

Chapter G

HYDRAULICS

(POWER BRAKING AND AUTOMATIC HEIGHT CONTROL SYSTEMS)

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Chapter G HYDRAULICS (POWER BRAKING AND HEIGHT CONTROL SYSTEMS) INTRODUCTION

Introduction

The Rolls-Royce Silver Shadow and Bentley T Series motor cars are equipped with a power braking system and an automatic height control system, both of which utilise the same hydraulic fluid (refer to Chapter D), and employ similar power sources.

The two systems are, to some extent, integrated and various components used in each system are common. Both systems are entirely new, thus different servicing procedures and operations are involved.

Since some of these new procedures and techniques are common to both systems, the opportunity has

been taken to combine the two in one Chapter under the general heading 'Hydraulics'.

Details of the mechanical hand brake linkage are included for convenience.

Acknowledgement

"Features of the hydraulic control of the brake system licenced by Soc. Anon. André Citroën under French Patent Number 1,014,251 and Pat. of Add. Number 61,598."

Section G1

SPECIAL PRECAUTIONS

Important

It is of the utmost importance that Service Personnel should fully appreciate that the hydraulic systems fitted to the Rolls-Royce Silver Shadow and Bentley T Series cars operate at **high pressures**.

The systems are designed to operate safely under normal working conditions, but, as is the case with any high pressure fluid or gas, when service procedures are carried out or work is performed on the systems, certain precautions **must** be observed to ensure adequate safety to Personnel and equipment.

It is essential that before attempting any work on the hydraulics of the car, Service Personnel should note carefully the contents of this Section and by fully conversant with the precautions which must be taken to ensure adequate safety and correct system operation.

It is also important to note and conform with the instructions given on the reservoir sight glass plate and the hydraulic accumulator warning plates.

Cleanliness

For the correct functioning of the hydraulic systems it is imperative that meticulous care is taken to ensure complete cleanliness at all times.

Since both the braking system and the height control system employ components which have very fine manufacturing limits, the ingress of even very fine particles of foreign matter could have very serious effects on the operation of the systems.

Care must therefore be taken to ensure that at all times only clean fluid of the specified type (refer to Chapter D) is used in the systems and that any overhauled units or components have not been exposed to contamination before they are fitted to the car. Contact with mineral based oils must be avoided at all times as these oils have a detrimental effect on the rubber seals used in the hydraulic systems.

Hydraulic fluid

Always refer to Chapter D for correct type of fluid to be used in the systems.

It must be noted that brake fluid is hygroscopic, i.e. that the fluid will absorb and chemically combine with water from the atmosphere.

Brake fluid which is contaminated by water will boil at a much lower temperature than fluid with no water content.

If the fluid is contaminated and the car is braked excessively or very hard from high speeds, there will be a tendency for the heat generated by the brakes to boil the fluid, finally resulting in vaporisation of the brake fluid and ineffective brakes.

To eliminate possible contamination of the brake fluid it is most essential that the fluid is not exposed to the atmosphere for more than the absolute minimum of time. It should always be stored in and used direct from **small** sealed containers and when the systems are replenished, the two reservoir covers and the container cover must be replaced immediately.

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Blanks

Whenever units, pipes or components are disconnected from the hydraulic systems all open ports and pipe ends must be blanked off immediately to avoid system contamination.

It is stressed that the clean condition of any blanks used is equally as important as the clean condition of the components they seal.

The size and type of each blank is as follows:

Male $\frac{3}{8}$ in. U.N.F.

Female $\frac{3}{8}$ in. U.N.F.

Male $\frac{7}{16}$ in. U.N.F.

Female push-on blanking cap (two types).

Male $\frac{3}{8}$ in. U.N.F.

Quantities of blanks may be obtained, on request, from the Parts Department at Crewe.

Note Masking tape and/or cork bungs do not constitute blanks. In addition, **special pressure blanks** are available, capable of withstanding full hydraulic system pressure, for use during testing and fault diagnosis procedures where it may be necessary to blank off a pipe or component and then charge the systems.

The Part Numbers of the pressure blanks listed in the Tools Catalogue are as follows:

When used, these blanks must be torque tightened to the figures quoted for the pipe unions which they replace.

RH 7810 Male $\frac{3}{8}$ in. U.N.F.

RH 7809 Female $\frac{3}{8}$ in. U.N.F.

It must be noted that normal bleed screws may be used in place of charging adaptor plunger (RH 7810) if desired.

Precautions before working on the car

Before any work, excepting bleeding and specified tests, is carried out on the car hydraulics, the systems must be de-pressurised as follows:

With the exception of bleed screws, pipes and components must never be disturbed when the systems are in a pressurised state.

System De-pressurisation

Either of the two following methods may be employed to de-pressurise the systems but generally it will be found that the first is the more convenient.

Method 1

Switch on the ignition with the gearchange selector in Neutral or a car door open (fast height control conditions) but do not start the engine, then pump the brake pedal 50 or 60 times until both hydraulic

warning lamps on the instrument panel are illuminated and remain illuminated.

De-pressurise the height control rams by placing a bleed tube on each ram bleed screw in turn, opening the screws and bleeding off the fluid into a clean container.

After each ram has been de-pressurised the bleed screw must be tightened up and the reservoir topped-up to replace that fluid bled off.

If the work on the system requires the removal of hydraulic pipes or components, disconnect the battery which is located in the boot.

Method 2

With the ignition switched off, place a length of bleed tube over the bleed screw in the accumulator valve body and immerse and hold the free end in a clean container.

Open the bleed screw slightly and bleed until fluid no longer flows from the accumulator. The bleed screw should only be opened fractionally otherwise the accumulator pressure will force the tube off the bleed screw.

Close the bleed screw, remove the tube and repeat the operation for the other accumulator.

Repeat the procedure for evacuating the height control rams, as given under Method 1.

Removing components

Prior to disconnecting any pipes or removing hydraulic components from the car, the area around the pipes and components should be thoroughly cleaned; particular attention should be paid to the localised areas around the pipe unions and their corresponding ports.

Blanks should be cleaned and fitted as quickly as possible to the exposed ports.

Cleaning components

Components which have been removed should be thoroughly cleaned before replacement.

Blow dry, compressed air through all pipes. Rubber pipes, sealing rings and other components should be washed in methylated spirits and then dried with dry compressed air.

Cloths, even the lint free type, should **never** be used to clean hydraulic components or sealing rings.

Note When rubber seals are washed in methylated spirits, they must not be allowed to soak, as prolonged immersion in spirit could have a detrimental effect.

Methylated spirits is the only recommended cleanser; trichlorethylene, paraffin or petrol must never be used to clean hydraulic components.

Hydraulic accumulator spheres

The hydraulic accumulator spheres are charged on one side of the diaphragm with Nitrogen gas (see Section G6—The hydraulic accumulators) through a one-way charging valve in the end of the sphere.

Replacement spheres are supplied in an uncharged state and therefore must be charged by the Retailer before they are used to replace existing faulty spheres.

Exchange spheres are supplied complete with charging valve cap; a warning plate and locking washer are supplied loose. A label is attached which reads 'Uncharged—Remove label on charging and attach warning plate'.

It is of the utmost importance that, when the sphere is charged, the warning plate is fitted below the charging valve cap (see Fig. G13).

Spheres must never be transported in a charged state. If spheres are to be returned to the Parts Department at Crewe, or transported by rail, air or sea, they must be discharged before despatch.

Service Personnel are advised that spare accumulator spheres should be charged and leak tested immediately on receipt and then stored in a charged condition.

This ensures that the storage period is utilised as a time/leakage test so that when a sphere is removed from store and the pressure of the Nitrogen is tested after fitting, it can be seen whether the sphere is still fully charged with Nitrogen.

Spheres which have been correctly charged and successfully leak tested before storage and which then show a loss of pressure in excess of 25 lb/sq. in. (1,75 kg/sq. cm.) when tested prior to fitting, must be rejected. The sphere should be recharged and leak tested again to determine the cause of leakage. If the leak persists, the sphere should be discharged and dismantled and the diaphragm checked and renewed if necessary (refer to Section G6) and returned to the Parts Department at Crewe, with all relevant information.

Lubrication

Seals, other than dust covers, used in the hydraulic systems should only be lubricated with clean brake fluid of the approved type.

Servicing rubber components

In the interest of safety, the rubber components used in the hydraulic systems have been allotted specific 'life' mileages at the completion of which, or at the nearest Service, it is recommended that the components are renewed. (Refer to Chapter D for the recommendations.)

Hydraulic system—General maintenance

When the hydraulic reservoir and systems are drained completely always fill with fresh clean fluid of the specified type. Refer to Chapter D for the mileage/time interval and fluid specification.

This procedure will require a complete bleeding operation to be performed afterwards to remove all air from the systems.

Storage and Transportation

The care taken to prevent contamination of components during storage or transportation is extremely important.

Replacement parts, pipes and units must be correctly and securely sealed with the recommended blanks which must not be removed until immediately prior to fitting. They must also be adequately protected from dust or damage.

Sealing rings and rubber pipes in store should be protected from dust, air, light and heat.

Fitting replacement units

Replacement hydraulic units are tested and blanked off before being despatched from the factory and are full of hydraulic fluid.

It is advisable, when fitting a replacement unit, that when the unit has been placed in position and the blanks removed, the fluid in the unit is allowed to drain before the pipes are connected.

Note The fluid should not be blown out; allowing it to drain is sufficient.

When drained, the pipes should be connected and the appropriate bleeding operations carried out.

Section G2

BLEEDING THE HYDRAULIC SYSTEMS

Introduction

It is essential that, in order to obtain optimum performance, the hydraulic systems must at all times be completely free from air. The two hydraulic systems are re-circulatory and therefore, if air is allowed to enter them at any point it could cause reduced efficiency.

Bleed screws are fitted to the systems at various points and it is imperative, should a system be disturbed in Service and pipes disconnected, that the entire system downstream of this point be thoroughly bled to expel all air.

The bleed screws are fitted to the following components.

The hydraulic accumulators, the brake calipers and the height control rams.

On early cars, bleed screws were fitted to both brake distribution valves but, owing to valve design changes, these are no longer necessary and can be ignored.

Two operators are necessary to bleed the systems. Whilst bleeding is being carried out it is essential that the two reservoir compartments are kept topped-up, above the topping-up level on the sight glass, with clean approved fluid (refer to Chapter D).

Note Bleed screws must be torque tightened to between 8 lb.ft. and 10 lb.ft. (1,10 kg.m. and 1,38 kg.m.).

Bleeding the low pressure (master cylinder) system

It is important that the following method of bleeding

the master cylinder hydraulic system is always employed.

1. Check that the hydraulic reservoir is topped-up to the 'Max' level mark; the low pressure system is fed from the rear reservoir compartment.
2. Before bleeding the low pressure system, depressurise the high pressure systems (see Special Precautions).
3. Fit a rubber bleed tube to one of the rear brake caliper **upper** cylinder of **early cars** and **lower** cylinder of **later cars** bleed screws (see Figs. G44 and G45) and immerse the free end in about one inch of fluid in a clean bottle.

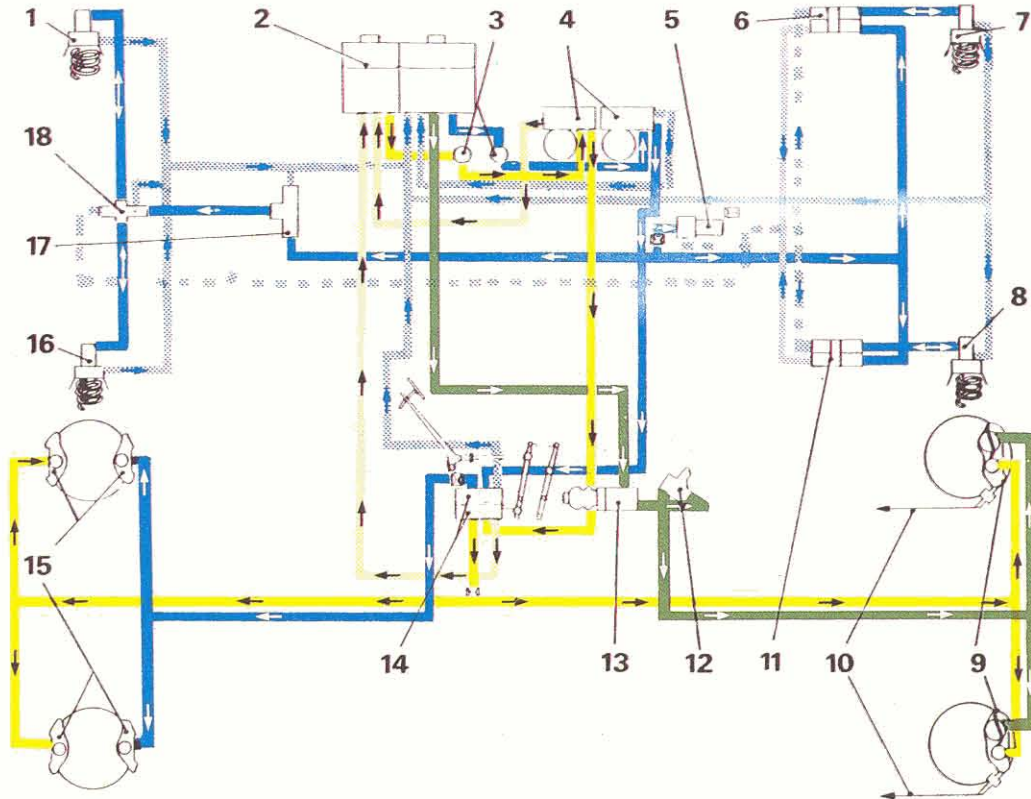
Note The cars affected by this modification are, Standard cars—1899 and onwards, Coachbuilt cars 1874 and onwards including Nos. 1807 and 1869.

As a second means of identification, the **green sleeved** pipe denotes the master cylinder system; the **blue sleeved** pipe denotes the high pressure (power braking) system.

4. Open the bleed screw wide while the second operator presses the foot brake pedal quickly down, tighten the bleed screw, then allow the pedal to return slowly. Repeat this operation until all bubbles cease, then tighten the bleed screw on a downward stroke of the pedal, i.e. when fluid is flowing into the container.
5. The operation should be repeated for the other rear brake caliper **upper** or **lower** cylinder, whichever

Chapter G

EARLY CARS



LATE CARS

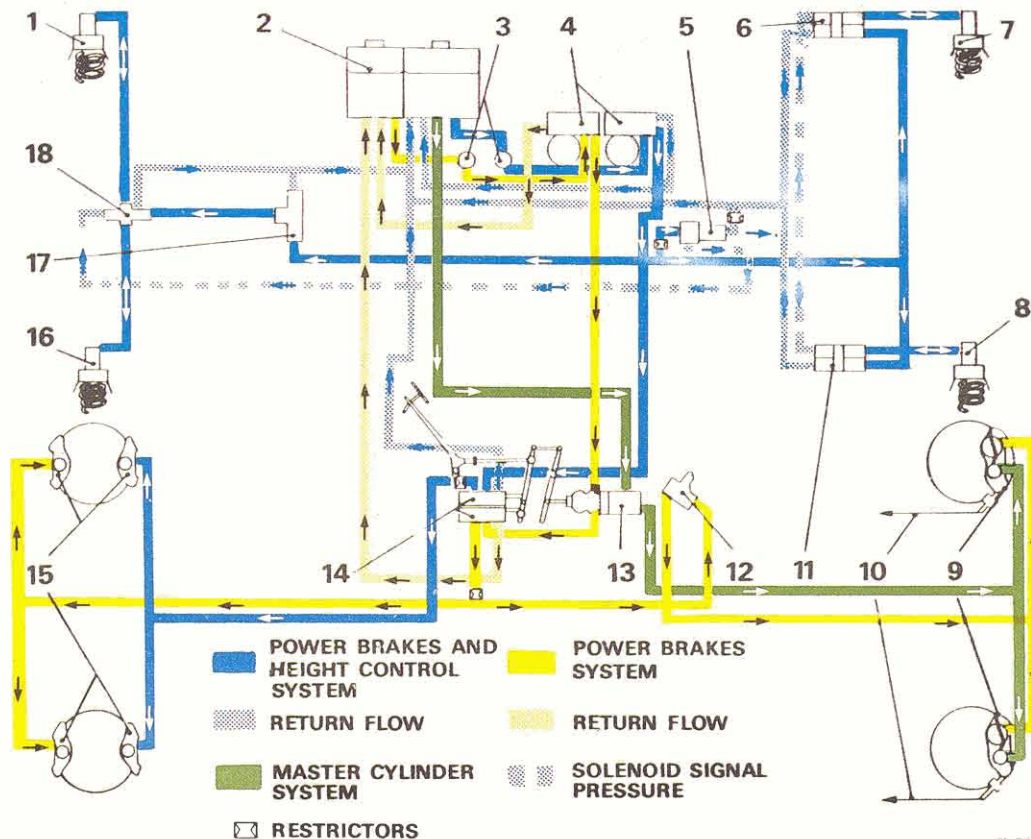


FIG. G1 DIAGRAM OF HYDRAULIC SYSTEMS (EARLY AND LATER CARS)

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- | | | |
|-----------------------------|---|-------------------------------|
| 1 Front height control ram | 7 Rear height control ram | 13 Brake master cylinder |
| 2 Reservoirs—brake fluid | 8 Rear height control ram | 14 Brake distribution valves |
| 3 Hydraulic pumps | 9 Rear wheel brake calipers | 15 Front wheel brake calipers |
| 4 Hydraulic accumulators | 10 Hand brake—mechanical | 16 Front height control ram |
| 5 Solenoid valve | 11 Rear height control valve | 17 Roll restrictor valve |
| 6 Rear height control valve | 12 Deceleration conscious pressure limiting valve | 18 Front height control valve |

is applicable, ensuring at all times that there is sufficient fluid in the reservoir. It is not necessary to bleed the front brakes, the low pressure system being applicable to the **upper** or **lower** cylinders of the rear brakes only.

6. After bleeding the master cylinder system, run the engine to charge the power systems, then top-up the reservoir compartment(s) to the level indicated.

Bleeding the high pressure (power braking and height control) systems

The front reservoir compartment supplies fluid for the front brake pump, the front hydraulic accumulator, the lower brake distribution valve, the front calipers of the front brakes and the **lower** or **upper** cylinders of the rear brake calipers. Refer to Operation 3 under 'Bleeding the low pressure (master cylinder) system'.

The rear reservoir compartment supplies the rear pump, the rear hydraulic accumulator, the automatic height control system, the upper brake distribution valve and the rear calipers of the front brakes.

It is recommended, in the interests of safety, that the gearchange thermal cut-out is removed from the fuse board underneath the facia, to isolate the electric gearchange.

1. To bleed either of the high pressure systems, run the engine for a short time to charge fully the power systems. Ensure that the reservoir fluid levels are topped-up to at least the topping-up mark on the sight glass at all times.

Run the engine at approximately 1,000 r.p.m. This can be best achieved by manipulating the throttle linkage manually on the fast-idle cams to obtain the correct speed.

2. Attach a bleed tube to one of the **hydraulic accumulator** bleed screws and immerse and hold the free end in a small quantity of fluid in a clean container. Carefully slacken the bleed screw just sufficiently for fluid to flow. Bleed until all air bubbles have ceased and for approximately a further 15 seconds after, then tighten the bleed screw.

3. Repeat the above operation on the other hydraulic accumulator.

4(a) Attach the bleed tube to the bleed screw in one of the **power brake** calipers then, while the second operator lightly depresses the brake pedal and holds it under a steady pressure of between 20 lb. and 25 lb. (9,07 kg. and 11,34 kg.), open the bleed screw and bleed until all bubbles have ceased and for approximately a further 15 seconds after; tighten the bleed screw.

4(b) To bleed the rear disc brake calipers on cars mentioned in the note under 'Bleeding the low

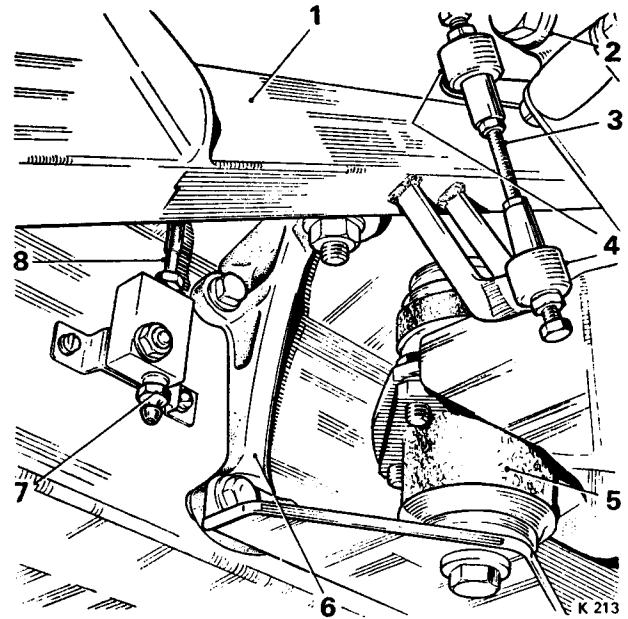


FIG. G2 REMOTE BLEED SCREW—REAR HEIGHT CONTROL RAM

- 1 Rear suspension trailing arm
- 2 Left-hand height control valve
- 3 Operating link—height control valve to trailing arm
- 4 Sealing boot—operating link ball joint
- 5 Rear suspension cross-member mount
- 6 Forged mounting bracket—rear suspension cross-member
- 7 Bleed screw
- 8 Pipe—ram to remote bleed screw (pink)

pressure (master cylinder) system' proceed as follows.

Attach the bleed tube to the upper bleed screw in one of the rear disc **power brake** calipers then while the second operator depresses the brake pedal half-way, open the bleed screw a very small amount until fluid appears in the bleed tube. When the fluid is free of air, the bleed screw may be opened a little further and the bleeding then continued for at least 15 seconds after air bubbles have ceased to appear.

Tighten the bleed screw then allow the brake pedal to return to its off position.

Note With these later cars (*see Fig. 1*) having the pressure conscious limiting valve in the power circuit, it is possible that if the upper bleed screw is opened too wide, the ball in the valve will be forced against its seat. If this happens, no fluid will flow into the bleed tube and this will necessitate closing the bleed screw, releasing the brake pedal and carefully repeating the procedure until fluid flows into the tube.

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5. Repeat this operation on the other power brake calipers.

Note The upper or lower cylinders of the rear wheel brake calipers are the only caliper cylinders which are not power operated (refer to Operation 3 under 'Bleeding the low pressure (master cylinder) system').

The engine should be allowed to run for approximately two minutes after the last caliper has been bled and before the height control rams are bled.

