

CHAPTER 11

THE BRAKING SYSTEM

11:1 Description
11:2 Routine maintenance
11:3 Brake pad renewal
11:4 Brake hoses
11:5 Front disc brakes
11:6 Rear disc brakes
11:7 Rear drum brakes

11:8 The master cylinder
11:9 Vacuum servo unit
11:10 Pressure regulating valve
11:11 The handbrake
11:12 Bleeding the system
11:13 Fault diagnosis

11:1 Description

The brake units on all four wheels are hydraulically operated from the footbrake pedal. Front disc brakes are standard on all models, but either disc or drum brakes may be fitted at the rear according to model type and year of manufacture. The handbrake mechanism is cable operated. If rear drum brakes are fitted, these are operated both by the footbrake system and by the handbrake mechanism, but if disc rear brakes are fitted the handbrake operates on a separate set of brake shoes against a small drum incorporated in the disc brake hubs.

The hydraulic system has two separate circuits, one chamber in the master cylinder providing pressure to all four brake units, the other chamber providing pressure to the front disc brakes only. Thus if the system is damaged and a brake fluid leak results, braking power can only be lost on the rear brakes, the front pair being unaffected. A leak can be detected by abnormally long pedal travel and reduced braking efficiency.

A vacuum servo unit to assist the pressure applied at the brake pedal is a standard fitment. A brake pressure regulating valve fitted in the circuit reduces hydraulic pressure supplied to the rear brakes according to the load

on the pedal, to minimise the possibility of the rear wheels locking under heavy braking.

The master cylinder which draws fluid from twin reservoirs is operated from the brake pedal via the servo unit by a short pushrod and coupling. Fluid pressure from the master cylinder is conveyed to the brake units by means of the brake pipes and hoses.

11:2 Routine maintenance

Regularly check the level of fluid in the master cylinder reservoir and replenish if necessary. Wipe dirt from around the cap before removing it and check that the vent hole in the cap is unobstructed. The fluid level should be maintained at the mark on the side of the reservoir. If frequent topping up is required, the system should be checked for leaks, but it should be noted that with disc brake systems the fluid level will drop gradually over a period of time due to the movement of caliper pistons compensating for friction pad wear. The recommended brake fluid is ATE 'S'. **Never use anything but the recommended fluid.** The brake fluid in the system should be completely changed at yearly intervals. This can be carried out by opening all bleed screws and pumping

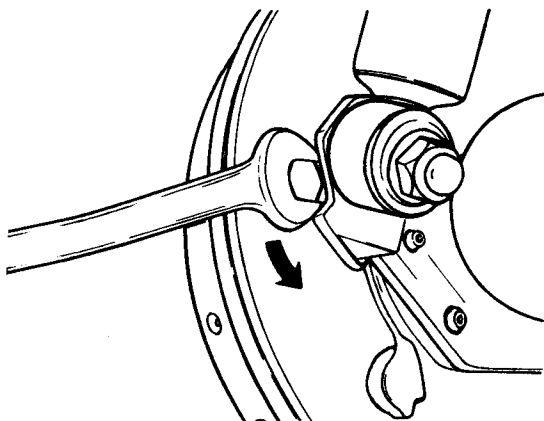


FIG 11:1 Rear drum brake adjustment

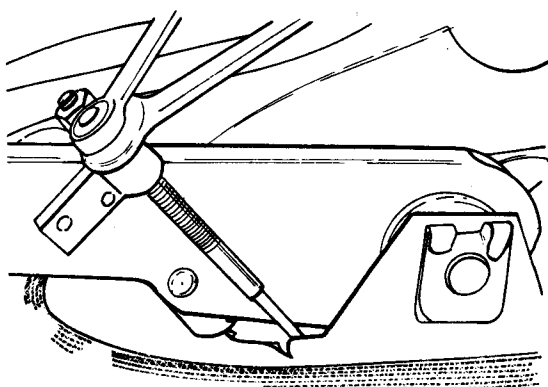


FIG 11:2 Handbrake cable adjustment

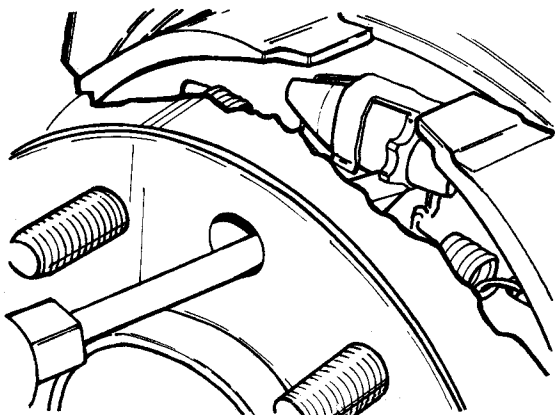


FIG 11:3 Cut-away view showing handbrake shoe adjustment mechanism

out the old brake fluid by operating the brake pedal. The system should then be filled with fresh brake fluid of the correct type and the brakes bled as described in **Section 11:12**. Alternatively, the work can be carried out very quickly by pressure-bleeding at a service station.

Checking brake pads and linings:

Regularly check the thickness of friction lining material on disc brake pads and drum brake shoes.

To check lining wear on disc brake pads, raise and safely support the car then remove the road wheels. Look into the caliper recess and examine the friction lining which is adjacent to the brake disc. If the lining on any pad has worn to a thickness of 2mm (0.08in), or if any lining is cracked or oily, all four friction pads on that axle (front or rear) must be renewed. **Do not renew pads singly or on one side of the car only as uneven braking will result.**

To check the friction linings on models fitted with drum rear brakes, or the linings for the handbrake mechanism on models fitted with drum rear brakes, the brake drum or brake disc must first be removed as described later. If any lining is worn down almost to the rivet heads, or to a thickness of 2mm (0.08in) in the case of bonded linings, or if any lining is damaged or oily, all four rear brake linings should be renewed.

Brake adjustment:

No adjustments are required for any of the disc brakes in the system. The disc brakes are self-adjusting, due to the action of the operating pistons in the calipers. These pistons are returned to the rest position after each brake operation by the piston seals, the seals being slightly stretched during brake application. As the friction pads wear, piston stroke is increased and the pistons will travel further than before and move through the stretched seals a little, the seals returning the pistons to new positions nearer the pads when the brakes are released. In this manner, the piston stroke remains constant regardless of the thickness of friction pads.

Rear drum brakes should be adjusted whenever brake pedal travel becomes excessive. Always check that the linings are not worn to the limit before carrying out the adjustment procedure. On all models, handbrake adjustment procedures should be carried out if the handbrake will not hold the car securely when the lever is pulled up by five clicks on the ratchet.

Drum brake adjustment:

Chock the front wheels against rotation, then raise and safely support the rear of the car and fully release the handbrake. The adjusters are located on the brake backplate as shown in **FIG 11:1**. To take up the adjustment, the adjuster at the rear of the backplate must be turned anticlockwise and at the front clockwise.

Spin the road wheel forwards while turning the adjuster until the wheel is just locked against rotation. Slacken the adjuster until the wheel is just able to spin freely, then apply the handbrake and footbrake several times and recheck the adjustment. Repeat the adjustment procedure at the second adjuster on the same brake unit, then repeat the entire adjustment procedure at the opposite rear wheel.

Handbrake adjustment:

Drum brakes:

On models fitted with drum rear brake units, the adjustment procedure described previously will normally take up excessive slack in the handbrake mechanism. Always carry out this adjustment before attempting to adjust the handbrake cables.

Chock the front wheels against rotation, then raise and safely support the rear of the car and fully release the handbrake. Release the rubber boot from the base of the handbrake lever then push the boot up the lever to expose the cable adjusting nuts (see FIG 11 :2). Using two spanners as shown, hold the adjusting nut against rotation while slackening the locknut on each cable. Pull the handbrake up by five clicks on the ratchet from the fully released position.

