

SECTION 5

BRAKE

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GENERAL DESCRIPTION

When the foot brake pedal is depressed, hydraulic pressure is developed in the master cylinder to actuate pistons (two in front and two in rear). The master cylinder is a tandem master cylinder and consists of two separate circuits. Front brake circuit is connected in parallel (left and right) and rear brake in series (left and right) proportioning valve is located in between master cylinder and rear brake.

Front brake is a disc type and rear brake is a leading trailing shoe type drum brake.

Parking brake system is mechanical, It applies brake force to only rear wheels by means of the cable.

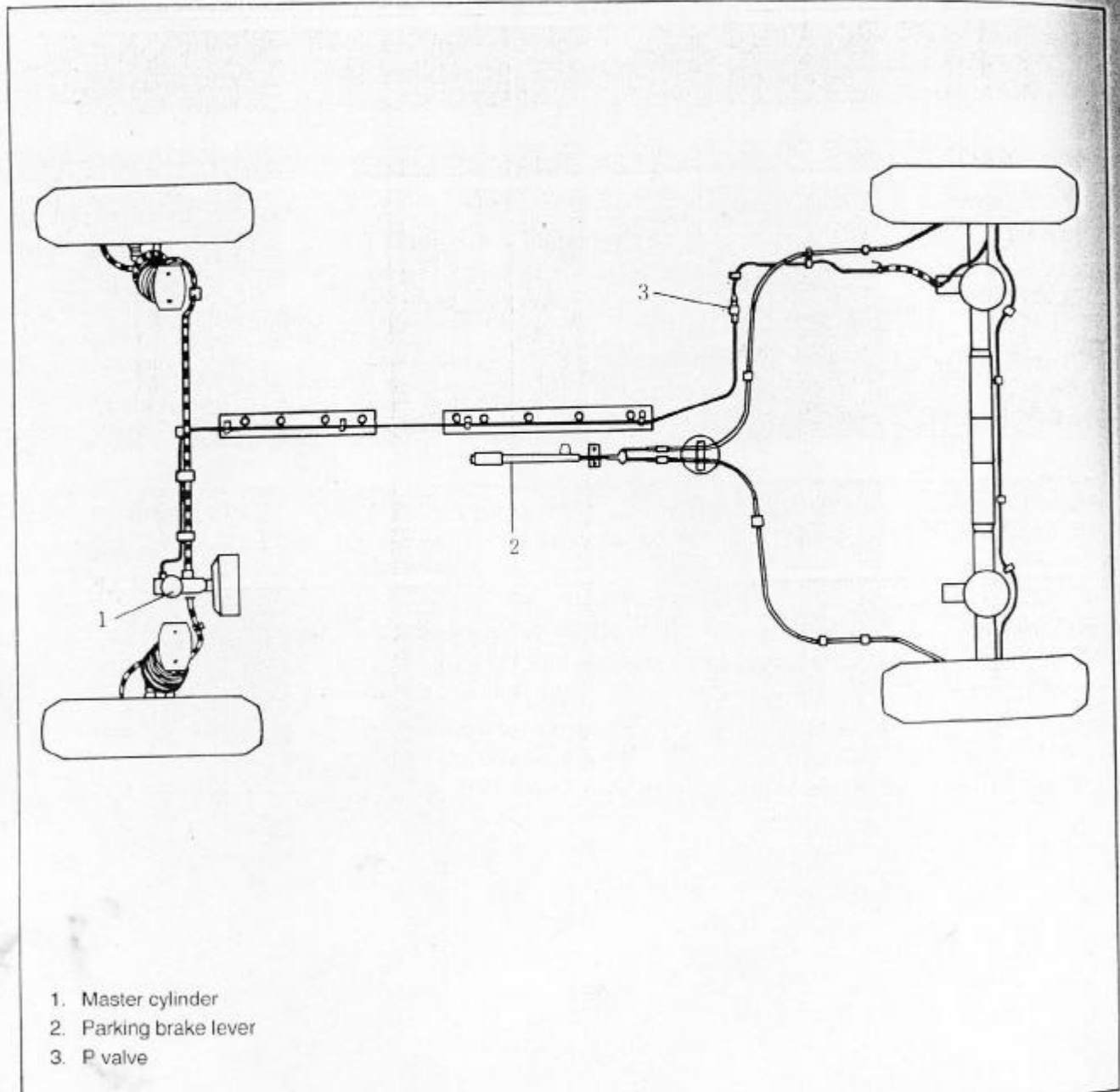


FIG. 5 — 1 BRAKE LINE

DISC BRAKE CALIPER

Disc brake is installed in the front wheels.

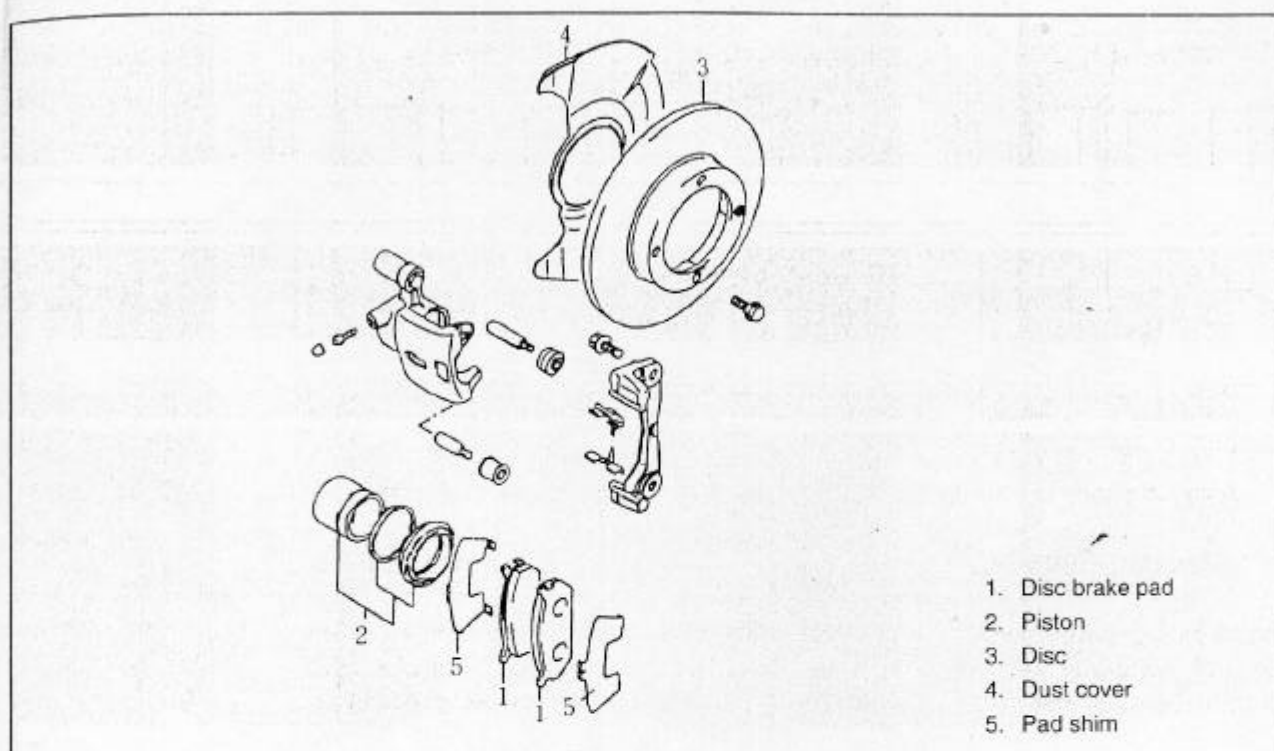


FIG. 5 — 2 DISC BRAKE CALIPER

Caliper Operation

The single piston floating caliper type brake is employed in this car, and one cylinder and one piston are conformed of integrity.

Fluid pressure generated in the cylinder causes the pad(1) on the piston side to press against the disc.

At the same time the floating type caliper body is moved to the right by the cylinder pressure as shown in figure which pulls pad(2) against the disc and so brakes the wheel.

The disc brake has no servo assistance and it is necessary to increase the working pressure of the piston and pad. For this purpose the wheel cylinder has a large bore.

Even only a little change in clearance between the disc and pad has therefore a large influence on the brake pedal stroke. It is necessary to keep the clearance adjusted to the minimum at all times, by means of the piston (rubber) seal.

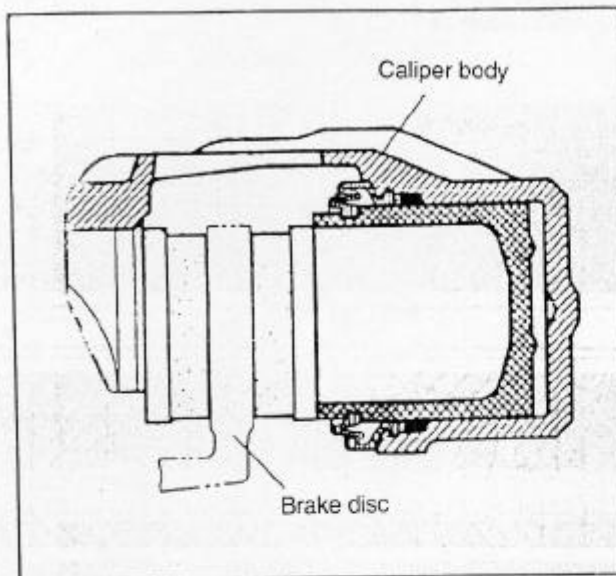


FIG. 5 — 3 CALIPER OPERATION

Clearance Calibration

When the oil pressure is applied to the piston, the piston moves leftward. The rubber seal, which extends considerable pressure against the piston, moves with the cylinder.

