

# Chapter 9

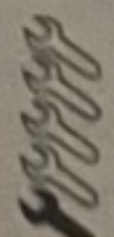
## Braking system

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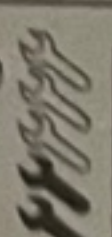
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### Degrees of difficulty

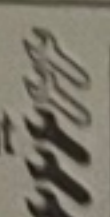
**Easy**, suitable for novice with little experience



**Fairly easy**, suitable for beginner with some experience



**Fairly difficult**, suitable for competent DIY mechanic



**Difficult**, suitable for experienced DIY mechanic



**Very difficult**, suitable for expert DIY or professional



### Specifications

#### General

Brake system type and layout:

Footbrake . . . . .

Diagonally-split dual hydraulic circuits; front left/rear right and front right/rear left. Discs fitted front and rear, ventilated at the front. Single-piston, sliding calipers on the front, double-piston fixed calipers (early) or floating calipers (late) on the rear. Anti-lock Braking System (ABS) fitted as standard on all models. Vacuum servo assistance. Electronic Stability Program (ESP) option on some models. Lever and cable operation, acting on shoes in drums incorporated in rear discs

#### Disc brakes

Type . . . . .

Outside diameter . . . . .

Thickness (new disc) . . . . .

Minimum thickness after grinding . . . . .

Minimum wear thickness . . . . .

Maximum run-out . . . . .

Maximum variation in disc thickness . . . . .

Ventilated  
288.0 mm  
25.0 mm  
23.5 mm  
22.0 mm  
0.08 mm  
0.015 mm

#### Calipers:

Type . . . . .

Piston diameter . . . . .

Single-piston, floating  
57.0 mm

#### Pads:

Minimum friction material thickness . . . . .

2.0 mm

## 9•2 Braking system

### Rear brakes

Discs	Solid
Type	286.0 mm
Outside diameter	10.0 mm
Thickness (new disc)	8.0 mm
Minimum thickness after grinding	6.0 mm
Minimum wear thickness	0.08 mm
Maximum run-out	0.015 mm
Maximum variation in disc thickness	160.0 mm
Handbrake drum inner diameter	0.08 mm
Handbrake drum maximum out of round	
Calipers	
Type	Fixed, double-piston
Early	Floating, single-piston
Late	30.0 mm
Piston diameter	
Pads	2.0 mm
Minimum friction material thickness	
Handbrake	1.0 mm
Shoe minimum friction material thickness	

### ABS components

Wheel sensors	1000 ± 100 ohms at 20°C
Resistance	0.2 to 1.0 mm
Clearance between sensor and tooth (not adjustable)	

### Torque wrench settings

	Nm	lbf ft
ABS hydraulic unit mounting nut	20	15
ESP hydraulic unit	20	15
Front brake caliper		
Guide bolts	28	21
Nut to caliper	40	30
Mounting bracket		
Stage 1	140	100
Stage 2	Angle-tighten & further 40°	
Handbrake cable support bracket	8	6
Master cylinder	28	21
Master cylinder hydraulic lines	18	13
Rear fixed brake caliper		
Caliper to bracket	30	22
Pipe union nut	18	13
Rear floating brake caliper		
Guide bolts	28	21
Nut to caliper	40	30
Mounting bracket	30	22
Rear wheel hub to rear axle		
Stage 1	55	40
Stage 2	Angle-tighten & further 20°	
Steering column to gear clamp bolt	25	18
Vacuum pump clamp bolt	25	18
Vacuum pump mounting bolt	25	18
Vacuum sensor	25	18
Wheel bolts	110	81

### 1 General information

Braking is achieved by a dual-circuit hydraulic system, assisted by a vacuum servo unit. All models have discs fitted at the front and rear. The front discs are ventilated, to improve cooling and reduce brake fade.

The dual hydraulic circuits are diagonally-split; on LHD models, the primary circuit operates the front left and rear right brakes,

and the secondary circuit operates the front right and rear left brakes. On RHD models, the circuits are opposite. This design ensures that at least 50% of the vehicle's braking capacity will be available should pressure be lost in one of the hydraulic circuits. Under these circumstances, the diagonal layout should prevent the vehicle from becoming unstable if the brakes are applied when only one circuit is operational.

The front brake calipers are of floating single-piston type. Each caliper has two brake pads, one inward and one outward of the

disc. During braking, hydraulic pressure moves the piston along the cylinder, and pushes the outward brake pad against the disc. The caliper body reacts to this effect by sliding along the guide bolts, bringing the other pad into contact with the disc. In this way, equal pressure is applied to both sides of the disc by the brake pads. When the pressure is released, the hydraulic pressure against the piston and returns the pads to their rest position.

The rear brake calipers on LHD models are of fixed double-piston type and on

brake pads, one inboard and one outboard of the disc. Later models have a floating, single-piston caliper with two brake pads. The pistons in the early type operate independently of each other, although, the later type function as described for the front calipers.

The rear discs incorporate drums with internal brake shoes for operation of the handbrake. A single primary cable, together with two secondary cables from the handbrake lever, operate the lever on each rear brake expander. The handbrake is not self-adjusting, and must be adjusted regularly.

The brake vacuum servo unit uses engine intake manifold vacuum to boost the effort applied to the master cylinder by the brake pedal. In order to supply sufficient vacuum to the servo on automatic transmission and diesel models, the intake manifold vacuum is supplemented by an additional vacuum pump driven from the exhaust camshaft. The vacuum pump is mounted on the left-hand end of the cylinder head and driven by the camshaft. Manual transmission petrol models are fitted with an 'ejector' device to boost the vacuum to the vacuum servo. The device is fitted in the charge air pipe, and operates by speeding up the flow of air across a venturi, thus providing vacuum to the servo.

The anti-lock braking system (ABS), fitted standard to all models, prevents wheel lock-up under heavy braking, and not only reduces stopping distances, but also improves steering control. By electronically monitoring the speed of each roadwheel in relation to the other wheels, the system can detect when a wheel is about to lock-up, and control is actually lost. The brake fluid is then applied to that wheel's brake caliper in a modulated (decreased and restored ('modulated') several times a second until control is regained. The system components comprise four wheel speed sensors, a hydraulic unit with integral electronic control module (ECM), brake lines and a dashboard-mounted warning light. The four wheel sensors are mounted on the wheel hub carriers. Each wheel has a rotating toothed hub mounted on the driveshaft (front) or on the hub (rear). The wheel speed sensors are mounted in close proximity to these hubs. The teeth produce a voltage waveform whose frequency varies with the speed of the hubs. These waveforms are transmitted to the ECM, and used to calculate the rotational speed of each wheel. The ECM has a self-diagnostic facility, to inhibit the operation of the ABS if a fault is detected, lighting the dashboard-mounted warning light. The braking system will then revert to conventional, non-ABS operation. If the nature of the fault is not immediately obvious upon inspection, the vehicle must be taken to a Saab dealer, who will have the diagnostic equipment required to interrogate the ABS ECM electronically and pin-point the problem.

The traction control system (TCS) is available as an option on some models, and uses the

basic ABS system, with an additional pump and valves fitted to the hydraulic actuator. If wheelspin is detected at a speed below 30 mph, one of the valves opens, to allow the pump to pressurise the relevant brake, until the spinning wheel slows to a rotational speed corresponding to the speed of the vehicle. This has the effect of transferring torque to the wheel with most traction. At the same time, the throttle plate is closed slightly, to reduce the torque from the engine.

The electronic stability program (ESP) system adds another function to the ABS system. Sensors measure the position of the steering wheel, the pressure in the brake master cylinder, the yaw velocity/rate, and the lateral acceleration. With this information, the system can compare the driver's intention with the vehicle's movement, and apply the appropriate corrective action.

## 2 Hydraulic system – bleeding



**Warning: Hydraulic fluid is poisonous; wash off immediately and thoroughly in the case of skin contact, and seek immediate medical advice if any fluid is swallowed or gets into the eyes. Certain types of hydraulic fluid are inflammable, and may ignite when brought into contact with hot components; when servicing any hydraulic system, it is safest to assume that the fluid is inflammable, and to take precautions against the risk of fire as though it is petrol that is being handled. Hydraulic fluid is also an effective paint stripper, and will attack plastics; if any is spilt, it should be washed off immediately, using copious quantities of fresh water. Finally, it is hygroscopic (it absorbs moisture from the air) – old fluid may be contaminated and unfit for further use. When topping-up or renewing the fluid, always use the recommended type, and ensure that it comes from a freshly-opened sealed container.**

### General

1 The correct operation of any hydraulic system is only possible after removing all air from the components and circuit; this is achieved by bleeding the system.

2 During the bleeding procedure, add only clean, unused hydraulic fluid of the recommended type; never re-use fluid that has already been bled from the system. Ensure that sufficient fluid is available before starting work.

3 If there is any possibility of incorrect fluid being already in the system, the brake components and circuit must be flushed completely with uncontaminated, correct fluid, and new seals should be fitted to the various components.

4 If hydraulic fluid has been lost from the

system, or air has entered because of a leak, ensure that the fault is cured before proceeding further.

5 Park the vehicle over an inspection pit or on car ramps. Alternatively, apply the handbrake then jack up the front and rear of the vehicle and support it on axle stands (see *Jacking and vehicle support*). For improved access with the vehicle jacked up, remove the roadwheels.

6 Check that all pipes and hoses are secure, unions tight and bleed screws closed. Clean any dirt from around the bleed screws.

7 Unscrew the master cylinder reservoir cap, and top the master cylinder reservoir up to the MAX level line; refit the cap loosely, and remember to maintain the fluid level at least above the MIN level line throughout the procedure, otherwise there is a risk of further air entering the system.

8 There is a number of one-man, do-it-yourself brake bleeding kits currently available from motor accessory shops. It is recommended that one of these kits is used whenever possible, as they greatly simplify the bleeding operation, and also reduce the risk of expelled air and fluid being drawn back into the system. If such a kit is not available, the basic (two-man) method must be used, which is described in detail below.

9 If a kit is to be used, prepare the vehicle as described previously, and follow the kit manufacturer's instructions, as the procedure may vary slightly according to the type being used; generally, they are as outlined below in the relevant sub-section.

10 Whichever method is used, the same sequence must be followed (paragraphs 11 and 12) to ensure the removal of all air from the system.

### Bleeding sequence

11 If the system has been only partially disconnected, and suitable precautions were taken to minimise fluid loss, it should only be necessary to bleed that part of the system (ie, the primary or secondary circuit).

12 If the complete system is to be bled, then it should be done working in the following sequence:

- a) Right-hand front brake.
- b) Left-hand rear brake.
- c) Left-hand front brake.
- d) Right-hand rear brake.

### Bleeding

#### Basic (two-man) method

13 Collect together a clean glass jar, a suitable length of plastic or rubber tubing, which is a tight fit over the bleed screw, and a ring spanner to fit the screw. The help of an assistant will also be required.

14 Remove the dust cap from the first bleed screw in the sequence (see illustration). Fit the spanner and tube to the screw, place the other end of the tube in the jar, and pour in sufficient fluid to cover the end of the tube.



2.14 Dust cap on the caliper bleed screw

15 Ensure that the master cylinder reservoir fluid level is maintained at least above the MIN level mark throughout the procedure.

16 Have the assistant fully depress and release the brake pedal several times to build-up initial pressure in the system.

17 Unscrew the bleed screw approximately half a turn then have the assistant slowly depress the brake pedal down to the floor and hold it there. Tighten the bleed screw and have the assistant slowly release the pedal to its rest position.

18 Repeat the procedure given in paragraph 17 until the fluid emerging from the bleed screw is free from air bubbles. After every two or three depressions of the pedal, check the level of fluid in the reservoir and top-up if necessary.

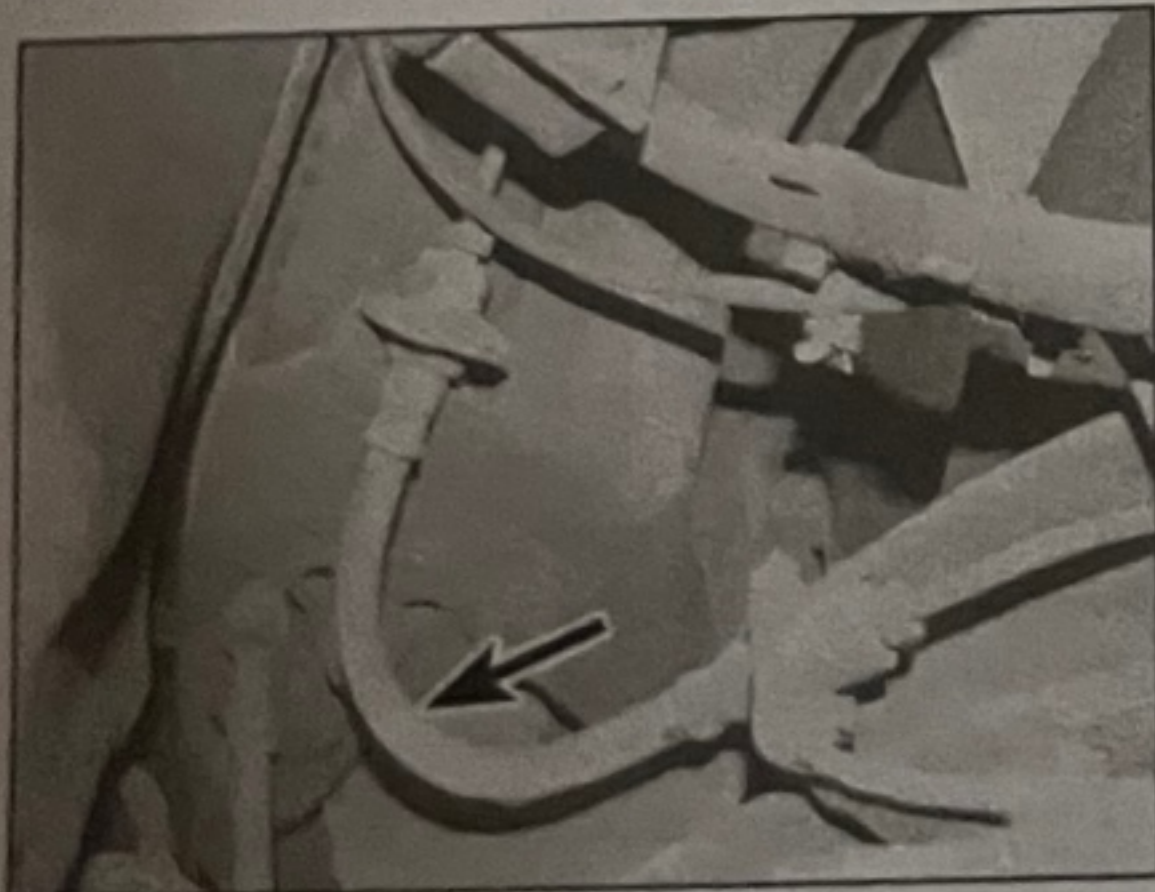
19 When no more air bubbles appear, securely tighten the bleed screw, remove the tube and spanner, and refit the dust cap. Do not overtighten the bleed screw.

20 Repeat the procedure on the remaining screws in the sequence until all air is removed from the system and the brake pedal feels firm again.

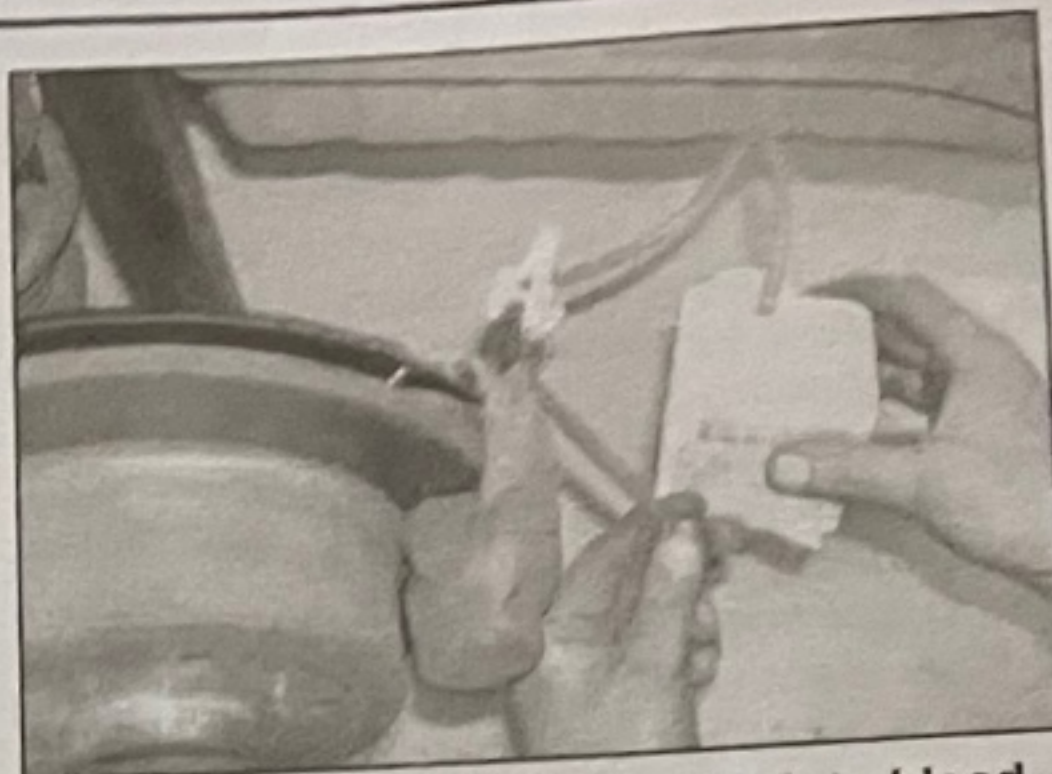
#### Using a one-way valve kit

21 As the name implies, these kits consist of a length of tubing with a one-way valve fitted, to prevent expelled air and fluid being drawn back into the system; some kits include a translucent container, which can be positioned so that the air bubbles can be more easily seen flowing from the end of the tube.

22 The kit is connected to the bleed screw, which is then opened (see illustration). The



3.2a Rear brake flexible hose located between the underbody and trailing arm



2.22 Using a one-way valve kit to bleed the rear brake circuit

user returns to the driver's seat, depresses the brake pedal with a smooth, steady stroke, and slowly releases it; this is repeated until the expelled fluid is clear of air bubbles.

23 Note that these kits simplify work so much that it is easy to forget the master cylinder reservoir fluid level; ensure that this is maintained at least above the MIN level line at all times.

#### Using a pressure-bleeding kit

24 These kits are usually operated by a reservoir of pressurised air contained in the spare tyre. However, note that it will probably be necessary to reduce the pressure to a lower level than normal; refer to the instructions supplied with the kit.

25 By connecting a pressurised, fluid-filled container to the master cylinder reservoir, bleeding can be carried out simply by opening each screw in turn (in the specified sequence), and allowing the fluid to flow out until no more air bubbles can be seen in the expelled fluid.

26 This method has the advantage that the large reservoir of fluid provides an additional safeguard against air being drawn into the system during bleeding.

27 Pressure-bleeding is particularly effective when bleeding 'difficult' systems, or when bleeding the complete system at the time of routine fluid renewal.

#### All methods

28 When bleeding is complete, and firm pedal feel is restored, wipe off any spilt fluid, securely tighten the bleed screws, and refit the dust caps.

29 Check the hydraulic fluid level in the



3.2b Withdraw the spring clip from the mounting bracket

master cylinder reservoir, and top-up if necessary (see *Weekly checks*).

30 Discard any hydraulic fluid that has been bled from the system; it will not be fit for re-use.

31 Check the feel of the brake pedal. If it feels at all spongy, air must still be present in the system, and further bleeding is required. Failure to bleed satisfactorily after a reasonable repetition of the bleeding procedure may be due to worn master cylinder seals.

### 3 Hydraulic pipes and hoses - renewal

1 If any pipe or hose is to be renewed, minimise fluid loss by first removing the master cylinder reservoir cap, then tightening it down onto a piece of polythene to obtain an airtight seal. The cap incorporates a level warning float, so hose clamps can be fitted to flexible hoses to isolate sections of the circuit; metal brake pipe unions can be plugged (if care is taken not to allow dirt into the system) or capped immediately they are disconnected. Place a wad of rag under any union that is to be disconnected, to catch any spilt fluid.

2 If a flexible hose is to be disconnected, unscrew the brake pipe union nut before removing the spring clip that secures the hose to its mounting bracket (see illustrations). Where applicable, unscrew the banjo union bolt securing the hose to the caliper and recover the copper washers. When removing the front flexible hose, pull out the spring clip and disconnect it from the strut.

3 To unscrew union nuts, it is preferable to obtain a 'split' brake pipe spanner of the correct size; these are available from most motor accessory shops. Failing this, a close-fitting open-ended spanner will be required, though if the nuts are tight or corroded, their flats may be rounded-off if the spanner slips. In such a case, a self-locking wrench is often the only way to unscrew a stubborn union, but it follows that the pipe and the damaged nuts must be renewed on reassembly. Always clean a union and surrounding area before disconnecting it. If disconnecting a component with more than one union, make a careful note of the connections before disturbing any of them.

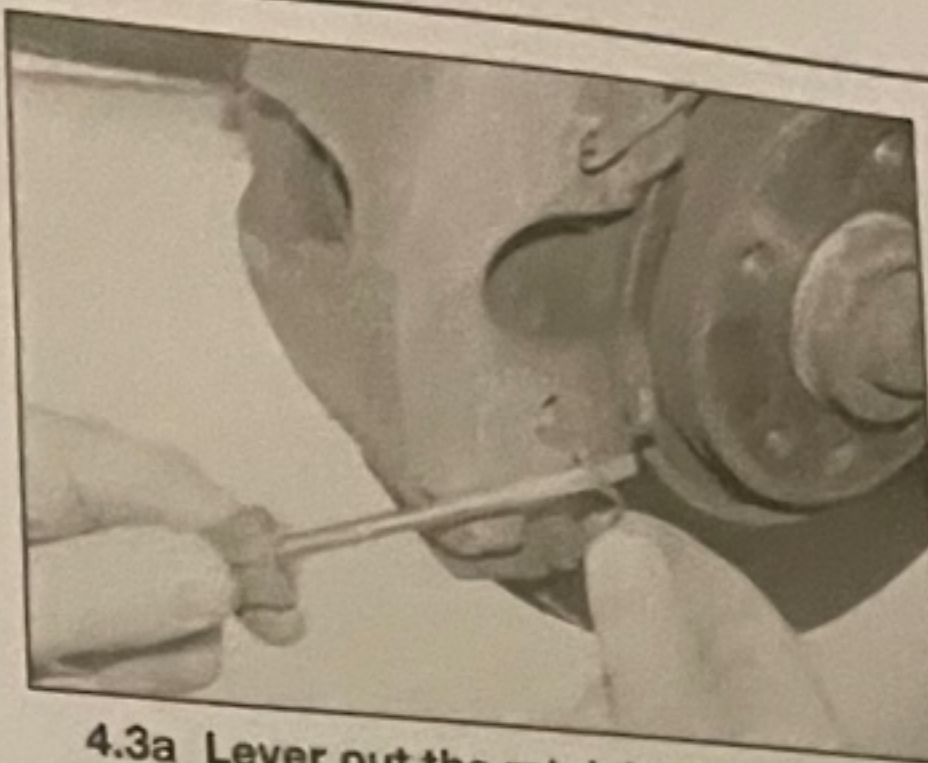
4 If a brake pipe is to be renewed, it can be obtained, cut to length and with the union nuts and end flares in place, from a dealer's parts shop. All that is then necessary is to bend it to shape, following the line of the original, before fitting it to the car. Alternatively, most motor accessory shops can make up brake pipes from kits, but this requires very careful measurement of the original, to ensure that the new part is of the correct length. The safest answer is usually to take the original to the shop as a pattern.

5 On refitting, do not overtighten the union nuts.

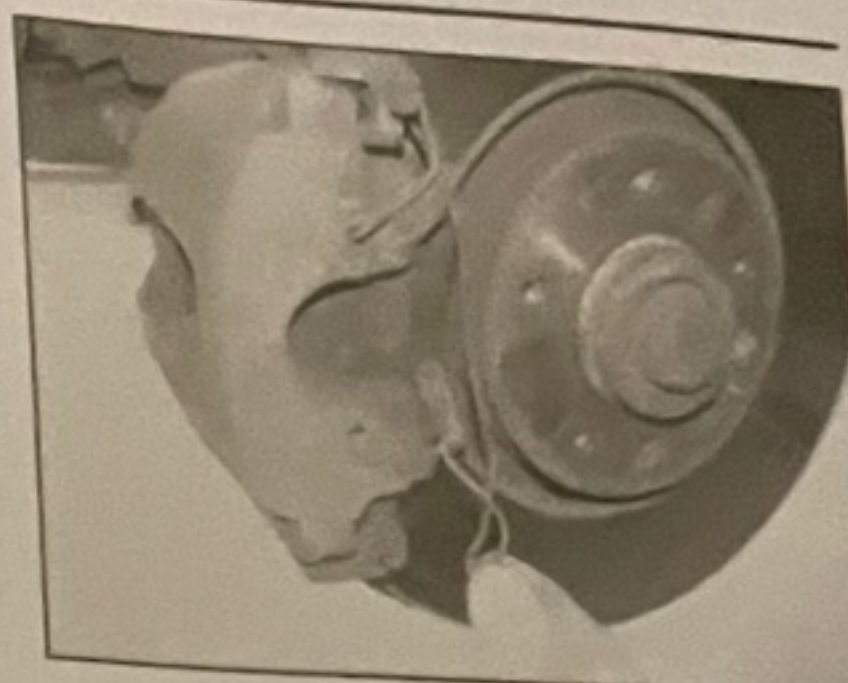
6 When refitting hoses to the callipers, always



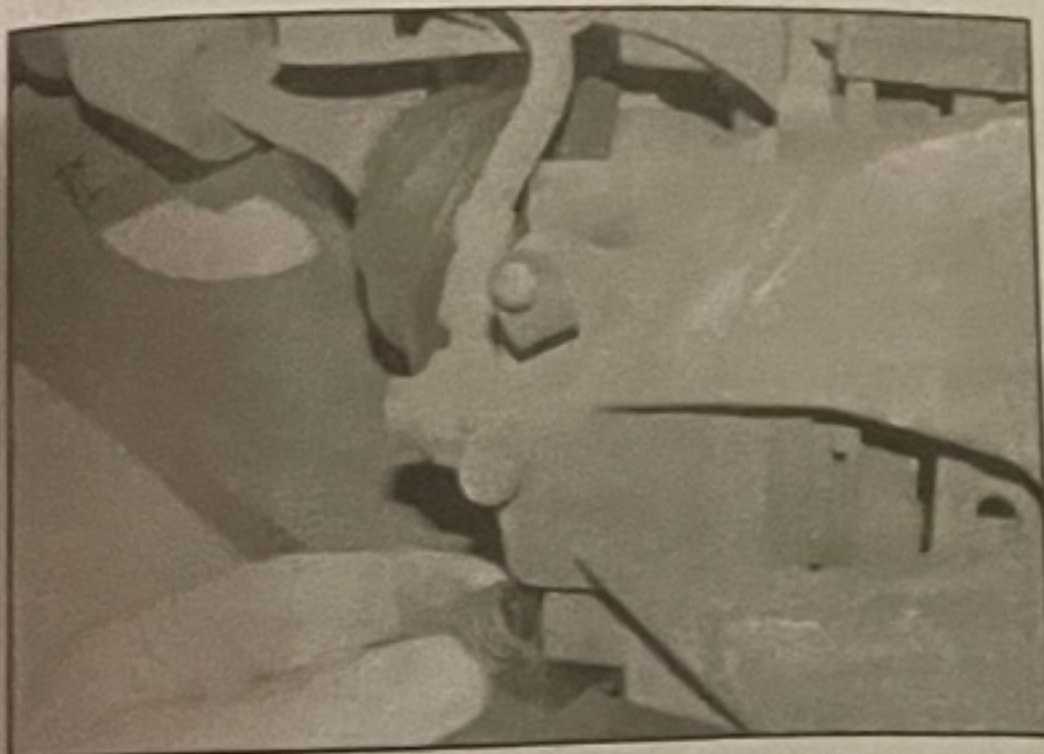
4.2 Using slip-joint pliers to press the piston into the caliper



4.3a Lever out the retaining spring ...



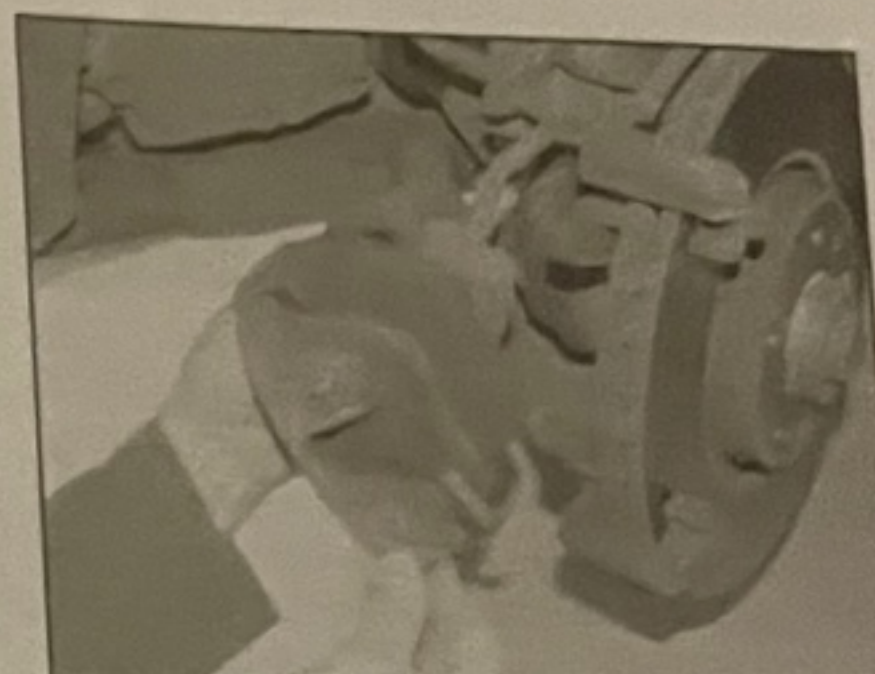
4.3b ... and remove it from the caliper



4.4 Remove the dust caps ...



4.5a ... then unscrew the guide bolts ...



