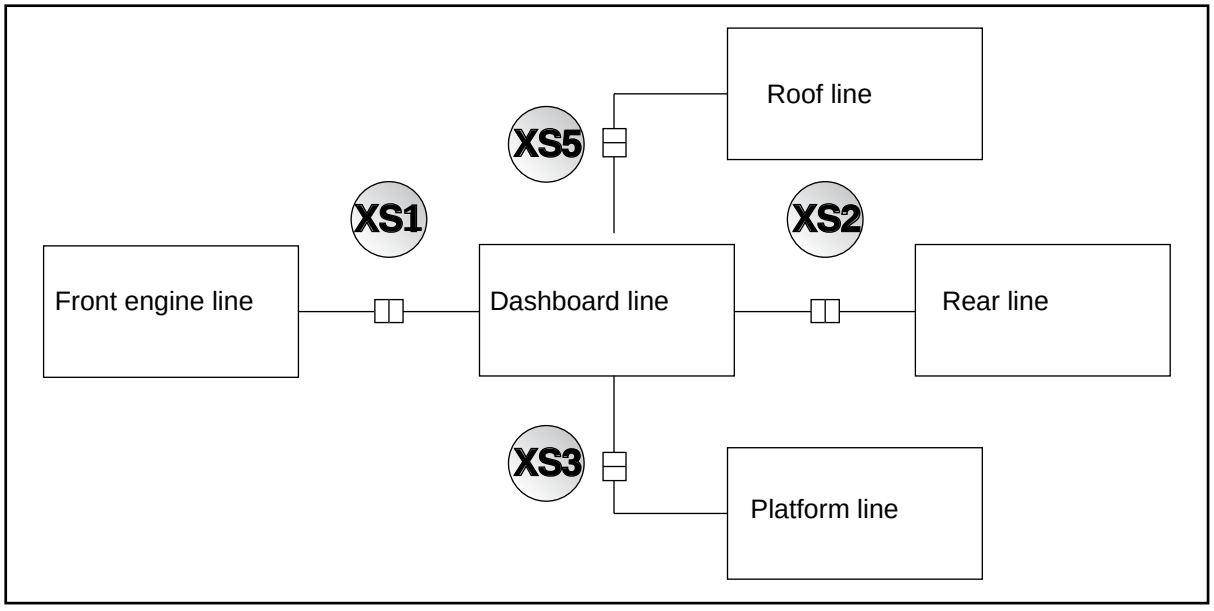


Fig. 10.945

3.11.5.2 Wiring

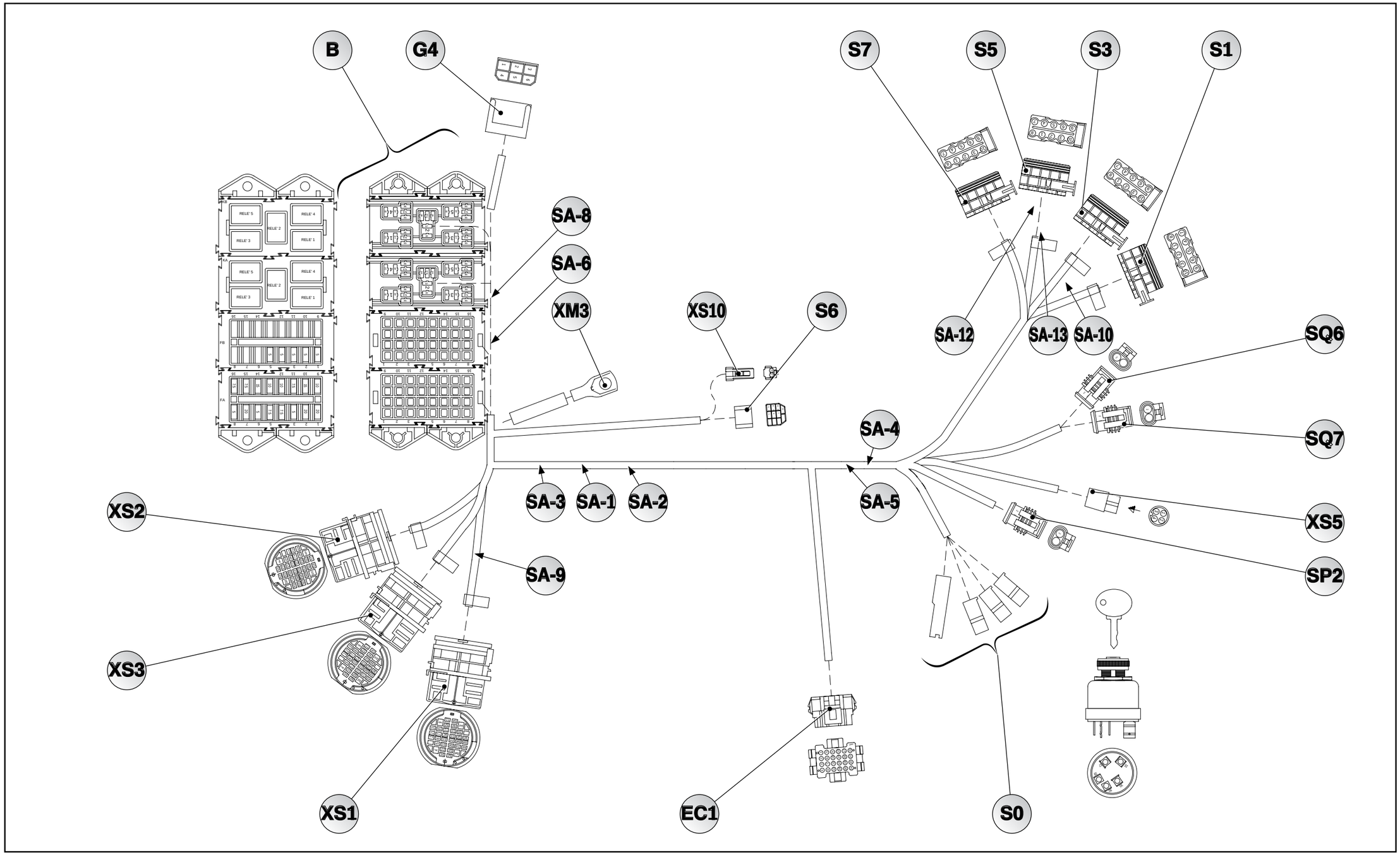


Fig. 10.946

B - Main relay and fuse box
EC1 - Connector for instrument
G4 - Connector for blinker
S0 - Faston terminals for ignition switch
S1 - Connector for revolving beacon switch
S3 - Connector for rear field light switch
S5 - Connector for emergency switch
S6 - Connector for light switch
S7 - Connector for side lights/dipped beams switch
SA-1_SA-10 - Junctions
SA1-12_SA-3 - Diodes
SP2 - Pressure switch for brake lights/diff lock release during braking
SQ6 - Lh brake pedal microswitch
SQ7 - Rh brake pedal microswitch
XM3 - Eyelet for dashboard line ground
XS1 - Terminal board (34-ways) for front line/dashboard line connection
XS2 - Terminal board (34-ways) for rear line/dashboard line connection
XS3 - Terminal board (34-ways) for platform line/dashboard line connection
XS5 - Terminal board (4-ways) for roof/dashboard line connection
XS10 - Connector for NAO supplementary turn indicators

3.11.5.3 Connector locations

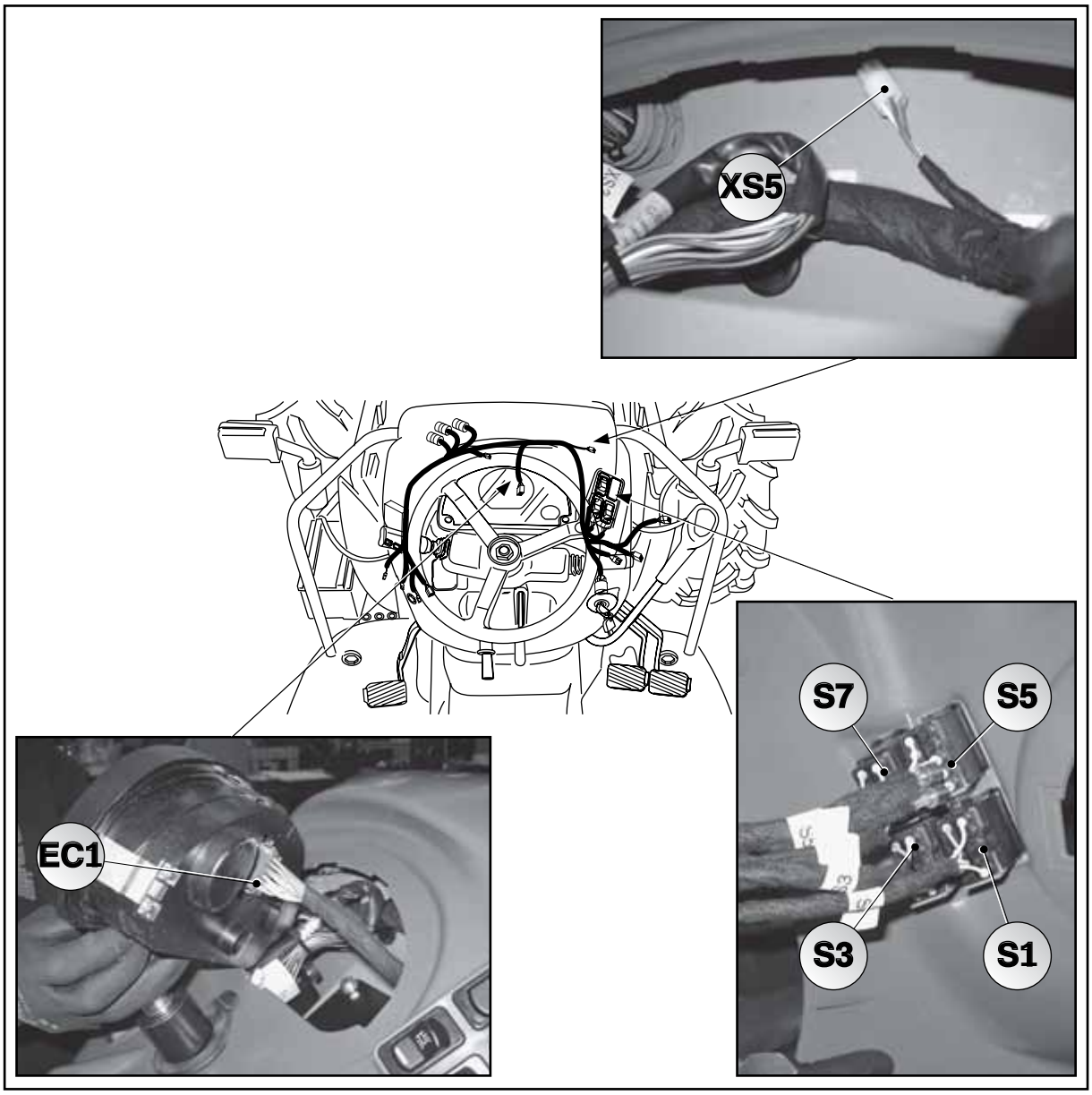


Fig. 10.947

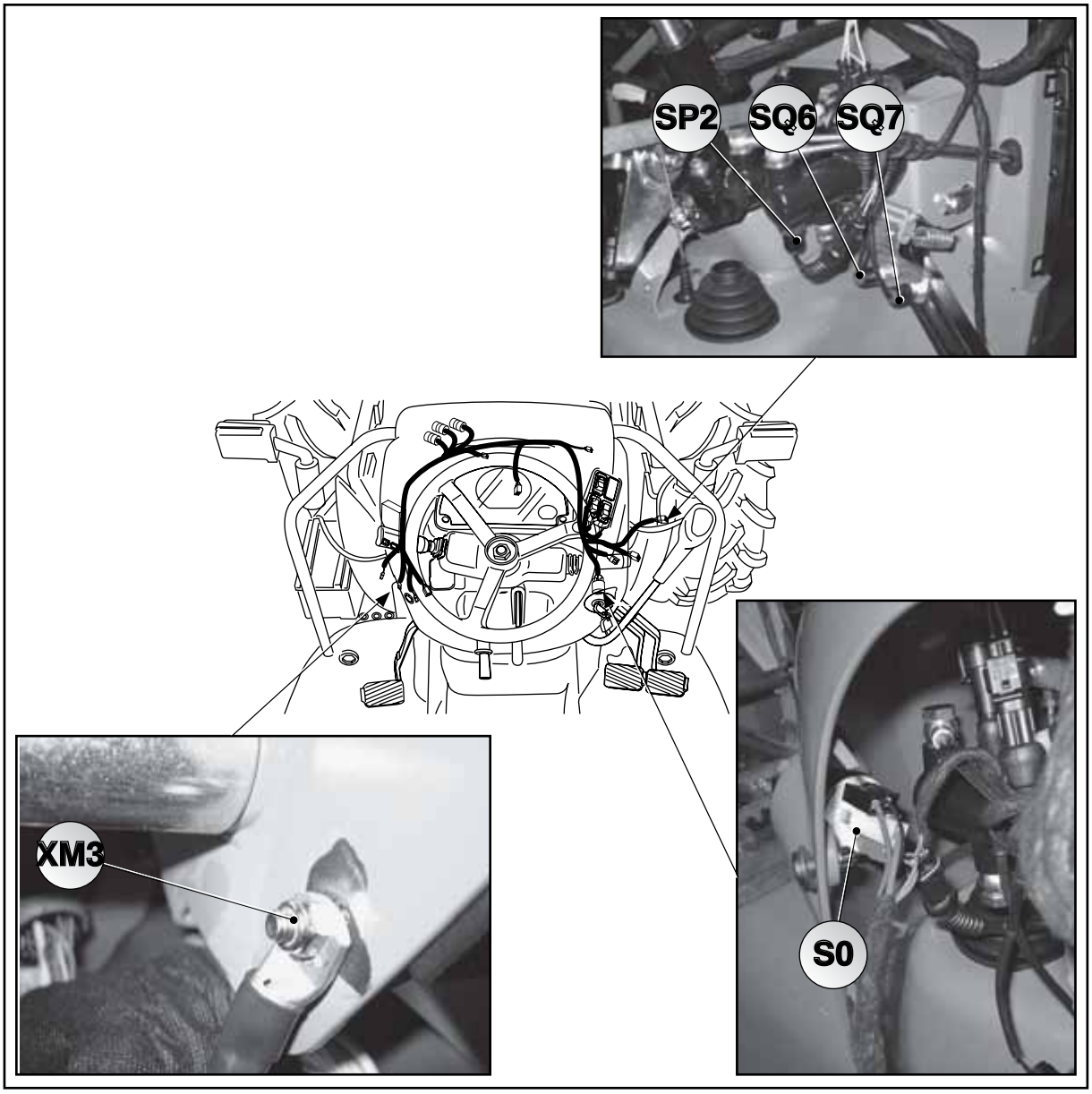


Fig. 10.948

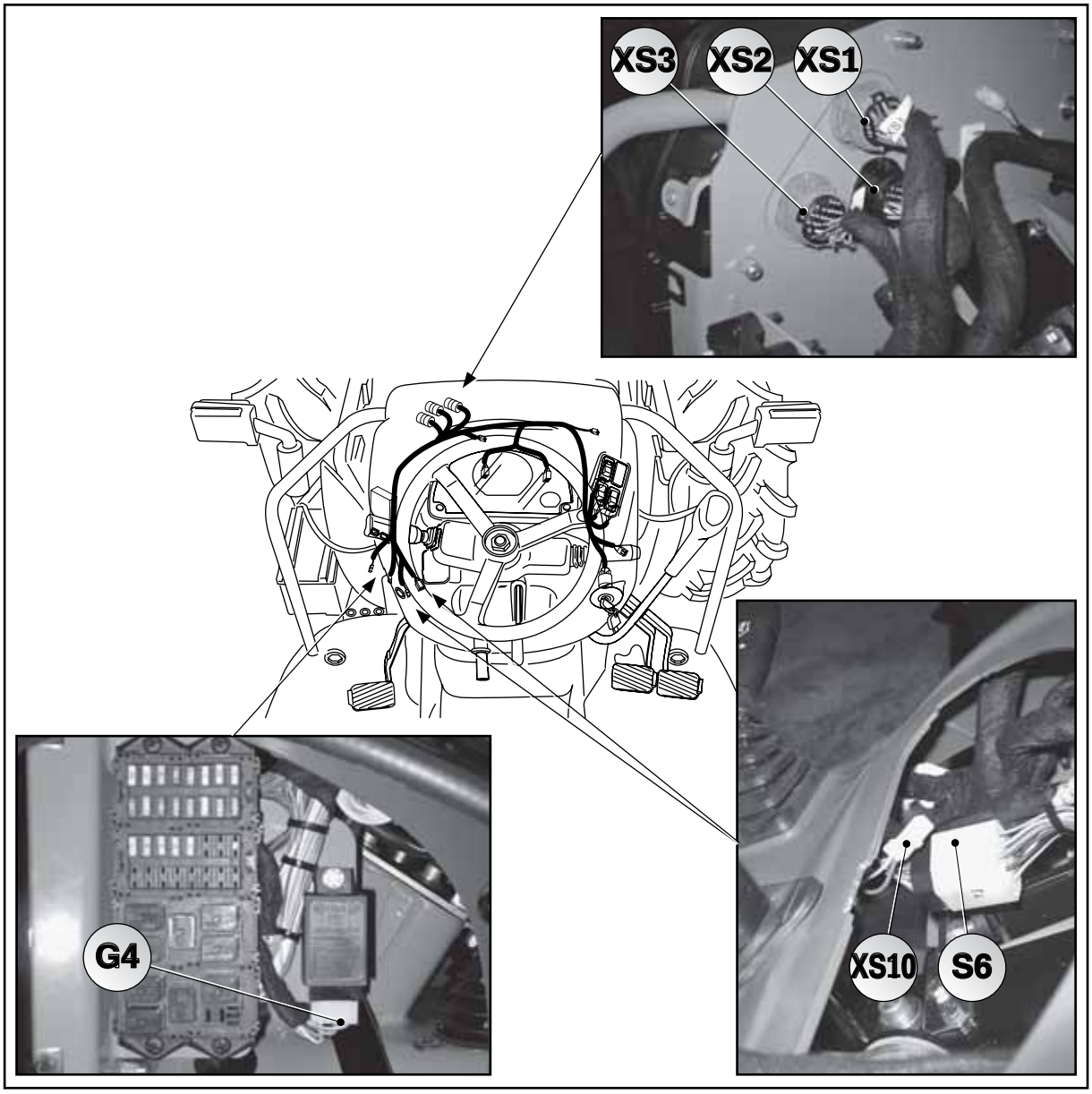


Fig. 10.949

G4 - Connector for blinker
S6 - Connector for light switch
XS1 - Terminal board (34-ways) for front line/dashboard line connection
XS2 - Terminal board (34-ways) for rear line/dashboard line connection
XS3 - Terminal board (34-ways) for platform line/dashboard line connection
XS10 - Connector for NAO supplementary turn indicators

3.11.5.4 Connector identification

Connector (EC1) for instrument connection

pin	colour	to con. or comp.	pin	wire function
1	ZN	XS2	10	hand brake
2	ZL	XS3	17	brake oil level
3	CL	XS2	11	trailer brake oil
4	C	XS2	12	synchronized PTO
5	RV	XS1	22	low engine oil pressure
6	LG	XS1	23	air filter clogged
7	ZH	XS1	24	transmission oil filter
8	HL	XS2	14	fast PTO
9	R	FB5		battery + key
10	HG	SA-5		side light junction
11	SV	KA5	87	four-wheel drive
12	HN	KA1	85	Independent PTO
13	VN	KB2	87	driving beams
14	HM	XS1	5	battery charge
15	S	XS3	18	fuel level
16	SG	XS3	19	fuel indicator
17	RN	FB4		+ 30 instrument
18	G	G4	5	turn indicators
19	GN	G4	2	1st trailer direction
20	VB	XS1	27	water temperature
21	BN	SA-3		battery direct grounding junction
22	GV	G4	3	2nd trailer direction
23	BR	KB3	30	differential lock
24	GR	XS1	3	engine rate

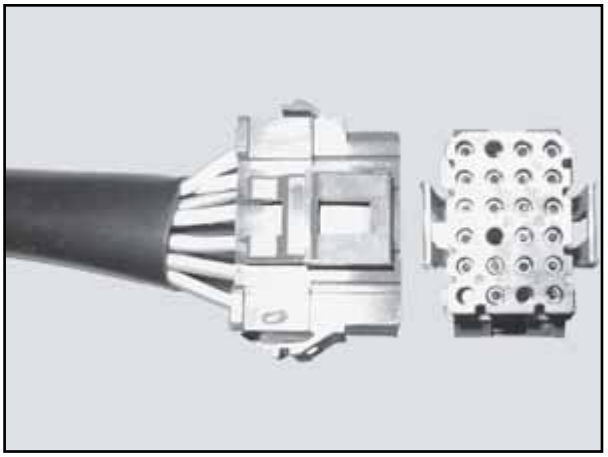


Fig. 10.950

Blinker connector (G4)

pin	colour	to con. or comp.	pin	wire function
1	B	XM3		ground
2	GN	EC1	19	1st trailer direction
3	GV	EC1	22	2nd trailer direction
4	MB-MB	S5-S6	5-5	
5	G	EC1	18	turn indicators
6	BR	S5	2	

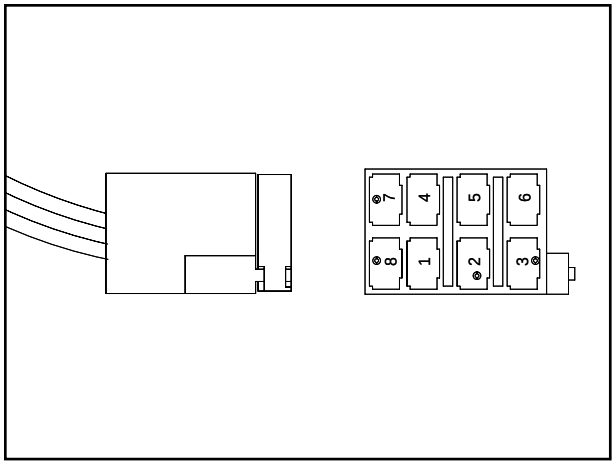


Fig. 10.951

Ignition switch faston terminals (S0)

pin	colour	to con. or comp.	pin	wire function
1	R	FA1		ignition key powering
2	M-M	FB5-FA3		instrument - auxiliary relay power
3	N	XS1	7	
4	L	FA2		starting

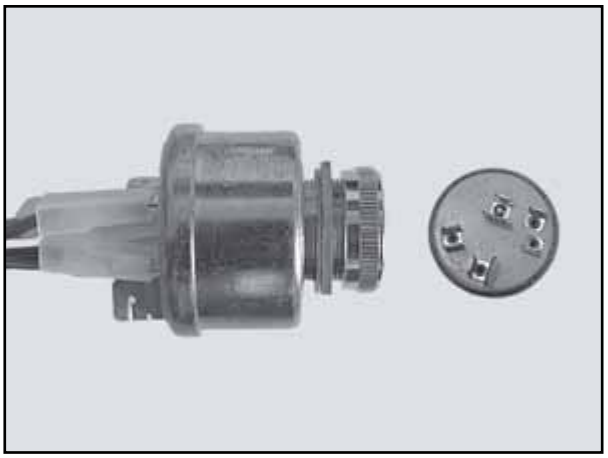


Fig. 10.952

Revolving beacon switch connector (S1)

pin	colour	to con. or comp.	pin	wire function
1				not used
2	LN	FA5		
3	GV	XS1	10	revolving beacon
4				not used
5				not used
6				not used
7	B	SA-2		junction
8	HG	SA-5		junction
9	B	SA-2		junction
10				not used

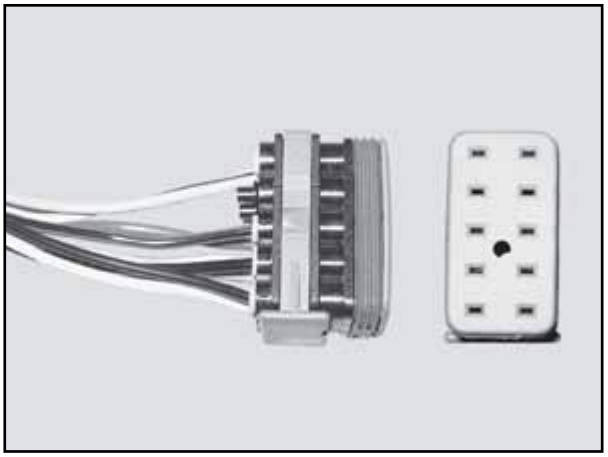


Fig. 10.953

Connector (S3) for rear field light switch

pin	colour	to con. or comp.	pin	wire function
1				not used
2	H	FA11		field light
3	HN	SA-10		junction
4				not used
5				not used
6				not used
7	B	SA-2		junction
8	HG	SA-4		junction
9	B	SA-2		junction
10	HN	SA-10		junction

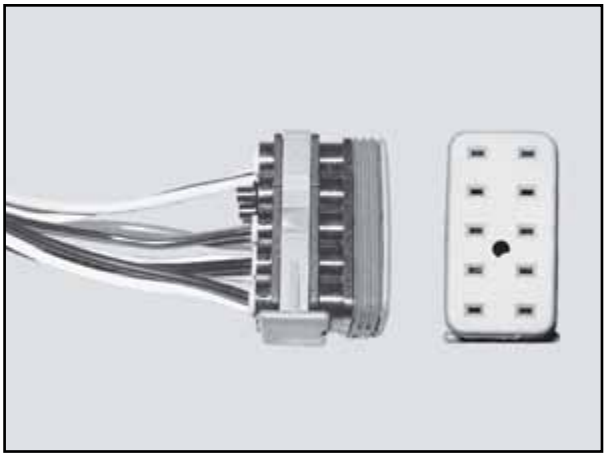


Fig. 10.954

Connector (S5) for emergency switch

pin	colour	to con. or comp.	pin	wire function
1	M	FA13		+ 15 emergency
2	BR	G4		
3	R	FA14		emergency sw.
4				not used
5	MB	G4		
6	G	SA-13		junction
7				not used
8	B	XM3		ground
9	V	SA-12		junction
10	HG	SA-4		junction

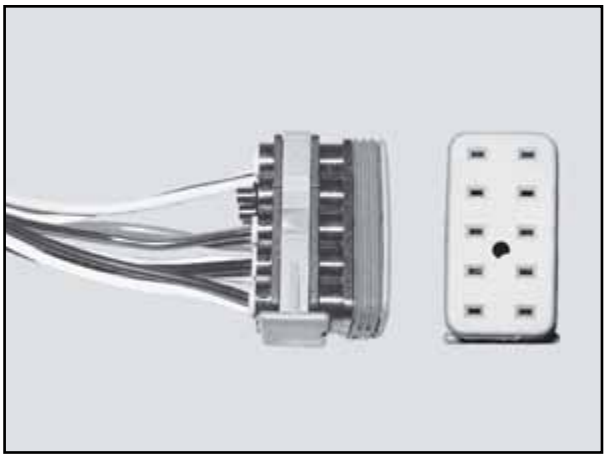


Fig. 10.955

Connector (S6) for light switch

pin	colour	to con. or comp.	pin	wire function
1	R	FA15		horn
2	GV	KB2	86	driving beams
3	G-G-G	XS3-XS1-SA-13	8-15	lh rear - lh front turn ind. junction
4	HR	S7	3	position switch
5	MB	G4	4	
6	V-V-V	XS1-XS3-SA-12	16-10	rh front - lh rear turn ind. junction
7	HR	KB1	86	dipped beams
8	ZR	XS1	18	horn
9	M	FA16		NAO plant
10	RN	FA16		NAO plant
11	B	XM3		ground

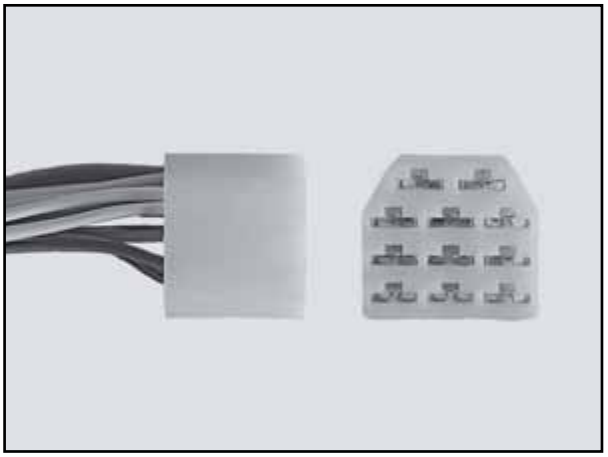


Fig. 10.956

Connector (S7) for side lights/dipped beams switch

pin	colour	to con. or comp.	pin	wire function
1				not used
2	M	FA16		NAO plant
3	HR	S6	4	position switch
4				
5	RN	FB1		light switch
6	N	SA-1		junction
7	B	SA-2		junction
8	HG	SA-5		junction
9	B	SA-2		junction
10	N	SA-1		junction

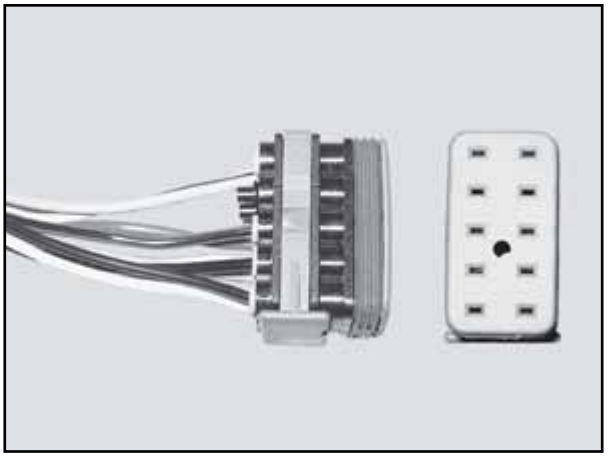


Fig. 10.957

Pressure switch (SP2) for brake lights/diff lock release during braking

pin	colour	to con. or comp.	pin	wire function
1	M	KB4	30	
2	GL	KB4	86	

Fig. 10.958

Lh brake pedal microswitch (SQ6)

pin	colour	to con. or comp.	pin	wire function
1	S	KA5	85	
2	S	SQ6	1	

Fig. 10.959

Rh brake pedal microswitch (SQ7)

pin	colour	to con. or comp.	pin	wire function
1	S	SQ6	2	
2	B	XM3		ground

Fig. 10.960

Terminal board (34-ways) (XS1) for front line/ dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	Z	KA1	87	
2	Z	KA1	87	
3	GR	EC1	24	engine rate
4	R	FA1		ignition key powering
5	HM	EC1	14	battery charge
6	CN	FA4		fuel enrichment device
7	N	S0	3	
8	LN	FA6		25A socket
9	R	KA2	30	
10	GV	S1	3	
11	H	KB1	87	
12	V	KB2	87	
13	M	SA9		junction
14	M	SA9		junction
15	G	S6	3	lh front turn ind.
16	V	S6	6	rh front turn ind.
17	L	FB1		light switch
18	ZR	S6	8	horn
19	M	SA-4		junction
20	M	SA-5		junction
21				not used
22	RV	EC1	5	low engine oil pressure
23	LG	EC1	6	air filter clogged
24	ZH	EC1	7	transmission oil filter
25	L	FA15		horn
26	M	KA3	30	
27	VB	EC1	20	water temperature
28	GM	XS5	2	
29	L	FA5		revolving beacon
30	BN	SA3		battery direct ground
31	M	KA4	30	
32				not used
33				not used
34				not used

Fig. 10.961

Terminal board (34-ways) (XS2) for rear/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	M	SA-8		junction
2	VN	KA1	86	
3	HN	KA1	85	
4	B	XM3		ground
5	HR	KA5	86	
6	L	XS2	1	
7	VR	KB3	86	
8	BR	KB3	30	
9				not used
10	ZN	EC1	1	hand brake
11	CL	EC1	3	trailer brake oil
12	C	EC1	4	synchronized PTO
13	R	FB5		instrument power
14	HL	EC1	8	fast PTO
15				not used
16				not used
17				not used
18				not used
19				not used
20				not used
21				not used
22				not used
23				not used
24				not used
25				not used
26				not used
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.962

Terminal board (34-ways) (XS3) for platform/ dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	L	XS2	6	
2	SV	KA5	87	
3	GL	KA5	87	
4	R	FA7		aux. socket (key-activated)
5	AN	FA6		aux. socket (direct)
6	HN	SA-10		junction
7	R	KB4	87	
8	G	S6	3	lh rear turn ind.
9	B	XM3		ground
10	V	S6	6	lh rear turn ind.
11	M	SA-4		junction
12	N	SA-5		junction
13	GR	XS10	1	
14	RV	XS10	2	
15	B	XM3		ground
16	HG	SA-5		switch lighting junction
17	ZL	EC1	2	brake oil level
18	S	EC1	15	fuel level
19	SG	EC1	16	fuel indicator
20	BR	KB3	85	
21	BN	SA-3		battery direct grounding junction
22				not used
23				not used
24				not used
25				not used
26	B	XM3		ground
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.963

Terminal board (4-ways) (XS5) for roof/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	HG	SA-5		junction
2	GM	XS1	28	
3	B	XM3		ground
4	M	SA-8		junction

Fig. 10.964

Connector (XS10) for NAO supplementary turn indicators

pin	colour	to con. or comp.	pin	wire function
1	GR	XS3	13	
2	RV	XS3	14	

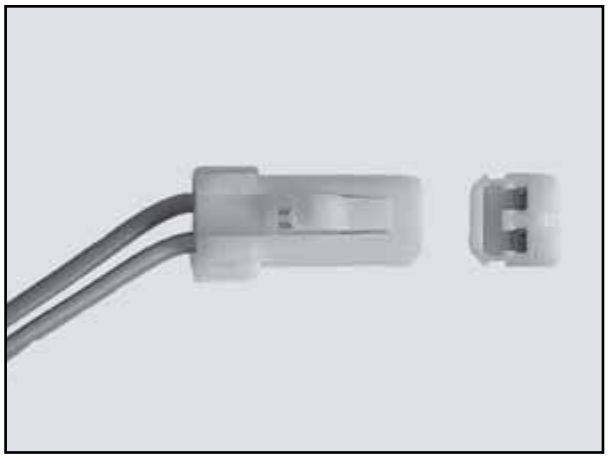


Fig. 10.965

The ground connection is made by means of the eyelet (XM3) fixed to the steering column, just behind the main fuse box (B).

Fig. 10.966

3.11.5.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

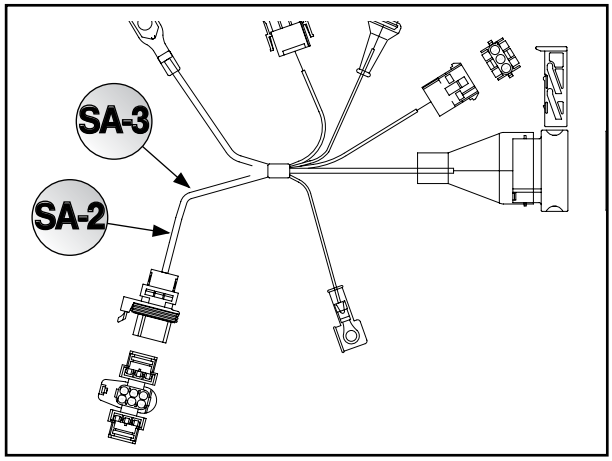


Fig. 10.967

Dashboard line solder point table

SA-1

Colour	Wire function
N	
N	lh side light
N	lh side light
N	

SA-2

Colour	Wire function
B	
B	
B	
B	
B	
B	
B	

SA-3

Colour	Wire function
BN	battery direct ground
BN	battery direct ground
BN	battery direct ground

SA-4

Colour	Wire function
M	
HG	
HG	
M	
M	lh side light

SA-5

Colour	Wire function
N	
HG	switch lighting
HG	
N	rh position
HG	
HG	side lights
N	
HG	

SA-6

Colour	Wire function
M	fuel enrichment jet
M	
M	b.d. +brake light
M	NAO plant
M	+15 emergency

SA-8

Colour	Wire function
M	
M	
M	
M	auxiliary relay
M	
M	

SA-9

Colour	Wire function
M	emergency sw.
M	
M	

SA-10

Colour	Wire function
HN	
HN	
HN	

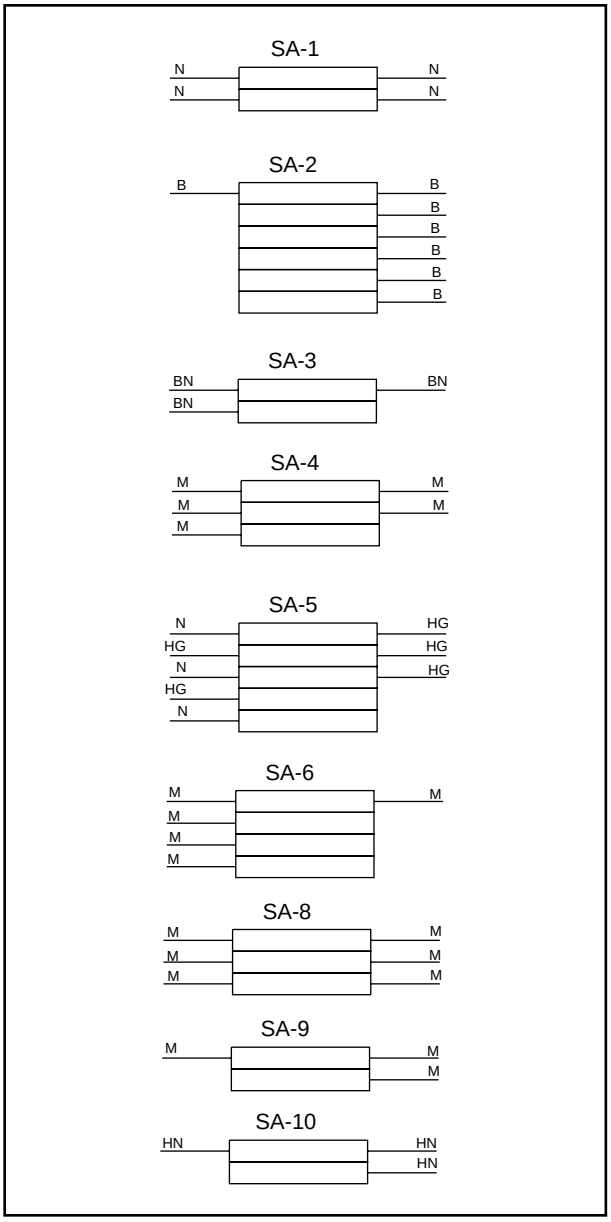


Fig. 10.968

3.11.6 Platform line

3.11.6.1 General description

The platform line connects the controls on the right-hand side of the platform, such as the switches and buttons for engaging/disengaging the 4WD and diff lock (Fig.10.969). It also connects the rear lights and auxiliary power socket.

It is connected to the dashboard line, by means of the connection between the terminal boards (XS3) (Fig.10.970) in each wiring line.

Fig. 10.969

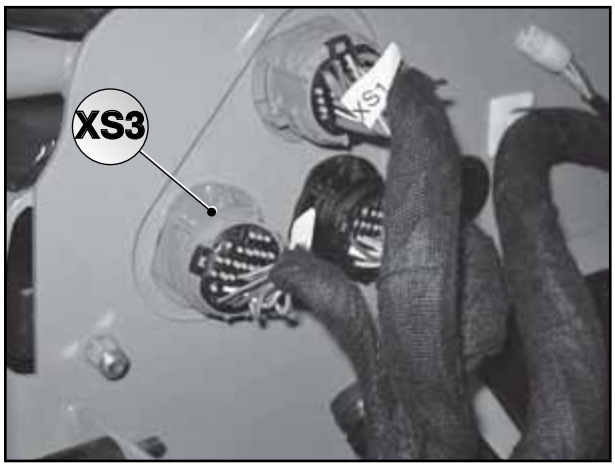


Fig. 10.970

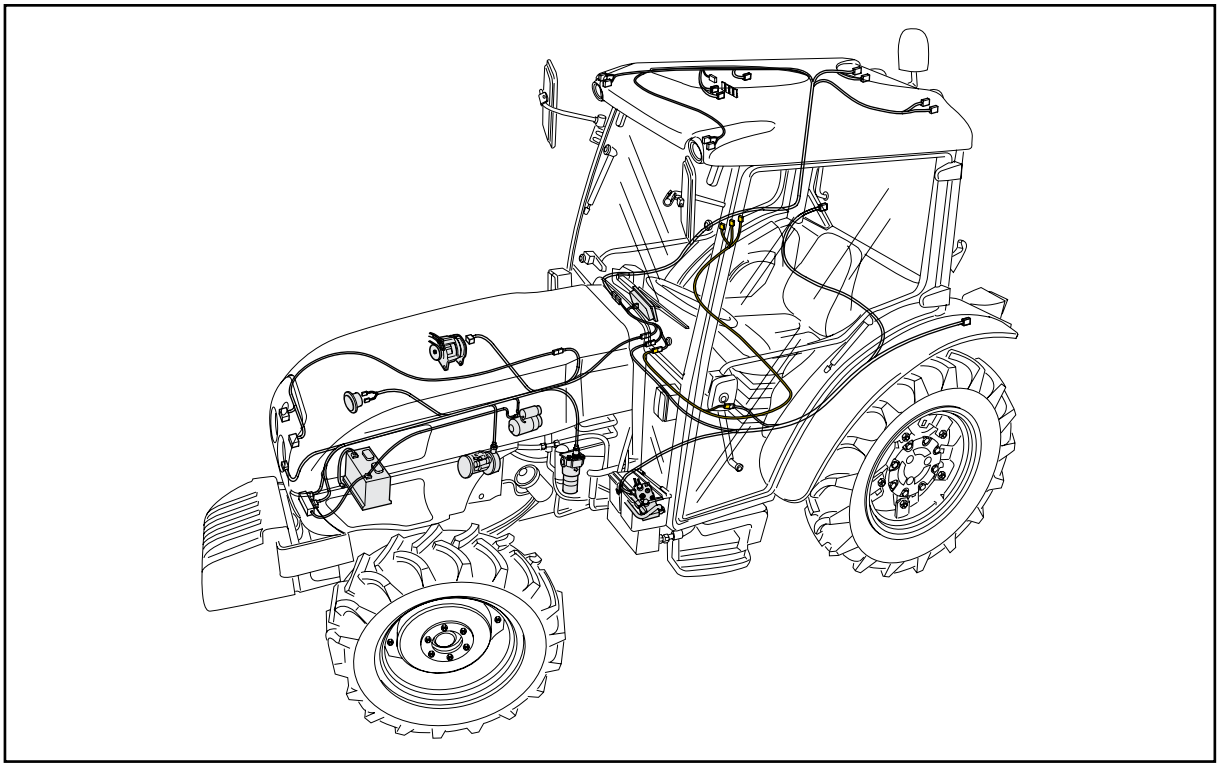


Fig. 10.971

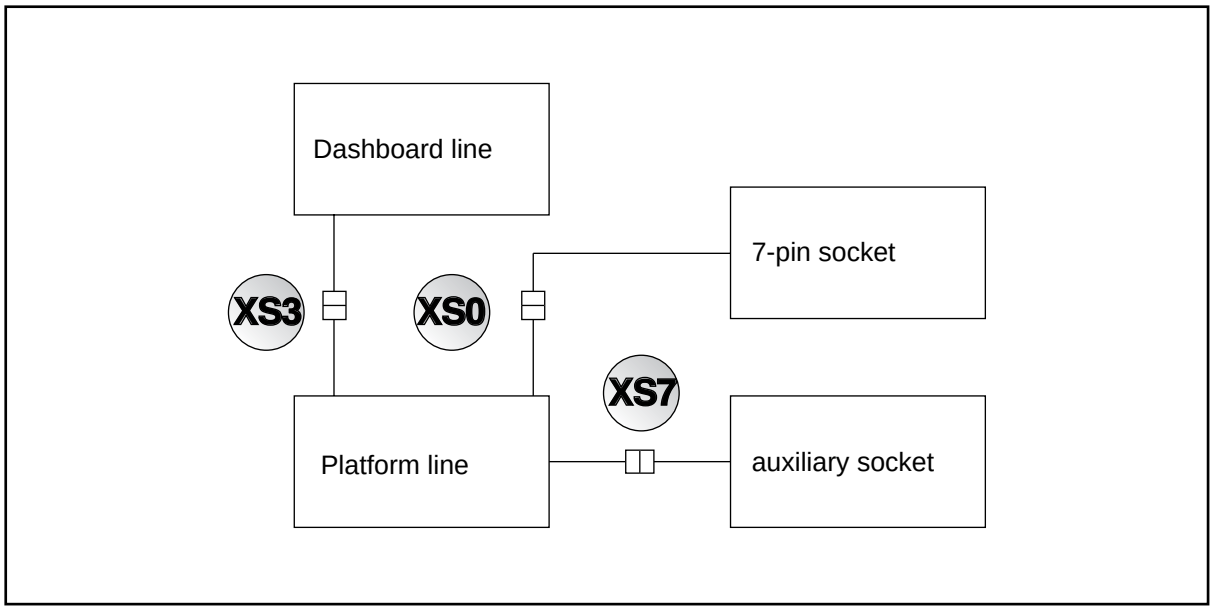


Fig. 10.972

3.11.6.2 Wiring

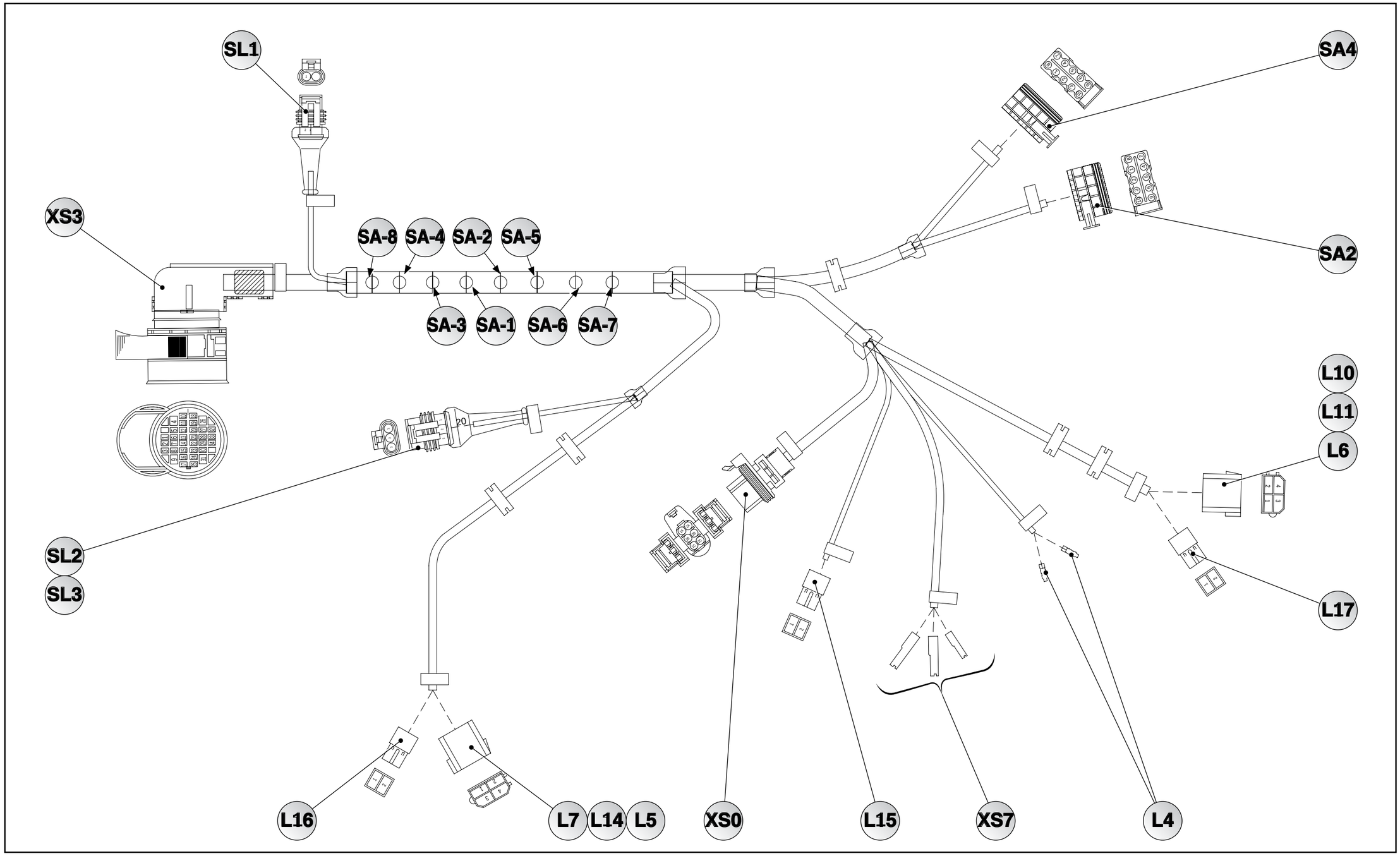


Fig. 10.973

L4 - Terminals for rear platform field light
L5_L7_L14 - Connector for turn ind., side light, lh brake light
L10_L11_L6 - Connector for turn ind., side light, rh brake light
L15 - License plate light connector
L16 - Connector for lh NAO suppl. light
L17 - Connector for rh NAO suppl. light
SA-1/SA-8 - Junctions
SA2 - Connector for 4WD switch
SA4 - Connector for differential lock button
SL1 - Brake oil level sensor connector
SL2_SL3 - Fuel level sensor connector
XS0 - Terminal board for platform-7-pin socket connector (6-ways)
XS3 - Terminal board (34-ways) for platform/dashboard line connection
XS7 - Terminals for auxiliary 3-pin socket

3.11.6.3 Connector locations

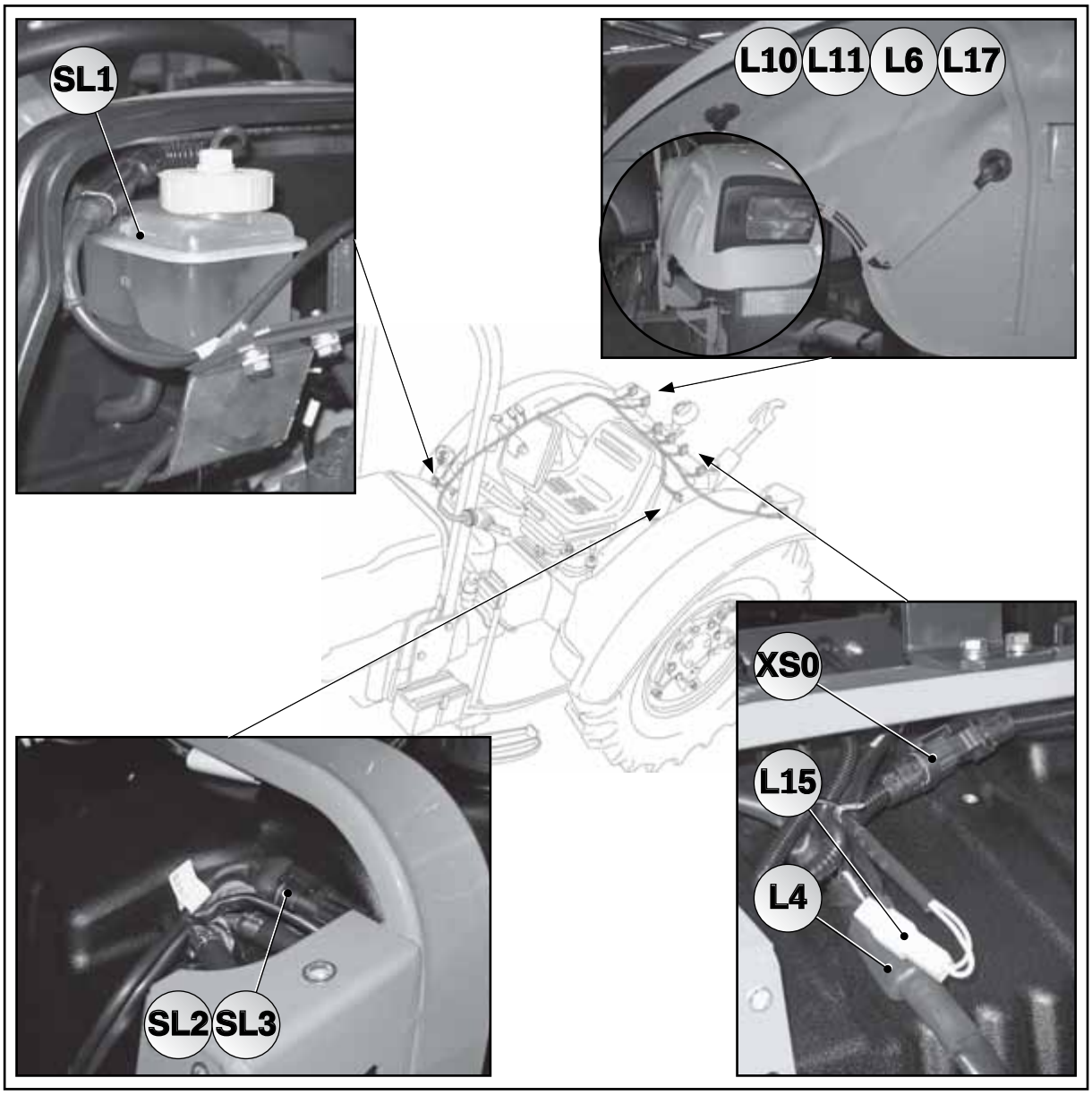


Fig. 10.974

L4 - Terminals for rear platform field light
L15 - License plate light connector
SL1 - Brake oil level sensor connector
SL2_SL3 - Fuel level sensor connector
XS0 - Terminal board for platform-7-pin socket connector (6-ways)

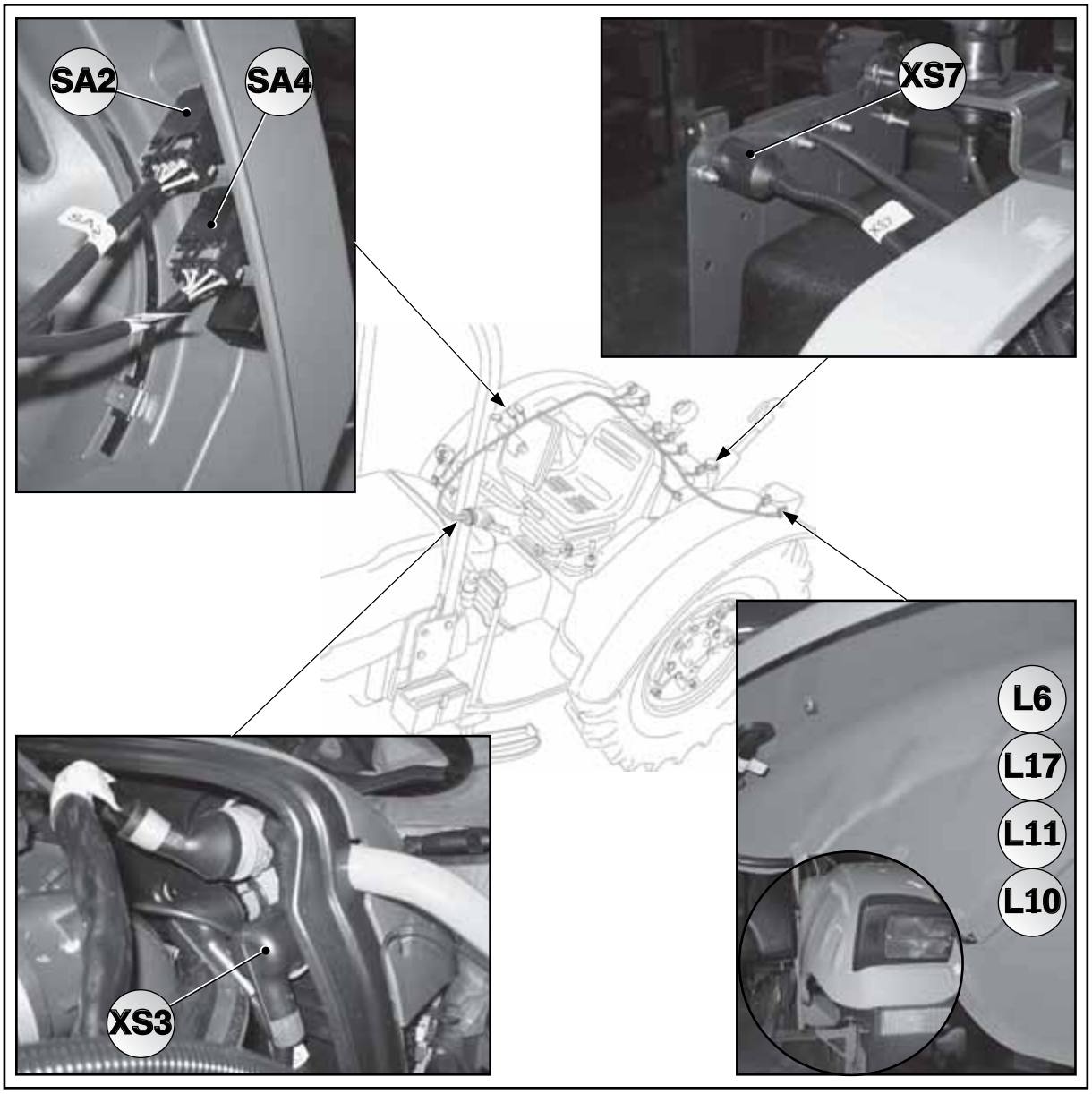


Fig. 10.975

L5_L7_L14 - Connector for turn ind., side light, lh brake light
L16 - Connector for lh NAO suppl. light
SA2 - Connector for 4WD switch
SA4 - Connector for differential lock button
XS3 - Terminal board (34-ways) for platform/dashboard line connection
XS7 - Terminals for auxiliary 3-pin socket

3.11.6.4 Connector identification

Terminals (L4) for rear platform field light

pin	colour	to con. or comp.	pin	wire function
1	HN	XS3	6	field light
2	B	SA-1		junction

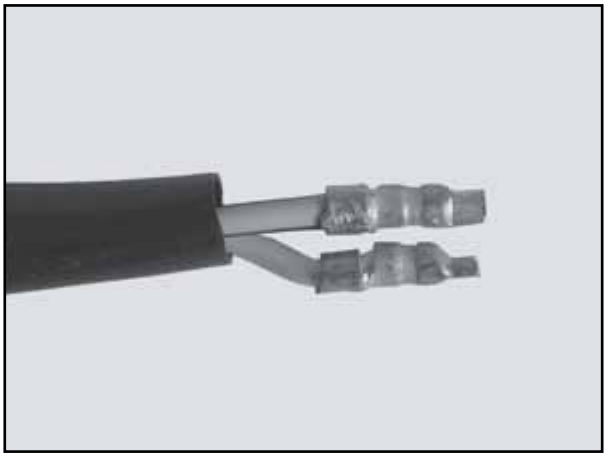


Fig. 10.976

Connector (L5_L7_L14) for turn ind., side light, lh brake light

pin	colour	to con. or comp.	pin	wire function
1	B-B	L16-SA-1	1	junction
2	G	SA-5		lh rear turn ind. junction
3	R	SA-2		lh brake light junction
4	N	SA-4		lh rear side light junction

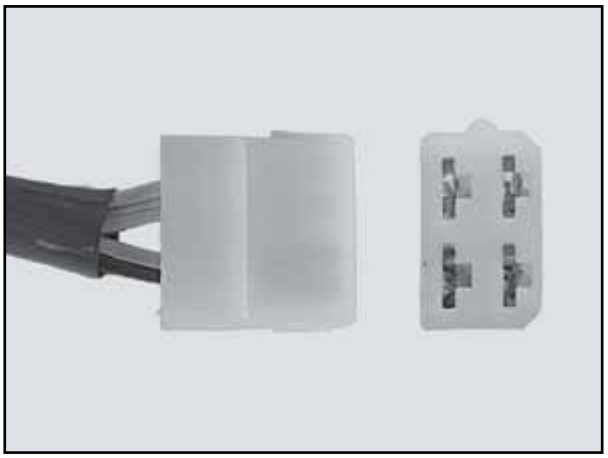


Fig. 10.977

Connector (L10_L11_L6) for turn ind., side light, rh brake light

pin	colour	to con. or comp.	pin	wire function
1	B-B	L17-SA-1	1	junction
2	V	SA-6		rh rear turn ind. junction
3	R	SA-2		rh brake light
4	M	SA-3		rh rear side light junction

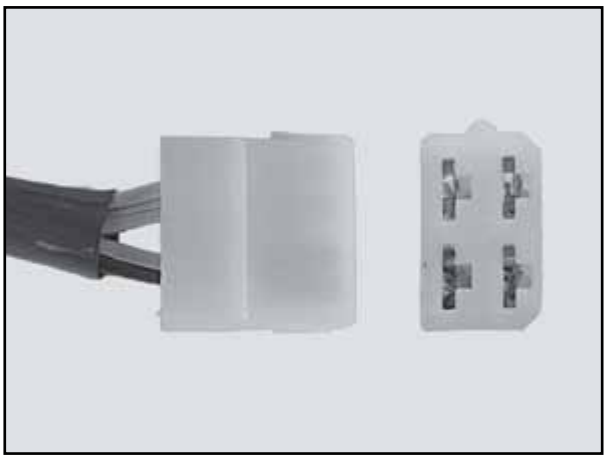


Fig. 10.978

License plate light connector (L15)

pin	colour	to con. or comp.	pin	wire function
1	N	SA-4		licence plate light junction
2	B	SA-1		junction

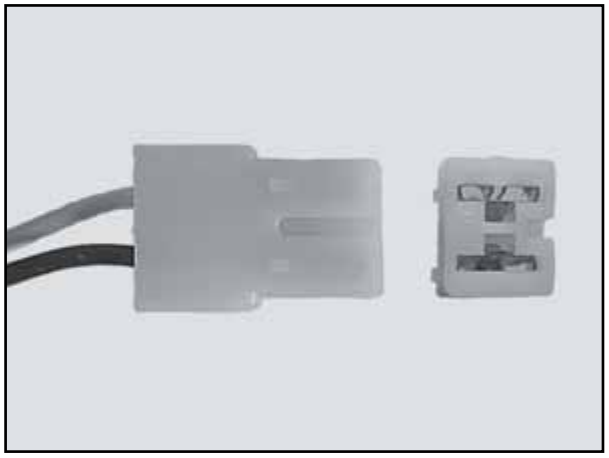


Fig. 10.979

Connector (L16) for lh NAO suppl. light

pin	colour	to con. or comp.	pin	wire function
1	B	L5_L7_L14		
2	GR	XS3		lh NAO

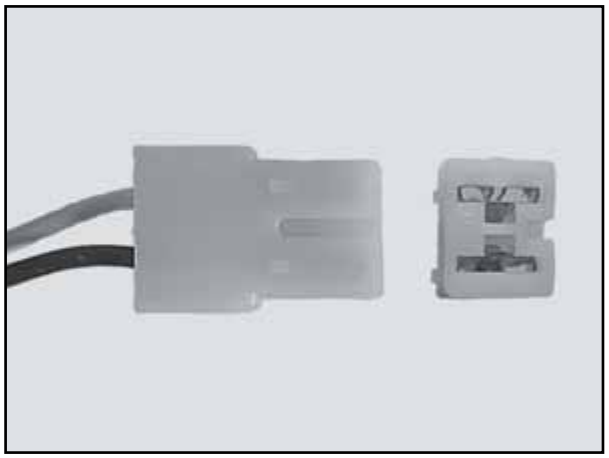


Fig. 10.980

Connector (L17) for rh NAO suppl. light

pin	colour	to con. or comp.	pin	wire function
1	B	L10_L11_L6	1	
2	RV	XS3	14	rh NAO

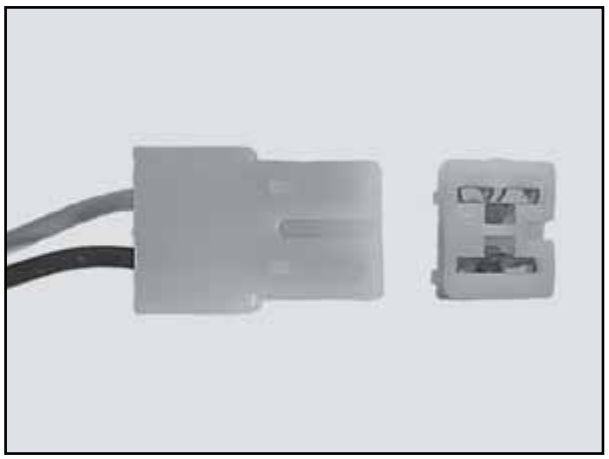


Fig. 10.981

Connector (SA2) for 4WD switch

pin	colour	to con. or comp.	pin	wire function
1	L	XS3	1	4WD sol.v.
2	GL	XS3	3	4WD safety
3	SV	XS3	2	4WD ind.light
4				not used
5				not used
6				not used
7	B	SA-1		
8	HG	SA-7		rh rear side light
9				not used
10				not used

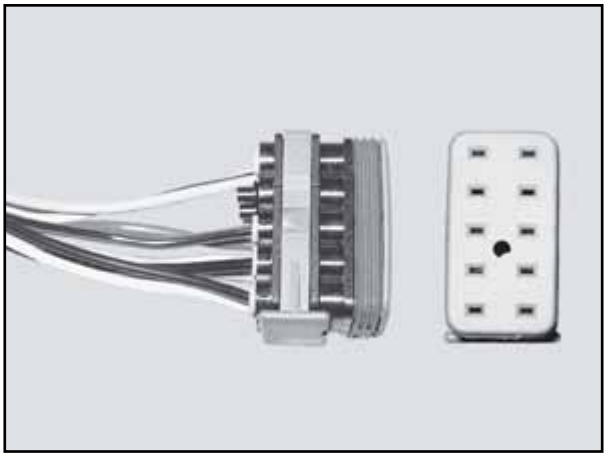


Fig. 10.982

Connector (SA4) for differential lock button

pin	colour	to con. or comp.	pin	wire function
1				not used
2	B	SA-1		junction
3	BR	XS3	20	differential lock
4				not used
5				not used
6				not used
7	B	SA-1		junction
8	HG	SA-7		rh rear side light junction
9				not used
10				not used

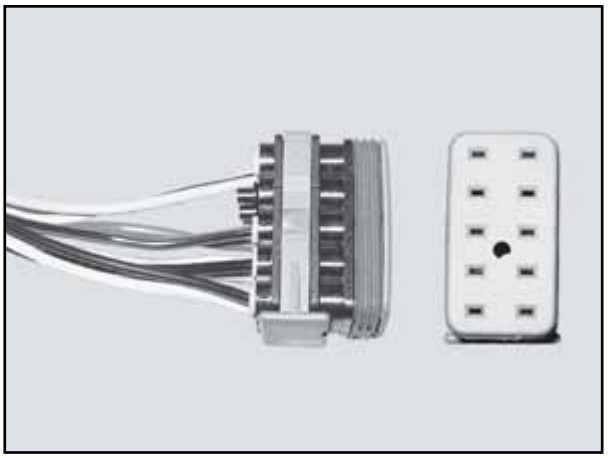


Fig. 10.983

Brake oil level sensor connector (SL1)

pin	colour	to con. or comp.	pin	wire function
1	ZL	XS3	17	brake oil level
2	BN	SA-8		ground junction

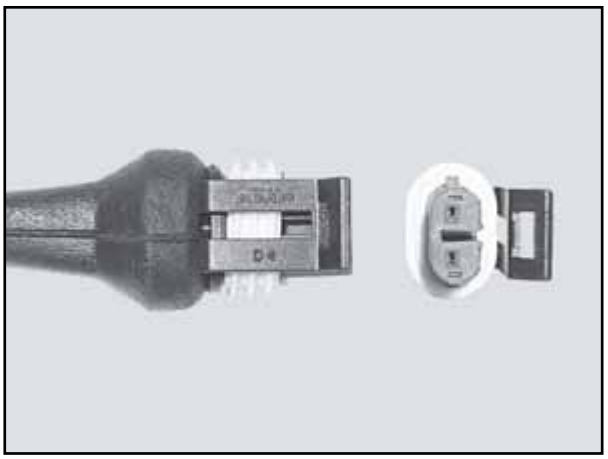


Fig. 10.984

Fuel level sensor connector (SL2_SL3)

pin	colour	to con. or comp.	pin	wire function
1	SG	XS3	19	supplementary tank level
2	S	XS3	18	fuel level
3	BN	SA-8		battery ground junction

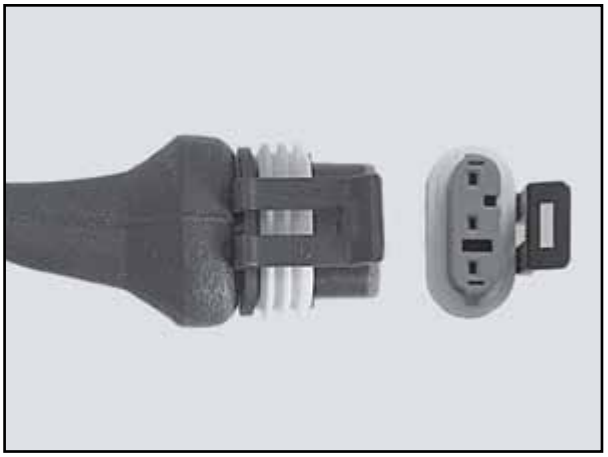


Fig. 10.985

Terminal board (XS0) for platform/7-pin socket connector (6-ways)

pin	colour	to con. or comp.	pin	wire function
A1	N	SA-4		lh rear side light junction
B1	M	SA-3		rh rear side light junction
C1	R	SA-2		brake light junction
A2	G	SA-5		lh rear turn ind. junction
B2	V	SA-6		rh rear turn ind. junction
C2	B	XS3	15	

Fig. 10.986

Terminal board (XS3) (34-ways) for platform/ dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	L	SA2	1	4WD sol.v.
2	SV	SA2	3	4WD ind.light
3	GL	SA2	2	4WD safety
4	R	XS7	1	aux. socket (key-activated)
5	AN	XS7	A	aux. socket (direct)
6	HN	L4	1	field light
7	R	SA-2		brake light junction
8	G	SA-5		lh rear turn ind. junction
9	B	XS7	2	
10	V	SA-6		rh rear turn ind. junction
11	M	SA-3		rh rear side light junction
12	N	SA-4		lh rear side light junction
13	GR	L16	2	lh NAO
14	RV	L17	2	rh NAO
15	B	XS0	C2	
16	HG	SA-7		switch lighting junction
17	ZL	SL1	1	brake oil level
18	S	SL2_SL3	2	fuel level
19	SG	SL2_SL3	1	supplementary tank level
20	BR	SA4	3	diff lock
21	BN	SA-8		battery ground junction
22				not used
23				not used
24				not used
25				not used
26	B	SA-1		junction
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.987

Terminals (XS7) for auxiliary 3-pin socket

pin	colour	to con. or comp.	pin	wire function
1	R	XS3	4	aux. socket (key-activated)
2	B	XS3	9	
3	AN	XS3	5	aux. socket (direct)

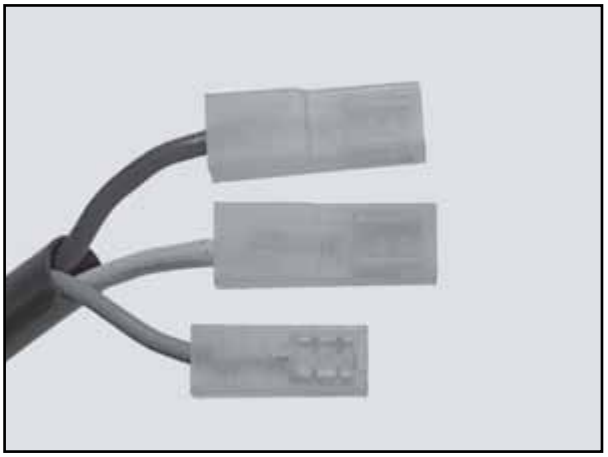


Fig. 10.988

3.11.6.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

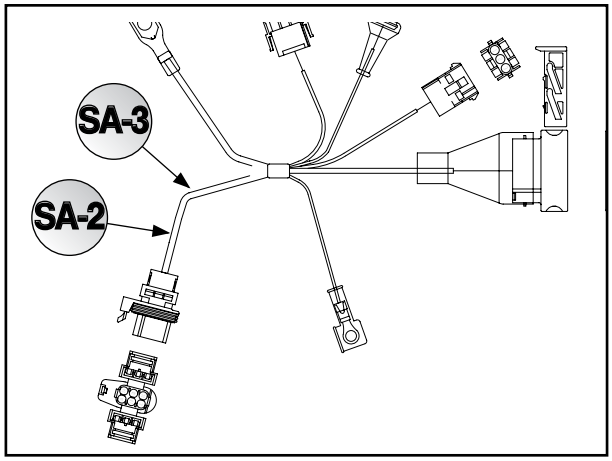


Fig. 10.989

Dashboard line solder point table

SA-1

Colour	Wire function
B	
B	
B	
B	
B	
B	
B	
B	

SA-2

Colour	Wire function
R	brake light
R	brake light
R	lh brake light
R	rh brake light

SA-3

Colour	Wire function
M	rh rear side light
M	rh rear side light
M	rh rear side light

SA-4

Colour	Wire function
N	lh rear side light
N	lh rear side light
N	lh rear side light
N	licence plate light

SA-5

Colour	Wire function
G	lh rear turn ind.
G	lh rear turn ind.
G	lh rear turn ind.

SA-6

Colour	Wire function
V	rh rear turn ind.
V	rh rear turn ind.
V	rh rear turn ind.

SA-7

Colour	Wire function
HG	switch lighting
HG	rh rear side light
HG	rh rear side light

SA-8

Colour	Wire function
BN	battery ground
BN	battery ground
BN	battery ground

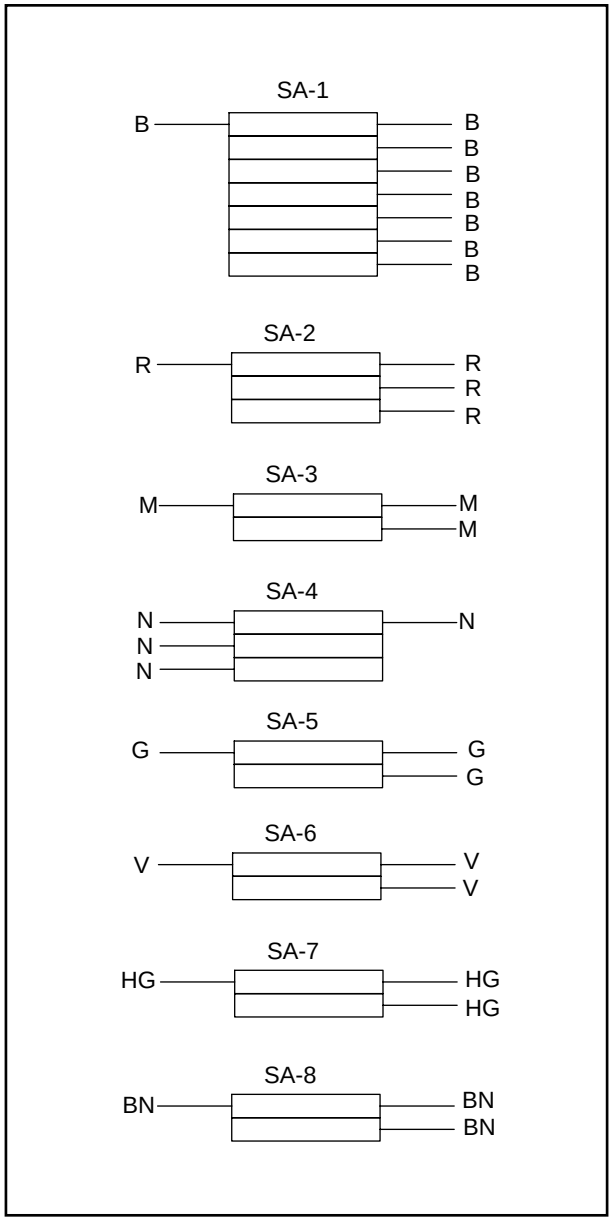

SA-1
B
B
B
B
B
B
B
B
SA-2
R
R
R
R
SA-3
M
M
M
SA-4
N
N
N
N
SA-5
G
G
G
SA-6
V
V
V
SA-7
HG
HG
HG
SA-8
BN
BN
BN

Fig. 10.990

3.11.7 Rear line

3.11.7.1 General description

The rear line powers the components installed on the transmission casing and hydraulic power packs, such as the solenoid valves (YV4) and (YV3)(Fig.10.991 e 10.992) for controlling users like the differential lock and four-wheel drive.

The rear line is connected to the dashboard line via connections between the terminal boards (XS2 Fig.10.993).

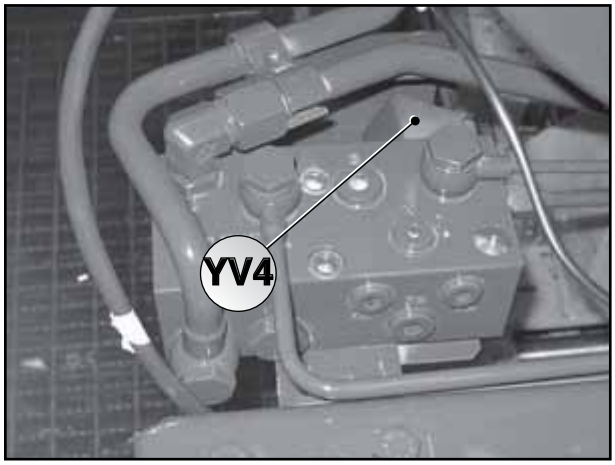


Fig. 10.991

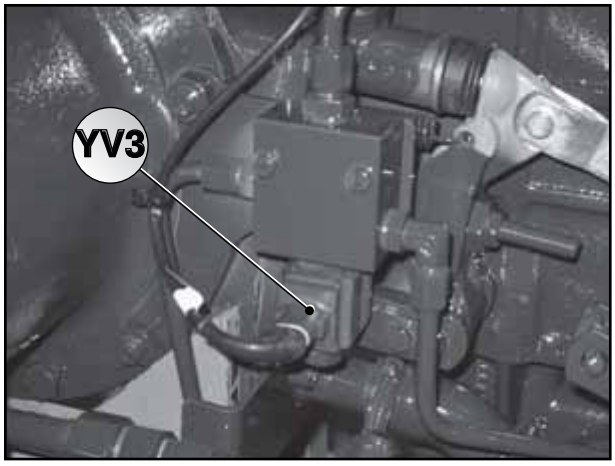


Fig. 10.992

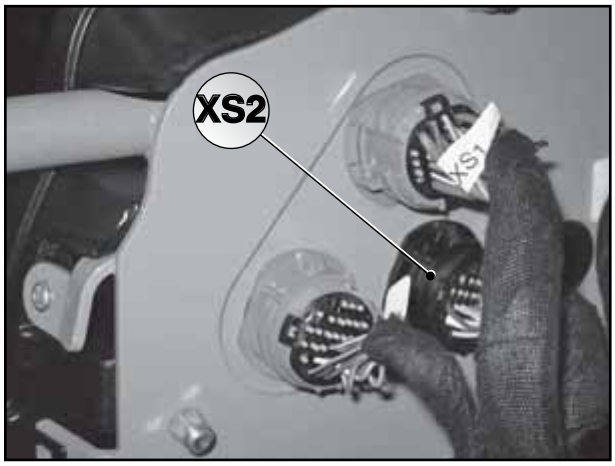


Fig. 10.993

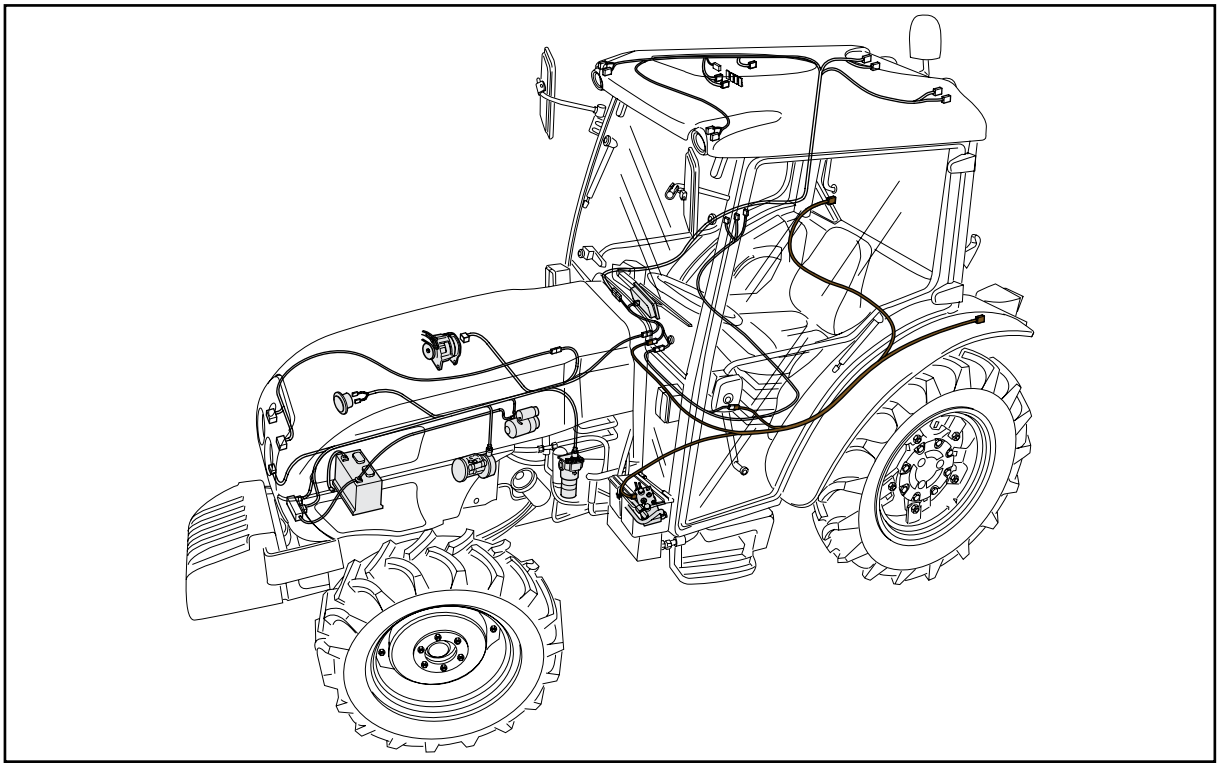


Fig. 10.994

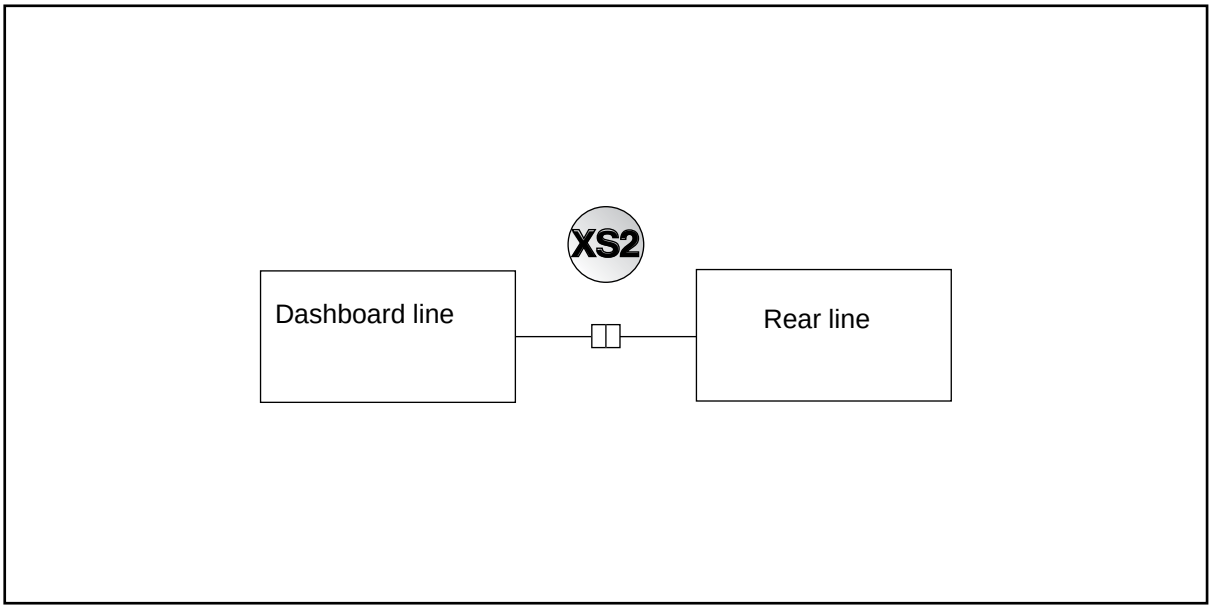


Fig. 10.995

3.11.7.2 Wiring

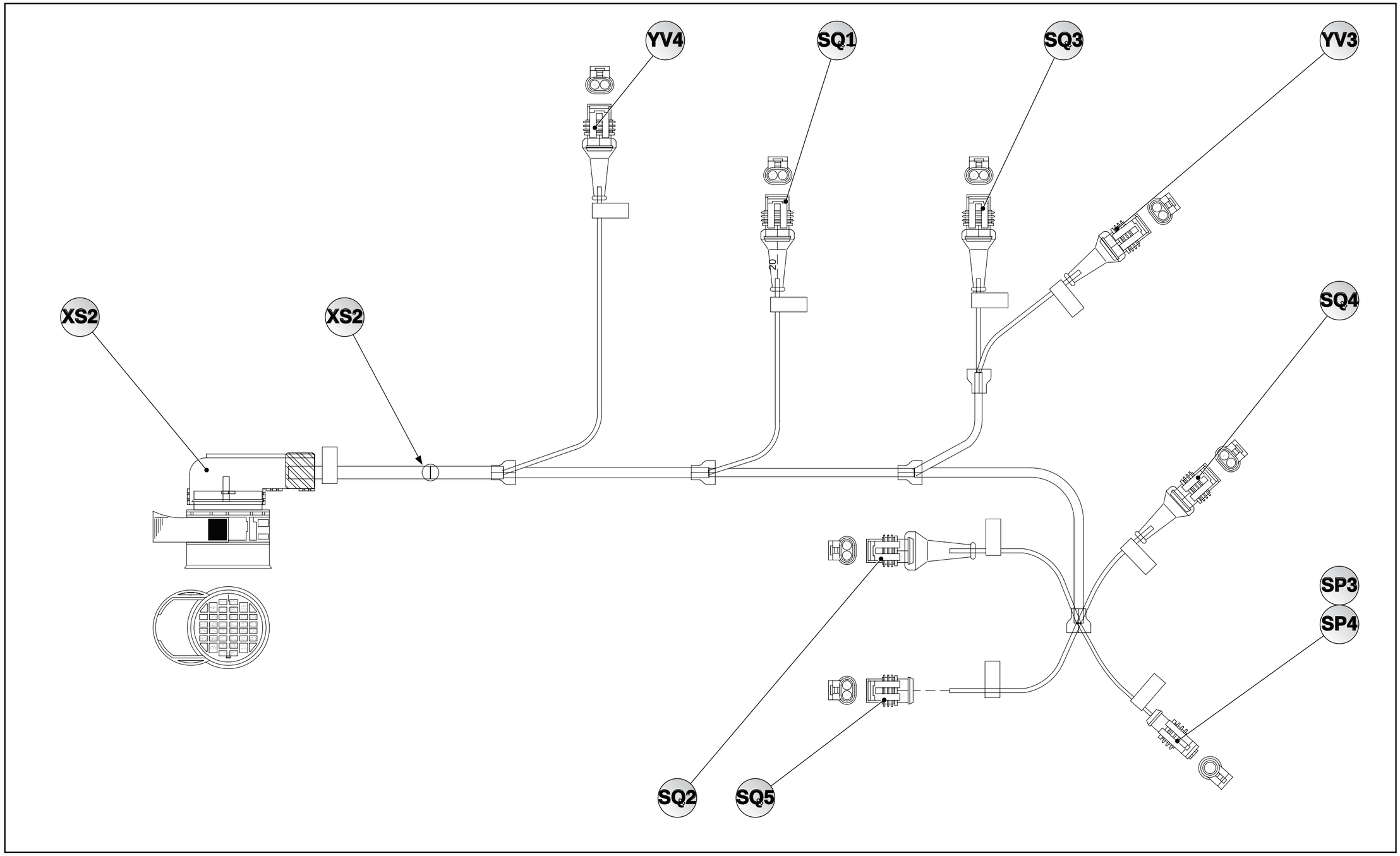


Fig. 10.996

SA-1 - Junction
SP4 - Trailer brake pressure switch connector
SQ1 - Connector for ignition enabling microswitch
SQ2 - Connector for independent rear PTO microswitch
SQ3 - Connector for parking brake hand lever microswitch
SQ4 - Connector for proportional rear PTO microswitch
SQ5 - Connector for fast rear PTO microswitch
YV3 - Connector for 4WD solenoid valve
YV4 - Diff lock solenoid valve connector
XS2 - Terminal board (34-ways) for rear line/dashboard line connection

3.11.7.3 Connector locations

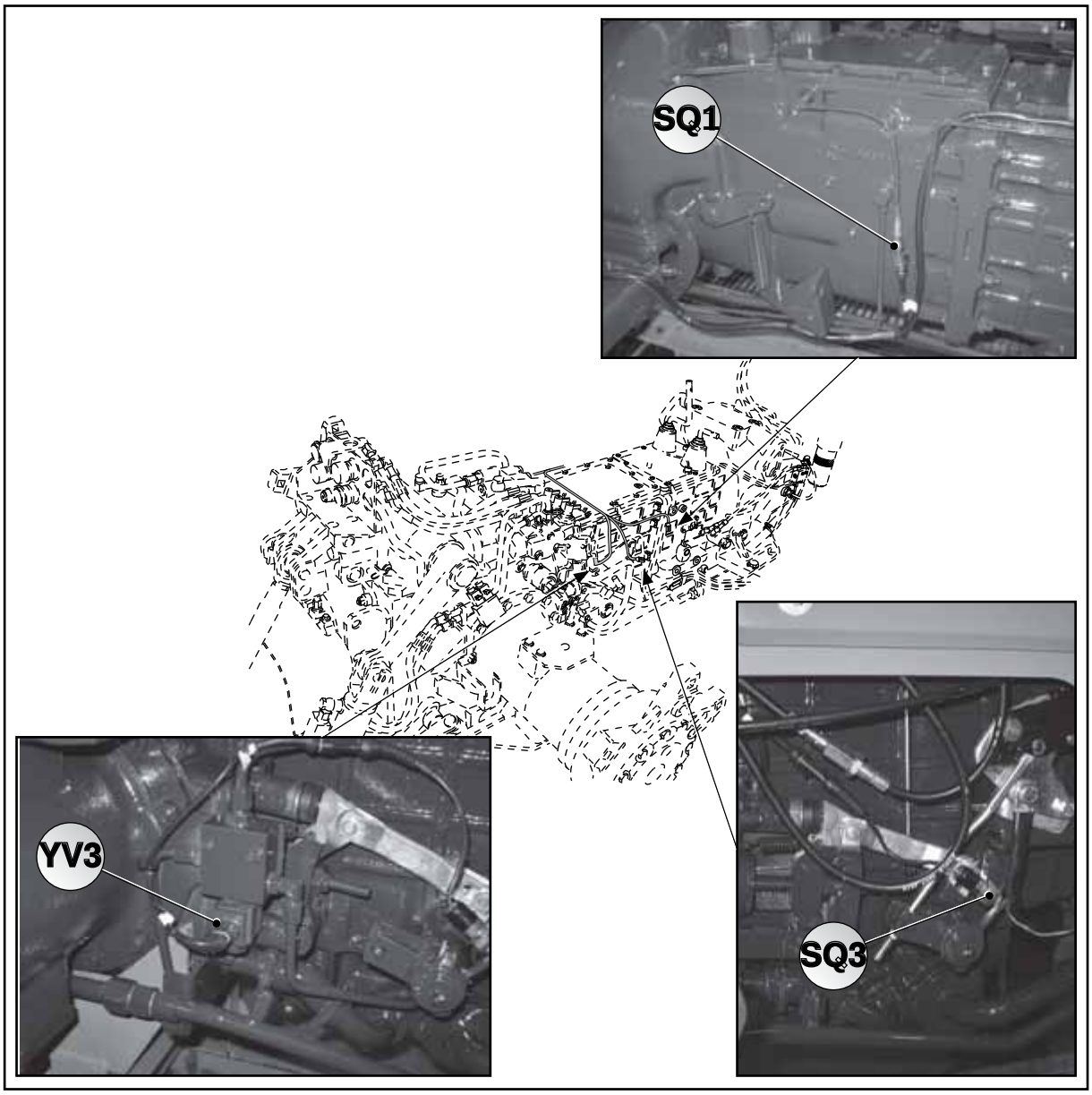


Fig. 10.997

SQ1 - Connector for ignition enabling microswitch
SQ3 - Connector for parking brake hand lever microswitch
YV3 - Connector for 4WD solenoid valve

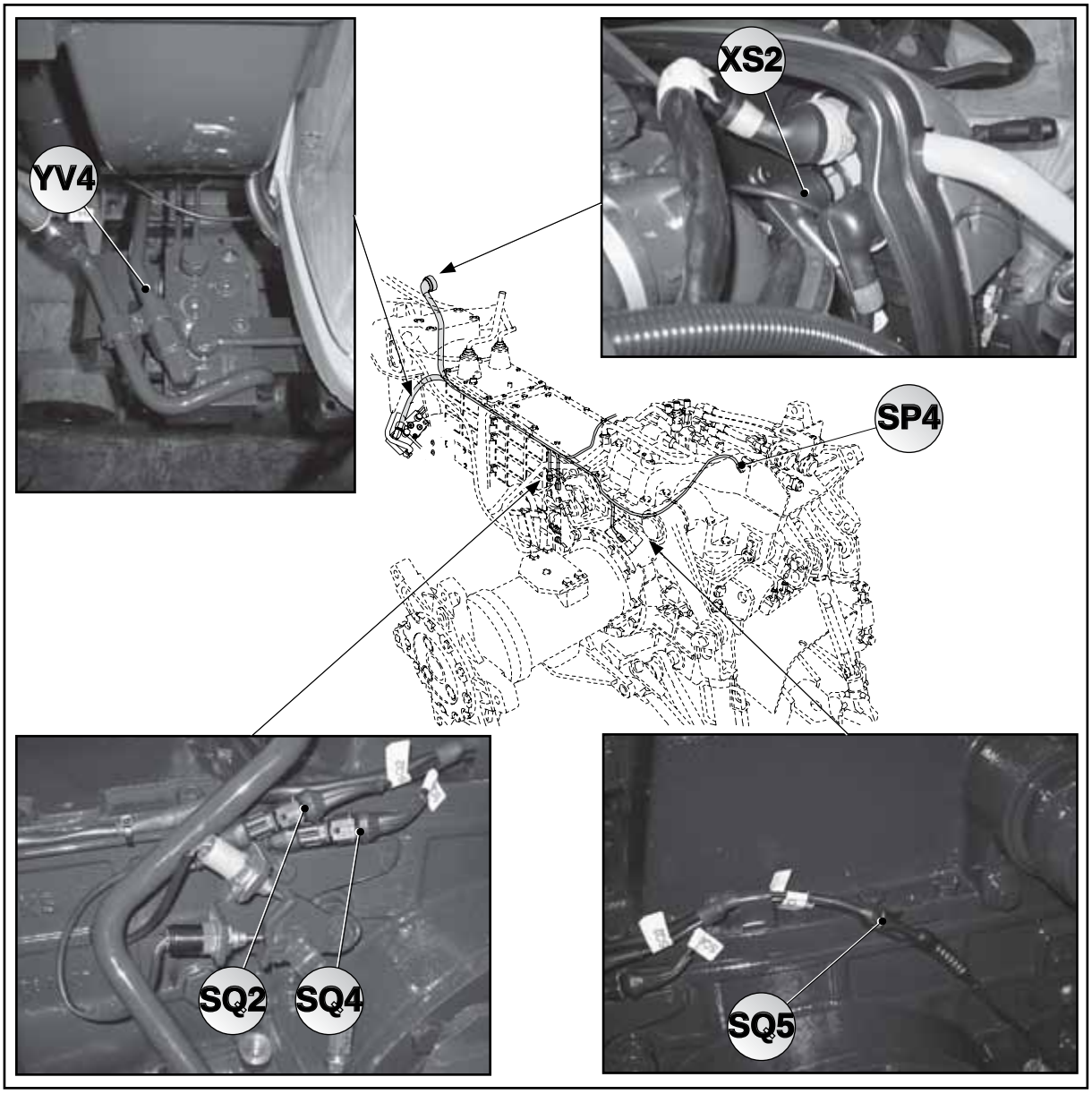


Fig. 10.998

SP4 - Trailer brake pressure switch connector
SQ2 - Connector for independent rear PTO microswitch
SQ4 - Connector for proportional rear PTO microswitch
SQ5 - Connector for fast rear PTO microswitch
YV4 - Diff lock solenoid valve connector
XS2 - Terminal board (34-ways) for rear line/dashboard line connection

3.11.7.4 Connector identification

Trailer brake pressure switch connector (SP4)

pin	colour	to con. or comp.	pin	wire function
1	CL	XS2	11	trailer brake bulb

Fig. 10.999

Connector (SQ1) for ignition enabling microswitch

pin	colour	to con. or comp.	pin	wire function
1	M	XS2	1	gearbox safety
2	VN	XS2	2	gearbox safety

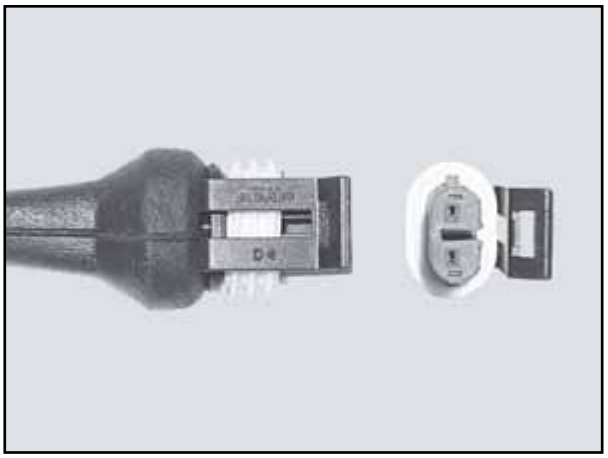


Fig. 10.1000

Connector (SQ2) for independent rear PTO microswitch

pin	colour	to con. or comp.	pin	wire function
1	B	SA-1		Independent PTO indicator
2	HL	XS2	14	junction

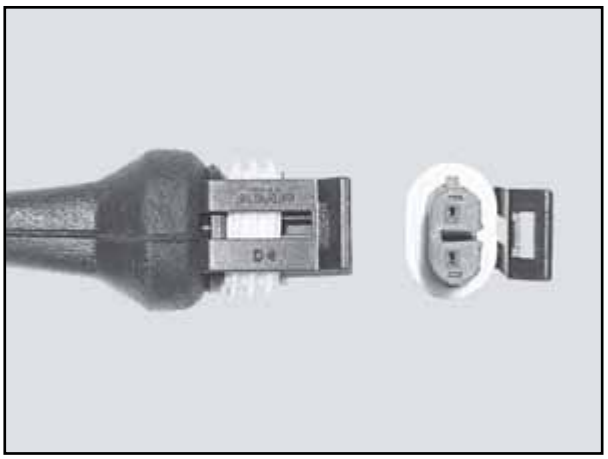


Fig. 10.1001

Connector (SQ3) for parking brake lever microswitch

pin	colour	to con. or comp.	pin	wire function
1	B	SA-1		junction
2	ZN	XS2	10	hand brake

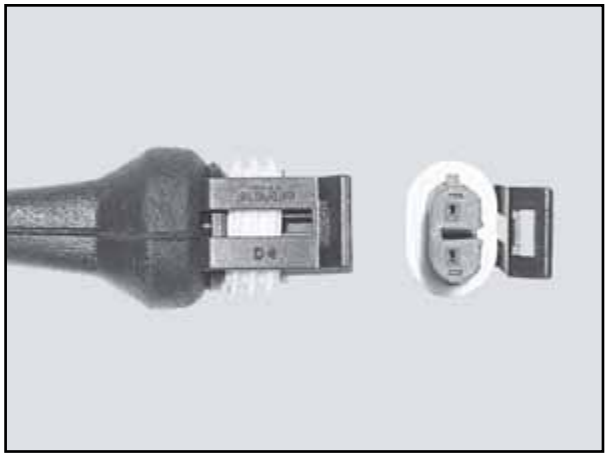


Fig. 10.1002

Connector (SQ4) for proportional rear PTO microswitch

pin	colour	to con. or comp.	pin	wire function
1	C	XS2	12	prop. PTO indicator light
2	R	XS2	13	prop. PTO indicator light

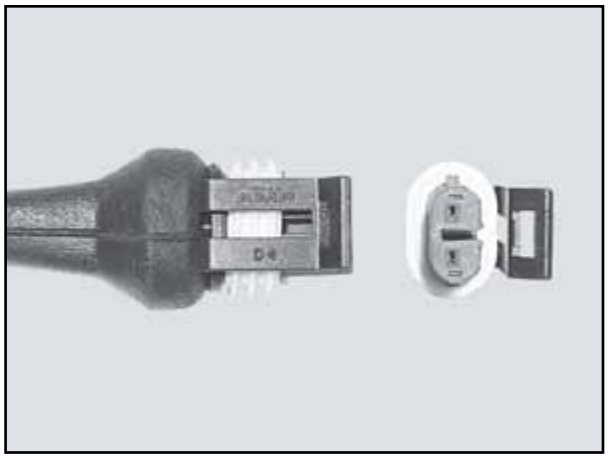


Fig. 10.1003

Connector (SQ5) for fast rear PTO microswitch

pin	colour	to con. or comp.	pin	wire function
1	B	SA-1		junction
2	HL	XS2	14	fast PTO indicator light

Fig. 10.1004

Connector (YV3) for 4WD solenoid valve

pin	colour	to con. or comp.	pin	wire function
1	HR	XS2	5	4WD solenoid valve
2	L	XS2	6	4WD solenoid valve

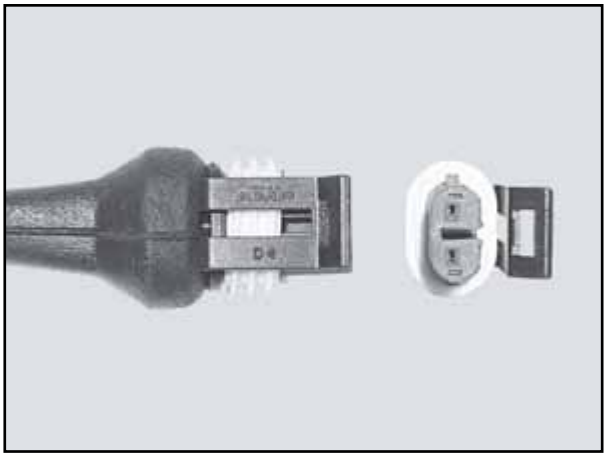


Fig. 10.1005

Connector (YV4) for diff. lock solenoid valve

pin	colour	to con. or comp.	pin	wire function
1	VR	XS2	7	diff lock solenoid valve
2	BR	XS2	8	diff lock solenoid valve

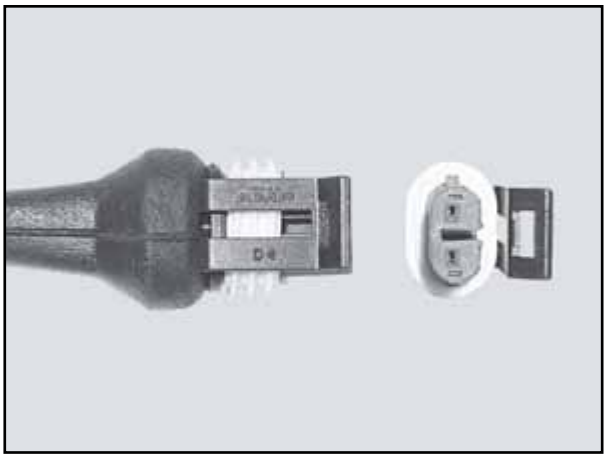


Fig. 10.1006

Terminal board (34-ways) (XS2) for rear/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	M	SQ1	1	gearbox safety
2	VN	SQ1	2	gearbox safety
3	HN	SQ2	1	Independent PTO indicator
4	B	SA-1		junction
5	HR	YV3	1	4WD solenoid valve
6	L	YV3	2	4WD solenoid valve
7	VR	YV4	1	diff lock solenoid valve
8	BR	YV4	2	diff lock solenoid valve
9				not used
10	ZN	SQ3	2	hand brake
11	CL	SP4	1	trailer brake bulb
12	C	SQ4	1	prop. PTO indicator light
13	R	SQ4	2	prop. PTO power
14	HL	SQ5	2	fast PTO indicator light
15				not used
16				not used
17				not used
18				not used
19				not used
20				not used
21				not used
22				not used
23				not used
24				not used
25				not used
26				not used
27				not used
28				not used
29				not used
30				not used
31				not used
32				not used
33				not used
34				not used

Fig. 10.1007

3.11.7.5 Soldering points tables

General description

There are “soldered” points in the wiring lines installed in **F-N Series E-Line** tractors so as to shunt common cables amongst the various functions.