However, as a part of the rubber seal has been fixed into a groove in the cylinder, the shape of the rubber seal is as shown in below figure, distorted toward the piston moving direction.

When pressure is taken off from the foot brake pedal and fluid pressure is released from the piston, a restoring elastic force is generated at the seal and pushes the piston rightward and back it in original position.

As the pads wear away and the clearance between disc and pads becomes larger, the piston moves a larger distance.

The seal then could change in shape further, but since the end of the seal is fixed into the groove in the cylinder, the distortion is limited to the same amount as previously described.

The piston moves further to cover the distance of clearance. As the piston returns by the same distance and the rubber seal recovers its original shape, the clearance between the disc and pads is maintained in original condition.

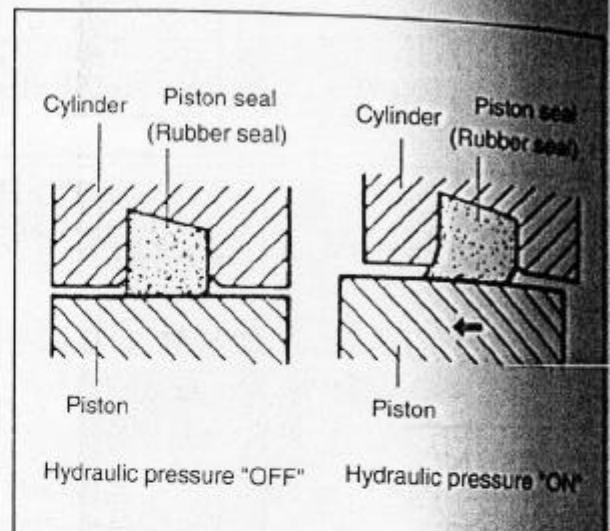


FIG. 5 — 4 PISTON SEAL OPERATION

DRUM BRAKE

The drum brake assembly includes an auto adjuster so that drum-to-shoe clearance is maintained appropriate at all times.

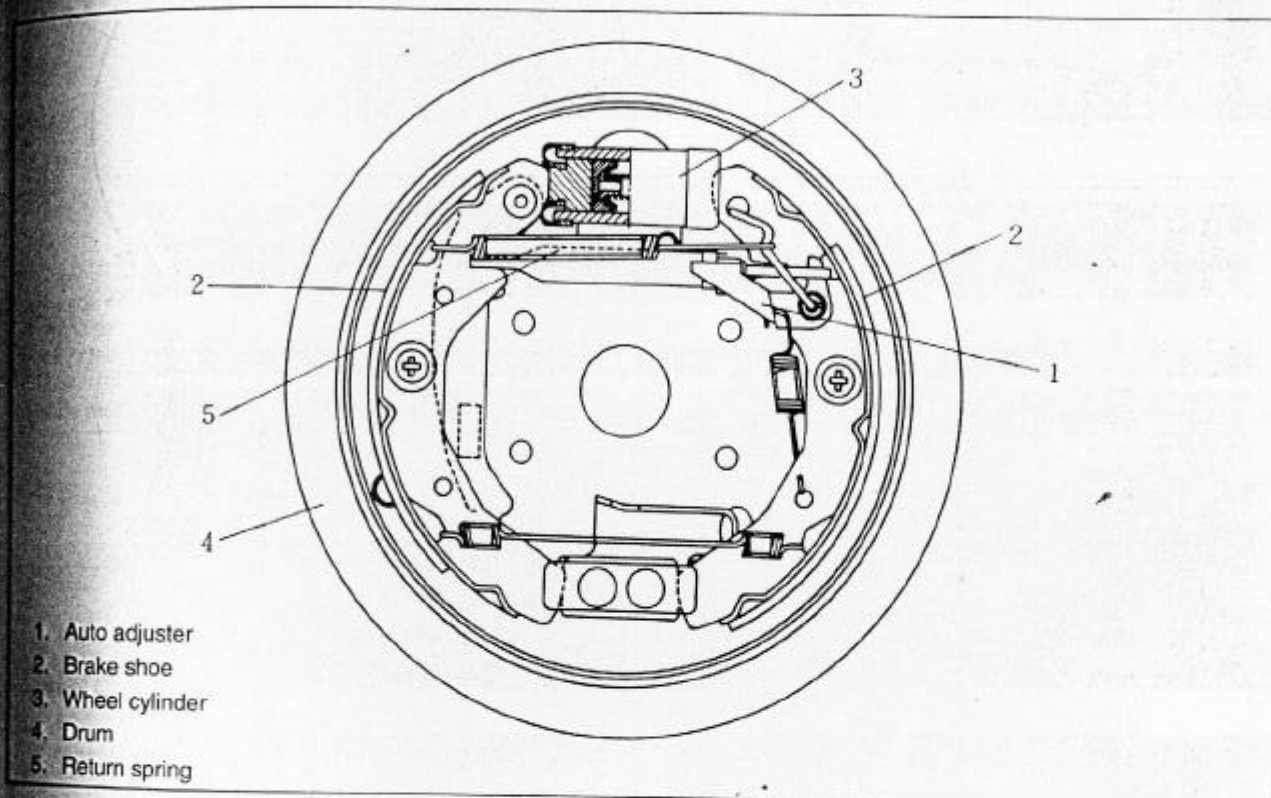


FIG. 5 — 5 DRUM BRAKE

Brake Operation

When the pedal is depressed, drum brake makes two pistons in the wheel cylinder extend the brake shoe outward and restrain drum revolution.

The more the brake shoes get worn the larger distance the pistons move.

As a result the brake pedal stroke is increased. Then the clearance between the drum and shoe must be adjusted by the shoe adjusting screws.

In general the periodical adjustment is required for drum brake.

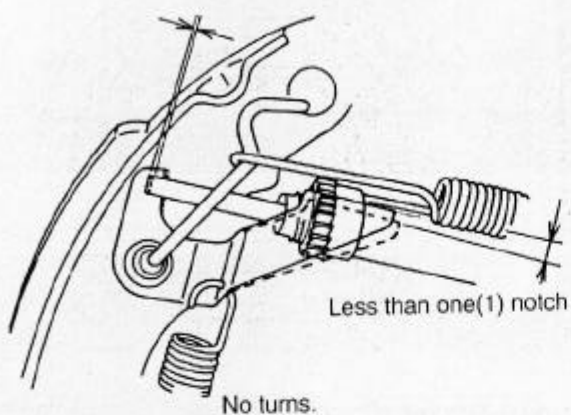
This rear brake is provided with an auto adjuster which automatically adjusts the shoe-to-drum clearance caused by such brake shoe wear.

Piston, piston cup and piston spring are assembled in the wheel cylinder.

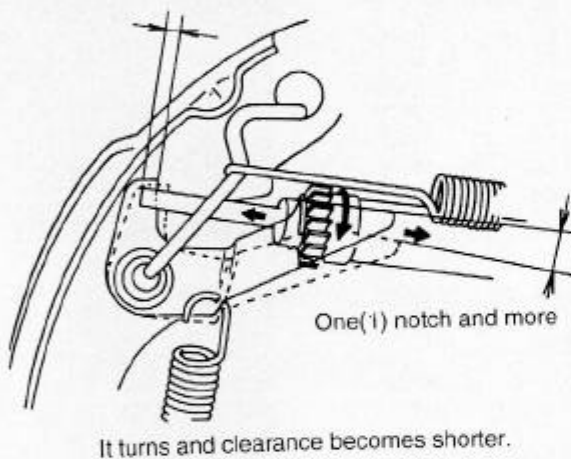
When the brake pedal is depressed, fluid pressure is applied to the inside of the chamber on the pistons being actuated by this pressure the piston presses the brake shoe against the drum, thus producing brake force.

Rear Wheel brake Clearance Auto Adjuster

① When clearance is proper.



② When clearance is excessive.



③ When shoe was worn.