4.5b ... and lift the caliper and pads away from the mounting bracket

use new copper washers and tighten the bolts to the specified torque. Ensure that the hoses are positioned so they do not touch surrounding bodywork or wheels.

Ensure that the pipes and hoses are correctly routed, with no kinks, and that they are secured in the clips or brackets provided. After fitting, remove the polythene from the reservoir, and bleed the hydraulic system as described in Section 2. Wash off any spilt fluid, and check carefully for fluid leaks.

#### 4 Front brake pads - renewal

**Warning:** Renew **BOTH** sets of front brake pads at the same time - NEVER renew the pads on only one wheel, as uneven braking may result. Note that the dust created by wear of the pads may contain asbestos, which is a health hazard. Never blow it out with compressed air, and do not inhale any of it. Use brake cleaner or methylated spirit to clean brake components.

1 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *Jacking and vehicle support*). Remove both front roadwheels.

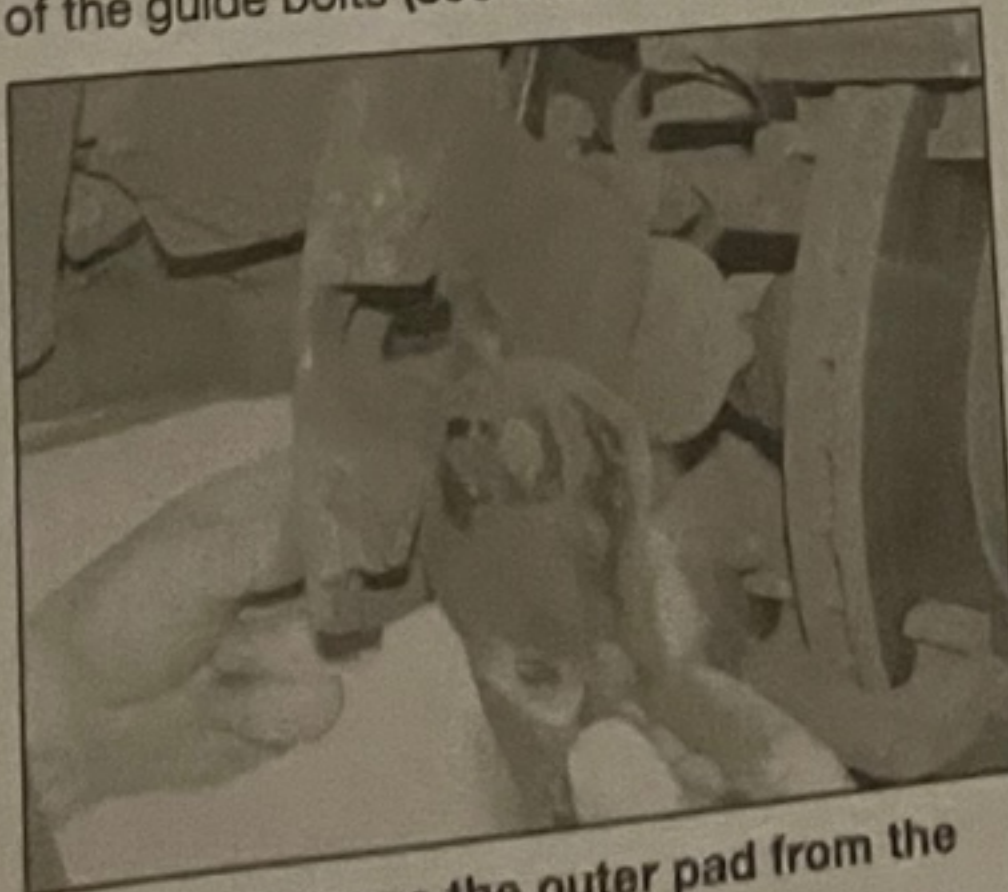
2 Using slip-joint pliers, press the piston fully into the caliper (see illustration). **Note:** Provided that the master cylinder reservoir has not been overfilled with hydraulic fluid, there should be no spillage, but keep a careful watch on the fluid

level while retracting the piston. If the fluid level rises above the MAX level line at any time, the surplus should be siphoned off or ejected via a plastic tube connected to the bleed screw.

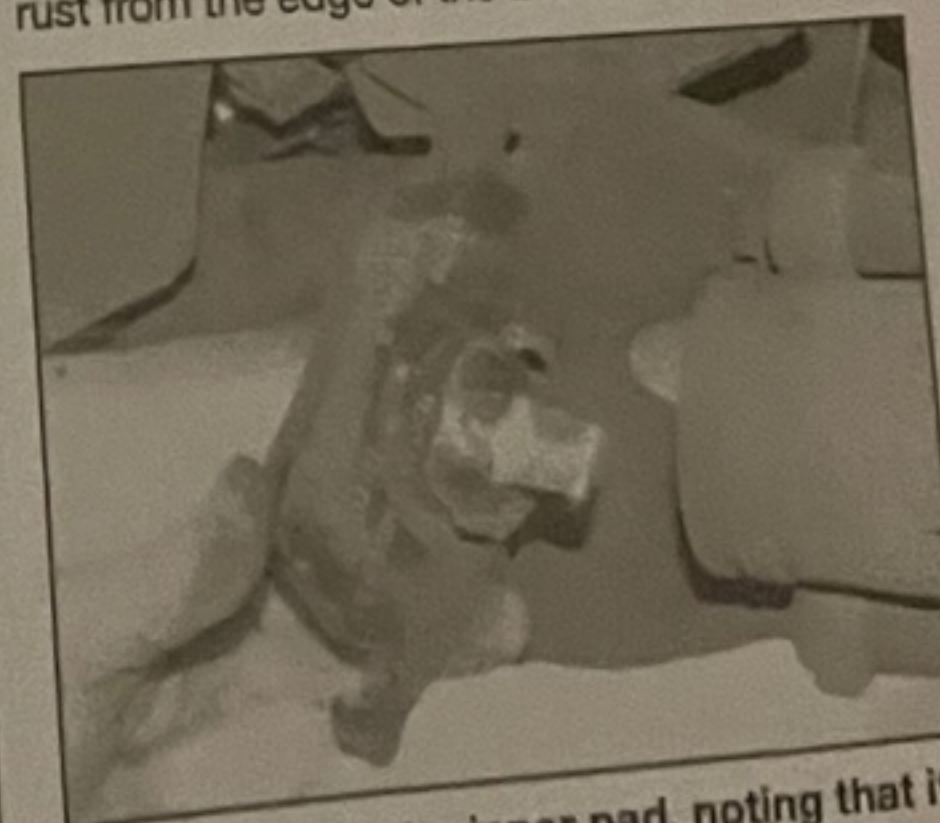
**Caution:** Pushing back the piston causes a reverse-flow of brake fluid, which has been known to 'flip' the master cylinder rubber seals, resulting in a total loss of braking. To avoid this, clamp the caliper flexible hose and open the bleed screw - as the piston is pushed back, the fluid can be directed into a suitable container using a hose attached to the bleed screw. Close the screw just before the piston is pushed fully back, to ensure no air enters the system.

3 Carefully lever off the retaining spring from the holes on the outer surface of the caliper, noting how the spring is located on the caliper mounting bracket (see illustrations).

4 Remove the dust caps from the inner ends of the guide bolts (see illustration).



4.6a Remove the outer pad from the caliper ...

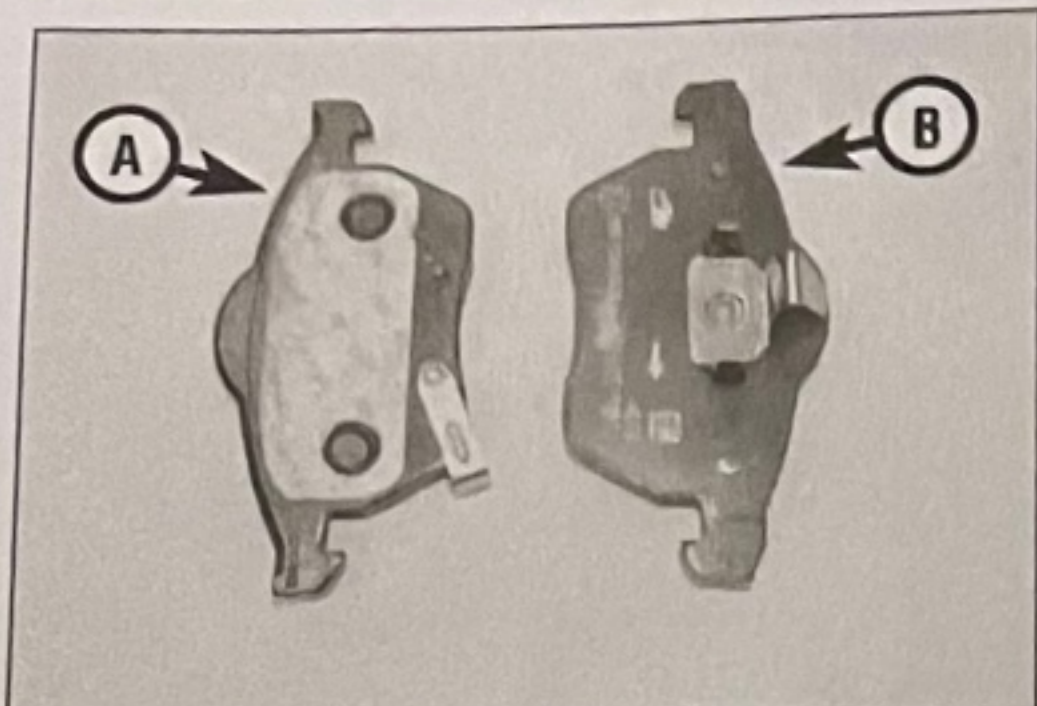


4.6b ... then the inner pad, noting that it is retained in the piston by a spring clip

5 Using an Allen key, unscrew the guide bolts from the caliper, and lift the caliper and pads away from the mounting bracket (see illustrations). Tie the caliper to the suspension strut using a suitable piece of wire. Do not allow the caliper to hang unsupported on the flexible brake hose.

6 Remove the inner and outer pads from the caliper, noting that the inner one is retained in the piston by a spring clip attached to the pad backing plate (see illustrations). **Note:** On some models, an acoustic wear warning device is fitted to the outer pad, consisting of a metal strip, which contacts the brake disc when the thickness of the friction material is less than 3.0 mm. This device causes a scraping noise that warns the driver that the pads are worn excessively.

7 Brush the dirt and dust from the caliper, but take care not to inhale it. Carefully remove any rust from the edge of the brake disc.

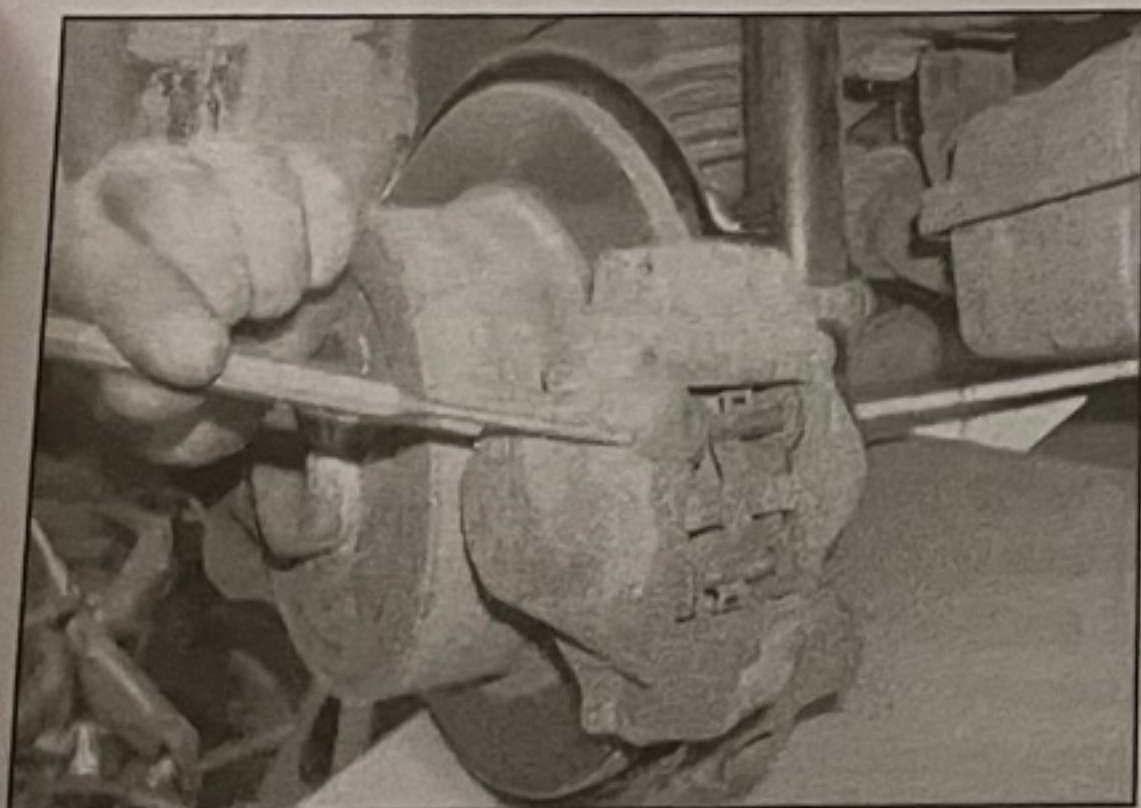


4.11a Outer (A) and inner (B) front brake pads

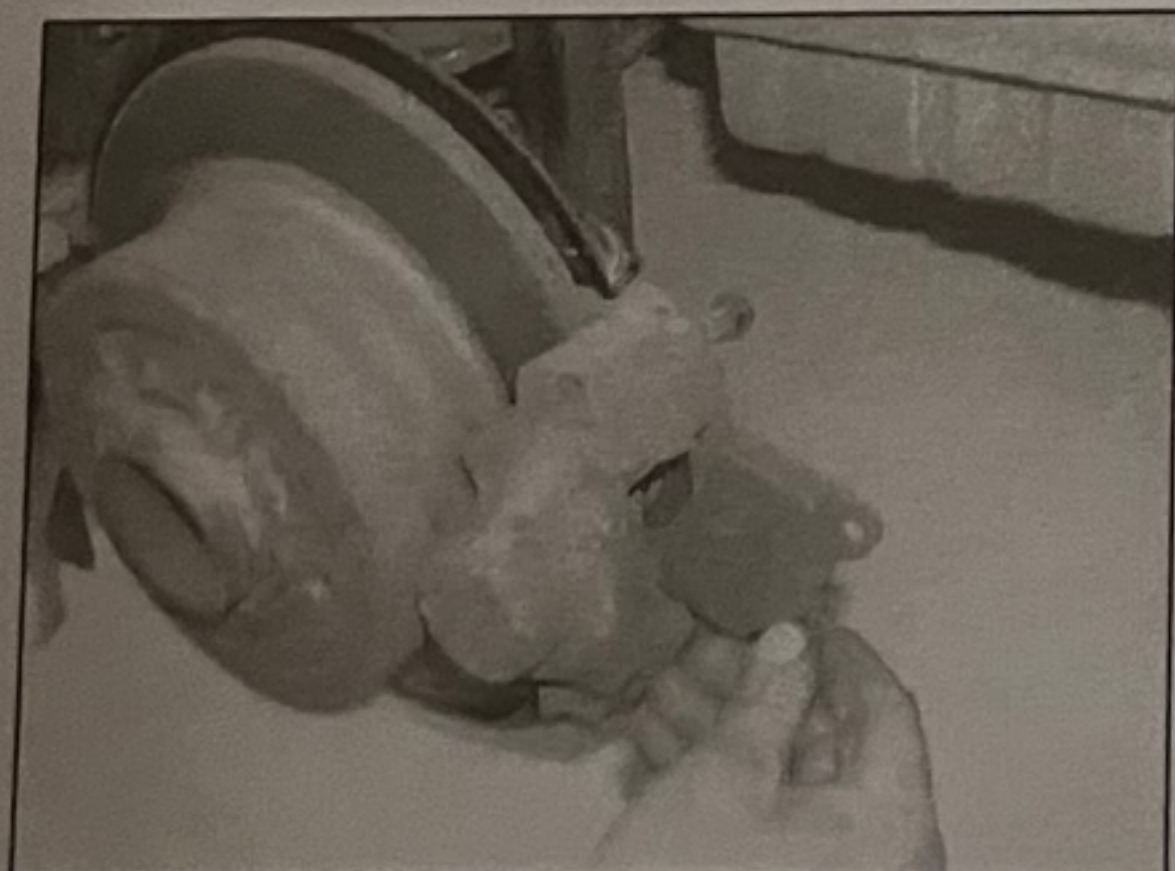
8 Measure the thickness of the friction material on each brake pad (excluding the backing plate). If either pad is worn at any point to the specified minimum thickness or less, all four pads must be renewed. The pads should also be renewed if any are contaminated with oil or grease; there is no satisfactory way of degreasing friction material. Trace and rectify the cause of contamination before reassembly.

9 If the brake pads are still serviceable, clean them using a clean, fine wire brush or similar, paying particular attention to the sides and back of the metal backing. Carefully clean the pad locations in the caliper body/mounting bracket.

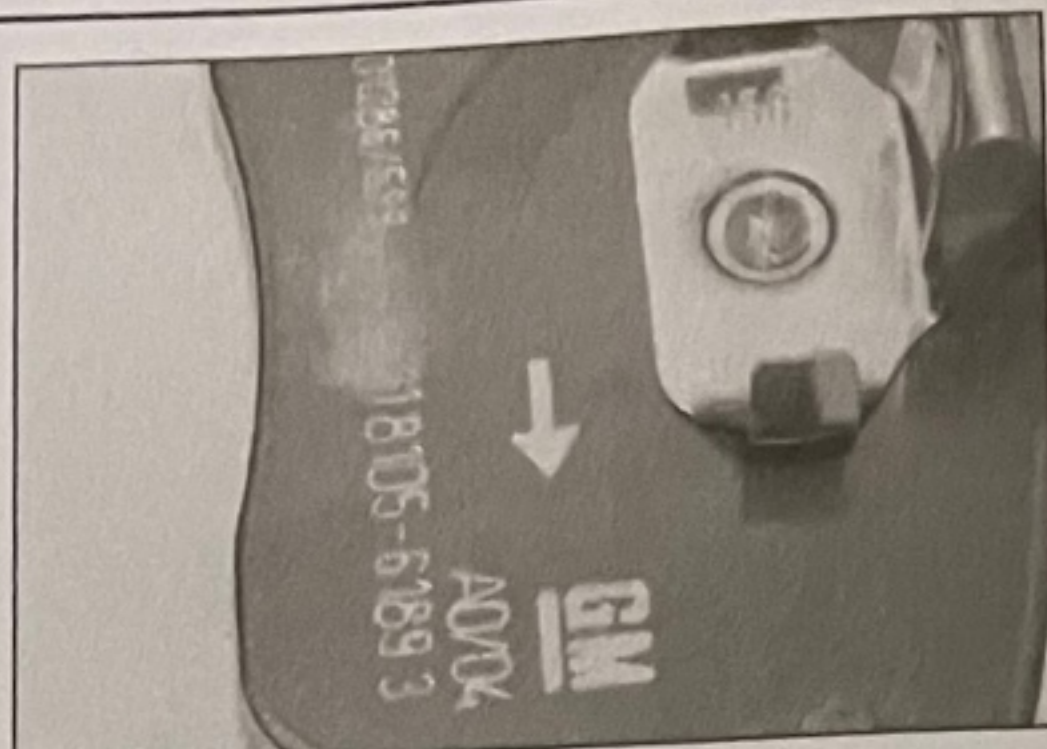
10 Prior to fitting the pads, check that the guide bolts are a good fit in the caliper bushes. Brush the dust and dirt from the caliper and piston (see **Warning** at the beginning of this Section). Apply a little high melting-point copper brake grease



5.2 Using a punch to drive out the rear brake pad retaining pins



5.5a Removing the inner rear brake pad



4.11b The pads must be fitted with the arrow pointing the normal, forward rotation of the brake disc

to the areas on the pad backing plates which contact the caliper and piston. Inspect the dust seal around the piston for damage, and the piston for evidence of fluid leaks, corrosion or damage. If attention to any of these components is necessary, refer to Section 6.

11 Fit the inner pad to the caliper, ensuring that its clip is correctly located in the caliper piston. Make sure that the arrows on the pad point in the normal, forward direction of rotation of the brake disc (see illustrations).

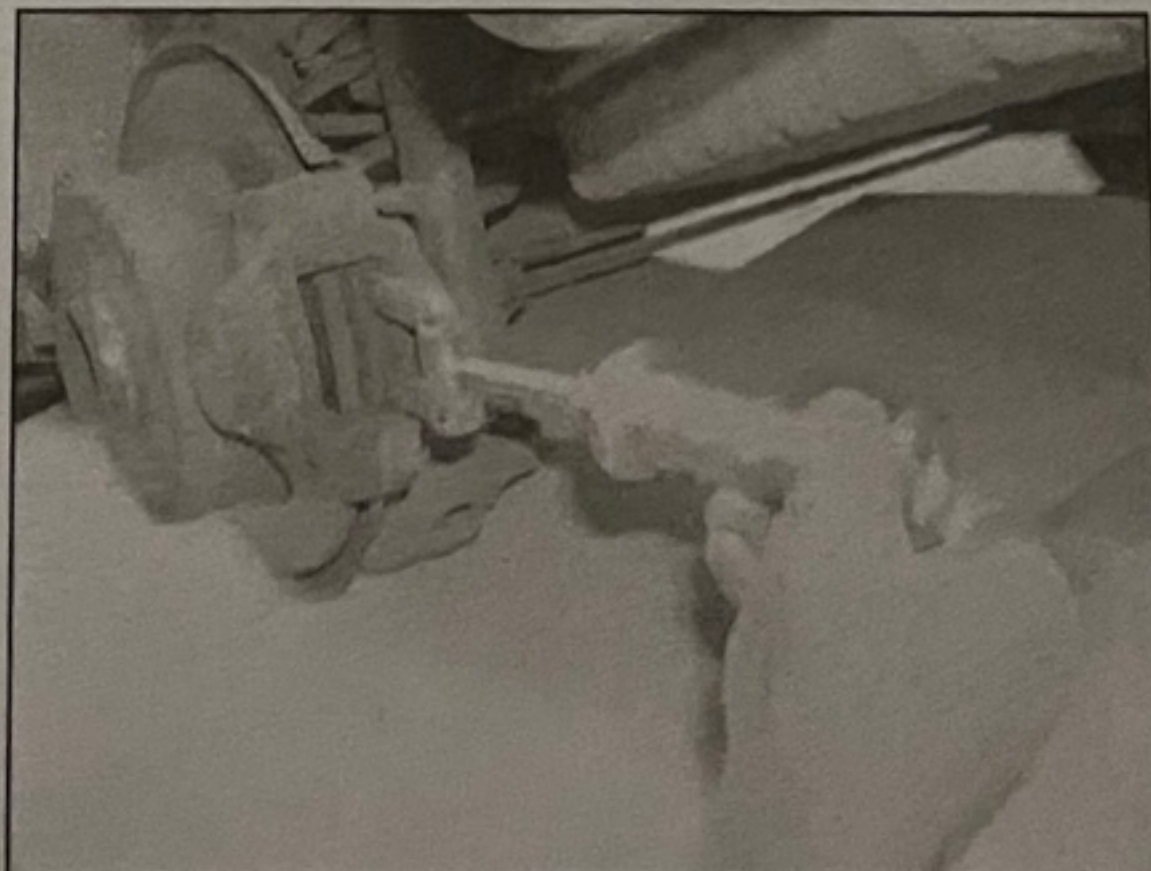
12 Fit the outer pad to the caliper mounting bracket, ensuring that its friction material is facing the brake disc. The acoustic wear indicators must face downwards.

13 Slide the caliper and inner pad into position over the outer pad, and locate it in the mounting bracket.

14 Insert the caliper guide bolts, and then tighten them to the specified torque setting.



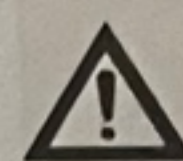
5.3 Removing the anti-squeal spring



5.5b Using a removal tool to remove the inner rear brake pad

- 15 Refit the guide bolt dust caps.
- 16 Refit the retaining spring to the caliper, ensuring that its ends are correctly located in the caliper holes.
- 17 Depress the brake pedal repeatedly, until normal pedal pressure is restored.
- 18 Repeat the above procedure on the remaining front brake caliper.
- 19 Refit the roadwheels, then lower the vehicle to the ground and tighten the roadwheel bolts to the specified torque setting.
- 20 Check the hydraulic fluid level as described in *Weekly checks*.

## 5 Rear brake pads - renewal



**Warning:** Renew BOTH sets of rear brake pads at the same time - NEVER renew the pads on only one wheel, as uneven braking may result. Note that the dust created by wear of the pads may contain asbestos, which is a health hazard. Never blow it out with compressed air, and do not inhale any of it. Use brake cleaner or methylated spirit to clean brake components.

1 Chock the front wheels, then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove the rear roadwheels.

### Fixed caliper

2 Note how the anti-squeal spring is located, then drive out the upper and lower pad retaining pins from the outside of the caliper using a punch (see illustration).

3 Remove the anti-squeal spring (see illustration).

4 Move the pads away from the disc slightly using a suitable lever or a pair of large adjustable pliers, and then withdraw the outer pad from the caliper using pliers or a special removal tool.

5 Withdraw the inner pad from the caliper (see illustrations).

### Floating caliper

6 Using slip-joint pliers, press the piston fully into the caliper (see illustration). Note: Provided that the master cylinder reservoir has

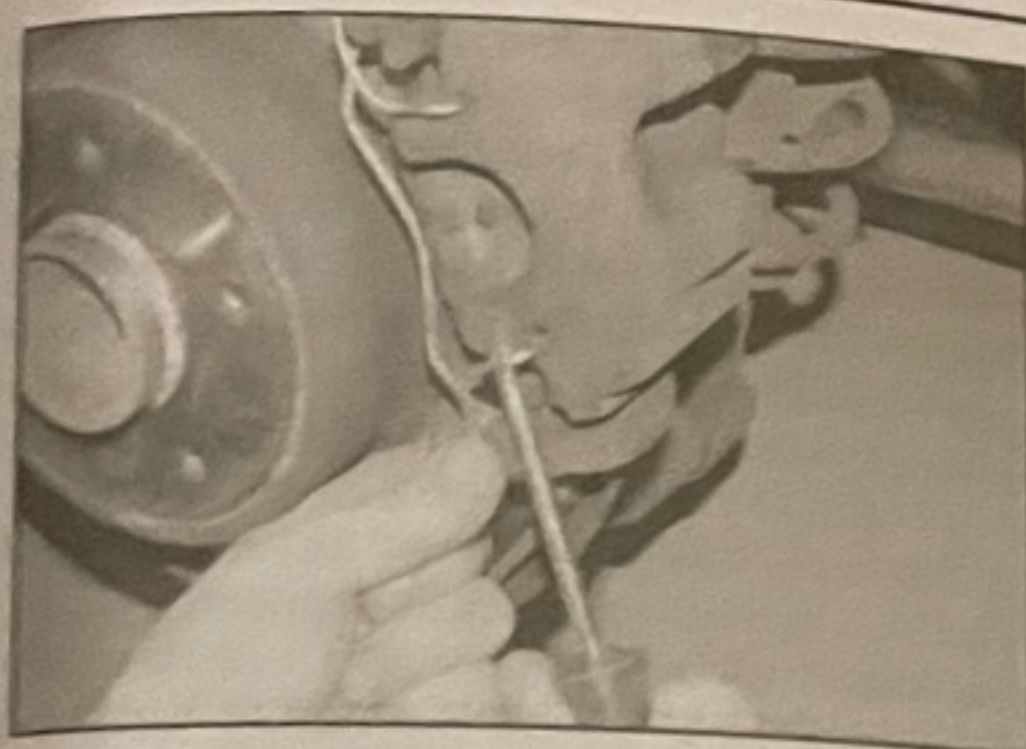


5.6 Using slip-joint pliers to press the piston fully into the caliper

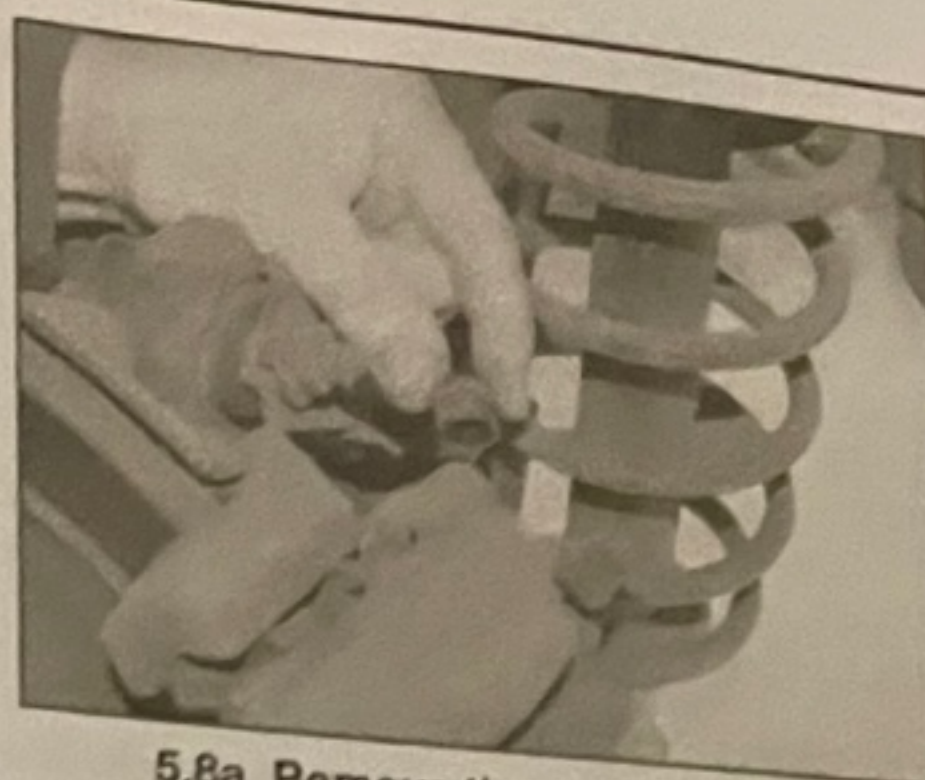
5.7 Use a

5.8c

not been  
should be  
on the fl  
the fluid  
any time  
or ejecte  
bleed so  
Caution  
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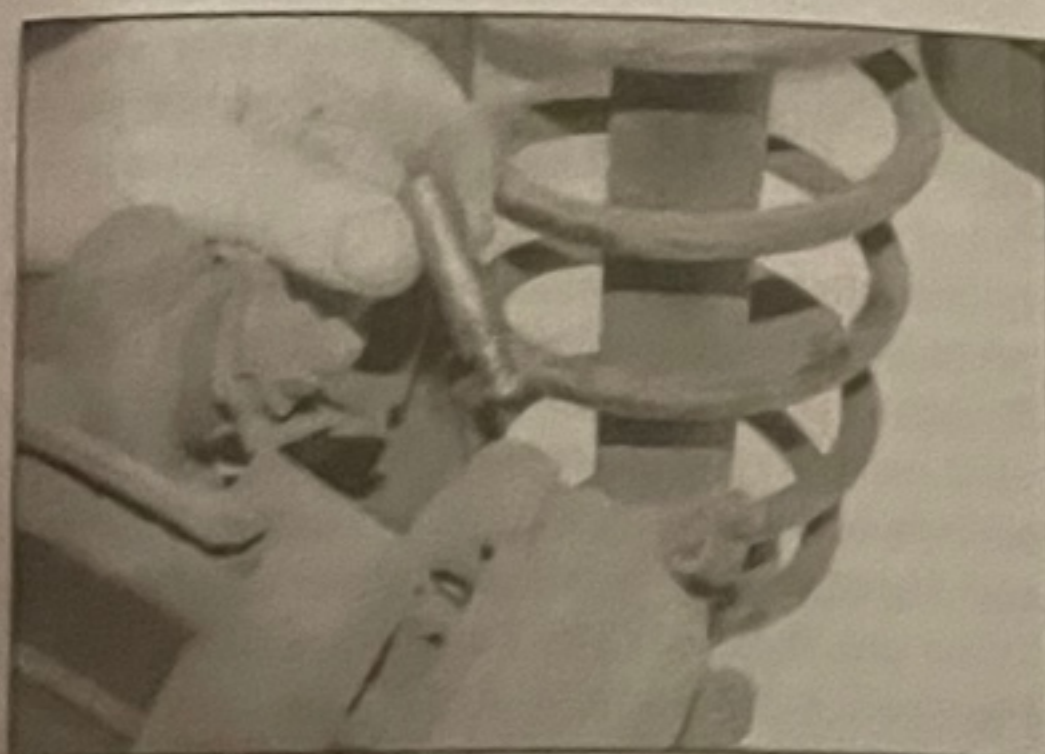
5.7 Use a screwdriver to lever off the retaining spring