Evenly tighten the adjusting nuts a little at a time until resistance to turning by hand can be felt at one or both of the rear wheels. If resistance is unequal, tighten the appropriate individual adjusting nut until resistance is equal at both wheels. Continue tightening equally until both rear wheels are locked against rotation under heavy hand pressure. Now fully release the handbrake and check that both rear wheels are completely free to turn, with no sign of binding. If necessary, slacken the adjusters a little. On completion, firmly tighten the locknuts to secure the adjustment then refit the rubber boot to the handbrake lever.

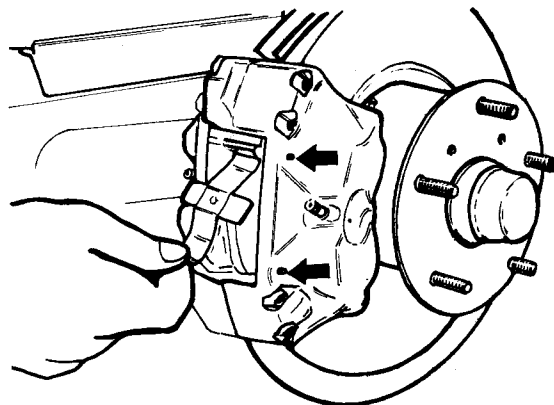


FIG 11 :4 Retaining pin and spring removal. Front brake caliper shown

Rear disc brakes:

Chock the front wheels, raise and safely support the rear of the car, then remove the rear road wheels and fully release the handbrake. Turn the brake disc until the access hole is aligned with the adjuster wheel in the brake unit, then insert a suitable screwdriver through the hole to engage the adjuster as shown in FIG 11 :3. Use the screwdriver to turn the adjuster one tooth at a time, removing the screwdriver and rotating the brake disc between each adjustment. Continue until the disc cannot be turned by hand, then slacken the adjuster by two to three teeth. Operate the handbrake several times and recheck the adjustment. Slacken a little further if binding is evident. Repeat the adjustment procedure for the opposite rear brake.

When shoe adjustment is correct as just described, refit the road wheels and carry out the handbrake adjustment procedure as described previously for models with drum rear brakes. Never carry out adjustments at the handbrake cables before carrying out the adjustment procedures at the handbrake shoes.

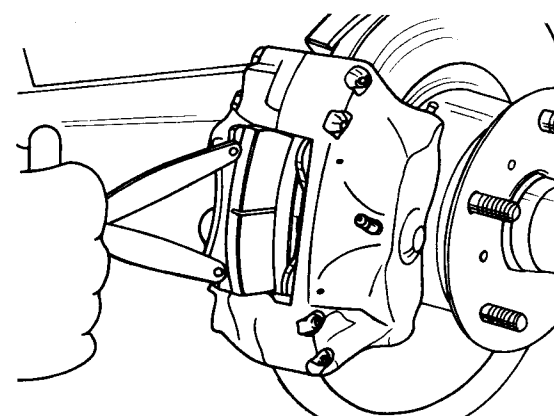


FIG 11 :5 Brake pad removal

11 :3 Brake pad renewal

Apply the handbrake then raise and safely support the front or rear of the car as necessary. Remove the road wheels.

Refer to FIG 11 :4 and drive out the pad retaining pins towards the centre of the car. Remove the spreader spring and pull out the pads, using a suitable hooked tool as shown in FIG 11 :5. If the pads are being removed only to allow for other servicing operations, they must be marked so that they can be refitted in their original positions. When renewing brake pads, the replacements

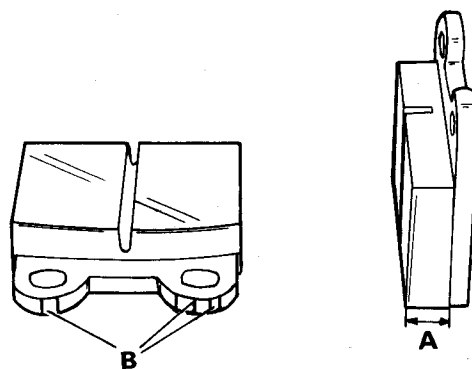


FIG 11 :6 Pad lining thickness A and colour code B

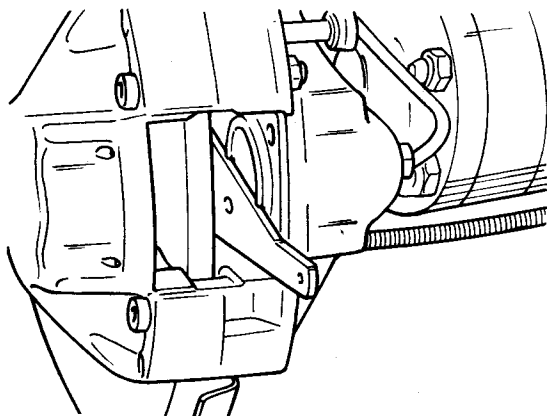


FIG 11:7 Checking piston cut-out position in rear caliper

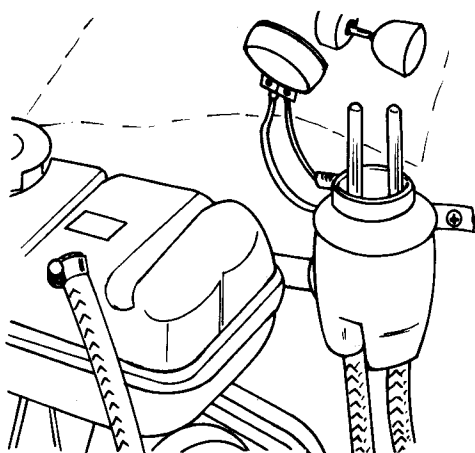


FIG 11:8 Plugging fluid reservoir outlets

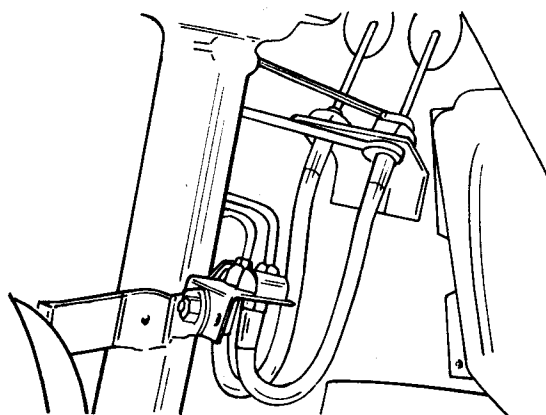


FIG 11:9 Disconnecting front brake hose

must always be of the same type as the originals, as indicated by the colour coding shown at **B** in **FIG 11:6**.

Check that the new pads are of the correct type and that they are free from grease, oil and dirt. Clean dirt and rust from the caliper before fitting the pads. To enable the new pads to be fitted, push the caliper pistons, four on front brake units or two on rear brake units, down into their bores to allow for the extra thickness of the new pads. Note that this operation will cause the level of brake fluid in the master cylinder reservoir to rise, so it may be necessary to siphon off some of the fluid to maintain the fluid at the correct level and prevent overflowing. Note that brake fluid is poisonous and that it can damage paintwork. On rear brake units, the positions of the cut-outs on the pistons must be checked, using the BMW special tool or similar as shown in **FIG 11:7**. The lower part of the tool which seats in the caliper is flat and the upper part which contacts the sides of the cut-out in the piston is at a 20° angle to the lower face. If necessary, the piston must be carefully rotated to the correct position using the special BMW tool or by other suitable means, taking care not to damage the piston or dust seal. If the piston cut-out is incorrectly positioned, brake judder, squealing or excessive pad wear may result.

Make sure that the recesses for the pads in the caliper are free from dirt and rust. Fit the new friction pads and drive one retaining pin through the pads and the caliper up to its stop. Fit the spreader spring beneath the first pin then install the second pin, making sure that the spring is correctly located. Any retaining pin which is not a tight fit in the caliper must be renewed. Check that the pads are free to move slightly in the caliper. If any pad binds in position, it must be removed and the backing plate lightly filed as necessary so that it fits freely in the caliper. When all four brake pads have been installed, operate the brake pedal hard several times to bring the pads close to the disc. If this is not done, the brakes may not function the first time that they are used. Top up the fluid in the master cylinder reservoir to the correct level. Refit the road wheels and lower the car, then carefully road test to check the brakes.