The locations of the soldering points are graphically indicated in the wiring diagrams.

The table below indicates the relative functions and the cable colours for each soldering point in the various wiring lines.

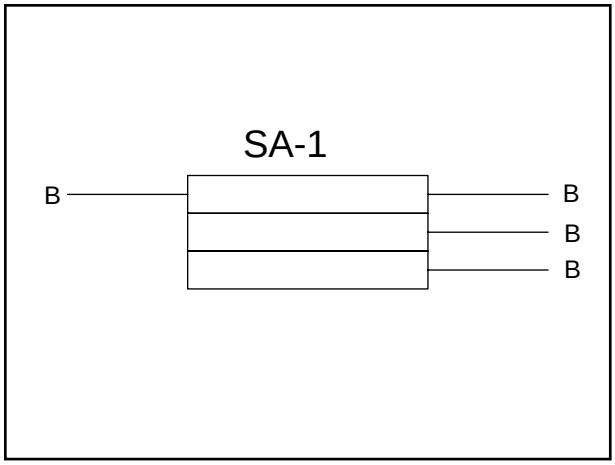


Fig. 10.1008

Dashboard line solder point table

SA-1

Colour	Wire function
B	ground
B	ground
B	ground
B	ground

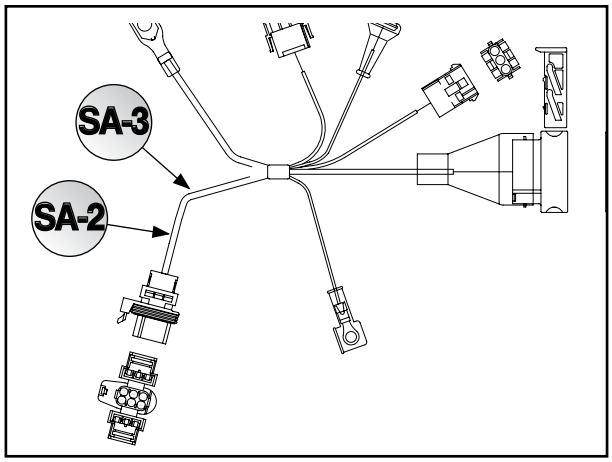


Fig. 10.1009

3.11.8 Headlight extension line

3.11.8.1 General description

The headlight extension line powers the lamps installed at the front of the tractor's bonnet (Fig.10.869).

The headlight extension line is connected to the engine's front line by means of the connection between connectors (XS6 Fig.10.870).

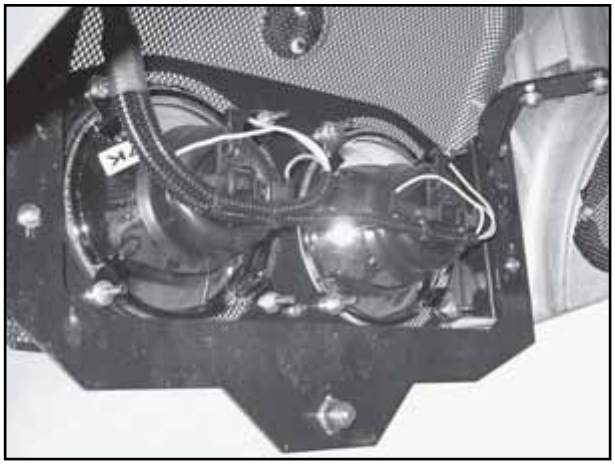


Fig. 10.1010

Fig. 10.1011

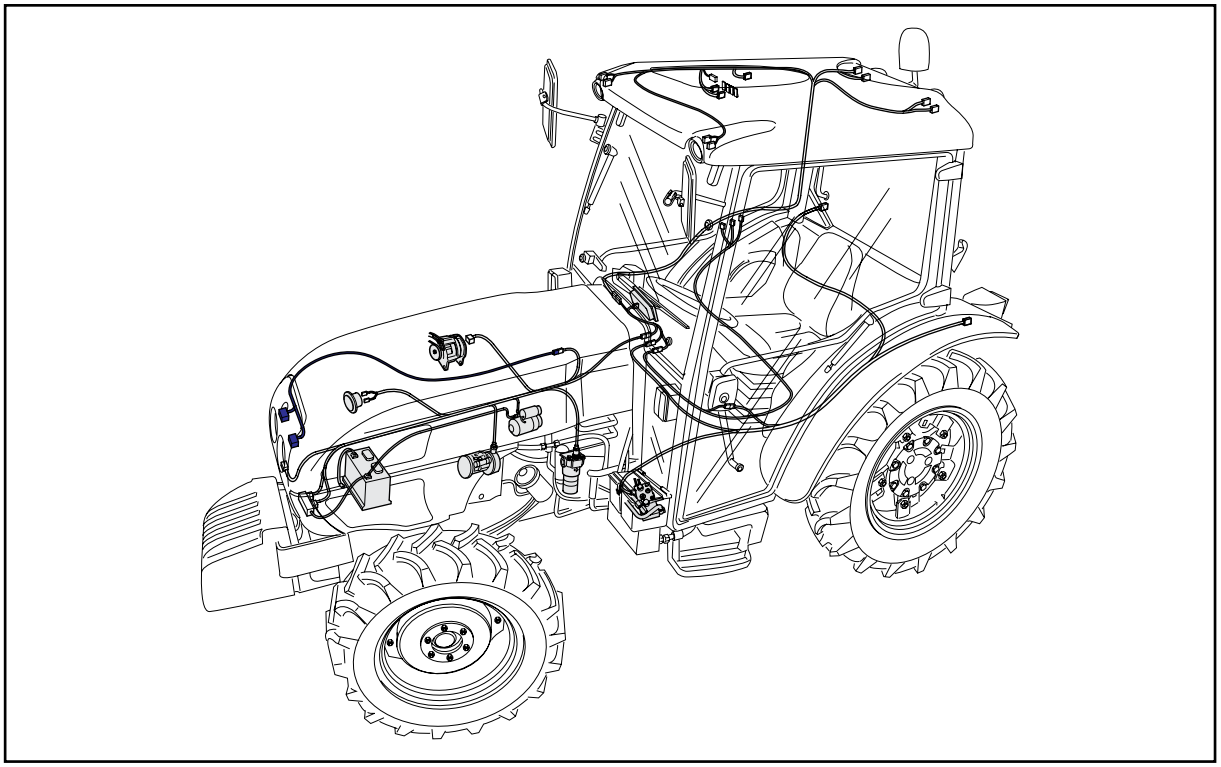


Fig. 10.1012

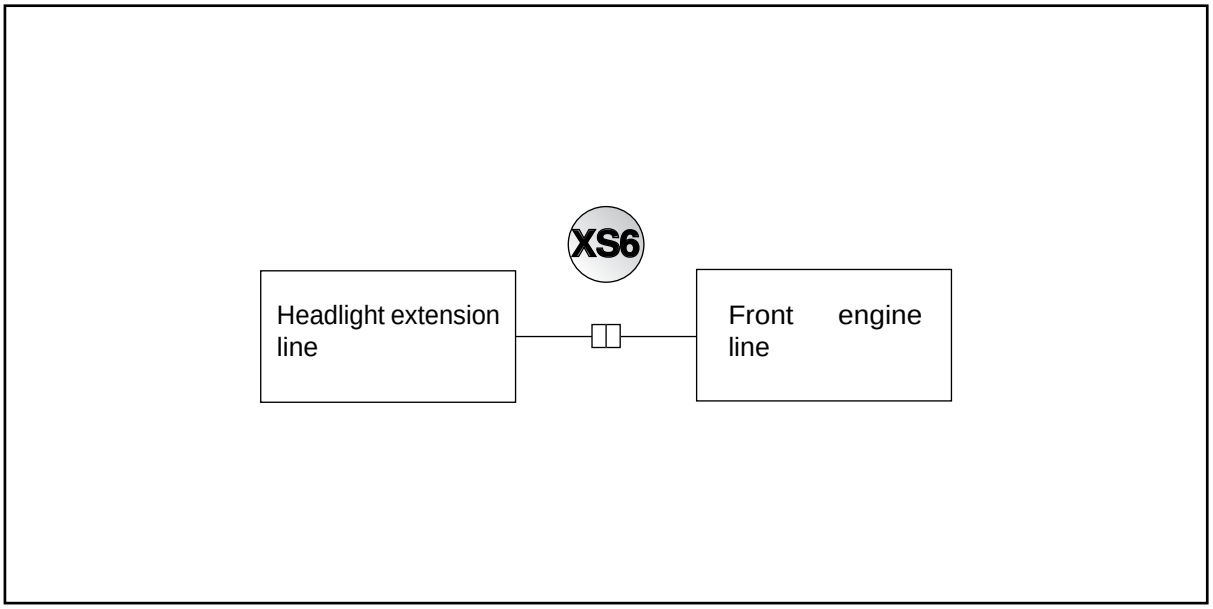


Fig. 10.1013

3.11.8.2 Wiring

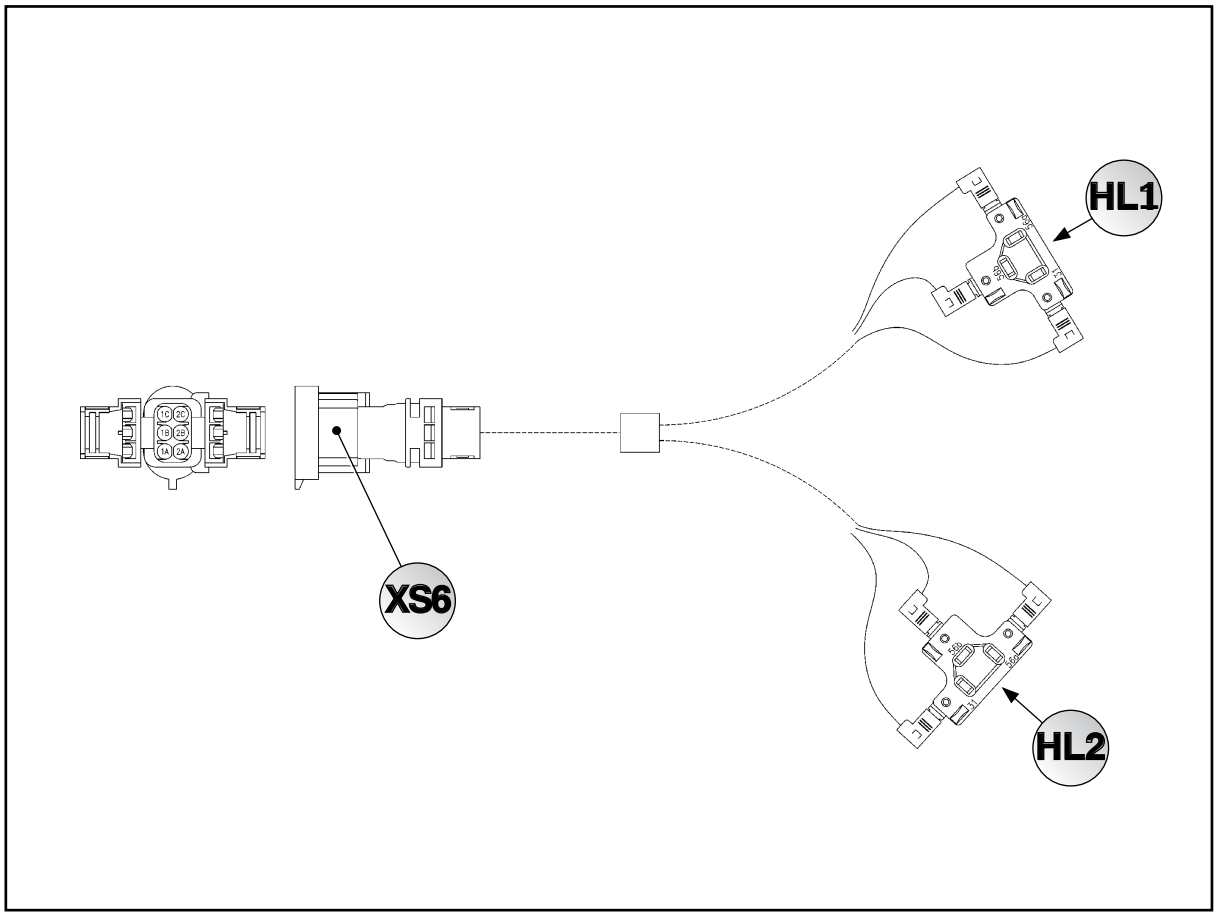


Fig. 10.1014

H1 - Lh headlight connector
H2 - Rh headlight connector
XS6 - Connector for connecting to the front line

3.11.8.3 Connector locations

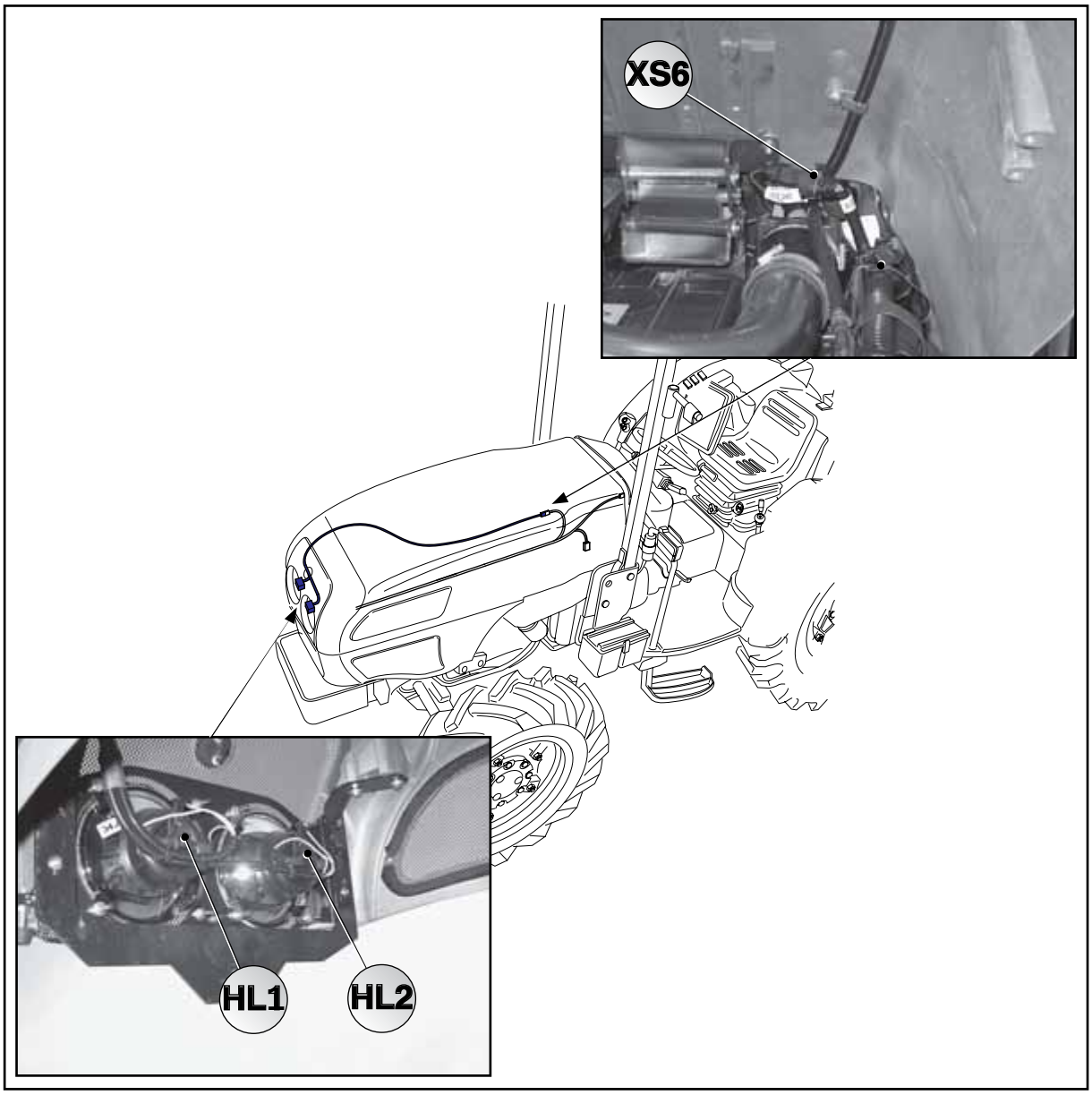


Fig. 10.1015

H1 - Lh headlight connector
H2 - Rh headlight connector
XS6 - Connector for connecting to the front line

3.11.8.4 Connector identification

Connector (HL1) for lh front field light connection

pin	colour	to con. or comp.	pin	wire function
1	B	XS6	2C	lh field light ground
2	H	XS6	2B	lh dipped beam
3	V	XS6	1A	lh driving beam

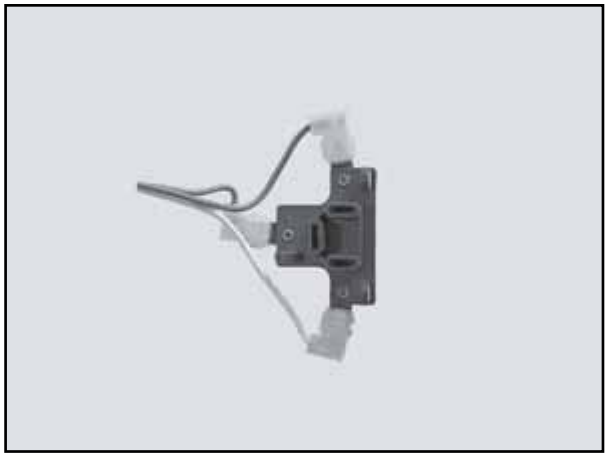


Fig. 10.1016

Connector (HL2) for rh front field light connection

pin	colour	to con. or comp.	pin	wire function
1	B	XS6	1C	rh field light ground
2	HN	XS6	2A	rh dipped beam
3	VN	XS6	1B	rh driving beam

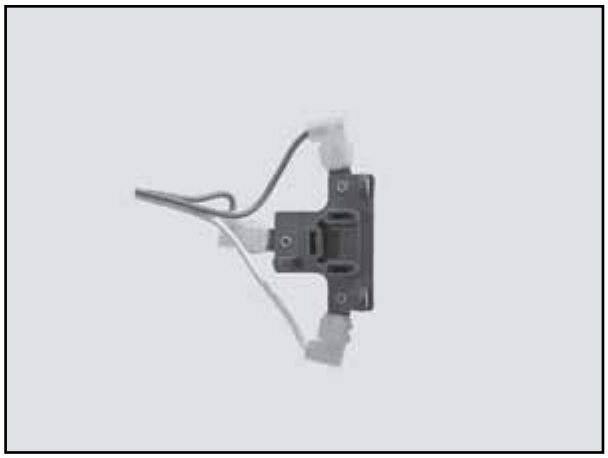


Fig. 10.1017

Connector (XS6) for connecting to the front line

pin	colour	to con. or comp.	pin	wire function
1A	V	HL1	3	lh front driving b.
1C	VN	HL2	3	rh front driving b.
1C	B	HL2	1	rh field light ground
2A	HN	HL2	2	rh dipped beam
2B	H	HL1	2	lh dipped beam
2C	B	HL1	1	lh field light ground

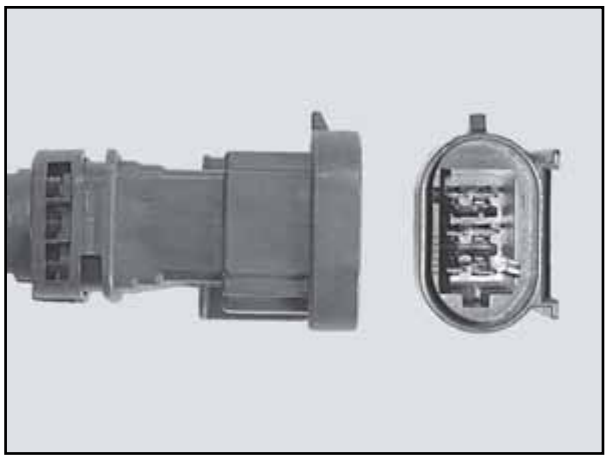


Fig. 10.1018

3.11.9 Roof line

3.11.9.1 General description

The roof wiring line powers the components installed on the cab roof. The air conditioning system is installed in the rear part of the roof and is connected to the system by this wiring line. The field light switches, windowscreen wiper switches, etc., are also powered by this line.

The cab roof line is connected to the dashboard line via the terminal boards (XS5) (Fig.10.1021).

The roof line is also equipped with another fuse (F6) which protects the direct powering system for the cab services. It is installed between the roof service line and the power from the alternator. The fuse (F6) is installed just under the bonnet;

Fig. 10.1019

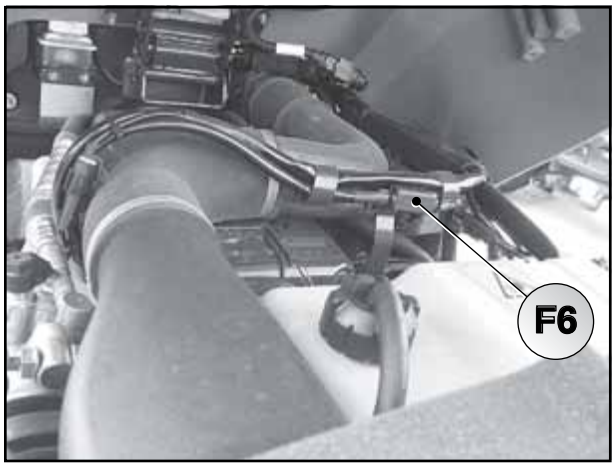


Fig. 10.1020

Fig. 10.1021

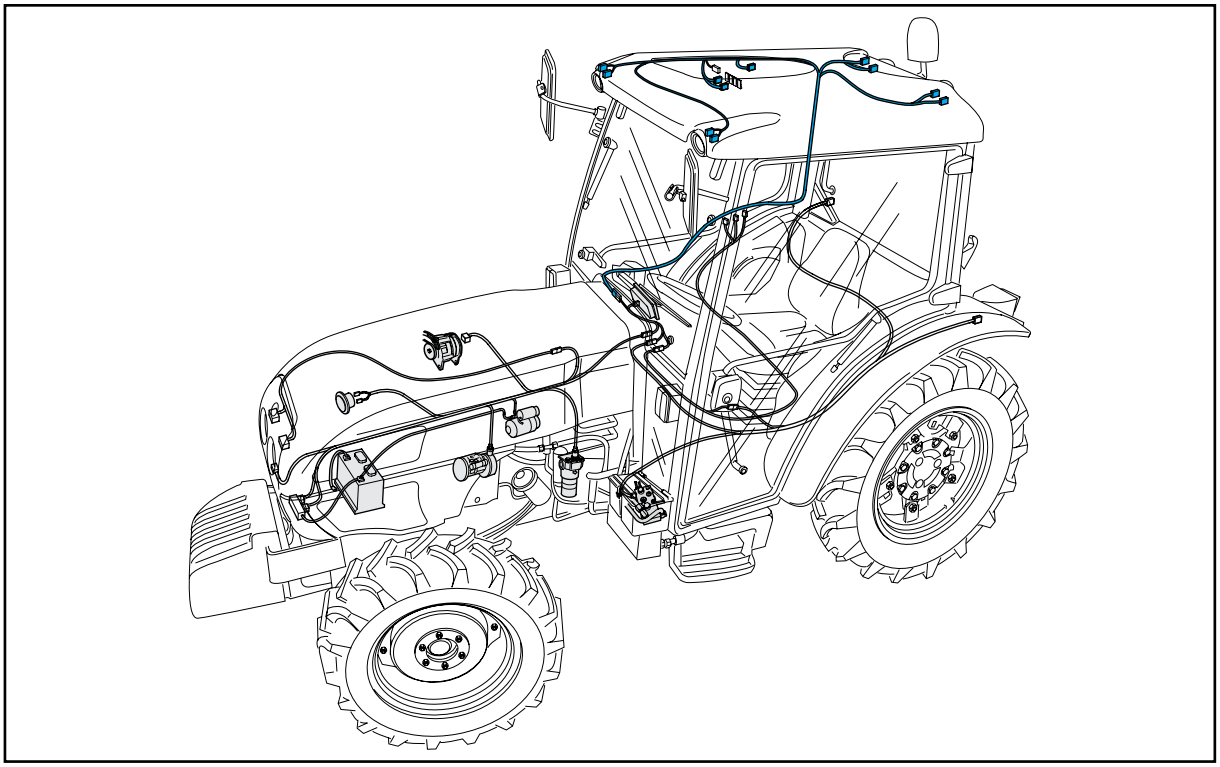


Fig. 10.1022

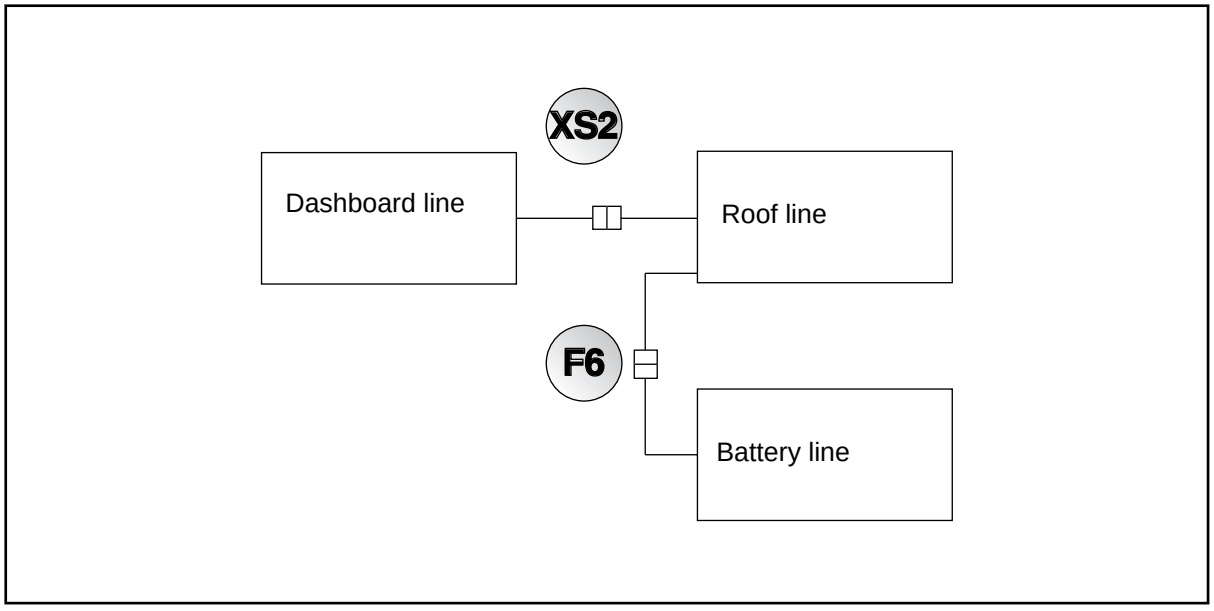


Fig. 10.1023

3.11.9.2 Wiring

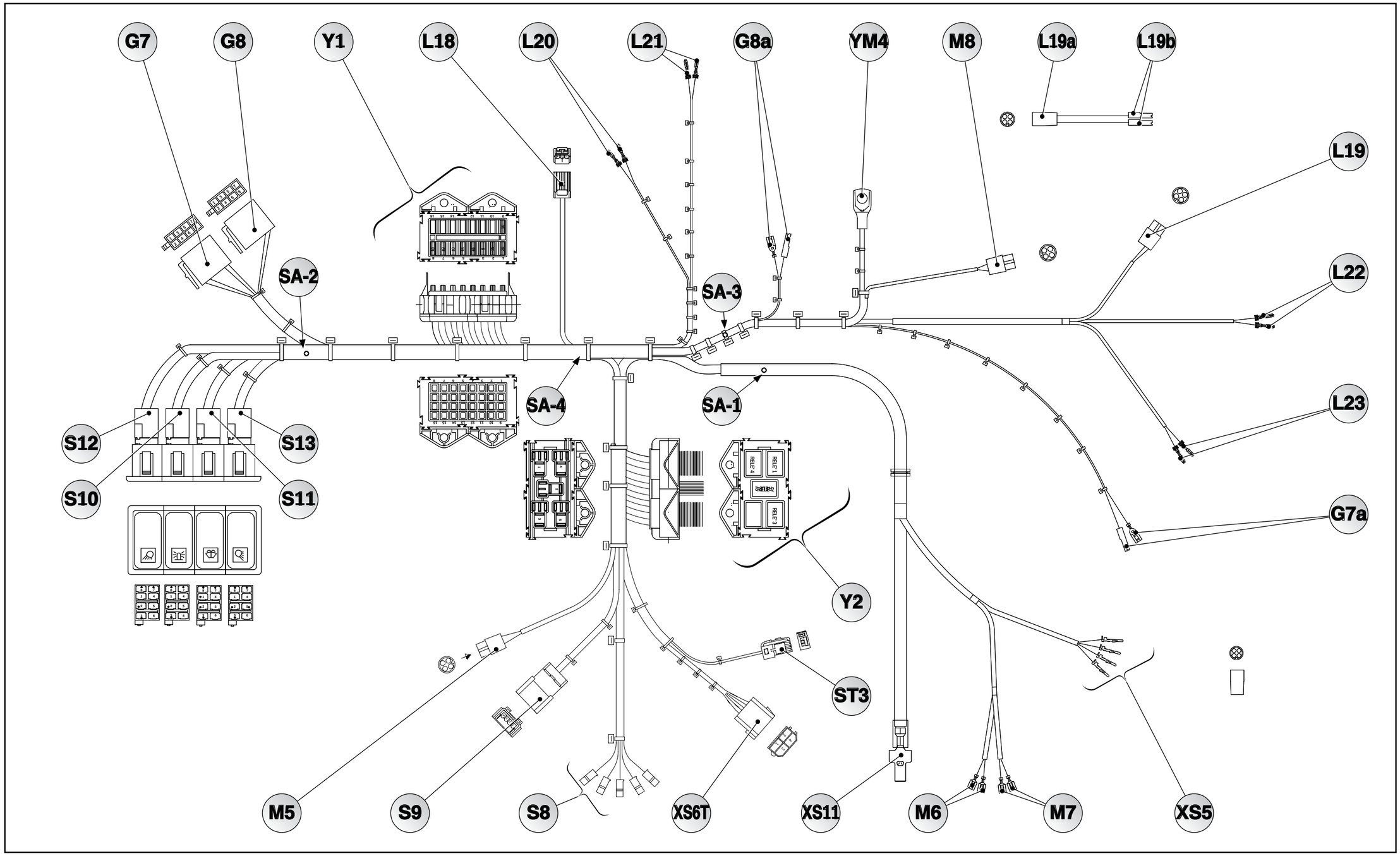


Fig. 10.1024

G7_G7a - Terminals for lh loud-speaker
G8_G8a - Terminals for rh loud-speaker
L18 - Ceiling light connector
L19 - Terminals for connecting the revolving beacon brace
L19a - Connector for revolving beacon brace
L19b - Terminals for connecting the revolving beacon
L20 - Terminals for lh front field light connection
L21 - Terminals for rh front field light connection
L22 - Terminals for lh rear field light connection
L23 - Terminals for rh rear field light connection
M5 - Windscreen wiper
M6 - Rear window washer terminals
M7 - Windscreen washer terminals
M8 - Connector for rear window wiper
S8 - Terminals for A/C fan selector
S9 - Connector for A/C button
S10 - Cab rotating beacon switch
S11 - Windscreen/rear window washer switch
S12 - Front roof field light switch
S13 - Rear roof field light switch
SA-1_SA-4 - Junction
ST3 - Connector for A/C anti-icing temperature sensor
XM4 - Eyelet for roof line ground
XS5 - Terminal board for roof line/dashboard connection
XS6T - Connector for A/C system
XS11 - Terminals for cab power connection
Y1 - Cab fuse box
Y2 - Cab relay box

3.11.9.3 Connector locations

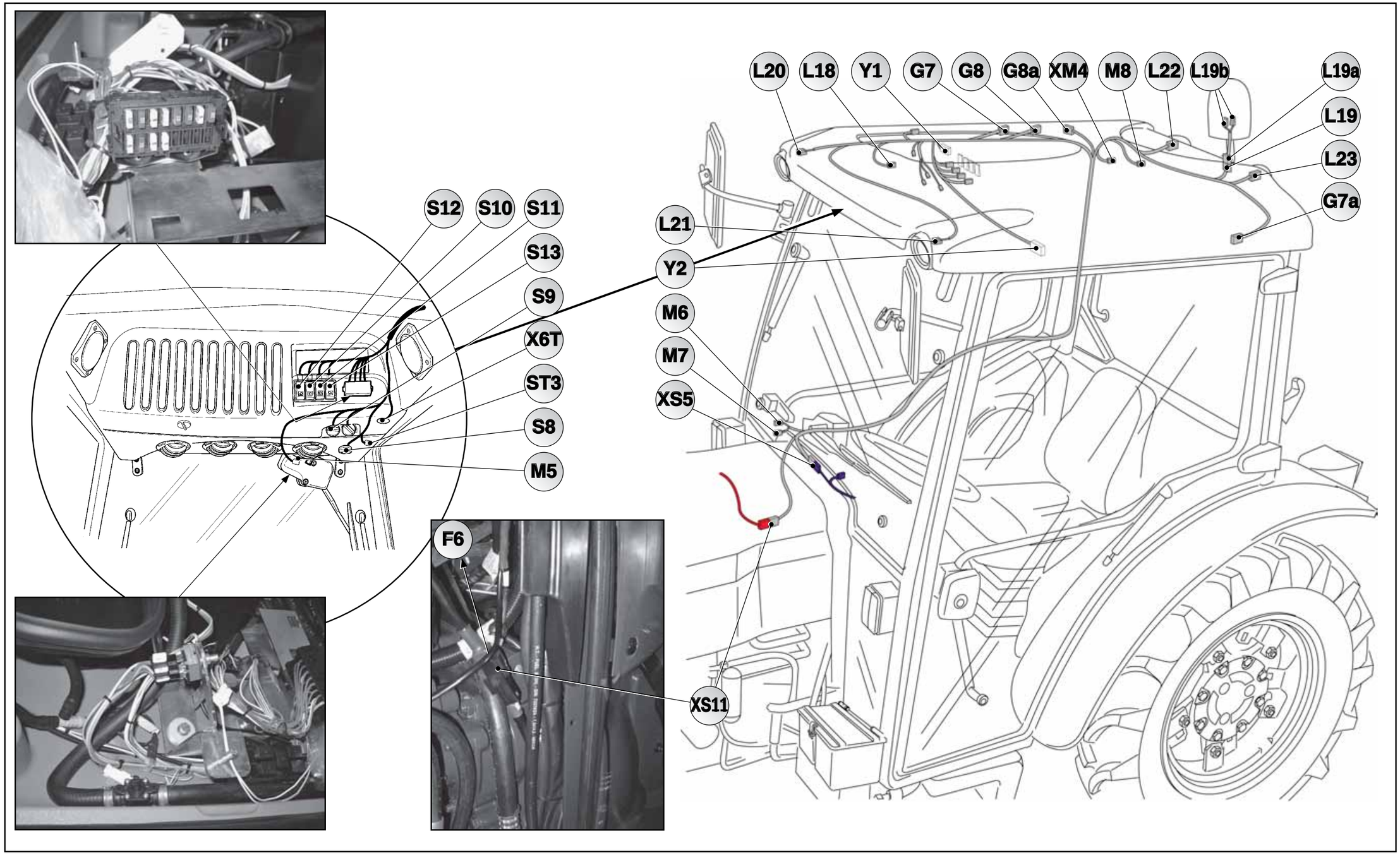


Fig. 10.1025

G7_G7a - Terminals for lh loud-speaker
G8_G8a - Terminals for rh loud-speaker
L18 - Ceiling light connector
L19 - Terminals for connecting the revolving beacon brace
L19a - Connector for revolving beacon brace
L19b - Terminals for connecting the revolving beacon
L20 - Terminals for lh front field light connection
L21 - Terminals for rh front field light connection
L22 - Terminals for lh rear field light connection
L23 - Terminals for rh rear field light connection
M5 - Windscreen wiper
M6 - Rear window washer terminals
M7 - Windscreen washer terminals
M8 - Connector for rear window wiper
S8 - Terminals for A/C fan selector
S9 - Connector for A/C button
S10 - Cab rotating beacon switch
S11 - Windscreen/rear window washer switch
S12 - Front roof field light switch
S13 - Rear roof field light switch
ST3 - Connector for A/C anti-icing temperature sensor
XM4 - Eyelet for roof line ground
XS5 - Terminal board for roof line/dashboard connection
XS6T - Connector for A/C system
XS11 - Terminals for cab power connection
Y1 - Cab fuse box
Y2 - Cab relay box

3.11.9.4 Connector identification

Terminals (G7_G7a) for lh loud-speaker

pin	colour	to con. or comp.	pin	wire function
1	AN	G7	8	
2	A	G7	7	

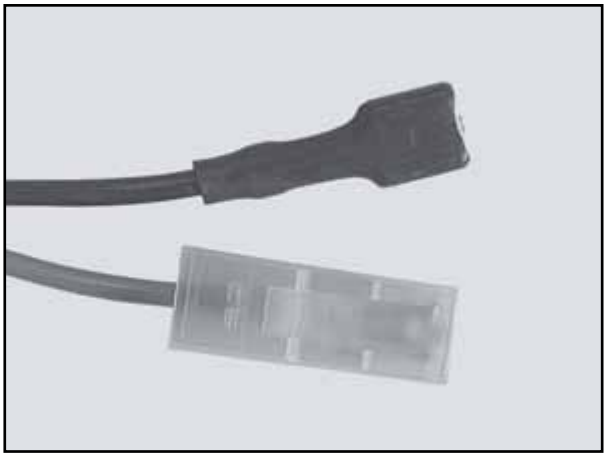


Fig. 10.1026

Terminals (G8_G8a) for rh loud-speaker

pin	colour	to con. or comp.	pin	wire function
1	G	G7	1	
2	GN	G7	2	

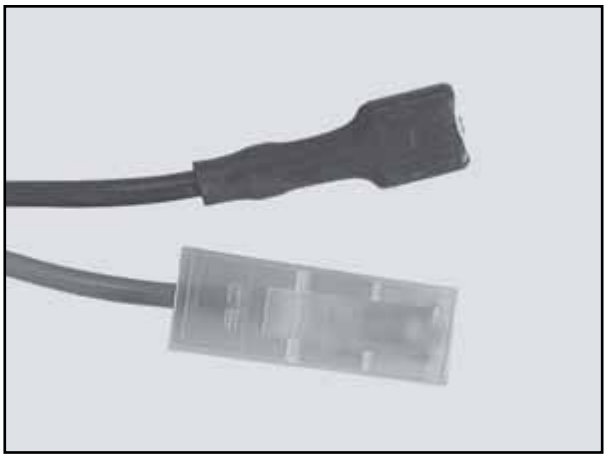


Fig. 10.1027

Ceiling light connector (L18)

pin	colour	to con. or comp.	pin	wire function
1	BR	FC4		
2	B	SA-3		junction
3				not used

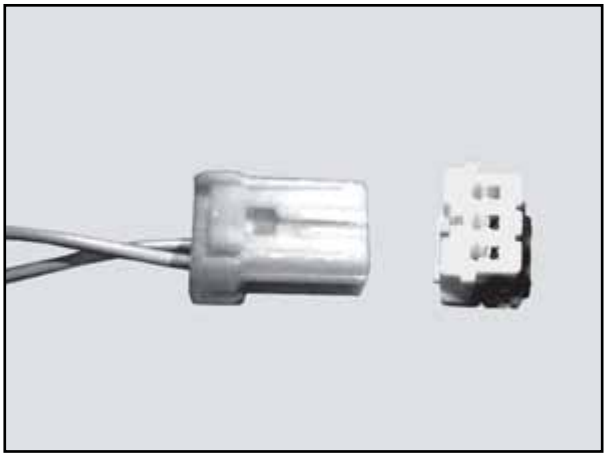


Fig. 10.1028

Terminal (L19) for revolving beacon brace connection

pin	colour	to con. or comp.	pin	wire function
1	RV	SA-10	3	
2	B	XM4		ground

Fig. 10.1029

Connector (L19a) for revolving beacon brace

pin	colour	to con. or comp.	pin	wire function
1	B	L19b	1	
2	RV	L19b	2	

Fig. 10.1030

Connector (L19b) for revolving beacon connection

pin	colour	to con. or comp.	pin	wire function
1	B	L19a	1	
2	RV	L19a	2	

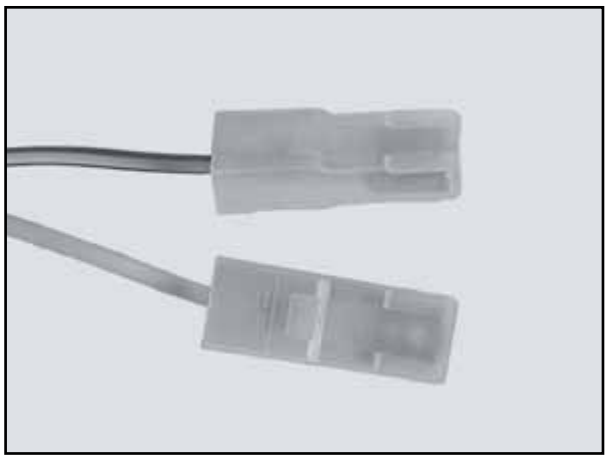


Fig. 10.1031

Terminals (L20) for lh front field light connection

pin	colour	to con. or comp.	pin	wire function
1	LN	KC4	87	
2	B	SA-3		junction

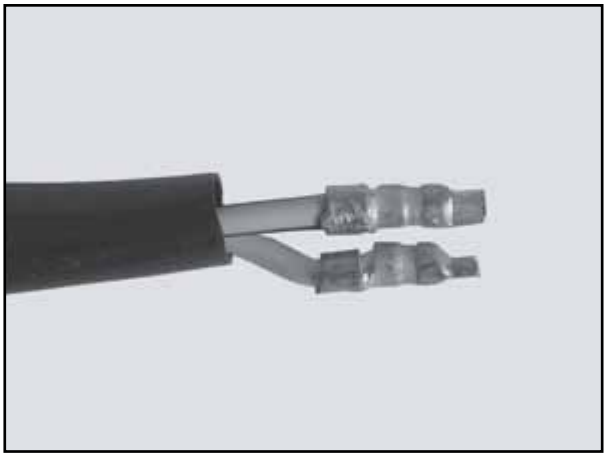


Fig. 10.1032

Terminals (L21) for rh front field light connection

pin	colour	to con. or comp.	pin	wire function
1	LN	KC4	87	
2	B	SA-3		junction

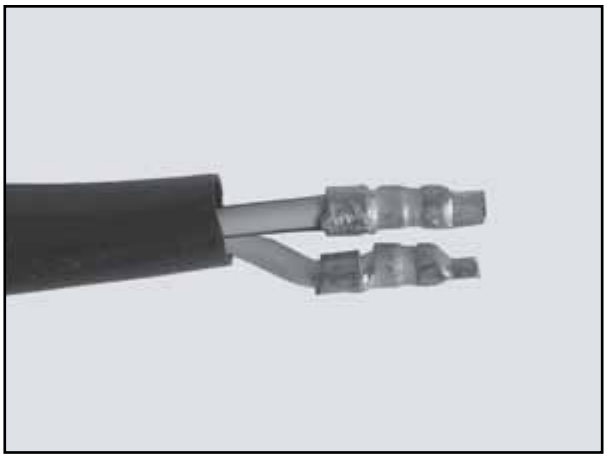


Fig. 10.1033

Terminals (L22) for lh rear field light connection

pin	colour	to con. or comp.	pin	wire function
1	AG	KC5	87	
2	B	XM4		ground

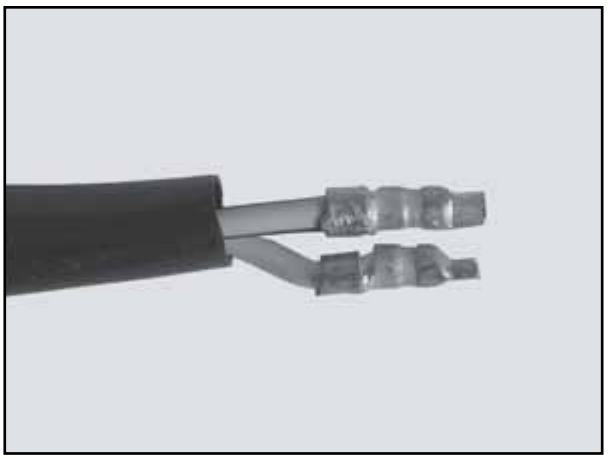


Fig. 10.1034

Terminals (L23) for rh rear field light connection

pin	colour	to con. or comp.	pin	wire function
1	AG	KC5	87	
2	B	XM4		ground

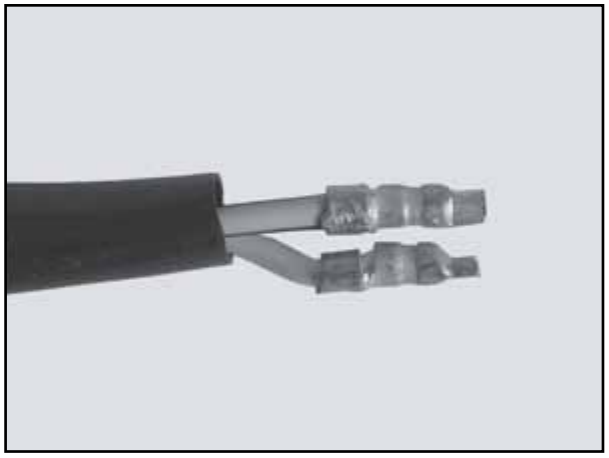


Fig. 10.1035

Connector (M5) for windscreen wiper

pin	colour	to con. or comp.	pin	wire function
1	MB	FC8		
2	B	SA-3		junction

Fig. 10.1036

Rear window washer terminals (M6)

pin	colour	to con. or comp.	pin	wire function
1	VB	SA11	1	
2	B	M7	2	

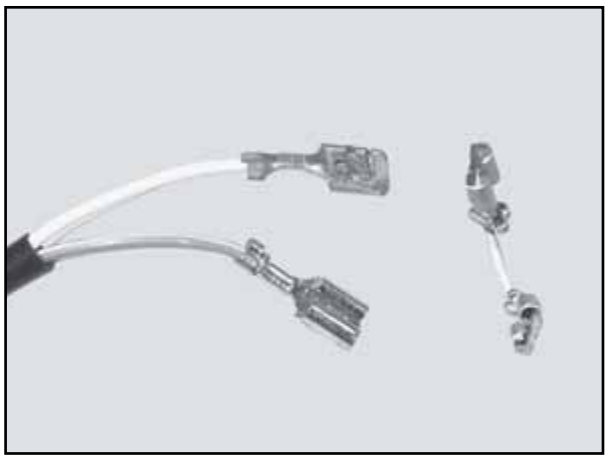


Fig. 10.1037

Windscreen washer terminals (M7)

pin	colour	to con. or comp.	pin	wire function
1	VZ	SA11	3	
2	B-B	M6-XS5	2-4	

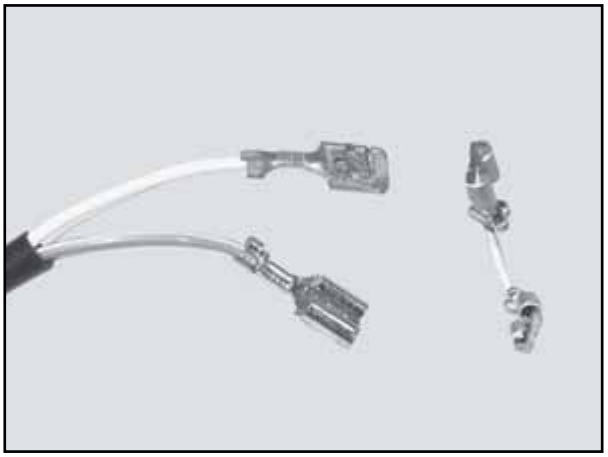


Fig. 10.1038

Connector (M8) for rear window wiper

pin	colour	to con. or comp.	pin	wire function
1	MN	FC10		
2	B	XM4		ground

Fig. 10.1039

Terminals (S8) for A/C fan selector

pin	colour	to con. or comp.	pin	wire function
1	G	XS6T	2	
2	C	XS6T	4	
3	R	XS6T	3	
4	LN	FC2		
5	S	FC1		

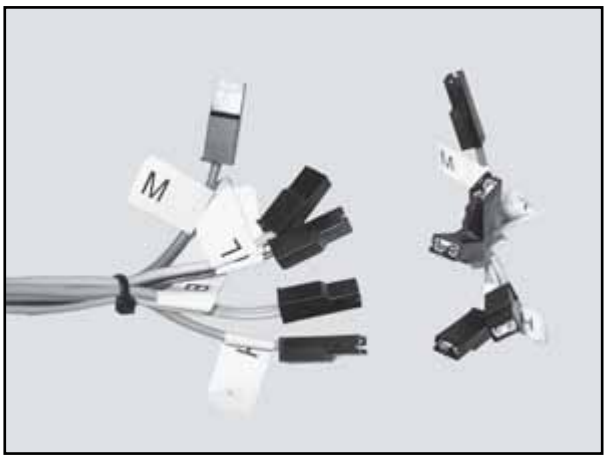


Fig. 10.1040

Connector (S9) for A/C button

pin	colour	to con. or comp.	pin	wire function
1	B	SA-3		junction
2	G	FC3		
3	GV	KC2	86	
4	L	FC2		

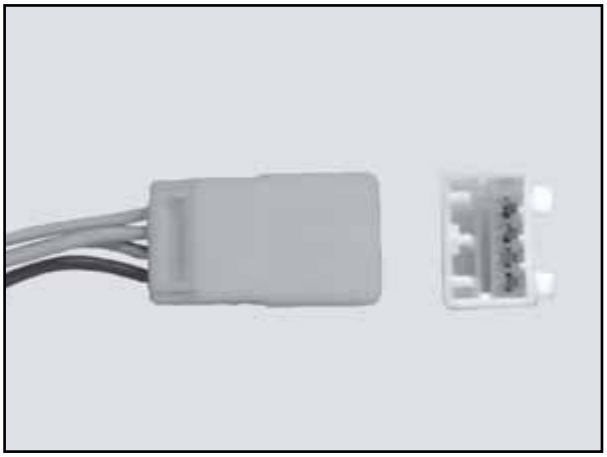


Fig. 10.1041

Cab rotating beacon switch (S10)

pin	colour	to con. or comp.	pin	wire function
1				not used
2	BR	FC4		
3	RV	L19	1	
4				not used
5				not used
6				not used
7	B	SA-3		junction
8	HG	SA-2		junction

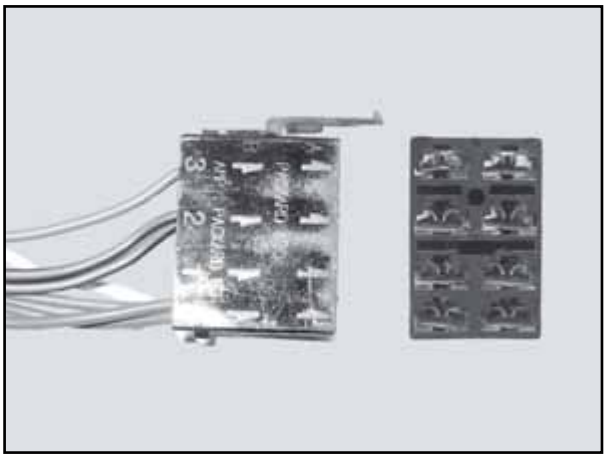


Fig. 10.1042

Windscreen/rear window washer switch (S11)

pin	colour	to con. or comp.	pin	wire function
1	VB	M6	1	
2	MR	FC9		
3	VZ	M7	1	
4				not used
5				not used
6				not used
7	B	SA-3		junction
8	HG	SA-2		junction

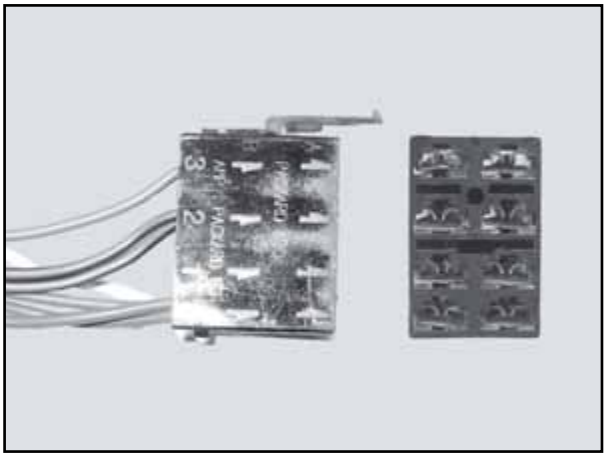


Fig. 10.1043

Front field light switch (S12)

pin	colour	to con. or comp.	pin	wire function
1				not used
2	M	SA-4		junction
3	MS	KC4	86	
4				not used
5				not used
6				not used
7	B	SA-3		junction
8	HG	SA-2		junction

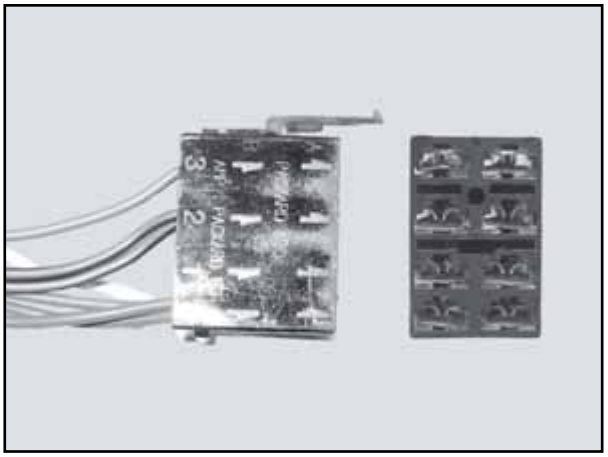


Fig. 10.1044

Rear field light switch (S13)

pin	colour	to con. or comp.	pin	wire function
1				not used
2	M	SA-4		junction
3	MC	KC5	86	
4				not used
5				not used
6				not used
7	B	SA-3		junction
8	HG	SA-2		junction

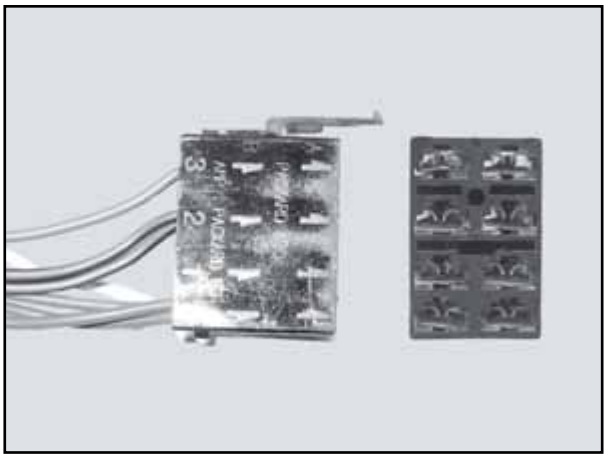


Fig. 10.1045

Connector (ST3) for A/C anti-icing temperature sensor

pin	colour	to con. or comp.	pin	wire function
1	GV	KC2	86	
2	B	SA-3		junction
3	VN	KC2	85	

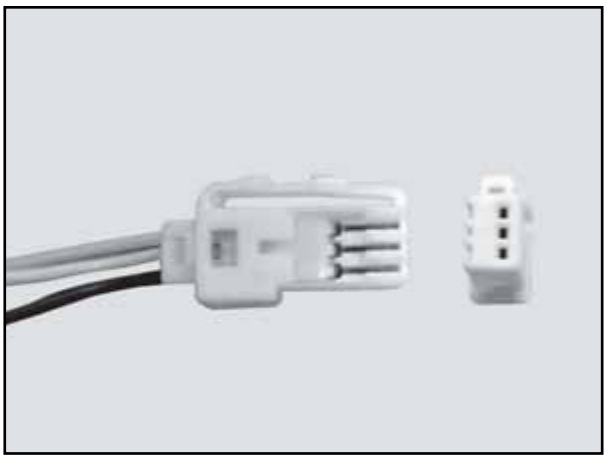


Fig. 10.1046

Terminal board (XS5) for roof/dashboard line connection

pin	colour	to con. or comp.	pin	wire function
1	M	KC1	86	
2	GM	KC2	87	
3	HG	SA-2		junction
4	B	M7	2	

Fig. 10.1047

Connector (XS6T) for A/C system

pin	colour	to con. or comp.	pin	wire function
1	B	SA-3		junction
2	G	S8	1	
3	R	S8	3	
4	C	S8	2	

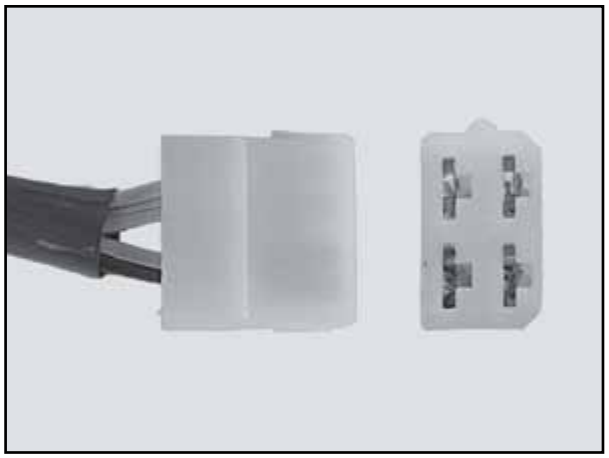


Fig. 10.1048

Terminal (XS11) for cab power connection

pin	colour	to con. or comp.	pin	wire function
1	R	SA-1		junction

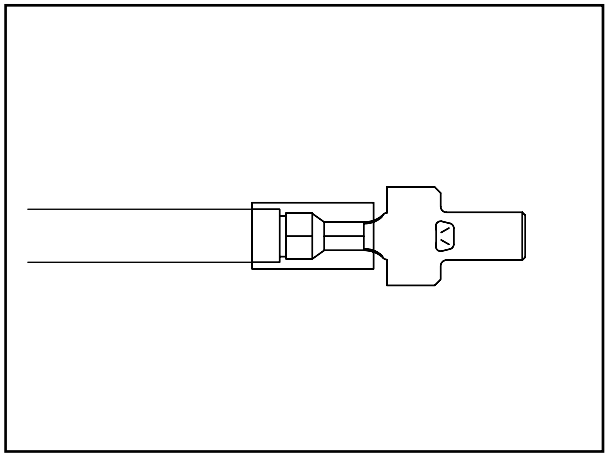


Fig. 10.1049

The ground connection is made by means of the eyelet (XM4) fixed to the rh rear cab pillar. The radio system is also grounded on the same connection.

Fig. 10.1050

Section 4 : Main components (Speed Five and Power Shuttle versions)

Index

4.1 Introduction 10-606

4.2 Sensors and potentiometers 10-607
4.2.1 General description 10-607
4.2.3 Identification 10-610
4.2.4 Adjustments 10-616

4.3 Solenoid valves 10-619
4.3.1 General description 10-619
4.3.2 Location 10-622
4.3.3 Identification 10-623
4.3.4 Inspections 10-630

4.4 Switches and buttons 10-632
4.4.1 General description 10-632
4.4.2 Location 10-633
4.4.3 Identification 10-634

4.5 Instrument 10-640
4.5.1 General description 10-640
4.5.2 Indicators and connections 10-642
4.5.3 Settings 10-648
4.5.4 “Model” and “Tyres” tables 10-652

4.1 Introduction

This section deals with the main electrical components installed in **F-N Series Speed Five and Power Shuttle**tractors, as well as particular information about the maintenance work and adjustments the repair technician must make, along with certain particular recommendations.

The potentiometers, sensors, solenoid valve, switches and buttons are identified with the same letters and progressive numbers used in the functional diagram. This identification is maintained throughout all the sections of this manual.

Comply with the recommendations and safety measures described in the operation and use manual and in chapter 1 of this manual, besides the elementary rules of “common sense” when servicing, repairing and replacing these components.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: Always consult the instructions in the operation and maintenance manual when working on the battery.
	Attention: When the acid is mixed with water, SLOWLY POUR THE ACID INTO THE WATER, NEVER EVER POUR WATER INTO THE ACID.
	Attention: do not smoke when checking or handling batteries.
	Attention: disconnect the negative terminal first. connect the positive terminal first when installing the battery again. Always take great care to check the polarity of the terminals.
	Attention: always disconnect the ground cable (-) of the battery before working on the electrical system.

4.2 Sensors and potentiometers

4.2.1 General description

I **sensors** have a double function:

- they detect faulty situations in the tractor,
- they detect operating statuses of the tractor.

In both cases, the operator is informed about the data detected by means of indicator lights and leds on the instrument.

Inductive sensor

The inductive sensor has an internal cylinder made of ferromagnetic material surrounded by a winding.

When the sensor is set in the frontal position in relation to the teeth of a turning gear, an alternate voltage is obtained (by induction) on the external winding of the sensor itself. The magnetic field of the plunger strikes the teeth of the gear which, by turning, influences the continuity.

The frequency of the voltage thus obtained allows the rotation rate to be calculated.

Inductive sensor inspection

Using a tester, measure the value of the resistance in the sensor. This value must be about **450 ohm**.

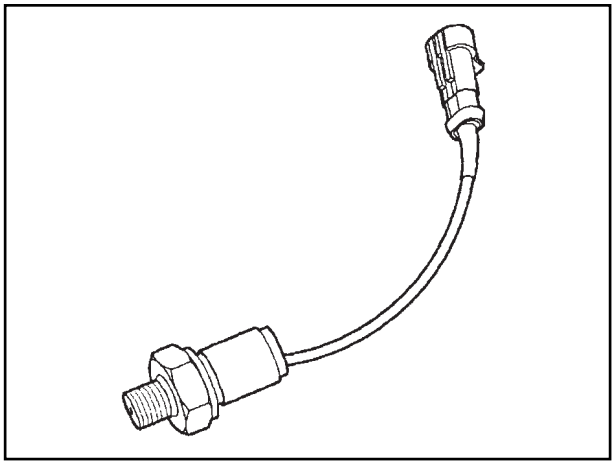


Fig. 10.1051

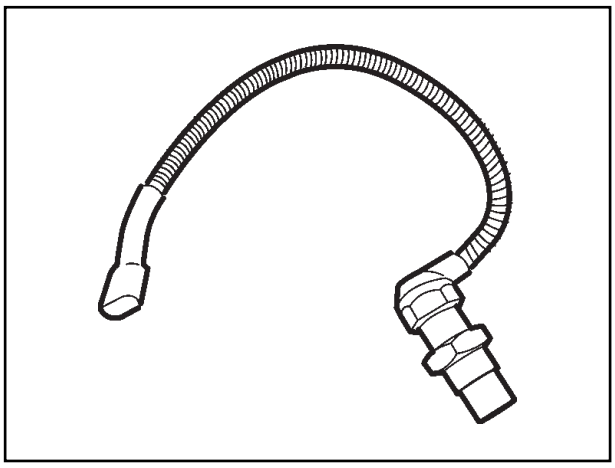


Fig. 10.1052

Hall sensor

The Hall sensor consists of an integrated device with a certain sensitivity at non-electric signals. This sensitivity is obtained by incorporating the sensitive elements, the power supply and signal amplifying and treatment circuits in the silicon plate. The force exercised on a “charged” particle within a magnetic field, creates the Hall effect which occurs when a current perpendicular to a magnetic field passes through a semiconductor.

The structure of a Hall sensor is illustrated in Fig.10.1054.

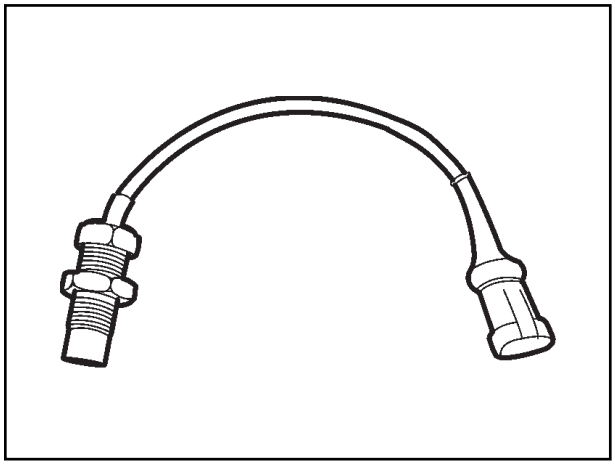


Fig. 10.1053

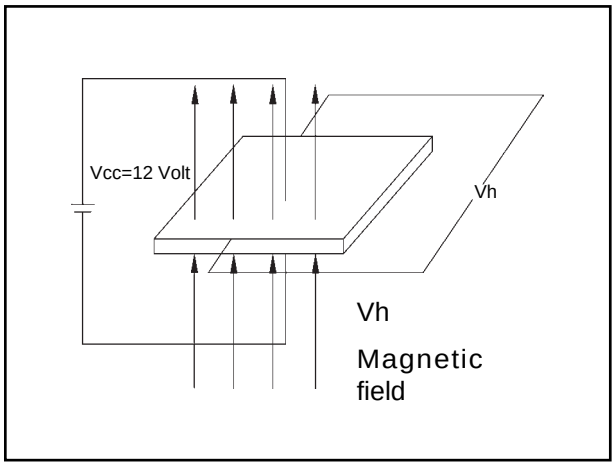


Fig. 10.1054

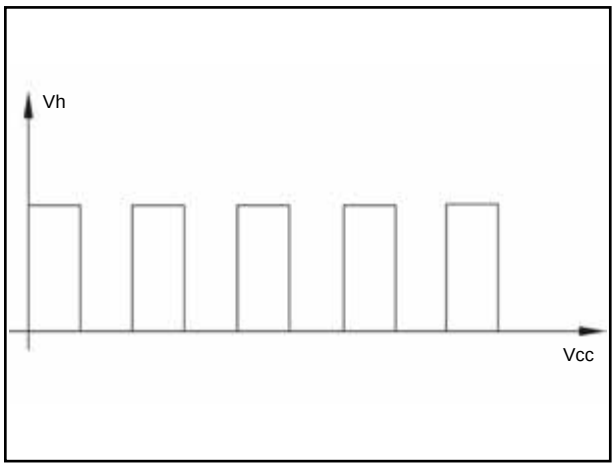


Fig. 10.1055

Vh

Location

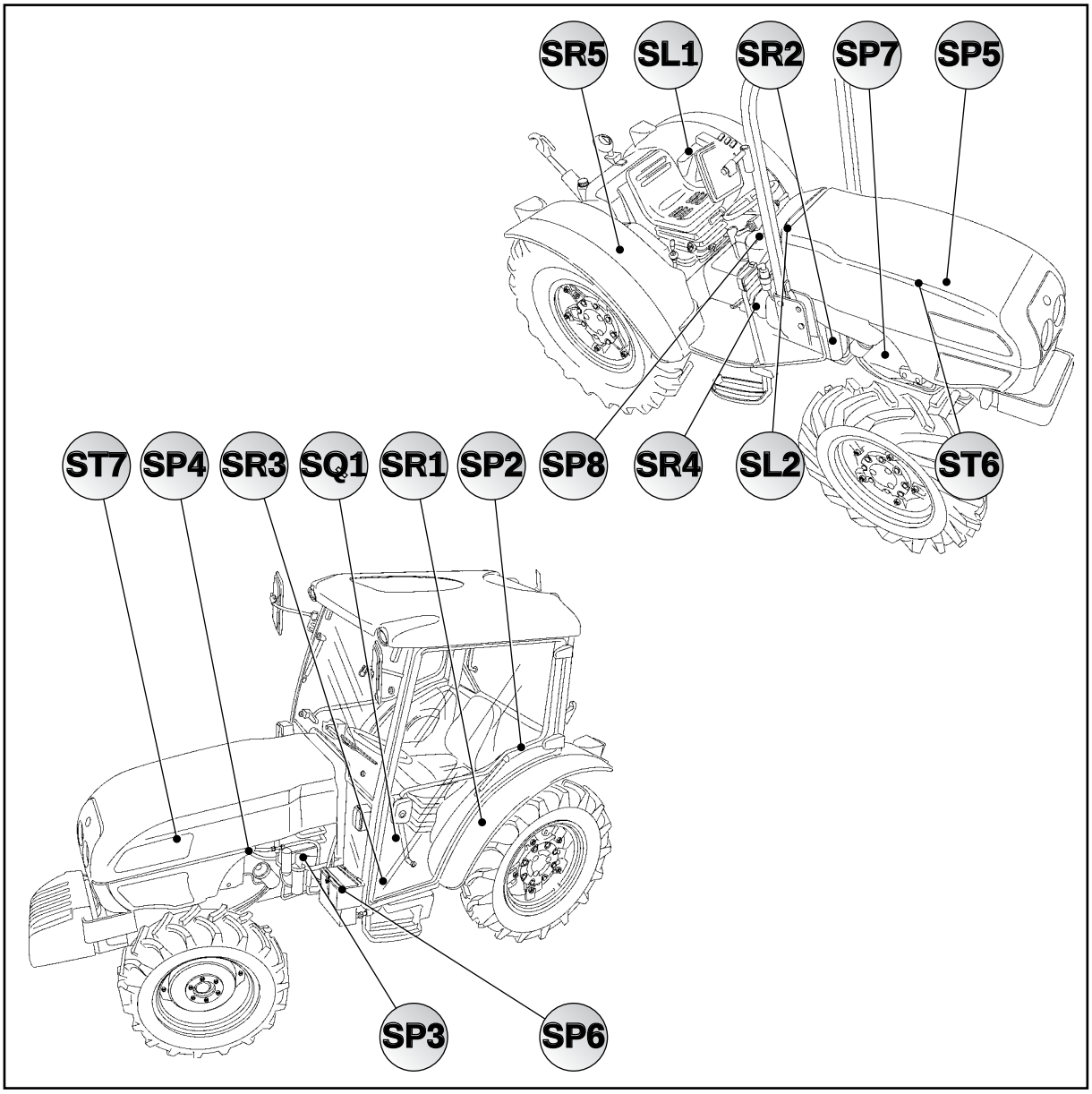


Fig. 10.1056

SL1 - Fuel level sensor
SL2 - Brake fluid level sensor
SP2 - Trailer brake oil pressure sensor
SP3 - Gearbox oil intake filter sensor
SP4 - Engine oil pressure sensor
SP5 - Engine air intake filter sensor
SP6 - Low flow circuit pressure sensor
SP7 - Gearbox oil filter clogging sensor
SP8 - Brake pump oil pressure sensor
SR1 - Ground speed sensor
SR2 - Engine rate sensor
SR3 - Lh speed sensor (Deltashift system)
SR4 - Rh speed sensor (Deltashift system)
SR5 - PTO speed sensor
ST6 - Engine coolant temperature sensor
ST7 - Temperature sensor for fuel enrichment jet
SQ1 - Clutch pedal potentiometer

4.2.3 Identification

Gearbox oil filter clogging sensor

The sensor (SP7) under the hydraulic pump, on the intake pipe, indicates when the transmission oil filter becomes clogged by means of an indicator light (unbroken light) on the instrument.

The sensor (SP7) is connected to the front wiring.

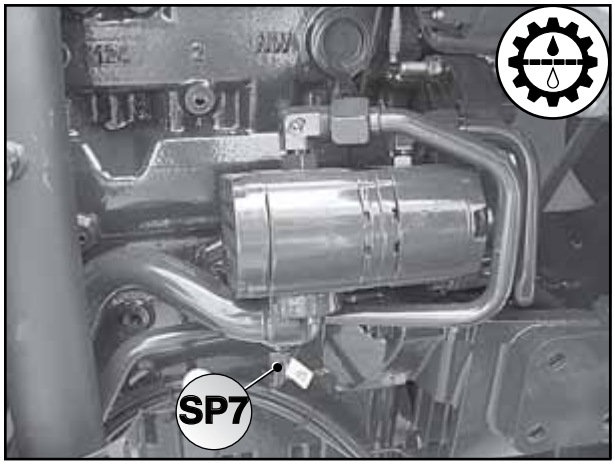


Fig. 10.1057

Engine coolant temperature sensor

This sensor (ST6), installed on the cylinder head, indicates the operating temperature of the engine and any overheating through an analog signal on the instrument.

The temperature sensor (ST6) changes the signal transmitted to the instrument according to the variation in its resistive value (expressed in Ohm).

The sensor (SP6) is connected to the front wiring.

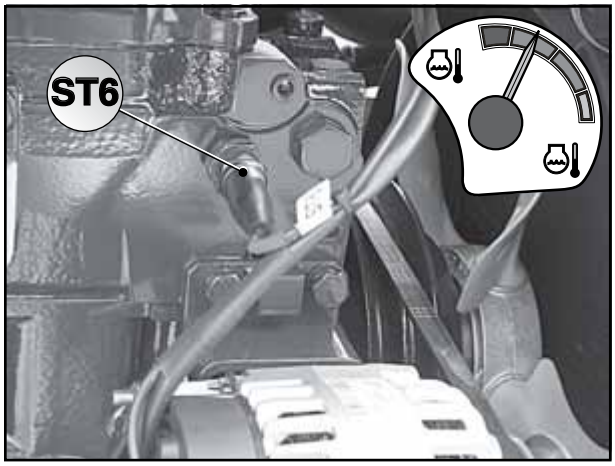


Fig. 10.1058

Engine oil pressure sensor

The sensor (SP4) on the left-hand side of the engine, indicates when the engine oil pressure is too low by means of an indicator light on the instrument.

The sensor (SP4) is connected to the front wiring.

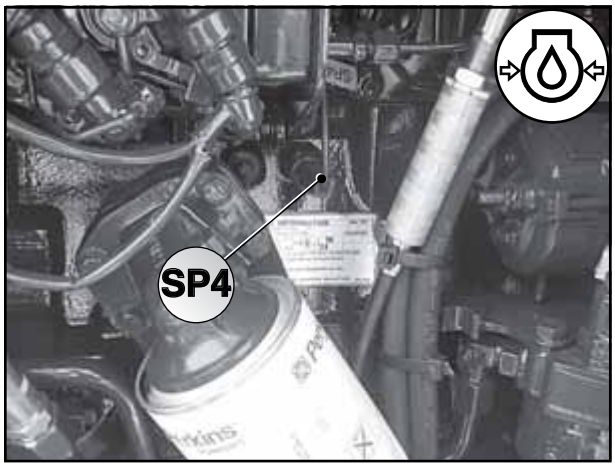


Fig. 10.1059

Engine air intake filter sensor

The sensor (SP5) on the sleeve that connects the intake manifold to the air filter, indicates when this latter becomes clogged by means of an indicator light on the instrument.

The sensor (SP5) is connected to the front wiring.

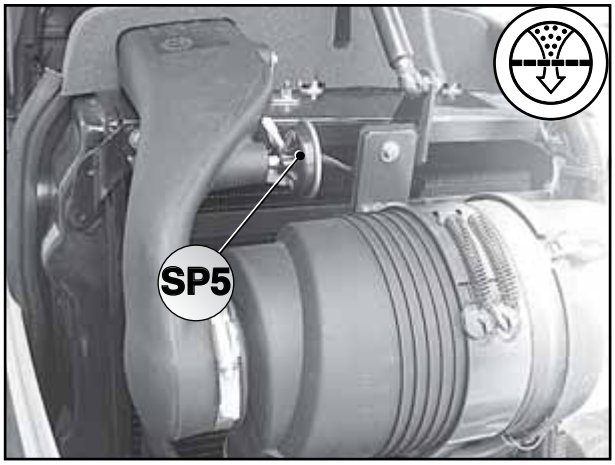


Fig. 10.1060

Fuel level sensor

The sensor (SL1) on the fuel tank plug indicates the level in the tank by means of an indicator light on the instrument.

The sensor (SP1) is connected to the platform wiring.

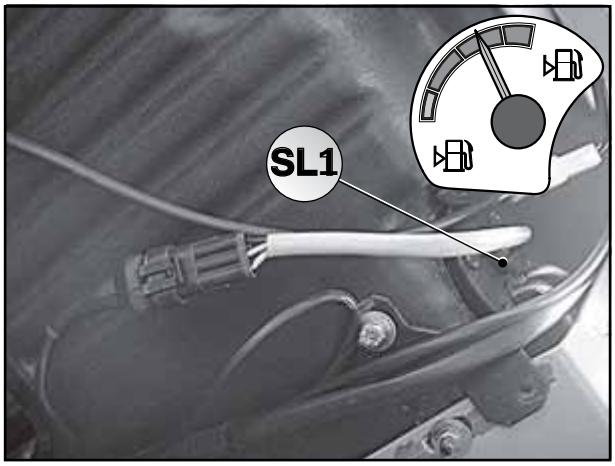


Fig. 10.1061

Low pressure circuit pressure sensor (20 bar)

The sensor (SP6) on the hydraulic power pack (10), indicates when the pressure in the low pressure hydraulic circuit is too low by means of an indicator light on the instrument. When the pressure detected is less than 10 bar, the sensor transmits a signal to the electronic control unit. The signal is transmitted to the instrument via the CAN BUS line.

The sensor (SP6) is connected to the rear wiring.

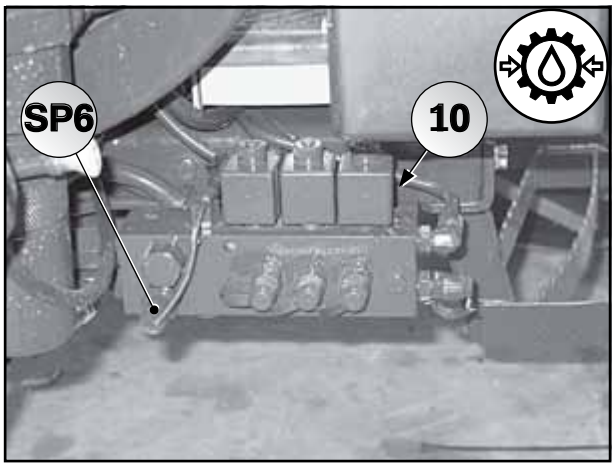


Fig. 10.1062

Gearbox oil intake filter sensor

The sensor (SP3) under the delivery filter (4) of the low flow circuit, indicates when the filter becomes clogged by means of an indicator light on the instrument.

The sensor (SP3) is connected to the front wiring.

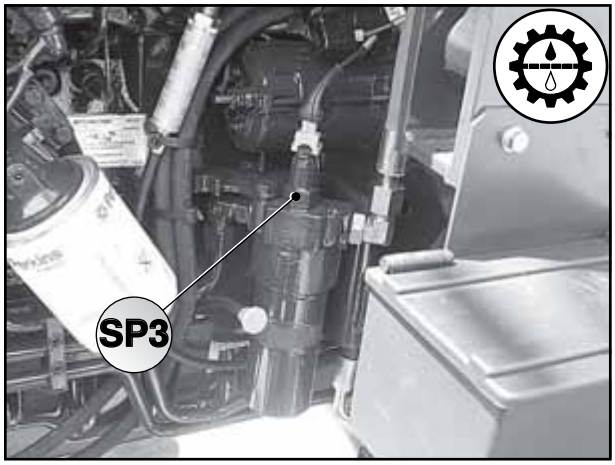


Fig. 10.1063

Temperature sensor for fuel enrichment jet

This sensor (ST7)) installed on the cylinder head on the left-hand side, indicates the operating temperature of the engine itself, and then sends a signal to the fuel enrichment jet. The sensor (ST7) is connected to the front wiring.

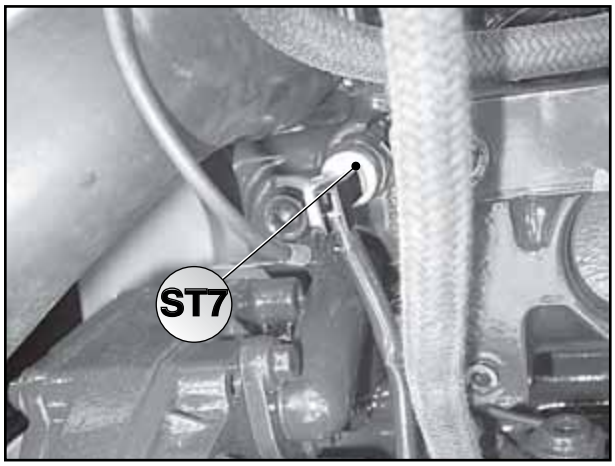


Fig. 10.1064

Trailer brake oil pressure sensor (Italian market)

The sensor (SP2)(only installed in tractors with the “trailer brake” unit) installed on the actual valve itself, comprises two pressure switches installed in series, each of which has a precise function, i.e.: pressure switch (E2) indicates when there is insufficient pressure in the relative hydraulic circuit prior to the actual valve itself and then measures the pressure of the oil circulating in the valve; pressure switch (E1) indicates that the trailer is hitched by measuring the pressure of the oil in the half-coupling.

The two pressure switches are the “normally closed” type and are respectively set at a pressure of:

E2 - 2 bar
E1 - 8 bar

The pressure switch (E2) only operates when the trailer is not hitched, since correct trailer braking leads to a pressure of at least 8 bar in the valve coupling.

The sensor (SP2) is connected to the rear wiring.

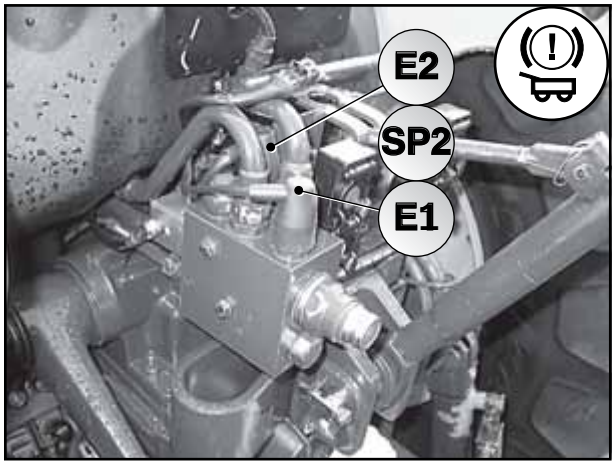


Fig. 10.1065

Ground speed sensor

The sensor (SR1), on the left-hand side of the gearbox housing, detects the ground speed of the tractor via the gear keyed to the bevel gear pinion and transmits a signal to the electronic control unit (Power Shuttle version) or to the instrument (Speed Five version). It processes the speed value (in kph or mph) which then appears on the display on the instrument.

The sensor (SR1) is connected to the rear wiring.

Note: in the Power Shuttle version of the tractors, the signal is transmitted to the instrument via the CAN BUS line.

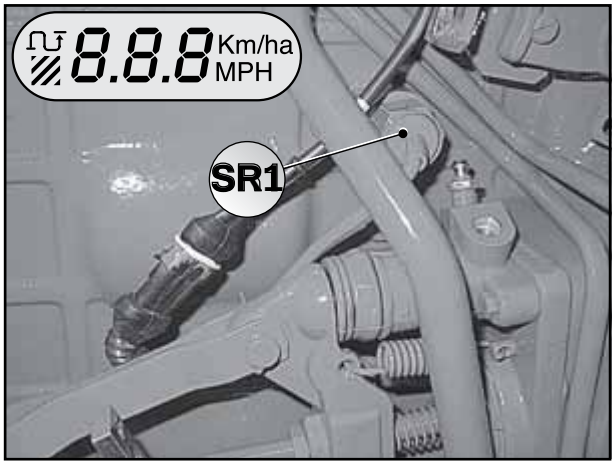


Fig. 10.1066

PTO speed sensor

The sensor (SR5), on the right-hand side of the gearbox housing, detects the speed of the PTO shaft and transmits a signal to the electronic control unit (Powershuttle version) or to the instrument (Speed Five version). It processes the speed value which then appears on the relative display.

The sensor (SP5) is connected to the rear wiring.

Note: in the Power Shuttle version of the tractors, the signal is transmitted to the instrument via the CAN BUS line.

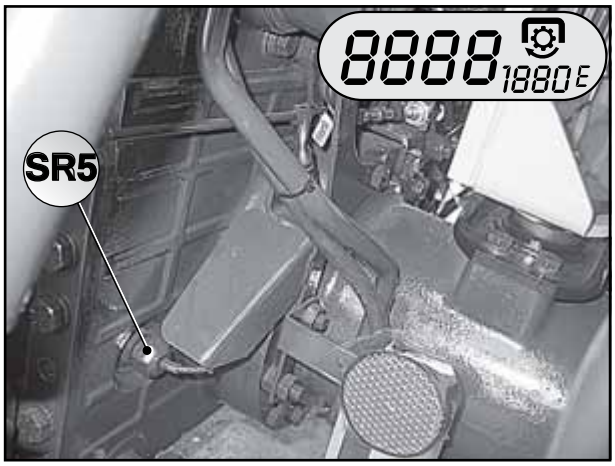


Fig. 10.1067

Engine speed sensor (Power Shuttle version)

The sensor (SR2) on the right-hand side of the engine-gearbox assembly, detects the engine rate and transmits a signal to the electronic power unit, that calculates the RPM number to display on an analogue indicator on the instrument, where a pointer turns around a graduated scale. The signal is transmitted to the instrument by the CAN BUS line.

The sensor (SP2) is connected to the rear wiring.

Note: in the Speedfive version of the tractors, the engine's speed rate reaches the instrument directly from alternator Pin W.

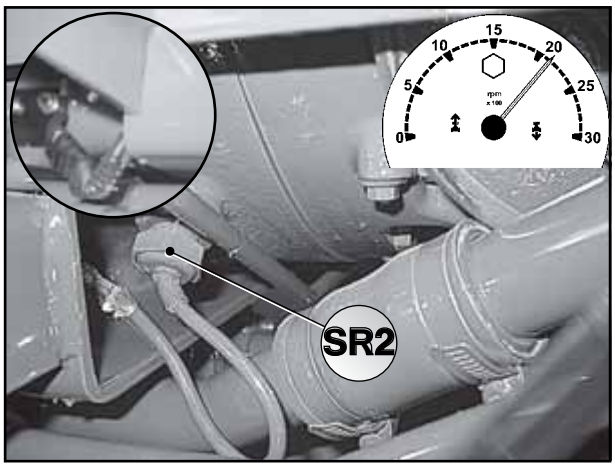


Fig. 10.1068

Brake pump oil pressure sensor

The sensor (SP8) under the brake pumps, transmits a signal to the relay (K14). It controls the differential releasing operation by de-energizing the relative solenoid valve (YV3) and turns on the rear brake lights.

The sensor (SP8) is connected to the cab wiring.

Fig. 10.1069

Brake fluid level sensor

The sensor (SL2) on the plug of the brake fluid reservoir, on the right-hand side just under the dashboard cover, indicates the level by means of an indicator light on the instrument.

The sensor (SL2) is connected to the cab wiring.

Fig. 10.1070

Rh speed sensor (Deltashift system) (Powershuttle version)

The sensor (SR4) in the rh part of the engine-gearbox assembly detects the speed at which drive enters the gearbox and the rotation direction. It then transmits a signal to the electronic plant that controls the Power Shuttle module, which controls the way the relative LEDs on the instrument come on (FORWARD-REVERSE turn indicators).

The sensor (SP4) is connected to the rear wiring.

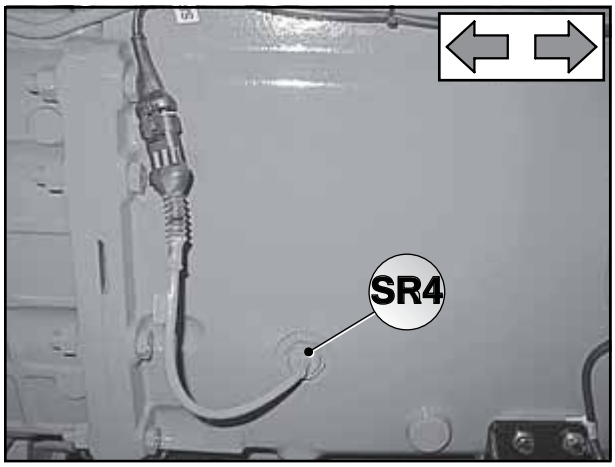


Fig. 10.1071

Lh speed sensor (Deltashift system) (Power Shuttle version)

The sensor (SR3) in the lh part of the engine-gearbox assembly detects the speed at which drive enters the gearbox and the rotation direction. It then transmits a signal to the electronic plant that controls the Power Shuttle module, which controls the way the relative LEDs on the instrument come on (FORWARD-REVERSE turn indicators).