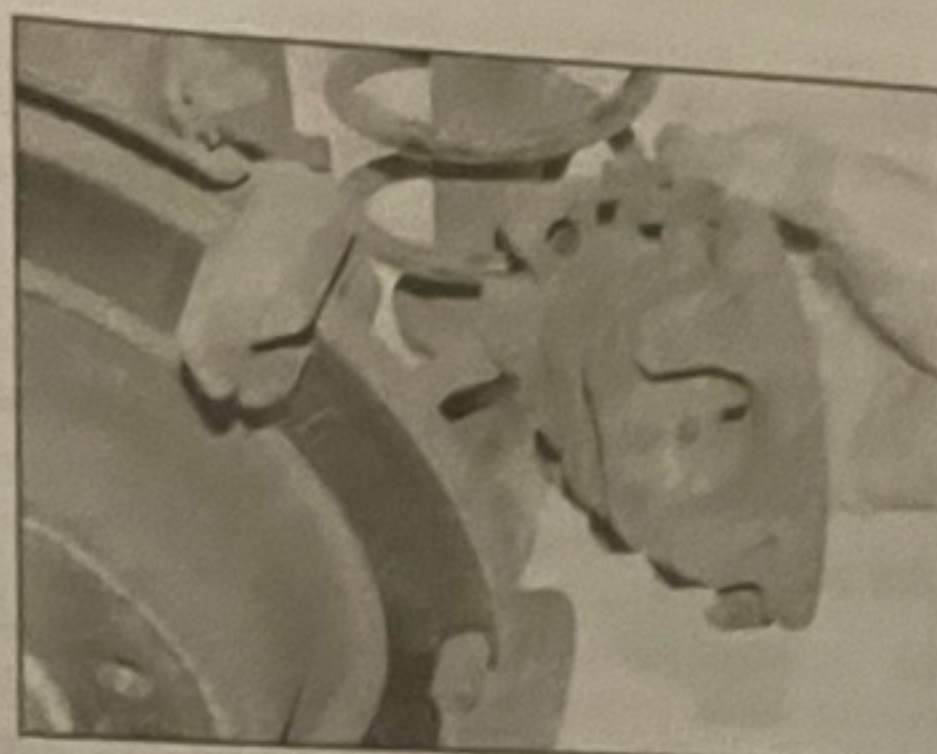
5.8a Remove the dust caps ...



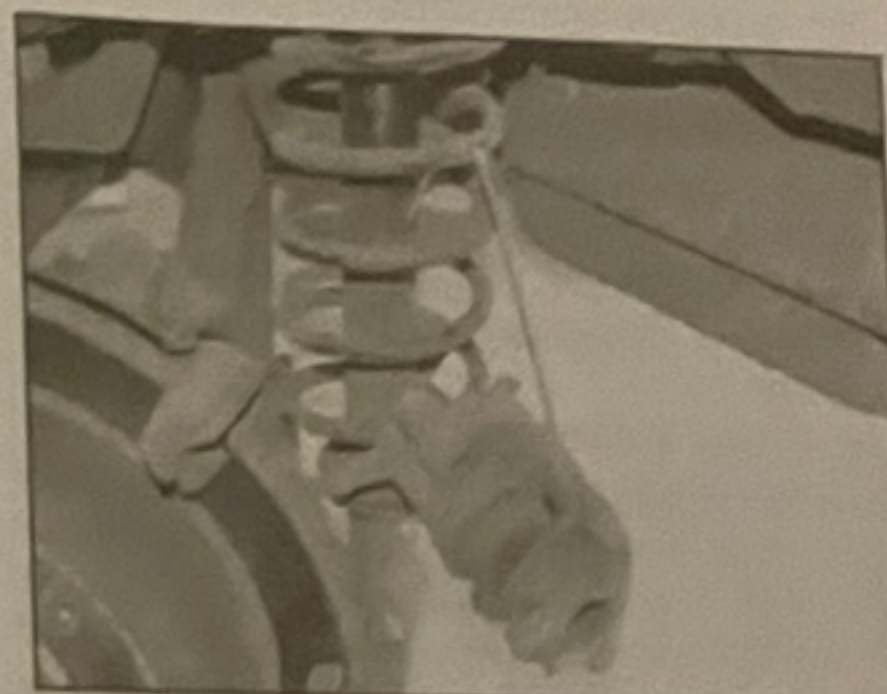
5.8b ... then use an Allen key to unscrew the guide bolts ...



5.8c ... and remove them from the caliper ...



5.8d ... then lift the caliper and pads from the mounting bracket ...



5.8e ... and suspend the caliper from the suspension coil spring

not been overfilled with hydraulic fluid, there should be no spillage, but keep a careful watch on the fluid level while retracting the piston. If the fluid level rises above the MAX level line at any time, the surplus should be siphoned off via a plastic tube connected to the bleed screw.

**Warning:** Pushing back the piston causes a reverse flow of brake fluid, which has been known to 'flip' the master cylinder rubber seals, resulting in a total loss of braking. To avoid this, clamp the caliper flexible hose and open the bleed screw - as the piston is pushed back, the fluid can be directed into a suitable container using a hose attached to the bleed screw. Close the screw just before the piston is pushed fully back, to ensure no air enters the system.

7 Carefully lever off the retaining spring from the holes on the outer surface of the caliper, noting how the spring is located on the caliper

mounting bracket (see illustration).

8 Remove the dust caps, then use an Allen key to unscrew the guide bolts from the caliper, and lift the caliper and pads away from the mounting bracket. Tie the caliper to the suspension coil spring using a suitable piece of wire (see illustrations). Do not allow the caliper to hang unsupported on the flexible brake hose.

9 Remove the outer and inner pads from the caliper, noting that the inner one is retained in the piston by a spring clip attached to the pad backing plate (see illustrations).

#### All models

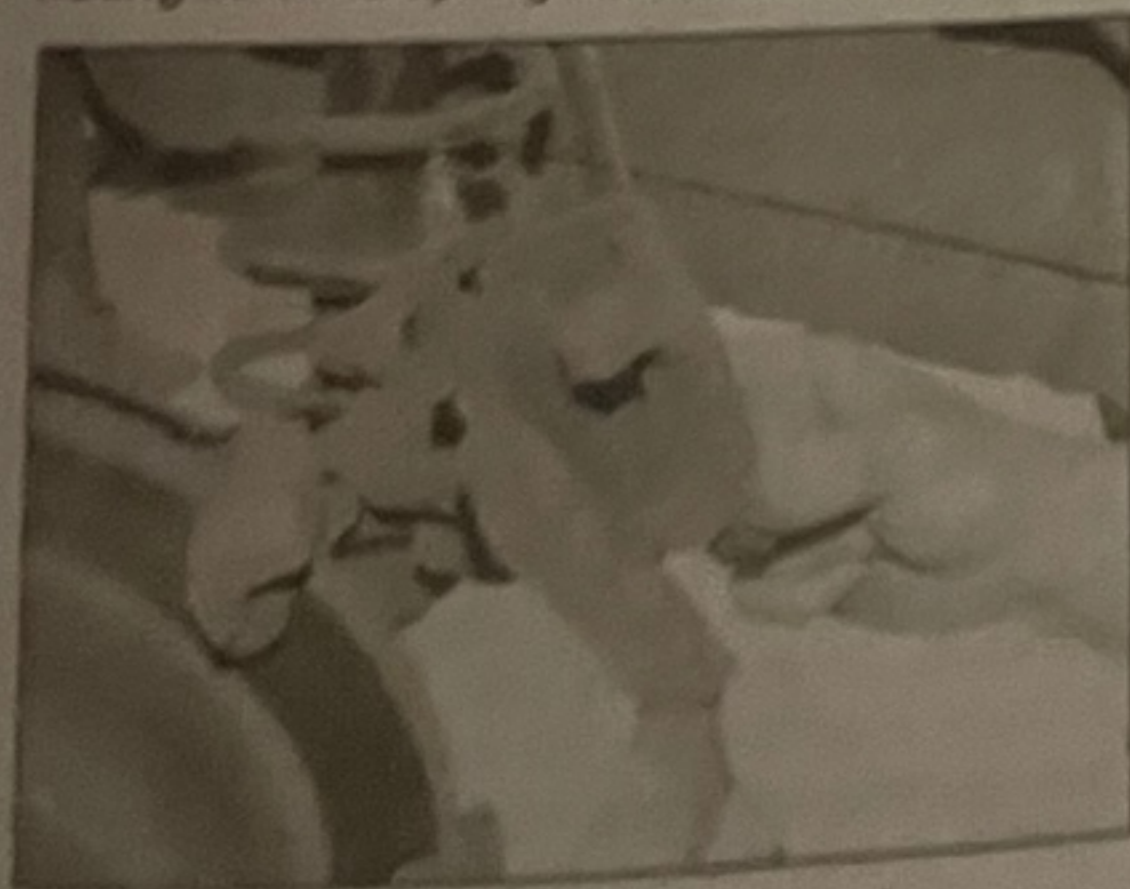
10 Brush the dirt and dust from the caliper, but take care not to inhale it. Carefully remove any rust from the edge of the brake disc.

11 Measure the thickness of the friction material on each brake pad (excluding the backing plate). If either pad is worn at any point

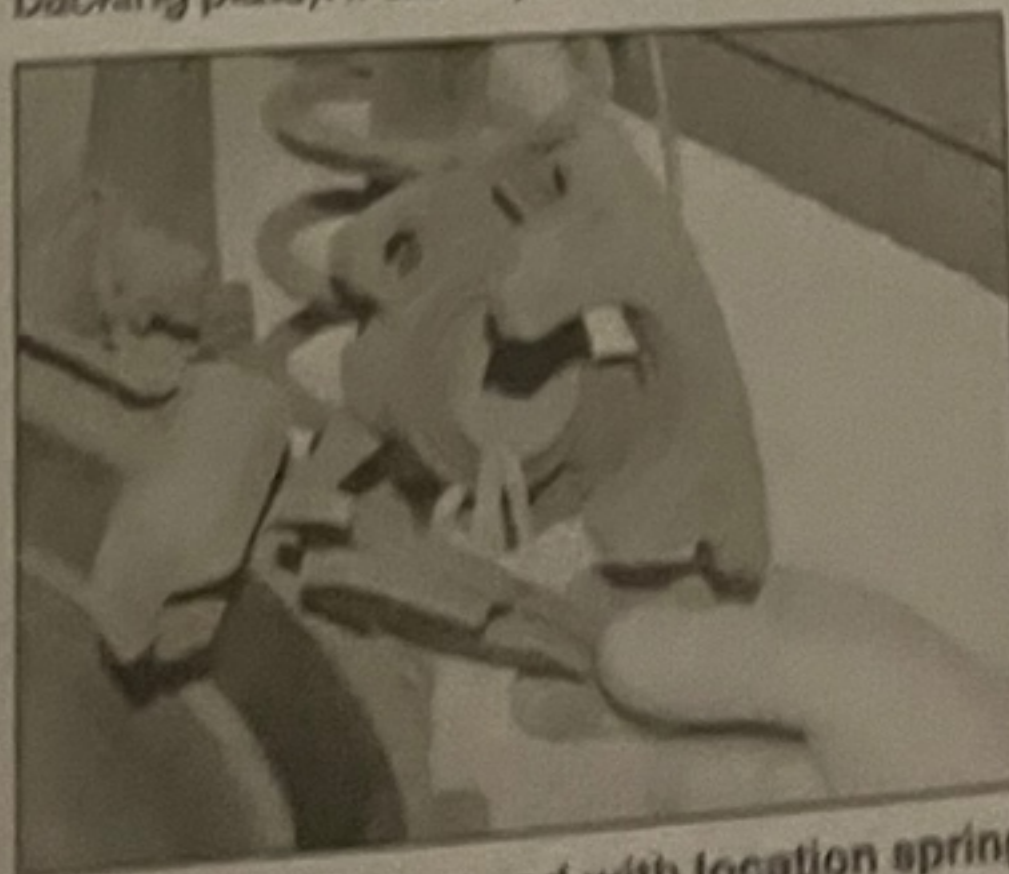
to the specified minimum thickness or less, all four pads must be renewed. The pads should also be renewed if any are contaminated with oil or grease; there is no satisfactory way of degreasing friction material. Trace and rectify the cause of contamination before reassembly.

12 If the brake pads are still serviceable, clean them using a clean, fine wire brush or similar, paying particular attention to the sides and back of the metal backing. Carefully clean the pad locations in the caliper body/mounting bracket.

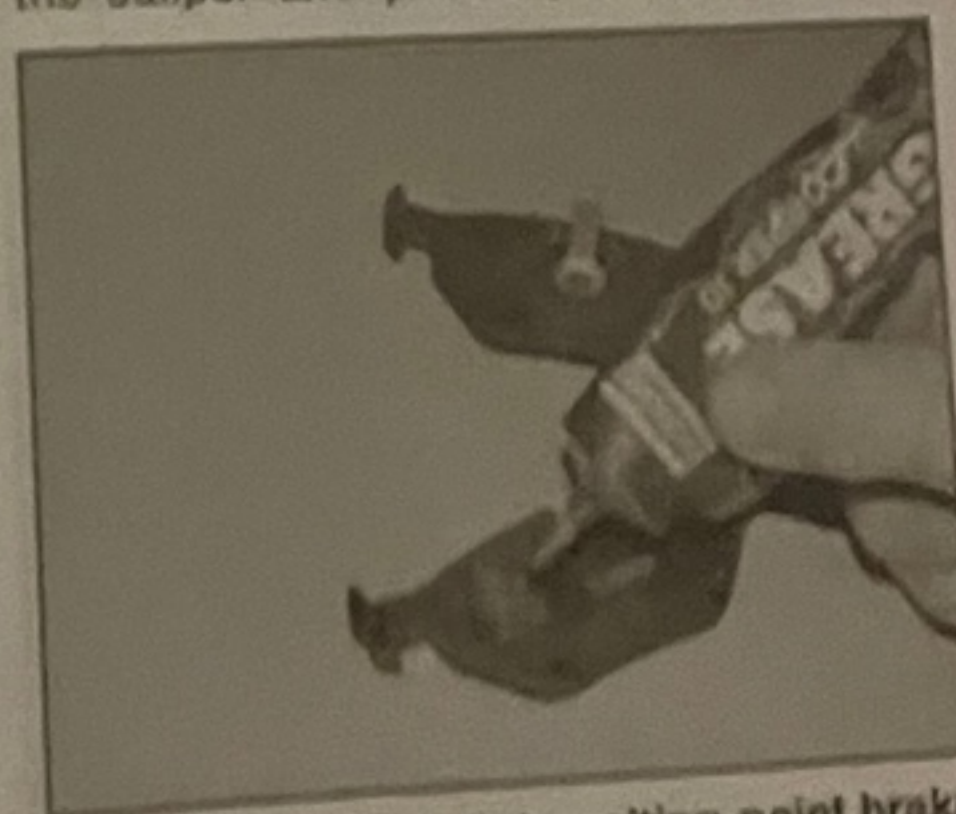
13 Prior to fitting the pads, clean and check the guide bolts/retaining pins are a good fit in the caliper. Brush the dust and dirt from the caliper and piston (see **Warning** at the beginning of this Section). Apply a little high melting-point copper brake grease to the areas on the pad backing plates that contact the caliper and piston (see illustration).



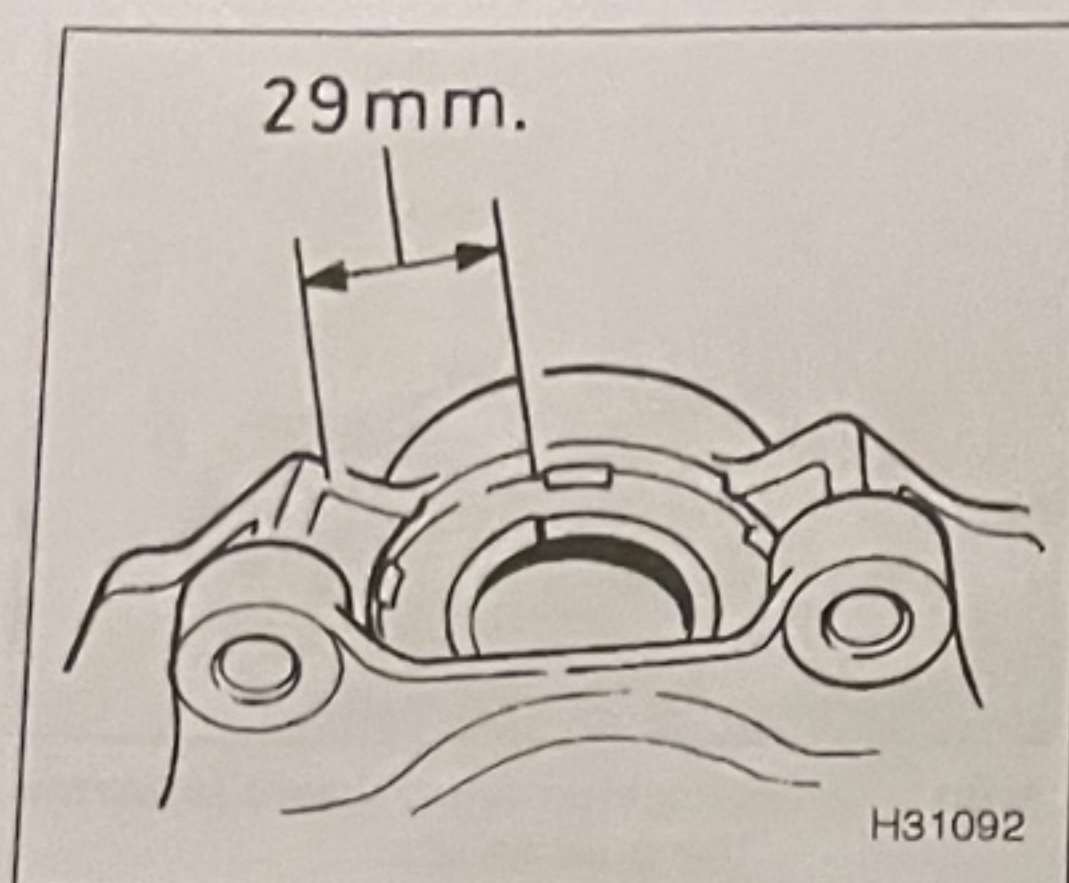
5.9a Remove the outer pad ...



5.9b ... and inner pad with location spring from the caliper



5.13 Apply a little high melting-point brake grease to the backs of the brake pads



5.15 Correct position of the piston in the rear brake caliper (early models)

Inspect the dust seal around the piston(s) for damage, and the piston(s) for evidence of fluid leaks, corrosion or damage. If attention to any of these components is necessary, refer to Section 7.

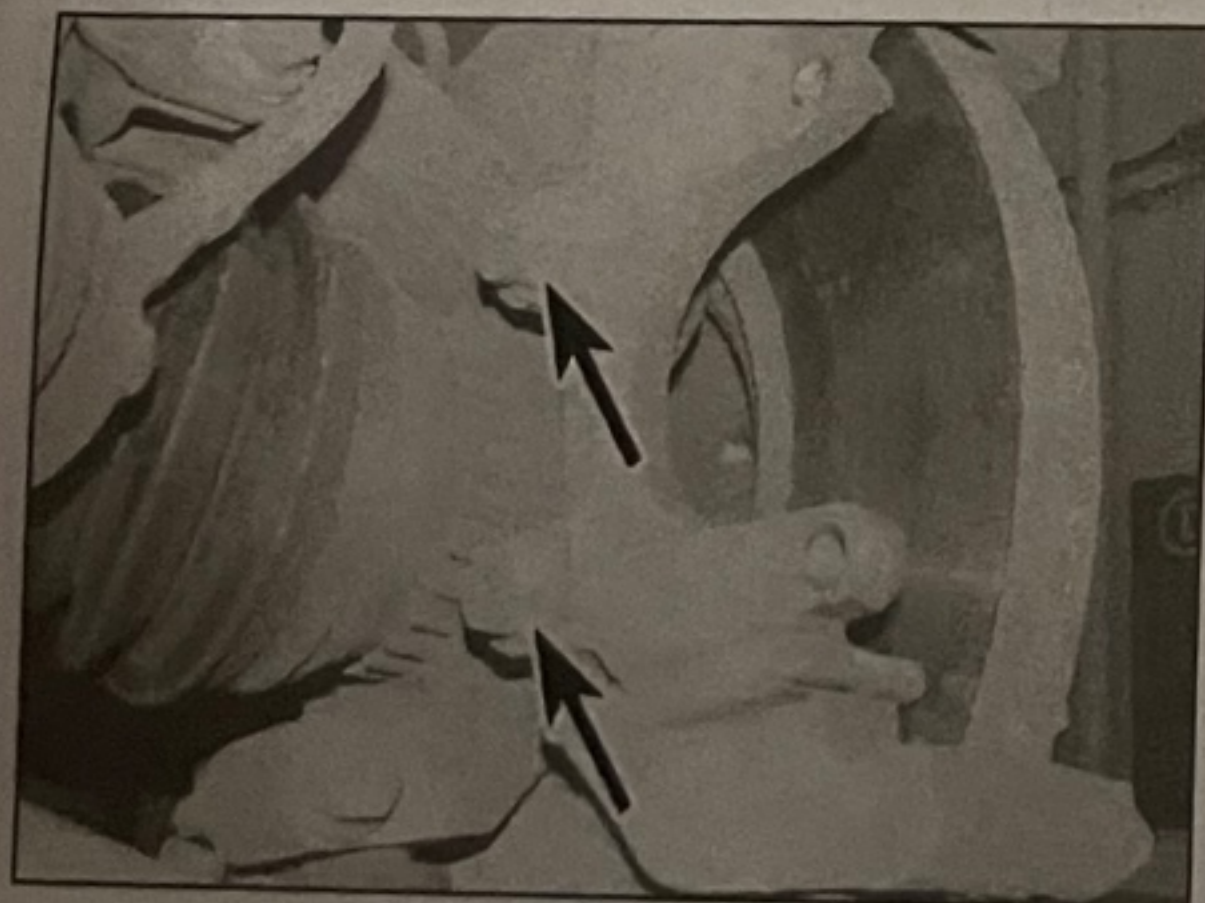
14 If new brake pads are to be fitted, the caliper piston(s) must be pushed back into the cylinder(s) to make room for them. Either use a G-clamp or similar tool, or use suitable pieces of wood as levers. Provided that the master cylinder reservoir has not been overfilled with hydraulic fluid, there should be no spillage, but keep a careful watch on the fluid level while retracting the piston(s). If the fluid level rises above the MAX level line at any time, the surplus should be siphoned off or ejected via a plastic tube connected to the bleed screw.

**Warning:** Do not siphon the fluid by mouth, as it is poisonous; use a syringe or an old antifreeze tester.

**Caution:** Pushing back the piston causes a reverse-flow of brake fluid, which has been known to 'flip' the master cylinder rubber seals, resulting in a total loss of braking. To avoid this, clamp the caliper flexible hose and open the bleed screw – as the piston is pushed back, the fluid can be directed into a suitable container using a hose attached to the bleed screw. Close the screw just before the piston is pushed fully back, to ensure no air enters the system.

### Fixed caliper

15 Where applicable, use a steel rule to check that the cutaway recess in the pistons



6.5a Unscrew the bolts . . .

are positioned correctly (see illustration). The recesses must be at the bottom of the caliper. If necessary, carefully turn the pistons to their correct positions.

16 Locate the new pads in the caliper. Ensure that the friction material faces the disc, and check that the pads are free to move.

17 Locate the anti-squeal spring on the pads, then insert the pad retaining pins from the inside edge of the caliper, while depressing the spring. Tap the pins firmly into the caliper.

### Floating caliper

18 Locate the inner and outer pads in the caliper, making sure that the inner pad location spring is fully entered in the piston.

19 Slide the caliper and pads over the disc and onto the mounting bracket.

20 Insert the caliper guide bolts, and then tighten them to the specified torque setting.

21 Refit the guide bolt dust caps.

22 Refit the retaining spring to the caliper, ensuring that its ends are correctly located in the caliper holes.

### All models

23 Depress the brake pedal repeatedly until normal pedal pressure is restored.

24 Repeat the above procedure on the remaining rear brake caliper.

25 Refit the roadwheels, then lower the vehicle to the ground and tighten the roadwheel bolts to the specified torque setting.

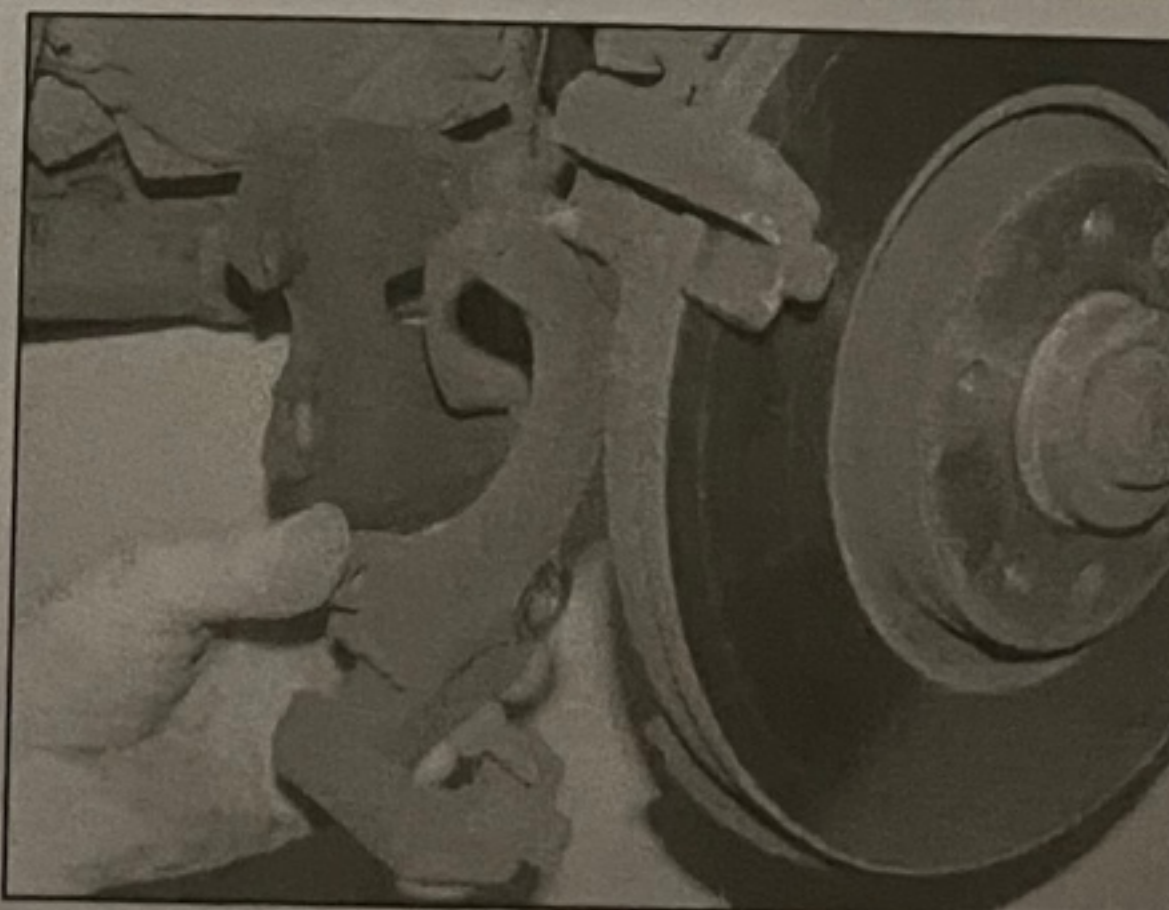
26 Check the hydraulic fluid level as described in *Weekly checks*.