When bleeding the height control rams, the weight of one person in the boot, or on the front of the car, is usually sufficient to compress the suspension sufficiently for the height control valves to actuate and allow pressurised fluid through to the rams. If, however, this weight is not sufficient, the front and rear of the car must be weighted slightly until fluid flows satisfactorily through the bleed tube.

Bleed the height control rams by attaching a bleed tube to the appropriate bleed screw, opening the bleed screw slightly and bleeding for approximately

15 seconds after bubbles have ceased.

The front ram bleed screws are located in the 'T' shaped castings on top of the front spring pots (see Fig. G31). The bleed screws for the rear rams will be found in two adaptors mounted on the body sills, just aft of the rear suspension cross-member, one on each side of the car (see Fig. G2).

The brake pedal need not be depressed when bleeding the height control rams, but the system must be on fast height control. This condition should exist even though the transmission is isolated, as the engine must have been started initially with Neutral selected.

The foregoing information is a comprehensive bleeding operation such as might be applied after a major overhaul or engine removal but, as previously stated, each system can be bled separately and must be bled at all points downstream after any replacements or pipe disconnections have been carried out. A planned bleeding chart is given below for this purpose but, if any doubt exists, it is advisable to bleed the complete system concerned.

Planned bleeding chart

DISTURBED PIPE RUN	PIPE COLOUR	BLEEDING REQUIRED
*1. (a) Any pipe between the hydraulic reservoir front compartment, front hydraulic pump and front hydraulic accumulator. (b) Any pipes between the hydraulic reservoir rear compartment, rear hydraulic pump and rear hydraulic accumulator.	Red Orange	Complete system: front accumulator, front calipers on the front wheels and the lower or upper cylinders on the rear wheel calipers. Complete system: rear accumulator, rear calipers on the front brakes, all height control rams.
*2. (a) Any pipes between the front hydraulic accumulator and the lower brake distribution valve. (b) Any pipes between the rear hydraulic accumulator and upper brake distribution valve.	Red Orange	Front calipers of the front wheels and the lower or upper cylinders of the rear wheel calipers. Rear calipers of the front wheels and all height control rams.
*3. Any pipes between the lower brake distribution valve and front calipers on the front wheels and lower or upper cylinders on the rear wheel calipers.	Blue	Front calipers of the front wheels and lower or upper cylinders of the rear wheel calipers.
4. Any pipes between the upper brake distribution valve and rear calipers on the front wheels.	Mauve	Rear calipers front wheels.
5. Any pipes between the pressure feed from the accumulator and the height control valves.	Orange	Height control rams.
6. Pipes between height control valves and height control rams.	Brown	Height control rams.
*7. Pipe between the rear reservoir compartment and the brake master cylinder.	Grey	Upper or lower cylinders of the rear wheel calipers.
*8. Any pipes between the brake master cylinder and the upper or lower cylinders on the rear wheel calipers.	Green	Upper or lower cylinders of the rear wheel calipers.

After bleeding, the system(s) must be fully charged and the reservoir compartment(s) topped-up in accordance with the instructions given on the sight glass instruction plate.

* Refer to Operation 3 and explanatory note given under 'Bleeding the low pressure (master cylinder) system.'

Section G3

HYDRAULIC SYSTEMS PIPEWORK

General

The fluid for the hydraulic systems is carried in bundy tubing throughout the car, except in certain cases where flexible hoses are used to accommodate relative movements between two units.

The pipework, with the exception of flexible hoses, is almost entirely $\frac{3}{8}$ in. (4,76 mm.) diameter tubing. The only exceptions are the ends of the return pipes from the hydraulic accumulators to the reservoir and the feed pipe to the master cylinder which are $\frac{1}{2}$ in. (6,35 mm.) diameter. The metal sections of the feed pipes from the reservoir to the hydraulic pumps are $\frac{3}{8}$ in. (9,52 mm.).

For the purposes of identification, a colour coding system has been devised to enable the various metal pipes to be easily recognizable anywhere on the car without the necessity of having to trace the pipe run back to a source.

The identification is by means of coloured Neoprene sleeves fitted over each end of the all metal pipes, except the short brake pipes bridging the brake calipers, i.e. passing over the braking disc, adjacent to the unions. A chart quoting the pipe colours and the functions is given on Page G13.

Thus, if the chart which follows is consulted, the function (i.e. high pressure, low pressure) and system of any pipe on the car can be quickly and easily identified.

Generally, pipework connections are effected by flared pipe ends and unions, either male or female as necessary, with conical seats machined in the components or junctions to seat the flares and provide

effective joints. In the case of certain flexible pipe joints, face seals and copper washers are employed.

If, at any time, hydraulic pipes are disturbed the following points should be noted.

The area around the pipe union and the pipe end must be **thoroughly** cleaned before the union is unscrewed.

Pipe ends should always be blanked off immediately after removal and the blanks should not be removed until immediately before fitting.

Whenever pipes are removed, the flares should be inspected for serviceability and pipes with flares showing any signs of damage, cracking or collapse must be renewed.

Before fitting, pipes and unions should be cleaned thoroughly, using methylated spirits, then blown through with clean dry compressed air. Particular attention should be paid to the union and the exterior of the pipe immediately behind the flare.

When fitting pipes, care should be taken not to overtighten unions as this could cause damage to the pipe flares. In the case of face seals, new copper washers must be used each time a pipe is refitted.

Care must be taken to ensure that when pipes are removed or fitted, the coloured pipe code sleeves are correctly fitted to each end and in good condition. If a pipe is removed and the coloured sleeves are in poor condition, the sleeves must be renewed before fitting the pipe. The sleeves expand sufficiently to clear the union when fitting a new one to a pipe. This is best achieved by using a small three-prong expander hand tool ('Penguin' pliers).

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As stated earlier, flexible pipes are fitted into the hydraulic systems, some of which are high pressure fluid transmitters and others which are low pressure fluid transmitters.

The flexible pipes can be readily identified, as with the rest of the systems, by means of the colour coding chart, and (see *Figs. G3 to G6 inclusive*) to determine whether the pipe is high or low pressure, or feed or return.

Identification sleeves are not fitted to the flexible hoses but the sleeves on the connecting pipes at either end may be used to identify the flexible pipe and its function.

Note The two flexible high pressure pipes from the hydraulic pumps to the hydraulic accumulators, the two low pressure hose returns from the accumulators to the reservoir and the feeds from the reservoir to the hydraulic pumps are not marked and do not connect to any other marked pipes. Since these pipes are the only ones in the systems without means of identification confusion should not arise.

Extreme caution should be exercised, when fitting or renewing flexible pipes, to ensure that the correct type of pipe is fitted in the correct place in accordance with the colour coding.

In the interests of safety, the flexible pipes fitted to the hydraulic systems have been allotted specific 'life' mileages at the completion of which or at the Service nearest to this mileage it is recommended that the flexible pipes be renewed.

The recommended 'life' mileages, pipe locations and colours are quoted in Chapter D, 'Lubrication and Maintenance'.

The positions of the flexible hoses are shown in *Figures G3 to G6 inclusive*, which give a complete illustration of the hydraulic systems pipework and the correct colours as located on the car.

It must be noted that non-standard torque figures are specified for certain pipe unions and fittings in the hydraulic systems. These figures are given in Chapter P which quotes all standard and non-standard torque figures. These must be adhered to at all times to avoid overtightening and possible damage.

The clipping points of all pipes, whether rigid or flexible, is most important because of the possibility of chafing or vibration. Always ensure that the pipes, particularly the flexible pipes, are routed to clear other components. Note the position and clipping point(s) of each pipe as it is removed to ensure that when it is refitted or replaced by a new one, the clipping point(s) is correct.

Pipework colour coding

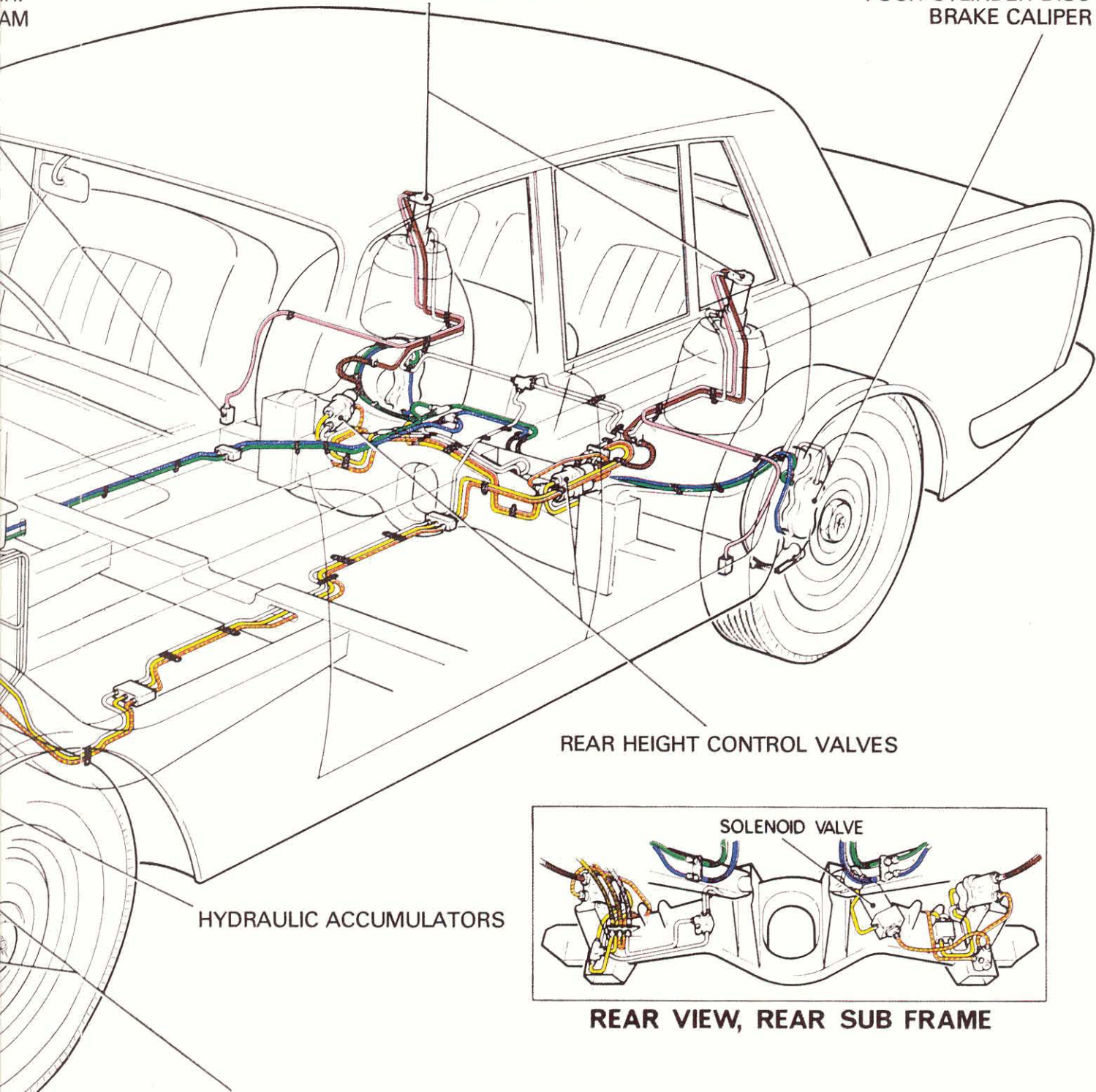
COLOUR	FUNCTION	SYSTEM AND LOCATION
Red	High pressure	All brakes system pipes from the front hydraulic pump, to front accumulator and from front accumulator to lower brake distribution valve.
Orange	High pressure	Brakes and height control system pipes from the rear hydraulic pump, to the rear accumulator; rear accumulator to front and rear height control valves; rear accumulator to height control solenoid valve and rear accumulator to upper brake distribution valve.
Black	Low pressure	All brakes system return pipe from the lower brake distribution valve to the fluid reservoir.
White	Low pressure	Brakes and height control system return pipes from the upper brake distribution valve to the fluid reservoir; return from front and rear height control valves to reservoir; returns from roll restrictor and height control solenoid valves to reservoir (all cars); returns from front and rear height control rams to reservoir (early right-hand and left-hand drive unmodified cars only, (see Figs. G3 and G4),
Green	High pressure	Brake master cylinder pipes from master cylinder to deceleration conscious pressure limiting valve and to upper cylinders of rear wheel brake calipers (early cars, see Figs. G3 and G4) and from master cylinder to lower cylinders of rear wheel brake calipers later cars (see Figs. G5 and G6).
Grey	Low pressure	Brake master cylinder feed pipe from rear reservoir compartment to master cylinder.
Blue	High pressure	All brakes system pipes from lower brake distribution valve to front calipers of front wheels (all cars) and lower cylinders of rear wheel calipers (early cars, see Figs. G3 and G4) and upper cylinders of rear wheel calipers, later cars (see Figs. G5 and G6).
Mauve	High pressure	Brakes and height control system pipes from upper brake distribution valve to rear calipers of front wheels.
Yellow	High pressure	Brakes and height control system pipes carrying signal pressure from solenoid valve to front and rear height control valves and roll restrictor valve.
Brown	High pressure	Brakes and height control system pipes from roll restrictor valve to front height control valve; front height control valve to front height control rams; rear height control valves to rear height control rams.
Pink	High pressure	Brakes and height control system pipes from rear height control rams to remote bleed screws on the body sills.

Fig. G3 Hydraulic systems pipework colour coding and component positions (early R.H.D. cars)

R.H.
RAM

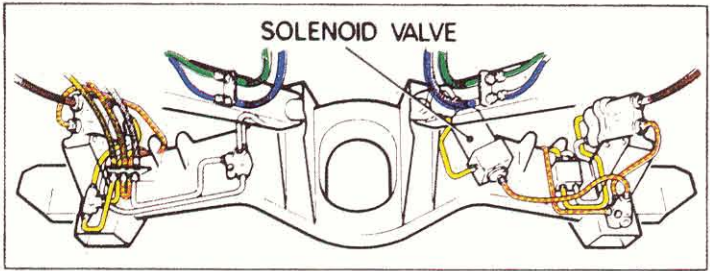
REAR HEIGHT CONTROL RAMS

FOUR CYLINDER DISC
BRAKE CALIPER



REAR HEIGHT CONTROL VALVES

HYDRAULIC ACCUMULATORS

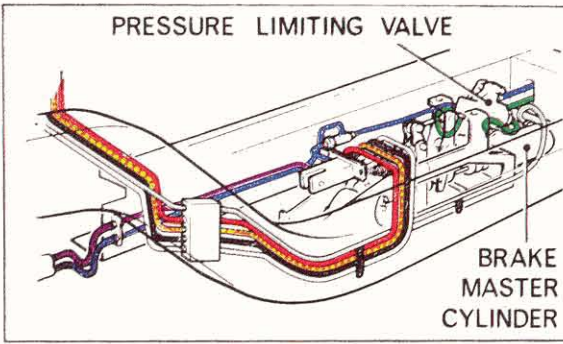
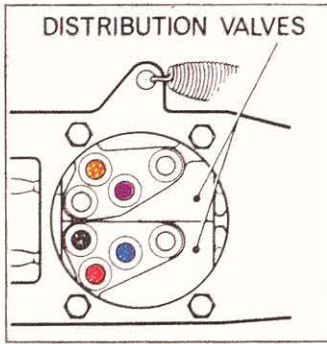


SOLENOID VALVE

REAR VIEW, REAR SUB FRAME

TWO TWIN CYLINDER DISC BRAKE CALIPERS

HYDRAULIC SYSTEMS PIPEWORK COLOUR CODING AND
COMPONENT LOCATION (LATER R.H.D. CARS)



BLEED POINT FOR R.H. HEIGHT CONTROL RAM

VALVE PORTS AND BRAKE ACTUATION BOX

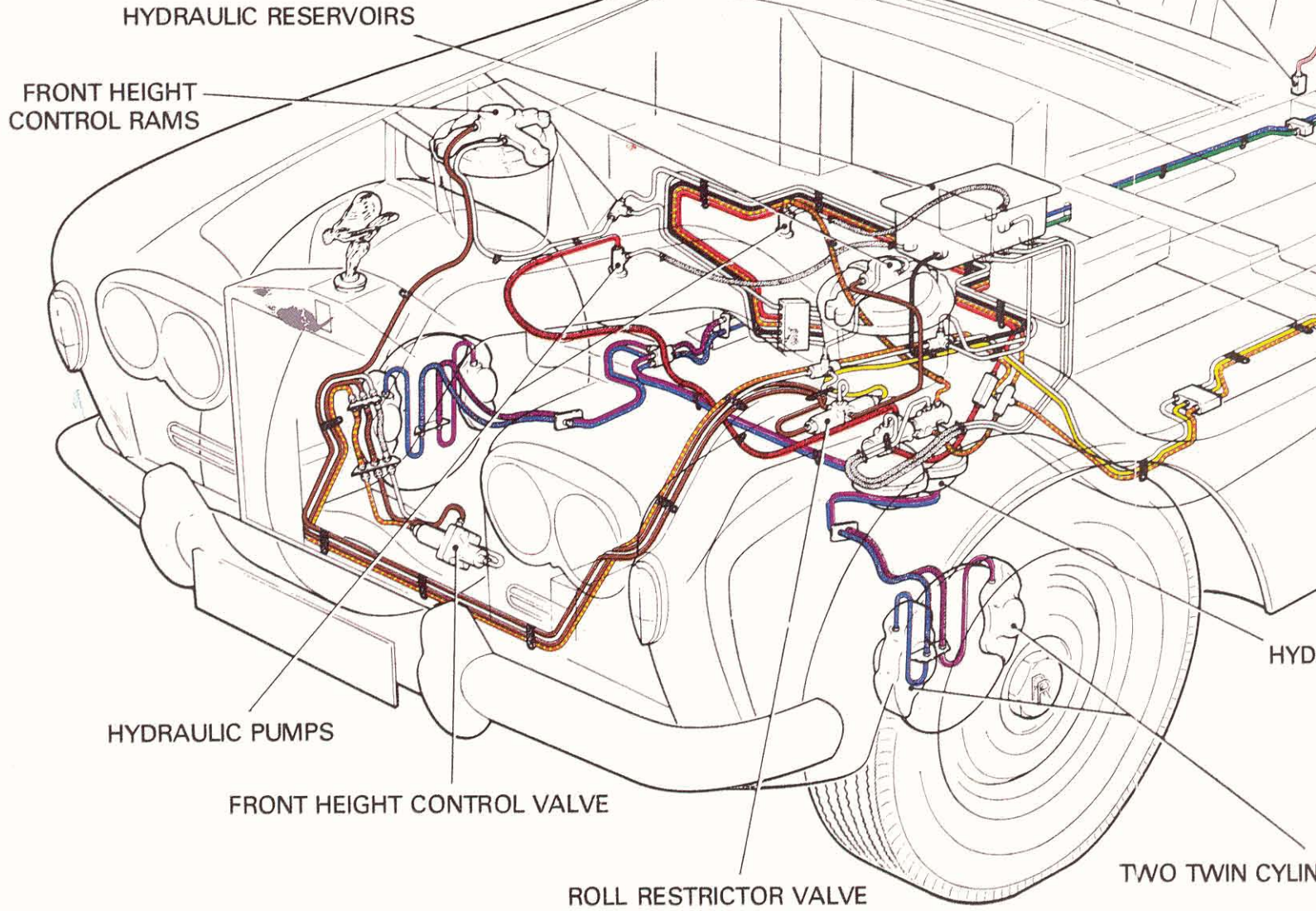


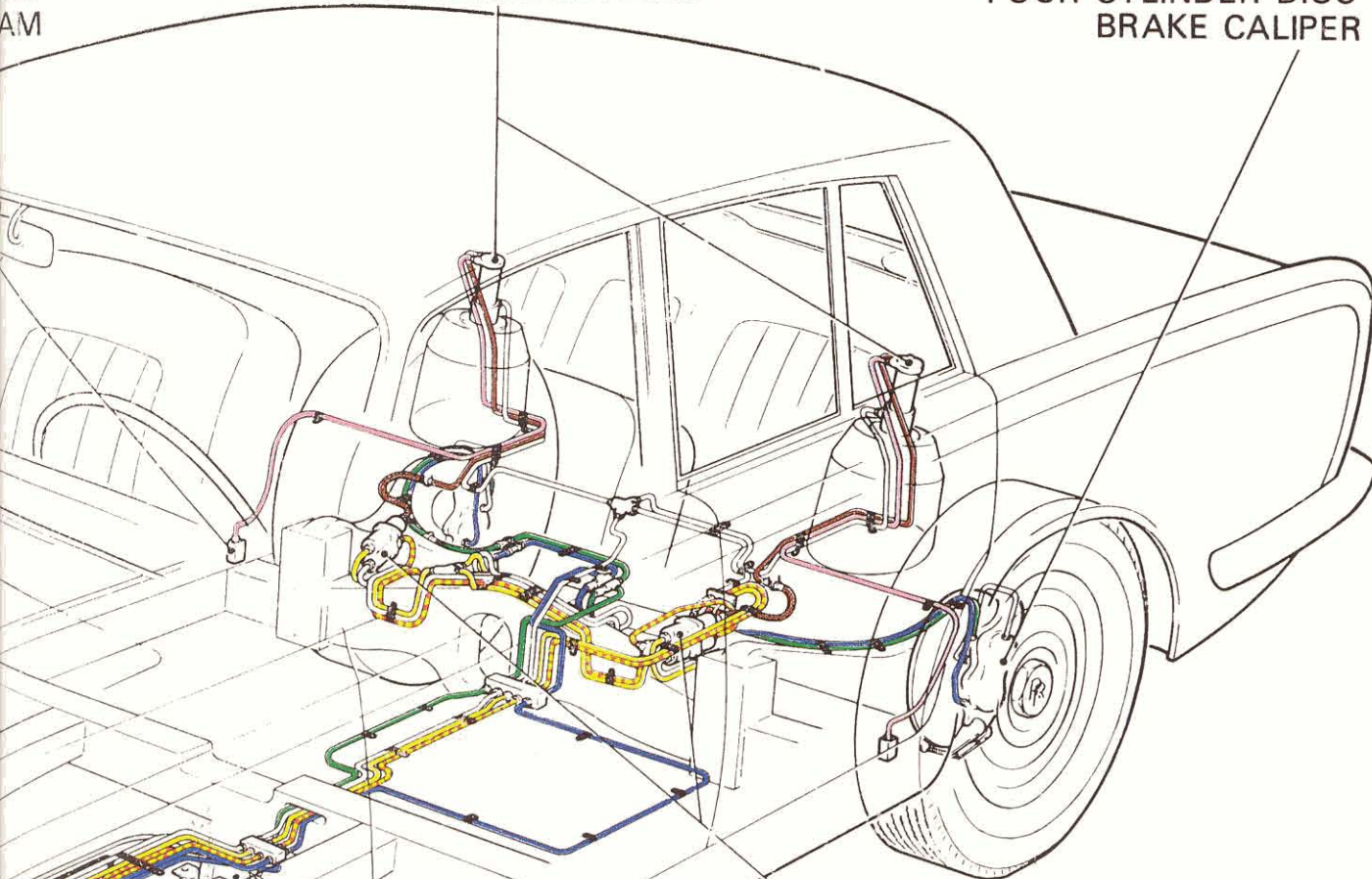
FIG. G3 HYDRAULIC SYSTEMS PIPEWORK COMPONENT LOCATION (LATER R.H.)