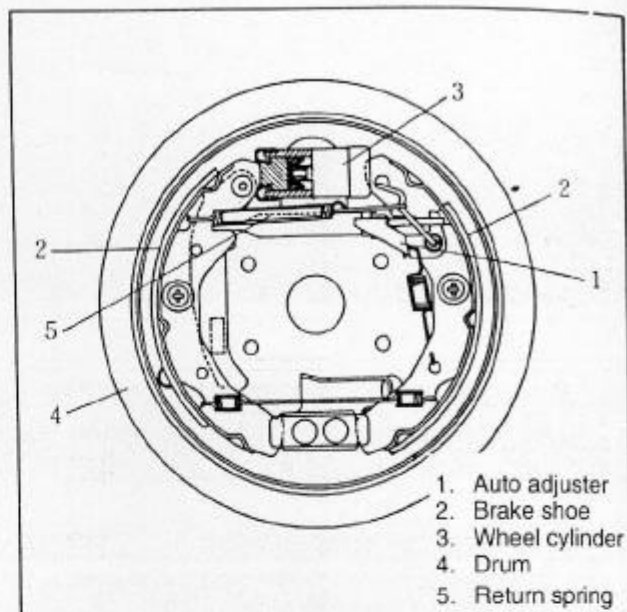
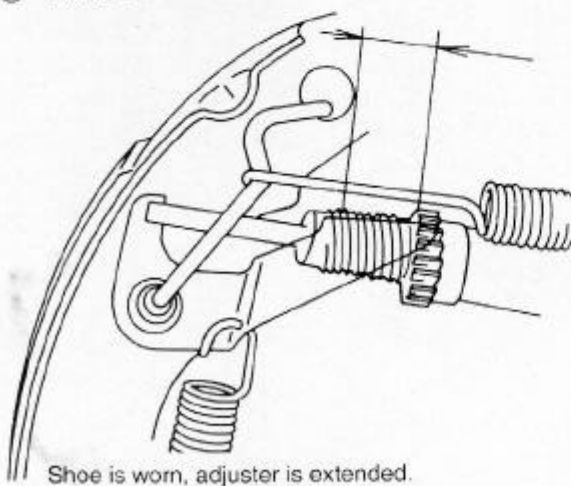


FIG. 5 — 7 DRUM BRAKE

FIG. 5 — 6 CLEARANCE CALIBRATION

MASTER CYLINDER

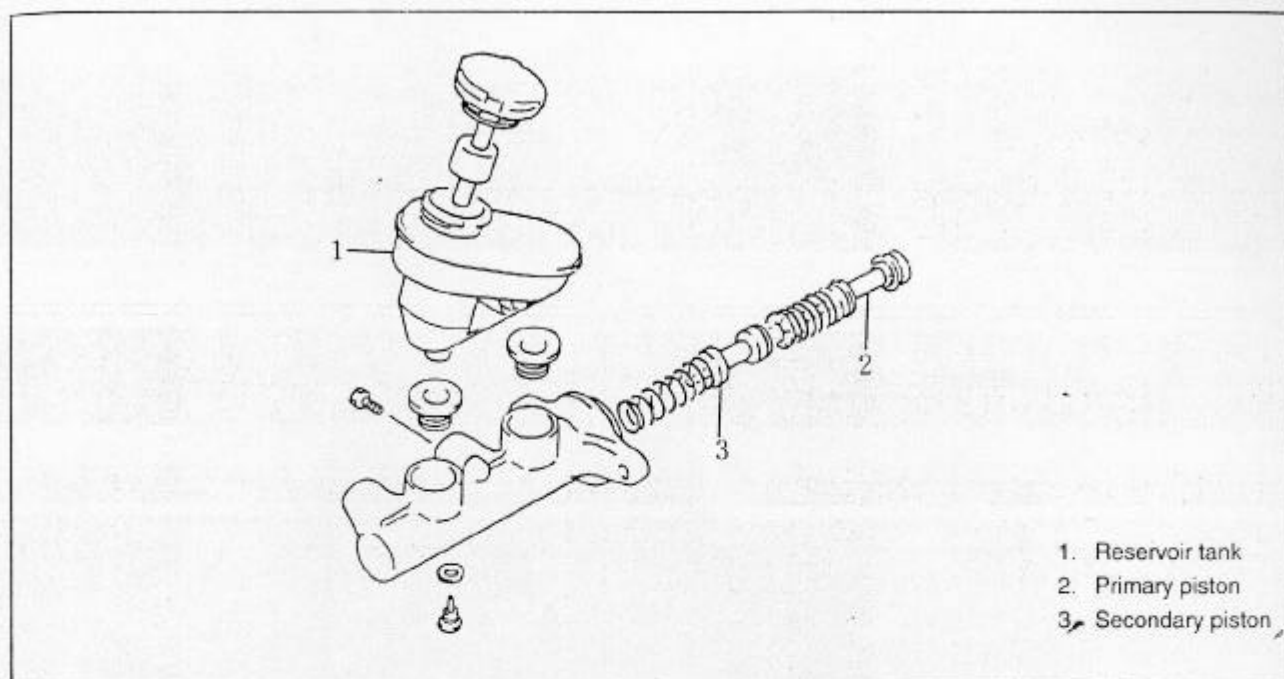


FIG. 5 — 8 MASTER CYLINDER DISASSEMBLY

Master Cylinder Assembly

The master cylinder has two pistons and three piston cups. Its hydraulic pressure is generated in the primary chamber("a") and secondary chamber("b").

The hydraulic pressure produced in the primary chamber("b") acts on the rear brake and the secondary chamber("a") acts on the front brake (left and right).

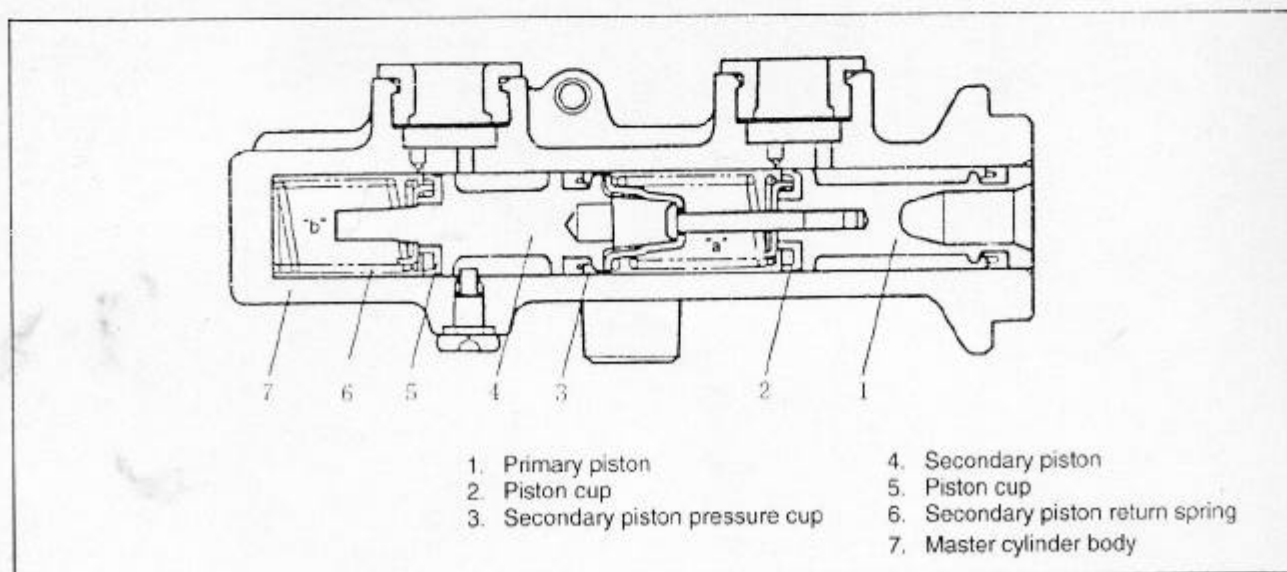


FIG. 5 — 9 MASTER CYLINDER STRUCTURE

Master Cylinder Operation

Depressing the brake pedal forces the primary piston to move to the left, and consequently the hydraulic pressure produced in the chamber "a".

By means of this pressure and the return spring force the secondary piston is also pushed to the left and the hydraulic pressure is also produced in the chamber "b".

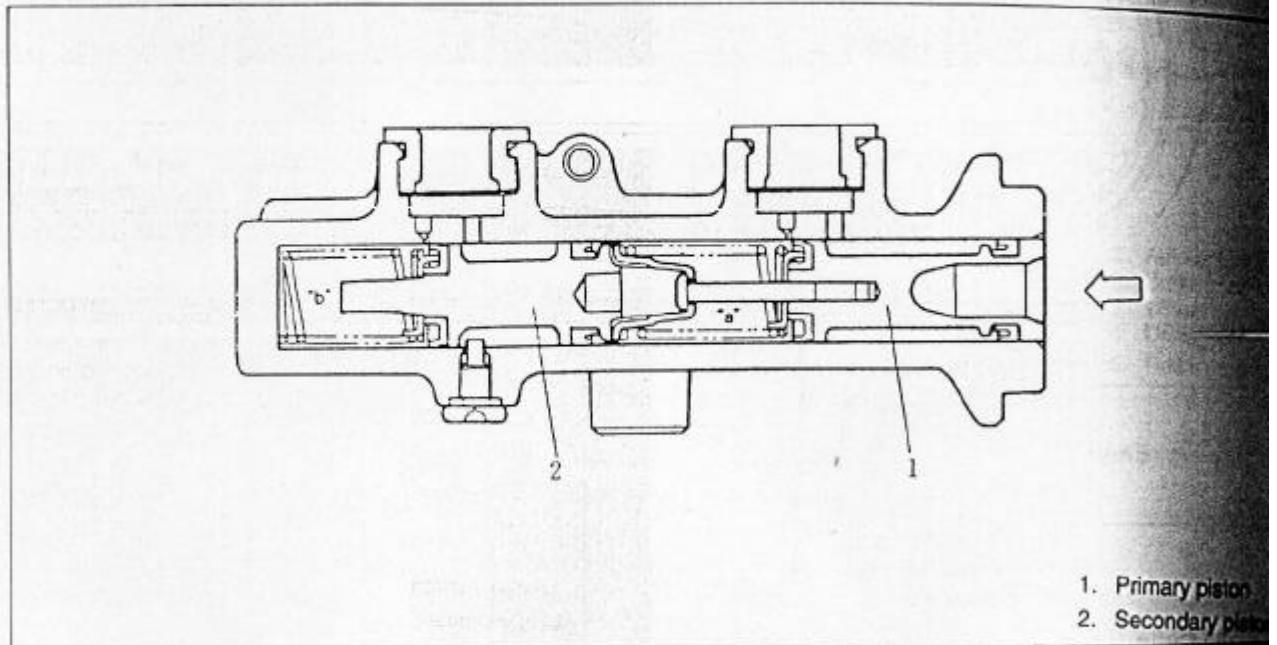


FIG. 5 — 10 MASTER CYLINDER OPERATION

PROPORTIONING VALVE

Proportioning valve controls the rear wheel lock by governing the hydraulic pressure produced in the rear wheel cylinder.