## 6 Front brake caliper – removal, overhaul and refitting

### Removal

1 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *Jacking and vehicle support*). Remove the roadwheel.

2 Minimise fluid loss by first removing the master cylinder reservoir cap, then tightening it down onto a piece of polythene to obtain an airtight seal. Alternatively, use a brake hose clamp to clamp the flexible hose leading to the brake caliper.



6.5b . . . and remove the caliper mounting bracket from the hub carrier

3 Clean the area around the caliper mounting bracket (to ensure correct refitting), then unscrew the union bolt and recover the dust cap. Remove the sealing washer from each side of the caliper hole to minimise fluid loss and prevent the ingress of dirt into the hydraulic system. Discard the washers; new ones must be used on refitting. Plug the hose end with a cap. Remove the brake pads as described in Section 4, then remove the caliper from the vehicle.

5 If necessary, unbolt the caliper mounting bracket from the hub carrier (see illustrations).

### Overhaul

**Note:** Before dismantling the brake caliper, check on the availability and cost of parts, as it may be more economical to renew the complete unit.

6 With the caliper on the bench, clean away all external dirt and debris.

7 Withdraw the piston from the caliper body and remove the dust seal. The piston can be withdrawn by hand or, if necessary, pushed out by applying compressed air to the brake hose union hole. Only low pressure should be required, such as from a foot pump.

8 Using a small screwdriver, carefully remove the piston seal from the caliper, taking care not to mark the bore.

9 Remove the guide bushes from the caliper body.

10 Thoroughly clean all components, using only methylated spirit or clean hydraulic fluid. Never use mineral-based solvents such as petrol or paraffin. Dry the components using compressed air or a clean, lint-free cloth. If available, use compressed air to blow clear the fluid passages.

11 Check all components, and renew any that are worn or damaged. If the piston and/or cylinder bore are scratched excessively, renew the complete caliper body. Similarly check the condition of the guide bushes and bolts; both bushes and bolts should be undamaged and a reasonably tight sliding fit. If there is any doubt about the condition of any component, renew it. Renew the caliper seals and dust covers as a matter of course; these are available as a repair kit together with assembly grease.

12 On reassembly, ensure that all components are absolutely clean.

13 Lubricate the new seal with the grease supplied, or dip it in clean hydraulic fluid. Locate the seal in the cylinder bore groove, using only the fingers to manipulate it into position.

14 Fill the inner cavity of the dust seal with the grease supplied, or dip it in clean hydraulic fluid, then locate it on the piston.

15 Locate the piston on the caliper, then carefully press it fully into the bore, twisting it from side-to-side to ensure it enters the internal seal correctly. At the same time, make sure that the inner end of the dust seal enters the groove on the caliper body, and the outer end enters the groove in the piston.

16 Insert the guide bushes in the caliper body, using suitable grease to lubricate them.

### Refitting

17 Locate the caliper mounting bracket on the hub carrier, then apply locking fluid to the threads of the mounting bolts, insert them, and tighten to the specified torque.

18 Refit the brake pads as described in Section 4, together with the caliper that at this stage will not have the hose attached.

19 Position a new copper sealing washer on each side of the hose union, and connect the brake hose to the caliper. Ensure that the hose is correctly positioned against the caliper body lug, then install the union bolt and tighten securely.

20 Remove the brake hose clamp or the polythene, where fitted, and bleed the hydraulic system as described in Section 2. Note that, providing the precautions described were taken to minimise brake fluid loss, it should only be necessary to bleed the relevant front brake.

21 Refit the roadwheel, then lower the vehicle to the ground and tighten the roadwheel bolts to the specified torque.

## 7 Rear brake caliper - removal, overhaul and refitting

1 Jack up the front wheels, then jack up the rear of the vehicle and support on axle stands (see Jacking and vehicle support). Remove the roadwheel.

2 Minimise fluid loss by first removing the master cylinder reservoir cap, then tightening it down onto a piece of polythene to obtain an airtight seal. Alternatively, use a brake hose clamp on the flexible hose leading to the brake line on the rear axle (early models with fixed caliper) (see illustration) or to the floating caliper (late models).

### Fixed caliper

3 Clean the area around the hydraulic line union nut, and then loosen the nut (see illustration). Do not fully unscrew the nut at this stage.

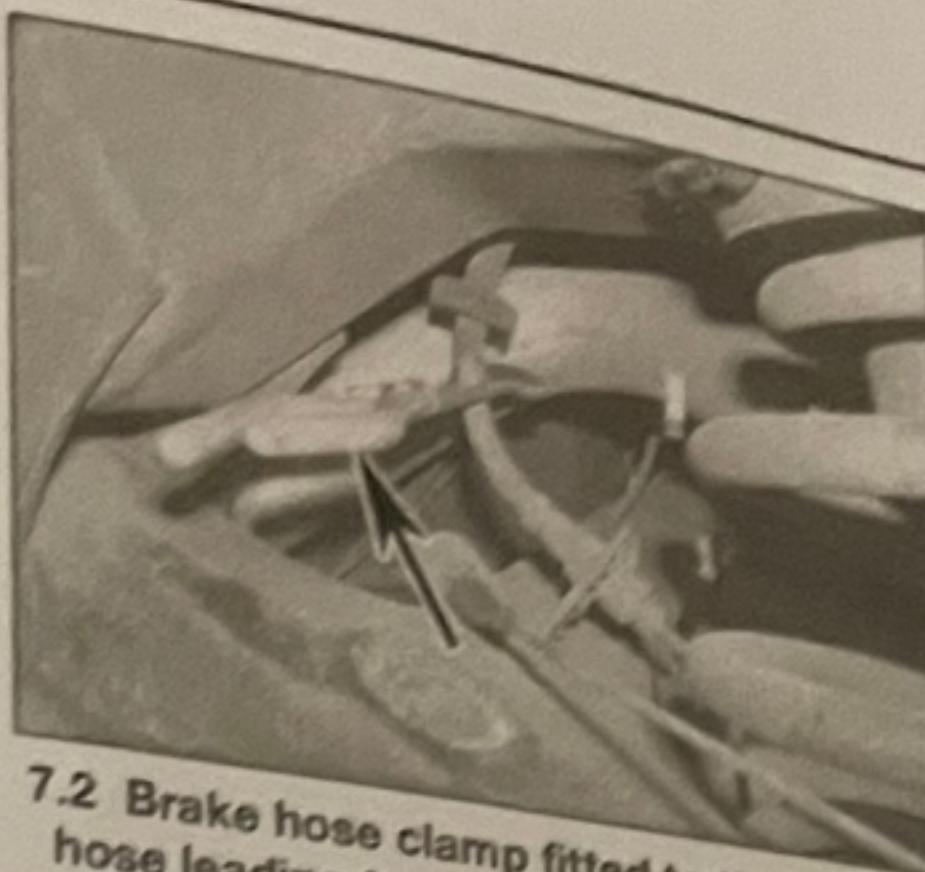
4 Remove the brake pads as described in Section 5.

5 Unscrew and remove the mounting bolts securing the caliper to the backplate (see illustration). Recover the cover plate from under the bolt heads.

6 Fully unscrew the union nut and disconnect the hydraulic line from the caliper, then withdraw the caliper from the disc (see illustration). Tape over or plug the hydraulic line to prevent entry of dust and dirt.

### Floating caliper

7 Clean the area around the brake hose on the caliper, then loosen the hose end fitting. The hose cannot be fully unscrewed from the caliper at this stage.



7.2 Brake hose clamp fitted to the flexible hose leading from the body to the brake line on the rear axle

8 At the other end of the brake hose, unscrew the union nut and disconnect the rigid brake line from the hose end fitting on the rear suspension trailing arm. Be prepared for some loss of brake fluid. Recover the clip, and withdraw the hose from the bracket. Tape over or plug the ends of the rigid line and hose to prevent entry of dust and dirt.

9 Remove the brake pads as described in Section 5, then remove the caliper from the vehicle. Fully unscrew the hose from the caliper.

10 If necessary, unbolt the caliper mounting bracket from the backplate.

### Overhaul

**Note:** Before dismantling the brake caliper check on the availability and cost of parts, as it may be more economical to renew the complete unit.

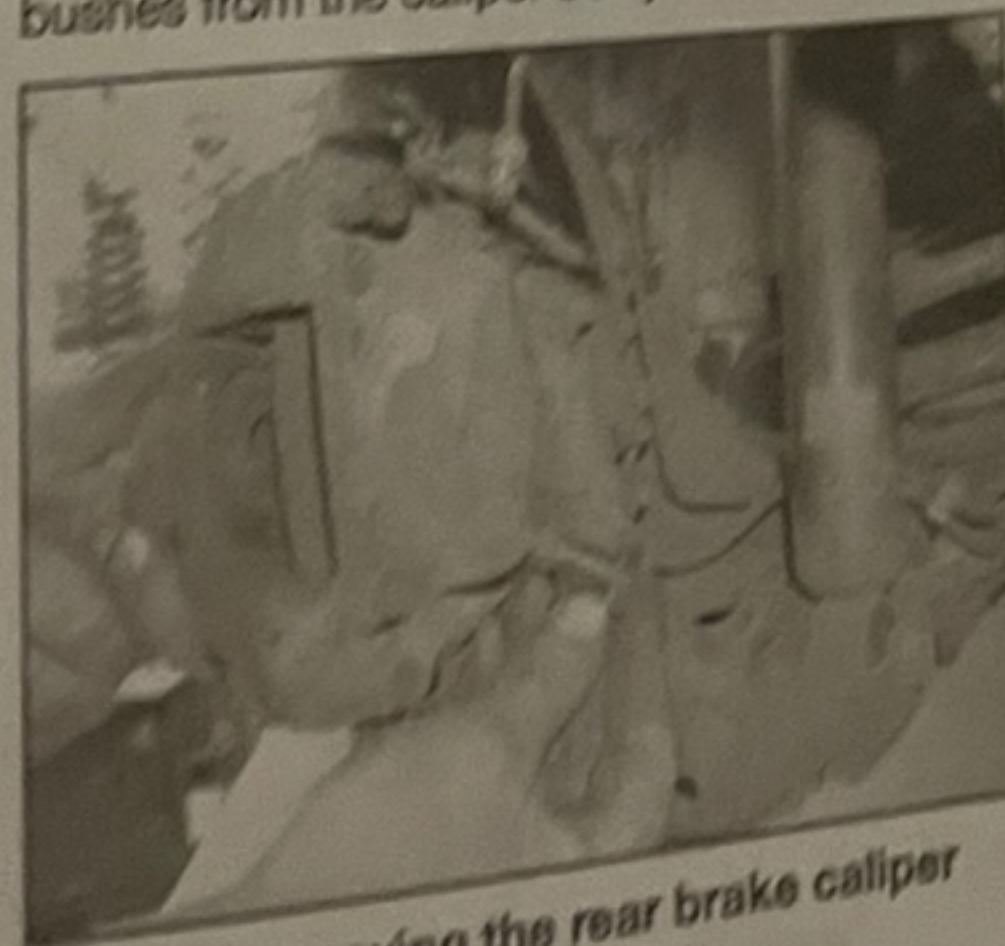
11 With the caliper on the bench, clean away all external dirt and debris.

12 Withdraw the piston(s) from the caliper body, and remove the dust seal(s). The piston(s) can be withdrawn by hand, or if necessary pushed out by applying compressed air to the brake hose union hole. Only low pressure should be required, such as from a foot pump.

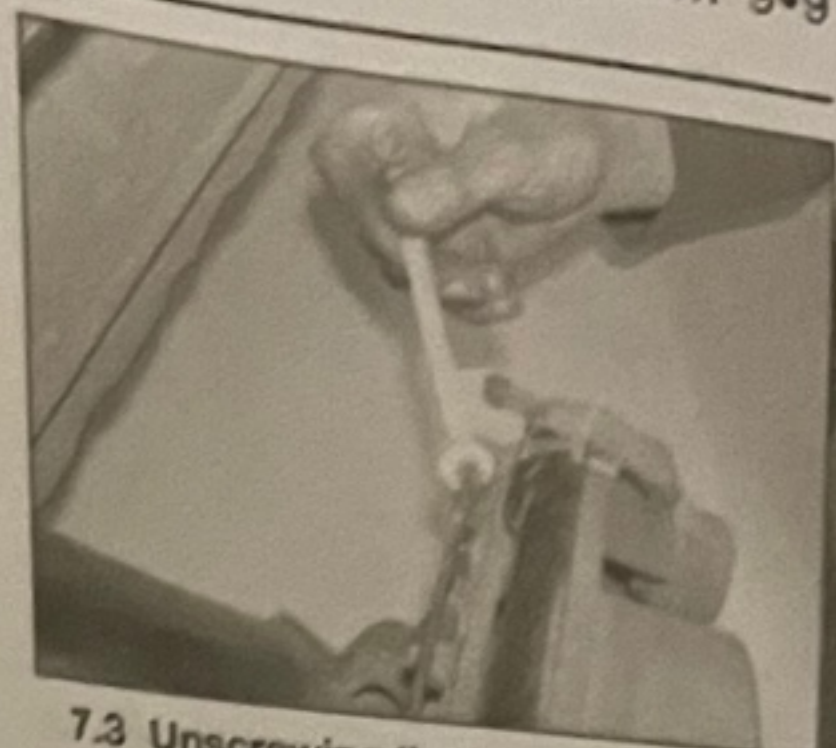
**Caution:** On the fixed caliper, keep each piston identified for position to ensure correct refitting.

13 Using a small screwdriver, carefully remove the piston seal(s) from the caliper, taking care not to mark the bore(s).

14 On the floating caliper, remove the guide bushes from the caliper body.



7.5 Removing the rear brake caliper mounting bolts



7.3 Unscrewing the hydraulic line union nut from the rear brake caliper

15 Thoroughly clean all components, using only methylated spirit or clean hydraulic fluid. Never use mineral-based solvents such as petrol or paraffin. Dry the components using compressed air or a clean, lint-free cloth. If available, use compressed air to blow clear the fluid passages.

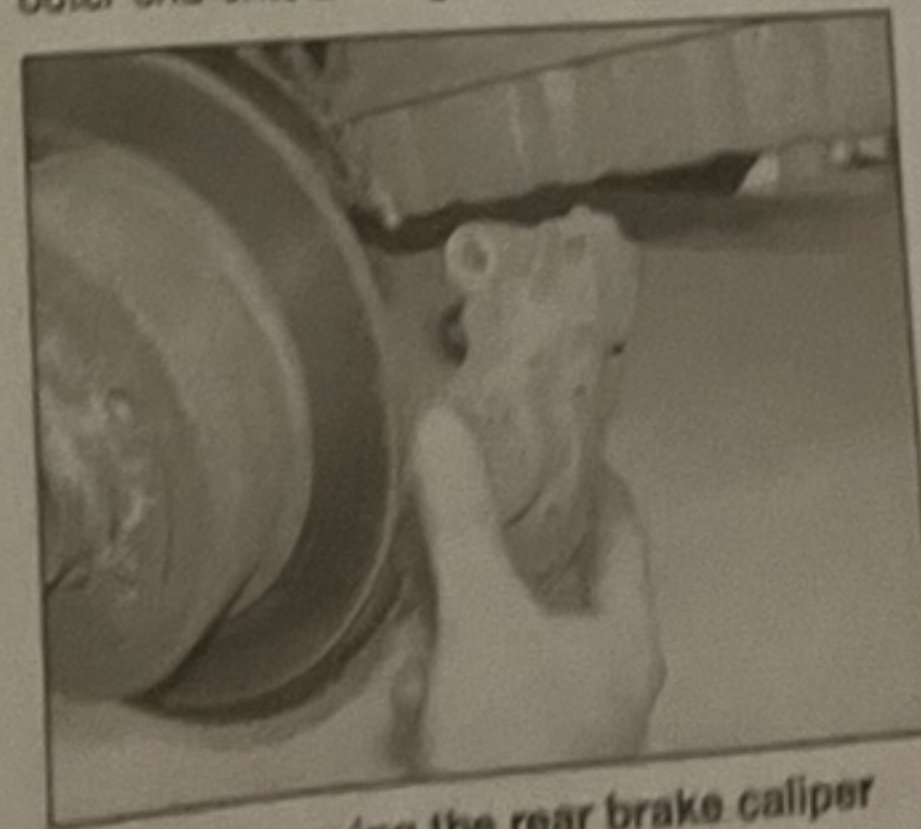
16 Check all components, and renew any that are worn or damaged. If the piston(s) and/or cylinder bore(s) are scratched excessively, renew the complete caliper body. On the floating caliper, check the condition of the guide bushes and bolts; both bushes and bolts should be undamaged and a reasonably tight sliding fit. Renew the caliper seals and dust covers as a matter of course; these are available as a repair kit together with assembly grease.

17 On reassembly, ensure that all components are absolutely clean.

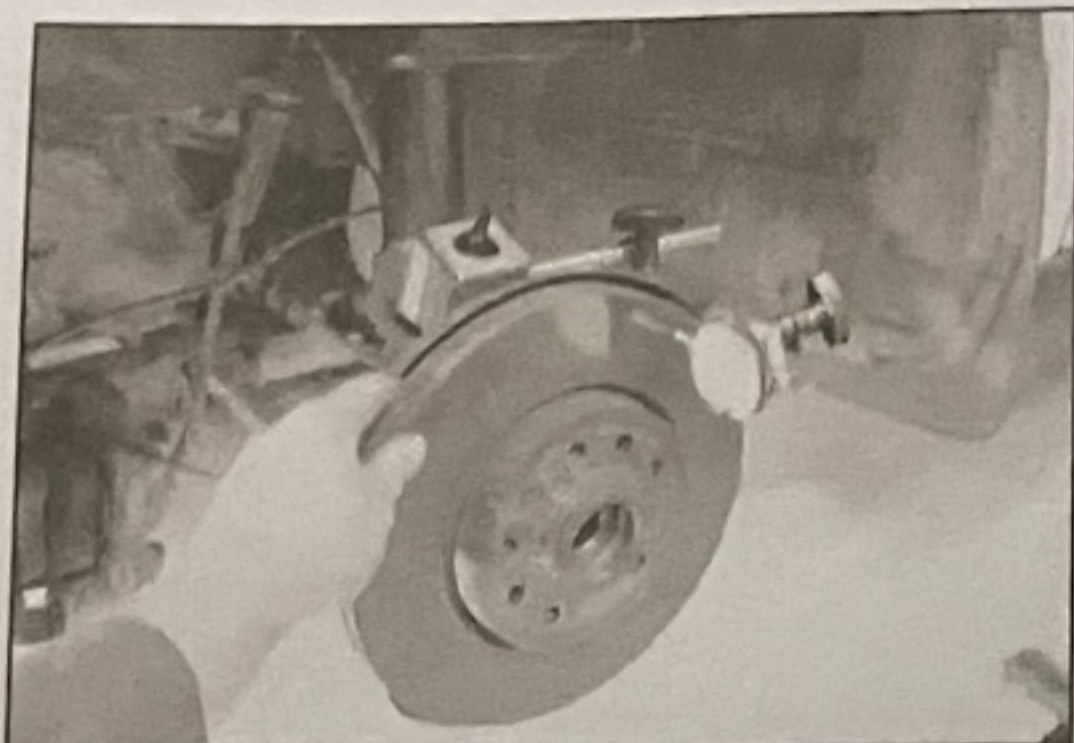
18 Lubricate the new seal(s) with the grease supplied, or dip them in clean hydraulic fluid, then locate them in the cylinder bore groove(s), using only the fingers to manipulate them into position.

19 Fill the inner cavities of the dust seals with the grease supplied, or dip them in clean hydraulic fluid, then locate them on the piston(s).

20 Locate the piston(s) on the caliper, then carefully press it fully into the caliper body, twisting it from side-to-side to ensure it enters the internal seal correctly. At the same time, make sure that the inner end of the dust seal(s) enters the groove on the caliper body, and the outer end enters the groove in the piston. On



7.6 Removing the rear brake caliper



8.5 Checking the front brake disc run-out with a dial gauge

the fixed caliper, make sure that the piston cutaway recesses are positioned as described in Section 5.

### Refitting

#### Fixed caliper

21 With both pistons refitted, locate the caliper over the disc and onto the backplate, then insert the hydraulic line and screw in the union nut. Do not fully-tighten the nut at this stage.

22 Apply a little locking fluid to the threads of the mounting bolts, then refit the cover plate and bolts, and tighten the bolts to the specified torque.

23 Refit the brake pads (see Section 5).

24 Fully tighten the hydraulic union nut.

#### Floating caliper

25 Locate the caliper mounting bracket on the backplate, then apply locking fluid to the threads of the mounting bolts, insert them, and tighten to the specified torque.

26 Screw the brake hose into the caliper and tighten it to the specified torque.

27 Refit the brake pads as described in Section 5, together with the caliper.

28 Locate the brake hose in the bracket making sure that it is not twisted. Refit the clip, then insert and tighten the rigid brake line union nut.

#### All models

29 Remove the polythene, where fitted, and bleed the hydraulic system as described in Section 2. Note that, providing the precautions described were taken to minimise brake fluid



8.7 Use a micrometer to check the disc thickness

loss, it should only be necessary to bleed the relevant rear brake.

30 Refit the roadwheel, then lower the vehicle to the ground and tighten the roadwheel bolts to the specified torque.

### 8 Front brake disc – inspection, removal and refitting



#### Inspection

1 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *Jacking and vehicle support*). Remove both front roadwheels.

2 For an accurate check and for access to each side of the disc, the brake caliper should be unbolted and suspended to one side as described later in this Section. Alternatively, just the brake pads can be removed as described in Section 5.

3 Check that the brake disc securing screw is tight, then fit spacers approximately 10.0 mm thick to each of the roadwheel bolts, and refit and tighten the bolts. This will hold the disc in its normal running position.

4 Rotate the brake disc, and examine it for deep scoring or grooving. Light scoring is normal, but if excessive, the disc should be removed and either renewed or machined (within the specified limits) by an engineering works. The minimum thickness is given in the Specifications at the beginning of this Chapter.

5 Using a dial gauge, or a flat metal block

and feeler blades, check that the disc run-out does not exceed the figure given in the Specifications (see illustration).

6 If the disc run-out is excessive, remove the disc as described later, and check that the disc-to-hub surfaces are perfectly clean. Refit the disc and check the run-out again. If the run-out is still excessive, the disc should be renewed.

7 Using a micrometer check that the disc thickness is not less than that given in the Specifications (see illustration). Take readings at several points around the disc.

8 Repeat the inspection on the other front brake disc.

#### Removal

9 Remove the roadwheel bolts and spacer used when checking the disc.

10 Remove the disc pads as described in Section 4, and tie the caliper to one side. Also remove the front brake caliper mounting bracket with reference to Section 6.

11 Remove the securing screw and withdraw the disc from the hub. If the screw is tight, use an impact driver to loosen it (see illustrations).

#### Refitting

12 Refitting is a reversal of removal, but make sure that the mating faces of the disc and hub are perfectly clean, and apply a little locking fluid to the threads of the securing screw before tightening it. If a new disc is being fitted, remove the protective coating from the surface, using an appropriate solvent. Refit the disc pads as described in Section 4, then refit the roadwheel and lower the vehicle to the ground.

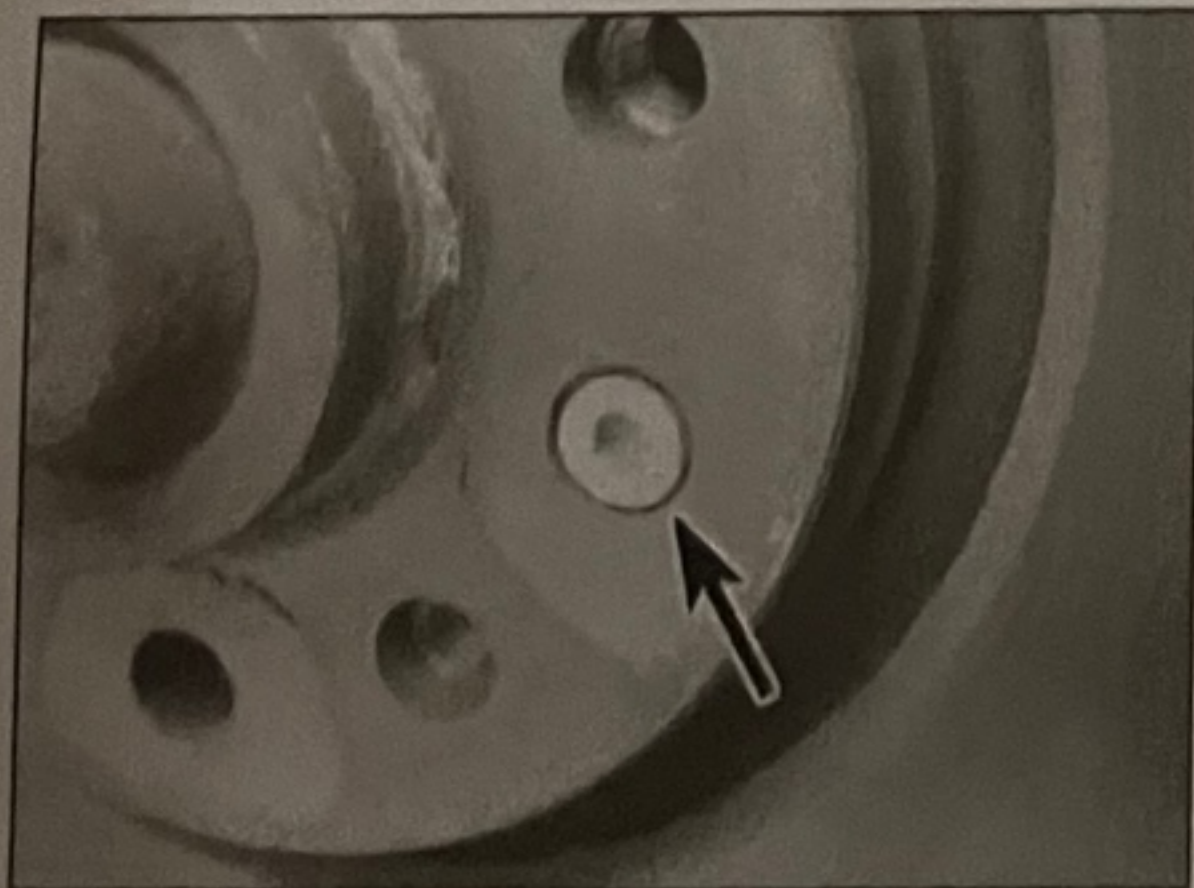
### 9 Rear brake disc – inspection, removal and refitting



#### Inspection

1 Chock the front wheels, then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove both rear roadwheels.

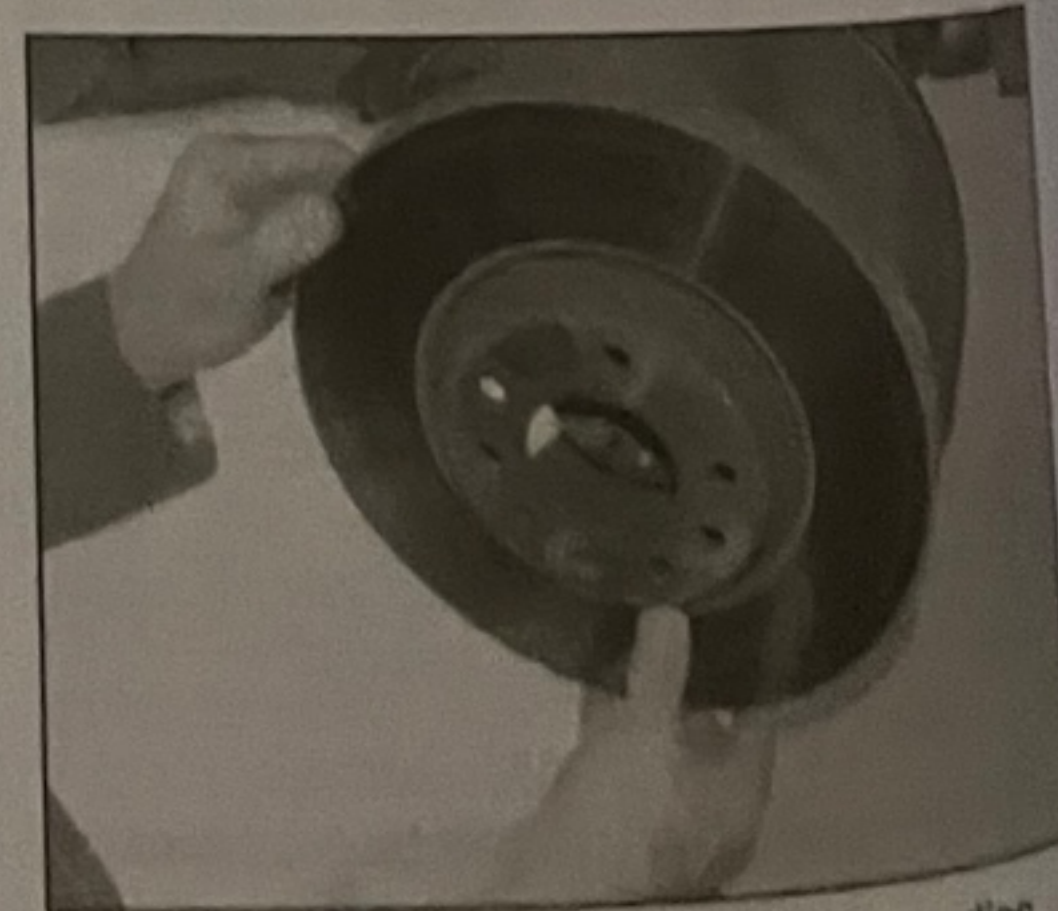
2 For an accurate check and for access to each side of the disc, the brake caliper should