Fig. G4 Hydraulic systems pipework colour coding and component location (early L.H.D. cars)

H.
AM

HEIGHT CONTROL RAMS

FOUR CYLINDER DISC
BRAKE CALIPER



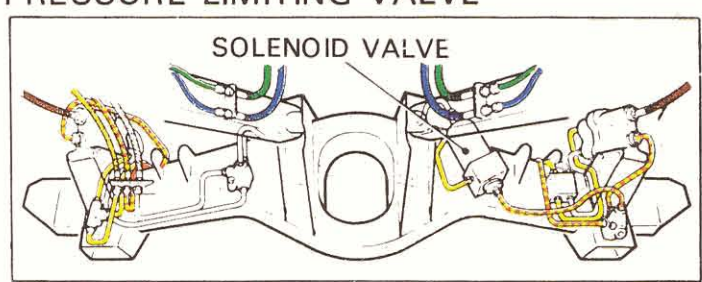
REAR HEIGHT CONTROL
VALVES

DECELERATION CONSCIOUS
PRESSURE LIMITING VALVE

BRAKE ACTUATION BOX

HYDRAULIC
ACCUMULATORS

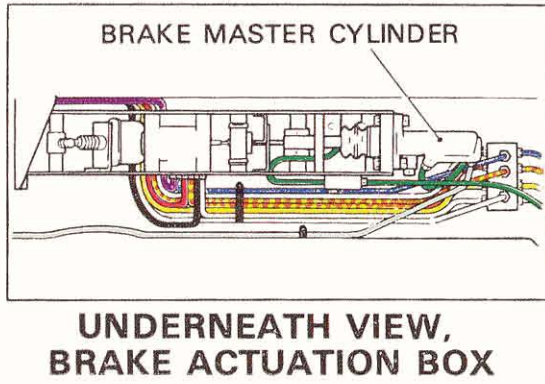
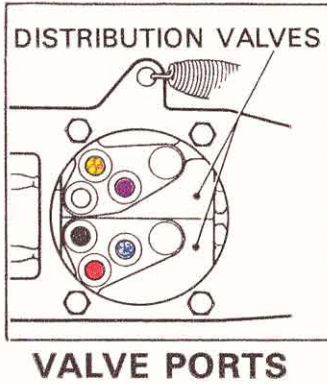
TWO TWIN CYLINDER
DISC BRAKE CALIPERS



REAR VIEW, REAR SUB FRAME

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SYSTEMS PIPEWORK COLOUR CODING AND
IDENTIFICATION (LATER L.H.D. CARS)



BLEED POINT FOR R.H.
HEIGHT CONTROL RAM

HYDRAULIC RESERVOIRS
HEIGHT CONTROL RAMS

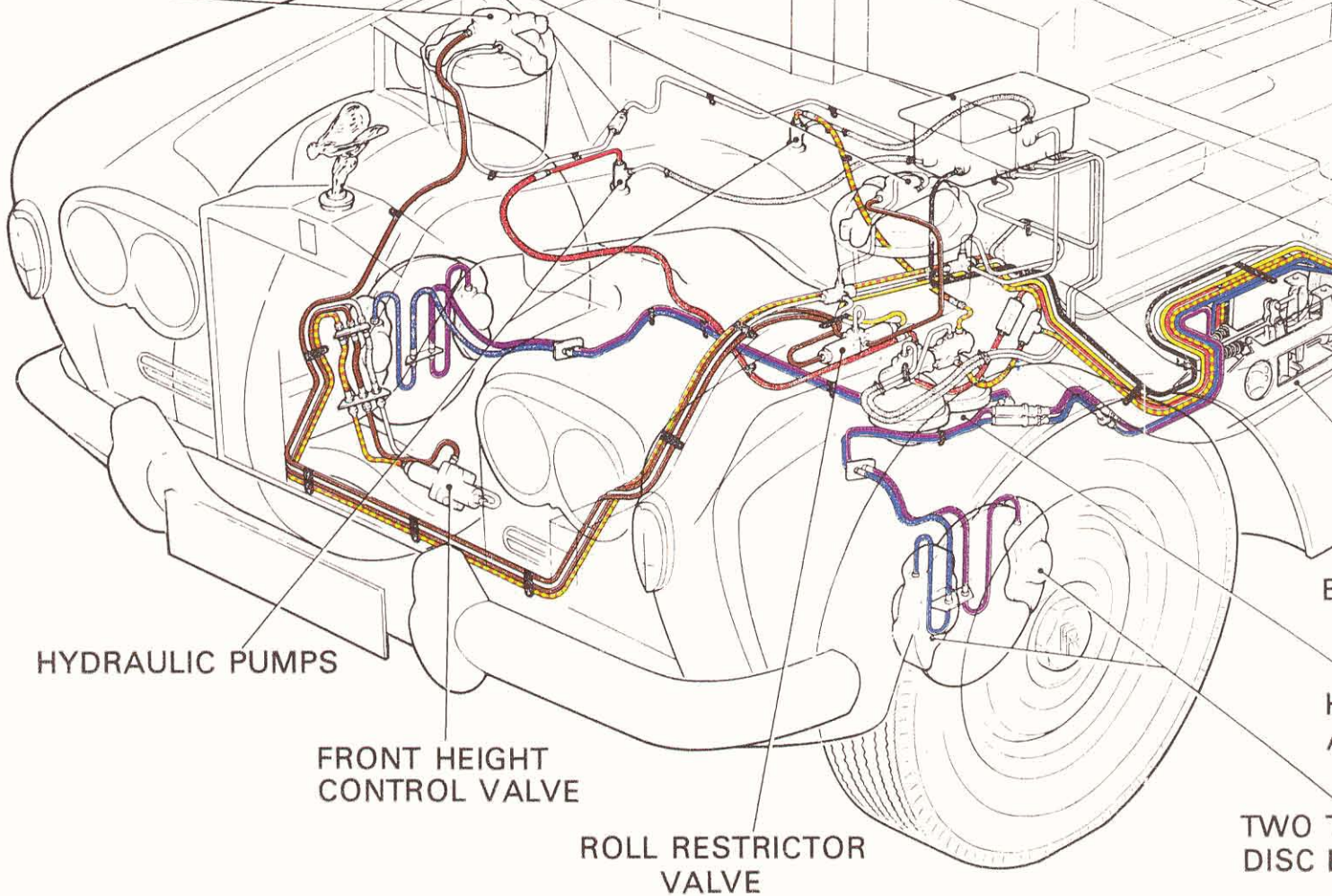


FIG. G4 HYDRAULIC SYSTEMS PIPEWORK COMPONENT LOCATION (LATER L.F.)

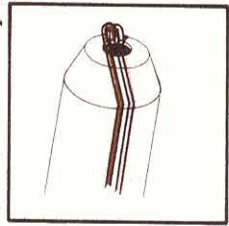
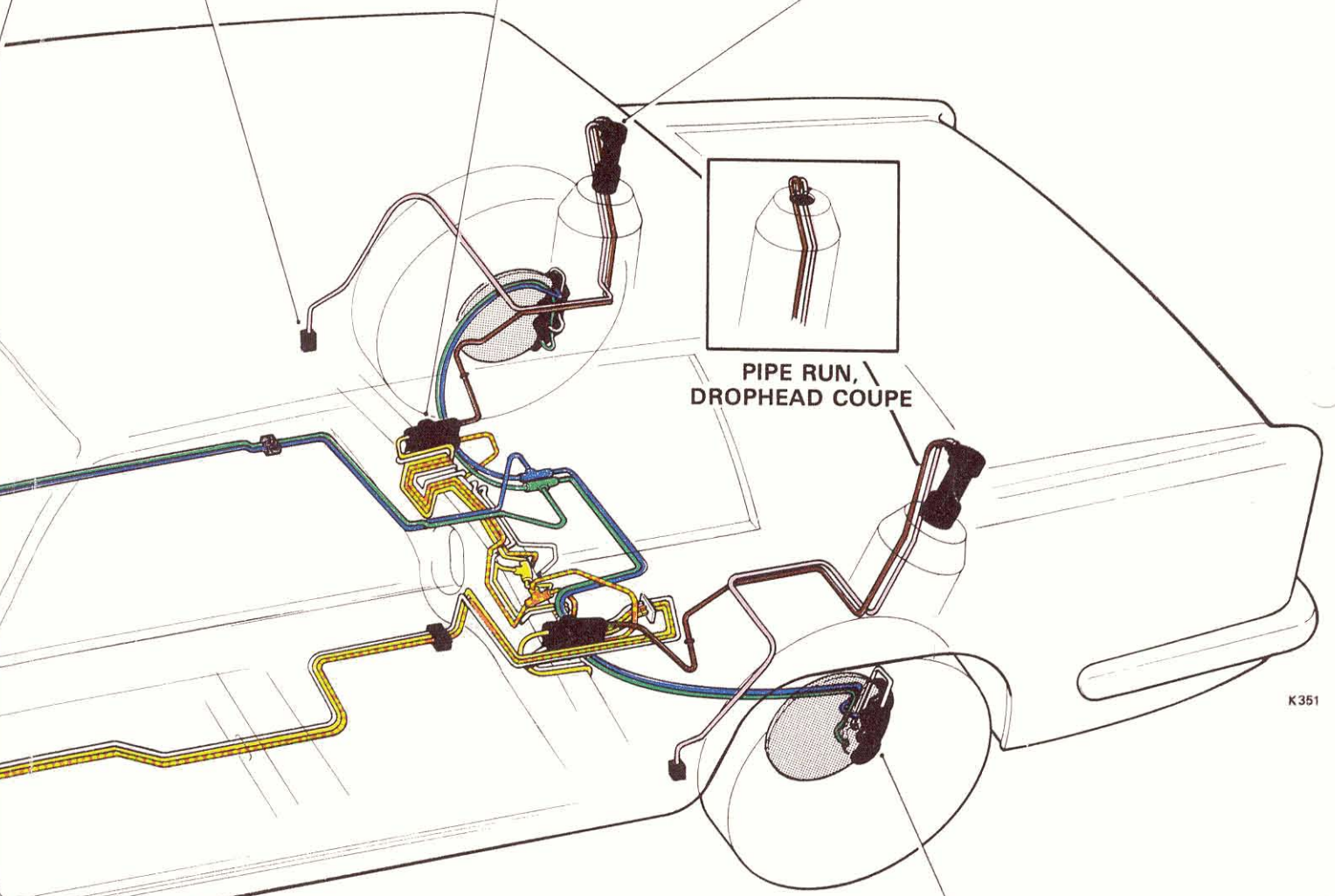
Fig. G5 Hydraulic systems pipework colour coding and component location (later R.H.D. cars)

MASTER
CYLINDER

BLEED POINT FOR R.H.
HEIGHT CONTROL RAM

REAR HEIGHT CONTROL VALVES

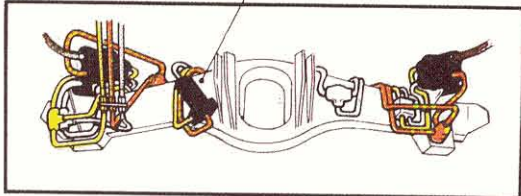
HEIGHT CONTROL RAMS



PIPE RUN,
DROPHHEAD COUPE

K351

SOLENOID VALVE



REAR VIEW, REAR SUB-FRAME

FOUR CYLINDER DISC BRAKE CALIPER

SLIC
AIRS

BRAKE ACTUATION BOX

SYSTEMS PIPEWORK COLOUR CODING AND
IDENTIFICATION (LATER R.H.D. CARS)

HEIGHT CONTROL RAMS

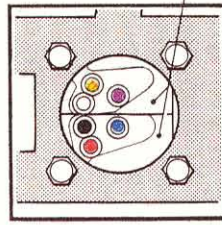
HYDRAULIC PUMPS

DISTRIBUTION VALVES

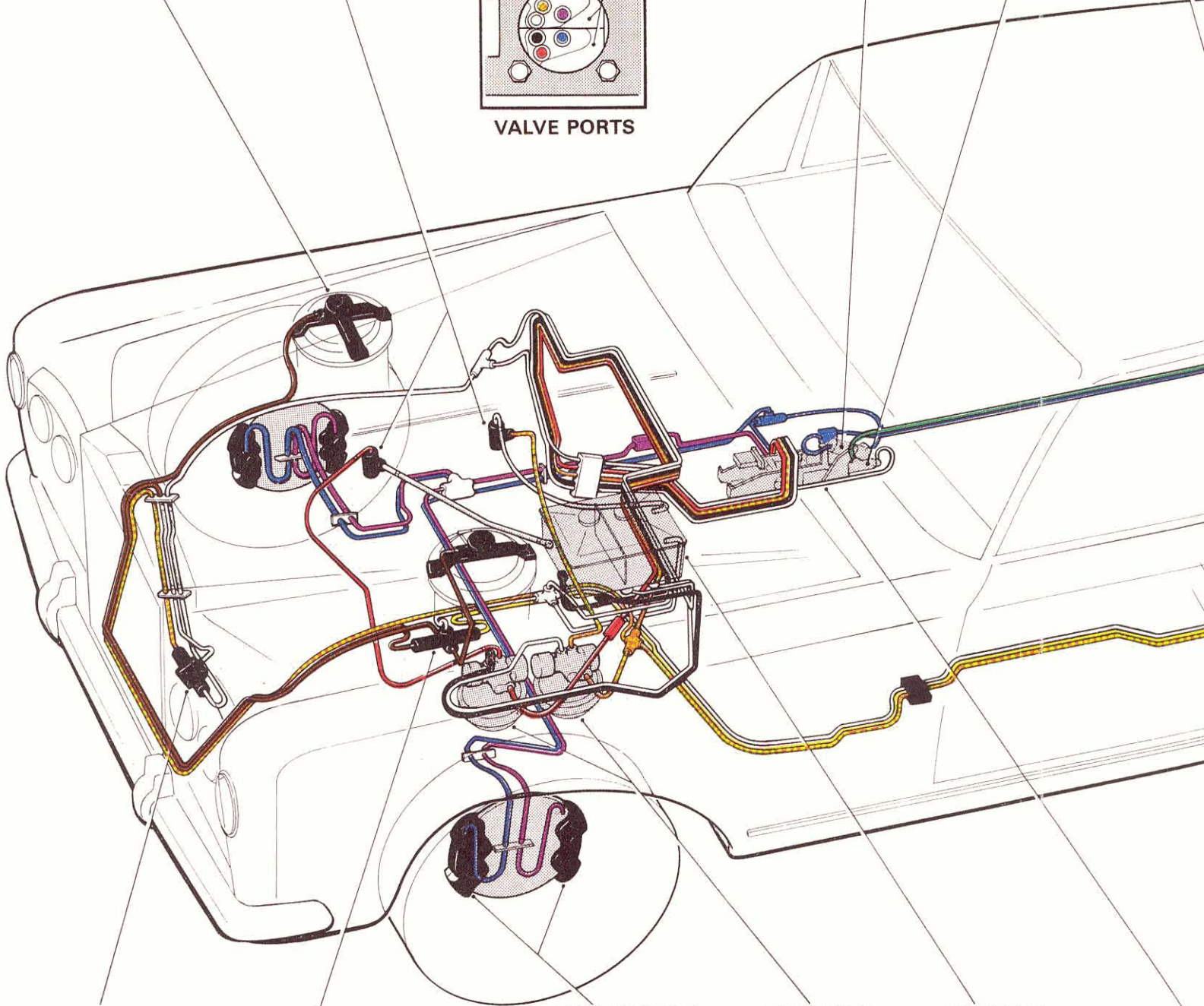
DECELERATION CONSCIOUS
PRESSURE LIMITING VALVE

BRAKE MASTER
CYLINDER

BLEED POINT
HEIGHT CON



VALVE PORTS



FRONT HEIGHT
CONTROL VALVE

ROLL RESTRICTOR VALVE

TWO TWIN CYLINDER
DISC BRAKE CALIPERS

HYDRAULIC
ACCUMULATORS

HYDRAULIC
RESERVOIRS

BRAKE ACTU

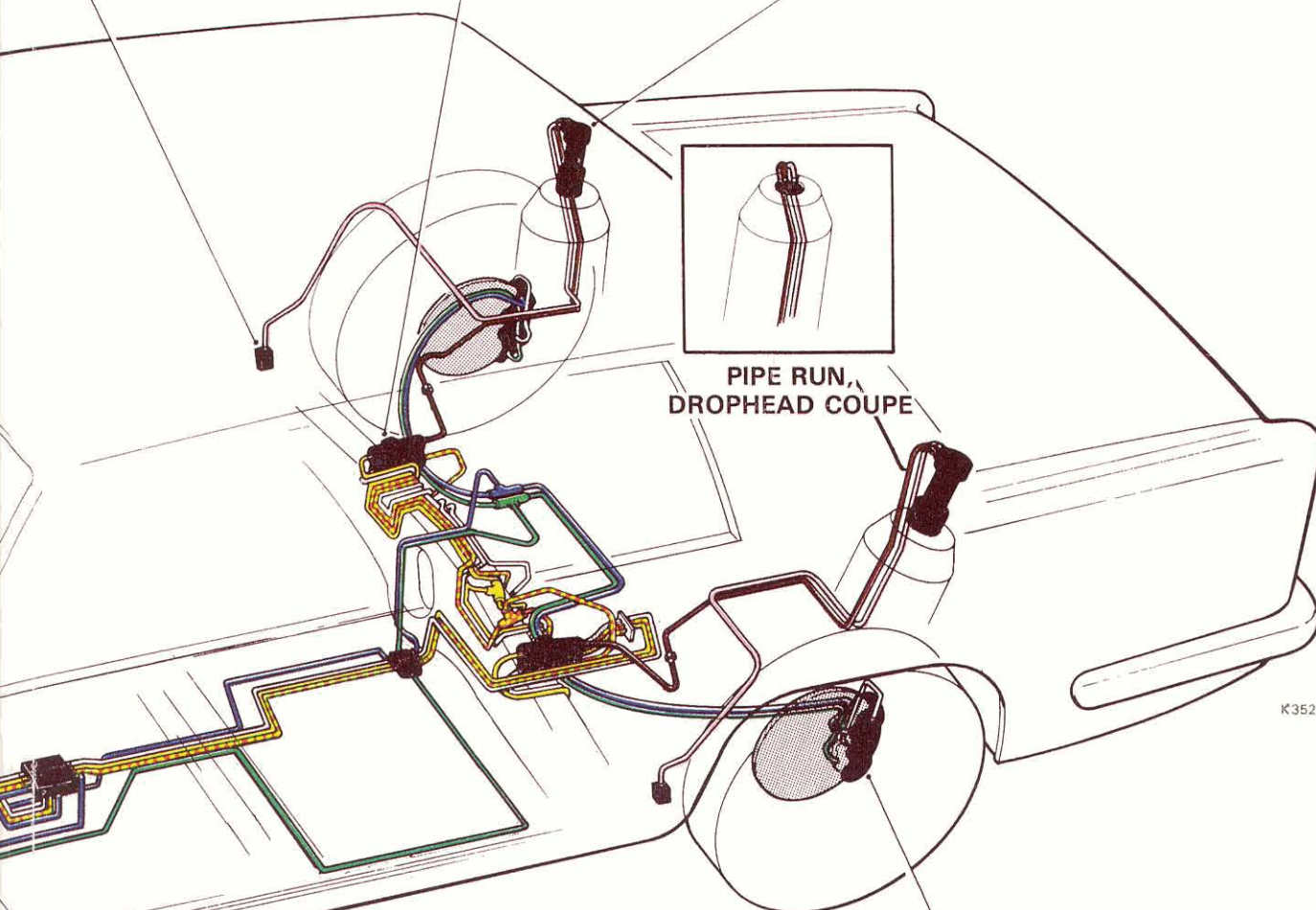
FIG. G5 HYDRAULIC SYSTEMS PIPEWORK CO
COMPONENT LOCATION (LATER R.H

Fig. G6 Hydraulic systems pipework colour coding and component location (later L.H.D. cars)

ANCHOR POINT FOR R.H. HEIGHT CONTROL RAM

REAR HEIGHT CONTROL VALVES

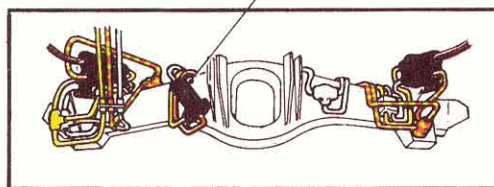
HEIGHT CONTROL RAMS



PIPE RUN, DROPHEAD COUPE

K352

SOLENOID VALVE



REAR VIEW, REAR SUB-FRAME

ACCELERATION CONSCIOUS PRESSURE LIMITING VALVE

BRAKE MASTER CYLINDER

FOUR CYLINDER DISC BRAKE CALIPERS

THIS PIPEWORK COLOUR CODING AND POSITION (LATER L.H.D. CARS)

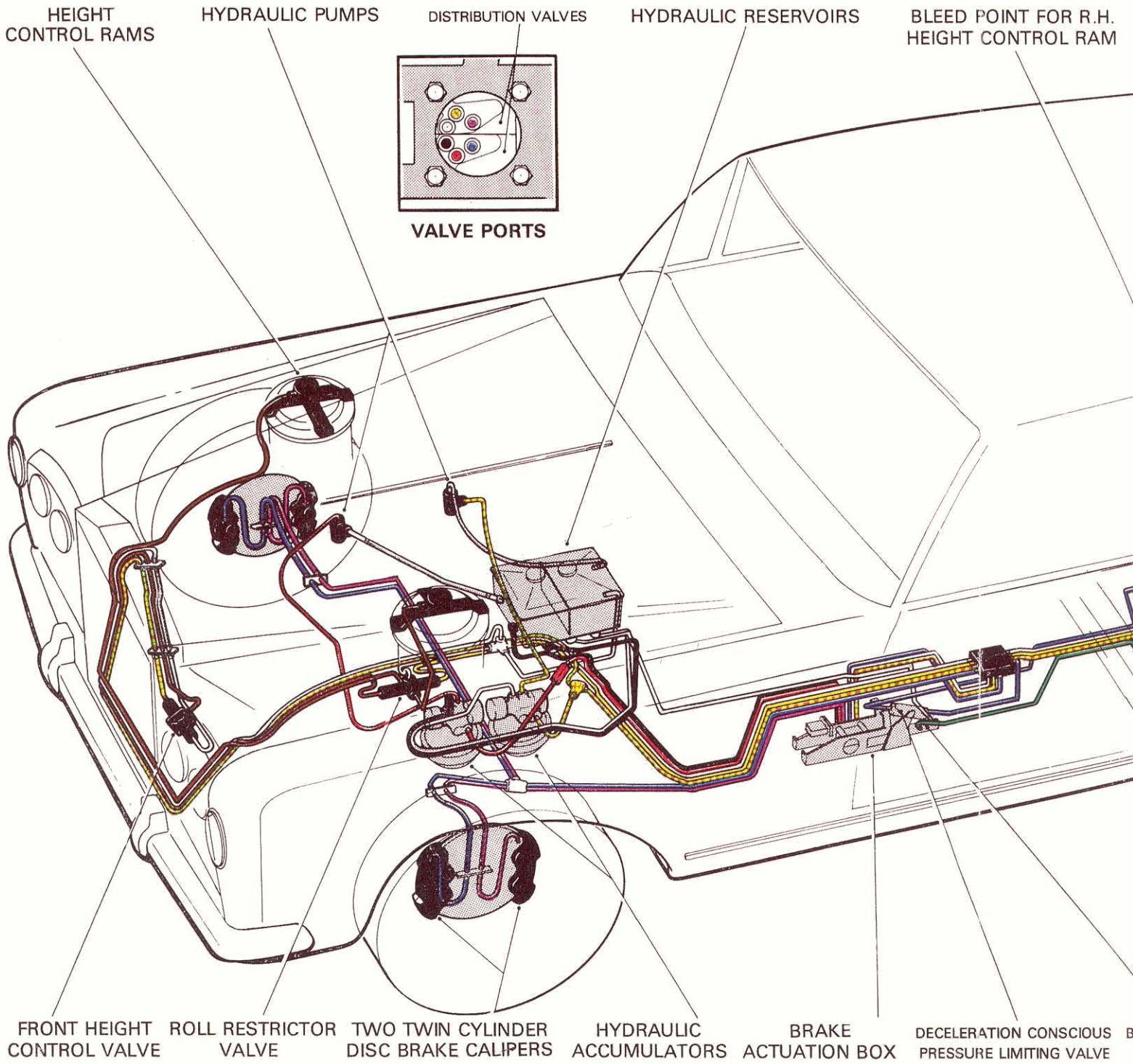


FIG. G6 HYDRAULIC SYSTEMS PIPEWORK COLOR COMPONENT LOCATION (LATER L.H.D.)