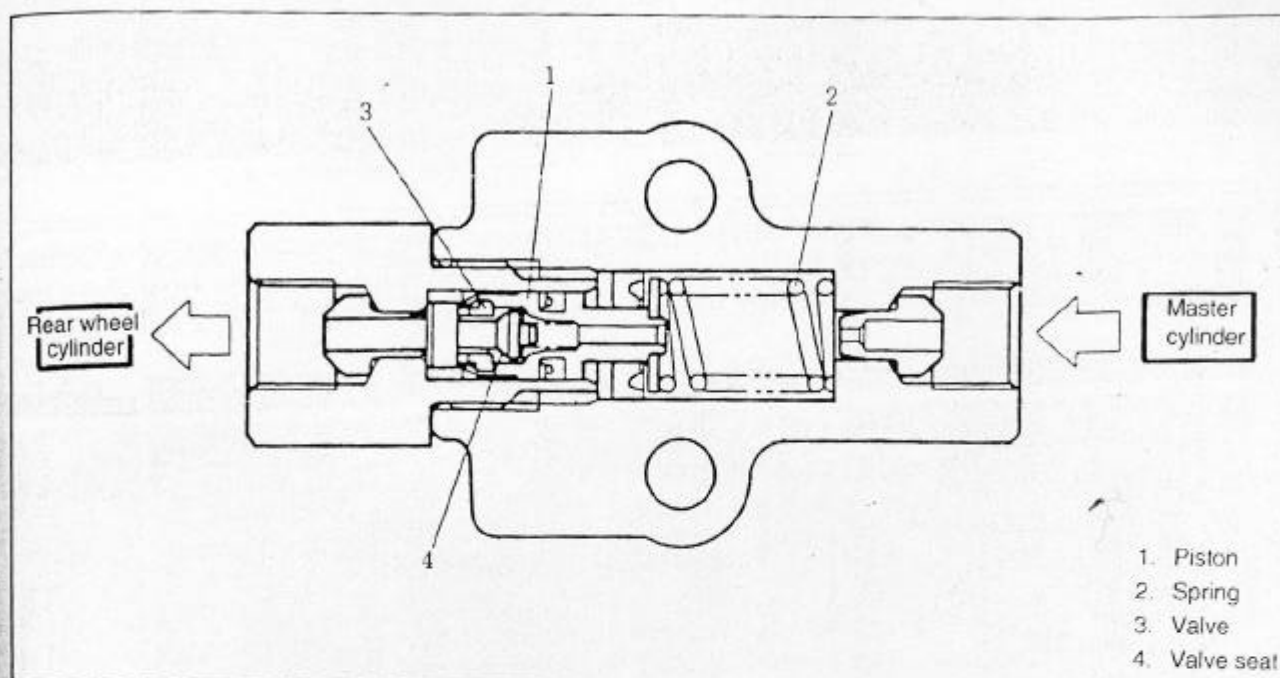


FIG. 5 — 11 PROPORTIONING VALVE

Non Operational

When the master cylinder pressure is below split point

Piston is pushed to left by spring and there is clearance between valve and valve seat. Therefore the master cylinder pressure is activated in rear wheel cylinder itself.

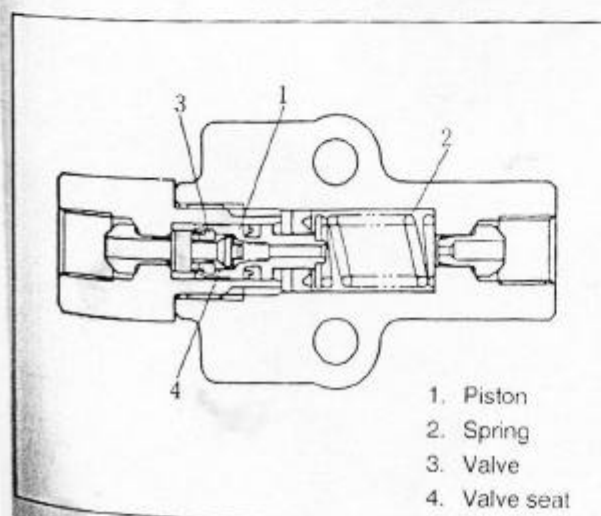


FIG. 5 — 12

Operational

When the master cylinder pressure is above split point

Valve is moved to right by the force produced in the "A" area and the valve seat is connected to valve then rear wheel cylinder path is closed.

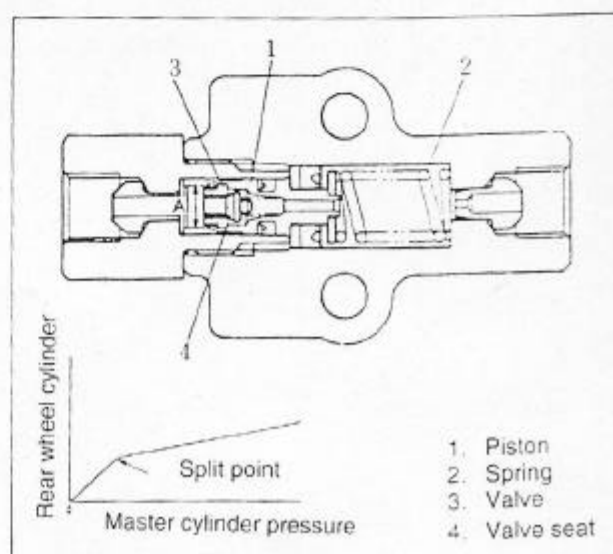
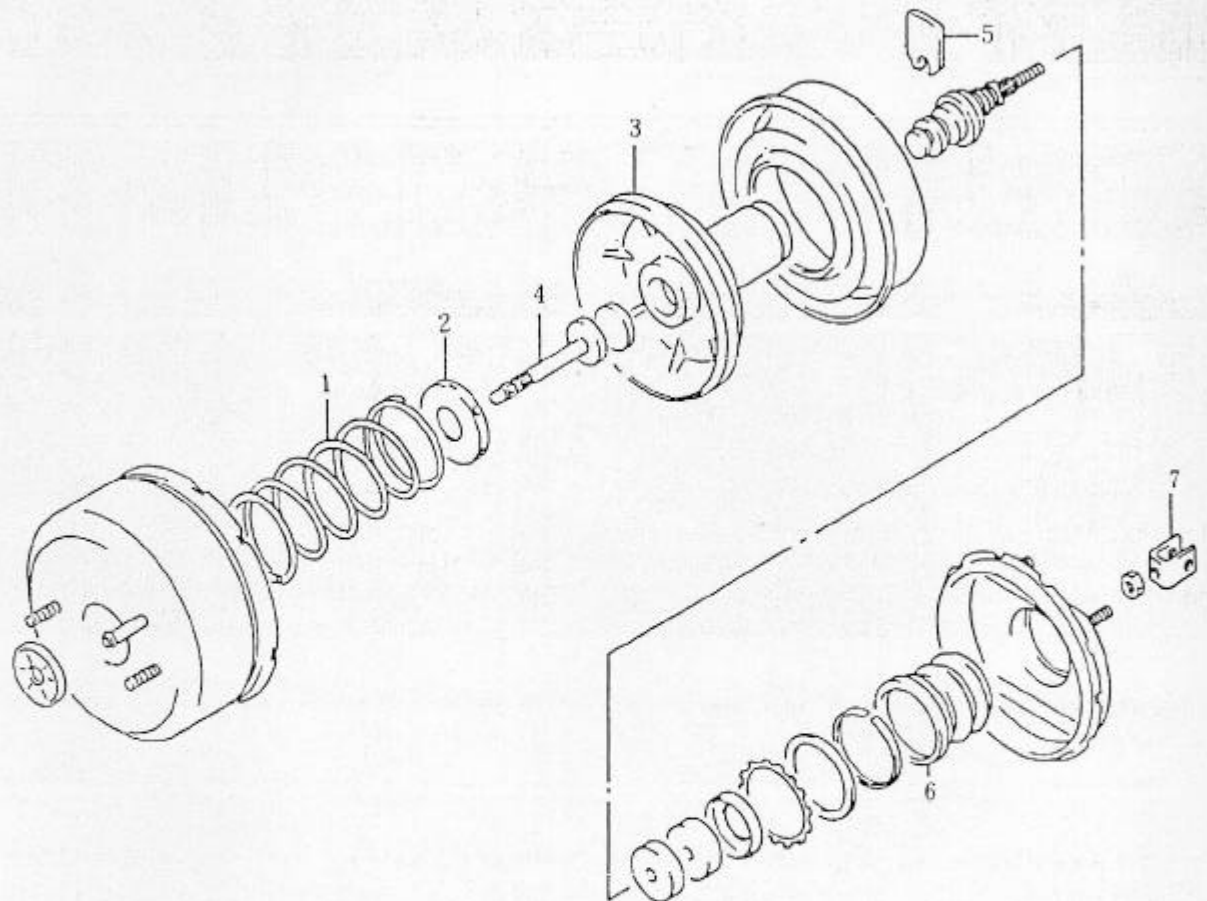


FIG. 5 — 13

BOOSTER ASSEMBLY

Booster is a unit which reduces the leg power of brake pedal by using the pressure difference between the negative pressure produced in the intake manifold and the ambient pressure.