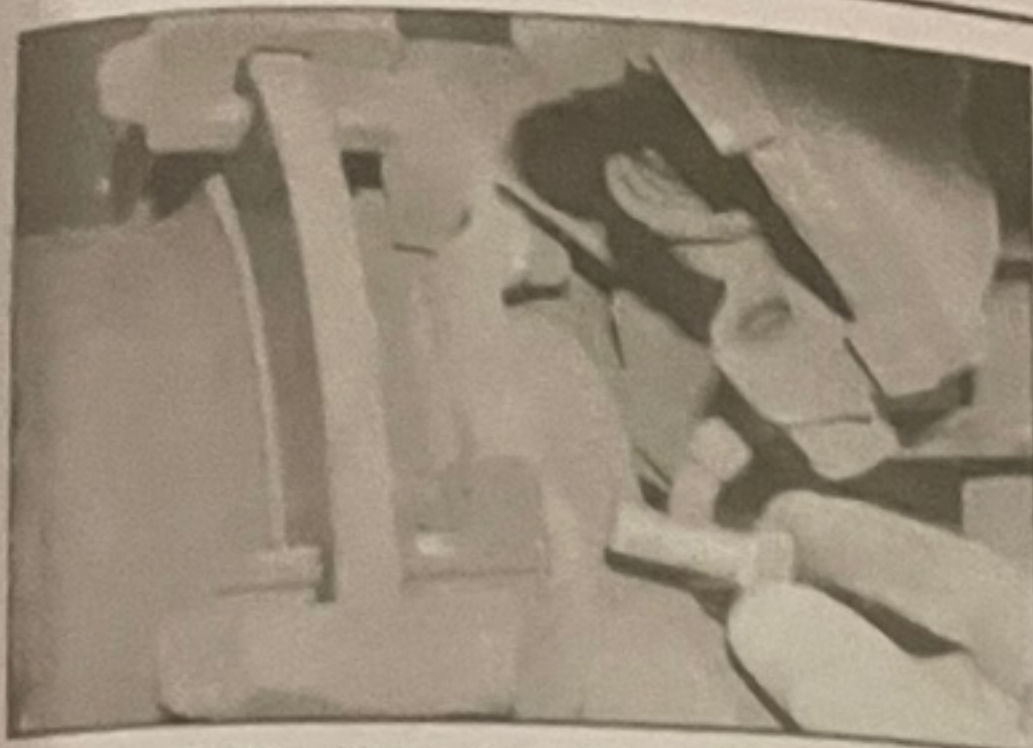
8.11a Front brake disc securing screw



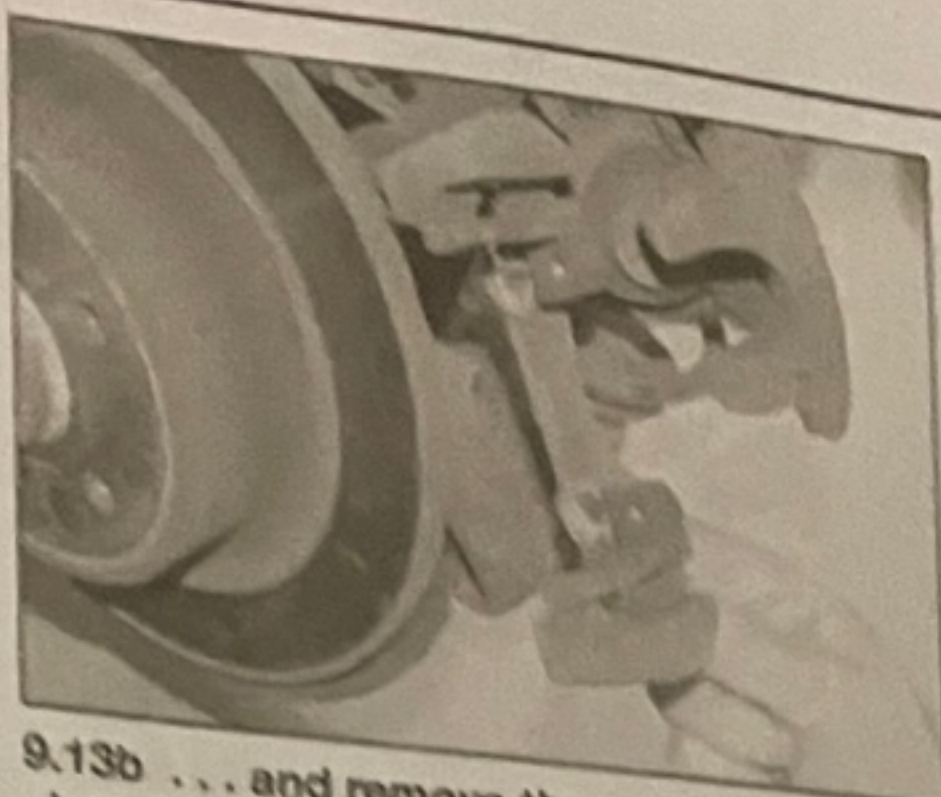
8.11b Using an impact driver to loosen the brake disc securing screw



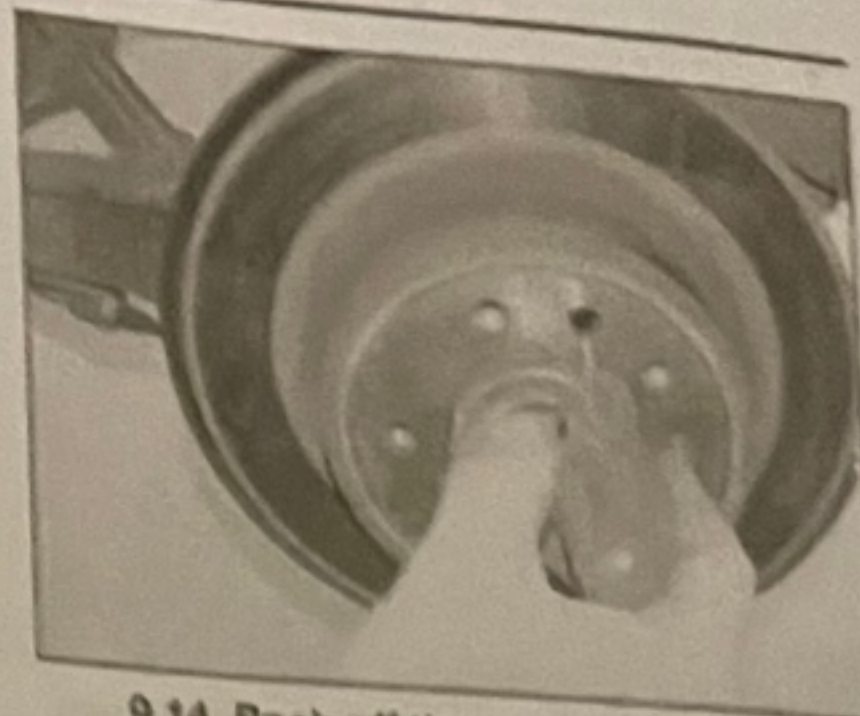
8.11c Removing the front brake disc



9.13a Unscrew the bolts...



9.13b ... and remove the caliper mounting bracket from the rear suspension trailing arm



9.14 Back off the handbrake shoe adjustment using a screwdriver through the access hole in the disc

be unbolted and suspended to one side as described later in this Section. Alternatively, just the brake pads can be removed as described in Section 5.

3 Check that the brake disc securing screw is tight, then fit spacers approximately 10.0 mm thick to each of the roadwheel bolts, and refit and tighten the bolts. This will hold the disc in its normal running position.

4 Rotate the brake disc, and examine it for deep scoring or grooving. Light scoring is normal, but if excessive, the disc should be removed and either renewed or machined (within the specified limits) by an engineering works. The minimum thickness is given in the Specifications at the beginning of this Chapter.

5 Using a dial gauge, or a flat metal block and feeler blades, check that the disc run-out does not exceed the figure given in the Specifications.

6 If the disc run-out is excessive, remove the disc as described later, and check that the disc-to-hub surfaces are perfectly clean. Refit the disc and check the run-out again. If the run-out is still excessive, the disc should be renewed.

7 Using a micrometer check that the disc thickness is not less than that given in the Specifications (see illustration 8.7). Take readings at several points around the disc.

8 Repeat the inspection on the other rear brake disc.

### Removal

9 Remove the roadwheel bolts and spacers used when checking the disc.

10 Remove the disc pads as described in Section 5.

### Fixed caliper

11 Carefully release the rear brake hydraulic line from the clip on the rear axle, taking care not to bend the line excessively.

12 Unbolt and remove the rear brake caliper with reference to Section 7, and tie it to one side. A convenient place to secure the caliper on the left-hand side is to the exhaust system, using a long plastic cable-tie.

### Floating caliper

13 With the caliper already removed in order

to remove the disc pads, unscrew the bolts and remove the mounting bracket from the rear suspension trailing arm (see illustrations).

### All models

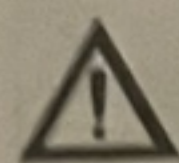
14 Using a screwdriver through the access hole, back off the handbrake shoe adjustment with reference to Section 16 (see illustration).

15 Remove the securing screw and withdraw the disc from the hub (see illustrations).

### Refitting

16 Refitting is a reversal of removal, but make sure that the mating faces of the disc and hub are perfectly clean, and apply a little locking fluid to the threads of the securing screw before tightening it. If a new disc is being fitted, remove the protective coating from the surface, using an appropriate solvent. Adjust the handbrake as described in Section 15 and the handbrake cables as described in Section 16. Refit the roadwheel and lower the vehicle to the ground.

### 10 Handbrake shoes - inspection, removal and refitting



**Warning:** Renew BOTH sets of rear brake shoes at the same time. Note that the dust created by wear of the pads may contain asbestos, which is a health hazard. Never blow it out with compressed air, and do not inhale any of it. Use brake cleaner or methylated spirit to clean brake components.

### Inspection

1 The handbrake operates independently of the footbrake, using brake shoes inside drums integral with the discs.

2 A quick check of the handbrake shoe wear may be made without removing the rear brake disc. Check the front wheels, then jack up the rear of the vehicle and support it on axle stands (see Jacking and vehicle support). Turn the brake disc so that the automatic adjuster is visible through the hole in the disc. If the adjuster has more than 10 threads visible, the shoes are worn excessively and should be renewed.

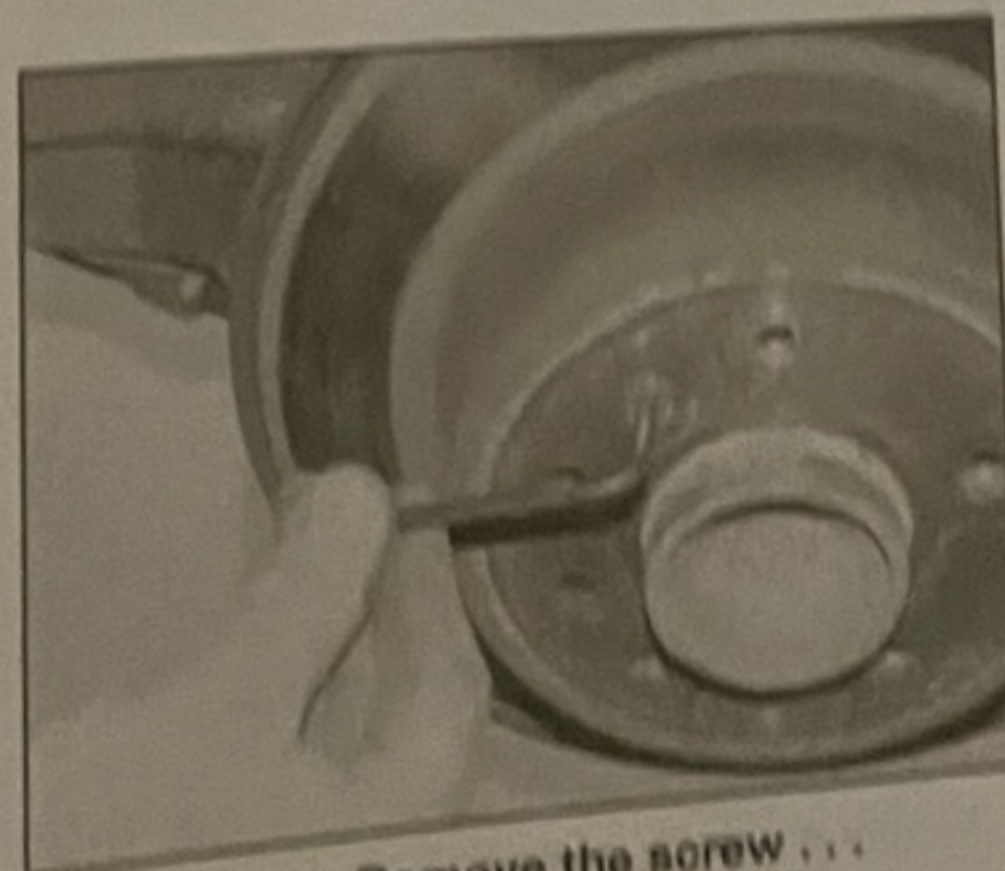
3 For a thorough check, remove the rear brake disc as described in Section 9, then check the minimum thickness of the friction material on each handbrake shoe. If any one of the shoes has worn below the specified limit, all four handbrake shoes must be renewed as a set.

### Removal

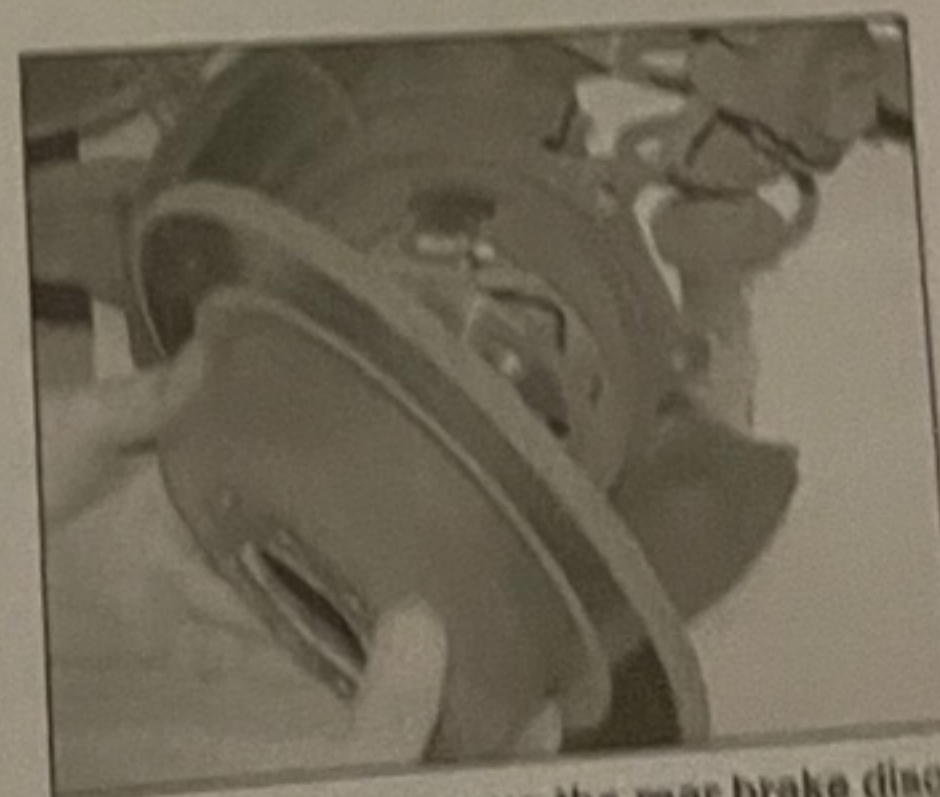
4 With the rear brake disc removed, clean the dust and dirt from the brake shoes and backplate.

5 It is possible to remove and refit the shoes without removing the rear hub, although we found it much easier with the hub removed and the backplate on the bench, particularly for the reassembly procedure. Refer to Chapter 10 and remove the rear hub, and the backplate complete with handbrake shoes.

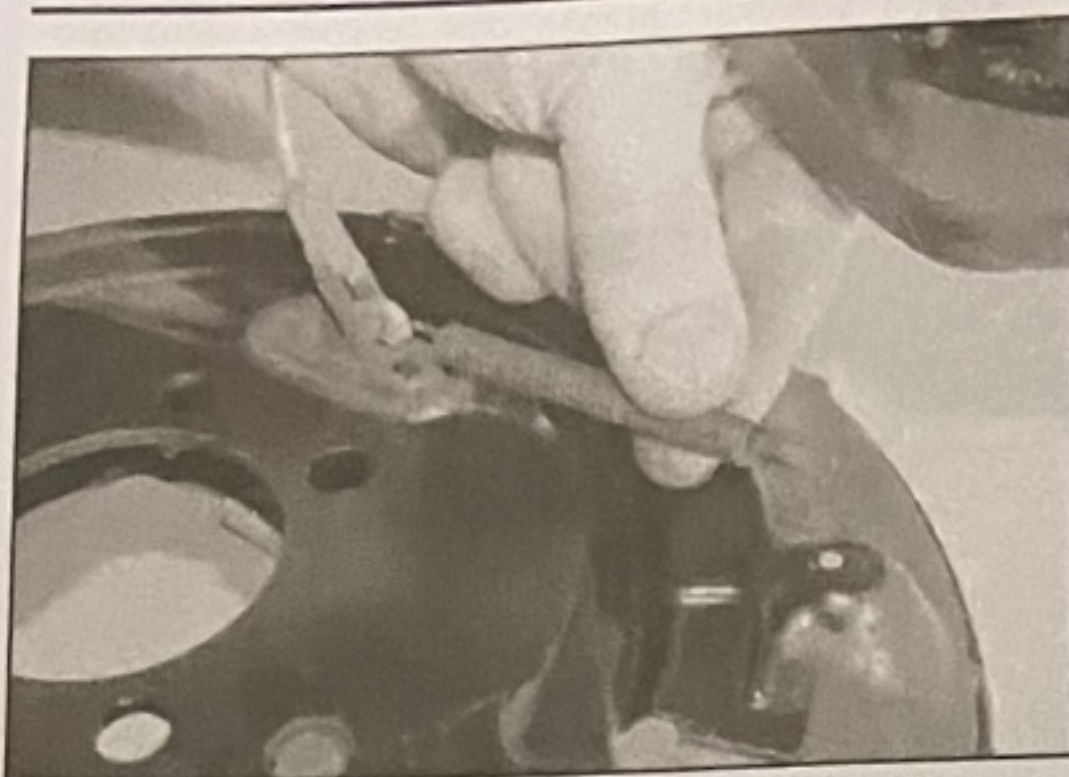
6 Unhook the cable return spring from the



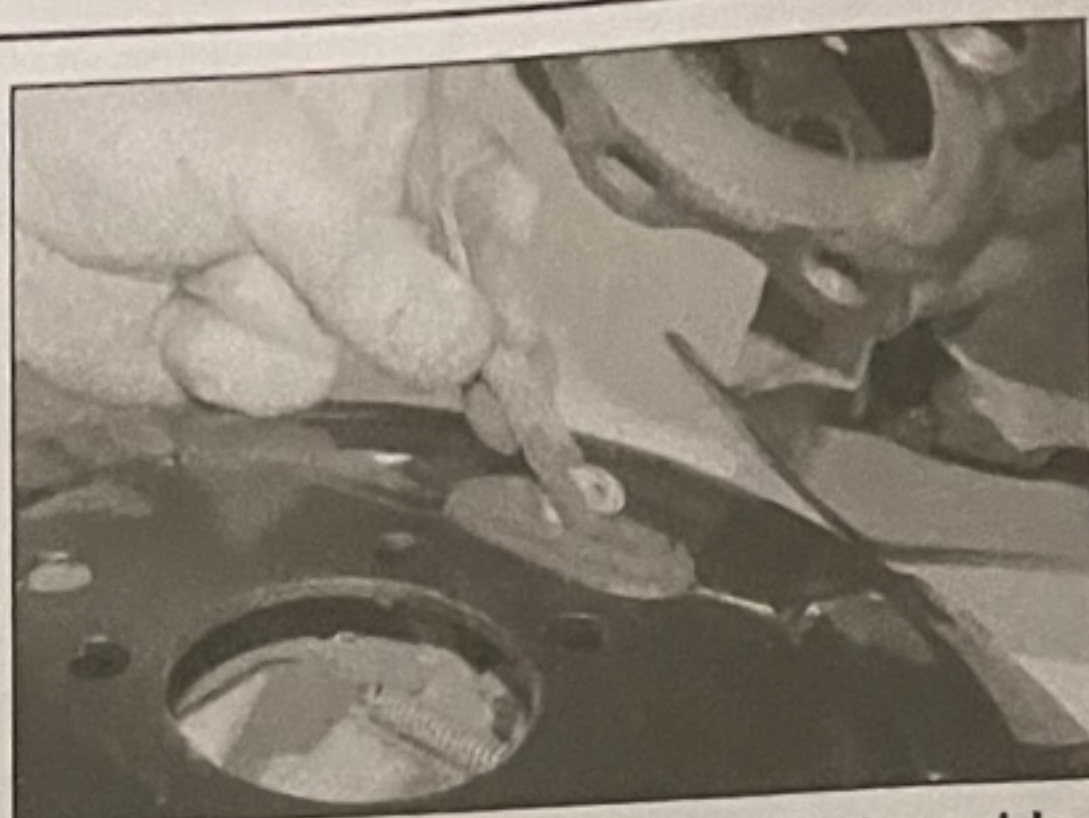
9.15a Remove the screw...



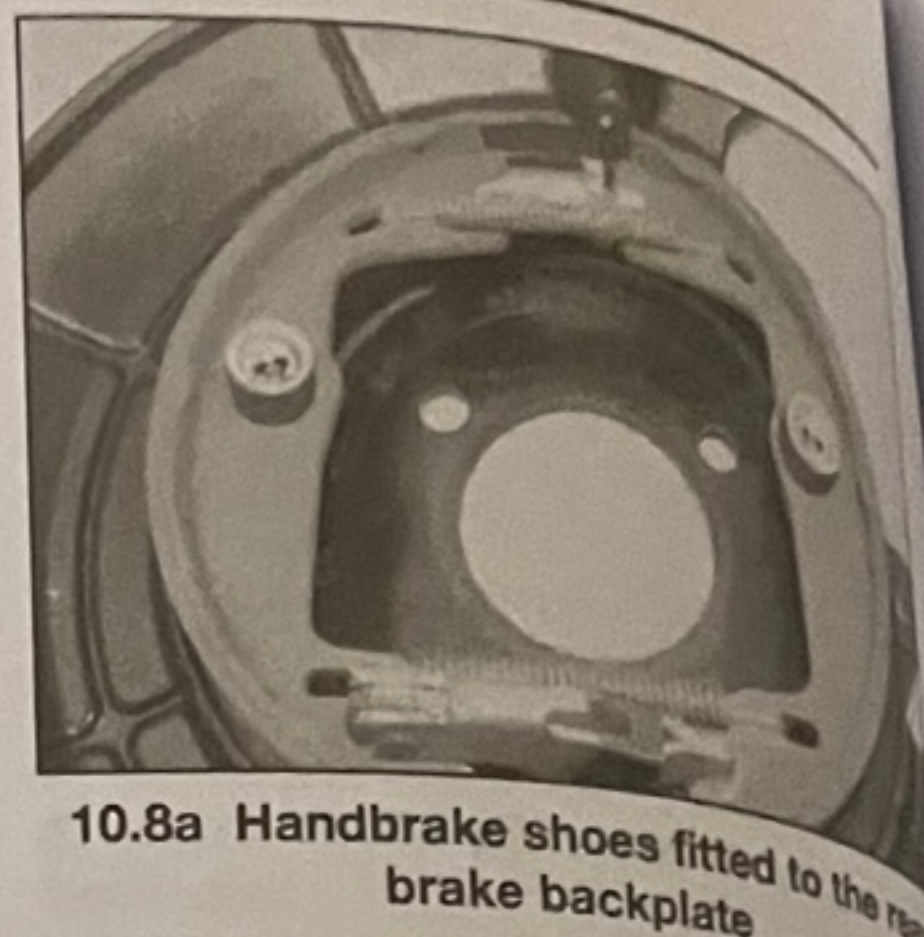
9.15b ... and remove the rear brake disc



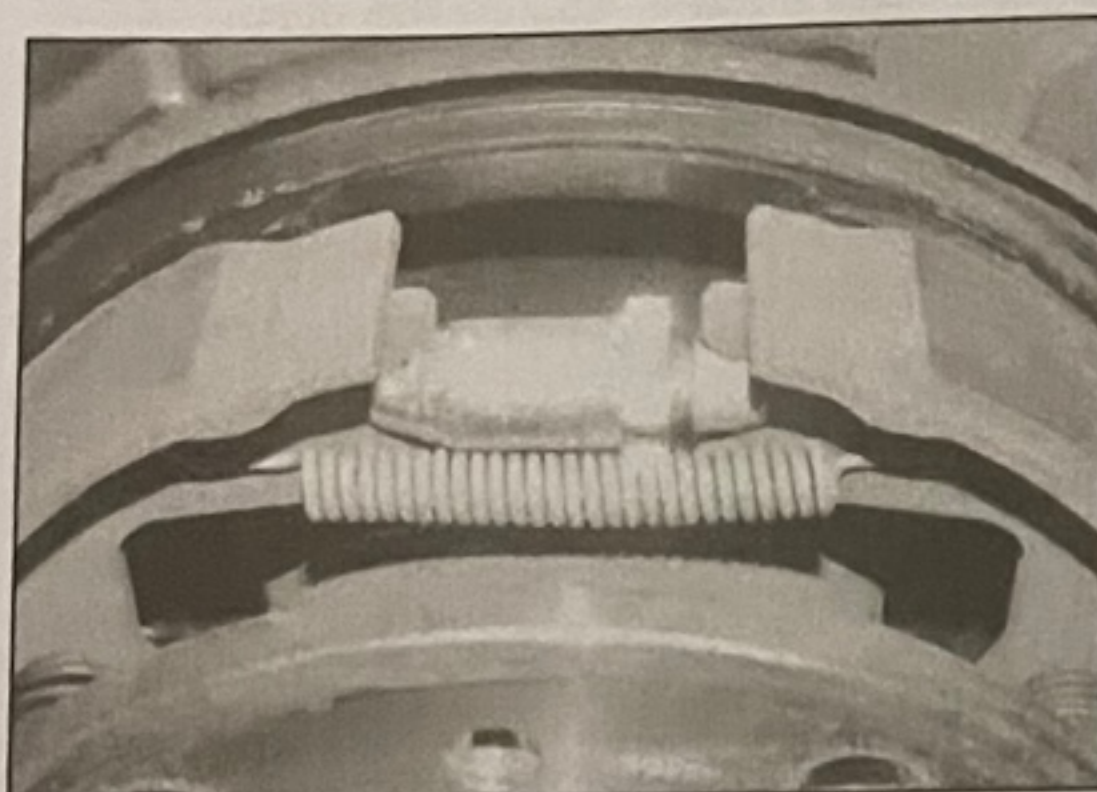
10.6 Unhook and remove the cable return spring



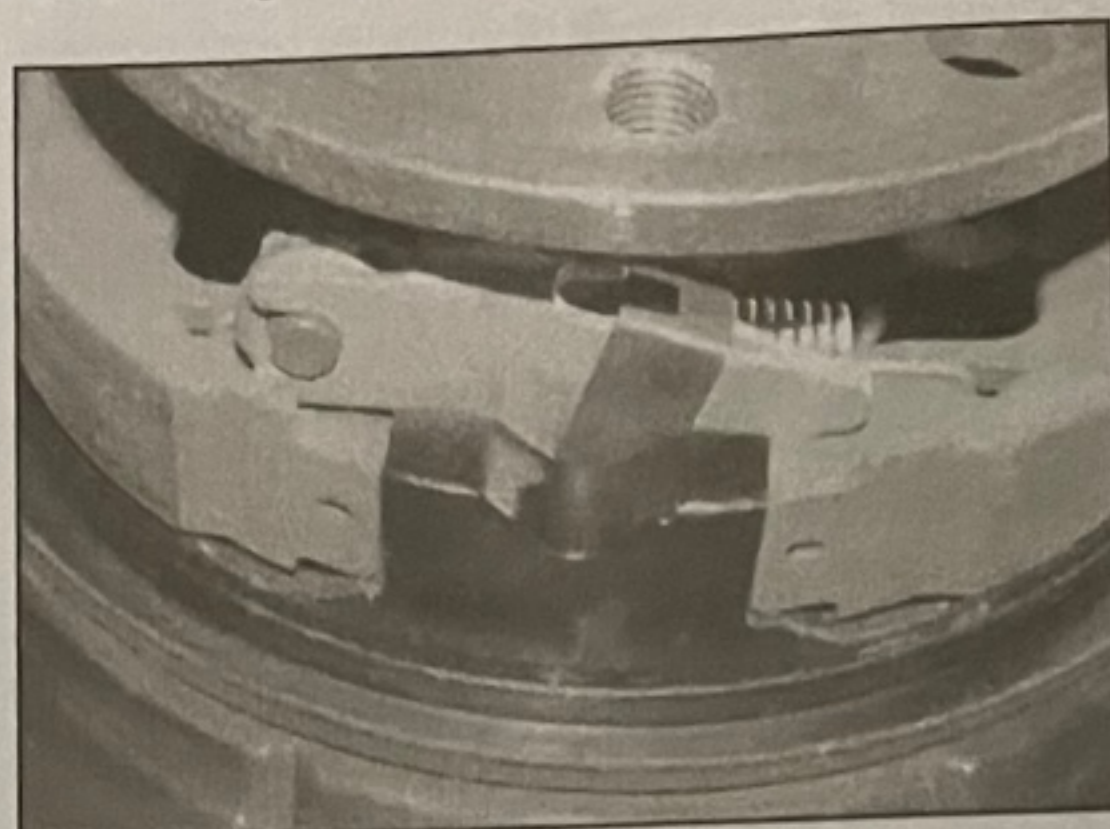
10.7 Disconnecting the handbrake cable end fitting from the lever on the backplate



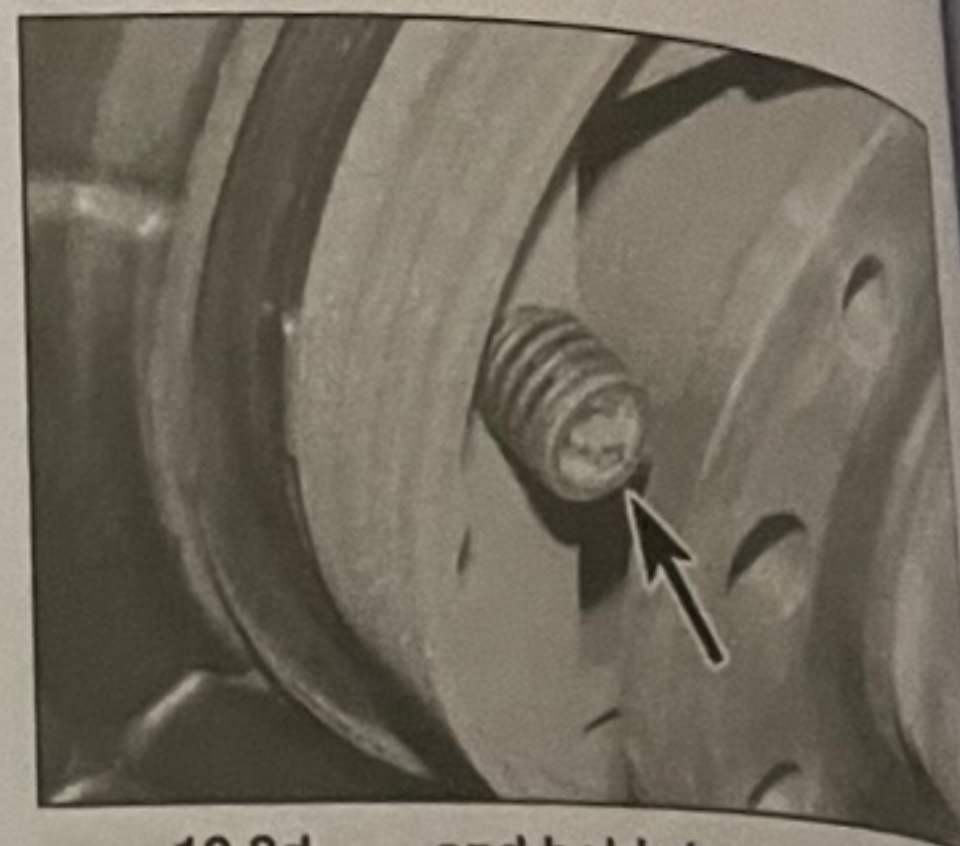
10.8a Handbrake shoes fitted to the rear brake backplate



10.8b Handbrake shoe adjuster (left-hand rear brake) ...