The sensor (SP3) is connected to the rear wiring.

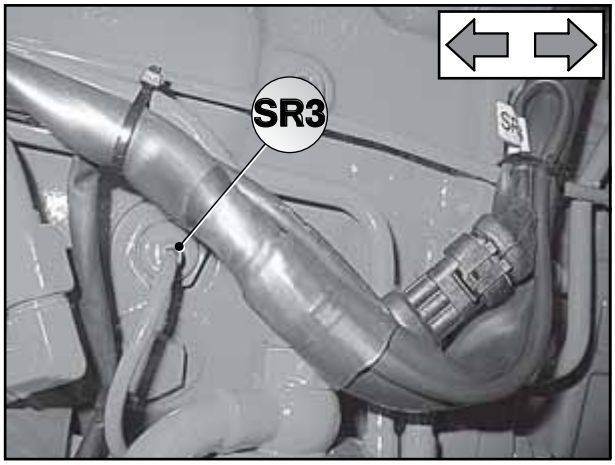


Fig. 10.1072

Clutch pedal potentiometer (Power Shuttle version)

The potentiometer (SQ1) installed alongside the clutch pedal, under the covering, detects the various pedal positions during its travel and transmits a signal to the electronic plant that controls the Power Shuttle unit.

The sensor (SQ1) is connected to the dasboard wiring.

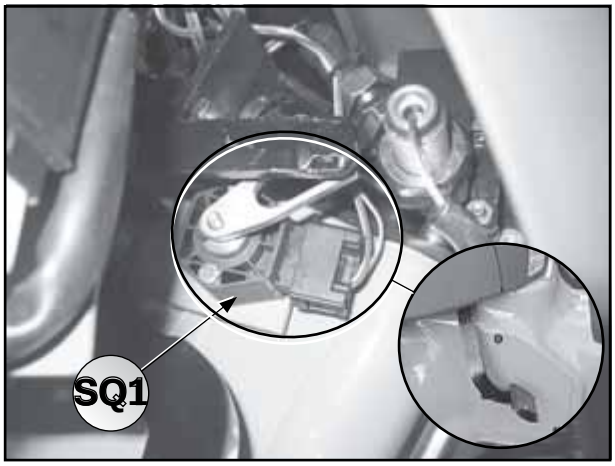


Fig. 10.1073

4.2.4 Adjustments

PTO speed sensor

The Hall sensor (SR5), on the right-hand side of the gearbox housing, detects the speed of the PTO shaft and transmits a signal to the electronic control unit or to the instrument.

If the sensor is replaced, re-install the same shims in order to maintain a distance of **0.8 mm**between the teeth of the PTO speed selector sleeve (269) and the actual sensor itself (SR5).

Note: the distance between the sleeve teeth (269) and the sensor must also be complied with if the gearbox housing is replaced.

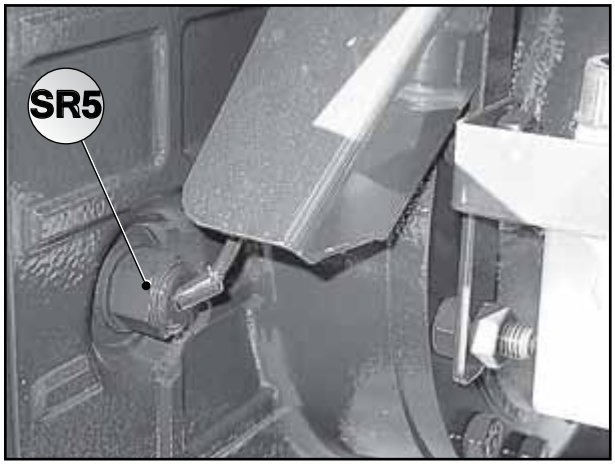


Fig. 10.1074

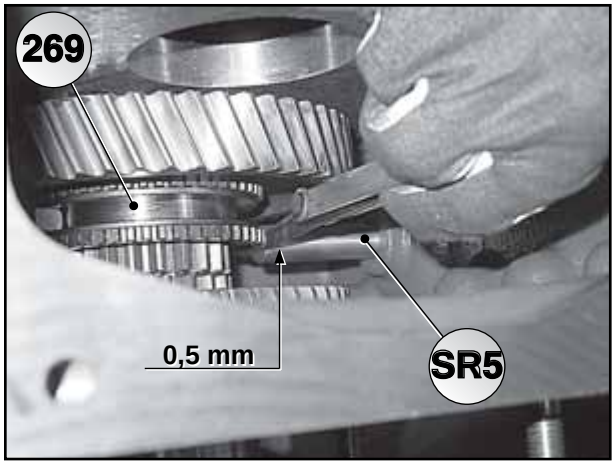


Fig. 10.1075

Speed sensor (Deltashift system) (Power Shuttle version)

The Hall sensors (SR3 and SR2) in the lh and rh parts of the engine-gearbox assembly respectively, detect the speed at which drive enters the gearbox and the rotation direction.

Note: if replacements are made, maintain the same shims when the new sensors are installed.

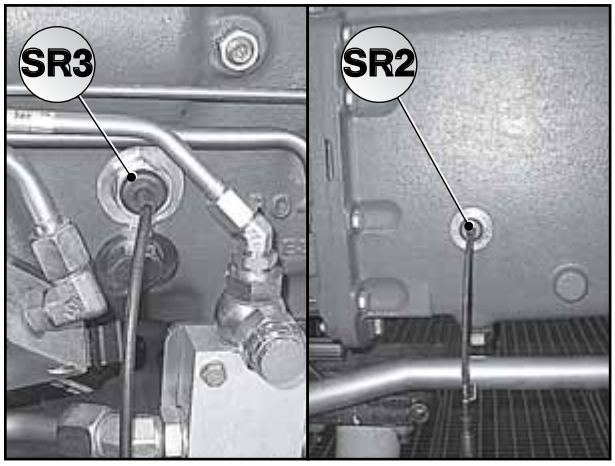


Fig. 10.1076

Ground speed sensor

The sensor (SR1) on the left-hand side of the gearbox housing, detects the ground speed of the tractor via the gear keyed to the bevel gear pinion and transmits a signal to the electronic control unit or to the instrument.

If replacements are made, maintain the same shims (3 mm) when the new sensor is installed.

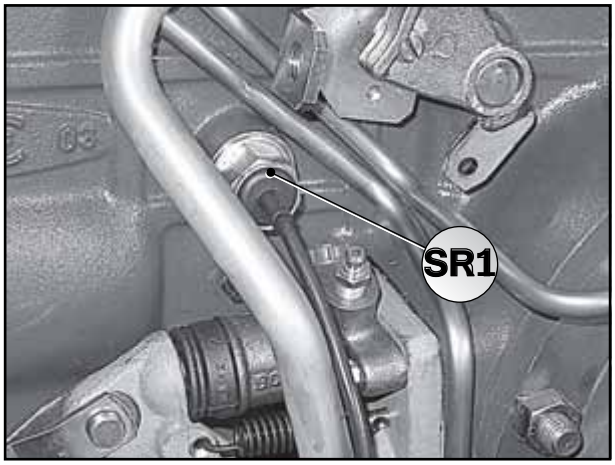


Fig. 10.1077

Engine rate sensor

The sensor (SR2) installed on the right-hand side of the engine-gearbox assembly, detects the engine speed by detecting the teeth of the flywheel's ring gear.

If a faulty sensor is replaced:

- screw it fully against the casing;
- unscrew it about 1/2 of a turn;
- tighten the check nut to secure the adjustment.

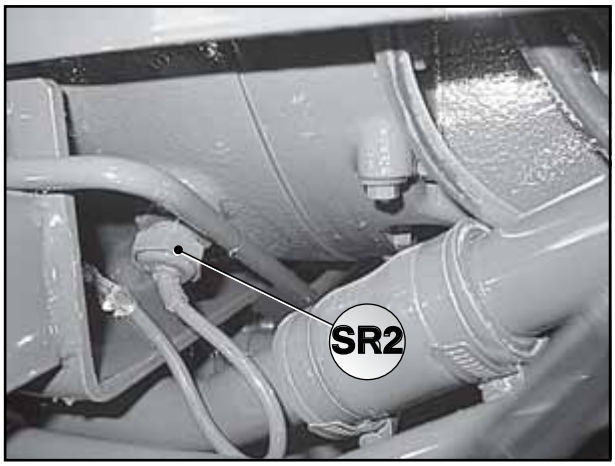


Fig. 10.1078

Clutch pedal potentiometer

The potentiometer (SQ1) installed alongside the clutch pedal, under the covering, detects the various pedal positions during its travel and transmits a signal to the electronic plant that controls the Powershuttle unit.

If the potentiometer is replaced, the following check operations must be carried out:

- power the potentiometer with 5 V voltage on terminal 1 (positive);
- make sure that the output voltage between terminals 1 (positive) and 4 (ground) is effectively 5 V;
- measure the voltage value between terminals 2 (signal) and 4 (ground):
  - when the clutch pedal is released, the value must be about **0.5 V**(adjust the position with the plug (X) if necessary (Fig.10.1081);
  - when the clutch pedal is fully depressed, the value must be about **4.5 V** (failing this, to regulate the position with the screw (Y) and then fix with Loctite 243 sealant Fig.10.1082).

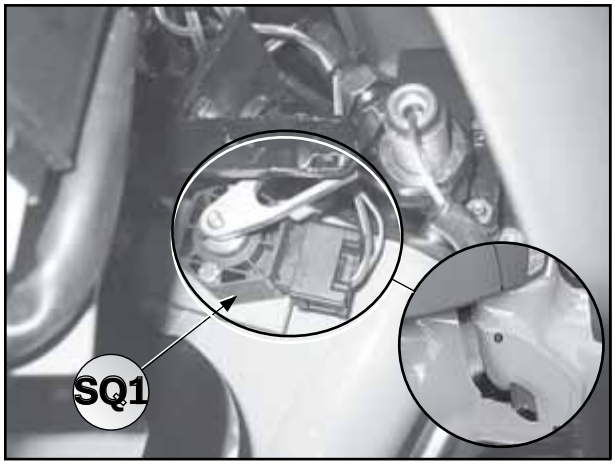


Fig. 10.1079

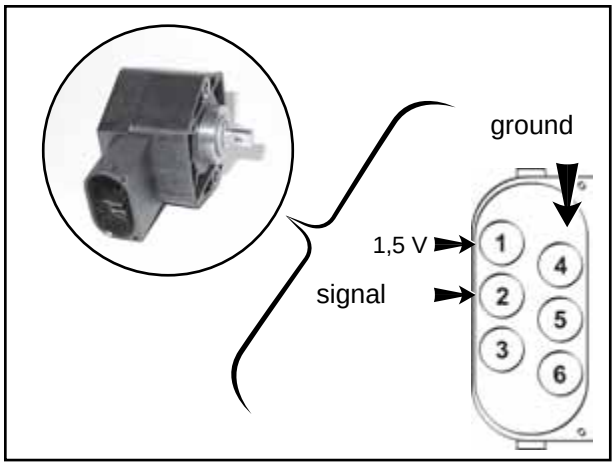


Fig. 10.1080

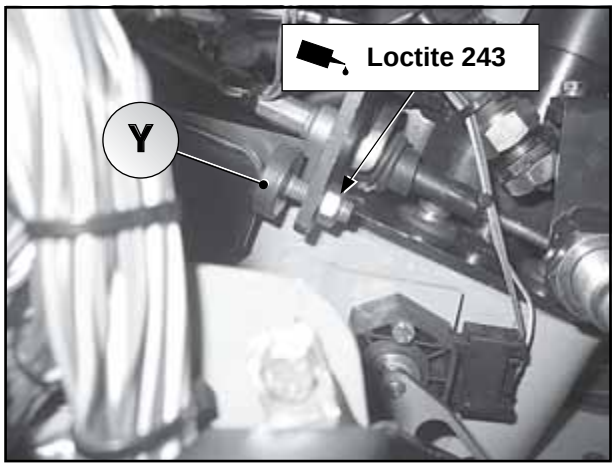


Fig. 10.1082

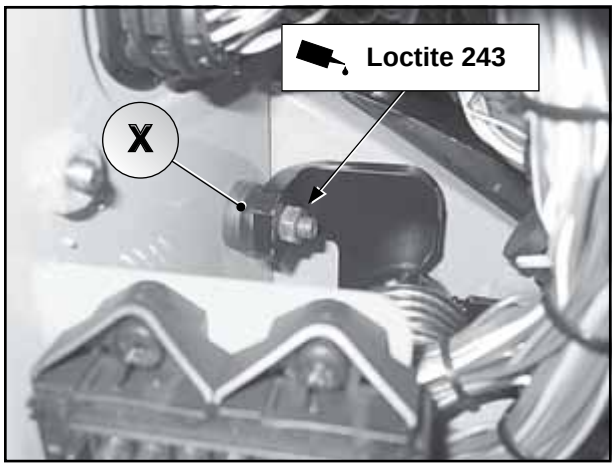


Fig. 10.1081

4.3 Solenoid valves

4.3.1 General description

The function of a solenoid valve is to open or close the oil supply and to discharge the oil to the relative user. This occurs by energizing or de-energizing the solenoid valve, i.e. by transmitting or shutting off electric voltage. This turns on or shuts off the oil flow.

There are two types of relay installed in **F-N Series** tractors:

- ON/OFF (Fig.10.1083)
- proportional (Fig.10.1086)
  P - Pressure
  U - User
  S - Discharge

Solenoid valve assembly

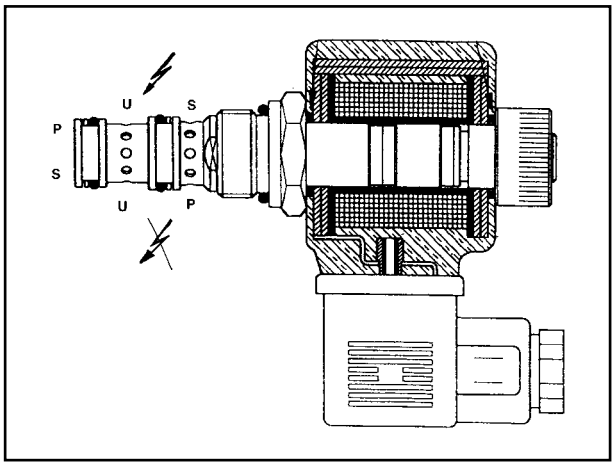


Fig. 10.1083

Solenoid valve not energized

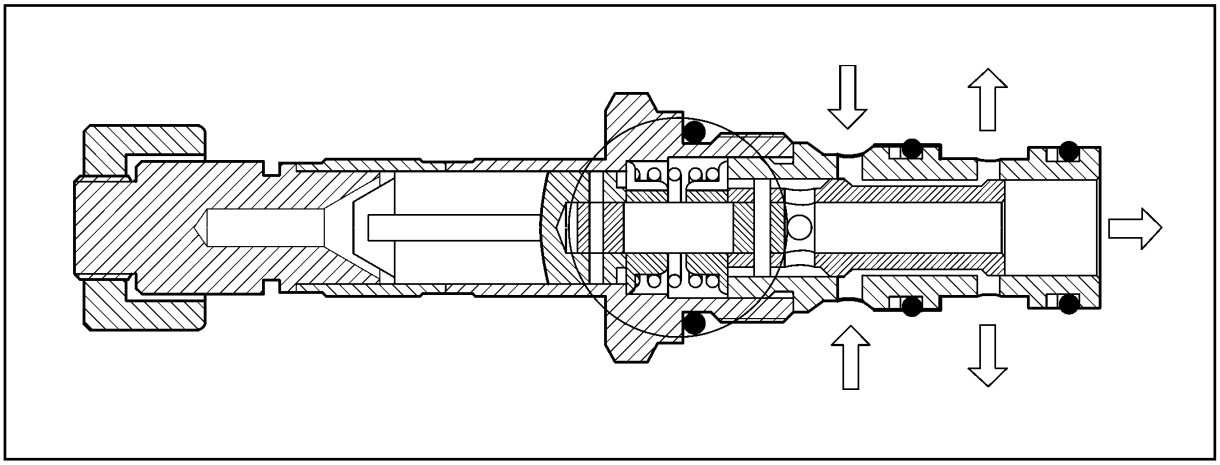


Fig. 10.1084

Solenoid valve energized

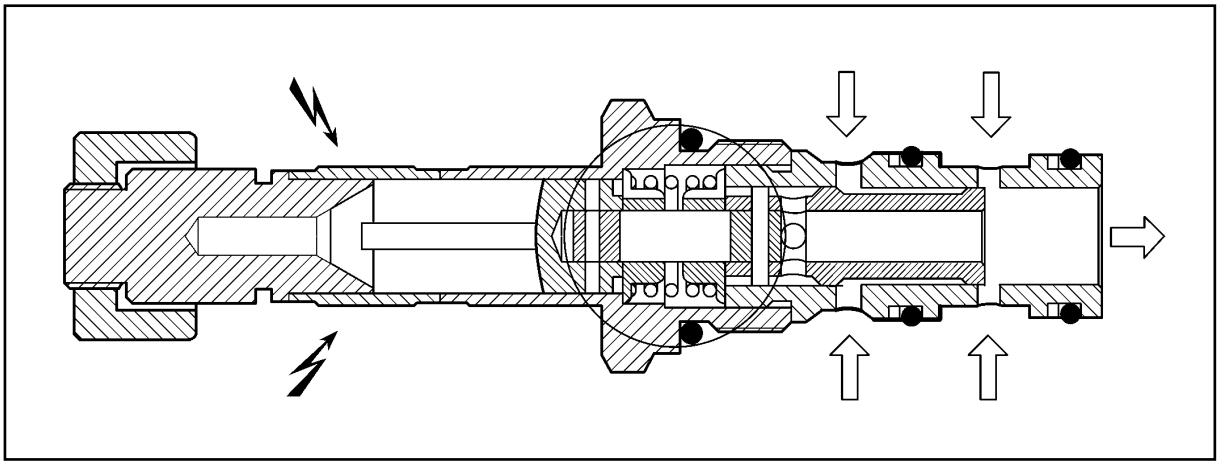


Fig. 10.1085

Proportional solenoid valves

The technique of proportional valves, as a link between controlling and regulating techniques, is a concept that has now become very clear when it comes to hydraulics.

The figure below shows the route covered by the signal: an input voltage signal (mainly between 0±9 V) is converted by means of an amplifier into a current that depends on the voltage itself.

E.g. 1mV = 1mA.

This electrical input signal is converted by the proportional magnet into output magnitudes such as force and travel.

Issue of the signal to monitor the direction and flow rate or pressure allows proportional valves to be installed right near the actuators, thus improving the dynamic characteristics of the control system.

The force or travel magnitudes, as the input signal for the strictly hydraulic valve part convert into a flow rate or pressure.

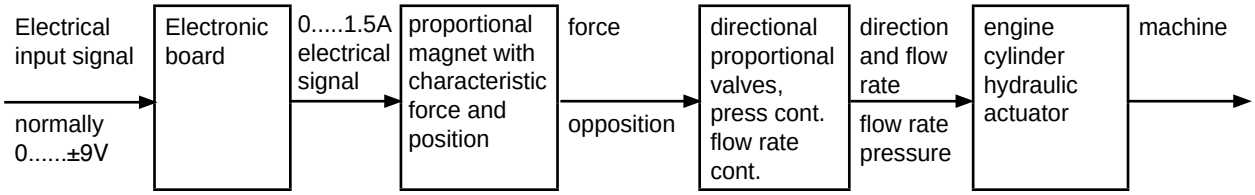
For the actuator and, consequently, the final operation of the machine, this means that not only the direction is monitored in a fade-free way but also the speed and force.

Similarly, acceleration and deceleration can be constantly controlled according to the behaviour of a device, e.g.a variation in the flow rate.

In **F-N Series** tractors, proportional solenoid valves allow the two hydraulic clutch assemblies to be engaged/disengaged in a modular way. Their function is to send oil to the user as needed, by varying the opening.

These solenoid valves are controlled by an electronic board installed in the control unit, which is part of an electronic management program.

Checks to ensure that these solenoid valves operate correctly must necessarily be carried out with the aid of a PC and using the electronic management software of the “Power Shuttle” module.



1 - Coil plug
2 - Retention ring
3 - Coil
4 - Retention ring
5 - Coil pin
6 - Retention ring
7 - Retention ring
8 - Plunger
9 - Spring
10 - Pin
11 - Pin guide

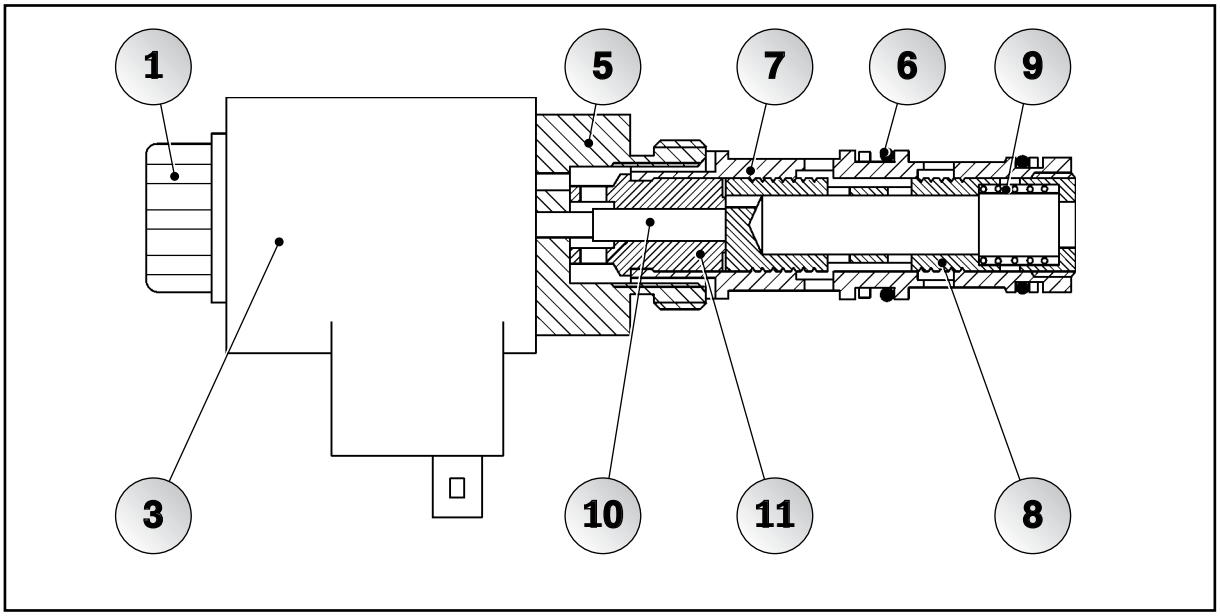


Fig. 10.1086

4.3.2 Location

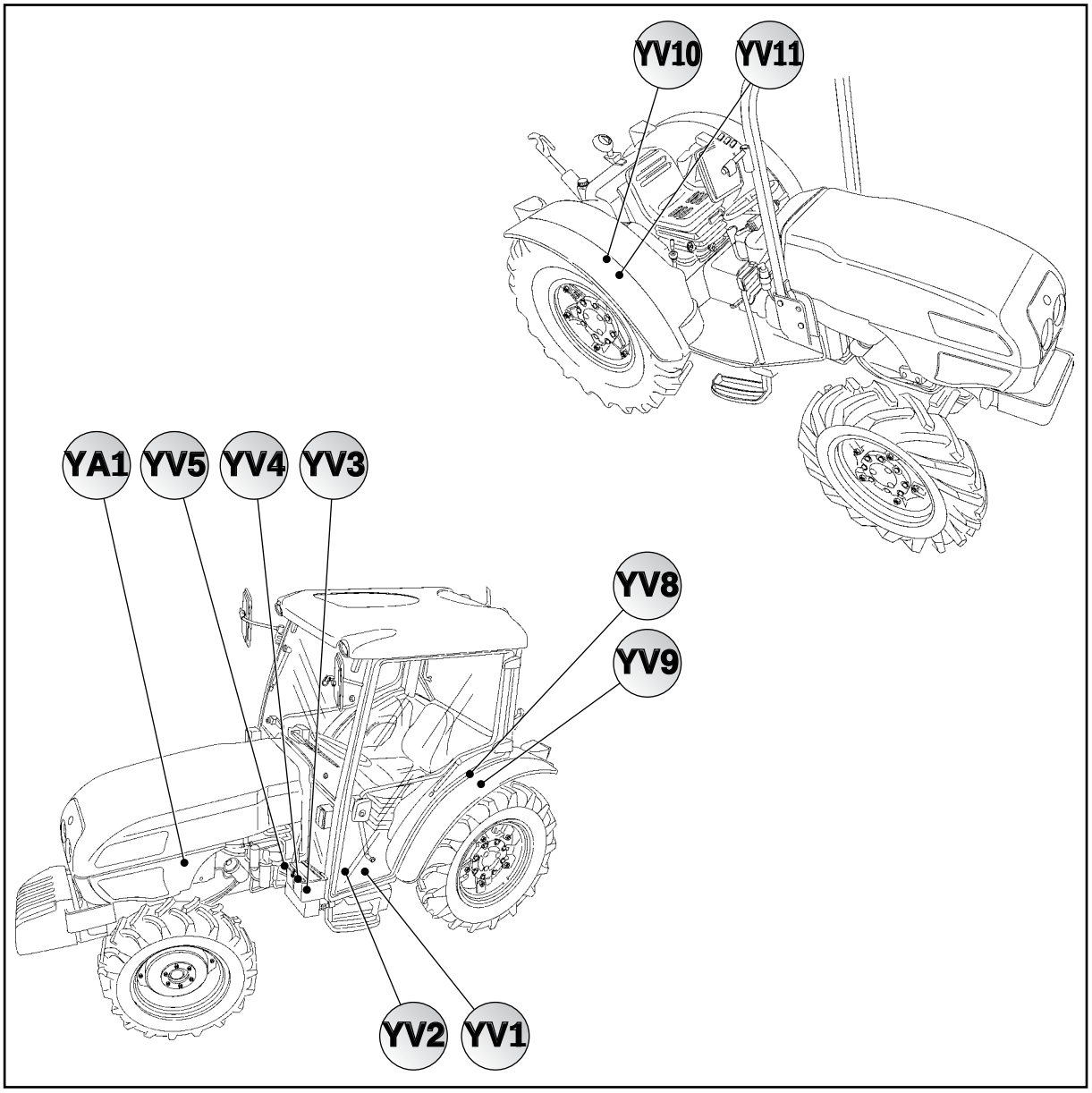


Fig. 10.1087

YA1 - Fuel injection pump solenoid valve
YV1 - Secondary clutch solenoid valve (direct)
YV2 - Main clutch solenoid valve (options)
YV3 - Diff lock solenoid valve
YV4 - 4WD solenoid valve
YV5 - Power Five solenoid valve (Power Shuttle version)
YV8 - P.T.O. brake solenoid valve
YV9 - P.T.O. clutch solenoid valve
YV10 - Auxiliary control valve solenoid valve (B)
YV11 - Auxiliary control valve solenoid valve (A)

4.3.3 Identification

Motor stop solenoid valve

Solenoid valve (YA1) on the injection pump opens or shuts off the fuel that flows towards the engine.

When the ignition key is turned clockwise, solenoid valve (YA1) energizes, thus allowing the fuel required to start the engine to pass through. On the other hand, when the ignition key is turned in an anti-clockwise direction, the solenoid valve de-energizes, thus shutting off the fuel flow and stopping the engine.

The solenoid valve (YA1) is connected to the front wiring.

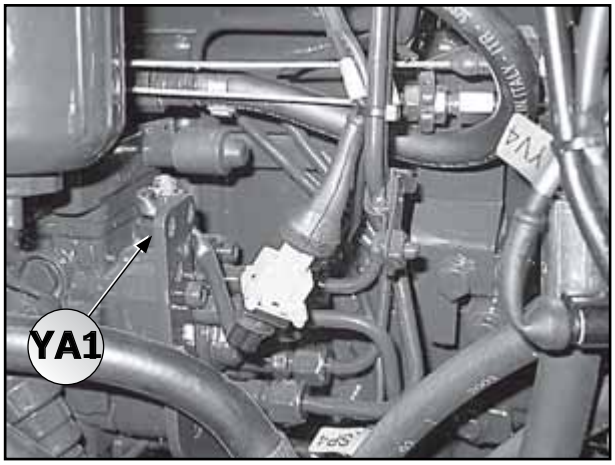


Fig. 10.1088

Auxiliary control valve solenoid valves

The two solenoid valves (YV10 and YV11) are installed in the power pack (32 Fig.10.1090) called electrohydraulic flow selector owing to its function. The two solenoid valves are the ON/OFF type, i.e. they open or shut the flow of oil towards the relative auxiliary control valve, controlled by means of button (SB9 Fig.10.1089). Press the button in position A to energize the solenoid valve (YV10). Press the button in position B to energize the solenoid valve (YV11).

The solenoid valve (YV10) is connected to the rear wiring.

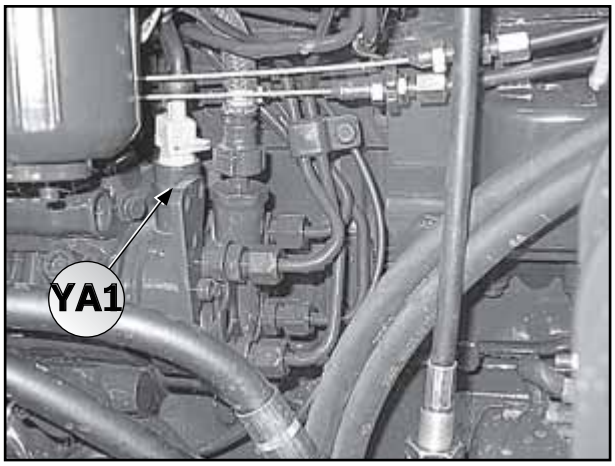


Fig. 10.1089

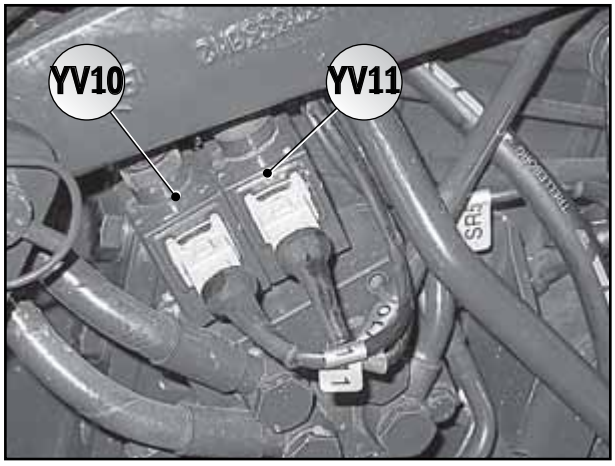


Fig. 10.1090

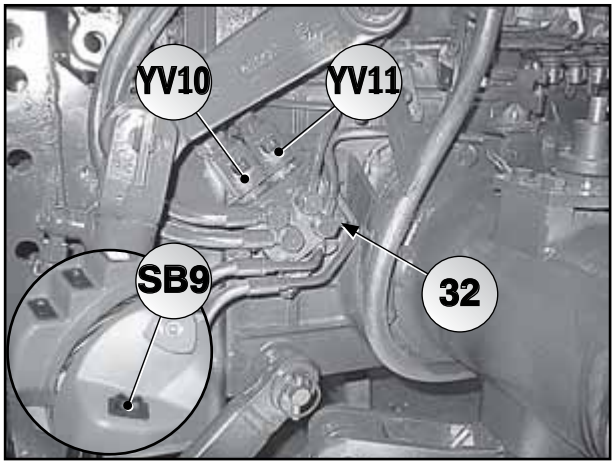


Fig. 10.1091

Solenoid valves on hydraulic power pack (10) (Power Shuttle version)

The four ON/OFF solenoid valves (YV3/YV4/YV5 Fig.10.1092) are installed in the hydraulic power pack (10) on the left-hand side of the tractor, near the footboard.

Their function is as follows:

- YV3 - diff lock control
- YV4 - 4WD control
- YV5 - Power Five control

They open or shut off the oil supply and discharge the oil to and from the relative user.

This occurs by energizing or de-energizing the solenoid valve, i.e. by transmitting or interrupting an electric voltage, thus allowing the oil to flow or shutting of the oil flow, according to the case in question.

These solenoid valves are the “ON/OFF” type and are controlled by switches and buttons installed near the driver’s seat.

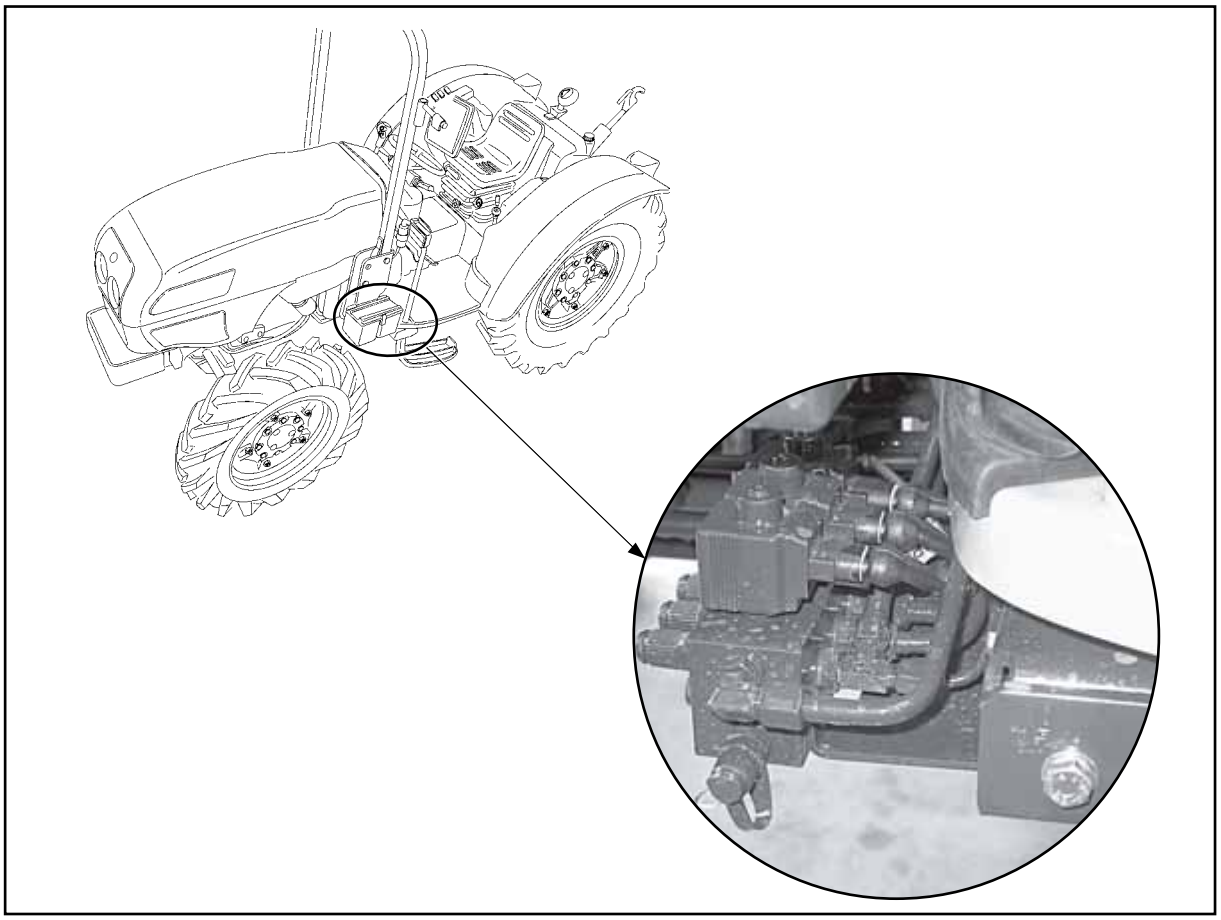


Fig. 10.1092

Diff lock solenoid valve (Power Shuttle version)

The front and rear differential locks are engaged through the movement of two mechanical clutches activated by a piston with oil at a pressure of **20 bar**.

This occurs when the driver energizes the solenoid valve (YV3) by operating the control button (SB8).

Energizing allows the solenoid valve to supply oil to the rear and front locks simultaneously. Releasing occurs when the solenoid valve (YV3) is de-energized by means of the brake pedals, thus shutting off the oil supply and opening on to the outlet.

The solenoid valve (YV3) is connected to the rear wiring.

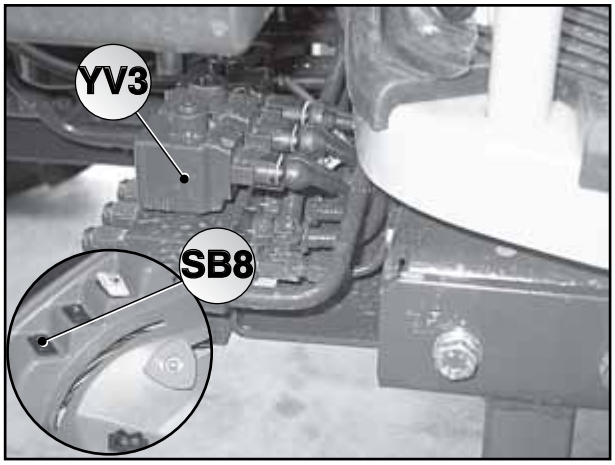


Fig. 10.1093

4WD solenoid valve (Power Shuttle version)

The four-wheel drive is engaged through the movement of two mechanical meshing systems operated by a spring (Spring-on).

This occurs when the driver operates the control switch (SA11) and energizes the solenoid valve (YV4), thus shutting off the flow of pressurized oil (**20 bar** to the four-wheel drive assembly and opening on to the outlet. When the switch (SA11) is operated, the solenoid valve (YV4) de-energizes and thus allows oil at a pressure of **20 bar** to flow to the four-wheel drive assembly.

The solenoid valve (YV4) is connected to the rear wiring.

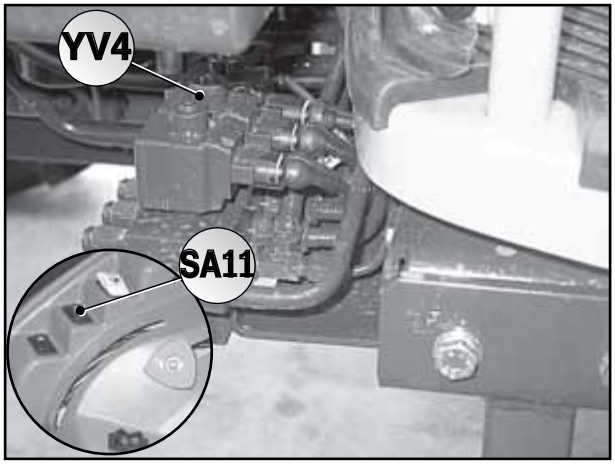


Fig. 10.1094

Power Five solenoid valve (Power Shuttle version)

The “Power Five” unit (if installed) is engaged when the driver operates the control button (SB2) and de-energizes the solenoid valve (YV5), thus allowing the pressurized oil that flows towards the Powerfive assembly to flow towards the outlet (0 bar) and to engage the “slow” speeds. When the solenoid valve (YV5) is energized, this action shuts off the oil that flows to the outlet, bringing it to a pressure of 20 bar and thus engaging the “fast” speeds.

The solenoid valve (YV5) is connected to the rear wiring.

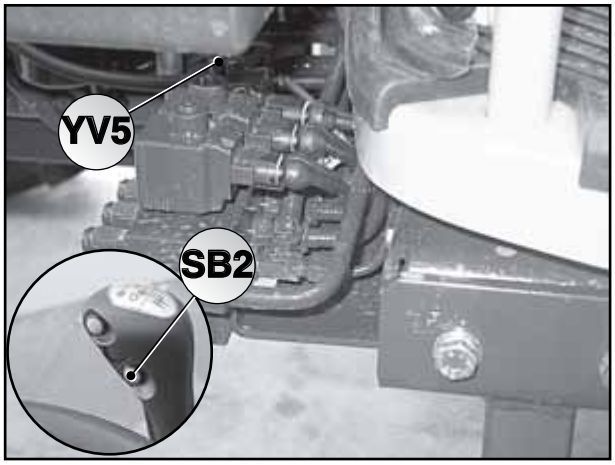


Fig. 10.1095

Solenoid valves on valve system of the power-assisted clutch (8) (Speedfive version)

The two solenoid valves (YV3/YV4 Fig.10.1096) are installed in the valve system of the power-assisted clutch (8 Fig.10.1097) installed on the left-hand side of the tractor, near the bonnet hinge.

Their function is as follows:
YV3 - diff lock control
YV4 - 4WD control

They open or shut off the oil supply and discharge the oil to and from the relative user.

This occurs by energizing or de-energizing the solenoid valve, i.e. by transmitting or interrupting an electric voltage, thus allowing the oil to flow or shutting of the oil flow, according to the case in question. These solenoid valves are the “ON/OFF” type and are controlled by switches and buttons installed on the right-hand side of the driver’s seat.

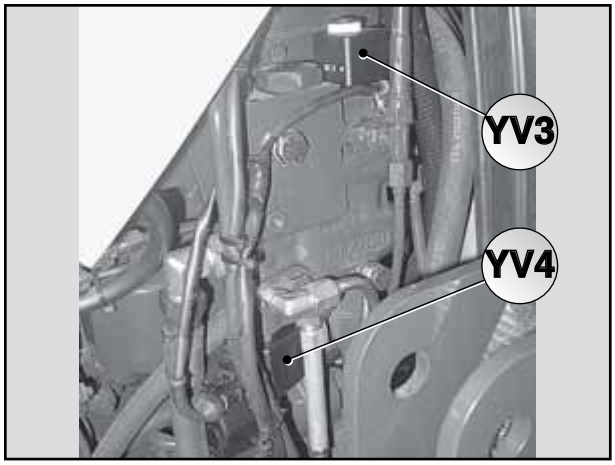


Fig. 10.1096

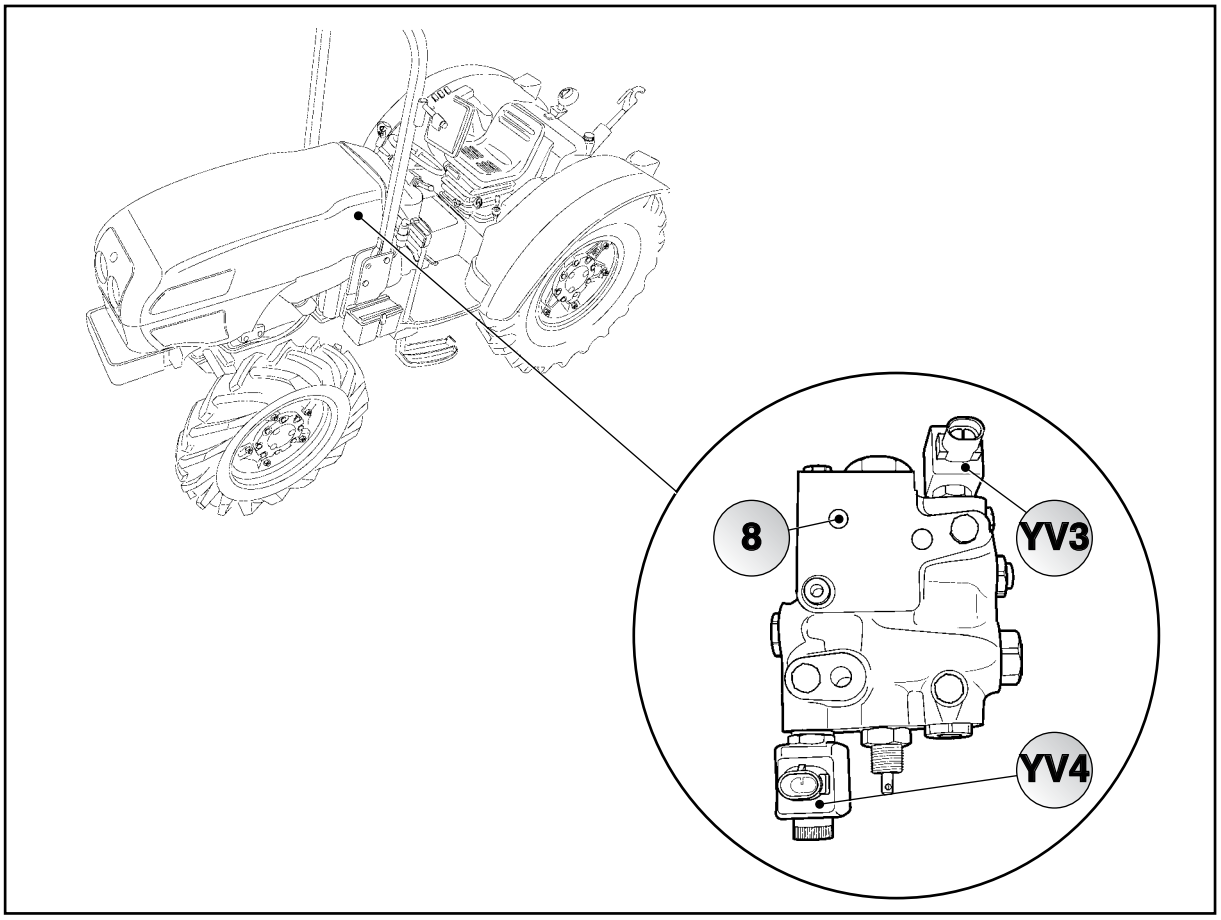


Fig. 10.1097

Differential lock solenoid valve (Speed Five version)

The front and rear differential locks are engaged through the movement of two mechanical clutches activated by a piston with oil at a pressure of **20 bar**.

This occurs when the driver energizes the solenoid valve (YV3) by operating the control button (SB8).

Energizing allows the solenoid valve to supply oil to the rear and front locks simultaneously. Releasing occurs when the solenoid valve (YV3) is de-energized by means of the brake pedals, thus shutting off the oil supply and opening on to the outlet.

The solenoid valve (YV3) is connected to the rear wiring.

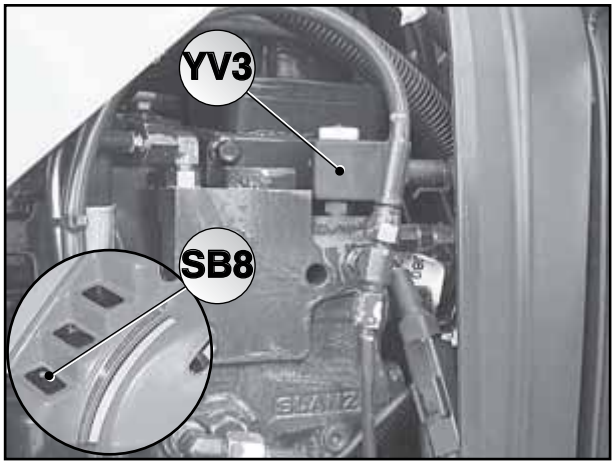


Fig. 10.1098

4WD solenoid valve (Speed Five version)

The four-wheel drive is engaged through the movement of two mechanical meshing systems operated by a spring (Spring-on).

This occurs when the driver operates the control switch (SA11) and energizes the solenoid valve (YV4), thus shutting off the flow of pressurized oil (**20 bar** to the four-wheel drive assembly and opening on to the outlet. When the switch (SA11) is operated, the solenoid valve (YV4) de-energizes and thus allows oil at a pressure of **20 bar** to flow to the four-wheel drive assembly.

The solenoid valve (YV4) is connected to the rear wiring.

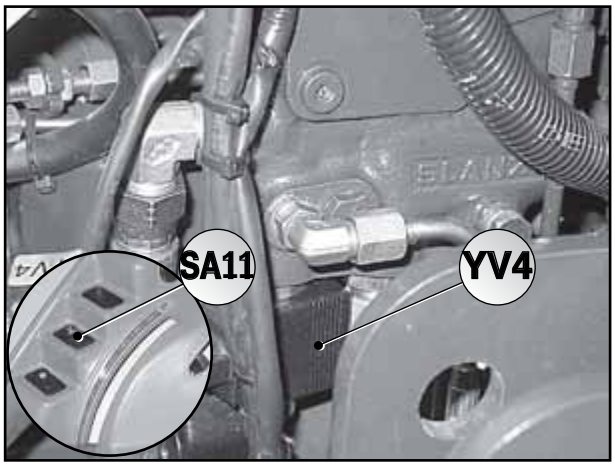


Fig. 10.1099

Main and secondary clutch solenoid valve (Power Shuttle version)

The two proportional solenoid valves (YV2 and YV1) are housed in the relative power pack (15) on the right-hand side of the axle housing.

The two solenoid valves (YV2 and YV1) open or shut off the oil flow that supplies the main clutch (options) and secondary clutch (direct) in the modulated mode.

They are the “proportional” type and are thus handled by the tractor’s electronic control system.

The solenoid valves (YV2 and YV1) are connected to the front wiring.

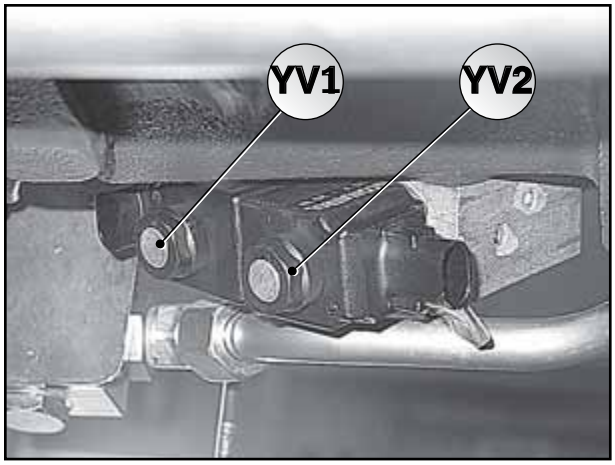


Fig. 10.1100

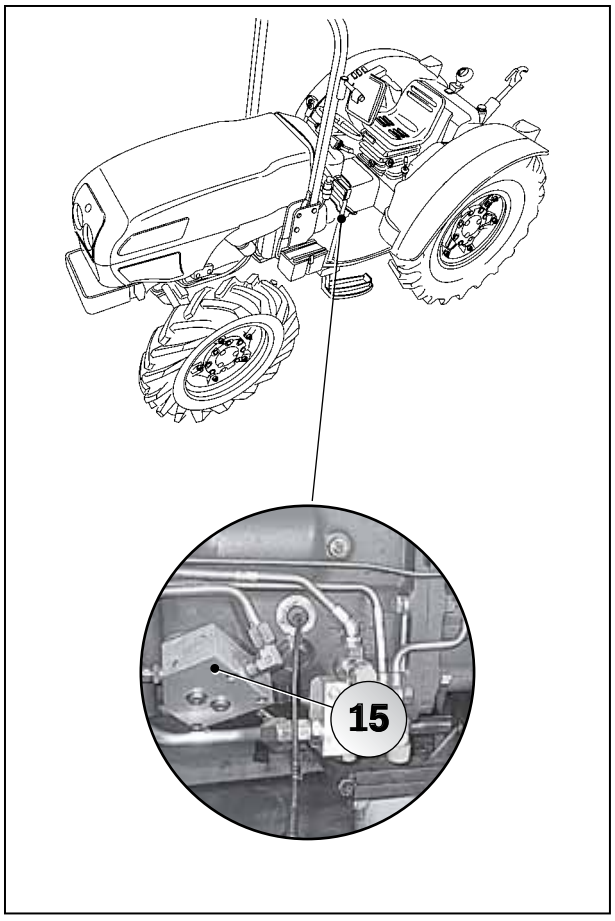


Fig. 10.1102

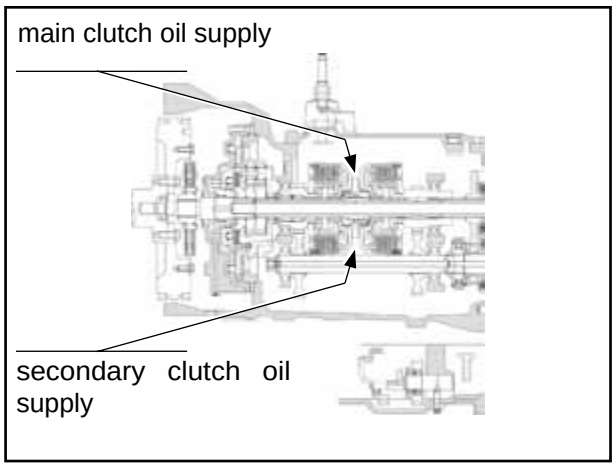


Fig. 10.1101

PTO brake solenoid valve (Power Shuttle version)

When the solenoid valve (YV8) is de-energized, oil at a pressure of (**20 bar**) supplies the PTO brake.

By operating the PTO control switch (SA2), a signal is transmitted to the electronic control unit, which energizes the solenoid valves (YV9-PTO clutch) and (YV8-brake).

By energizing, the solenoid valve (YV8) shuts off the flow of pressurized oil to the brake pistons, and disengages the brake.

The solenoid valve (YV8) is connected to the rear wiring.

- **Solenoid valve (YV8) de-energized = brake engaged**
- **Solenoid valve (YV8) energized = brake disengaged**

PTO clutch solenoid valve (Power Shuttle version)

By operating the PTO control switch (SA2), a signal is transmitted to the electronic control unit, which energizes the solenoid valves (YV9-PTO clutch) and (YV8-brake).

Pressurized oil (**20 bar**) is supplied to the PTO in the modulated mode. Gradual opening of the solenoid valve (YV9) is controlled by the electronic control unit so that the PTO is smoothly and progressively engaged.

The solenoid valve (YV9) is connected to the rear wiring by means of connector (P6).

- **Solenoid valve (YV9) de-energized = PTO clutch disengaged**
- **Solenoid valve (YV9) energized = PTO clutch engaged.**

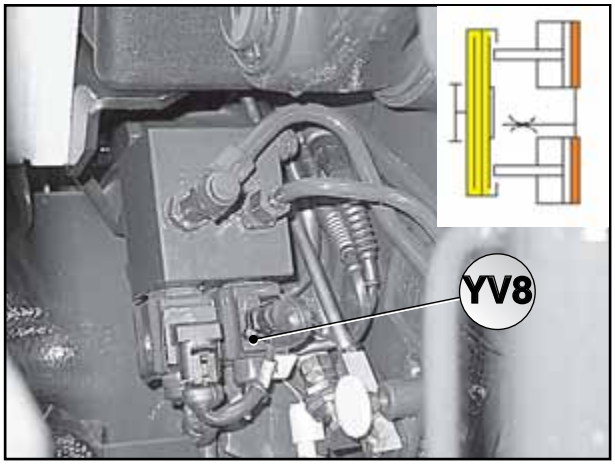


Fig. 10.1103

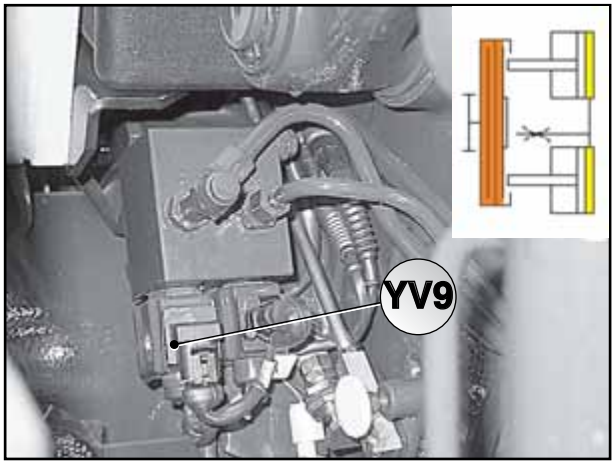


Fig. 10.1104

Fig. 10.1105

4.3.4 Inspections

Certain tests can be made to ensure that the solenoid valves installed in **F-N Series** tractors operate correctly:

1 - winding resistance test

2 - voltage value test (ON/OFF valves)

3 - current value test (valves of the proportional type)

Note: these tests are indicative and concern the electrical nature of the solenoid valve. A faulty solenoid valve could also be due to problems of a mechanical/hydraulic nature (e.g. the internal plunger could have seized).

Winding resistance test

- make sure that the coil winding is not broken with the aid of a tester;
- place the tester prods at the end of the winding, i.e. the connection terminals (Fig.10.1106);
- measure the resistive value of the winding.
- this value must be between 8 and 10 Ω, at a temperature of approximately 20 °C (Fig.10.1107).

Note: the coil resistance test can also be conducted without removing the component from the tractor.

Fig. 10.1106

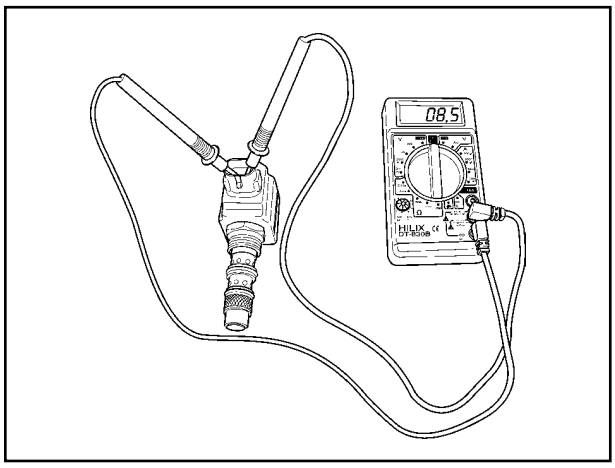


Fig. 10.1107

Voltage value test (ON/OFF valves)

- check the voltage at the end of the coil winding with the aid of a tester.
- position the tester prods “in parallel” to the coil (Fig.10.1108);
- power the solenoid valve’s coil.
- the value measured by the tester must be declared by the manufacturer and stamped on the coil (generally 12 V ± 10%).

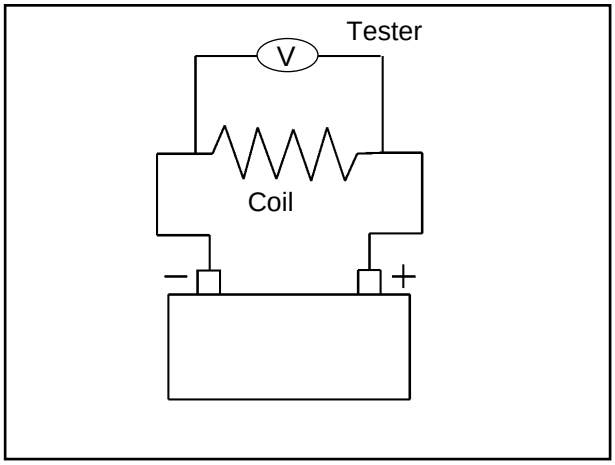


Fig. 10.1108

Current value test (valves of the proportional type)

- check the power draw of the coil winding with a tester;
- position the tester prods “inseries” to the coil (Fig.10.1109);
- power the solenoid valve’s coil.
- The peculiar feature of this solenoid valve is that the movement of the plunger can be checked, thus allowing the pressure in the user to be controlled.
  A board in the tractor’s electronic control unit handles the valve piloting function.
- the pressure towards the user depends on the measured current value, a value which must comply with the curve shown in (Fig10.1110.

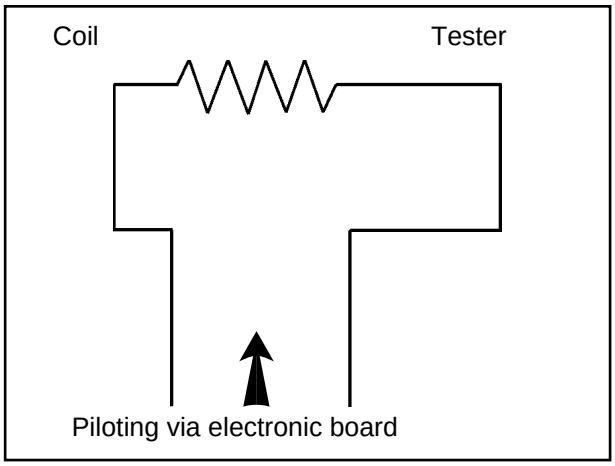


Fig. 10.1109

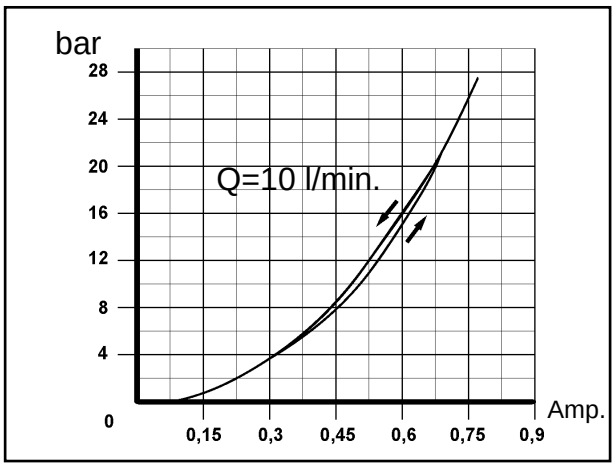


Fig. 10.1110

4.4 Switches and buttons

4.4.1 General description

The functions of the switches and buttons installed in **F-N Series** tractors are to activate or de-activate a certain facility. The signals transmitted can be of two types: permanent and temporary.

Permanent signal means a signal that indicates a determined situation in a fade-free way.

Temporary signal is a control pulse sent to the monitoring plant in order to modify an already existing situation.

For example, the parking brake activated indicator switch transmits a permanent signal which is maintained constant by means of the engaging lever of the actual brake itself.

The diff lock engaging/disengaging button transmits a temporary signal, thus modifying an already existing situation.

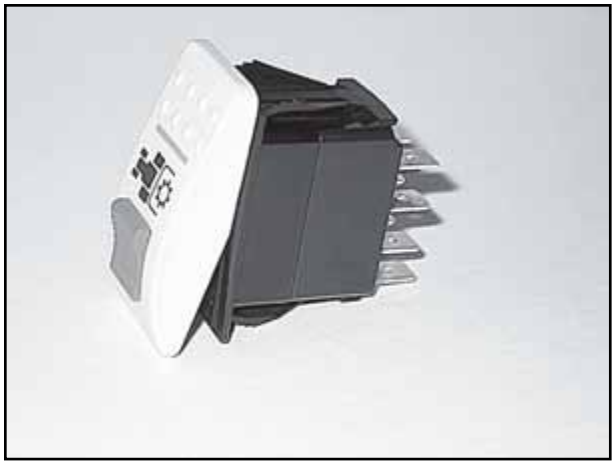


Fig. 10.1111

Fig. 10.1112

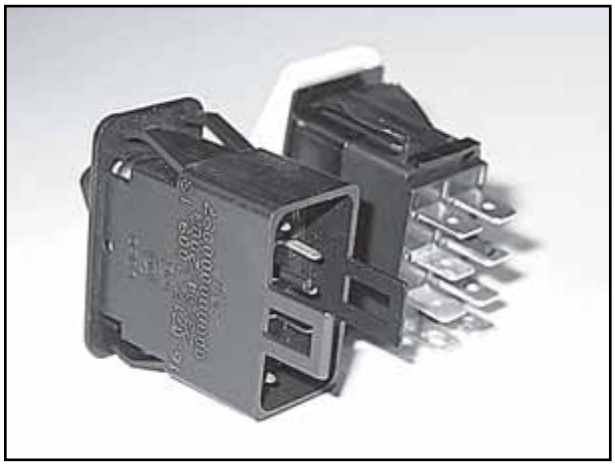


Fig. 10.1113

4.4.2 Location

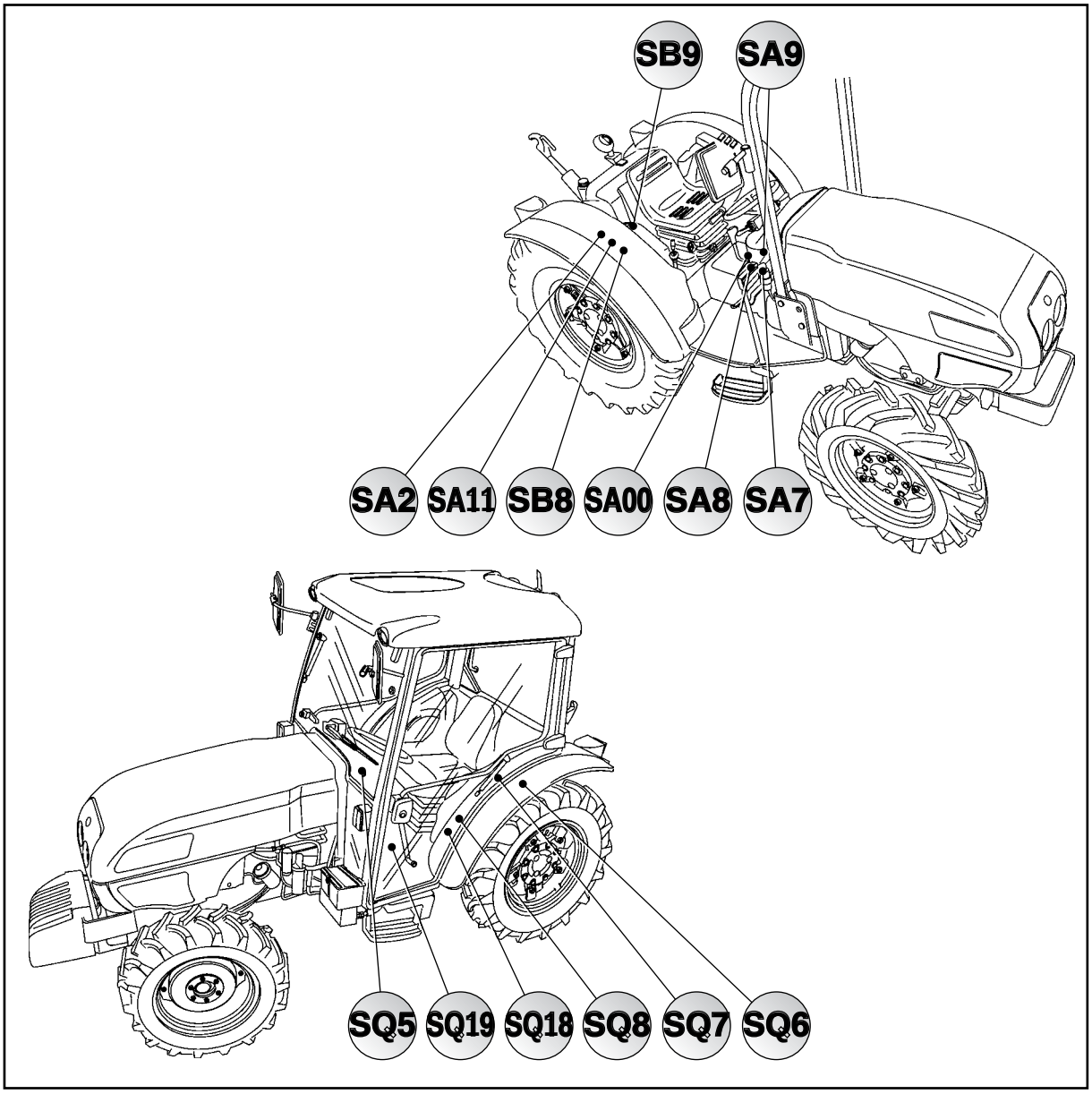


Fig. 10.1114

SA00 - Ignition switch
SA2 - PTP engaging/disengaging switch (Power Shuttle version)
SA7 - Rear field light switch
SA8 - Revolving beacon switch
SA9 - Emergency switch
SA11 - 4WD engaging/disengaging switch
SB2-SB3 - Buttons on the gearshift lever
SB8 - Diff lock engaging button
SB9 - Control button for auxiliary spool valves (A-B)
SQ4 - Parking brake switch
SQ5 - Park lock enabling microswitch
SQ6 - Fast rear PTO microswitch
SQ7 - Slow rear PTO microswitch
SQ8 - Proportional rear PTO microswitch
SQ18 - Independent rear PTO microswitch (Speedfive version)
SQ19 - Ignition enabling microswitch

4.4.3 Identification

Switches on the dashboard

Switches (SA7, SA8, SA9) on the dashboard, on the right-hand side of the steering wheel, have the following functions and are connected to the dashboard wiring by means of the following connectors:

SA7 - rear field light switch.
SA8 - revolving beacon switch
SA9 - emergency light switch connector

Fig. 10.1115

PTP engaging/disengaging switch (Power Shuttle version)

The switch (SA2) on the right-hand side, is used to engage/disengage the rear PTO.

It transmits a signal to the electronic control unit, which energizes the solenoid valves (YV8 and YV9), thus allowing pressurized oil (20 bar) to flow to the PTO clutch and towards the oil outlet in the “brake” unit.

The switch (SA2) is connected to the platform wiring.

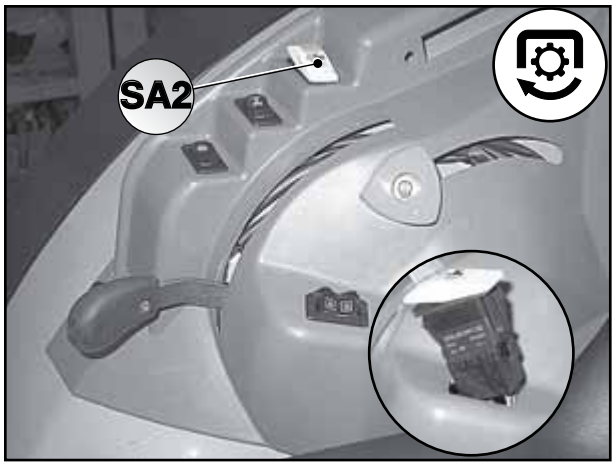


Fig. 10.1116

Park Lock engaging switch (Power Shuttle version)

The switch SQ5) in contact with the Park Lock engaging lever, informs the electronic control unit when the device is engaged. The control valves of the main and secondary clutch assemblies cannot be piloted when the Park Lock is engaged. Park Lock engagement is revealed by a LED coming on in the instrument.

The switch (SQ5) is connected to the dashboard wiring.

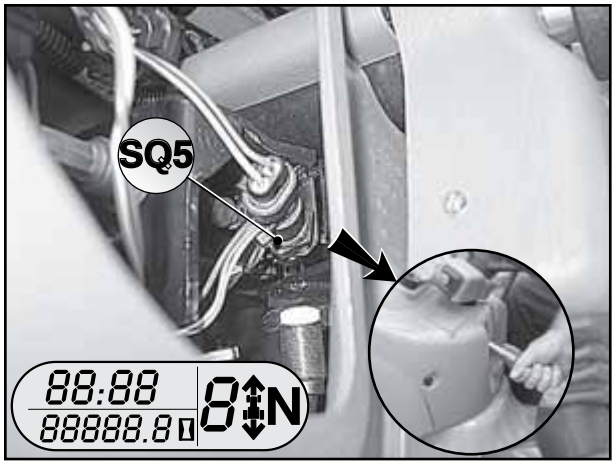


Fig. 10.1117

4WD engaging/disengaging switch

The switch (SA11) on the right-hand side, is used to engage/disengage the four-wheel drive. It transmits a signal to the solenoid valve (YV4 Fig.10.1096 Speed Five version - Fig.10.1094 Power Shuttle version). By energizing, it shuts off the flow of pressurized oil (20 bar) to the 4WD unit, thus freeing the movement of the spring (Spring-on) in order to mechanically engage the four-wheel drive.

The switch (SA11) is connected to the platform wiring.

Fig. 10.1118

Diff lock engaging button

The button (SB8) on the right-hand side, is used for engaging the diff lock through the movement of the relative solenoid valve. The button transmits a signal to the solenoid valve (YV3 Fig.10.1096 Speed Five version - Fig.10.1093 Power Shuttle version) which, by energizing, allows oil at a pressure of 20 bar to flow towards the differential lock unit.

The sensor (SB8) is connected to the platform wiring.

The differential is disengaged by means of the brake pedals.

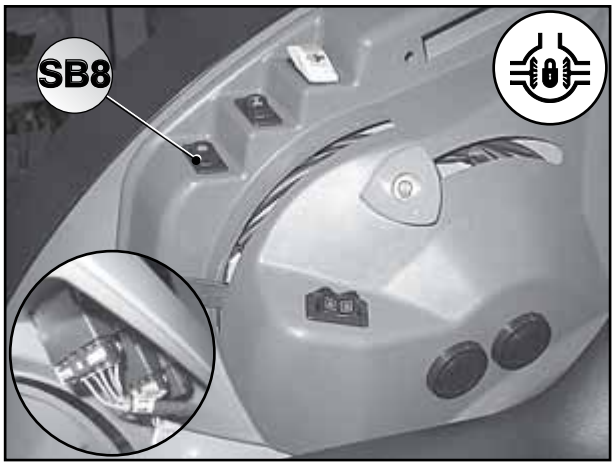


Fig. 10.1119

Parking brake switch

The switch (SQ4) on the right-hand side, in contact with the rear brake linkages, indicates when the parking brake is engaged by means of the relative indicator light on the instrument.

The switch (SQ4) is connected to the rear wiring.

Note: when the ignition switch (SA00) is off, the relative indicator light on the instrument flashes to indicate that the parking brake has not been applied.

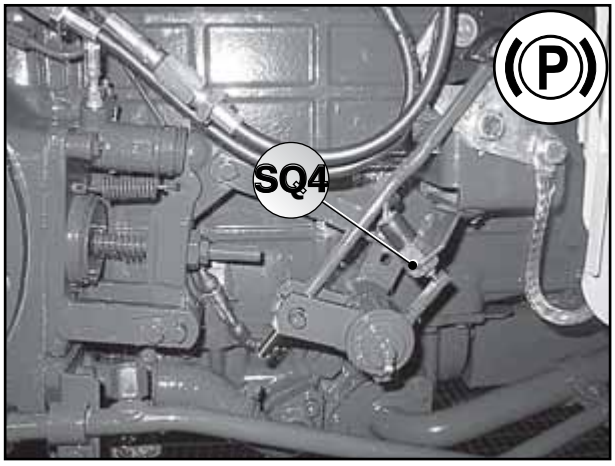


Fig. 10.1120

Buttons on the gearshift lever (Power Shuttle version)

Switches (SB2 and SB3 Fig.10.1121) on the gearshift lever are used to engage the “Power Five” unit (if installed) and to shift gear without using the clutch pedal (“declutch”). Press the relative button (SB2) to de-energize the solenoid valve (YV5 Fig.10.1095), thereby allowing pressurized oil to flow towards the Power Five assembly and towards the outlet (0 bar), thus engaging the “slow” speeds. When the solenoid valve (YV5) is energized, this action shuts off the oil that flows to the outlet, bringing it to a pressure of **20 bar**, thus engaging the “fast” speeds. If the button (SB3) is pressed in order to use the “declutch” gearshifting mode, a signal is transmitted to the electronic control unit which then transmits another signal to the solenoid valve that controls the relative clutch (“main” or “secondary”) on the valve block (15 Fig.10.1102).

The switches (SB2 and SB3) are connected to the platform wiring by means of connector (E2).

Button functionality test

The signals transmitted are electrical pulses. Make sure that the values shown in the table below are present by using a tester:

Button function	PIN colour	Button status	Value
SB3 Declutch	1-2 C-V	Released Pressed	2740 ±10Ω; 550 ±10Ω;
SB3 Overdrive	2-4 V-VB	Released Pressed	Circuit open Circuit closed

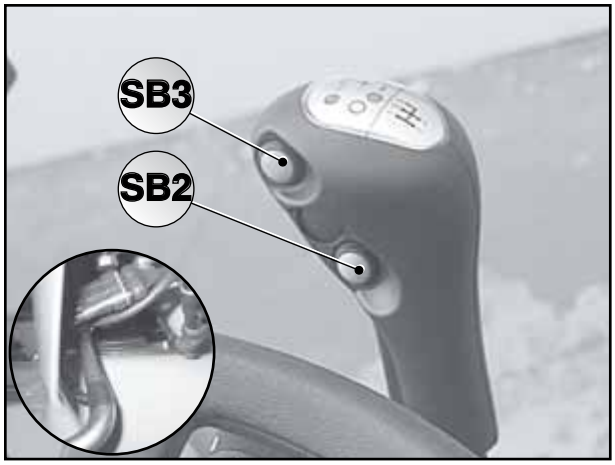


Fig. 10.1121

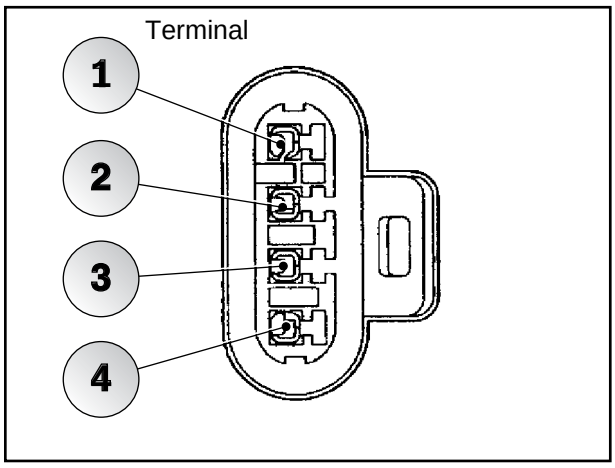


Fig. 10.1122

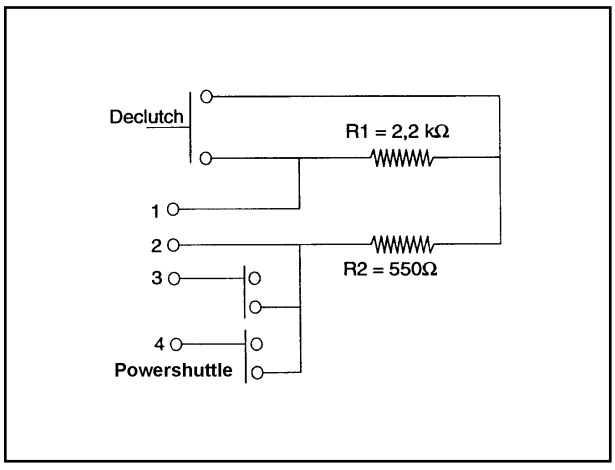


Fig. 10.1123

Ignition switch

The ignition switch (SA00) under the steering wheel on the right-hand side, allows the battery to power the starter motor, thus enabling the engine to start.

The ignition switch (SA00) is connected to the dashboard wiring.

Fig. 10.1124

Control button for the auxiliary spool valves (A-B)

The button (SA9) installed on the right-hand side is used for controlling external hydraulic rams, such as those of the top link and levelling rod. The button (SB9) has three positions: **A - 0 - B**. Press this button to energize the solenoid valves (pos.A - YV10) (pos.B - YV11) installed in the power pack (32) (Fig.10.1090).

The switch (SB9) is connected to the platform wiring.

Fig. 10.1125

Ignition enabling microswitch

The microswitch (SQ19) on the left-hand side of the gearbox-engine assembly housing, is a safety device since it prevents the engine from starting when: -the PTO is engaged -a gear is engaged -the reverse shuttle lever is not in the neutral position.

The switch (SQ19) can be accessed by disassembling the protecting panel (X).

The switch (SQ19) is connected to the rear wiring.

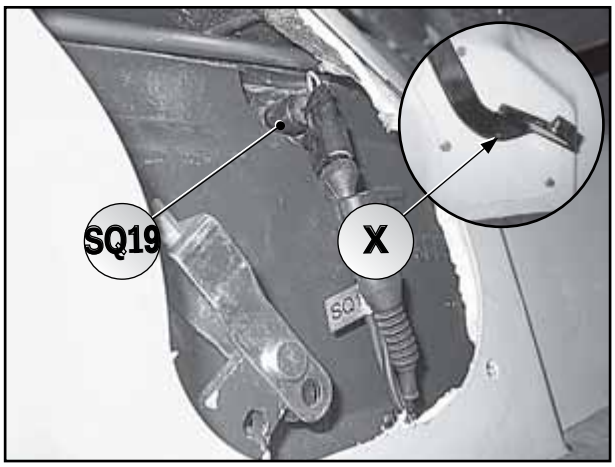


Fig. 10.1126

PTO type selector switches (Speed Five version)

The switches (SQ8 and SQ18) installed on the left-hand side near the final drive, indicate when the PTO is used in the proportional or independent mode by means of an indicator light on the instrument. When the type of PTO function is selected with the relative lever (T), the switches (SQ8 and SQ18) transmit a signal to the instrument in order to turn on the relative indicator.

The switches (SQ8 - proportional PTO) and (SQ18 - independent PTO) are connected to the rear wiring.

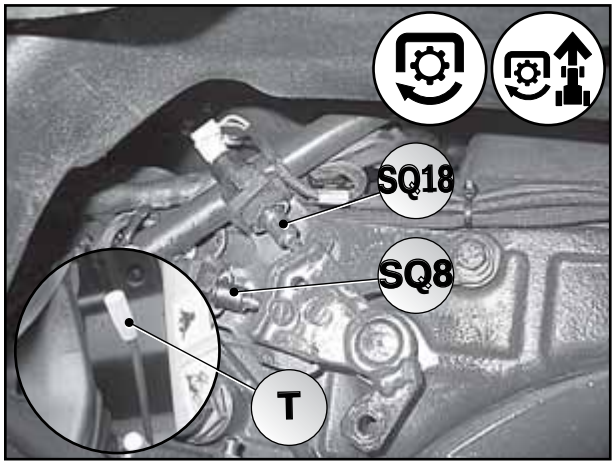


Fig. 10.1127

PTO mode selector switches (Powershuttle version)

The switch (SQ18) installed on the left-hand side near the final drive, indicates when the PTO is used in the proportional mode by means of an indicator light on the instrument. When the proportional PTO is selected by means of the relative lever (T), the switch (_SQ8) transmits a signal to the instrument and the relative indicator lights up.

The switch (SQ18) is connected to the rear wiring.

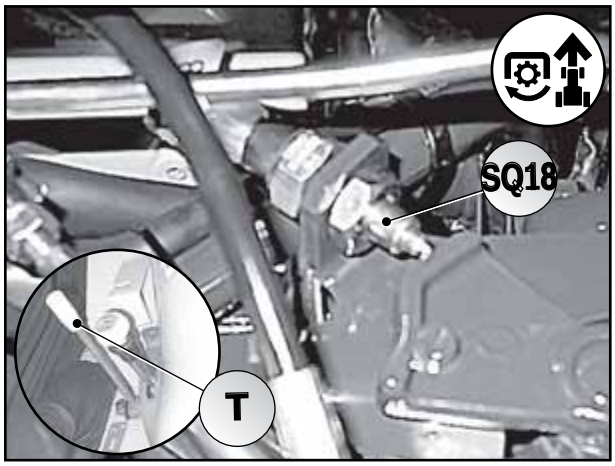


Fig. 10.1128

PTO speed selector switch (Powershuttle version)

The switches (SQ6 and SQ7) installed on the left-hand side behind the final drive, indicate when the PTO is used in the slow or fast mode by means of the relative indicator lights on the instrument. When the required PTO speed is selected, the switch affected by movement of lever (R) transmits a signal to the instrument.

The switches (SQ6 and SQ7) are connected to the rear wiring.

SQ6 - slow speed
SQ7 - fast speed

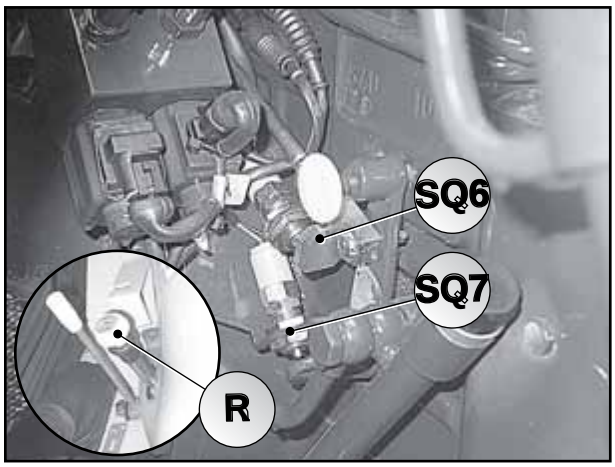


Fig. 10.1129

PTO type selector switch (Speed Five version)

The switch (SQ7) installed on the left-hand side behind the final drive, indicates when the PTO is used in the fast mode by means of an indicator light on the instrument. When the required PTO speed is selected, the switch affected by movement of lever (R) transmits a signal to the instrument.

The switch (SQ7) is connected to the rear wiring.
SQ7 - fast speed

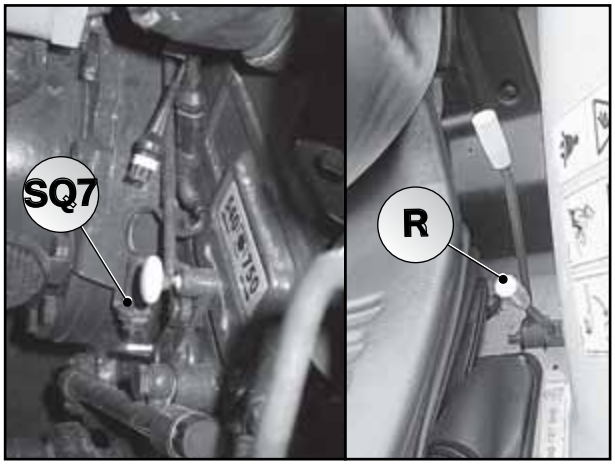


Fig. 10.1130

4.5 Instrument

4.5.1 General description

The instrument installed in **F-N Series** tractors provides the operator in real time, with all the information he needs to control the tractor itself. Digital displays show the PTO speed rate and the tractor's ground speed in a precise way. Analog indicators provide information concerning the engine rate, the fuel level and the temperature of the engine coolant.

"Non-reflecting" glass ensures that the information displayed is clearly visible in any weather condition.

The instrument allows the tractor's operating mode to be kept constantly under control through digital indications showing the type of range engaged.

The warning lights are arranged on the instrument depending on their specific indicating functions.

The instrument is connected to the dashboard wiring by means of the 26-PIN connectors (C1) and (C2) (Fig. It can be easily accessed, since the instrument is snap-fitted into the dashboard covering.

The table gives the characteristic values of the engine coolant temperature sensor, according to an applied voltage value and a Pull Up resistance value.

The values measured by the sensor (ST6 Fig.) are displayed by an analog indicator on the left-hand side of the instrument (Fig.

Voltage (Volts)	R Pull UP (OHM)	R Sensor (OHM)	Temperature (°C)
5	1000	1230	40
		810	50
		575	60
		390	70
		275	80
		210	90
		140	100
		106	110
		85	120

Fig. 10.1131

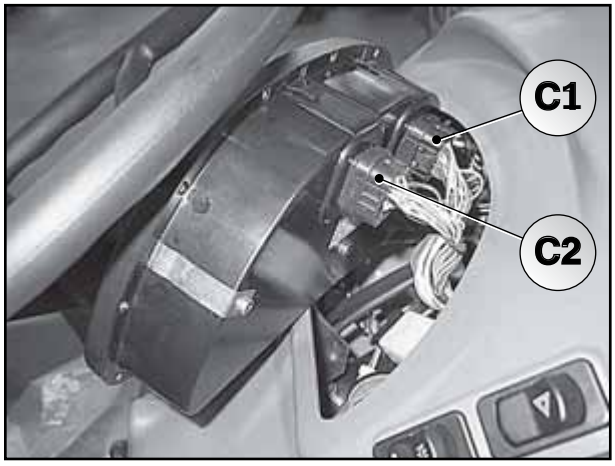


Fig. 10.1132

Fig. 10.1133

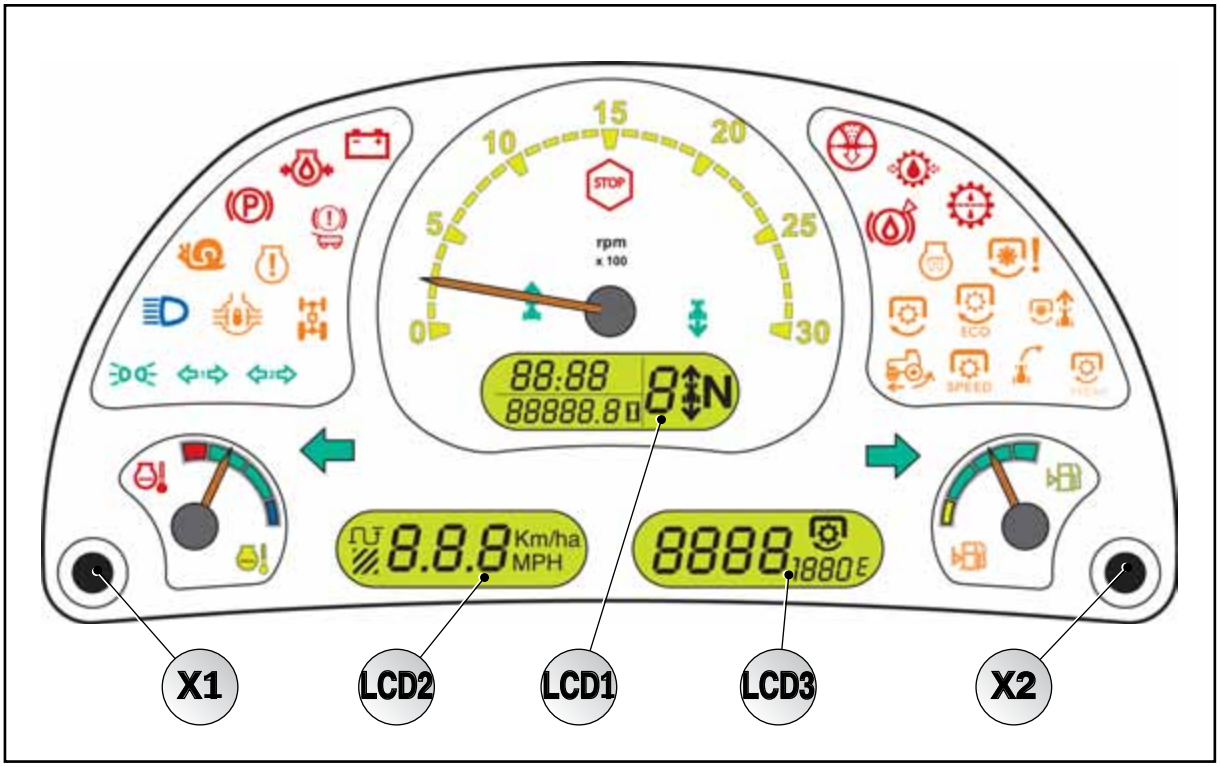


Fig. 10.1134

- Indicators showing the driving functions
- Indicators showing the driving functions
- Indicators showing the functions selected
- Indicators showing the tractor faults

Instrument check

The instrument will show the time on the display (LCD1) when the ignition key is in the OFF position, while the other displays (LCD2 and LCD3) will not display any information.

Turn the key to the ON position and the instrument will proceed with a checking phase lasting a few seconds. All the indicator lights and display characters will light up during this operation. Once the initial checking phase has terminated, the instrument will set to a default status (LCD1) where the time and hours worked up to that moment, the tractor's direction and the Powerfive range engaged will be displayed. The tractor's speed will appear on the (LCD2) display while the type of range engaged and the speed of the rear PTO will appear on the (LCD3) display.

The instrument will always set to the default status when the ignition key is turned from ON to OFF and then to ON again.

Computer

Using the side buttons (X1) and (X2), the operator can access the functions of the computer with which the instrument installed in **F-N Series** . tractors is equipped These functions allow the operator to optimize his use of the tractor and to handle the jobs required: area worked, distance covered, size of the implement, type of tyres and timetable selection.

The operations required to access the computer are described in section 4.5.3 of this chapter and in the tractor's instruction manual.

4.5.2 Indicators and connections

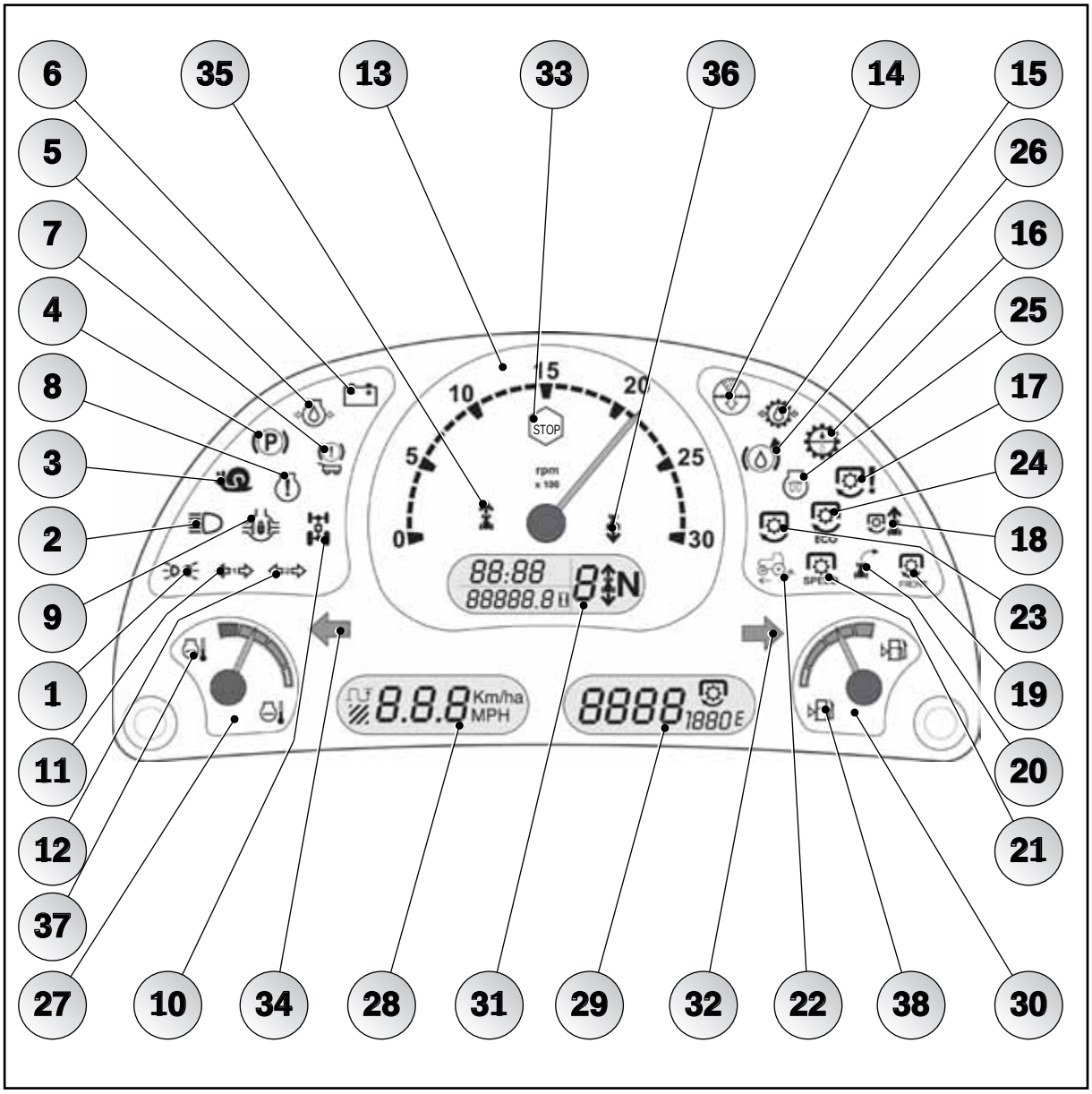


Fig. 10.1135

Warning buzzer

The buzzer starts operating if the red indicator (15) comes on to warn of low pressure in the transmission's hydraulic circuit. Immediately contact your dealer's specialized workshop if this happens. The buzzer also rings along with a flash from the red indicator (4) when the tractor engine is off and the hand brake has not been engaged. This acoustic signal lasts for about 10 seconds and will then either stop automatically or when the actual brake lever (L) is used. The same acoustic signal is given to warn that the headlights are on when the tractor engine is off.