- | | |
|--------------------------|----------------------|
| 1. Booster piston spring | 5. Valve stopper key |
| 2. Piston rod stopper | 6. Boot |
| 3. Booster piston | 7. Push rod clevis |
| 4. Piston rod | |

FIG. 5 — 14

Booster Operation

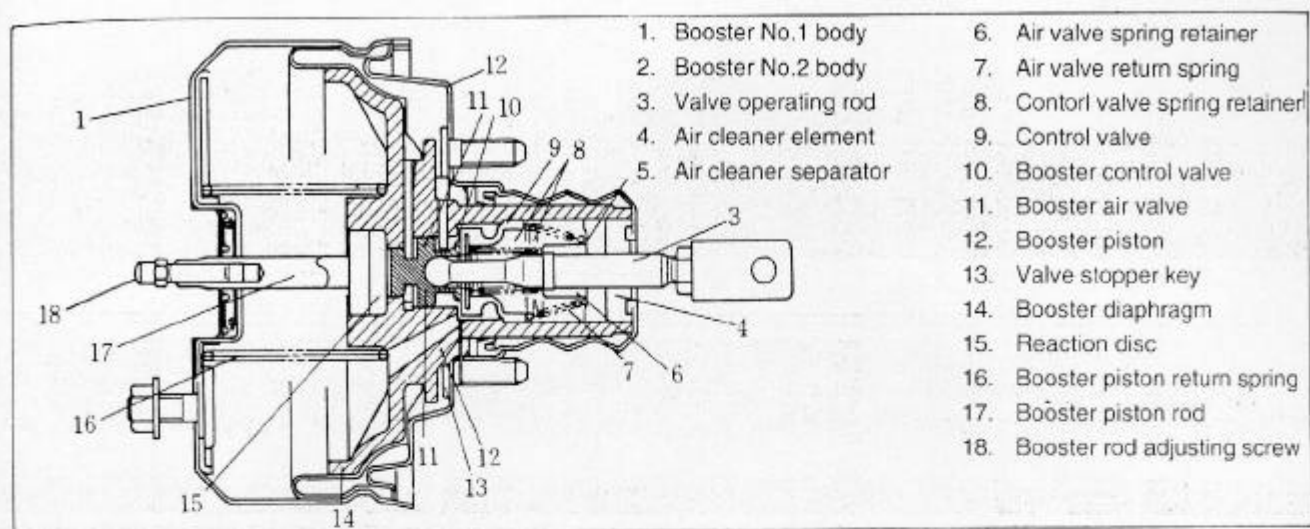


FIG. 5 — 15 VACUUM BOOSTER ASSEMBLY

When the brake pedal is depressed, the force is transmitted to the master cylinder piston through the valve operating rod, booster air valve, reaction disc and piston rod.

At the same time, the force of the booster piston developed due to the pressure difference between the two chambers "A" and "B" is added to it. The booster control valve has a double function of a vacuum valve and air valve.

That is, as shown in below figure, the booster control valve closes between the "A" and "B" chambers as its outer end "C" contacts the booster piston seat (vacuum valve function).

Also it closes between the "B" chamber and outside air as its inner end "D" contacts the air valve seat and opens as "D" leaves the air valve seat (air valve function).

When foot brake pedal is not depressed.

The valve operating rod is pushed to the right by the spring force as shown. The air valve is also contacts to the right valve stopper key as shown. In this state, the vacuum valve (control valve "C") is open and the air valve (control valve "D") is closed. Thus the chamber "A" and "B" conduct and share the same negative pressure (because of no pressure difference) which allows the return spring to push the booster piston to the right.

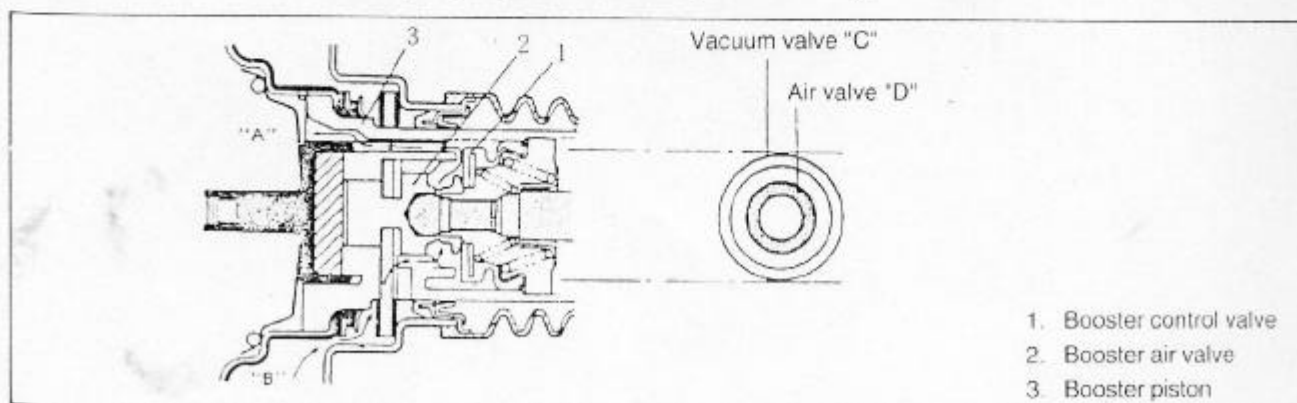


FIG. 5 — 16 BOOSTER (NOT OPERATIONAL)

When brake pedal is depressed.

Being pushed by the operating rod the booster air valve moves to the left as shown.

Then the control valve is pushed against the booster piston seat closely by the valve spring force. Thus the vacuum valve(control valve "C") is closed to cut off between the chambers "A" and "B". At this time the air valve(control valve "D") is still closed.

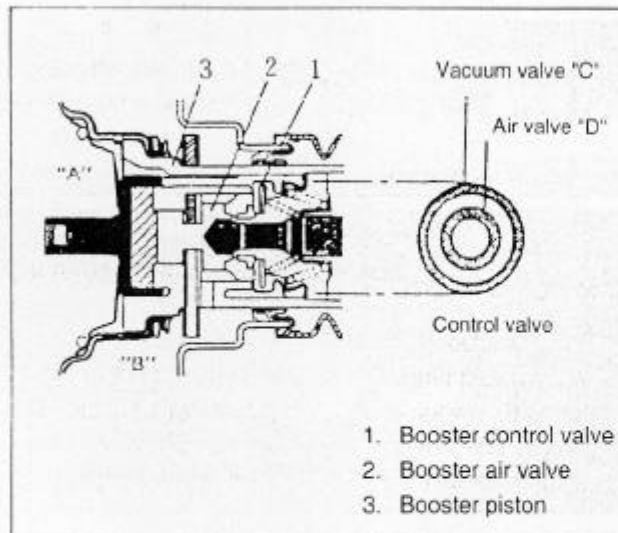


FIG. 5 — 17 BOOSTER(BEGIN TO OPERATE)

As the booster air valve moves further to the left, it moves away from the control valve and the air valve(control valve "D") opens to allow the air to flow into the chamber "B". The entry of air causes a difference in pressures between the chambers "A" and "B". When this pressure difference grows greater than the piston return spring force, the booster piston removes to the left and the booster control valve also removes to the left.

The resulting air valve(control valve "D") closure stops the airflow into the chamber "B" and its pressure remains as it is. In this way brake pedal depressing force is made into a strong push to the master cylinder push rod to produce high hydraulic pressure.

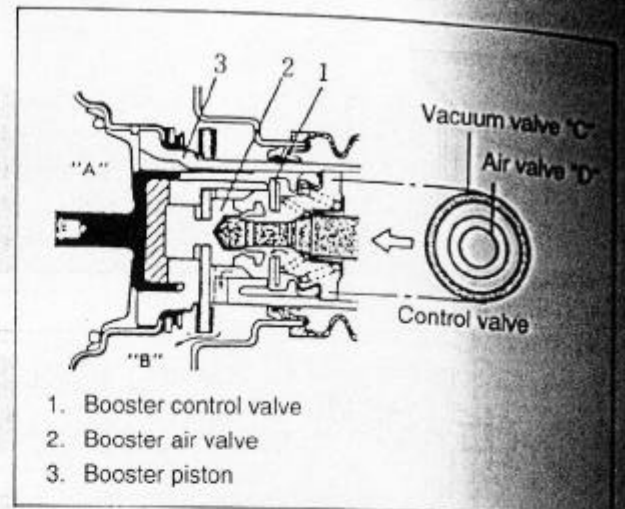


FIG. 5 — 18 BOOSTER (OPERATION)

When the brake pedal is released.