Section G4

HYDRAULIC SYSTEMS RESERVOIRS

Reservoir—To remove

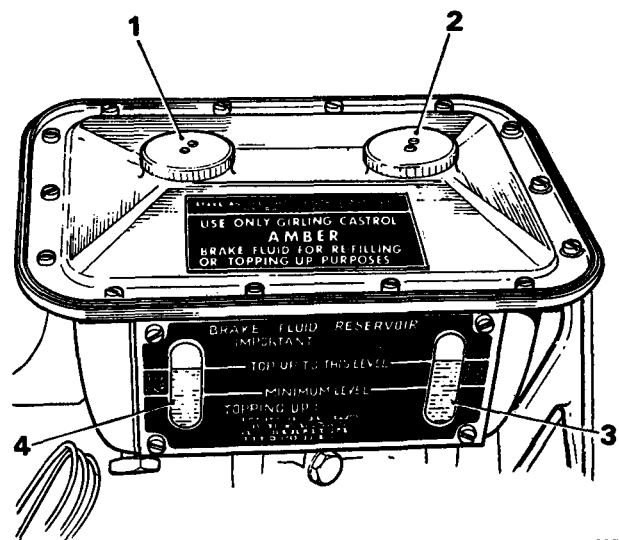
1. De-pressurise the hydraulic systems (see Section G1—Special Precautions) then disconnect the battery which is located in the boot.
2. Slacken the worm-drive clips securing the accumulator low pressure return pipes to the adaptors in the reservoir base, then remove the pipes and drain the contents of each compartment into a clean container.
3. Blank off the ends of the return pipes and the adaptors in the reservoir base.
4. Remove the remaining five pipes from the reservoir base and securely blank off all pipe ends and ports.
5. Remove the three setscrews, nuts and washers securing the reservoir bracket to the spring pot.
6. Remove the three setscrews, nuts and washers which secure the reservoir to the vertical rear mounting bracket.
7. Lift the reservoir from its location.

Reservoir filters—To clean or renew

Providing that proper precautions are taken against the ingress of dirt into the systems and that perfectly clean fluid is always used when topping-up, the reservoir will not require servicing and the filters should never require attention.

If, however, the system has become contaminated and it is necessary to clean the reservoir and filters, the following procedure should be adopted.

1. Drain and remove the reservoir as described previously.
2. Remove the screws and nuts which secure the top cover, then remove the cover.
3. Remove the large combined filter and gasket.
4. Remove the two setscrews and nuts which secure the baffle plate over the dividing wall then remove the plate.



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FIG. G7 HYDRAULIC SYSTEMS RESERVOIRS

- 1 Front reservoir filler cap
- 2 Rear reservoir filler cap
- 3 Rear reservoir sight glass
- 4 Front reservoir sight glass

Chapter G

5. Clean out any residual fluid in the reservoir.
6. On **early cars** remove the centre setscrew from each filter and remove the filters.

On **later cars**, unscrew and remove the hexagon based filters from their respective positions (see Fig. G8).

7. Clean the filters, thoroughly washing them in methylated spirits, then drying them with dry compressed air. The large filter, fitted under the top cover, should be cleaned in a similar manner.

8. Thoroughly clean out the reservoir tank, washing it with methylated spirits and drying it with dry compressed air.

Note It is important to clean carefully the threads and holes in the adaptors fitted to the reservoir base and blank them off with clean blanks immediately afterwards.

9. Assembly is the reverse of the procedure given for dismantling, noting that, if it is considered necessary, new filters should be fitted.

Note On reservoirs of **early cars**, care must be taken when tightening the filter retaining setscrews so as not to damage the filters compression.

Reservoir sight glass sealing rings—To renew

To renew the two rubber sealing rings which are fitted behind the sight glass and instruction plate, proceed as follows.

1. Drain the reservoir as described previously.
2. Remove the four screws which secure the instruction plate to the reservoir; remove the instruction plate.

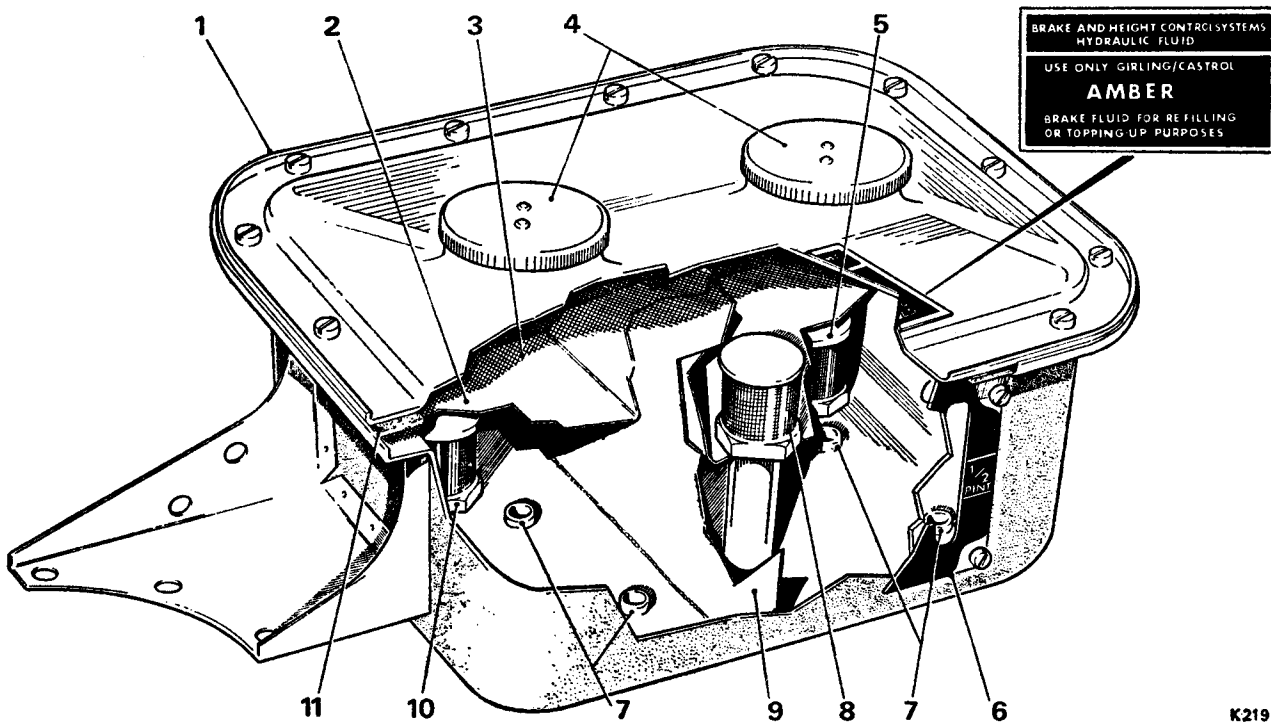


FIG. G8 CUT-AWAY VIEW OF HYDRAULIC SYSTEMS RESERVOIRS

- | | |
|----------------------------------|--|
| 1 Cover | 6 Sight glass instruction plate |
| 2 Baffle plate | 7 Low pressure return ports |
| 3 Filter gauze | 8 Filter and outlet to master cylinder |
| 4 Filler caps | 9 Dividing wall |
| 5 Filter and outlet to rear pump | 10 Filter and outlet to front pump |
| 11 Cover gasket | |

3. Remove the four screws which secure the inner ends of the glass retaining plates; carefully remove the plates and the glass.

4. Remove the sealing rings.

Lightly smear the new sealing rings with clean brake fluid and locate them in position.

5. Assembly is the reverse of the procedure given for dismantling but care must be taken to ensure that the sealing rings and glasses are clean and properly located.

Reservoir—To fit and top-up

To fit the reservoir, reverse the procedure given for its removal, noting the positions.

1. When the reservoir has been fitted and all pipes securely connected, fill the reservoir with clean

specified fluid (see Chapter D) until the levels are slightly above the topping-up level on the sight glass.

2. Run the engine for approximately five minutes then top-up the reservoir to the topping-up marks on the sight glass. Never allow the levels to drop below the minimum levels on the sight glass.

3. Check for leaks around all unions and pipes which have been disturbed.

4. The hydraulic systems must now be bled completely as described in Section G2—Bleeding the systems.

On completion, and if not already fitted, an identification plate marked 'AMBER BRAKE FLUID', etc. (see Fig. G8) must be bonded to the reservoirs' covers with a suitable adhesive ('Araldite' or equivalent).

Section G5

THE HYDRAULIC PUMPS

Hydraulic pump outer sealing rings—To renew

Should the fault at the pump(s) be leakage only, it is possible to renew the two outer sealing rings with the pump(s) in position on the engine.

The procedure to adopt is as follows:

1. Remove any engine accessories in the vicinity of the pump(s) as described in Chapter E—Engine—Valve gear and hydraulic pumps.
2. Ensure that the pump(s) and immediate area around it is as clean as possible.
3. De-pressurise the hydraulic systems and disconnect the two pipe connections on the pump(s).
4. Remove the large circlip from the top of the pump body and draw the outer housing upwards to clear the pump and expose the two sealing rings.
5. Discard the two old sealing rings and fit new ones, lubricating them in clean brake fluid of the correct type.
6. Fit the pump body outer sleeve, aligning the ports with the appropriate pipes. Press the sleeve firmly into position then fit the circlip.
7. Prime the pump with the approved fluid then connect the pipes to the pump, pressurise the systems and check the pump(s) for leaks.

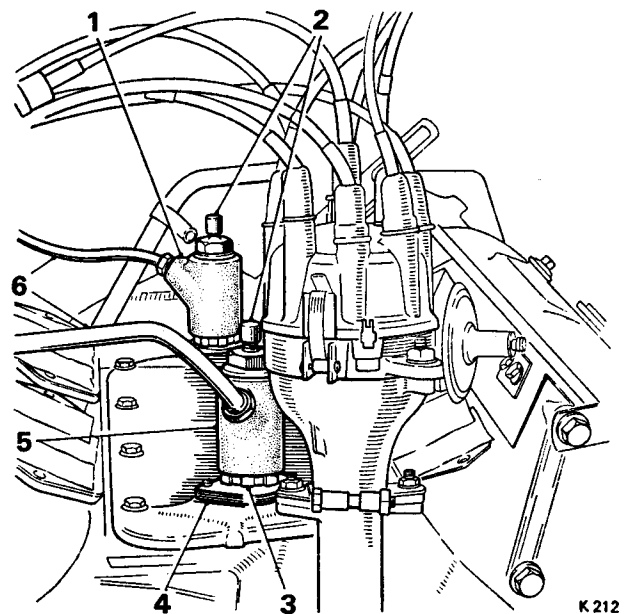


FIG. G9 HYDRAULIC PUMPS IN POSITION

- 1 Front pump
- 2 Outlet ports and adaptors
- 3 Serrated nut
- 4 Pump pedestal
- 5 Rear pump
- 6 Inlet pipes from reservoir

Chapter G

Hydraulic pump—To remove

1. To remove a hydraulic pump from the engine, the following procedure must be adopted.

2. De-pressurise the hydraulic systems (see Section G1—Special Precautions) then disconnect the battery which is located in the boot.

3. Remove the flexible air intake from the carburettors; remove the carburettors, generator or refrigeration compressor and associated parts as described in Chapter E—Engine.

4. Remove the low pressure inlet pipes and high pressure outlet pipes from both brake pumps, blanking off the pipe ends and pump apertures.

5. Remove the setscrew and clip which secures the rear pump feed pipe and ignition coil to the manifold; replace the setscrew to secure the coil.

6. Remove the inlet manifold as described in Chapter E—Engine.

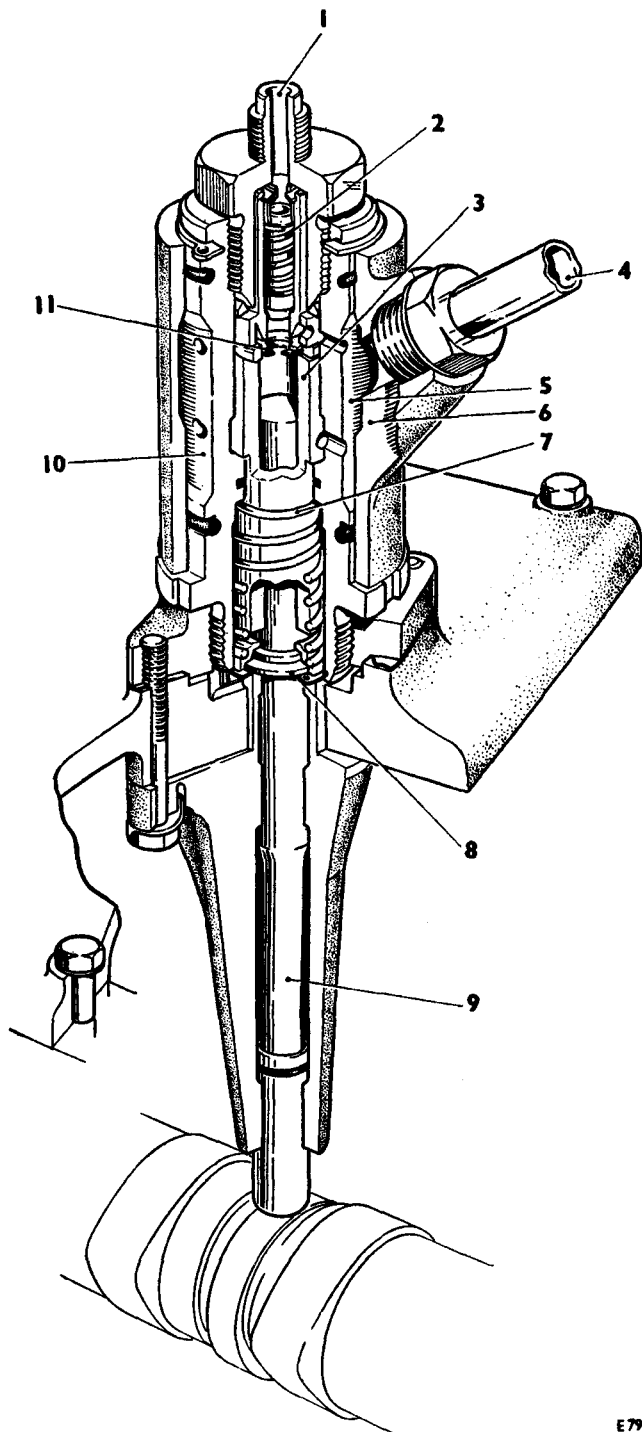
7. Using special 'C' spanner (RH7856), unscrew and remove the hydraulic pump from its pedestal on the tappet chest cover; blank off the pedestal against the ingress of dirt.

Note Prior to dismantling two pumps, remember that the parts from each must not be mixed.

Hydraulic pumps—To service

Distributors and Retailers are advised that the hydraulic pumps are units which can now be overhauled on the premises and all parts are available as spares. Prior to this, the pumps were treated as sealed units and as such, service exchange units were supplied in the event of pump failure.

It should be noted that on cars produced after SRH 2970—Standard cars and CRH 3130—Coach-built cars the sealing arrangement of the reservoir pipe to hydraulic pump outer body was changed.



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FIG. G10 CUT-AWAY OF HYDRAULIC PUMP

- | | |
|-------------------------------|-----------------------|
| 1 Adaptor and outlet port | 6 Pump housing—outer |
| 2 Non-return valve and spring | 7 Plunger spring |
| 3 Pump barrel | 8 Plunger |
| 4 Adaptor and inlet port | 9 Push rod |
| 5 Inlet annulus | 10 Pump housing—inner |
| 11 Inlet valve | |

Earlier cars were fitted with a pipe connected to the pump by means of a brass olive and special nut, the pump housing having a stepped seating.

Later cars are fitted with a pipe having a flared end and a special nut, the pump housing seat being conical.

Should it be necessary to replace a hydraulic pump, ensure that the seat of the low pressure inlet port is correct for the type of reservoir pipe fitted to the car. If this is not so, the outer housing of the new pump should be replaced with the housing of the original pump.

Hydraulic pump—To dismantle (refer to Figs. G10 and G11)

1. Working on a clean bench, remove the adaptor.
2. Using suitable circlip pliers remove the circlip which secures the pump outer housing. Remove the housing.
3. Remove and discard the two 'O' ring seals.
4. From the pump adaptor bore remove the non-return valve assembly and the chamfered sealing ring.

Gentle use of a small screw-driver may be necessary to assist removal of the chamfered washer; if the washer has been badly spread it should be discarded and a new one fitted in its place on assembly.

5. Remove the inlet valve ring, spacer ring and valve spring (conical).
6. Carefully withdraw the plunger barrel.
7. From the opposite end (lower) of the pump remove the circlip and withdraw the barrel and spring collar from the pump body. Collect the spring.
8. Remove the one remaining 'O' ring seal from the pump body bore. Discard the ring. Dismantle the non-return valve as follows.
9. Remove the circlip.
10. Push out the non-return valve from the outer body and collect the spring, end stop and valve.

Hydraulic pump components—To clean and inspect

Important Ensure that all parts are absolutely clean. Tapped holes require special attention to ensure that they are free from foreign matter and slivers of thread which might break off during assembly and become entrapped in the hydraulic system. One method of achieving this is to screw 'slave' adaptors or setscrews down the threads then thoroughly clean the components in methylated spirits and dry with compressed air, **not cloth**.

Wash all retained components in methylated spirits only. No other cleanser is recommended.

Under normal circumstances, after a thorough cleaning, and the introduction of a new set of sealing rings, the only parts that might require renewal are the small coil springs.

Another important check is the correct seating of the valves in their seatings and that the finely machined valve outer diameter is not scuffed or scored.

Hydraulic pump—To assemble

1. Wet all new 'O' rings in Castrol-Girling Brake Fluid Amber and insert them in their respective positions in and around the pump body.

Lubricate each part with clean fluid prior to fitting to the pump body.

2. Invert the plunger barrel into position in the pump body, pressing it through the sealing ring until it abuts the shoulder.

3. Insert the spacer, valve spring (conical face downward) and inlet valve into position adjacent to the barrel head.

Note Should the seating face of the inlet valve be marked, the valve should be inserted with the unused face toward the valve seat.

4. Assemble the non-return valve reversing the procedure given for its dismantling, ensuring that the valve is fully seated and the circlip is fully engaged in its groove. The end stop should be drawn upward to abut the circlip.

5. Fit the non-return valve assembly, larger diameter leading, into the pump body bore to abut the inlet valve ring.

6. Fit the chamfered sealing ring, small bore diameter leading, into the pump body bore, to abut the shoulder of the non-return valve.

7. Fit and torque tighten the adaptor in the threaded hole to between 55 lb.ft. and 60 lb.ft. (7,60 kg.m. and 8,30 kg.m.). Ensure that a blanking plug is fitted to the adaptor open end.

8. Lubricate the bore of the pump outer housing with brake fluid amber then fit it over the brake pump body taking care when passing over the fitted 'O' sealing rings.

9. Ensure that the housing abuts the slotted end of the pump body then fit the circlip. Ensure that a blanking plug is fitted to the exposed port.

10. Fit the coil spring into the lower end of the pump body, then fit the spring collar to the barrel plunger.

Chapter G

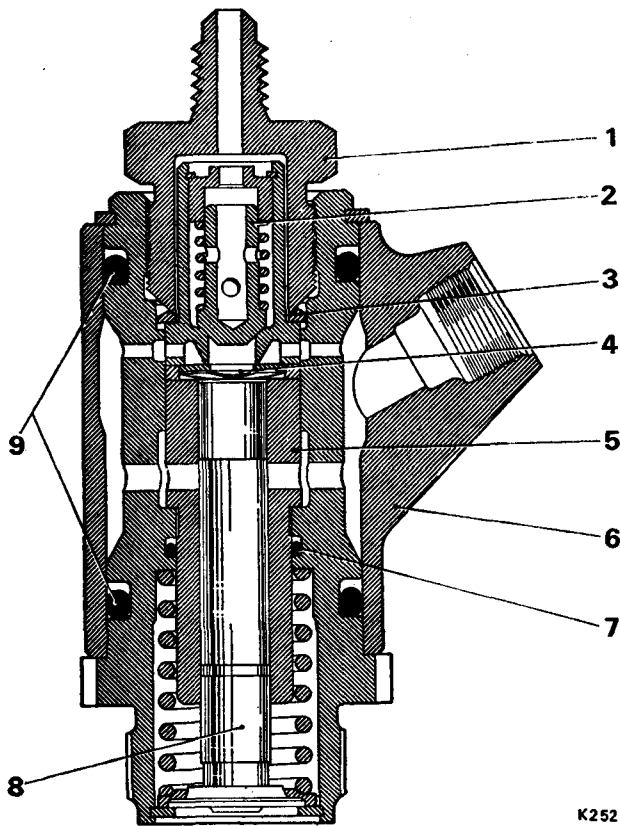
11. Smear amber brake fluid on the plunger and carefully fit the close fitting plunger into the bore of the barrel.

