# BRAKES

## CONTENTS

# BRAKES—ALPINE

## GENERAL

Girling type disc brakes are fitted to the front wheels and Girling drum brakes to the rear wheels. All four brakes are hydraulically operated pressure being generated in the master cylinder by application of the brake foot pedal. The handbrake operates the rear brakes by an independent mechanical linkage.

## MAINTENANCE

The brake linings should be examined for wear at regular intervals. The front brake friction pads must be renewed when the friction material has worn down to a minimum of $\frac{1}{16}$ in. (1·59 mm) in thickness. (See under "Brake Pads—to remove and refit").

### Brake adjustments

The front brakes are self adjusting; the rear brakes should be adjusted as follows:—

Chock up one of the front wheels to prevent the car from rolling, release the handbrake, and jack up one rear wheel.

Turn the adjuster situated at the rear of the backplate (arrowed in Fig. 1), in a clockwise direction until solid resistance is felt.

Slacken back the adjuster until the drum is able to rotate (usually two clicks). A slight drag may be felt from the trailing shoe but this should not be sufficient to prevent the wheel from being turned by hand.

Spin the wheel and apply the brakes hard to centralise the shoes in the drum and re-check adjustment.

Repeat for other rear wheel.

Normally adjustment of the rear brakes will automatically adjust the handbrake. When the handbrake is correctly adjusted there is four to six notches of handbrake movement before the wheels are locked. If with the rear brakes in correct adjustment, there is excessive handbrake free travel, the handbrake should be adjusted as follows:—

Chock up one of the front wheels, release the handbrake and jack up both rear wheels.

Lock the shoes by means of the adjusters (arrowed in Fig. 1).

Take up the slack in the linkage at the compensator situated beneath the rear axle, (see Fig. 1), by slackening off the locking nut, removing the jaw pin, and screwing in the jaw as necessary.

Re-adjust brakes as previously described.

A lubricator is provided on the handbrake cable, on Series I and II Models.

On the Alpine II and III there is provision for relocating the master cylinder push-rod in another position on the brake pedal. This in effect moves the pedal pad approximately $1\frac{1}{2}$ in. (4cm) further away from the driver. The inset of Fig. 2, Section D shows a similar arrangement on the clutch pedal

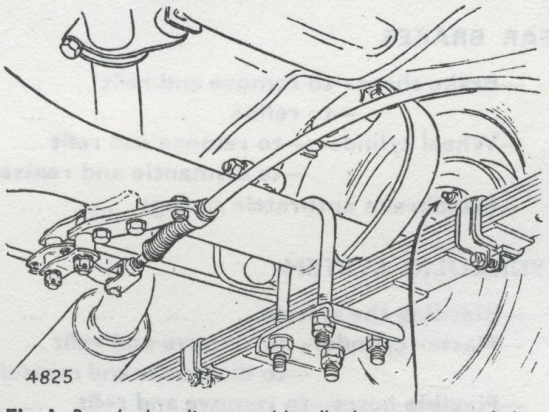


**Fig. 1.** *Rear brake adjuster and handbrake compensator linkage on Series I to II Models.*

### Brake fluid level

The fluid level in the master cylinder reservoir should be checked at regular intervals and should be kept within $\frac{1}{2}$ in. (12 mm) of the filler cap orifice Never fill completely since the expansion of fluid in hot weather may cause the brakes to build up and the shoes to bind.

Before removing the filler cap to top up, clean the area around the filler cap to prevent dirt entering the reservoir. Ensure that the air vent in the filler cap is not choked; blockage at this point could cause the brakes to drag.

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The addition of fluid will be required at regular intervals due to the repositioning of the front wheel pistons as a result of friction lining wear, but a rapid fall in fluid level would indicate a leak at some point in the system which should be traced and rectified.

Use only the specified type of brake fluid for replenishment purposes. (See Section P). Care should be taken not to spill any of the fluid on the car body since the fluid is injurous to paint.

The brake hoses should be checked at regular intervals for leakage, chafing and general deterioration. If there is any doubt replace the hoses. It is advisable in any case to replace the hoses every five years. For removal instructions see under "Flexible hoses—to remove and refit".

To check for leaks, apply a firm pressure to the brake pedal whilst an assistant examines the units, pipes, hoses and fittings.

It is also advisable to occasionally check for tightness the brake mounting bolts and hydraulic unions. It is important not to overtighten the bleed screws and unions, since this may very easily result in stripped threads. The specified torque figures for the bleed screws and pipe unions are as follows:—

| | | |
|---|---|---|
| Bleed screws | | |
| (conical pointed) | 5–7·5 lbs. ft. | (70–104 kg. cm.) |
| Feed pipe unions | | |
| (male) | 7–8 lbs. ft. | (97–111 kg. cm.) |
| (female) | 8–10 lbs. ft. | (111–138 kg. cm.) |

## FRONT BRAKES

### DESCRIPTION

Each brake consists of a high quality cast iron disc which is attached to and rotates with the hub, and a cast iron caliper which straddles the disc and is rigidly attached to the axle carrier.

The caliper houses two hydraulic pistons operating on a pair of brake pads, the pistons are protected by dust covers and sealing between the pistons and caliper is effected by rubber rings fitted in grooves in the caliper bores.

A metal splash guard is fitted to protect the inner face of the disc from grit. On Series I and II models, these guards are attached by brackets under the heads of the steering arm and caliper attachment bolts, but on Series III models onwards the guards are attached to the hub side of the stub axle carriers with three bolts each.

On Series II models, after chassis No. B.913936, anti-squeal shims are fitted between the pistons and brake pads.

On Series I and II models, anti-rattle springs can be fitted in Service should any brake pad rattle be experienced.

Upon application of the brakes, the hydraulic pressure generated in the system causes the pistons to apply equal pressure to each brake pad in proportion to the foot effort applied to the pedal.

When the brakes are released, the hydraulic pressure is relieved and the pistons and brake pads remain in position for the next application. In this manner, pad wear is automatically taken up thus no manual adjustment is required.

After negotiating a ford, water splash or when driving on flooded roads, it may be necessary to dry out the brakes to restore full braking power by a few light applications of the brake pedal. It is also advisable to do this after or during prolonged driving in wet weather, under circumstances where the brakes are not in use, such as may occur on motorways etc.

### BRAKE PADS

The friction linings are bonded and riveted to their backing plates and can therefore only be renewed by the fitment of complete new brake pad assemblies.

It should not be necessary to bleed the system after replacing the brake pads.

When replacing the brake pads, the opportunity should be taken to examine the condition and fitting of the rubber dust covers (item 17 Fig. 2). The method of removing the dust covers is given under "Calipers—to dismantle".

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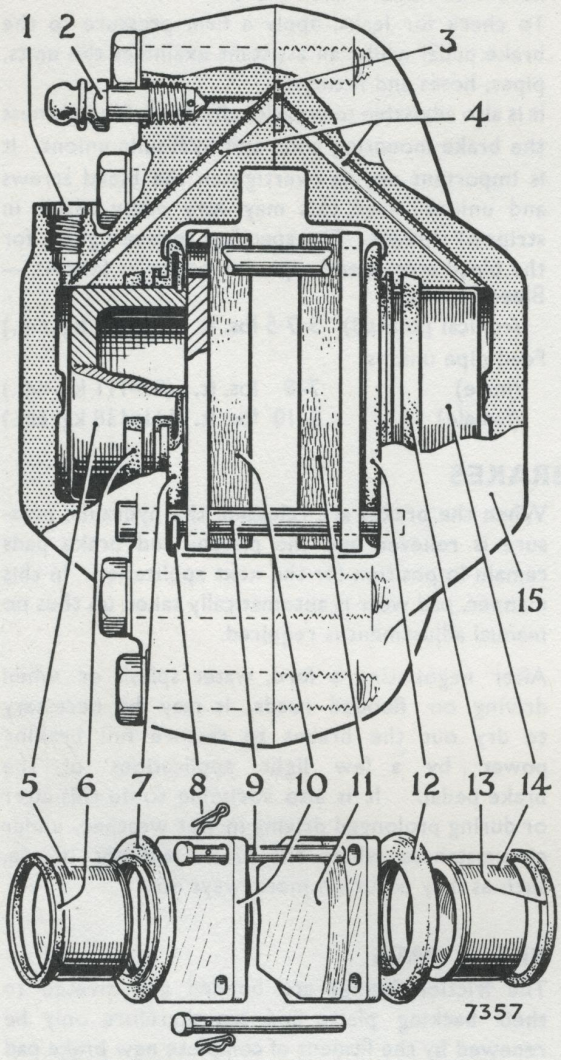


**Fig. 2.** *Exploded view of caliper assembly, Series II models onwards.*

1. FLEXIBLE HOSE CONNECTION
2. BLEED SCREW
3. FLUID CHANNEL SEAL
4. INTERNAL FLUID CHANNELS
5. & 14 PISTONS
6. & 13 PISTON SEALING RINGS
7. & 12 DUST COVERS
8. RETAINING CLIPS
9. RETAINING PINS
10. & 11 BRAKE PADS
15. CALIPER BODY

**To remove and refit** (Figs. 2 and 2a)

1. Apply the handbrake, jack up the front of the car and remove the road wheel.

2. Withdraw the two brake pads from the caliper and when fitted, the anti-rattle springs and anti-squeal shims by removing the two retaining clips and pins.

3. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

   (i) Check the fluid level in the master cylinder reservoir to assess the possibility of overflowing when the pistons are pressed into the calipers. The overflowing can be staunched by wrapping the reservoir in an absorbent cloth or by syphoning off some of the fluid.

   (ii) Ensure the discs and pads are free of dirt and grease.

   (iii) When fitted insert the anti-squeal shims, "D" shaped apertures are downward, between the pistons and pads. (See Fig. 2a).

   (iv) When fitted, ensure the tongues of the anti-rattle springs bear against the pad backing plates and the retaining pins pass through the slotted ends. (See Fig. 2a).

   (v) Pump the brake pedal until solid resistance is felt.

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## CALIPERS

### To remove and refit

1. Apply the handbrake, jack up the front of the car and remove the road wheel.

2. Detach the caliper from the stub axle carrier by withdrawing two bolts and identifying any packing washers, shims and splash guard brackets that may also be held by these bolts.

3. Suspend the caliper nearby without straining the flexible hose. When it is necessary to remove the caliper from the car, disconnect the feed pipe from the flexible hose and remove the flexible hose from the support bracket, see under "Flexible hoses—To remove and refit".

4. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

   (i) When refitting the original calipers; any packing washers, shims and splash guard brackets must be refitted to their original positions.

   (ii) When fitting replacement calipers to Series I and II models, check that the caliper is centrally astride the disc to within 0·025 in. (0·64 mm). Measurements are taken between the four machined faces inside the caliper and the disc. Any off-centre is corrected by positioning shims between the caliper and stub axle carrier with an equivalent thickness of packing washers between the front steering arm lug and the stub axle carrier.

   On Series III models onwards, machining limits made packing washers and shims unnecessary.

   (iii) Bleed the hydraulic system when the caliper has been removed from the car, see under "Bleeding the hydraulic system".

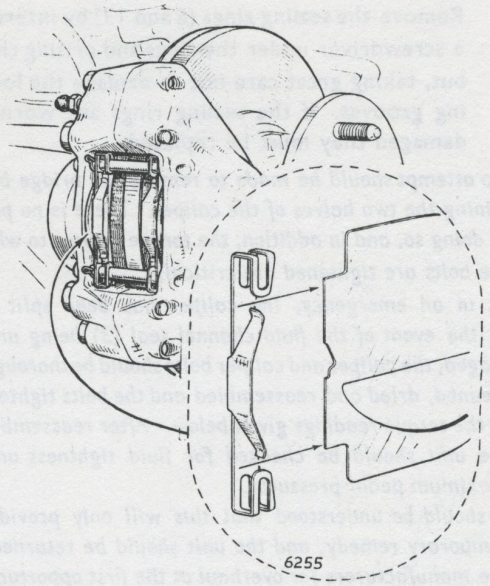


*Fig. 2a. Series I and II models. The illustration shows the pad retaining pins passing through the slotted ends of the anti-rattle springs and the tongues bearing against the pad backing plates. The inset shows the outward end of the anti-squeal shim cut off to accommodate the anti-rattle spring, when both are fitted to the same caliper.*

   (iv) Pump the brake pedal when solid resistance is felt.

### To dismantle (See Fig. 2)

1. Remove the calipers as previously described.

2. Clean off the dirt from the outside of the calipers and remove the brake pads (10 and 11) as previously described.

3. Withdraw the pistons (5 and 14) from the caliper bodies, taking care not to damage the bores.

4. Remove the dust covers (7 and 12).

5. Remove the sealing rings (6 and 13) by inserting a screwdriver under the rings and prising them out, taking great care not to damage the locating grooves. If the sealing rings are worn or damaged they must be replaced.

*No attempt should be made to remove the bridge bolts joining the two halves of the caliper. There is no point in doing so, and in addition, the torque figures to which the bolts are tightened are critical.*

*If, in an emergency, the caliper has been split and in the event of the fluid channel seal (3) being undamaged, the caliper and caliper bolts should be thoroughly cleaned, dried and reassembled and the bolts tightened to the torque readings given below. After reassembling the unit should be checked for fluid tightness under maximum pedal pressures.*

*It should be understood that this will only provide a temporary remedy, and the unit should be returned to the manufacturers for overhaul at the first opportunity.*

| | |
|---|---|
| *Bridge bolt—inner* | 720 *lb in.* (830 *kg cm*) |
| *Bridge bolt—outer* | 540 *lb in.* (622 *kg cm*) |

### To reassemble

1. Thoroughly clean the caliper bores with methylated spirits and allow to evaporate, then lubricate with clean brake fluid.
2. Carefully refit the sealing rings into the larger of the two annular grooves in each of the caliper bores.
3. Fit the dust covers back into position with the projecting lips inserted into the smaller grooves in the caliper bores.
4. Insert the pistons, closed ends first, into the bores. Fit the outer lips of the dust covers into the grooves in the pistons.
5. Push the pistons to the bottom of their cylinders and refit the brake pads as previously described.
6. Refit the calipers to the vehicle as previously described.

## SPLASH GUARDS

Splash guards are fitted to protect the inner faces of the discs against grit.

On early Series I models they are secured by brackets to the steering arm forward mounting bolts and caliper lower mounting bolts. On later Series I models* and on all Series II models, the splash guards are retained on the stub axles by distance pieces and are secured to the lower bosses of the stub axle carrier by nuts, brackets and bolts.

On Series III models onwards, the splash guards are secured to the hub side of the stub axle carrier by three bolts each.

### To remove and refit

*Early Series I models only*

1. Apply the handbrake, jack up the front of the car and remove the road wheel.
2. Remove the splash guard from the stub axle carrier by withdrawing the bolts from the front steering arm lug and lower caliper lug, identifying any packing washers and shims that may be on these bolts.

*Later Series I* and Series II models*

1. Remove the caliper from the stub axle carrier, see under "Caliper—To remove and refit", suspend nearby without straining the flexible hose.
2. Remove the hub assembly from the stub axle, see under "Front hub—To remove and refit" in Section F.
3. Support the distance piece from below, grind the outside edge to cut through the case hardening and split the distance piece with a cold chisel and hammer blows.
4. Detach the splash guard from the mounting brackets by removing three nuts and washers.

*Series III models onwards*

1. Proceed with the first two operations for Late Series I and Series II models.
2. Remove the splash guard from the stub axle carrier by withdrawing three bolts and washers.

Refitting is the reverse of the removal sequence, but particular attention must be given to the following:—

*The later type of splash guard was introduced on Series I models from chassis number B 9006694

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*Series I models only*

Ensure that any packing washers and shims are refitted to their original positions.

*Later Series I* and Series II models*

Immerse the distance piece in boiling water and while still hot tap the distance piece onto the stub axle with a tubular drift until it clamps the splash guard to the stub axle carrier. The hub end float is set, see under "Front hubs—To adjust" in Section F.

*Series III models onwards*

The hub end float is set, see under "Front hubs—To adjust" in Section F.

*All Models*

Ensure that the splash guard does not foul the brake disc.

## DISCS

### Run-out

Excessive run-out on the discs will cause knocking back of the pistons which may create increased pedal travel when the brakes are applied.

Before checking the run-out, hub end-float should be eliminated by tightening the hub retaining nut, readjusting it at the end of the test. (See Section F, "Front Hubs—to adjust"). After tightening the retaining nut, check that the hub can still be rotated.

A dial test indicator should then be clamped to the caliper body so that the stylus bears on the disc at a point approximately 1 in. (25·4 mm) from the outer edge. Revolve the disc and check the indicator reading; the maximum reading on the gauge should not exceed 0·004 in. (0·10 mm).

When the disc has suffered damage or has become excessively scored, it must be renewed.

### To remove and refit

1. Apply the handbrake, jack up the front of the car and remove the road wheel.
2. Remove the caliper from the stub axle carrier, see under "Caliper—To remove and refit" and suspend nearby without straining the flexible hose.

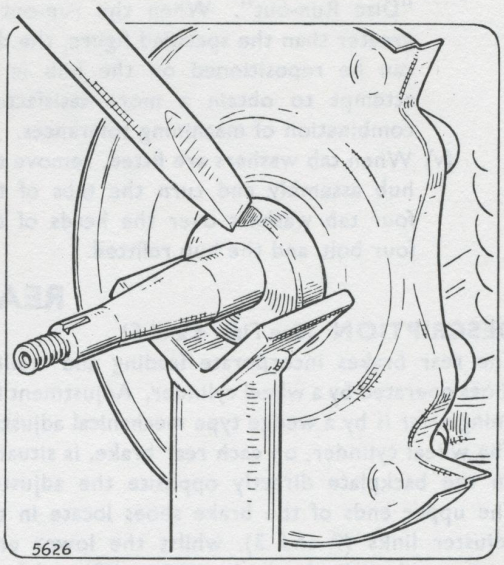


**Fig. 3a.** *Method of removing distance piece.*

3. Remove the hub assembly from the stub axle, see under "Hubs—To remove and refit" in Section F.
4. Remove the disc from the hub by withdrawing four bolts and tab washers or washers.
5. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

   (i) Ensure the fitting faces of the hub and disc are free from dirt and burrs before assembly. In the instance of replacement discs ensure its protective coat is washed off.

   (ii) The four bolts are tightened to the torque given in the "General Data Section" but when tab washers are used on the bolts, do NOT turn up the tabs until AFTER the disc run-out has been checked.

   (iii) The hub assembly is fitted, see under "Front Hub—To remove and refit", but the hub end float is set AFTER the disc run-out has been checked.

(iv) The disc run-out is checked, see under "Disc Run-out". When the run-out is greater than the specified figure, the disc can be repositioned on the hub in an attempt to obtain a more satisfactory combination of machining tolerances.

(v) When tab washers are fitted, remove the hub assembly and turn the tabs of the four tab washers over the heads of the four bolt and the hub refitted.

(vi) Set the hub end float, see under "Front hubs—To adjust" in Section F.

(vii) When a replacement disc is fitted to Series I and II models position the caliper centrally astride the disc, using packing shims and washers see under "Caliper—To remove and refit".

(viii) Only when the caliper has been removed completely from the car is it necessary to bleed the hydraulic system of air.

# REAR BRAKES

**DESCRIPTION** (See Figs. 4 and 5)

The rear brakes incorporate leading and trailing shoes operated by a wheel cylinder. Adjustment for lining wear is by a wedge type mechanical adjuster. The wheel cylinder, on each rear brake, is situated on the backplate directly opposite the adjuster. The upper ends of the brake shoes locate in the adjuster links (9 and 3), whilst the lower ends locate in the wheel cylinder piston (13) and body (15) respectively. The shoes are supported by platforms formed in the backplate, and are held in position by two hold-down leaf springs (11) and pegs (12) which pass through holes in the backplate. The shoes are linked together by return springs (1 and 2), situated between shoe webs and the backplate.

