GROUP 5

BRAKES

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POWER BRAKE BOOSTER AND MASTER CYLINDER

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DESCRIPTION AND OPERATION

POWER BRAKE BOOSTER

The vacuum power cylinder contains the power piston assembly which houses the control valve and reaction mechanism and the power piston return spring. The control valve is composed of the air valve and the floating control valve assembly. The reaction mechanism consists of a hydraulic piston, reaction plate, and a series of springs. An air filter element is assembled around the push rod and fills the cavity inside the hub of the power piston. This keeps dirt and dust from entering the vacuum booster. The push rod, which operates the air valve, projects out of the end of the power cylinder 'housing through a boot.

MASTER CYLINDER

The master cylinder is composed of a primary piston and secondary piston; it is supplied with fluid from two separate reservoirs. A check valve is mounted on the primary circuit which supplies fluid to the rear brakes. This keeps a slight static pressure in the rear brake system. When the pedal is depressed, the push rod moves the two pistons forward simultaneously until the seals of the two pistons cover the compensating ports in the cylinder. The pressure is increased in the two chambers simultaneously, thus supplying fluid to both front and rear brake systems.

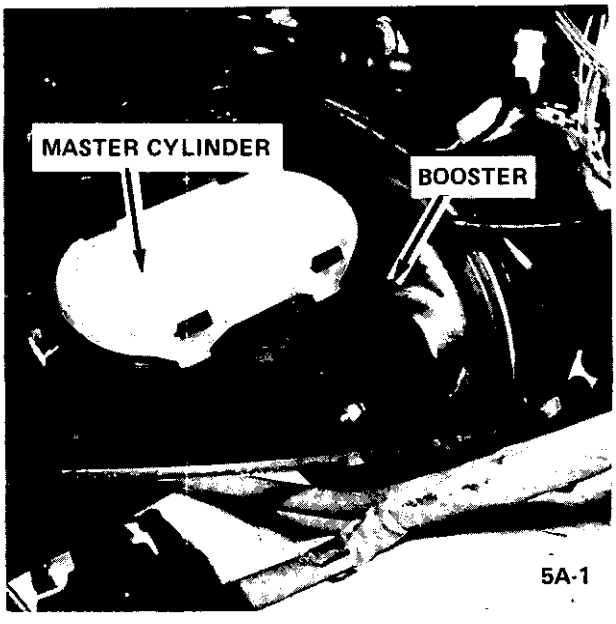

Figure 5A-1 Brake Booster Attachment (Opel 1900 and Manta)

In the GT, the brake fluid container is arranged at right angles to the tandem brake master cylinder. See Figure 5A-3. It is pushed over the feed port of the rear brake circuit onto the brake master cylinder and

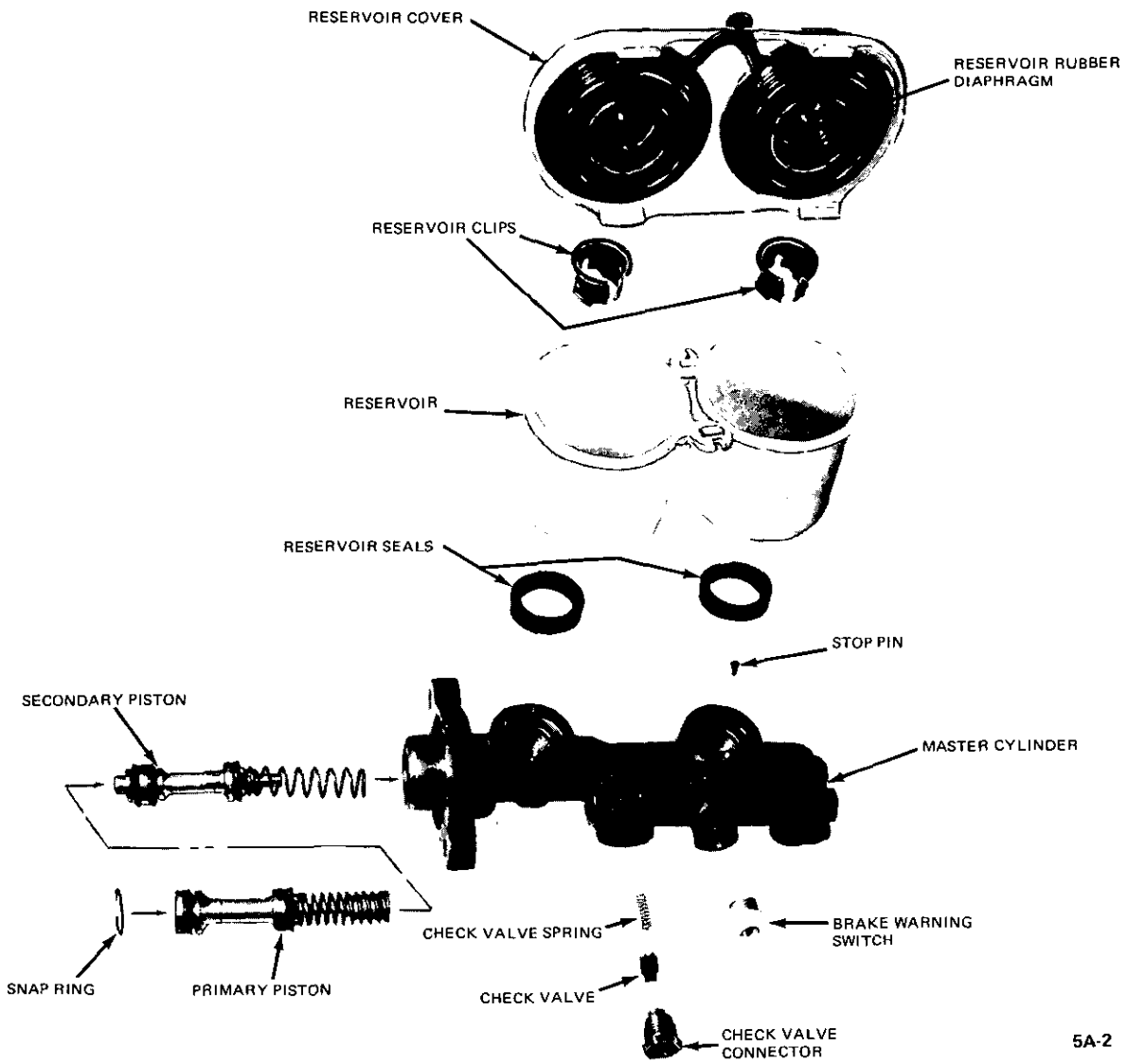

Figure 5A-2 Exploded View Master Cylinder (Opel 1900 and Manta)

held in position **by** a retaining plate. The front brake circuit is connected to the brake fluid container by a hose **and** a connector. See Figure 5A-4.

An offset brake actuating rod, consisting of pedal rod, adjuster and connecting tube, is used between the brake pedal, the tandem brake master cylinder and brake booster respectively. The connecting tube is pressed onto the pedal rod and adjuster. The specified brake pedal free travel of 1/4 inch is obtained by adjusting the brake booster piston rod and lock nut of the adjuster.

VACUUM CONTROL VALVE

A vacuum control valve is installed into the vacuum hose between the intake manifold and the brake booster and serves to prevent air from flowing back (vacuum release) when the engine is shut off. See Figure 5A-5. ***This valve cannot be disassembled and must be replaced when defective.*** To do this, the short hose should be used between the intake manifold and the vacuum control valve and the long hose between the vacuum control valve and the brake booster. Arrows on the valve housing indicate its correct position in the line. Should a vacuum control valve be installed backward no air could be drawn out of brake booster, thus rendering it inoperative. Hose clamps should be installed to prevent the possibility of vacuum leaks.

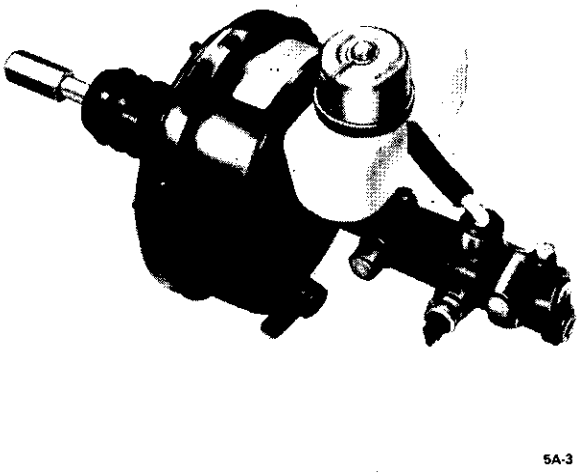

Figure 5A-3 Power Brake Master Cylinder (GT)

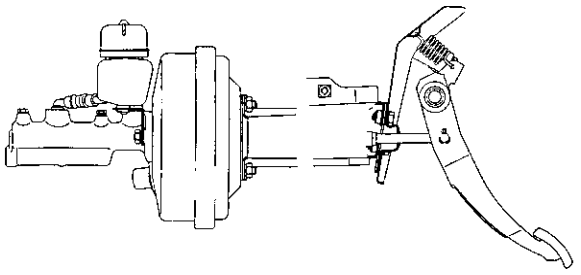

Figure 5A-4 Brake Pedal and Master Cylinder Attachment (GT)

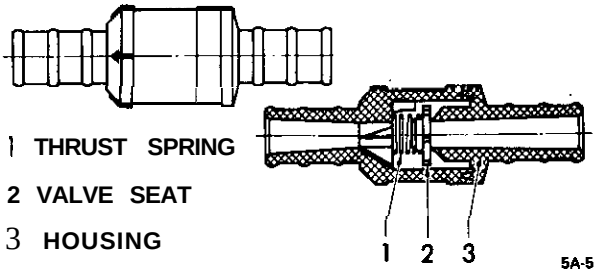

Figure 5A-5 Vacuum Control Valve

DIAGNOSIS

POWER BRAKE UNIT TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Hard Pedal	1. Broken or damaged hydraulic brake lines.	1. Inspect and replace as necessary.
	2. Vacuum failure.	2. Check for: a) Faulty vacuum check valve or grommet - replace. b) Collapsed or damaged vacuum hose - replace. c) Plugged or loose vacuum fitting - repair. d) Faulty air valve seal or support plate seal - replace. e) Damaged floating control valve.
	3. Defective diaphragm.	3. Replace
	4. Restricted air filter element.	4. Replace
	5. Defective apply piston seals.	5. Repair and replace master cylinder.
	6. Cracked or broken power pistons or retainer.	6. Replace power unit.

Condition	Possible Cause	Correction
Grabby Brakes (Apparent Off- and On Condition)	1. Broken or damaged hydraulic brake lines.	1. Inspect and replace, as necessary.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid check for leaks.
	3. Defective master cylinder seals.	3. Repair or replace, as necessary.
	4. Cracked master cylinder casting.	4. Replace
	5. Leaks at front disc brake calipers or rear wheel cylinders in pipes or connections.	5. Inspect and repair, as necessary.
	6. Air in hydraulic system.	6. Bleed system.
Brakes Fail to Release	1. Blocked passage in power piston.	1. Inspect and repair or replace, as necessary.
	2. Air valve sticking shut.	2. Check for proper lubrication of air valve "0" ring.
	3. Broken piston return spring master cylinder.	3. Replace
	4. Tight pedal linkage.	5. Repair or replace, as necessary.

MAINTENANCE AND ADJUSTMENTS

CHECKING BRAKE BOOSTER OPERATION

The operation of the brake booster can be checked by simple means and without any special devices.

1. With engine off, first clear the booster of any vacuum by depressing brake pedal several times.

2. Then depress brake pedal and start engine. If the vacuum system is working correctly, the brake pedal, kept under even foot pressure, moves farther downwards due to the additional pressure developed by the booster. Should the brake pedal not move farther downwards, the vacuum system is deficient. In this case check the vacuum hose to booster, to vacuum control valve and to engine intake manifold connections.

3. If the vacuum system operates properly, the defect is in the brake booster itself. A dirty filter impairs or even prevents air from entering into the booster and thereby the formation of a difference in pressure in the vacuum cylinder.

Repairs cannot be carried out on the brake booster. If no deficiency can be found in the vacuum system or filter, the brake booster has to be replaced.

Under normal operating conditions the brake booster requires no service. However, under adverse conditions such as frequent driving on sandy or dusty roads, the filter and sound deadener should be replaced occasionally. To do so, the brake booster must be removed but it isn't necessary to detach the master cylinder.

BRAKE BOOSTER FILTER SERVICE

Under normal operating conditions the filter need not be exchanged for a new one.

Under adverse operating conditions - frequent driv-

ing on dusty and sandy roads - the filter and sound deadener should occasionally be replaced. To do so, brake booster has to be removed without detaching brake master cylinder.

Proceed as follows:

1. Remove protective cap (boot).

2. On the GT only, pry retainer from housing using a screwdriver. See Figure 5A-6.

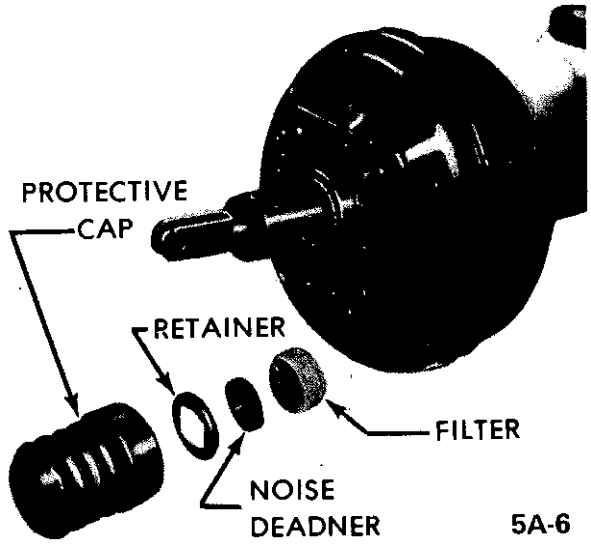

Figure 5A-6 Brake Booster Filter (GT)

3. With a pointed tool remove air silencer and filter out of control housing bore and pull it off thrust rod.

4. Install new filter and air silencer. On the GT, the smooth side of the filter must face towards the inside. The radial slots in filter and deadener must be staggered to each other by 180 degrees.