The efficiency and life of new brake pads will be greatly increased if they are allowed to bed-in gradually. To ensure this, heavy braking, except in emergencies, should be avoided until the car has been driven for approximately 600km (375 miles) under normal running conditions.

11:4 Brake hoses

Master cylinder supply hoses:

Before removing the hoses connecting the fluid reservoir to the master cylinder, siphon out the contents of the reservoir into a clean container. Note that brake fluid is poisonous and can damage paintwork. Carefully pull the hoses from the reservoir, then pull the connectors from the rubber plugs in the master cylinder. Always pull the connectors vertically out of the plugs, as if they are tilted they may be fractured. When refitting, make sure that the connectors are seated correctly in the master cylinder sealing plugs. Refill the fluid reservoir to the correct level then bleed the brakes as described in **Section 11:12**.

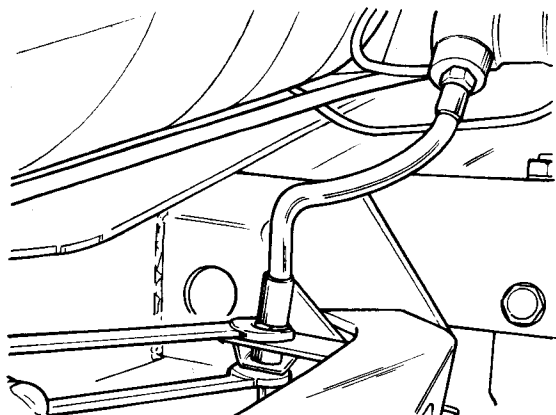


FIG 11:10 Disconnecting rear brake hose

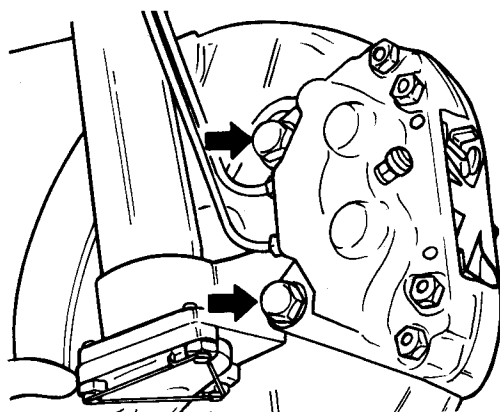


FIG 11:11 Front brake caliper mounting bolts

Front and rear brake hoses:

Before disconnecting a hose, plug the fluid reservoir outlets using two pointed wooden dowels as shown in FIG 11:8. Make sure that the dowels are free of dirt and splinters to avoid contamination of the fluid. Hold the hose connector with one spanner as shown in FIG 11:9 or 11:10, then use a second spanner to unscrew the pipe connector. Detach the hose and collect the retaining spring, then disconnect the other end of the hose in a similar manner. When refitting, allow the hose to adopt a natural sweep so that it is not strained or twisted. Hold the hose connector with one spanner while carefully tightening the pipe connector with a second spanner. Remove the dowels and top up the fluid in the reservoir if necessary. On completion, bleed the brake in question as described in Section 11:12. Have an assistant apply heavy pressure on the brake pedal, then check for fluid leaks at the hose connections.

11:5 Front disc brakes

Caliper removal and refitting:

Raise and safely support the front of the car and remove the road wheel. If the caliper is to be detached for access to other components only, remove the two mounting bolts arrowed in FIG 11:11, then remove the nut arrowed in FIG 11:12 to disconnect the brake line connector. Carefully lift the caliper with connected brake lines from the mounting on the suspension strut. Wire the caliper by one mounting hole to the inside of the wheel arch so that the brake pipes and hoses are not strained.

If the caliper is to be dismantled, plug the fluid reservoir outlets and remove the brake pads all as described previously. Remove the mounting bolts arrowed in FIG 11:11, then disconnect the brake pipes from the caliper. Lift the caliper from the suspension.

Refit the caliper in the reverse order of removal. If the brake pipes were disconnected, bleed the brake as described in Section 11:12 on completion.

Caliper overhaul:

Remove dirt and grease from the outside of the caliper before dismantling. If two calipers are to be dismantled

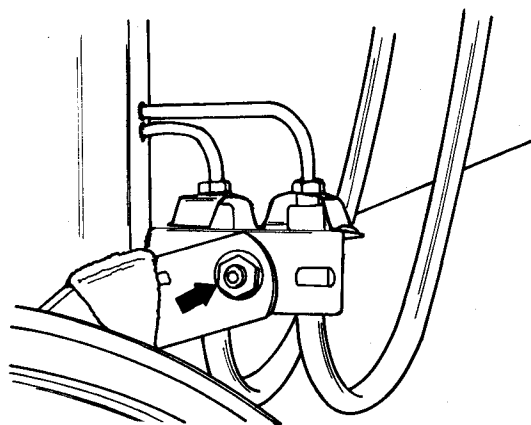


FIG 11:12 Brake line connector removal

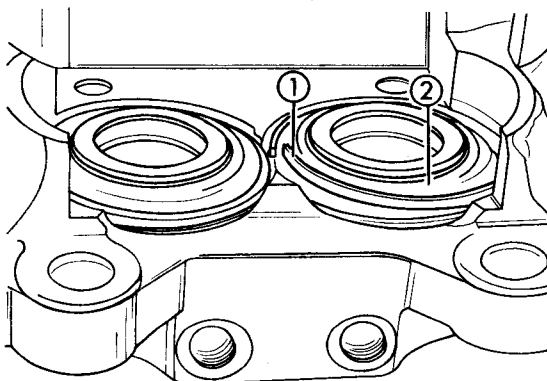


FIG 11:13 Clamp ring 1 and dust cover 2

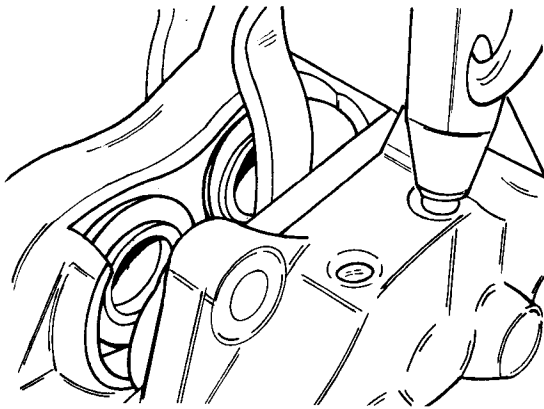


FIG 11:14 Removing a caliper piston

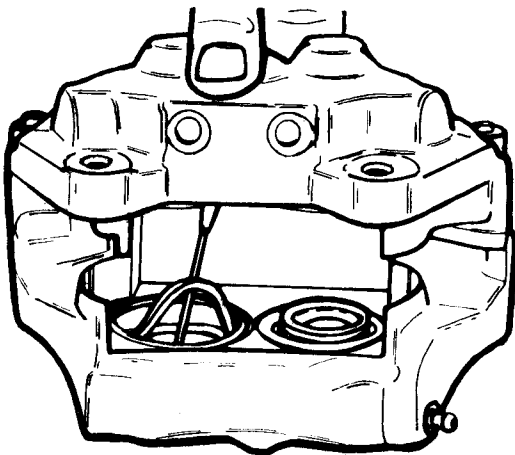


FIG 11:15 Piston seal removal

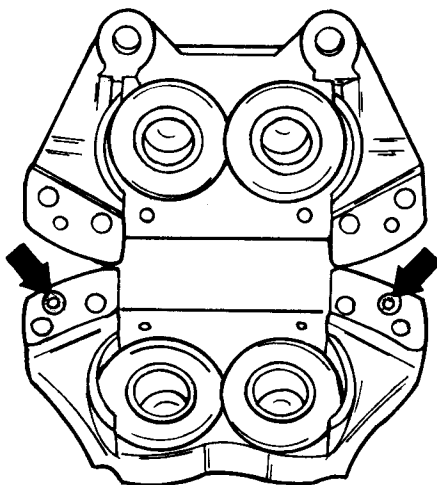


FIG 11:16 Caliper internal seals

at the same time, take care not to mix the parts. **The calipers must not be separated into two halves during servicing, unless leakage from the internal seals is detected.** Otherwise, all work is carried out with the two halves bolted together.