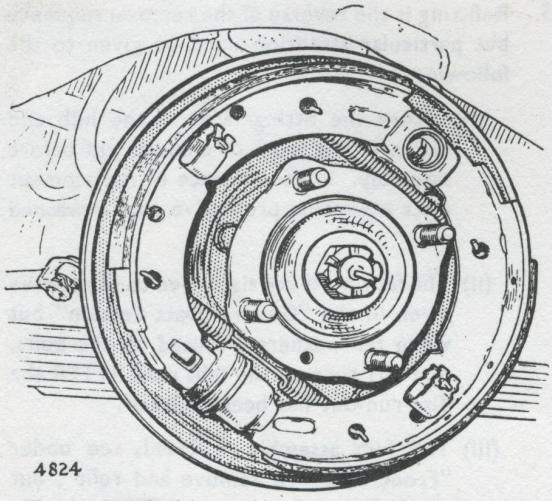


**Fig. 4** *Rear brake assembly—right-hand side illustrated*

When hydraulic pressure is applied, the piston operates the leading shoe and the cylinder body reacts by sliding on the backplate to operate the trailing shoe. When the pressure is released, the shoes are returned to their original positions by the return springs.

**Adjuster** (See Fig. 5)

The adjuster has a light alloy housing (10) which is spigoted and bolted firmly to the inside of the backplate. The housing carries two opposed steel links (3 and 9), their outer ends slotted to take the shoe flanges, and the inclined inner faces bearing on the cone of the hardened steel wedge (8), the axis of which is at right angles to the links. The wedge has a finely threaded spindle and a square end which projects on the outside of the backplate. By rotating the squared end clockwise, the wedge is screwed inwards forcing the links apart and thus expanding the fulcrum of the brake shoes.

**Wheel Cylinders** (See Fig. 5)

Each wheel cylinder consists of a die-cast aluminium body (15) containing a seal (14) and a piston (13), with dust cover (5) secured to the body by a clip (4). A bleed screw (16) is also incorporated in the body with a rubber dust cap over the nipple end. A spring plate (18) and retaining plate (7) hold the wheel cylinder in position on the backplate, but allow the body to slide laterally.

**Handbrake** (See Fig. 5)

A cable linkage connects the handbrake lever to the levers (6) housed in each rear wheel cylinder which operate the leading shoes. The trailing shoes are operated by reaction through the wheel cylinder bodies (15) which slide in the backplates.

## BRAKE SHOES

### General

It will be noted that the brake shoe linings are off-set on the shoe platforms to which they attached. The

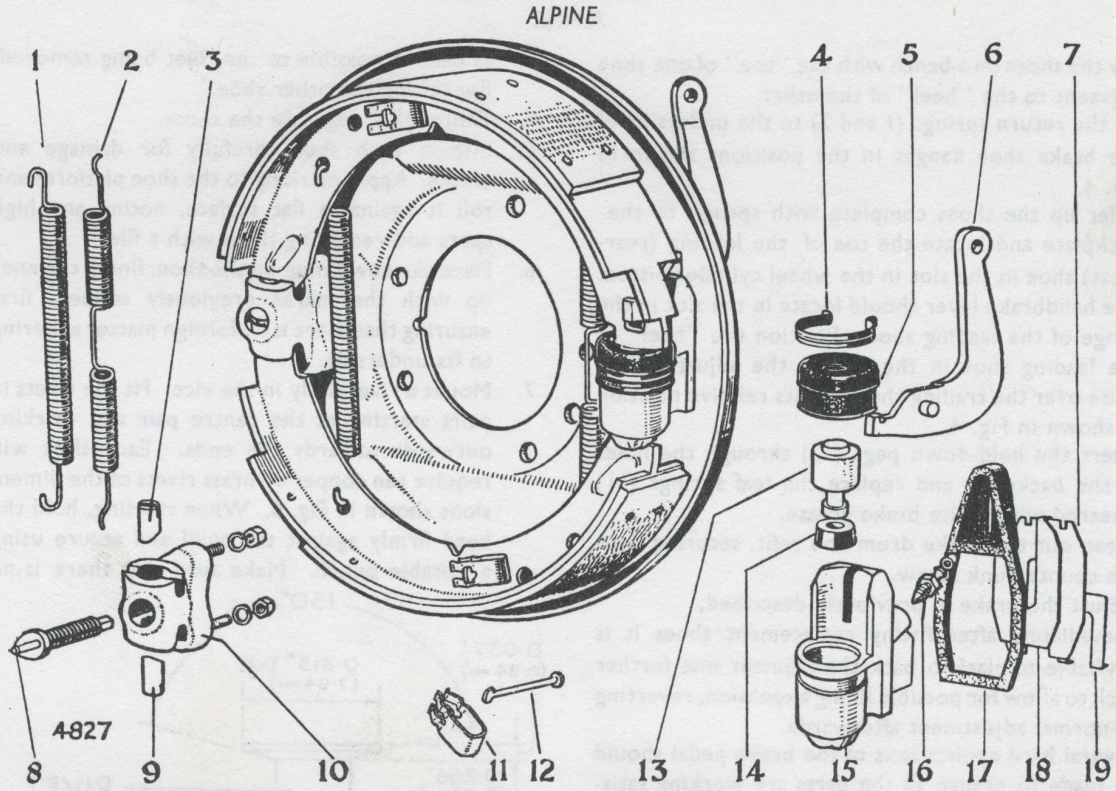


**Fig. 5.** *Exploded view of rear brake*

1 RETURN SPRING
2 RETURN SPRING
3 ADJUSTER LINK
4 DUST COVER CLIP
5 DUST COVER
6 HANDBRAKE LEVER
7 RETAINING PLATE
8 WEDGE
9 ADJUSTER LINK
10 ADJUSTER HOUSING
11 LEAF SPRING
12 PEG
13 PISTON
14 SEAL
15 CYLINDER BODY
16 BLEED SCREW
17 DUST COVER
18 SPRING PLATE
19 DISTANCE PIECE

end of the shoe at which the greater length of platform is exposed is known as the "toe" whilst the other end is called the "heel".

When fitting replacement shoes always fit a new set of shoe return springs.

**To remove**

Chock the front wheels, jack up the rear of the car and remove a road wheel.

Slacken off all available shoe adjustment by rotating the square-headed adjuster anti-clockwise, (arrowed in Fig. 1).

Remove the countersunk screw securing the brake drum to the hub and remove the drum.

Remove the hold-down springs and pegs by compressing the springs and sliding them from under the peg heads.

Pull the leading (rear-most) shoe out of the slot in the adjuster link and then lift the other end of the shoe clear of the wheel cylinder piston and handbrake lever.

Disconnect the return springs, and remove the shoes.

Repeat the above operations for the opposite rear wheel.

**To refit** (See Fig. 5)

Smear the shoe platforms and the operating and abutment ends of the new shoes with (white) brake grease. Keep all grease off the linings of new replacement shoes and do not handle the linings more than necessary.

Lay the shoes on a bench with the "toe" of one shoe adjacent to the "heel" of the other.

Fit the return springs (1 and 2) to the underside of the brake shoe flanges in the positions shown in Fig. 4.

Offer up the shoes complete with springs to the backplate and locate the toe of the leading (rear-most) shoe in the slot in the wheel cylinder piston. The handbrake lever should locate in the slot in the flange of the leading shoe. Position the "heel" of the leading shoe in the slot in the adjuster link. Prise over the trailing shoe into its relative position as shown in Fig. 4.

Insert the hold-down pegs (12) through the holes in the backplate and replace the leaf springs (11) smeared with white brake grease.

Clean out the brake drum and refit, securing with the countersunk screw.

Adjust the brake as previously described.

Immediately after fitting replacement shoes it is advisable to slacken back the adjuster one further click to allow for possible lining expansion, reverting to normal adjustment afterwards.

Several hard applications of the brake pedal should be made to ensure all the parts are working satisfactorily and the shoes bedding to the drums. Refit road wheel, lower the jack and test.

The above instructions hold true for both rear brakes.

**To reline**

It is strongly recommended that advantage be taken of the Factory Reconditioned Service Unit Scheme, whereby replacement brake shoe assemblies can be obtained in exchange for the old ones. In territories where these facilities are not available, relining may be carried out as follows:—

1. Remove the brake shoes as previously described.
2. Mark the position of the lining across each end of one of the brake shoes with a scriber. This will ensure that the new lining will be fitted in the correct position.
3. Grip the shoe *lightly* in a vice, in order not to distort the shoe. Cut away the portion of each rivet which protrudes through the underside of the brake shoe platform with a sharp chisel. Position the shoe in the vice so that it is held as near as possible to the rivet being removed. Repeat for the other shoe.
4. Thoroughly degrease the shoes.
5. Inspect each shoe carefully for damage and cracks. Apply marking to the shoe platform and roll it against a flat surface, noting any high spots and removing them with a file.
6. Place the new lining on the shoe, lining the ends up with the marks previously scribed, first ensuring that there is no foreign matter adhering to its underside.
7. Mount a rivet dolly in the vice. Fit the rivets in pairs starting at the centre pair and working outwards towards the ends. Each shoe will require ten copper or brass rivets of the dimensions shown in Fig. 6. When riveting, hold the head firmly against the anvil and secure using a suitable punch. Make sure that there is no

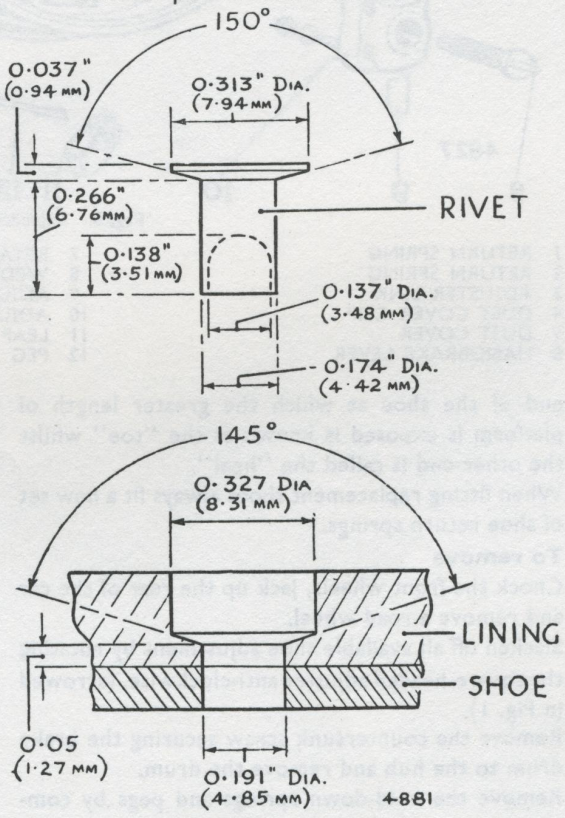


**Fig. 6.** *Rivet details*

gap between the lining and the brake shoe platform.

8. Refit the brake shoes as previously described.

It is not necessary to chamfer the heel and toe of the new lining after refitting.

The utmost care must be taken to ensure that all abrasive particles are removed from the brakes before the drums are finally fitted.

Should replacement linings not be available, linings can be made up to the following dimensions:—

**Linings**

| | | |
|---|---|---|
| Thickness ... ... ... | 0·19″ | (4·8 mm.) |
| Width ... ... ... | 1·75″ | (44·5 mm.) |
| Length ... ... ... | 8·64″ | (219·5 mm.) |

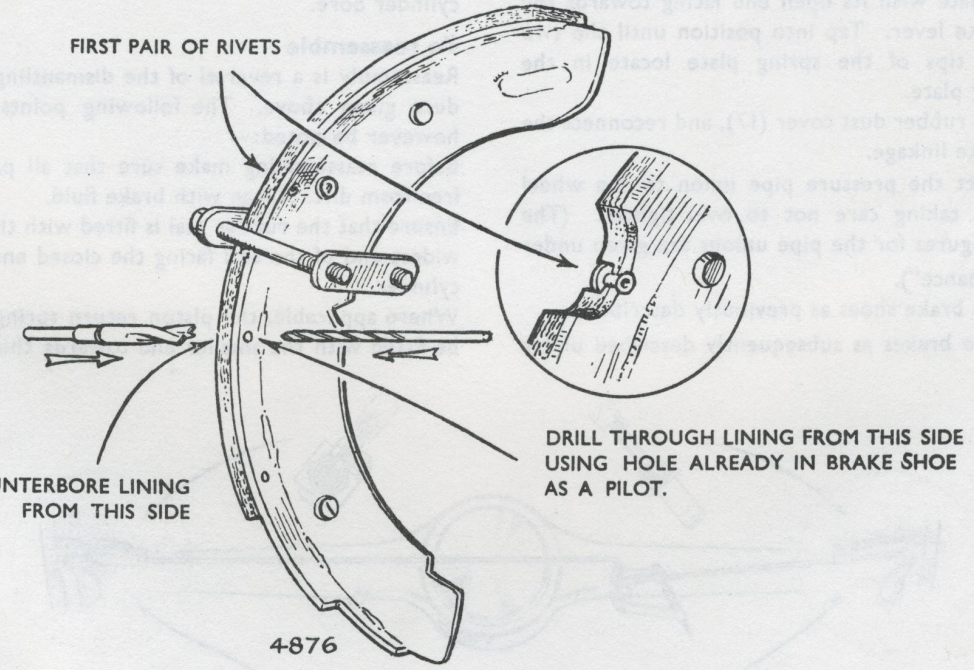


**Fig. 7.** *Method of drilling "off the roll" linings when these have to be used*

The linings should be bored to the dimensions shown in Fig. 6 to receive the rivets. The holes should be positioned to line up with those already in the brake shoes. This may easily be done by clamping the linings to the brake shoes and using the shoes as templates. (See Fig. 7).

It is essential that a good lining material is used or efficient braking may not be maintained.

When lining "off the roll" is used, the heel and toe of each lining should be slightly chamfered after fitting to the brake shoe.

*No attempt should be made to reline the brake pads on the front brakes.*

## WHEEL CYLINDERS

**To remove** (See Fig. 5)

Remove the rear brake shoes as previously described.

Disconnect the handbrake operating rod from the handbrake lever (6) protruding through the backplate by removing the clevis pin.

Disconnect the pressure pipe union from the wheel cylinder.

Remove the dust cover (17) from the rear of the backplate.

Using a screwdriver, prise the retaining plate (7) and spring plate (18) apart, and pull the retaining plate from beneath the neck of the wheel cylinder.

Withdraw the handbrake lever (6) from its position between the backplate and the wheel cylinder.

Remove the spring plate (18) and distance piece, (19) and withdraw the wheel cylinder from the backplate.

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**To refit** (See Fig. 5)

Insert the neck of the wheel cylinder (15) through the slot in the backplate.

Fit the distance piece (19) between the cylinder neck and the backplate, with the open end away from the handbrake lever location and the cranked lips facing away from the backplate.

Fit the spring plate (18) between the distance piece (19) and the backplate also with the open end away from the handbrake lever location and the cranked tips facing away from the backplate.

Replace the handbrake lever (6). Locate the retaining plate (7) between the distance piece and the spring plate with its open end facing towards the handbrake lever. Tap into position until the two cranked tips of the spring plate locate in the retaining plate.

Refit the rubber dust cover (17), and reconnect the handbrake linkage.

Reconnect the pressure pipe union to the wheel cylinder, taking care not to over-tighten. (The torque figures for the pipe unions are given under "Maintenance").

Refit the brake shoes as previously described.

Bleed the brakes as subsequently described under "Bleeding the system".

**To dismantle** (See Fig. 5)

Remove the wheel cylinder from the backplate as previously described.

Release the clip (4) and remove the rubber dust cover (5).

Remove the piston (13) complete with rubber seal (14). This operation may be simplified by applying gentle air pressure to the fluid pipe connection.

Remove the seal from the piston by easnig it over the piston flange.

Where applicable, remove the piston return spring fitted between the piston and the end of the cylinder bore.

**To reassemble**

Reassembly is a reversal of the dismantling procedure given above. The following points should however be noted:—

Before reassembling make sure that all parts are free from dirt. Clean with brake fluid.

Ensure that the rubber seal is fitted with the lip or widest end of the seal facing the closed end of the cylinder.

Where applicable, the piston return spring should be fitted with the smaller end towards the piston.

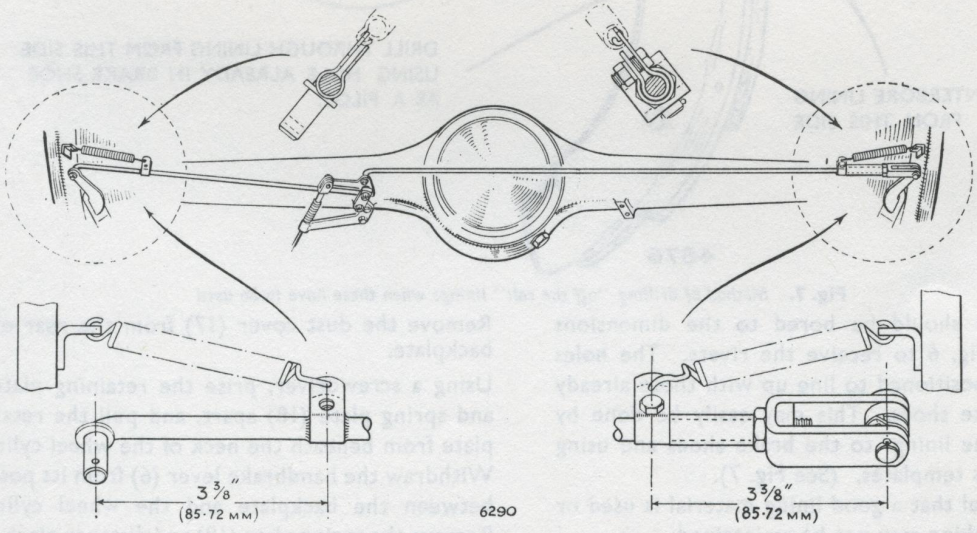


**Fig. 7A.** *Handbrake anti-rattle springs*

*ALPINE*

## HANDBRAKE ANTI-RATTLE SPRINGS

The anti-rattle springs shown in Fig. 7A must be in equal tension, otherwise binding may occur on one side. An important factor controlling the tension of the springs is the positioning of the brake rod anti-rattle spring clips. On cars built after chassis B9110954, the clips are positively located on the adjustable side by a distance piece and are welded onto the rod on the non-adjustable side. On cars built prior to this chassis number, the dimensions given in Fig. 7A should be carefully checked in cases of brake binding. Check also that the clips are in correct alignment as shown in the end views.

# HYDRAULIC SYSTEM

## GENERAL

Great cleanliness is essential when dealing with any part of the hydraulic system, and especially so where the brake fluid is concerned. Dirty or aerated fluid must never be added to the system.
Use only the specified type of brake fluid for topping up the reservoir. (See Section P).

## BLEEDING THE SYSTEM

"Bleeding" (expelling air) the hydraulic system is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected or if the level of the brake fluid in the reservoir has been allowed to fall so low that air has entered the master cylinder.
Always keep a careful check on the fluid level in the reservoir during bleeding. It is most important that the master cylinder be kept at least half full otherwise air may be drawn in necessitating a fresh start.
Two people are required to carry out the operation.

### Procedure

1. With all the hydraulic connections secure and the reservoir topped up with fluid, remove the rubber cap from the near-side rear wheel cylinder bleed screw and fit the bleed tube, immersing the free end of the tube in a jar containing a little clean brake fluid.
2. Unscrew the bleed nipple three-quarters of a turn, operate the brake with a fairly fast full stroke, tightening the bleed screw at the end of the stroke before allowing the pedal to fly back unassisted. Any check to the return of the pedal or master cylinder piston will prevent effective bleeding. One or two faster applications should now be made, tightening the bleed screw at the end of each downward stroke and opening again after the pedal has fully returned. Repeat the applications until the fluid entering the jar is completely free of air bubbles, then tighten up the bleed screw. Make sure that the bleed screw is fully tightened before the pedal reaches the end of its final stroke.
3. Repeat the above operations for each of the remaining three brakes, finishing at the wheel nearest the master cylinder.
4. Top up the reservoir to its correct level of $\frac{1}{2}$" (13mm) below the bottom of the filler cap orifice.