5. Slide retainer over control housing (GT only) and seal it with light plastic hammer strokes. Slide protective cap over control housing and slip it onto brake booster housing.

VACUUM CONTROL VALVE SERVICE

A vacuum control valve is installed into the vacuum hose between intake manifold and brake booster. It serves to prevent air from flowing back (vacuum release), when engine is shut off.

The vacuum control valve cannot be disassembled and has to be replaced, if defective. On replacement, note the following:

1. The vacuum control valve should be located near the intake manifold. Therefore, the short vacuum hose has to be installed between intake manifold and vacuum control valve and the long hose between vacuum control valve and brake booster.

2. The arrows on the vacuum control valve housing must point towards the intake manifold, otherwise no air can be drawn out of the brake booster which renders the brake booster ineffective.

3. The connections of the vacuum hoses to the intake manifold, vacuum control valve and brake booster must be airtight. For this reason make sure. that the hose clamps are properly installed.

MAJOR REPAIR

BRAKE BOOSTER REMOVAL AND INSTALLATION

Removal

1. Disconnect brake pipes from master cylinder. Place a cloth under the master cylinder and brake pipes to absorb any brake fluid drippings.

2. Disconnect vacuum hose from brake booster.

3. Remove four nuts and washers attaching brake booster to brake booster support.

4. On the GT only, remove master cylinder support to fender skirt bolts.

5. On the GT, loosen thrust rod lock nut and unscrew the piston push rod while holding the master cylinder brake booster assembly. On the Opel 1900 and Manta, remove the nut and bolt attaching clevis on the pedal.

6. Remove assembly from car.

7. Disconnect master cylinder from brake booster.

Installation

CAUTION: ***Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.***

1. Using a new front housing seal, assemble master

cylinder to brake booster and torque nuts to 14 lb.ft. on the GT and 12 lb.ft. on the Opel 1900 and Manta.

2. Position assembly into brake booster bracket and, on the GT only, thread piston push rod onto the thrust rod.

3. Install brake booster to support attaching washers and nuts and tighten to 11 lb.ft. of torque.

4. On the GT install master cylinder support to inner fender skirt bolts.

5. Connect vacuum hose to brake booster.

6. By turning the piston push rod on the thrust rod, (GT only) adjust until the brake pedal free travel is 1/4 inch and tighten the lock nut.

7. Connect brake pipes to master cylinder and bleed brakes.

MASTER CYLINDER OVERHAUL. GT

Removal of Master Cylinder

1. Disconnect the two brake pipes from the master cylinder.

2. Remove the front support to skirt attaching bolts, the cylinder to booster retaining nuts and lift out master cylinder.

Disassembly

1. Prior to brake master cylinder disassembly, pour brake fluid out of brake fluid reservoir, remove reservoir from master cylinder and take sealing plugs out of housing.

2. Screw static pressure valve(s) out of housing.

3. To facilitate disassembly, push piston somewhat into cylinder and insert a rounded off piece of welding rod approx. .12 in. thick into feed port to retain piston in this position.

4. Remove stop screw and snap ring out of housing and take out both pistons together with springs.

5. Remove stop screw from piston for rear brake circuit and remove all component parts. Remove also all component parts from intermediate piston of front brake circuit.

Cleaning and Checking

1. Clean parts with genuine brake fluid, Delco Supreme No. 11, or equivalent. Do not use any other cleaning solvents. Dry with compressed air. Free up compensating and feed ports.

2. Polish cylinder bore of housing with crocus cloth. If lapping scores and rust spots are still noticeable, replace brake master cylinder assembly.

3. Check inner components for damage and replace, if required. The rubber seals and static pressure valve always have to be replaced.

Assembly

1. Assemble front and rear brake circuit pistons. Prior to assembly coat rubber seals with brake fluid.

2. Coat cylinder bore, piston sliding surfaces and seals with brake fluid.

3. Insert preassembled intermediate piston for front brake circuit together with thrust spring and spring seat into clyinder bore. The smaller diameter of the tapered thrust spring must face piston.

4. With a drift, push piston (against spring pressure) into housing and insert a piece of welding rod into feed port of front brake circuit to retain piston.

5. Install stop screw with new seal ring into housing and tighten.

6. Insert preassembled piston for rear brake circuit into cylinder bore and install snap ring into groove in housing.

7. Check piston fof free movement by moving it to and fro. If required, place washers under the head of the stop screw.

8. Lightly push piston into housing and remove piece of welding rod out of feed port of front brake circuit.

9. With a rounded off piece of welding rod (.020 - .024 in.) check whether compensating ports are free.

10. Screw in new static pressure valve(s).

11. Coat new sealing plugs with brake fluid and insert them into housing. Push twin brake fluid container into sealing plugs and install screen and cover with seal ring.

Installation

1. Install master cylinder onto brake booster with washers and nuts. Torque to 14 lb.ft.

2. Attach the front mounting bracket.

3. Install brake lines on master cylinder, and bleed brakes.

4. If required, adjust mechanically actuated stop light switch. Pedal travel of 5/8" to 1" should actuate switch. Add or subtract washers between bracket and switch to obtain proper adjustment.

5. Road test car for proper brake performance.

MASTER CYLINDER OVERHAUL. OPEL 1900 AND MANTA

Removal of Master Cylinder

1. Remove master cylinder from brake booster by disconnecting brake pipes and removing two self-tightening nuts that secure master cylinder to brake booster. Be careful not to loosen the front housing seal.

Disassembly

1. Prior-to brake master cylinder disassembly, pour brake fluid out of brake fluid reservoir.

2. Remove reservoir from master cylinder body by removing reservoir clips with snap ring pliers. See Figure 5A-7.

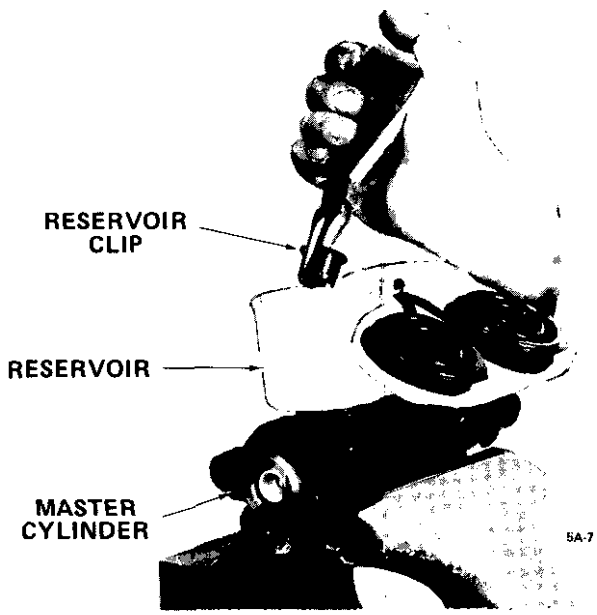

Figure 5A-7 Removing Reservoir Clips

3. Remove the piston stop screw which is fitted in master cylinder body.

4. Place master cylinder in a vise and push piston forward and insert a rod with a spherical end into the hole nearest the mounting flange. This will retain the piston in a forward position and allow for removal of snap ring. See Figures 5A-8 and 5A-9.

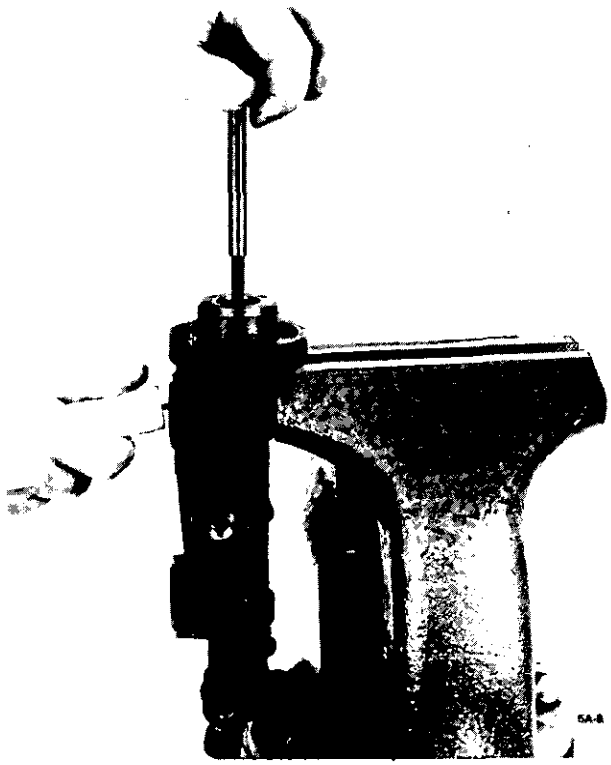

Figure 5A-8 Retaining Piston in Forward Position

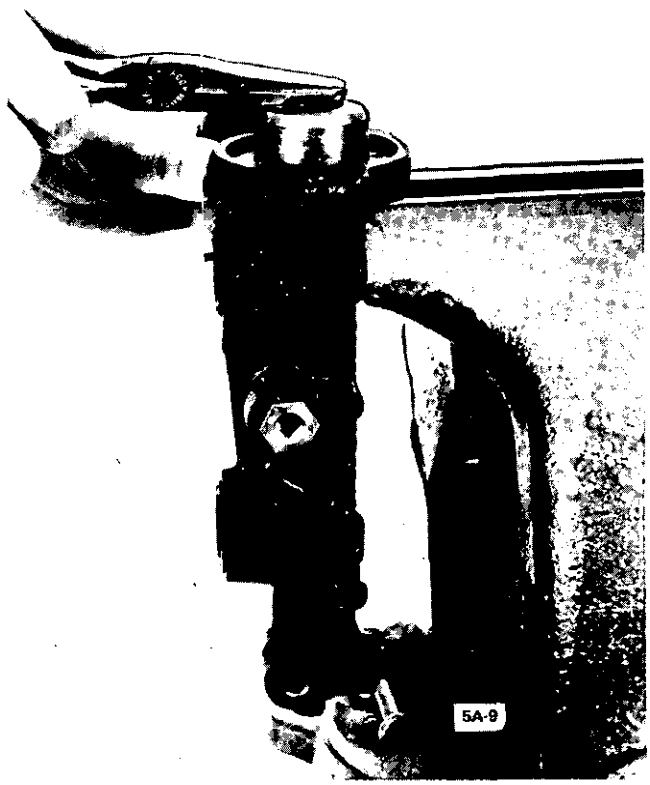

Figure 5A-9 Removing Snap Ring

NOTE: Snap *ring should not be reused.*

5. Remove primary and secondary pistons from cylinder.

6. Remove check valve by unscrewing check valve connection.

Cleaning and Checking

1. Clean parts with genuine brake fluid, Delco Supreme No. 11, or equivalent. Do not use any other cleaning solvents. Dry with compressed air. Free up compensating and feed parts.

2. Inspect cylinder bore for pits, scoring, cracks, nicks or other defects.

NOTE: ***Whenever the master cylinder is overhauled, a new repair kit must be used.***

Assembly

NOTE: ***Before reassembly double check that there is no foreign particles in the master cylinder bore or on any parts that are to be assembled into it.***

1. Coat master cylinder bore with clean brake fluid and install secondary and primary pistons.

2. Install new snap ring while holding primary piston in a forward position.

3. Install check valve spring, check valve and check valve connector and torque to 26 lb.ft.

4. Install stop screw.

5. Lubricate reservoir seals and remount on master cylinder body.

6. Install reservoir clips into reservoir and mount reservoir onto master cylinder without distorting seals. Do not force reservoir onto master cylinder.

7. Position reservoir cover onto reservoir.

Installation

1. Mount master cylinder to brake booster, using a new front housing seal if old one is damaged or distorted. Torque nuts to 12 lb.ft.

2. Install brake pipes to master cylinder and bleed brakes.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Brake Booster Size	7 in.
Brake Boost Ratio - (GT)	2.06 to 1
Brake Boost Ratio - (Opel 1900 and Manta)	2.64 to 1

	Name	Torque Lb.Ft.
Nut	Master Cylinder to Brake Booster (GT)	14
	Master Cylinder to Brake Booster (Opel 1900 and Manta)	12
Nut	Brake 'Booster to Support	11

DISC BRAKES

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DESCRIPTION AND OPERATION

DESCRIPTION

The front wheel disc brake consists of two major parts: The brake disc and the brake caliper with the two friction pads. See Figure 5B-20.