Refer to FIG 11:13 and remove clamp rings 1 and dust covers 2 from all four pistons. Use a suitable clamp to hold one piston on one side of the caliper in position as shown in FIG 11:14, then use low-pressure compressed air applied at the brake pipe connection to eject the opposite piston far enough to be removed with the fingers. Do not use high pressure as the piston may be ejected rapidly causing damage or accidental injury. Move the clamp to the opposite side and use it to retain a suitable wooden or rubber sealing plate against the open end of the cylinder, then repeat the operation to remove the opposite piston. Repeat the entire operation to remove the remaining pair of pistons.

Use a suitable plastic or wooden rod to remove the piston seals from the cylinder bores as shown in FIG 11:15, taking care not to damage the bores or seal grooves.

If leaks have been detected from the caliper internal seals, remove the four bolts holding the two caliper halves together, then carefully remove the seals which are arrowed in FIG 11:16. Discard the four bolts, as it is essential to fit new ones during reassembly.

Discard all rubber parts and wash the remaining parts in commercial alcohol, methylated spirits or clean approved brake fluid. **Use no other cleaner or solvent on brake components.** Inspect all parts for wear or damage and the pistons and cylinder bores for scoring or pitting. Renew any parts found worn, damaged or corroded, making sure that the correct replacement part is obtained and fitted.

Dip all internal parts in clean brake fluid or smear with ATE brake cylinder paste before installation. Reassemble the caliper using new rubber parts throughout, and new expansion bolts to hold the two halves of the caliper together if they were separated. In the latter case, carefully fit the new internal seals then fit the two caliper halves together and fit the expansion bolts finger tight. Tighten the bolts a little at a time, in the order shown in FIG 11:17, to the specified torque figure.

Use the fingers only when fitting new seals to the caliper bores, making sure that they are fully seated in the grooves. Fit the pistons, crown first, taking care not to dislodge the seals. Press the pistons down to the bottom of their bores. Fit the new dust covers and retain with the clamp rings. Install the brake pads after the caliper has been refitted, as described previously.

Brake disc removal:

The brake disc is removed together with the front hub assembly as described in **Chapter 9, Section 9:2**. Using a suitable hexagonal key, remove the fixing bolts and detach the disc from the hub. If the disc is rusted in position or is otherwise difficult to remove, refit the hub assembly to the removed road wheel and tighten the wheel nuts. Lay the wheel down with the disc uppermost, then stand on the wheel and twist and pull the disc from the hub. **Never hammer against the disc in an attempt to remove it, as this will cause damage or distortion.** When refitting, it is permissible to lightly tap

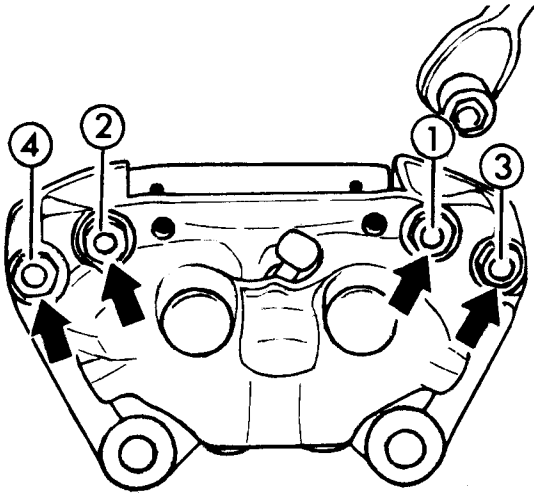


FIG 11:17 Caliper expansion bolt tightening sequence

the disc on to the hub, using a block of wood placed across the disc to cushion the hammer blows. Tighten the retaining bolts alternately and evenly to the specified torque. Lubricate the hub bearings and refit the assembly as described in **Chapter 9, Section 9:2**.

11:6 Rear disc brakes

Caliper removal and refitting:

Raise and safely support the rear of the car then remove the road wheel. If the caliper is to be removed for access to other components only, remove the two mounting bolts arrowed in **FIG 11:18** and carefully detach the brake caliper and support in such a way that the brake pipe is not strained. If the caliper is to be dismantled, plug the fluid reservoir outlets and remove the brake pads, all as described previously. Remove the mounting bolts and disconnect the brake pipe from the rear of the caliper, plugging the end of the pipe to prevent the entry of dirt. Lift the caliper from the mountings.

Refit in the reverse order of removal. If the brake line was disconnected, bleed the brake as described in **Section 11:12** on completion.

Caliper overhaul:

Apart from having only two pistons instead of four, design and construction of the rear caliper is similar to that of the front, so dismantling and overhaul procedures should be carried out as described in **Section 11:5**. Note however that during reassembly the cut-outs in the piston faces must be properly located as described in **Section 11:3** and shown in **FIG 11:7**.

Brake disc removal:

Detach the rear brake caliper without disconnecting the brake pipe, as described previously. Make sure that the handbrake is fully released, then separate the brake disc from the axle shaft as shown in **FIG 11:19**. Refit in the reverse order of removal, making sure that the holes in the brake disc assembly and the stub axle flange are correctly aligned.