When the brake pedal is released, the booster air valve returns to the right by the master cylinder piston return force and the air valve return force as shown. Then the vacuum valve(control valve "C") opens and causes negative pressure in the chamber "B". The result is that the master cylinder piston and booster piston return to their original positions.

This is the same state as described under when the brake pedal is not depressed.

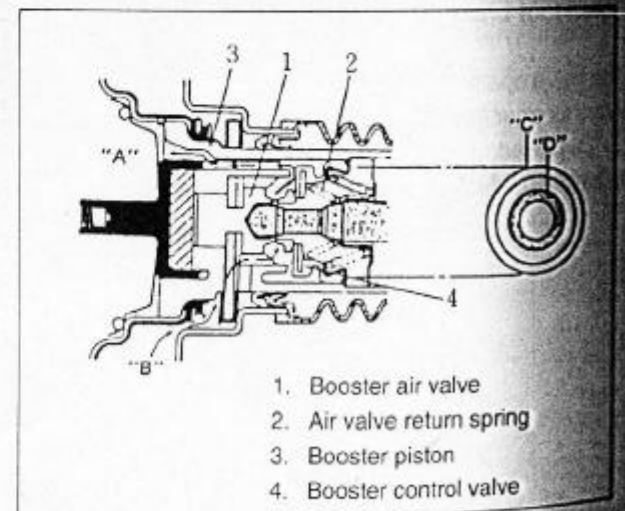


FIG. 5 — 19 BOOSTER(RELEASED)

Reference

Should any of the vacuum related parts in the booster be faulty, the brake force is not increased. Even then, however, the brake depressing force is transmitted to the valve operating rod, booster air valve, valve stopper key and booster piston in that order, to push the master cylinder push rod.

Thus the brake operation will not fail even though the vacuum related parts is in faulty.

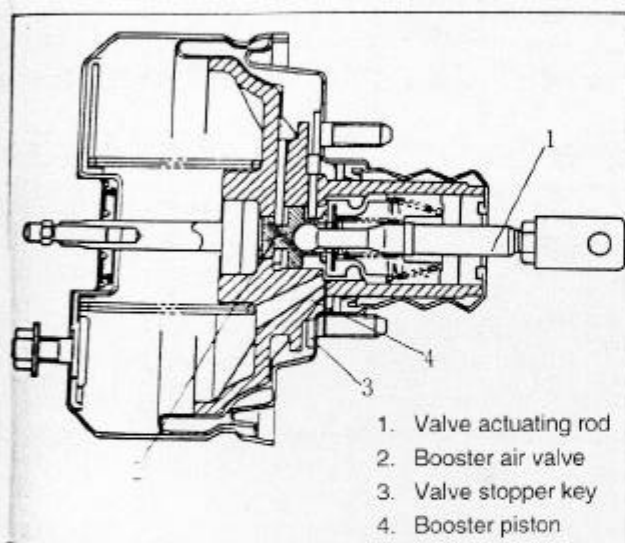


FIG 5 — 20 BOOSTER

TROUBLESHOOTING

Condition	Probable Cause	Correction
Not enough braking force	<ul style="list-style-type: none"> • Brake oil leakage from brake lines • Brake disc or pads stained with oil • Overheated brakes • Unmatched brake shoes • Brake shoe linings stained with oil • Badly worn brake shoe linings • Wheel cylinder condition faulty • Malfunctioning caliper assembly • Air in system 	<ul style="list-style-type: none"> • Locate leaking point and repair • Clean or replace • Determine cause and replace • Adjust as prescribed • Replace • Replace • Repair or replace • Repair or replace • Bleed system
Brake unbalanced (Brake is not working in union)	<ul style="list-style-type: none"> • Shoe linings stained with oil • Drum-to-shoe clearance out of adjustment (malfunctioning auto adjuster) • Badly worn drum • Improper tire pressure • Front wheel alignment adjusting faulty • Malfunctioning wheel cylinder • Unmatched tires on same axle • Malfunctioning brake pipes or hoses • Malfunctioning caliper assembly • Loose suspension parts • Loose calipers 	<ul style="list-style-type: none"> • Replace • Check and repair • Replace • Adjust as specified • Adjust as specified • Repair and replace • Use same tires • Replace with new pipes and new hoses • Check for sluggish pistons, proper lubrication of caliper slide bush and caliper slide, and repair • Check all suspension mountings • Check and torque bolts to specifications
Noise, without brake applied	<ul style="list-style-type: none"> • Worn brake disc pad 	<ul style="list-style-type: none"> • Replace pad

Condition	Probable Cause	Correction
Excessive pedal travel	<ul style="list-style-type: none"> • Brake system failure • Insufficient brake fluid • Air in brake system(pedal spongy phenomenon) • Rear brake system not adjusted (malfunctioning auto adjusting mechanism) • Bent brake shoes • Worn rear brake shoes 	<ul style="list-style-type: none"> • Check and replace as necessary • Fill reservoirs with approved brake fluid, check for leaks and air in brake system, check warning light. • Bleed system • Check and repair auto adjusting mechanism, adjust rear brakes • Replace brake shoes • Replace brake shoes
Dragging brakes after pedal is released	<ul style="list-style-type: none"> • Master cylinder pistons not returning correctly • Restricted brake pipes or hoses • Incorrect parking brake adjustment • Sluggish parking brake cables • Weakened or broken return springs • Wheel cylinder or caliper piston sticking 	<ul style="list-style-type: none"> • Repair master cylinder • Replace with new pipes and hoses • Adjust parking brake • Replace cable • Replace springs • Repair
Pedal pulsation	<ul style="list-style-type: none"> • Damaged or loose wheel bearings • Distorted steering knuckle or rear axle shaft • Excessive disc run out • Distorted rear drum 	<ul style="list-style-type: none"> • Replace wheel bearings • Replace knuckle or rear axle shaft • Machine disc or replace • Machine drum or replace
Braking noise	<ul style="list-style-type: none"> • Glazed shoe linings or foreign materials stuck to linings • Worn or distorted shoe linings • Loose front wheel bearings • Distorted back plates or loose mounting bolts 	<ul style="list-style-type: none"> • Check and repair shoe linings, replace if necessary. • Replace shoe lining(or pad) • Replace wheel bearing • Replace back plate, tighten or replace bolts

ON-CAR SERVICE

Pedal Travel Check

1. Start engine.
2. Depress brake pedal two or three times.
3. With brake pedal depressed with about 30kg load, measure pedal arm to wall clearance "B". It must be more than 75mm.

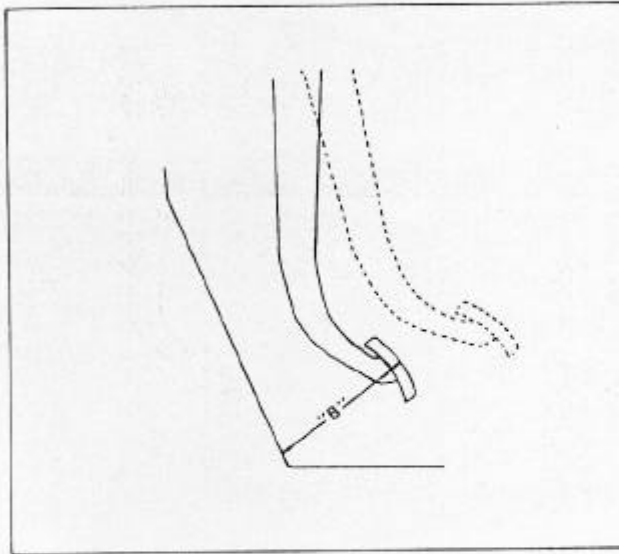


FIG. 5 — 21 BRAKE PEDAL-TO-WALL CLEARANCE MEASUREMENT

4. If clearance "B" is less than 75mm, the most possible cause is either rear brake shoes are worn out beyond limit or air is in lines. Clearance "B" still remains less than 75mm even after replacement of brake shoes and bleeding of system, other possible but infrequent cause is malfunction of rear brake shoe adjusters or booster push rod length out of adjustment.
- Auto clearance adjuster check is performed after removing brake drums. If the faulty is found repair or replace it.

Brake Pedal Play Inspection

Inspect pedal play. Check pedal shaft bolt and master cylinder pin installation for looseness and replace if defective.