The brake disc is attached to the inside of the wheel hub flange by four bolts and centered on a shoulder of the hub. The brake caliper consists of two halves: the mounting half, arranged on the inside of the brake disc, and the rim half. The two halves are firmly attached to each other by four bolts. Two flanges on the mounting half serve as attachment of the brake caliper to the steering knuckle. The brake caliper is positioned behind the front suspension cross member at steering knuckle spindle level. It is attached to the steering knuckle by two bolts. Both caliper halves act as brake cylinders and each houses a piston and a fluid seal. The fluid seal, of square cross section, is positioned in an annular groove of the caliper bore, preventing fluid leakage past the piston and entry of water and dirt. The pistons and caliper half bores are protected against entry of water and dirt in brake disc direction by a rubber seal, held on the caliper half collar by a clamp ring and against

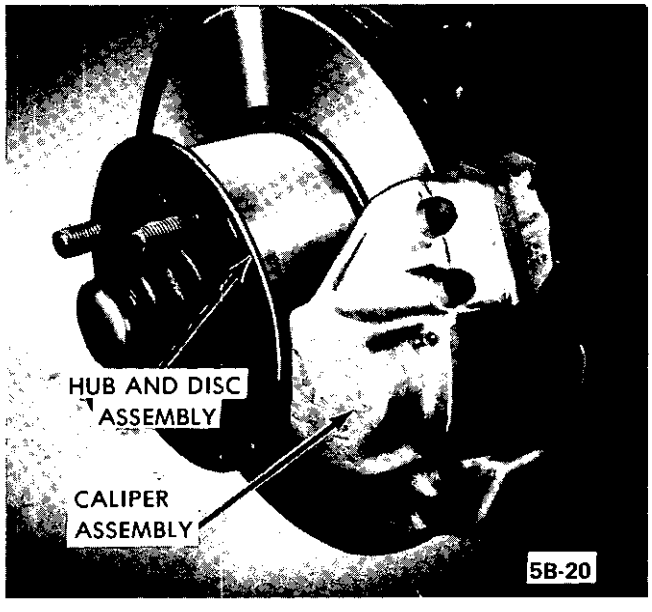

Figure 5B-20 Left Front Disc Brake Assembly

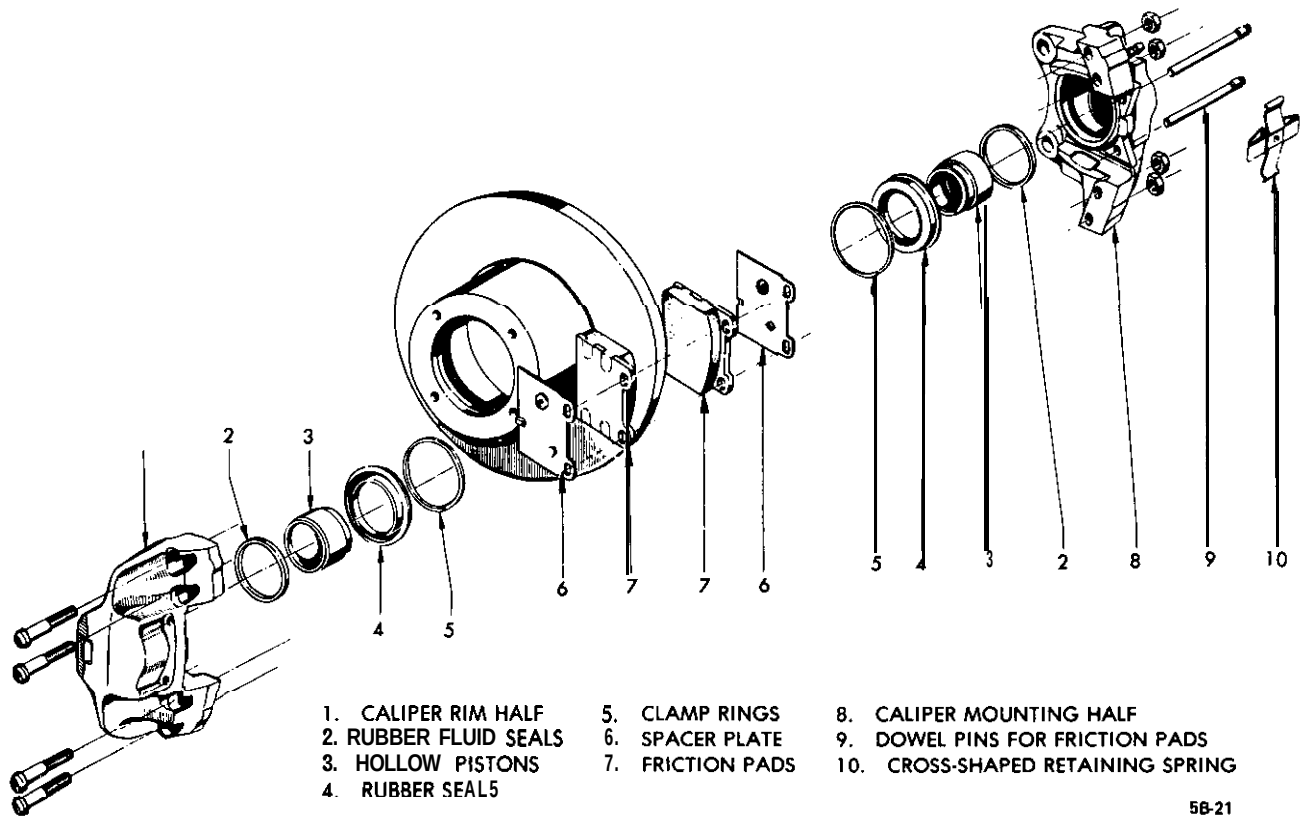

Figure 5B-21 Left Front Disc Brake - Exploded View

the piston circumference by its inherent tension. See Figure 5B-21. Both pistons are hollow. The open end of each piston faces the brake disc.

A sheet metal spacer plate with two impressions for preventing the piston from rotating is installed between each piston and friction pad and secured by the friction pad dowel pins. The two friction pads are positioned on the right and left of the brake disc recesses in the caliper halves. Each friction pad consists of a backing plate with friction material, which is abrasive-coated, bonded to it. The friction pad assemblies are held in position in the brake caliper by two dowel pins, secured by slit dowel pin retainers, and by a cross-shaped retaining spring which is preloaded and positioned under the dowel pins, thus pressing the friction pads and spacer plates firmly against the pistons. The front brake line leading from the brake master cylinder attaches to a distribution tee from which a brake line leads to each front wheel caliper. The caliper bores are interconnected by fluid ducts within the caliper halves.

OPERATION

The front wheel disc brakes have self-adjusting pistons. See Figure 5B-22.

The adjustment of the pads is effected by the pistons which push the friction pads ahead towards the brake disc for a distance equivalent to the amount of friction pad wear. This means that the greater the wear the closer the pistons move towards the brake disc. A running clearance exists between friction pads and brake disc when the brakes are in "off" position. This running clearance is provided by the rubber fluid seals which are positioned in the caliper half bores and which tightly grip and exert their pre-load pressure on the pistons. The rubber fluid seals also prevent the pistons from being pushed into the caliper half bores more than the distance equivalent to the running clearance. As the friction pads are adjusted by the pistons, there must be no static pressure in the front brake circuit when the brakes are in "off" position. Non-existence of a static pressure in the front brake circuit is achieved by eliminating the check valve in the brake master cylinder on the front brake circuit. During brake application the pressure from the brake master cylinder is transferred to the pistons in the brake caliper. The pistons move ahead and press the friction pads against both friction surfaces of the rotating brake disc. The force exerted on the brake pedal determines the pressure of the friction pads against the brake disc. On releasing the brake pedal, the brake lines of the front brake circuit, including the caliper half bores, are relieved of hy-

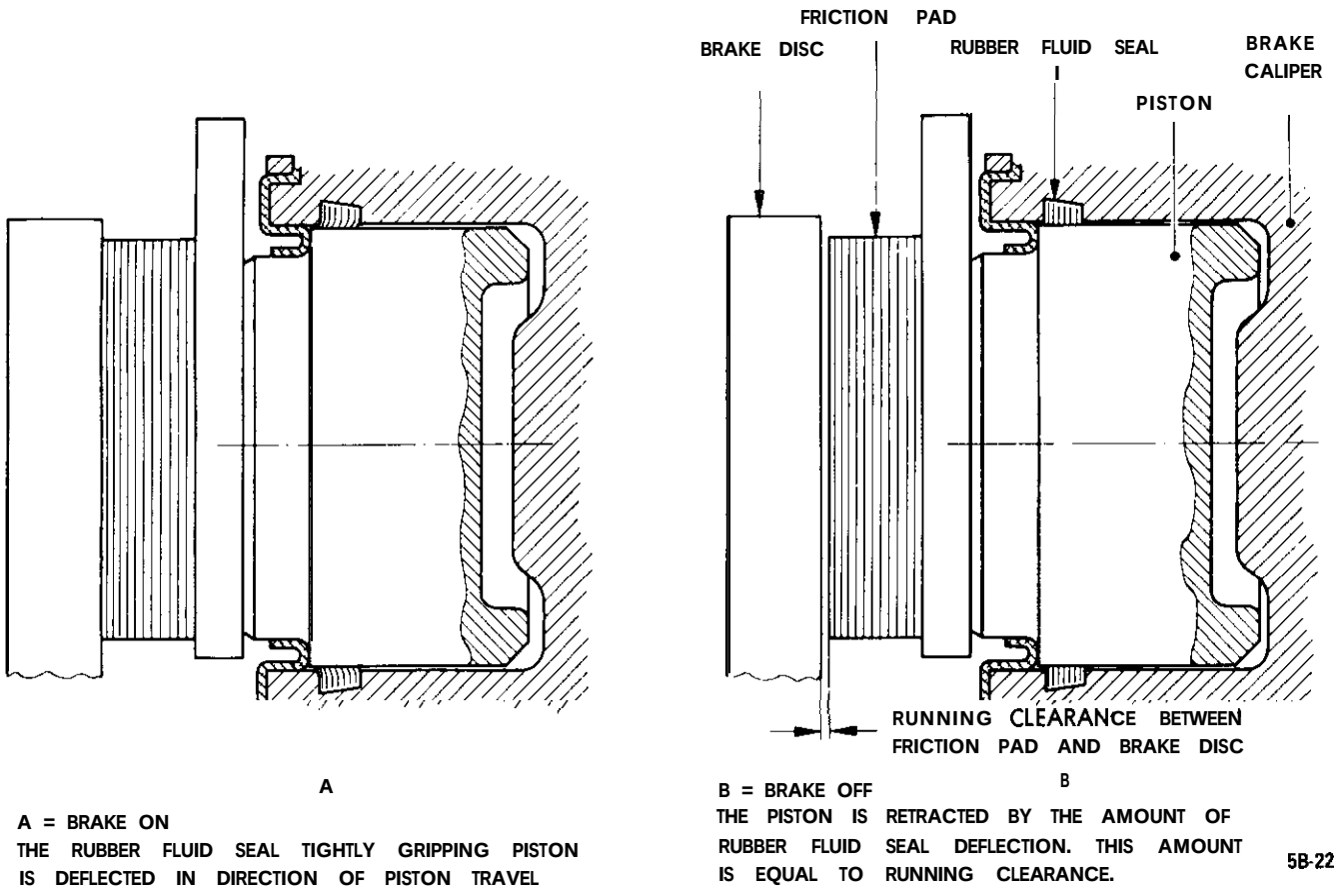

Figure 5B-22 Rubber Fluid Seal -Automatic Piston Retraction

draulic pressure, and the friction pads and pistons move away from the brake disc, leaving a small running clearance. The brake disc can now rotate freely.

The amount of brake travel is dependent upon the amount of running clearance. For this reason the runout of the brake disc should be checked, besides bleeding of the brake system and adjusting the rear brake shoes, when the pedal free travel is too great.

The running clearance between brake disc and friction pads is attained as follows: When the pistons in the caliper halves are moved towards the brake disc during braking, the rubber seals in the annular grooves of the brake caliper bores deflect laterally in the direction of piston movement. See Figure 5B-22, View (A). The seal remains deflected for the duration of the braking operation. After braking, the caliper bores are relieved of hydraulic pressure and the rubber seals resume their normal position, thus pulling or retracting the pistons. The distance traveled by the pistons is equal to that of the running clearance between brake disc and friction pads.

The shifting of the pistons in the direction of the brake disc due to friction pad wear has no effect on the running clearance. The running clearance remains the same in all piston positions.

DIAGNOSIS

DISC BRAKE TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Pulls	1. Incorrect tire pressures.	1. Inflate evenly on both sides to the recommended pressures (see Owner's Manual).

Condition	Possible Cause	Correction
	2. Front end out of line.	2. Check and align to manufacturer's specifications.
	3. Unmatched tires on same axle.	3. Tires with approximately the same amount of tread should be used on the same axle.
	4. Restricted brake tubes or hoses.	4. Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	5. Malfunctioning caliper assembly.	5. Frozen caliper - check for stuck or sluggish pistons, proper lubrication.
	6. Defective or damaged shoe and lining (grease or brake fluid on lining or bent shoe).	6. Install new shoe and lining in complete axle sets.
	7. Malfunctioning rear brakes.	7. Check for brake adjustment, defective lining (grease or brake fluid on lining) or defective wheel cylinders. Repair as necessary.
	8. Loose suspension parts.	8. Check all suspension mountings.
	9. Loose calipers.	9. Check and torque bolts to specifications.
Brake Roughness or Chatter (Pedal Pulsates)	1. Excessive lateral runout.	1. Check per instructions and replace or machine the rotor, if not within specifications.
	2. Parallelism not within specifications.	2. Check per instructions and replace or machine the rotor, if not within specifications.
	3. Wheel bearings not adjusted.	3. Adjust wheel bearings to correct specifications.
	4. Rear drums out of round.	4. Check runout and, if not within specifications, turn the drums within specifications.
	5. Shoe reversed (steel against iron).	5. Replace shoe and lining and machine rotor within specifications.
Excessive Pedal Effort	1. Malfunctioning power brake.	1. Check power brake and repair, if necessary.