*Care should be taken not to over-tighten the bleed screws since this may very easily result in stripped threads. For the correct torque figures see under "Maintenance".*

## MASTER CYLINDER

### Description (See Fig. 8)

The master cylinder is situated under the bonnet on the bulkhead immediately in front of the brake pedal. On right-hand drive cars the fluid reservoir is cast integrally with the cylinder body, and is connected with it hydraulically by a drilling into the centre of the end of the pressure cylinder. On left-hand drive cars the fluid reservoir is mounted separately on the wing valance and is connected to the end of the pressure cylinder by a metal pipe and union nuts. (See inset).
When pressure is applied to the brake pedal, the plunger (8) moves up the bore of the cylinder and the valve seal (4) closes the port to the reservoir. The seal is held initially on its seat by spring washer

(5) and by fluid pressure in the drilling at the back of the valve stem (7). As the plunger continues to move up the bore, fluid is forced through the pipe line to the wheel cylinders. On the return stroke, the plunger moves back down the bore. With the final movement of the plunger the seal is lifted from its seat allowing free flow of fluid between the master cylinder reservoir and wheel cylinder.

**To remove**

Disconnect the pressure and feed pipe* unions from the cylinder collecting the brake fluid in a suitable container.

Remove the clevis pin from pedal at push rod location.

Remove the two bolts† passing through the master cylinder flanges.

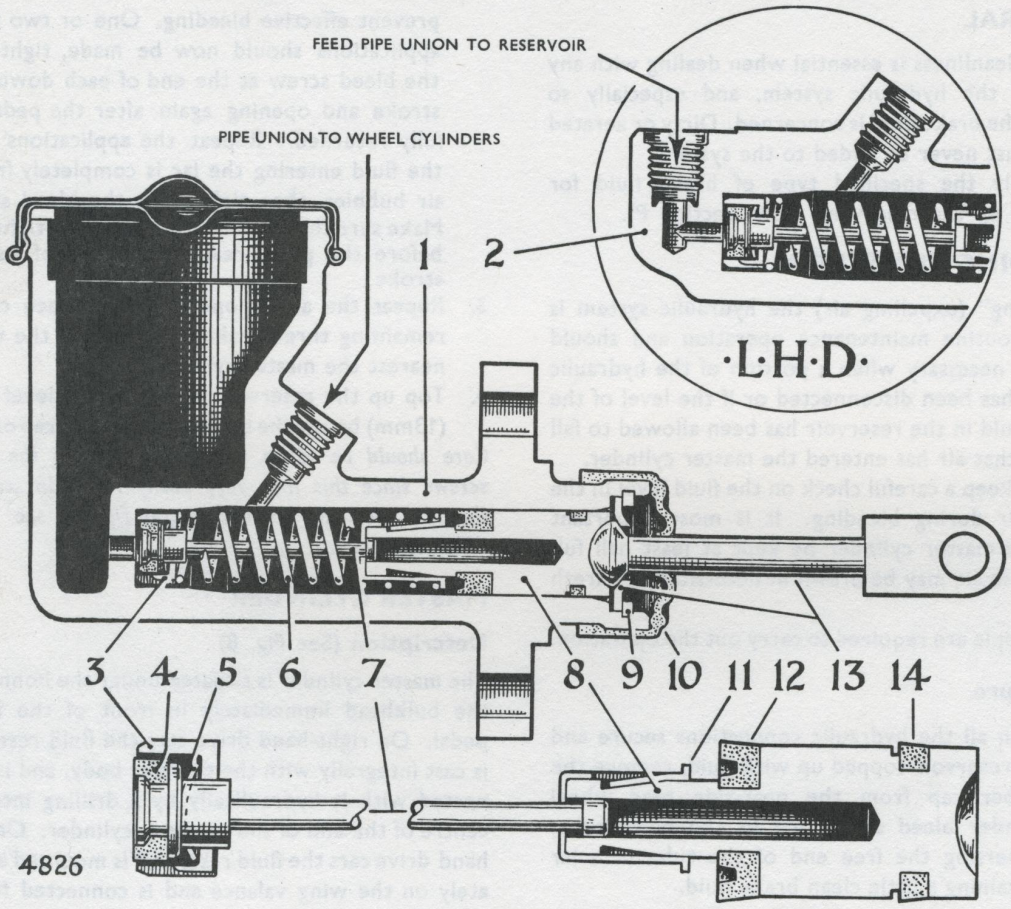


**Fig. 8.** *Sectional view of master cylinder*

1 Cylinder body and reservoir (R.H.D.)
2 Cylinder body (L.H.D.)
3 Valve spacer.
4 Valve seal.
5 Spring washer.
6 Plunger return spring.
7 Valve stem.
8 Plunger.
9 Circlip.
10 Rubber dust cover.
11 Thimble.
12 Plunger seal.
13 Push rod and dished washer.
14 Plunger seal.

*Left-hand drive cars only

†The upper bolt is superseded by a stud and nut from chassis number B 9006694

Remove the master cylinder from the bulkhead by easing it forward. Note the position of the packing.

**To refit**

Refitting is a reversal of the above instructions.

Care should be taken not to over-tighten the pipe unions. (See under "Maintenance" for torque figures).

After refitting, the brakes should be bled as described under "Bleeding the system".

**To dismantle** (See Fig. 8)

Remove the master cylinder from the car as previously described.

Clean off all dirt and grease from the outside of the master cylinder.

Drain the residue fluid from the pressure cylinder and reservoir into a suitable container.

Depress and withdraw return spring cap to release return spring.

Pull back the rubber dust cover (10).

Remove the circlip (9) with a pair of long nosed pliers thus releasing the push rod and dished washer (13).

When the push rod assembly (13) has been removed, the end of the plunger (8) will be exposed. Remove the plunger (8); this operation can be simplified by inserting a low pressure air nozzle in the fluid outlet port.

Separate the thimble (11) and return spring (6) from the plunger (8) by levering the thimble leaf over the shouldered end of the plunger.

Depress the plunger return spring (6) and slide the valve stem (7) through the elongated hole of the thimble and withdraw. Remove valve spacer (5). Take care not to lose the spacer spring washer (5) which is located under the valve head.

Remove seals (12, 14, and 4) from the plunger and the valve head. Seal (14) is omitted from later master cylinders.

Examine all parts, especially the seals, for wear or distortion and replace with new parts where necessary.

**To reassemble** (See Fig. 8)

It is essential that all internal parts are meticulously cleaned with brake fluid before reassembly. Do **not** use petrol, paraffin, trichlorethylene or any other similar agents to wash the parts.

Replace the valve seal (4) so that the flat side is correctly seated on the valve head with its lip facing outwards. The spring washer (5) should then be located with the dome side against the underside of the valve head, and held in position by the valve spacer, the legs of which face towards the valve seal.

Replace the plunger return spring (6) on the spacer (3). Insert the thimble (11) into the spring and depress until the valve stem (7) engages through the elongated hole of the thimble, making sure that the stem is correctly located in the centre of the thimble. Also check that the return spring is placed centrally on the spacer.

Refit plunger seals (12 and 14) onto the plunger (8) with the projecting lips facing towards the thimble. (See inset). Seal (14) is omitted from later master cylinders.

Insert the reduced end of the plunger (8) into the thimble (11) until the thimble engages under the shoulder of the plunger. Press home the thimble leaf.

Smear the plunger (8) well with rubber-proof grease (red) and insert the assembly into the bore of the cylinder (1), valve end first, easing the plunger seal lips over the edge of the bore.

Refit the push rod assembly (13) to the cylinder securing it with the circlip (9) which should engage into the groove machined in the cylinder bore.

Refit the rubber dust cover (10) into position by stretching it over the end of the barrel.

Refit return spring and return spring cap.

Refit the master cylinder to the car as previously described.

## FLEXIBLE HOSES

Do not attempt to clear the bore of a flexible hose by probing. If a hose is choked or perished, fit a replacement.

**To remove** (See Fig. 9)

Disconnect the metal fluid pipe by unscrewing the union nut from the hose union.

Hold the hexagon of the flexible hose end sleeve at one side of the support bracket and unscrew the locknut from the other side to release the hose and washer.

Unscrew the hose at its other end, allowing the hose to rotate.

**To refit** (See Fig. 9)

Refitting is a reversal of the above instructions. It is important not to attach the hose to the support bracket until its other end has been secured.

Feed the hose sleeve into the support bracket, apply a spanner to the hexagon and set the run of the hose clear of all obstructions that could cause chafing. Secure the hose with the washer and nut while holding the sleeve hexagon to prevent the hose from rotating.

When fitted, slide the hose locating plate onto the support bracket so the plain hole is on the feed pipe side; feed the hose sleeve into the plate and bracket, locating the sleeve hexagon within the plate so the run of the hose is clear of all obstructions that could cause chafing. Secure the hose with the washer and nut.

Check that no chafing can occur under conditions of bump and rebound, by bouncing the car up and down. This check should be carried out with the front wheels in the straight ahead position and on right and left-hand locks.

Be careful not to over-tighten hose unions since this may very easily result in stripped threads. For the specified torque figures see under "Maintenance".

After fitting the hose(s) it will be necessary to bleed the brakes as described under"Bleeding the system".

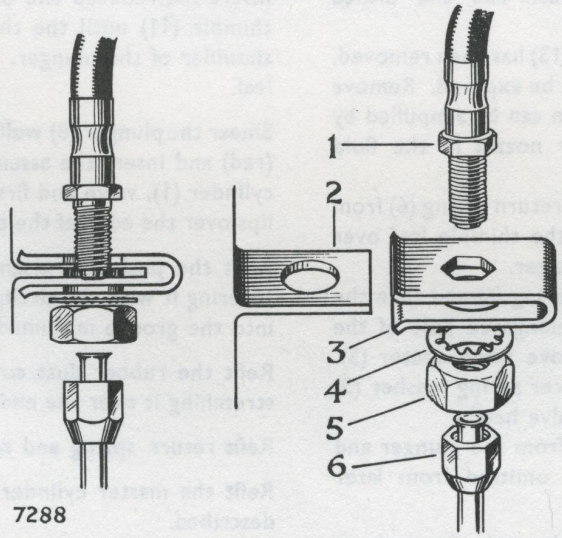


**Fig. 9.** *Flexible hose connection - In some instances the locating plate (3) is omitted.*

1. SLEEVE HEXAGON
2. SUPPORT BRACKET
3. LOCATING PLATE
4. WASHER
5. NUT
6. FEED PIPE UNION NUT

# BRAKES — RAPIER

## GENERAL

Lockheed PM34 disc brakes are fitted to the front wheels and Lockheed drum brakes to the rear wheels. All four brakes are hydraulically operated, pressure being generated in the master cylinder by application of the brake foot pedal. The handbrake operates the rear brake shoes by an independent mechanical linkage.

## MAINTENANCE

The front brake friction pads should be examined for wear at regular intervals and renewed when the friction material has worn to a minimum of $\frac{1}{16}$" (1·6 mm.) in thickness (see under "Brake Pads—To remove and refit").

### Brake Adjustments

The front brakes are self adjusting; the rear brakes should be adjusted as follows:—

Place chocks in front of and behind one of the front wheels to prevent the car from rolling, and release the handbrake.

Remove the nave plates and jack up one rear wheel until it is free to rotate

Turn the wheel so that the hole is opposite the slotted head of the "micram" adjuster Using a screwdriver, turn the adjuster in a clockwise direction until solid resistance is felt. (See Fig. 10).

Slacken back the adjuster until the brake drum can be rotated (usually two clicks). A slight drag may be felt from the trailing shoe but this should not be sufficient to prevent the wheel from being turned by hand.

Spin the wheel and apply the brakes hard to centralise the shoe in the drum and re-check adjustment. When correctly adjusted there should be $\frac{1}{4}$" (6·3 mm.) free movement of the brake pedal pad before the plunger in the master cylinder begins to move.

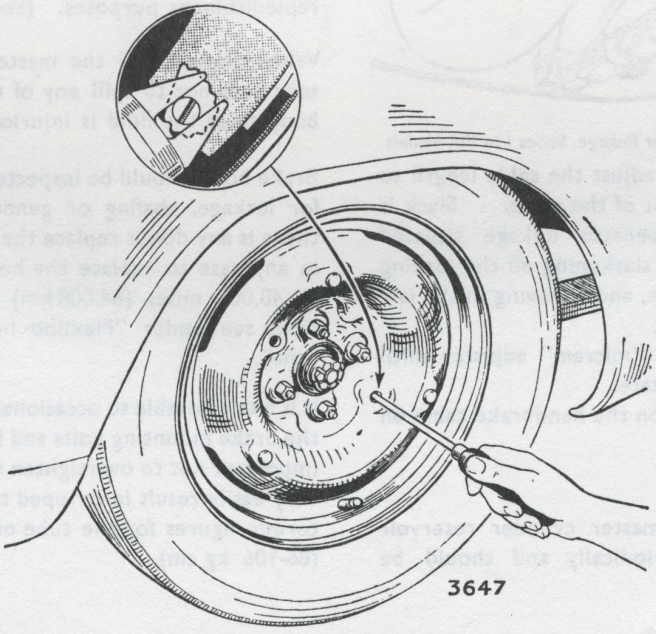


**Fig. 10.** *Rear brake adjustment*

Repeat for the other wheel.

Normally adjustment of the rear brakes will automatically adjust the handbrake. If, however, with the rear brakes in correct adjustment, there is excessive handbrake free travel, adjust as follows:—
Turn each rear brake "micram" adjuster clockwise as far as it will go, so that the rear brakes are locked on hard.

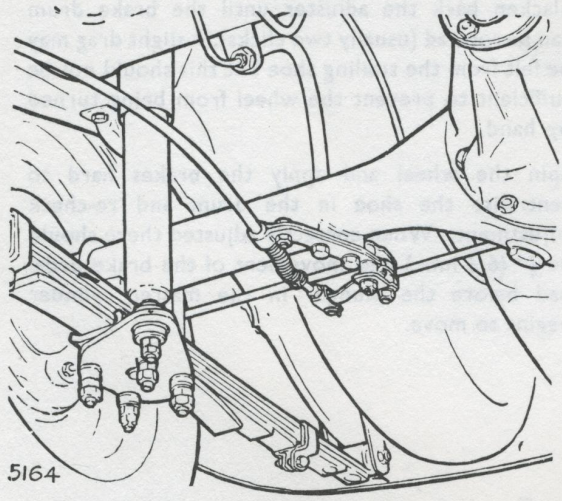


**Fig. 11.** *Handbrake compensator linkage. Series I to IIIA Models.*

With the handbrake off, adjust the cable length so that the slack is taken out of the cable. Slack is taken up at the compensator linkage situated beneath the rear axle by slackening off the locking nut, removing the jaw pin, and screwing in the jaw as necessary (See Fig. 11).
Release each rear brake "micram" adjuster until the brakes are free to rotate.
A lubricator is provided on the handbrake cable on Series I to IIIA Models.

**Brake fluid level**

The fluid level in the master cylinder reservoir should be checked periodically and should be kept within $\frac{1}{2}$ in. (13 mm) below the filler cap orifice. Never fill completely since the expansion of fluid in hot weather may cause the brakes to build up. Brake build up can also be caused by the by-pass port being blocked. (See item B, Fig. 18).

Before removing the filler cap, to top up, clean the area around the filler cap to prevent dirt entering the reservoir. Ensure that the air vent in the filler cap is not choked.

The addition of fluid will be required at regular intervals due to the repositioning of the front wheel pistons as a result of friction lining wear, but a rapid fall in fluid level would indicate a leak at some point in the system which should be traced and rectified.

To check for leaks, apply a firm pressure to the brake, pedal whilst an assistant examines the units, pipes hoses and fittings.

Use only the specified type of brake fluid for replenishment purposes. (See Section P).

When topping up the master cylinder reservoir take care not to spill any of the fluid on the car body since the fluid is injurious to paintwork.

Brake hoses should be inspected at regular intervals for leakage, chafing or general deterioration. If there is any doubt replace the hoses. It is advisable in any case to replace the hoses every three years or 40,000 miles (64,000 km) For removal instructions see under "Flexilbe hoses—to remove and refit".

It is also advisable to occasionally check for tightness the brake mounting bolts and hydraulic unions. It is important not to overtighten unions, since this may very easily result in stripped threads. The specified torque figures for the tube nuts are 6·25-7·0 lb. ft. (86-106 kg cm).

*RAPIER*

# FRONT BRAKES

## DESCRIPTION

Each brake consists of an 11 in. (279 mm) diameter high quality cast iron disc which is attached to and rotates with the hub, and a cast iron caliper which straddles the disc and is rigidly attached to the axle carrier. The caliper houses two hydraulic piston assemblies operating a pair of brake friction pads. The pistons are protected by dust seals which are held in place by metal retainers. Hydraulic sealing between the cylinders and the pistons is effected by rubber rings positioned in grooves in the body. A metal shield is fitted to protect the inner face of the disc against grit.

Upon application of the brake pedal the hydraulic pressure generated in the system causes the co-axially aligned pistons to apply equal and opposite pressure by the brake pads onto the rotating disc in direct proportion to the foot effort applied at the pedal.

The movement of the piston extrudes the rectangular sectioned seal from the cylinder bore as

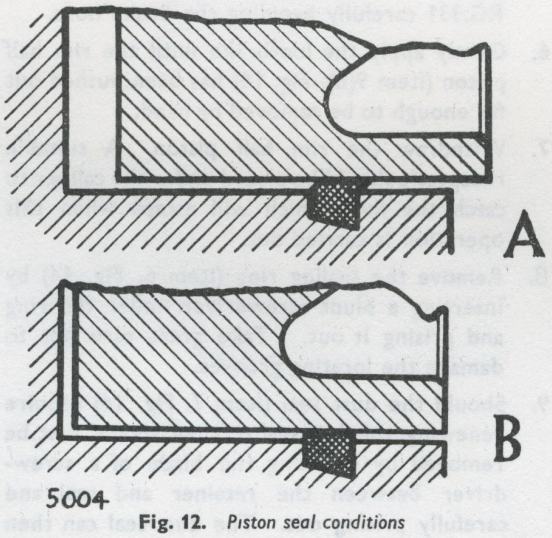


**Fig. 12.** *Piston seal conditions*

illustrated in Fig. 12(A). On releasing the brake pedal, the seal moves back to its original position, taking the piston with it, as illustrated in Fig. 12(B), thus providing clearance between friction pads and the discs when the brakes are not in use.

After negotiating a ford, water splash, or when driving on flooded roads, it may be necessary to dry out the brakes to restore full braking power by a few light applications of the brake pedal. It is also advisable to do this after or during prolonged driving in wet weather, under circumstances where the brakes are not in use, such as may occur on motorways etc.

## BRAKE PADS

The friction linings are bonded to their pressure plates and can therefore only be renewed by the fitment of complete new brake pad assemblies. The brake pads are supplied in a kit together with new steady springs and split pins.

**To remove** (See Fig. 14)

1. Jack up the car and remove the appropriate road wheel.
2. On the rear of each caliper (2) there are two steady springs (5) which are held in place by two split pins. On earlier cars, retaining pins of the type shown in the inset of Fig. 13 were used. To remove depress the steady springs and withdraw the pins. The steady springs may now be removed.
3. Remove the brake pad assemblies (10) by rotating them within the caliper and withdrawing.