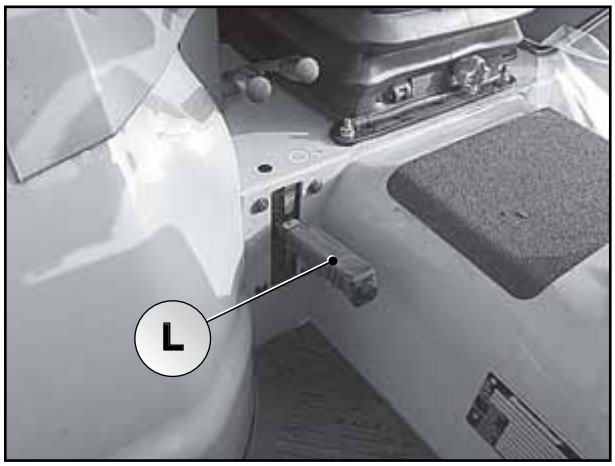


Fig. 10.1136

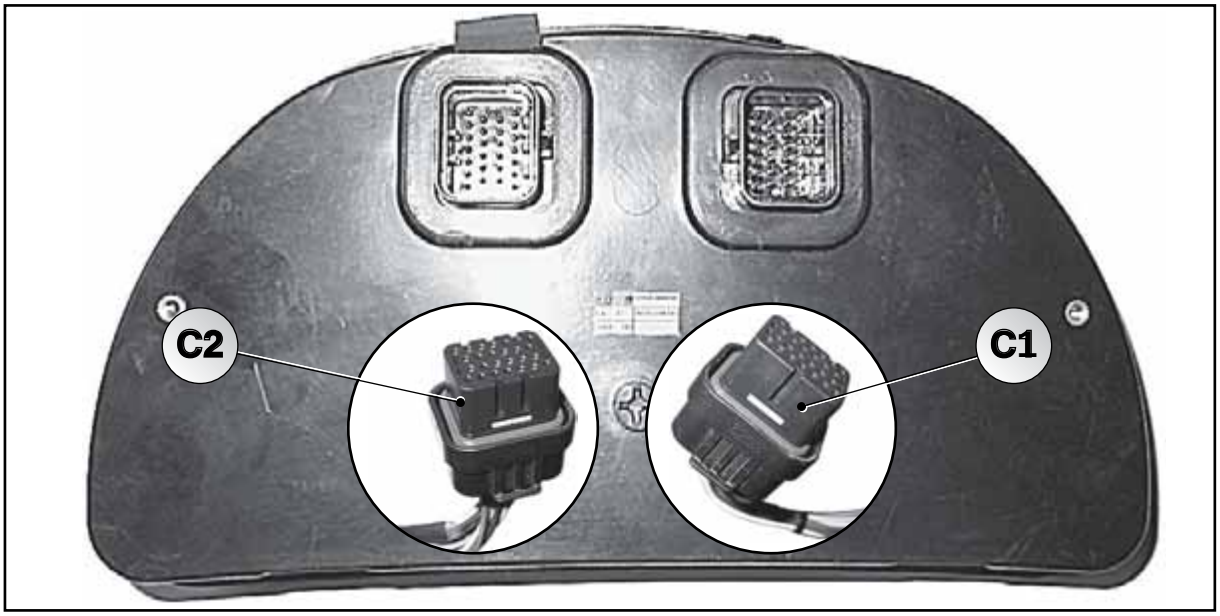


Fig. 10.1137

Number Led	Symbol Led	Function / Led colour	Description of function	Input signal		
				Conn.	Term.	Colous
1		Side lights GREEN	Indicates that side lights and/or driving beams are on.	PULL UP		
				A01	22	HG
2		Driving beams i BLUE	Indicates that dipped beams are on.	PULL UP		
				A01	21	VB
3		Park ing brake RED	Indicates that creeper is engaged.	PULL UP		
				A01	12	-
4		Engine oil pressure RED	Indicates that hand brake is engaged. Flashing when the key is off indicates that hand brake is disengaged.	PULL DOWN		
				A01	2	ZN
5		Engine oil pressure RED	Indicates low engine oil pressure. Should go out as soon as engine starts. It is quite normal for this light to come on if a hot engine is left to idle	PULL DOWN		
				A01	3	RV
6		Engine oil pressure RED	Indicates a fault in the battery recharging system. Should go out as soon as the engine starts.	D+ ALTERNATOR		
				A02	10	HM
7		Engine alarm ORANGE	Indicates low pressure in the hydraulic circuit of the trailer brake valve.	PULL DOWN		
				A01	19	BL
8		Differential lock ORANGE	Indicates possible engine faults.			
9		Four-wheel drive ORANGE	Indicates that diff lock is engaged.	PULL UP		
				A01	11	BR
10		1st trailer direction GREEN	Indicates that 4WD is engaged..	PULL UP		
				A01	10	SV
11		1st trailer direction GREEN	Indicates flashing of turn indicator lights on 1st trailer.	PULL UP		
				A01	25	GV
12		2nd trailer direction GREEN	Indicates flashing of turn indicator lights on 2nd trailer.	PULL UP		
				A01	26	AN
14		Air filter RED	Indicates clogged engine air filter. Clean or replace the filter.	PULL DOWN		
				A01	7	ZH

Number Led	Symbol Led	Funzione / Led colour	Description of function	Input signal		
				Conn.	Term.	Colors
15		Vacuum gauge of transmission's hydraulic circuit RED	With unbroken light, indicates low pressure in the transmission circuit. With flashing light, indicates clogged Powershuttle filter.	PULL DOWN		
				A01	6	ZN
				POWERSHUTTLE VERSION		
16		Transmission oil filter RED	Indicates clogged transmission oil filter.	PULL DOWN		
				A01	9	ZH
17		PTO overspeed (NAO) ORANGE	Indicates that the PTO speed is too fast	INSTRUMENT'S INTERNAL CALC.		
18		Proportional PTO ORANGE	Indicates that proportional PTO is engaged	CAN BUS		
				POWERSHUTTLE VERSION		
				PULL DOWN		
				A01	15	-
19		Front PTO ORANGE	Indicates that front PTO is engaged.	PULL DOWN		
				A01	17	-
20		By Speed ORANGE		PULL DOWN		
				A01	13	-
21		Front PTO ORANGE	Indicates PTO speed engagement (1000 RPM)	PULL DOWN		
				A02	16	HL
22		Slippage ORANGE	Indicates that the slippage control is engaged.	PULL DOWN		
				A01	20	-
23		Independent PTO ORANGE	Indicates that rear PTO is engaged.	PULL DOWN		
				A01	16	GM
24		Economy PTO ORANGE	Indicates that economy PTO (540 ECO) is engaged.	PULL DOWN		
				A01	18	-
25		Glow plugs ORANGE	Indicates that engine glow plugs are preheating.	PULL UP		
				A02	17	N
26		Brake oil RED	Indicates a low oil level in the brake fluid reservoir.	PULL DOWN		
				A01	4	ZL
32		RH turn ind. GREEN	Indicates that rh turn indicators are engaged.	PULL UP		
				A01	24	V
33		STOP RED	Indicates possible faults. Stop engine. Comes on at the same time as indicators (5), (26), (15), (7).			
34		LH turn ind. GREEN	Indicates that lh turn indicators are engaged. .	PULL UP		
				A01	23	G
35		Forward direction GREEN	Indicates that the forward speed is engaged.			
36		Reverse direction GREEN	Indicates that the reverse speed is engaged.			
37		Water temperature RED	Indicates that coolant temperature is high.	PULL DOWN		
				A02	21	VB
38		Fuel reserve ORANGE	Indicates that fuel level is low.	PULL DOWN		
				A02	14	S

Engine RPM meter

The engine rate is shown on an analog gauge on which, as the engine rate increases, a pointer moves up the scale. Never exceed the zone indicated in the figure (2450 RPM) where the engine will start to race.

The engine rate is calculated by means of the alternator signal (W). This signal is transmitted to the instrument via connector (A02 - Terminal 1 - colour GR).

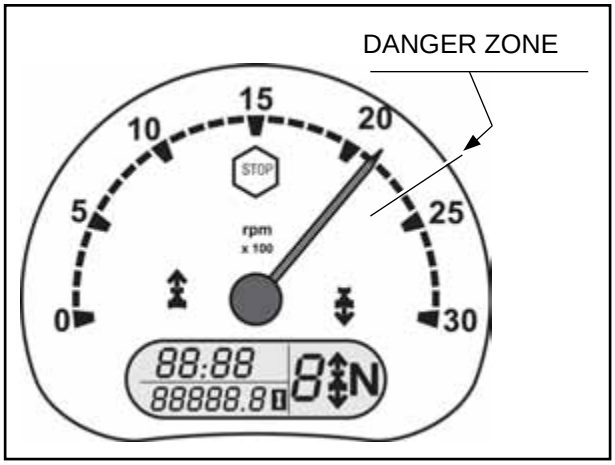


Fig. 10.1138

Indicator (31) (LCD1)

Part 1: indicates the hours and minutes (see section “Settings” for the relative settings).

Part 2: Indicates the effective work hours, regardless of the engine rate: 5 white numbers indicate the hours, 1 yellow number indicates 1/10th of an hour.

Part 3 (Power Shuttle version only): indicates the Powerfive range: 1-creeper range, 2-direct range.

Part 4: indicates the direction of advancement

Part 5 (Power Shuttle version only): indicates the Powershuttle status and Park Lock engagement.

N - Powershuttle in NEUTRAL
F - Powershuttle FORWARD
R - Powershuttle in REVERSE
P - Park Lock engaged

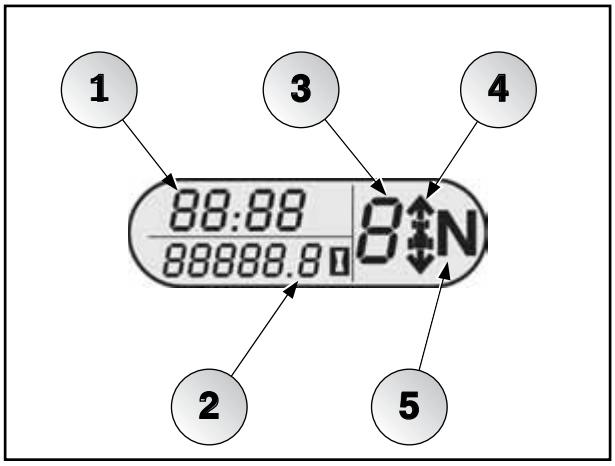


Fig. 10.1139

Indicator (29) (LCD3)

The indicator (29) accurately displays the operating rate (“shaft revolutions”) of the rear PTO. This allows the rate of implements that need precise selection of the spinning speed to be kept under constant control.

The speed rate is detected by the sensor (SR1). The signal is transmitted to the instrument via connector (A02 - Terminal 2 - colour CN).

Fig. 10.1140

Indicator (28) (LCD3)

The indicator (28) displays the ground speed of the tractor without considering wheel slip.

The speed can be expressed in kph or mph, depending on the country in which the tractor is to be used.

If the originally fitted tyres must be changed for special jobs, the speedometer can be re-programmed to suit the size of the new ones.

The speed rate is detected by the sensor (SR2). The signal is transmitted to the instrument via connector (A02 - Terminal 3 - colour SN).

Fig. 10.1141

Engine coolant temperature gauge (27)

Blue zone = ambient temperature. Before working at full rate, wait until the pointer has reached the green zone (normal operating temperature).

Green area = normal operating temperature.

Red area = temperature too high.

The overheating warning light (37) comes on at 105-110°C (221-230°F). the engine could overheat. Possible causes of engine overheating:

a - Low engine coolant level.
b - Radiator caked with mud, dust, straw, etc.
c - Build-up of deposits in coolant circuit.
d - Loose fan belt.
e - Faulty thermostat valve.

⚠	**Attention:** If the engine temperature is too high, let the engine idle immediately but do not switch it off. If the temperature gauge stays in the red, identify the cause immediately and seek expert advice if necessary.

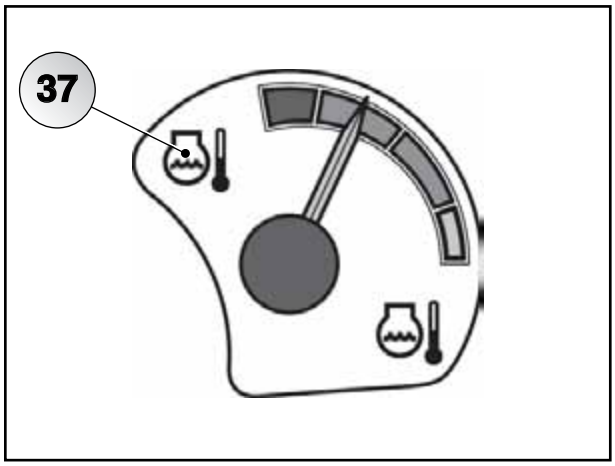


Fig. 10.1142

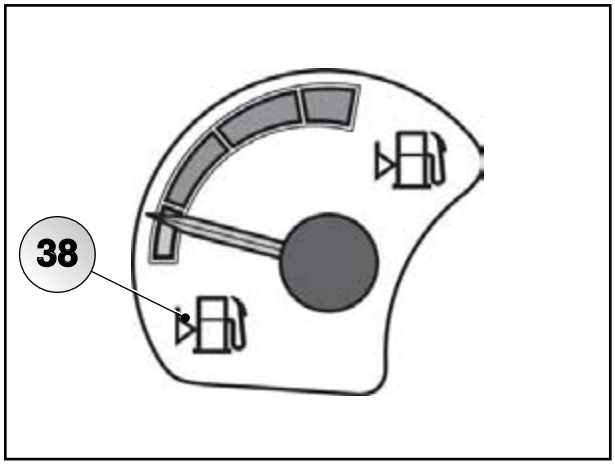


Fig. 10.1143

Fuel level gauge (30)

When the pointer moves into the yellow zone and the yellow reserve warning light comes on (38), there is still about 10 liters of fuel in the tank (2.25 gal.)(2.64 US gal.).

Alarm code indicators

The codes that indicate faults in the tractor are shown on the display (LCD1).

If a fault occurs, the corresponding alarm code flashes in part (3) of the LCD1 display. In some cases, this is also accompanied by an acoustic signal from the buzzer (HA2).

Fig. 10.1144

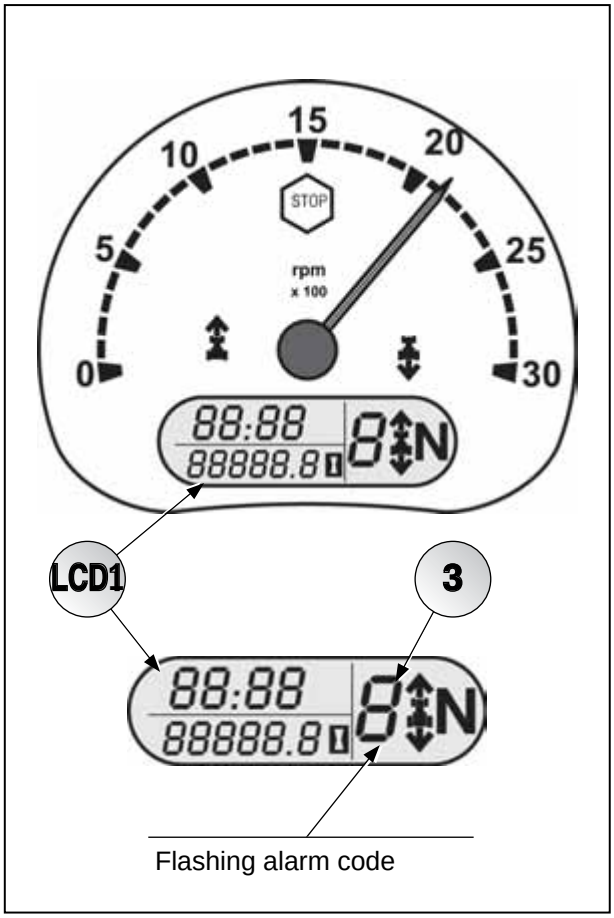


Fig. 10.1145

Instrument line connections

Type of line	Description of function	Conn. connections	Term. connections	Col. connections
CAN BUS (Power Shuttle version)		C2	4	N (shield)
		C2	5	M (high)
		C2	6	B (low)
K		C2	11	/
		C2	12	/
+ VBATT		C1	1	RN
		C2	12	/
- GND		C1	14	B
		C2	19	B
+ VBAT KEY		C1	8	R
		C2	13	R
Buzzer		C2	9	HB

4.5.3 Settings

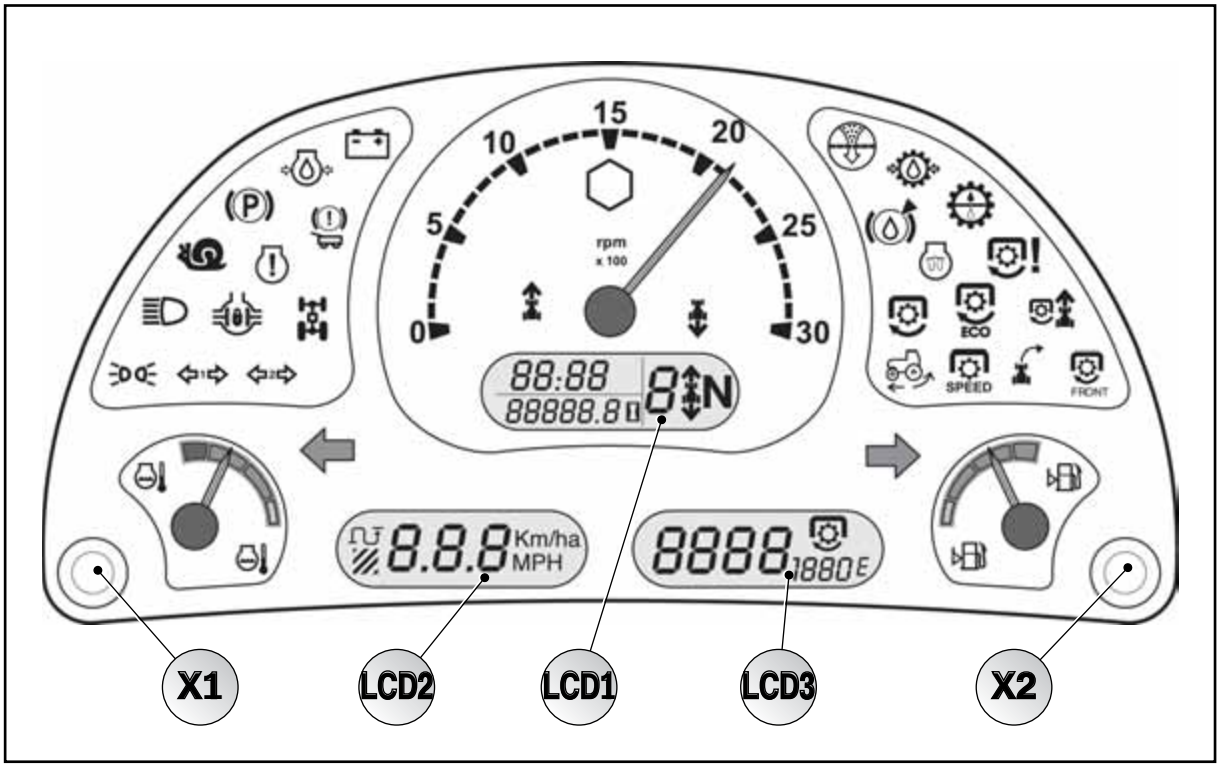


Fig. 10.1146

Codes **LCD1**, **LCD2**, **LCD3**indicate the 3 digital displays, while **X1** and **X2** indicate the left and right selector buttons, respectively.

Keys X1 and X2 are used to access functions controlled by the tractor's computer and concerning selection of the tractor model.

The functions concerning the tractor's computer are divided between:

1 - **Normal mode**

2 - **Set Parameters Mode**

NORMAL MODE

Only concerns **LCD2**

Whenever key **X1**is briefly pressed, the Speed (kph), the**worked area (ha)** and **distance covered (km) will appear on display LCD2**.

Worked area

In the **worked area**position, a brief pressure on key **X2**activates the worked area count (identified by the flashing symbol shown in Fig.10.1147 which flashes at a frequency of 2 - 3 times per second).

A further brief pressure on key **X2**stops the count (the symbol will stop flashing and remain on with a fixed light). A longer pressure (more than 5 sec) on key **X2** will reset the count. Switch the ignition key ON-OFF-ON to return the instrument to the default status, without however loosing the above mentioned counts.

Switch the ignition key ON-OFF-ON to return the instrument to the default status, without however loosing the above mentioned counts.

A longer pressure (more than 5 sec) on key **X2** will reset the count. Switch the ignition key ON-OFF-ON to return the instrument to the default status, without however loosing the above mentioned counts.

Fig. 10.1147

Distance covered

In the **distance covered**position, a brief pressure on key **X2**activates the distance covered count (identified by the flashing symbol shown in Fig.10.1148 which flashes at a frequency of 2 - 3 times per second).

A further brief pressure on key **X2**stops the count (the symbol will stop flashing and remain on with a fixed light).

A longer pressure (more than 5 sec) on key **X2** will reset the count.

Switch the ignition key ON-OFF-ON to return the instrument to the default status, without however loosing the above mentioned counts.

Fig. 10.1148

PARAMETER SETTING MODE (LCD1, LCD2 and LCD3)

A longer pressure (more than 5 sec) on key **X1**displays the setup procedure for the **implement size**, **type of tyre** and **time of day on LCD2, LCD3 and LCD1, respectively.**.

Implement size

A brief pressure10.1149), a brief pressure on key **X2**, allows you to increase the flashing value. A brief pressure on key **X1** allows you to move the cursor to the next character and to then use key **X2** to set the flashing value.

The values entered can be saved by exercising a longer pressure (more than 5 sec) on key **X1**, (thus switching to the next set-up procedure), or by simply waiting for 10 seconds (all displays go back to the default status, saving the previous settings).

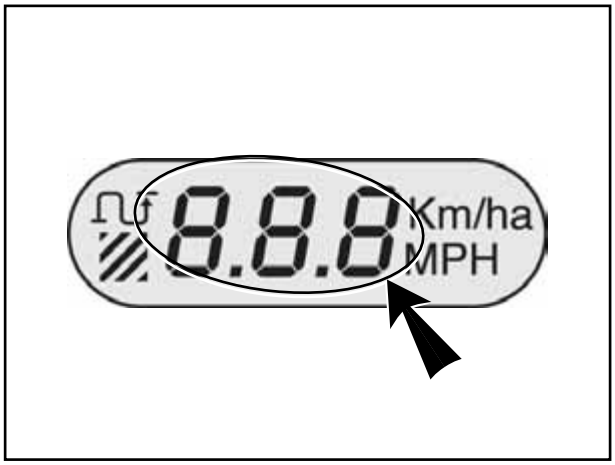


Fig. 10.1149

Rear tyre type

In the **type of tyre** position (shown in Fig.10.1150), a brief pressure on key **X2**, allows you to increase the flashing value. A brief pressure on key **X1** allows you to move the cursor to the next character and to then use key **X2** to set the flashing value.

The values entered can be saved by exercising a longer pressure (more than 5 sec) on key **X1**, (thus switching to the next set-up procedure), or by simply waiting for 10 seconds (all displays go back to the default status, saving the previous settings).

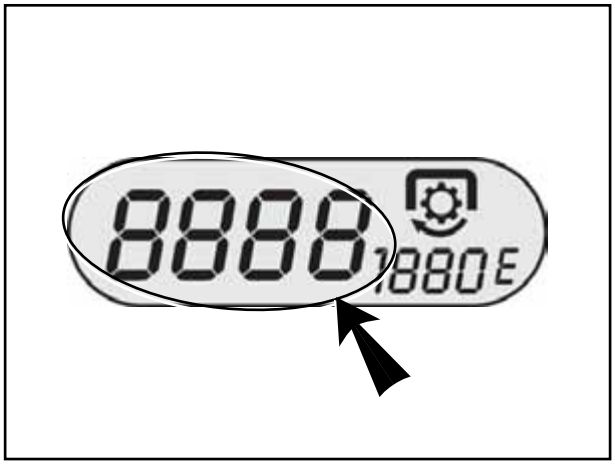


Fig. 10.1150

Clock

In the **clock** position (shown in Fig.10.1151), a brief pressure on key **X2**, allows you to increase the flashing value. A brief pressure on key **X1** allows you to move the cursor to the next character and to then use key **X2** to set the flashing value.

The values entered can be saved by exercising a longer pressure (more than 5 sec) on key **X1**, (thus switching to the next set-up procedure), or by simply waiting for 10 seconds (all displays go back to the default status, saving the previous settings).

Turn the ignition key ON -OFF-ON to set the instrument to the default status, thus losing any values that have not yet been saved.

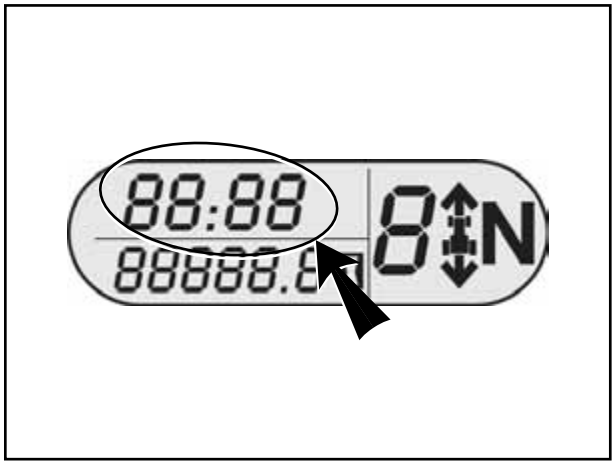


Fig. 10.1151

Electronic control unit parameter calibration mode

Only concerns LCD1

When the instrument is in the “default” status, pressure on both keys X1 and X2 (for longer than 100 msec.) is signalled to the electronic controller (D02 Fig.10.1152) via a Frame CAN. This forces the control unit to set to the parameter calibration mode.

On access to the “calibration” mode, use of the two keys X1 and X2 is identical to that of the buttons on the gearshift lever (M Fig.10.1153) for activating the calibration values.

Fig. 10.1152

Fig. 10.1153

Tractor model selection mode

Only concerns LCD1

To select the model of the tractor where the instrument in question is to be fitted, press the two keys **X1** and **X2** at the same time, the moment in which the key is turned from OFF to ON.

In this situation, LCD1 will display a “**dash**” (instead of the time) and “**M xxx**” if the model of the instrument is Medium, or “**b xxx**” if the model is Basic, instead of the hours worked.

Press key **X2** briefly to increase the value of code **xxx**, corresponding to the required tractor model (see table in next section).

Press key **X1** (briefly) to terminate that selection mode.

At the end of this procedure, it is advisable to turn the ignition key OFF and ON again after a few seconds.

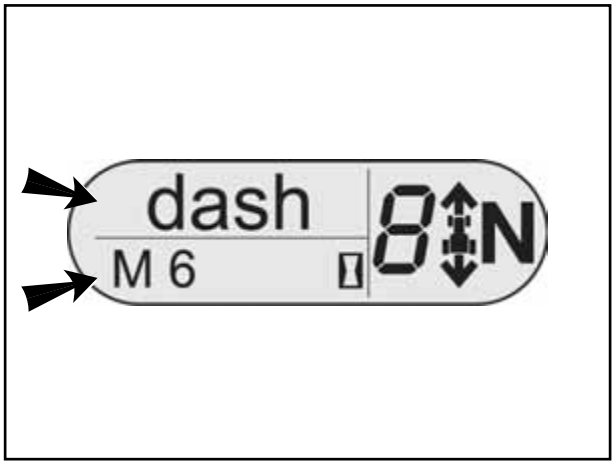


Fig. 10.1154

4.5.4 “Model” and “Tyres” tables

The following tables list the tractor model identification “numbers”, in relation to the type of Power Take-off installed, required for configuring the instrument.

F-N Series Speed Five version

Commercial denomination	Type of PTO	Market	Number (LCD1)
60 F	540 - 1000	nao	17
60 F	540 - 1000	st.	18
60 F	540-540E	nao	19
60 F	540-540E	st.	20
60 GE	540 - 1000	nao	21
60 GE	540 - 1000	st.	22
60 GE	540-540E	nao	23
60 GE	540-540E	st.	24
70 F	540 - 1000	nao	13
70 F	540 - 1000	st.	14
70 F	540-540E	nao	15
70 F	540-540E	st.	16
70 GE	540 - 1000	nao	25
70 GE	540 - 1000	st.	26
70 GE	540-540E	nao	27
70 GE	540-540E	st.	28
75 F	540 - 1000	nao	13
75 F	540 - 1000	st.	14
75 F	540-540E	nao	15
75 F	540-540E	st.	16
75 GE	540 - 1000	nao	25
75 GE	540 - 1000	st.	26
75 GE	540-540E	nao	27
75 GE	540-540E	st.	28
75 GT	540 - 1000	nao	13
75 GT	540-540E	nao	15
75 GT	540-540E	st.	16
80 F	540 - 1000	nao	13
80 F	540 - 1000	st.	14
80 F	540-540E	nao	15
80 F	540-540E	st.	16
80 GE	540 - 1000	nao	25
80 GE	540 - 1000	st.	26
80 GE	540-540E	nao	27
80 GE	540-540E	st.	28
85 F	540 - 1000	nao	13
85 F	540 - 1000	st.	14
85 F	540-540E	nao	15

85 F	540-540E	st.	16
85 GE	540 - 1000	nao	25
85 GE	540 - 1000	st.	26
85 GE	540-540E	nao	27
85 GE	540-540E	st.	28
85 GT	540 - 1000	nao	13
85 GT	540 - 1000	st.	14
85 GT	540-540E	nao	15
85 GT	540-540E	st.	16
95 F	540 - 1000	nao	5
95 F	540 - 1000	st.	6
95 F	540-540E	nao	7
95 F	540-540E	st.	8
95 GE	540 - 1000	nao	9
95 GE	540 - 1000	st.	10
95 GE	540-540E	nao	11
95 GE	540-540E	st.	12
95 GT	540 - 1000	nao	5
95 GT	540 - 1000	st.	6
95 GT	540-540E	nao	7
95 GT	540-540E	st.	8
105 F	540 - 1000	nao	5
105 F	540 - 1000	st.	6
105 F	540-540E	nao	7
105 F	540-540E	st.	8
105 GE	540 - 1000	nao	9
105 GE	540 - 1000	st.	10
105 GE	540-540E	nao	11
105 GE	540-540E	st.	12
105 GT	540 - 1000	nao	5
105 GT	540 - 1000	st.	6
105 GT	540-540E	nao	7
105 GT	540-540E	st.	8
3660 F	540 - 1000	nao	17
3660 F	540 - 1000	st.	18
3660 F	540-540E	nao	19
3660 F	540-540E	st.	20
3660 GE	540 - 1000	nao	21
3660 GE	540 - 1000	st.	22
3660 GE	540-540E	nao	23
3660 GE	540-540E	st.	24
3670 F	540 - 1000	nao	13
3670 F	540 - 1000	st.	14
3670 F	540-540E	nao	15
3670 F	540-540E	st.	16

3670 GE	540 - 1000	nao	25
3670 GE	540 - 1000	st.	26
3670 GE	540-540E	nao	27
3670 GE	540-540E	st.	28
3675 F	540 - 1000	nao	13
3675 F	540 - 1000	st.	14
3675 F	540-540E	nao	15
3675 F	540-540E	st.	16
3675 GE	540 - 1000	nao	25
3675 GE	540 - 1000	st.	26
3675 GE	540-540E	nao	27
3675 GE	540-540E	st.	28
3675 GT	540 - 1000	nao	13
3675 GT	540 - 1000	st.	14
3675 GT	540-540E	nao	15
3675 GT	540-540E	st.	16
3680 F	540 - 1000	nao	13
3680 F	540 - 1000	st.	14
3680 F	540-540E	nao	15
3680 F	540-540E	st.	16
3680 GE	540 - 1000	nao	25
3680 GE	540 - 1000	st.	26
3680 GE	540-540E	nao	27
3680 GE	540-540E	st.	28

F-N Series Power Shuttle version

Commercial denomination	Type of PTO	Market	Number (LCD1)
F-N Series - 60 F	540 - 1000	nao	1
F-N Series - 60 F	540 - 1000	st.	2
F-N Series - 60 F	540-540E	nao	3
F-N Series - 60 F	540-540E	st.	4
F-N Series - 60 GE	540 - 1000	nao	1
60 GE	540 - 1000	st.	2
F-N Series - 60 GE	540-540E	nao	3
60 GE	540-540E	st.	4
F-N Series - 70 F	540 - 1000	nao	1
F-N Series - 70 F	540 - 1000	st.	2
F-N Series - 70 F	540-540E	nao	3
F-N Series - 70 F	540-540E	st.	4
F-N Series - 70 GE	540 - 1000	nao	1
F-N Series - 70 GE	540 - 1000	st.	2
F-N Series - 70 GE	540-540E	nao	3
F-N Series - 70 GE	540-540E	st.	4
F-N Series - 75 F	540 - 1000	nao	1
F-N Series - 75 F	540 - 1000	st.	2
F-N Series - 75 F	540-540E	nao	3

F-N Series - 75 F	540-540E	st.	4
F-N Series - 75 GE	540 - 1000	nao	1
F-N Series - 75 GE	540 - 1000	st.	2
F-N Series - 75 GE	540-540E	nao	3
F-N Series - 75 GE	540-540E	st.	4
F-N Series - 75 GT	540 - 1000	nao	1
F-N Series - 75 GT	540 - 1000	st.	2
F-N Series - 75 GT	540-540E	nao	3
F-N Series - 75 GT	540-540E	st.	4
F-N Series - 80 F	540 - 1000	nao	1
F-N Series - 80 F	540 - 1000	st.	2
F-N Series - 80 F	540-540E	nao	3
F-N Series - 80 F	540-540E	st.	4
F-N Series - 80 GE	540 - 1000	nao	1
F-N Series - 80 GE	540 - 1000	st.	2
F-N Series - 80 GE	540-540E	nao	3
F-N Series - 80 GE	540-540E	st.	4
F-N Series - 85 F	540 - 1000	nao	1
F-N Series - 85 F	540 - 1000	st.	2
F-N Series - 85 F	540-540E	nao	3
F-N Series - 85 F	540-540E	st.	4
F-N Series - 85 GE	540 - 1000	nao	1
F-N Series - 85 GE	540 - 1000	st.	2
F-N Series - 85 GE	540-540E	nao	3
F-N Series - 85 GE	540-540E	st.	4
F-N Series - 85 GT	540 - 1000	nao	1
F-N Series - 85 GT	540 - 1000	st.	2
F-N Series - 85 GT	540-540E	nao	3
F-N Series - 85 GT	540-540E	st.	4
F-N Series - 95 F	540 - 1000	nao	1
F-N Series - 95 F	540 - 1000	st.	2
F-N Series - 95 F	540-540E	nao	3
F-N Series - 95 F	540-540E	st.	4
F-N Series - 95 GE	540 - 1000	nao	1
F-N Series - 95 GE	540 - 1000	st.	2
F-N Series - 95 GE	540-540E	nao	3
F-N Series - 95 GE	540-540E	st.	4
F-N Series - 95 GT	540 - 1000	nao	1
F-N Series - 95 GT	540 - 1000	st.	2
F-N Series - 95 GT	540-540E	nao	3
F-N Series - 95 GT	540-540E	st.	4
F-N Series - 105 F	540 - 1000	nao	1
F-N Series - 105 F	540 - 1000	st.	2
F-N Series - 105 F	540-540E	nao	3
F-N Series - 105 F	540-540E	st.	4

F-N Series - 105 GE	540 - 1000	nao	1
F-N Series - 105 GE	540 - 1000	st.	2
F-N Series - 105 GE	540-540E	nao	3
F-N Series - 105 GE	540-540E	st.	4
F-N Series - 105 GT	540 - 1000	nao	1
F-N Series - 105 GT	540 - 1000	st.	2
F-N Series - 105 GT	540-540E	nao	3
F-N Series - 105 GT	540-540E	st.	4
3660 F	540 - 1000	nao	1
3660 F	540 - 1000	st.	2
3660 F	540-540E	nao	3
3660 F	540-540E	st.	4
3660 GE	540 - 1000	nao	1
3660 GE	540 - 1000	st.	2
3660 GE	540-540E	nao	3
3660 GE	540-540E	st.	4
3670 F	540 - 1000	nao	1
3670 F	540 - 1000	st.	2
3670 F	540-540E	nao	3
3670 F	540-540E	st.	4
3670 GE	540 - 1000	nao	1
3670 GE	540 - 1000	st.	2
3670 GE	540-540E	nao	3
3670 GE	540-540E	st.	4
3675 F	540 - 1000	nao	1
3675 F	540 - 1000	st.	2
3675 F	540-540E	nao	3
3675 F	540-540E	st.	4
3675 GE	540 - 1000	nao	1
3675 GE	540 - 1000	st.	2
3675 GE	540-540E	nao	3
3675 GE	540-540E	st.	4
3675 GT	540 - 1000	nao	1
3675 GT	540 - 1000	st.	2
3675 GT	540-540E	nao	3
3675 GT	540-540E	st.	4
3680 F	540 - 1000	nao	1
3680 F	540 - 1000	st.	2
3680 F	540-540E	nao	3
3680 F	540-540E	st.	4
3680 GE	540 - 1000	nao	1
3680 GE	540 - 1000	st.	2
3680 GE	540-540E	nao	3
3680 GE	540-540E	st.	4

Tyre	Index radius	Number (LCD1)
21.5L-16.1	485	10
14.9 LR20	520	1
375/75 R20	520	1
11.2 R24	525	2
320/70 R24	525	2
12.4 R24	550	3
360/70 R24	550	3
11.2 R28	575	4
13.6 R24	575	4
380/70 R24	575	4
17.5L-24	580	11
14.9 R24	600	6
420/70 R24	600	6
480/65 R24	600	6
12.4 R28	600	6
14.9 R24	600	6
360/70 R28	600	6
420/70 R24	600	6
13.6 R28	625	7
16.9 R24	625	7
380/70 R28	625	7
480/70 R24	625	7
13.6 R28	625	7
16.9 R24	625	7
380/70 R28	625	7
12.4 R32	650	9
14.9 R28	650	9
420/70 R28	650	9
480/65 R28	650	9
9.5 R36	650	9
14.9 R28	650	9

Section 5 : Main components (E-Line version)

Index

5.1 Introduction 10-660

5.2 Sensors and potentiometers 10-661
5.2.1 Location 10-661
5.2.2 Identification 10-662

5.3 Solenoid valves 10-665
5.3.1 Location 10-665
5.3.2 Identification 10-666

5.4 Switches and buttons 10-667
5.4.1 Location 10-667
5.4.2 Identification 10-668

5.5 Instrument 10-671
5.5.1 General description 10-671
5.5.2 Technical specifications 10-672
5.5.3 Indicators and connections 10-672

5.1 Introduction

This section deals with the main electrical components installed in **F-N Series E-Line**tractors, as well as particular information about the maintenance work and adjustments the repair technician must make, along with certain particular recommendations.

The potentiometers, sensors, solenoid valve, switches and buttons are identified with the same letters and progressive numbers used in the functional diagram. This identification is maintained throughout all the sections of this manual.

The general concepts of each component described are the same as those illustrated in section 4 for the **Speed Five and Power Shuttle versions**.

Comply with the recommendations and safety measures described in the operation and use manual and in chapter 1 of this manual, besides the elementary rules of “common sense” when servicing, repairing and replacing these components.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: Always consult the instructions in the operation and maintenance manual when working on the battery.

	Attention: When the acid is mixed with water, SLOWLY POUR THE ACID INTO THE WATER, NEVER EVER POUR WATER INTO THE ACID.

	Attention: do not smoke when checking or handling batteries.

	Attention: disconnect the negative terminal first. connect the positive terminal first when installing the battery again. Always take great care to check the polarity of the terminals.

	Attention: always disconnect the ground cable (-) of the battery before working on the electrical system.

5.2 Sensors and potentiometers

5.2.1 Location

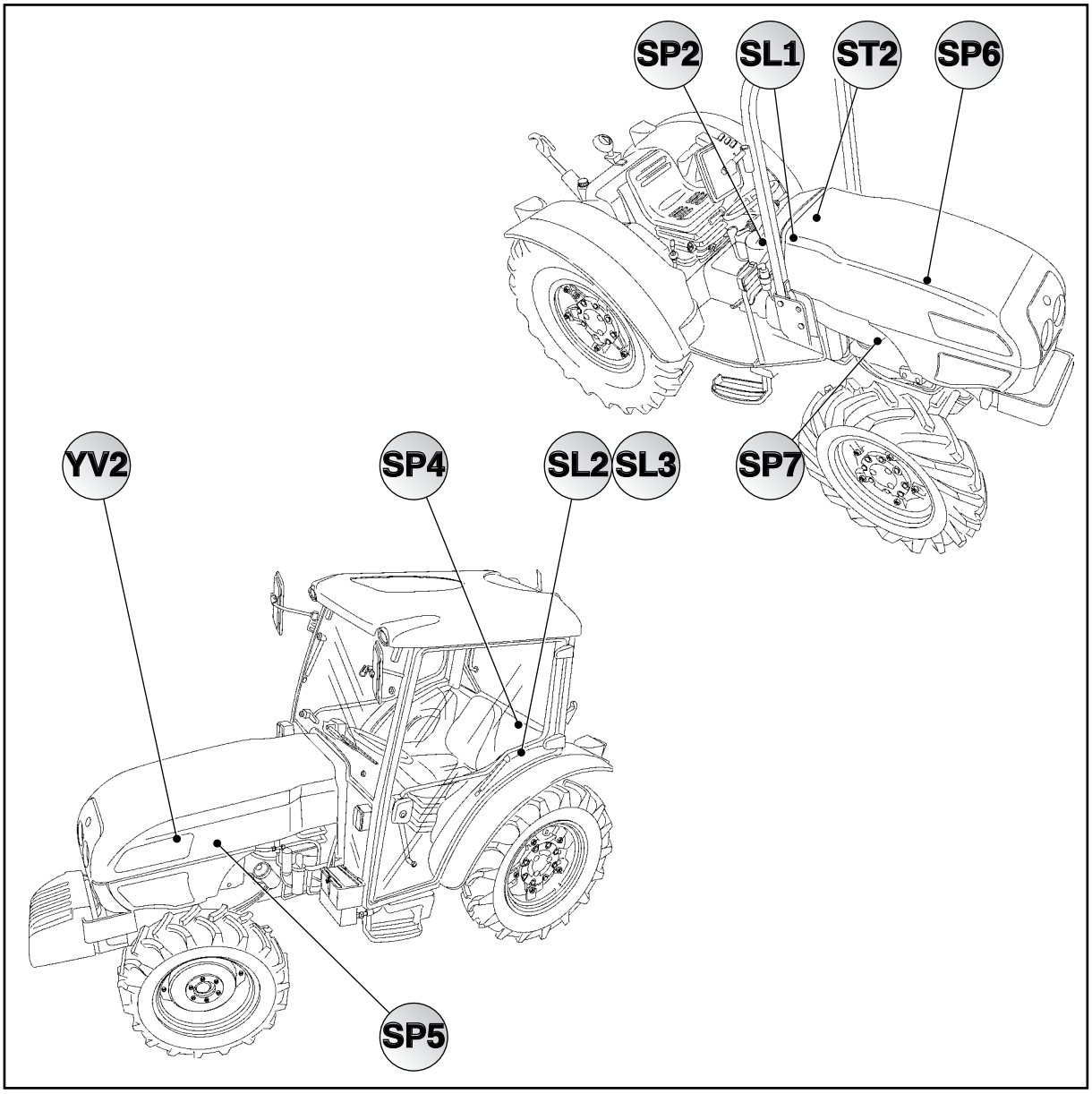


Fig. 10.1155

SL1 - Brake fluid level sensor
SL2_SL3 - Fuel level sensor
SP2 - Brake pump oil pressure sensor
SP4 - Trailer brake oil pressure sensor
SP5 - Engine oil pressure sensor
SP6 - Engine air intake filter sensor
SP7 - Low flow circuit pressure sensor
ST2 - Engine coolant temperature sensor
YV2 - Temperature sensor for fuel enrichment jet

5.2.2 Identification

Low flow circuit pressure sensor

The sensor (SP7) under the hydraulic pump, on the intake pipe, indicates when the transmission oil filter becomes clogged by means of an indicator light (unbroken light) on the instrument.

The sensor (SP7) is connected to the front wiring.

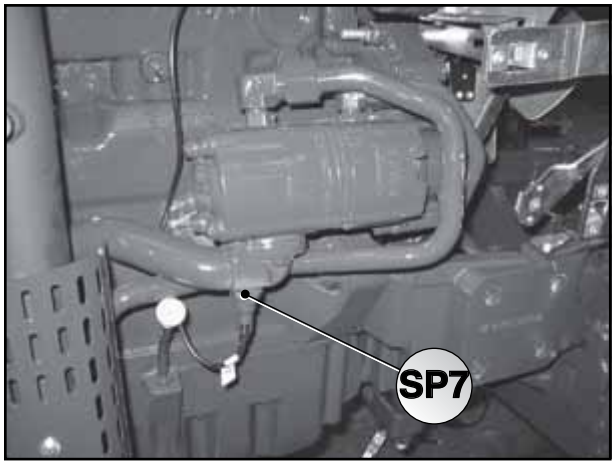


Fig. 10.1156

Engine coolant temperature sensor

This sensor (ST2) installed on the cylinder head, indicates the operating temperature of the engine and any overheating through an analog signal on the instrument.

The temperature sensor (ST2) changes the signal transmitted to the instrument according to the variation in its resistive value (expressed in Ohm).

The sensor (ST2) is connected to the front wiring.

Fig. 10.1157

Engine oil pressure sensor

The sensor (SP5) on the left-hand side of the engine, indicates when the engine oil pressure is too low by means of an indicator light on the instrument.

The sensor (SP5) is connected to the front wiring.

Fig. 10.1158

Engine air intake filter sensor

The sensor (SP6) on the sleeve that connects the intake manifold to the air filter, indicates when this latter becomes clogged by means of an indicator light on the instrument.

The sensor (SP6) is connected to the front wiring.

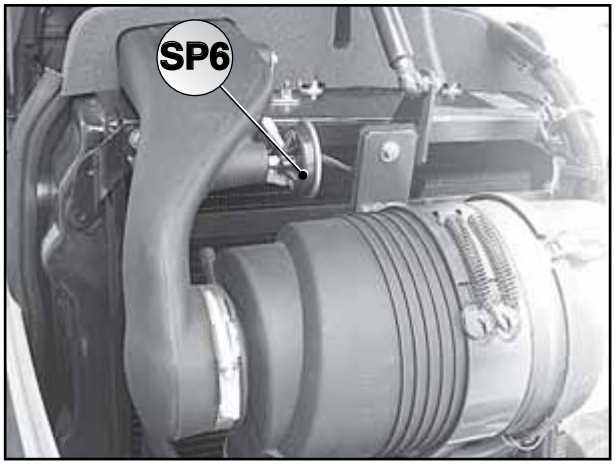


Fig. 10.1159

Fuel level sensor

The sensor (SP2_SL3) on the fuel tank plug, indicates the level in the tank by means of an indicator light on the instrument.

The sensor (SL2_SL3) is connected to the platform wiring.

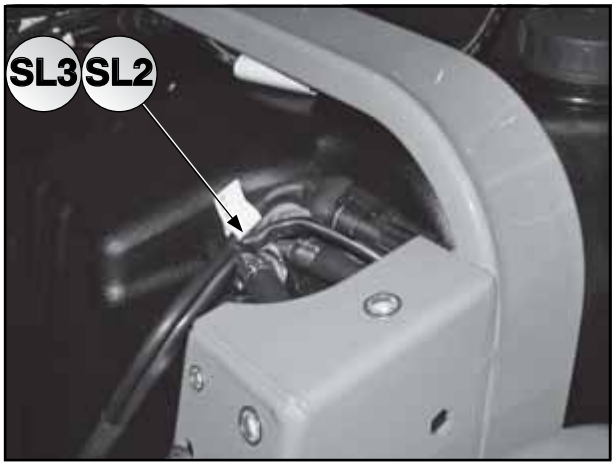


Fig. 10.1160

Brake fluid level sensor

The sensor (SL1) on the plug of the brake fluid reservoir, on the right-hand side just under the dashboard cover, indicates the level by means of an indicator light on the instrument.

The sensor (SP1) is connected to the platform wiring.

Fig. 10.1161

Temperature sensor for fuel enrichment jet

This sensor (YV2) installed on the cylinder head on the left-hand side, indicates the operating temperature of the engine itself, and then sends a signal to the fuel enrichment jet.

The sensor (YV2) is connected to the front wiring.

Fig. 10.1162

Brake pump oil pressure sensor

The sensor (SP2) under the brake pumps, transmits a signal to the relay (KB4). It controls the differential releasing operation by de-energizing the relative solenoid valve (YV4) and turns on the rear brake lights.

The sensor (SP2) is connected to the dashboard wiring.

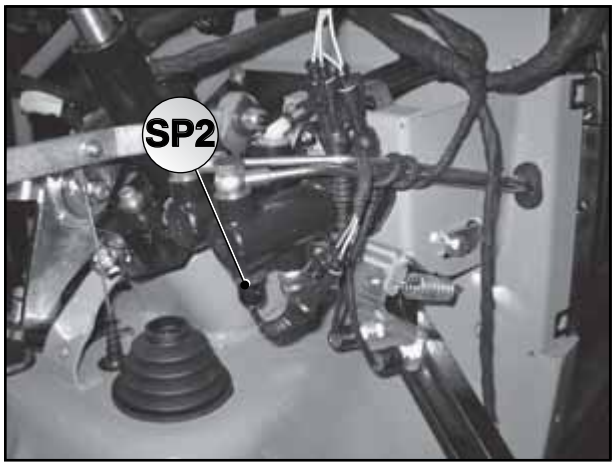


Fig. 10.1163

Trailer brake oil pressure sensor (Italian market)

The sensor (SP4)(only installed in tractors with the “trailer brake” unit) installed on the actual valve itself, comprises two pressure switches installed in series, each of which has a precise function, i.e.: pressure switch (E2 Fig.762-11) indicates when there is insufficient pressure in the relative hydraulic circuit prior to the actual valve itself and then measures the pressure of the oil circulating in the valve; pressure switch (E1 Fig.762-11) indicates that the trailer is hitched by measuring the pressure of the oil in the half-coupling.

The two pressure switches are the “normally closed” type and are respectively set at a pressure of:

E2 - 2 bar
E1 - 8 bar

The pressure switch (E2) only operates when the trailer is not hitched, since correct trailer braking leads to a pressure of at least 8 bar in the valve coupling.

The sensor (SP4) is connected to the rear wiring.

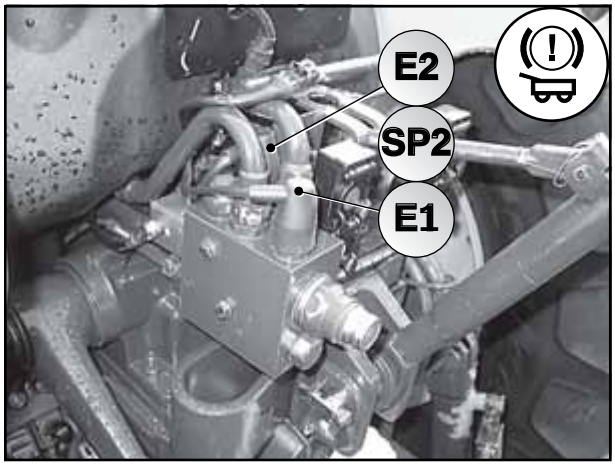


Fig. 10.1164

5.3 Solenoid valves

5.3.1 Location

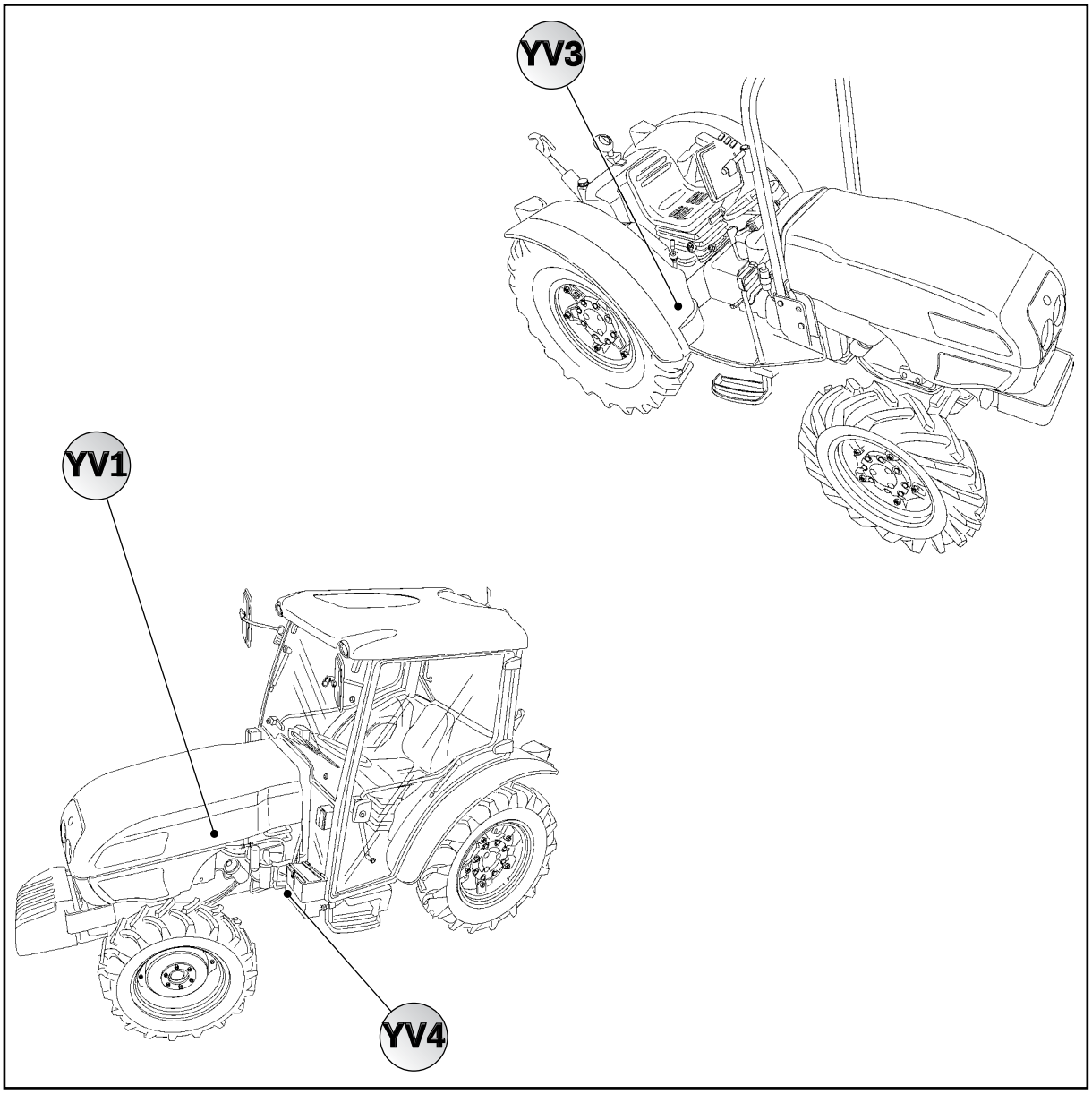


Fig. 10.1165

YV1 - Fuel injection pump solenoid valve
YV3 - 4WD solenoid valve
YV4 - Diff lock solenoid valve

5.3.2 Identification

Injection pump sol. valve

Solenoid valve (YV1) on the injection pump opens or shuts off the fuel that flows towards the engine.

When the ignition key is turned clockwise, solenoid valve (YV1) energizes, thus allowing the fuel required to start the engine to pass through. On the other hand, when the ignition key is turned in an anti-clockwise direction, the solenoid valve de-energizes, thus shutting off the fuel flow and stopping the engine.

The solenoid valve (YV1) is connected to the front wiring.

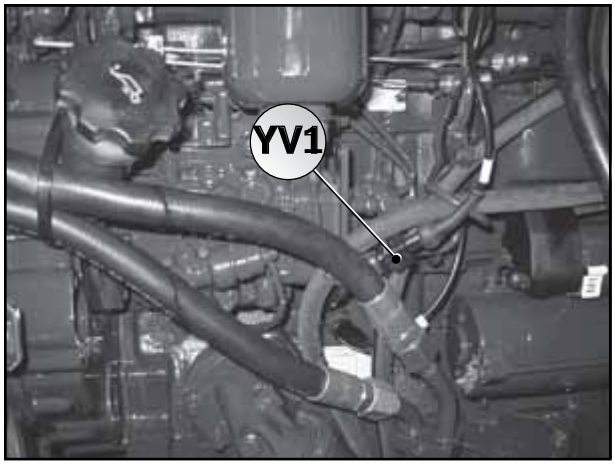


Fig. 10.1166

4WD solenoid valve

The four-wheel drive is engaged through the movement of two mechanical meshing systems operated by a spring (Spring-on).

This occurs when the driver operates the control switch (SA2) and de-energizes the solenoid valve (YV3), thus shutting off the flow of pressurized oil at **20 bar** to the four-wheel drive assembly and opening on to the outlet. When the switch (SA3) is operated, the solenoid valve (YV3) de-energizes and thus allows oil at a pressure of **20 bar** to flow to the four-wheel drive assembly.

The four-wheel drive is also engaged through the contact of switches (SQ6) and (SQ7) installed in contact with the brake levers. 4WD braking engages for safety reasons.

The solenoid valve (YV3) is connected to the rear wiring.

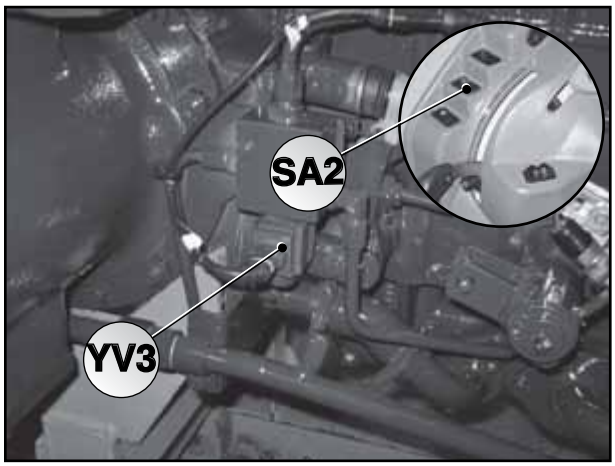


Fig. 10.1167

Diff lock solenoid valve

The front and rear differential locks are engaged through the movement of two mechanical clutches activated by a piston with oil at a pressure of **20 bar**.

This occurs when the driver energizes the solenoid valve (YV4) by operating the control button (SA4).

Energizing allows the solenoid valve to supply oil to the rear and front locks simultaneously. Releasing occurs when the solenoid valve (YV4) is de-energized by means of the brake pedals, thus shutting off the oil supply and opening on to the outlet.

The solenoid valve (YV4) is connected to the rear wiring.

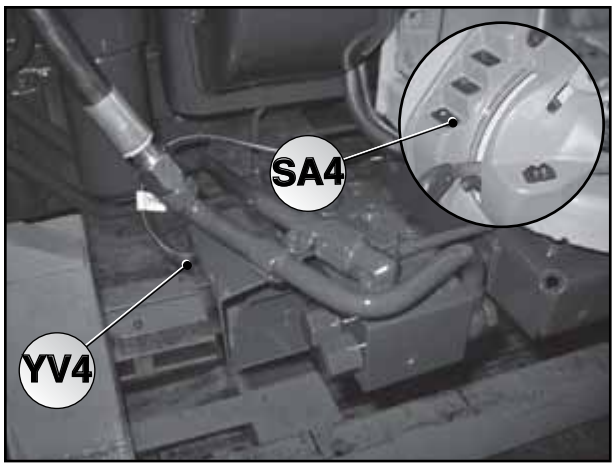


Fig. 10.1168

5.4 Switches and buttons

5.4.1 Location

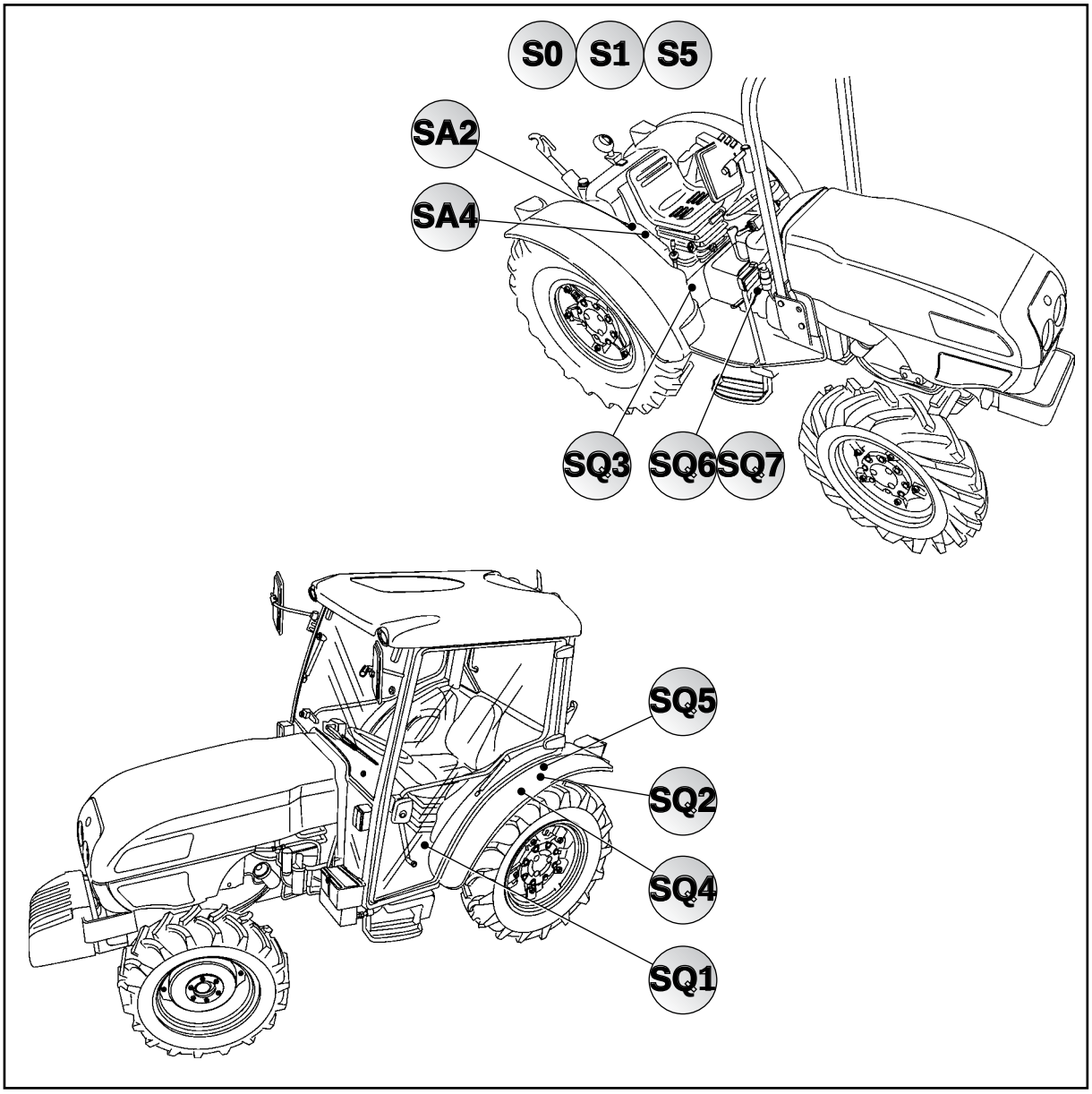


Fig. 10.1169

S0 - Ignition switch
S1 - Revolving beacon switch
S5 - Emergency switch
SA2 - 4WD engaging/disengaging switch
SA4 - Diff lock engaging button
SQ1 - Ignition enabling microswitch
SQ2 - Independent rear PTO microswitch
SQ3 - Parking brake switch
SQ4 - Proportional rear PTO microswitch
SQ5 - Fast rear PTO microswitch

5.4.2 Identification

Switches on the dashboard

Switches (S1) and (S5) on the dashboard, just under the steering wheel, have the following functions and are connected to the dashboard wiring:

S1 - revolving beacon switch
S5 - emergency light switch connector

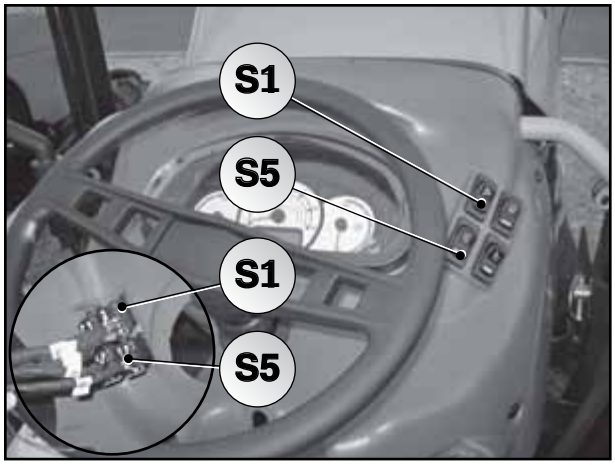


Fig. 10.1170

Ignition switch

The ignition switch (S0) under the steering wheel on the right-hand side, allows the battery to power the starter motor, thus enabling the engine to start.

The ignition switch (S0) is connected to the dashboard wiring.

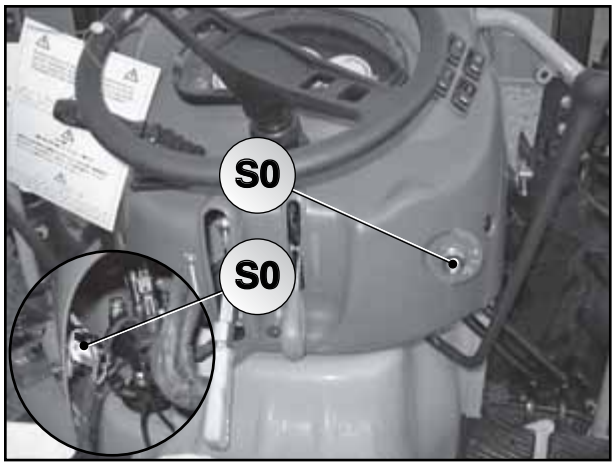


Fig. 10.1171

Ignition enabling microswitch

The microswitch (SQ1) on the left-hand side of the gearbox-engine assembly housing, is a safety device since it prevents the engine from starting when: -the PTO is engaged -a gear is engaged -the reverse shuttle lever is not in the neutral position.

The switch (SQ1) is connected to the rear wiring.

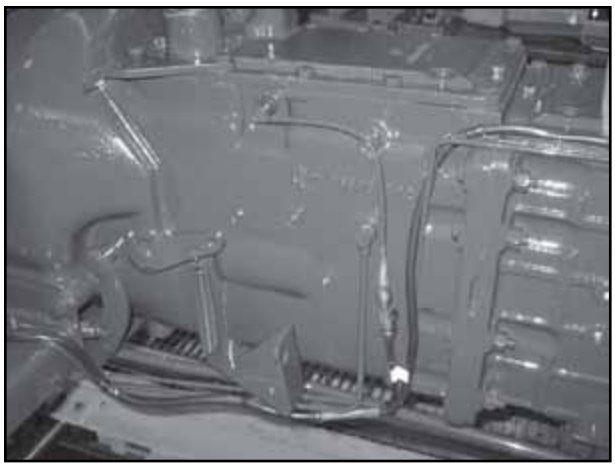


Fig. 10.1172

4WD engaging/disengaging switch

The switch (SA2) on the right-hand side, is used to engage/disengage the four-wheel drive. It transmits a signal to the solenoid valve (YV3) which, by de-energizing, shuts off the flow of oil at a pressure of **20 bar** towards the 4WD, thus freeing the movement of the spring (Spring-on) in order to mechanically engage the four-wheel drive.

The switch (SA2) is connected to the platform wiring.

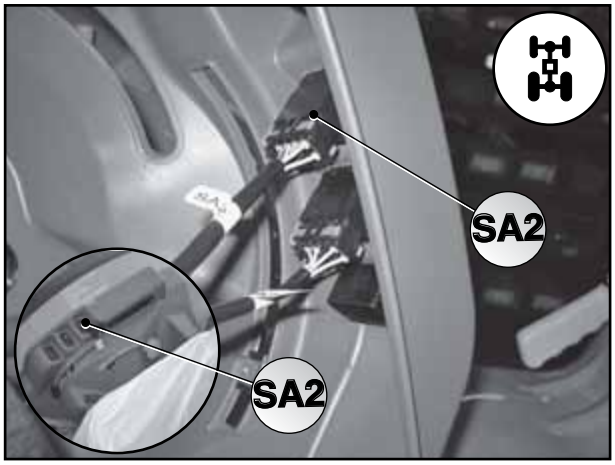


Fig. 10.1173

Diff lock engaging button

The button (SA4) on the right-hand side, is used for engaging the diff lock through the movement of the relative solenoid valve. The button transmits a signal to the solenoid valve (YV4) which, by energizing, allows oil at a pressure of 20 bar to flow towards the differential lock unit.

The sensor (SA4) is connected to the platform wiring.

The differential is disengaged by means of the brake pedals.

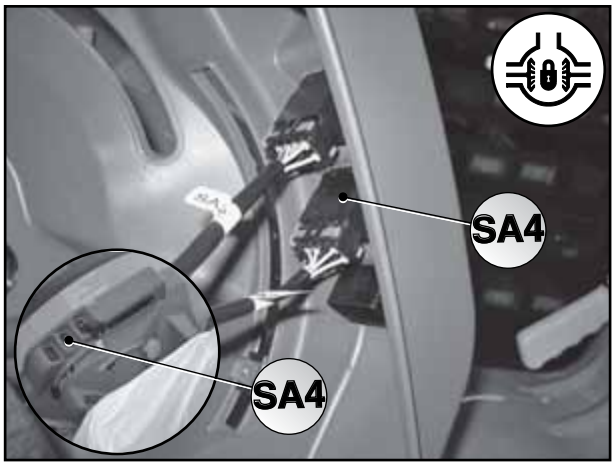


Fig. 10.1174

Parking brake switch

The switch (SQ3) on the right-hand side, in contact with the rear brake linkages, indicates when the parking brake is engaged by means of the relative indicator light on the instrument.

The switch (SQ3) is connected to the rear wiring.

Fig. 10.1175

PTO type selector switches

The switches (SQ2) and (SQ4) installed on the left-hand side near the final drive, indicate when the PTO is used in the proportional or independent mode by means of an indicator light on the instrument. When the type of PTO function is selected with the relative lever (T), the switches (SQ2) and (SQ4) transmit a signal to the instrument in order to turn on the relative indicator.

The switches (SQ2) and (SQ4) are connected to the rear wiring.

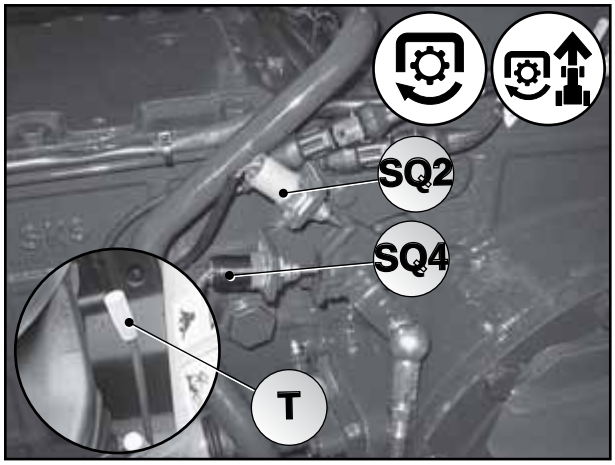


Fig. 10.1176

PTO speed selector switch

The switch (SQ5) installed on the left-hand side behind the final drive, indicates when the PTO is used in the fast mode by means of an indicator light on the instrument. When the required PTO speed is selected, the switch affected by movement of lever (R) transmits a signal to the instrument.

The switch (SQ5) is connected to the rear wiring.

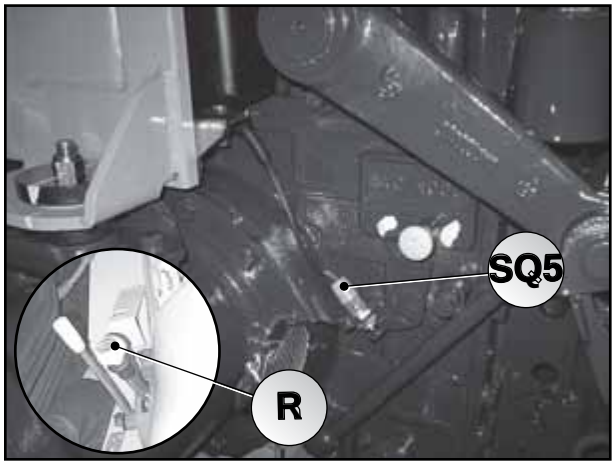


Fig. 10.1177

Rh and lh brake pedal switches (4WD engagement on braking)

The switches (SQ7) and (SQ6) are in contact with the brake pedal levers. They are responsible for engaging the 4WD on braking and for turning on the rear brake lights.

When the brake pedals are depressed (individually or latched), they transmit a signal to the solenoid valve (YV3). By energizing, this latter shuts off the flow of pressurized oil (20 bar) to the 4WD unit, thus freeing the movement of the spring (Spring-on) in order to mechanically engage the four-wheel drive. When the brake pedals are released, the solenoid valve (YV3) returns to the energized status, thus allowing pressurized oil to flow and disengage the 4WD.

The switches (SQ7) and (SQ8) are connected to the tractor's electrical system by means of the dashboard harness.

Fig. 10.1178

5.5 Instrument

5.5.1 General description

The instrument installed in **F-N Series E-Line** tractors provides the operator in real time, with all the information he needs to control the tractor itself. Analog indicators show the engine rate, the fuel level and the engine coolant temperature in a precise way. The PTO speed rate is found by matching the engine rate with the information on the decal in the central part of the instrument.

The signal reaches the instrument by means of the alternator's W (G3).

"Non-reflecting" glass ensures that the information displayed is clearly visible in any weather condition.

The warning lights are arranged on the instrument depending on their specific indicating functions.

The instrument is connected to the dashboard wiring by means of the 24-PIN connector (EC1). It can be easily accessed, since the instrument is snap-fitted into the dashboard covering.

The instrument is pre-engineered for the addition of two buttons (SW1) and (SW2) for regulating the clock (LCD1 display). The one on the left (SW1) regulates the hours, while the one on the right (SW2) regulates the minutes of the clock.

Note: The instrument installed in **F-N Series E-Line** tractors does not include: - the use of some of the indicator lights shown on the general decal, since the tractor does not possess those specific functions; - clock in the display (LCD1) and the relative buttons at the side for regulating it.

The instrument panel's night lighting comes on when power (+12V) reaches the input of the tractor's side lights (indicator light L2).

Fig. 10.1179

Fig. 10.1180

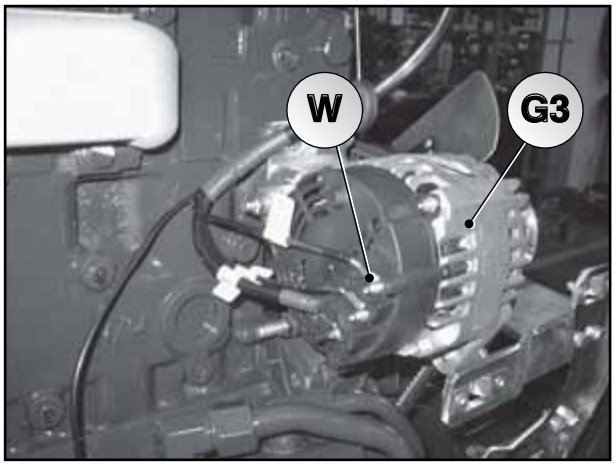


Fig. 10.1181

5.5.2 Technical specifications

Instrument

Power supply voltage	12 VDC
Operating range	10 16 VDC
Voltage setting	13.5 VDC
Protection degree	IP66 frontal
Protections	polarity reversal
Resistance to vibrations	5g (5-200 Hz)
Make	Unx

5.5.3 Indicators and connections

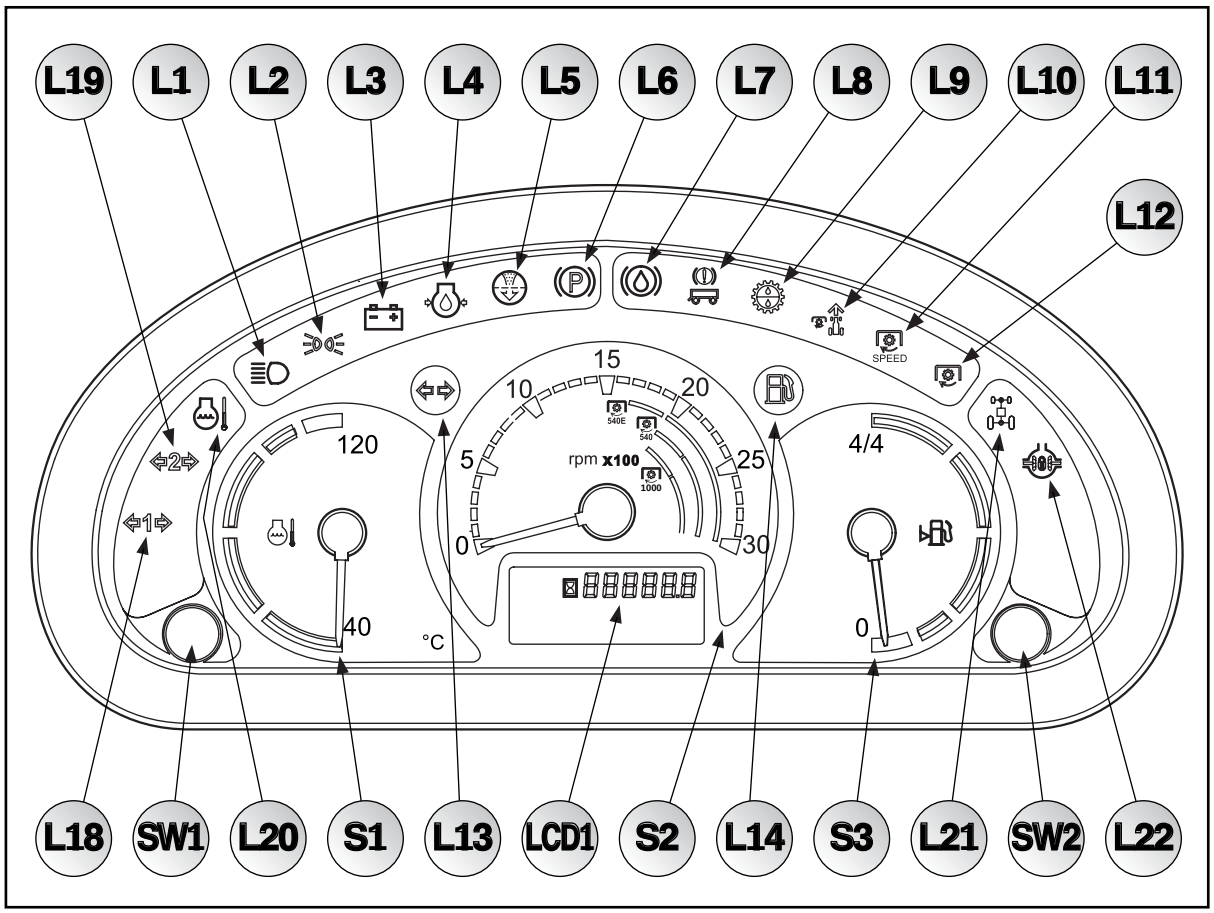


Fig. 10.1182

L1 - Driving beams
L2 - Side lights
L3 - Battery
L4 - Low engine oil pressure
L5 - Air filter
L6 - Parking brake
L7 - Brake oil pressure
L8 - Trailer brake oil pressure
L9 - Transmission oil filter
L10 - Synchronized PTO
L11 - Fast PTO
L12 - Independent PTO
L13 - Turn indicators
L14 - Low fuel level
L18 - 1st trailer turn indicators
L19 - 2nd trailer turn indicators
L20 - High engine coolant temperature
L21 - 4WD engaged
L22 - Differential lock
LW1 - Lh clock regulating button
LW2 - Rh clock regulating button
LCD1 - Hour counter and clock display
S1 - Engine coolant temperature indicator
S2 - Engine and PTO speed indicator
S3 - Fuel level indicator

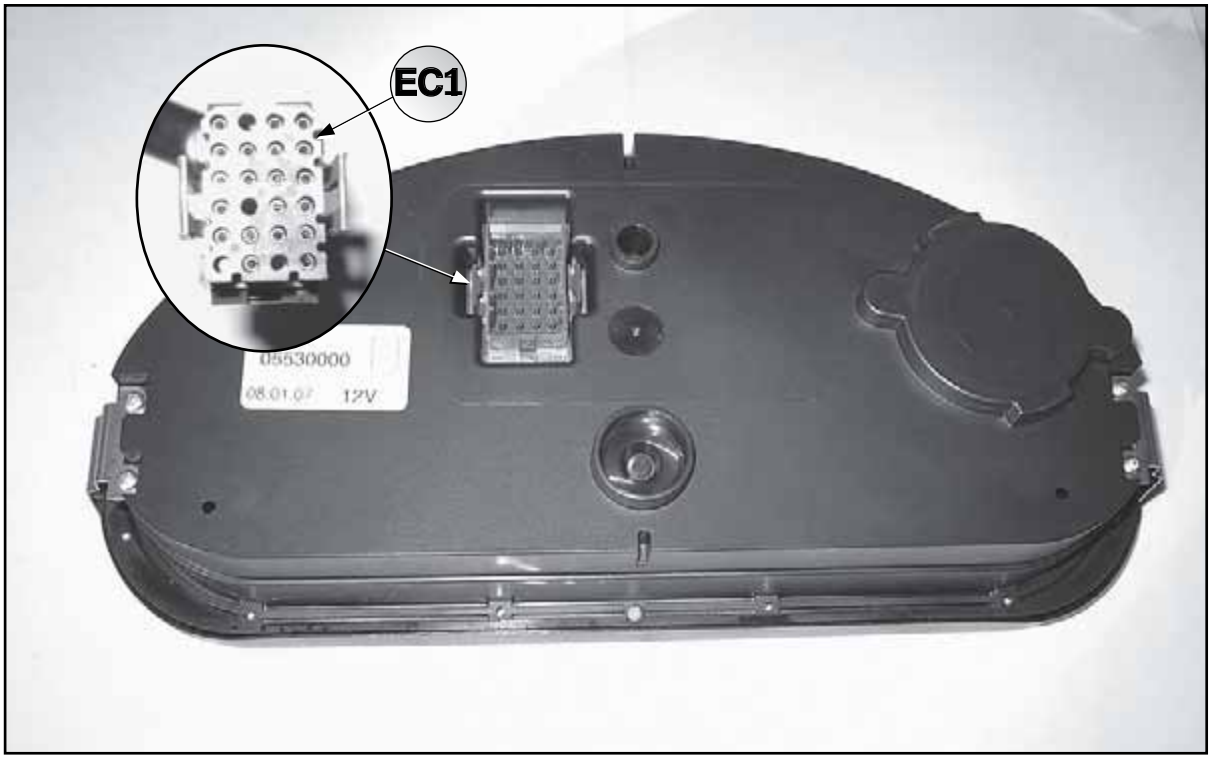


Fig. 10.1183

EC1 pin	Ind. N°	description	ind. colour	polarity
13	L1	Driving beams	Blue	+12V
10	L2	Side lights	Green	+12V
14	L3	Battery	Red	GND
5	L4	Low engine oil pressure	Red	GND
6	L5	Air filter	Red	GND
1	L6	Parking brake	Red	GND
2	L7	Brake oil pressure	Red	GND
3	L8	Trailer brake oil pressure	Red	GND
7	L9	Transmission oil filter	Red	GND
4	L10	Synchronized PTO	Yellow	+12V
8	L11	Fast PTO	Yellow	GND
12	L12	Independent PTO	Yellow	GND
18	L13	Turn indicators	Green	+12V
16	L14	Low fuel level	Yellow	GND
19	L18	1st trailer turn indicators	Green	+12V
22	L19	2nd trailer turn indicators	Green	+12V
-	L20	High engine coolant temperature	Red	Internal <87.5 Ω
11	L21	4WD engaged	Yellow	GND
23	L22	Differential lock	Yellow	GND

Connector (EC1)

The instrument is connected to the dashboard wiring by means of the connector (EC1). The connections of the 24 PINs are given in the table below.

pin	colour	to con. or comp.	pin	wire function
1	ZN	XS2	10	hand brake
2	ZL	XS3	17	brake oil level
3	CL	XS2	11	trailer brake oil
4	C	XS2	12	synchronized PTO
5	RV	XS1	22	low engine oil pressure
6	LG	XS1	23	air filter clogged
7	ZH	XS1	24	transmission oil filter
8	HL	XS2	14	fast PTO
9	R	FB5		battery + key
10	HG	SA-5		side light junction
11	SV	KA5	87	four-wheel drive
12	HN	KA1	85	Independent PTO
13	VN	KB2	87	driving beams
14	HM	XS1	5	battery charge
15	S	XS3	18	fuel level
16	SG	XS3	19	fuel indicator
17	RN	FB4		+ 30 instrument
18	G	G4	5	turn indicators
19	GN	G4	2	1st trailer direction
20	VB	XS1	27	water temperature
21	BN	SA-3		battery direct grounding junction
22	GV	G4	3	2nd trailer direction
23	BR	KB3	30	differential lock
24	GR	XS1	3	engine rate

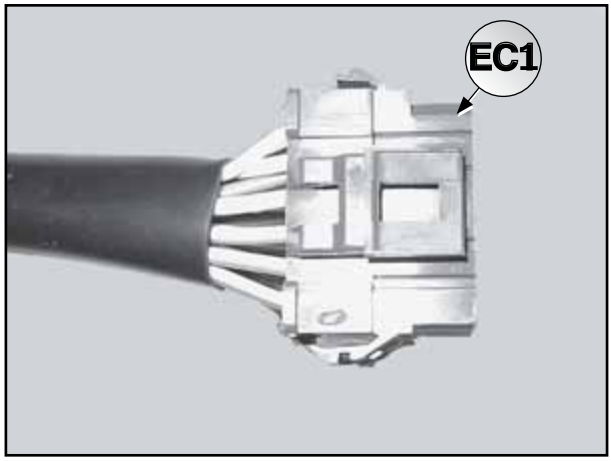


Fig. 10.1184

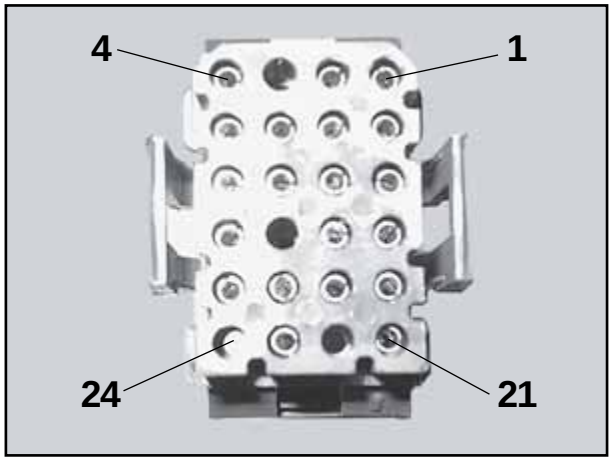


Fig. 10.1185

The table gives the characteristic values of the engine coolant temperature sensor, according to an applied voltage value and a resistance value.

The values measured by the sensor (ST2) are displayed by an analog indicator (S1) on the left-hand side of the instrument.

Angular degrees	Sector	R Sensor (OHM)	Temperature (°C)
0	start of scale	834	40
22.5		604	50
45	first position	438	60
67.5		317	70
90	scale halfway	230	80
112.5		167	90
135	third position	121	100
157.5	start of red zone	87.5	110
180	end of red zone	63.4	120

The work hours are displayed in the top line of the display (LCD1) with 1/10th of an hour resolution (6 minutes). The total hour counter can never be reset and the work hours are saved each minute and when the ignition key is removed. The hour count is only activated when the engine is running (engine rate more than 200 RPM).

The decimal point only flashes when the hour counter is counting.

The table gives the characteristic values of the fuel level sensor, according to an applied voltage value and a resistance value.

The values measured by the sensor (SL2_SL3) are displayed by an analog indicator (S3) on the right-hand side of the instrument.

Angular degrees	Level	R Sensor (OHM)	Sector
0	0/8	834	start of red zone
22.5	1/8 reserve	604	end of red zone
90	4/8	438	scale halfway
180	8/8	317	end of scale

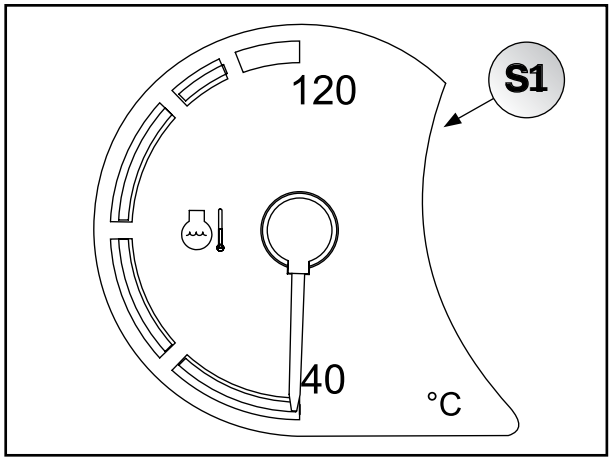


Fig. 10.1186

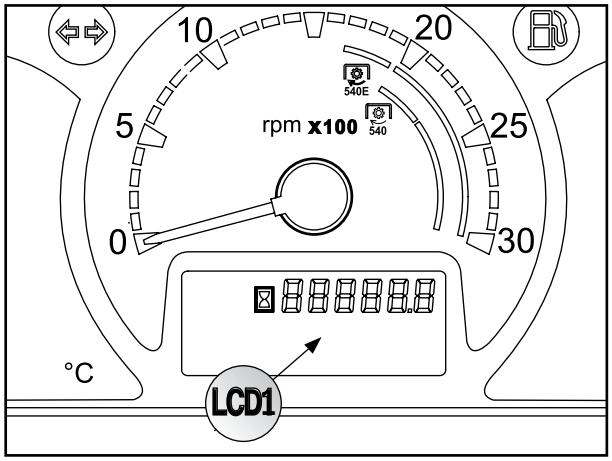


Fig. 10.1187

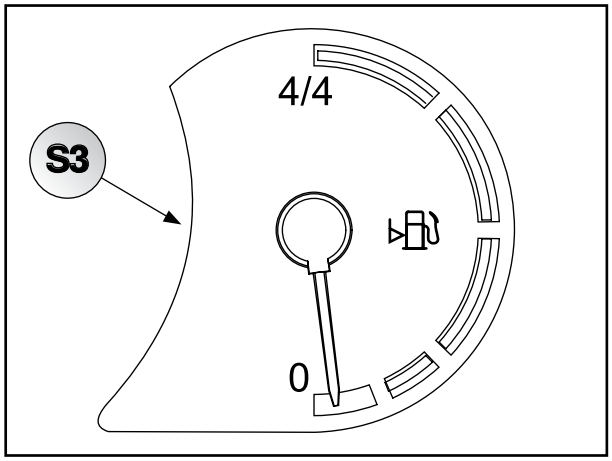


Fig. 10.1188

Chapter 11 : Calibration

Index

Section 1 : Precautions and safety recommendations 11-2

Section 2 : Introduction 11-3

2.1 Introduction to calibration 11-4
2.2 The components involved 11-6
2.3 Main technical specifications 11-9

Section 3 : Calibration procedure 11-11

3.1 Safety notes 11-12
3.2 When to calibrate and in which conditions 11-13
3.3 Calibration 11-14

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: always consult the instructions in the operation and maintenance manual when working on the battery.
	Attention: Take all the necessary precautions when batteries containing sulphuric acid are installed. If the acid splashes on to the skin or into the eyes, immediately rinse the affected parts under clean running water.
	Attention: When the acid is mixed with water, SLOWLY POUR THE ACID INTO THE WATER, NEVER EVER POUR WATER INTO THE ACID.
	Attention: Explosive gas escapes when batteries are recharged. Work in places where there is good air circulation and keep well away from flames or sparks.
	Attention: always switch off the charging apparatus before disconnecting the cables.
	Attention: keep batteries well out of children's reach.
	Attention: do not smoke when checking or handling batteries.
	Attention: disconnect the negative terminal first. connect the positive terminal first when installing the battery again. Always take great care to check the polarity of the terminals.
	Attention: always disconnect the ground cable (-) of the battery before working on the electrical system.

Section 2 : Introduction

Index

2.1 Introduction to calibration 11-4

2.2 The components involved 11-6

2.3 Main technical specifications 11-9

2.1 Introduction to calibration

Purpose of calibration

Calibration allows the tractor to operate in an excellent way in all conditions, guaranteeing:

- smooth, immediate and progressive start-ups;
- acceleration proportional to the load;
- smooth, immediate and progressive direction changes.

When to calibrate

Calibration is carried out accurately in the production plant and need not be done again, unless one or both of the proportional solenoid valves (YV1/YV2 Fig.11.3) or the electronic control unit (D02) need to be replaced (Fig.11.4).

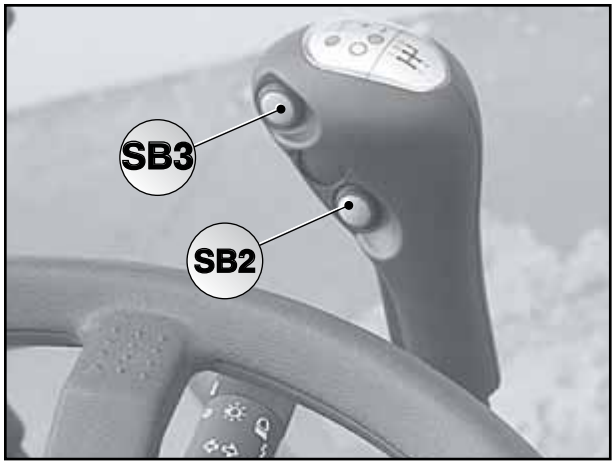


Fig. 11.1

How to calibrate

Use the buttons (SB2/SB3 Fig.11.1) on the gearshift lever or buttons (X1 and X2 Fig.11.2) on the instrument to operate the processor in the electronic control unit, which finds and synchronizes the times required for the hydraulic clutch assemblies (Main and Secondary Fig.11.5) to engage so as to optimize the settings and ensure the tractor operates correctly.