Condition	Possible Cause	Correction
	2. Partial system failure.	2. Check front and rear brake system and repair, if necessary. Also, check brake warning light, if a failed system is found and light did not function.
	3. Excessively worn shoe and lining.	3. Check and replace in axle sets.
	4. Piston in caliper stuck or sluggish.	4. Remove caliper and rebuild.
	5. Fading brakes due to incorrect lining.	5. Remove and replace with original equipment lining.
	6. Vacuum leak.	6. Check for ruptured hose or loose attachment.
Excessive Pedal Travel	1. Partial brake system failure.	1. Check both front and rear system for a failure and repair. Also, check warning light - it should have indicated a failure.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid. Check for leaks.
	3. Poor rear brake adjustment.	3. Adjust rear brake per specifications.
	4. Air trapped in system.	4. Bleed system.
	5. Bent shoe and lining.	5. Replace axle set of shoe and lining.
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.)	1. Master cylinder pistons not returning correctly.	1. With reservoir cover off, check for fluid spurt at bypass holes as pedal is depressed. Adjust push rod, if necessary, or rebuild master cylinder.
	2. Restricted brake tubes or hoses.	2. Check for soft hoses or damaged tubes and replace with new hoses and new double-walled steel brake tubing.
	3. Incorrect parking brake adjustment on rear brakes.	3. Check and readjust to correct specifications.
	4. Check valve installed in outlet to front disc brakes.	4. Check master cylinder outlet and remove check valve if present.
Grabbing or Uneven Braking Action (All conditions listed under "Pulls".)	1. Malfunction of power brake unit.	1. Check operation and repair, if necessary.

Condition	Possible Cause	Correction
	2. Binding brake pedal mechanism.	2. Check and lubricate, if necessary.
	3. Corroded caliper assembly.	3. Clean and lubricate.

MAINTENANCE AND ADJUSTMENTS

DISC BRAKE MAINTENANCE

Checking Brake Fluid Level

The brake fluid level in the brake fluid container must be checked during predelivery inspection, then every 3,000 miles during inspection and preventive maintenance servicing.

The brake fluid level must not be higher than the inscription "MAX" and must be at least up to "MIN". Replenish brake fluid, if necessary.

Because of the relatively large brake caliper bore cross section and the self-adjustment of the disc brakes, resulting in a greater piston travel to compensate for friction pad wear, the brake fluid level drops faster than in fluid containers for drum brakes with their smaller wheel brake cylinders. For this reason pay special attention to the fluid level in the **brake** fluid container.

Drop of brake fluid level can be due to friction pad wear and may not be due to leakage in the braking system.

On loss of brake fluid due to leakage, the brake system must be checked thoroughly.

Friction Pad Adjustment

Friction pad adjustment is not necessary on the front wheel disc brakes as this is done automatically by the pistons in the brake calipers.

Lubricating Front Wheel Bearings

When removing one or both brake discs, check lubrication of front wheel bearings and the cavity of the wheel hub and replenish if necessary (see operation "Removing and Reinstalling Brake Disc"). When carrying out other work on disc brakes which does not necessitate the removal and installation of the brake disc, lubricating wheel bearings is not necessary.

Checking Disc Brake Friction Pads for Wear

Whenever a disc brake equipped car is in for periodic service, while the car is raised, the friction pads in both brake calipers should be checked for wear by making a simple measurement. Worn or oily friction pads must be replaced.

Measure friction pad wear as follows:

1. Remove friction pads.

2. Using a one-inch micrometer, measure the thickness of the pad and friction plate. See Figure 5B-23.

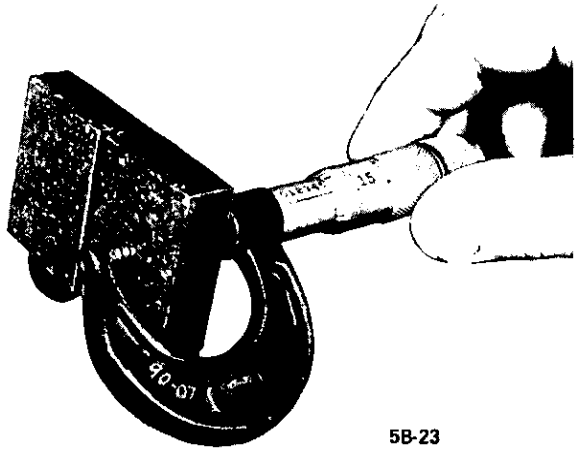

Figure 5B-23 Checking Brake Friction Pad Thickness

3. If any one of the four measurements is less than -.280, replace all four friction pads. (Partial replacement of friction pads would cause unequal braking.)

Removal and Installation of Friction Pads

1. Raise car and remove front wheels.

2. Drive dowel pins out of brake calipers toward center of car. See Figure 5B-24. Dowel pins must be driven inward because they are secured by enlarge fluted inner ends.

3. Remove friction pads from brake calipers. See Figure 5B-25.

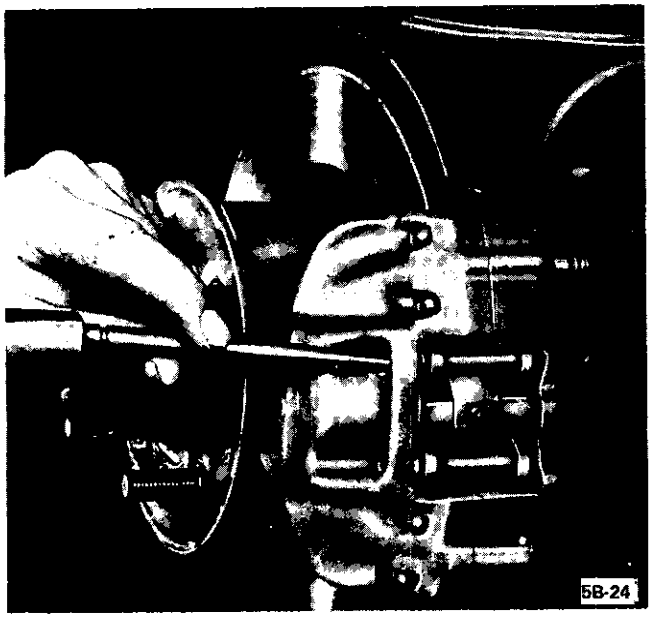

Figure 5B-24 Removing Dowel Pins

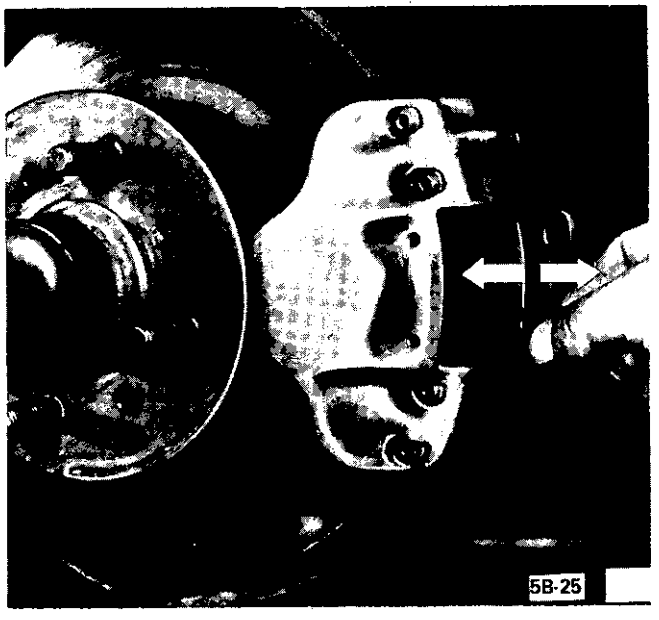

Figure 56-25 Removing Friction Pads

4. Check rubber seals for wear. If rubber seals are hardened, brittle or cracked, they must be replaced as follows:

(a) Remove brake caliper from steering knuckle and brake disc. Leave hose attached to brake caliper.

(b) Remove seal clamp rings with screwdriver and remove seal rings from calipers. See Figure 5B-26.

(c) Install new rubber seals and clamp rings. Make sure rubber seal is properly seated. Make sure clamp ring is correctly positioned on rubber seal.

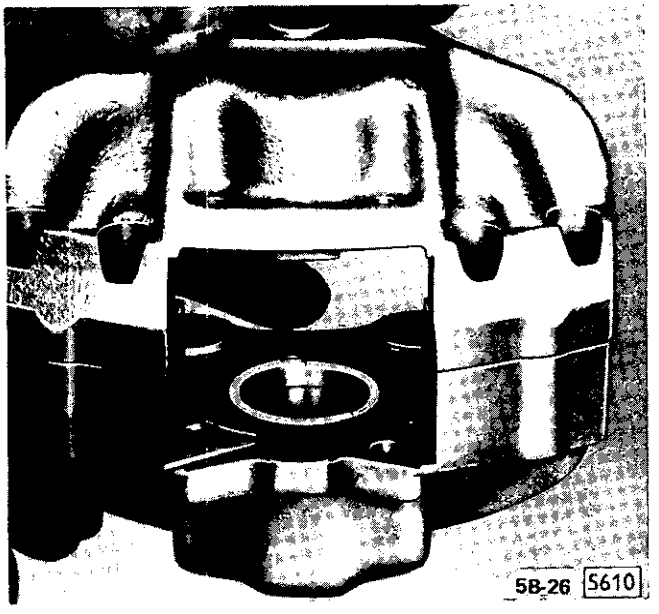

Figure 56-26 Removing or Installing Rubber Seal Clamp Ring

(d) Attach brake caliper to steering knuckle and torque bolts to 72 lb.ft. ***Prior to installation of caliper, make sure contacting surfaces of both caliper and steering knuckle are perfectly clean and free of any burrs.***

CAUTION: ***This disc brake caliper attachments fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.***

5. Before installing new friction pads, press both pistons of each caliper to bottom of their bores, using Return Clamp ***J-22430. While pressing piston into bores, open caliper bleeder valve to prevent excess brake fluid from overflowing master cylinder container*** As soon as pistons are bottomed, tighten bleeder valve.

6. Check brake disc for lateral runout.

7. Install new friction pads into brake caliper. ***Friction pads must be free enough to be easily moved in their caliper recesses. See*** Figure 5B-25.

If new friction pads are not free, it will be necessary to remove pads and clean recesses and recess corners with a wooden spatula and then with denatured alcohol and a brush. After cleaning, blow out recesses with compressed air. Remove any high spots on edges of friction pads contacting caliper recesses with

a tine cut file. ***Do not use any solvent except denatured alcohol. Do not use a metallic scraper tool.***

8. With a punch, drive one dowel pin from inboard side through caliper and friction pads to stop. Install new cross-shaped retaining spring under installed dowel pin, then install second dowel pin. Loose fitting dowel pins must be replaced.

9. Before operating vehicle, depress brake pedal several times to adjust friction pads to brake discs. Check brake fluid level and add fluid as necessary to bring level up to "MAX" on reservoir.

Car owners must be informed that a break-in period exists for new friction pads, and that they must avoid unnecessary, forceful braking during the first 125 miles after installation of new friction pads.

Checking Brake Disc for Lateral Runout

1. Remove front wheel assembly.

2. Remove front wheel bearing hub cap and spindle nut cotter pin. Tighten spindle nut until all free play is removed from wheel bearings.

3. To check disc runout, use Dial Indicator Set J-8001. Attach dial support C-clamp to an upper ball joint attaching bolt as shown in Figure 5B-27. Position dial indicator button against brake disc 1/2 inch from outer circumference.

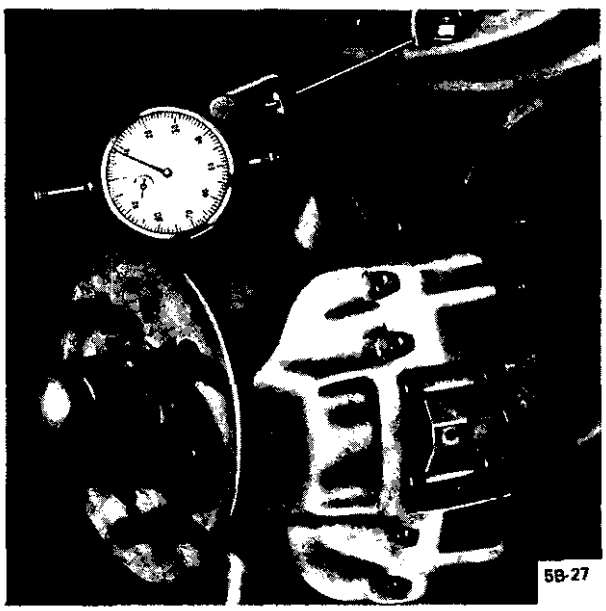

Figure 5B-27 Checking Brake Disc Lateral Runout

4. Rotate disc, reading maximum dial indicator movement. Maximum permissible runout is .004 inch.

5. If runout exceeds .004 inch, remove disc and hub assembly and true disc in a suitable disc turning lathe, following manufacturer's instructions. The depth of cut on each side of disc should be just deep enough to get a true flat surface.

6. After truing disc on both sides, check thickness with a micrometer. A disc with a thickness of less than ,394 inch is liable to warp after hard braking and, therefore, must be discarded.

7. Reinstall brake disc and hub assembly, removing all play from wheel bearings. Repeat runout check. If runout still exceeds .001 inch, replace brake disc.

8. Adjust front wheel bearings.

9. Reinstall front wheel assembly.

MAJOR REPAIR

REMOVING AND INSTALLING BRAKE CALIPER

1. Remove left or right front wheel and remove friction pads from brake caliper.

2. Loosen brake line to brake caliper union nut several turns. Unscrew brake caliper plus brake hose bracket from steering knuckle. Remove it from brake disc and swing it sideways. Then unscrew brake pipe from brake hose and remove brake caliper and brake pipe (bent pipe). To prevent brake fluid loss, close brake hose with a plug.