10.8c ... expander ...



10.8d ... and hold-down springs

hole in the backplate and from the cable end fitting (see illustration).

7 Unhook the cable end fitting from the lever on the bottom of the backplate (see illustration).

8 Note the fitted position of all components, and if necessary make a sketch of them (see illustrations).

9 Remove the shoe hold-down cups, springs and pins by depressing the cups and turning

them through 90° using a pair of pliers (see illustration). If the hub is still fitted, insert a suitable tool through the hole in the hub flange.

10 Carefully lift the shoes directly from the backplate anchors and guide the expander lever through the rubber grommet (see illustration).

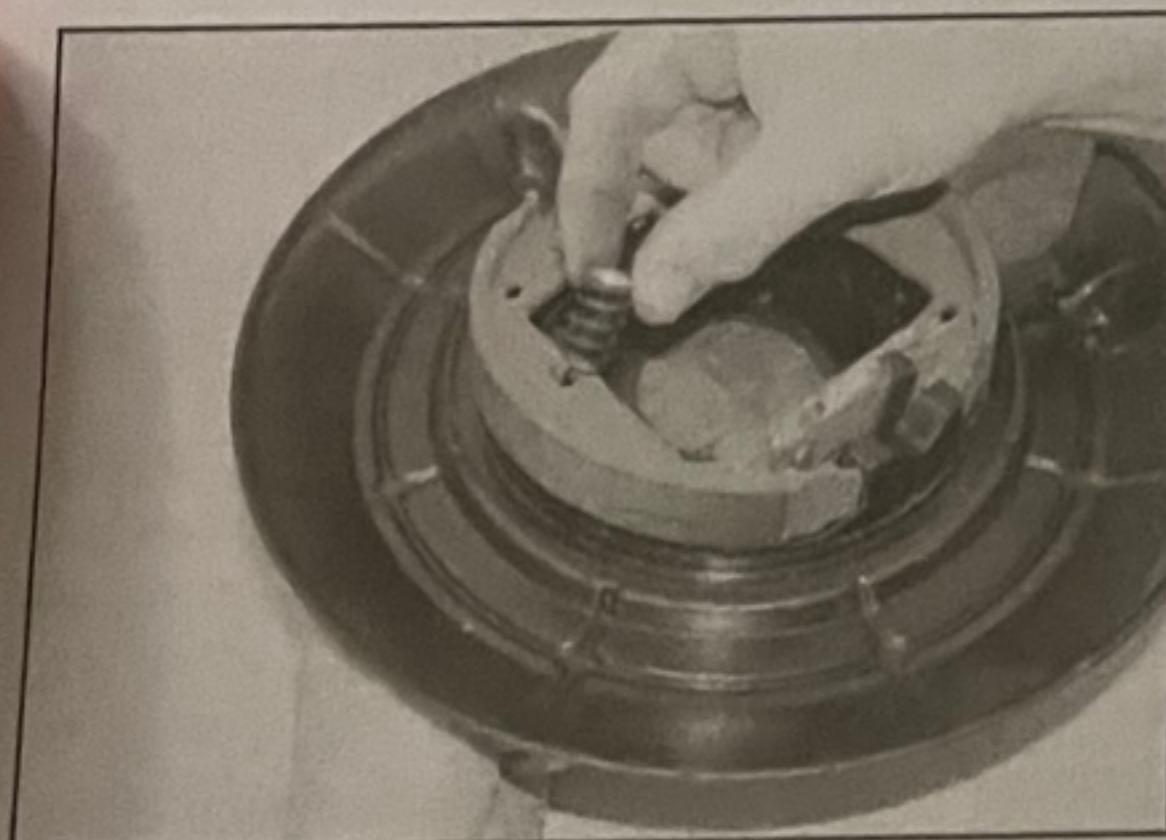
11 Pull the shoes apart and remove the adjuster, followed by the upper return spring (see illustrations).

12 Swivel the upper ends of the shoes inwards, and remove the expander from the bottom ends (see illustrations).

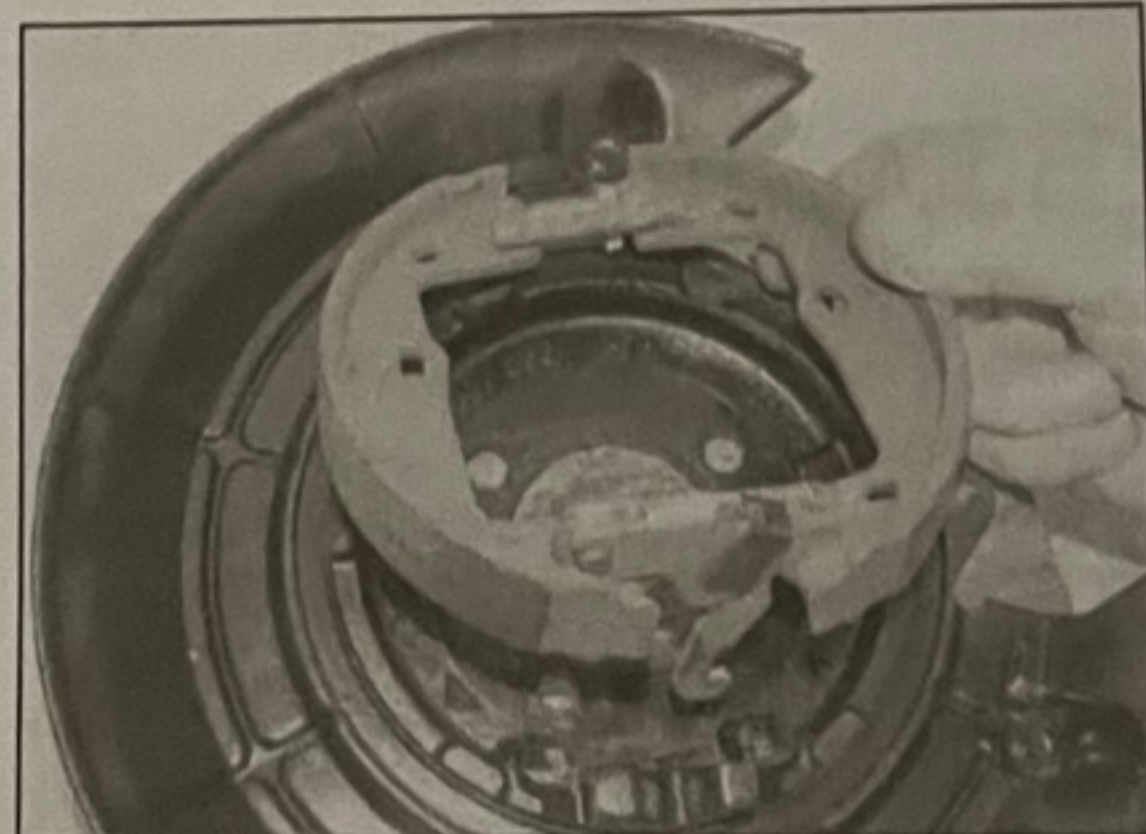
13 Unhook the lower return spring from the shoes (see illustration).

14 Dismantle the adjuster and expander components for cleaning (see illustration).

15 If both handbrake assemblies are dismantled at the same time, take care not to mix them up.



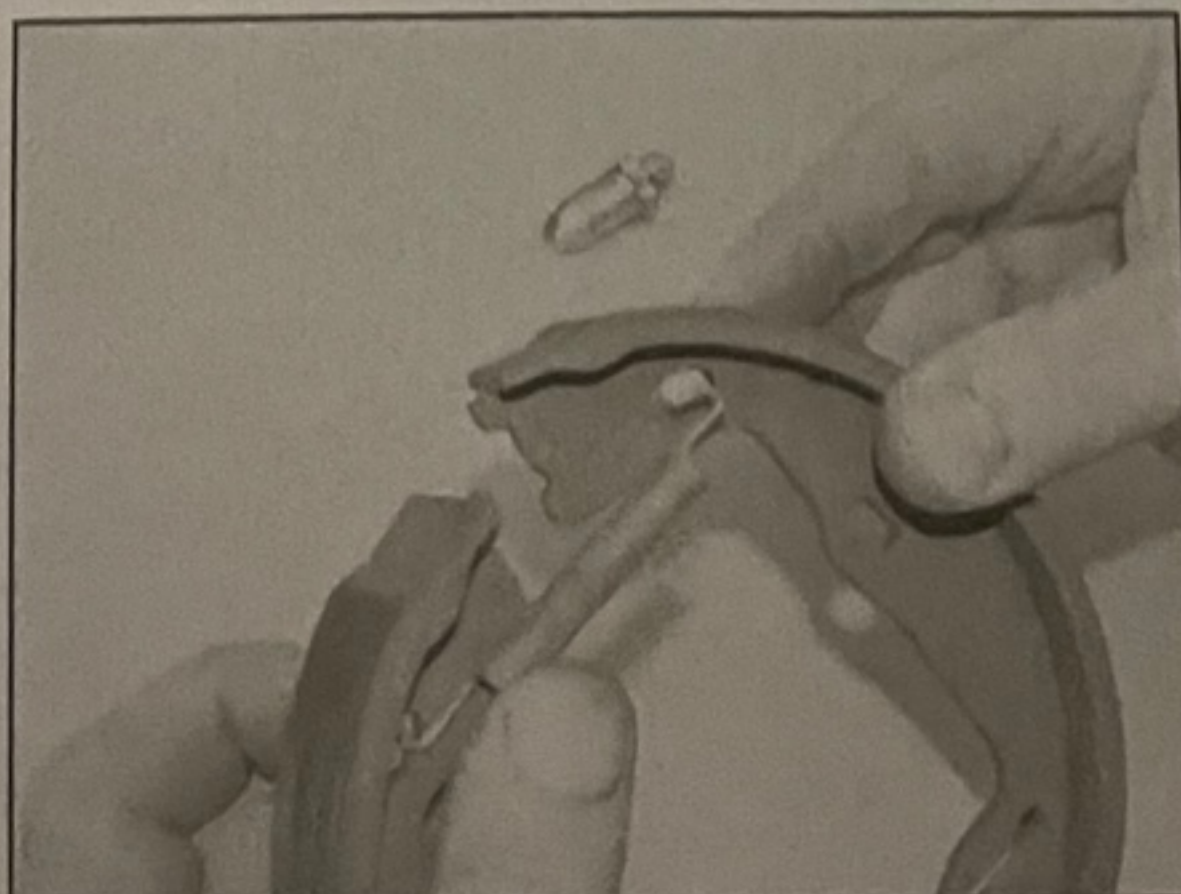
10.9 Removing the handbrake shoe hold-down cups, springs and pins



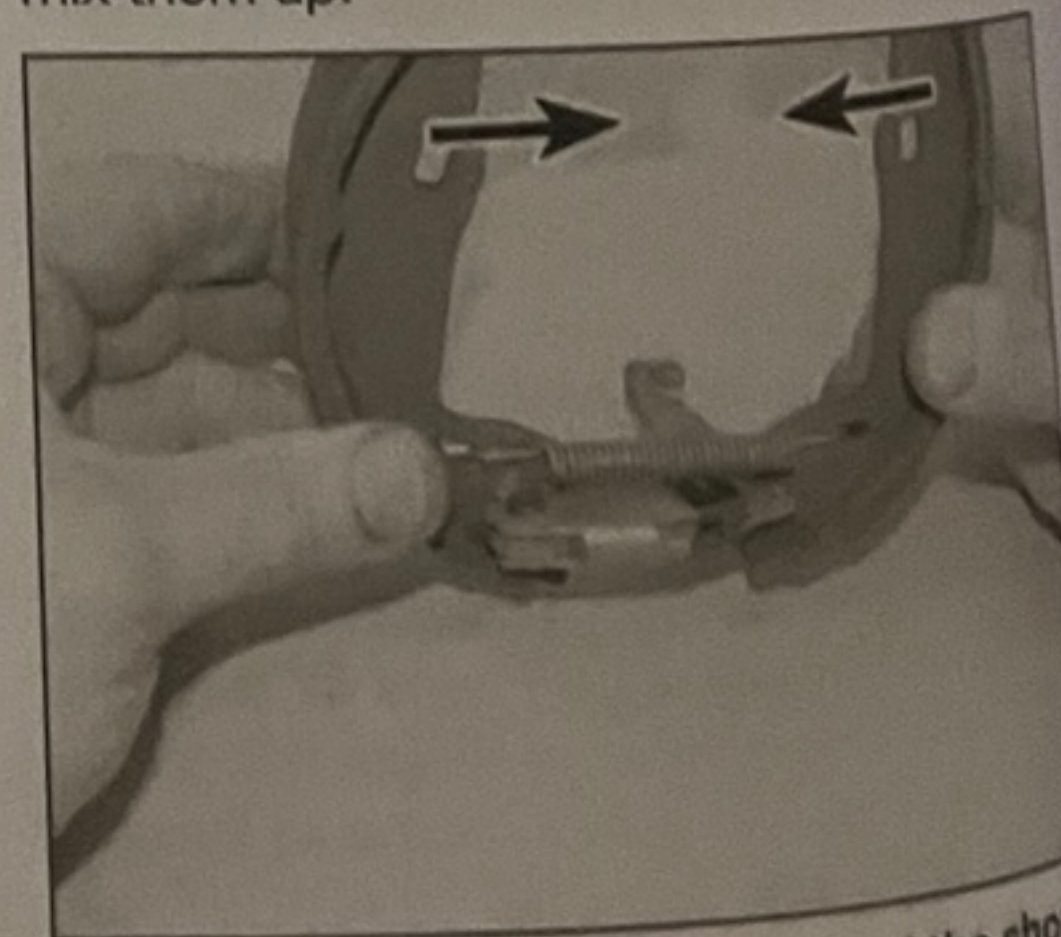
10.10 Lift the shoes directly from the backplate



10.11a Remove the adjuster ...



10.11b ... followed by the upper return spring



10.12a Swivel the upper ends of the shoes inwards ...

16 Clean all components for wear and tear, replace damaged components, apply grease to the pivots, and apply grease to the reassembling minimum length

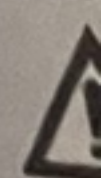
## Refitting

17 Clean the points (see illustration).  
18 Assemble using a reverse reference to the lever and bracket.  
21 Hook the backplate H.  
22 Refit the described in Section  
23 Adjust lower the

## 11 Maintenance

### Removal

1 Exhaust servo unit pedal.  
2 On left fusebox from the more v bracket.  
3 Wheel brake.  
4 Siphon Altern in the pedal con



5 P to c  
6 C the res  
7 ca gr u  
8 u t  
9

16 Clean all components, then examine them for wear and damage. Renew worn or damaged components. Make sure that the expander and adjuster operate freely and are not seized – apply a spot of oil to the expander pivots, and apply a little high melting-point grease to the threads of the adjuster before reassembling it. Set the adjuster to its minimum length.

### Refitting

17 Clean the backplate thoroughly, and apply a little copper grease to the shoe contact points (see illustration).

18 Assemble the shoes onto the backplate using a reversal of the removal procedure.

19 Refit the backplate and rear hub with reference to Chapter 10.

20 Hook the cable end fitting on the expander lever and locate the cable holder in the bracket.

21 Hook the cable return spring in the backplate hole and on the end fitting.

22 Refit the rear brake disc and caliper as described in Section 9.

23 Adjust the handbrake shoes as described in Section 15, then refit the roadwheels and lower the vehicle to the ground.

## 11 Master cylinder – removal, overhaul and refitting



Exhaust the vacuum present in the brake servo unit by repeatedly depressing the brake pedal.

2 On left-hand drive models, remove the main fusebox and holder, then disconnect the wiring from the anti-theft alarm switch. To provide more working room, unbolt and remove the bracket.

3 Where fitted, disconnect the wiring from the brake fluid warning switch in the reservoir.

4 Siphon out the fluid from the reservoir. Alternatively, open any convenient bleed screw in the system, and gently pump the brake pedal to expel the fluid through a plastic tube connected to the bleed screw (see Section 2).

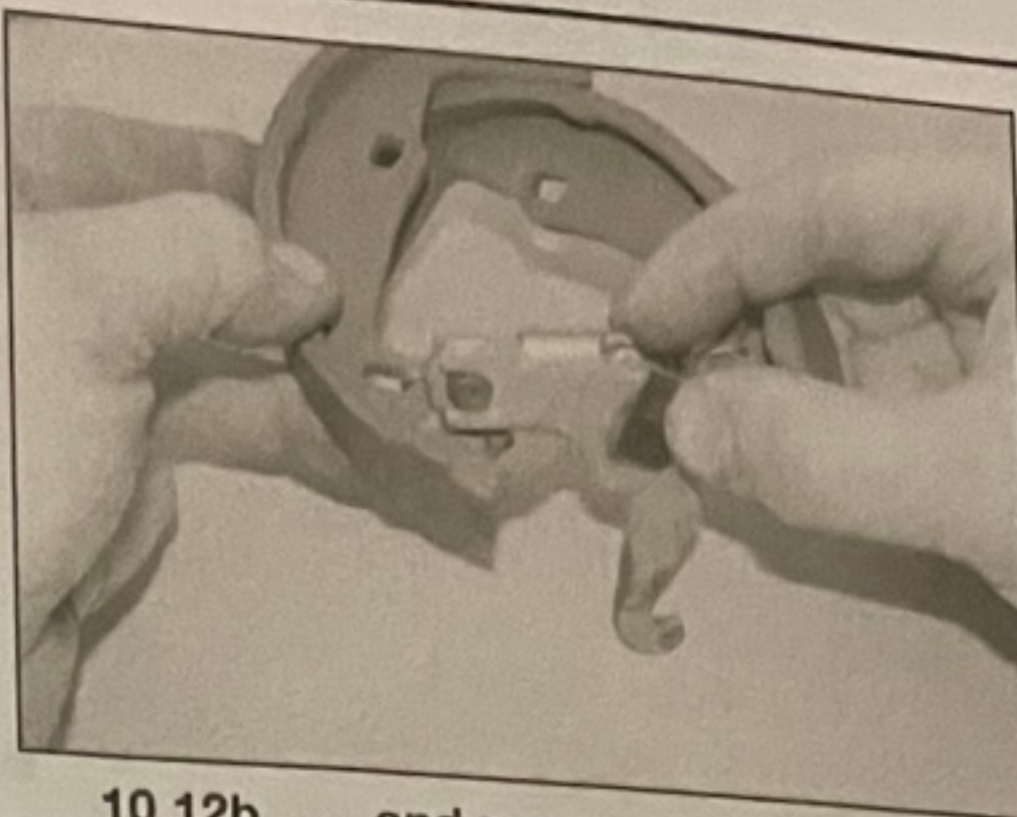
**Warning:** Do not siphon the fluid by mouth, as it is poisonous; use a syringe or an old poultry baster.

5 Place cloth rags beneath the master cylinder to catch spilt fluid.

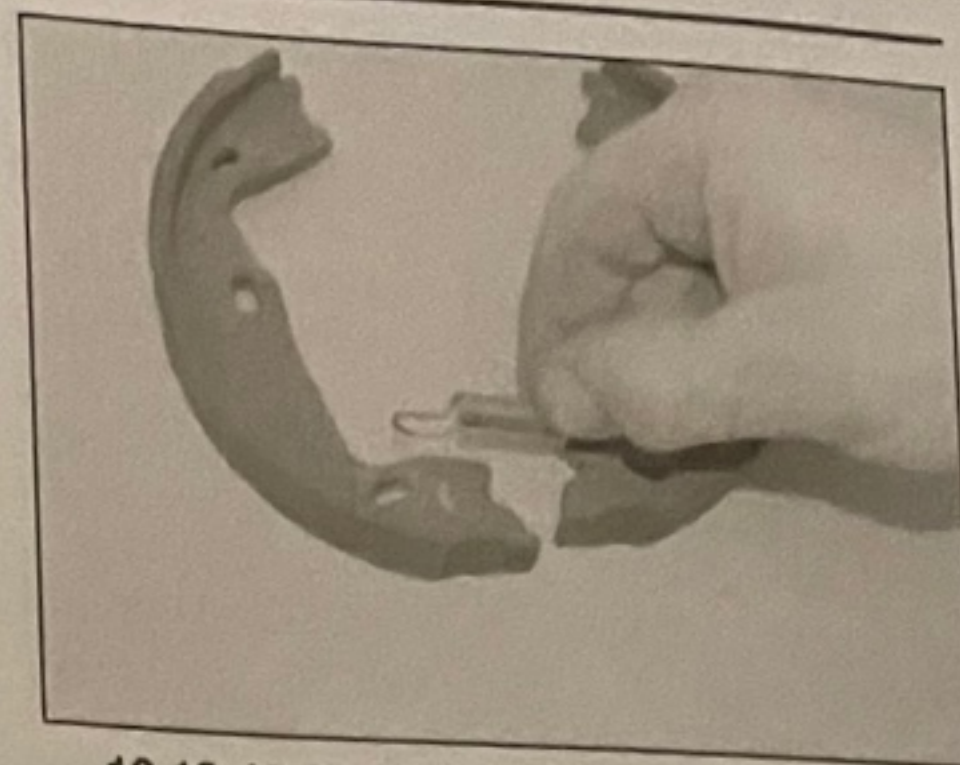
6 On manual transmission models, disconnect the clutch hydraulic hose from the brake fluid reservoir.

7 Refit the filler cap on the reservoir, then carefully lever the reservoir from the rubber grommets in the top of the master cylinder using a wide-bladed screwdriver.

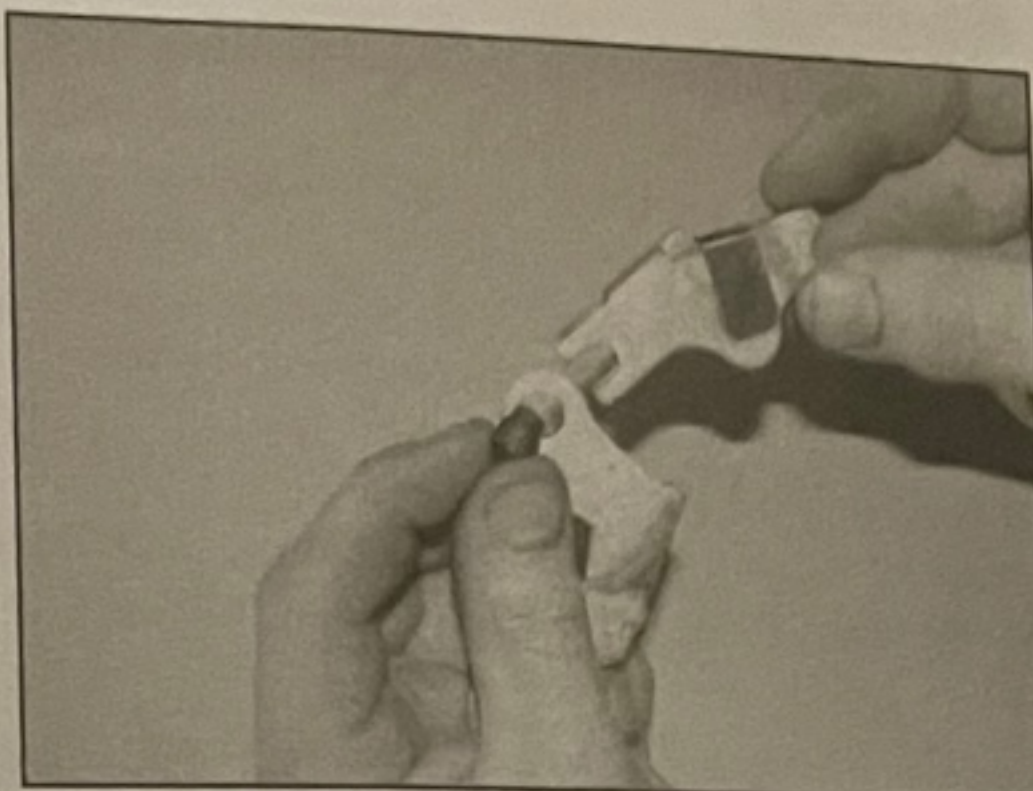
8 Note the position of the brake lines, then unscrew the union nuts and move the lines to one side so that they are just clear of the master cylinder. Do not bend the brake lines excessively. If available use a split spanner to



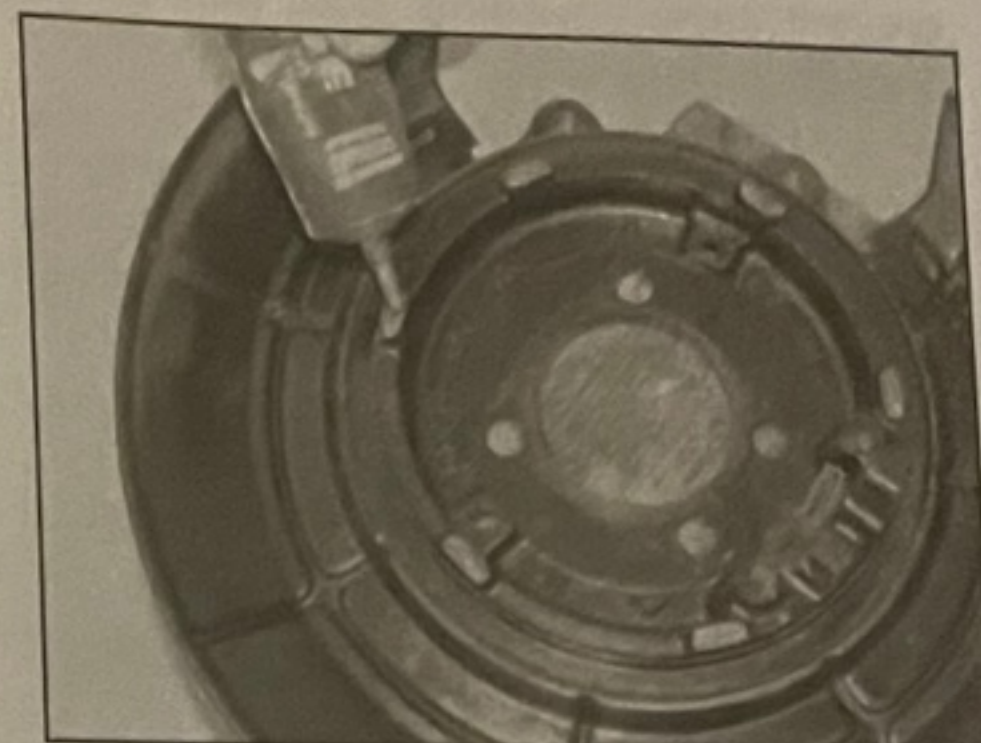
10.12b ... and remove the expander



10.13 Unhook the lower return spring



10.14 Dismantling the expander



10.17 Apply a little copper grease to the shoe contact points

unscrew the nuts, as they can be very tight. Tape over or plug the outlets of the brake lines and master cylinder.