Which calibrations

- C3: Clutch pedal calibration.
- C4: Secondary clutch limit calibration
- C5: Main clutch limit setting

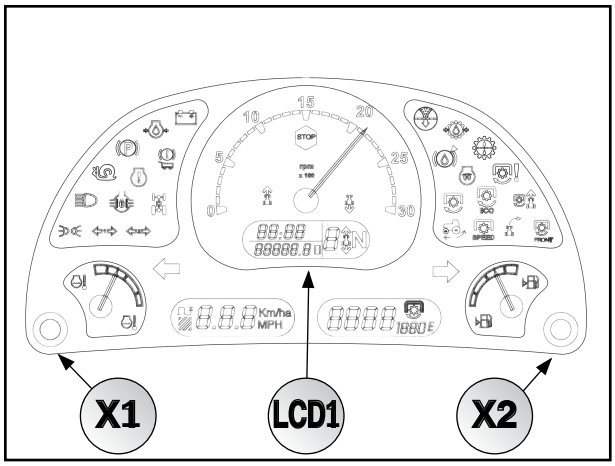


Fig. 11.2

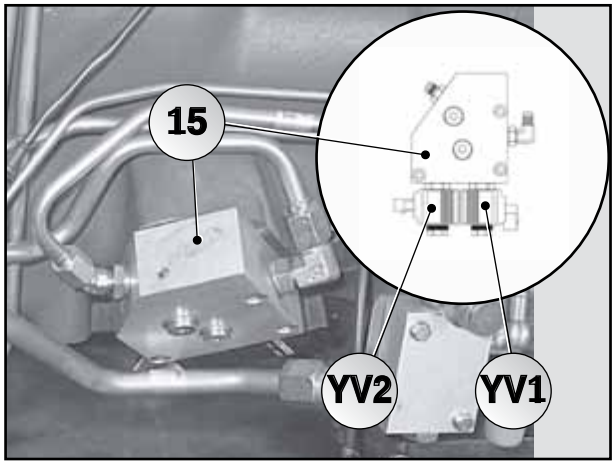


Fig. 11.3

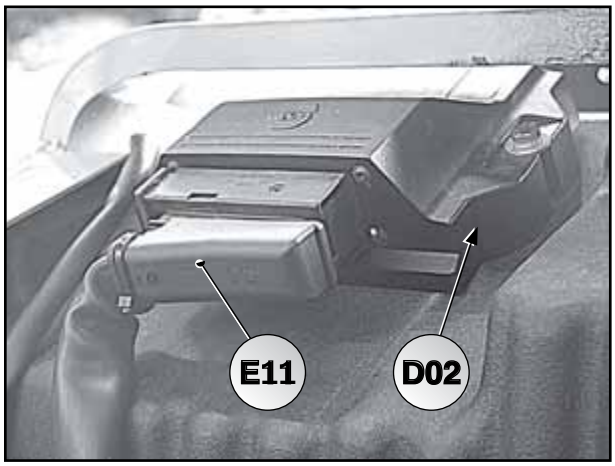


Fig. 11.4

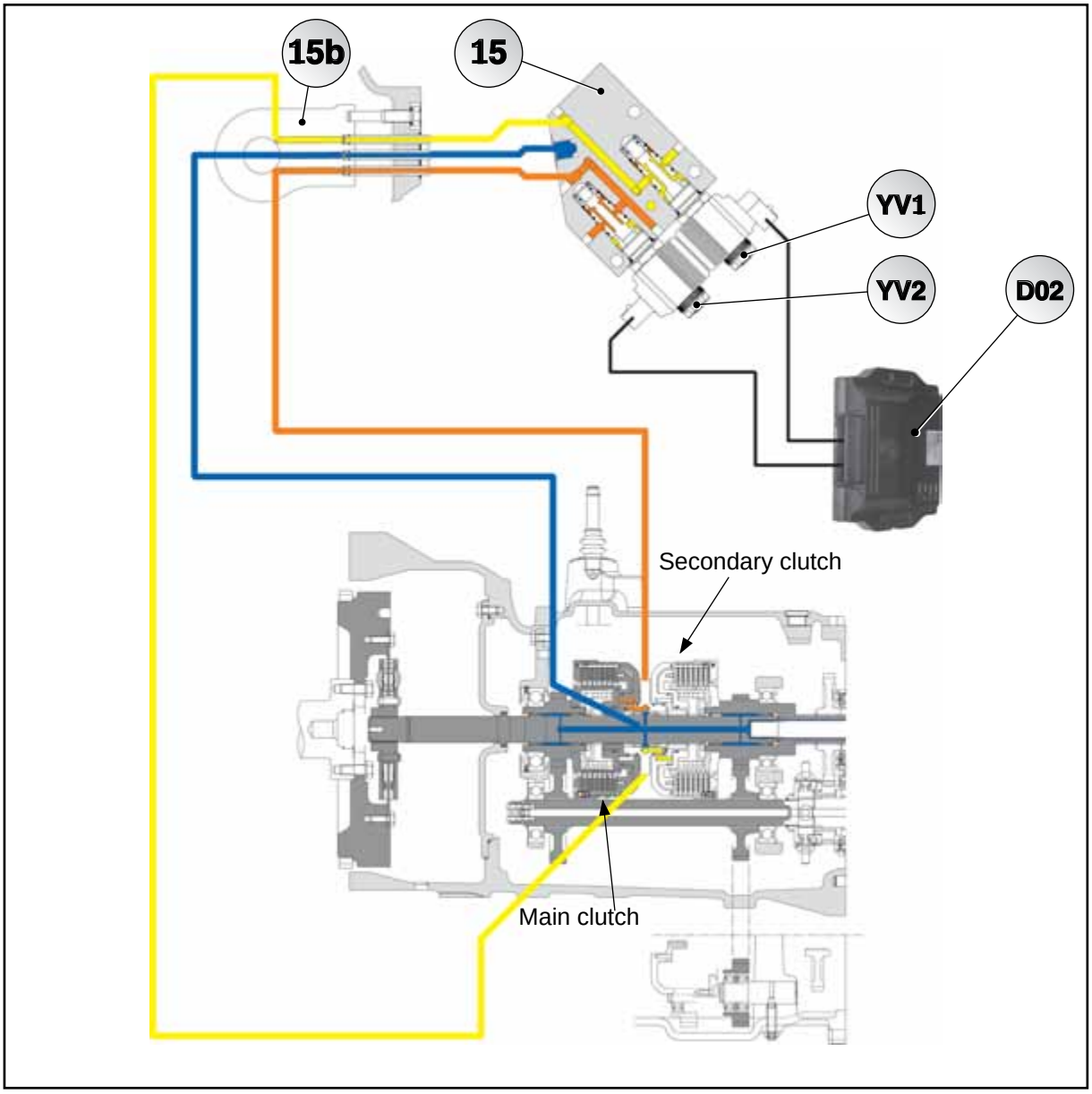


Fig. 11.5

2.2 The components involved

The main components that interact to guarantee that calibration allows the tractor to operate in an excellent way are the following:

A - Electronic control unit
B - Powershuttle speed sensors
C - Ground speed sensor
D - Instrument
E - Clutch pedal potentiometer
F - Proportional solenoid valves
G - Gearshift lever
H - Reverse shuttle lever

Fig. 11.6

A - Electronic control unit

The electronic control unit (D02) is the “brain” that electronically controls the Deltashift module. The control unit establishes the operating mode of the clutch assemblies forming the Deltashift module depending on the status of the system, the engagement detected, the conditions of the tractor and the input provided by the operator. The operating mode settings allow the operating point required for engagement or the speed to be calculated by means of closed loop monitoring systems. Accurate regulation of the clutch engaging parameter allows a slow, regular and accurate movement to be achieved.

The operating mode settings allow the operating point required for engagement or the speed to be calculated by means of closed loop monitoring systems. Accurate regulation of the clutch engaging parameter allows a slow, regular and accurate movement to be achieved.

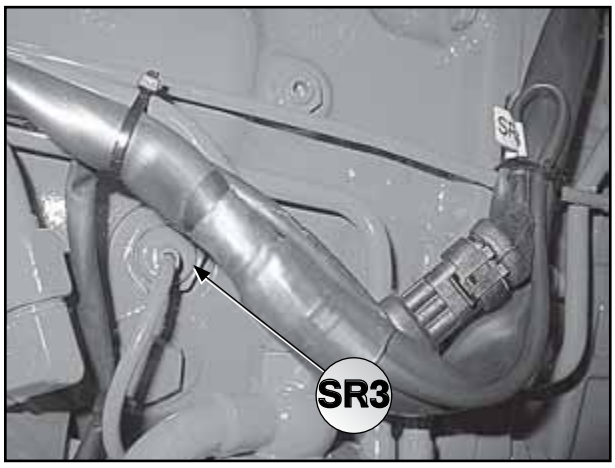


Fig. 11.7

B - Powershuttle speed sensors

The Hall sensors (SR3 and SR4) in the rh and lh sides of the engine-gearbox assembly, detect the speed at which drive enters the gearbox and the rotation direction.

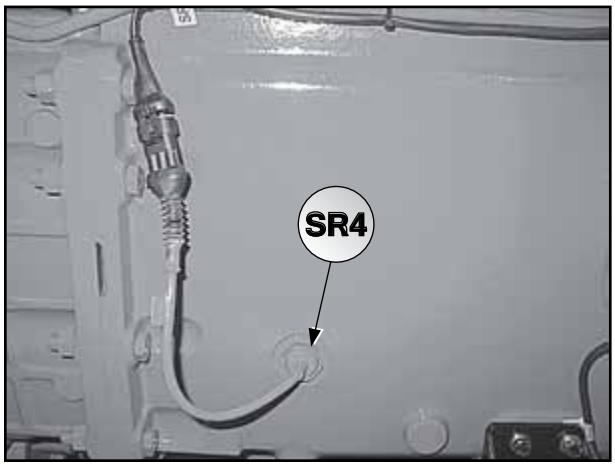


Fig. 11.8

C - Ground speed sensor

The sensor (SR1) detects the ground speed of the tractor via the gear keyed to the bevel gear pinion and transmits a signal to the electronic control unit. It processes the speed value (in kph or mph) which then appears on the display on the instrument.

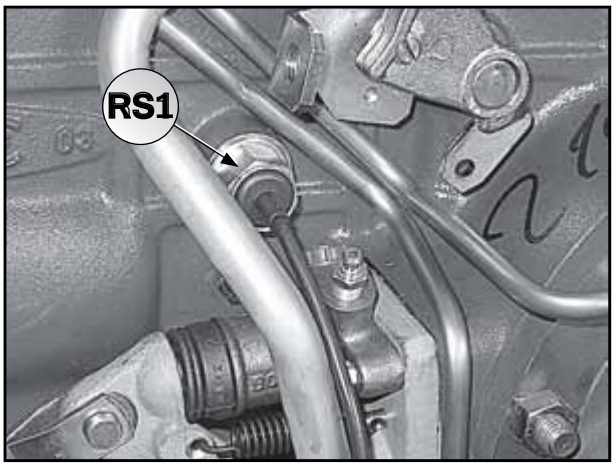


Fig. 11.9

D - Instrument

Besides indicating the various operating modes of the tractor, the instrument also monitors the calibration in the LCD1 window and initiates calibration by means of the buttons X1 and X2.

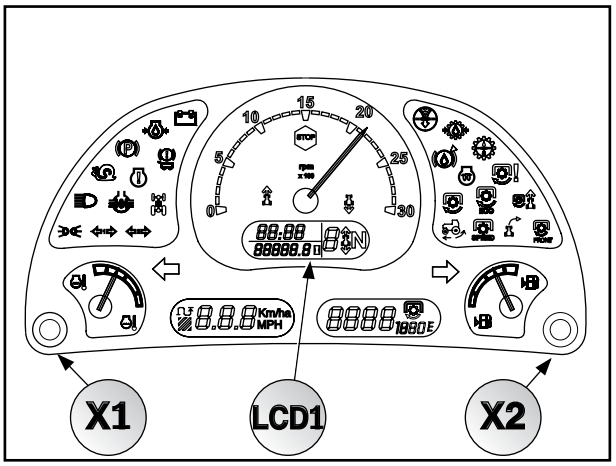


Fig. 11.10

E - clutch pedal potentiometer

The potentiometer (SQ1) installed alongside the clutch pedal, under the covering, detects the various pedal positions during its travel and transmits a signal to the electronic plant that controls the Deltashift module.

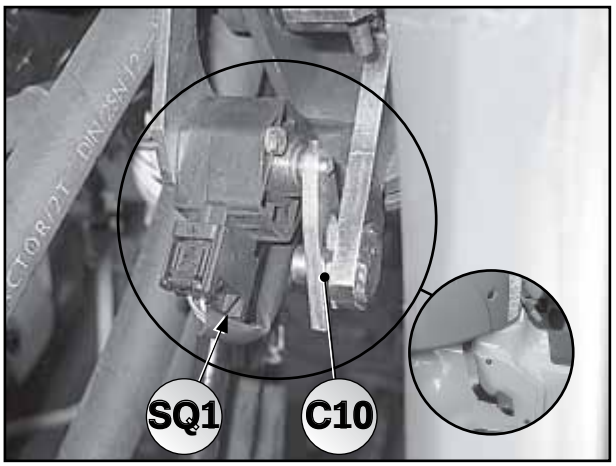


Fig. 11.11

F - Proportional solenoid valves

When they are energized, the two solenoid valves allow the clutch assemblies to be powered in a modulated way thanks to the gradual movement of the plunger which is controlled by the electronic control unit.

Solenoid valve (YV2) powers the Main clutch assembly (Reverse drive) while (YV1) powers the Secondary clutch assembly (Forward drive).

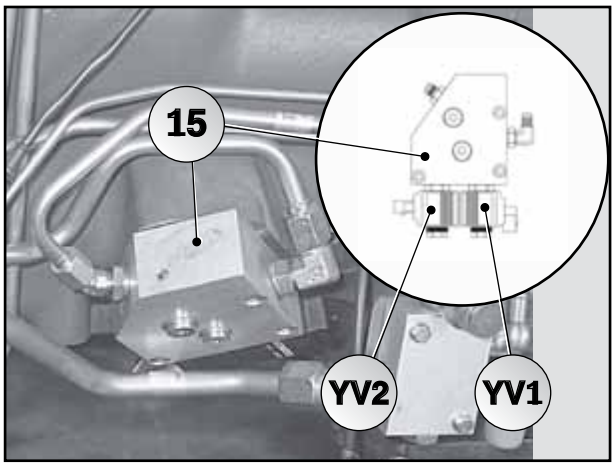


Fig. 11.12

G - Gearshift lever

Button (SB3) on the gearshift lever is used by the gearbox in the "automatic function" mode (without use of the clutch pedal); button (SB2) serves to engage the "Hi-Lo" mode (20% speed decrease);

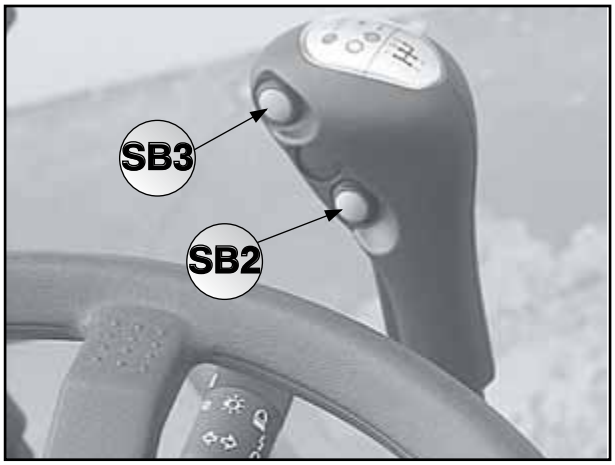


Fig. 11.13

H - Reverse shuttle lever

The reverse shuttle lever (I) is installed on the driver's left, between the instrument and the steering wheel. It allows the direction of the tractor to be reversed on load. Electronic control of the system allows this operation to be carried out at any speed, but it is advisable to use this option at speeds of less than 10 kph. A buzzer operates if the speed is higher.

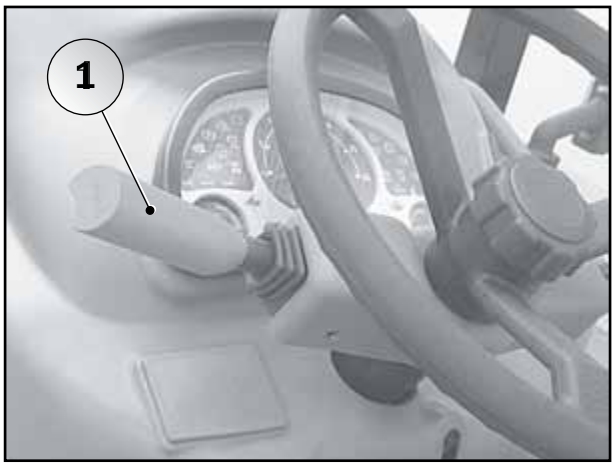


Fig. 11.14

2.3 Main technical specifications

Battery

Manufacturer	Mx - Scx - Fx
Type	"Maintenance free
Voltage	12 V (negative ground)
Starting surge when cold at -18°C in 30 s	450 A
20 hour capacity	100 Ah

Control unit

Voltage rating	12 V or 24 V
Input battery current	max 6.5 A
Internal sensor voltage:	from 5 V to 200 mA
Communication:	full buffer RS232 interface
Electrical connections:	AMP I/O connectors
CAN interface:	Optional

Standard ISO 11898

LED outputs:	2 (controlled by the program) 2 (for internal voltages)
Temperature:	from -40 °C to 70 °C
Vibrations:	from 5 to 2000 Hz with pause/rotation resonance
Shock:	50 gs lasting 11 ms in all 3 axes for a total 18 shocks
Electrical system:	Withstands short-circuits, polarity reversal, overvoltage, transient voltages, static discharge, EMI/RFI and charging discharging

Solenoid valves

Manufacturer	Cx
Type	On/Off
Voltage	12 V
Resistance at 20°C	6.85 □ ±5%
Type	Proportional valves
Voltage	12 V
Model	With 2 positions and 3 ways

Sensors

Manufacturer	Jx-Stx
Type	Inductive
Manufacturer	Hx
Type	Hall type

Instrument

Manufacturer	Jx

Section 3 : Calibration procedure

Index

3.1 Safety notes 11-12

3.2 When to calibrate and in which conditions 11-13

3.3 Calibration 11-14

3.3.1 Calibration (C3): clutch pedal 11-16
3.3.2 Calibration (C4): secondary clutch limit 11-18
3.3.3 Calibration (C5): main clutch limit 11-20

3.1 Safety notes

Before beginning to calibrate, read and strictly comply with the safety notes given below.

Attention: The tractor could move accidentally during the calibration operations.

It is therefore important that the tractor is safely parked on level ground and there are no obstacles either in front or behind the tractor.

The operator should be ready to switch the engine off with the ignition key and to use the brakes to immediately stop the tractor.

Attention: When calibrations are carried out with the engine running, make sure that there are no bystanders in the vicinity, just the technician sitting in the driving seat

Attention: Make sure that the ambient temperature is between 20 and 30 °C.

Attention: Comply with the instructions described in point 3.3 in detail and in the given order.

Attention: Do not make unnecessary calibrations or when not indicated.

Attention: Repeat the calibration operations without testing the tractor if the calibration values differ from those indicated.

Attention: Repeat the calibration operations if the tractor operates in an unsatisfactory way.

Attention: Exhaust gas contains carbon monoxide which can cause diseases and even death.

Make sure that there is a suitable ventilation.

Attention: If one of the sensors breaks, the tractor could move forwards or in reverse whilst it is being calibrated.

Attention: The tractor could move accidentally during the calibration operations. It is therefore important that the tractor is safely parked on level ground and there are no hindrances both in front of and behind the tractor. Be ready to use the brake pedals to stop the tractor.

Attention: exhaust gas contains carbon monoxide which can cause diseases and even death. Make sure that there is a suitable ventilation.

Attention: If one of the sensors breaks, the tractor could move forwards or in reverse whilst it is being calibrated. If this happens, turn off the ignition key and stop the tractor with the brake pedals.

3.2 When to calibrate and in which conditions

Calibration is carried out accurately in the production plant and need not be done again, unless one or both of the proportional solenoid valves (YV1/YV2 Fig.11.15) or the electronic control unit (D02) need to be replaced (Fig.11.16).

Proceed in the following way to calibrate:

a - strictly comply with the safety notes given in section 3.1;

b - Make sure that the ambient temperature is between 20 and 30 °C.

c - if one or both the solenoid valves have been replaced, use a tester to make sure that the resistance between the two terminals is between 8 - 9 Ohm (Fig.11.17) .
If differences are detected, replace the solenoid valve that fails to correspond to the prescribed value.

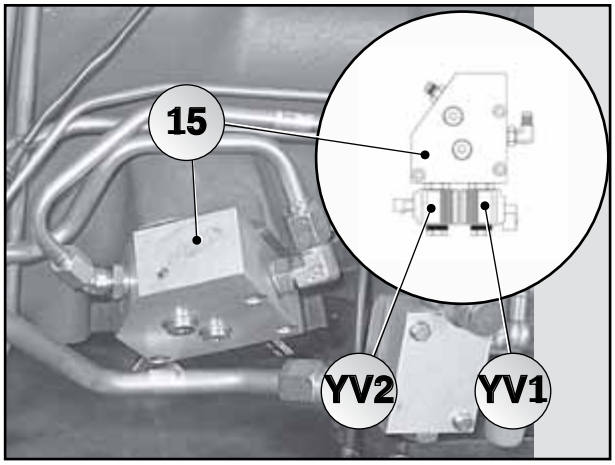


Fig. 11.15

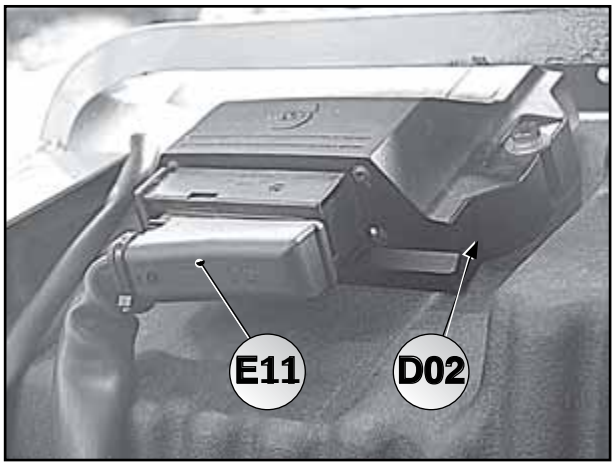


Fig. 11.16

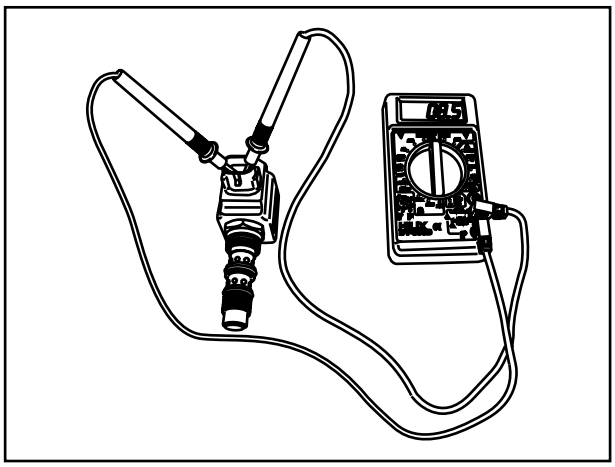


Fig. 11.17

3.3 Calibration

The Deltashift unit is calibrated by means of 3 tests. The first one (C3) is carried out with the engine off while the last two (C4 - C5) are carried out with the engine on.

The purpose of calibration is to map the position of the clutch pedal (C3) and the engaging position of the main and secondary clutch assemblies (C4 and C5).

The tests to be carried out are:

- **Calibration (C3): clutch pedal**
- **Calibration (C4): secondary clutch limit**
- **Calibration (C5): main clutch limit**

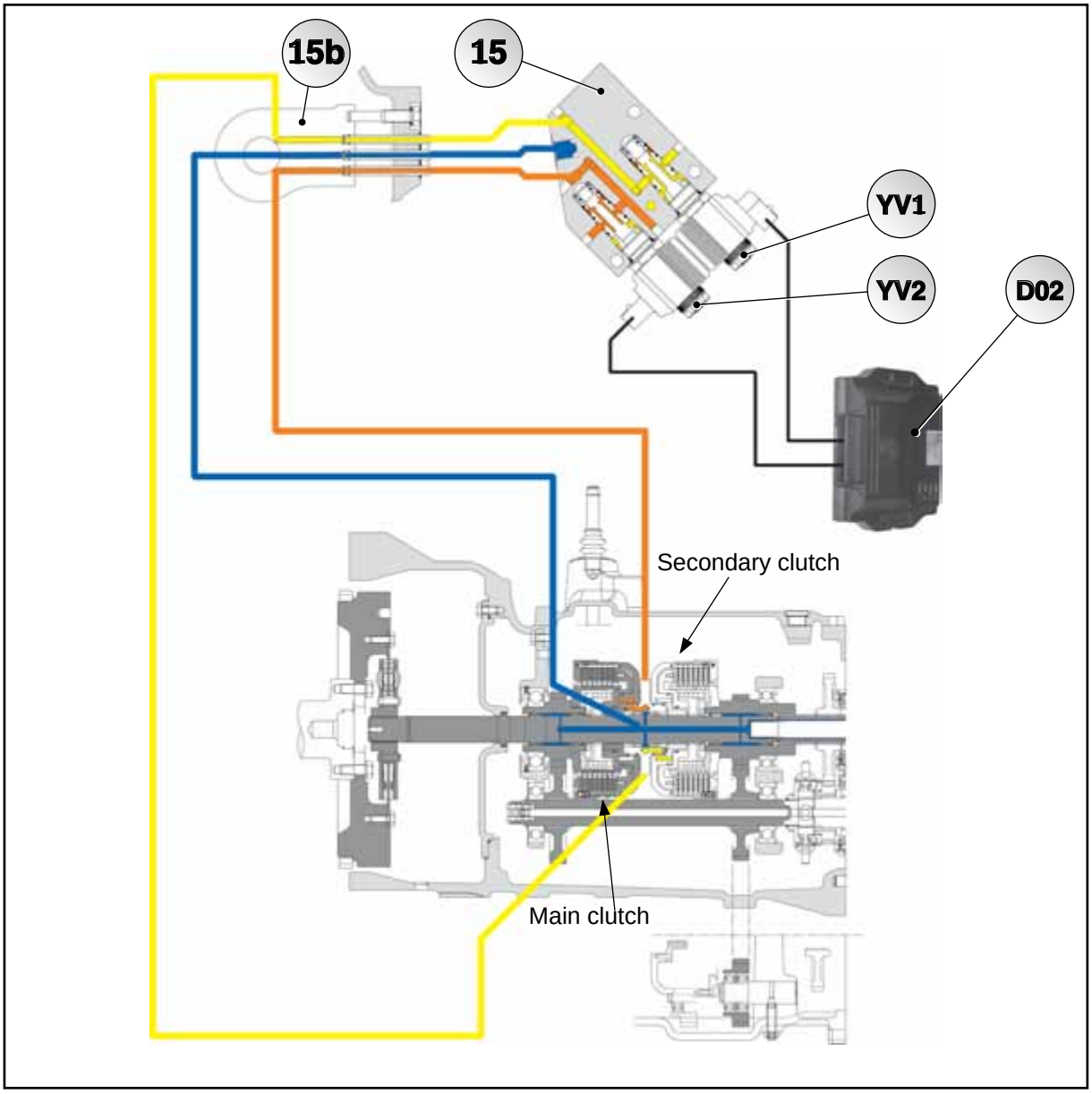


Fig. 11.18

3.3.1 Calibration (C3): clutch pedal

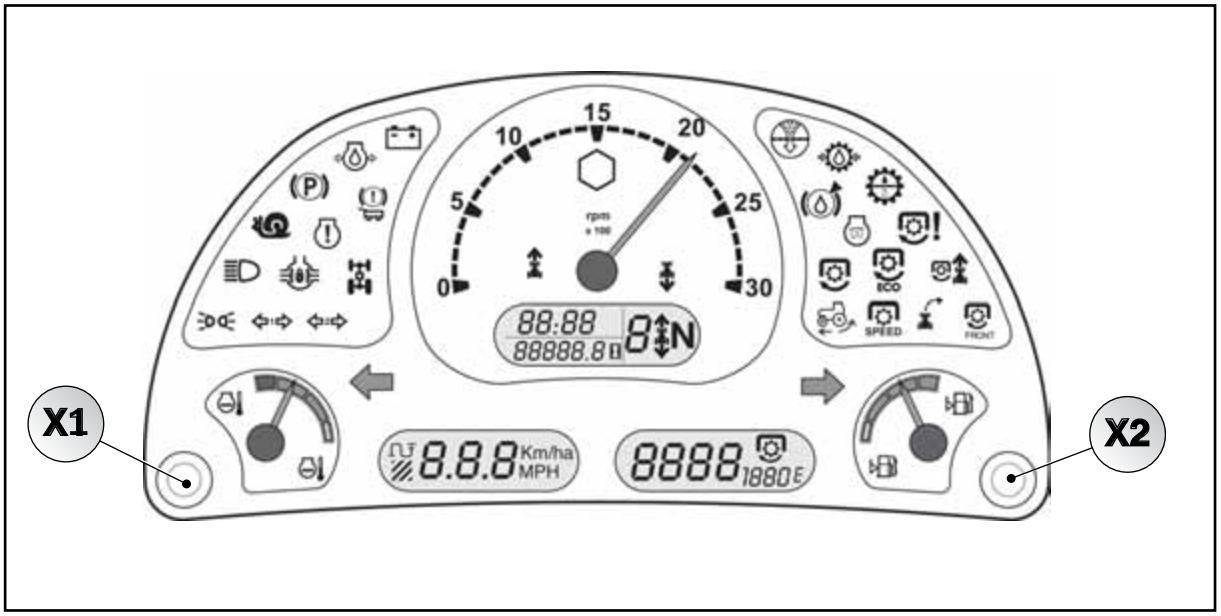


Fig. 11.19

Purpose of calibration

map the position of the clutch pedal on the board when it is fully depressed and fully released.

This to obtain millimetric movements during use of the pedal itself.

Foreword

Calibration is obtained both by means of the two buttons (SB2 and SB3 Fig.11.21) on the gearshift lever and with buttons (X1 and X2) on the instrument.

In the following descriptions, for the sake of brevity, we will refer only to the buttons (SB2 and SB3), but the same results can be had by operating the other buttons (X1 and X2).

Fig. 11.20

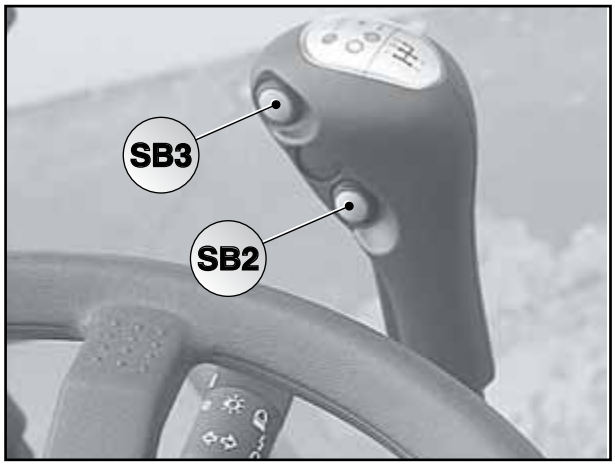


Fig. 11.21

Fig. 11.22

How to begin the calibration procedure (C3)

1 - Turn the ignition key to the contact position (Instrument on), but keep the engine off.

2 - Press the buttons (SB3 and SB2) on the gearshift lever at the same time and keep them depressed (Fig.11.27) for 10 sec. Flashing code (C03) must appear on the display, alternating with the time.

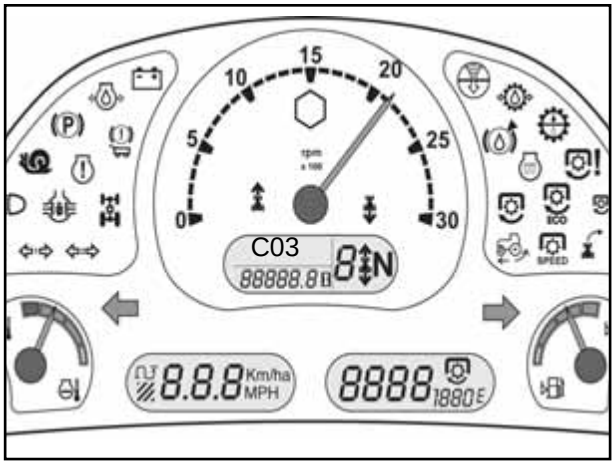


Fig. 11.23

3 - Press buttons (SB2 and SB3) again and keep them depressed for 10 sec. The flashing message **(AC 03) should appear on the display**.

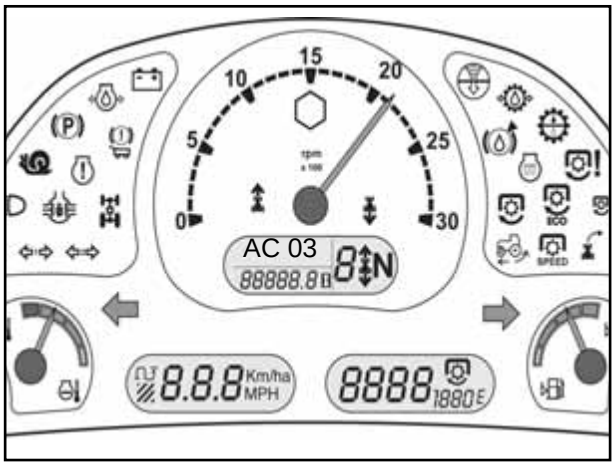


Fig. 11.24

4 - Completely release the clutch pedal for 5 sec. and then depress it for 5 sec. immediately afterwards.

5 - After a few seconds, the message (do) will appear, indicating that calibration has been completed.

Note: if the messages fail to appear as listed, repeat the calibration operations again from the beginning.

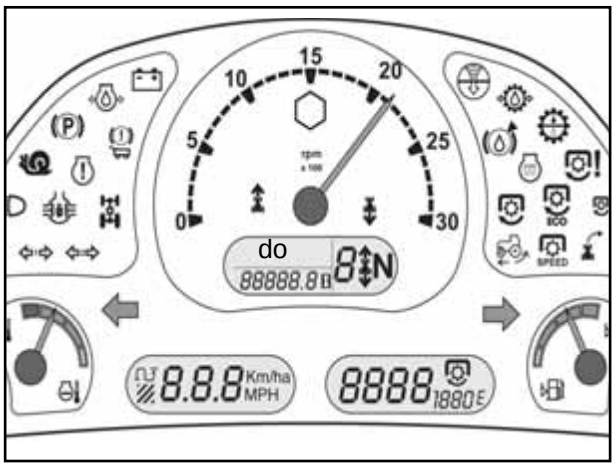


Fig. 11.25

3.3.2 Calibration (C4): secondary clutch limit

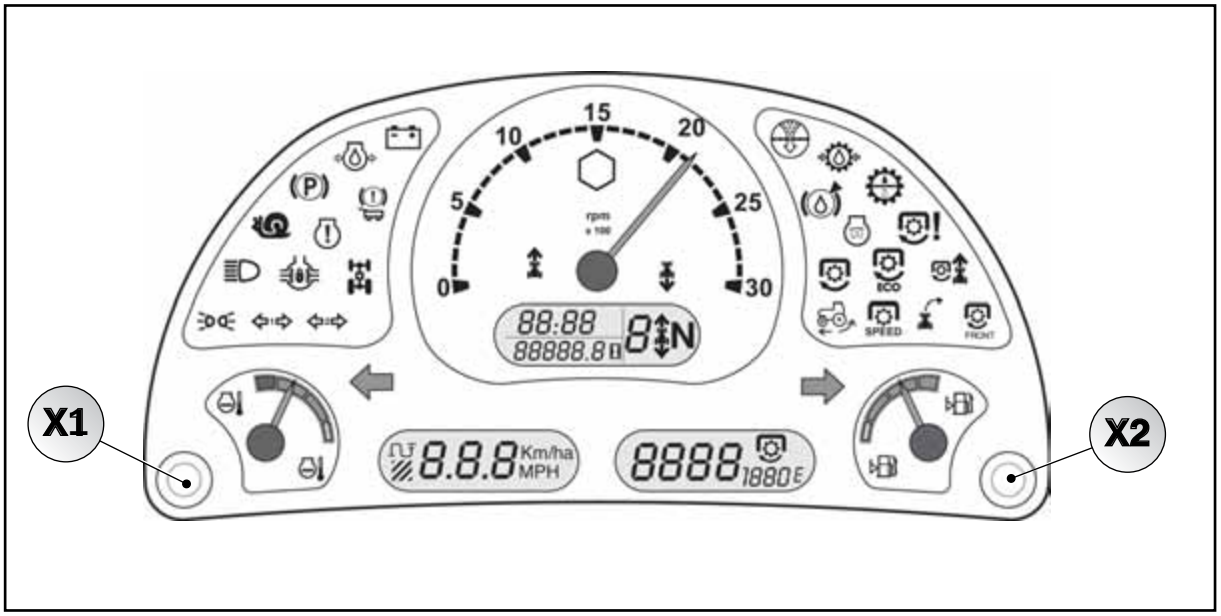


Fig. 11.26

Purpose of calibration:

Map the secondary clutch engaging limit on the board and check how many mA are required to obtain this condition.

The value found will allow the Deltashift system to engage the gears in a fast and gradual way.

During this calibration phase, the engine must be brought to a temperature of 20°C to 30°C with a 1500 to 2000 RPM rate.

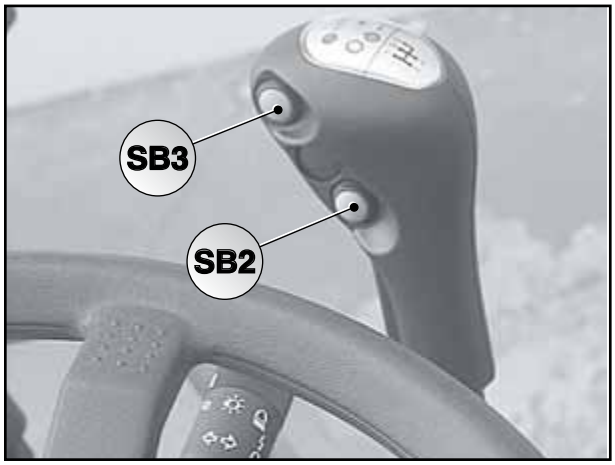


Fig. 11.27

⚠	**Attention:** park the tractor on flat ground and make sure that there are no obstructions or bystanders for several meters in front and behind the vehicle. Now release the hand brake and comply with the instructions in detail in order to calibrate in the correct way.

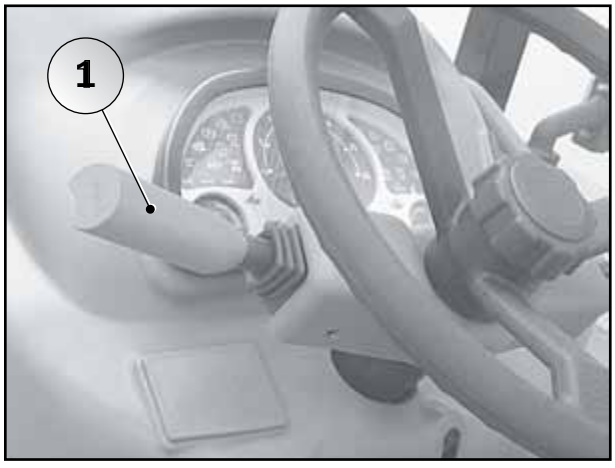


Fig. 11.28

How to begin the calibration procedure (C4)

1 - Start the engine.

2 - Press buttons (SB2 and SB3) on the gearshift lever at the same time and keep them depressed for 10 sec. The message**C 04 should appear on the display.**).

3 - Press buttons (SB2 and SB3) again and keep them depressed for 10 sec. The flashing message**AC 04 must appear on the display.**).

4 - Engage the 1st gear in the fast range and bring the engine rate to 1500/2000 RPM.

5 - Using the reverse shuttle lever (I), select the forward gear by pushing the lever fully forwards: a number (e.g. **331** Fig.11.31), representing the necessary current intensity in mA, must appear on the display after a few seconds.

6 - After a few seconds, the display will show (**do**) indicating that calibration is complete.

Note: if the messages fail to appear as listed, repeat the calibration operations again from the beginning.

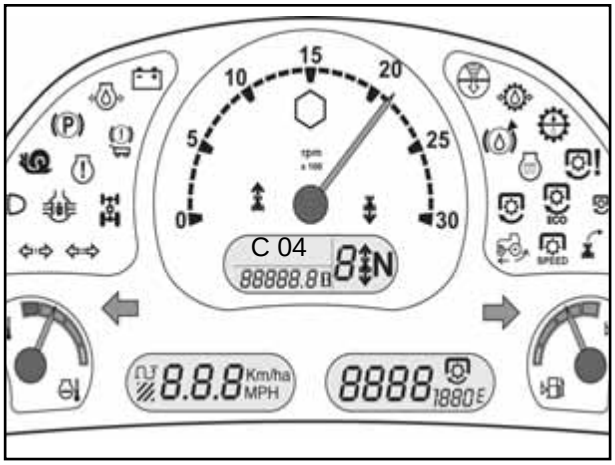


Fig. 11.29

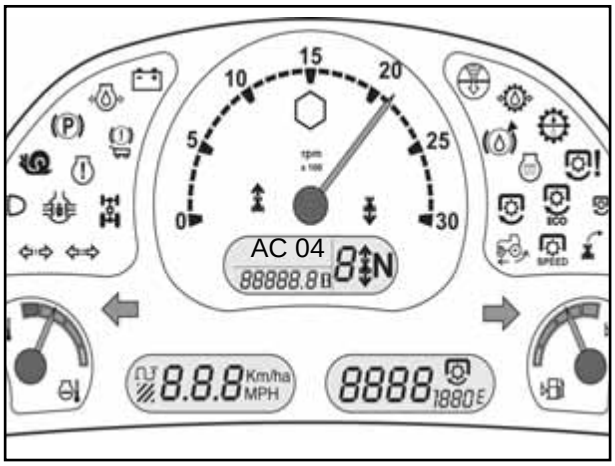


Fig. 11.30

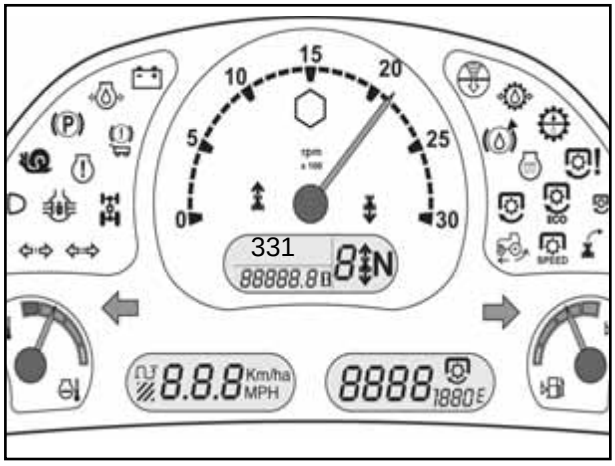


Fig. 11.31

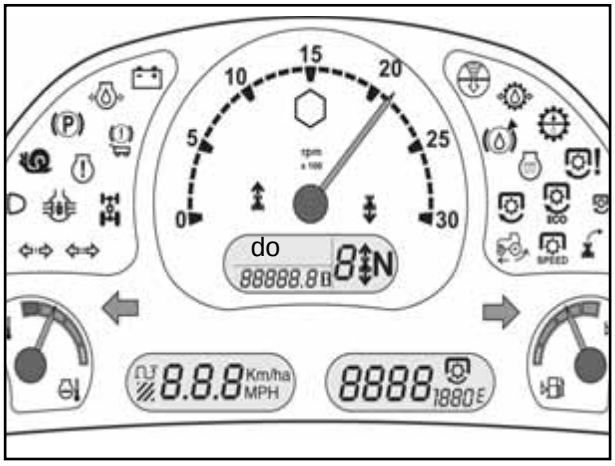


Fig. 11.32

3.3.3 Calibration (C5): main clutch limit

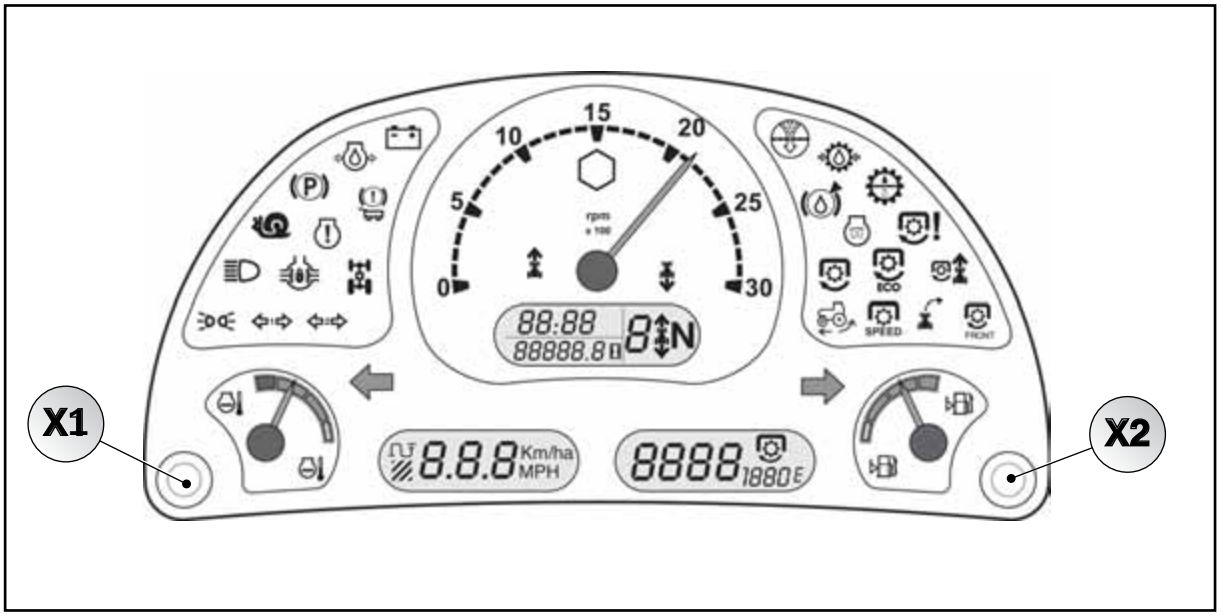


Fig. 11.33

Purpose of calibration:

Map the main clutch engaging limit on the board and check how many mA are required to obtain this condition.

The value found will allow the system to engage the gears in a fast and gradual way.

During this calibration phase, the engine must be brought to a temperature of 20°C to 30°C with a 1500 to 2000 RPM rate.

⚠	**Attention:** park the tractor on flat ground and make sure that there are no obstructions or bystanders for several meters in front and behind the vehicle. Now release the hand brake and comply with the instructions in detail in order to calibrate in the correct way.

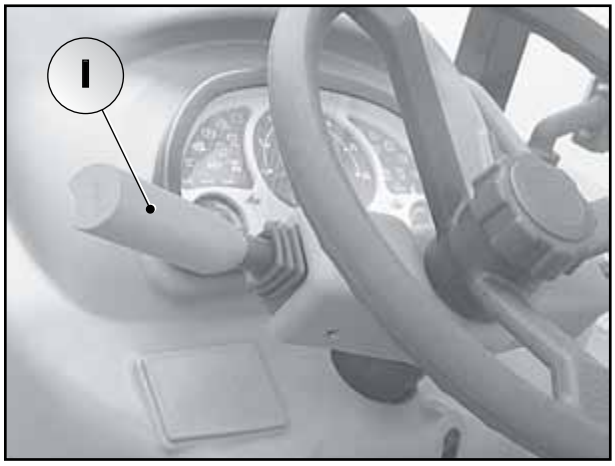


Fig. 11.34

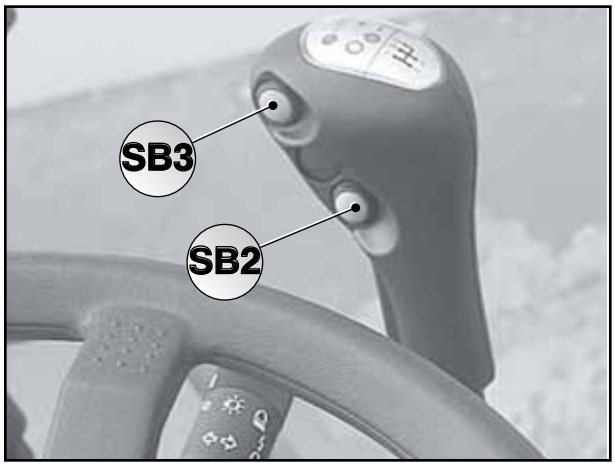


Fig. 11.35

How to begin the calibration procedure (C5)

1 - Keep the engine running.

2 - Press buttons (SB2 and SB3) on the gearshift lever at the same time and keep them depressed for 10 sec. The flashing message (**C 04**) should appear on the display.

3 - To go on to the next phase (C 05), press the upper button (SB3) on the gearshift lever and keep it depressed until the flashing message (**C 05**) appears on the display.

4 - Press buttons (SB2 and SB3) again and keep them depressed for 10 sec. The flashing message (**AC 05 appears.**).

5 - Engage the 1st gear in the fast range and bring the engine rate to 1500/2000 RPM.

6 - Move the reverse shuttle lever (I Fig.11.35) back to select the reverse gear: a number (e.g. **261** Fig.11.38).

7 - After a few seconds, the display will show (**do**) indicating that calibration is complete.

Note: if the messages fail to appear as listed, repeat the calibration operations again from the beginning.

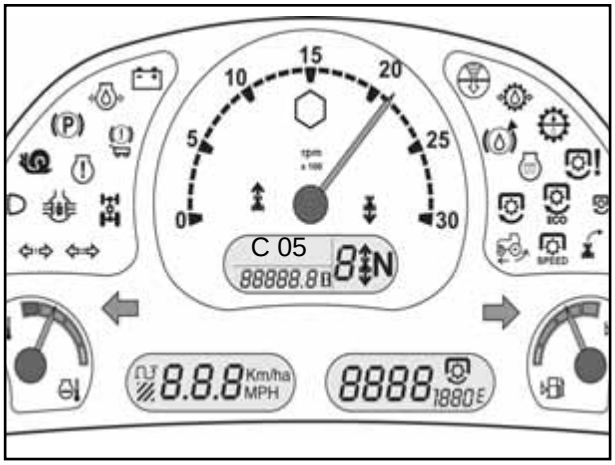


Fig. 11.36

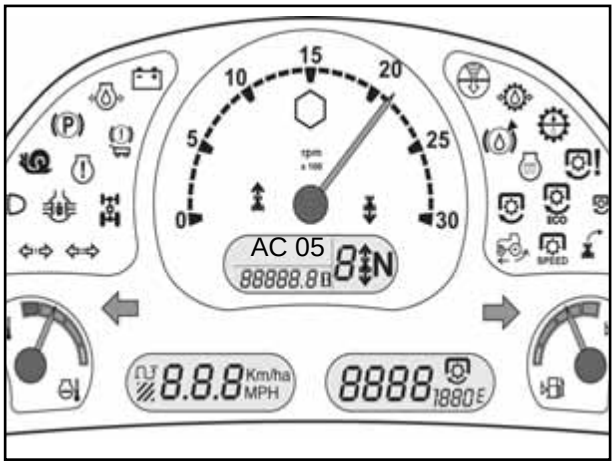


Fig. 11.37

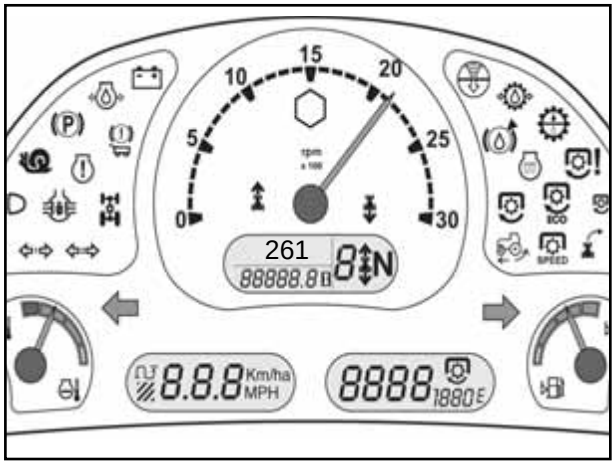


Fig. 11.38

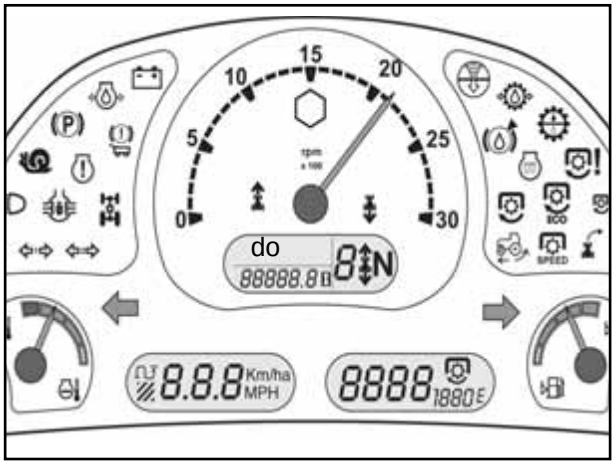


Fig. 11.39

Chapter 12 : Check-control and troubleshooting

Index

Section 1 : Precautions and safety recommendations 12-2

Section 2 : Introduction 12-3

2.1 Check-control and troubleshooting 12-4

2.2 Conventional troubleshooting 12-5

Section 3 : Alarm codes 12-9

3.1 Safety notes 12-10

3.2 Alarm code autodiagnosis 12-12

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: always consult the instructions in the operation and maintenance manual when working on the battery.
	Attention: Take all the necessary precautions when batteries containing sulphuric acid are installed. If the acid splashes on to the skin or into the eyes, immediately rinse the affected parts under clean running water.
	Attention: When the acid is mixed with water, SLOWLY POUR THE ACID INTO THE WATER, NEVER EVER POUR WATER INTO THE ACID.
	Attention: Explosive gas escapes when batteries are recharged. Work in places where there is good air circulation and keep well away from flames or sparks.
	Attention: always switch off the charging apparatus before disconnecting the cables.
	Attention: keep batteries well out of children's reach.
	Attention: do not smoke when checking or handling batteries.
	Attention: disconnect the negative terminal first. connect the positive terminal first when installing the battery again. Always take great care to check the polarity of the terminals.
	Attention: always disconnect the ground cable (-) of the battery before working on the electrical system.

Section 2 : Introduction

Index

2.1 Check-control and troubleshooting.....12-4

2.2 Conventional troubleshooting 12-5

2.1 Check-control and trouble-shooting

The **F-N Series Orchard** tractors are equipped with an autodiagnosis system that allows the operator to identify and locate the main faults that have occurred in the tractor.

When a fault occurs, a code will appear on the display (LCD1) to identify the type of problem in question, while a buzzer will sound, depending on the priority.

The alarm codes have different priorities (identified by the number that appears on the display). They activate optic signals (flashing alarm code) and acoustic signals from the buzzer.

There are two priorities, i.e.:

priority 9:	the buzzer sounds and the alarm code flashes on the display;
priority 8:	the buzzer sounds and the alarm code flashes on the display;

The code allows the maintenance technician to identify the final components at fault along with the relative harness.

Section 3 gives all the alarm codes, with indications as to the components, terminals and various remedies.

Proceed with the conventional troubleshooting operations described in point 2.2 for any faults not signalled by an alarm code.

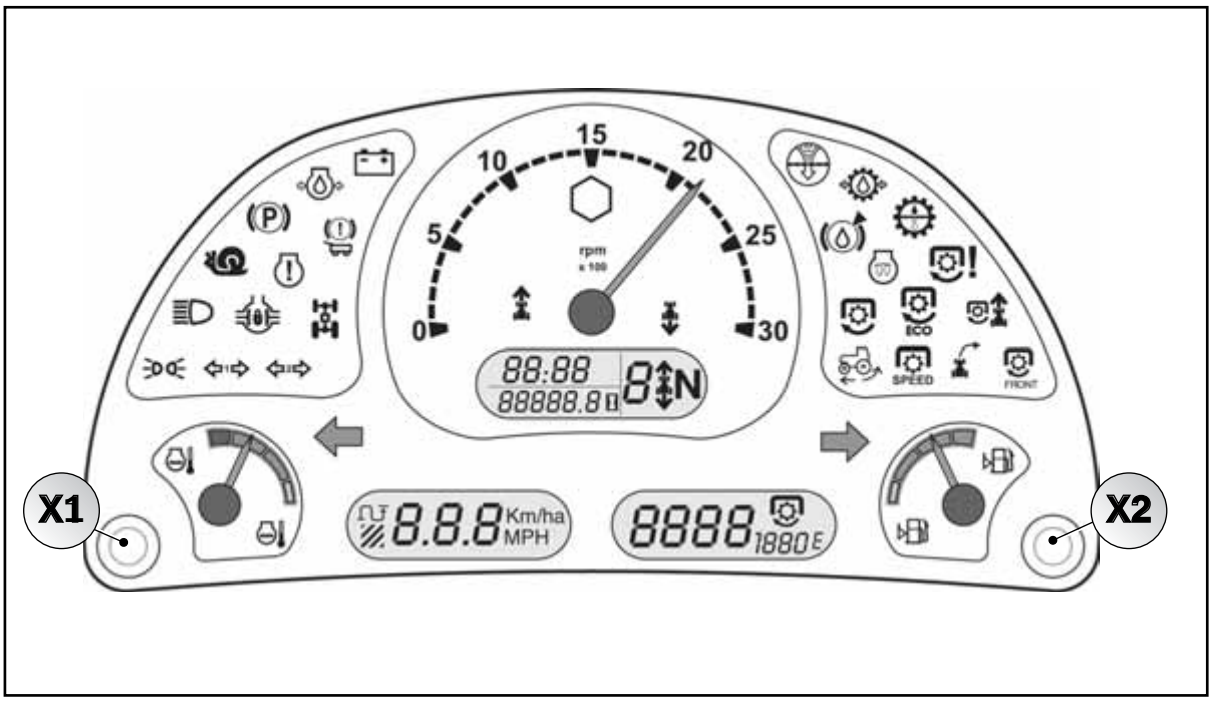


Fig. 12.1

2.2 Conventional troubleshooting

The purpose of troubleshooting is to establish what has caused the tractor to operate in a faulty way.

It is first necessary to find out whether the origin of the fault is of a mechanical, hydraulic or electrical nature.

It is the repair technician's experience that allows him to identify many of the mechanical faults, as he is able to recognize when certain components begin to seize and prevent other parts from engaging properly, or create noise.

To identify the nature of faults in the hydraulic circuit, the technician must check the pressure of the oil in the circuit of the component in question, as described in chapter 7.

Identification of electrical faults must begin by analysing the most probable causes through to the least probable ones. We suggest that these inspections be carried out in the following order:

- Switches, sensors, potentiometers;
- Connectors and wiring;
- Electronic control unit

To efficiently identify and repair faults, it is advisable to:

- Have the tractor in the workshop;
- Have previously checked the battery charge;
- Have spare sensors in stock, particularly the ones that cannot be checked with a normal tester.

Operating faults in electrical circuits

There are four types of operating faults that may occur in electrical circuits:

- excessive resistance in the circuit (high resistance);
- broken circuit (open circuit);
- grounded circuit;
- short-circuit.

In a simple circuit like the one indicated in (Fig.12.2), there are only three parts in which these operating faults can occur:

- prior to the control switch (A);
- between the control switch (A) and the load (B);
- after the load (B);

It is easy to mistake the operating fault of a component with that of a circuit. Great care must therefore be taken when the cause of a fault is identified, so as to ensure that it can be correctly and quickly resolved.

Example: a component may not operate before a connector is connected and operate after the same connector has been reconnected. The reason for this could be excessive resistance, which created a drop in the voltage supplied to the connector terminals, thus preventing the right amount of current to flow towards the component.

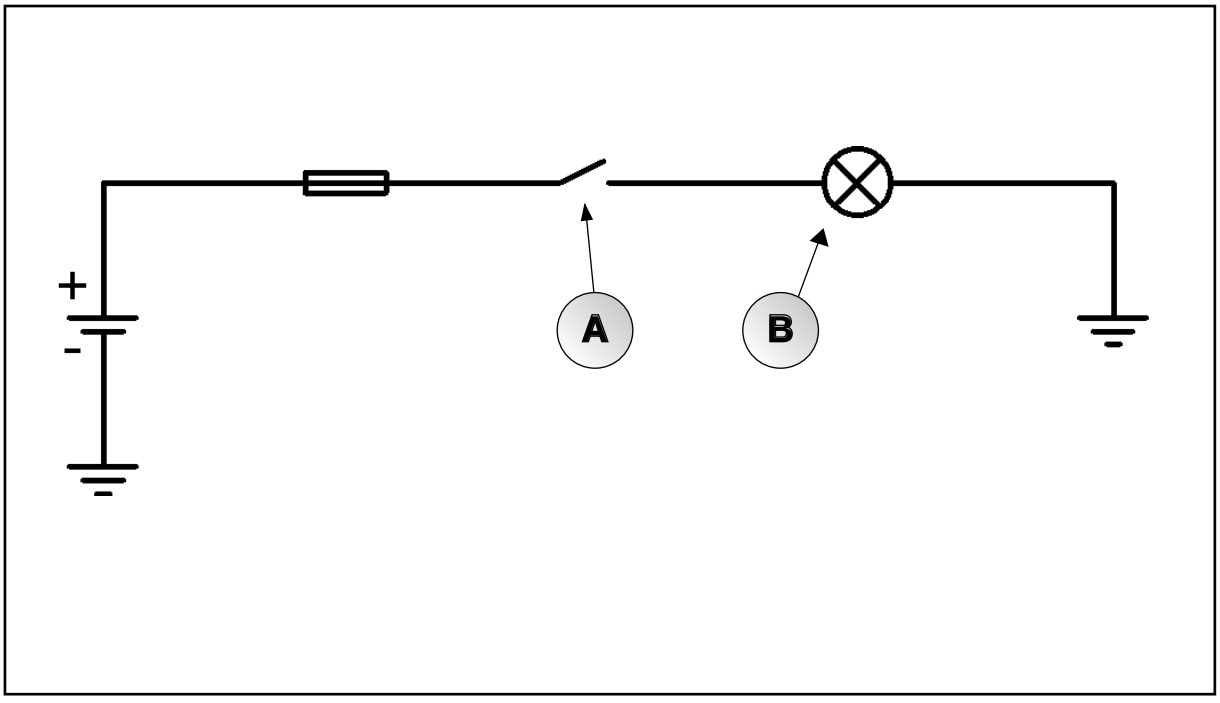


Fig. 12.2

High resistance and Open circuit

A circuit with high resistance could lead to a slow movement, a fluttering light or failure of a component to operate (e.g.: caused by loose, tarnished, dirty or greasy terminals, if the wire diameter is too small, or if the wires have been pulled).

If the circuit is “open”, the component will be unable to operate since the circuit is broken (e.g.: torn wire, disconnected terminals, open protection device on switch).

Proceed as described below to find out where “excessive resistance” or an “open circuit” is located:

- with the control switch (C) “on” and the load (I) connected in the circuit, check to find out whether the voltage is correct in an easily accessible point between (D) and (H).

  If the voltage is low, move towards the current source (A) until you have found the point in which the voltage drop occurs.

A - Battery
B - Fuse
C - Switch
D - Component terminal
E - Circuit resistance
F - Connector of the circuit
G - Connector of the circuit
H - Component terminal
I - Lamp
J - Ground

If the voltage is correct, move towards the load (I) and the ground terminal (J) until you have found the point in which the voltage drop occurs.

Note: the example refers to excessive resistance between (D) and (F), and an open circuit between (F) and (G).

- Repair the circuit as required;
- Repeat the test procedure after the repairs have been made.

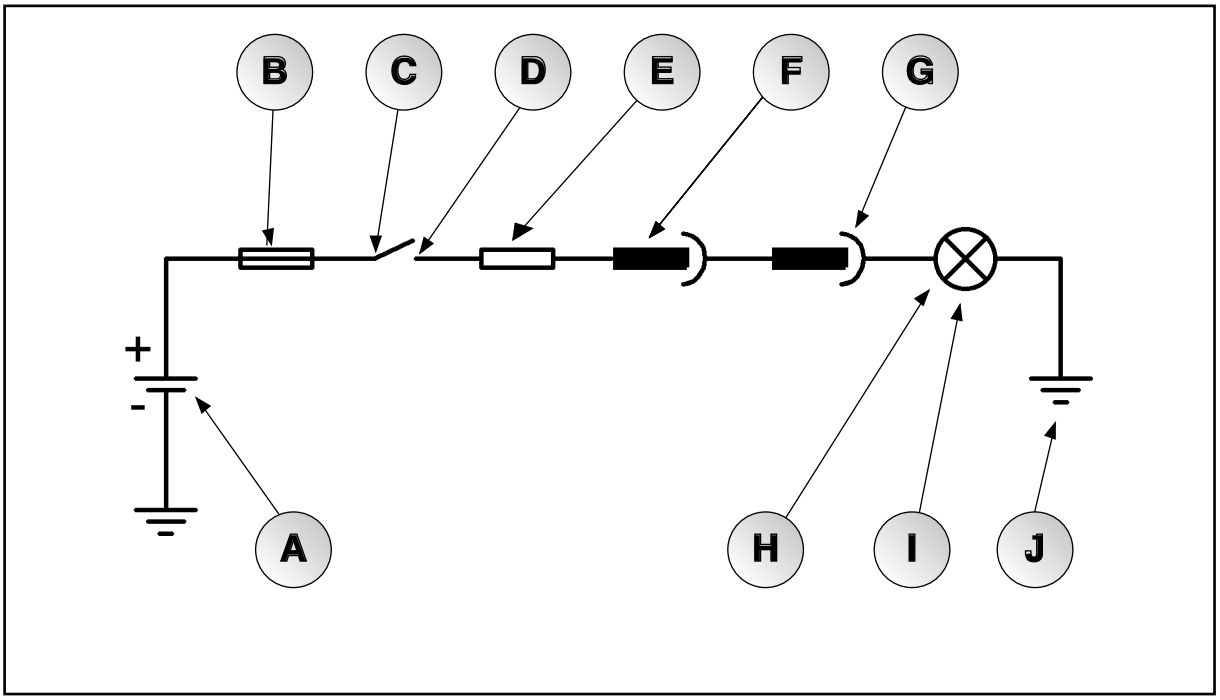


Fig. 12.3

Grounded circuit

A grounded circuit prevents the components from operating and the fuse or automatic switch open (e.g.: the powering wire has a contact towards ground).

Proceed as described below to find out where a “grounded circuit” is located:

- With the control switch (D) off, check to find out whether there is continuity towards ground between (C) and (D).

  If there is no break, then the grounded circuit is between (C) and (D). Eliminate the fault from this part of the circuit.

  If there is a break towards ground between (C) and (D), disconnect the load (H) in point (G), then turn off the control switch (D) and check to find out whether there is a break towards ground between (D) and (F). If there is no break, then the grounded circuit is between (E) and (F). Eliminate the fault from this part of the circuit.

  Note: there is a ground between (E) and (F) in the example.

- Repeat the functional test after the repairs have been made.

A - Battery
B - Fuse terminal
C - Fuse terminal
D - Switch
E - Component terminal
F - Ground circuit
G - Component terminal
H - Lamp

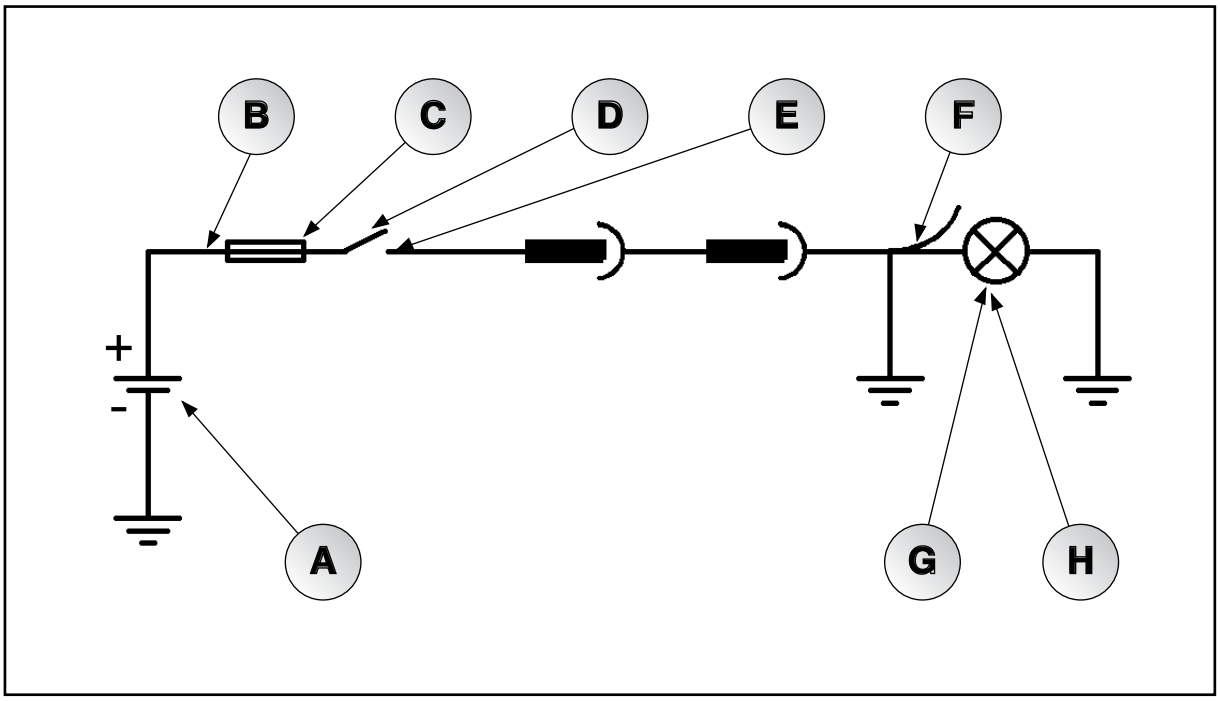


Fig. 12.4

Short-circuit

The thing that usually happens when there is a short-circuit in the electrical system, is that two components operate at the same time when only one switch is operated (e.g.: improper contact between two wires).

There can also be a short-circuit in one component. However, this usually activates the relative protection circuit.

Proceed as described below to find out where a short-circuit is located:

- use switch (A) to operate the right lamp (B).
- Begin with the control switch (D) of the lamp (I), which should not come on, and disconnect the wire at the terminal (E).
- Following the circuit, disconnect the wire at the connectors (F, G or H) until the supplementary lamp (I) goes out.
- The short-circuit or improper connection will be between the last two points in which the wire was connected. In the example, it is between (F) and (G).
- Repair the circuit in the following way:
  - Wires that are not installed within a protective tube: wrap insulating tape around the wire in question, or replace it and wrap with tape as required.
  - Wires that are installed within a protective tube:
    replace the entire harness if there are hot points in the short-circuited parts of the pre-assembled wiring.
    If no hot points have been detected, install a new wire of an appropriate size between the last two connectors and wrap insulating tape around the wire as required.
- Repeat the functional test after the repairs have been made.

A - Switch
B - Lamp
C - Fuse
D - Switch
E - Component terminal
F - Connector of the circuit
G - Connector of the circuit
H - Component terminal
I - Lamp

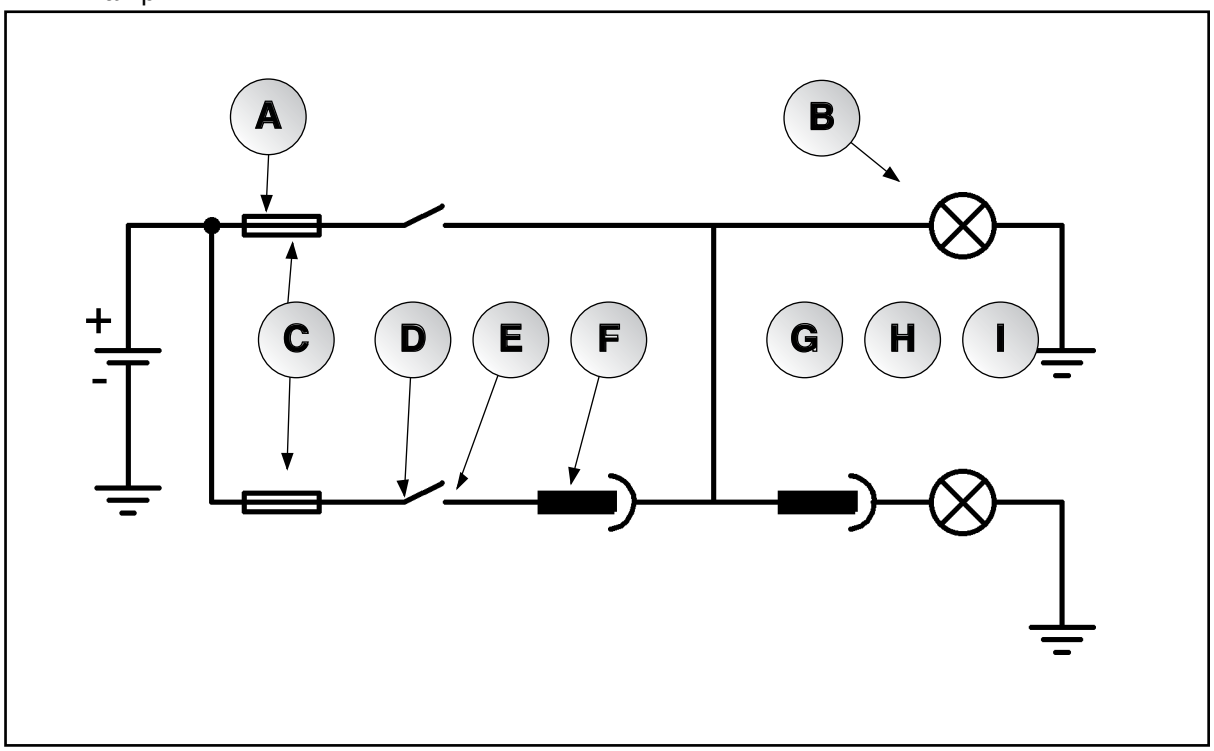


Fig. 12.5

Section 3 : Alarm codes

Index

3.1 Safety notes 12-10

3.2 Alarm code autodiagnosis 12-12

3.2.1 Alarm code (99) 12-12
3.2.2 Alarm code (98) 12-13
3.2.3 Alarm code (97) 12-15
3.2.4 Alarm code (96) 12-17
3.2.5 Alarm code (95) 12-20
3.2.6 Alarm code (94) 12-22
3.2.7 Alarm code (90) 12-23
3.2.8 Alarm code (86) 12-26
3.2.9 Alarm code (85) 12-28
3.2.10 Alarm code (82) 12-30
3.2.11 Alarm code (81) 12-32
3.2.12 Alarm code (80) 12-34

3.1 Safety notes

	Attention: Before beginning the autodiagnosis operations, read and strictly comply with the safety notes given below.

	Attention: Always disconnect the ground cable (-) of the battery before working on the electrical system.

	Attention: If possible, stop the machine on a flat, solid surface in order to carry out repairs. Make sure that the machine has been blocked to prevent it from accidentally moving when work is carried out on top or under it.

	Attention: Take care to prevent the cables from being damaged when parts are dismantled. Install the electrical system again to prevent it from being damaged by sharp edges, rubbing against other parts or hot surfaces when the work is carried out.

	Attention: The tractor could move accidentally during the calibration operations. It is therefore important that the tractor is safely parked on level ground and there are no obstacles either in front or behind the tractor. The operator should be ready to switch the engine off with the ignition key and to use the brakes to immediately stop the tractor.

	Attention: When calibrations are carried out with the engine running, make sure that there are no bystanders in the vicinity, just the technician sitting in the driving seat

3.2 Alarm code autodiagnosis

3.2.1 Alarm code (99)

Component involved

Electronic control unit

Cause

Short-circuit/open circuit in the control unit.

Terminals involved

PINS 1 and 14 of terminal board E11.

Remedy

Replace the electronic control unit (D02).

The clutch assemblies that engage the “Power Shuttle” unit must be calibrated if the electronic control unit is replaced.

In the Powershuttle version the (D02) control unit is mounted in the rear part inside the cab, just behind the driver’s seat. It can be accessed by removing the protective protective covering (P Fig.12.7).

It is connected to the dashboard line by means of the 42-PIN Fig.12.8) connectors.

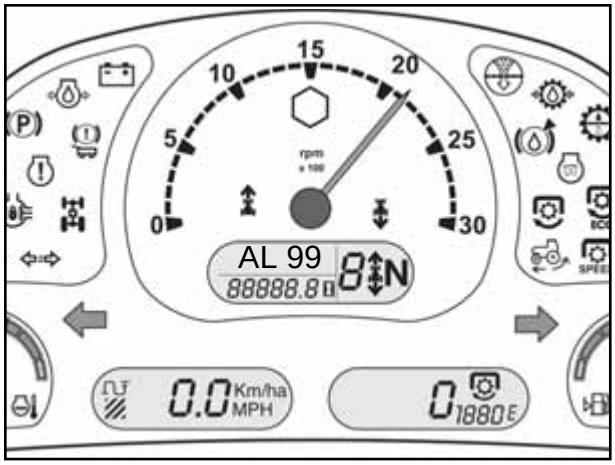


Fig. 12.6

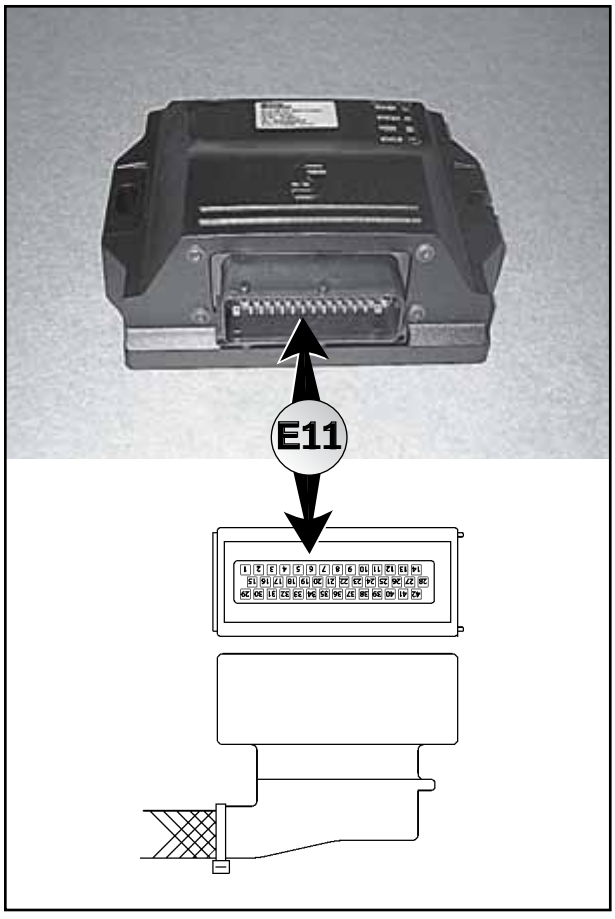


Fig. 12.8

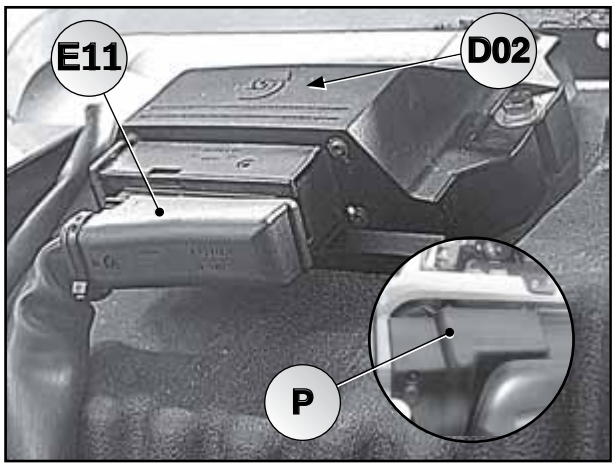


Fig. 12.7

Alarm code (99)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

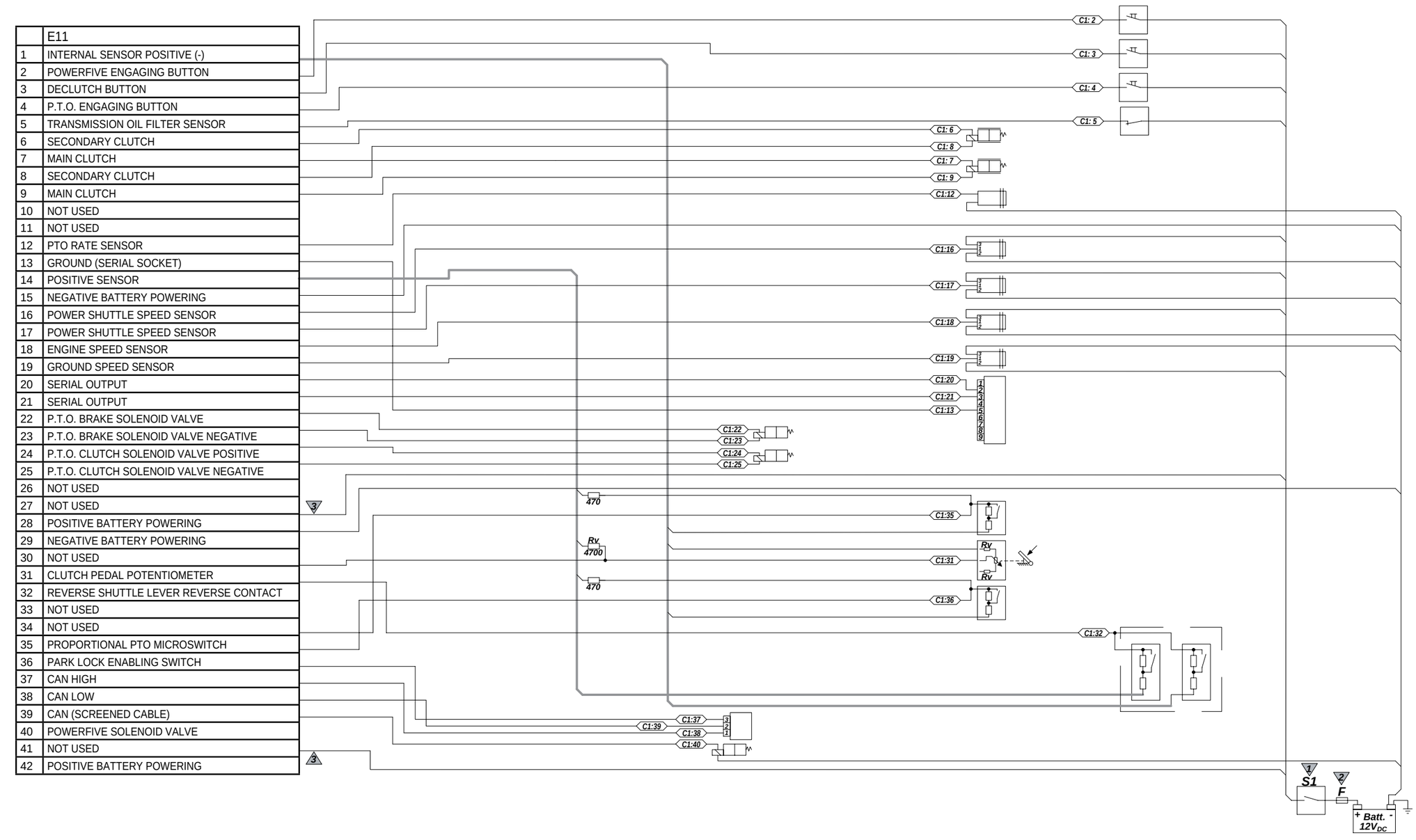


Fig. 12.9

3.2.2 Alarm code (98)

Component involved

Clutch pedal potentiometer

Cause

Short-circuit/open circuit.

Terminals involved

PIN 31 of terminal board E11.

Remedy

- Check/replace the clutch pedal potentiometer.
- Eliminate the short-circuit/open circuit from the line.

The potentiometer (SQ1 Fig.12.11) installed alongside the clutch pedal, under the covering, detects the various pedal positions during its travel and transmits a signal to the electronic plant that controls the Power Shuttle module.

If the potentiometer is replaced, the following check operations must be carried out:

- power the potentiometer with 5 V voltage on terminal 1 (positive);
- make sure that the output voltage between terminals 1 (positive) and 4 (ground) is effectively 5 V;
- measure the voltage value between terminals 2 (signal) and 4 (ground): the value must be about 0.5 V with the clutch pedal released, and about 4.5 V with the pedal fully depressed. Failing this, use the pad (Y Fig.12.12) to regulate the position and then fix with Loctite 243 sealant).

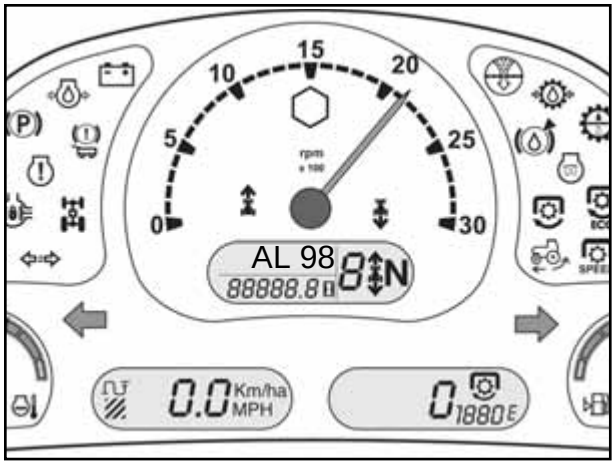


Fig. 12.10

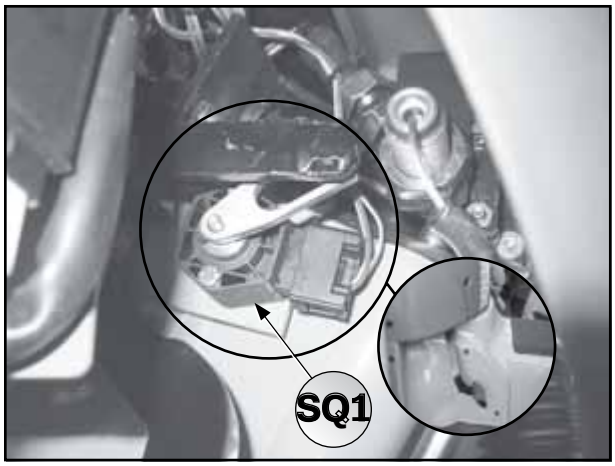


Fig. 12.11

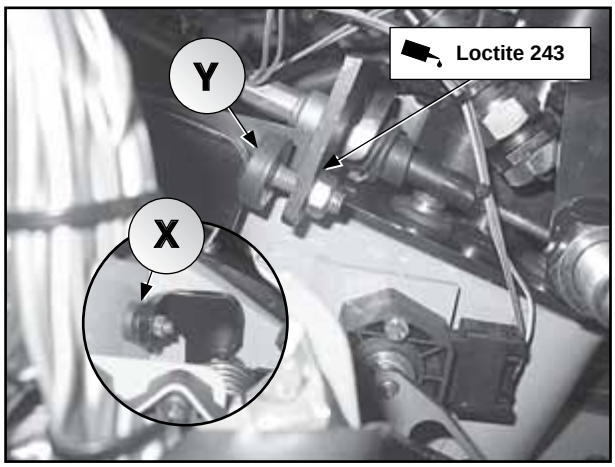


Fig. 12.12

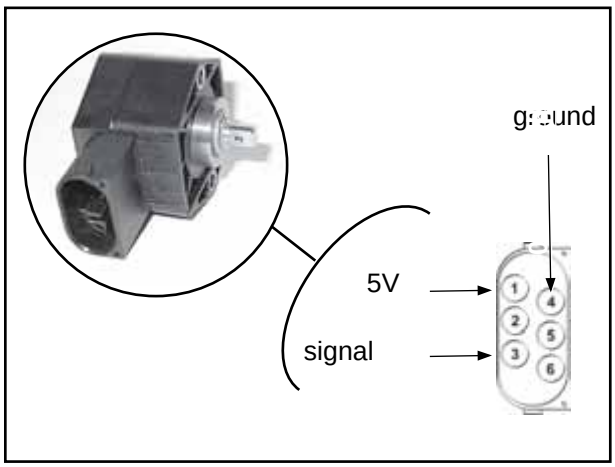


Fig. 12.13

Alarm code (98)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

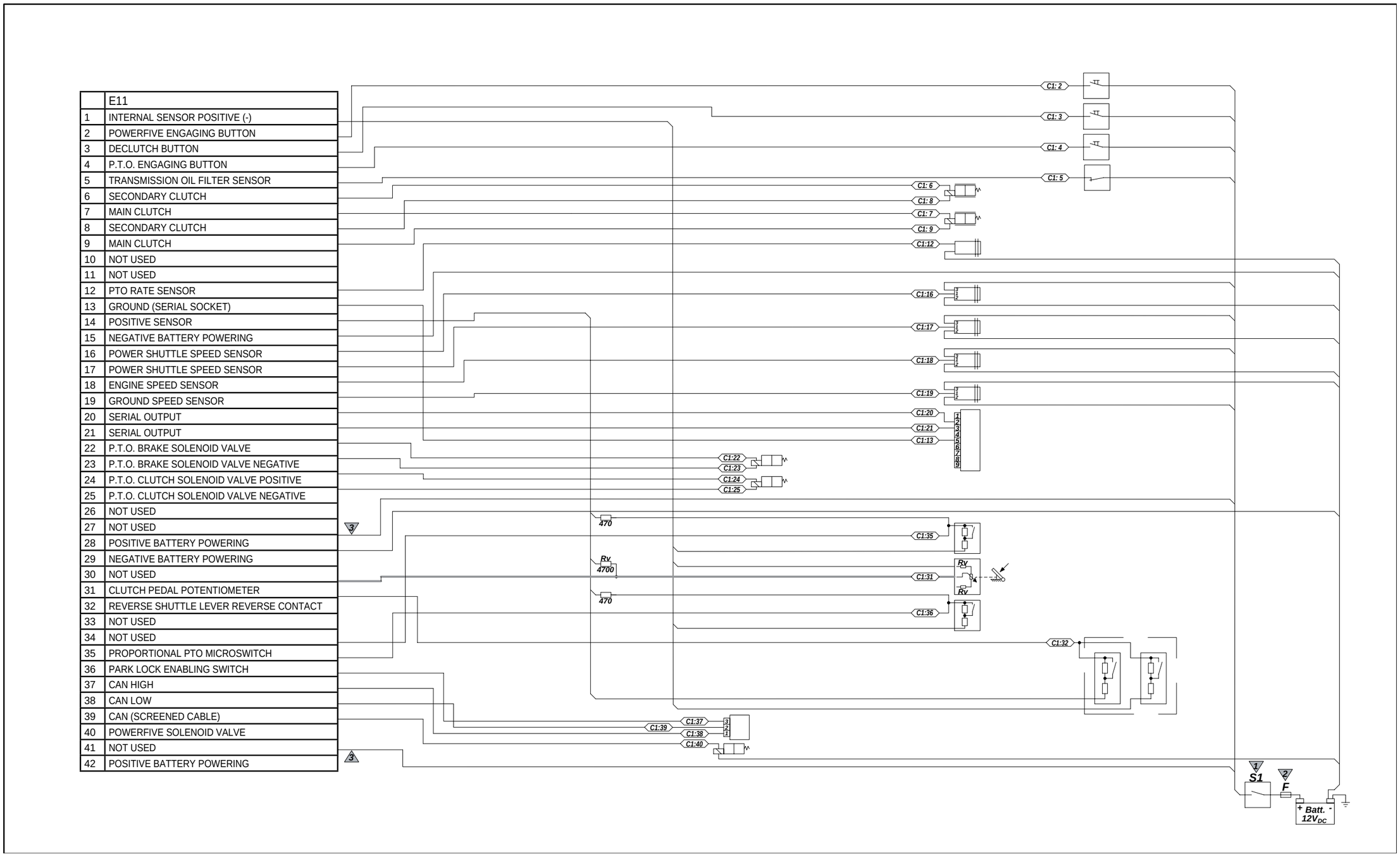


Fig.12.14

3.2.3 Alarm code (97)

Component involved

Power Shuttle lh speed sensor

Cause

Short-circuit/open circuit.

Terminals involved

PIN 16 of terminal board E11.

Remedy

- Replace the sensor.
- Eliminate the short-circuit/open circuit from the line.

The sensor (SR3) in the lh part of the engine-gearbox assembly detects the speed at which drive enters the gearbox and the rotation direction. It then transmits a signal to the electronic plant that controls the Power Shuttle module, which controls the way the relative LEDs on the instrument come on (FORWARD-REVERSE turn indicators). The sensor (_SR3) is connected to the rear wiring by means of connector (P15)(Fig.12.16).

The sensor (SR3) is connected to the rear wiring by means of connector (P15)(Fig.12.16).

Note: if replacements are made, maintain the same shims when the new sensors are installed.

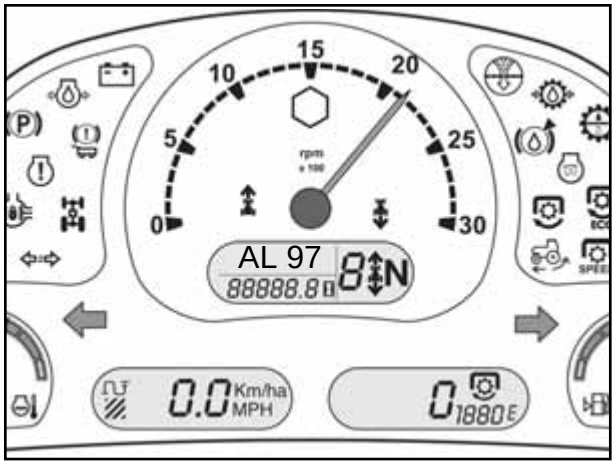


Fig. 12.15

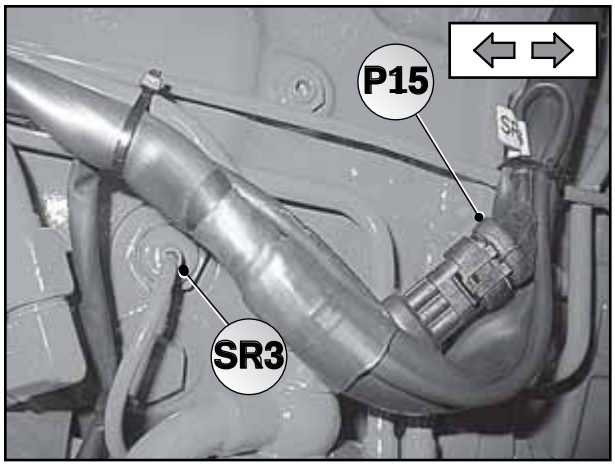


Fig. 12.16

Alarm code (97)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

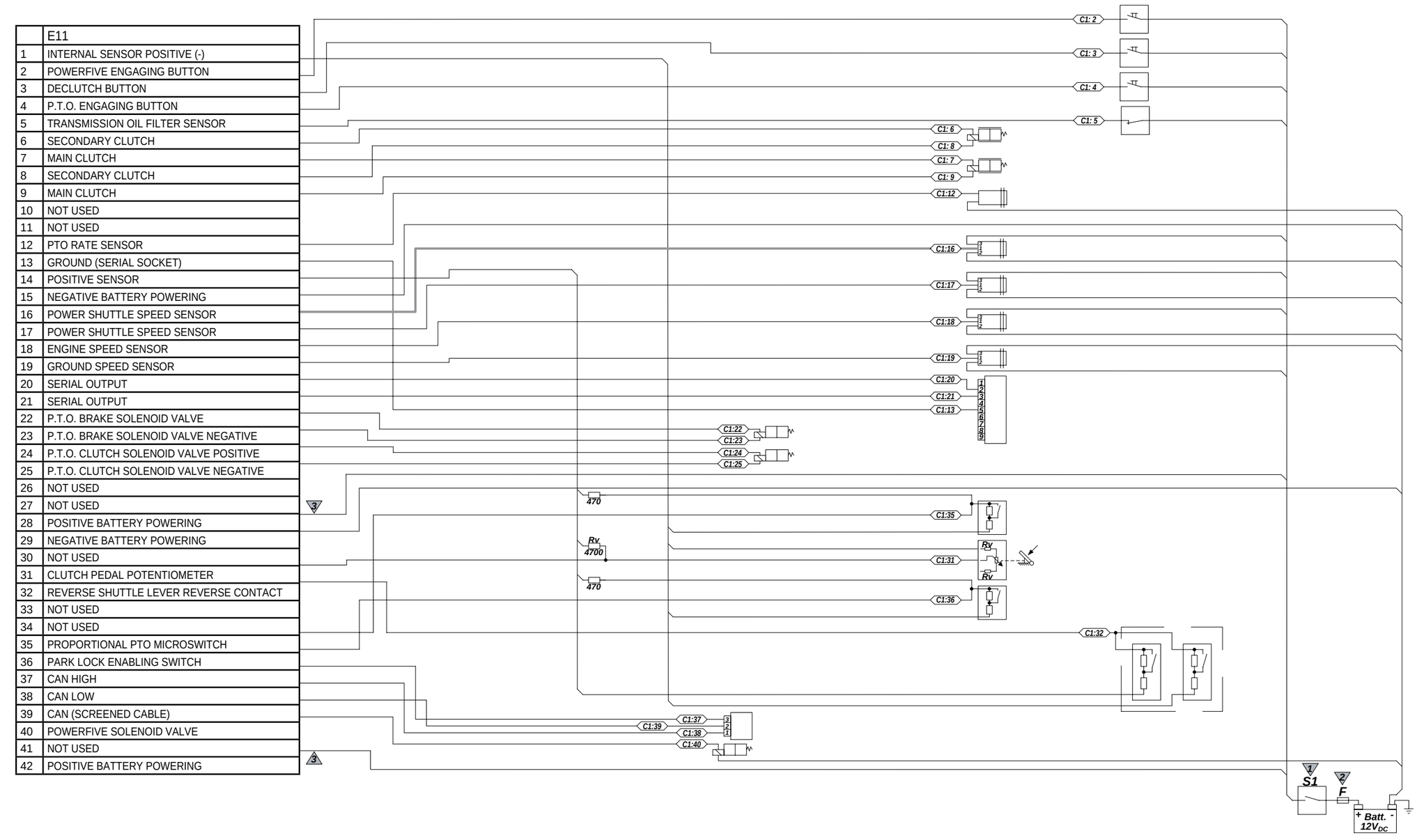


Fig.12.17

3.2.4 Alarm code (96)

Component involved

Power Shuttle rh speed sensor

Cause

Short-circuit/open circuit.

Terminals involved

PIN 17 of terminal board E11.

Remedy

- Replace the sensor.
- Eliminate the short-circuit/open circuit from the line.

The sensor (SR4) on the rh side of the engine-gearbox assembly detects the speed at which drive enters the gearbox and the rotation direction. It then transmits a signal to the electronic plant that controls the Power Shuttle unit, which controls the way the relative LEDs on the instrument come on (FORWARD-REVERSE turn indicators).