3. Prior to installation, ***check contacting surfaces of the brake caliper and steering knuckle to make sure they are free of any burrs and dirt.***

4. Install brake caliper on steering knuckle and torque attaching bolts to 72 lb.ft. See Figure 5B-28.

CAUTION: ***This disc brake caliper attachments fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.***

5. Attach brake pipe to brake hose.

6. Install friction pads and replace wheel.

REMOVING AND INSTALLING BRAKE DISC

1. Jack-up and support front of car and remove front

Figure 5B-28 Brake Caliper to Steering Knuckle Attaching Bolts

wheel. Disconnect brake caliper with friction pads from steering knuckle **and** support the assembly as shown in Figure 5B-29.

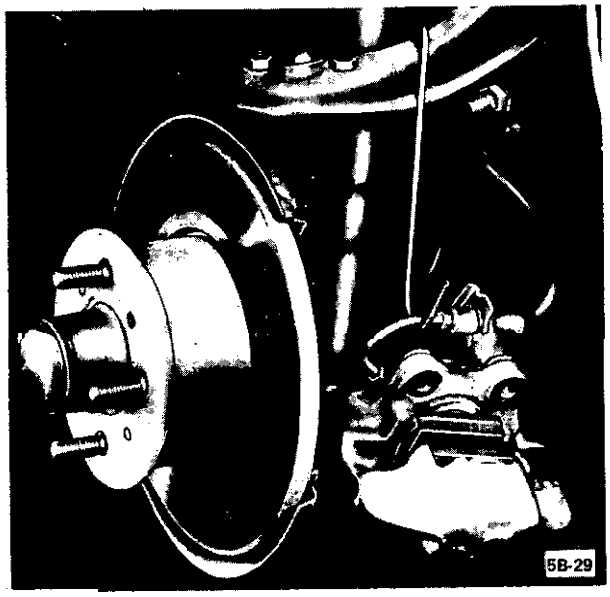

Figure 5B-29 Supporting Brake Caliper

2. Remove front wheel hub and disc assembly along with wheel bearings.

3. Mount brake disc and wheel hub between soft metal jaws in vise. ***Do not hold too tightly, to avoid bending*** whet-1 ***bolts.*** Remove four star head bolts with lockwashers using Star Wrench Adapter J-21737. Prior to removal, ***markposition of brake disc in relation to wheel hub. See*** Figure 5B-30.

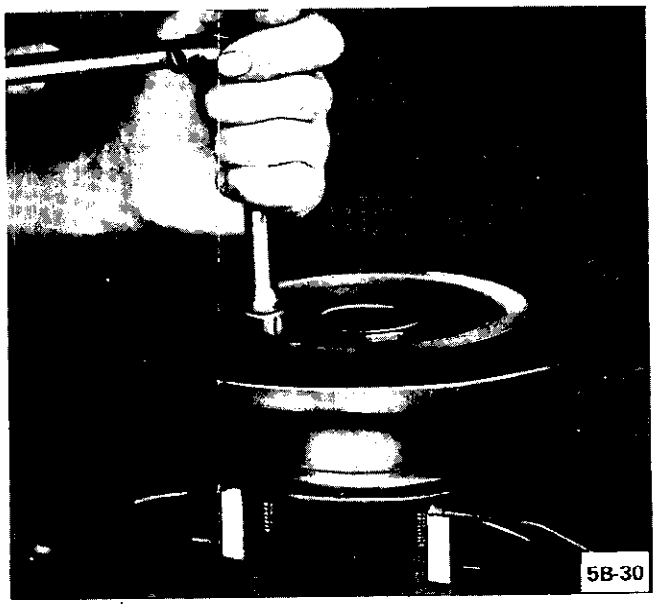

Figure 5B-30 Removing Brake Disc to Hub Bolts

4. Pull brake disc from wheel hub. Do not drive if off. Install in reverse sequence, paying attention to the following:

5. Prior to installation of the brake disc, ensure that the contacting surface of brake disc to wheel hub is free of burrs, dirt and high spots. If necessary, remove high spots and check disc for flatness on a surface plate. Carefully remove burrs with a scraper or file.

6. Also check contacting surface of wheel hub to brake disc to **make** sure it is in good condition. The same applies to brake disc aligning shoulder on wheel hub. See Figure 5B-31

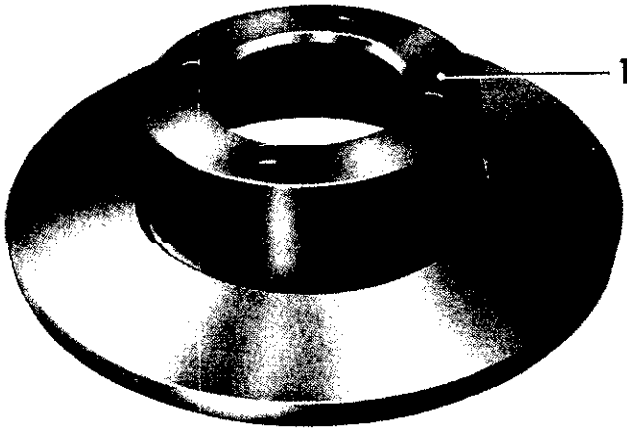

Figure 5B-31 Brake Disc to Hub Contact Surface

CAUTION: ***Fasteners in Steps 7 and 9 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.***

7. Install brake disc on wheel hub and torque attaching bolts to 36 lb.ft. If old brake disc is reused, pay attention to locator marks on brake disc and wheel hub.

8. Prior to installing brake disc and hub assembly to steering knuckle, check lubrication of both roller bearings and quantity of grease in cavity of wheel hub. If necessary, repack front wheel bearings.

9. Adjust front wheel bearing clearance and tighten brake caliper to steering knuckle, attaching bolts to a torque of 72 lb.ft. Prior to installing brake caliper to steering knuckle, ensure that all contacting surfaces are free of dirt and burrs. Also make sure that the friction pads are not damaged when sliding the brake caliper onto brake disc.

10. Install wheel assembly, remove supports and lower front of car.

REMOVING AND INSTALLING BRAKE DISC SHIELD

Removal

1. Remove brake disc.

2. Remove disc shield from steering knuckle by removing one Phillips head screw on the outside and on the inside, the lower steering arm and disc shield to steering knuckle bolt. Remove paper gaskets from steering knuckle. See Figure 5B-32.

Installation

1. Prior to placing new paper gasket between brake disc shield and steering knuckle, lightly coat both surfaces of paper gasket with chassis lubricant.

2. Install disc and tighten disc shield and steering arm to steering knuckle bolt to a torque of 47 lb.ft.

CAUTION: ***This steering arm and steering knuckle to backing plate fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.***

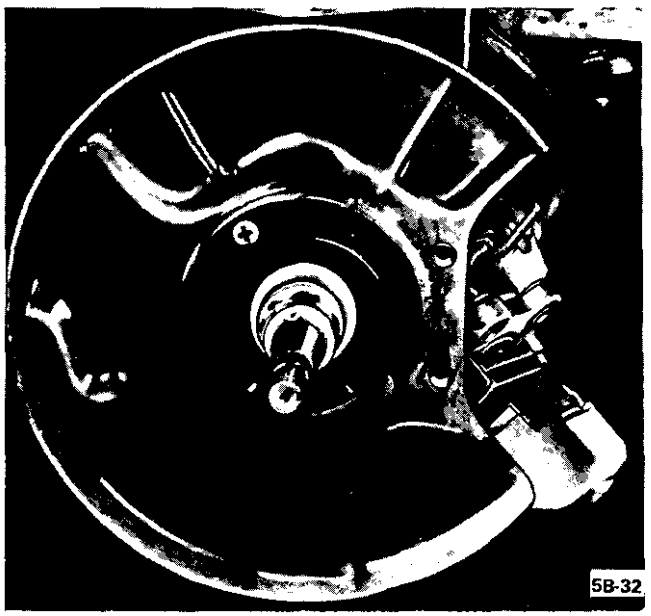

Figure 5B-32 Brake Disc Shield Attached to Steering Knuckle

3. Replace one Phillips head screw on outside of disc. See Figure 5B-32.

DISASSEMBLY AND ASSEMBLY OF BRAKE CALIPER

1. Remove brake pipe from brake caliper. If both calipers have to be repaired, it is advisable to mark them with "L" or "R" on removal to avoid errors when installing parts, such as pistons, etc. The brake caliper halves must not be disassembled during repair work. All work, such as pressing out pistons, replacing seals in brake caliper, is carried out with the two caliper halves bolted together.

2. Pry clamp rings from rubber seals, using a screwdriver (Figure 5B-26) and remove rubber seals.

3. Remove piston first from caliper rim half (Figure 5B-33), and then out of the caliper mounting half (Figure 5B-34) of the brake caliper, using mounting clamp J-22429. To be able to force the piston out of the caliper rim half, block the piston in the caliper mounting half with mounting clamp J-22429 as shown in Figure 5B-33. To force the piston out of the caliper mounting half, place the mounting clamp on caliper rim half, as shown in Figure 5B-34, and tighten wing nut so that the rubber plate seals off the caliper rim half bore. Then connect compressed air hose to brake line connection in the caliper mounting

half, and blow out pistons, carefully regulating air flow. When removing pistons, proceed with extreme caution and always keep the fingers of the hand holding the brake caliper away from the piston.

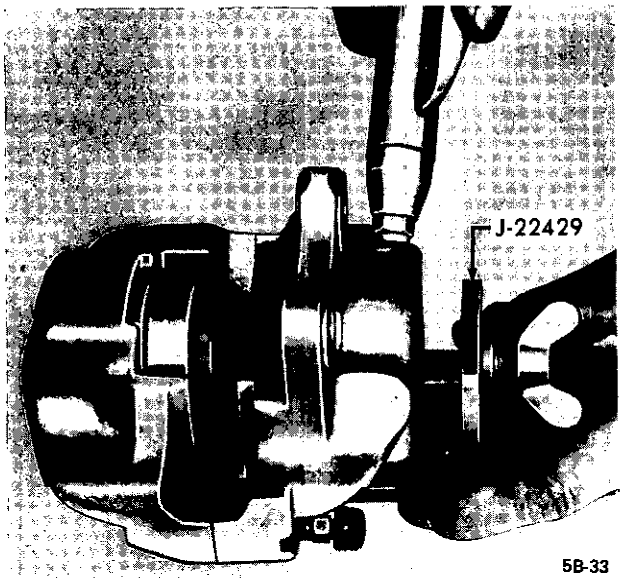

Figure 5B-33 Removing Caliper Rim Half Piston

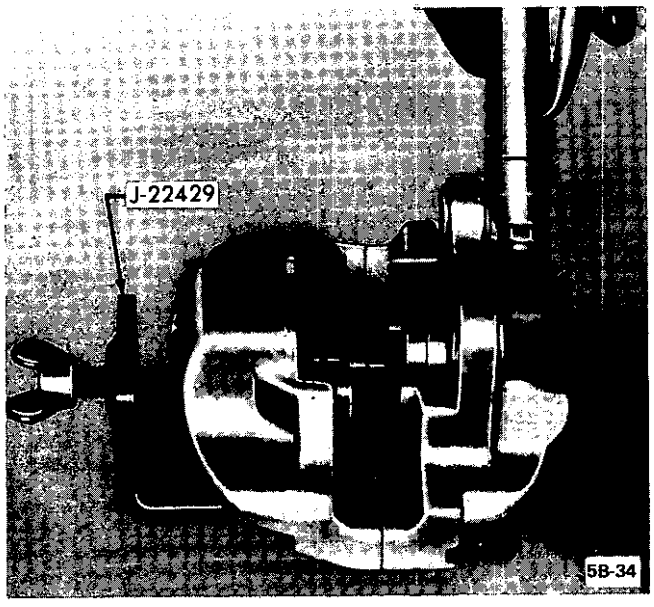

Figure 5B-34 Removing Caliper Mounting Half Piston

4. Pry rubber fluid seals out of the annular grooves in the caliper half bores. See Figure 5B-35.

5. Check all parts of the brake caliper for wear. If the caliper half bores are scored or rusted, use a new complete brake caliper **and** friction pads. Small, light rust spots in the caliper half bores or on the pistons can be removed with fine emery cloth. If pistons are damaged, even though the caliper half bores are in

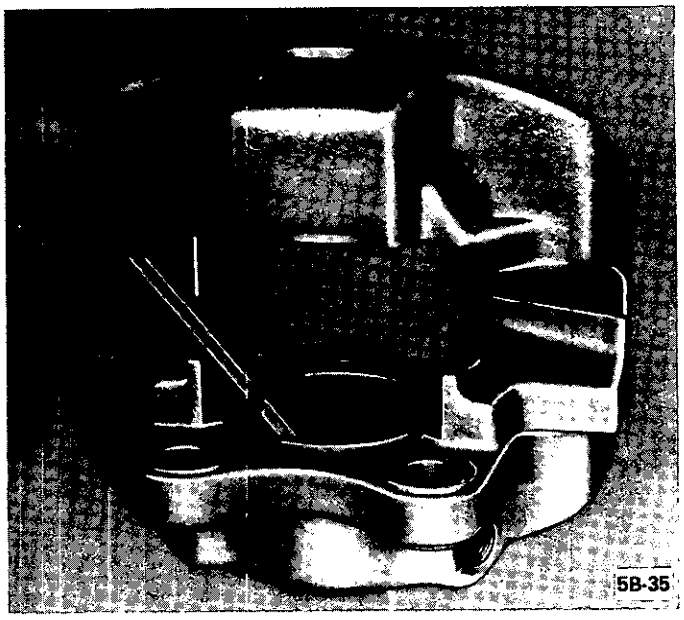

Figure 5B-35 Removing Rubber Fluid Seal From Caliper Bores

good condition, the piston must be replaced. The rubber fluid seals and rubber seals with clamp rings for the pistons are to be replaced every time repair work is carried out on the brake caliper.