**To refit**

1. Clean off any dirt from the protruding portions of the pistons.
2. Push the pistons to the bottom of their cylinder bores by levering with a screwdriver against the edge of the disc. Whilst this is being carried out, a check should be made on the fluid level in the master cylinder in the case displaced fluid returning to the reservoir causes it to overflow.
3. Offer up the brake pad assemblies to the caliper with the outside edges facing away from the caliper. The outside edge of a brake pad may be identified by a rectangular boss on the pressure plate. The earlier design of brake pad did not have this boss and the outside edge in this case can only be identified by the fact

that the pressure plate extends beyond she friction lining along that edge (see Fig. 13). Enter the pads, lower ends first, into the caliper and rotate until correctly positioned.

4. Fit the new springs and split pins or retaining pins. Where the retaining pins are supplied, make sure that the steady springs are securely located between the shoulders of the pins (see inset Fig. 13). Make sure that the steady springs are fitted the right way round; with reference to Fig. 13, it will be seen that each steady spring is shaped like the letter 'H', having a pair of long and a pair of short legs. When assembled the long legs of the two springs should be facing each other.
5. Pump the brake pedal until solid resistance is felt.
6. Refit the road wheel.
7. Lower the jack and road test the car.

*It should be noted that bleeding of the brakes is unnecessary when replacing the brake pad assemblies.*

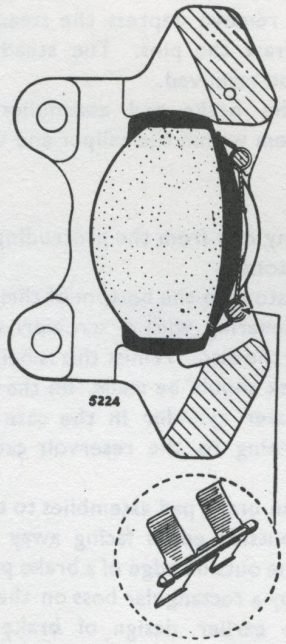


**Fig. 13.** *Section through caliper (early type of brake pad and retaining pin shown)*

## CALIPERS

If the rubber sealing rings (item 6, Fig. 14) are worn or damaged, they should be replaced immediately. Before refitting seals, seal retainers and pistons, they should be coated with Lockheed Disc Brake Lubricant.

### To dismantle and reassemble

*Special tool number RG 331 will be required when carrying out this operation.*

1. Apply the handbrake, jack up the front of the car and remove a road wheel.
2. Undo the two bolts securing the caliper to its adaptor plate and swing the caliper clear of the disc. In order to prevent any strain on the brake hose the caliper must now be suitably supported.
3. Clean off all dirt from the outside of the calipers.
4. Remove the brake pads as previously described.
5. Retain the mounting half piston (item 9(a), Fig.14) in its cylinder using special tool No. RG.331 carefully avoiding the brake hose.
6. Gently apply the footbrake until the rim half piston (item 9(b), Fig. 14) has been pushed out far enough to be removed by hand.
7. Withdraw the rim half piston. A suitable receptacle should be placed under the caliper to catch the fluid which will escape when this operation is carried out.
8. Remove the sealing ring (item 6, Fig. 14) by inserting a blunt screwdriver under the ring and prising it out. Take great care not to damage the locating grooves.
9. Should the dust seal (item 7, Fig. 14) require renewing, the dust seal retainer should first be removed by inserting the blade of a screwdriver between the retainer and seal and carefully prising out. The dust seal can then be lifted out. When renewing the dust seals, always fit new dust seal retainers.
10. Ensure that the caliper bore and component parts are completely free from any foreign matter.

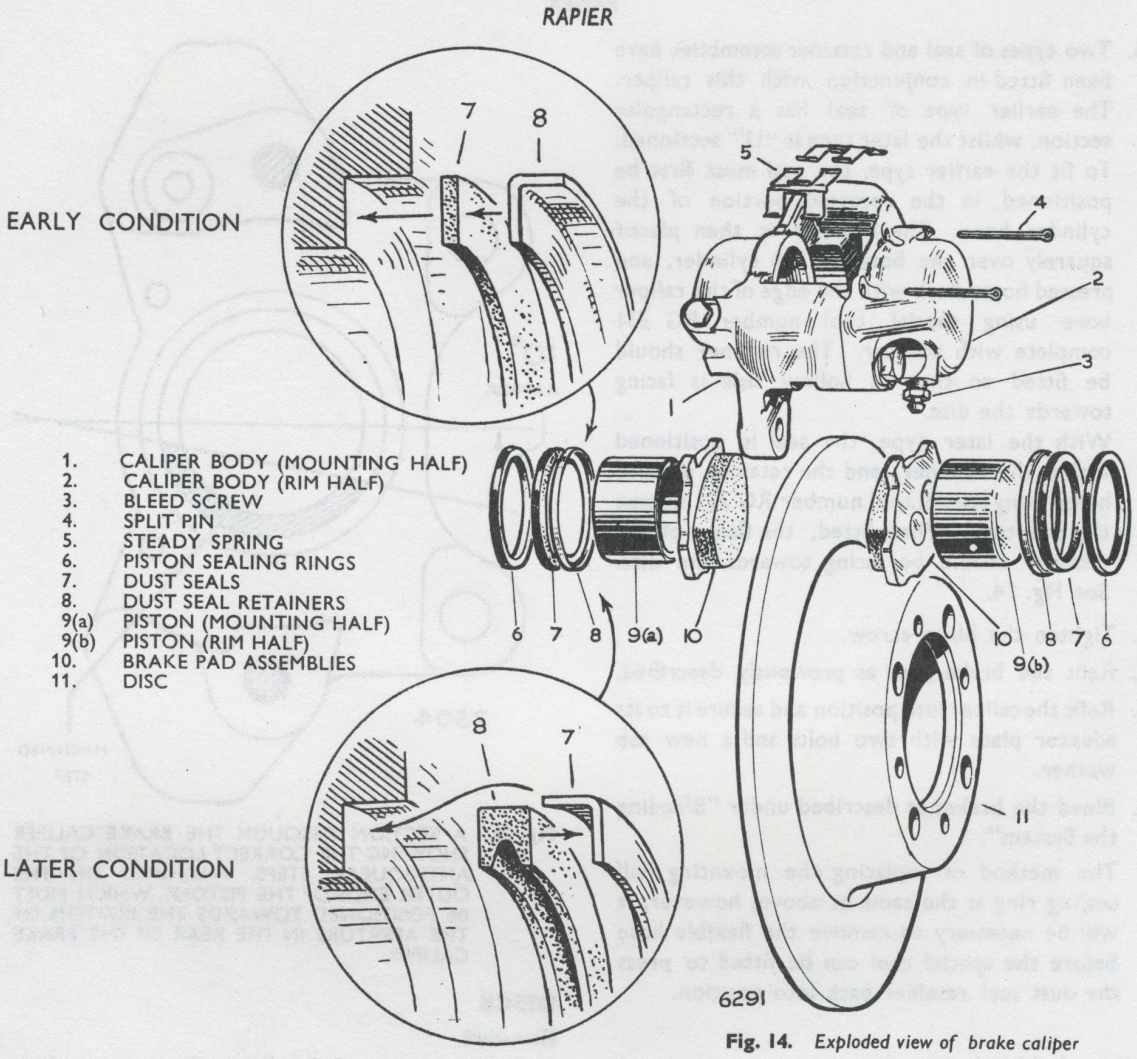


**Fig. 14.** *Exploded view of brake caliper*

11. Smear the sealing ring with lubricant (having first made sure that it is quite dry) and carefully refit into the groove in the caliper bore. Gently work round the seal with the fingers to ensure correct seating.

12. Open the bleed screw (item 3, Fig. 14).

13. Coat the pistons (9a and b) with lubricant and offer up squarely to the caliper bores so the anti-squeak steps, machined on the outer ends of the pistons, are towards the bottom of the aperture in the rear of the brake caliper as shown in Figure 15.

    Care must be taken to ensure that the piston enters the bore squarely.

14. Smear the new dust seal with disc brake lubricant, having first made sure that it is quite dry.

15. Two types of seal and retainer assemblies have been fitted in conjunction with this caliper. The earlier type of seal has a rectangular section, whilst the later type is "U" sectioned. To fit the earlier type, the seal must first be positioned in the recessed portion of the cylinder bore. The retainer is then placed squarely over the bore of the cylinder, and pressed home flush with the edge of the caliper bore using special tool number RG 331 complete with adaptor. The retainer should be fitted so that its hollow side is facing towards the disc.
    With the later type, the seal is positioned within the retainer, and the retainer pressed home using special tool number RG 331 **minus** the adaptor. When fitted, the flange of this retainer should be facing towards the disc. See Fig. 14.
16. Tighten the bleed screw.
17. Refit the brake pads as previously described.
18. Refit the caliper into position and secure it to its adaptor plate with two bolts and a new tab washer.
19. Bleed the brakes as described under "Bleeding the System".
    The method of replacing the mounting half sealing ring is the same as above; however, it will be necessary to remove the flexible hose before the special tool can be fitted to press the dust seal retainer back into position.

### Caliper bridge bolts

*No attempt should be made to remove the bridge bolts joining the two halves of the caliper. There is no point in doing so and, in addition, the torque figure to which the bolts are tightened is critical. If, in an emergency, the caliper has been split, a new fluid channel seal, lock plates and bolts must be fitted. The caliper must be thoroughly cleaned before reassembly, and the bolts tightened to a torque reading of* 35 to 40 *lbs. ft.* (4·8 to 5·5 kg.m) *After reassembly, the unit should be checked for fluid tightness under maximum pedal pressures.*

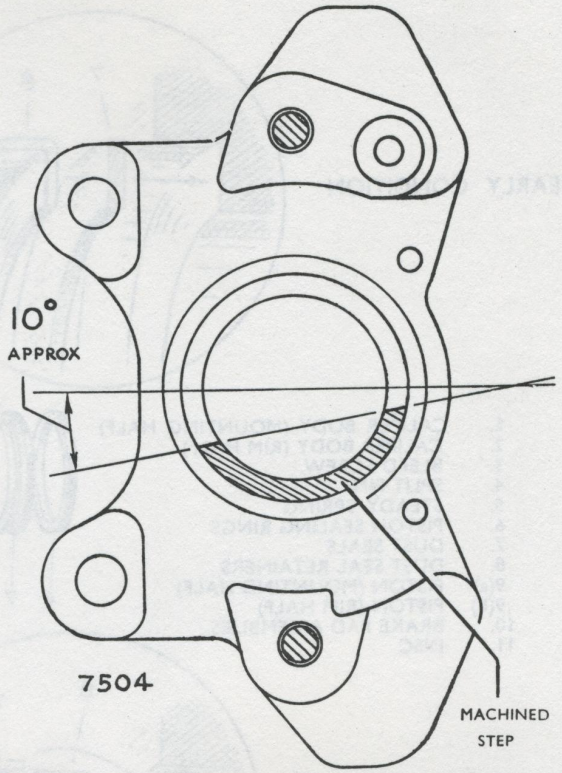


**Fig. 15** A SECTION THROUGH THE BRAKE CALIPER SHOWING THE CORRECT LOCATION OF THE ANTI-SQUEAK STEPS, MACHINED ON THE OUTER ENDS OF THE PISTONS, WHICH MUST BE POSITIONED TOWARDS THE BOTTOM OF THE APERTURE IN THE REAR OF THE BRAKE CALIPER.

## DISCS

### Run-out

Excessive run-out of the discs will cause knocking back of the pistons which may create excessive pedal travel when the brakes are applied.
Before checking the run-out, hub end-float should first be eliminated by tightening the retaining nut, re-adjusting it at the end of the test. (See Section F, "Front Hubs—to adjust"). After tightening the retaining nut, check that the hub can still be rotated. A dial test indicator should then be clamped either to the stub axle carrier or to the caliper body so that the stylus bears on the disc at a point approximately 1 in. (25·4 mm) from the outer edge.

Revolve the disc and check the indicator reading; the maximum reading on the gauge should not exceed 0·004 in. (0·10 mm).

When the disc has suffered damage or has become excessively scored, it must be renewed.

**To remove and refit**

1. Apply the handbrake, jack up the front of the car and remove the road wheel.
2. Remove the caliper from the stub axle carrier, see under "Caliper—To remove and refit" and suspend nearby without straining the flexible hose.
3. Remove the hub assembly from the stub axle, see under "Hubs—To remove and refit" in Section F.
4. Remove the disc from the hub by withdrawing four bolts and tab washers or washers.
5. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—
   (i) Ensure the fitting faces of the hub and disc are free from dirt and burrs before assembly. In the instance of replacement discs ensure its protective coat is washed off.
   (ii) The four bolts are tightened to the torque given in the "General Data Section" but when tab washers are used on the bolts, do NOT turn up the tabs until AFTER the disc run-out has been checked.
   (iii) The hub assembly is fitted, see under "Front hub—To remove and refit" but the hub end float is set AFTER the disc run-out has been checked.
   (iv) The disc run-out is checked, see under "Disc Run-out". When the run-out is greater than the specified figure, the disc can be repositioned on the hub in an attempt to obtain a more satisfactory combination of machining tolerances.
   (v) When tab washers are fitted, remove the hub assembly and turn the tabs of the four tab washers over the heads of the bolt and the hub refitted.
   (vi) Set the hub end float, see under "Front hubs—To adjust" in Section F.
   (vii) When a replacement disc is fitted to Series I and II models, position the caliper centrally astride the disc, using packing shims and washers see under "Caliper—To remove and refit."
   (viii) Only when the caliper has been removed completely from the car is it necessary to bleed the hydraulic system of air.

## REAR BRAKES

**DESCRIPTION** (See Fig. 16)

The rear brakes incorporate leading and trailing shoes operated by a single wheel cylinder. The lower ends of the shoes locate in slots in the wheel cylinder piston (3) and body (11), whilst the upper ends pivot about an abutment (16), situated directly opposite the wheel cylinder on the backplate (12). The shoes are supported by platforms formed in the backplate and are held in position by two damper springs and pegs which pass through holes in the backplate (see item 18). The shoes are linked together by pull-off springs (13 and 15), situated between shoe webs and backplate.

When hydraulic pressure is applied, the pistons in the wheel cylinders are thrust outwards operating the leading shoes (14) and the cylinder bodies react by sliding in their slots in the backplates to operate the trailing shoes (17). When the pressure is released the shoes are returned to their original positions by the pull-off springs.

Adjustment for lining wear is made possible by a "micram" adjuster (1) which is attached together with its mask (2) to the top edge of each leading shoe.

**Handbrake** (See Fig. 11)

A cable linkage connects the handbrake to levers housed in each rear wheel cylinder.

Each lever (6) is retained in its cylinder body by a pin (7). When the handbrake is applied, the linkage pulls on the levers which pivot about their pins and force the outer pistons (3) in the wheel cylinders outwards. The pistons in turn operate the leading shoes and the cylinder bodies react as before to operate the trailing shoes.

On certain cars the lever (6) is extended by a pressing but for later cars the length of the lever was increased in manufacture. The extension, in either form, increases the efficiency of the handbrake for the same effort applied to the handbrake lever at the side of the driver's seat.

## BRAKE SHOES

It will be noted that the brake shoe linings are off-set on the platforms to which they are attached. The end of the shoe at which the greater length of platform is exposed is known as the "toe" whilst the other end is called the "heel".

The leading and trailing shoes are identical except that the "micram" adjuster and mask are attached to the toe of the leading shoe.

### To remove

Chock the front wheels, jack up the car and remove a road wheel. Make sure that the handbrake is fully released. Slacken off all available adjustment by

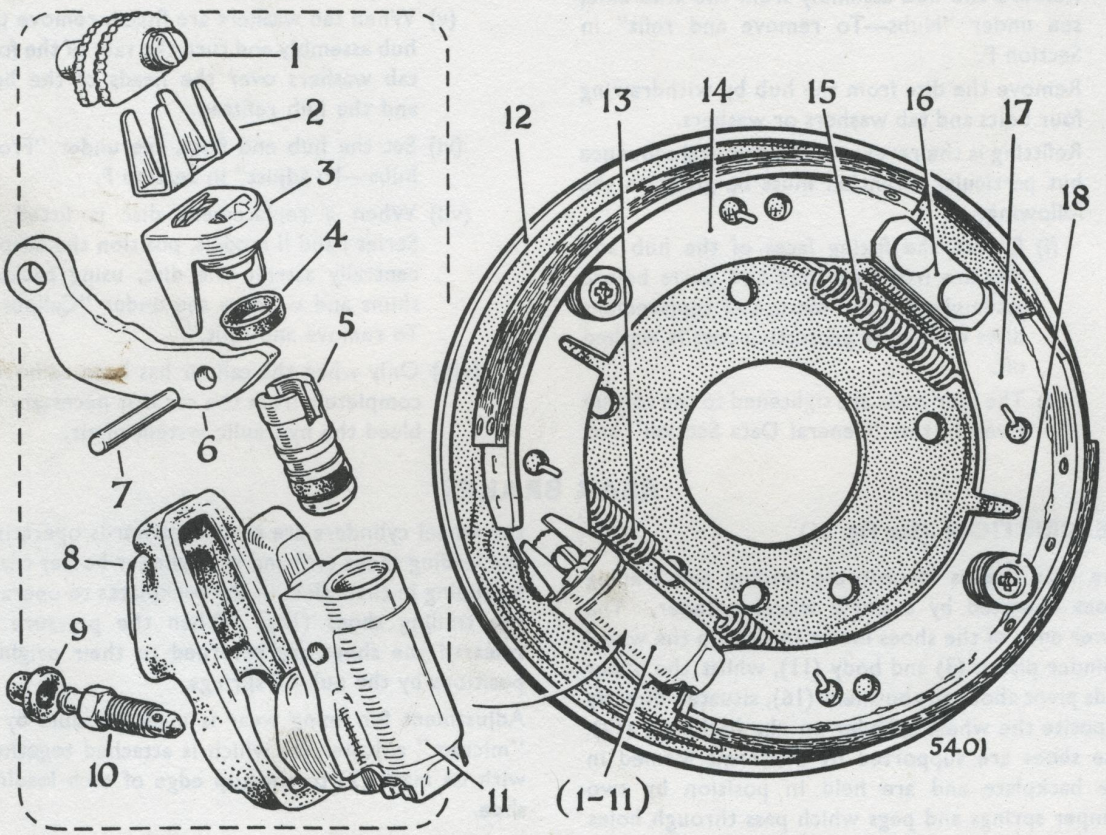


**Fig. 16.** *Exploded view of rear brake—right-hand side illustrated*

1. Micram Adjuster.
2. Mask.
3. Outer Piston.
4. Seal (Outer Piston).
5. Inner Piston.
6. Handbrake Lever.
7. Pivot Pin.
8. Rubber Boot.
9. Dust Cap.
10. Bleed Screw.
11. Cylinder Body.
12. Backplate.
13. Pull-Off Spring.
14. Brake Shoe Assembly.
15. Pull-Off Spring.
16. Abutment.
17. Brake Shoe Assembly.
18. Damper Spring Assembly

turning the "micram" adjuster anti-clockwise to the full extent using a screwdriver. (See Fig. 10).

Remove the brake drum and distance piece, when fitted, from the axle flange by withdrawing a countersunk screw. A light blow on the side of the brake drum will loosen it and facilitate removal.

Release the damper spring assemblies (item 18, Fig. 16) by depressing the cups and turning the pegs through ninety degrees. The pegs may be withdrawn from the rear of the backplate.

Disengage the leading (rearmost) shoe from the locating slots in the wheel cylinder piston and abutment by pulling it against the tension of the pull-off springs. The trailing shoe will then automatically be released.

Remove the "micram" adjuster and mask from the toe end of the leading shoe.

**To refit** (See Fig. 16)

Lay the shoes on a bench with the toe of the leading shoe adjacent to the heel of the trailing shoe.

Connect the two-coiled pull-off spring (13), between the toe of the leading shoe and the heel of the trailing shoe, with the longer coil nearest the leading shoe. Use the outer of the two holes when hooking it to the heel end of the trailing shoe.