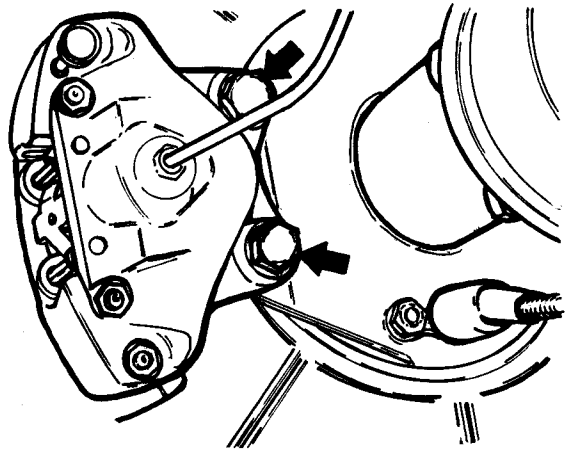


FIG 11:18 Rear brake caliper mounting bolts

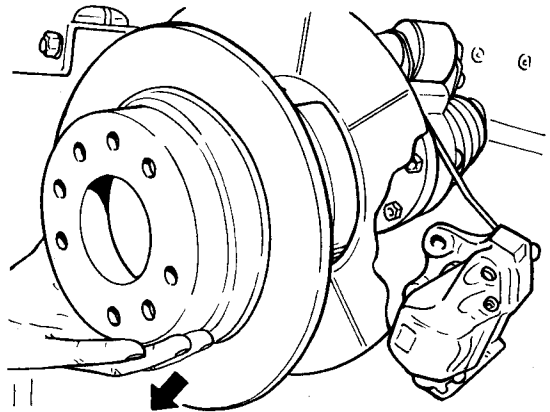


FIG 11:19 Rear brake disc removal

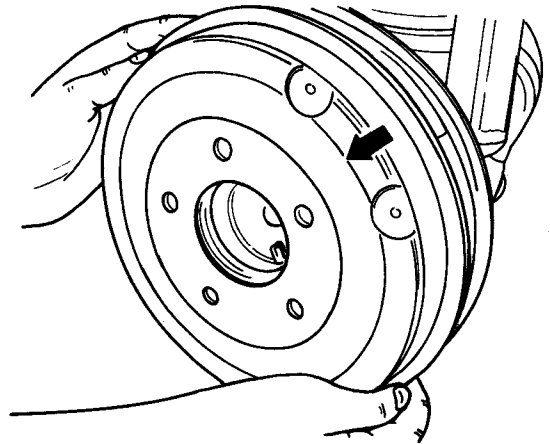


FIG 11:20 Rear brake drum removal

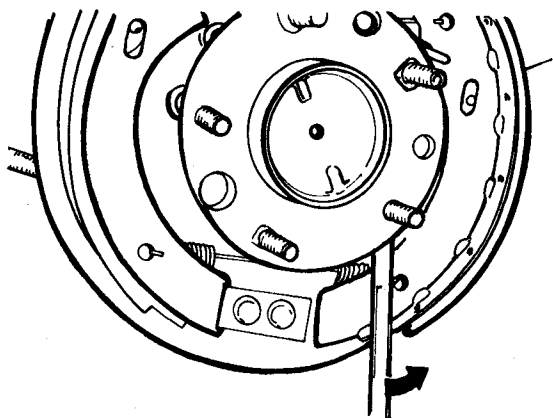


FIG 11:21 Levering out rear shoe to disconnect return spring

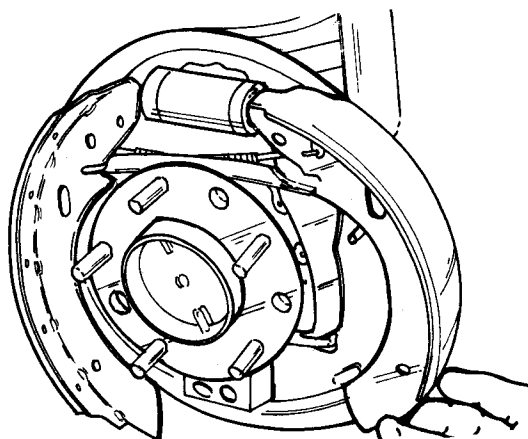


FIG 11:22 Brake shoe removal

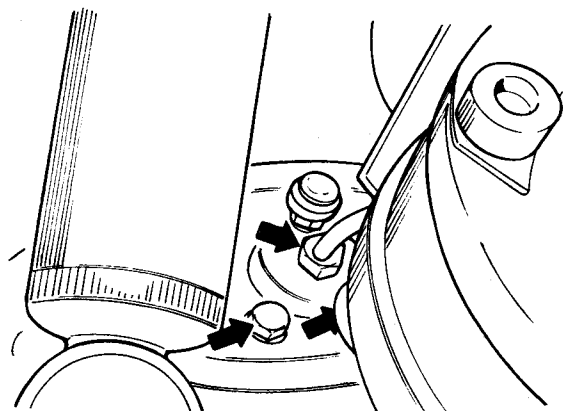


FIG 11:23 Wheel cylinder retaining screws and brake pipe connection

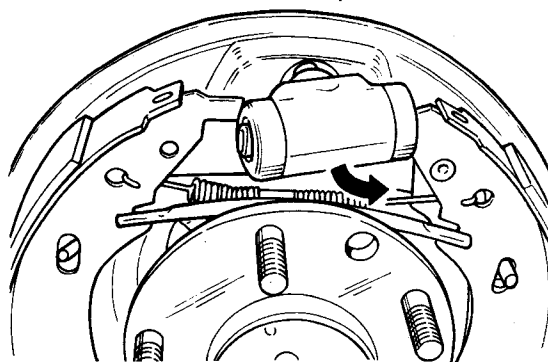


FIG 11:24 Wheel cylinder removal

11:7 Rear drum brakes

This section covers models having rear drum units for both service brake and handbrake, the auxiliary drum brakes fitted to models having rear disc brakes being covered in **Section 11:11**.

Removing brake shoes:

Chock the front wheels against rotation, then raise the rear of the car and remove the road wheels. Fully release the handbrake.

Remove the brake drum as shown in **FIG 11:20**, slackening the adjusters as described in **Section 11:2** if the brake shoes bind against the drum and make removal difficult. Use a screwdriver to lever one shoe out of the lower mounting as shown in **FIG 11:21**, then pull the shoe away from the backplate and disconnect the return spring. Pull the upper ends of the shoes from the wheel cylinder as shown in **FIG 11:22**, then detach the thrust rod, upper return spring and handbrake cable. Note that the rear shoe is serviced complete with handbrake operating lever.

Clean all dirt and grease from the inside of the brake assembly. Clean the inside surfaces of the brake drum, using a suitable solvent to remove all traces of grease.

Refitting:

This is a reversal of the removal procedure, making sure that the return springs are properly fitted to the shoe webs. Note that the longer hooked end of the upper return spring locates in the hole in the handbrake lever on the rear shoe. Check that the shoe webs engage correctly in the slots provided in the wheel cylinder pistons. On completion, adjust the brake shoes as described in **Section 11:2**.

Relining brake shoes:

It is not recommended that owners attempt to reline brake shoes themselves. It is important that the linings should be properly bedded to the shoes and ground for concentricity. For this reason it is best to obtain sets of replacement shoes, or have the relining carried out by a service station. **Do not allow grease, oil or brake fluid to contact brake linings.** If the linings become contaminated in any way they must be renewed as they cannot be successfully cleaned. **If any one lining is**

worn or contaminated all four linings for the rear brakes must be renewed. Do not renew linings singly or on one side only.

Servicing a wheel cylinder:

Remove the brake drum and plug the fluid reservoir outlets, all as described previously. Slacken the brake adjusters fully as described in **Section 11:2**. Refer to **FIG 11:23** and disconnect the brake pipe from the wheel cylinder, plugging the end of the pipe to prevent the entry of dirt. Remove the two screws indicated by the lower arrows. Remove the wheel cylinder by pressing it to the right and simultaneously pulling forward as shown in **FIG 11:24**.

Refer to **FIG 11:25**. Remove dust covers 5, then remove pistons 4 and spring 2 from wheel cylinder 1. If necessary, remove bleed screw 6 with dust cover 7. Remove and discard seals 3 as new ones must always be used when reassembling. Also renew the dust covers 5 unless in perfect condition. Wash all remaining metal parts in commercial alcohol, methylated spirits or approved brake fluid only. Inspect all parts for wear or damage and renew any found to be unserviceable.

Smear all internal parts with ATE brake cylinder paste or dip them in clean approved brake fluid during re-assembly. Use the fingers only to fit the seals to the pistons to avoid damage.

Refit the wheel cylinder in the reverse order of removal, correctly engaging brake shoe webs in the piston slots. Bleed the brake on completion as described in **Section 11:12**.

11:8 The master cylinder

Removal:

Plug the fluid outlets in the reservoir and pull the flexible hoses from the sealing plugs in the master cylinder, all as described previously. As an additional precaution against loss of fluid, raise the free ends of the flexible hoses above the level of fluid in the reservoir and tie the hoses in this position. Refer to **FIG 11:26** and disconnect the brake pipes from the master cylinder. Pipe connections are as follows:

1 front righthand and 2 front lefthand (second brake circuit), 3 front righthand, 4 front lefthand and 5 both rear brakes (first brake circuit). Plug the open ends of the pipes to prevent the entry of dirt. Unscrew the mounting nuts and detach the master cylinder, collecting the sealing ring fitted between the mounting flange and the brake servo unit.

Dismantling:

Refer to **FIG 11:27**. Press secondary piston 1 down the bore slightly to relieve spring pressure then remove stop screw 2. Remove circlip 3 and extract the secondary piston assembly. Pull off stop washer 4, seal 5, intermediate ring 6, seal 7 and stop washer 8. To dismantle the piston assembly, refer to **FIG 11:28** and remove special screw 9. Remove spring cap 10, spring 11, spring cup 12, pressure plate 13, seal 8 and spacing washer 14.

Apply low pressure compressed air to the front feed pipe union to eject the primary piston 15 (see **FIG 11:29**). Pull off spring 16, spring cup 17, pressure plate 18, seal 19 and spacing washer 20. Remove seals 21 and 22.