The sensor (SR4) is connected to the rear wiring by means of connector (P1)(Fig.12.19).

Note: if replacements are made, maintain the same shims when the new sensors are installed.

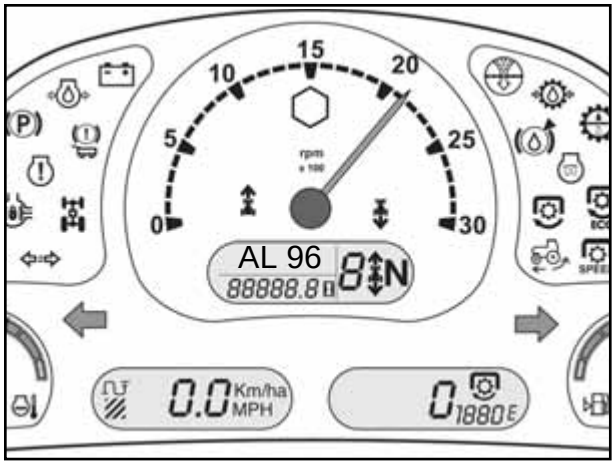


Fig. 12.18

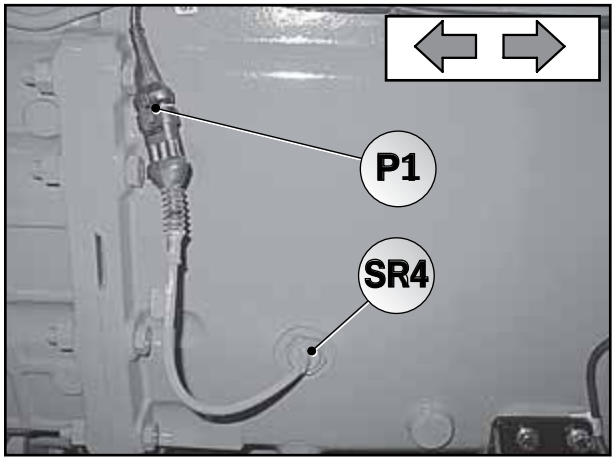


Fig. 12.19

Alarm code (96)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

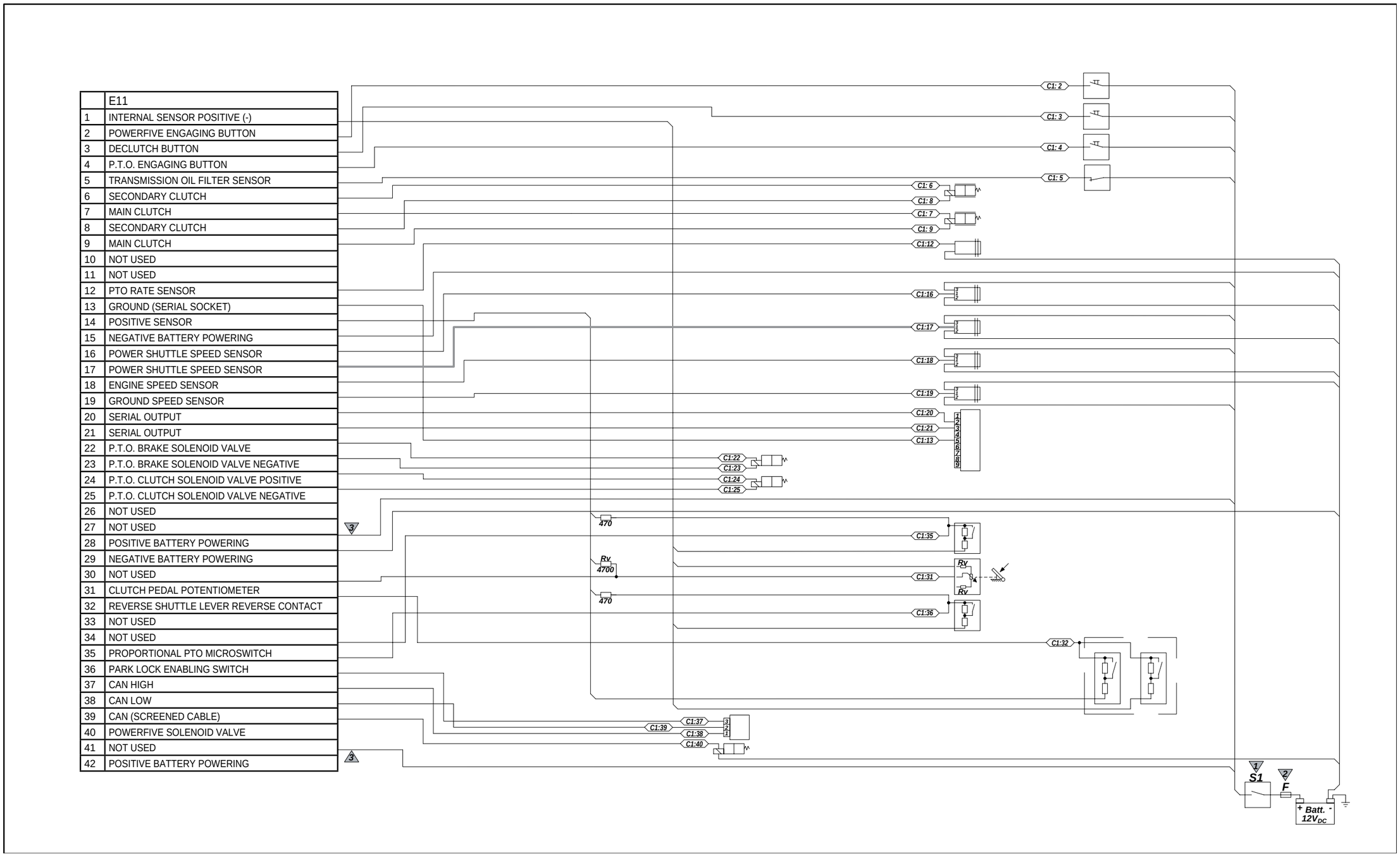


Fig. 12.20

3.2.5 Alarm code (95)

Component involved

Engine RPM rate sensor.

Cause

Short-circuit/open circuit.

Terminals involved

PIN 18 of terminal board E11.

Remedy

- Replace the sensor.
- Eliminate the short-circuit/open circuit from the line.

The sensor (SR2) on the right-hand side of the engine-gearbox assembly, detects the engine rate and transmits a signal to the electronic power unit, that calculates the RPM number to display on an analogue indicator on the instrument, where a pointer turns around a graduated scale. The signal is transmitted to the instrument by the CAN BUS line.

The sensor (SR2) is connected to the rear wiring by means of connector (P21)(Fig.12.22).

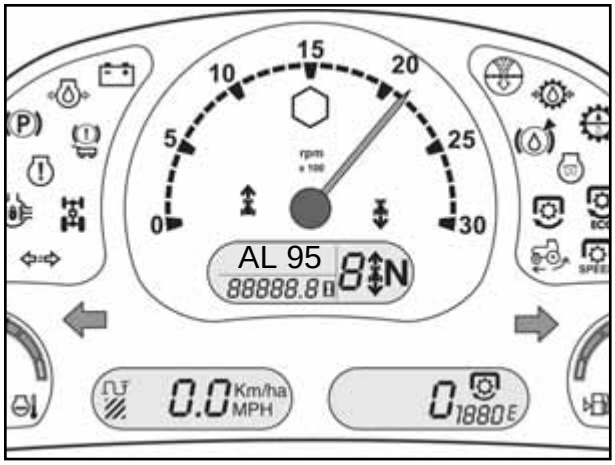


Fig. 12.21

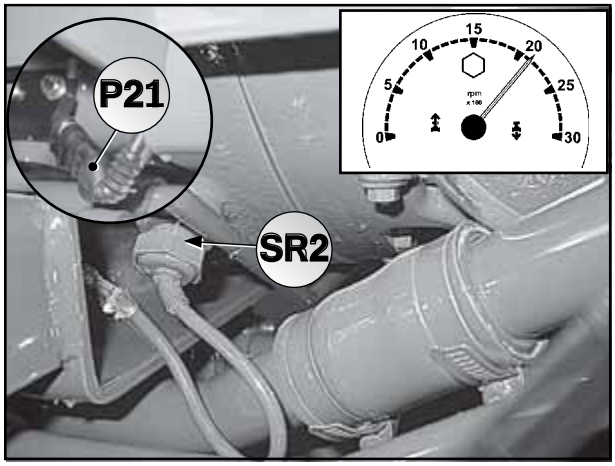


Fig. 12.22

Alarm code (95)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

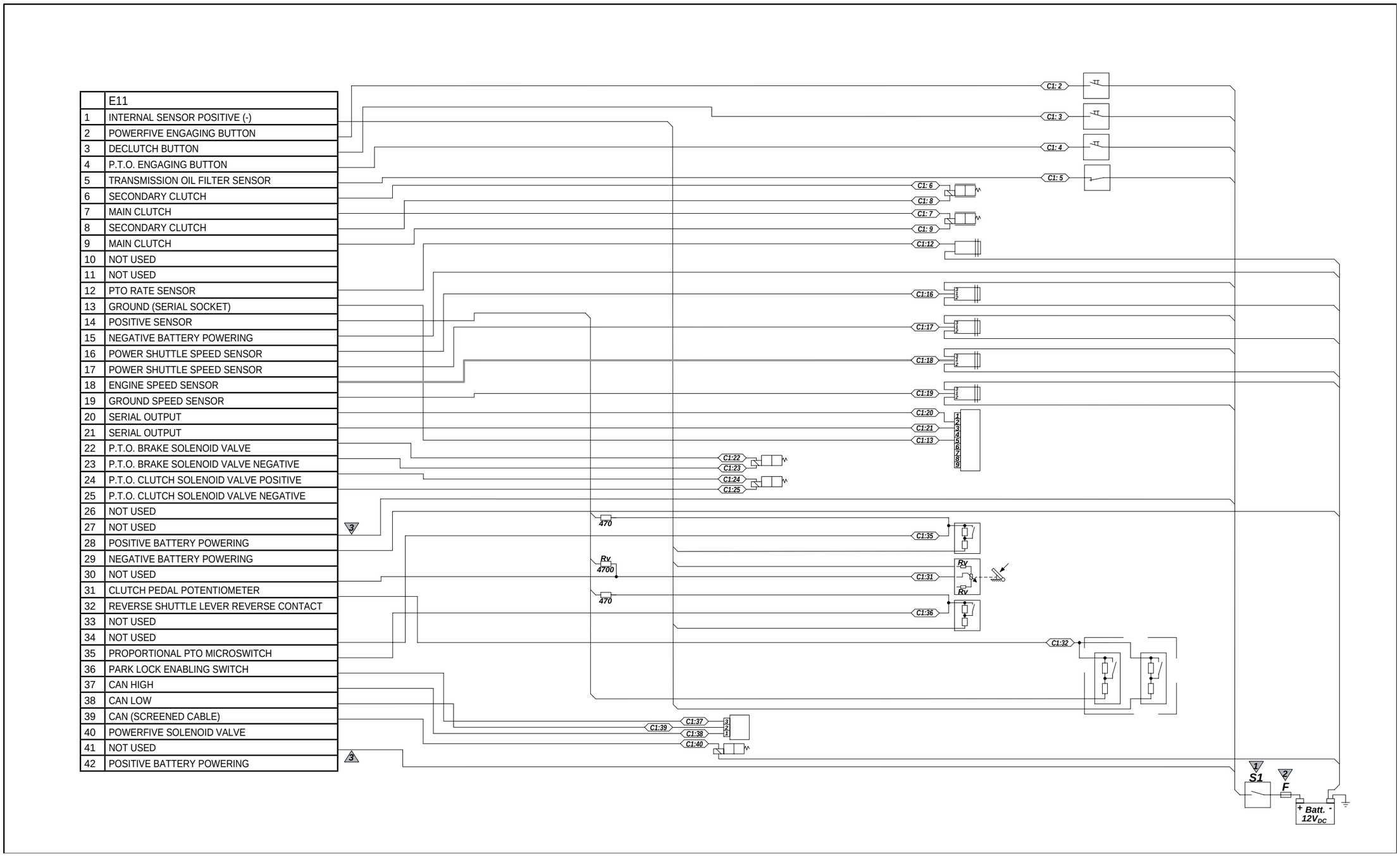


Fig. 12.23

3.2.6 Alarm code (94)

Component involved

Park Lock enabling switch.

Cause

Short-circuit/open circuit.

Terminals involved

PIN 36 of terminal board E11

Remedy

- Check/replace the Park Lock enabling switch.
- Eliminate the short-circuit/open circuit from the line.

The switch (SQ5 Fig.12.25) in contact with the Park Lock (P) engaging teeth, informs the electronic control unit when the device is engaged. The control valves of the main and secondary clutch assemblies cannot be piloted when the Park Lock is engaged.

Park Lock engagement is revealed by a LED coming on in the instrument.

The switch (SQ5) is connected to the dashboard wiring.

Switch function test

Disconnect the switch connector and measure the values between the switch terminals with a tester:

- switch pressed = circuit closed
- switch released = circuit open

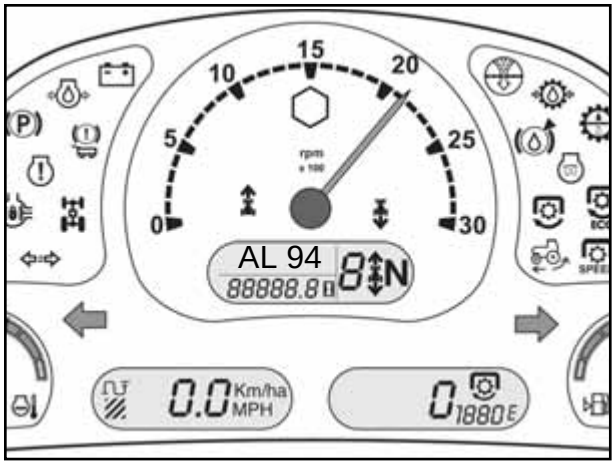


Fig. 12.24

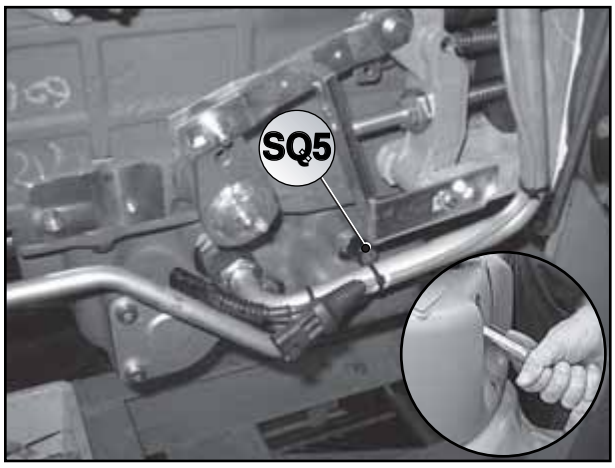


Fig. 12.25

Alarm code (95)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

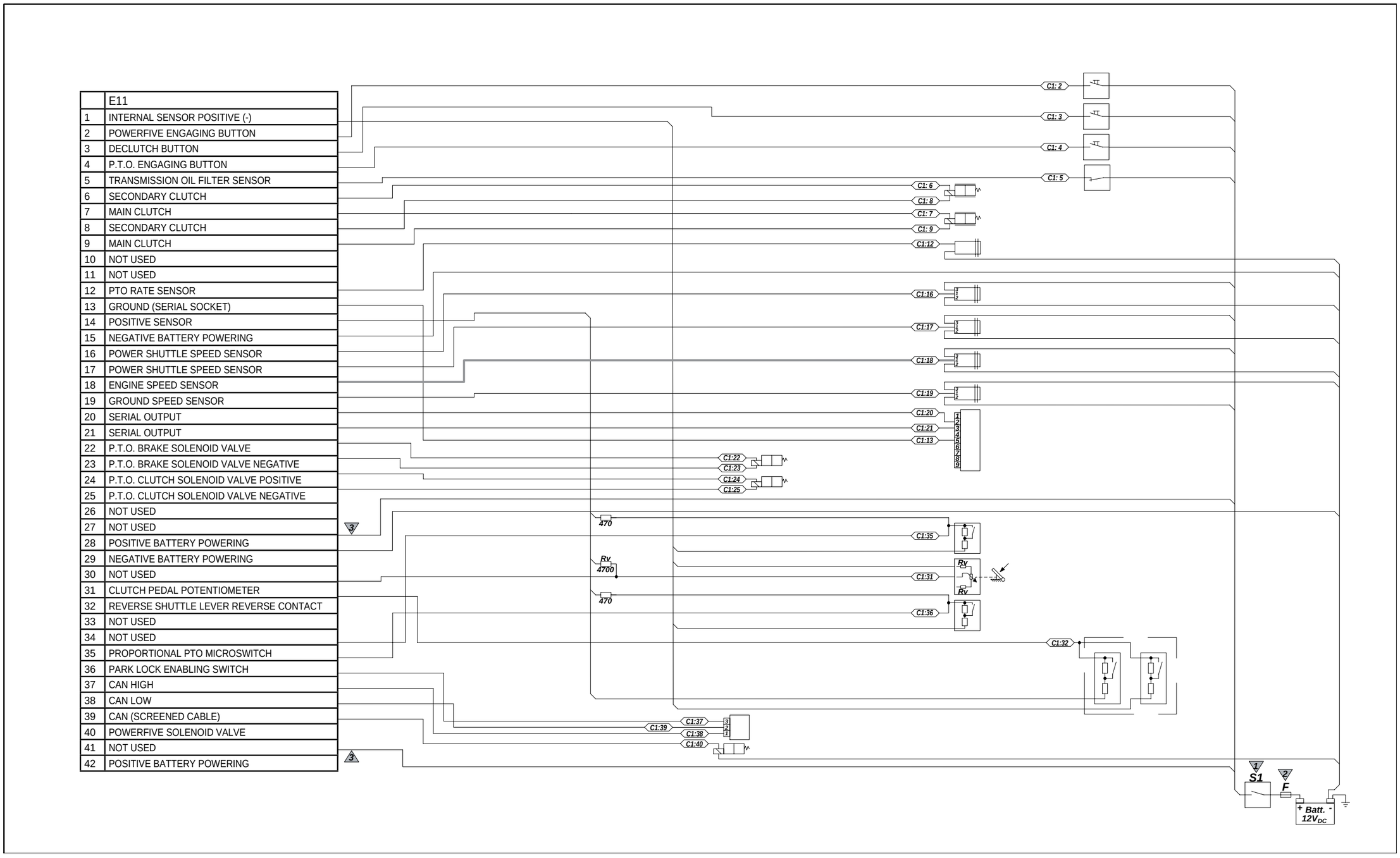


Fig. 12.23

3.2.7 Alarm code (90)

Component involved

Reverse shuttle lever

Cause

The internal contacts of the reverse shuttle lever have closed at the same time.

Terminals involved

PIN 32 of terminal board E11.

Remedy

Replace the reverse shuttle lever (I).

Functionality test

To check the functionality of the reverse shuttle lever, use a tester to ascertain whether the values given in the table below are provided.

Positions of the lever:
AV - lever forward
N - lever in neutral position
RM - lever back (reverse)

Lever position	Reference wire colours	Reference number
FWD/REV	H/R	Circuit open
N	H/N	Circuit closed
N	HN/AN	2720 ± 10 ohm
AV	HN/AN	560 ± 10 ohm
N	HN/A	2720 ± 10 ohm
RM	HN/A	560 ± 10 ohm

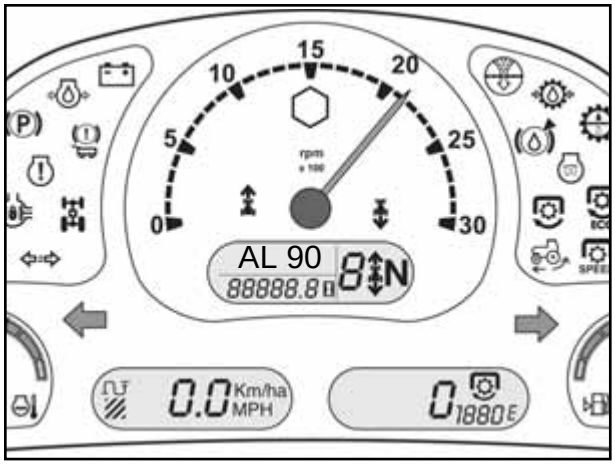


Fig. 12.27

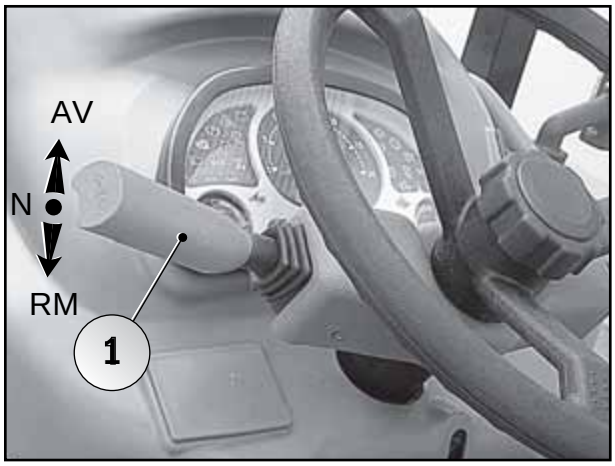


Fig. 12.28

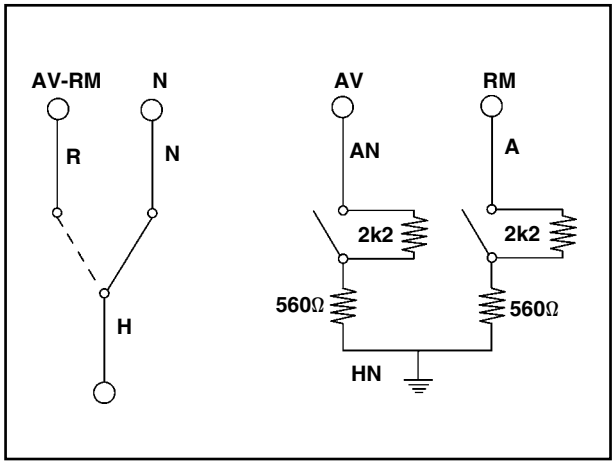


Fig. 12.29

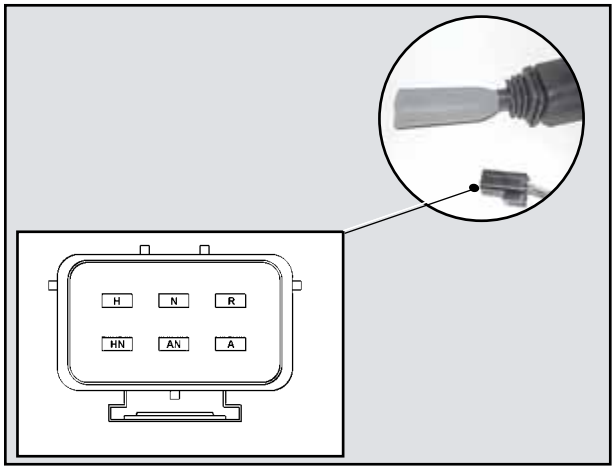


Fig. 12.30

Alarm code (90)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

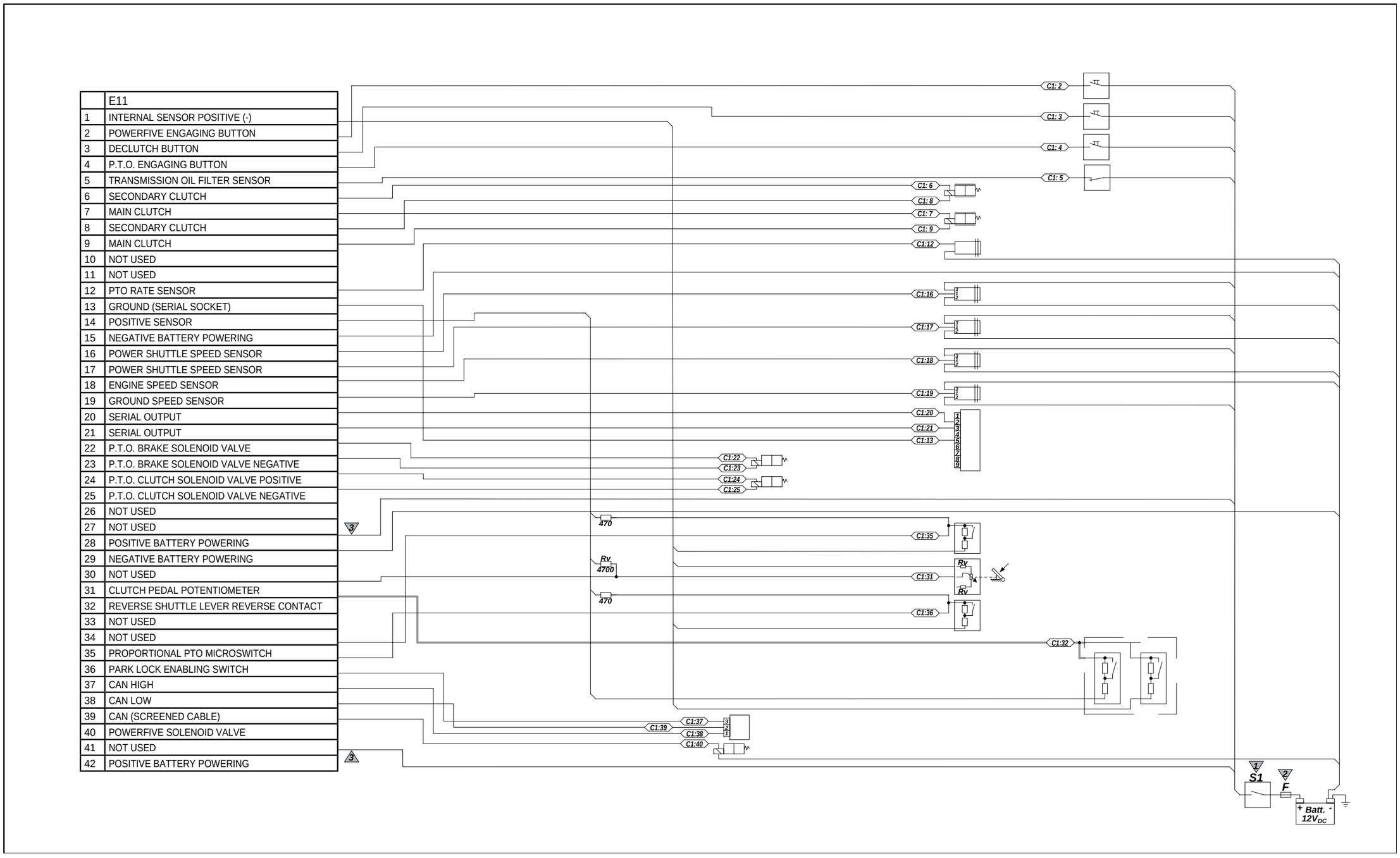


Fig. 12.31

3.2.8 Alarm code (86)

Component involved

Speed Four switch

Cause

Short-circuit.

Terminals involved

PIN 7 of terminal board E11.

Remedy

- Check functionality/replace Speed Four switch.
- Eliminate the short-circuit from the line.

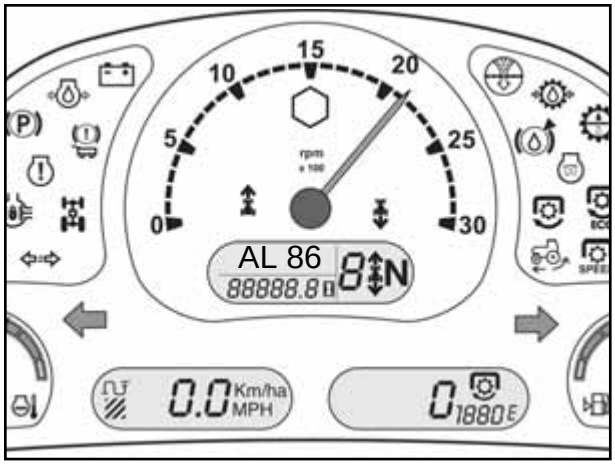


Fig. 12.32

The two proportional solenoid valves (YV1 and YV2 Fig.12.33) are installed in the hydraulic power pack (15), on the left-hand side of the axle housing. The solenoid valve (YV2) is connected to the rear wiring with the connector.

CURRENT VALUE TEST (PROPORTIONAL VALVES)

- check the power draw of the coil winding with a tester;
- position the tester prods “inseries” to the coil (Fig.12.35);
- power the solenoid valve’s coil.
- the value of the current measured by the tester varies depending on the extent at which the valve opens. The peculiar feature of this solenoid valve is that the movement of the plunger can be checked, thus allowing the pressure in the user to be controlled.

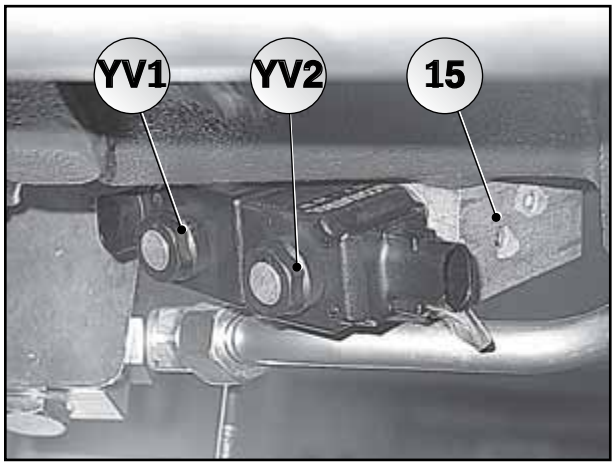


Fig. 12.33

A board in the tractor’s electronic control unit handles the valve piloting function.

- the pressure towards the user depends on the measured current value, a value which must comply with the curve shown in (Fig12.34).

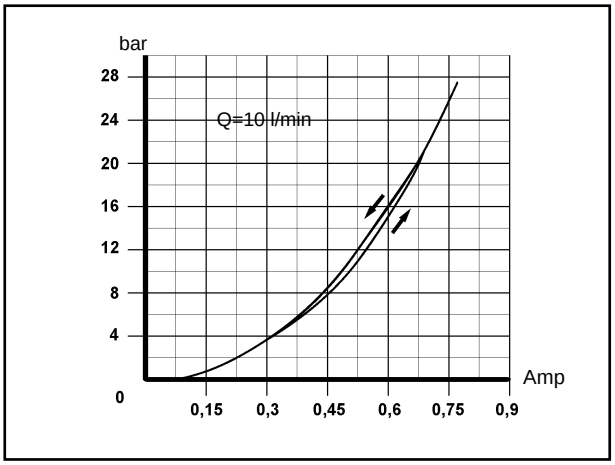


Fig. 12.34

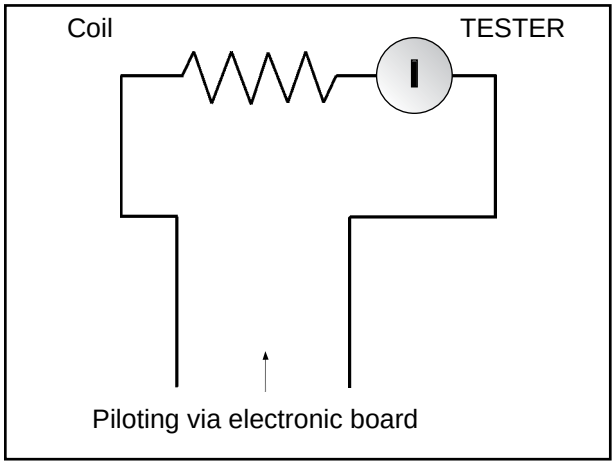


Fig. 12.35

Alarm code (86)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

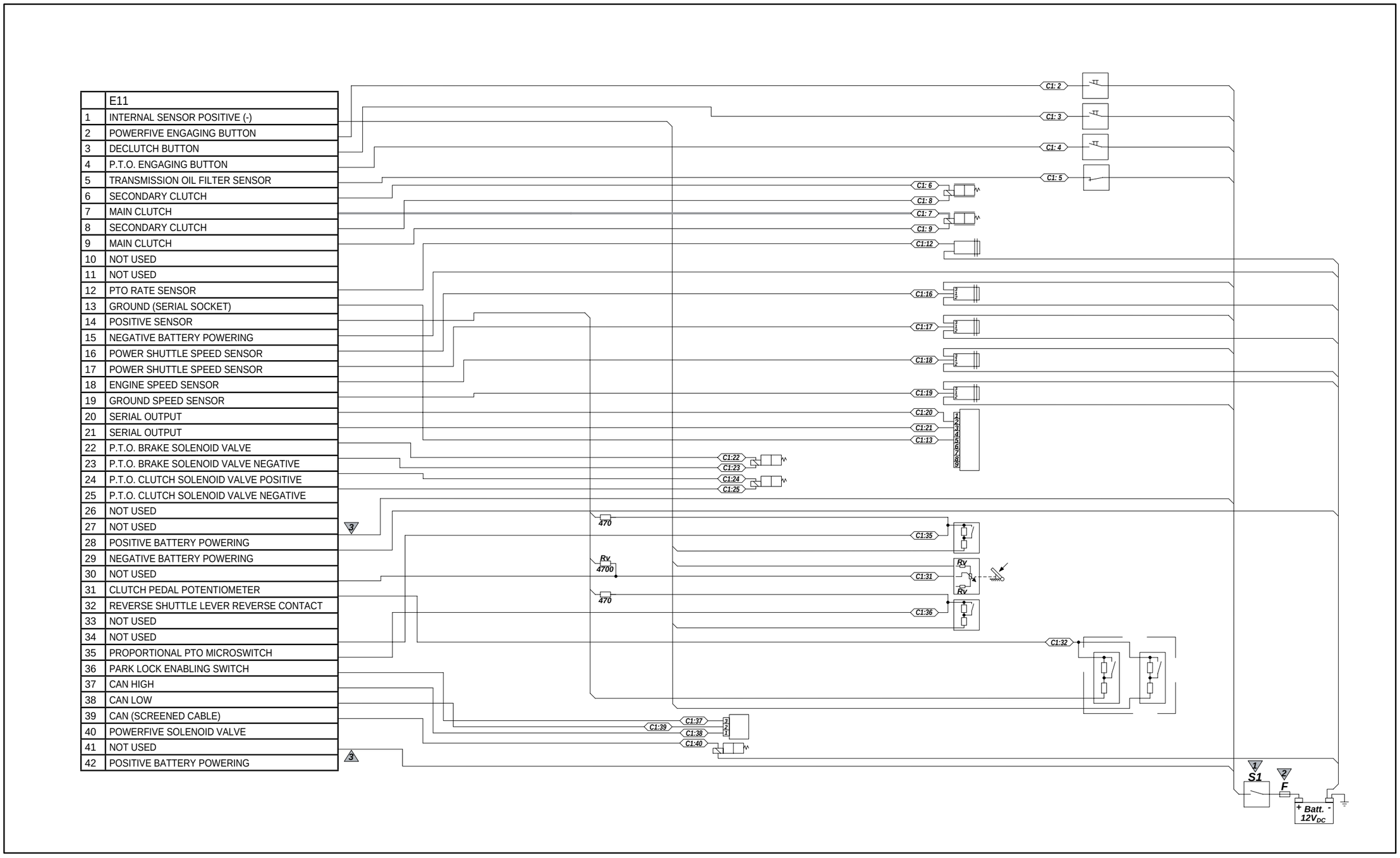


Fig. 12.36

3.2.9 Alarm code (85)

Component involved

Secondary clutch solenoid valve.

Cause

Short-circuit/open circuit.

Terminals involved

PIN 6 of terminal board E11.

Remedy

- Check functionality/replace declutch switch.
- Eliminate the short-circuit/open circuit from the line.

The two proportional solenoid valves (YV1 and YV2 Fig.12.38) are installed in the hydraulic power pack (15), on the left-hand side of the axle housing. The solenoid valve (YV1) is connected to the rear wiring.

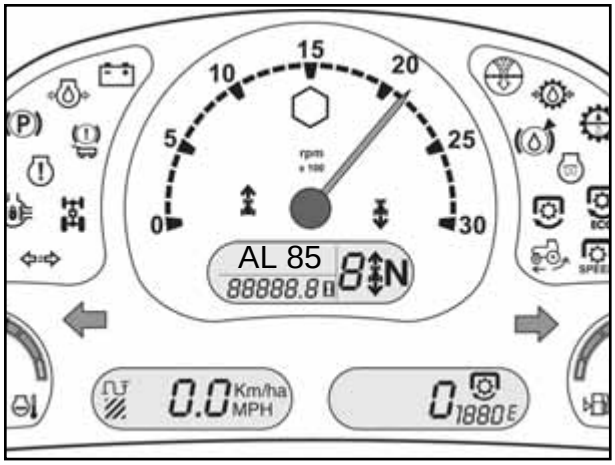


Fig. 12.37

CURRENT VALUE TEST (PROPORTIONAL VALVES)

- check the power draw of the coil winding with a tester;
- position the tester prods “inseries” to the coil (Fig.12.40);
- power the solenoid valve’s coil.
- the value of the current measured by the tester varies depending on the extent at which the valve opens. The peculiar feature of this solenoid valve is that the movement of the plunger can be checked, thus allowing the pressure in the user to be controlled.

A board in the tractor’s electronic control unit handles the valve piloting function.

- the pressure towards the user depends on the measured current value, a value which must comply with the curve shown in (Fig12.39).

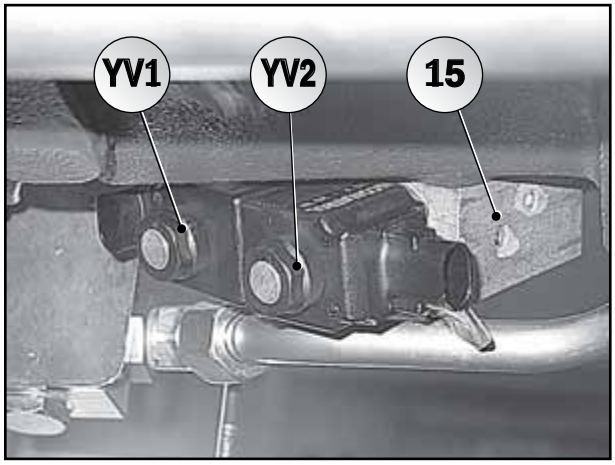


Fig. 12.38

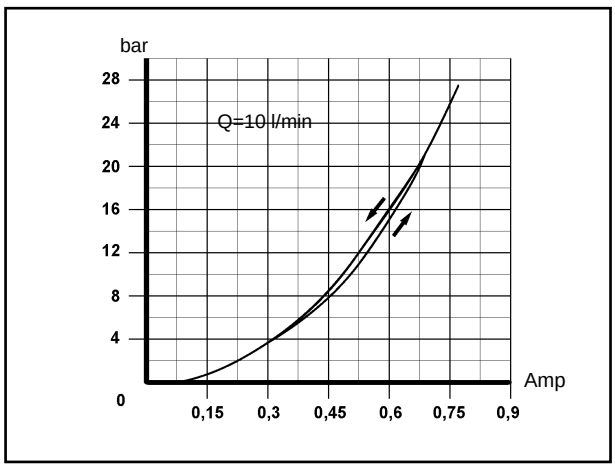


Fig. 12.39

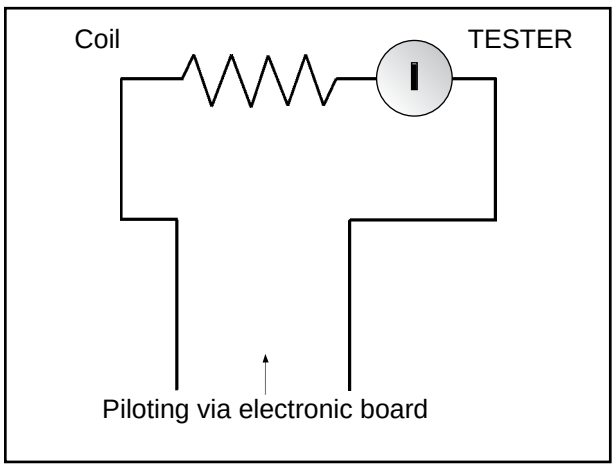


Fig. 12.40

Alarm code (85)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

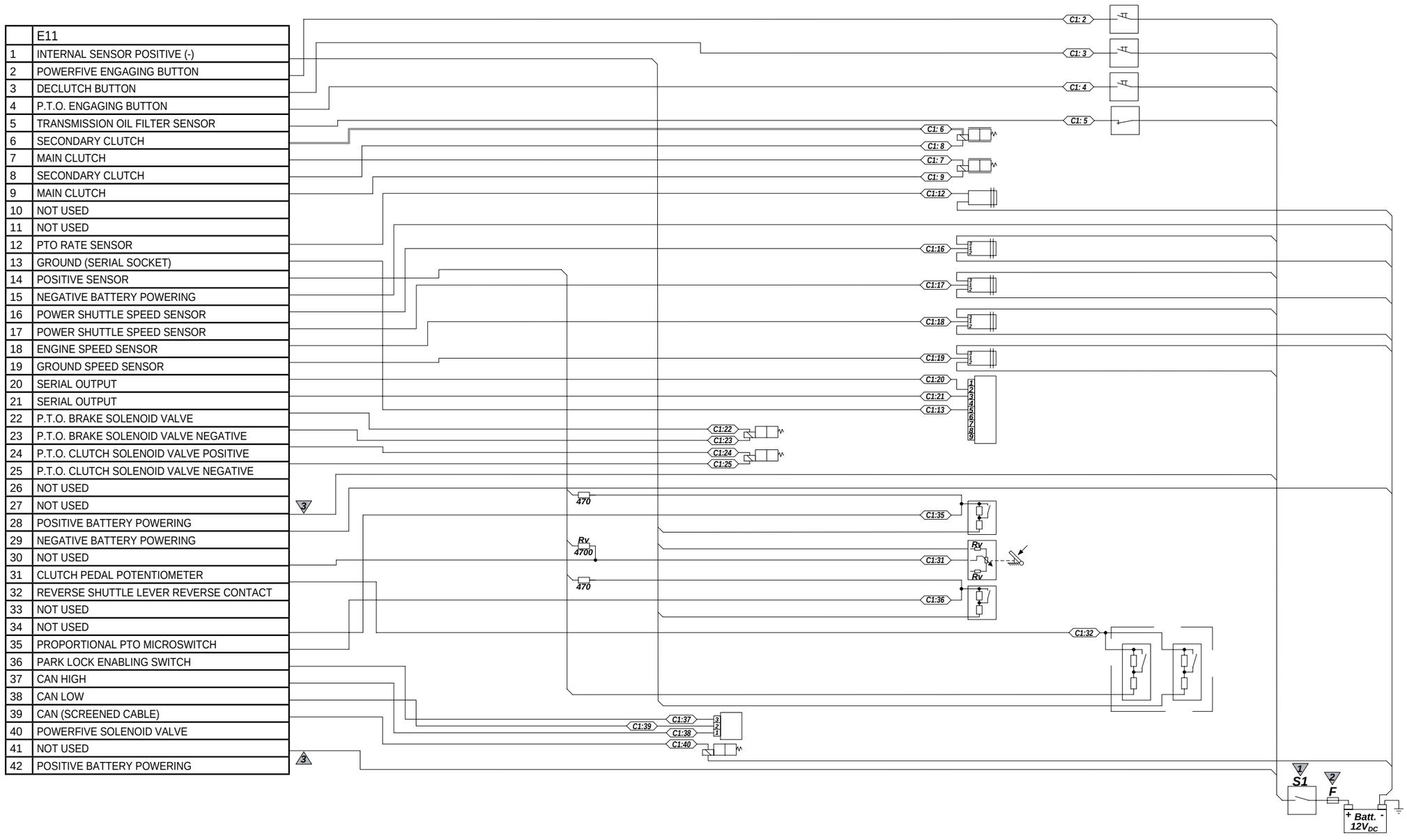


Fig. 12.41

3.2.10 Alarm code (82)

Component involved

Proportional PTO switch.

Cause

Short-circuit/open circuit.

Terminals involved

PIN 35 of terminal board E11.

Remedy

- Replace the switch.
- Eliminate the short-circuit/open circuit from the line.

The switch (SQ18) (Fig.12.43) is installed on the left-hand side near the final drive, indicates when the PTO is used in the proportional mode by means of an indicator light on the instrument. When the proportional PTO is selected by means of the relative lever (T), the switch (SQ18) transmits a signal to the instrument and the relative indicator lights up.

The switch (SQ18) is connected to the rear wiring.

SWITCH FUNCTION TEST

Disconnect the faston terminals and measure the values between the switch terminals with a tester:

- switch pressed = circuit closed
- switch released = circuit open.

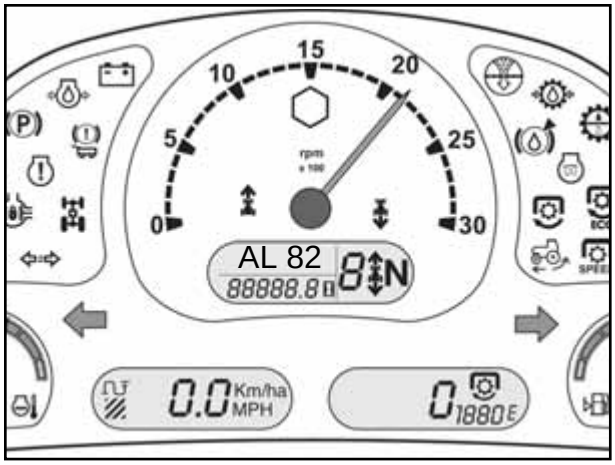


Fig. 12.42

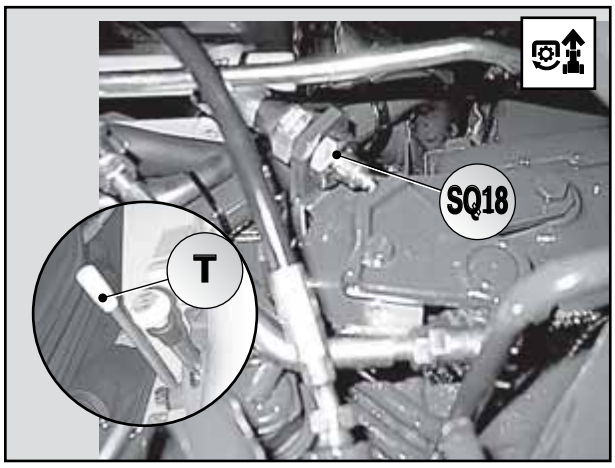


Fig. 12.43

Alarm code (82)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

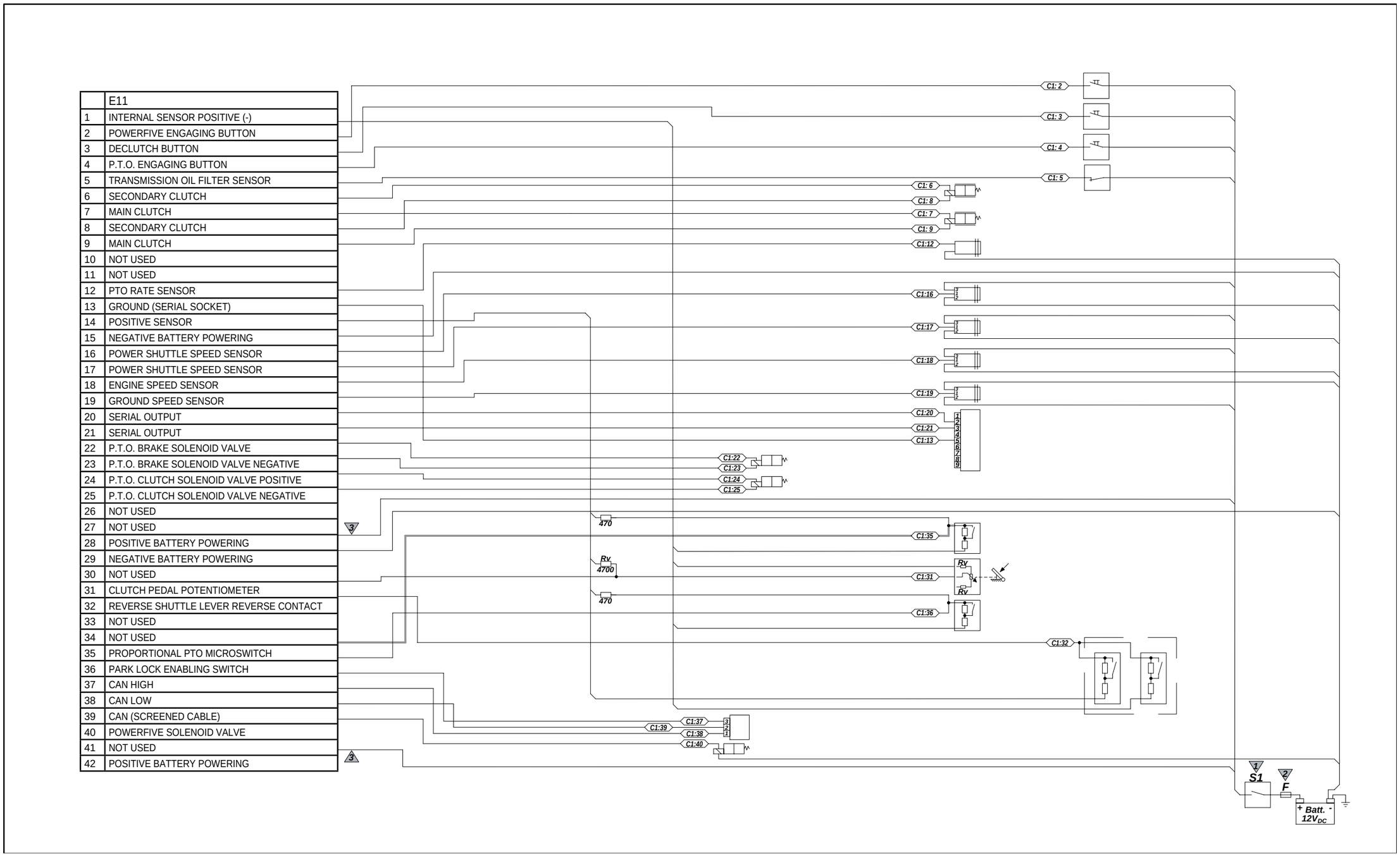


Fig. 12.44

3.2.11 Alarm code (81)

Component involved

P.T.O. brake solenoid valve

Cause

Short-circuit/open circuit.

Terminals involved

PIN 22 of terminal board E11.

Remedy

- Check/replace the brake solenoid valve.
- Eliminate the short-circuit/open circuit from the line.

The solenoid valve (YV8) is connected to the rear wiring.

Solenoid valve (YV8) de-energized = brake engaged

Solenoid valve (YV8) energized = brake disengaged

Coil resistance test

- make sure that the coil winding is not broken with the aid of a tester;
- place the tester prods at the end of the winding, i.e. the connection terminals.
- measure the resistive value of the winding.
- this value must be between 8 and 10, at a temperature of approximately 20 °C (Fig.12.47).

Note: the coil resistance test can also be conducted without removing the component from the tractor. These tests are indicative and do not have an absolute value. They concern the electrical nature of the solenoid valve. A faulty solenoid valve could also be due to problems of a mechanical/hydraulic nature (e.g. the internal plunger could have seized).

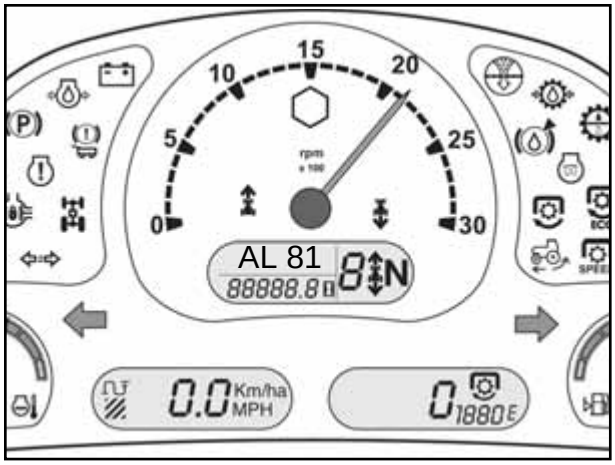


Fig. 12.45

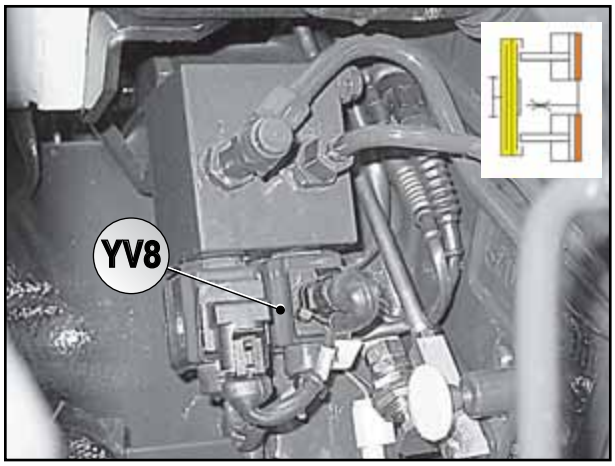


Fig. 12.46

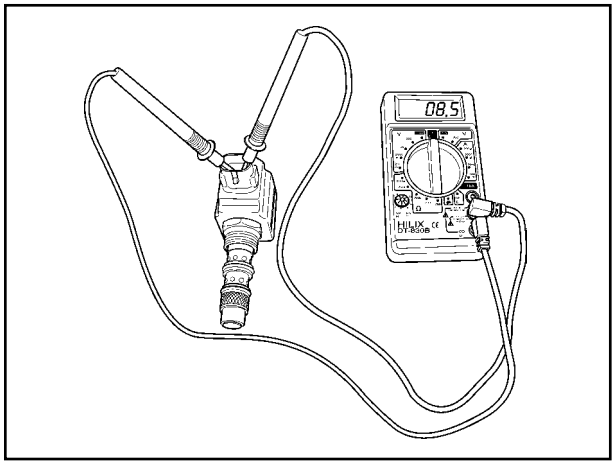


Fig. 12.47

Alarm code (81)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

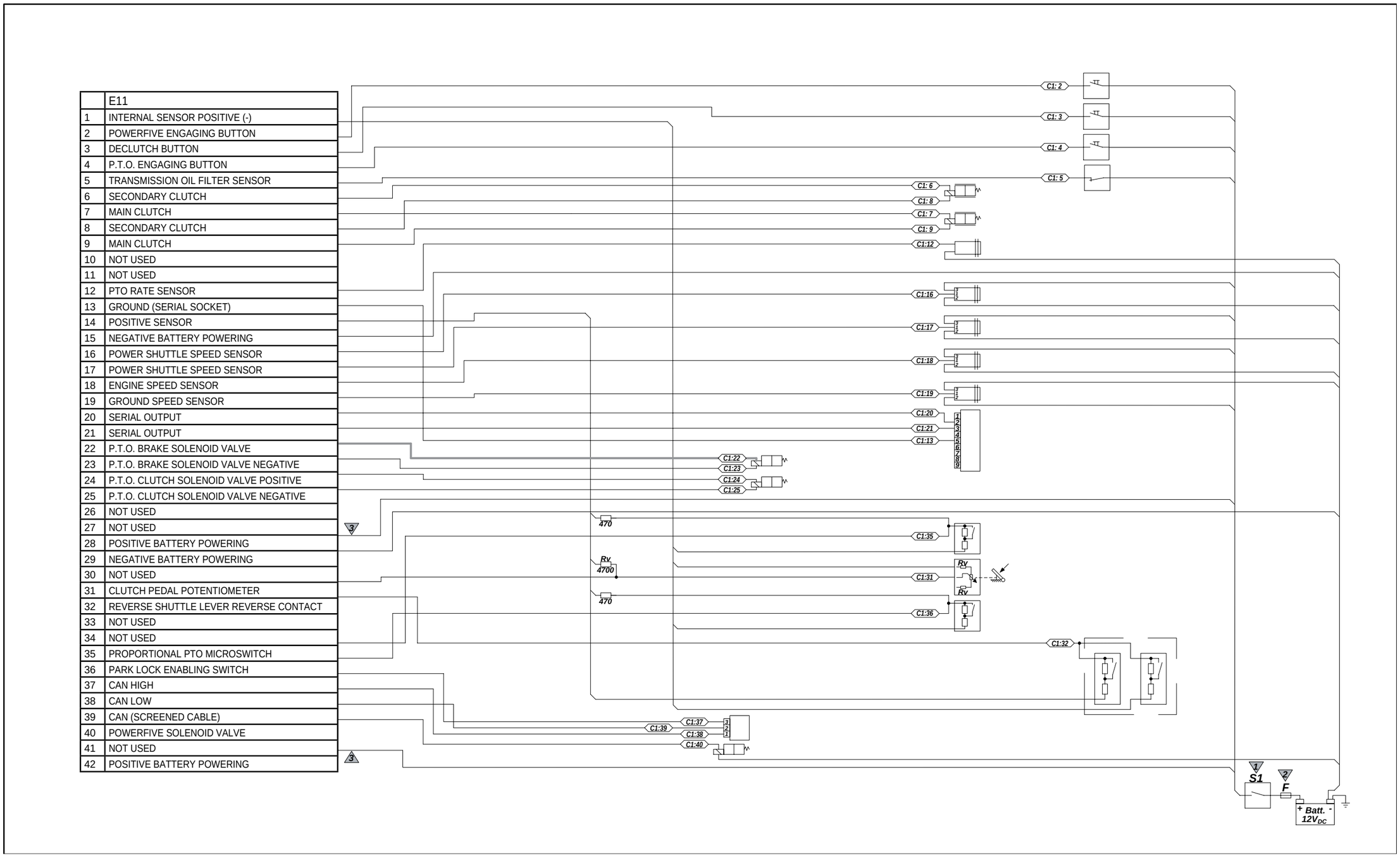


Fig. 12.48

3.2.12 Alarm code (80)

Component involved

PTO solenoid valve.

Cause

Short-circuit/open circuit.

Terminals involved

PIN 24 of terminal board E11.

Remedy

- Check/replace the PTO solenoid valve.
- Eliminate the short-circuit/open circuit from the line.

The solenoid valve (YV9) is connected to the rear wiring.

Solenoid valve (YV4) de-energized = PTO clutch disengaged

Solenoid valve (YV4) energized = engaged PTO.

CURRENT VALUE TEST (PROPORTIONAL VALVES)

- check the power draw of the coil winding with a tester (Fig.12.52)
- position the tester prods “inseries” to the coil (Fig.12.52);
- power the solenoid valve’s coil.
- The peculiar feature of this solenoid valve is that the movement of the plunger can be checked, thus allowing the pressure in the user to be controlled.

A board in the tractor’s electronic control unit handles the valve piloting function.

- the pressure towards the user depends on the measured current value, a value which must comply with the curve shown in (Fig12.51).

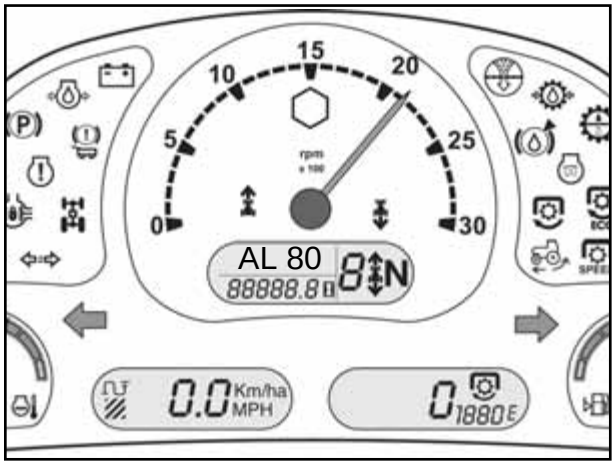


Fig. 12.49

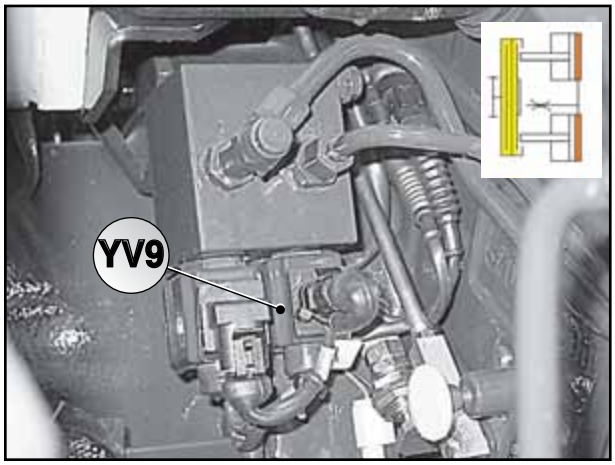


Fig. 12.50

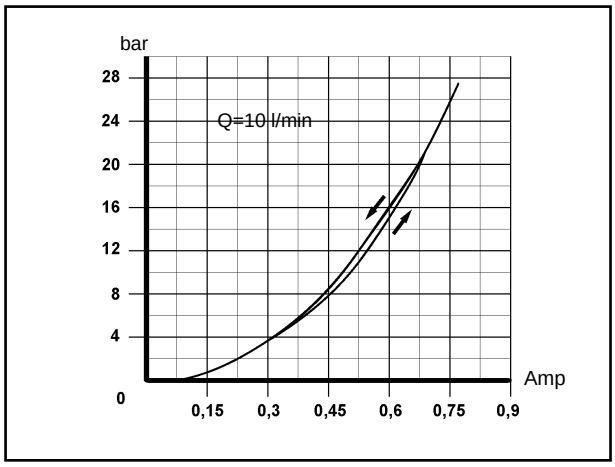


Fig. 12.51

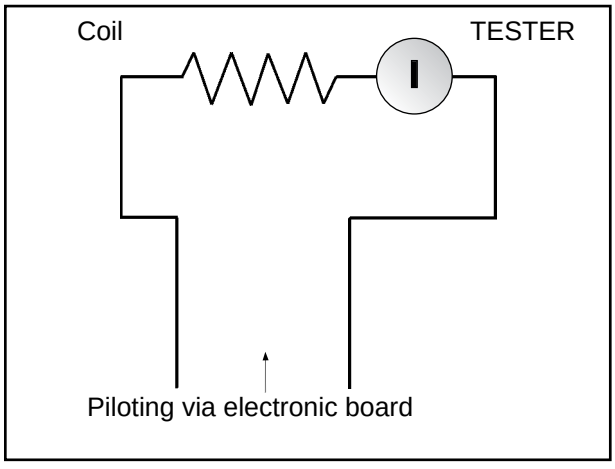


Fig. 12.52

Alarm code (80)

	E11
1	INTERNAL SENSOR POSITIVE (-)
2	POWERFIVE ENGAGING BUTTON
3	DECLUTCH BUTTON
4	P.T.O. ENGAGING BUTTON
5	TRANSMISSION OIL FILTER SENSOR
6	SECONDARY CLUTCH
7	MAIN CLUTCH
8	SECONDARY CLUTCH
9	MAIN CLUTCH
10	NOT USED
11	NOT USED
12	PTO RATE SENSOR
13	GROUND (SERIAL SOCKET)
14	POSITIVE SENSOR
15	NEGATIVE BATTERY POWERING
16	POWER SHUTTLE SPEED SENSOR
17	POWER SHUTTLE SPEED SENSOR
18	ENGINE SPEED SENSOR
19	GROUND SPEED SENSOR
20	SERIAL OUTPUT
21	SERIAL OUTPUT
22	P.T.O. BRAKE SOLENOID VALVE
23	P.T.O. BRAKE SOLENOID VALVE NEGATIVE
24	P.T.O. CLUTCH SOLENOID VALVE POSITIVE
25	P.T.O. CLUTCH SOLENOID VALVE NEGATIVE
26	NOT USED
27	NOT USED
28	POSITIVE BATTERY POWERING
29	NEGATIVE BATTERY POWERING
30	NOT USED
31	CLUTCH PEDAL POTENTIOMETER
32	REVERSE SHUTTLE LEVER REVERSE CONTACT
33	NOT USED
34	NOT USED
35	PROPORTIONAL PTO MICROSWITCH
36	PARK LOCK ENABLING SWITCH
37	CAN HIGH
38	CAN LOW
39	CAN (SCREENED CABLE)
40	POWERFIVE SOLENOID VALVE
41	NOT USED
42	POSITIVE BATTERY POWERING

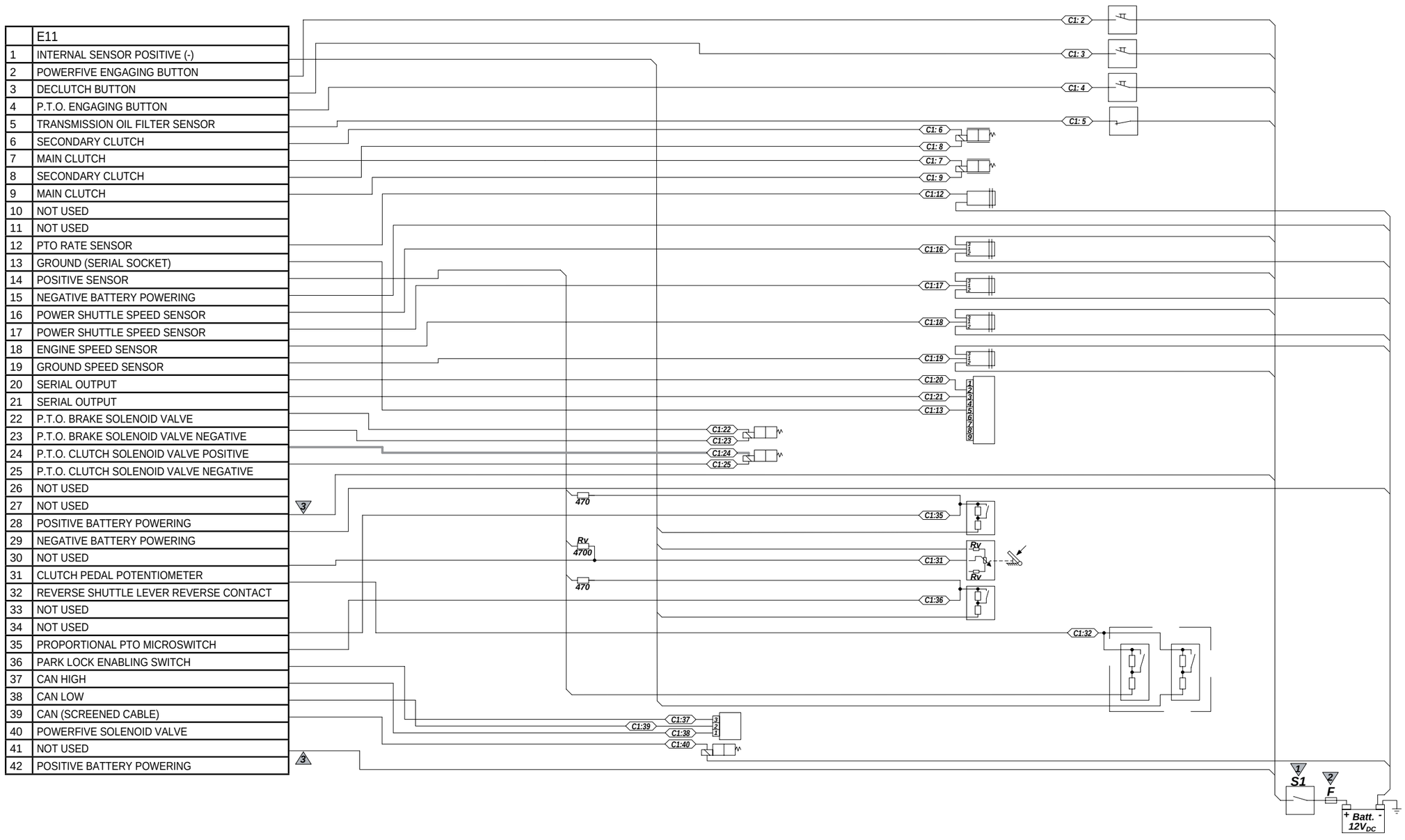


Fig.12.58

Chapter 13 : AC system

Index

Section 1 : Precautions and safety recommendations 13-2

Section 2 : General description 13-3
- 2.1 Basic concepts 13-4
- 2.2 Operating principle of a cooling cycle 13-14
- 2.3 Main components of an air conditioning system 13-19

Section 3 : Technical specifications 13-23
- 3.1 Main technical specifications 13-24

Section 4 : Air conditioning system (AC) 13-25
- 4.1 Main components 13-26
- 4.2 Operating instructions 13-27

Section 5 : How to empty and recharge the system 13-29
- 5.1 Safety notes 13-30
- 5.2 Maintenance instructions 13-31
- 5.3 Recharging procedure 13-32

Section 6 : Functionality tests 13-37
- 6.1 Specific equipment 13-38
- 6.2 How to check the efficiency of the A/C system 13-39

Section 1 : Precautions and safety recommendations

Certain precautions and safety recommendations are described in this section. It is important for operators to comply with these instructions in order to prevent accidents. Moreover, always bear in mind the safety measures described in the Operation and Maintenance Manual and in chapter 1 of this manual.

Carefully comply with the Warnings indicated by means of this symbol:

	Attention: always wear protective goggles and gloves when handling coolant.
	Attention: do not allow the coolant to splash on to the skin.
	Attention: the equipment for treating the coolant must be used in adequately ventilated places, with at least four air changes per hour.
	Attention: do not use equipment for treating coolant near open containers holding inflammable substances or with leaks.
	Attention: do not tamper with or modify the settings of the breather and safety valves in the containers and equipment for treating coolant.
	Attention: do not fill any vessel (cylinder, A/C charging equipment) with coolant unless it has not been approved for the purpose and equipped with a relative safety valve.
	Attention: do not fill any storage vessel beyond 80% of its capacity.
	Attention: take the utmost care when the service pipes are connected since they may contain pressurized coolant.

Section 2 : General description

Index

2.1 Basic concepts 13-4
2.1.1 Introduction 13-4
2.1.2 Pressure 13-4
2.1.3 Heat and temperature 13-6
2.1.4 Influence of heat on transformations of physical states in bodies (at constant pressure) 13-8
2.1.5 Influence of pressure on transformations of physical state in bodies 13-11
2.1.6 Relations between temperature, pressure and volume in aeriform substances 13-13
2.1.7 Humidity 13-13

2.2 Operating principle of a cooling cycle 13-14
2.2.1 Description of a cooling cycle and air treatment 13-14
2.2.2 Notes and considerations 13-17

2.3 Main components of an air conditioning system 13-19
2.3.1 Coolant or cooling fluid 13-19
2.3.2 Evaporator 13-20
2.3.3 Compressor (F13.15) 13-20
2.3.4 Condenser (G13.16) 13-21
2.3.5 Expansion or governor valve 13-21
2.3.6 Filter or dehydrator (H13.17) 13-21

2.1 Basic concepts

2.1.1 Introduction

We considered it advisable to give a brief explanation of the more important basic principles dictated by elementary notions of physics before proceeding with the theoretic-practical analysis of the air conditioning system installed in Powerfarm tractors.

Nowadays, an increasingly higher number of tractors is being equipped with an air conditioning system. It is therefore essential for repair engineers to acquire a theoretic knowledge of those fundamental principles on which a cooling system is based in order to be able to work with adequate competence when servicing and repairing such systems.

2.1.2 Pressure

The **pressure** is a physical entity defined by the ratio between a certain force, perpendicular to a surface, and the area of the surface itself (e.g.: 1 kg on 1 cm*2 of a horizontal surface Fig.13.1).

The **atmospheric pressure**in a determined point of the atmosphere, is the weight of the air column of unitary section (e.g.: 1 cm*2), that goes from the above mentioned point to the upper limit of the atmosphere itself. The higher the point in which atmospheric pressure is measured, the less it will therefore be (e.g.: atmospheric pressure in mountain districts is less than at sea level).

The unit of measurement most commonly used in the past was the**Atmosphere**, since it corresponded to the atmospheric pressure at sea level in determined conditions - Normal Atmospheric Pressure - and equivalent to the pressure exercised by a mercury column (Hg) of unitary section, 760 mm high at 0°C, at sea level and at a latitude of 45°. This unit of measurement is the**physical atmosphere** and its symbol is the **atm**.

The official units of measurement are currently established by the International System of Units (SI). The basic SI unit for pressure is the **Pascal** (Pa):

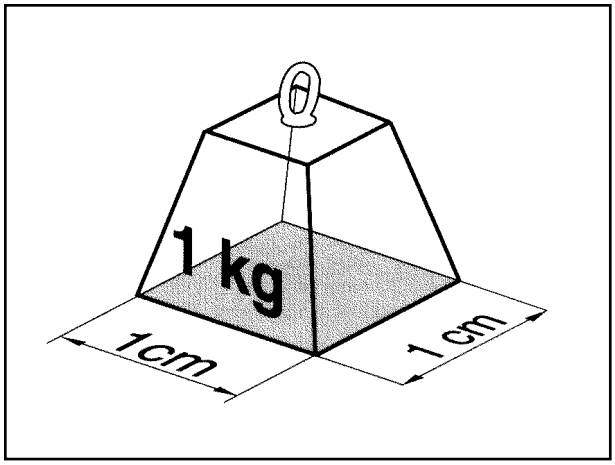


Fig. 13.1

1 Pa = 1 Newton/m*2 (1 N/m*2)

The **Newton** (N) is the unit of force, i.e.: 1 N = force that imparts an acceleration of 1 m/s2 to a mass of 1 kg, i.e.: An acceleration of 1m/s*2, i.e. **1 N** = 1 Kg m/s*2

Other units of measurement for pressure permitted or transitorily tolerated by the SI are:

the **bar** (for the pressure of fluids):

1 bar = 10*5 Pa

the**technical atmosphere** (1 kg/cm*2):

1 at = 98066.5 Pa

the **millimeter of mercury** (torr):

1 mm Hg = 133.322 Pa

the **millimeter of water**:

1 mm H*2O = 9.807 Pa

In English speaking countries, the unit of measurement for pressure conventionally used is pounds/square inch (lbs/sq in) (**psi**)

- **1 pound** (lb) = 0.4536 kg
- **25.40 mm** (in) = 25.4 mm
- **6.45 cm²** = 6.452 cm*2 = 645.2 mm*2

The instrument used to measure the pressure of fluids is the **pressure gauge** (Fig.13.2).

The pressure gauges normally used in practice are the differential type since they indicate the difference between the pressure of the environment in question and the atmospheric pressure.

The dials of differential pressure gauges have scales (in the required units of measurement) where zero “0” corresponds to the atmospheric pressure and where the indicated pressure or manometric pressure is called **relative pressure.**

In the other hand, **absolute pressure** is the pressure measured on a scale where zero “0” is the absolute vacuum and “1” corresponds to the normal atmospheric pressure.

The absolute pressure is therefore given by the sum of the manometric (or relative) pressure and the normal pressure (1 by definition).

A relative pressure that is less than normal pressure is called **negative pressure** or vacuum or degree of vacuum. The instrument used to measure the negative pressure is the **vacuometer** (Fig.13.3).

Main conversions between the more common units of measurement for pressure:

- **1 N/m*2** = 1 Pa
- **1 N/cm*2** = 104 Pa
- **1 bar** = 10*5 Pa = 10*5 N/m*2 = 10 N/cm*2
- **1 atm**= 101325 Pa= 1.01325 x 10*5 Pa
- **1 at** = 98066.5 Pa= 0.980665 x 10*5 Pa
- **1 atm** = 1.01325 bat = 10.1325 N/cm*2
- **1 at** = 0.980665 bar = N/cm*2
- **1 bar** = 0.98692 atm = 1.01972 at
- **1 psi** = 0.068 atm = 0.069 bar = 6894.6 Pa
- **1 atm** = 14.697 psi
- **1 bar** = 14.505 psi

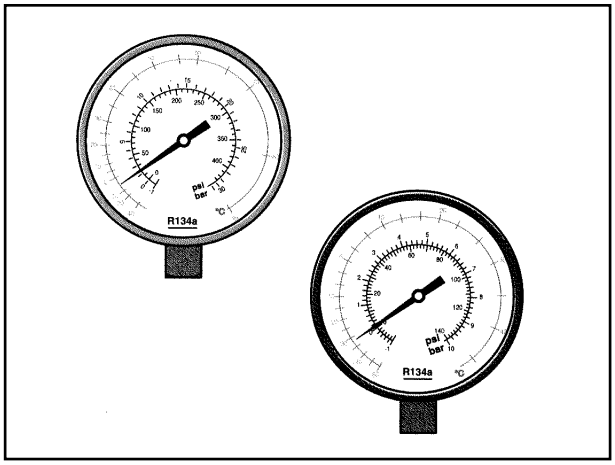


Fig. 13.2

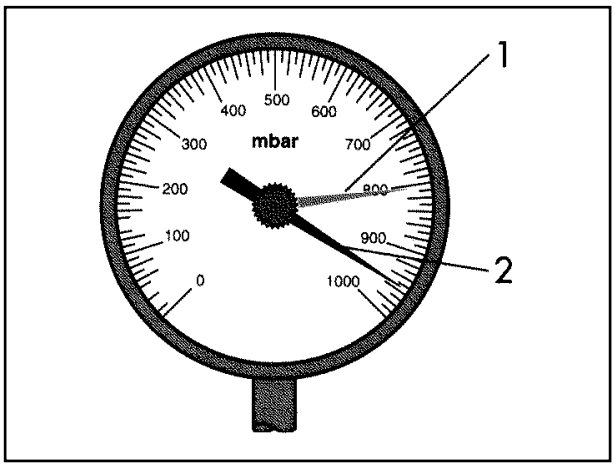


Fig. 13.3

1 - reference pointer
2 - measuring pointer

2.1.3 Heat and temperature

In daily practice, one often uses the terms **heat** and **temperature**.

For example, heat is received from a flame or from the Sun. For this reason, they are called **heat sources.**

An object which, when touched, gives us the sensation of being hotter than another, is said to have a higher temperature.

To explain the meanings of the terms heat and temperature and to allow them to be correctly used, we will now give stricter definitions indicating the main priorities and the relative units of measurement (which are widely interdependent).

2.1.3.1 Heat

The **heat** is a form of energy (thermal energy) generally present in nature since it is contained in all bodies, although in different concentrations.

The quantity of heat exchanged between bodies cannot be measured directly but only according to the effects produced (temperature variation, modification of the physical status, chemical reactions, production of mechanical work, etc.).

The unit of measurement of heat quantities is the **calorie** (cal) or **small calorie**, thus defined: the quantity of heat required to increase the temperature of the mass of 1 gram of distilled water at the normal atmospheric pressure at sea level by 12°C - from 14.5 to 15.5°C.

In practice, one generally uses the **large calorie** (Cal) or **kilocalorie** (kcal) = 1000 cal, defined as: the quantity of heat required to increase the temperature of the mass of one kg of distilled water at the normal atmospheric pressure at sea level by 1 degree - from 14.5 to 15.5°C.

In English speaking countries, the unit of measurement for heat in use is the **British Thermal Unit** (BTU):

1 BTU =0.252 kcal

Both the calorie and the BTU are units of measurement that are not permitted by the International System (SI), according to which the unit of measurement for the heat quantity is the **Joule** (J):

1 J = 0.000239 kcal = 0.000948 BTU

Other conversion formulas amongst the above mentioned units of measurement are:

- **1 cal** =4.186 J
- **1 kcal** = 4186 J = 4.186 kJ
- **1 kcal** = 3.968 BTU
- **1 BTU** =1,054.87 J

In refrigerating, air conditioning systems and in the cold industry in general, the commonly used unit of measurement is the **refrigeration unit**, defined as the quantity of heat removed equivalent to 1 kcal.

In English speaking countries, the unit of measurement for heat in use is the **ton of refrigeration** (which stands for the extraction of 288000 BTU/day). Hence the following equivalences:

1 ton = 12000 BTU/h = 3027 kcal/h = 12672 kj/h = 3.52 kw.

2.1.3.2 Temperature

The **temperature** of a body indicates the level of heat concentration it contains, given the weight (qualtity of matter) and the volume of the body itself.

The unit of measurement of temperature is the **degree**.

Since the temperature can be measured with reference to the different scales in use, the temperature interval corresponding to 1 degree differs in the various scales themselves.

The most common scales are **Celsius** and **Kelvin**.

The **Celsius scale** is obtained by dividing the interval between the temperature of melting ice (considered = 0) and that of boiling water (considered = 100) into one hundred equal parts (distilled water, atmospheric pressure at seal level). The symbol of the Celsius degree is **°C**. By convention, the absolute absence of heat is -273.16°C on the Celsius scale.

The **Kelvin scale** always considers the same reference points (melting ice and boiling water) and the same division (into 100 equal parts) of the relative temperature interval, but the zero mark corresponds to **absolute zero** (absence of heat): this is why the Kelvin scale is also called **absolute scale** of temperature. This scale includes the temperature of ice.

It thus gives the temperature of melting ice at 273.16 and the temperature of boiling water at 37316. In the Kelvin scale, the symbol for the degree is **K**.

The Fahrenheit scale is used in English speaking countries, where the temperature of ice is 32 and that of boiling water 212 and the absolute absence of heat is -459.67. The symbol of the Fahrenheit temperature degree is **°F**.

The figure shows a comparison between the different temperature scales: Fahrenheit (°F), Celsius (°C), Réaumur (°r), Kelvin (K) and Rankine (°R).

The table on the right gives the conversion formulas allowing users to switch from one unit of measurement to the other.

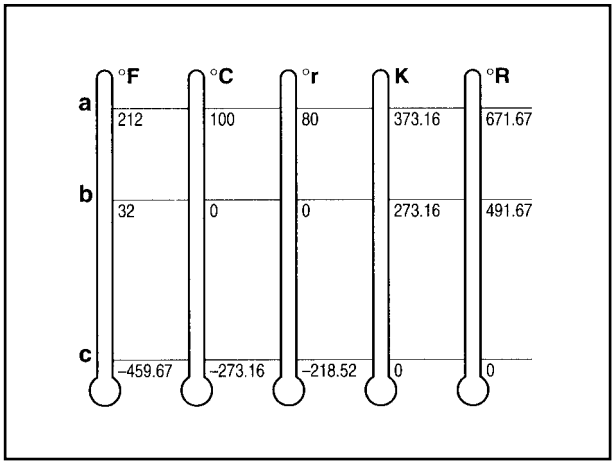


Fig. 13.4

a - Boiling point of water
b - Freezing point of water
c - Absolute zero

SCALES	CONVERSION TABLES
°F Ÿ °C	°C = (°F-32):1.8
°F Ÿ °C	°F = (°Cx1.8)+32
°F Ÿ K	K = (°F+459.67):1.8
°C Ÿ K	K = °C+273.16
°r Ÿ K	K = (°r x 1.25)+273.16
°R Ÿ K	K = °R:1.8
K Ÿ °F	°F = (Kx1.8)-459.67
KŸ °C	°C = K-273.16

2.1.3.3 Heat transmission properties and modes

The basic property is that, according to which, when there are two bodies at different temperatures, heat moves spontaneously from the higher temperature body (the warmer one) to that with a lower temperature (the cooler one); or, within a single body where the temperature is not uniform, heat moves spontaneously from the higher temperature parts to those at a lower temperature.

Heat transfer from a cooler body to a warmer one can only be carried out in a forced way, thus with a use of energy.

The quantity of heat that can be transmitted within a given time unit from a body at a higher temperature to one at a lower temperature is directly proportional to the temperature difference.

There are three basic methods according to which heat can be transmitted from one body to another of a different temperature:

- **Transmission by conduction**

  This occurs by contact between the two bodies without movement of matter (characteristic between solid bodies).
- **Transmission by convection**
  Occurs by movement of matter (typical in fluids).
- **Transmission by radiation**
  Occurs between different bodies, not in contact, by means of electromagnetic waves (particularly infrared rays) even if the space between the bodies themselves is completely empty (without matter).
  Typical and most important example in nature is the Earth, heated by the sun's rays.

2.1.4 Influence of heat on transformations of physical states in bodies (at constant pressure)

To make the general considerations given on this subject easier to understand and to justify their use in an air conditioning system, we are proposing a simple experiment for purely indicative purposes, which will allow certain physical phenomena to take place in a determined substance (e.g.: water) depending on the heat administered.

The experiment must be carried out at sea level and at normal atmospheric pressure (760 mmHg = 1 absolute Atm) using a vessel, a heat source (e.g.: a flame), a thermometer and 1 kg of distilled water.

2.1.4.1 Experiment

The experiment begins by placing water in a freezer to form ice, i.e. so that it solidifies. Now transfer the block of ice to the vessel, place the thermometer bulb in contact with the ice and place everything over the flame (Fig.13.6 a-b).

At the beginning of the experiment, the thermometer will indicate the temperature of ice as taken from the freezer, e.g.: - 10°C. As time goes by, you will note that the heat will cause the temperature of the ice to progressively rise to -9°C, -8°C, etc., until it reaches 0°C.

Drops of liquid will now begin to form on the surface of the ice (Fig.13.6 c): the ice has begun to melt and this process will continue (Fig.13.6 d) until the solid phase disappears and the water is all in the liquid state (Fig.13.6 e).

If you watch the thermometer, you will note that the temperature indicated will remain at 0°C all through the ice melting phase.

If you continue to administer heat, maintaining the thermometer bulb immersed in the water, you will note that the temperature progressively increases (Fig.13.6 f) until the following phenomena occur at the same time (Fig.13.6 g):

- the thermometer indicates 100°C
- turbulent movement occurs in the water, with separation of a great quantity of steam.

Boiling or water evaporation has begun. This phenomenon will continue for as long as a trace of water remains. During this period of time (from the beginning of evaporation to the end) and if the thermometer bulb is kept in continuous contact with the boiling liquid, the temperature indicated will have remained at 100°C. If the steam that forms is then collected in a suitable vessel (Fig.13.6 h) and heat continues to be administered, the liquid will completely disappear (Fig.13.6 i), after which the temperature of the steam will progressively increase above 100°C (Fig.13.6 l).

The graph represents the successive phases of the experiment.

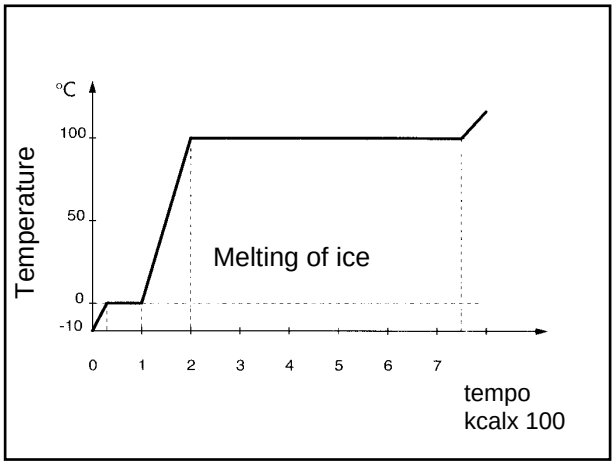


Fig. 13.5

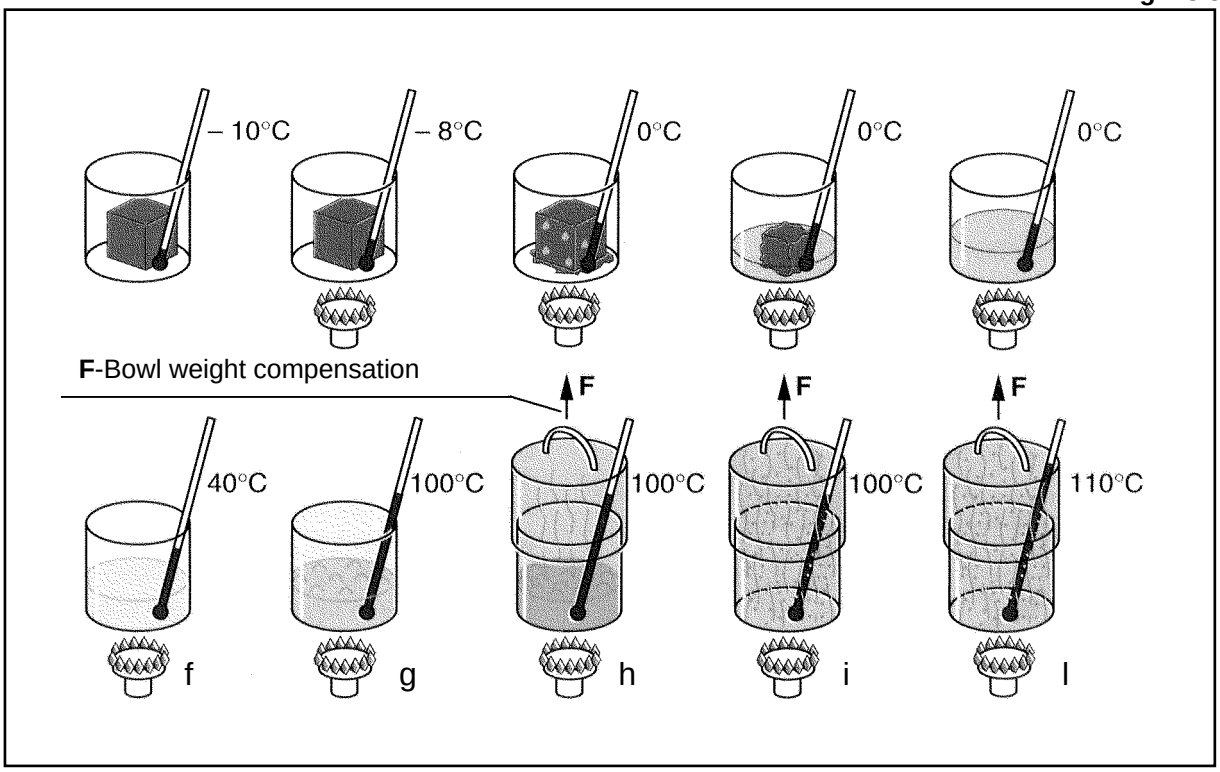


Fig. 13.6

Two changes in the physical state will have been observed during the experiment, by solely administering heat and keeping the pressure at a constant value:

- from solid (iced) to liquid **melting**
- from liquid to steam **evaporation**

You will have also noted that heat applied when there is one single phase (solid, liquid, steam) is shown by a temperature increase in the examined substance (water):

- from - 10°C to 0°C, for the solid state (ice)
- from - 0°C to 100°C, for the liquid state
- over 100°C for steam (water in a gaseous state).

The heat applied within these intervals and that determines the temperature variation, is called **sensitive heat**.

On the other hand, you will have noted that during changes in the physical state - melting and evaporation - the heat applied caused no variations to the temperature, which remained the same:

- at 0°C during the melting phase
- at 100°C during the evaporation phase.

The heat exchanged during these intervals is called **latent heat** – of melting and evaporation –, i.e. hidden, since there is no temperature variation.

Steam in the presence of liquid and at evaporation temperature is called **saturated steam**.

Steam that is no longer in the presence of liquid and with a higher temperature than that of evaporation is called **overheated steam**.

If the above described experiment is repeated beginning with overheated steam and subtracting heat, one obtains in succession: saturated steam at 100°C, liquid at 100°C, liquid at 0°C, solid (ice) at 0°C, solid at a temperature of less than 0°C (e.g.: –10°C).

The conversion of saturated steam into liquid water is called **condensation** and the quantity of heat removed is **latent condensation heat**.

The physical state transformations are schematized and outlined in the figure and the relative quantities of heat exchanged are schematized in (Fig.13.8.

If the described experiment is conducted using a constant source of heat and all the heat issued by this source is transferred to the substance in question, the quantity of heat exchanged will be proportional to the time elapsed. You will also note (Fig.13.6) that the quantity of heat absorbed by the substance itself as the physical state changes from liquid to saturated steam (latent heat) is much more than that absorbed during the heating phase from 0°C to 100°C (sensitive heat).

In this particular case, 1 kg of water: approx. 100 kcal (418.6 kj) are required to heat it from 0°C to 100°C while 540 kcal (2260 kl) are required to evaporate it.

Similar considerations can be made proceeding in reverse, i.e. when heat is subtracted.

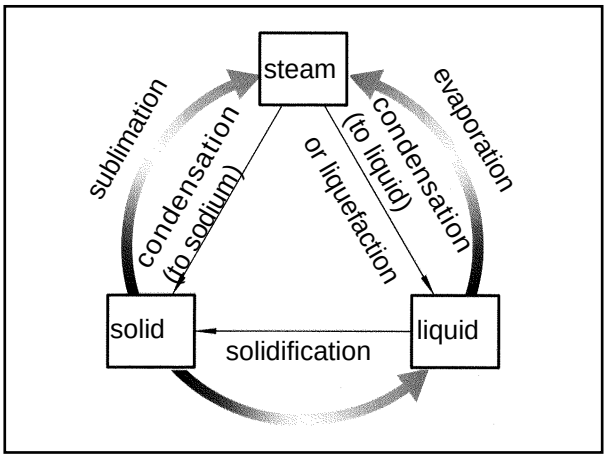


Fig. 13.7

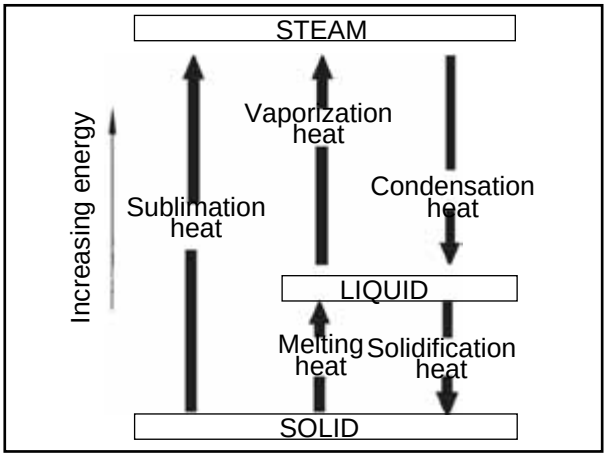


Fig. 13.8

2.1.4.2 Observations

In view of the above:

one can affirm that for a certain mass of substance, the quantity of heat required to change its physical state at a constant pressure is much more than that required to change the temperature from the end of one state to the beginning of the next (e.g.: from the end of melting to the beginning of evaporation or vice versa).

This important property of bodies is used to form the operating cycle of an air conditioner (cooling cycle).

Note: Solid substances that melt at a given temperature, called melting point, are those with a crystalline structure.

There are solid substances, i.e. with an amorphous structure (e.g.: glass, plastic) which, when heated, do not melt immediately but which are subjected to a gradual softening process and that become fluid within a more or less extensive temperature range.

2.1.5 Influence of pressure on transformations of physical state in bodies

As explained in the previous section, if a certain quantity of water is kept at a pressure **(p)** (constant) of 1 absolute bar, boiling occurs when the temperature (t) of the water itself reaches 100°C (Fig.13.9 a).

If a pressure is created in the vessel above the liquid, e.g. with a piston tight against the walls of the vessel, pushed with a force F (Fig.13.9 b) - at a pressure of more than 1 absolute atm, the water will boil at a temperature of more than 100°C.

Vice versa, if a pressure of less than 1 absolute atm (vacuum) is created in the vessel, e.g. by removing the piston (Fig.13.9 c) - the water will boil at a temperature of less than 100°C.

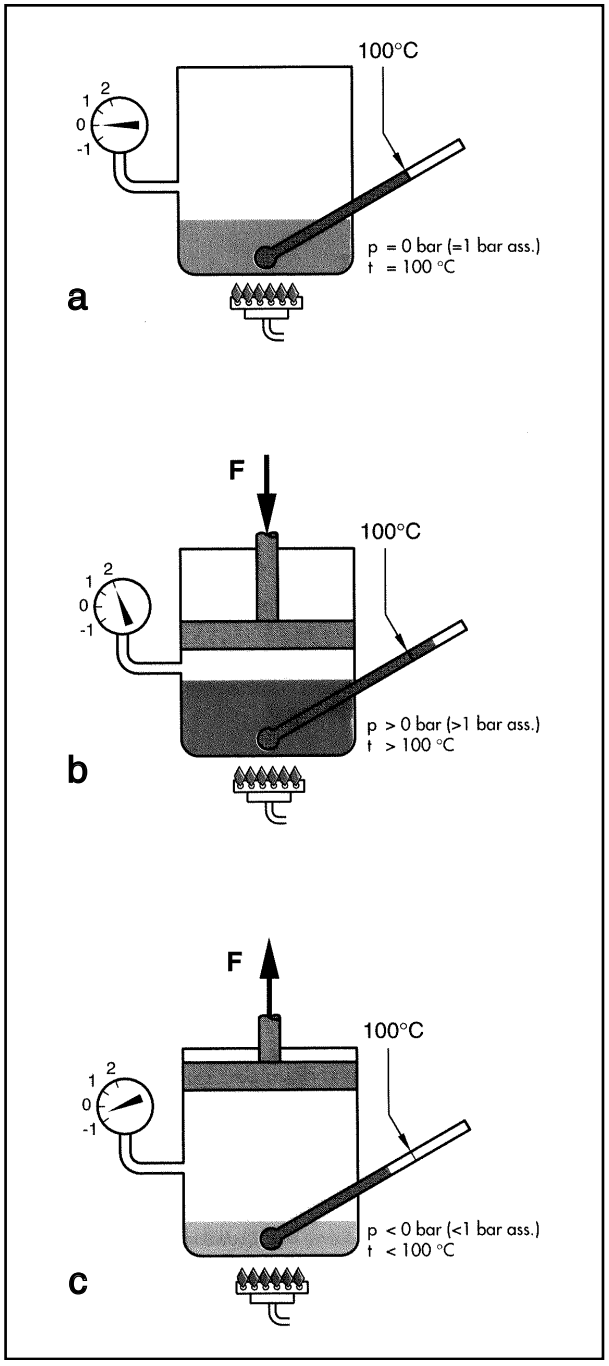


Fig. 13.9

By conducting a significant number of tests in various conditions, one can plot a graph (Fig.13.10) in which curve **(Z)** is formed by all the pressure/temperature conditions in correspondence to which the liquid state and the saturated steam state of water are balanced. Liquid changes into steam when heat is applied in correspondence to these combinations, while steam changes into liquid when heat is subtracted.