Similarly connect the single-coil pull-off spring (15), between the heel of the leading shoe and the toe of the trailing shoe, with the coiled portion facing inwards. Use the inner of the two holes when hooking it to the heel end of the leading shoe. Both springs should be fitted to the *underside* of the brake shoe flanges.

Fit the "micram" adjuster (1) and mask (2) into the slot at the toe of the leading shoe.

Offer up the shoes complete with pull-off springs to the backplate and locate the leading shoe in the slots in the wheel cylinder piston (3) and abutment (16).

Prise the trailing shoe into position with its ends ocating in the wheel cylinder body (11) and abutment. Refit the damper spring assemblies (18), (reversal of the removal procedure).

Refit the brake drum and distance piece, when fitted; secure with the countersunk screw and adjust the brakes as described under "Maintenance".

Lower the jack and remove the chocks.

**To reline**

It is strongly recommended that advantage be taken of the Factory Reconditioned Service Unit Scheme whereby replacement brake shoe and lining assemblies can be obtained in exchange for the old ones. In territories where these facilities are not available relining may be carried out as follows:—

1. Remove the brake shoes as previously described.
2. Mark the position of the lining across each end of one of the brake shoes with a scriber. This will ensure that the new lining will be fitted in the correct position.

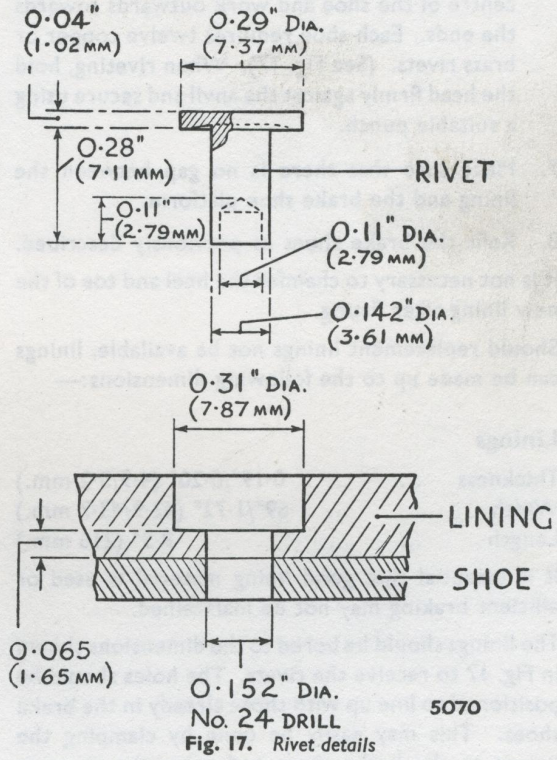


**Fig. 17.** *Rivet details*

3. Grip the shoe *lightly* in a vice, in order not to distort the shoe. Cut away the portion of each rivet, which protrudes through the underside of the brake shoe platform, with a sharp chisel. Position the shoe in the vice so that it is held as near as possible to the rivet being removed Repeat for the other shoe.

4. Thoroughly degrease the shoes.
5. Inspect each shoe carefully for damage and cracks. Apply marking to the brake shoe platform and roll it against a flat surface noting any high spots and removing them with a file.
6. Place the new lining on the shoe, first ensuring that there is no foreign matter adhering to its underside, and line up the ends with the marks previously scribed. Mount a rivet dolly in the vice. Fit the rivets in pairs to line up with the holes in the brake shoe platforms. Start at the centre of the shoe and work outwards towards the ends. Each shoe requires twelve copper or brass rivets. (See Fig. 17). When riveting, hold the head firmly against the anvil and secure using a suitable punch.
7. Make sure that there is no gap between the lining and the brake shoe platform.
8. Refit the brake shoes as previously described.

It is not necessary to chamfer the heel and toe of the new lining after fitting.

Should replacement linings not be available, linings can be made up to the following dimensions:—

**Linings**

| | | |
|---|---|---|
| Thickness | ... ... | 0·19″/0·20″ (4·9/5·2 mm.) |
| Width | ... ... | 1·69″/1·72″ (42·9/43·7 mm.) |
| Length | ... ... ... | 8·5″ (216 mm.) |

It is essential that good lining material is used or efficient braking may not be maintained.

The linings should be bored to the dimensions shown in Fig. 17 to receive the rivets. The holes should be positioned to line up with those already in the brake shoes. This may easily be done by clamping the linings to the brake shoes and using the shoes as templates. (See Fig. 7).

When lining "off the roll" is used, the heel and toe of each lining should be slightly chamfered after fitting to the brake shoe.

*No attempt should be made to reline the brake pads on the front brakes.*

**WHEEL CYLINDERS** (See Fig. 16)

Each wheel cylinder consists of a die-cast aluminium body (11) containing two pistons. The outer piston (3) has a metal dust cover welded to it and is grooved to accommodate a rectangular sectioned seal (4). The inner piston (5) is slotted to receive the heel of the handbrake lever and is fitted with a tapered seal. A rubber boot is also fitted.

When the footbrake is applied the inner piston is forced outwards taking the outer piston with it. When the handbrake is applied, however, only the outer piston is moved.

A bleed screw (10) is incorporated in the cylinder body with a rubber dust cap (9) over the nipple end

**To remove**

Remove the brake shoes as described under "Brake shoes—to remove".

Unscrew the union nut securing the brake fluid pipe to the wheel cylinder.

Disconnect the handbrake cable from the wheel cylinder lever by removing the clevis pin but when a lever extension is fitted disconnect the lever extension from the lever by removing a nut, bolt and washer.

Remove the rubber boot and bleed screw from the wheel cylinder.

The wheel cylinder can now be manœuvred from the brake drum side of the backplate.

**To refit**

Refitting is a reversal of the above instructions.

It is important to ensure that the rubber boot is correctly located in the groove along the wheel cylinder and around the union boss. Care should be taken not to trap the boot between the wheel cylinder and backplate.

When a lever extension is fitted ensure that the fold of the pressing is towards the centre of the car.

It will be necessary to bleed the brakes after refitting as described under "Bleeding the brakes".

**To dismantle** (See Fig. 16)

Remove the wheel cylinder from the backplate as previously described.

Withdraw the outer piston (3).

Push out the handbrake pivot pin (7) and remove the lever (6).

With the bleed screw (10) in position, remove the inner piston (5) by applying gentle air pressure to the fluid pipe connection.

Remove the rubber seals from each piston. It should be noted that the metal dust cover cannot be removed from the outer piston.

**To reassemble** (See Fig. 16)

Fit the tapered rubber seal into the groove in the inner piston with the lip facing away from the slotted end of the piston.

Fit the rectangular sectioned seal (4) into the groove in the outer piston.

Insert the inner piston (5) into the wheel cylinder body closed end first and with the longest slot in the piston adjacent to the slot in the body. Take great care when easing the lip of seal past the edge of the bore not to damage or turn back the lip.

Place the handbrake lever (6) in position and refit the securing pin.

Refit the outer piston (3) into the bore.

Refit the wheel cylinder onto the backplate as previously described.

## HYDRAULIC SYSTEM

### GENERAL

Great cleanliness is essential when dealing with any part of the hydraulic system, and especially so where the brake fluid is concerned. Dirty or aeriated fluid must never be added to the system. Use only the specified type of brake fluid for topping up the reservoir. (See Section P).

### BLEEDING THE SYSTEM

"Bleeding" (expelling air from) the hydraulic system is not a routine maintenance operation, and should only be necessary when a portion of the hydraulic system has been disconnected or if the level of the brake fluid in the master cylinder reservoir has been allowed to fall so low that air has entered the system.

Always keep a careful check on the fluid level in the reservoir during bleeding. It is most important that the master cylinder be kept at least half full otherwise air may be drawn in necessitating a fresh start.

1. Ensure that all connections are secure, the fluid reservoir is topped up with brake fluid and kept topped up during the whole operation. Remove the rubber cap from the bleed screw of the left hand rear wheel cylinder, fit a bleed tube and immerse its free end in a glass vessel containing some brake fluid.
2. Slacken off the bleed screw $\frac{1}{2}$ to $\frac{3}{4}$ of a turn and depress the brake pedal with full strokes allowing its return to be as quick as possible; any check on its return will prevent effective bleeding. Actuate the brake pedal in this manner until the brake fluid entering the vessel is free of air and tighten the bleed screw on the next downward stroke ensuring that it is fully tightened before the pedal reaches the bottom of its stroke. Remove the bleed tube and glass vessel, refit the rubber cap.
3. Repeat operations 1 and 2 at each of the remaining bleed screws, finishing at the right hand front. In the instance of late Rapier Series IV Cars onwards repeat operations 1 and 2 at the front brakes only as the right hand rear wheel cylinder has no bleed screw.
4. Top up the reservoir to the correct level, refit the filler cap ensuring its seal is in good condition and its air vent is unobstructed.

*Care should be taken not to over-tighen the bleed screws since this may very easily result in stripped threads. For the correct torque figures see under "Brakes" in the "General Data Section"*

## MASTER CYLINDER

**Description** (See Fig. 18)

The master cylinder is situated under the bonnet on the bulkhead, immediately in front of the brake pedal. It consists of a fluid reservoir soldered to a cylinder body, containing a piston, seals and other parts as illustrated in Fig. 18.

On depressing the foot pedal, the push rod (11) moves the piston (9) down its bore. The displaced fluid in front of the piston is forced through holes in the check valve (4), lifting the rubber seal clear of the holes to provide an unblocked passage to the wheel cylinders. On releasing the brake pedal the return spring (5) thrusts the piston (9) back against its stop faster than fluid is able to return from the wheel cylinders. This creates a partial vacuum in the cylinder, which causes fluid to be drawn past the lip of the main cup (7) from the reservoir via the main port (A) and the small holes in the head of the piston (9). Meanwhile fluid returning from the wheel cylinders lifts the check valve (4) away from its seat and re-enters the master cylinder.

When the piston has fully returned, a small by-pass port (B) is uncovered which allows release of excess fluid to the reservoir, and also compensates for contraction and expansion of the fluid due to changes in temperature.

The purpose of the check valve (4) is to prevent the re-entry into the master cylinder of fluid pumped into the line during the "bleeding" operation; this ensures a fresh charge of fluid at each stroke of the pedal.

**To remove**

Disconnect the metal fluid pipe from its connection at the front of the cylinder by unscrewing the union nut, collecting any escaping fluid in a suitable container.

Disconnect the push rod from the brake pedal by removing the clevis pin.

Remove the two bolts securing the master cylinder to the bulkhead.

The master cylinder can now be removed by easing it forwards.

**To refit**

Refitting is a reversal of the above instructions.
Care should be taken not to over-tighten the feed pipe union nut. (See under "Maintenance" for torque figure).

After refitting, the brakes should be bled as described under "Bleeding the system".

**To dismantle** (See Fig. 18)

Remove the master cylinder from the car as previously described.
Remove the filler cap (1) and drain the brake fluid into a clean container.
Depress and withdraw return spring cap to release return spring.
Detach the rubber boot (13) from the end of the barrel.

Depress the push rod to relieve the load of the spring (5) and remove the circlip (12).
Remove the piston (9), piston washer (8), main cup (7), retainer (6), return spring (5), and check valve (4). The removal of the main cup may be simplified by applying gentle air pressure to the pipe connection at the end of the barrel.
Remove the secondary cup (10) by stretching it over the end flange of the piston (9).

**To reassemble** (See Fig. 18)

It is important that all parts are meticulously cleaned with brake fluid before reassembly. Do **not** use petrol, trichlorethylene or any other similar cleaning agents to wash the parts.
Fit the secondary cup (10) onto the piston (9) so that the lip of the cup faces towards the head (drilled end) of the piston. Gently work the cup round the groove with the fingers to ensure that it is properly seated.

Fit the spring retainer (6) onto the small end of the spring (5) and the check valve (4) into the large end. Insert the spring assembly into the cylinder bore, large end first.

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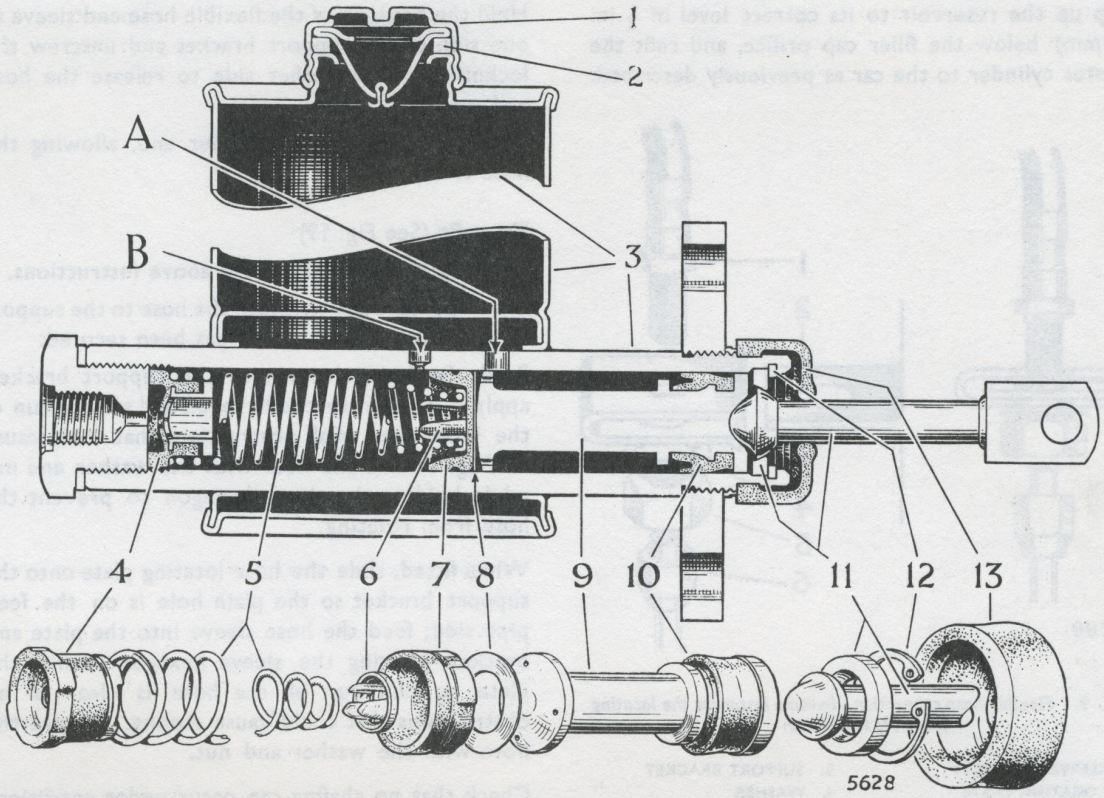


**Fig. 18.** *Master Cylinder*

1. FILLER CAP
2. WASHER
3. MASTER CYLINDER BODY
4. *CHECK VALVE
5. RETURN SPRING
6. SPRING RETAINER
7. MAIN CUP
8. WASHER
9. PISTON
10. SECONDARY CUP
11. PUSH ROD ASSEMBLY
12. CIRCLIP
13. RUBBER BOOT

A. MAIN PORT
B. BY-PASS PORT

*On earlier models the shape of this item differs from that shown.

Insert the main cup (7) into the cylinder bore, lip foremost, taking care not to damage or turn back the lip.

Insert the piston washer (8) into the barrel with the curved edge towards the main cup, followed by the piston, head (drilled end) innermost.

Push the piston inwards with the end of the push rod (11) and secure the push rod by fitting circlip (12). Make sure that the circlip beds evenly in its groove and that the collar is properly retained by the circlip.

Refit the return spring and cap.

Refit the boot (13) into position by stretching it over the end of the barrel and into its groove.

Fill the reservoir and test the master cylinder by pushing the push rod and piston inwards and allowing it to return unassisted; after a few applications fluid should flow from the outlet connection in the cylinder head.

Top up the reservoir to its correct level of $\frac{1}{2}$ in. (13mm) below the filler cap orifice, and refit the master cylinder to the car as previously described.

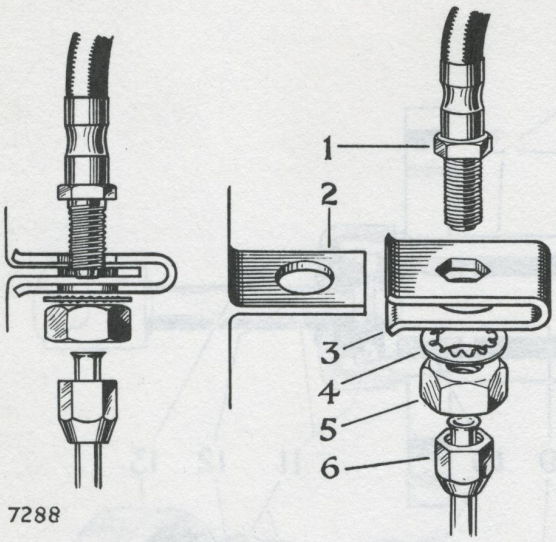


**Fig. 9.** *Flexible hose connection. In some instances the locating plate (3) is omitted.*

1. SLEEVE HEXAGON
2. SUPPORT BRACKET
3. LOCATING PLATE
4. WASHER
5. NUT
6. FEED PIPE UNION NUT

## FLEXIBLE HOSES

Do not attempt to clear the bore of a flexible hose by probing. If a hose is choked or perished, fit a replacement.

### To remove (See Fig. 19)

Disconnect the metal fluid pipe by unscrewing the union nut from the hose union.

Hold the hexagon of the flexible hose end sleeve at one side of the support bracket and unscrew the locknut from the other side to release the hose and washer.

Unscrew the hose at its other end, allowing the hose to rotate.

### To refit (See Fig. 19)

Refitting is a reversal of the above instructions.

It is important not to attach the hose to the support bracket until its other end has been secured.

Feed the hose sleeve into the support bracket, apply a spanner to the hexagon and set the run of the hose clear of all obstructions that could cause chafing. Secure the hose with the washer and nut while holding the sleeve hexagon to prevent the hose from rotating.

When fitted, slide the hose locating plate onto the support bracket so the plain hole is on the feed pipe side; feed the hose sleeve into the plate and bracket, locating the sleeve hexagon within the plate so the run of the hose is clear of all obstructions that could cause chafing. Secure the hose with the washer and nut.

Check that no chafing can occur under conditions of bump and rebound, by bouncing the car up and down. This check should be carried out with the front wheels in the straight ahead position and on right and left-hand locks.

Be careful not to overtighten the tube (union) nut since this may very easily result in stripped threads. For the specified torque figure, see under "Maintenance".

After fitting the hose(s) it will be necessary to bleed the brakes as described under "Bleeding the system'

# GIRLING VACUUM SERVO UNIT

The Girling Vacuum Servo Unit is installed in the brake hydraulic system between the master cylinder and the brake assemblies on the roadwheels with master cylinder outlet pipe connected to the vacuum servo unit and the servo hydraulic outlet is connected to the brake assemblies. The force required to augment the drivers effort is obtained by admitting atmospheric pressure to a vacuum cylinder containing a piston.

The pressure difference thus created across the piston produces a thrust load which is used to increase the hydraulic pressure available at the brake assemblies.

In the Girling Vacuum Servo Unit, the piston in the vacuum cylinder is normally subjected to vacuum on both sides and this principle is known as "Suspended Vacuum System". The vacuum is obtained from the inlet manifold of the engine and therefore servo assistance is only available while the engine is running.

Between the engine inlet manifold and the vacuum servo unit is a non-return valve which prevents air or petrol fumes entering the servo unit.

## Operation (Fig. 20)

When air, at atmospheric pressure, is admitted to the vacuum cylinder (19) by a composite control valve the piston (5) drives the piston rod (18) and the output piston (25) down the hydraulic output cylinder (28) providing a considerable increase of hydraulic pressure to the brake assemblies on the roadwheels.