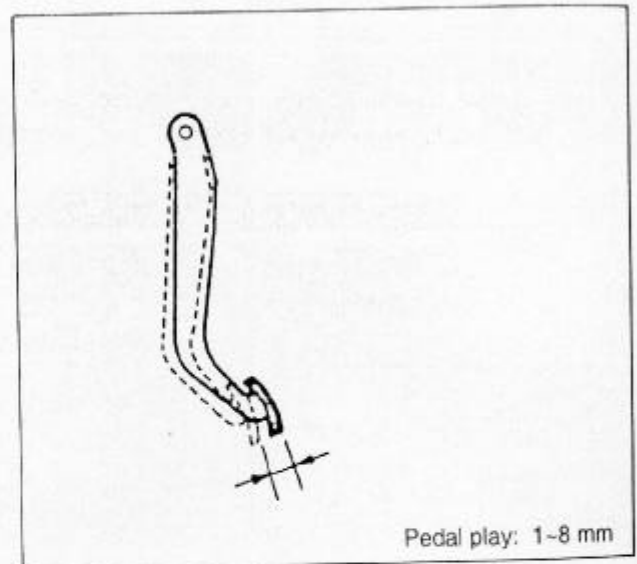


FIG. 5 — 22 BRAKE PEDAL PLAY INSPECTION

Brake pedal play(mm)	1 — 8
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PARKING BRAKE

Inspection and Maintenance

1. Pull up parking brake lever with about 20kg force and count ratchet notches in ratchet engaged sector.

Specified limit	3 — 8 notches
Play	Less than 2 notch

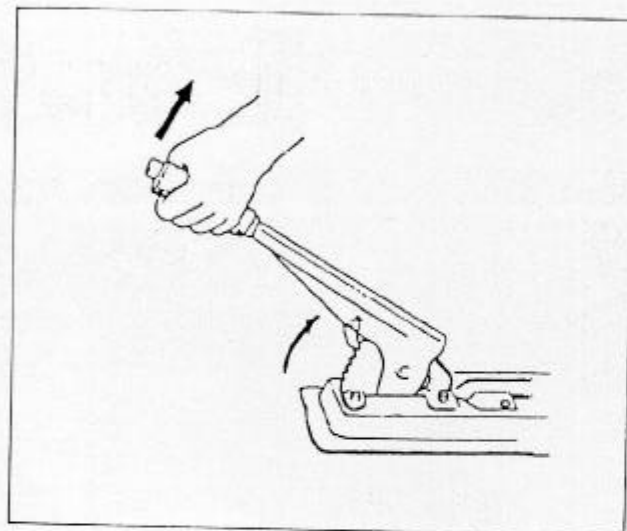


FIG. 5 — 23 PARKING BRAKE CHECK

2. If measured value is out of specification, adjust parking brake cable by tightening adjust nuts.

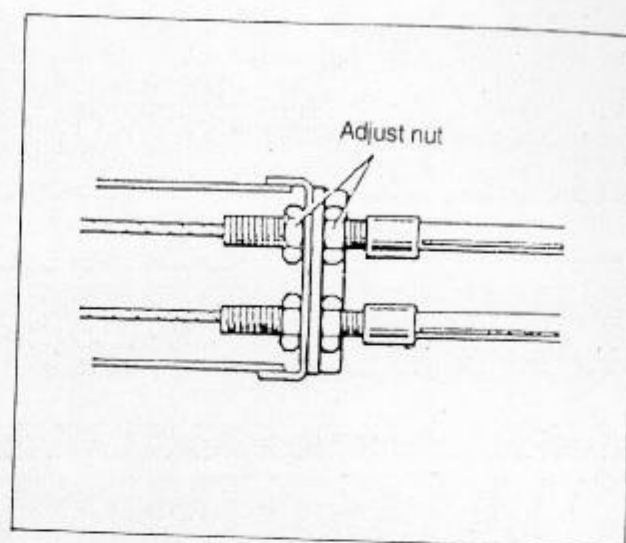
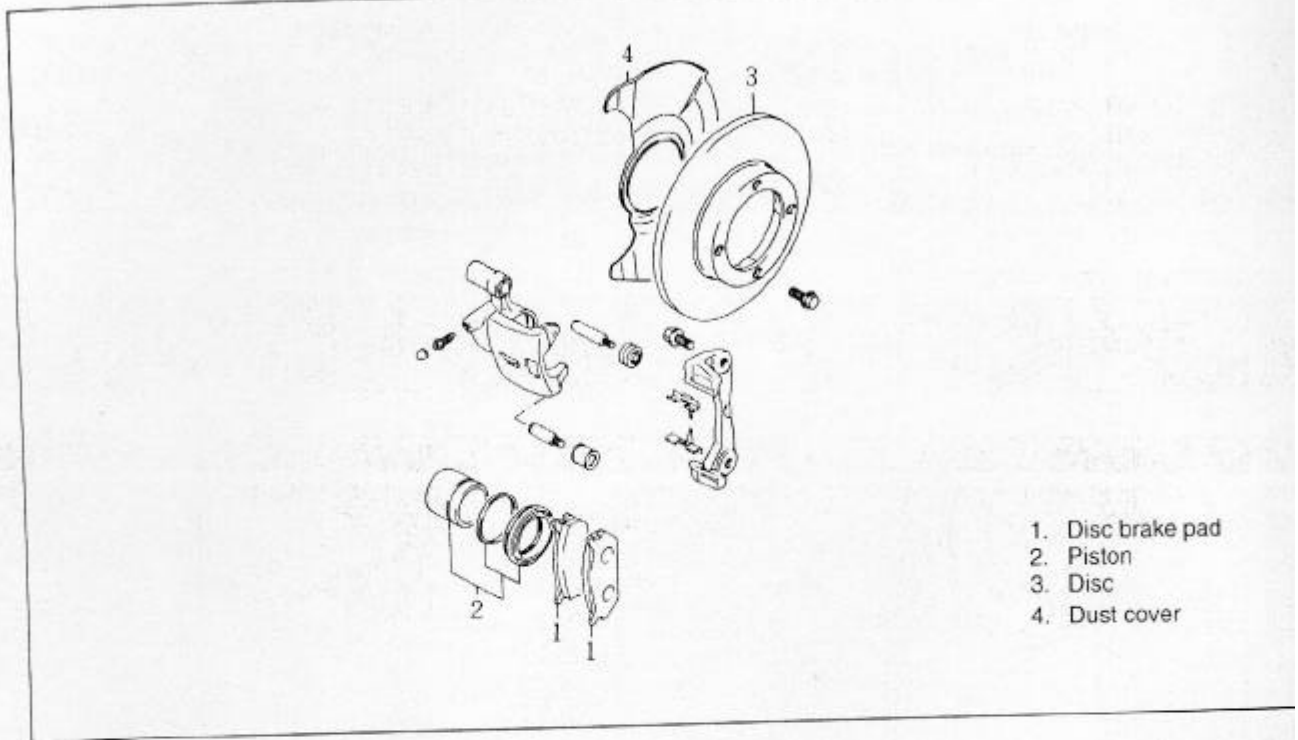


FIG. 5 — 24 PARKING BRAKE CABLE ADJUSTMENT

INSPECTION



1. Disc brake pad
2. Piston
3. Disc
4. Dust cover

FIG. 5 — 25 DISC, CALIPER, PAD DEAL DRAWING

Brake Pad

Measure the thickness of brake pad(excluding pad plate).

Pad thickness limit(mm)	1.0
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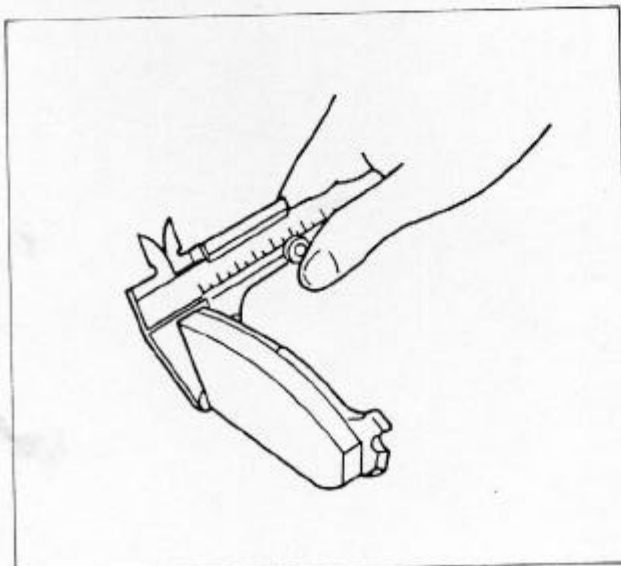


FIG. 5 — 26 BRAKE PAD THICKNESS CHECK

Brake Disc

- Run-out check
Install dial gauge on disc surface and measure the run out with brake slowly turns.

Limit(mm)	less than 0.15
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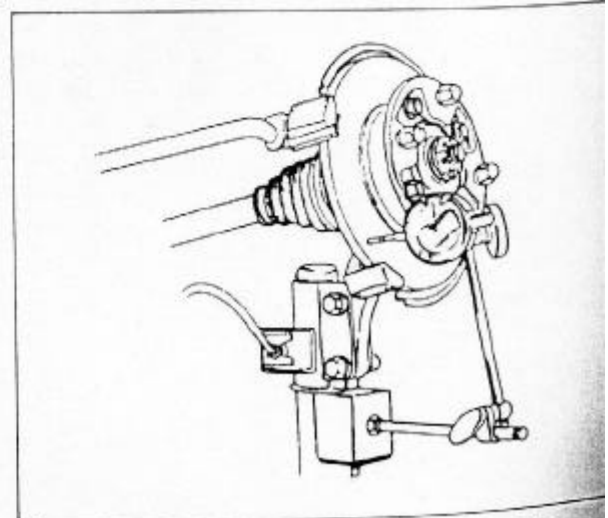


FIG. 5 — 27 DISC RUN-OUT CHECK

- Measuring disc thickness
Using micrometer, measure the thickness of disc.