12. Depress the plunger against the spring sufficiently to enable the circlip to be fitted. Fit the circlip, ensuring that it is fully seated.

The pump is now ready for fitting to the engine.

Hydraulic pump—To fit and set

Prior to fitting the pump to the engine tappet cover flange, ensure that the shim washer fitted between the flange and cover is of the correct thickness. The procedure for this check is to be found in Chapter E—Engine—Section E10.



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FIG G11. SECTIONAL VIEW-HYDRAULIC PUMP

- | | |
|--------------------|-----------------|
| 1 Adaptor | 5 Pump barrel |
| 2 Non-return valve | 6 Outer housing |
| 3 Chamfered ring | 7 Sealing ring |
| 4 Inlet valve | 8 Plunger |
| 9 Sealing rings | |

To fit the hydraulic pump, reverse the procedure given for its removal noting the following points.

1. It will be found that when the pump has been fitted to the tappet chest cover, the pump outer casing can be rotated to position the inlet port relative to the feed pipe run from the reservoir.

2. When the pump has been correctly positioned, it must be secured using the special 'C' spanner (RH7856) and torque tightened to between 32 lb.ft. and 35 lb.ft. (4,42 kg.m. and 4,83 kg.m.). The pump must not be tightened down by using the adaptor in the top as a spannering point.

3. Replace the induction manifold, connect the pump feed and pressure pipes then fit the carburetters, generator and associated parts (see respective Chapters in this Manual).

4. Bleed the hydraulic system as described in Section G2—Bleeding the systems. At the same time check the pump's disturbed unions for leaks.

Hydraulic Pumps—To test (on the car)

1. De-pressurise the system(s).
2. Place a length of bleed tube over the bleed screw in the accumulator which is fed by the suspect pump; open the bleed screw then place and secure the other end of the tube in a clean measuring vessel.
3. Fill the appropriate reservoir compartment and start the engine.

4. Fluid should flow from the bleed tube in a series of spurts, coinciding with each revolution of the camshaft. The rate of flow should be approximately 250 c.c. or just under ½ pint per minute at an engine speed of 1,000 r.p.m.

5. If fluid does not flow from the accumulator then the pump has failed, but a second check can be made as follows.

6. Switch off the ignition, de-pressurise the systems, then tighten the accumulator bleed screw and remove the tube.

7. Disconnect the flexible high pressure inlet hose from the accumulator (see Fig. G12) and repeat the above test procedure. The fluid should now be ejected from the hose and will not be passed through the accumulator.

8. If a pump is faulty it must be removed and overhauled.

Section G6

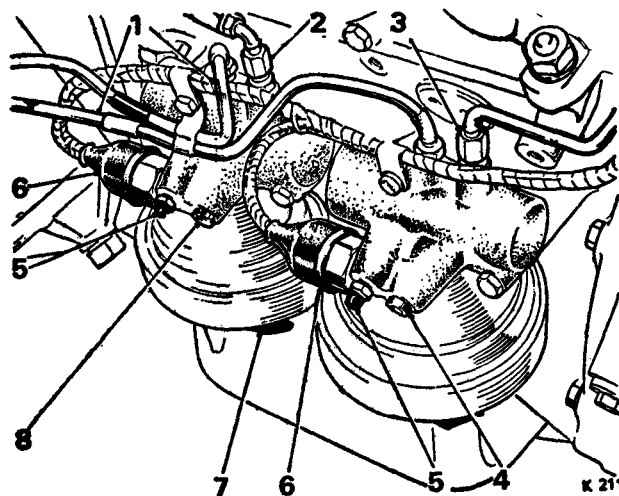
THE HYDRAULIC ACCUMULATORS

(comprising a sphere, valve and pressure switch)

Hydraulic pressure switches—Introduction

Since the introduction of the Rolls-Royce Silver Shadow and Bentley T Series cars, three types of pressure switch have been fitted, any one of which may be found on a car being serviced. The most common of these are the S.T.O.P. and Rolls-Royce manufactured switches.

If a pressure switch requires renewal, only the latest type (Rolls-Royce) must be fitted. The two types displaced are the Lucas and S.T.O.P. manufactured switches. The S.T.O.P. switch has metric threads and to enable it to be fitted to the accumulator, an adaptor was attached with the appropriate threaded end piece.



**FIG. G12 HYDRAULIC ACCUMULATORS
IN POSITION**

Hydraulic pressure switch—To remove

Lucas Type

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions), then disconnect the battery.
2. Ease the rubber seal to expose the electrical terminals.
3. Detach the terminal of the black cable from the switch, bend the cable back along the loom and secure with adhesive tape.
4. Detach the feed cable from the switch.

- 1 Return pipes to reservoir
- 2 Inlet from front pump
- 3 Inlet from rear pump
- 4 Outlet to distribution valve
- 5 Bleed screw
- 6 Warning lamp (pressure) switch
- 7 Warning plate
- 8 Outlet to distribution valve and height control

Chapter G

5. Using a suitable spanner, unscrew and remove the switch from the accumulator valve, then blank off the accumulator port to prevent the ingress of dirt.

Note It is recommended that the opportunity be made to renew both switches even though one only may be unserviceable.

Repeat Operations 1 to 5 inclusive for the other switch.

S.T.O.P. Type

1. Carry out Operation 1 of 'Lucas switch—To remove'. The note after Operation 5 also applies.

2. Ease back the rubber sleeve to expose the feed terminal and disconnect the cable from the terminal.

3. Using a suitable spanner, remove the pressure switch from the accumulator.

Rolls-Royce Type

In the event of failure of a Rolls-Royce type switch, use the removal procedure adopted for the S.T.O.P. switch, noting that a single Lucar blade is fitted to the switch.

Pressure switch (Rolls-Royce type)—To fit

1. Fit one steel and two aluminium washers to the pressure switch, the steel one located between the two aluminium washers.

2. Fit the new switch to the accumulator valve and torque tighten them to between 12 lb.ft. and 15 lb.ft. (1,66 kg.m. and 2,10 kg.m.).

3. If necessary fit a Lucar terminal to the feed cable with appropriate sleeve and connect to the switch terminal.

4. Fit the rubber boot over the switch and terminal to keep out foreign matter and water.

5. Run the engine and check the base of the pressure switch for leaks and the operation of the warning lamp on the instrument panel.

6. When the engine has been running for approximately four minutes top-up the appropriate compartment of the reservoir to the level indicated.

Repeat operations 1 to 4 to fit the other switch.

Pressure switches—To test (on the car)

1. The hydraulic pressure switches will normally always 'fail safe', i.e. if a pressure switch fails, it will operate the warning lamp on the instrument panel.

2. The warning lamp bulbs can be checked for correct operation by pressing the oil level indicator button on the instrument panel which will result in all the bulbs in the warning lamp panel being illuminated.

3. The easiest way of testing a pressure switch is by substitution, but if it is required to test a switch and a hydraulic rig is not available, a test may be carried out utilising the master cylinder system on the car.

4. De-pressurise the hydraulic systems then remove the bleed screws from the upper cylinders of each rear brake caliper and connect a Zero lb/sq.in. to 3,000 lb/sq.in. (Zero kg/sq.cm. to 210,92 kg/sq.cm.) gauge and pipe to one of the bleed screw ports, and the pressure switch and a suitable pipe and adaptor to the other bleed screw port.

5. The electrical contacts of the switch should be wired as shown in *Figures G12 and G13*.

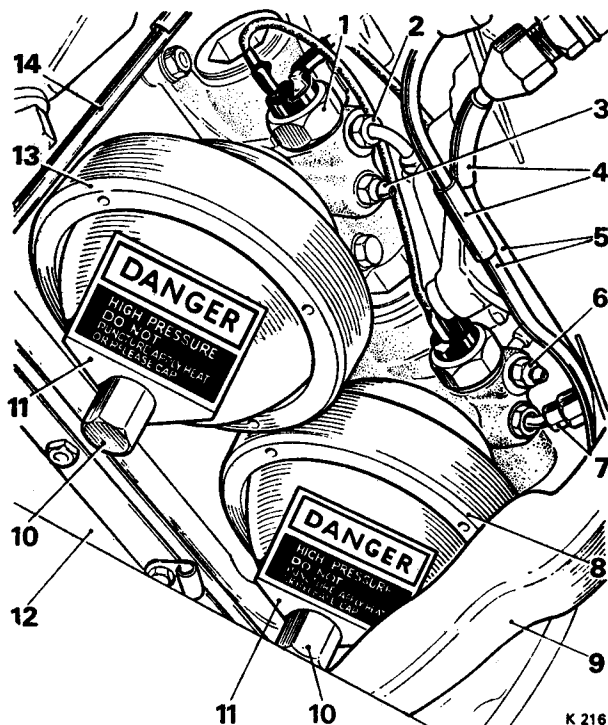


FIG. G13 ACCUMULATORS AND WARNING PLATES

- 1 Pressure switch (early type)
- 2 High pressure outlet—front accumulator
- 3 Bleed screw—front accumulator
- 4 Identification sleeves (blue or mauve)
- 5 Front brake pipes
- 6 Bleed screw—rear accumulator
- 7 High pressure outlet—rear accumulator
- 8 Rear accumulator
- 9 Suspension lever—lower
- 10 Charging valve cap (nitrogen)
- 11 Warning plate
- 12 Engine sump
- 13 Front accumulator
- 14 Engine dipstick

The switch can now be tested by actuating the brake pedal which, with 'flat' power systems, operates the upper cylinders of the rear calipers only, through the master cylinder.

Hydraulic accumulator assembly— To service

The hydraulic accumulator assembly comprises the accumulator sphere and valve fitted to the top of the sphere, complete with pressure switch. These items were previously treated as sealed units and service exchange units were provided in the event of failure.

These units, with the exception of the pressure switch, may now be dismantled and overhauled, although not all parts are supplied as individual spares. Those that are can be seen itemised in the current Parts List.

In order to comply with French regulations, a modified type of accumulator sphere is fitted to cars destined for France. This sphere functions identically to the standard type, the difference being a more shallow sphere lower half, thus decreased volume.

Front hydraulic accumulator assembly— To remove

The hydraulic accumulator must be removed from underneath the car.

1. De-pressurise the system (see Section G1—Special Precautions) then disconnect the battery which is located in the boot.
2. Carefully ease the rubber boot away from the pressure switch body and remove the electrical connection(s).
3. Remove the pipe union from the accumulator outlet, which is situated adjacent to the bleed screw and blank off the pipe and the accumulator port.
4. Remove the rearmost of the pipes fitted to the top of the accumulator valve body. This is the pressure feed from the hydraulic pump. Blank off the pipe quickly to avoid loss of fluid, then blank the port in the accumulator valve body.
5. Remove the setscrew and clip which secures the remaining pipe—the low pressure return to the fluid reservoir—from the accumulator; then remove the pipe.

Note The low pressure return pipes are under a large head pressure and consequently they must be blanked off quickly to prevent excessive loss of fluid.

6. Release and remove the two remaining setscrews securing the accumulator to the crankcase, noting that the dipstick tube is secured by the front setscrew on the front accumulator, then carefully remove the accumulator from the engine.

Front hydraulic accumulator (sphere) and valve—To separate

1. Carefully remove the charging valve cap and the warning plate (refer to special precautions given under 'Hydraulic accumulator sphere—To discharge').

Note Great care must be taken when removing this cap should any gas escape from the sphere at this point. If the later type of cap with the additional sealing nylon ball fitted (see Fig. G14), the gas pressure may cause the ball to eject quickly from the cap thus possibly causing personal injury.

2. Using special tool RH7860 on the hexagon machined on the sphere adjacent to the charging valve cap position on the accumulator, unscrew the sphere from the valve body. Re-fit the valve cap immediately.

Note It is of the utmost importance that, when the sphere is unlocked and unscrewed from the valve body, both halves of the sphere **MUST** rotate as a unit. The halves must not rotate relative to each other.

One method of checking this is to mark the halves with a piece of chalk and observe the markings whilst unlocking the sphere.

In the unlikely event of the halves rotating relative to each other, i.e. the lower half unscrewing from the upper half, the operation must be stopped **IMMEDIATELY**. The large hexagon machined on the upper half of the sphere just below the valve body should then be used to separate the sphere from the valve body.

Rear hydraulic accumulator assembly— To remove

1. Remove the front hydraulic accumulator as already described.
2. Carefully ease the rubber boot away from the pressure switch body and remove the electrical connection(s).
3. Disconnect the pipes from the valve body, blanking off each pipe and port in turn and noting that the return to the fluid reservoir must be blanked off quickly to avoid excessive loss of fluid.
4. Remove the setscrews securing the accumulator assembly to the crankcase then remove the assembly.

Rear hydraulic accumulator (sphere) and valve—To separate

1. Refer to 'Front hydraulic accumulator sphere and valve—To separate'.

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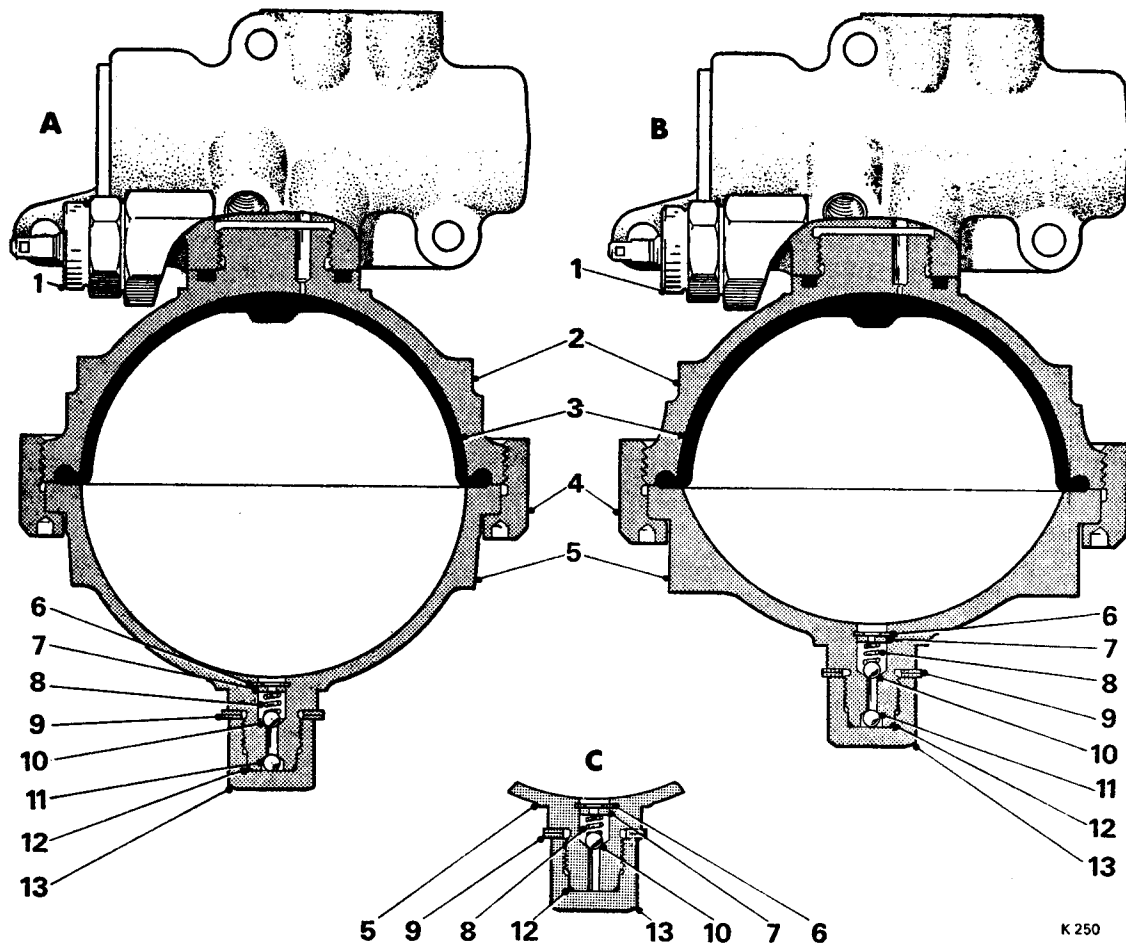


FIG. G14 SECTIONAL VIEW—HYDRAULIC ACCUMULATORS

- | | | |
|---------------------------------|---------------------------------|-----------------------|
| 1 Pressure switch | 5 Accumulator sphere—lower half | 10 Steel ball |
| 2 Accumulator sphere—upper half | 6 Circlip | 11 Nylon ball |
| 3 Diaphragm | 7 Washer | 12 Sealing ring |
| 4 Clamping ring | 8 Spring | 13 Charging valve cap |
| | 9 Washer and warning plate | |

A Accumulator valve and sphere assembly, all cars other than those destined for France **B** Accumulator valve and sphere assembly, cars destined for France

C Charging valve and cap sealing arrangement—early cars

Hydraulic accumulator (sphere)—To discharge

Before commencing to remove the charging valve sealing cap from the base of the sphere, compare the illustrations of *Figure G14*. The later type sealing arrangement shows an additional sealing steel ball which comes out as the cap is removed. If the cap is removed too quickly, and if gas is escaping from the

sphere, this ball may be ejected quickly, thus possibly causing injury to a person. This can only happen, however, if the ball, itemised 11 in *Figure G14*, is not seating correctly.

1. Carefully remove the sealing cap and collect the nylon ball (if fitted). Collect the warning plate and waved washer, if not previously removed. Discard the nylon ball and sealing ring.

Accumulator (sphere)—To dismantle

1. De-pressurise the sphere by fitting the charging/discharging valve (RH 7808) to the base of the sphere and by screwing the end cap/plunger assembly inward just sufficiently to 'crack' the one-way valve from its seating.

This allows the gas to escape slowly. It is not advisable to open the valve too quickly or too wide, thus allowing the Nitrogen gas to escape quickly.

When the sphere is completely discharged, remove the adaptor from the sphere.

2. Clamp the sphere in a vice fitted with jaw protectors and using the special tool RH 8144 remove the clamping ring in order to separate the halves of the sphere.

3. Remove the rubber diaphragm.

4. In order to dismantle the one-way valve at the base of the sphere lower half, remove the circlip, washer, small spring and valve steel ball.

Hydraulic accumulator (sphere)**—To assemble**

Assemble the sphere by reversing the method adopted for dismantling, noting the following points.

1. If necessary, renew the diaphragm.

2. Examine the one-way valve seating and return spring. Renew the ball. Renew the spring if necessary.

3. Lightly tap a new steel ball onto the charging valve seat then fit the spring, washer and circlip. The washer counterbore is seating location for the spring.

4. Smear a little Molytone C grease or its equivalent onto the buttress threads of the clamping ring.

When tightening the sphere clamping ring, use a suitable torque spanner attached to the special tool (RH8144) and torque tighten to between 265 lb.ft. and 275 lb.ft. (36,6 kg.m. and 38 kg.m.).

Ensure that the halves of the sphere do not rotate during the tightening process otherwise damage to the diaphragm may result.

Note A new steel ball and seal will be required for the charging valve cap after charging the accumulator sphere with Nitrogen.

Hydraulic accumulator (sphere)—To charge

1. Fit the charging valve (RH 7808), less the nut and plunger assembly, to the base of the sphere and attach the high pressure hose of the nitrogen gas cylinder to the valve.

2. Slowly open the valve in the top of the cylinder and gradually build up the pressure until the gauge shows a reading of 1,000 lb/sq.in. (70,31 kg/sq.cm.).

3. Close the valve and observe the gauge. If the gauge does not remain steady at 1,000 lb/sq.in.

(70,31 kg/sq.cm.) there is a leak either from the sphere or from the high pressure pipe.

4. If the pressure is maintained, remove the pipe from the sphere slowly allowing the pressure in the pipe to escape, then quickly fit the warning plate, washer and charging valve cap complete with new steel ball and sealing ring, torque tightening the cap to between 22 lb.ft. and 25 lb.ft. (3,07 kg.m. and 3,46 kg.m.).

Note The cap should be fitted as quickly as possible to provide a secondary seal in case there is a slight seepage from the one-way charging valve.

5. With the fluid inlet ports in the upper half of the sphere suitably blanked, partially immerse the other end of the sphere in water until the level is above the clamping ring and check for leakage around the clamping ring and the charging valve cap. If leakage is evident from the clamping ring then the diaphragm is faulty, presumed damaged on assembly, and the diaphragm must be renewed.

6. If a leak is observed from the charging valve cap, the 'O' ring fitted in the cap may be renewed, but the sphere must be re-charged to 1,000 lb/sq.in. (70,31 kg/sq.cm.) before the cap is refitted. The submerged leak test must also be carried out again.

7. After a successful submerged test, the sphere should be thoroughly dried with dry compressed air, with particular attention being paid to the fluid inlet ports, and the fluid inlet ports then correctly blanked off while awaiting fitting to the engine.

8. A more accurate check of the accumulator pressure when fitted to the engine may be achieved by using the hydraulic system pressure gauge rig (RH 7938).

Hydraulic accumulator valve—To dismantle

Separate the hydraulic accumulator (sphere) from the valve as described earlier.

Dismantle the valve as follows.

1. Remove the end plug from the accumulator valve, by using either a length of hexagon bar or the barrel of a discarded Lucas pressure switch inserted into the plug end and slacken by using a suitable spanner.

2. Using a $\frac{1}{4}$ in. U.N.F. setscrew screwed into the threaded hole of the valve sealing plug, withdraw the plug then discard the sealing ring.

3. Remove the aluminium sealing disc (if fitted), non-return valve, and the return spring from the smaller bore of the bobbin.

4. Remove the valve bobbin by gently tapping the valve body on a piece of wood. Remove and discard the three sealing rings.

Note The white Fluon seal remains in place.