The control valve, operated by hydraulic pressure from the master cylinder, exercises a precise control over the pressure increase and the brakes are applied exactly in proportion to the pressure applied to the foot pedal.

When the servo unit is at rest with no pressure in the hydraulic system, the vacuum valve (22) of the control valve is open and permits vacuum from the inlet manifold to temporarily communicate with the second side of the piston (5) in the vacuum cylinder (19) thus vacuum on both sides of the piston (5) is equal.

When pressure is applied to the brake pedal, hydraulic pressure is exerted throughout the braking system and equally on both ends of the valve control piston (10 & 13). As one end of this control piston is larger than the other, an equal pressure per square inch on both its ends causes a proportionally greater thrust to be exerted on the larger end moving the control piston and results in the "Tee" shaped lever (11) opening the air valve (31) to the atmosphere and closing the vacuum valve (22). Air is admitted to the second side of the piston (5) destroying the temporary vacuum, driving the piston (5) forward. The piston rod (18) seals the centre hole in the output piston (25) and continued movement applies additional pressure to the hydraulic pressure proceeding to the brake assemblies and also to the small end of the valve control piston (13).

The movement of the output piston (25) continues until the thrust on the small end of the valve control piston (13) by the higher pressure to the brake assemblies, overcomes the thrust on the large end of the control piston (10), by the lower pressure from the master cylinder. The valve control piston (10 & 13) is thus moved back and closes the air valve (31); at this point both valves are closed and the brakes held on.

When the brake pedal is released the lower pressure from the master cylinder is reduced at the large end of the valve control piston (10) which moves back towards its rest position causing the "Tee" shaped lever (11) to open the vacuum valve (22) drawing the air from the second side of the piston (5) in the vacuum cylinder (19), the piston (5) returns to its rest position and with it the output piston (25) relieving the hydraulic pressure in the brake assemblies. The piston rod (18) is withdrawn from the centre hole in the output piston

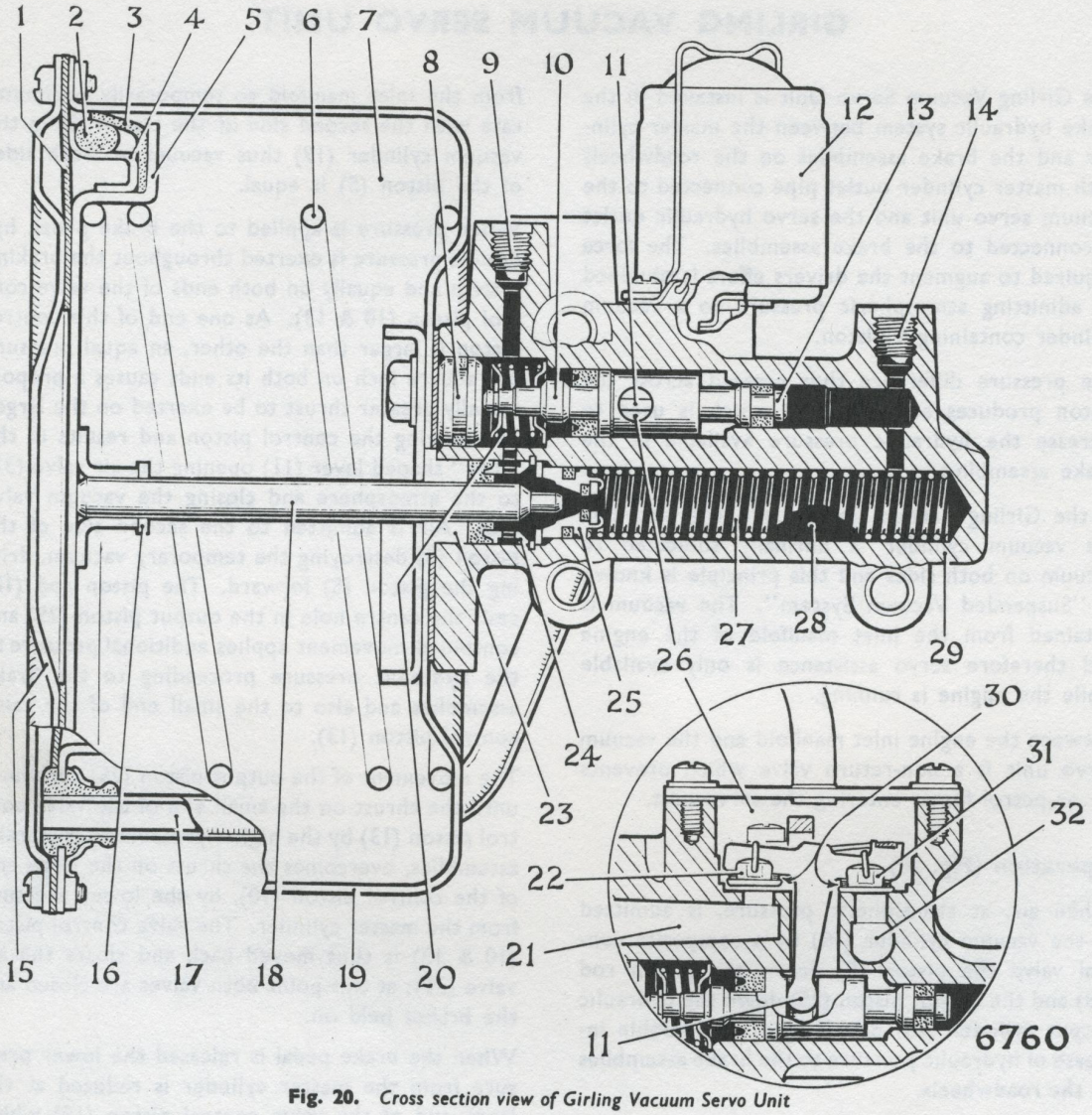


**Fig. 20.** *Cross section view of Girling Vacuum Servo Unit*

1 END COVER GASKET
2 PISTON BACKING RING
3 PISTON SEAL
4 PISTON SEAL RETAINER
5 PISTON
6 PISTON RETURN SPRING
7 CONSTANT VACUUM
8 END PLUG
9 HYDRAULIC INLET PORT
10 VALVE CONTROL PISTON, LOW PRESSURE END
11 "T" SHAPED LEVER
12 AIR FILTER ASSEMBLY
13 VALVE CONTROL PISTON, HIGH PRESSURE END
14 HYDRAULIC OUTLET PORT
15 END COVER
16 PISTON BUFFER
17 TRANSFER TUBE
18 PISTON ROD
19 VACUUM CYLINDER
20 CONTROL PISTON SPRING
21 VACUUM INLET
22 VACUUM VALVE
23 BEARING BUSH
24 NYLON SPACER
25 OUTPUT PISTON
26 VALVE CHEST
27 OUTPUT PISTON SPRING
28 OUTPUT CYLINDER
29 CAST BODY
30 VALVE SPRINGS
31 AIR VALVE
32 AIR INLET

(25) allowing a flow of hydraulic fluid between the brake assemblies and the fluid reservoir of the master cylinder.

If the brake pedal pressure was increased instead of being decreased the control valve operates to give additional assistance until the thrust on each end of the valve control piston is balanced or until the limit of available vacuum is reached. Conversely, if the pedal pressure is only reduced, the control valve operates to reduce the hydraulic pressure in the brake assemblies until, again, a state of balance of the valve control piston is reached.

## SERVICING

Whenever possible the Girling Vacuum Servo Unit should be returned to the manufacturers for replacement but if this is not possible the renewing of all seals as contained in the Service Kit should provide a satisfactory unit providing **the internal working surfaces are in good condition.**

**There should be no sign of corrosion, pitting, scoring or steps on the piston rod, pistons or bores and the surfaces should be smooth to the touch.**

When dismantling, absolute cleanliness is essential. Wash the hands and lay out a clean sheet of paper on which to work and place the parts. Take care of all highly finished working surfaces on pistons, rods and bores. Clean hydraulic parts with Girling Cleaning Fluid, Alcohol or Girling Brake and Clutch Fluid (Crimson) and do not allow any other fluid, oil or grease to touch them. Special care should be exercised when removing or refitting the circlip in the hydraulic output cylinder and when re-assembling the vacuum cylinder to the body. On some servo units a screw and locknut is fitted to the end cover, IN NO CIRCUMSTANCES MUST THE SCREW BE DISTURBED.

## AIR FILTER

The air filter element is of a moulded cellular construction and should be renewed in accordance with the instructions given in the Owners Instruction Book.

### To renew

Remove the cover from the top of the servo unit by moving aside the spring clip and discard the soiled filter beneath. Clean the base plate and cover, position the clean filter on the base plate followed by the cover and secure the cover with the clip.

Alternately, remove the cover by withdrawing the centre screw, discard the soiled filter beneath but salvage the rubber washer. Clean the rubber washer and cover, position the rubber washer on the servo unit followed by the clean filter and cover; secure the cover with the centre screw.

## SERVO UNIT

### To remove and refit

1. Detach the vacuum pipe from the cast body of the servo unit by releasing the union nut.
2. Detach the hydraulic inlet and outlet pipes from the cast body by releasing the union nuts, trapping any escaping hydraulic fluid in a drip tray.
3. Remove the servo unit from the bracket in the engine compartment by withdrawing three bolts and washers; one nut, bolt and washer.
4. Refitting is the reverse of the removal sequence but the hydraulic system must be bled of air as previously described.

### To dismantle and re-assemble (Fig. 20)

1. Grip the servo unit in a vice by the two lower lugs on the cast body.
2. Remove the piston assembly (5) spring (6) gasket (1) and end cover (15) from the vacuum cylinder (19) by removing the transfer pipe retaining plate and seven nuts and bolts while controlling the pressure of the spring (6). When fitted DO NOT DISTURB THE SCREW AND LOCKNUT IN THE END COVER (15).
3. Remove the vacuum cylinder (19) and gasket from the cast body (29) by withdrawing three bolts, washers and a clamping plate and easing the grommet in the flange of the cylinder from the transfer pipe (17).

4. Remove the cover and transfer pipe (17) from the valve chest (26) by withdrawing four screws and washers.

5. Remove the valve retainer and flat horseshoe spring from inside the valve chest (26) by withdrawing two screws.

6. Withdraw the valves (22 & 31) and "Tee" shaped lever (11) complete from inside the valve chest (26) by applying light pressure to the plug (8) in the end of the control piston bore.

7. Remove the cast body (29) from the vice and withdraw the control piston assembly from the top bore by tapping the mounting flange of the cast body on a wooden block.

8. Dismantle the control piston assembly by compressing the piston spring, easing off the circlip and removing the spring and retainers.

9. Remove the two seals from the control piston and one from the plug (8).

10. Withdraw the piston rod bearing bush (23) from the output piston bore and using a hooked tool remove the gland seal beneath followed by the nylon spacer (24).

11. Mount the cast body vertically in the vice by one of the mounting lugs and fit the compression tool to press the output piston (25) into the bore. For the compression tool details see Fig. 21.

12. Using circlip pliers fully compress the circlip in the bore and carefully lift out the circlip exercising great care not to damage the bore, otherwise a brake failure may result.

13. Release the compression tool when the piston spring (27) will push out the washer followed by the output piston (25) the latter is then discarded

14. Refitting is the reverse of the removal sequence but particular attention must be given to the following.

    i All seals must be renewed and lubricated with Girling Brake Fluid; lubricate the bores and pistons with Girling Red Rubber Grease.

    ii Fit a new output piston (25) as the piston rod seal can only be fitted during manufacture and confirm that the taper seal has the larger diameter nearer the reduced end of the piston.

    iii Fit the spring (27) to the output piston (25) feed into the bore, spring first, followed by the washer and hold in position with the compression tool and clip the tool under the mounting flange of the cast body (29).

    iv Ensure that the circlip does not foul the side of the bore and fits snugly into its groove; this operation must be unhurried and the circlip pliers must be secure on the circlip, for any damage to the bore can result in brake failure. Remove the compression tool from the cast body.

    v Fit the nylon spacer (25) into the bore, large end first, followed by the gland seal, lip end first and finally fit the bearing bush (23).

    vi Fit the control piston to the bore so the transverse hole aligns with the hole in the valve chest (26).

    vii It is unlikely that the two nylon valves (22 & 31) will need renewing but when it is necessary their faces should be lapped on a piece of glass with fine lapping paste to ensure they are airtight.

    Fit the valves (22 & 31) and "Tee" shaped lever (11) complete so the horseshoe spring location above the

air valve (31) is away from the two securing screws inside the valve chest (26). It will be necessary to compress the end plug (8) to locate the end of the "Tee" shaped lever (11) in the control piston.

viii Fit a new rubber grommet in the flange of the vacuum cylinder (19) and locate a new gasket on the mounting face of the cast body (29).

ix Fit the vacuum cylinder (19) and clamping plate with the centre hole of the cylinder over the protruding bearing bush (23) and transfer pipe (17) ensuring there will be space over the grommet for the passage of air when the end cover (15) is fitted but leave the three bolts slack.

x Position the piston (5) and return spring (6) inside the vacuum cylinder (19) and push it down through the full stroke several times to align the bearing bush (23); remove the piston (5) and return spring (6) and tighten the three cylinder attachment bolts taking care not to displace the vacuum cylinder (19) on the flange of the cast body (19). If the cylinder is displaced it can cause the brakes to "hang-on".

xi Remove the sponge rubber backing ring (2) from the piston flange and fit the new one from the service kit. Smear the special lubricant, supplied in the kit, on the leather seal (3) of the piston (5).

xii Smear the piston rod (18) with Girling Red Rubber Grease and with the return spring in front offer up the assembly to the vacuum cylinder (19).

xiii Position the end cover (15) with a new gasket (1) on top of the piston (5) and press down, taking care the piston rod (18) enters the bearing bush (23) without damage.

xiv Secure the end cover (15) with the nuts and screws.

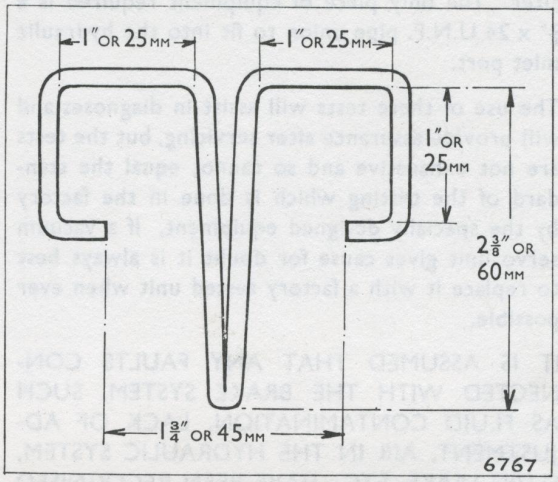


**Fig. 21.** *The compression tool*

## COMPRESSION TOOL (Fig. 21)

The compression tool, necessary to compress the output piston, is made from a 12 in. (30 cm.) length of ⅛ in. (3 mm.) diameter iron wire.

Bend the wire back on itself in the centre to make the middle "leg" of the tool. Follow with the six other bends as shown in the illustration, finally cutting the two ends so there is 1¾ in. (45 mm.) between them.

The centre "leg" is inserted into the output cylinder bore and pressed down until the two ends can be sprung apart and clipped under the mounting flange of the cast body. The tool is then pushed aside towards the control cylinder bore to allow room to insert the circlip pliers.

## TESTING EQUIPMENT

To make comprehensive tests, of the vacuum servo unit, requires complex and expensive equipment and this kind of testing is outside the capacity of many Service Workshops.

A number of simple tests can be made when the servo unit is installed which gives some useful information and these tests are described hereafter. The only piece of equipment required is a $\frac{3}{8}$" x 24 U.N.F. pipe union to fit into the hydraulic inlet port.

The use of these tests will assist in diagnoses and will provide assurance after servicing, but the tests are not exhaustive and so cannot equal the standard of the testing which is done in the factory by the specially designed equipment. If a vacuum servo unit gives cause for doubt it is always best to replace it with a factory tested unit when ever possible.

IT IS ASSUMED THAT ANY FAULTS CONNECTED WITH THE BRAKE SYSTEM, SUCH AS FLUID CONTAMINATION, LACK OF ADJUSTMENT, AIR IN THE HYDRAULIC SYSTEM, FLUID LEAKS, ETC., HAVE BEEN RECOGNISED AND ELIMINATED.

### Test 1

1. Fit the servo unit to the mounting bracket and before connecting, the air or fluid pipes fit a bleed screw to the fluid outlet port and the special adaptor to the fluid inlet port.
2. Connect the vacuum pipe from the engine inlet manifold to the adaptor and remove the air filter element.
3. Start the engine and while "ticking over" place the fingers over the air inlet port of the air filter and the vacuum port to determine if there is any suction at either orifice.
4. If suction can be detected, it indicates that the bores are scored or the components incorrectly assembled
5. Remove the adaptor.

### Test 2

1. Connect the vacuum pipe from the inlet manifold to the vacuum port.
2. Connect the fluid inlet and outlet pipes to their respective ports and bleed the hydraulic system of air.
3. Start and run the engine. While the brake is being applied, it should be possible to hear the hiss of the air inlet and with the hand on the vacuum cylinder feel the movement of the piston inside the vacuum cylinder.

### Test 3

1. Start and run the engine for half a minute then switch off and leave for two minutes.
2. Apply the brake and the servo unit should operate and the operation should be detected as described in Test 2.

### Test 4

Start and run the engine, apply the brake hard and hold it on for fifteen to twenty seconds. There should be no perceptible creep in the brake pedal.

If there is any creep, it indicates leaks or scored bores in the components.

### Test 5

1. Jack up the front roadwheels.
2. Start and run the engine.
3. Apply the brake and release.
4. The front roadwheels should be free to move half a second after the release of the pedal.

Tests 2 to 5 can be used to test a suspect Vacuum Servo Unit before it is removed from the car.

IF THE RESULT IS UNSATISFACTORY ON:—

Test 2. It means the servo unit is not working at all, which could be caused by a lack of vacuum, possibly a faulty non-return valve, or a fault within the servo unit.

Test 3. It indicates leaking gaskets, air valve or rubber grommet. Clamp the vacuum hose and repeat Test 3. If satisfactory, the non-return valve is faulty. To test for a leaking air valve run the engine and place the finger over the air inlet. If the suction is only slight the air valve is satisfactory and the leak is elsewhere.

Test 4. The source of the trouble can only be found by elimination. Check for leaks. If no leak of hydraulic fluid is evident clamp each hose successively and repeat the test each time. Finally plug the master cylinder outlet and test. If creeping of the pedal is evident when the hoses are clamped and the pedal is solid when the master cylinder outlet is plugged, the servo unit is faulty.

Test 5. If the brakes remain on, disconnect the vacuum pipe, operate the brakes to eliminate all the vacuum in the servo unit and repeat the test. If the brakes remain on, the fault is not in the servo unit. If the brakes now release normally, the fault is in the servo unit and the alignment of the piston in the vacuum cylinder is suspect.

## FAULT FINDING CHART

| FAULT | CAUSE | ACTION |
|---|---|---|
| Hard pedal—Apparent lack of servo assistance with engine running. | i Lack of vacuum. | i Check vacuum connections |
| | ii Restricted hose. | ii Check hose and renew if necessary. |
| | iii Rubber grommet. | iii Fit new parts from Service kit. |
| | iv Blocked air filter. | iv Examine air filter element and renew if necessary. |
| | v Faulty output piston. | v Fit new parts from Service Kit. |
| | vi Major fault in servo unit. | vi Fit new servo unit. |
| Brakes hanging on. | i Misaligned vacuum piston. | i Check as Test No. 5. |
| | ii Swollen rubber grommet or piston backing ring. | ii Fit new parts from Service Kit. |

| FAULT | CAUSE | ACTION |
|---|---|---|
| Slow action of servo unit | i Swollen rubber grommet. | i Fit new parts from Service Kit. |
| | ii Blocked filter or restricted air inlet. | ii Examine air filter element and renew if necessary.<br>Renew vacuum hose. |
| Lack of servo assistance on heavy braking. | Leak in servo vacuum. | Check for leaks. |
| Loss of fluid. | i Failure of seal or seals. | i Fit new parts from Service Kit. |
| | ii Scored bore. | ii Fit new servo unit. |

# THE LOCKHEED VACUUM SERVO UNIT

## GENERAL

The purpose of the vacuum servo unit is to lower the pedal pressure required to produce a given braking effect. This is achieved, essentially, by allowing fluid pressure from the master cylinder to operate a valve situated in the servo unit, which admits air to one side of a diaphragm contained within a vacuum cylinder (the vacuum being derived from the engine's inlet manifold).