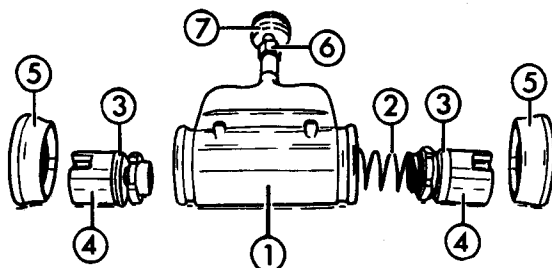


FIG 11:25 Wheel cylinder components

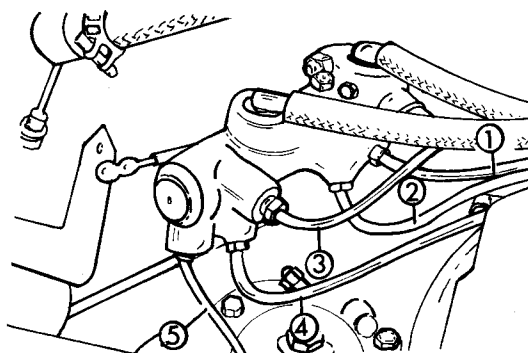


FIG 11:26 Master cylinder removal

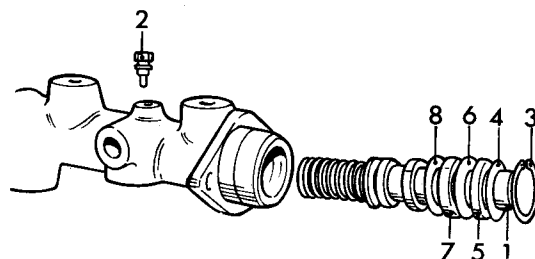


FIG 11:27 Removing secondary piston

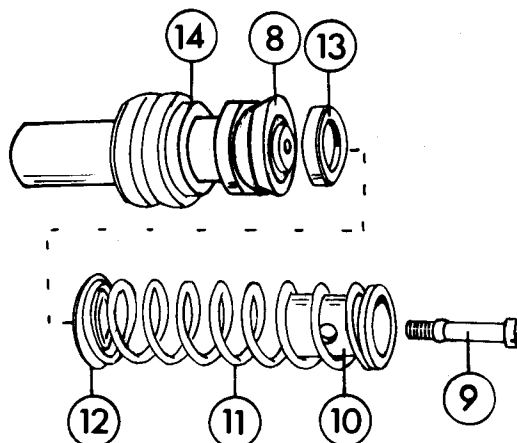


FIG 11:28 Dismantling secondary piston

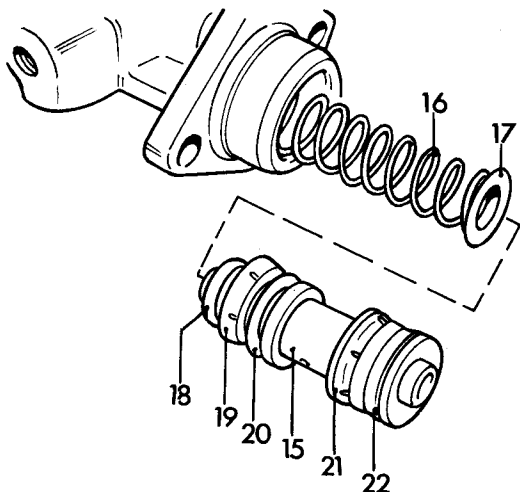


FIG 11 : 29 Removing primary piston

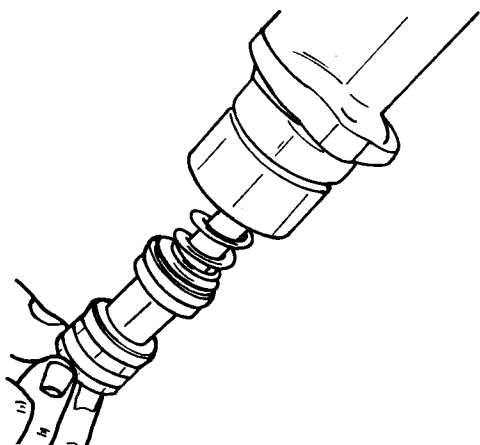


FIG 11 : 30 Refitting pistons to master cylinder

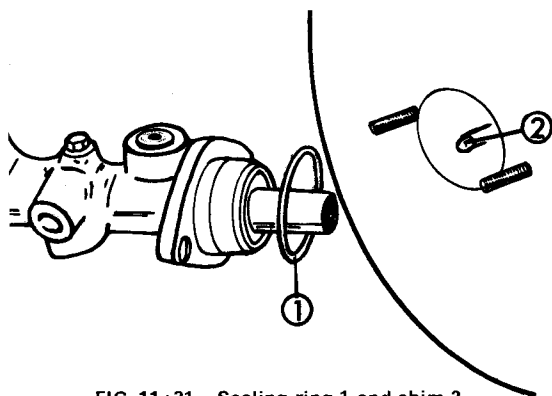


FIG 11 : 31 Sealing ring 1 and shim 2

Servicing:

Wash all parts in commercial alcohol, methylated spirits or approved brake fluid. Use no other cleaner or solvent on brake hydraulic system components. Inspect the pistons and cylinder bore for score marks and inspect all parts for wear or damage. Renew any faulty parts. Always use new rubber seals and a new copper gasket for the stop screw. Check the feed pipe plugs and renew if not in perfect condition.

Reassembly:

Observe absolute cleanliness to prevent the entry of dirt or any trace of oil or grease. Coat all internal components with ATE brake cylinder paste or dip them in clean approved brake fluid during reassembly. Clamp the master cylinder vertically in a vice with the open end down, so that internal components will not be displaced when refitted. Use tool 6063 if available to ensure that the seals are correctly entered into the bore (see FIG 11 : 30). If this tool is not available, carefully enter the seals into the bore using the fingers, making sure that the seal lips are not turned back.

Reassemble in the reverse order of dismantling. When the primary piston assembly has been installed, carefully push it down the bore against spring pressure and insert the stop screw. The stop screw must retain the piston assembly in position.

Refitting:

Before installing the master cylinder assembly, check the sealing ring shown at 1 in FIG 11 : 31 and renew if not in perfect condition. A faulty sealing ring will prevent the vacuum servo unit from operating correctly. Install the master cylinder assembly temporarily, placing a piece of Plastigage between the piston and the servo pushrod. Tighten the nuts to the specified torque then remove the master cylinder again and check the resulting thickness of Plastigage with the scale provided with the material. This will give the clearance between the piston and pushrod, which should be 0.5mm (0.02in). Adjust to the correct clearance, if necessary, by adding a shim 2 of suitable thickness. Finally install the master cylinder assembly in the reverse order of removal, then bleed the braking system as described in Section 11 : 12.

11 : 9 Vacuum servo unit

The vacuum servo unit operates to assist the pressure applied at the brake pedal and so reduce braking effort. The vacuum cylinder in the servo is connected to the engine inlet manifold by a hose. The servo unit is a sealed assembly and, if it is faulty or inoperative, a new unit must be fitted.

Testing:

To test the servo unit, switch off the engine and pump the brake pedal several times to exhaust all vacuum from the unit. Hold a steady light pressure on the brake pedal and start the engine. If the servo is working properly, the brake pedal will move further down without further foot pressure, due to the build-up of vacuum in the system.

With the brakes off, run the engine to medium speed and turn off the ignition, immediately closing the throttle.

This builds up a vacuum in the system. Wait one to two minutes, then try the brake action again with the engine still switched off. If not vacuum assisted for two or three operations, the servo check valve is faulty. Poor overall performance of the vacuum servo unit can be caused by a clogged air filter, or a faulty master cylinder sealing ring shown at 1 in FIG 11:31.

Check valve renewal:

Remove and discard the old check valve, which is fitted in the hose between the servo unit and the inlet manifold (see FIG 11:32). Make sure that the hose is clear, then fit a new check valve with the arrow or the black coloured end facing towards the inlet manifold.

Servo unit removal:

Refer to **Chapter 2** and remove the air cleaner assembly. Disconnect and remove the battery. On models with power assisted steering, carefully detach the fluid reservoir and move to one side. Disconnect the expansion tank to radiator hose at the tank and secure to one side. Plug the brake fluid reservoir outlets and disconnect the fluid feed hoses from the master cylinder sealing plugs, all as described previously.