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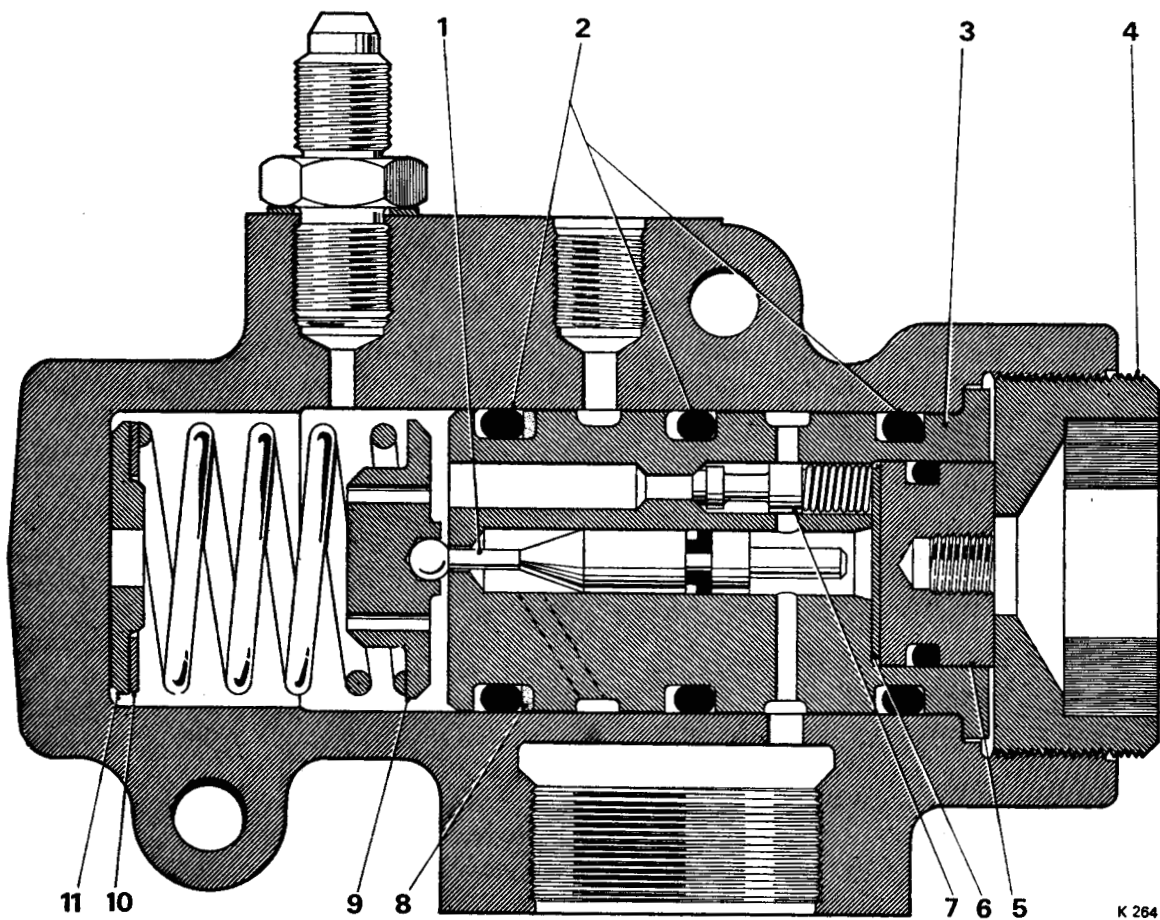


FIG. G15 SECTIONAL VIEW—ACCUMULATOR VALVE

- | | |
|---------------------------------------|------------------------|
| 1 Piston and sealing ring | 6 Sealing disc |
| 2 Bobbin and sealing rings | 7 Non-return valve |
| 3 Valve bobbin | 8 Fluon washer |
| 4 End plug | 9 Regulator valve |
| 5 Valve seating plug and sealing ring | 10 Adjusting washer(s) |
| 11 Seating washer | |

5. Remove the piston from the centre bore of the bobbin, remove and discard the combined Fluon and rubber sealing ring only if obviously damaged, necessitating renewal.

6. Remove the regulator valve, spring and adjusting washers from the valve body.

Hydraulic accumulator valve—To inspect

1. Thoroughly wash all the components, including the valve housing, in clean methylated spirits. Dry, using clean compressed air. Never use cloths to dry the components.

2. Inspect the ball seat in the bobbin and the ball of the regulator valve for ingrained dirt. Any dirt present should be removed and the parts washed a second time in clean methylated spirits.

3. Burnish the ball seat of the bobbin by holding lightly, the ball on to the seat, rotating the regulator valve by hand.

Service experience to date has shown that no other faults have occurred on this unit, but if a dismantled unit is damaged during handling, parts are available as matched sets, refer to current Parts Lists.

Hydraulic accumulator valve—To assemble

1. Assemble the valve by reversing the procedure adopted for dismantling, lubricating all internal parts with clean brake fluid of the correct type (see Chapter D).
2. Fit new sealing rings to the bobbin, piston and sealing plug (see Operation 3).
3. If renewal of the combined Fluon/rubber sealing ring of the small piston is **necessary**, great care should be taken when fitting it. Note also the position in which it is to be fitted.

**Hydraulic accumulator (Sphere) and valve—
To fit**

1. Screw the sphere into the accumulator valve body and, using the special tool (RH 7860), lock the sphere to the valve, torque tightening to between 55 lb.ft. and 60 lb.ft. (7,6 kg.m. and 8,3 kg.m.).

Note Do not use the charging valve cap as a spannering point.

2. Fit the accumulator assembly to the engine, reversing the procedure adopted for its removal, noting the following points.

Note Blanks should only be removed immediately prior to connecting the pipes.

All securing setscrews must be torque tightened to the standard figures quoted in Chapter P and care should be taken not to overtighten the pipe unions, as this could cause damage to the pipe flares.

After fitting, the appropriate compartment of the reservoir should be topped-up and the system must be bled at the accumulator and all points downstream from it on that particular system, as described in Section G2—Bleeding the systems.

When the engine is running and immediately prior to bleeding, check all unions which have been disturbed to ensure that none is leaking.

Check the nitrogen pressure as follows.

Hydraulic accumulators—To test

1. De-pressurise the system(s).
2. Remove the high pressure outlet pipe (red or orange) and attach a Zero lb/sq.in. to 3,000 lb/sq.in. (Zero kg/sq.cm. to 210,92 kg/sq.cm.) pressure gauge (RH 7938) with a length of high pressure pipe to the outlet port or alternatively remove the pressure switch and attach the pipe to the switch port.

3. Start the engine. The gauge needle should immediately jump to 1,000 lb/sq.in. (70,307 kg/sq.cm.) which is the Nitrogen pressure in the accumulator sphere, and then rise slowly to 2,500 lb/sq.in. (175,77 kg/sq.cm.). At this pressure the accumulator control valve should operate and the pump should cease to charge the accumulator.

4. After initially settling to approximately 2,400 lb/sq.in. (168,74 kg/sq.cm.) the pressure should remain steady unless the brake pedal is operated, the height control is actuated, or the accumulator bleed screw is opened.

5. Fit a bleed pipe to the accumulator bleed screw, then slightly open the accumulator bleed screw, thus allowing the pressure gauge reading to fall. When the pressure has fallen to between 1,850 lb/sq.in. and 1,900 lb/sq.in. (126,55 kg/sq.cm. and 133,58 kg/sq.cm.) the accumulator control valve should allow the pump to cut in again and charge the accumulator back to 2,500 lb/sq.in. (175,77 kg/sq.cm.).

If the above requirements are met the accumulator is operating correctly.

6. If, on first starting the engine, the pressure gauge needle fluctuates violently, rapidly climbs to 2,500 lb/sq.in. (175,77 kg/sq.cm.) and then immediately falls to zero when the brake pedal is depressed, this indicates a complete loss of nitrogen pressure from the accumulator sphere.

7. This could be caused by a leaking charging cap or a failure of the Butyl diaphragm in the sphere.

If, when the engine is started, the gauge needle jumps to a pressure less than the accumulator nitrogen pressure of 1,000 lb/sq.in. (70,31 kg/sq.cm.) this indicates a partial loss of nitrogen pressure from the sphere.

If the above condition exists the sphere must be further charged.

If, on starting the engine, the pressure gauge correctly jumps to 1,000 lb/sq.in. (70,31 kg/sq.cm.) but then fails to attain 2,500 lb/sq.in. (175,77 kg/sq.cm.) this could be due to either the accumulator controlling at a low pressure or leakage. Should the gauge needle rise to a pressure below 2,500 lb/sq.in. (175,77 kg/sq.cm.) and then remain steady, the accumulator valve is controlling at too low a pressure and the valve body (minus sphere) should be overhauled or renewed. If observation of the gauge shows that the pump is still pumping (needle fluctuating with the pump pulses) without giving a pressure rise then there is a leak which is equal to the pump flow at that pressure.

To verify this, de-pressurise the systems, remove the hose connection and blank off the high pressure outlet from the accumulator to the system. Repeat

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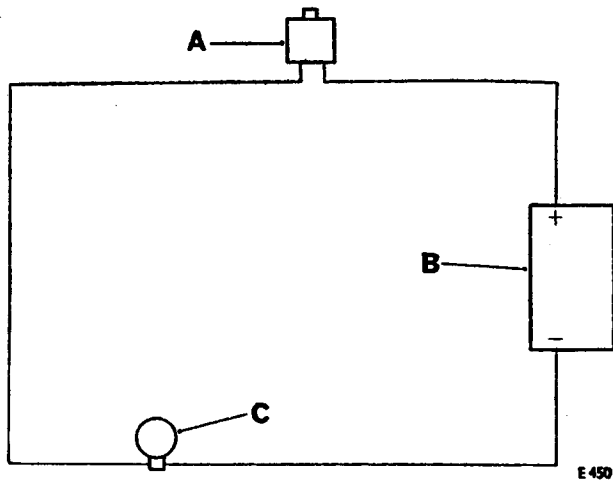


FIG. G16 PRESSURE SWITCH TEST CIRCUIT

A Pressure switch **B** Battery **C** Test lamp

the test. If the above symptom persists then the accumulator valve body has an internal leak and the accumulator valve body should be removed and overhauled. If, however, the gauge now behaves correctly, the leakage is occurring downstream and further checking will be necessary in order to isolate the faulty item, including blanking off the feeds to individual components such as the distribution valves and height control valves, depending upon the system involved.

The component isolating procedure consists of de-pressurising the system(s) then removing or blanking off the pressure feed to the various components and repeating the above test.

The pressure feeds to the components can be readily identified from the colour coding chart (see Section G3—Hydraulic pipework) and the symptoms for determining whether units are functioning correctly are given under their applicable test procedures, within their respective sections.

Note When a unit has been blanked off, before removing the blank, the systems **must be de-pressurised** either by continuous system operation with the engine switched off or by bleeding the appropriate accumulator until it is de-pressurised.

If, when the engine is started, the gauge works correctly and the accumulator controls at 2,500 lb/sq.in. (175,77 kg/sq.cm.) but then the pressure drops steadily without brake or height control actuation, until the accumulator allows the pump to cut in again at 1,850 lb/sq.in. to 1,900 lb/sq.in. (130,06 kg/sq.cm. to 133,58 kg/sq.cm.) a leak in the system is indicated and the component checking procedure should be carried out to determine the location.

Note After tests have been carried out involving blanking off components **do not** forget to remove blanks and reconnect the components to the system(s).

Section G7

FRONT AND REAR HEIGHT CONTROL VALVES

Height control valve—To service

The one front and two rear height control valves, formerly classified as service exchange units, may now be dismantled, cleaned and have new sealing rings fitted if leakage is evident and/or a fault is suspected caused by dirt in the fluid.

It will be seen from the current Parts List that only **sealing rings** of the units internal components are supplied as individual items. If other damage is evident, the unit must be renewed as an assembly.

The only maintenance required on the height control valves is lubrication of the operating arm ball joints.

1. Disconnect, clean and pack the joints with the approved grease at the specified mileage (see Chapter D).

Note When this operation is performed, the length of the link must not be altered as this would necessitate setting the height control valves relating to the car standing height.

2. After greasing, the rubber seals fitted to the rear height control valves must be fitted, then all joints connected and adjusted to give free movement without any lost motion.

Front height control valve—To remove

The height control valves are removed from underneath the car.

1. Place the car on a ramp, de-pressurise the hydraulic systems as described in Section G1—Special Precautions, then disconnect the battery, located in the boot.

2. Remove the small pinch bolt from the lower ball joint on the connecting rod and remove the rod from its pivot by unscrewing the centre adjusting screw and seat (*see Fig. G25*).

3. Remove the single pipe union from the end of the height control valve which faces the nearside of the car (white). This pipe is the low pressure return to the fluid reservoir and is subjected to a head pressure from the reservoir. Consequently, the pipe must be blanked off quickly to avoid loss of fluid.

4. Remove the two remaining pipes, blanking off each pipe and port in turn.

5. Remove the nuts and bolts securing the height control valve to the front sub-frame member. Note that only the two nuts actually connecting the valve to the bracket should be removed. Removal of all four nuts will result in the valve halves parting which must be avoided at this stage.

6. Remove the height control valve.

7. Disconnect and remove completely the connecting rod from the valve.

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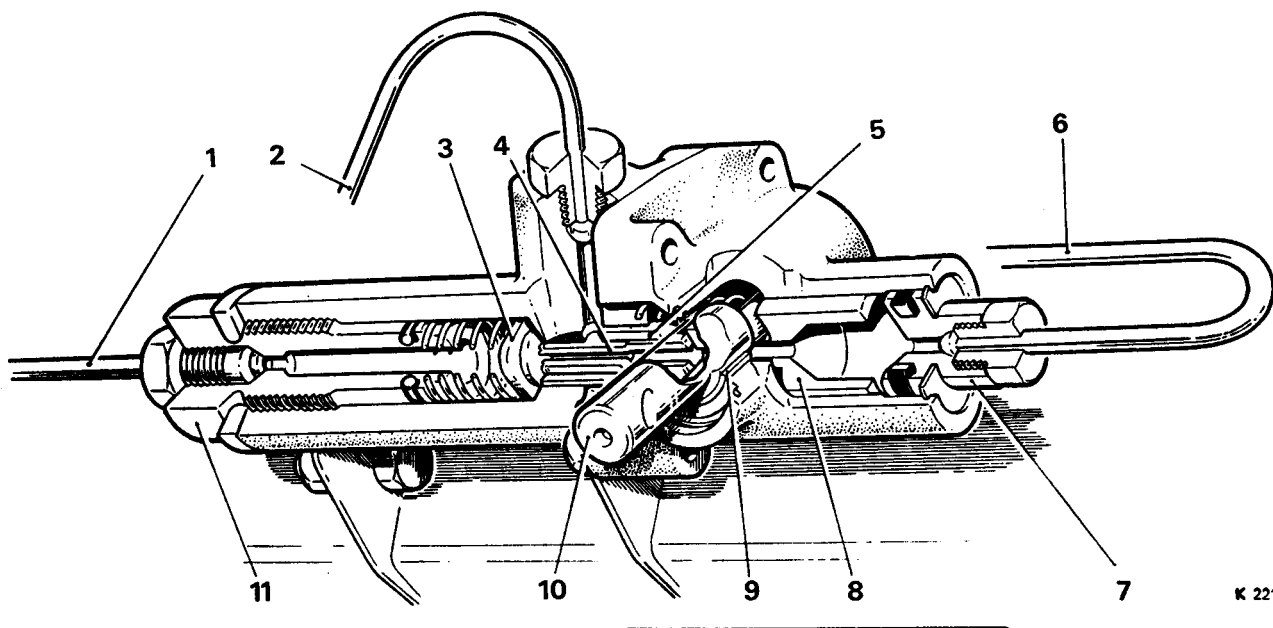


FIG. G17 CUT-AWAY VIEW—FRONT HEIGHT CONTROL VALVE

- | | | |
|---|---|--------------------|
| 1 High pressure inlet port (orange) | 5 Insert | 8 Plunger |
| 2 Connection to roll restrictor valve (brown) | 6 Connection to hydraulic reservoir (white) | 9 Shaft bearing |
| 3 Inlet valve | 7 Adaptor | 10 Operating shaft |
| 4 Sleeve valve | | 11 Adaptor |

Front height control valve—To dismantle

(see Figs. G17 and G18)

1. Remove the nuts and collect the washers (where fitted) to separate the halves of the valve.
2. Remove the exposed return spring and discard the casing sealing ring. Carefully remove the housing sleeve valve.
3. Remove the adaptor complete with thick washer from the valve housing; remove and discard the sealing ring.
4. Remove the inlet valve return spring and the inlet valve from the housing bore.
5. Remove the circlip from the casing bore; remove the adaptor and discard its sealing ring.
6. In order to remove the valve plunger, rotate the valve operating shaft to clear the plunger groove. When clear, push the plunger out of the valve casing bore.
7. In order to remove the operating shaft, remove the circlip from each end of the shaft, push the

shaft out of its bush bearings and collect the two seal washers. Discard the two sealing rings.

Front height control valve—To clean and inspect

1. Wash all parts of the unit thoroughly in methylated spirits and dry with clean compressed air, not cloths.
2. Lubricate the valve moving parts and respective bores with clean brake fluid of the correct type (see Chapter D).
3. Check that the sleeve valve slides smoothly along its bore in the valve housing.
4. Similarly, check that the plunger slides smoothly in its bore in the valve casing and that the operating shaft rotates smoothly in its bearings.
5. Examine for smoothness, the end faces of the inlet valve, the sleeve valve and the plunger where they abut.
6. Re-wash all parts thoroughly in methylated

spirits and dry with compressed air. Pay particular attention to the adaptor and pipe connection threads.

Front height control valve—To assemble

Assembly of the front height control valve is a careful reversal of the procedure adopted for its dismantling, noting the following points.

Refer also to 'Rear Height Control Valve—To assemble' for the method adopted to fit the inlet valve.

1. Lubricate all moving parts, respective bores and sealing rings with clean brake fluid of the correct type (see Chapter D).
2. Smear a little Molytone C grease or equivalent on the adaptor threads prior to fitting.
3. Ensure that all moving parts are free to move as required. Ensure also that the plunger is located correctly by the eccentric portion of the operating shaft and that the shaft is fitted the correct way round.
4. Note that when securing the halves of the valve together, two washers only are fitted, these being fitted beneath the two upper nuts.

5. Fit plastic plugs to each threaded orifice to prevent the ingress of dirt, etc., until such time as the valve is fitted to the car.

Front height control valve—To fit

To fit a front height control valve reverse the procedure given for its removal, noting the following points.

1. Before fitting the valve, assemble the connecting rod to the ball pin on the height control valve operating arm, grease the linkage joints with Rocol MT 265 grease or equivalent and adjust the joint to give free movement but without free play.
2. The valve securing nuts should be torque tightened to conform with the standard figures given in Chapter P; pressure blanks should not be removed until immediately prior to fitting the pipes.
3. After fitting, the system must be bled as described in Section G2—Bleeding the Systems; at the same time, while the engine is running, all pipes which have been disturbed must be checked for leaks.

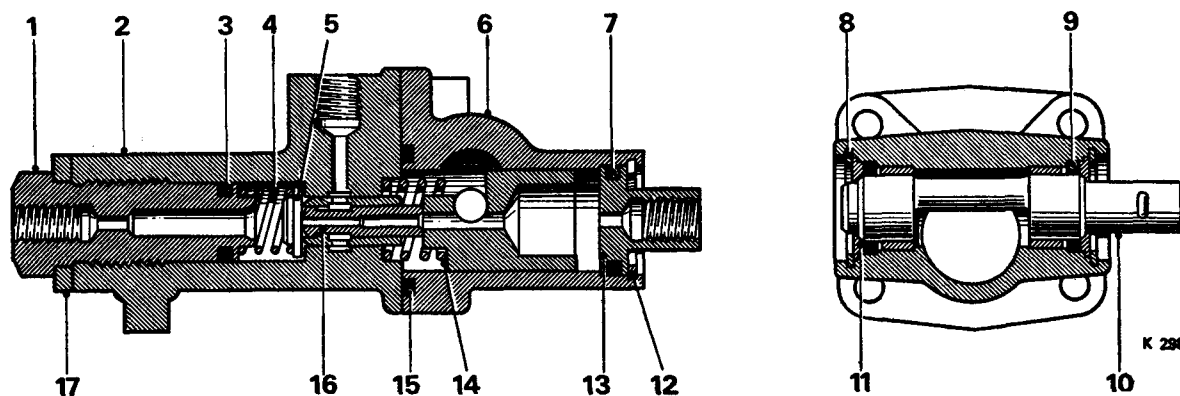


FIG. G18 SECTIONAL VIEW—FRONT HEIGHT CONTROL VALVE

- | | |
|----------------|--------------------|
| 1 Adaptor | 9 Sealing ring (2) |
| 2 Housing | 10 Operating shaft |
| 3 Housing ring | 11 Washer (2) |
| 4 Spring | 12 Circlip |
| 5 Inlet valve | 13 Adaptor |
| 6 Casing | 14 Spring |
| 7 Sealing ring | 15 Sealing ring |
| 8 Circlip (2) | 16 Plunger valve |
| 17 Washer | |

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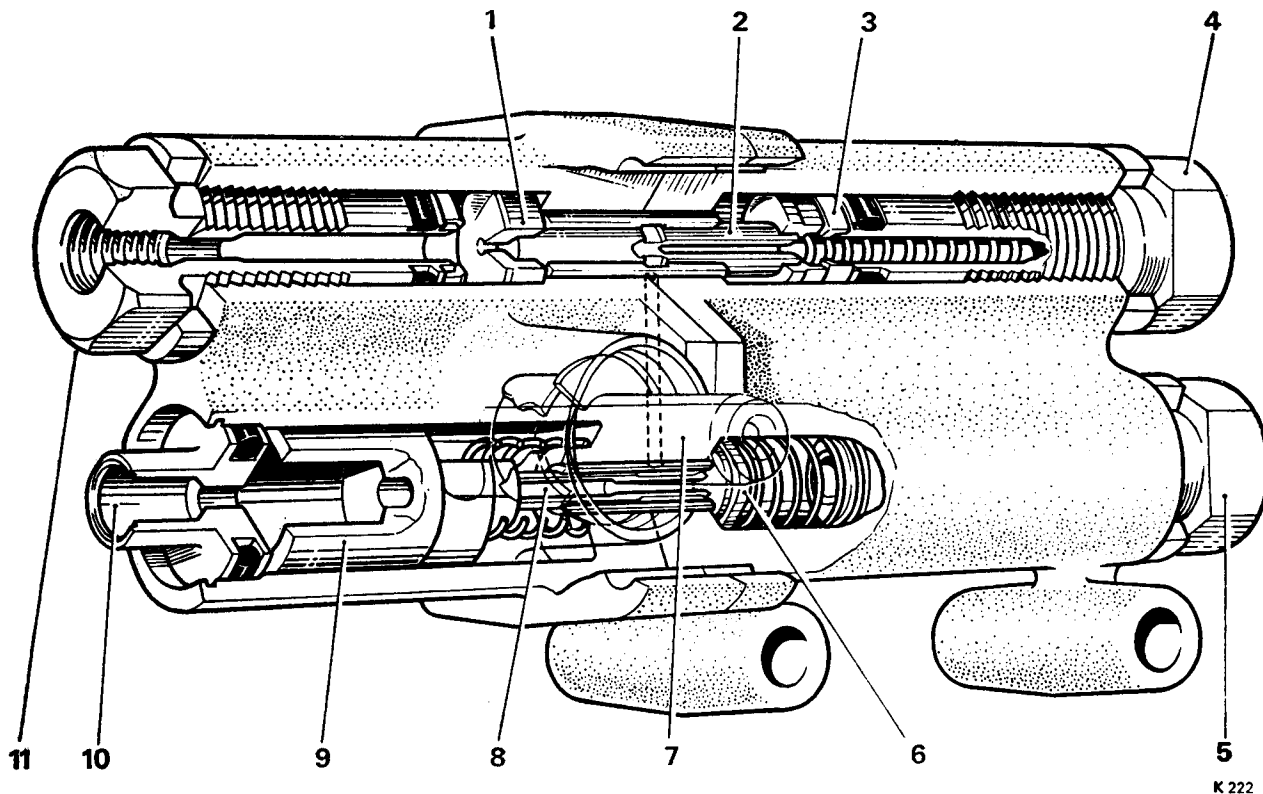


FIG. G19 CUT-AWAY VIEW—REAR HEIGHT CONTROL VALVE

- | | |
|--|--|
| 1 Fast height control plunger | 6 Inlet valve |
| 2 Restrictor plunger | 7 Operating shaft |
| 3 Plunger stop | 8 Sleeve valve |
| 4 Adaptor—connection to height control ram (brown) | 9 Sleeve valve plunger |
| 5 Adaptor—high pressure inlet (orange) | 10 Adaptor—connection to reservoir (white) |
| 11 Adaptor—connection to solenoid valve (yellow) | |

4. Following this operation the height control valve must be adjusted to give the correct standing height at the front of the car (see Standing height—To set).