The difference in pressure thus created across the diaphragm induces it to flex towards the low pressure side, taking with it a push rod which boosts the line pressure of the brake fluid going to the brakes. This operation is described in more detail under the heading "Principles of Operation".

The design of the servo unit is such that, if for any reason the servo fails to function, there remains an unrestricted passage for brake fluid to pass from master cylinder to wheel cylinder, so that normal unassisted braking is still available.

## MAINTENANCE

### Servo Air Filter

The filter in the air valve cover of the servo unit should be cleaned at regular intervals.
The procedure is as follows:—

1. With the ignition switched off, pump the foot brake to destroy any vacuum in the servo unit.

2. Remove the air valve cover assembly (item 19, Fig. 22) by withdrawing the five securing screws.

3. Lift the air valve (item 20, Fig. 23) off its seat and blow compressed air at low pressure into the filter chamber. Do not lubricate the filter or attempt to remove it from the air valve cover.

4. When renewing the filter, fit a complete air valve cover.

## DESCRIPTION

The unit is installed in the hydraulic braking system between the master cylinder and the wheel cylinders; that is to say, the outlet pipe from the master cylinder is connected to the inlet of the servo unit and the servo unit outlet is connected by pipes to the brake wheel cylinders.

The servo unit may be considered in three sections:

1. **The Slave Cylinder** from which pressure is applied to the brakes.

2. **The Vacuum Cylinder** which supplies the force required to operate the slave cylinder.

3. **The Control Valve Gear** which regulates the actions of the other two sections.

Reference should be made to Fig. 22 for details of the parts which comprise these three sections.

## PRINCIPLES OF OPERATION

The operation is shown diagrammatically in Fig. 24. The reference numbers used correspond with those used in the exploded view (Fig. 22) and sectional view (Fig. 23).

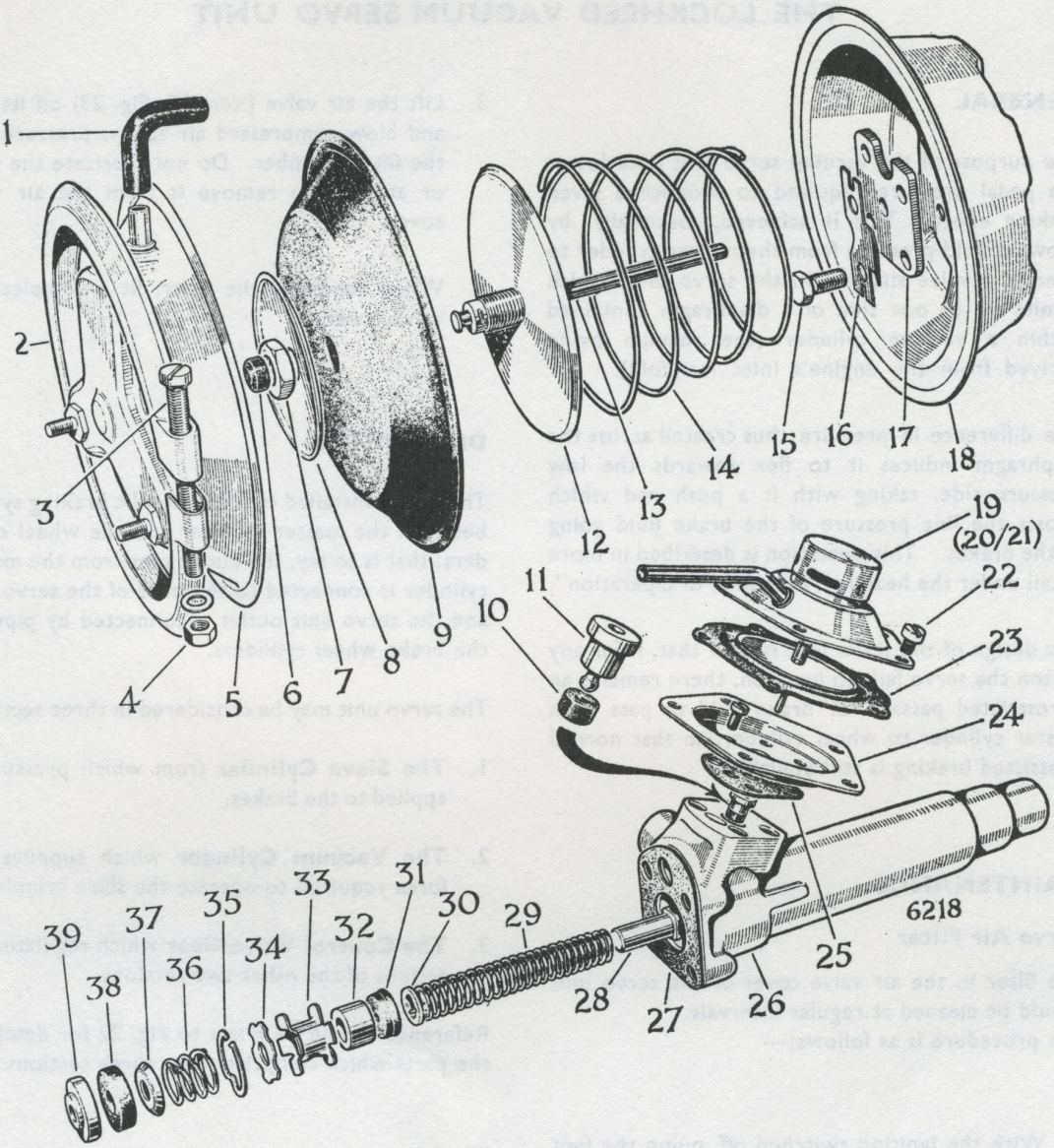


**Fig. 22** *Servo unit—exploded view*

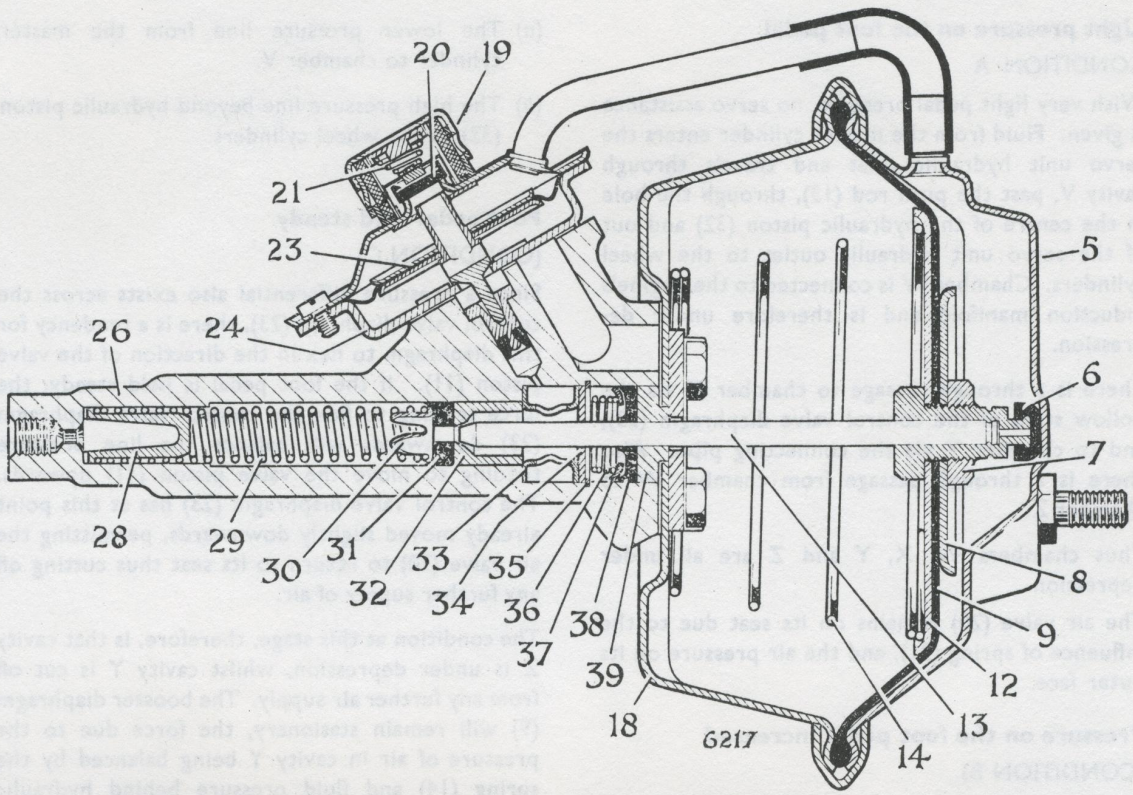


**Fig. 23.** *Sectional view of the servo unit*

*Annotation for Figs. 22 and 23*

1. RUBBER ELBOW
2. CLAMPING RING
3. CLAMPING SCREW
4. NUT
5. END COVER
6. RUBBER BUFFER
7. NUT
8. SMALL PLATE
9. BOOSTER DIAPHRAM
10. SEAL
11. VALVE PISTON
12. LARGE PLATE
13. PUSH ROD
14. RETURN SPRING
15. BOLT
16. LOCKING PLATE
17. ABUTMENT PLATE
18. VACUUM SHELL
19. AIR VALVE COVER ASSEMBLY
20. AIR VALVE
21. AIR VALVE SPRING
22. SCREW
23. CONTROL VALVE DIAPHRAM ASSEMBLY
24. VALVE HOUSING
25. GASKET
26. SLAVE CYLINDER BODY
27. GASKET
28. SPRING RETAINER
29. SPRING
30. SPRING GUIDE
31. MAIN CUP
32. HYDRAULIC PISTON
33. DISTANCE PIECE
34. WASHER
35. CIRCLIP
36. SPRING
37. CUP SPREADER
38. SECONDARY CUP
39. GUIDE PIECE

**Light pressure on the foot pedal**

CONDITION A

With very light pedal pressure, no servo assistance is given. Fluid from the master cylinder enters the servo unit hydraulic inlet and travels through cavity V, past the push rod (13), through the hole in the centre of the hydraulic piston (32) and out of the servo unit hydraulic outlet to the wheel cylinders. Chamber W is connected to the engine's induction manifold and is therefore under depression.

There is a through passage to chamber X via the hollow stem of the control valve diaphragm (23), and to chamber Y via the connecting pipe. Also there is a through passage from chamber W to chamber Z.

Thus chambers W, X, Y and Z are all under depression.

The air valve (20) remains on its seat due to the influence of spring (21), and the air pressure on its outer face.

**Pressure on the foot pedal increased**

(CONDITION B)

This results in an increase of hydraulic pressure on the bottom face of the valve piston (11) which causes it to move upwards taking with it the control valve diaphragm (23), the stem of which butts against the air valve (20) thus isolating chambers X and Y from the vacuum source. If the increase in hydraulic pressure is great enough, the air valve (20) is lifted off its seat causing air (at atmospheric pressure) to be admitted to chamber X and thence chamber Y.

The difference in pressure thus created across the booster diaphragm (9) induces it to flex towards the slave cylinder, taking with it the push rod (13).

The end of the push rod engages with the hydraulic piston (32), blocking off the hole in its centre and moving it down the slave cylinder bore, thereby increasing the hydraulic line pressure to the wheel cylinders. There now exists, therefore, two hydraulic line pressures:—

(*a*) The lower pressure line from the master cylinder to chamber V.

(*b*) The high pressure line beyond hydraulic piston (32) to the wheel cylinders.

**Foot pedal held steady**

(CONDITION C)

Since a pressure differential also exists across the control valve diaphram (23), there is a tendency for this diaphragm to flex in the direction of the valve piston (11). If the foot pedal is held steady, the force tending to flex the control valve diaphragm (23) downwards will balance the line pressure tending to move the valve piston (11) upwards. The control valve diaphragm (23) has at this point already moved slightly downwards, permitting the air valve (20) to return to its seat thus cutting off any further supply of air.

The condition at this stage, therefore, is that cavity Z is under depression, whilst cavity Y is cut off from any further air supply. The booster diaphragm (9) will remain stationary, the force due to the pressure of air in cavity Y being balanced by the spring (14) and fluid pressure behind hydraulic piston (32) and no further servo assistance will be given.

**Pressure on the foot pedal further increased**

(CONDITION B)

Increase in pressure from the master cylinder will increase the force on the bottom of the valve piston (11), re-opening the air valve (20) and increasing the servo assistance in the manner previously described.

When the opposing forces on the control valve diaphragm (23) are once more in balance, the air valve (20) will again close on its seat. It will be apparent, therefore, that the control valve diaphragm (23) acts as a balancing device so that for a given foot pedal pressure, a certain amount of servo assistance is supplied, which is proportional to the pedal pressure.

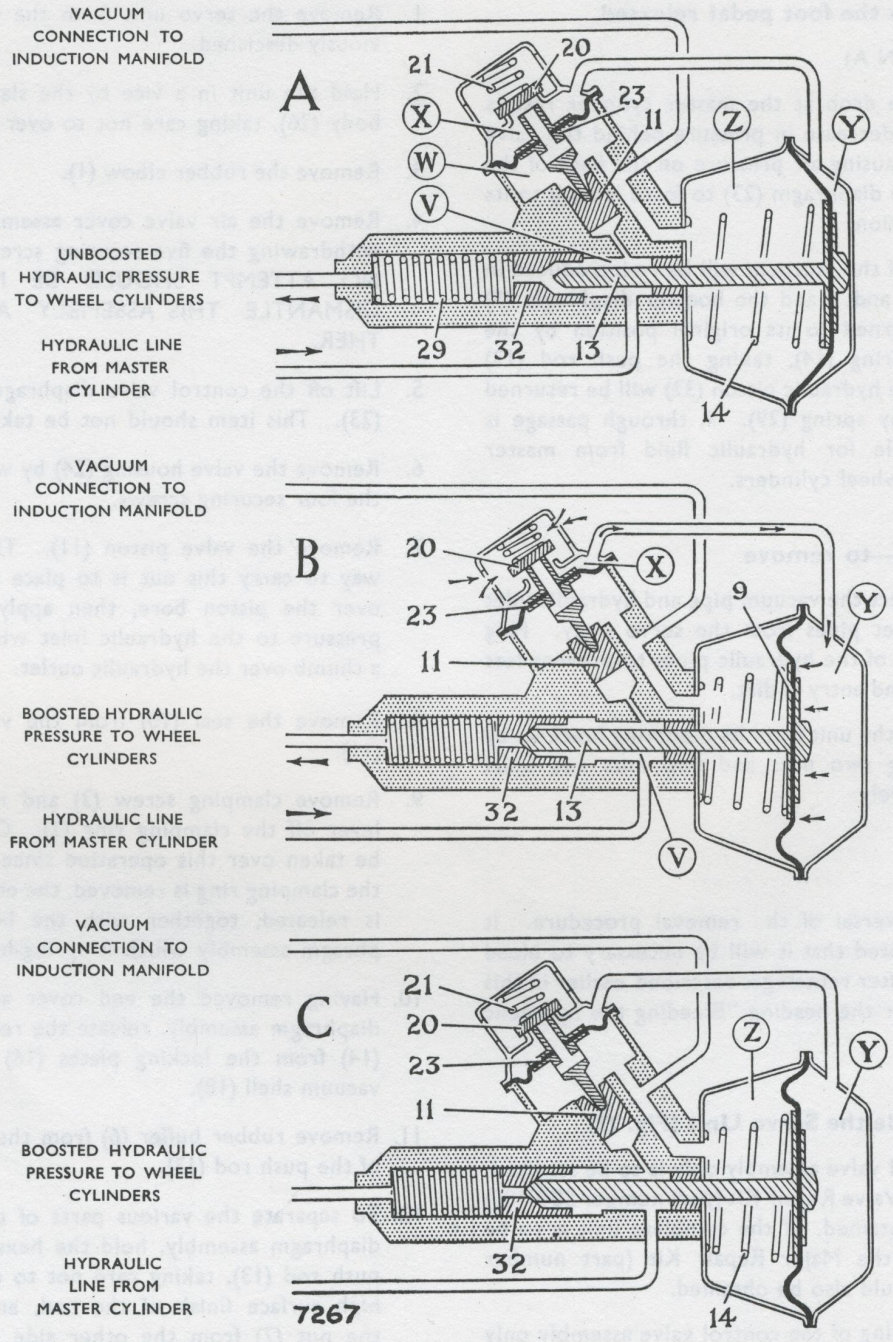


**Fig. 24.** *Diagram of the operating principles*

**Pressure on the foot pedal released**

(CONDITION A)

The pressure drop at the master cylinder results in a sudden decrease in pressure behind the valve piston (11) causing air pressure on the back of the control valve diaphragm (23) to force it back to its original position.

As a result of this, vacuum will be re-introduced in chambers X and Y and the booster diaphragm (9) will be returned to its original position by the action of spring (14), taking the push rod (13) with it. The hydraulic piston (32) will be returned to its seat by spring (29). A through passage is then available for hydraulic fluid from master cylinder to wheel cylinders.

**Servo Unit—to remove**

1. Disconnect the vacuum pipe and hydraulic inlet and outlet pipes from the servo body. Plug the ends of the hydraulic pipes to prevent loss of fluid and entry of dirt.
2. Remove the unit from its mounting brackets by removing two nuts and two nuts and bolts respectively.

**To refit**

This is a reversal of the removal procedure. It should be noted that it will be necessary to bleed the brakes after refitting as described earlier in this section under the heading "Bleeding the hydraulic system".

**To dismantle the Servo Unit (Fig. 22)**

If the control valve assembly only is to be serviced, the Control Valve Repair Kit (part number 5040185) should be obtained. If the complete unit is to be overhauled, the Major Repair Kit (part number 5040184) should also be obtained.

The dismantling of the control valve assembly only is covered by operations 1—5.

1. Remove the servo unit from the car as previously described.
2. Hold the unit in a vice by the slave cylinder body (26), taking care not to over-tighten.
3. Remove the rubber elbow (1).
4. Remove the air valve cover assembly (19) by withdrawing the five securing screws (22). NO ATTEMPT SHOULD BE MADE TO DISMANTLE THIS ASSEMBLY ANY FURTHER.
5. Lift off the control valve diaphragm assembly (23). This item should not be taken apart.
6. Remove the valve housing (24) by withdrawing the four securing screws.
7. Remove the valve piston (11). The simplest way to carry this out is to place a clean rag over the piston bore, then apply LOW air pressure to the hydraulic inlet whilst placing a thumb over the hydraulic outlet.
8. Remove the seal (10) from the valve piston (11).
9. Remove clamping screw (3) and nut (4) and lever off the clamping ring (2). Care should be taken over this operation since as soon as the clamping ring is removed, the end cover (5) is released, together with the booster diaphragm assembly which is spring-loaded.
10. Having removed the end cover and booster diaphragm assembly, release the return spring (14) from the locking plates (16) inside the vacuum shell (18).
11. Remove rubber buffer (6) from the outer end of the push rod (13).
12. To separate the various parts of the booster diaphragm assembly, hold the hexagon of the push rod (13), taking care not to damage the high surface finish of the rod, and unscrew the nut (7) from the other side of the diaphragm (9).