Disc thickness limit(mm)	8.0
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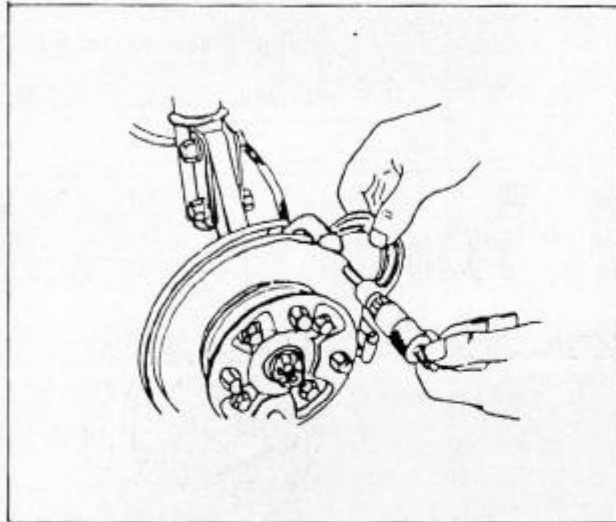


FIG. 5 — 28 DISC THICKNESS CHECK

Brake Drum

Check brake drum for eccentric cracks, damage and distortion of lining contact surface and oil.
If partial wear of drum is found or wear of drum edge is serious, repair or replace brake drum.

Service limit I.D(mm)	182.0
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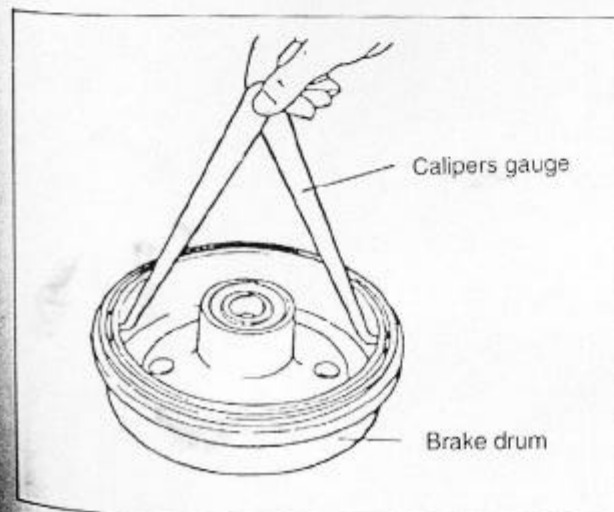


FIG. 5 — 29 BRAKE DRUM CHECK

Brake Shoe

Check shoe for case hardening of lining, wear and oil contamination and measure the thickness(excluding shoe plate).

Shoe thickness limit(mm)	1.0
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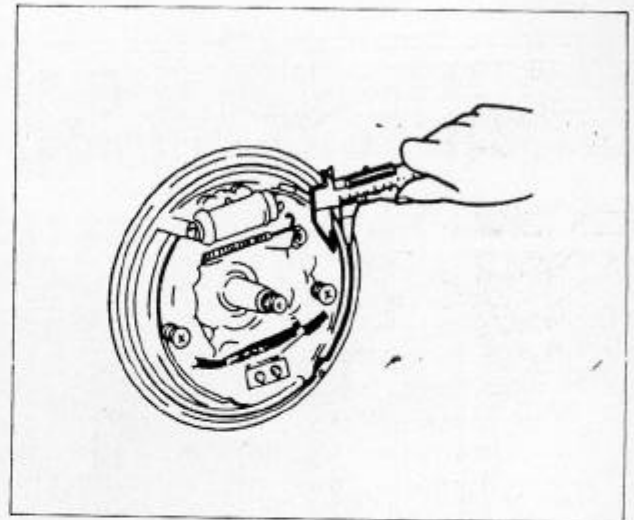


FIG. 5 — 30 BRAKE SHOE CHECK

MASTER CYLINDER

Disassembly

1. Remove primary piston.
2. Remove stopper bolt and secondary piston.

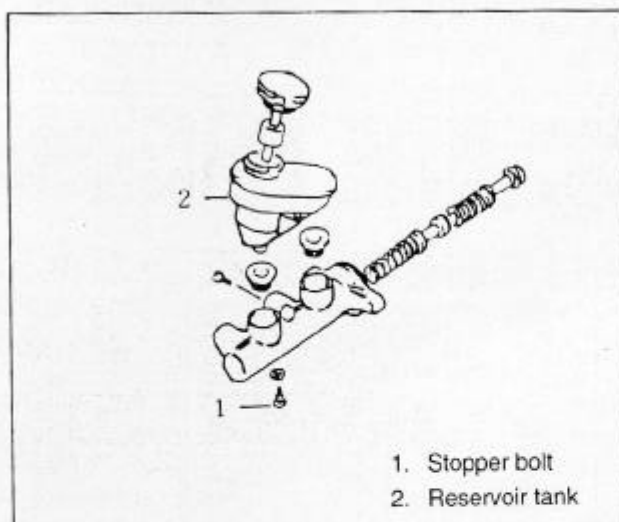


FIG. 5 — 31 MASTER CYLINDER DISASSEMBLY

Assembly

It is the reverse of removal procedures. Take care of the followings.

CAUTION

Before assembling, wash each part with brake fluid.

VACUUM BOOSTER PUSH ROD ADJUSTMENT

Adjustment

1. Remove master cylinder. Set the rod of special tool (booster piston rod gauge 09950 — 96010) to the position that contacts slightly with the 1st piston of master cylinder with the master cylinder removed and gasket attached to cylinder.

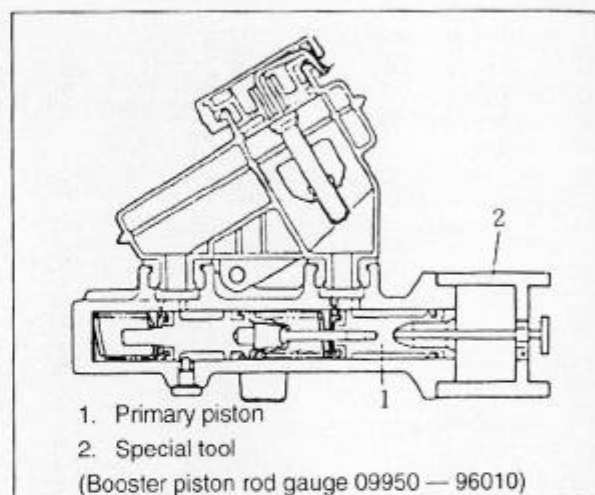


FIG. 5 — 32 INSTALLATION OF SPECIAL TOOL

2. In that state, reverse special tool as following figure. Measure protrusion quantity or clearance of special tool rod and booster push rod.

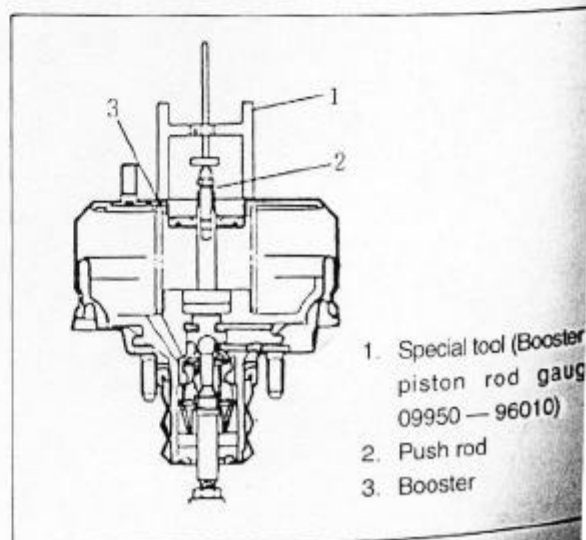


FIG. 5 — 33 BOOSTER PUSH ROD CLEARANCE MEASUREMENT

3. Using special tool (booster push rod adjuster) and T wrench(7mm), adjust push rod length, so that the clearance between special tool rod and the brake booster push rod becomes 0.

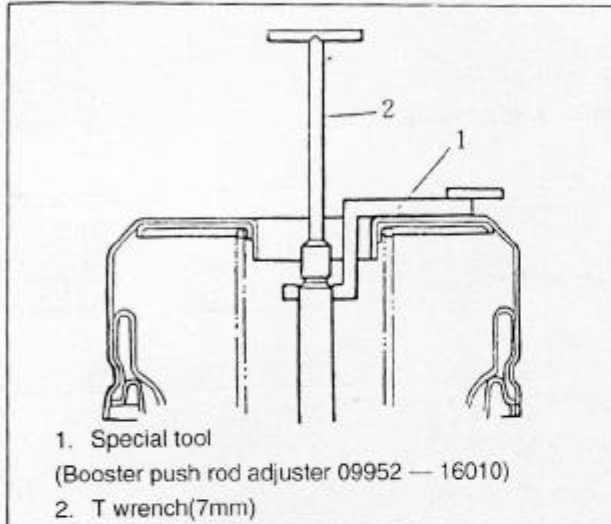


FIG. 5 — 34 PUSH ROD LENGTH ADJUSTMENT

SPECIAL TOOLS