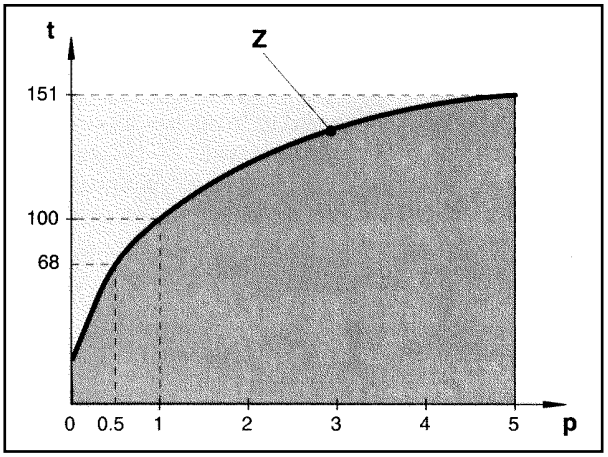


Fig. 13.10

p - absolute pressure (in bar)
t - temperature (in °C)

2.1.6 Relations between temperature, pressure and volume in aeriform substances

Certain laws established by Physics for ideal gases can be considered valid for aeriform fluids (gases and vapours) used in technics, although with the appropriate approximations.

These laws are summarized in the **Perfect gas status equation**:

PV = RT

Where **P** = pressure, **T** = absolute temperature, **V** = volume, **R** = universal constant.

This means that in practice, if one of the entities is varied at least one of the other two also varies.

The following relations should be considered when use is made in a cooling cycle:

- a reduction in volume (compression) determines an increase in pressure and temperature;
- an increase in volume (expansion) determines a reduction in pressure and temperature.

In particular, for a given mass of substance one has:

- **with constant temperature**
  - an increase in volume involves a decrease in pressure;
  - a decrease in volume involves an increase in pressure;
- **with constant pressure**
  - an increase in temperature involves an increase in volume;
  - a decrease in temperature involves a decrease in volume.
- **with constant volume**
  - an increase in temperature involves an increase in pressure;
  - a decrease in temperature involves a decrease in pressure.

2.1.7 Humidity

The**humidity**is the percentage ratio between the weight (or the volume) of the water in a body and the weight (or the volume) of the body itself.

In relation to atmospheric air, it is a mixture of dry air and water vapour, the rate of which is**atmospheric humidity**.

Two temperature values are used to define the atmospheric humidity rate:

- **dry bulb temperature (in °C):**
  measured with a common thermometer
- **wet bulb temperature (in °C):**
  measured with a thermometer whose bulb is covered with a gauze soaked in water and ventilated.

The wet bulb temperature is always lower than that of the dry bulb since the water used to soak the gauze tends to evaporate, cooling the bulb itself still further.

The following values can be determined using the two values indicated above:

- **Absolute humidity**, defined as the mass of the water vapour contained in the unit of volume of air: it is expressed in grams of vapour per cubic meter of air;
- **relative humidity**, defined as the percentage relation between the mass of water vapour effectively present in a certain volume of air and the amount that could be there in saturation conditions, with the same temperature and pressure.

100% relative humidity indicates saturation point.

When saturated air is cooled, the water vapour condenses and produces fog, rain and snow.

2.2 Operating principle of a cooling cycle

2.2.1 Description of a cooling cycle and air treatment

Let us now examine the basic layout and operating principle of the air conditioning system.

In the highly simplified layout shown in Fig.13.11, the system appears to consist of a closed circuit formed by the chain of four components: evaporator (1), compressor (2), condenser (3) and expansion valve (4) (all essential in a cooling cycle and arranged in their functional sequence), plus pipes (5) which connect the components together.

The essential function of the system, i.e. that of transferring heat from one place (passenger compartment) to another (the environment surrounding the vehicle) is achieved by subjecting a cooling fluid with which the system itself must be filled, to a thermodynamic cycle that includes pressure variations (by means of the compressor and expansion valve) and changes in physical state (by means of two heat exchangers: the evaporator and the condenser).

The notions of Physics mentioned in the previous chapter allow each phase in the cycle to be explained and justified. For the sake of convenience, we will also refer to another simplified layout of the circuit (Fig.13.13), similar to the one in Fig.13.11. Before continuing, for a clearer understanding of the previously mentioned pressure and temperature values (only for explanatory purposes and very approximate), we have included the **pressure/temperature diagram** of the **R134a**refrigerant currently used in air conditioning systems for agricultural tractors and vehicles (see Fig.13.12).

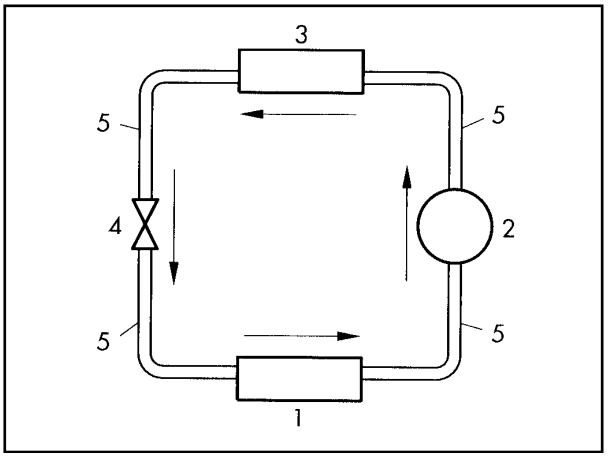


Fig. 13.11

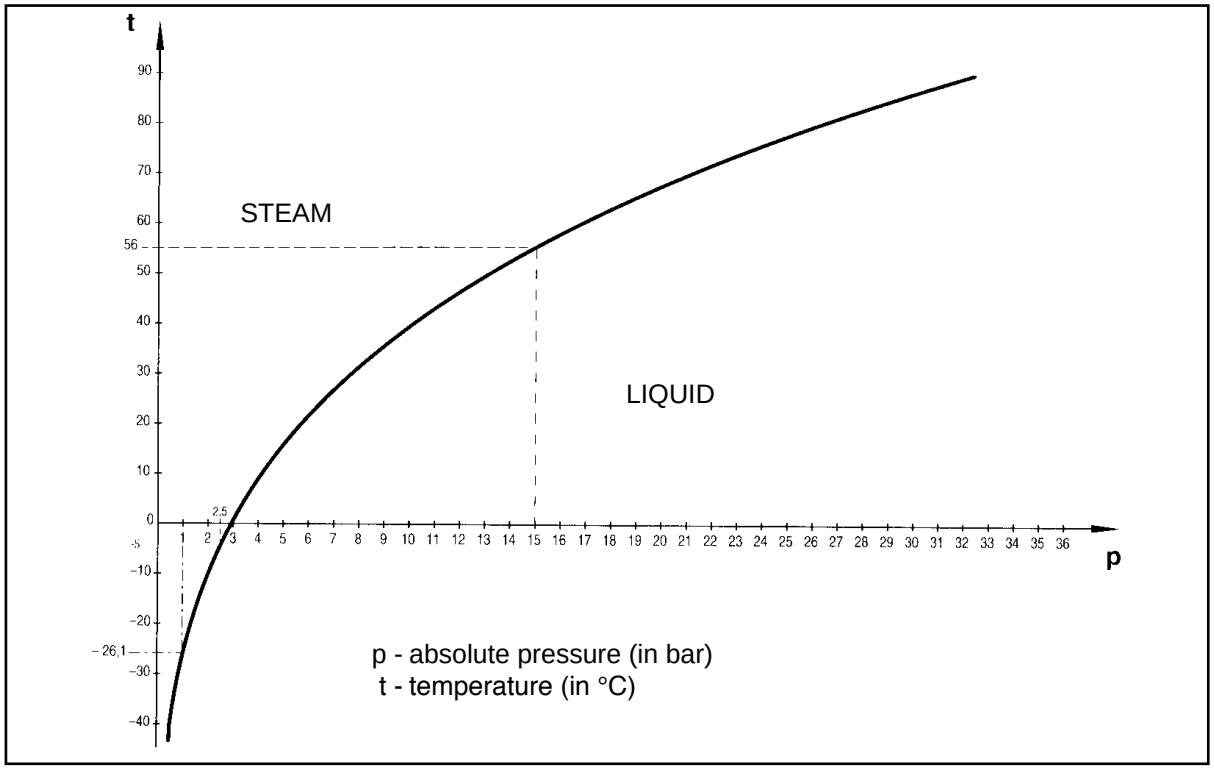


Fig. 13.12

By examining the previously mentioned diagram and while waiting to go more deeply into the subject in the next chapter, note that the boiling point of R134a is -26.1°C at a pressure of 1 abs.bar (atmospheric pressure above sea level.**R134a** has a boiling point of - 26.1°C, thus very low temperatures can be obtained by expanding it at low pressure. Vice versa, when compressed at relatively modest pressures, vapour can remain as such at fairly high temperatures (e.g.: p = 15 bar and t = 56 °C).

Another important characteristic for the particular use in question, is the high latent heat value of evaporation and condensation (e.g.: 51 kcal/kg at 1 abs.bar).

In short, this substance possesses characteristics that make it suitable for cooling circuits since both very low temperatures and relatively high temperatures can be obtained while working with modest pressure values that therefore allow fairly lightweight and not very bulky components to be used in the system.

To get back to the phases in the cycle, we will consider Sect. A (Fig.13.13) at the entrance to the evaporator as starting point. The**evaporator** is the component that removes heat from the cab. It is therefore positioned either in the actual cab itself or in close communication with it. To allow it to carry out its function, its temperature must be lower than that of the environment to cool so that heat can spontaneously flow from this (higher temperature) towards the evaporator itself. Let us suppose that the coolant in A is liquid at a pressure of 2.5 bar, thus at a temperature of about -5°C (Fig.13.12).

To cool the cab, it is necessary to:

- either “flush” it with cold air
- or remove the air it contains, cool it and then let it in again.

In the former case, air from the outside environment is allowed to flow towards the evaporator and is then forced into the cab, thus expelling the hotter air inside this.

In the latter case, the air in the cab must be made to recirculate through the evaporator.

Supposing that the air in the environment surrounding the vehicle or the air in the cab is at a temperature of 25°C.

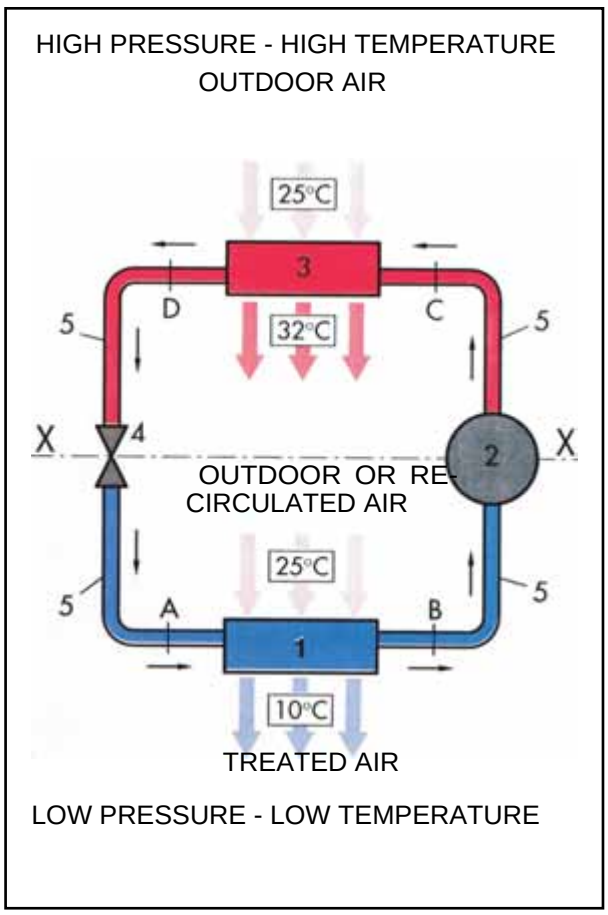


Fig. 13.13

Sect.A - **p**=2.5bar **t**=-5°C
Sect.B - **p**=2.5bart=-5°C
Sect.C - **p**=15bar **t**=56°C
Sect.D - **p**=15bar **t**=56°C

This air passes through the evaporator, the external walls of which are at a temperature of 1 to 3°C for example. By virtue of its higher temperature of 22 to 24°C, the air transfers part of the heat to the evaporator, thus lowering its temperature from the initial 25°C to 10°C, for example.

Thus treated, the air enters the cab and, mixing with the already existing air initially at 25°C, progressively lowers the temperature there.

Meanwhile, the coolant that had p = 2.5 bar and t = -5°C at the evaporator inlet, passes through this, absorbs the heat removed from the air and, at the same pressure, converts it from a liquid state to vapour, also maintaining the same temperature (latent heat).

The coolant will therefore have p = 2.5 bar and t = -5°C at the evaporator outlet (Sect.B), but will be vapour and charged with the quantity of heat yielded by the air.

If the cycle is to have continuity and since the circuit is sealed, the coolant, which is now in B, will flow through the remaining part of the circuit and returns to A in the initial conditions (p = 2.5 bar, t = -5°C).

To achieve this, the coolant itself must first be freed from the heat it absorbed as it passed through the evaporator and must then be brought to a low pressure and a low temperature.

The only way to dispose of the heat is to expell it into the surrounding environment where, however, the temperature is higher (25°C). The temperature of the coolant must therefore be raised from -5°C to a value higher than 25°C so that the heat can be apontaneously transferred from the coolant itself to the outside environment. This is carried out by the compressor.

The **compressor** possesses these functions: it intakes vapour at a low pressure and low temperature from the evaporator, compresses it and discharges it (Sect. C) at a high pressure and high temperature (e.g.: 15 bar –56 °C).

Refrigerant, in the form of vapour at high pressure and a high temperature (approximately the same values as Sect.C), enters the 2nd heat exchanger, the **condenser**, which discharges the heat accumulated by the refrigerant in the evaporator into the outside environment.

To achieve this as efficiently as possible, its pressure and, thus, its temperature are kept at constant levels, but the vapour is transformed into liquid, thus the transferred heat will be latent condensation heat.

Note: **By removing heat, the outside air that passes through the condenser is subjected to a temperature increase (e.g.: from 25 to 32°C), but then spreads around the surrounding environment without changing its conditions in an appreciable way.**

On leaving the condenser, in Sect.D, the coolant will be in a liquid state and without the previously collected heat. However, compared to the initial condition (Sect. A), it is still at a high pressure and temperature. To lower the pressure and temperature of the refrigerant, you need the **expansion valve**.

The main purpose of this component is to throttle the circuit, upstream of which the pressure and temperature are high. Downstream, since there is a space where it can expand, the coolant is subjected to a drastic pressure reduction (e.g.: from 15 to 2.5 bar) and, consequently, a temperature reduction (from 56°C to -5°C), remaining in the liquid state (even though atomized).

This forms the initial conditions again. The cycle can then be repeated in a continuous way for as long as the compressor operates.

Note: **All this shows that when operating, the system is partly hot and partly cold.**

The ideal separating line between the two parts is represented, in the diagram in Fig.13.13

, by straight line X-X, which cuts through the compressor and expansion valve.

Note that this is one of the basic elements to consider when evaluating whether the circuit is operating correctly or when identifying faults.

2.2.2 Notes and considerations

The described process has been extremely simplified. We have therefore added a certain number of notes that allow readers to understand how the notions of physics in the previous chapter have been used and have added considerations, at least in principle, about the differences between the described scheme and what actually happens in practice.

Heat exchanges

Heat exchanges amongst the various elements in question (air, components of the A/C system) and within the elements themselves, occur in the following way:

- from the air to the external walls of the evaporator (by convection)
- from the external walls to the internal walls of the evaporator and from these to the coolant (by conduction)
- from inside the coolant and when this is transferred from the evaporator to the condenser
- through the compressor (by convection)
- from the coolant to the internal walls of the condenser (by conduction)
- from internal walls to the external walls of the condenser (by conduction)
- from the external walls of the condenser to the air that passes through it and to the outside environment (by convection and by radiation).

Note: Heat exchanges between the internal parts of the system and the outside environment also occur through the walls of tubes and the filter, and this negatively influences the efficiency of the system although to a modest extent.

Practical notes

The pairs of temperature and pressure values chosen as examples for the sake of convenience, have been considered constants in each of the two parts (cold and hot) of the system and have been given with reference to the conditions of the coolant.

In practice, the following points must be taken into account:

a - there is a certain temperature difference between the internal and external surfaces of heat exchangers (e.g.: in the evaporator, internal temperature -5°C and external temperature +2°C; in the condenser, internal temperatrure +56°C and external temperature +50°C).

b - there is a difference in temperature between the coolant on the inlet and that leaving the exchangers established by the size of the system and how it is regulated in order to ensure that:

- the coolant that leaves the evaporator is completely in the state of vapour and that it reaches the compressor as such (the compressor is a pump that is only suitable for gaseous substances and not liquids).

  To achieve this, the **steam** must be slightly **overheated**, i.e. its temperature must be higher than that of saturated steam (e.g.: – 2°C instead of – 5°C);
- when leaving the condenser, the coolant is completely in a liquid state to optimize its efficiency. Thus its temperature, at the considered pressure, must be lower than that of condensation (e.g.: 52°C instead of 56°C, liquid being cooled);

c - further differences (a few degrees more for the cold part or a few degrees less for the hot part) should then be considered owing to the effect of the heat exchanges along the route leading from one exchanger to the next (see previous note);

d - the pressure of the coolant is lowered along its route due to friction, turbulence, etc. (load loss); further variations to a greater or lesser extent than those determined by the expansion valve and compressor, are due to the previously mentioned heat exchanges along the circuit beyond the exchangers;

e - the energy used to operate the compressor (normally drawn from the vehicle's engine), is converted into heat and is then yielded to the coolant from which it must be extracted along with that collected by the evaporator.

Given that the sequence of components in the system along the circuit remains unchanged, in practice, their positions in the vehicle will be influenced by the availability of space and by all the measures taken to optimize both functionality and safety.

One essential constant to prevent the efficiency from being impaired is that the **expansion valve must be positioned extremely near to the evaporator** (ir must practically form a single unit).

In the simplified diagram of Fig.13.14, the four essential main components (evaporator, compressor, condenser, expansion valve) are represented together with the coolant they contain, by way of principle, in order to form the thermodynamic cycle (cooling cycle).

In practice, another component, the **dehydrator filter** , is installed in series in the circuit (between the condenser and the expansion valve) and has important functions, but does not contribute towards the operation of the thermodynamic cycle itself.

2.3 Main components of an air conditioning system

2.3.1 Coolant or cooling fluid

This is the fluid used to fill the A/C system. It acts as a carrier of heat, transferring this from the point in which it is removed from the cab (or rather, from the air let into or re-circulated around the compartment) by means of the evaporator, to the point in which it is disposed of in the outside environment by means of the condenser.

Until a few years ago, a product bearing the code name **R12** with the chemical formula **CCI*2+F*2** (Dichlorodifluoromethane) was generally used (and is still marketed by various producers under different trademarks / denominations).

Since this product contains Chlorine (CI) in its molecule, it is part of the group of CFC substances most greatly responsible for the destruction of the Ozone layer (O*3) in the stratosphere and the consequent damage to the ecology of the earth followed with worried attention by the International Community. Right from the "Vienna Convention" of 1985 and the successive "Protocol of Montreal" in 1987, the objective has been to prohibit the above mentioned substances both by gradually reducing their use until their production completely ceases and, parallelly, by establishing regulations to govern the permitted uses.

Production has already stopped throughout Europe (in Italy, with law N° 549 of 28/12/93) and in the majority of all the other countries, while use of the product, governed by the above mentioned regulations, is now limited to the very small amounts oif the substance available on the market.

In view of the above, three alternative substances have been identified with suitable technical characteristics which do not, however, contain Chlorine and which therefore do not damage the Ozone in the stratosphere.

In particular,**R12** (CFC-12) has been substituted with a substance known by the code name of **R134a** (HFC - 134a) and with the chemical formula **CH*2+FCF*3+** (1, 1,2 – Tetrafluorothane).

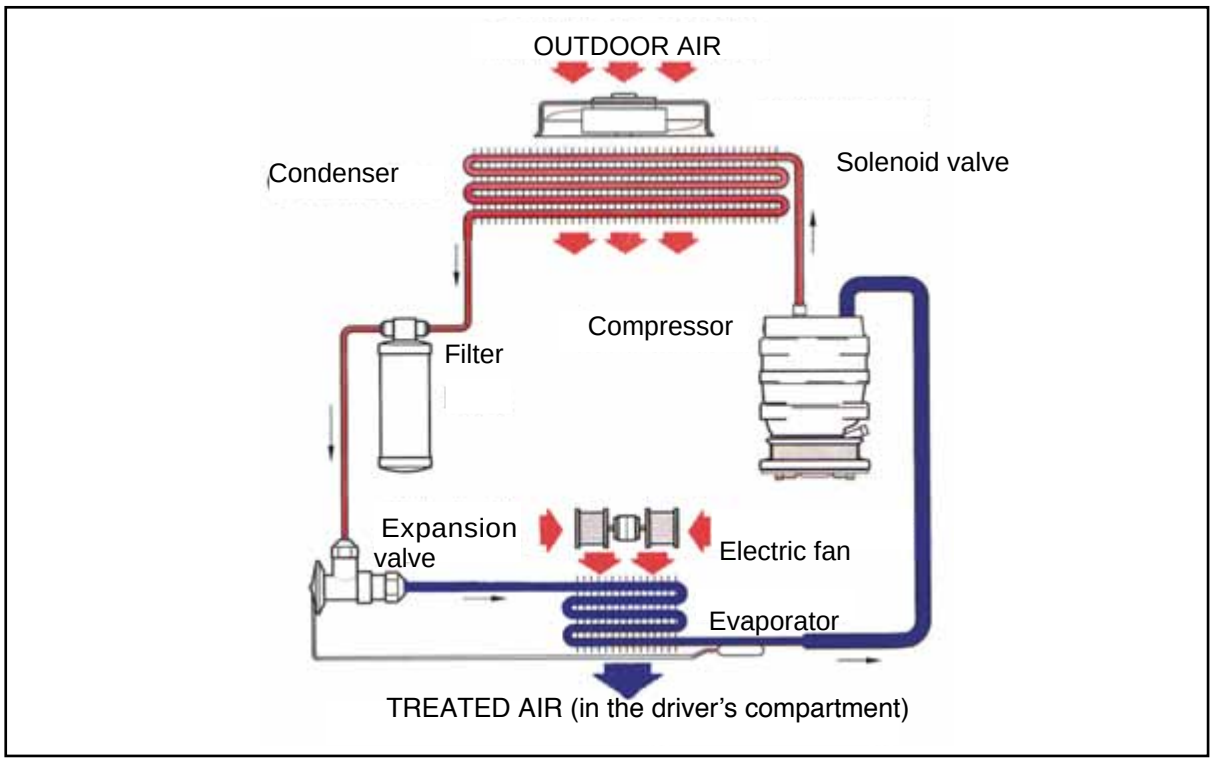


Fig. 13.14

- **High pressure liquid**
- **High pressure vapour**
- **Low pressure liquid**
- **Low pressure vapour**

The basic proiperties of these products that make them particularly suitable for use as coolants are:

- low boiling temperature, at atmospheric pressure at sea level (29.8°C for R12 and –26.1°C for R134a).

  This means that it is easy to make a cold body (evaporator) able to collect the heat from the hot air that hits it.
- high boiling temperatures in relation to even high ambient temperatures (30 to 35°C) in summer, with relatively low pressures (e.g.: 70°C with 18 and 21 bar, for R12 and R134a, respectively).
  This means that the heat can be disposed of into the outside environment by means of the condenser and without having to build an excessively strong system with a heavy weight and high cost.
- high vaporizing heat (latent) and condensation values in the various temperature and pressure conditions.

2.3.2 Evaporator

As was said in the previous chapter, the evaporator is that part of the A/C system that removes heat from the air let into the cab (the way the heat is exchanged has already been described).

Another very important function carried out by the evaporator and that has not been mentioned previously is that of dehumidifying the treated air.

This is done in the following way:

- in normal conditions, the air contains a certain quantity of watery vapour
- the vapour condenses as it comes into contact with the cold surfaces of the evaporator;
- water in the liquid state (condensation) is collected in a receptacle and is disposed of through the relative channels;
- the condensing heat of the humidity is yielded to the coolant through the walls of the evaporator as occurs for the heat removed from the air in order to lower the temperature.

In view of the above, the treated air leaving the evaporator and let into the cab contains a lower quantity of moisture besides being cooler.

2.3.3 Compressor (F13.15)

The compressor is the propelling part for the coolant in A/C systems.

Its functions are:

- to circulate the coolant around the circuit
- to raise the pressure and, thus, the temperature of the gaseous coolant from the evaporator at low pressure and low temperature.

Basically, to carry out these functions, they consist of:

- a container body (or casing) formed by a more or less large number of components and equipped with hangers to fix it to the vehicle;
- an internal mechanism to produce the pumping effect;
- a valve system to regulate coolant intake and delivery;
- fittings to connect the pipes;
- a pulley / clutch assembly (electro-clutch).
- a load of oil.

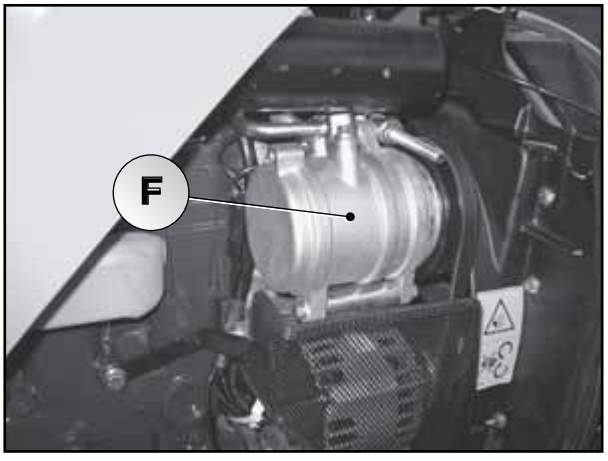


Fig. 13.15

2.3.4 Condenser (G13.16)

The condenser is the exchanger that removes the heat absorbed by the evaporator and that created by converting the energy used to operate the compressor from the coolant that circulates around the A/C or ECC system.

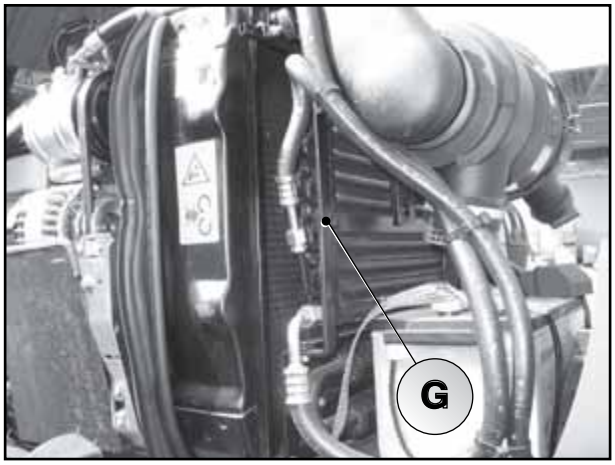


Fig. 13.16

2.3.5 Expansion or governor valve

The expansion valve in A/C systems carries out the following essential functions:

1 - it drastically reduces the pressure (and, thus, the temperature of the coolant fluid arriving from the condenser through the filter);

2 - it continuously regulates the coolant that flows to the evaporator so that it can completely evaporate and it passes through the evaporator in the various thermal load conditions. As it passes through the system, it also reaches a minimum degree of overheating that is sufficient to ensure it arrives in the compressor as vapour.

2.3.6 Filter or dehydrator (H13.17)

The filter is a component which, although being installed in series in the coolant flow within the A/C system, does not cause any type of thermodynamic effect and therefore does not influence the changes of state to which the coolant is subjected or the heat exchanges.

However, its functions are equally many and of considerable importance, as explained further on.

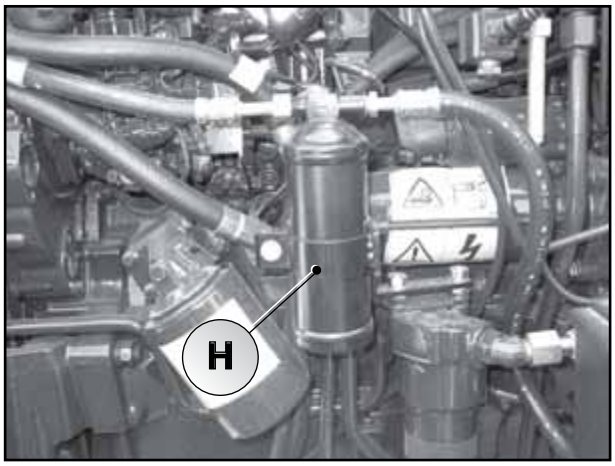


Fig. 13.17

Section 3 : Technical specifications

Index

3.1 Main technical specifications.....13-24

3.1 Main technical specifications

Manufacturer	Dvx
Minimum safety pressure	2 bar
Maximum safety pressure	25 bar
Coolant fluid	R134a
Quantity of coolant gas	1300 kg
Total quantity of antifreeze oil (when filled for the first time)	0.240 cc

Section 4 : Air conditioning system (AC)

Index

4.1 Main components 13-26

4.2 Operating instructions 13-27

4.1 Main components

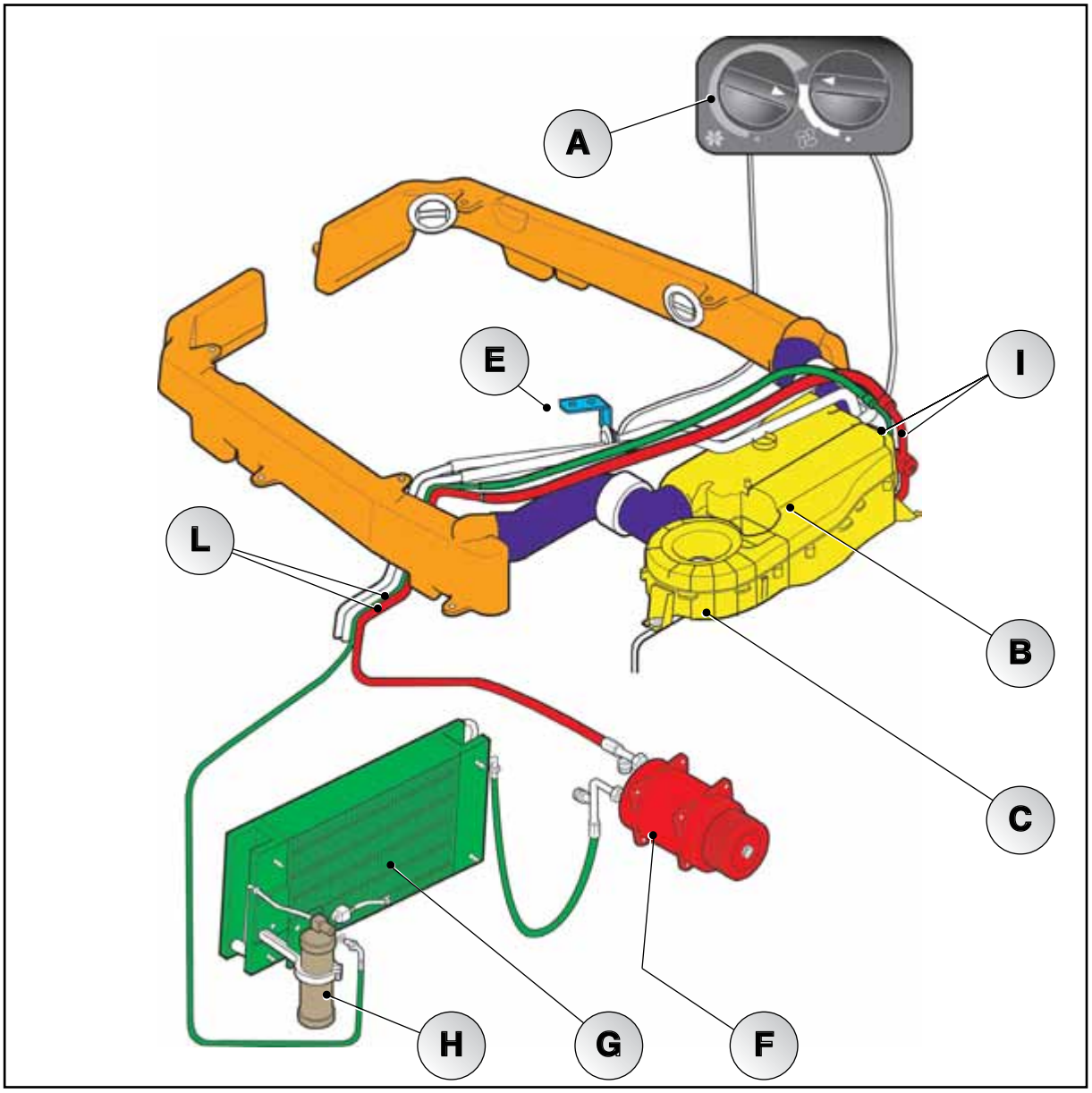


Fig. 13.18

A - Control panel
B - Evaporator
C - Fan unit
E - Heater tap
F - Compressor
G - Condenser
H - Filter or dehydrator
I - Air conditioning pipes
L - Heating pipes

4.2 Operating instructions

- Make sure that all the doors and windows are closed, then press the air conditioner button (12);
- With the engine running, turn the temperature adjuster knob (42) fully clockwise to obtain a maximum initial cooling effect;
- Turn the fan control knob (41) fully clockwise for a quick cooling action, opening the air vents. Reduce the fan speed once the required temperature has been obtained;
- Regulate the temperature with the knob (4213.19);

  Note: if the air conditioning system is operated at a low temperature for a long time, ice may form on the evaporator. If this happens, or if the automatic control mechanism cuts out the system, adjust the temperature control to increase the temperature setting. If the problem persists, increase the fan speed.

- Adjust the fan speed to maintain comfortable operating conditions. Bear in mind that low fan speeds give cooler, if slower air.

  Note: clean the cab filter at the prescribed intervals and fit special filters when using chemical products.

- If the red light (40) that indicates faulty air conditioner operation comes on, turn off the system and have it checked by a specialized technician.

⚠	**Attention:** if the tractor is to remain unused for a long period of time, or if the system is not used, remember to allow the air conditioner to operate for about 15 minutes each week. This precautionary measure prevents gas from leaking from the compressor.

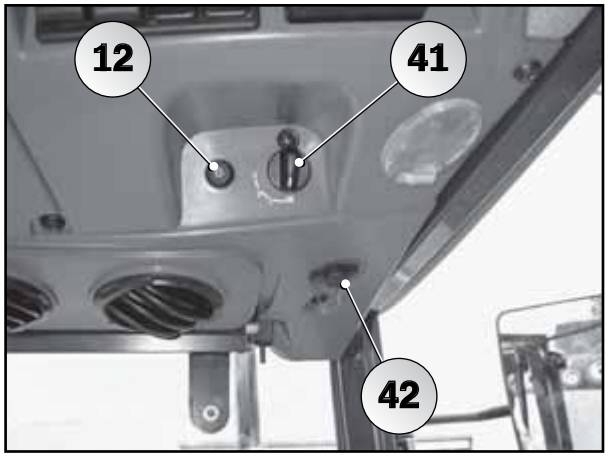


Fig. 13.19

41 - Fan speed switch
42 - Temperature control knob

Section 5 : How to empty and recharge the system

Index

5.1 Safety notes 13-30

5.2 Maintenance instructions 13-31

5.3 Recharging procedure 13-32

5.3.1 Introduction 13-32
5.3.2 Basic equipment 13-32
5.3.3 Procedure 13-33

5.1 Safety notes

When coolants are handled, it is always necessary to comply with the following safety rules to safeguard the health.

	Attention: Always wear protective goggles and gloves when handling coolant. If coolant splashes into the eyes it can damage the sight and cause blindness.
	Attention: Do not allow the coolant to splash on to the skin. Coolant has a very low boiling temperature which can lead to freezing (approx. –26°C for R134a and approx. –30°C for R12, at atmospheric pressure at sea level).
	Attention: The equipment for treating the coolant must be used in adequately ventilated places, with at least four air changes per hour. Do not inhale coolant vapours for lengthy periods of time. It can be dangerous and even lethal.
	Attention: Do not use equipment for treating coolant near open containers holding inflammable substances or with leaks.
	Attention: Do not tamper with or modify the settings of the breather and safety valves in the containers and equipment for treating coolant.
	Attention: Do not fill any vessel (cylinder, A/C charging equipment) with coolant unless it has not been approved for the purpose and equipped with a relative safety valve.
	Attention: Do not fill any storage vessel beyond 80% of its capacity.
	Attention: Take the utmost care when disconnecting service pipessince they may contain pressurized coolant.

5.2 Maintenance instructions

Before setting the air conditioning system at work, make sure that the doors and windows of the vehicle are securely shut. Keep the cab interior as clean as possible. If the cab cannot be completely closed for any reason, it is essential to shut off the air re-circulation system. Failure to comply with these instructions can lead to the evaporator becoming clogged (B). This would consequently stop the air conditioning system and could damage the compressor (F).

a - Clean the cab air filter every 100 hours or more frequently if necessary.

b - Replace the cab air filter every 1000 hours or once a year.

c - Replace the carbon air filters every 250 hours service with chemical products. Activated carbon filters cannot be repaired.

d - To ensure the system operates in the correct way, periodically check the filter installed at the rear of the cab, the condenser (G), the fan blades (C) and the evaporator (B). Built up dirt can lead to an increase in the high and low pressure values and impair the efficiency of the cooling system. It is advisable to check the tension and alignment of the transmission belt.

e - Check the conditions of the pipes that drain off the cooling water leading from the evaporator (B). Water accumulated in the drip tray can freeze the evaporator and prevent the coolant from circulating, thus reducing the efficiency of the system.

f - Have the system checked once a year, at the beginning of summer.

g - To keep the system in order, remember to operate the A/C system for a few minutes a week in order to keep all the components lubricated.

h - Periodically check the tension of the compressor belt (F) in the middle of its longest side. It must give 15 mm.
To adjust the belt tension, loosen the fixing screws and check nuts on the belt idler under the bearing plate and move the compressor until the correct tension has been obtained. Now tighten all the screws and check nuts.

5.3 Recharging procedure

5.3.1 Introduction

An A/C system can be installed in a vehicle at its origin, when it is being assembled during the production phase, or it can be installed at a later date in a finished vehicle ready for delivery to the Purchaser or even in a tractor that has already been operating for some time.

In any case, once it has been completely and correctly installed, an A/C system must be adequately filled with coolant fluid. The following paragraphs therefore describe:

- the **equipment** required for **charging** (filling with coolant);
- the **relative** procedures;
- i **tests** to verify the performances of the installed system.

5.3.2 Basic equipment

The basic equipment required to charge an A/C system consists of:

- a **pump** to create the **vacuum**;
- a **dosing cylinder** or a **scale**for measuring the quantity (in weight) of coolant required;
- a **pair of pressure gauges**;
- a **vacuometer**;
- a **set of cocks**to handle the connections of the various above listed components to the A/C system and to the coolant reserve tank (bottle);
- the **service pipes**with relative **unions**for connecting the service valves to the system and to the bottle.

The above listed parts are normally assembled in relative casings to form a single component, allowing all the charging procedures to be carried out.

Remember that, according to the current laws in force in Italy, in Europe and in the majority of other countries, coolant can no longer be disposed of in the environment and that it is therefore obligatory to collect all the coolant emptied from a system in a suitable vessel.

It is consequently essential to be in possession of the adequate equipment when these operations are carried out.

The Dvx station for recovering, preparing and charging the coolant in versions for **R 12** and **R 134a** and the “refmaticplus” (Fig.26-12) which, besides the specific components for the previously mentioned charging operations, also has:

- a **hermetic compressor**, which intakes the coolant when the A/C system is emptied and allows it to re-circulate through a special internal mechanism in order to prepare it, lastly depositing it in the reservoir for future use;
- a **filter** to retain the solid particles, the humidity and polluting acids in the recovered coolant;
- a **distiller** to separate the oil;
- a **condensing apparatus** to separate the incondensable gases, with relative automatic or manual expelling device;
- an **electronic scale** for weighing the coolant;
- a **microprocessor**, plus keypad and display, to automatically handle the various functions.

5.3.3 Procedure

This procedure includes the following phases:

- emptying the air from the system;
- dehydration;
- vacuum tightness test;
- filling with coolant;
- activation of the system and performance tests.

5.3.3.1 Emptying the air from the system

The air must be eliminated from the system:

- to leave all the space inside for the coolant;
- to prevent the air and the moisture it contains (even in tiny quantities) from polluting the coolant and altering its thermodynamic characteristics.

The coolant is emptied out by means of the vacuum pump which is connected, through the service pipes of the charging plant, to the HP and LP service valves of the A/C system and with the vehicle engine off.

This operation takes a very short time and during it, the pointers of the HP and LP pressure gauges move from 0 to positions near to -1.

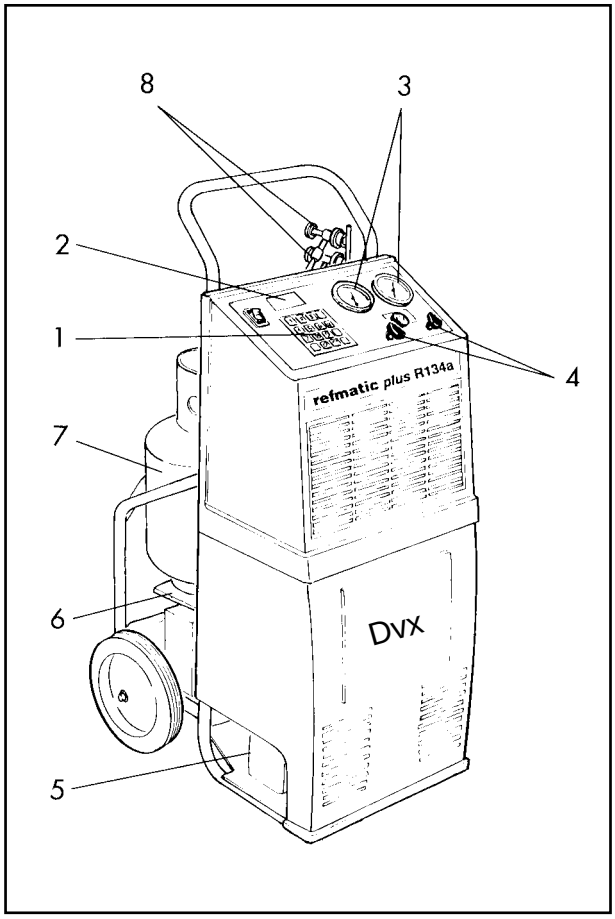


Fig. 13.20

1 - Keypad
2 - Display
3 - Pressure gauges
4 - Taps
5 - Vacuum pump
6 - Scale
7 - Container
8 - Quick couplings for the service pipes

5.3.3.2 Dehydration

This follows the previous operation. The vacuum pump continues to operate and the pressure, indicated by the pressure gauges, remains near to -1.

The recommended length of this operation is 40 to 45 minutes and more, if the system is very large. In this way, humidity that is not discharged with the air but which has remained, in the liquid state, in the system (in the pores and recesses of the internal walls, especially in flexible hoses, dissolved in the compressor oil, absorbed by the filter, etc.) can be released as vapour and, as such, removed by means of the vacuum pump.

Note: Remember that the boiling point of water depends on the pressure.

Since the temperatures in a system when the charge is being prepared are practically the same as those of the environment (workshop) in which the work is carried out, they can also be very low (e.g.: 10 to 15°C) particularly in winter. The only way to evaporate the internal humidity is to lower the pressure. This is done by working with the vacuum pump.

The considerable length of this operation is also required to allow the vapour, escaping from the most distant parts of the system, to reach the service valves and to then be extracted.

Humidity must be eliminated from the system to prevent:

- the formation of corrosive acids caused by a chemical reaction with the coolant fluid and oil, which would consequently damage the components;
- the formation of ice around the expansion valve, which would clog the calibrated hole and block the system.

5.3.3.3 Vacuum tightness test

Before beginning to charge with coolant, make sure that the system is perfectly tight. To do this, at the end of the dehydration phase, shut off the tap that sets the A/C system in communication with the vacuum pump, stop this latter and open the connection between the system and the vacuometer.

The pointer of the vacuometer will set near to the -1 position. Note down this position (vacuometers often have a movable pointer. If the pointer itself has not appreciably moved after 10 minutes, the system can be considered perfectly tight). Now shut the vacuometer tap and proceed with the charging operation.

Vice versa, if the pointer of the vacuometer moves towards 0 during the above mentioned period of time, it means that the system is not tight and that, if it were to be charged in those conditions, it would very quickly lose its charge and, thus, its efficiency. In this case, identify the leak point or points, repair and repeat the procedure from the start.

5.3.3.4 Filling with coolant

The quantity (in weight) of coolant required to operate the A/C system in an optimum way is determined by the Manufacturer and indicated in the relative operation and maintenance manual.

If this value is not available for some reason, it can be determined in an empiric way by gradually charging with coolant until optimum pressure values are obtained.

Given, therefore, that the weight required for charging is known, this quantity must be measured exactly.

This can be done in two ways, depending on the available apparatus:

- by the difference between the two weight values of the coolant holder at the beginning and at the end of the charge, if a **high precision scale** (electronic) is available, as in Dvx “refmatic” stations for example.
- In an indirect way, depending on its pressure (temperature) and volume, with the traditional **dosing cylinder** (as in the Dvx “fill station”), again through the difference in initial and final weight.

The coolant can be added:

In the liquid phase

When the pressure in the container or dosing cylinder is sufficiently high (8 to 10 bar), to allow the required quantity of coolant to be completely transferred with the sold aid of the difference in pressure between the container and the A/C system.

As the pressure inside a container of coolant (not in the presence or in contact with heat sources) is that corresponding to the temperature of the ambient in which it is to be found (e.g.: 5.7 bar at 20°C), the same pressure is also created in the A/C system by simply connecting one to the other.

Consequently, charging the liquid phase would not be completed owing to pressure balancing

To sufficiently raise the pressure in the container, the coolant is heated before it is transferred to the A/C system:

- with the resistance applied to the dosing cylinder (e.g.: in the “fill station”);
- with the compressor in the plant (e.g.: in “refmatic”).

Note: Recharging in the liquid phase can only be done by adding the coolant in the plant section after the compressor, through the high pressure valve.

If coolant were to be added prior to the compressor, it would damage this when the plant was activated.

In the vapour phase

If the container is connected to the low pressure service valve, the engine can be started and coolant drawn by the compressor in the pure vapour state. This is obtained by means of adequate throttles created with the plant taps installed along the route the coolant takes from the container to the system.

In a mixed phase

By first transferring liquid until the pressures are balanced and then vapour, with the aid of suction from the compressor.

In this case, it will be necessary to work with the plant taps so that liquid is transferred after the compressor and vapour prior to it.

5.3.3.5 Activation of the system and performance tests

Having completed the charging procedure and keeping the plant connected, activate the system and check its performances in the following way:

- start the engine and regulate the charging rate (1500 to 1800 RPM);
- select the A/C plant controls to obtain maximum cooling, i.e. the thermostat (when accessible) must be set to max position and the fan to minimum speed;
- open the doors of the vehicle;
- allow the system to operate in these conditions for about 10 minutes;
- shut the doors and windows;
- check the pressure values indicated on the HP and LP gauges;
- check the temperature of the place in which the work is being carried out with the thermometer.

Taking the ambient temperature as a reference, the pressure values that indicate correct plant operation are within the ranges given in Table 1.

R134a				
Ambient temperature (°C)	Pressure gauge (HP)(kg/cm²)		Pressure gauge (LP)(kg/cm²)	
	min	max	min	max
15,5	9,5	13	0,5	1
21,0	12	17,5	0,5	1
26,5	14	20,5	0,5	1
32,0	16	24	0,5	1
38,0	18,5	25,5	0,5	2
43,0	22	28	0,5	2,3
Table 1				

To correctly interpret the values shown on the pressure gauges, also remember that the pressures themselves are influenced by the atmospheric pressure which, apart from the differences bound to the climatic conditions, gradually decreases as the altitude increases.

To take these pressure variations into account, subtract the correction data of Table 2 from the values read on the pressure gauges.

Pressure variations depending on altitude		
Altitude (m above sea level)	Absolute atmospheric pressure (kg/cm²)	Correction (kg/cm²)
0	1,029	0
300	0,994	-0,035
600	0,959	-0,070
900	0,924	-0,105
1200	0,889	-0,140
1500	0,854	-0,175
1800	0,815	-0,210
2100	0,791	-0,238
2400	0,763	-0,266
Table 2		

Section 6 : Functionality tests

Index

6.1 Specific equipment.....13-38

6.2 How to check the efficiency of the A/C system.....13-39

6.1 Specific equipment

Use the following equipment to test plant operation and identify any faults:

- Plant to recover, prepare and charge coolant (Fig.13.21).
- Thermometer and hygrometer (Fig.13.22).
- Coolant leak detectors (Fig.13.23).
- Protective goggles and gloves (Fig.13.24).

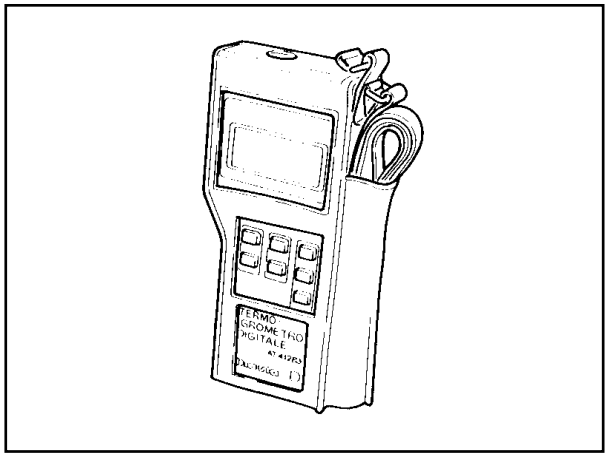


Fig. 13.22

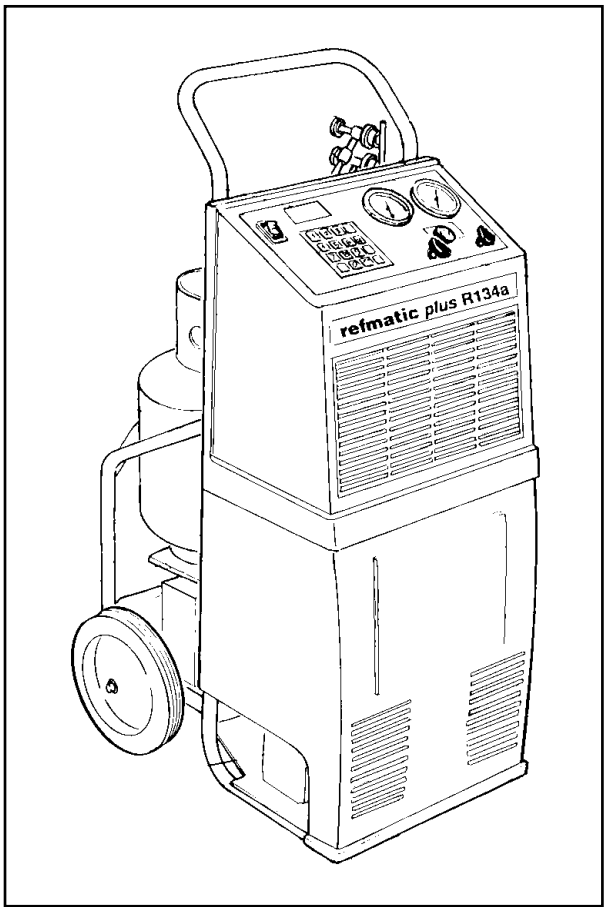


Fig. 13.21

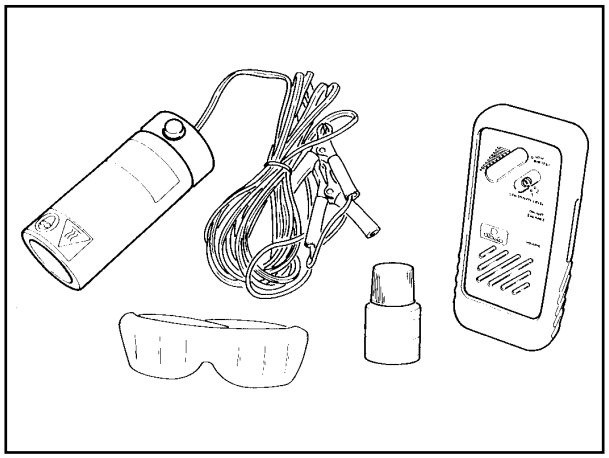


Fig. 13.23

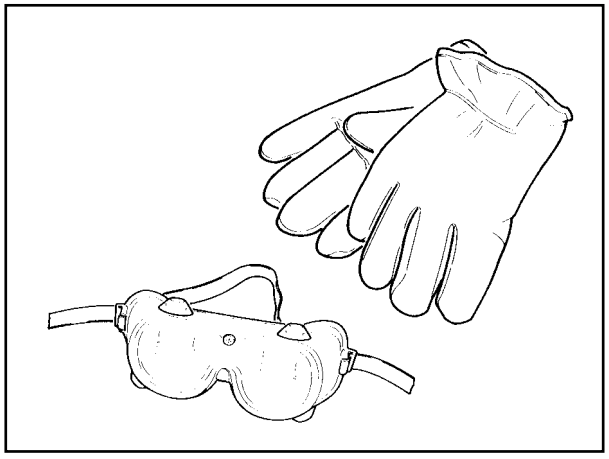


Fig. 13.24

6.2 How to check the efficiency of the A/C system

1 - Set the AC temperature regulator knob to the coldest position;

2 - start the tractor engine and bring it to 1500/1800 RPM;

3 - start the A/C system;

4 - select an intermediate speed for internal ventilation;

5 - check the outdoor and ambient temperatures with a thermometer;

6 - activate the cab air re-circulation system if the outdoor temperature exceeds 28°C;

7 - if the inside temperature exceeds the outdoor one, open the doors, wait for the internal temperature to stabilize to the value of the outdoor one, then shut the doors and allow the AC system to operate for 5-10 minutes. Allow the AC system to operate for 5-10 minutes if the inside temperature is lower than the outdoor one;

8 - measure the temperature by setting the thermometer near to the cold air vents and make sure that the average value is within those indicated in table 3.

If the measured temperature is not within the given value range and if the system is too noisy or issues unpleasant odours, contact a specialized center and have the fault identified and resolved.

Temperature table				
Temp. outside the vehicle (°C)	20°	25°	30°	35°
Temp. of air from central vents (°C) (average value)	6°-8°	8°-10°	8°-12°	9°-14°

Table 3

Chapter 14 : Special tools

Index

Section 1 : 01 FRI MYT 14-3

Section 2 : 01 FRI REX 14-4

Section 3 : 141 DS LG 14-5

Section 4 : 143 DS LG 14-6

Section 5 : 01 DS REX 14-7

Section 6 : 02 DS REX a 14-8

Section 7 : 02 DS REX b 14-9

Section 8 : 01 CMB MYT a 14-10

Section 9 : 01 CMB MYT b 14-11

Section 10 : 01 CMB MYT c 14-12

Section 11 : 01 CMB MYT d 14-13

Section 12 : 01 CMB REX 14-14

Section 13 : 02 CMB REX 14-15

Section 14 : 03 CMB REX 14-16

Section 15 : 01 DIF MYT 14-17

Section 16 : 02 PTO MYT 14-18

Section 17 : 01 PTO REX a 14-19

Section 18 : 01 PTO REX b 14-20

Section 19 : 01 PTO REX c 14-21

Section 20 : 01 PTO REX d 14-22

Section 21 : 02 DT MYTa 14-23

Section 22 : 02 DT MYT b 14-24

Section 23 : 02 DT MYT c 14-25

Section 24 : 01 DT REX a 14-26

Section 25 : 01 DT REX b 14-27

Section 26 : 02 DT REX 14-28

Section 27 : 04 DT REX 14-29

Section 28 : 122 IDR GL 14-30

Section 29 : 125 IDR GL 14-31

Section 30 : 26 POT VS 14-32

Section 31 : 02 IDR MYT 14-33

Section 32 : 03 IDR MYT 14-34

Section 33 : 05 IDR MYT 14-35

Section 34 : 01 IDR REX 14-36

Section 35 : 02 IDR REX 14-37

Section 36 : 03 IDR REX 14-38

Section 37 : 05 IDR REX 14-39

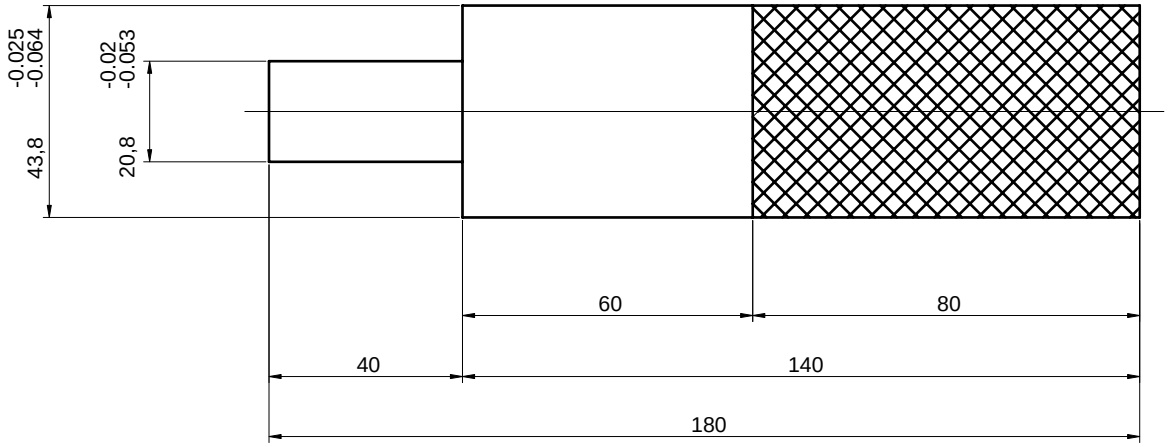
Section 38 : CR 342 a 14-40

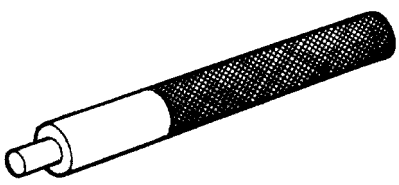
Section 39 : CR 342 b 14-41

Section 40 : CR 347 14-42

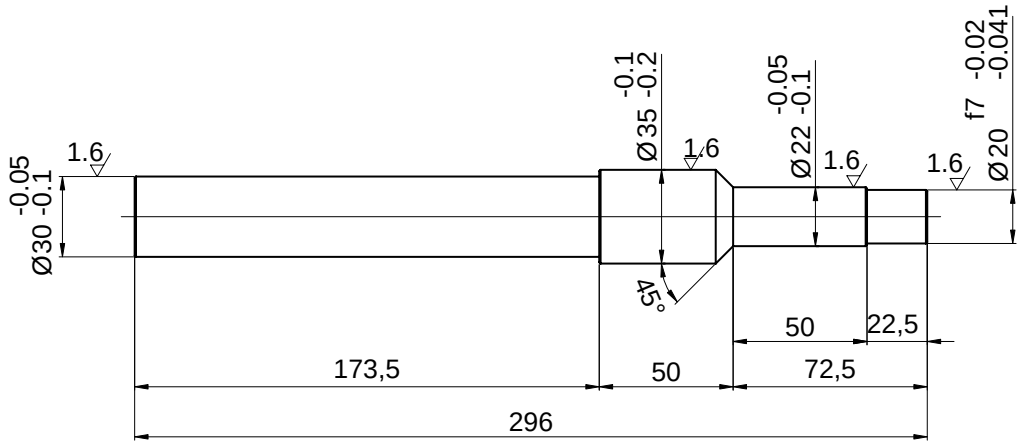
Section 41 : R 504 14-43

Section 1 : 01 FRI MYT

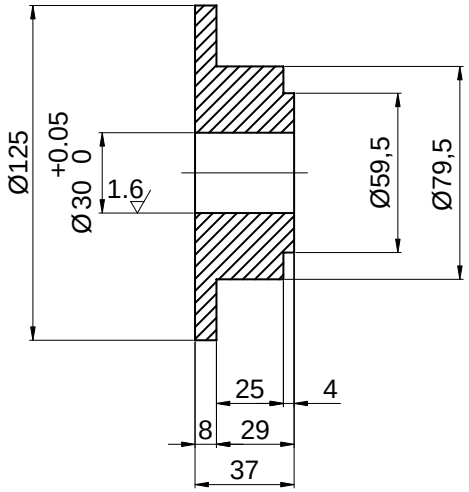


01 FRIMYT	Clutch plate centering pin	
Quantity : 1	Material : Anticorodal aluminium UNI 3571	
Notes :		

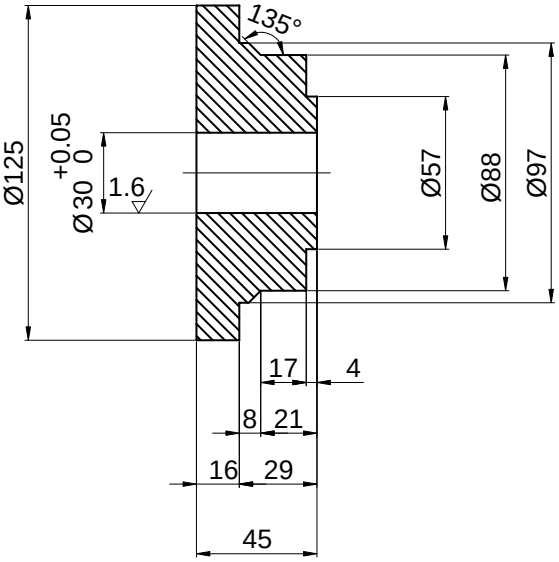
Section 2 : 01 FRI REX



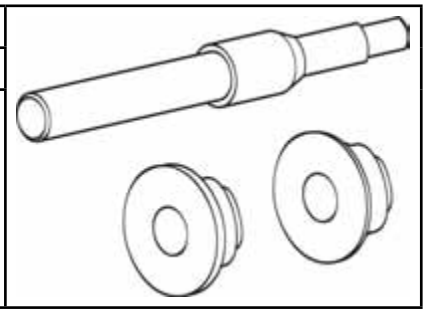
12"



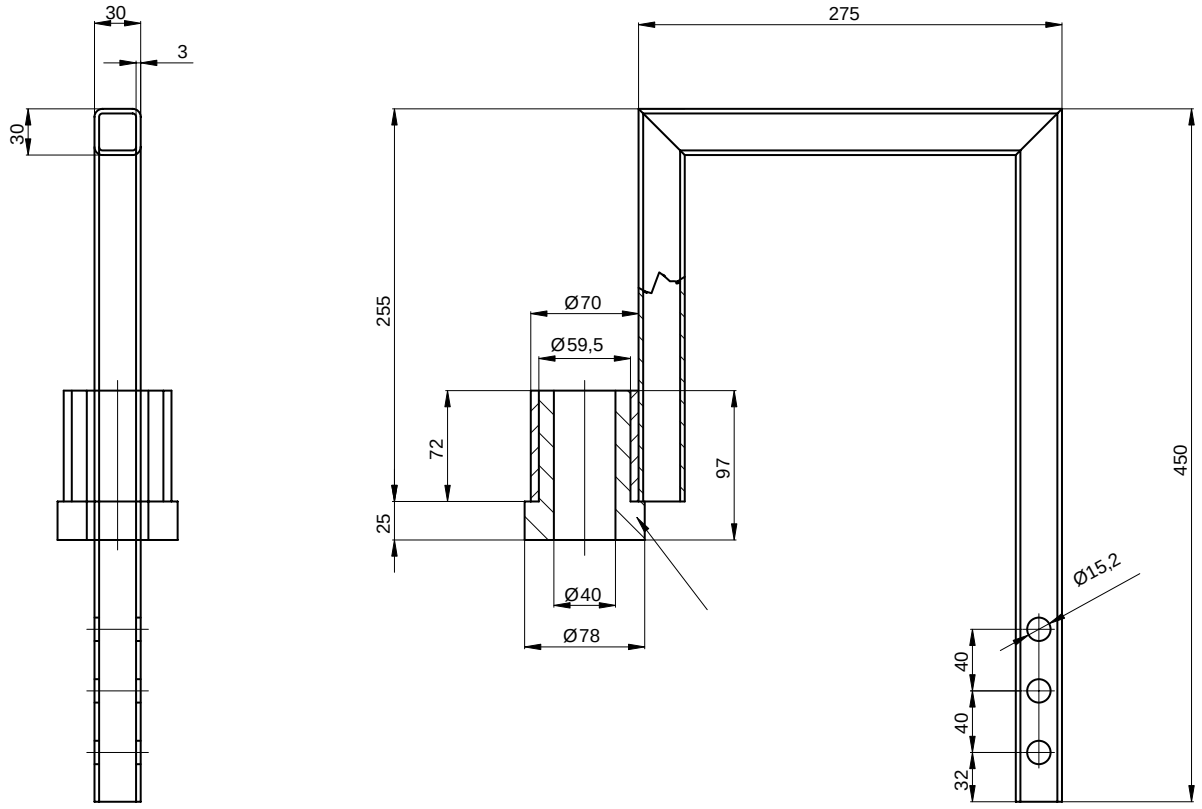
11"

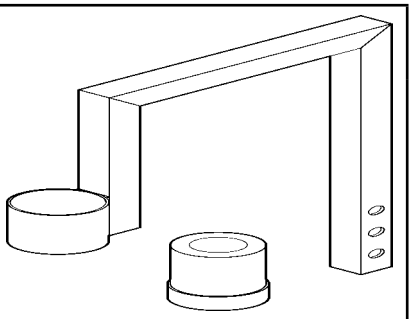


01 FRI REX	Clutch plate centering pin and lever height check
Quantity : 1	Material : Anticorodal aluminium UNI 3571
Notes :	

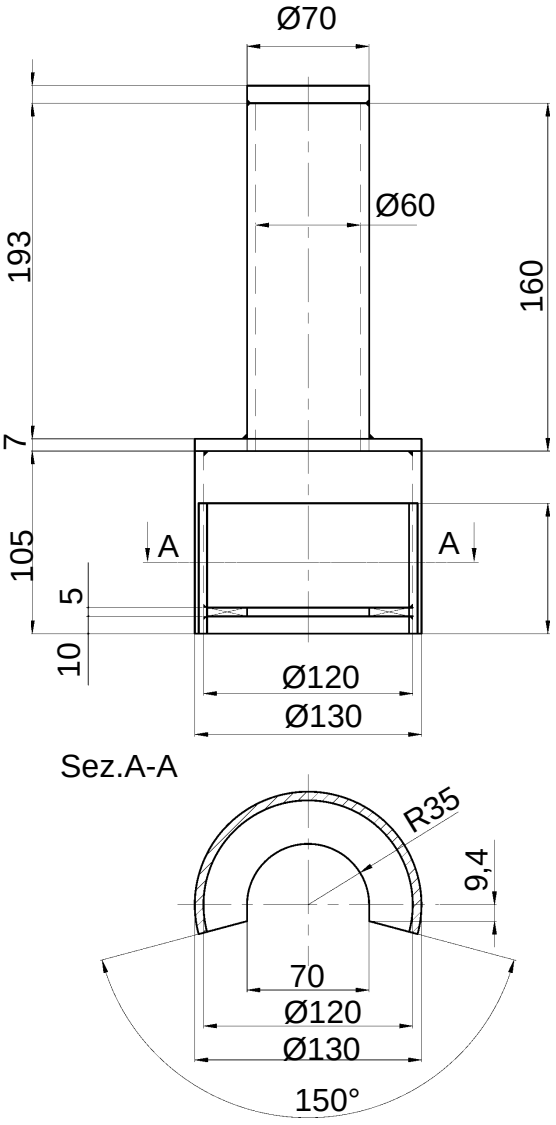


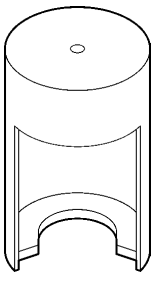
Section 3 : 141 DS LG



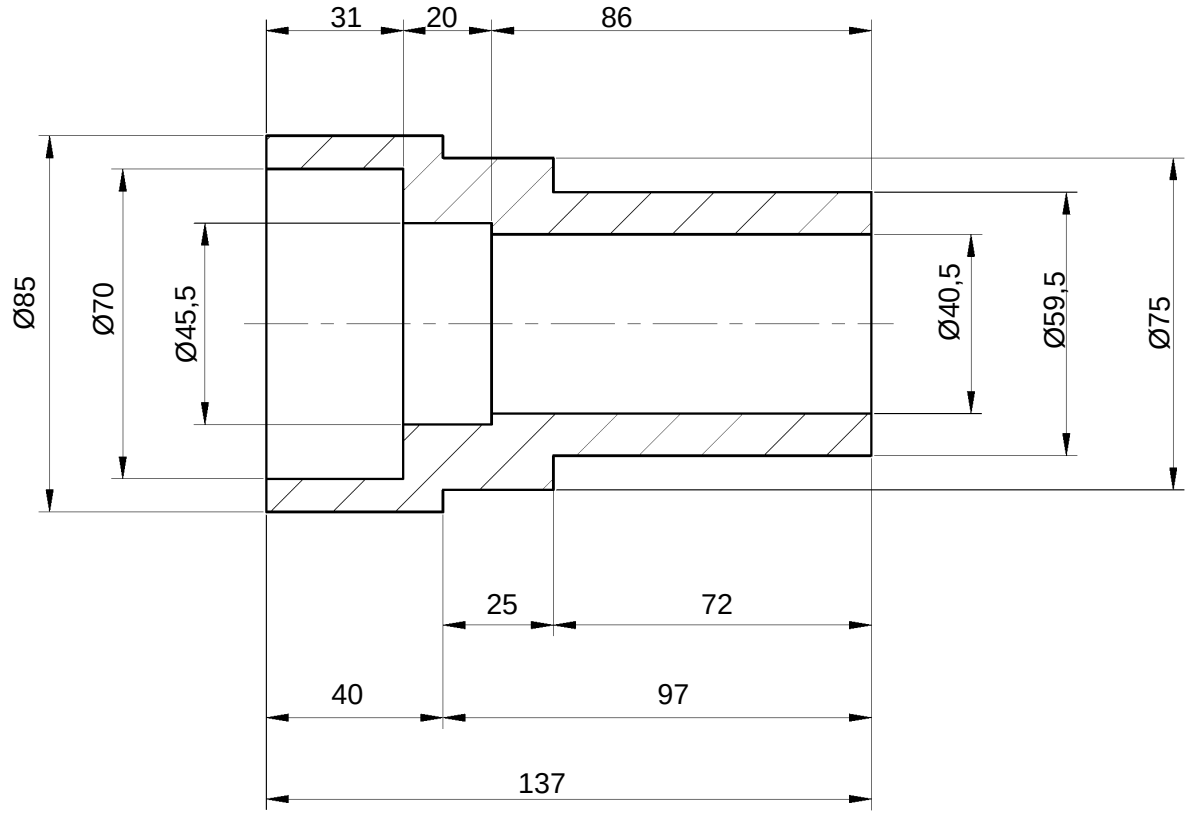
141 DS LG	Support for assembling and disassembling the main shaft-clutch assembly	
Quantity : 1	Material : extruded FE 360	
Notes :		

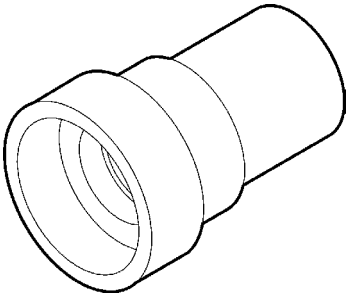
Section 4 : 143 DS LG



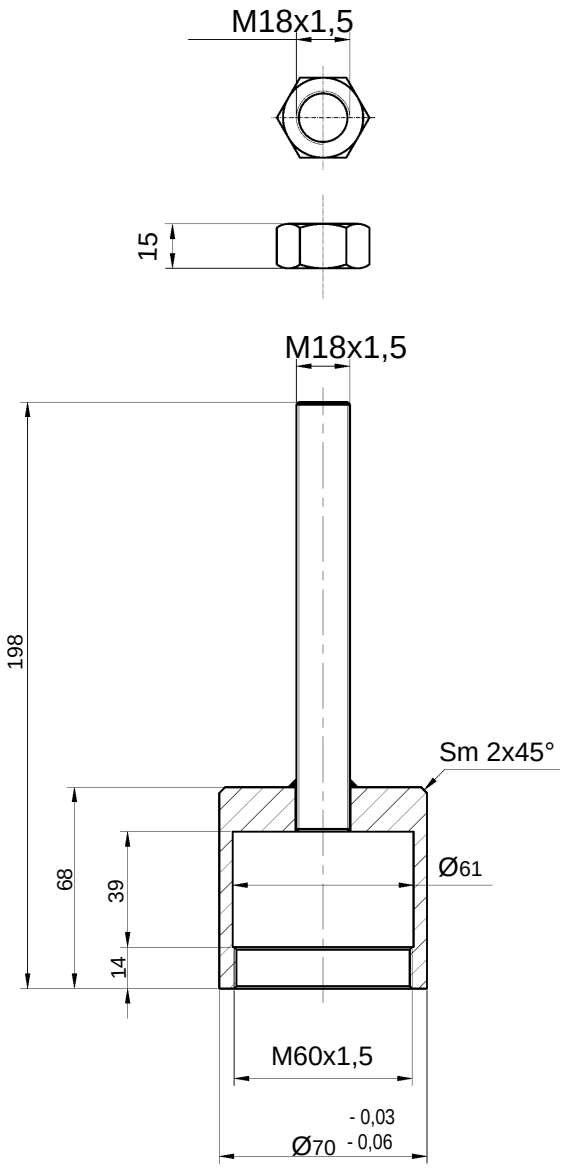
143 DS LG	Compressor for assembling and disassembling the hydraulic clutch spring	
Quantity : 1	Material : extruded FE 360	
Notes :		

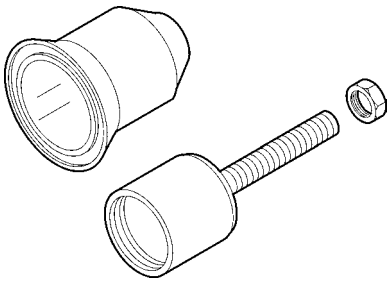
Section 5 : 01 DS REX



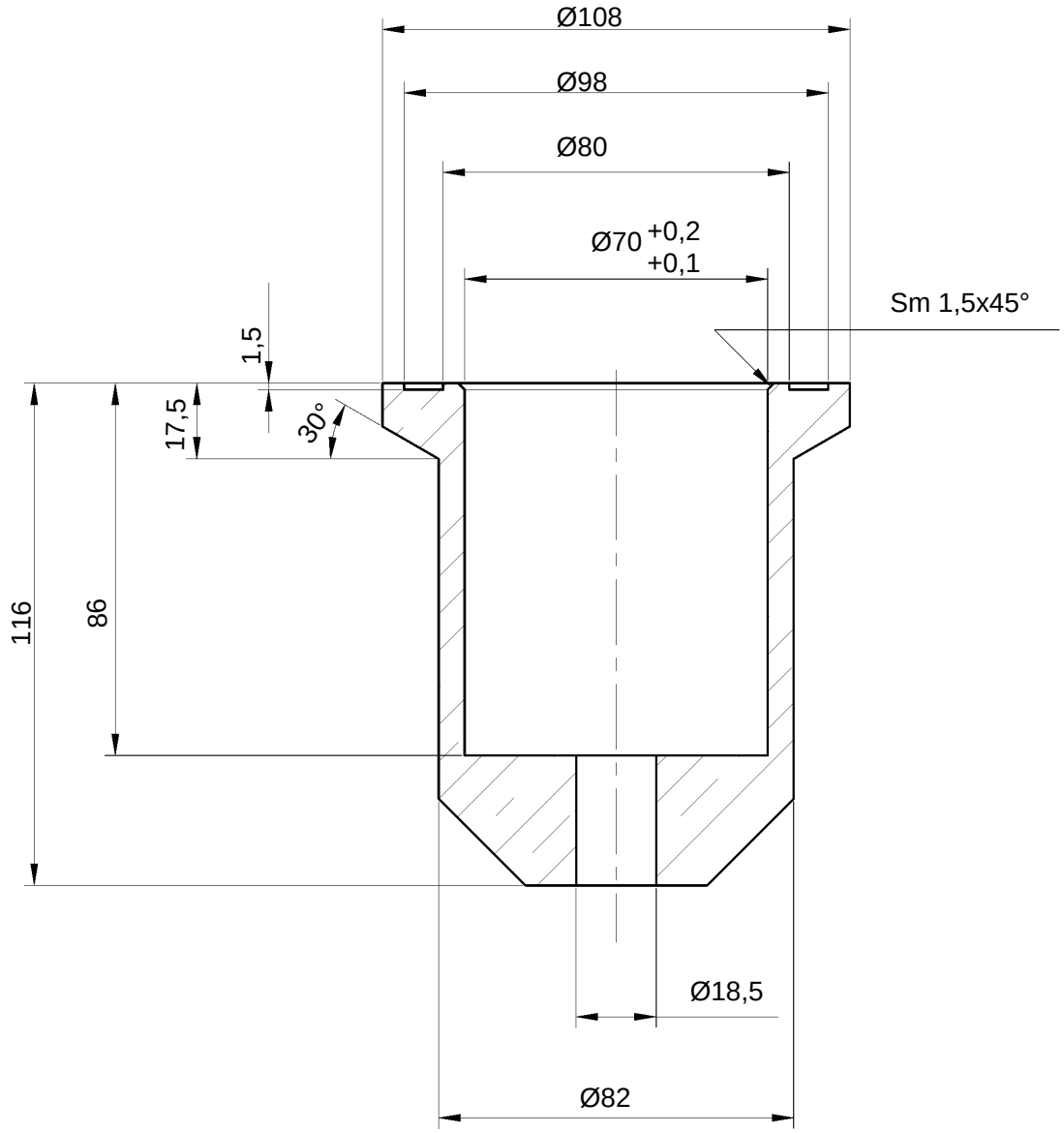
01 DS REX	Bush to use with tool 141 DS-LG for assembling and disassembling the Powershuttle clutch shaft assembly	
Quantity : 1	Material : TEFLON	
Notes :		

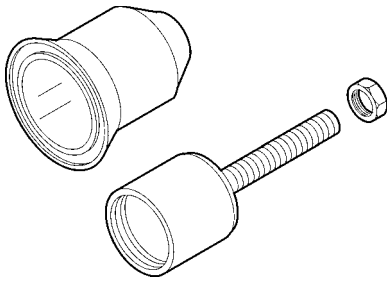
Section 6 : 02 DS REX a



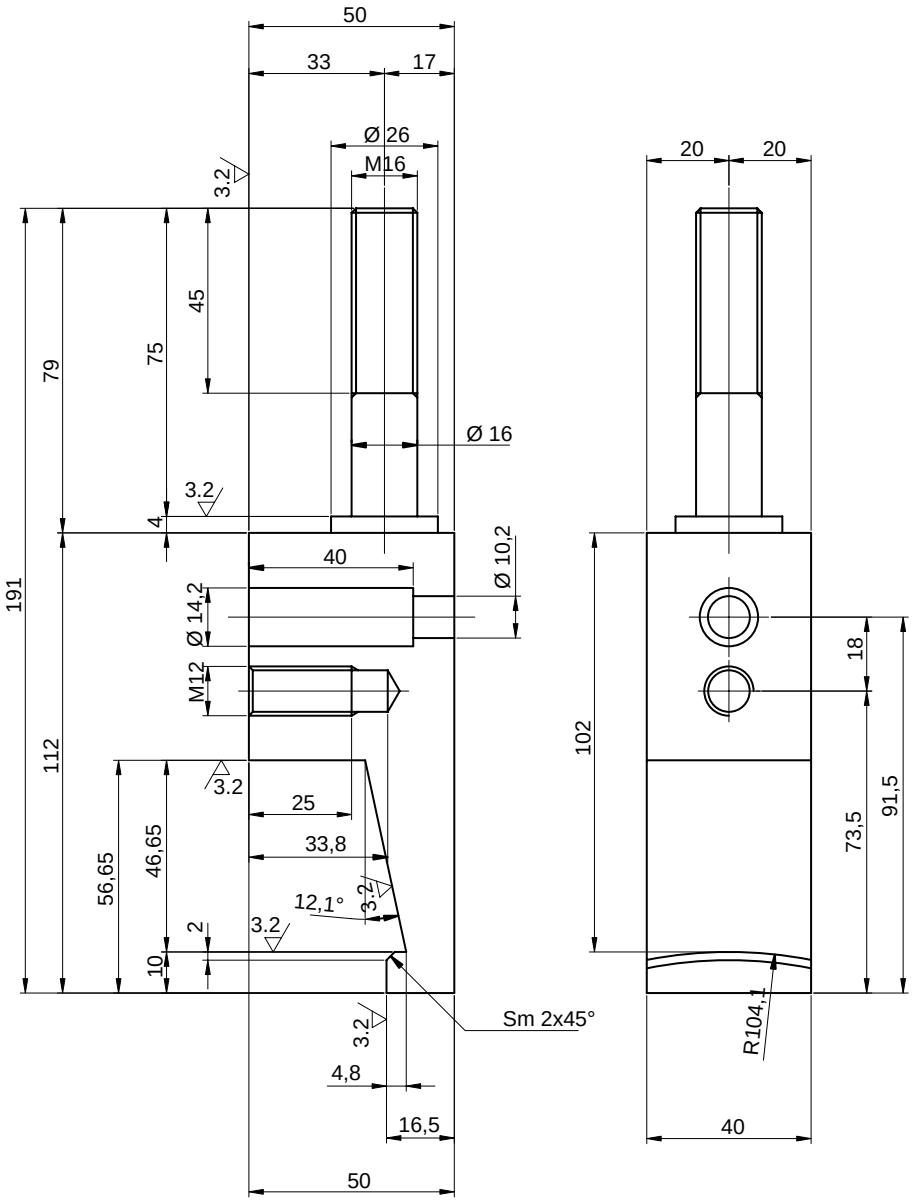
02 DS REX a	Tool to introduce the main shaft into bearing of the Powershuttle unit	
Quantity : 1	Material : 38NiCrMo4 UNI 7845	
Notes :		

Section 7 : 02 DS REX b

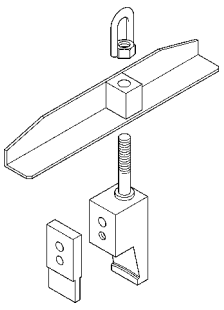


02 DS REX b	Tool to introduce the main shaft into bearing of the Powershuttle unit	
Quantity : 1	Material : 38NiCrMo4 UNI 7845	
Notes :		

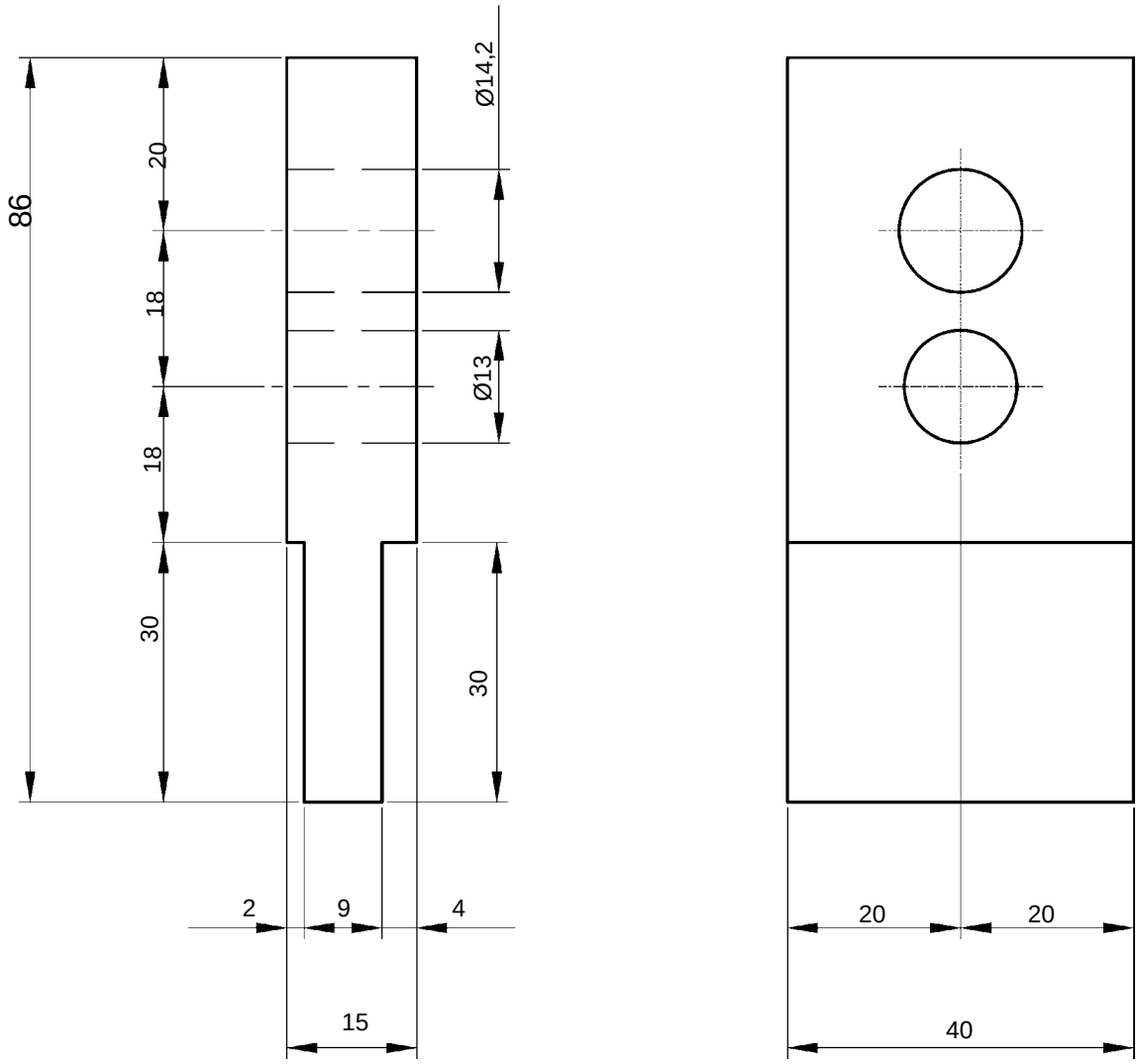
Section 8 : 01 CMB MYT a

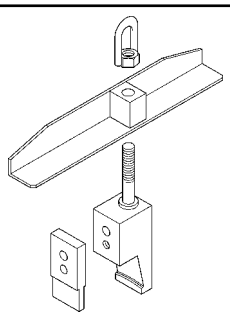


01 CMB MYT a	Support for disassembling and assembling the differential unit along with ring gear
Quantity : 1	Material : 38NiCrMo4 UNI 7845
Notes :	

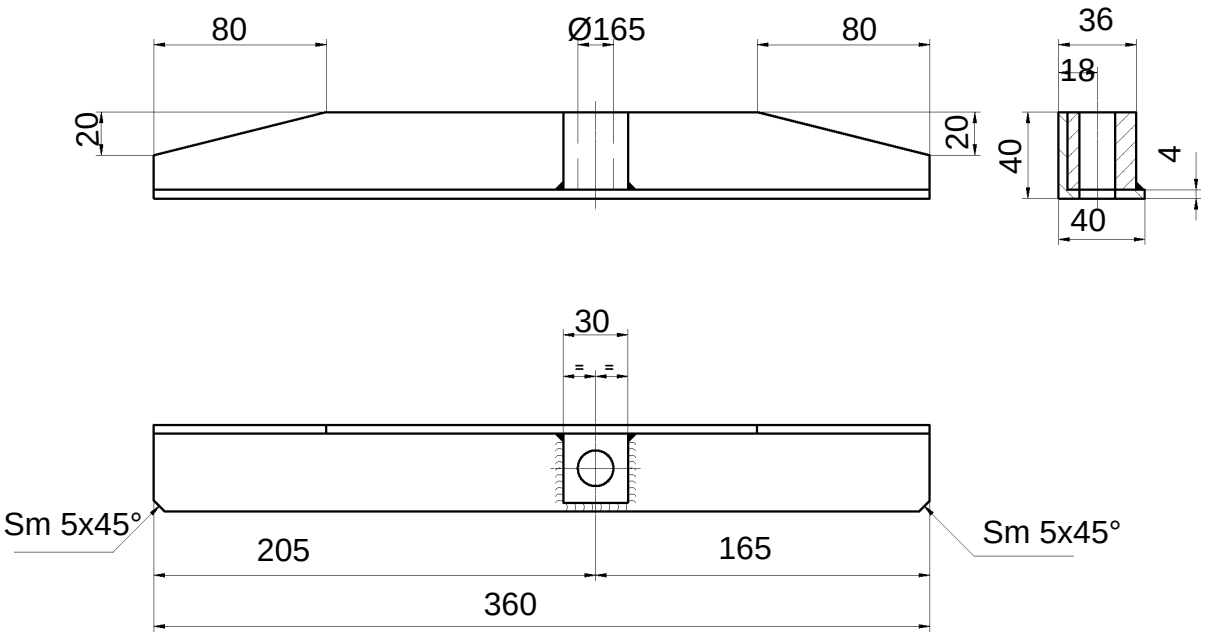


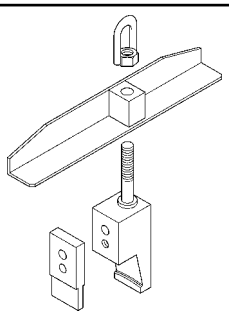
Section 9 : 01 CMB MYT b



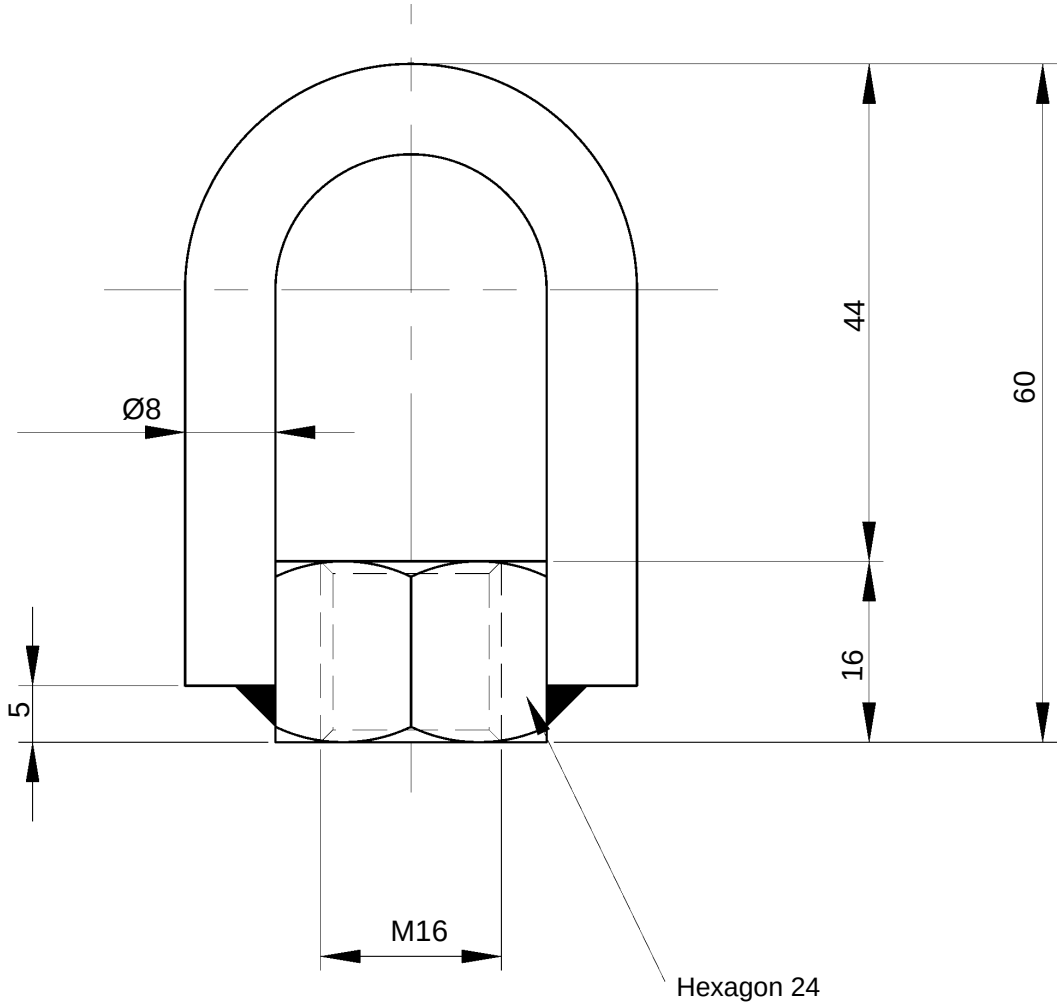
01 CMB MYT b	Support for disassembling and assembling the differential unit along with ring gear	
Quantity : 1	Material : C40 UNI 7845	
Notes :		

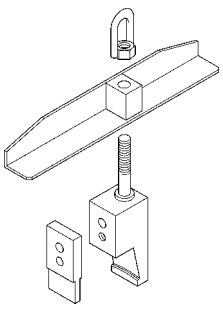
Section 10 : 01 CMB MYT c



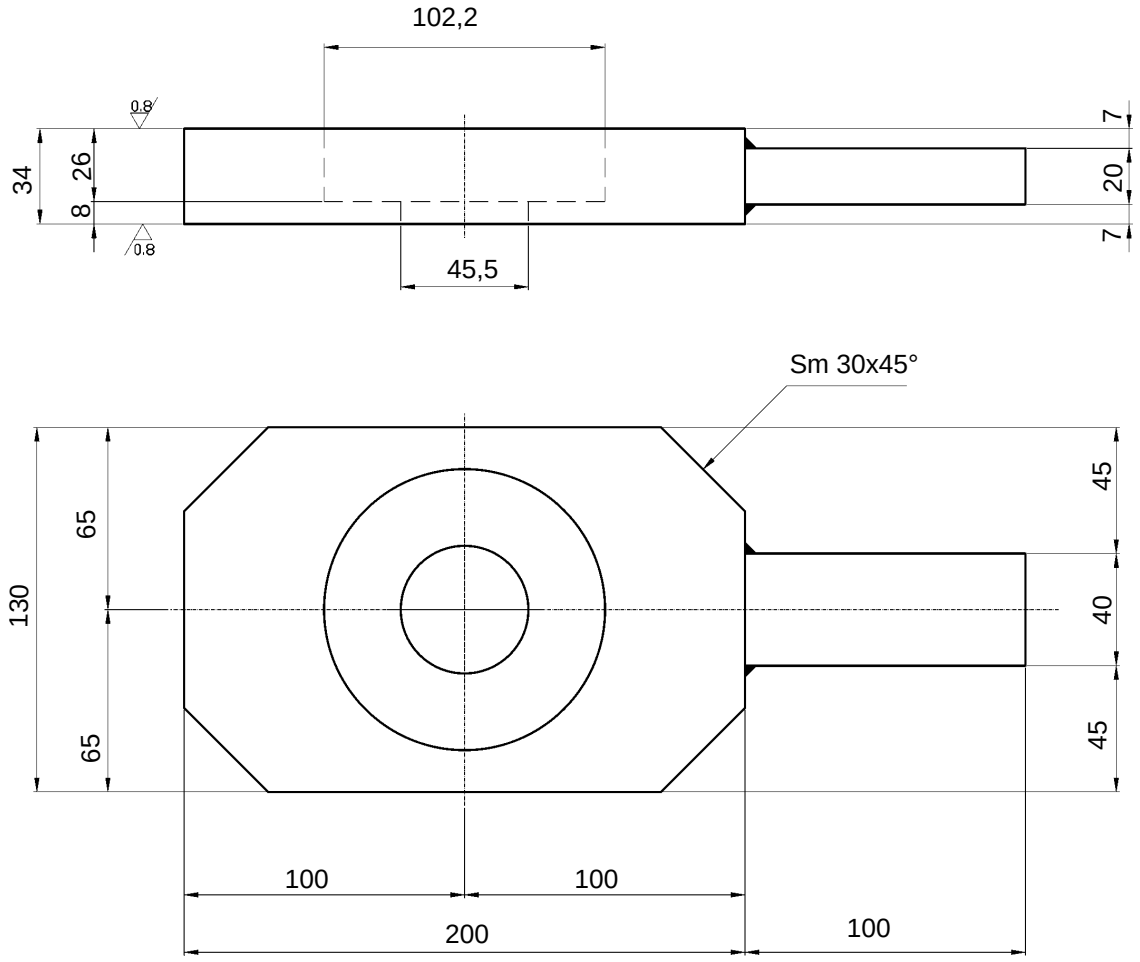
01 CMB MYT c	Support for disassembling and assembling the differential unit along with ring gear	
Quantity : 1	Material : extruded Fe 360	
Notes :		