13. Bend back the tabs of the locking plates (16) and remove the four bolts (15) securing the vacuum shell (18) and abutment plate (17) to the slave cylinder (26). Note the gasket (27).

14. Extract the guide piece (39) and secondary cup (38) from the slave cylinder using a suitable hooked tool; also the cup spreader (37) and spring (36).

15. Depress the hydraulic piston (32) against the spring pressure by using the push rod (13) or a suitable piece of $\frac{5}{16}$ in. (7.9 mm.) diameter brass rod, and release the circlip (35). Removal of the circlip will then release the washer (34), distance piece (33), hydraulic piston (32), main cup (31) and spring (29) complete with spring guide (30) and spring retainer (28).

### To inspect

If the air-valve, air-valve cover, pipe, or filter are faulty a new air-valve cover assembly must be fitted.

Examine all metal parts for damage or wear, particularly those listed below, and renew as necessary.

(*a*) valve piston (11)

(*b*) valve piston bore

(*c*) slave cylinder main bore

(*d*) push rod (13)

(e) distance piece (33).

### To reassemble

Discard those parts for which replacements are supplied in the repair kit. The remaining original parts, apart from the air valve cover assembly *, should be washed in industrial methylated spirit and allowed to dry.

Just before assembling, the rubber cups and seals should be dipped in Lockheed brake fluid of the specified grade (see Section "P").

In order to fit the main cup (31) it will be necessary to make up a fitting sleeve, the ideal dimensions for which are as follows:

| | | |
|---|---|---|
| Inside diameter | ... | 0·688—0·690 in. (17·48—17·53 mm.) |
| Outside diameter | ... | 0·9735—0·9745 in. (23·73—23·75 mm.) |
| Length | ... ... | 1·37—1·38 in. (34·8—35·1 mm.) |

1. Position the slave cylinder (26) in the vice with the hydraulic outlet facing downwards, taking care not to overtighten the clamp.

2. Fit the spring retainer (28) into one end of the spring (29) and the spring guide (30) into the other end. Insert the spring assembly into the slave cylinder bore, retainer end first.

3. Fit the main cup (31) by positioning the fitting sleeve, previously made up, at the mouth of the slave cylinder bore and passing the main cup through it (lip foremost). Take particular care not to turn back or buckle the lip.

4. Fit the hydraulic piston (32), flat face leading, into the bore and holding the piston against the spring pressure, fit the distance piece (33), washer (34) and circlip (35). Use the push rod (13), or a $\frac{5}{16}$ in. (7·9 mm.) diameter brass rod to depress the piston when fitting the circlip. Take care not to score the slave cylinder bore with the circlip and after fitting check that it is properly seated in its groove.

5. Insert spring (36) into the slave cylinder bore followed by the cup spreader (37), dished side facing inwards. Next, insert the secondary cup (38), hollow side facing inwards, ensuring that it locates properly on the cup spreader (see Fig. 23).

6. Fit the guide piece (39) in the end of the bore with the flat side facing inwards.

7. Place the gasket (27) in position.

8. Offer up the vacuum shell (18) to the slave cylinder (26), locating its base on the projecting portion of the guide piece (39).

*Refer to "Maintenance" for method of cleaning the filter in the air valve cover assembly

9. Place the abutment plate (17) in position inside the vacuum shell (18) and secure, using two locking plates (16) and four bolts (15). The four bolts should be tightened to a torque reading of 150—170 lb. in. (175—195 kg. cm.).

10. To build up the booster diaphragm assembly proceed as follows:—

    (*a*) Hold the hexagon of the push rod (13) in a vice with the push rod facing downwards.

    (*b*) Slide the large plate (12) over the threaded spigot with the lip side facing downwards.

    (*c*) Similarly, slide the rubber diaphragm (9) over the push rod with the hollow side facing the large plate (12).

    (*d*) Slide the small plate (8) over the spigot, lip side upwards, and secure by fitting the nut (7).

    (*e*) Lock the nut by punching the thread in two separate places.

    (*f*) Fit the rubber buffer (6).

11. Engage the small end of the return spring (14) under the locking plate tabs (16).

12. Engage the booster diaphragm assembly on the large end of the return spring and enter the end of the push rod (13) into the slave cylinder bore by compressing the spring. Whilst holding the assembly in this position, fit the end cover (5) and secure, using the clamping ring (2), bolt, nut and washer. Do not fully tighten the nut and bolt at this stage.

13. Fit the seal (10) on to the valve piston (11) with the lip facing away from the piston, and insert the piston, seal end first, into the bore in the inclined face of the slave cylinder.

14. Place the gasket (25) in position on the inclined face of the slave cylinder, followed by the valve housing (24), and secure by fitting the four screws.

15. Place the control valve diaphragm assembly (23) on the valve housing (24), with the narrow stem inserted into the piston (11) and the screw holes in the periphery of the diaphragm in line with the holes in the flange of the valve housing.

16. Fit the air valve cover assembly (19) complete with rubber elbow (1) and secure, using five screws (22).

17. Reposition the end cover (5) so that the connecting pipe is in line with the rubber elbow (1) then fully tighten the nut and bolt securing the clamping ring (2).

18. Fit the rubber elbow over the connecting pipe.

19. Refit the servo unit to the car as previously described, and test for correct operation.

**Vacuum non-return valve**

The vacuum non-return valve is fitted to the engine's induction manifold.

Its purpose is to preserve vacuum in the servo and to prevent damage to the servo unit in the event of backfire. It consists of a spring-loaded valve which, under normal conditions, will be open due to suction from the manifold. Should the suction from the manifold become insufficient to preserve the vacuum in the servo unit, the valve will close on its seat due to the action of the spring.

Since it is not possible to service the non-return valve, in the event of trouble it should be renewed.

To remove, pump the footbrake several times to destroy any vacuum in the servo and vacuum hose pipe, then remove pipe from the non-return valve.

Unscrew non-return valve from engine manifold.

When refitting use a new copper washer between the non-return valve and manifold.

## HANDBRAKE CABLE

### Alpine Series III and Rapier Series IV Models onwards

The long handbrake cable from the driver's handbrake lever to the compensating lever mounted on the rear axle is nylon lined and requires no periodcal lubrication, thus no greaser is provided.

## HANDBRAKE COMPENSATING LEVER

### Alpine Series III and Early Rapier Series IV Models (Fig. 25)

A new type handbrake compensating lever is mounted on the rear axle in a central position.

The compensating lever consists of a downward pointing lever pivoting in a bracket welded onto the rear face of the differential casing.

The lower end of the compensating lever accommodates the end of the outer casing from the driver's handbrake lever, while the inner cable passes through the compensating lever and runs parallel with the axle casing to one brake assembly. The compensating lever also accommodates the inner end of a short cable from the opposite rear brake assembly.

When the handbrake is correctly adjusted and fully released the compensating lever should be inclined 5° towards the short cable side, i.e., the driver's side of the car.

### Adjusting handbrake (Fig. 25)

Adjustment of the rear brake shoes will automatically adjust the handbrake and when the handbrake operation is correct there is four to six clicks of handbrake lever travel before the rear wheels are fully locked.

If, with the rear brakes in correct adjustment, excessive handbrake lever travel is still experienced, adjust the length of the long and short handbrake cables as follows:—

1. Chock the front wheels, release the handbrake and jack up the rear of the car.

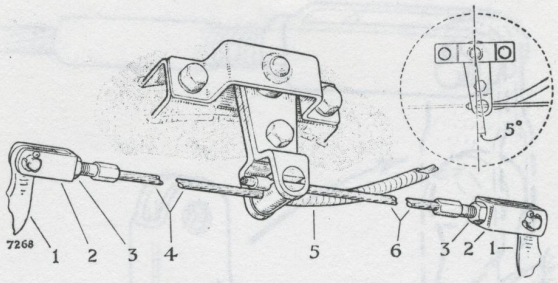


**Fig. 25.** *Compensating lever assembly mounted on the rear axle; note the 5° inclination of the compensating lever towards the side having the short cable. Right-hand drive shown, left-hand drive symmetrically opposite*

*In some instances an extension lever (Fig. 26) may be fitted between the lever (1) and the handbrake cable forkend (2).*

1. WHEEL CYLINDER LEVER
2. FORK END
3. LOCKNUT
4. INNER CABLE
5. OUTER CASING
6. SHORT CABLE

2. Lock both rear wheels by rotating the rear brake shoe adjusters fully clockwise.

3. Detach the inner cable (4) of the long handbrake cable from the wheel cylinder lever (1) by discarding the split pin, removing the plain and spring washers and withdrawing the clevis pin from the cable fork-end (2).

4. Apply light pressure to the compensating lever to tighten the short cable (6); when it is observed that the compensating lever is not inclined 5° towards the short cable side, detach the short cable (6) from the wheel cylinder lever (1) by discarding the split pin, removing the plain and spring washers and withdrawing the clevis pin from the cable fork-end (2). Adjust the length of the short cable (6) by slackening off the locknut (3) and screwing the cable fork-end in or out to shorten or lengthen the cable respectively and retighten the locknut. Refit the cable fork-end (2) to the wheel cylinder lever (1) by reversing the removal sequence and using a new split pin.

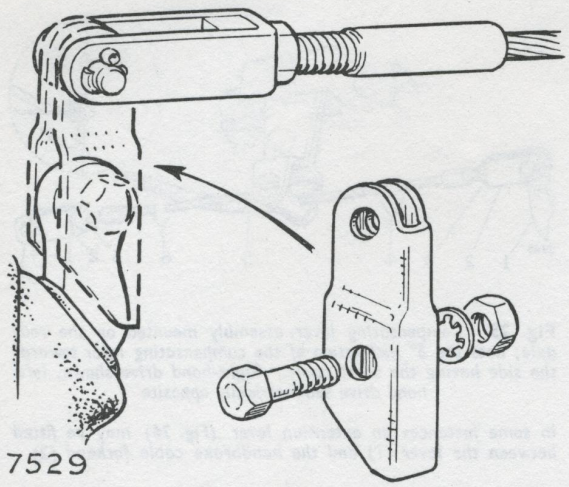


**Fig. 26.** *The lever extension fitted between the wheel cylinder lever and the handbrake cable forkend; note the position of the "fold" in the lever extension relative to the wheel cylinder lever.*

5. Adjust the length of the long handbrake cable (4), detached during a previous operation, to remove all slackness from itself and the short cable. Refit the cable fork-end (2) to the wheel cylinder lever (1) by reversing the removal sequence and using a new split pin.

6. Re-adjust the rear brake shoes, see under "Brake Adjustments".

7. Lower the car to the ground, apply the handbrake and remove the chocks.

## Handbrake operation (Fig. 26)

### Early Rapier Series IV Models

To improve handbrake operation on early Rapier Series IV Cars an extension is fitted to the wheel cylinder levers and the forkends of the handbrake cables are attached to these lever extensions.

The lever extensions can be fitted retrospectively to very early cars of the same Series should the need arise.

### To remove and refit (Fig. 26)

The removal of the lever extension will be necessary only when the wheel cylinder is being removed from the back plate, by withdrawing a bolt, nut and washer.

When refitting the lever extension ensure that the fold of the pressing is towards the centre of the car.

# SELF ADJUSTING REAR BRAKES

## DESCRIPTION (Fig. 27)

Later Rapier Series IV Cars and onwards are equipped with self adjusting rear brakes which will maintain a specific brake shoe clearance. The self adjusting action is effected as the brakes are released whether foot or hand operated.

The previous "micram" adjusters have been replaced by screwed tappets and adjuster wheels with a pawl linkage mounted on the outer piston and wheel cylinder body. Self adjustment is effected by movement of the outer piston.

### Adjustment—foot operated

Periodical adjustment is unnecessary and will only be required after the brake shoes have been refitted.

1. Pump the foot pedal a number of times, when each pump will be of a lesser depth than the previous pump while brake shoe clearance is being reduced.
2. Stop, when the pedal reaches a constant depth.

### Adjustment—hand operated (Fig. 28)

The handbrake mechanism is set during initial assembly and will only require attention when replacement parts have been fitted or the length of the cable inadvertantly altered.

1. Chock the front wheels, release the handbrake and jack up the rear of the car.
2. Remove all slackness from the handbrake cable by slackening off the locknut and rotating the threaded sleeve, retighten the locknut.

   Correct adjustment can be ascertained by counting the clicks of hand lever travel, when five or six clicks will be heard.
3. Ensure that the brakes do not bind by rotating the rear wheels by hand.
4. Apply the handbrake, remove the jack and the chocks.

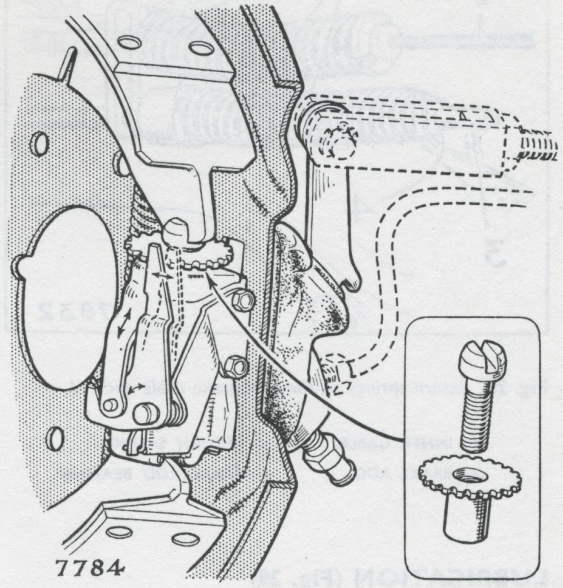


**Fig. 27.** *A left hand self adjusting wheel cylinder with arrows on the pawl linkage indicating the direction of travel as the brake is applied and released. The insert shows the screwed tappet and adjuster wheel.*

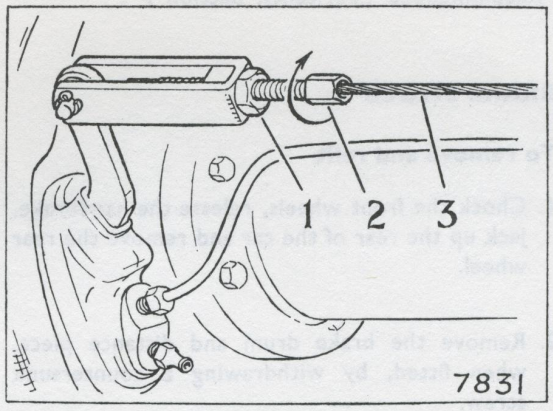


**Fig. 28.** *The handbrake cable adjuster, the arrow indicates the direction of rotation to shorten the cable.*

1. LOCKNUT. 2. THREADED SLEEVE.
3 INNER CABLE

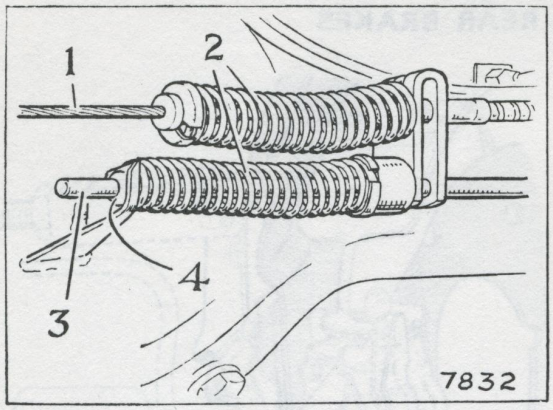


**Fig. 29.** *Return springs on the handbrake cable and rod.*

1. INNER CABLE.
2. RETURN SPRINGS.
3. BRAKE ROD.
4. BRAKE ROD BEARINGS.

## LUBRICATION (Fig. 29)

At regular intervals, clean off and coat the pull off springs on the handbrake cable and rod together with the rod bearing on the rear axle differential casing with the recommended grease see under "Recommended Lubricants, Section P".

## BRAKE SHOES

### To remove and refit

1. Chock the front wheels, release the handbrake, Jack up the rear of the car and remove the rear wheel.

2. Remove the brake drum and distance piece, when fitted, by withdrawing a countersunk screw.

3. Withdraw the two brake shoe steady posts from the back plate by holding the head of the steady post and rotating the dished washer 90°.

4. Apply a rubber band to the wheel cylinder to retain the tappet and adjuster wheel in the head of the piston; identify the four holes in the brake shoe webs accommodating the two pull off springs.

5. Remove the heel ends of both brake shoes from the abutment opposite the wheel cylinder followed by the toe end of the trailing shoe from the wheel cylinder body; the tension of the pull off springs is released and the leading shoe can now be removed from the slot in the tappet.

6. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

   i. Ensure that the wheel cylinder moves freely within the back plate slot, when this condition is not evident determine and eliminate the cause of the stiffness.

   ii. Smear the slots in the fixed abutment, tappet and wheel cylinder body also the underside of the adjuster wheel sparingly with high melting point grease; screw, the tappet into the adjuster wheel to its fullest extent, the round headed tappet has a right hand thread and the hexagon headed tappet a left hand thread.

   iii. When fitting new brake shoes also fit new pull off springs and position the springs between the brake shoe webs and the back plate. The double coil spring is fitted adjacent to the wheel cylinder and using the outer large hole in the leading shoe and the outer hole of the two in the trailing shoe. The single coil spring is fitted adjacent to the abutment so that coil faces inward using the inner hole of the two in the leading shoe and the outer large hole in the trailing shoe.

   iv. Adjust the brakes by pumping the foot pedal.

## WHEEL CYLINDERS

### To remove and refit

1. Remove the brake shoes from the back plate, see under "Brake shoes—To remove and refit".

2. Detach the handbrake cable or rod from the wheel cylinder lever by withdrawing the spring clip from the clevis pin, removing the plain and spring washers and the clevis pin from the cable forkend or by releasing the spring clip from the upturned end of the brake rod.

3. Withdraw the hydraulic pressure pipe(s) from the wheel cylinder by releasing the union nut(s), trapping any escaping fluid in a drip tray.

4. Remove the wheel cylinder from the back plate by detaching the rubber dust cover and sliding the wheel cylinder in the back plate slot towards the piston end, then manoeuvring the opposite end out of the slot.

5, Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

   i. Grease the back plate slot sparingly with high melting point grease, ensure that the wheel cylinder moves freely within the slot both before and after the rubber dust cover is fitted.

   ii. The brake shoes are fitted, see under "Brake shoes—To remove and refit".

   iii. When a new wheel cylinder is fitted, check the operation of the handbrake.

### To dismantle and reassemble

1. Clean off all road dirt and when working on two wheel cylinders, identify them left or right hand.
2. Remove the tappet and adjuster wheel from the outer piston by removing the rubber band.
3. Withdraw the outer piston and pressing from the wheel cylinder; it will be necessary to rotate the piston a short distance to disengage the pin in the end of the pressing from the adjuster pawl.
4. Remove the adjuster pawl, tension spring and mounting plate from the wheel cylinder by withdrawing two bolts. Remove the lever by ejecting the pivot pin.
5. Eject the inner piston from the wheel cylinder by applying low pressure air to pressure pipe or bleed screw tappings.
6. Remove the rubber seals from the inner and outer pistons.
7. Reassembly is the reverse of the dismantling sequence but particular attention must be given to the following:—

   i. All parts must be meticulously clean and reassembled under equally clean conditions.

   ii. The tapered seal is fitted to the inner piston using a liberal coating of brake fluid and with the wider end of the taper away from the slotted end of the piston.

   iii. Smear the inner piston and seal with brake fluid and feed the piston, seal end first, into the body exercising care not to damage the fine edge of the seal and so the longest side of the slot in the piston aligns with the slot in the wheel cylinder body.

   iv. The rectangular seal is fitted to the outer piston using a liberal coating of brake fluid and fed into the wheel cylinder body, engage the pin at the end of the pressing in the groove in the adjuster pawl.

   v. The hexagon and round headed tappets have left and right hand threads respectively and are fitted to the right and left hand wheel cylinders respectively.