Note Since the steel lower pipe is a short 'S' shape it may be necessary to release both ends of it before the pipe can be removed from the valve.

Rear height control valve—To remove

1. Place the car on a ramp, de-pressurise the hydraulic systems (see Section G1—Special Precautions) then disconnect the battery located in the boot.

2. Slacken the lock-nut on the adjusting screw underneath the bottom ball joint; remove the adjusting screw and lock-nut then disengage the joint.

Right-hand rear height control valve:

1. Remove the flexible and the steel pipes from the rear end of the valve.

2. The two pipes from the front end of the valve are connected into a four-way junction on the rear face of the sub-frame cross-member and must be removed (see Fig. G21). Remove the two unions indicated then remove the two valve mounting bolts and nuts and remove the valve, operating arm and the two pipes from the car.

Left-hand rear height control valve:

1. Remove the flexible and steel pipes from the rear of the valve.

2. The two pipes entering the front of the valve are connected into a three-way junction and a restrictor

mounted on the rear face of the sub-frame cross-member; release the pipes at these points (see Fig. G22).

3. Remove the two valve mounting bolts and nuts. Remove the valve, operating arm and the two pipes as a complete assembly.

Note If an exchange valve is being fitted the two pipes must be removed from the faulty valve and fitted to the exchange valve before it is located in position on the car.

Rear height control valve—To dismantle

(see Figs. G19 and G20)

Prior to removing any part of the valve, refer to its position relative to the valve to facilitate assembly.

1. Remove the adaptor complete with washer, sealing ring, nylon valve stop and return spring from the valve (top left-hand bore of illustrations); discard the sealing ring.

2. Remove adaptor complete with washer and sealing ring (bottom left-hand bore of illustration); discard the sealing ring.

3. Remove the return spring and inlet valve from the bore.

4. Remove the nuts and washers securing the halves of the unit together. Carefully separate the unit and discard the sealing rings.

5. Collect the exposed plunger return spring and remove the sleeve valve from its bore.

6. Carefully remove the restrictor valve assembly from the upper bore (see illustrations) and collect the spring seating from the upper bore of the housing.

7. Unscrew and remove the threaded adaptor complete with washer, adjusting washers (when fitted) and fitted valve stop. Discard the sealing ring.

8. Remove the circlip from the lower bore, remove the adaptor and discard the sealing ring.

9. Rotate the operating shaft to allow the shaft eccentric to clear the plunger groove; push the plunger out of its bore.

10. Remove the circlips retaining the operating shaft in its bore, remove the stepped washers and press out the driving shaft. Remove and discard the two sealing rings.

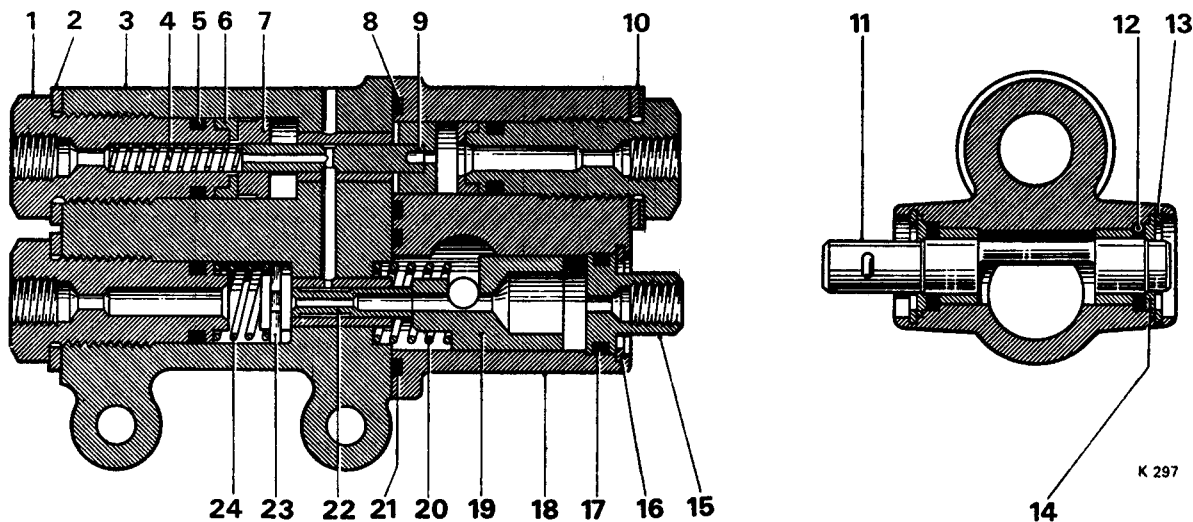


FIG. G20 SECTIONAL VIEW—REAR HEIGHT CONTROL VALVE

- | | |
|----------------------|-------------------|
| 1 Adaptor (3) | 13 Circlip (2) |
| 2 Washer (3) | 14 Washer (2) |
| 3 Housing | 15 Adaptor nut |
| 4 Spring | 16 Circlip |
| 5 Sealing ring (3) | 17 Sealing ring |
| 6 Valve (2) | 18 Casing |
| 7 Spring seat | 19 Plunger |
| 8 Sealing ring | 20 Plunger spring |
| 9 Valve | 21 Sealing ring |
| 10 Adjusting washers | 22 Plunger valve |
| 11 Operating shaft | 23 Inlet valve |
| 12 Sealing ring (2) | 24 Spring |

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Rear height control valve—To clean and inspect

1. The operations necessary are similar to those quoted for the front height control valve, noting that two valves (sleeve and restrictor) are to be checked for freedom of movement without excess radial clearance and that the end face of the sleeve valve and adjacent valve and plunger faces are smooth and free from burrs, etc.

Rear height control valve—To assemble

Ensure that all parts to be used in the assembly are scrupulously clean and free from minute particles of swarf; lubricate the internal components and rubber

sealing rings with clean brake fluid of the correct type (see Chapter D). Apply a little Molytone C grease or equivalent onto the threads of each adaptor.

1. Insert the operating shaft into position in the casing bearing bores, noting that the position of the shaft denotes whether the valve assembly is to be left-hand or right-hand (refer to *Figs. G19 and G20* for relative positions).

2. Fit a seal to one end of the shaft and (by using a blunt instrument) ensure that it is fully seated.

3. Position a seal retaining washer over the end of the shaft and locate it in its recess. Fit a circlip.

4. Position the second seal into its recess between the shaft and casing. Take care not to damage the seal.

5. Fit the seal retaining washer, locating it in its recess, then fit the circlip.

6. Insert the plunger into its bore ensuring that it moves freely. Allow the nose of the plunger to pass the operating shaft then rotate the shaft 180° to lock the plunger into position. Leave the plunger in this position.

7. Carefully fit a sealing ring to the adaptor nut. Fit this assembly into position in the casing behind the plunger and locate it with the circlip.

8. Fit a sealing ring to the casing threaded adaptor (complete with nylon end stop). Fit the large washer and any previously fitted adjusting washers to the adaptor, then fit and tighten the adaptor into position in the casing.

9. Fit a sealing washer to each of the remaining adaptors (one adaptor fitted with a nylon stop).

10. Fit a sealing ring to each groove in the end face of the casing and fit the return spring over the nose of the plunger.

11. Ensure that each valve (restrictor and sleeve) is well lubricated with brake fluid. Position them in their respective bores in the housing and ensure that they move freely.

12. Carefully secure the housing and casing of the height control valve together using the four nuts and washers.

13. Insert through the adaptor (with nylon stop), a length of clean straight $\frac{1}{16}$ in. (1.59 mm.) wire, approximately 6 in. (15 cm.) long. Thread the return spring onto the wire and into the adaptor bore. Locate the spring seat on the wire to abut the spring.

14. Locate the large washer on the adaptor, then carefully locate the end of the wire in the restrictor valve bore. Carefully slide the parts down the wire into their correct positions then screw and tighten the adaptor into position in the end of the housing.

15. Fit the nylon inlet/exhaust valve in the following manner. Rest the valve on a short length of clean aluminium bar of approximately $\frac{1}{2}$ in. (12.7 mm.)

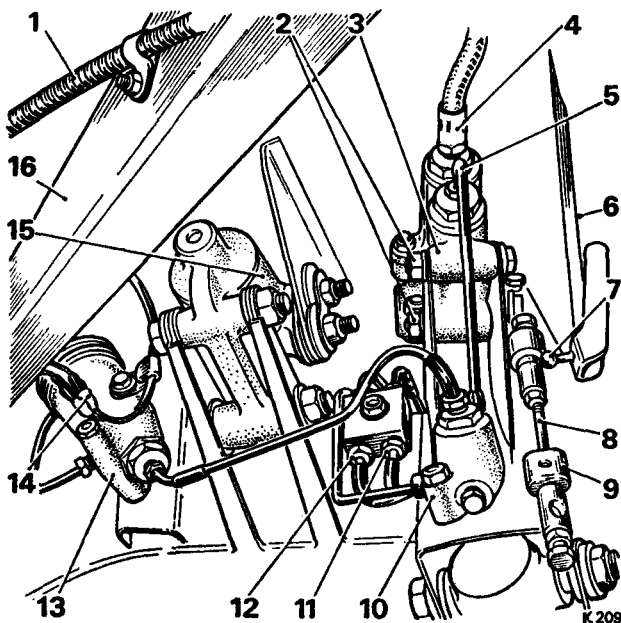


FIG. G21 REAR RIGHT-HAND HEIGHT CONTROL VALVE

- 1 Hand brake cable
- 2 Securing bolts
- 3 Rear height control valve
- 4 Connection to height control ram (brown)
Connection—high pressure feed pipe (orange)
- 6 Trailing arm outer
- 7 Ball connection—height control valve link
- 8 Operating link—trailing arm to height control valve
- 9 Joint sealing boot
- 10 Restrictor—solenoid valve
- 11 Disconnection point—valve removal (white)
- 12 Disconnection point—valve removal (yellow)
- 13 Height control solenoid valve
- 14 Solenoid valve electrical connections
- 15 Rear suspension compliance mount
- 16 Trailing arm inner

diameter. Invert the height control valve assembly and feed the bar and valve carefully into the housing bore. Uprturn the valve assembly and withdraw the bar.

16. Fit the return spring, fit the large washer to the adaptor, then fit and tighten the adaptor into the bore.

17. Fit clean plastic plugs to each of the exposed ports to prevent the possible ingress of dirt, etc. Remove these plugs immediately prior to fitting the unit to the car.

Rear height control valve—To fit

To fit a rear height control valve, reverse the procedure given for its removal, noting the following points.

1. The linkage joints must be greased with Rocol MT 265 grease or equivalent and the ball joints should be adjusted to give complete freedom of movement without slackness or free play and the valve securing setscrews should be torque tightened to conform with the figures given in Chapter P.

2. After fitting a height control valve the system must be bled as described in Section G2—Bleeding the System(s) and then the height control valve must be 'set' to give the correct car levelled height as described in the following paragraphs.

Levelled height—To set

The levelled height of the car is set correctly before leaving the factory and is to be checked at the required intervals (see Chapter D). If, however, any of the height control valves are removed from the car, on their replacement the levelled height must be checked and corrected as necessary.

The procedure for checking and setting the levelled height is as follows.

Note Before any attempt is made to set the levelled height it is imperative that the car suspension height is checked to ensure that it is correct (see Chapter H).

1. Weight the car with four occupants, or weights to simulate four occupants (600 lb. approx.) (272,16 kg.) equally disposed between the front and rear seats.

2. Run the engine with the accumulators charged and the gearchange selector in 'Neutral' so that the system is on 'fast' height control. In the interests of safety it is recommended that the gearchange thermal cut-out is removed from the fuse board beneath the instrument panel.

3. For the car to be standing at the correct height the following dimensions must be correct.

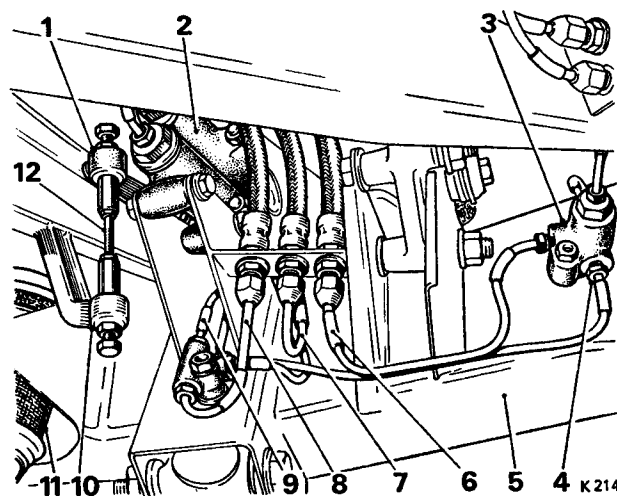


FIG. G22 LEFT-HAND SIDE REAR HEIGHT CONTROL VALVE IN POSITION

- 1 Upper ball joint—connecting rod
- 2 Height control valve
- 3 Restrictor—solenoid valve
- 4 Disconnection point—valve removal (white)
- 5 Rear suspension cross-member
- 6 Return to reservoir (white)
- 7 High pressure feed (orange)
- 8 Pressure line from solenoid valve (yellow)
- 9 Disconnection point—valve removal (yellow)
- 10 Lower ball joint—connecting rod
- 11 Rear cross-member mount
- 12 Connecting rod—height control ram

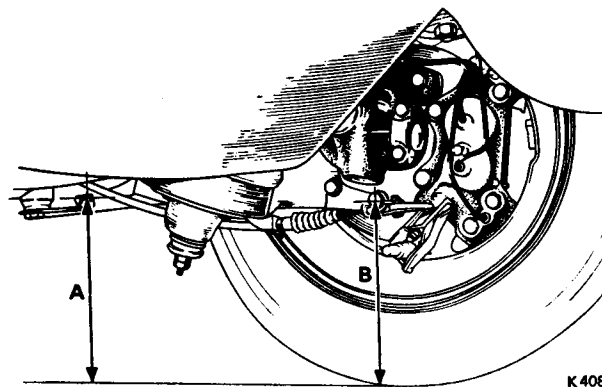


FIG. G23 CAR HEIGHT CHECKING POINTS—REAR

- A Datum to centre of forging securing bolt
- B Datum to centre of axle yoke securing bolt

Chapter G

(a) Front (see Fig. G24)

The height from the ground, or some other convenient datum, to the faces of the machined locating pads on the front of the sub-frame should be 3.525 in. \pm 0.125 in. (8,953 cm. \pm 3,175 mm.) **greater than** the height from the floor to the centre of the outer bolts connecting the lower suspension ball joint housings to the lower triangle levers.

(b) Rear (see Fig. G23)

The height from the ground or other datum, to the centre of the rearmost bottom bolt which attaches the rear suspension cross-member mounting forging to the body sill should be 0.875 in. \pm 0.125 in. (22,22 mm. \pm 3,175 mm.) **less than** the distance from the datum to the centre of the rearmost bottom bolt attaching the rear yoke to the trailing arm.

Front and Rear

In each case it is necessary to take two measurements. Before taking the first measurement, the car should be lifted approximately 2 in. (5,08 cm.) above its static position and then lowered gently before the measurements are taken.

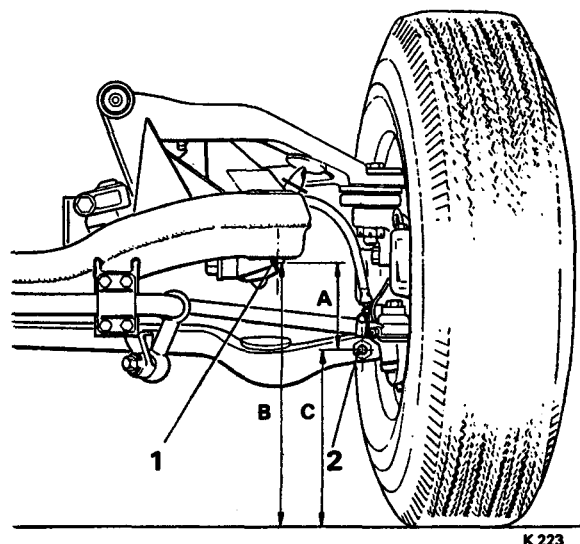


FIG. G24 CAR HEIGHT CHECKING POINTS—FRONT

- 1 Sub-frame boss 2 Lower triangle lever bolt
- A Difference between dimensions
- B Measurement to sub-frame boss
- C Measurement to bolt centre

The car should then be depressed approximately 2 in. (5,08 cm.) below its static position and again allowed to rise gently before measurements are taken.

The levelled height is the average of the two readings.

The levelled height is adjusted by varying the lengths of the height control valve operating links.

If the car is sitting too low at the rear, the rear height control valve connecting rods require lengthening and conversely, if it is too high they require shortening.

At the front the opposite applies. If the car is too low the valve connecting rod requires shortening and if it is too high the link must be lengthened.

The links must be adjusted by unlocking the lock-nut on the lower end of the link and re-setting the joint housing. The lock-nut must be tightened after the desired setting has been achieved.

Note At least 0.250 in. (6,35 mm.) of rod must remain in engagement in the joint housing.

Should the linkages be disturbed at any time between the specified maintenance periods, e.g. levelled height setting, the linkages and rubber boots should be greased on replacement.

It must be noted that adjustment can be effected at three points on the car (**one at the front and two at the rear**) and it is probable that adjustment at any one point may influence the setting at the others. Therefore, if any one point of the three is adjusted, the other two must be checked and adjusted if necessary. This triangulated check must be done as often as is necessary to achieve the correct front and rear settings.

Height control valves—To test (on the car)

The height control valves can be isolated and checked for operation on the car as follows.

1. De-pressurise the systems and isolate the gear-change selector by removing the thermal cut-out.
2. Remove the feed pipe from a rear height control valve (orange pipe) at the junction on the rear suspension cross-member and blank off the pipe and valve port.
3. Run the engine at approximately 1,000 r.p.m. If the height control valve was not operating before and now works on the opposite side of the car to the isolated valve then the isolated valve or its associated height control ram is at fault.

4. Stop the engine, de-pressurise the system(s) and reconnect the height control valve feed.

5. A further check can be made by removing the height control valve return pipe (white pipe) from the junction on the rear suspension cross-member (rear valve) or the end of the valve (front height control valve). Blank off the junction and insert the end of the pipe into a clean container (rear valve) or blank off the pipe and insert a union and short length of pipe into the valve port and place the open end of the pipe in a clean container (front valve).

6. Disconnect the height control valve operating arm and link from its pivot on the suspension then push the operating arm upward if it is a rear height control valve or pull it downward if it is the front height control valve. Run the engine at a fast tick-over.

Fluid should not flow from the pipe, if it does, the height control valve is at fault and should be changed.

7. Manually operate the height control valve linkage so as to lower the car, i.e. pull the lever downward on a rear height control valve or push it upward on the front height control valve.

Note Do not push the front height control valve linkage upward too far otherwise a foul with the engine fan may occur.

Fluid contained in the ram(s) should now flow into the container and then stop when the rams are completely exhausted. If the flow does not stop then the height control valve has a damaged valve seat.

8. If the valve is working correctly, de-pressurise the systems, remove the spare pipe and reconnect the height control valve return pipe.

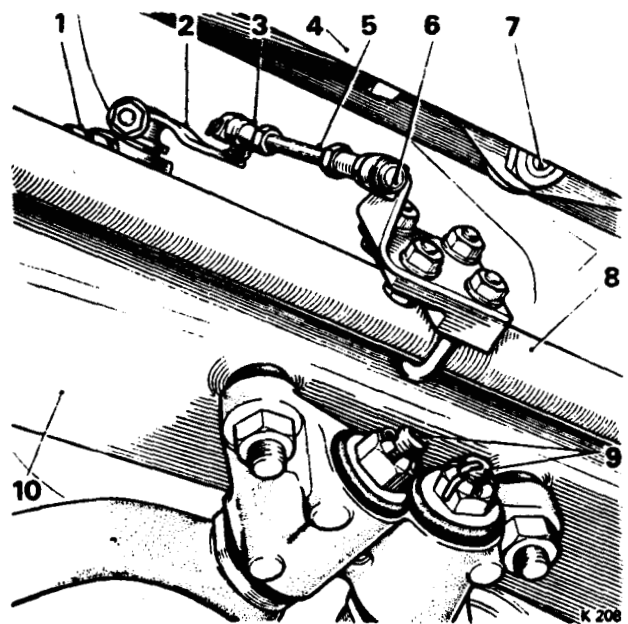


FIG. G25 OPERATING LINKAGE—FRONT HEIGHT CONTROL VALVE

- 1 Front height control valve
- 2 Valve operating arm
- 3 Connecting rod upper ball joint
- 4 Body front panel
- 5 Connecting rod
- 6 Connecting rod lower joint
- 7 Body pivot—transverse link
- 8 Suspension stabiliser bar
- 9 Lower suspension lever front pivots (early type)
- 10 Front sub-frame

Section G8

THE ROLL RESTRICTOR VALVE

Roll restrictor valve—To service

The roll restrictor valve unit was previously treated as a sealed unit and service exchange units were provided in the event of failure. This unit may now be dismantled and overhauled, although not all parts of the unit are supplied as individual items. Those that are can be seen itemised in the current Parts List.