6. Thoroughly clean all reusable parts - complete brake caliper and pistons - with denatured alcohol and dry with compressed air. Prior to cleaning, screw bleeder valve out of caliper.

7. Lightly coat new rubber fluid seals with brake fluid and insert fluid seals into grooves of brake caliper bores.

8. Place brake caliper into vise to install pistons. After installing one piston, change position of brake caliper in vise to install second piston. The piston to friction pad spacer plates should be used as a gauge to locate relieved edge of piston at 20 degrees to horizontal during piston installation. See Steps 9-10-11-12.

9. Place caliper mounting half in vise and coat its bore and piston lightly with brake fluid. Then push piston, with hollow end towards brake disc, into the caliper bore. Turn piston so that the relieved edge faces downwards at an angle of 20 degrees and facing in brake disc direction. The guide surface in the caliper half recess at the brake pipe connection side, will properly align the piston. Push piston into caliper bore up to the stop.

10. Change position of brake caliper **and** install second piston in the same manner.

11. Install new rubber seals with clamp rings. Make sure that the rubber seals are properly seated on the

caliper half collars and the clamp rings are correctly positioned on rubber seals.

12. Install brake caliper on steering knuckle, torquing bolts to 72 lb.ft.

CAUTION: ***This disc brake caliper attachments fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.***

13. Attach brake pipe to caliper and torque to 22 lb.ft.

14. Bleed brakes as necessary.

SPECIFICATIONS

DISC BRAKE SPECIFICATIONS

General Specifications

Disc Brake Type	2 Piston Fixed Caliper - Disc
Location	Front Wheels Only
Disc Type	Solid Cast Iron
Disc Diameter	9.370
Disc Lateral Runout (Maximum)	.004
Disc Thickness (New)	.430
Disc Thickness (Minimum)	.394
Disc Parallelism (Thickness Tolerance)	.0006
Brake Shoe and Lining Type	Bonded
Brake Shoe and Lining Thickness (New)	,550
Brake Shoe and Lining Minimum Thickness Before Replacement	.280
Disc Brake Master Cylinder Bore	.810
Disc Brake Caliper Cylinder Bore - GT	1.770
Disc Brake Caliper Cylinder Bore Opel 1900 and Manta	1.890
Disc Brake Shoe Adjustment	Self-Adjusting

Torque Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

	Name	Torque Lb.Ft.
Bolt	Brake Caliper to Steering Knuckle	72
Bolt	Brake Disc to Wheel Hub	36
Bolt	Brake Disc Shield to Steering Knuckle and Steering Arm .	47
Nut	Brake Pipe to Caliper	22

DRUM BRAKES

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DESCRIPTION AND OPERATION - DRUM BRAKES

DESCRIPTION OF BRAKE MECHANISM

Wheel Brake Assemblies

Each rear wheel brake assembly uses two brake shoes which are actuated by a single wheel brake cylinder. The center of the brake shoes are held against the backing plate by a hold down pin, spring and retainer. The bottom of the shoes pivot in a support plate, and the top of the shoes rest directly on the wheel brake cylinder push rods. The brake shoes are connected by upper and lower return springs which pull the shoes back to resting position after application. See Figure 5C-40.

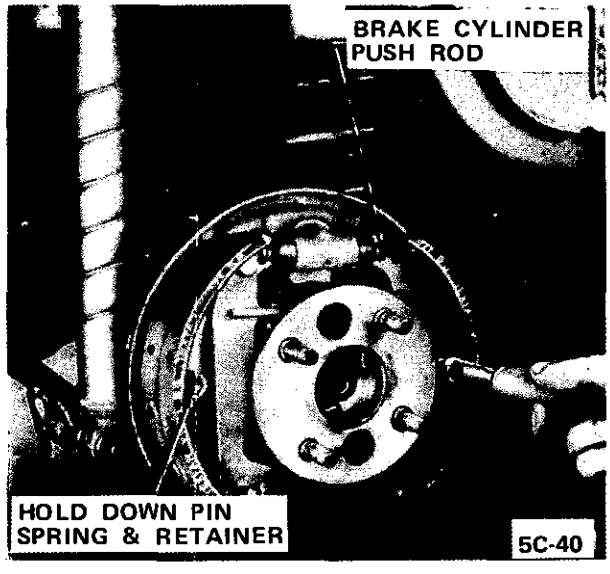


Figure 5C-40 Rear Wheel Brake

Two adjusting eccentrics at each wheel provide individual adjustment for each brake shoe to obtain clearance with. the brake drum. An arrow on the brake backing plate circumference shows direction in which eccentrics must be turned to make adjustment.

A hydraulic wheel cylinder is mounted on the backing plate between the upper ends of the brake shoes and forces the shoes against the drum when pressure is applied on the brake pedal. A lever mounted on each rear shoe is used for applying parking brakes.

Parking Brake Control System

The hand-operated parking brake lever is mounted between the front seats on the propeller shaft tunnel. A pawl is riveted into the parking brake lever and is actuated by a control rod provided with a spring loaded push button. When the parking brake is applied, the parking brake lever is locked by the pawl which engages the teeth on a stop plate. The parking brake is disengaged by pressing the spring loaded push button. See Figure 5C-41.

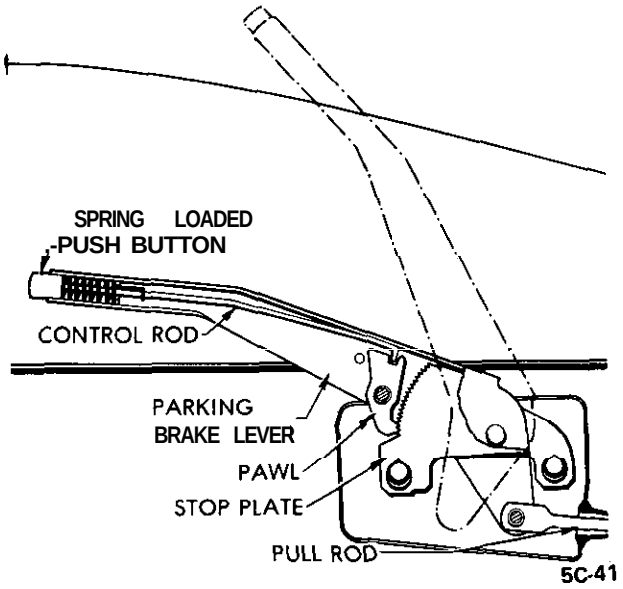


Figure 5C-41 Parking Brake Lever (Opel 1900 and Manta)

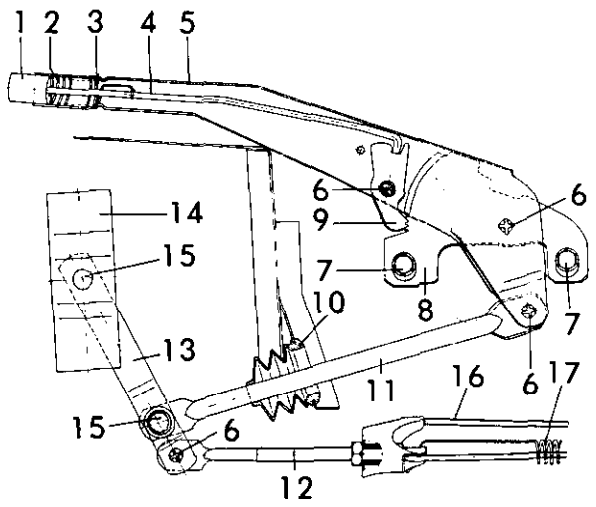
The GT arrangement of the parking brake is, with the exception of the additional transmittal lever at the floor panel, identical with that of the Opel models. The transmittal lever is attached to the propshaft tunnel by means of a mounting support. See Figure 5C-42.

The parking brake lever is connected with the front parking brake pull rod. By means of an equalizer, the front pull rod is connected to the forward portion of a center cable. The center cable is routed rearward through retaining guides and attaches at either end to the lower end of a parking brake lever. See Figure 5C-43. The parking brake levers and struts actuate the rear wheel brakes.

Service Brake Control System

Standard Brakes

The service brake control system is a pedal operated hydraulic system which applies the brakes at all four wheels with equal pedal pressure. The hydraulic system consists of a master cylinder (and attached transparent fluid reservoir) connected by pipes and flexible hoses to a wheel cylinder mounted between the brake shoes at each rear wheel.



1. PUSH BUTTON
2. THRUST SPRING
3. WASHER
4. PAWL CONTRO ROD
5. PARKING BRAKE LEVER
6. RIVET
7. HEX. HEAD BOLT
8. TOOTHED SEGMENT
9. PAWL WITH TWO TEETH
10. RUBBER CAP
11. THRUST ROD
12. PULL ROD
13. TRANSMITTAL LEVER
14. MOUNTING SUPPORT
15. BOLT
16. PARKING BRAKE CABLE
17. RETURN SPRING

5C-42

Figure 5C-42 Parking Brake Lever (GT)

A mechanically-operated stop light switch is mounted on a bracket just forward of the brake pedal on the GT and just rearward of the brake pedal on the Opel 1900 and Manta. With brake pedal released, the switch plunger is fully depressed against the switch actuating lever. See Figures 5C-45 and 5C-46. Any time the stop light switch fails, the stop lights will stay on at all times.

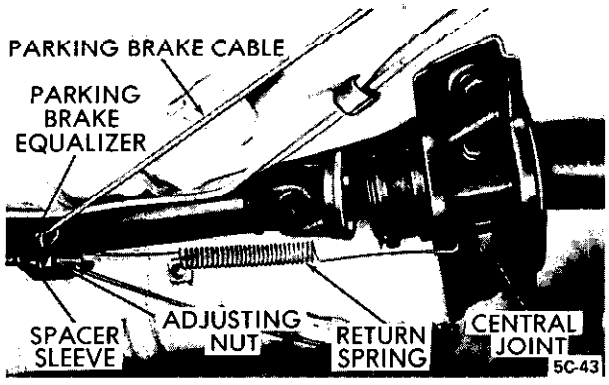


Figure 5C-43 Parking Brake Equalizer (Opel 1900 and Manta)

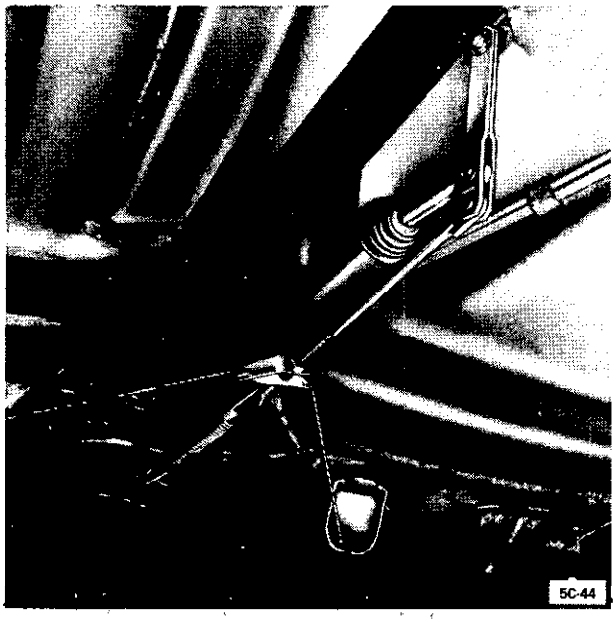


Figure 5C-44 Parking Brake Equalizer (GT)

The brake pedal on the GT is suspended from a pivot shaft. The pivot shaft inserts through the support bracket which is mounted on the cowl. The pedal is stopped in "off" position by the thrust rod coming in contact with the support plate on the cowl. The thrust rod (master cylinder push rod) connects directly into the brake pedal providing no pedal height adjustment. See Figure 5C-45.

OPERATION OF HYDRAULIC SERVICE BRAKE

A dual master cylinder, equipped with one (1) static pressure valve - for rear brake circuit - and used along with a power booster, is used on all models.