Remove the lower instrument panel housing for access to the pedal connections and secure the housing to one side. Refer to FIG 11:33 and remove pin 6 at the brake pedal. Detach the vacuum hose from the inlet manifold, then detach the brake pipes from the master cylinder connection 1, 2, 3, 4 and 5, as described previously. Remove the nuts securing the servo unit to the support bracket and pull out the servo and master cylinder assembly towards the front of the car.

Refitting:

This is a reversal of the removal procedure, carrying out the following adjustment procedures to ensure the

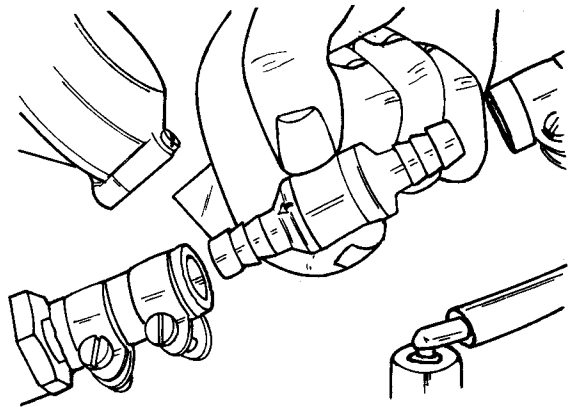


FIG 11:32 Servo check valve installation

correct dimensions **A**, **B** and **C** shown in FIG 11:33. Adjust length of piston rod (**A**) to $367 + 1\text{mm}$ ($14.45 + 0.04\text{in}$) by slackening both locknuts and rotating the pushrod as necessary. Tighten the nuts securely on completion. Check distance **B** between brake pedal pad and bulkhead. This should be 245mm (9.65in). Adjust position of stop light switch by slackening locknut and turning the switch assembly, until dimension **C** is 6.0 to 7.0mm (0.24 to 0.28in).

Filter and silencer renewal:

Refer to FIG 11:34. Pull off rubber boot 1, retaining ring 2, silencer 3 and filter 4. Discard the filter and silencer. Reassemble in the reverse order of removal, using a new filter and silencer.

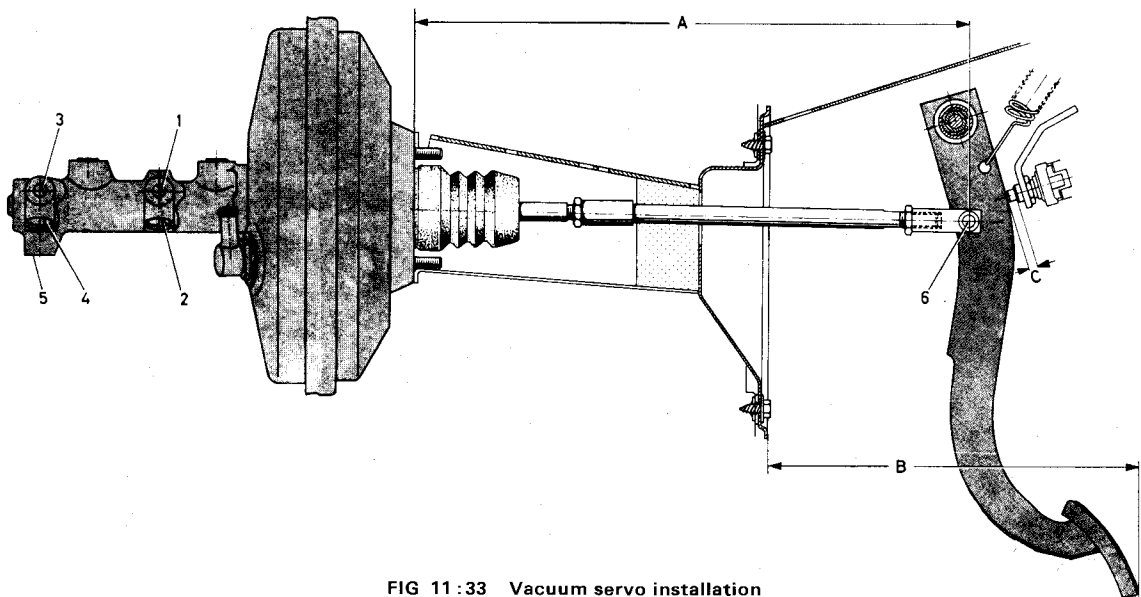


FIG 11:33 Vacuum servo installation

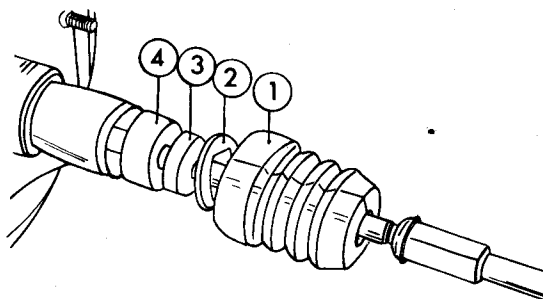


FIG 11:34 Removing servo filter and silencer

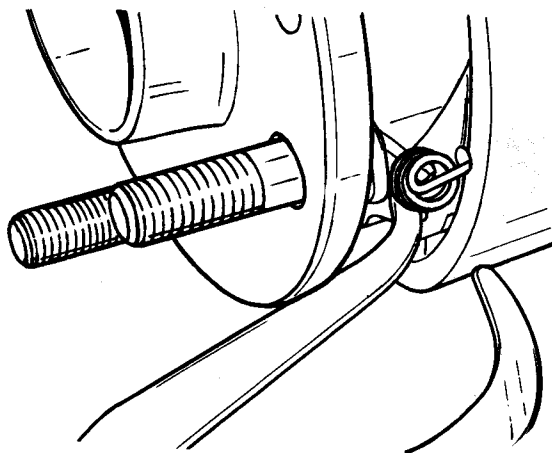


FIG 11:37 Disconnecting lower return spring

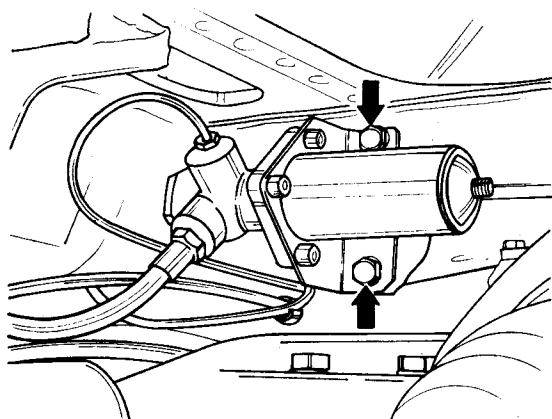


FIG 11:35 Pressure regulating valve mounting bolts

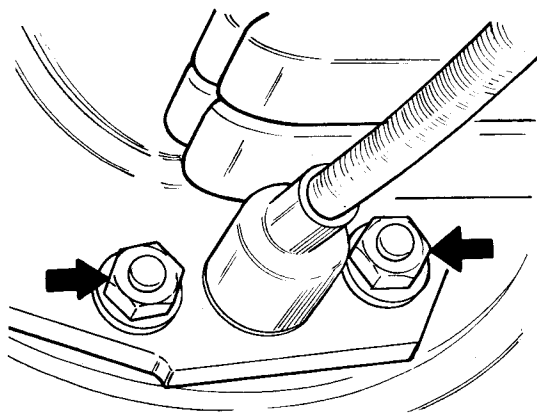


FIG 11:36 Handbrake cable support

11:10 Pressure regulating valve

The pressure regulating valve operates to progressively reduce the pressure supplied to the rear brake hydraulic circuit under increasing brake pedal pressure. This reduces the tendency for the rear wheels to lock under heavy braking. The unit is a sealed assembly and must be renewed complete if defective.

Removal:

Plug the brake fluid reservoir outlets with two dowels and remove the rear lefthand brake hose, all as described previously. Disconnect the brake pipes from the pressure regulating valve and plug the ends of the pipes to prevent the entry of dirt. Remove the two bolts arrowed in FIG 11:35 and remove the regulating valve.

Refitting is a reversal of the removal procedure, bleeding the braking system on completion as described in Section 11:12.

11:11 The handbrake

Handbrake adjustment procedures for all models are described in Section 11:2.