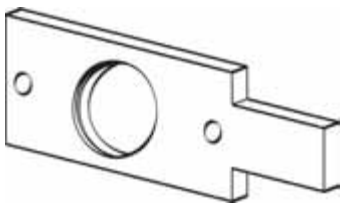
Section 11 : 01 CMB MYT d



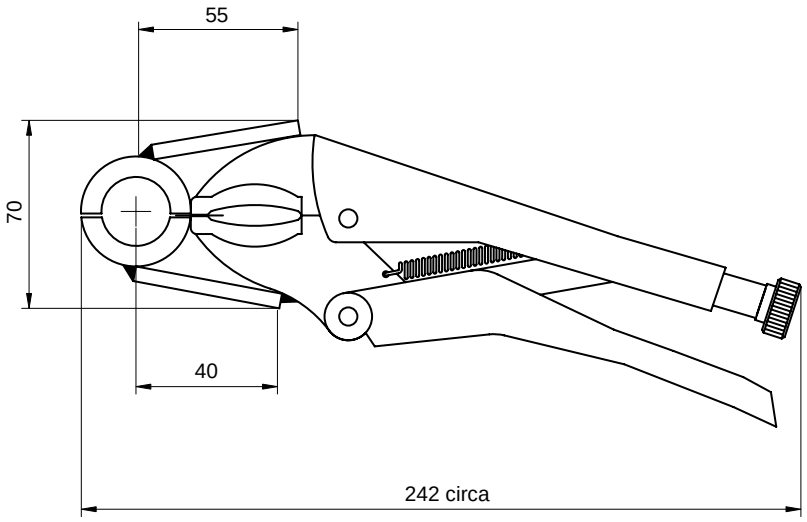
01 CMB MYT d	Support for disassembling and assembling the differential unit along with ring gear	
Quantity : 1	Material : extruded FE 360	
Notes :		

Section 12 : 01 CMB REX

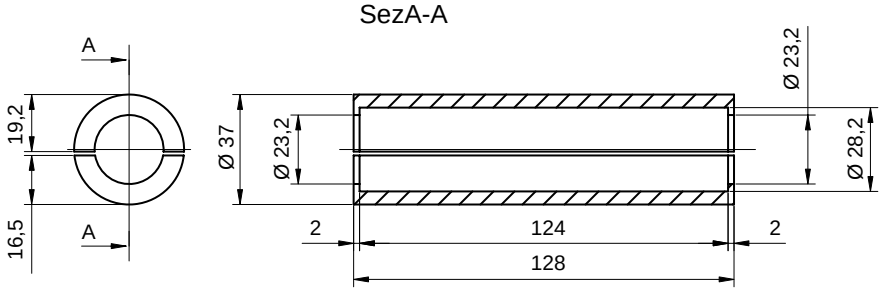


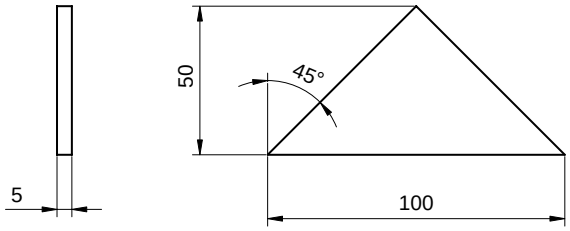
01 CMB REX	Support to measure dimension C, bevel pinion adjustment	
Quantity : 1	Material : C40 UNI 7845	
Notes :		

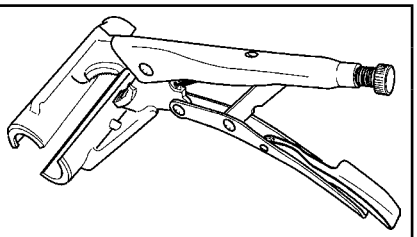
Section 13 : 02 CMB REX



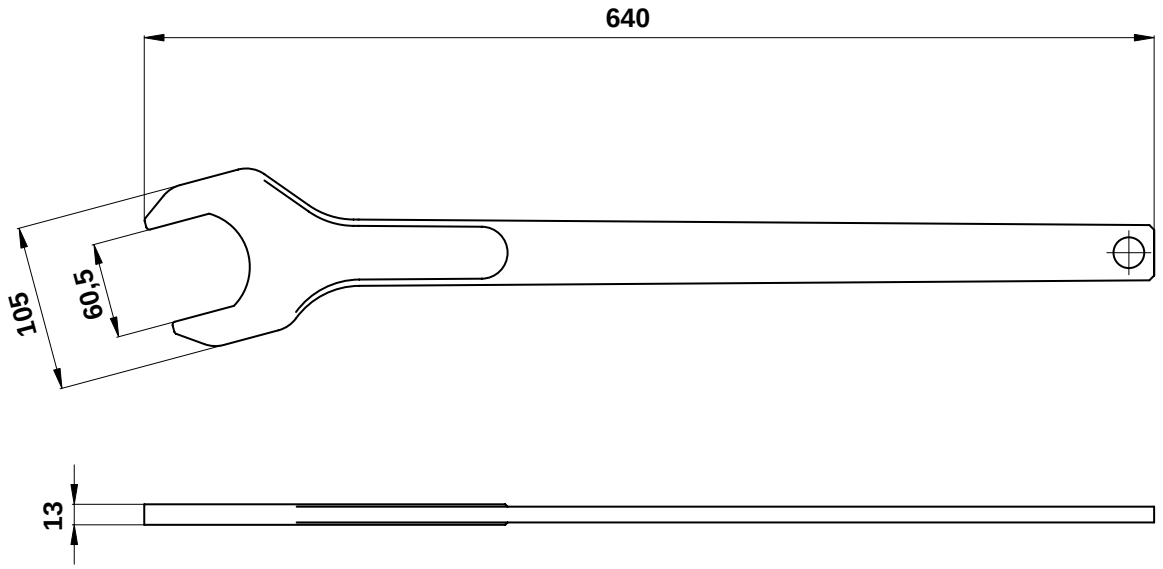
SezA-A

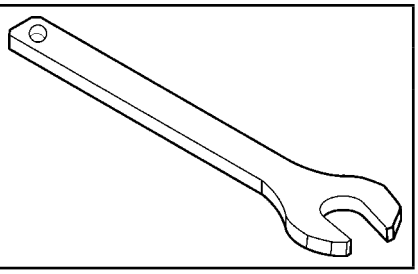




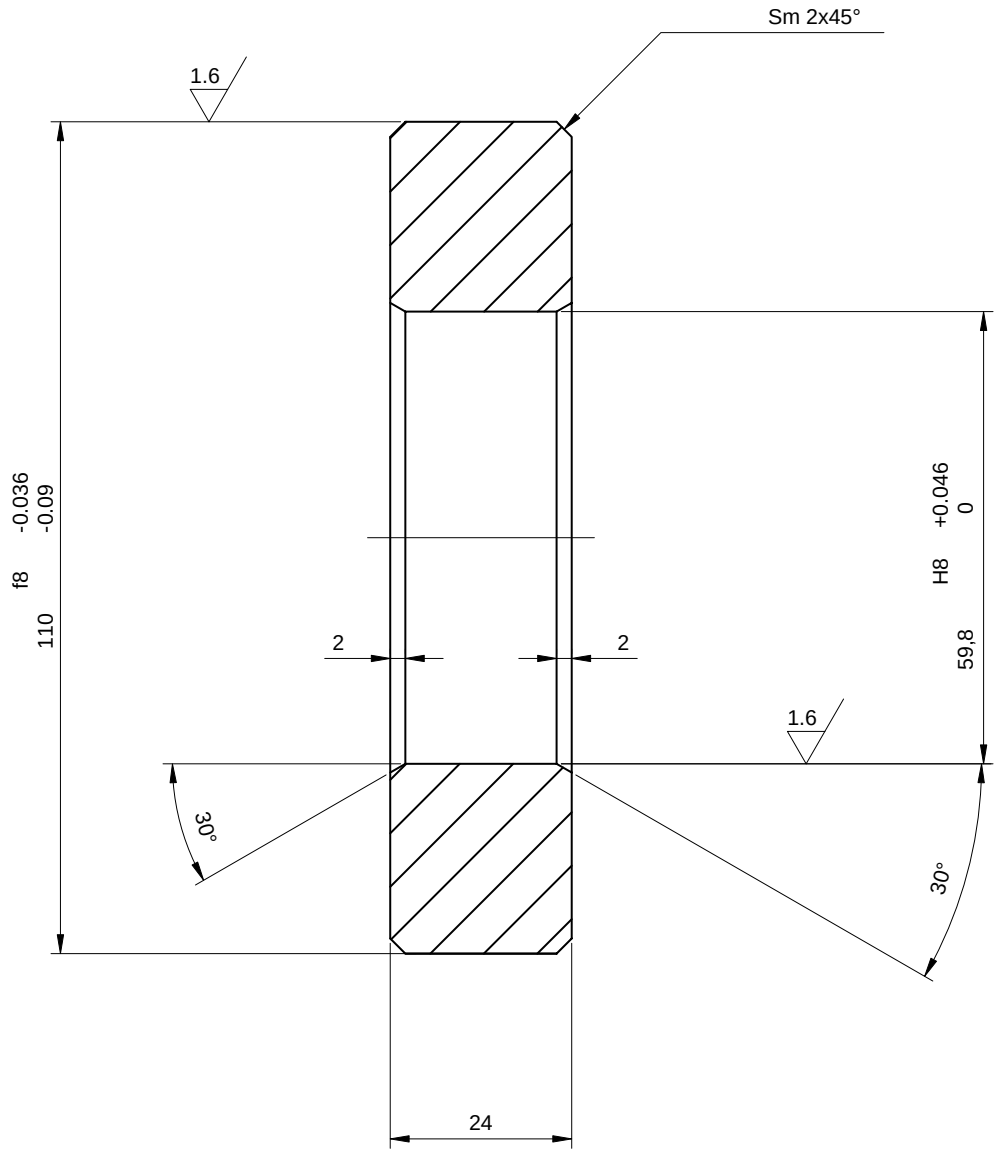
02 CMB REX	Differential lock spring compressor	
Quantity : 1	Material :	
Notes : Use pliers type “USAG” 134-250 (code 134002)		

Section 14 : 03 CMB REX

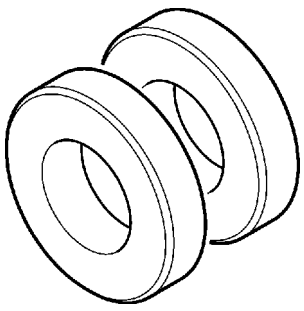


03 CMB REX	Wrench for bevel pinion nut	
Quantity : 1	Material :	
Notes : Obtain the material from simple fork wrench “USAG” code 248-68		

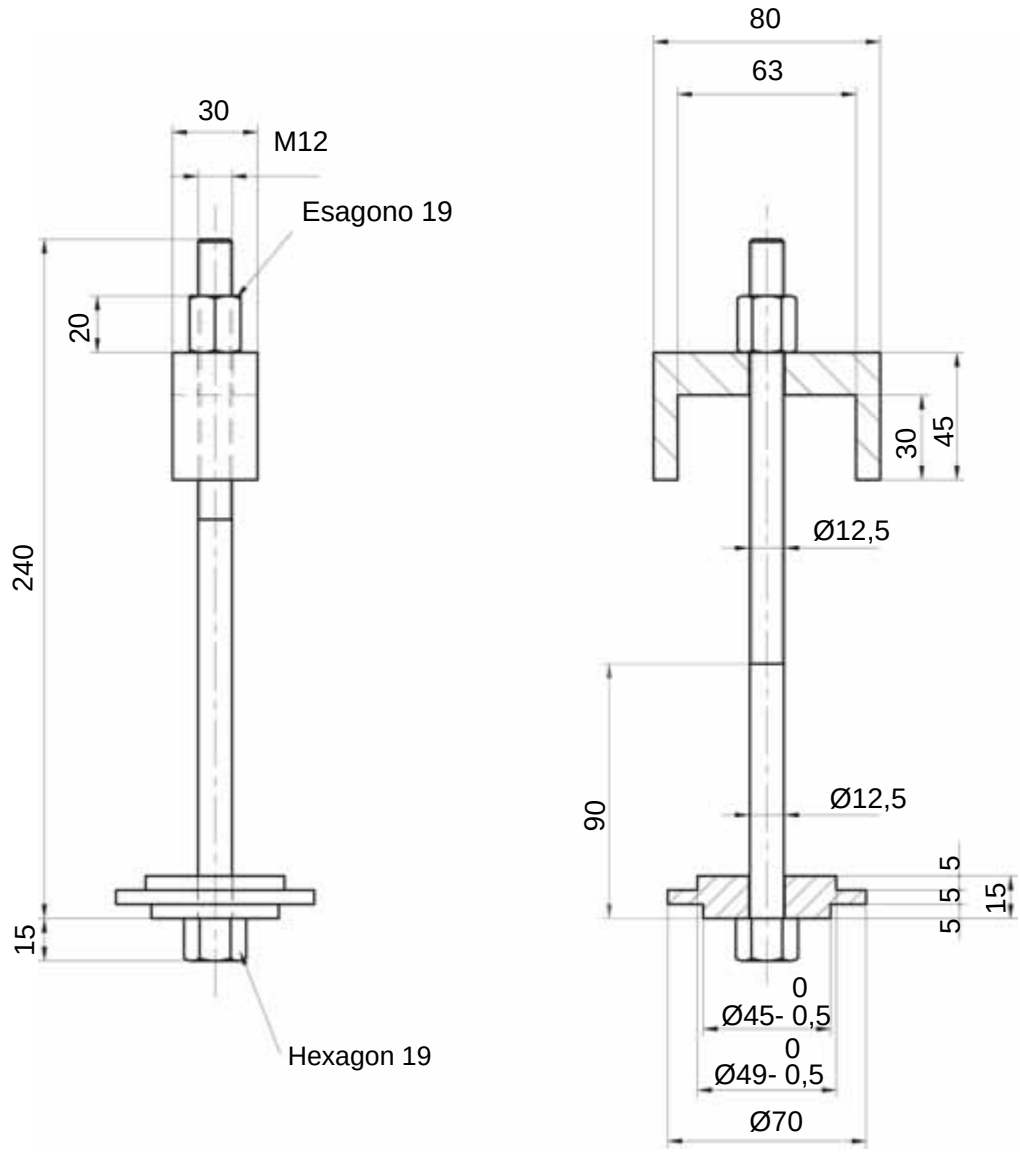
Section 15 : 01 DIF MYT

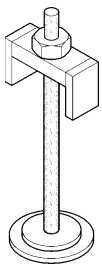


01 DIF MYT	Dummy bearings to adjust the rear bevel gear pair
Quantity : 2	Material : 100Cr6 UNI 3097
Notes :	

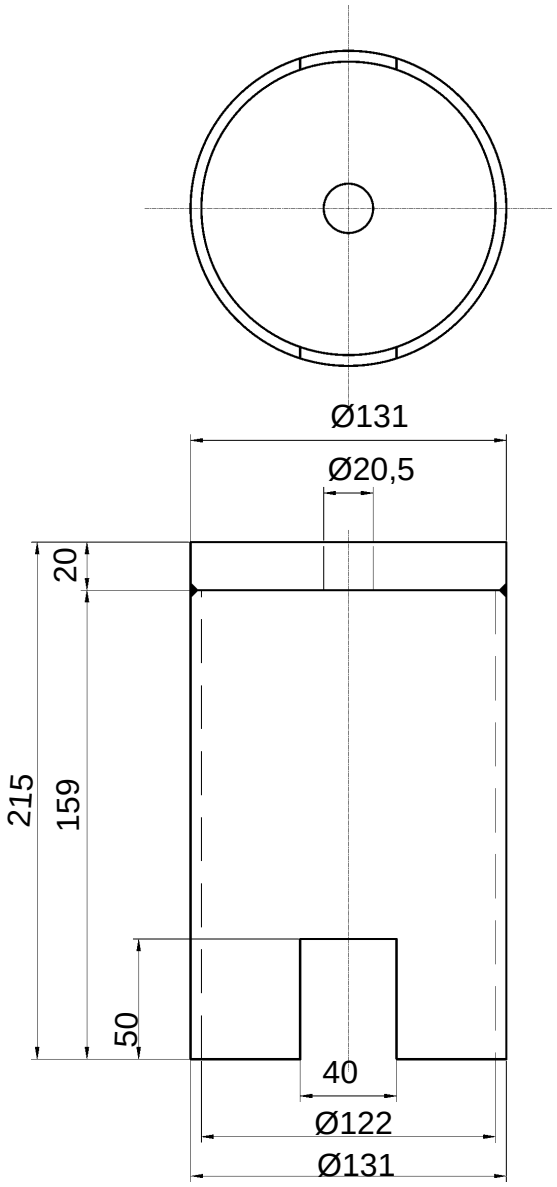


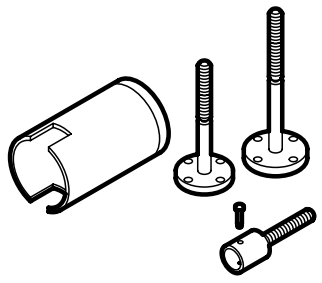
Section 16 : 02 PTO MYT



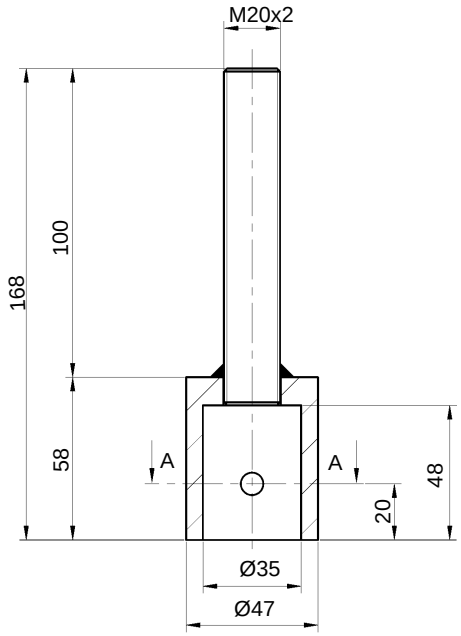
02 PTO MYT	Puller for disassembling and re-assembling the PTO clutch piston spring.	
Quantity : 1	Material : 30NiCrMo12 UNI 7845	
Notes :		

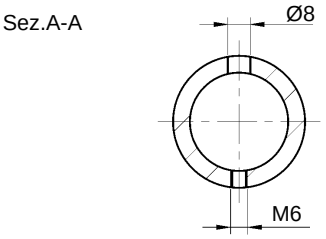
Section 17 : 01 PTO REX a

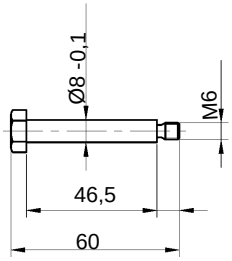


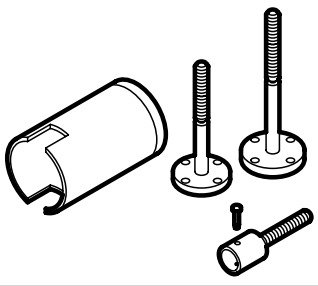
01 PTO REX a	Puller for PTO lower shaft	
Quantity : 1	Material : 38NiCrMo4 UNI 7845	
Notes :		

Section 18 : 01 PTO REX b

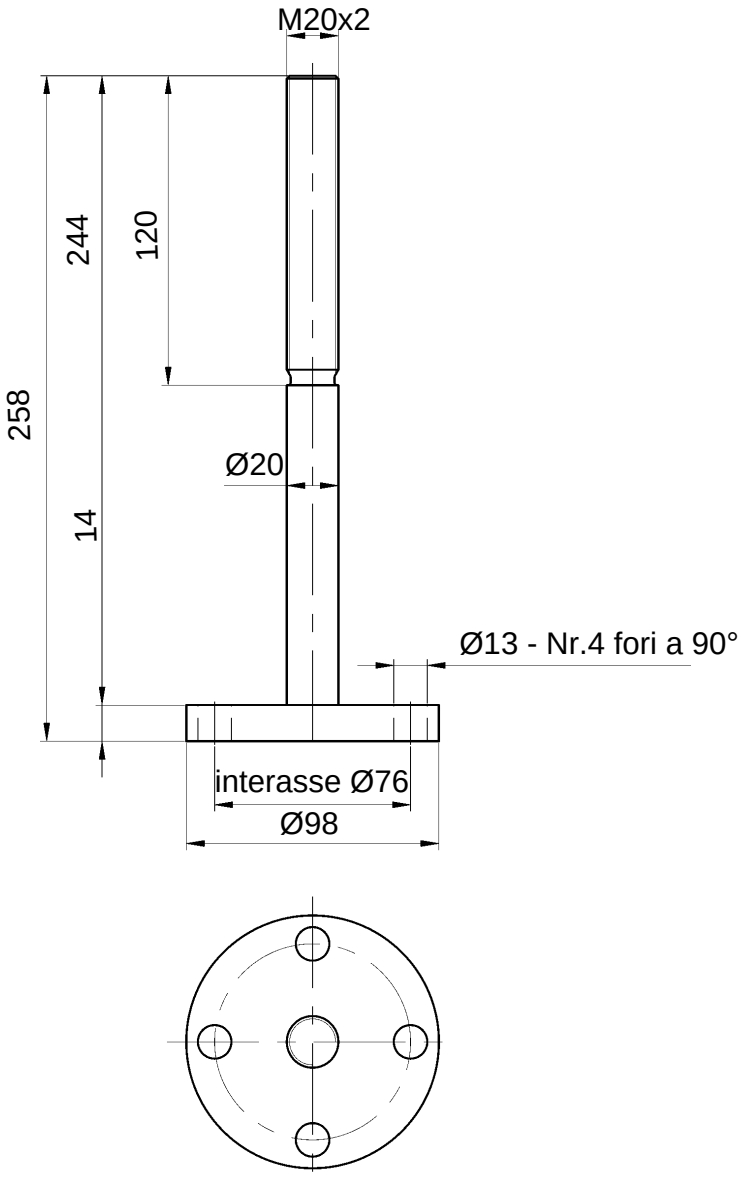


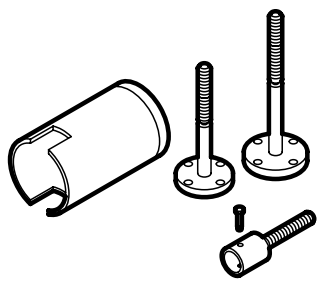




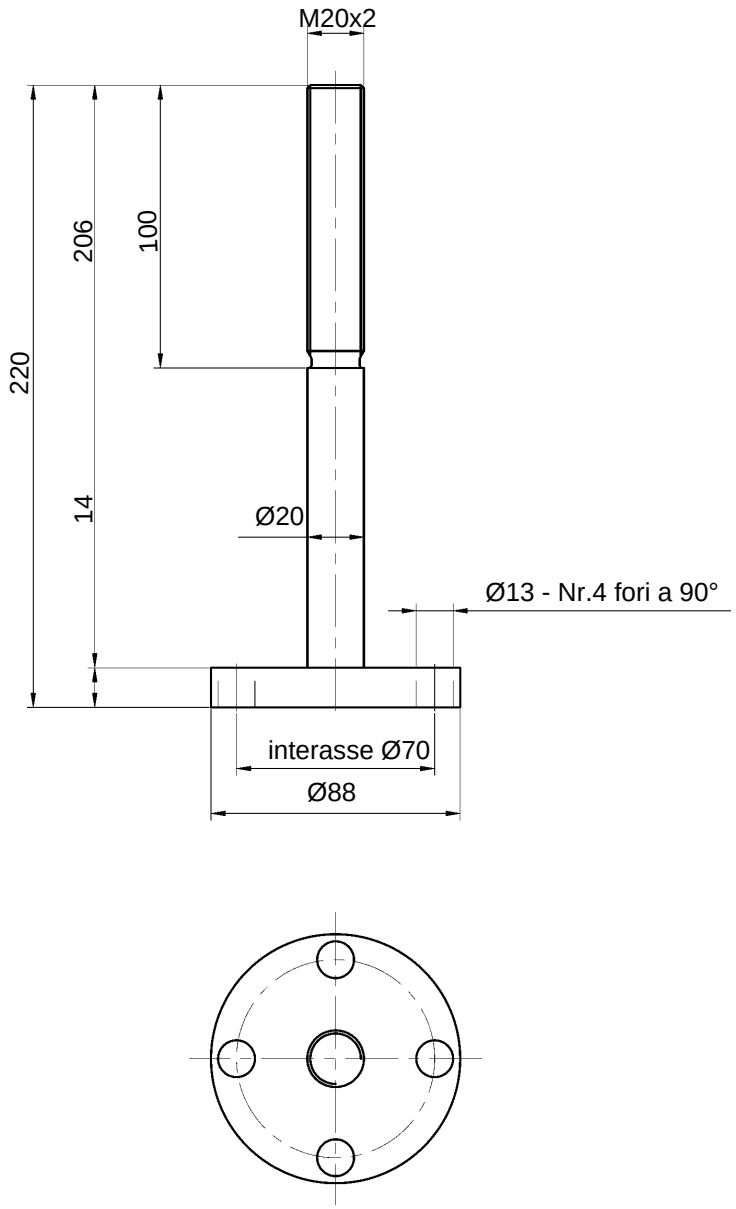
01 PTO REX b	Puller for PTO lower shaft	
Quantity : 1	Material : 38NiCrMo4 UNI 7845	
Notes :		

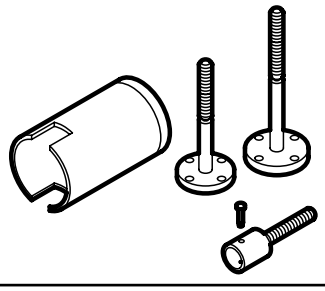
Section 19 : 01 PTO REX c



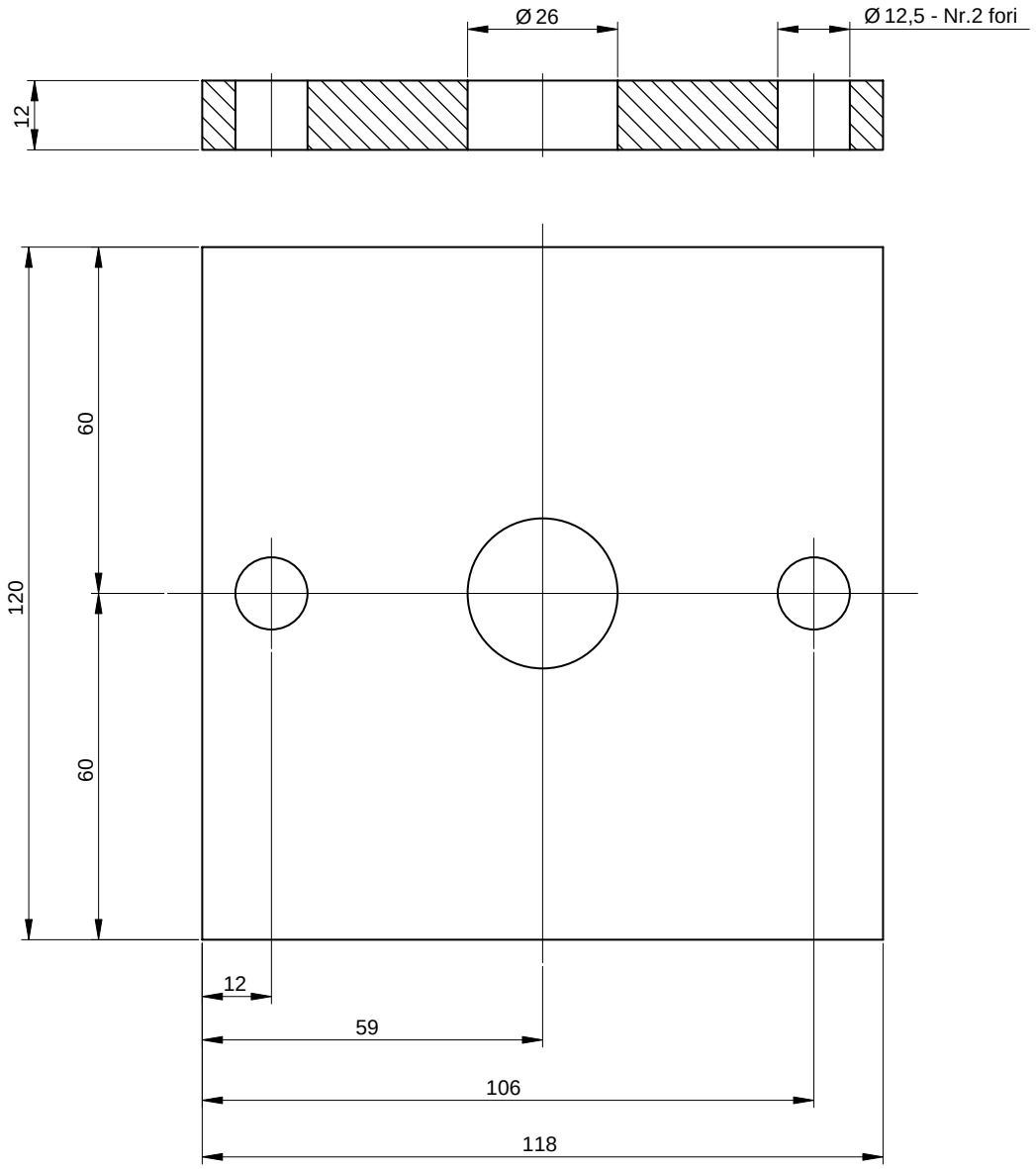
01 PTO REX c	Puller for PTO lower shaft	
Quantity : 1	Material : 38NiCrMo4 UNI 7845	
Notes :		

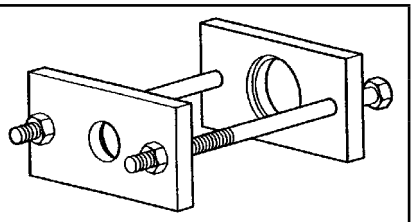
Section 20 : 01 PTO REX d



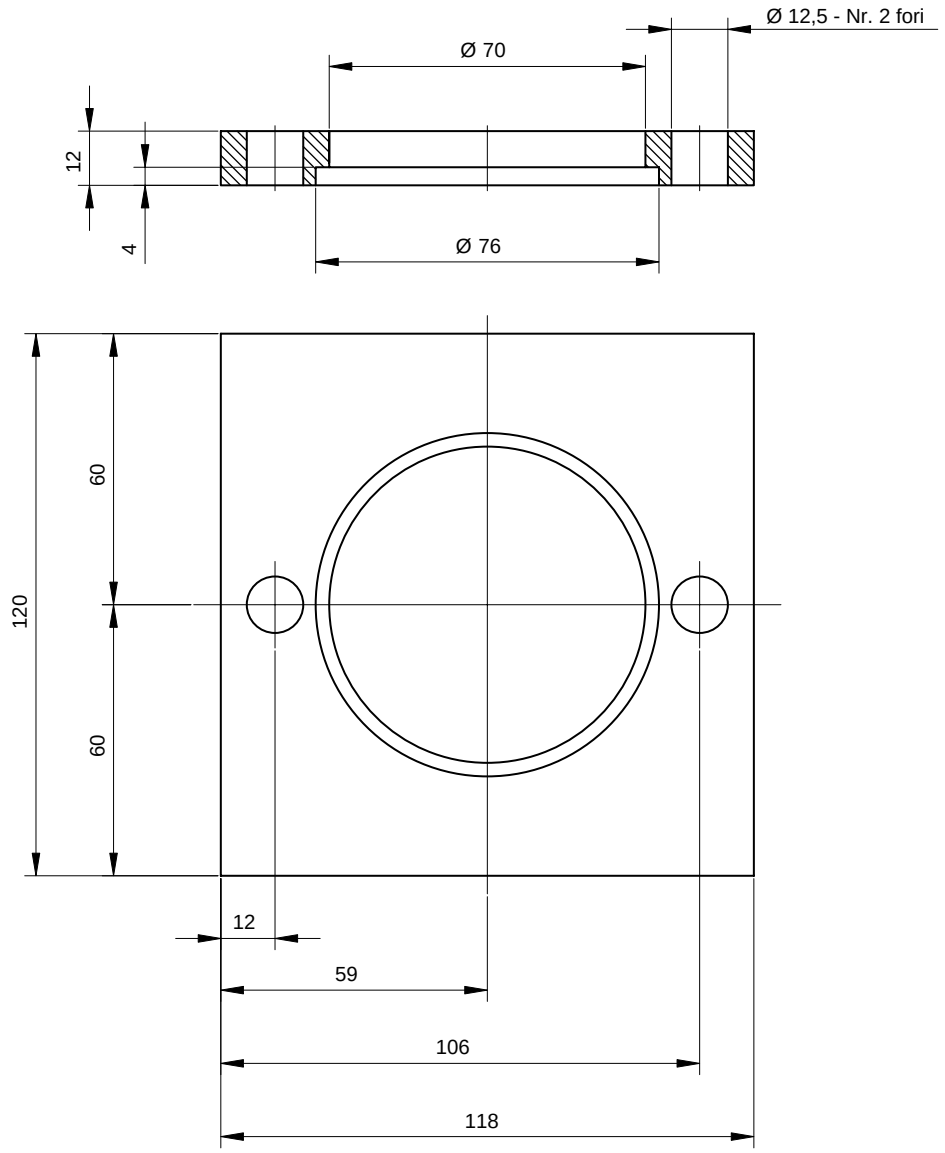
04 DT MYT a	Compressor for disssembling and re-assembling the diff lock piston spring	
Quantity : 1	Material : 18NiCrMo12 UNI 7845	
Notes :Hardening and tempering stress relieving treatment		

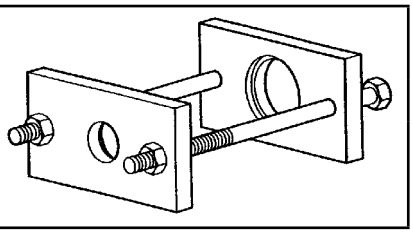
Section 21 : 02 DT MYTa



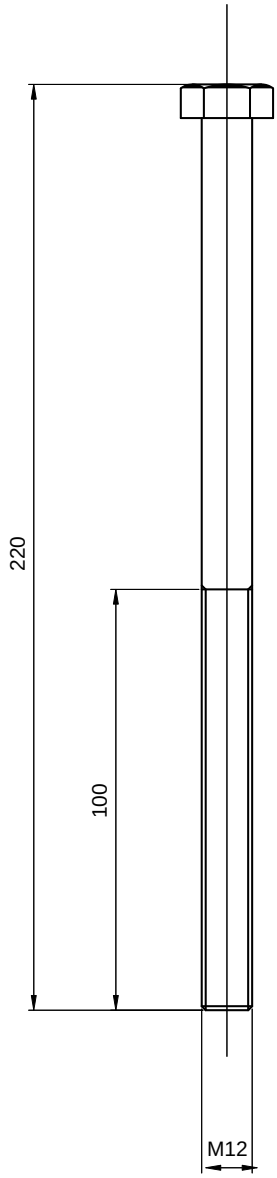
02 DT MYTa	Compressor for assembling and disassembling the spring-on spring	
Quantity : 1	Material : C40 UNI 7845	
Notes :		

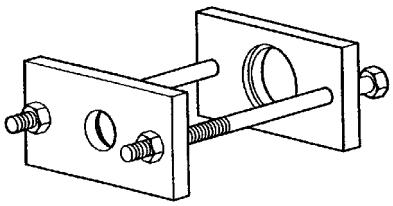
Section 22 : 02 DT MYT b



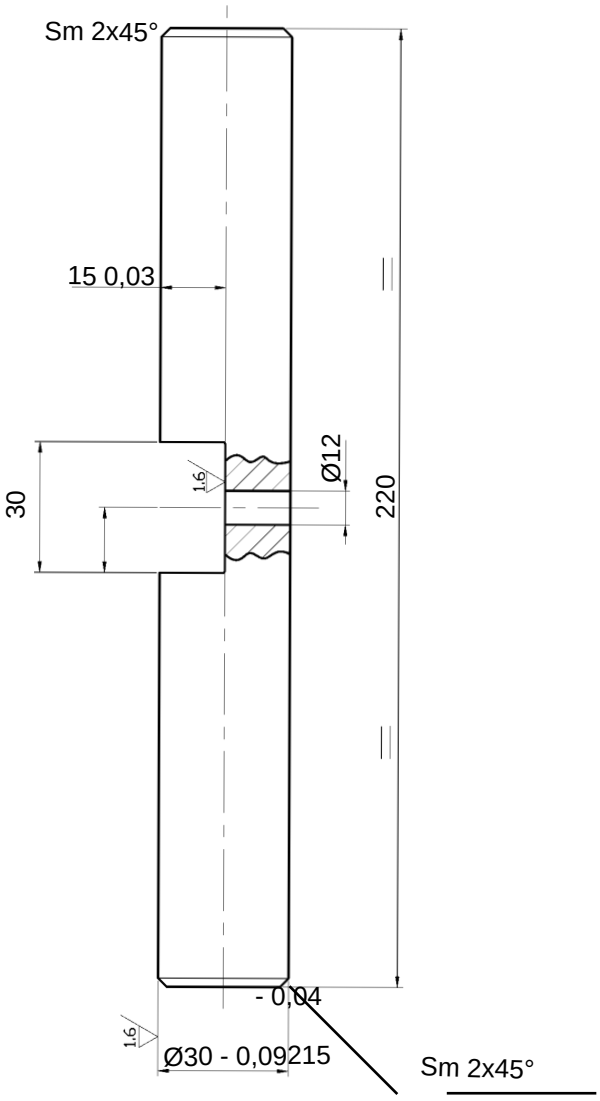
02 DT MYT b	Compressor for assembling and disassembling the spring-on spring	
Quantity : 2	Material : C40 UNI 7845	
Notes :		

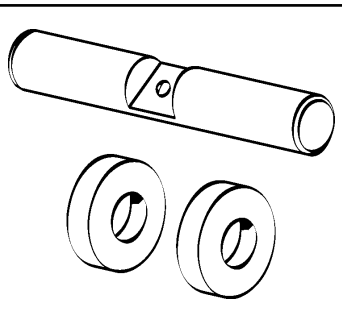
Section 23 : 02 DT MYT c



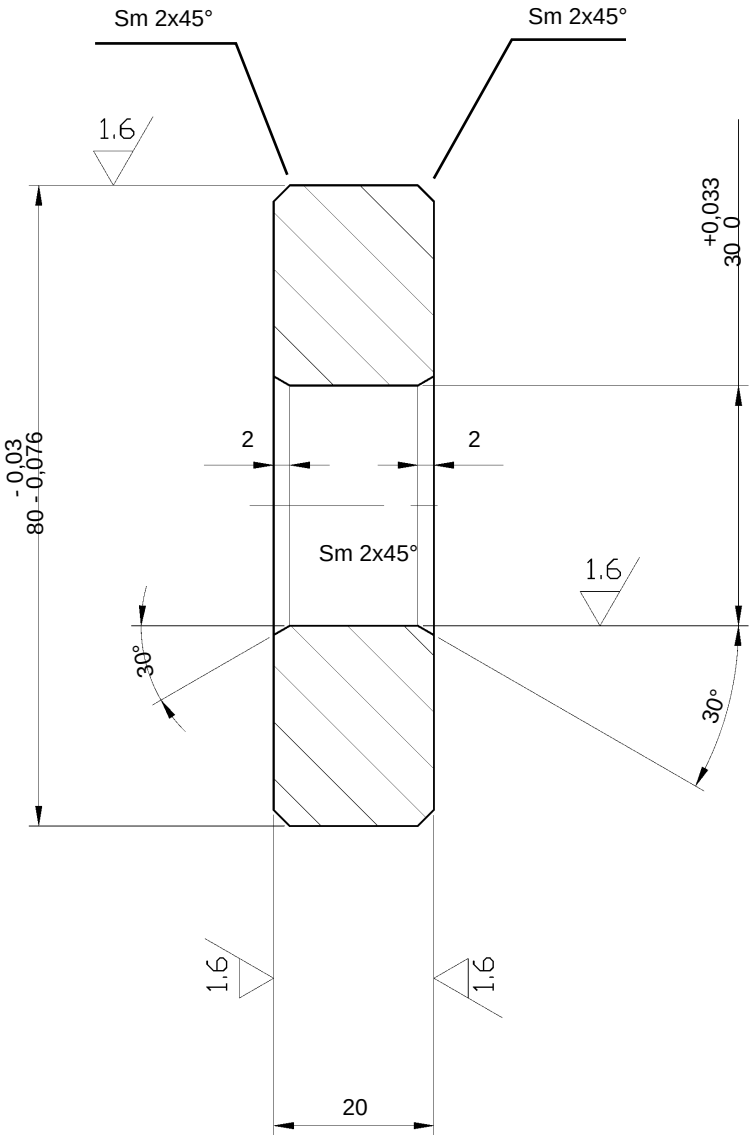
02 DT MYT c	Compressor for assembling and disassembling the spring-on spring	
Quantity : 1	Material : C40 UNI 7845	
Notes :		

Section 24 : 01 DT REX a

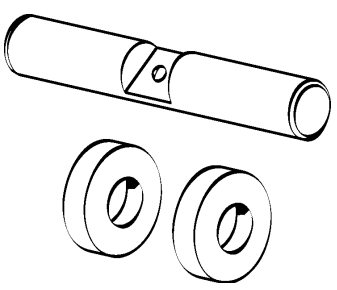


01 DT REX a	Dummy bearings with 4WD shaft bevel gear pair adjuster shaft	
Quantity : 1	Material : 30NiCrMo12 UNI 7845	
Notes :		

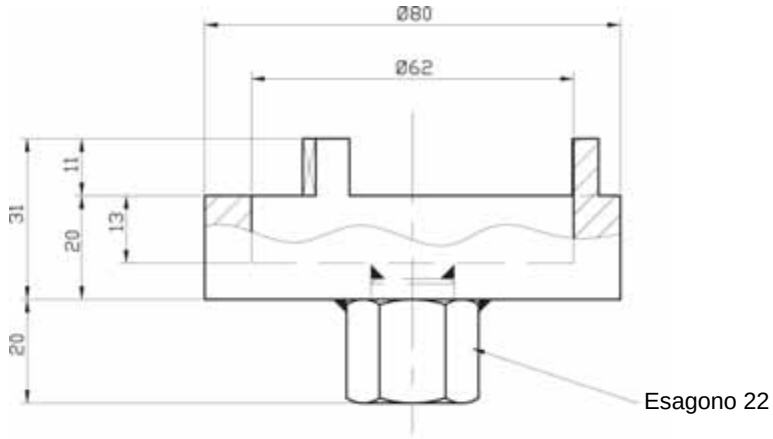
Section 25 : 01 DT REX b

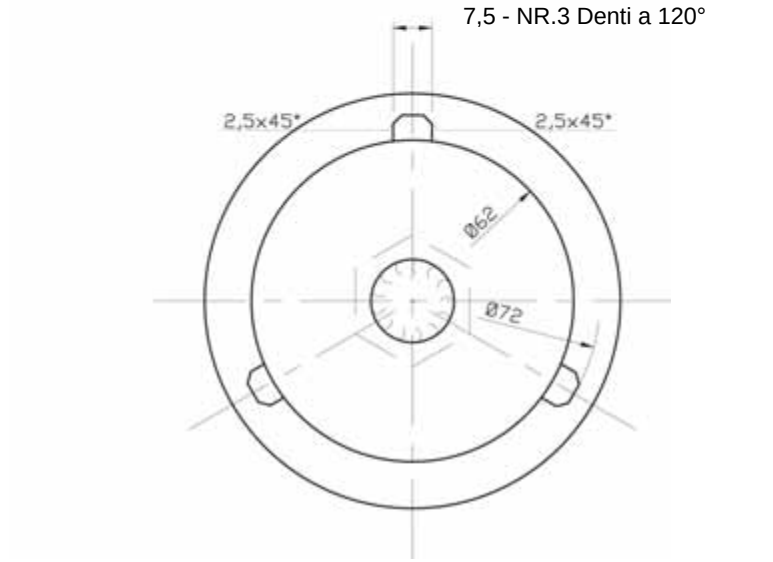


01 DT REX b	Dummy bearings with 4WD shaft bevel gear pair adjuster shaft
Quantity : 1	Material : 100Cr6 UNI 3097
Notes :	



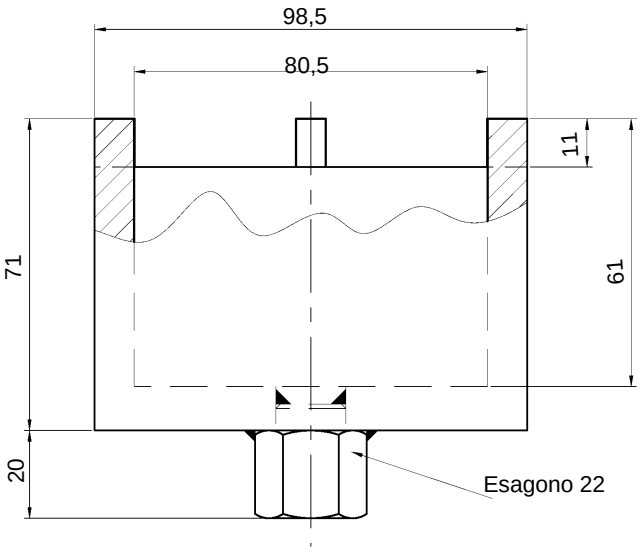
Section 26 : 02 DT REX

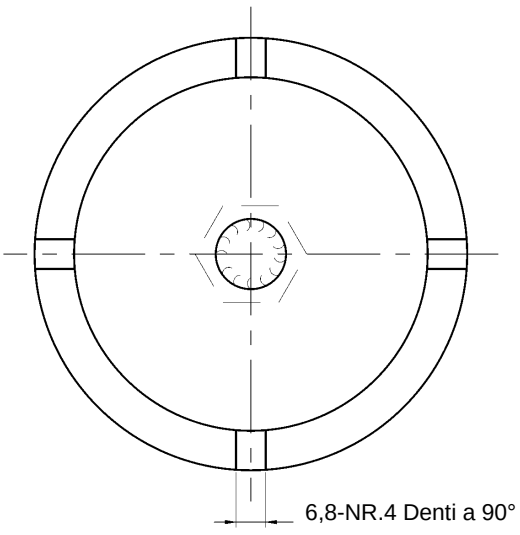


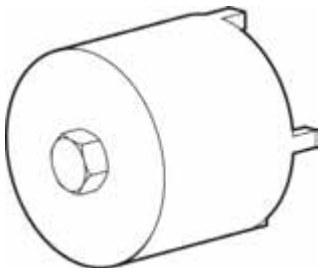


02 DT REX	Wrench for 4WD differential ring nuts	
Quantity : 1	Material : 30NiCrMo12 UNI 7845	
Notes :		

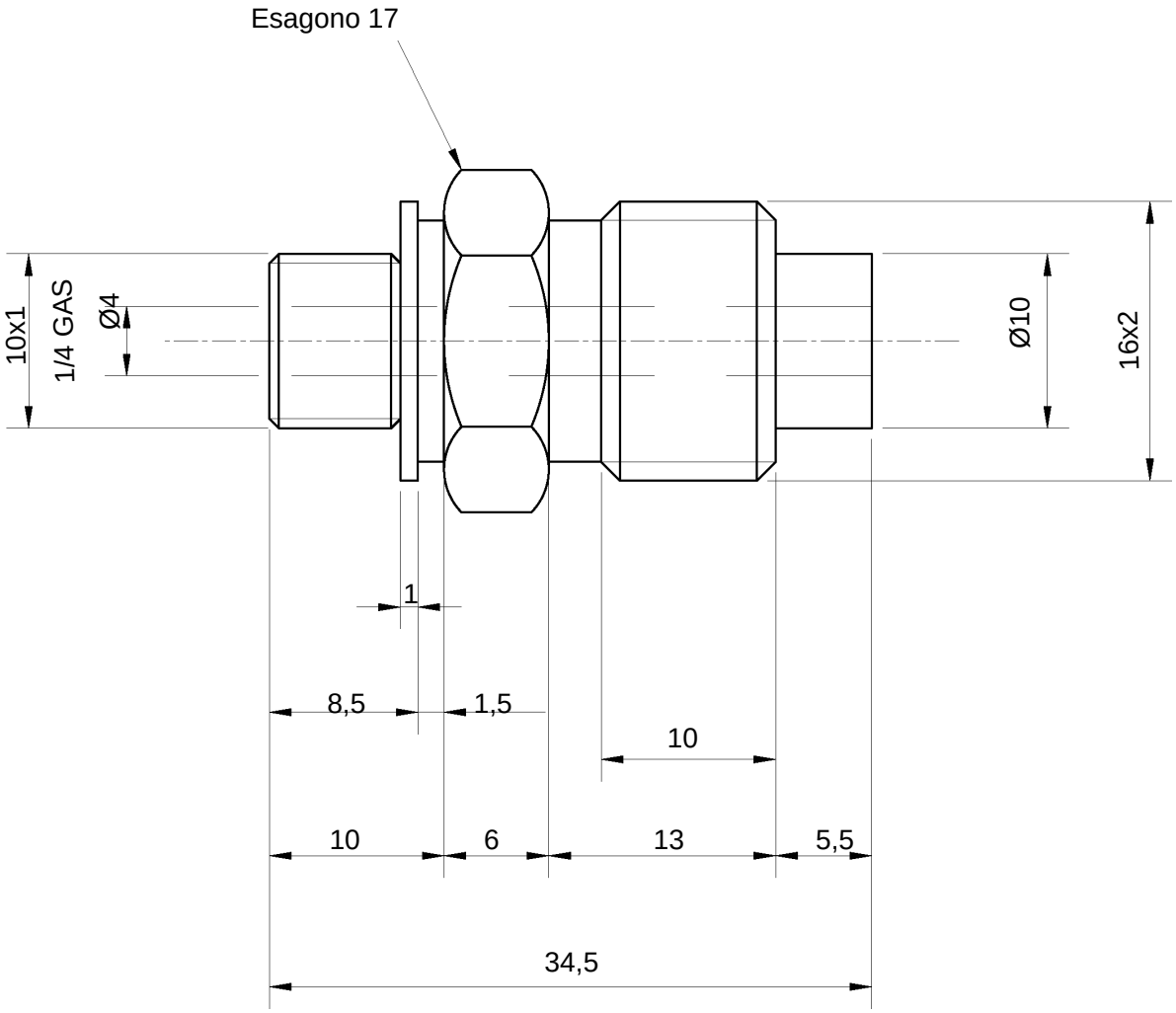
Section 27 : 04 DT REX





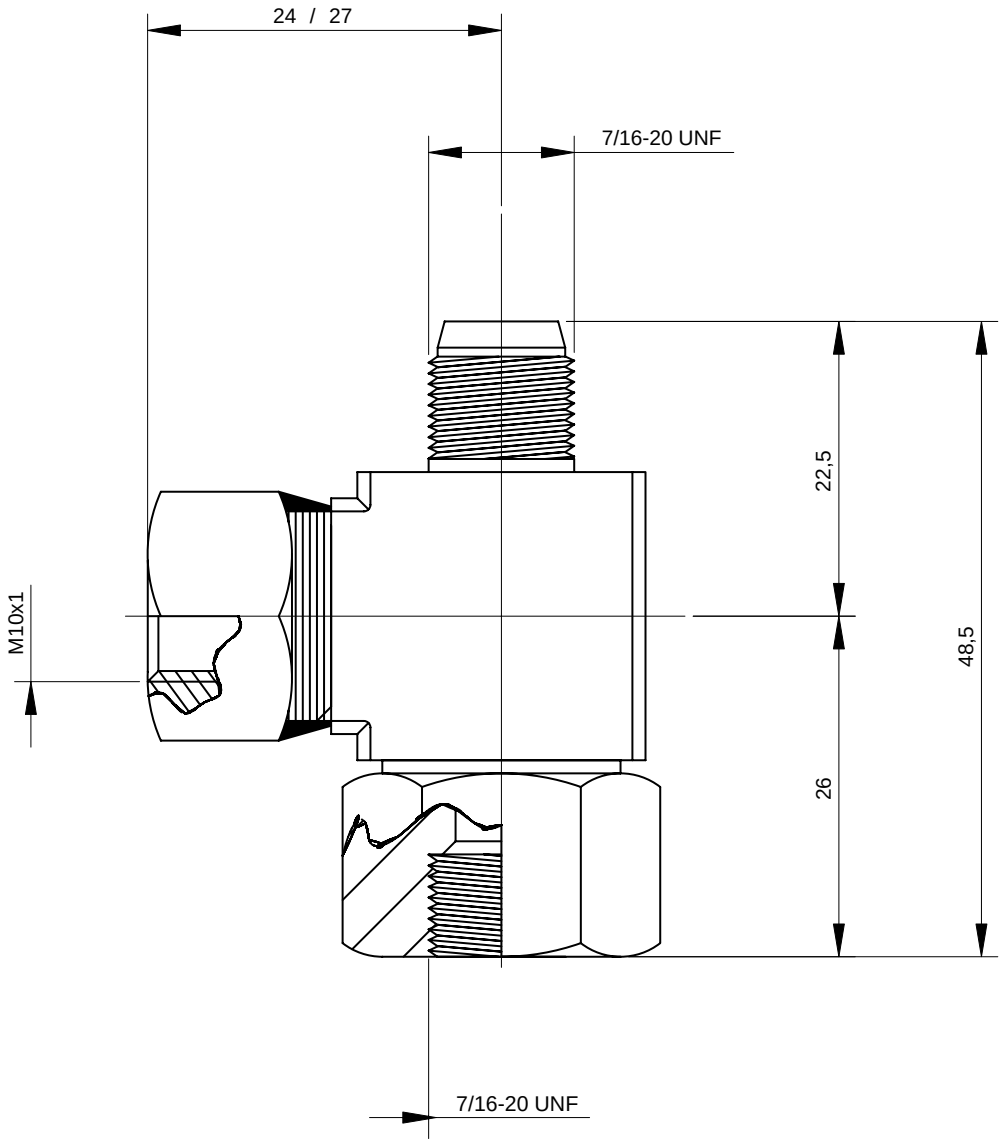
04 DT REX	Wrench for ring nuts of 4WD side final drive	
Quantity : 1	Material : 30NiCrMo 12 UNI 7845	
Notes :		

Section 28 : 122 IDR GL

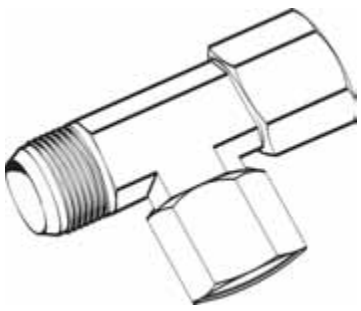


122 IDR GL	Universal adapter union (commercial)
Quantity : 1	Material : extruded FE 360
Notes :	

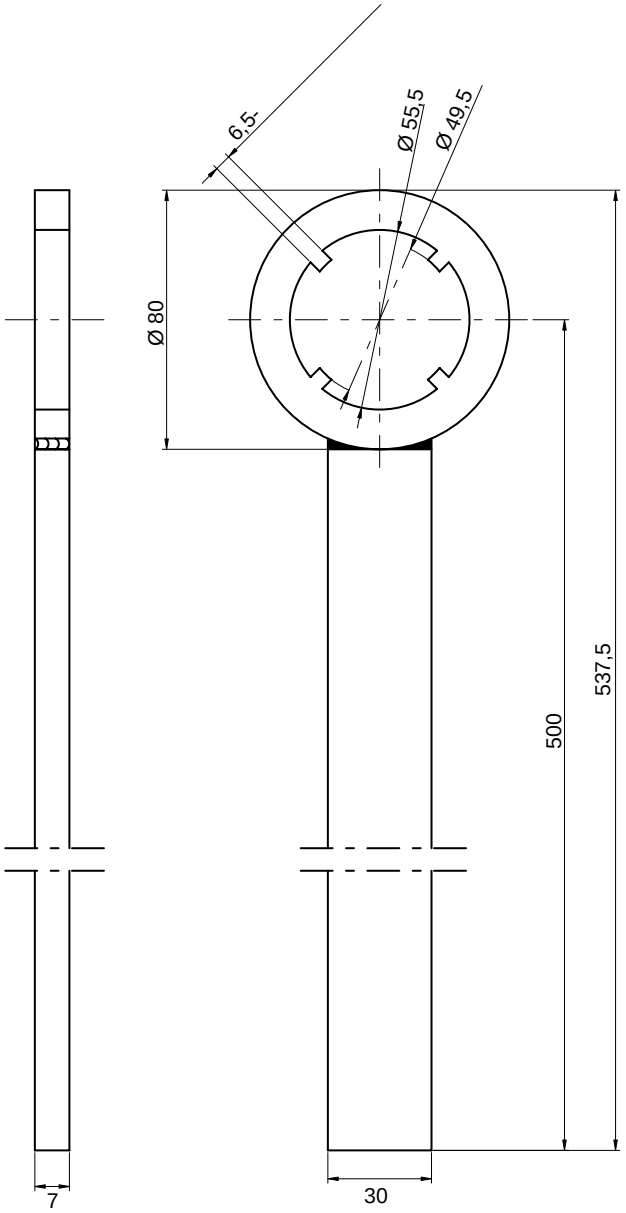
Section 29 : 125 IDR GL



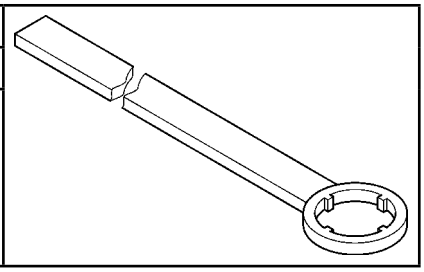
125 IDR GL	Diff lock pressure measuring union
Quantity : 1	Material : extruded FE 360
Note: Can be formed from union FOR 113.003-06	



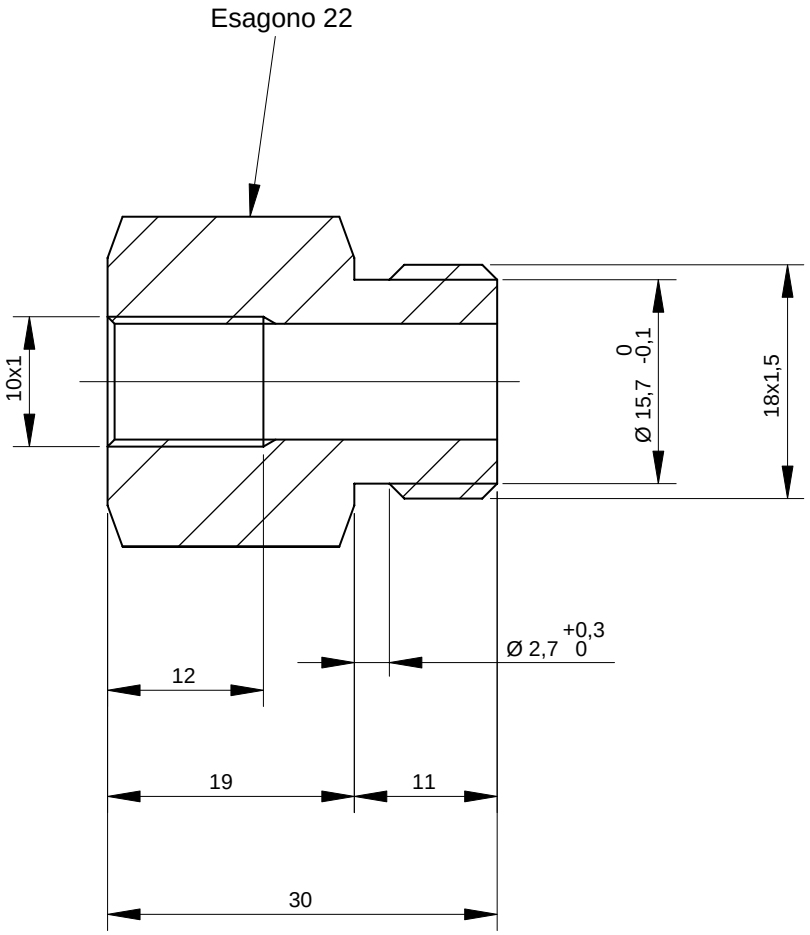
Section 30 : 26 POT VS



c26 POT VS	Wrench for the PTO ring nut.
Quantity : 1	Material : C40 UNI 7845
Note: blend sharp edges	

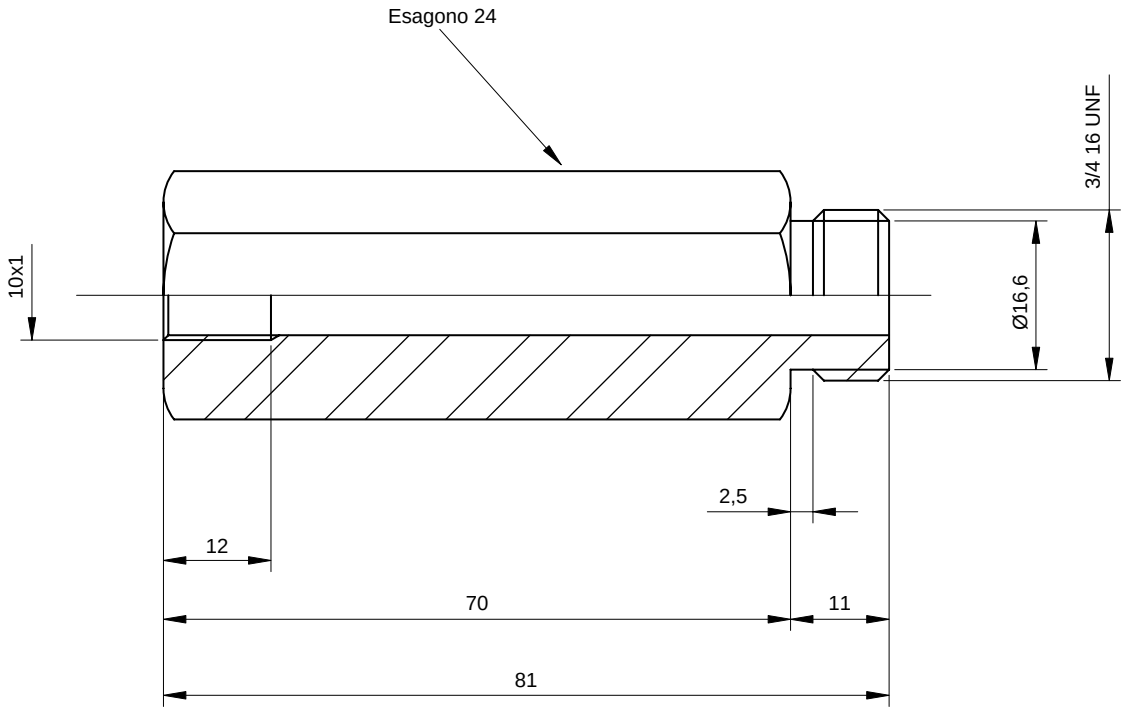


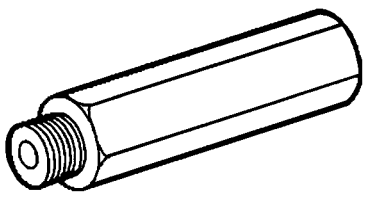
Section 31 : 02 IDR MYT



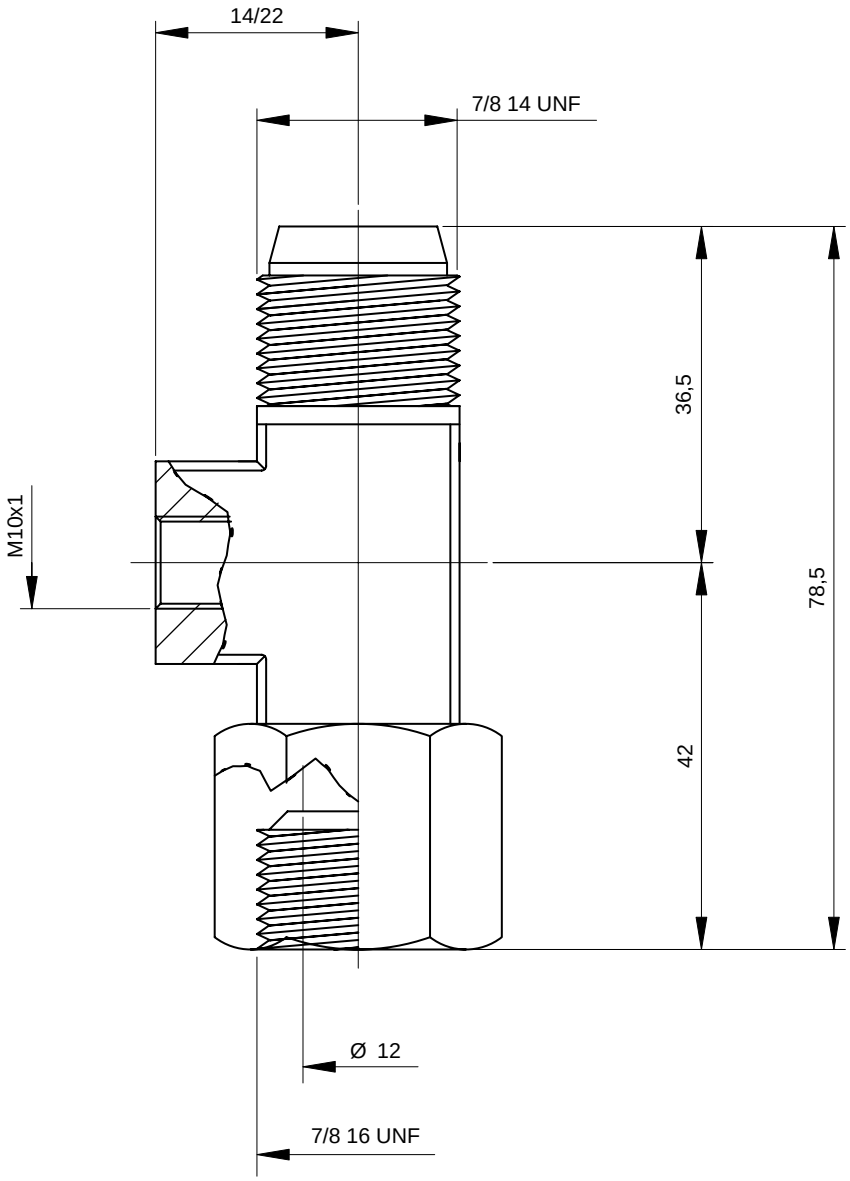
02 IDR MYT	Trailer brake pressure measuring union. To be used with a standard “female” union	
Quantity : 1	Material : extruded FE 360	
Notes :		

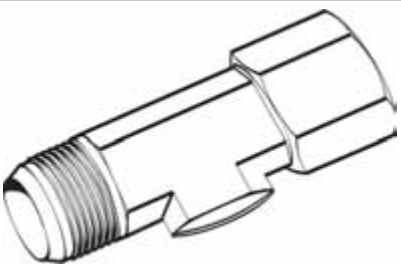
Section 32 : 03 IDR MYT



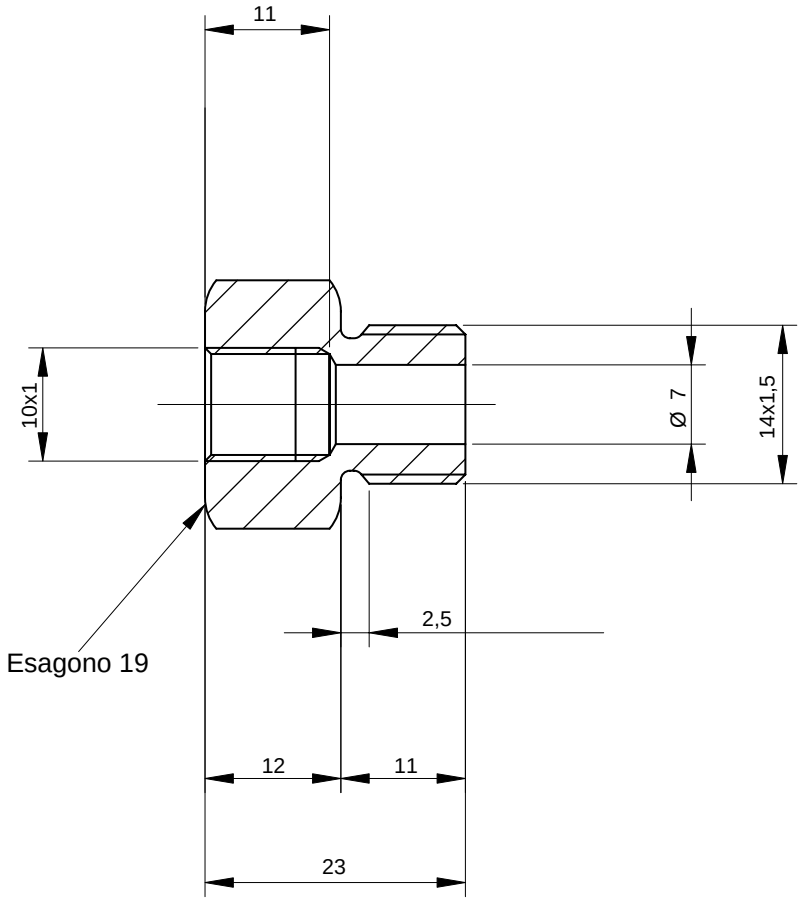
03 IDR MYT	Union for measuring the pressure of auxiliary control valves. To be used with a “male” union for quick coupling	
Quantity : 1	Material : extruded FE 360	
Notes :		

Section 33 : 05 IDR MYT



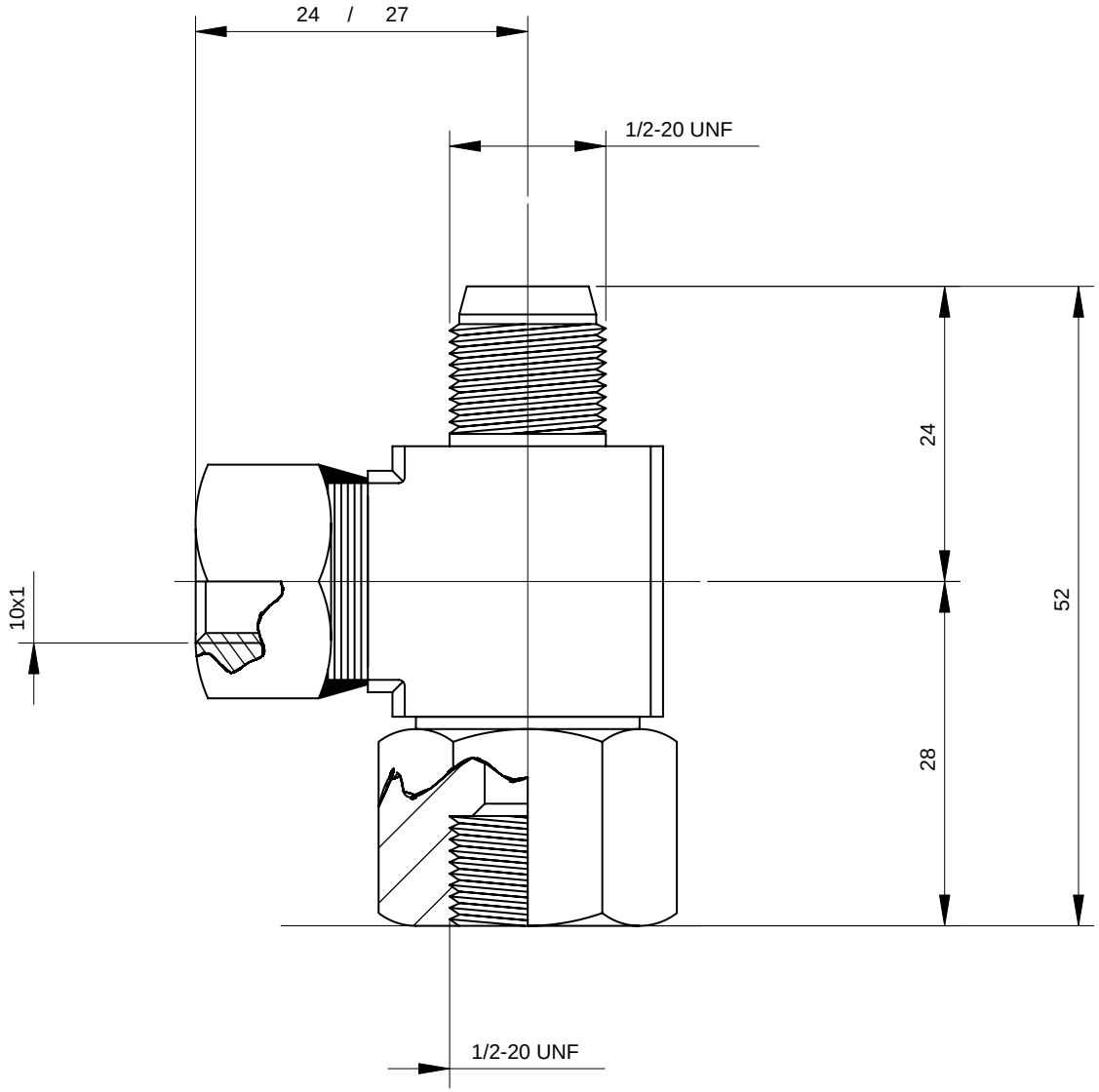
05 IDR MYT	Cooling circuit pressure measuring union	
Quantity : 1	Material : extruded FE 360	
Notes : Use union FOR 113,003-15		

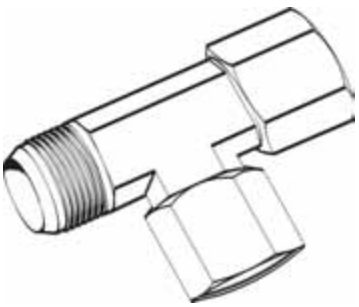
Section 34 : 01 IDR REX



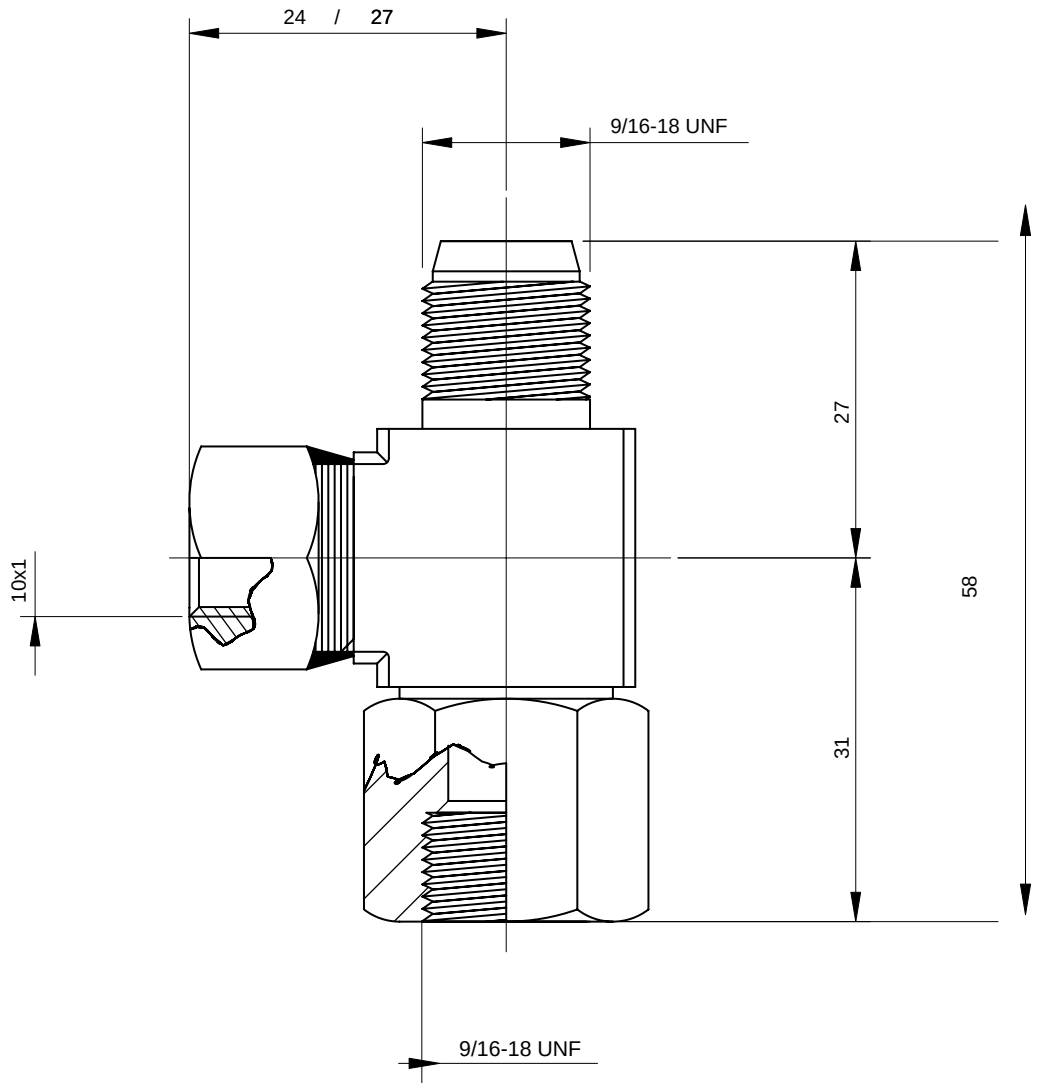
01 IDR REX	Lift pressure measuring union	
Quantity : 1	Material : extruded FE 360	
Notes :		

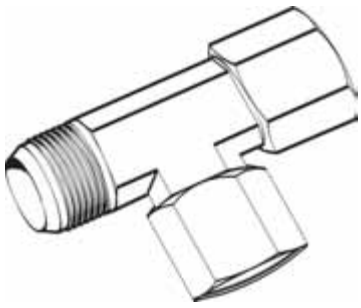
Section 35 : 02 IDR REX



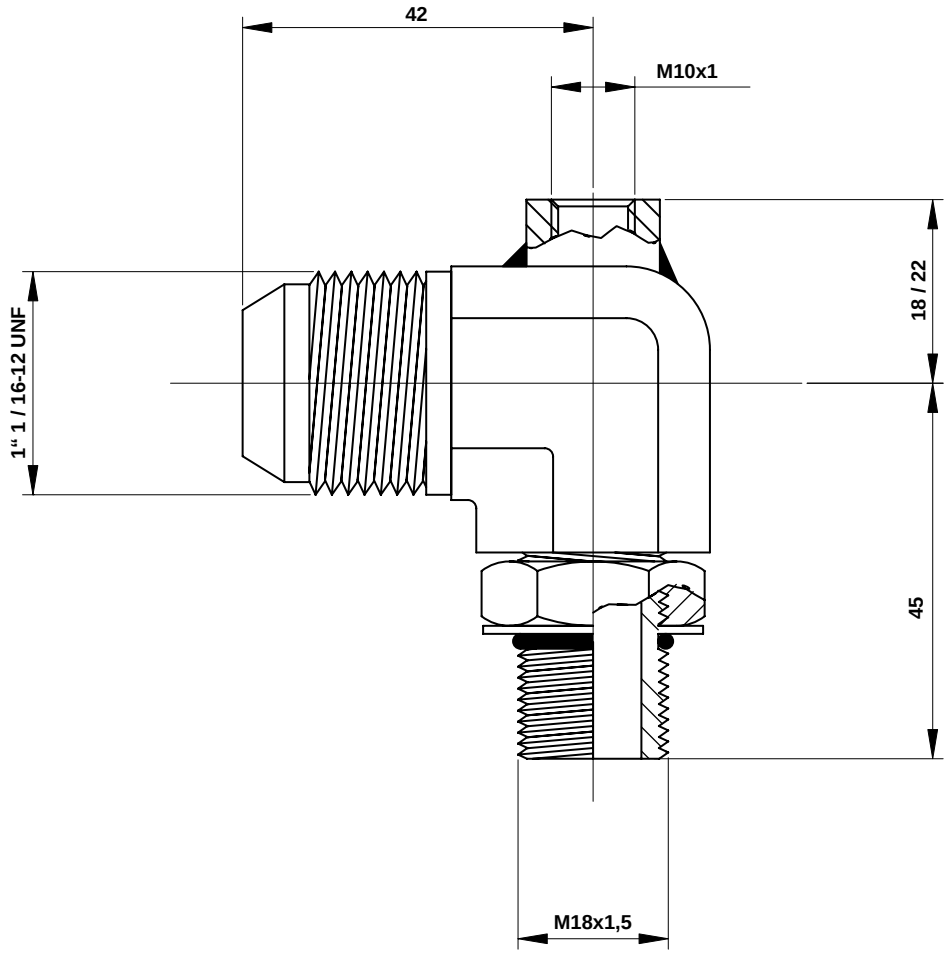
02 IDR REX	4WD engagement pressure measuring union	
Quantity : 1	Material : extruded FE 360	
Note: Use union FOR 113003-08		

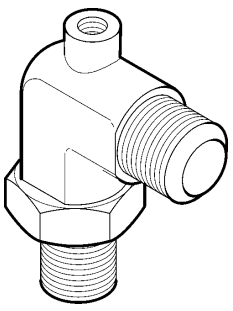
Section 36 : 03 IDR REX



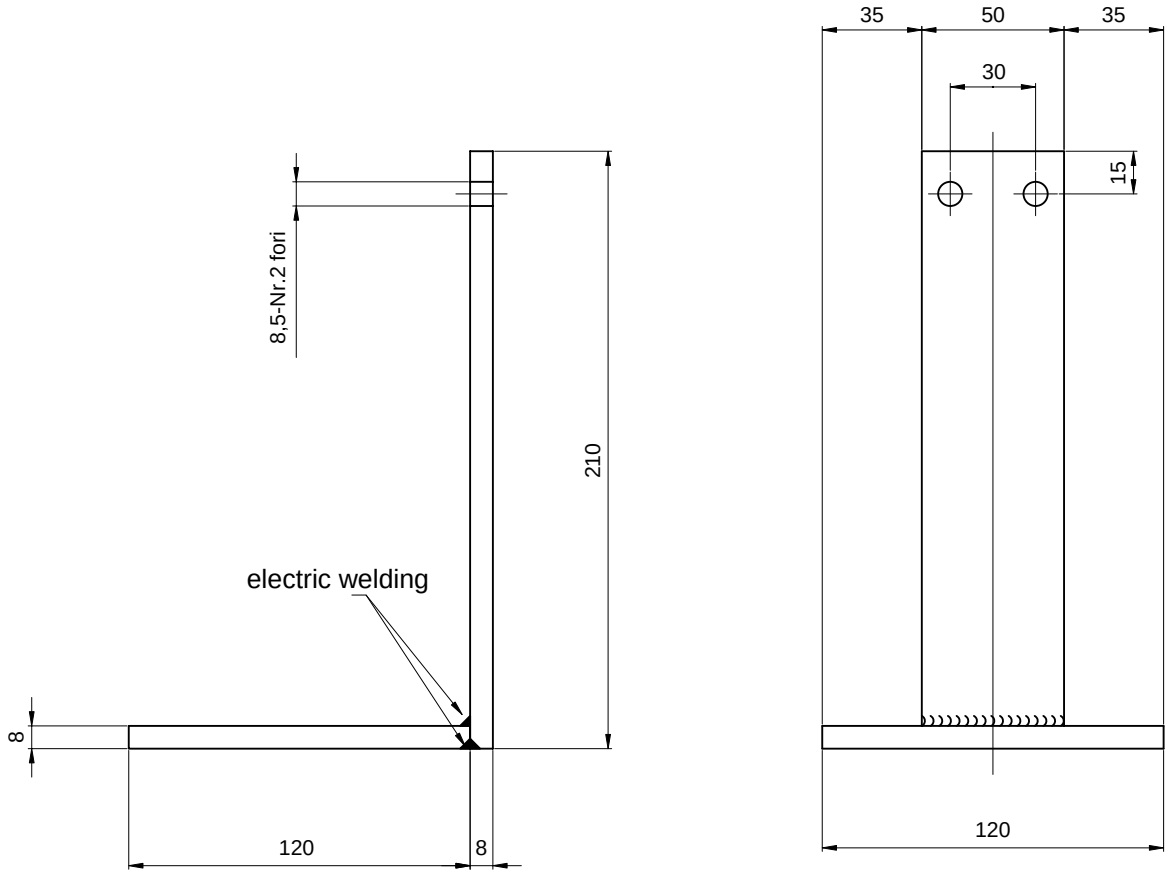
03 IDR REX	Steering circuit pressure measuring union	
Quantity : 1	Material : extruded FE 360	
Note: Use union FOR 113003-10		

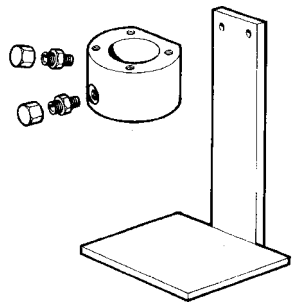
Section 37 : 05 IDR REX



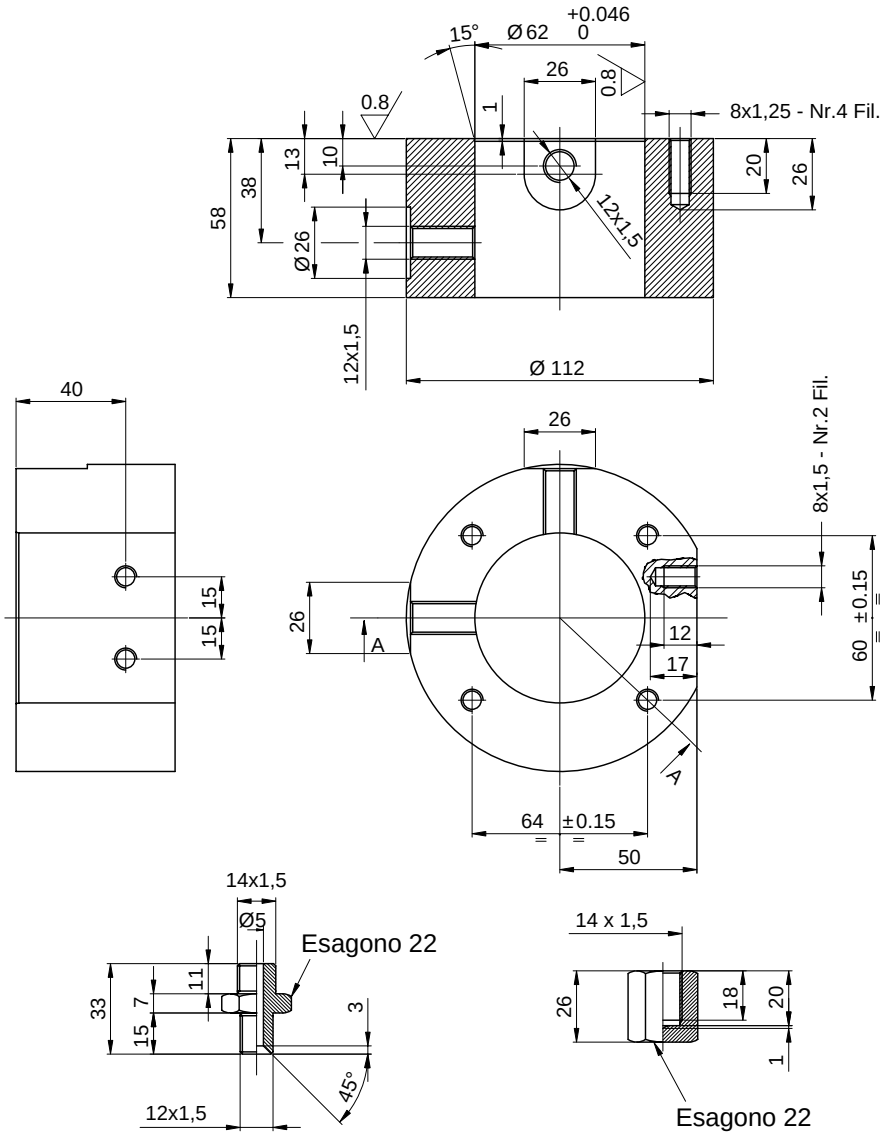
05 IDR REX	Lift pressure measuring union	
Quantity : 1	material: extruded FE 360	
Notes : blend sharp edges		

Section 38 : CR 342 a

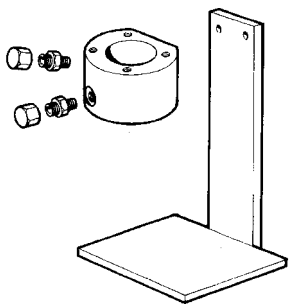


CR 342 a	Tool to check hydraulic lift control valve	
Quantity : 1	Material : C40 UNI 7845	
Notes :		

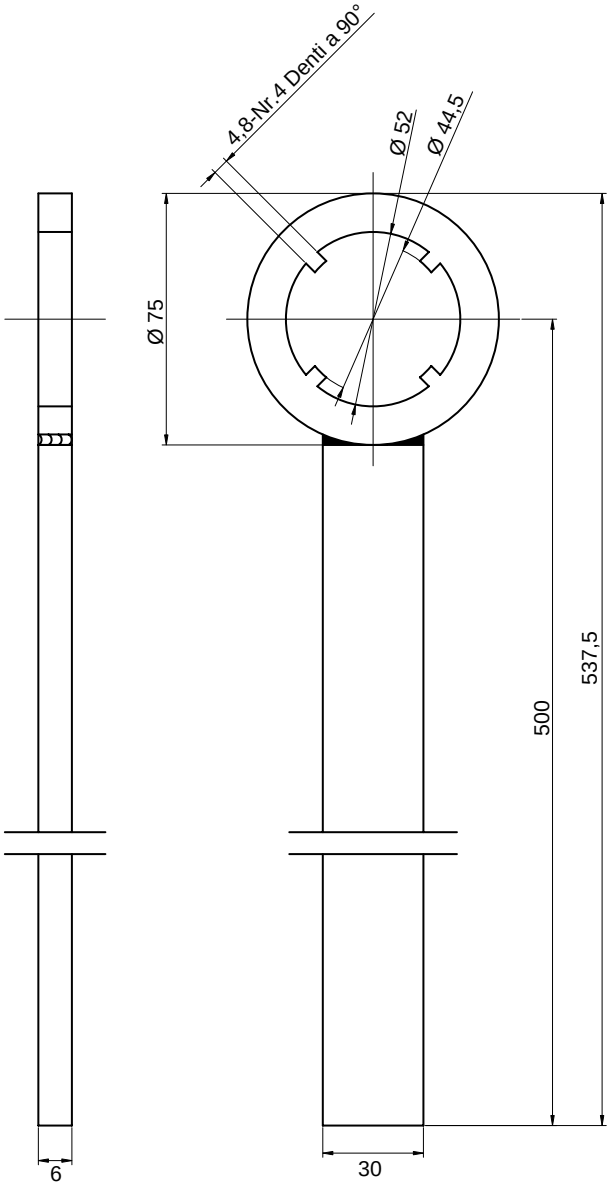
Section 39 : CR 342 b

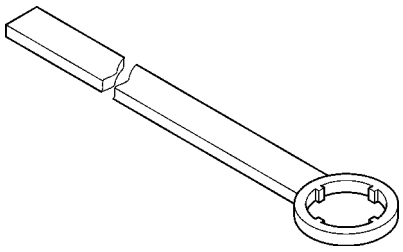


CR 342 b	Tool to check hydraulic lift control valve
Quantity : 1	Material : 38NiCrMo4 UNI 7845
Notes :	

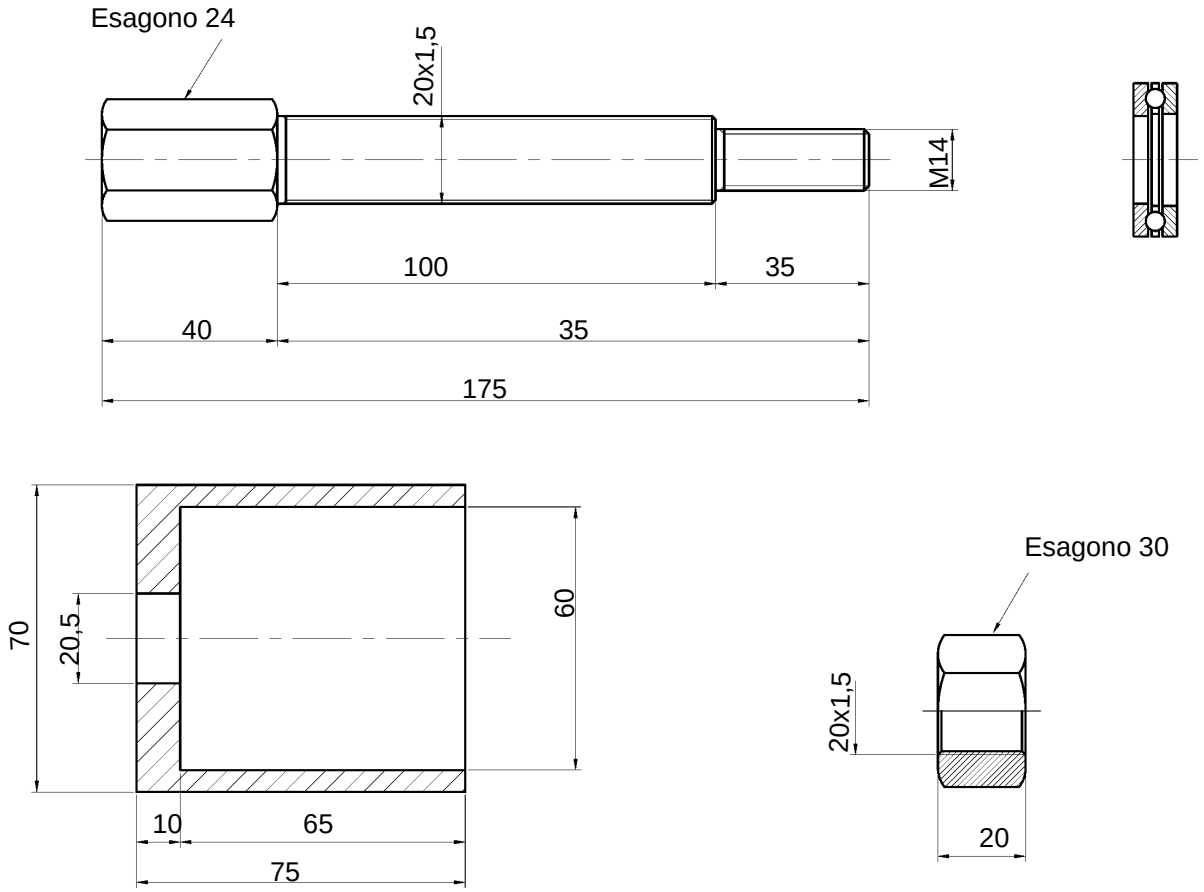


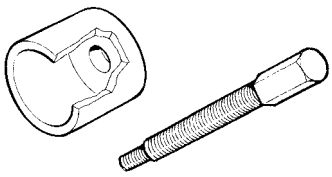
Section 40 : CR 347



CR 347	Wrench for 4WD differential ring nuts	
Quantity : 1 per component	Material : C40 UNI 7845	
Notes :		

Section 41 : R 504



R 504	Puller for hinge pins of the fork bearing the 4WD axle final drive	
Quantity : 1 per component	Material : 30NiCrMo12 UNI 7845	
Notes :		

PRE-SALE SERVICE
42042 FABBRICO (RE) ITALY

PRE-SALE SERVICE

42042 FABBRICO (RE) ITALY
Created by: DALET