Each rear wheel cylinder contains two pistons and two rubber cups which are held in contact with the pistons by a central coil spring. The wheel cylinder

Figure 5C-45 Brake and Clutch Pedal Arrangement - GT

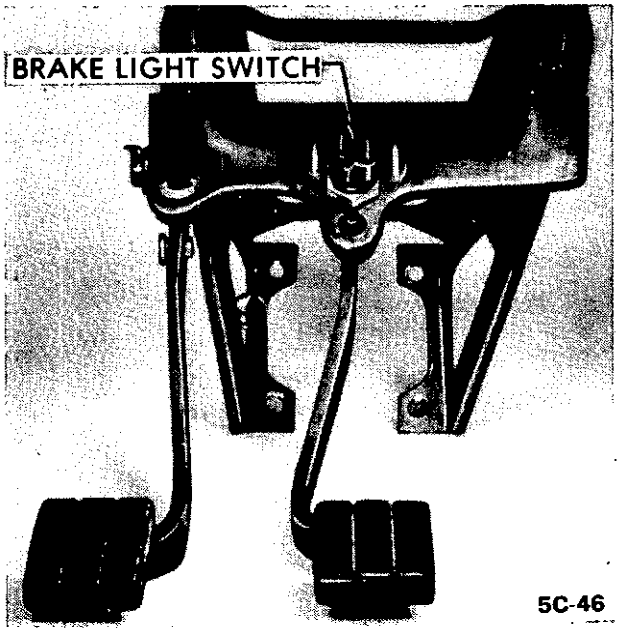


Figure 5C-46 Brake Light Switch - Opel 1900 and Manta

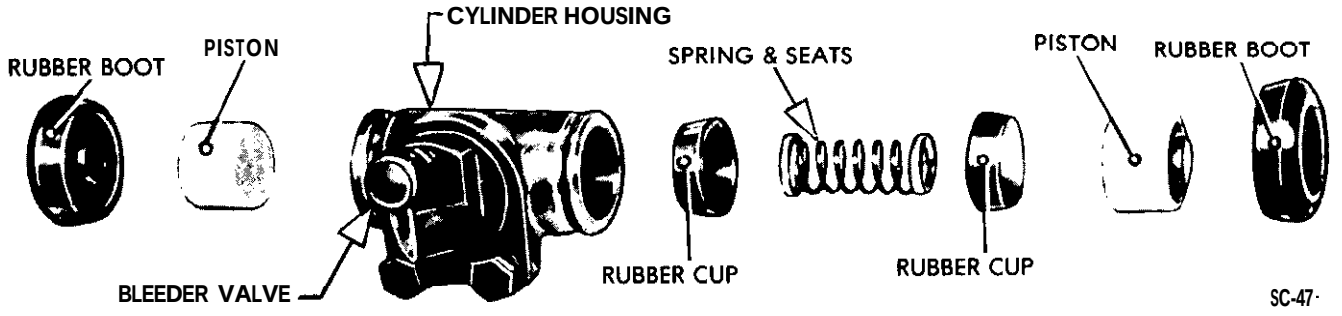


Figure 5C-47 Wheel Cylinder Exploded View

cups are of a special heat resisting rubber. The inlet port for brake fluid is located between the pistons so that when fluid pressure is applied, both pistons move outward in the wheel cylinders. The pistons impart movement to the brake shoes of the rear wheel brakes by bearing directly against the ends of the shoes. Rubber boots enclose both ends of the cylinder to exclude foreign matter. A valve for bleeding brake pipes and wheel cylinder is located in the back of the cylinder casting and extends through the brake backing plate assembly. See Figure 5C-47.

DIAGNOSIS

BRAKE TROUBLE DIAGNOSIS CHART

SYMPTOM / CAUSE	EXCESSIVE BRAKE PEDAL TRAVEL	BRAKE PEDAL TRAVEL GRADUALLY INCREASES	EXCESSIVE BRAKE PEDAL EFFORT	BRAKES SLOW TO RESPOND	BRAKES SLOW TO RELEASE	BRAKES DRAG	UNEVEN BRAKING ACTION (SIDE TO SIDE)	UNEVEN BRAKING ACTION (FRONT TO REAR)	SCRAPING NOISE FROM BRAKES APPLICATION	BRAKES SQUEAK DURING	BRAKES SQUEAK DURING STOP	BRAKES CHATTER (ROUGHNESS)	BRAKES GROAN AT END OF STOP	BRAKE TELL-TALE GLOWS DURING STOP
LEAKING BRAKE LINE OR CONNECTION	X	XX							X					XX
LEAKING WHEEL CYLINDER OR PISTON SEAL	X	XX		X				X						X
LEAKING MASTER CYLINDER	X	XX												X
AIR IN BRAKE SYSTEM	XX								X					XX
CONTAMINATED OR IMPROPER BRAKE FLUID					X	X	X							X
LEAKING VACUUM SYSTEM			XX		X									
RESTRICTED AIR PASSAGE IN POWER HEAD			X		XX	X								
DAMAGED POWER HEAD			X	X	X	X	X							
WORN OUT BRAKE LINING - REPLACE			X	X				X	X	X	X	X		X	
UNEVEN BRAKE LINING WEAR - REPLACE AND CORRECT	X			X				X	X	X	X	XX		X	X
GLAZED BRAKE LINING - SAND LIGHTLY			XX					X	X		X	X			
INCORRECT LINING MATERIAL - REPLACE			X	X				X	X			X		X	
CONTAMINATED BRAKE LINING - REPLACE				XX				XX	XX	X	X	X		X	
LININGS DAMAGED BY ABUSIVE USE - REPLACE			X	XX				X	X	X	X	X		X	
EXCESSIVE BRAKE LINING DUST - REMOVE WITH AIR			X	XX				XX	XX		X	XX		X	
HEAT SPOTTED OR SCORED BRAKE DRUMS OR ROTORS				X				X	X		X	X	XX	X	
OUT-OF-ROUND OR VIBRATING BRAKE DRUMS												X	XX		
OUT-OF-PARALLEL BRAKE ROTORS													XX		
EXCESSIVE ROTOR RUN-OUT													X		
INCORRECT WHEEL CYLINDER SIZES			X	X				X	X						
WEAK OR INCORRECT BRAKE SHOE RETENTION SPRINGS				X		X	XX	X	X	XX	X	XX			
BRAKE ASSEMBLY ATTACHMENTS - MISSING OR LOOSE	X						X	X	X	X		X	X	X	
INSUFFICIENT BRAKE SHOE GUIDE LUBRICANT						X	X	X	X	XX	XX				
RESTRICTED BRAKE FLUID PASSAGE OR STICKING WHEEL CYLINDER PISTON		X	X		X	X	X	X	X						
BRAKE PEDAL LINKAGE INTERFERENCE OR BINDING			X		X	XX	XX								
IMPROPERLY ADJUSTED PARKING BRAKE							X								
DRUMS TAPERED OR THREADED										XX					
INCORRECT FRONT END ALIGNMENT								XX							
INCORRECT TIRE PRESSURE								X	X						
INCORRECT WHEEL BEARING ADJUSTMENT	X									X			X		
LOOSE FRONT SUSPENSION ATTACHMENTS								X		XX			X	X	
OUT-OF-BALANCE WHEEL ASSEMBLIES													XX		
OPERATOR RIDING BRAKE PEDAL	X	X	X				X		X					X	
STICKING WHEEL CYLINDER OR CALIPER PISTONS			X			X	X	X	X						

XX - INDICATES MORE PROBABLE CAUSE(S) X - INDICATED CAUSES

5C-48

Figure 5C-48 Brake Trouble Diagnosis Chart

MAINTENANCE AND ADJUSTMENTS

BRAKE ADJUSTMENT

Preliminary Checks

1. Depress brake pedal firmly. If pedal travels to within two inches of toeboard and has a hard feel, brake shoes require adjustment or relining. However, if pedal has a spongy feel, brake system needs bleeding.

2. Remove one rear drum if lining is worn nearly to rivets. Reline both rear brakes (drum brakes only).

3. Check fluid level in master cylinder reservoir and add fluid if necessary.

4. Fully release parking brake lever and place transmission in neutral.

5. Pull on both ends of rear brake cable a number of times to make sure that cables operate rear brake shoes freely and do not bind in conduits. Check for free movement of cable in brake cable sheave and check brake cable spring for tension. Replace a weak or broken cable spring.

Pedal Height Adjustment

Brake pedal height can be adjusted by first removing the nut and lock tab from the brake pedal to clevis attaching bolt and then by turning the head of the bolt and rotating the eccentric until there is approximately 1/4 of an inch play in the brake pedal. See Figures 5C-49 and 5C-50. Replace lock tap and nut. If one of the tabs on lock tap breaks replace lock tab.

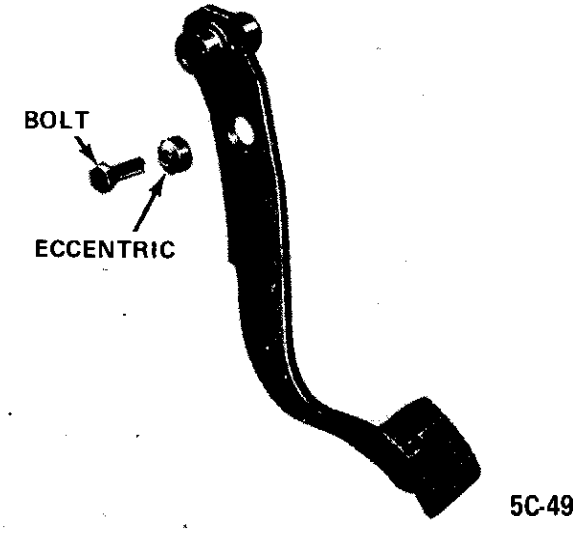


Figure 5C-49 Brake Pedal Attaching Bolt and Eccentric

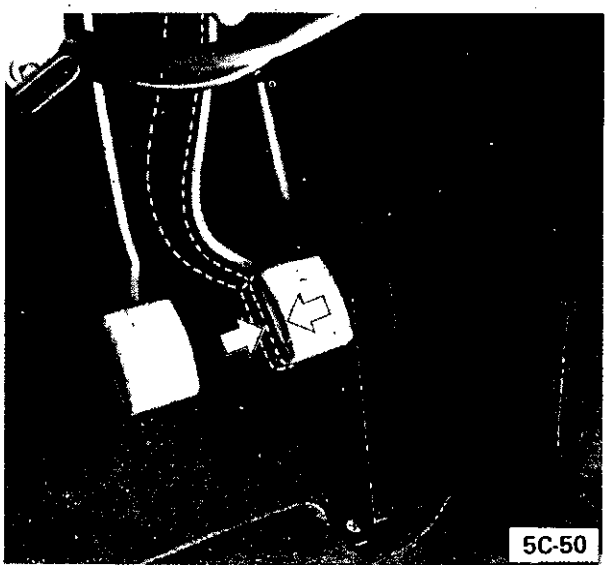


Figure 5C-50 Brake Pedal Height Adjustment

If binding does occur, take pedal assembly apart and clean. Check for broken parts. Lubricate and replace.

Adjustment at Wheels

At each rear wheel brake assembly there are two (2) brake shoes, and **each** brake shoe has an individual adjustment eccentric. Therefore, each shoe must be adjusted separately by turning its adjustment eccentric which is mounted on the brake backing plate. Arrows on backing plate circumference show direction in which eccentrics should be turned to get brake shoe-to-drum contact. See Figure X-51.

When adjusting front brake shoe of rear brakes, turn wheel forward. When adjusting rear brake shoe of rear wheel brakes, turn wheel rearward. Adjust as follows:

1. Raise car and support in a safe manner so that all wheels clear ground. Prior to wheel brake adjustment, check that all brake drums rotate freely.

2. Revolve drum in forward direction and turn front brake shoe eccentric in direction of arrow until brake shoe contacts brake drum. See Figure 5C-49, then turn eccentric in opposite direction until brake drum is **just** free to **turn.** Adjust rear brake shoe in the same **way but** revolve brake drum in backward direction.

3. Remove car jacking and support equipment, and road test car for brake performance.

Disc brakes do not require adjustment.

Parking Brake Adjustment

Adjustment of parking brake cable is necessary whenever the rear brake cables have been

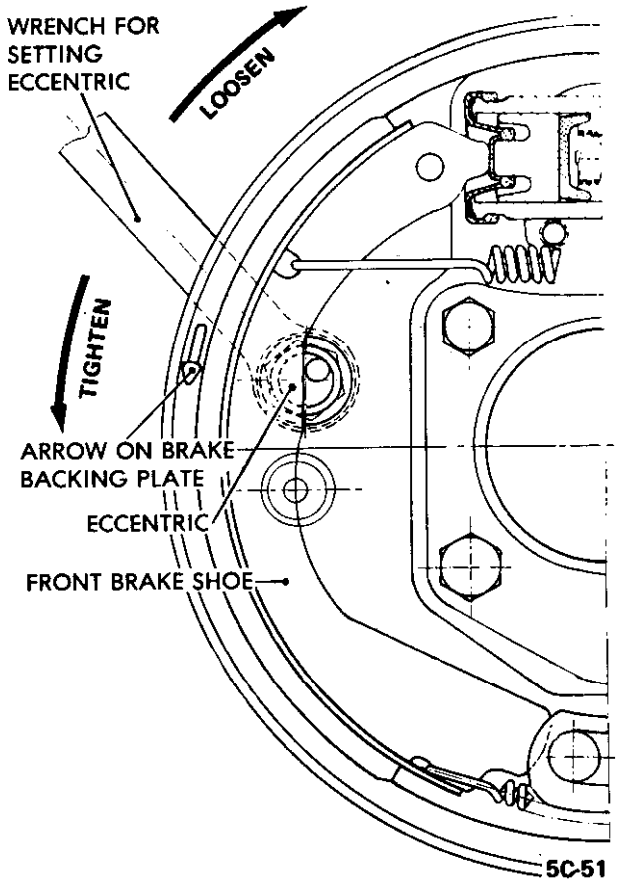


Figure 5C-51 Rear Wheel Brake Adjustment

disconnected, or when cables have been stretched through extended use. Need for parking brake adjustment is indicated if the service brake operates with good reserve, but the parking brake handle can be engaged, more than eight ratchet clicks under heavy pressure.

After making certain that service brakes are in good adjustment, adjust parking brake mechanism as follows:

1. Fully release parking brake lever; check parking brake cable for free movement.

2. Loosen equalizer nut or adjusting nut, depending upon whether. tension is to be increased or decreased on cable.

3. Pull parking brake lever up by three (3) clicks. In this position, adjust equalizer with adjusting and lock nuts so that rear brakes just begin to bind. Take care that rear brake action is equal on both rear wheels. In case of unequal brake action, apply lubricant to equalizer and brake cable.

4. After adjustment, tighten lock nut. Be certain that equalizer is in horizontal position. Check operation of parking brake. If parking brake adjustment does not result in proper brake action, inspect linings on both rear wheels for possible replacement.

Filling Brake Master Cylinder Reservoir

The master cylinder reservoir must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overtilled.

The plastic brake fluid reservoir is attached to the master cylinder which is located under the hood on the left side of the cowl.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and add fluid as required to bring level up to "MAX." marked on reservoir.

Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent.

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil. Even a trace of mineral oil will cause swelling and distortion of rubber parts in the hyrdaulic brake system.