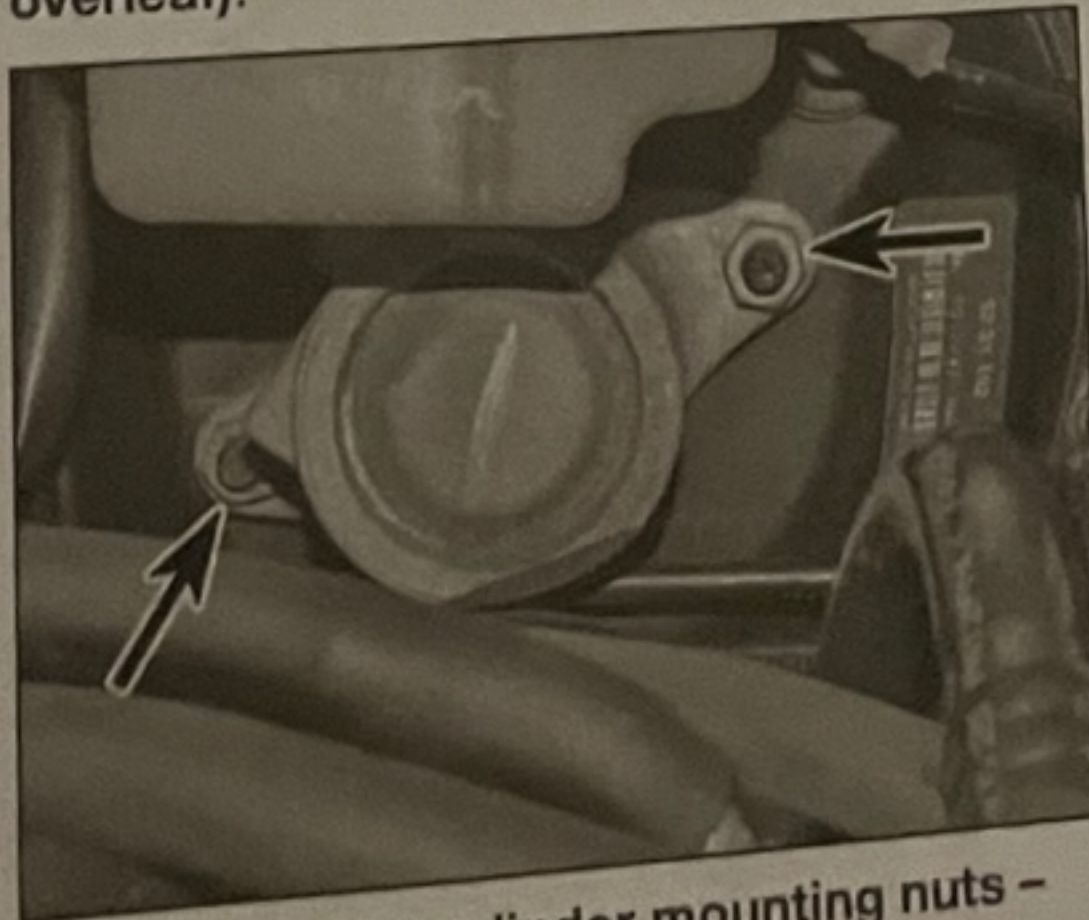
9 Unscrew the mounting nuts and withdraw the master cylinder from the front of the vacuum servo (see illustration). Recover the seal. Wrap the master cylinder in cloth rags and remove it from the engine compartment. Take care not to spill fluid on the vehicle paintwork.

### Overhaul

10 Before dismantling the master cylinder check on the availability and cost of parts, as it may be more economical to renew the complete unit.

11 Clean all dirt and debris from the exterior of the master cylinder.

12 Prise out the reservoir rubber seals from the top of the master cylinder (see illustration overleaf).



11.9 Master cylinder mounting nuts – arrowed

13 Remove the cover and the lockpin from the fluid aperture to the secondary piston.

14 Using circlip pliers, extract the circlip from the mouth of the master cylinder while slightly depressing the piston against the spring tension.

15 Remove the primary and secondary pistons, together with their springs, from the master cylinder bore, noting their order of removal. If the pistons are tight, tap the cylinder on the work bench or on a block of wood to release them.

16 Thoroughly clean the master cylinder components with methylated spirit or clean brake fluid, and examine them for wear and damage. In particular, check the bore surfaces and rubber seals. The bore surface must not be pitted or scored, and the rubber seals must not be perished or worn. Clean the fluid entry ports of any rust or sediment.

17 If the cylinder bore is in good condition but the rubber seals are worn excessively, obtain new seals or complete new pistons and seals.

18 Lubricate the seals and bore surface with clean brake fluid. Insert the secondary piston assembly with the slot in line with the top of the cylinder, and then insert the lockpin and cover to hold the piston in place. Make sure that the seal lip is not damaged as it enters the cylinder.

19 Insert the primary piston assembly; again making sure that the seal lip is not damaged as it enters the cylinder.

20 Depress the primary piston, then fit the circlip in the groove in the cylinder mouth. Release the piston.

21 Dip the rubber seals in clean fluid and

locate them in the apertures on the top of the master cylinder.

### Refitting

- 22 Ensure the mating surfaces are clean and dry then fit the new seal to the rear of the master cylinder.
- 23 Fit the master cylinder to the studs on the vacuum servo unit, ensuring that the servo unit pushrod enters the master cylinder piston centrally. Fit the retaining nuts and tighten them securely.
- 24 Remove the tape or plugs, and reconnect the brake lines to the master cylinder. Tighten the union nuts initially with the fingers to prevent cross-threading, then fully tighten them with a spanner.
- 25 Locate the fluid reservoir stubs in the rubber seals, and press firmly until it is fully entered.
- 26 On manual transmission models, reconnect the clutch hydraulic hose to the brake fluid reservoir.
- 27 Fill the fluid reservoir with fresh brake fluid up to the MAX level mark.
- 28 Reconnect the wiring to the brake fluid warning switch in the reservoir filler cap.

29 On left-hand drive models, reconnect the wiring to the anti-theft alarm switch. Refit the bracket, main fusebox and holder.

30 Bleed the hydraulic system as described in Section 2. Thoroughly check the operation of the braking system before using the vehicle on the road.

### 12 Vacuum servo unit non-return valve – removal, testing and refitting

#### Removal

- 1 The non-return valve is located in the hose leading from the vacuum servo unit to the intake manifold. It cannot be obtained separately from the hose.
- 2 Carefully ease the hose adapter from the rubber grommet on the front of the servo unit.
- 3 Unscrew the union nut and disconnect the hose from the intake manifold.
- 4 Release the hose from the support and remove from the engine compartment.

### Testing

- 5 Examine the check valve and hose for signs of damage, and renew if necessary. The valve may be tested by blowing through the hose in both directions. Air should flow through the valve in one direction only – when blown through from the servo unit end. Renew the valve and hose complete if necessary.
- 6 Examine the sealing grommet in the vacuum servo unit for signs of damage or deterioration and renew as necessary.

### Refitting

- 7 Refitting is a reversal of removal, but tighten the union nut securely. On completion, start the engine and check the function of the brakes; also check that there are no air leaks.

### 13 Vacuum servo unit – testing, removal and refitting

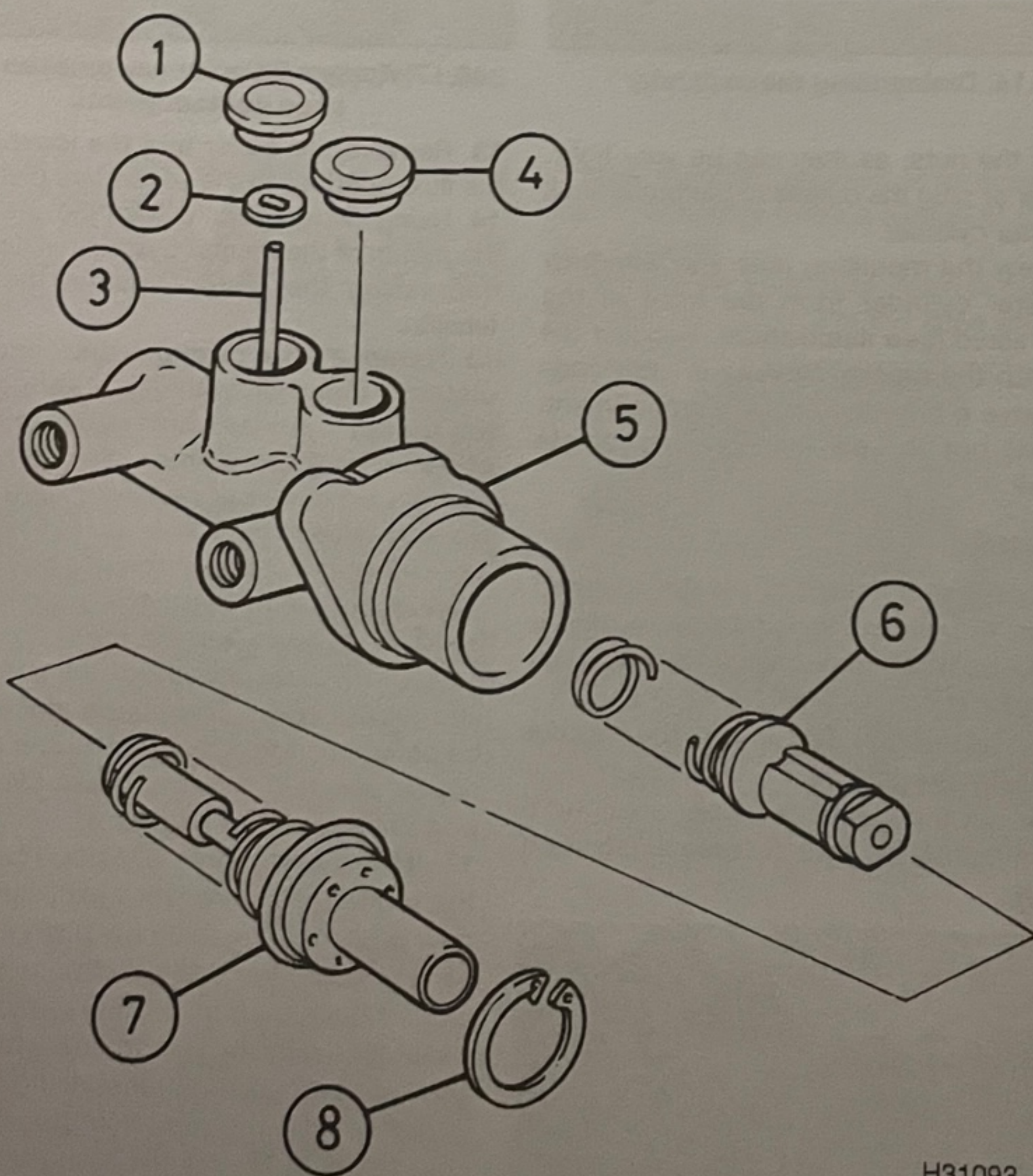
#### Testing

- 1 To test the operation of the servo unit, with the engine off, depress the footbrake several times to dissipate the vacuum. Now start the engine, keeping the pedal firmly depressed. As the engine starts, there should be a noticeable 'give' in the brake pedal as the vacuum builds-up. Allow the engine to run for at least two minutes, and then switch it off. The brake pedal should now feel normal, but further applications should result in the pedal feeling firmer, the pedal stroke decreasing with each application.
- 2 If the servo does not operate as described, first inspect the servo unit check valve as described in Section 12.
- 3 If the servo unit still fails to operate satisfactorily, the fault lies within the unit itself. Repairs to the unit are not possible; if faulty, the servo unit must be renewed.

### Right-hand drive models

#### Removal

- 4 Remove the master cylinder as described in Section 11.
- 5 Remove both windscreen wiper arms as described in Chapter 12. Remove the plastic cover from the engine compartment rear bulkhead area for access to the wiper linkage.
- 6 Ease the vacuum hose adapter from the rubber grommet in the front of the vacuum servo unit.
- 7 To provide more working room, remove the crankcase breather valve and hoses.
- 8 Working inside the vehicle, remove the facia lower trim panel from beneath the steering column.
- 9 Unhook the brake pedal return spring, then extract the spring clip and pull out the pivot pin securing the pushrod clevis to the brake pedal (see illustrations).
- 10 On the bulkhead next to the wiper linkage,



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11.12 Exploded view of the brake master cylinder

- |                               |                             |
|-------------------------------|-----------------------------|
| 1 Fluid reservoir rubber seal | 5 Master cylinder body      |
| 2 Cover                       | 6 Secondary piston assembly |
| 3 Lockpin                     | 7 Primary piston assembly   |
| 4 Fluid reservoir rubber seal | 8 Circlip                   |

unscrew the servo bracket mounting bolt and nuts. Withdraw the servo unit and upper mounting bracket from the bulkhead, and remove from the engine compartment.

11 Undo the nuts and remove the bracket from the rear of the servo unit.

### Refitting

12 Fit the bracket to the rear of the servo unit, and tighten the nuts.

13 Locate the servo unit and mounting bracket on the bulkhead making sure that the upper bracket locates correctly on the lower bracket. Refit the mounting bolt and nuts, and tighten securely.

14 Inside the vehicle, connect the pushrod clevis on the pedal, then insert the pivot pin and secure with the spring clip. Reconnect the brake pedal return spring (see illustration).

15 Refit the facia lower trim panel beneath the steering column.

16 Refit the crankcase breather valve and hoses.

17 Press the vacuum hose adapter in the rubber grommet in the front of the vacuum servo unit.

18 Refit the plastic cover to the rear bulkhead area, then refit the windscreen wiper arms (reference to Chapter 12).

19 Bleed the master cylinder with reference to Section 11, and bleed the brake hydraulic system as described in Section 2.

### Hand drive models

20 Remove the master cylinder as described in Section 1.

21 Clean the area around the master cylinder. Disconnect the unit rear brake line, note its position, then unscrew the union nut and remove the line from the ABS unit. Tape over or plug the aperture and line ends to prevent entry of dust and dirt.

22 Ease the vacuum hose adapter from the rubber grommet in the front of the vacuum servo unit.

23 Unscrew the mounting nuts securing the servo unit to the bracket, then remove the clip from the pushrod and withdraw the servo unit from the vehicle.

### Refitting

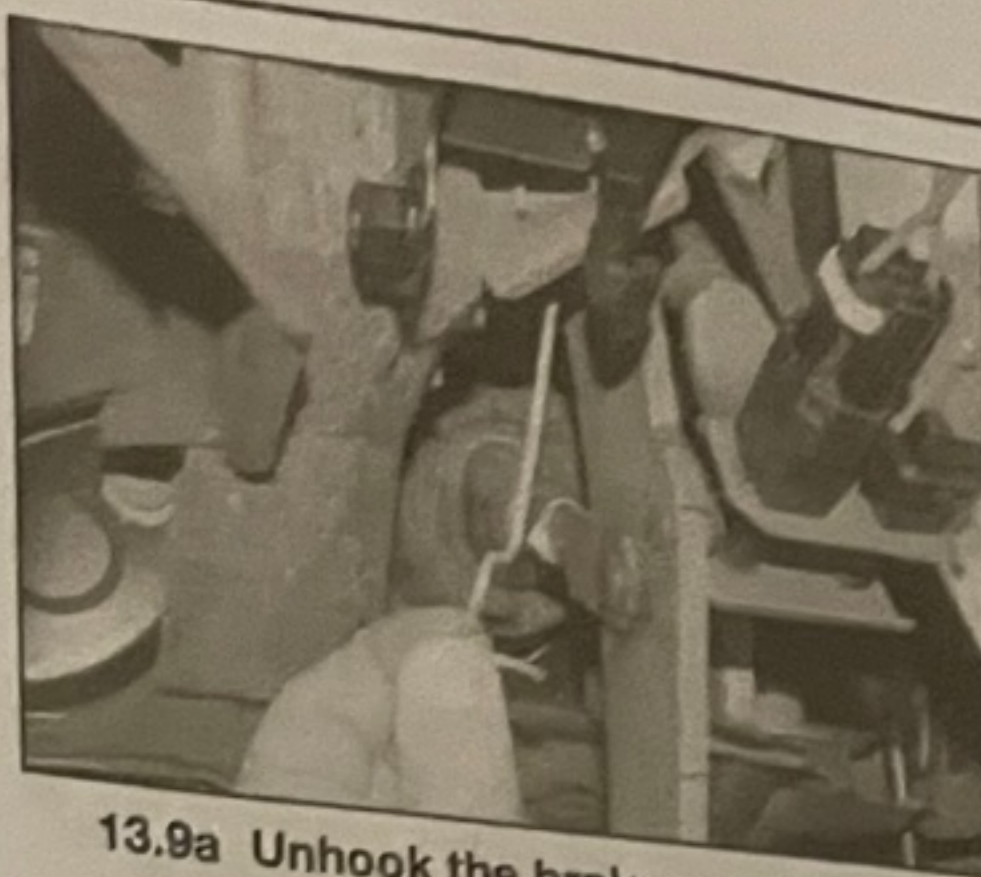
24 Locate the servo unit on the bracket and engage the brake pedal pushrod with the servo pushrod. Refit and tighten the mounting nuts.

25 Refit the clip to the pushrod, and then depress the brake pedal to lock the clip.

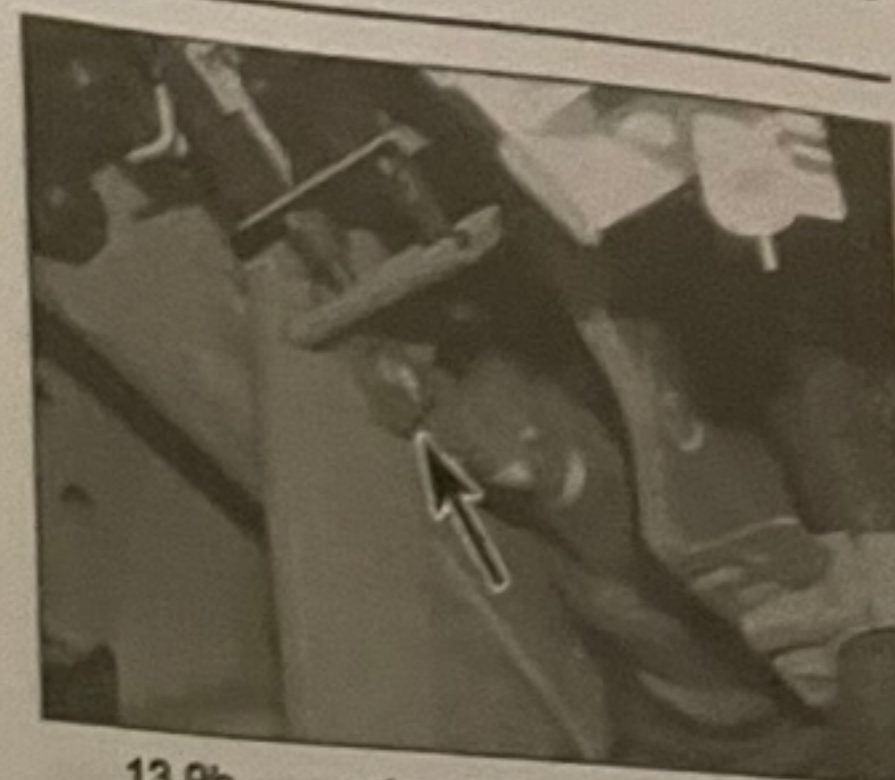
26 Press the vacuum hose adapter into the rubber grommet on the front of the servo unit.

27 Refit the rear brake line to the ABS unit in its previously-noted position, and then tighten the union nut.

28 Refit the brake master cylinder with reference to Section 11, and bleed the brake hydraulic system as described in Section 2.



13.9a Unhook the brake pedal return spring ...



13.9b ... extract the spring clip ...



13.9c ... and remove the pushrod pivot pin



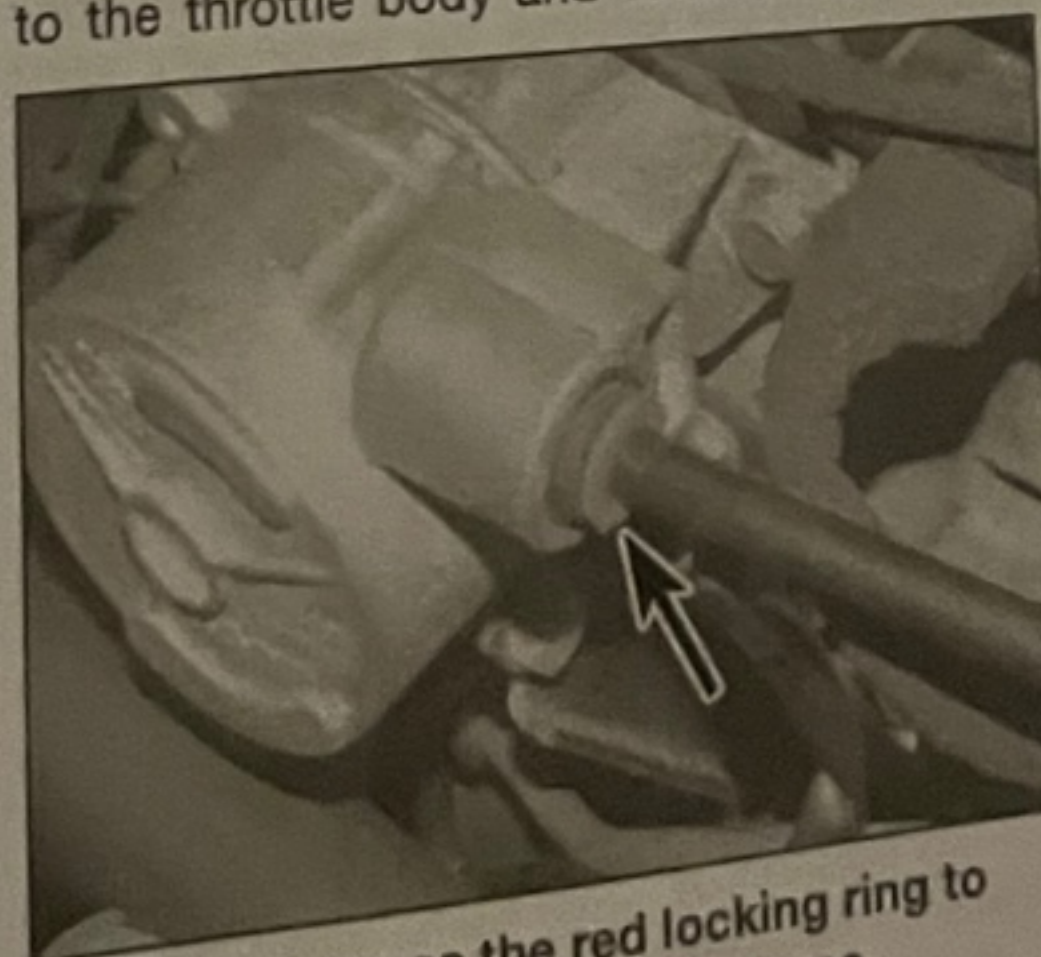
13.14 Fitted position of the brake pedal return spring

### 14 Vacuum pump - removal and refitting

#### Mechanical vacuum pump

##### Removal

- 1 Unclip and remove the engine top cover.
- 2 Disconnect the vacuum hose from the pressure sensor located on the side of the turbocharger.
- 3 Undo the screw, and detach the bypass pipe from the turbocharger inlet pipe.
- 4 Disconnect the bypass valve from the charge air pipe.
- 5 Disconnect the wiring from the temperature sensor on the charge air pipe.
- 6 Loosen the clips securing the charge air pipe to the throttle body and turbocharger, then



14.7 Depress the red locking ring to release the vacuum hose

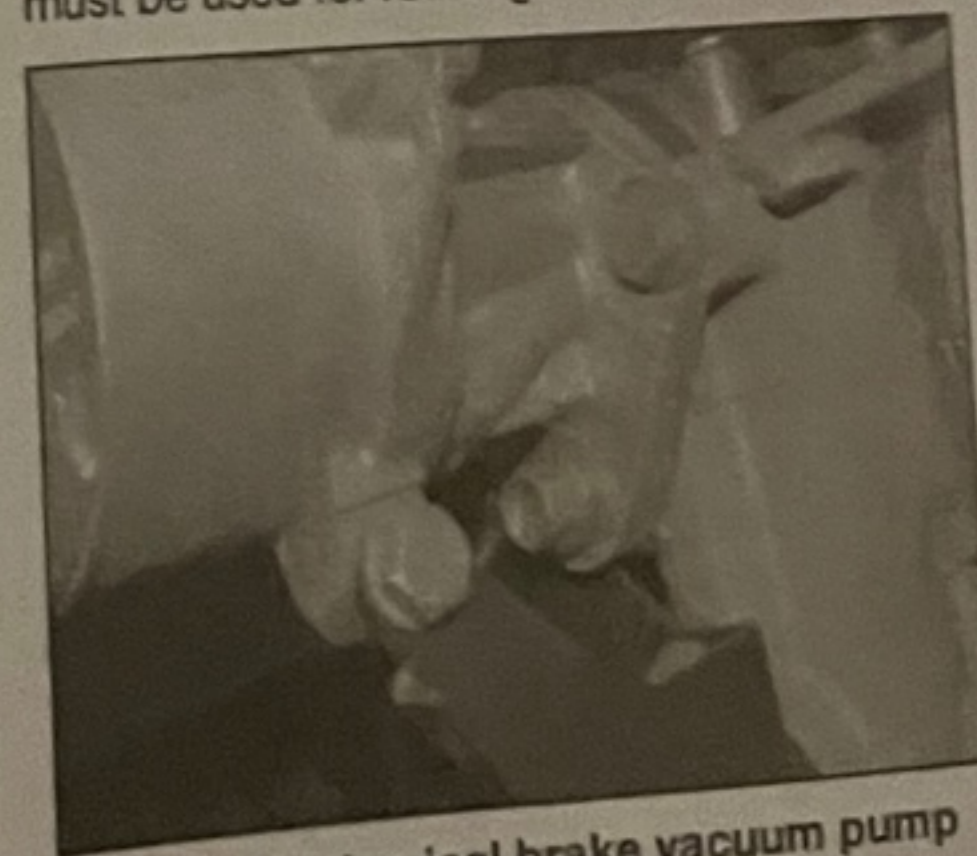
unscrew the mounting bolt from the bracket on the cylinder head, and withdraw the pipe from the engine compartment. Temporarily tape over or cover the turbocharger and throttle body apertures.

7 Disconnect the vacuum hose from the vacuum pump on the left-hand end of the cylinder head. To do this, press in the red locking ring while pulling the hose out (see illustration).

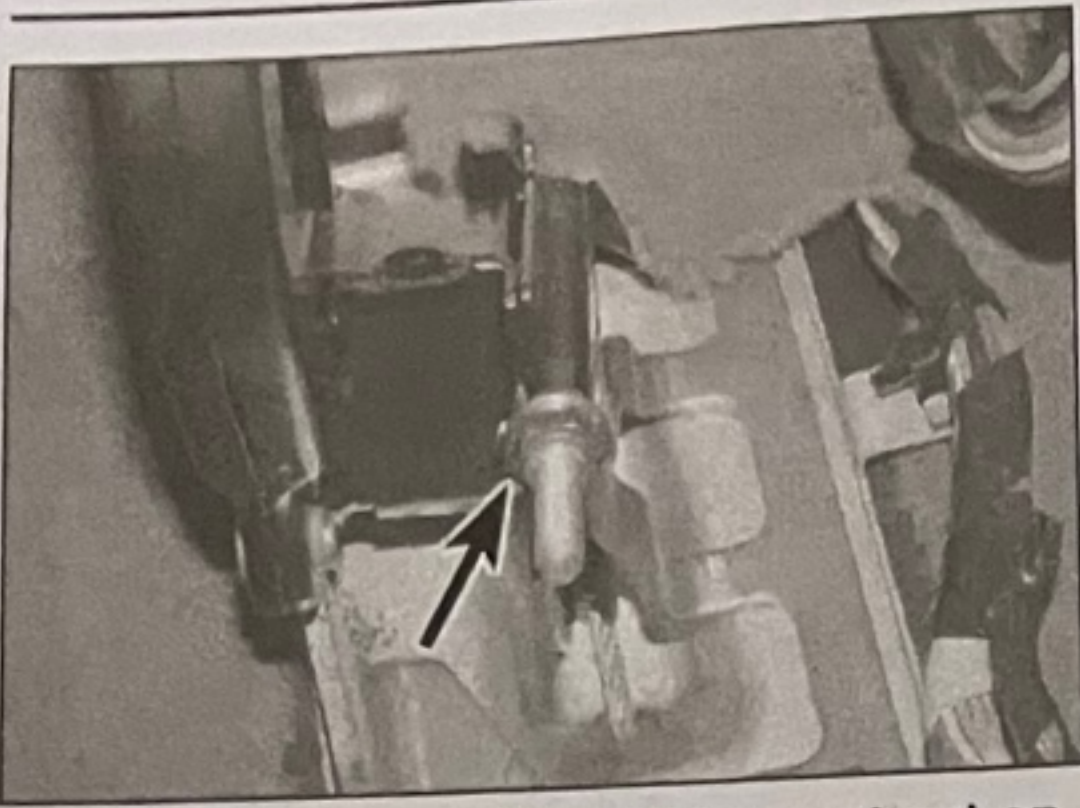
8 Disconnect the wiring from the ignition discharge module on the cylinder head.

9 Place some cloth rags below the vacuum pump lubrication banjo, then unscrew and remove the banjo bolt. Recover the outer seal.

10 Unscrew the pump mounting bolts, including the bracket bolt, and then withdraw it from the cylinder head (see illustration). Recover the inner lubrication seal and the main pump seal. Discard all seals as new ones must be used for refitting.



14.10 Mechanical brake vacuum pump mounting bolts



15.7 Handbrake cable adjustment nut on the handbrake lever

### Refitting

- 11 Clean the contact surfaces of the pump and cylinder head. Position the new inner and main seals on the pump and retain with a little grease.
- 12 Position the pump drive dog so that it will engage with the slot in the end of the camshaft when refitted. Locate the pump on the cylinder head, and refit the mounting bolts, hand-tight at this stage. Wipe away any spilt oil from the cylinder head.
- 13 Refit the banjo bolt, together with a new O-ring seal, and tighten it to the specified torque.
- 14 Insert the mounting bolts, and first tighten the two in the cylinder head to the specified torque, then tighten the remaining bolt in the bracket to the specified torque.
- 15 Reconnect the wiring to the ignition discharge module, then reconnect the vacuum hose to the pump.
- 16 Refit the charge air pipe to the throttle body and turbocharger, and tighten the mounting bolt. If necessary, apply a little petroleum jelly to the throttle body O-ring to facilitate refitting it. Tighten the pipe securing clips.
- 17 Reconnect the wiring to the temperature sensor on the charge air pipe.
- 18 Reconnect the bypass valve to the charge air pipe, then reconnect the bypass pipe to the turbocharger inlet pipe and tighten the screw.
- 19 Reconnect the vacuum hose to the pressure sensor.
- 20 Refit the engine top cover.