Cable removal:

Refer to Section 11:2 and remove the cable lock-nuts and adjusting nuts at the handbrake lever. Pull the front ends of the cable through the floor panel from beneath the car. Disconnect the handbrake cables from the rear suspension arms and pull the cables from the protective sleeves. Note that the rubber caps must be perfectly tight on the seals to seal effectively when the cables are refitted.

On models with drum rear brakes, refer to Section 11:7 and disconnect the lower brake shoe return spring and detach the handbrake cable from the lever on the rear shoe. Pull the cable outer sleeve from the location at the brake backplate.

On models fitted with disc rear brakes, remove the handbrake shoe expander as described later, then loosen the handbrake cable support as shown in FIG 11:36

and pull the cable assembly from the backplate. Note that the collar on the outer sleeve must fit securely in the location when the cable is refitted.

Refit handbrake cables in the reverse order of removal, carrying out the adjustment procedures described in **Section 11:2** on completion.

Handbrake shoe removal:

To remove the handbrake shoes on models equipped with rear disc brakes, the disc must first be removed as described in **Section 11:6**. Use a suitable hooked tool to disconnect the lower return spring as shown in **FIG 11:37**. Use tool 7014 or other suitable Allen key to detach the shoe retaining springs, as shown in **FIG 11:38**. Pull the shoes apart at the bottom and lift away upwards, then disconnect the upper return spring.

To remove the handbrake expander mechanism, refer to **FIG 11:39**. Pull component **A** to the right and press out pin **B**, then pull component **C** to the left. Install in the reverse order of removal, coating the sliding surface with a thin layer of Molykote paste.

Install the handbrake shoes in the reverse order of removal, then slacken the brake adjuster completely as described in **Section 11:2** before installing the brake disc. On completion, adjust the handbrake shoes and cables as described in **Section 11:2**.

11:12 Bleeding the system

This is not routine maintenance and is only necessary if air has entered the hydraulic system due to parts being dismantled, or because the level in the master cylinder supply reservoir has been allowed to drop too low. The need for bleeding is indicated by a spongy feeling at the brake pedal accompanied by poor braking performance. Each brake must be bled in turn, starting with the one furthest from the master cylinder and finishing with the one nearest the master cylinder. **Vacuum must be exhausted from the servo by depressing the brake pedal several times with the engine switched off before starting the work and the engine must not be run whilst bleeding is carried out. Do not attempt to bleed the brakes with any drum or caliper removed.**

Top up the fluid reservoir to the correct level with approved brake fluid. Clean dirt from around the first bleed screw and remove the rubber dust cap. Fit a length of rubber or plastic tube to the screw and lead the free end of the tube into a clean glass jar containing a small amount of approved brake fluid. The end of the tube must remain immersed in the fluid during the bleeding operation.

Unscrew the bleed screw about half-a-turn and have an assistant depress the brake pedal fully. With the pedal held down tighten the bleed screw. Allow the pedal to return fully and wait a few seconds for the master cylinder to refill with fluid before repeating the operation. Continue operating the pedal in this manner until no air bubbles can be seen in the fluid flowing into the jar, then hold the pedal against the floor on a down stroke while the bleed valve is tightened. **Do not overtighten.**

On rear brake units, bleeding is carried out at the single bleed screw on each brake caliper or wheel cylinder. On front disc brakes, bleeding must be carried out at the three screws shown in **FIG 11:40**. It is essential to bleed

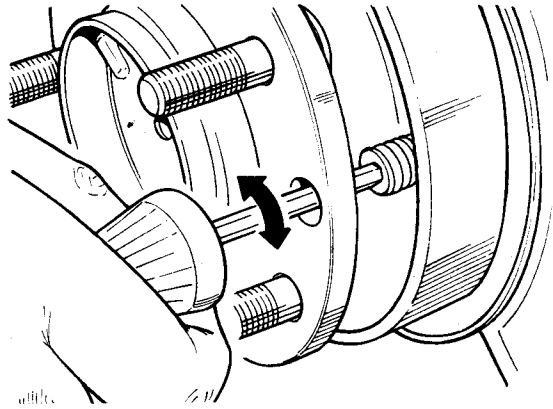


FIG 11:38 Detaching retaining spring

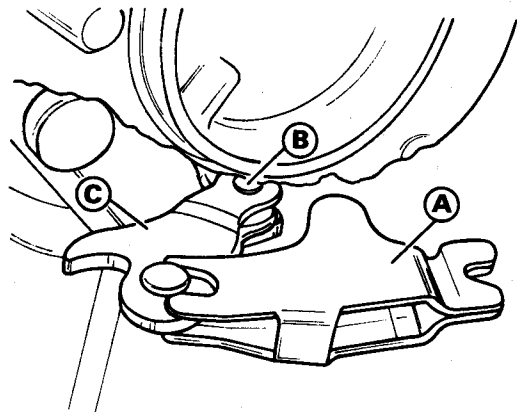


FIG 11:39 Shoe expander mechanism

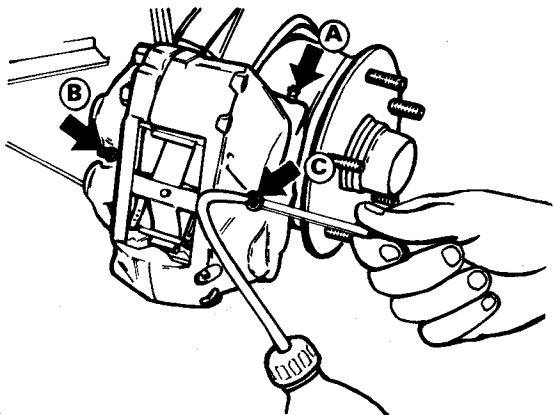


FIG 11:40 Front brake caliper bleed screws

at each screw separately, in the order **B**, **C** and **A**. If this is not carried out correctly, air bubbles may be trapped in the caliper.

At frequent intervals during the operation, check the level of fluid in the reservoir, topping up as needed. If the level drops too low air will enter the system and the operation will have to be restarted.

Remove the bleed tube, refit the dust cap and repeat the operation on each other brake unit in turn.

On completion top up the fluid to the correct level. Discard all used fluid. Always store brake fluid in clean, sealed containers to avoid air or moisture contamination.

11 : 13 Fault diagnosis

(a) Spongy pedal

- 1 Leak in the system
- 2 Worn master cylinder
- 3 Leaking wheel or caliper cylinders
- 4 Air in the fluid system
- 5 Gaps between brake shoes and underside of linings

(b) Excessive pedal movement

- 1 Check 1 and 4 in (a)
- 2 Excessive lining or pad wear
- 3 Drum brakes require adjustment
- 4 Very low fluid level in supply reservoir

(c) Brakes grab or pull to one side

- 1 Distorted discs or drums
- 2 Wet or oily pads or linings
- 3 Loose backplate or caliper
- 4 Disc or hub loose

- 5 Worn suspension or steering connections
- 6 Mixed linings of different grades
- 7 Uneven tyre pressures
- 8 Broken shoe return springs
- 9 Seized handbrake cable
- 10 Seized wheel cylinder or caliper piston

(d) Brakes partly or fully locked on

- 1 Swollen pads or linings
- 2 Damaged brake pipes preventing fluid return
- 3 Master cylinder compensating hole blocked
- 4 Master cylinder piston seized
- 5 Brake or pedal return spring broken
- 6 Dirt in the hydraulic system
- 7 Seized wheel cylinder or caliper piston
- 8 Seized drum brake adjusters
- 9 Seized handbrake mechanism or cable

(e) Brake failure

- 1 Empty fluid reservoir
- 2 Broken hydraulic pipeline
- 3 Ruptured master cylinder seal
- 4 Ruptured wheel cylinder or caliper seal

(f) Reservoir empties too quickly

- 1 Leaks in pipelines
- 2 Deteriorated cylinder seals

(g) Pedal yields under continuous pressure

- 1 Faulty master cylinder seals
- 2 Faulty wheel cylinder or caliper seals
- 3 Leak in brake pipe or hose