Bleeding Brake Hydraulic System

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system. Since air is compressible and hydraulic fluid is not, the presence of air in the system is indicated by a springy, spongy feeling of the brake pedal accompanied by poor braking action.

Air will be introduced into the hydraulic system if the brake pedal is operated when the fluid is too low in master cylinder reservoir. Air will also enter the system whenever any part of hydraulic system is disconnected.

It will be necessary to bleed both hydraulic systems if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If brake pipe is disconnected at any wheel cylinder, then that wheel cylinder only need be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then the wheel cylinder(s) served by the disconnected pipe must be bled.

Sequence for Bleeding Wheel Cylinders or Calipers

It is advisable to bleed one wheel cylinder or caliper

at a time to avoid getting fluid level in reservoir dangerously low. The correct sequence for bleeding is bleed the wheel cylinder or caliper nearest the master cylinder first in either circuit.

Do not perform bleeding operation while any brake drum is removed.

Bleeding Wheel Cylinder or Caliper

1. Check fluid level, in reservoir and refill, if necessary. Level must be brought up to "MAX" mark on plastic reservoir.

2. Clean all dirt from around respective bleeder valve, and then remove cap.

3. Push bleeder hose over bleeder valve, placing other end of hose in a glass jar. Bleeder hose should always be used to avoid getting fluid on linings.

4. Hold pressure on brake pedal and crack open the bleeder valve to allow air (and,or) brake fluid to flow out of the system. Allow pedal to travel to the floor. Close bleeder valve. Release pedal and repeat this procedure at each wheel cylinder in the circuit until all air is removed. Frequently check reservoir fluid level. Allowing fluid to be emptied will draw air into the system.

5. Remove bleeder hose and install cap.

6. When bleeding operation is completed, make sure that fluid level is brought up to "MAX" marking on reservoir, then install cover.

7. Discard the brake fluid deposited in glass jar during bleeding operation.

Flushing Brake Hydraulic System

It is recommended that both brake system circuits be thoroughly flushed whenever the master cylinder is replaced or if there is any doubt as to the grade of fluid in the system.

Flushing of the brake system is performed in the same manner as the bleeding operation except that fluid is forced through the lines and wheel cylinder until it emerges clear in color. Approximately one half pint of brake fluid is required to flush the hydraulic system thoroughly.

When flushing is completed, make certain the master cylinder reservoir is filled to the proper level.

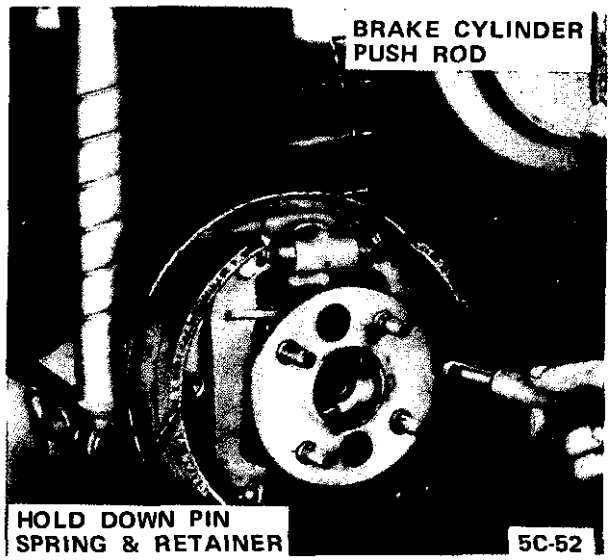


Figure 5C-52 Rear Drum Brake Assembly

MAJOR REPAIR

REPLACE OR RELINE BRAKE SHOES (DRUM BRAKES)

Removal and Inspection

1. Jack up car in safe manner and support adequately.

2. Remove wheel and drum assembly.

3. Remove upper and lower brake shoe return springs.

4. Remove retaining pins and springs, as shown in Figure 5C-52.

5. Clean all dirt out of brake drum. Inspect drums and replace or recondition if required.

6. Blow all dirt from brake assemblies and inspect for any unusual condition.

7. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Fluid at this point indicates leakage past piston cup, requiring overhaul or replacement of wheel cylinder.

8. Inspect all brake pipe and hose connections for evidence of fluid leakage. Tighten any leaking connection, then apply heavy pressure to brake pedal and recheck connections.

9. Inspect backing plate for oil leak past rear wheel bearing oil seals. Correct any leak by installation of new seals.

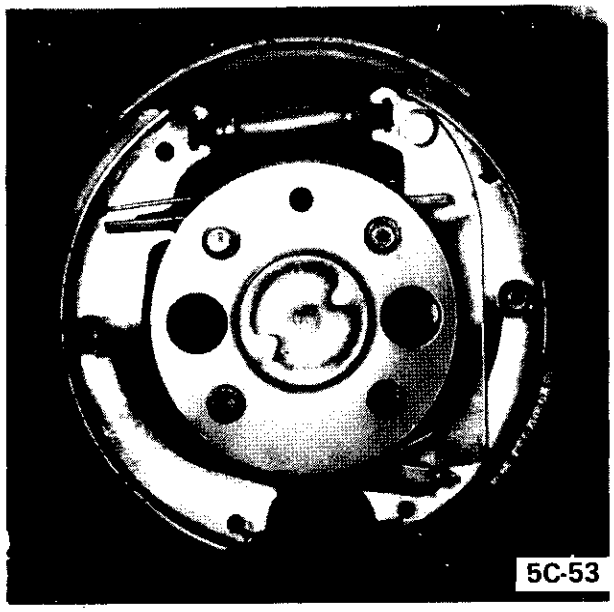


Figure 5C-53 Rear Brake Assembly

10. Check all backing plate attaching bolts to make sure they are tight. Using line emery cloth, clean all rust and dirt from shoe contact surfaces on plate. See Figure 5C-53.

Relining Brake Shoes

If old brake shoes are to be relined, inspect shoes for distortion and for looseness between the rim and web; these are causes for discarding any shoe. If shoes are serviceable, be governed by the following points in installing new linings:

1. Remove old rivets by drilling them out. Punching out rivets will cause distortion of shoe rim. Care must also be taken to support shoes properly while drilling.

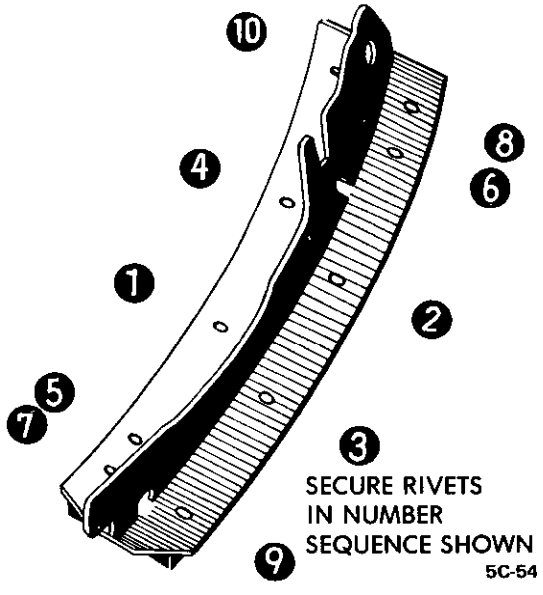


Figure 5C-54 Brake Lining Riveting Sequence

2. Thoroughly clean brake shoes and remove all burrs around rivet holes.

3. Use Opel brake lining or equivalent. Install in place and rivet in sequence shown in Figure 5C-54. Keep hands clean while handling brake lining. Do not permit oil or grease to come in contact with lining.

Installation and Adjustment

1. If any hydraulic connections were disturbed, bleed hydraulic system. If new parts were installed in brake system, flushing of hydraulic system is recommended.

2. Adjust rear wheel brakes.

3. Adjust parking brake.

4. Check fluid level in master cyliner and add fluid if necessary.

5. Check brake pedal for proper feel and for proper return.

6. Remove jacks and road test car for proper brake action. Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently injure new linings and may score brake drums. When linings are new, they must be given moderate use for several days until burnished.

INSPECTING AND RECONDITIONING BRAKE DRUMS

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep groves, and out-of-round. Any of these conditions must be corrected since they can impair the efficiency of brake operation and also can cause premature failure of other parts.

Cracked, Scored or Grooved Drum

A cracked drum is unsafe for further service and must be replaced. Welding a cracked drum is not recommended.

Smooth up any slight scores by polishing with tine emery cloth. Heavy or extensive scoring will cause excessive brake lining wear and it will be necessary to rebore in order to true up the braking surface.

If the brake linings are slightly worn and drum is grooved, the drum should be rebored just enough to

remove grooves, and the ridges in the lining should be lightly removed with a lining grinder.

If brake linings are more than half worn, but do not need replacement, the drum should be polished with fine emery cloth but should not be rebored. At this stage, eliminating the grooves in drum and smoothing the ridges on lining would necessitate removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be rebored for use with oversize linings. A grooved drum, if used with new lining, will not only wear the lining but will make it difficult, if not impossible, to obtain efficient brake performance.

Out-of-Round Drum

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause brake pulsation. Maximum permissible drum runout is .004". A drum that has more run-out than this should be rebored. Runout can be accurately checked by using an inside micrometer fitted with proper extension rods.

When measuring a drum for run-out, take measurements at open and closed edges of machined surface and at right angles to each other.

Turning Brake Drums

If a brake drum is to be turned, enough metal should be removed to obtain a true, smooth braking surface. Measure brake drum diameter; standard drum inner diameter is 9.060". Drums may be turned to an oversize of .030". If maximum inner diameter after turning exceeds 9.090", brake drum will have to be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

1. Remove rear wheels and drums.

2. Mount brake drum on brake drum lathe and turn drums as necessary, within limits.

3. After turning, check drum diameter. Inner diameter not to exceed 9.090.

4. A newly-bored drum should always have center contact with brake shoes. For this reason, arc grind linings to .010" under drum radius, or to .020" under drum diameter.

5. Clean and install drums and wheels.

BRAKE WHEEL CYLINDER OVERHAUL

1. Remove wheel, drum, and brake shoes. Be careful not to get grease or dirt on brake lining.

2. Disconnect brake pipe or hose from wheel cylinder and cover opening with tape to prevent entrance of dirt. Remove wheel cylinder from backing plate.

3. Remove boots, pistons, cups, and spring from cylinder. Remove bleeder valve.

4. Discard rubber boots and piston cups. Thoroughly clean all other parts with hydraulic brake fluid or Declene. Do not use anti-freeze, alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

5. Inspect pistons and cylinder bore for scores, scratches, or corrosion. Light scratches may be polished with crocus cloth. Do not use emery cloth or sandpaper. Slight corrosion may be cleaned with tine steel wool. If scratches or corroded spots are too deep to be polished satisfactorily, the cylinder should be replaced since honing is not recommended.

6. Dip internal parts in brake fluid and reassembly wheel cylinder. When installing piston cups, use care to avoid damaging the edges.

7. If the rear wheel backing plate is removed: Always install new paper gaskets one on each side • on the backing plate. Prior to installation, lightly coat paper gaskets with chassis lubricant. Torque backing plate to rear axle housing bolts to 43 lb.ft. and wheel brake cylinder to backing plate bolts to 5 lb.ft. Install wheel cylinder on brake backing plate and connect brake pipe or hose.

8. Install brake shoes, drum, and wheel, then flush and bleed hydraulic system.

9. Adjust brakes, then road test car for brake performance.

CAUTION: ***This brake backing plate to rear axle fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.***

REPLACING BRAKE PIPES

Any brake pipe assembly which is needed must be made up from service bulk tubing and fittings. All brake pipes must be made of tin or copper coated wrapped steel tubing with the ends double lap flared.

Never use copper tubing because copper is subject to fatigue cracking which would result in brake failure.

To make up a brake pipe assembly, proceed as follows:

1. Procure the recommended tubing and fittings of the correct size. (Outside diameter of tubing is used to specify size.)

2. Cut tubing to length. The correct length may be determined by measuring the old pipe using a cord and adding 1/8" for each double lap flare.

3. Double lap flare tubing ends, using a suitable flaring tool such as J-8051. Follow the instructions included in the tool set. Make sure fittings are installed before starting second flare.

4. Bend pipe assembly to match old pipe.

SPECIFICATIONS

BRAKE SPECIFICATIONS

Torque Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurage measurement of tightness.

Part	Name	Torque Lb.Ft.
Nut	Brake Hose to Front Wheel Brake Cylinder	22
Bolt	Brake Backing Plate to Steering Knuckle (Upper Bolts)	22
Bolt	Brake Backing Plate to Steering Knuckle and Steering Arm (Lower Bolts)	47
Bolt	Backing Plate to Rear Axle Housing	43
Nut	Master Cylinder Actuator Rod to Brake Pedal	5
Bolt	Wheel Brake Cylinder to Brake Backing Plate	5

General Specifications

Operating Mechanism, Service Brakes	Hydraulic
Parking Brakes	Lever and Cables
Operation of Service Brakes Independent of Parking Brakes	Yes
Wheel Brakes, Service	Front and Rear
Parking.	Rear Only
Brake Pedal Height Adjustment	None
Static Pressure in Hydraulic System When Brakes are Released - Drum Brakes	4 psi Min.
Static Pressure in Hydraulic System to Rear Brakes Only - Disc Brakes	4 psi Min.
Brake Master Cylinder (for Drum Brakes) Bore	13/16
Wheel Cylinder Size - Rear - All	. 5/8
Approved Hydraulic Brake Fluid	GM or Delco Supreme No. 11
Fluid Level in Reservoir	Fill to "Max." Level
Brake Drum Rebore, Maximum Allowable Inside Diameter	9.090
Max. Allowable Out-of-Round	.004
Rear Brake Drum Size. New	9.060