### Electrical vacuum pump

#### Removal

- 21 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *jacking and vehicle support*). Remove the left-hand front wheel.
- 22 Remove the wheel arch liner, and where applicable, the engine undershield.
- 23 Disconnect the vacuum hose from the pump.
- 24 Disconnect the wiring from pump.
- 25 Unscrew the mounting nuts and bolts and withdraw the vacuum pump from the inner wing panel.

#### Refitting

- 26 Refitting is the reversal of the removal procedure.

### 15 Handbrake – adjustment

- 1 First chock the front wheels, then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove both rear wheels. Fully release the handbrake lever.
- 2 Check that the cables are not pulling the expander levers on the rear backplates. If they are, loosen the cable adjusting nut as necessary with reference to paragraph 6.
- 3 Working on each side at a time, adjust the shoe positions as follows. Turn the rear disc/drum until the access hole is positioned over the upper adjuster serrations. Using a screwdriver through the hole, turn the adjuster serrations until the disc/drum is locked. Now back off the serrations until the disc/drum is just free to turn. Repeat the adjustment on the remaining disc/drum.
- 4 Refit the rear wheels and tighten the bolts.
- 5 Set the handbrake lever on the 1st notch.
- 6 Open the lid of the centre console, and remove the mat for access to the handbrake cable, adjusting nut.
- 7 Tighten the cable adjusting nut until slight resistance is felt when turning the rear wheels (see illustration). Fully release the handbrake lever and check that the rear wheels turn freely, then set the lever on the 2nd or 3rd notch and check that the rear wheels are locked firmly. If necessary, make a final adjustment of the adjusting nut.
- 8 If only one rear wheel locks, one of the brake cables may be seized, and this must be attended to before finally adjusting the handbrake.
- 9 On completion, lower the vehicle to the ground.

### 16 Handbrake cables – removal and refitting

#### Removal

- 1 One primary and a double secondary cable are fitted. An equaliser is permanently attached to the front of the secondary inner cables, and the primary cable is attached to the centre of the equaliser. The secondary cables are supplied as one assembly. First, chock the front wheels then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*).
- 2 Refer to Chapter 4A or 4B and separate the exhaust front and rear sections, then disconnect the rubber mounting from the left-hand side of the exhaust and lower the exhaust.
- 3 Unscrew the rear nuts from the heat shield on the underbody, then bend down the heat shield for access to the handbrake equaliser.
- 4 At the rear brake backplates, disconnect

the handbrake cable return springs from the expander levers.

- 5 Unhook each cable end fitting from the expander levers.
- 6 Turn the primary cable end fitting through 90° and disconnect it from the equaliser.
- 7 Release the front ends of each cable from the supports.
- 8 Support the fuel tank with a trolley jack and large block of wood, then unscrew the fuel tank front support strap bolts. Pull down the straps to release the handbrake secondary cables.
- 9 Release the cables from the supports and withdraw from under the vehicle.

#### Refitting

- 10 Refitting is a reversal of removal, but adjust the handbrake as described in Section 15.

### 17 Handbrake lever – removal and refitting

#### Removal

- 1 Chock the front wheels, then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove both rear wheels.
- 2 Working at each rear wheel brake, disconnect the left- and right-hand return springs from the holes in the backplates then unhook the cable fittings from the handbrake shoe operating levers.
- 3 Remove the centre console as described in Chapter 11, and lift up the gaiter.
- 4 Disconnect the wiring from the handbrake warning light switch, and release the wiring from the cable-ties.
- 5 Unscrew the nuts securing the handbrake assembly to the floor.
- 6 Raise the handbrake assembly directly from the floor, and carefully ease the equaliser up through the floor aperture. Tie a length of string to the equaliser so that it can be recovered for refitting.
- 7 Turn the primary cable end fitting through 90° and disconnect it from the equaliser. Withdraw the handbrake lever assembly from inside the vehicle.

#### Refitting

- 8 Refitting is a reversal of removal, but finally adjust the handbrake as described in Section 15. Tighten the handbrake lever mounting bolts securely.

### 18 Handbrake 'on' warning light switch – removal, testing and refitting

#### Removal

- 1 The handbrake 'on' warning light switch is mounted on the front of the handbrake lever mounting bracket (see illustration). Refer to

- Chapter 11 and remove the centre console.  
 2 Disconnect the wiring from the switch.  
 3 Undo the mounting screw and remove the switch.

### Testing

- 4 Connect a multimeter or battery test probe to the wiring contact and switch body.  
 5 With the switch plunger at rest, there should be continuity and the multimeter should read no resistance, or the test light should light. With the plunger depressed, there should be infinity resistance or the test light should be extinguished.  
 6 Failure to operate correctly may indicate corroded contacts or ultimately a faulty switch. Check that there is a 12 volt supply to the wiring with the ignition switched on. Renew the switch if necessary.

### Refitting

- 7 Refitting is a reversal of removal.

## 19 Brake pedal – removal and refitting

### Removal

- 1 Move the driver's seat fully rearwards.

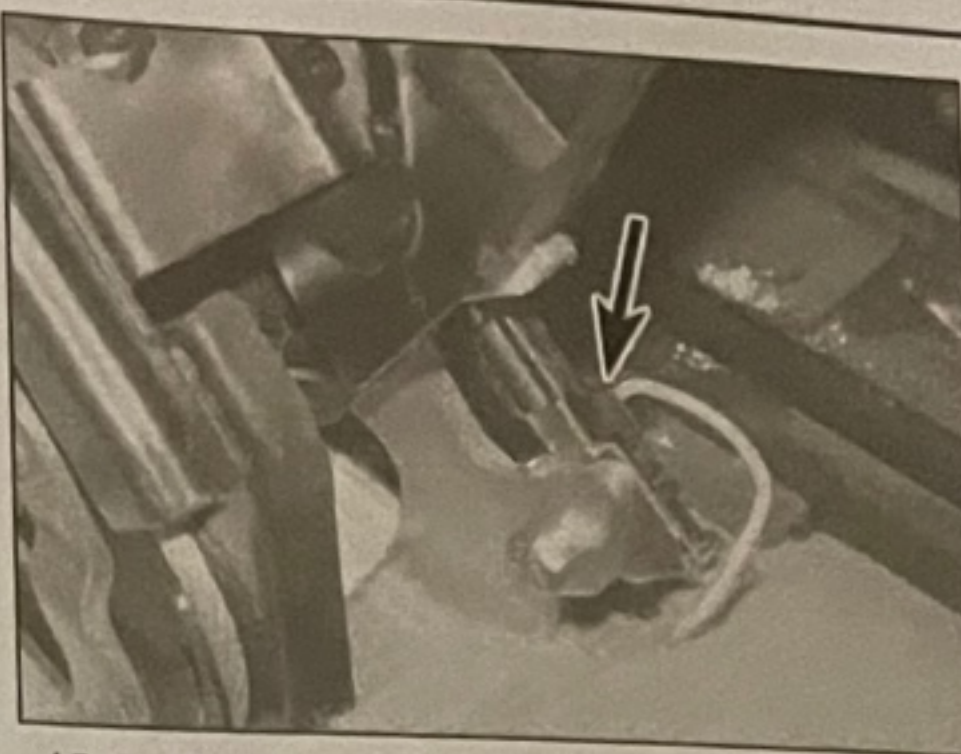
#### Right-hand drive models

- 2 Remove the brake vacuum servo unit as described in Section 13.  
 3 With the vacuum servo removed, unscrew the two bolts securing the brake pedal bracket to the bulkhead.  
 4 Inside the vehicle, remove the facia trim panel, as described in Chapter 11.  
 5 Refer to Chapter 10 and detach the steering column from the steering gear pinion, taking care not to separate the splined/telescopic section. The front wheels must be pointing straight-ahead and the steering wheel should be taped in position as a precaution.  
 6 Disconnect the wiring from the pedal switches.

- 7 Unbolt the steering column assembly from the bulkhead and pedal bracket, and move it rearwards as far as possible without straining the wiring.  
 8 Lift the pedal bracket assembly from the bulkhead and remove from the vehicle. Recover the foam packing.

#### Left-hand drive models

- 9 Remove the battery from the front left-hand corner of the engine compartment (Chapter 5A).  
 10 Remove the ABS/TCS/ESP hydraulic unit as described in Section 22.  
 11 Unbolt and remove the main fusebox from the rear left-hand corner of the engine compartment after disconnecting the wiring.  
 12 Disconnect the engine wiring harness and remove the retaining box from the bulkhead partition behind the engine.  
 13 Unscrew the four nuts securing the brake pedal bracket to the bulkhead.



18.1 Handbrake 'on' warning light switch

- 14 Refer to Chapter 11 and remove the lower facia trim from the driver's side.  
 15 Remove the stepping motor located beneath the brake pedal.  
 16 Refer to Chapter 10 and detach the steering column from the steering gear pinion, taking care not to separate the splined/telescopic section. The front wheels must be pointing straight-ahead and the steering wheel should be taped in position as a precaution.  
 17 Unscrew the two bolts securing the pedal assembly to the steering column assembly.  
 18 Disconnect the wiring from the pedal switches.  
 19 Unhook the return spring from the pedal, then remove the circlip and pull out the clevis pin connecting the pedal to the pushrod.  
 20 Lift the pedal bracket assembly from the bulkhead and remove from the vehicle. Recover the foam packing.

### Refitting

- 21 Refitting is a reversal of removal, but tighten all nuts and bolts to their correct specified torque where given.

## 20 Stop-light switch – removal, testing and refitting

### Removal

- 1 The stop-light switch is mounted on top of the pedal bracket. An internal spring tensions the switch plunger so that the contacts are normally closed, however, when the brake pedal



20.3 Remove the stop-light switch from the bracket ...

is released, the pedal return spring tension is greater than the switch spring, so the contacts are separated when the pedal is in its released position. When the brake pedal is depressed, the switch supplies a current of 12 volts to the central electronic control module, which then supplies the stop-lights with power. The control unit checks the three stop-light bulbs and if necessary displays a warning on the instrument panel. Where a trailer is being towed, current to the trailer stop-lights is supplied direct from the stop-light switch.

- 2 To remove the switch, first remove the lower trim panel from the facia with reference to Chapter 11.  
 3 Twist the switch anti-clockwise 90° and withdraw it from the mounting bracket (see illustration).  
 4 Disconnect the wiring from the switch (see illustration).

### Testing

- 5 The switch is a single-pole device, and has normally-closed contacts. The operation of the switch can be tested using either a multimeter (switched to the ohmmeter function), or a continuity tester made up of a flashlight bulb, dry cell battery and two pieces of wire. Connect the meter/tester to the switch connector terminals with the switch in its rest position, and check that the meter reads zero resistance or the tester lights up.  
 6 Press the switch plunger down, and check that the meter reads infinity resistance (open-circuit) or the tester is extinguished.  
 7 If the switch does not behave as described, or is intermittent in its operation, then a new switch must be fitted; the unit is not serviceable.

### Refitting

- 8 Refit the brake stop-light switch by reversing the removal procedure.

## 21 Anti-lock Braking System (ABS) – general information and fault finding

### General information

- 1 The Anti-lock Braking System (ABS) is managed by an electronic control module



20.4 ... and disconnect the wiring

(ECM), which has the capacity to monitor the status and condition of all the components in the system, including itself. If the ECM detects a fault it responds by shutting down the ABS and illuminating the dashboard-mounted ABS warning light. Under these circumstances, conventional non-ABS braking is maintained. Note also that the warning light will be illuminated if the power supply to the ABS ECM is disconnected (eg, if the supply fuse blows). On models manufactured from late 1998, when the ABS warning light is illuminated the standard brake warning light and central warning light are also illuminated.

2 If the ABS warning lights indicate a fault, it is very difficult to diagnose problems without the equipment and expertise to electronically 'interrogate' the ECM for fault codes. Therefore, this Section is limited firstly to a list of the basic checks that should be carried out, to establish the integrity of the system.

3 If the cause of the fault cannot be immediately identified using the checklist described, the *only* course of action open is to take the vehicle to a Saab dealer for examination. Dedicated test equipment is needed to interrogate the ABS ECM to determine the nature of the fault.

### Basic fault finding checks

#### Brake fluid level

4 Check the brake fluid level (see *Weekly checks*). If the level is low, check the complete braking system for signs of leaks. Refer to Chapter 1A and 1B and carry out a check of the brake hoses and pipes throughout the vehicle. If no leaks are apparent, remove each road wheel in turn, and check for leaks at the brake caliper pistons.

#### Fuses and relays

5 The fuse for the ABS is located beneath a cover on the end of the instrument panel. Remove the cover and pull out the fuse. Visually check the fuse filament; if it is difficult to see whether or not it has blown, use a multimeter to check the continuity of the fuse. If any of the fuses are blown, determine the cause before fitting a new one – if necessary, have the vehicle inspected by a Saab dealer.

6 The ABS system relay is located beneath a cover on the left-hand side of the engine compartment. In general, relays are difficult to test conclusively without any electrical specification. However, the metal contacts inside a relay can usually be felt (and often heard) to open or close as it operates – if the relay in question does not behave in this way when the ignition switch is turned on, it may be faulty. It should be noted that this is not a conclusive test, and substitution with a known good relay of the same type is the only way to verify the component operation. If any of the relays is suspected of being faulty, it can be renewed by pulling it out of its socket – noting its orientation – and pushing in a new unit.

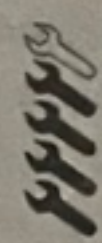
### Electrical connections and earthing points

7 The engine bay is a hostile environment for electrical connections, and even the best seals can sometimes be penetrated. Water, chemicals and air will induce corrosion on the connector's contacts and prevent good continuity, sometimes intermittently. Disconnect the battery negative cable, and then check the security and condition of all connectors at the ABS hydraulic unit, situated on the left-hand side of the engine bay.

8 Unplug each connector, and examine the contacts inside. Clean any contacts that are found to be dirty or corroded. Avoid scraping the contacts clean with a blade, as this will accelerate corrosion later. Use a piece of lint-free cloth in conjunction with a proprietary cleaning solvent to produce a clean, shiny contact surface.

9 In addition, check the security and condition of the system electrical earthing point on the side of the hydraulic unit.

### 22 Anti-lock Braking System (ABS) components – removal and refitting



**Note:** If the ABS system is faulty, have it checked by a Saab dealer before removing any component.

#### Front wheel sensor

##### Removal

1 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *Jacking and vehicle support*). Remove the relevant roadwheel.

2 Disconnect the wiring plug in the engine compartment. For the front left-hand sensor, it is located next to the battery, and it is recommended that the battery and battery tray are removed (see Chapter 5A); also, if required, unclip the coolant expansion tank and position it to one side. For the right-hand sensor it is located behind the power steering fluid reservoir, and it will be necessary to release the locking tab on the wiring connector; if required, remove the power steering fluid reservoir and position it to one side.

3 Clean the area around the wheel sensor on the front hub carrier, then unscrew the mounting bolt and remove the sensor.

4 Prise the rubber grommet from the inner wing panel, and pull out the wiring.

5 Release the wiring from the retaining clips on the inner wing panel and brake hose.

##### Refitting

6 Refitting is a reversal of removal, but tighten the mounting bolt securely.

#### Rear wheel sensor

##### Removal

7 The rear wheel sensors are integral with the

rear wheel hubs, so this section essentially describes the removal of the hub. First, chock the front wheels then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove the relevant roadwheel.

8 Remove the rear brake disc as described in Section 9.

9 Where fitted, remove the protective cover from the bottom of the rear suspension trailing arm, and unbolt the handbrake cable support bracket.

10 Disconnect the wiring from the wheel sensor on the rear of the hub.

11 Unscrew the mounting nuts and withdraw the hub assembly from the rear axle. Leave the backplate, handbrake shoes and the spacer(s) hanging on the cable. **Note:** Discard the hub nuts, as new ones must be used on refitting. Recover the shims where fitted.

##### Refitting

12 Clean the mounting faces of the rear axle backplate, spacer(s) and hub then mount the components in the correct order. Fit and progressively tighten the new nuts to the torque wrench setting and angle given in the Specifications.

13 Reconnect the wiring to the wheel sensor.

14 If removed, refit the handbrake cable support bracket and the protective cover to the bottom of the rear suspension trailing-arm.

15 Refit the rear brake disc (see Section 9) and adjust the handbrake shoes (see Section 15).

16 Refit the roadwheel, then lower the vehicle to the ground.

17 Depress the footbrake pedal firmly to set the rear brake pads in their normal position.

### ABS/ESP/TCS hydraulic unit

**Note:** The ABS electronic control module (ECM) is supplied as an integral part of the hydraulic unit and cannot be removed separately. After fitting a new unit, the ECM must be calibrated by a Saab dealer using the Saab Tech2 hand-held diagnostic instrument. It is recommended that the ESP system be switched off until the calibration has been carried out.

##### Removal

18 Disconnect the battery negative lead.

19 Cut the plastic cable-ties holding the battery positive cable to the main fusebox, then unscrew the nuts and position the fusebox to one side without disconnecting the wiring. If necessary, suspend the fusebox using a piece of string.

20 Minimise fluid loss by first removing the master cylinder reservoir cap, then tightening it down onto a piece of polythene to obtain an airtight seal. Also, place cloth rags beneath the ABS unit to catch spilt fluid.

21 Disconnect the wiring plug from the electronic control module, cut the plastic cable-ties holding the cable and position the wiring connector plug to one side (see illustration).

22 Identify each location on the union nuts at the front or plug the prevent entry of the ABS hydraulic compartment not to spill the paintwork.

### Refitting

24 Refitting is the reverse of removal. Tighten the hydraulic brake torque, and fit as described.

### 23 Electronic (ESP) control module removal

### Yaw rate sensor removal

1 Remove the sensor from the Chapter 11. 2 On manual transmission models, refer to Chapter 7 with reference to the forward face, then 4 Release the wiring.

### Refitting

5 Refitting is the reverse of removal. Ensure that the vehicle.

### Steering sensor

**Note:** After fitting the sensor, the Saab dealer must calibrate the ESP system.



in the excess of the sensor.

### Removal

6 Remove the sensor from the vehicle. 7 The sensor will only be removed if both the color and the sensor are damaged. 8 Caution: Do not touch the sensor.

22 Identify each hydraulic brake pipe for its location on the hydraulic unit, then unscrew the union nuts and disconnect the pipes. Tape over or plug the apertures and pipe ends to prevent entry of dust and dirt.

23 Unscrew the mounting nuts and remove the ABS hydraulic unit from the engine compartment (see illustration). Take care not to spill hydraulic fluid on the vehicle paintwork.

### Refitting

24 Refitting is a reversal of removal, but tighten the unit mounting nuts and the hydraulic brake pipe union nuts to the specified torque, and finally bleed the hydraulic system as described in Section 2.

## 23 Electronic Stability Program (ESP) components – removal and refitting

### Yaw rate (gyro) sensor

#### Removal

1 Remove the centre console as described in Chapter 11.

2 On manual transmission models, remove the sensor housing with reference to Chapter 7B. On automatic transmission models, remove the selector lever housing with reference to Chapter 7B.

3 Note the position of the sensor, and the direction of the arrow on the upper mounting screws.

4 Remove the locking tab, then disconnect the sensor.

5 Refitting is a reversal of removal, but make sure the arrow points to the front of the vehicle.

### Steering wheel angle sensor

**Note:** After fitting a new steering wheel angle sensor, the sensor must be calibrated by a Saab dealer using the Saab Tech2 hand-held diagnostic instrument. It is recommended that the ESP system be switched off until the calibration has been carried out.

**Warning:** Never fit a damaged steering wheel angle sensor, as the vehicle may react dangerously in the event of an emergency. Do not use excessive force when removing or refitting the sensor.

#### Removal

6 Remove the steering column assembly as described in Chapter 10.

7 The inner steering column consists of two splined sections, which are collapsible and will only fit together in one position. First, mark both inner column sections and the outer column housing in relation to each other.

8 Carefully pull the lower inner column, together with the bearing bracket and angle sensor, from the outer column.



22.21 Disconnect the wiring connector (arrowed) from the control unit

9 Undo the locking screw securing the bearing bracket to the bearing carrier, then use a screwdriver to depress the plastic retaining catch on the opposite side, and withdraw the bracket over the lower inner column.

10 Using circlip pliers, expand the circlip and remove it from the lower inner column/intermediate shaft, followed by the spring washer (see illustration).

11 Remove the bearing carrier and the steering wheel angle sensor from the lower inner column/intermediate shaft.

#### Refitting

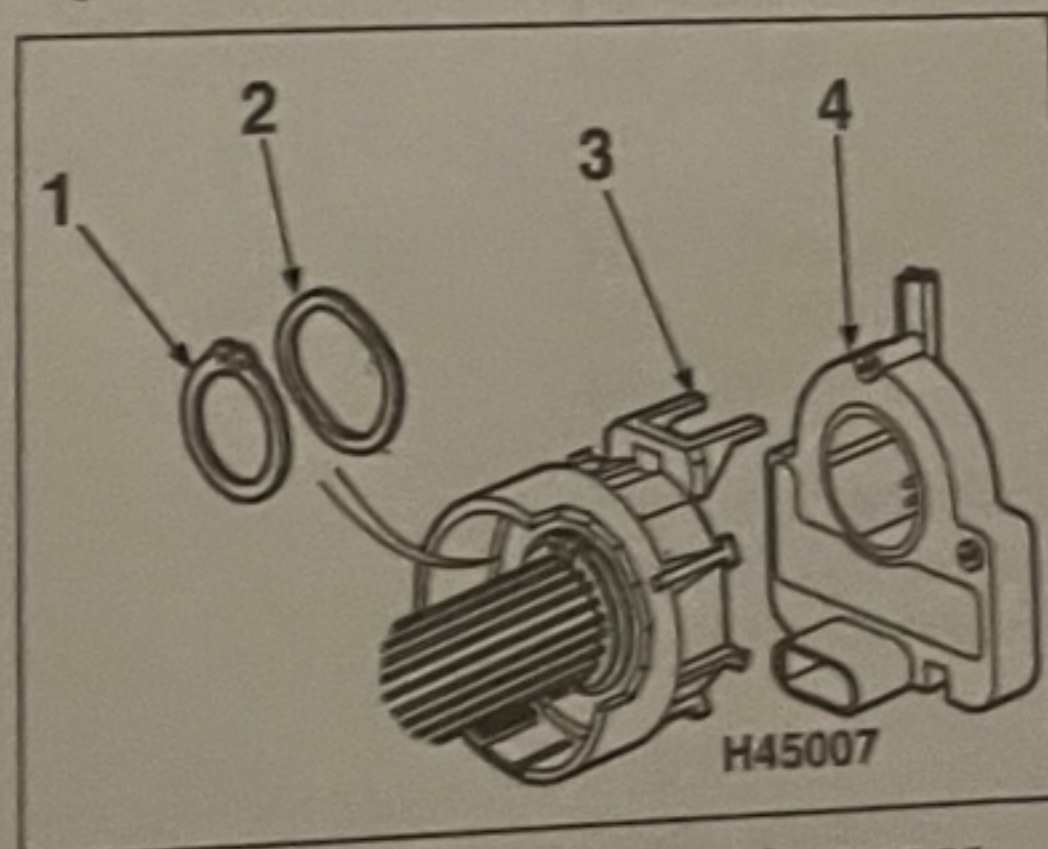
12 Locate the sensor on the lower inner column/intermediate shaft, and engage its groove with the raised tab (see illustration). If a new sensor is being fitted, complete the label and attach it to the sensor.

13 Locate the bearing carrier onto the shaft, engaging the arms with the sensor leg.

14 Refit the spring washer and the circlip, making sure that the circlip fully enters the groove.

15 Locate the bracket onto the bearing carrier, making sure that the plastic retaining catch engages correctly, then insert and tighten the locking screw.

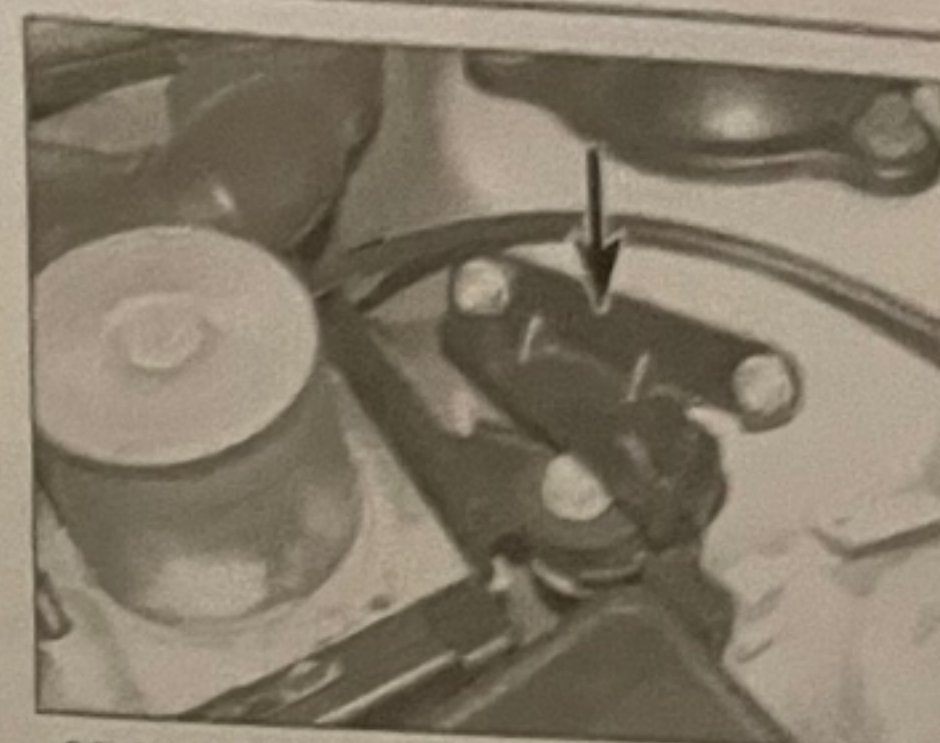
16 Align the marks made on both inner column sections with the marks made on the outer column housing, then engage the upper and lower inner columns with each other. Do not force the columns if they are not correctly aligned.



23.10 Steering wheel angle sensor components

- 1 Circlip
- 2 Spring washer

- 3 Bearing carrier
- 4 Steering wheel angle sensor



22.23 ABS hydraulic unit upper mounting bracket

17 Refit the steering column assembly with reference to Chapter 10.

18 Have the steering wheel angle sensor calibrated by a Saab dealer at the earliest opportunity.

### Brake pressure sensor

#### Removal

19 The brake pressure sensor is located on the rear of the hydraulic unit, at the left-hand rear corner of the engine compartment. Have ready a means of plugging the sensor hole to prevent loss of brake fluid.

20 Disconnect the wiring from the sensor.

21 Using a 24.0 mm spanner, unscrew the sensor from the hydraulic unit. Plug the opening immediately, taking care not to allow dust and dirt to enter the circuit.

#### Refitting

22 Refitting is a reversal of removal, but tighten the sensor securely. Finally, bleed the hydraulic circuit with reference to Section 2; if minimal fluid was lost, it is only necessary to bleed the front left- and rear right-hand brakes.

### ESP/TCS switch

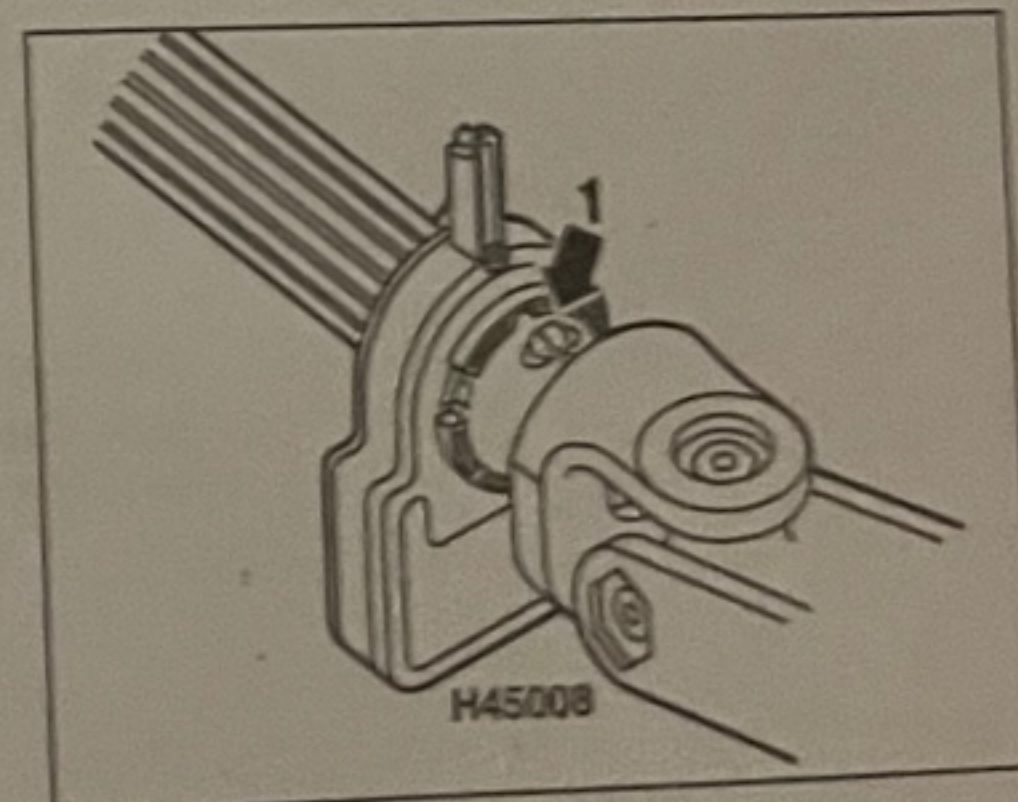
#### Removal

23 The ESP/TCS on/off switch is located on the instrument panel. To remove it, carefully ease it out using a flat-bladed screwdriver.

24 Disconnect the wiring.

#### Refitting

25 Refitting is a reversal of removal.



23.12 Steering wheel angle sensor location raised tab (1) on the intermediate shaft