Service experience has shown that a fault in the valve is usually seal leakage and/or attributed to dirt, the latter causing malfunctioning.

Roll restrictor valve—To remove

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions).
2. Remove the five pipes from the roll restrictor valve and blank off each pipe end and valve port securely.
3. Remove the two securing setscrews; remove the valve.

Roll restrictor valve—To dismantle (refer to Figs. G26 and G27)

1. Remove the longer of the two adaptors and the plain washer.
2. Remove and then discard the sealing ring from the adaptor.
3. Remove the valve spring.
4. Remove the spring seating. This can be achieved by gently striking the restrictor valve against a piece of wood such that the spring seat drops down the bore.

5. Remove the adaptor from the opposite end of the valve, noting the number and position of the adjusting washers. A plain washer is also fitted.

6. Remove and then discard the adaptor sealing ring.

7. Remove the four nuts and plain washers, then detach the plunger housing from the restrictor valve housing. Discard the sealing ring.

8. Remove the plunger from its sleeve in the housing, noting its position to facilitate assembly.

9. Remove the restrictor valve, noting that the axial bore of the valve faces the spring on assembly.

10. Remove and then discard the restrictor valve sealing ring.

11. Thoroughly wash all components in methylated spirits and dry with compressed air, not cloths.

Roll restrictor valve—To assemble

Assemble the valve by carefully reversing the procedure given for dismantling, noting the following points.

1. Lubricate all moving parts of the valve and the new sealing rings with clean brake fluid of the correct type.

2. Note also the position of the adjusting washers and the restrictor valve (*see Fig. G27*).

3. Should the valve assembly not be fitted to the car immediately, fit suitable blanks to the exposed threaded ports.

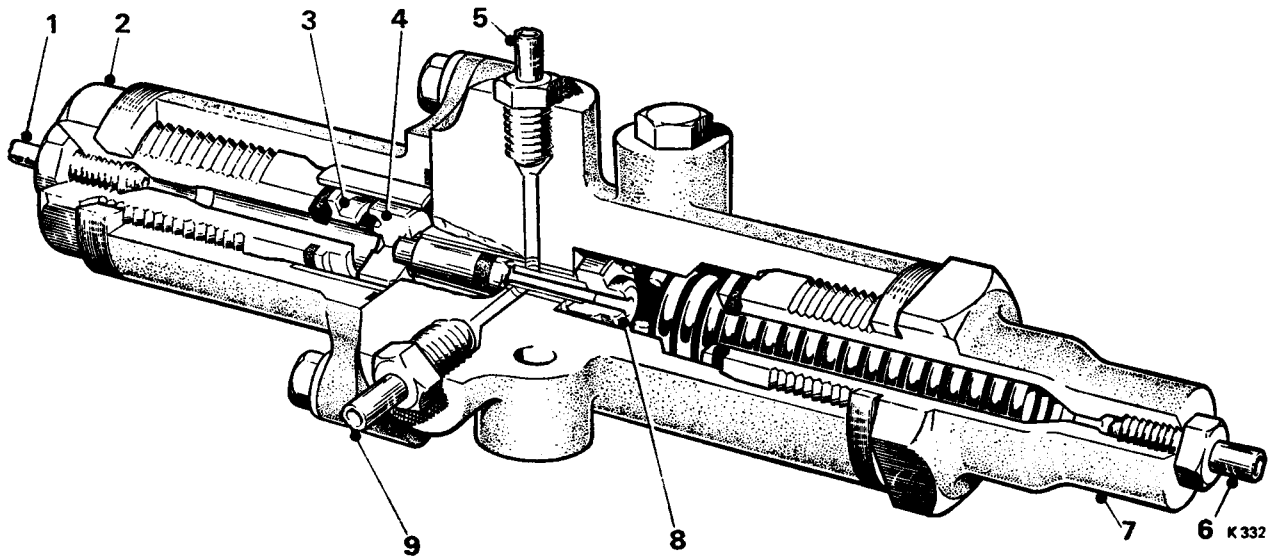


FIG. G26 CUT-AWAY VIEW—ROLL RESTRICTOR VALVE

- | | |
|--|--|
| 1 Connection to solenoid valve (yellow) | 6 Connection to front height control valve (brown) |
| 2 Adaptor | 7 Adaptor |
| 3 Adaptor seal and plunger stop | 8 Restrictor valve |
| 4 Fast height control plunger | 9 Connection to height control ram (brown) |
| 5 Connection to height control ram (brown) | |

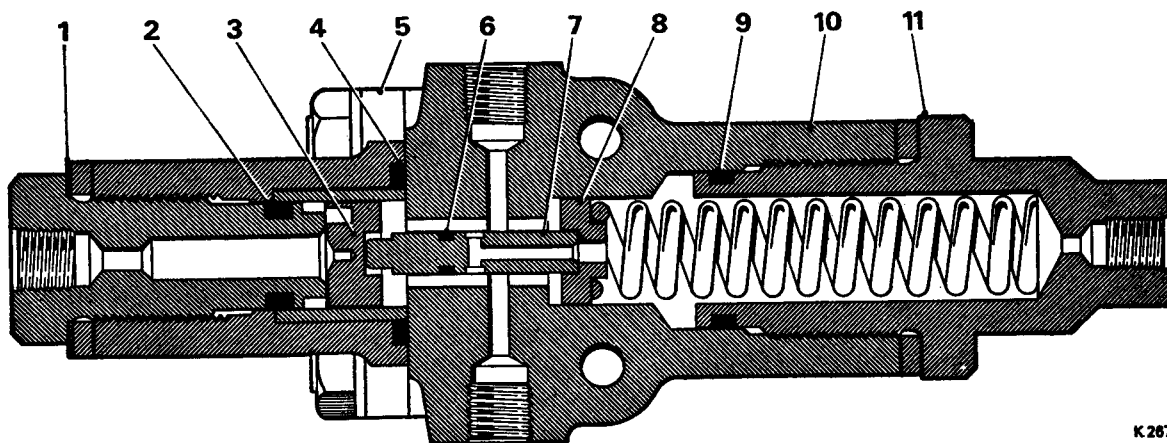


FIG. G27 SECTIONAL VIEW—ROLL RESTRICTOR VALVE

- | | | |
|--------------------|--------------------|-----------------------------|
| 1 Adjusting washer | 5 Plunger housing | 9 Sealing ring |
| 2 Sealing ring | 6 Sealing ring | 10 Restrictor valve housing |
| 3 Plunger | 7 Restrictor valve | 11 Adaptor |
| 4 Sealing ring | 8 Spring seat | |

Roll restrictor valve—To fit

To fit the roll restrictor valve reverse the procedure given for its removal.

1. The two securing setscrews should be torque tightened to the standard figures given in Chapter P.
2. After fitting, the systems must be bled as described in Section G2—Bleeding the Systems, and the valve and pipes should be visually inspected for leaks.

Roll restrictor valve—To test (on the car)

If the front height control is not functioning correctly and tests have shown that the height control valve is in order, the roll restrictor valve should be checked for serviceability.

1. To check whether solenoid signal pressure is reaching the roll restrictor, pressurise the systems then with the ignition still switched on energise and de-energise the solenoid valve by removing and re-

placing one of the electrical leads, at the same time holding the roll restrictor signal pressure pipe (yellow pipe). A faint pulse should be felt through the pipe.

The 'slow' height control action of the restrictor valve should be checked as follows.

1. De-pressurise the systems then connect a bleed tube to each front ram bleed screw and place the ends in clean containers.
2. Disconnect an electrical lead from the solenoid valve and disconnect the front height control valve operating link from the front stabiliser bar and pull the valve operating arm down.
3. Slacken the two bleed screws slightly then run the engine at a fast tick-over.

Fluid should flow slowly from both bleed screws.

4. If the loose electrical lead is now touched onto the solenoid valve terminal to energise the valve and select 'fast' height control, fluid should flow quickly from the bleed tubes.

Section G9

THE SOLENOID VALVE AND RESTRICTORS

Solenoid valve—To service

The solenoid valve, formerly classified as a service exchange unit, may now if the need arises be overhauled by Service Personnel. The majority of the components making up the unit are available as individual items, although two small factory tested sub-assemblies are included in the list.

Always refer to the current Parts List for the parts available.

Solenoid valve—To remove

With the introduction of the anti-roll bar to the rear suspension, and to give greater access to the compliance damper bolts, the solenoid valve and one restrictor fitted to the rear of the suspension sub-frame are transposed and the hydraulic pipework re-routed accordingly. The coloured illustrations (*see Figs. G3 to G6 inclusive*) show the variations to the run of the pipework.

The solenoid valve is fitted to the rear off-side face of the rear suspension sub-frame.

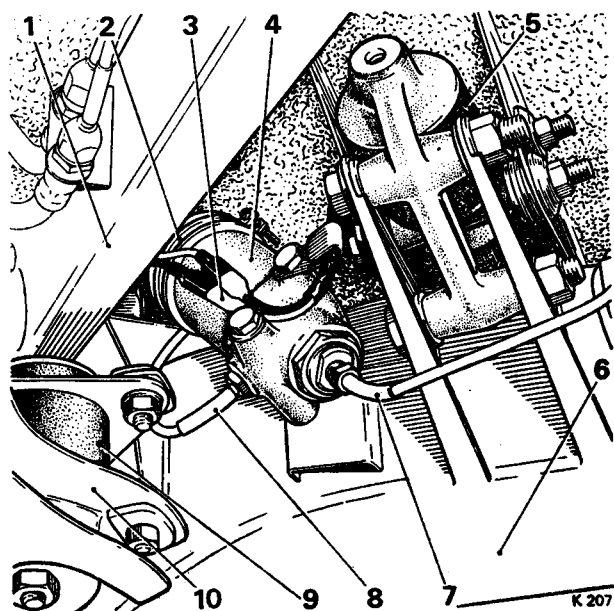
1. Before removing the solenoid valve it is necessary to de-pressurise the systems (*see Section G1—Special Precautions*) and to disconnect the battery.
2. Remove the electrical connections from the solenoid valve (*see Fig. G28*).
3. Remove the three hydraulic pipes and securely blank the pipe ends and the solenoid valve ports. Note the position of each connection to facilitate assembly.
4. Remove the two setscrews securing the valve to the rear suspension cross-member.
5. Remove the solenoid.

Height control solenoid—To dismantle

(refer to Fig. G29)

1. Unscrew and remove the protective cover retaining clips.
2. Remove the rubber protective cover to expose the solenoid end face.
3. Unlock the tab washer and remove the nut; remove and discard the tab washer.
4. Remove the flux plate, carefully withdrawing the two cables (black and green/yellow) from the plate grommets.
5. Note the position of the sealing ring situated immediately behind the plate to facilitate assembly. Remove and discard the old sealing ring.
6. Carefully withdraw the coil from the housing.
7. Remove the spacer.
8. Remove the housing from the solenoid body; remove and discard the sealing ring.
9. From the opposite end of the solenoid, remove the lock-nut and unscrew and remove the valve. Remove and discard the sealing ring.
10. Remove the valve and bobbin assembly from the main bore of the solenoid valve. Collect also the shims which are situated between the faces of the valve and cone valve.
11. Remove the cone valve body from the main bore of the solenoid valve; remove and discard the sealing ring.
12. Remove the cone valve from the valve body and collect the return spring.
13. Wash all non-electrical components in clean methylated spirits and dry with compressed air, not cloths. Wipe clean the electrical components.

Chapter G



**FIG. G28 HEIGHT CONTROL SOLENOID VALVE
IN POSITION**

- 1 Trailing arm
- 2 Solenoid rubber boot
- 3 Solenoid electrical connections
- 4 Solenoid valve body
- 5 Compliance mount
- 6 Rear cross-member
- 7 High pressure inlet
- 8 Pressure outlet to height control and roll restrictor valves (yellow)
- 9 Torque arm mount
- 10 Torque arm

Solenoid valve—To inspect

1. After the thorough cleansing, examine the two valves for correct seating.
2. If leakage is suspected from the seal and joint of the solenoid body and extension, the sub-assembly should be renewed, no attempt should be made to correct the fault.
3. Check the insulation resistance of the coil. The resistance between either lead and the coil measured at 250 volts D.C. must not be less than 2 megohms. Renew the coil if necessary.

**Height control solenoid valve—To assemble
(refer to Fig. G29)**

To assemble the solenoid, reverse the procedure adopted for dismantling, noting the following points.

1. Lubricate each part of the non-electrical components with brake fluid of the correct type (see Chapter D). Keep those faces facing or abutting the electrical components clean and dry.

2. Fit new lubricated sealing rings. Note the position for the sealing ring situated between the coil and flux plate. This sealing ring is to be left dry then cut and positioned suitably to clear the electrical wiring.

3. Using feeler gauges, set the gap Z to between 0.008 in. and 0.011 in. (0,22 mm. and 0,28 mm.) with the cone valve fully seated. The gap is arranged by fitting selective shims at point Y between the mating faces of the cone valve, and the valve and bobbin assembly, prior to fitting the assembly to the housing bore.

4. The nut (with new tab washer) retaining the cone valve body should be torque tightened to between 18 lb.ft. and 20 lb.ft. (2,48 kgm. and 2,77 kgm.).

5. Set the gap X between the opposing faces of the valve and bobbin assembly, and the screw threaded valve to between 0.020 in. and 0.025 in. (0,51 mm. and 0,63 mm.). In order to obtain this setting, carefully screw in the valve, without a sealing ring and lock-nut, until it bears on the valve and bobbin assembly. Further gentle screwing in will seat the cone valve to close the orifice.

(a) Using a dial test indicator or suitable depth micrometer, screw out the valve the required amount, see figure quoted earlier, and scribe accurately, a short line on the end of the valve and body respectively.

(b) Remove the valve, noting the number of turns necessary in order to remove it completely from the bore.

(c) Fit a new lubricated sealing ring to the valve groove, then screw in the valve the required number of turns, aligning the pre-scribed lines accurately.

(d) Fit and torque tighten the lock-nut to the exposed threaded end of the valve to retain it in the set position. The torque tightness figure for this nut should be between 38 lb.ft. and 40 lb.ft. (5,25 kg.m. and 5,53 kg.m.).

6. Ensure that the solenoid protective rubber cover is cleaned and in good condition, if not, renew it and tighten the retaining clips to give good sealing against dirt, etc.

7. Fit blanking plugs to each of the exposed ports as a precaution against dirt, until such time as the solenoid valve is fitted to the car.

Solenoid valve—To fit

To fit the solenoid valve reverse the procedure given for its removal, noting the following points.

1. Torque tighten the two securing setscrews in accordance with the standard values given in Chapter P.

2. After fitting the valve, run the engine to charge the systems. Place on 'fast' height control and check the solenoid and pipes visually for leakage.

Solenoid valve restrictor—To service

Should a fault diagnosis check indicate that a solenoid valve restrictor is blocked or if the system has become contaminated, the solenoid valve restrictors may be removed from the car, dismantled and cleaned.

Solenoid valve restrictor—To remove

The solenoid valve high pressure and low pressure restrictors are fitted to the rear face of the rear suspension sub-frame.

The high pressure restrictor with three pipes (orange sleeved) is fitted to the off-side of the sub-frame close to the solenoid valve (see Fig. G21). The low pressure restrictor is fitted to the near-side of the sub-frame adjacent to the compliance cushions and has four (white sleeved) pipes adjoining it. (see Fig. G22).

1. Place the car on a ramp, de-pressurise the hydraulic systems (see Section G1—Special Precautions) and disconnect the battery which is located in the boot.

2. Disconnect the hydraulic pipes from the solenoid valve restrictor (3 pipes on the off-side restrictor and 4 on the near-side restrictor) and blank off all pipes and ports.

3. Remove the nut and washer securing the restrictor to the sub-frame; remove the restrictor.

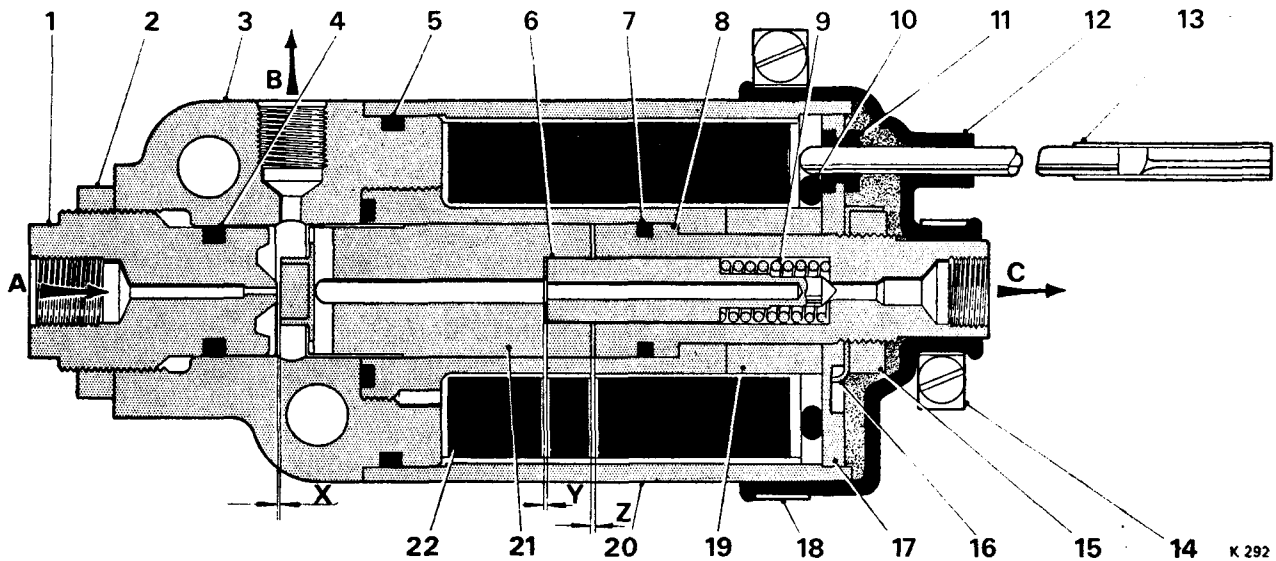


FIG. G29 SECTIONAL VIEW—HEIGHT CONTROL SOLENOID VALVE

- | | |
|---|---------------------------------|
| 1 Valve | 11 Grommet |
| 2 Valve lock-nut | 12 Protective cover |
| 3 Body and extension assembly | 13 Lucar connector |
| 4 Valve sealing ring | 14 Cover retaining clip (small) |
| 5 Body sealing ring (extension sealing ring not accessible) | 15 Lock-nut |
| 6 Cone valve | 16 Tab washer |
| 7 Cone valve body sealing ring | 17 Flux plate |
| 8 Cone valve body | 18 Cover retaining clip (large) |
| 9 Return spring | 19 Spacer |
| 10 Sealing ring (cut and positioned to clear coil wiring) | 20 Housing |
| | 21 Valve and body assembly |
| | 22 Coil |

A High pressure inlet

B Connection to roll restrictor and rear height control valves

C Connection to fluid reservoir

X Gap 0.020 in. to 0.025 in. (0,50 mm. to 0,63 mm.)

Y Shims—suitable thickness to adjust gap Z

Z 0.008 in. to 0.011 in. (0,20 mm. to 0,28 mm.)

Chapter G

Solenoid valve restrictor—To dismantle and clean

The restrictor should be dismantled and cleaned as follows.

1. Remove the large 0.750 in. (19.05 mm.) A.F. hexagon headed union and the sealing ring located beneath it.
2. Holding one hand over the end, invert the restrictor body and catch the two end plates, restrictor plate and restrictor roller as they emerge from the bore.
3. Clean all parts in methylated spirits and dry with clean compressed air.

Solenoid valve restrictor—To assemble

To assemble the restrictor valve reverse the procedure given for its dismantling, noting the following points.

1. All parts must be scrupulously clean and, on assembly, a new sealing ring, lubricated with clean hydraulic fluid, must be fitted below the hexagon headed union.
2. Fit one of the two end plates then the restrictor plate and restrictor roller, followed by the other end plate. Fit the sealing ring and adaptor, torque tightening it to between 22 lb.ft. and 25 lb.ft. (3.04 kg.m. and 3.45 kg.m.).

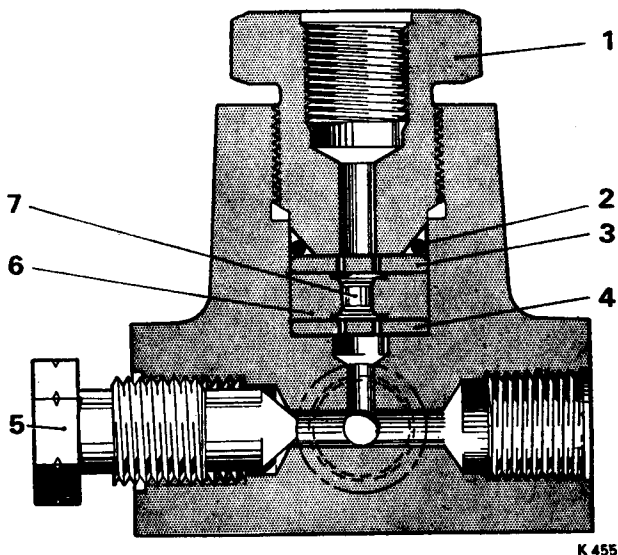


FIG. G30 SOLENOID RESTRICTOR

- 1 Hexagon headed union
- 2 Sealing ring
- 3 End plate
- 4 End plate
- 5 Sealing plug (off-side restrictor only)
- 6 Restrictor plate
- 7 Restrictor roller

3. Fit the sealing plug to the off-side mounted restrictor and torque tighten to between 5 lb.ft. and 7 lb.ft. (0.70 kg.m. and 1.24 kg.m.).

Solenoid valve restrictor—To fit

To fit the solenoid restrictor reverse the procedure given for its removal, noting the following points.

1. All nuts and unions must be torque tightened in accordance with the standard figures given in Chapter P.
2. After removal and fitting the solenoid inlet (right-hand) restrictor, the rear height control rams should be bled (see Section G2—Bleeding the Systems) and the restrictor connections checked for leaks.

Solenoid valve—To test

If either 'slow' or 'fast' height control is not available, the hydraulic system solenoid valve may be checked for serviceability on the car.

1. Run the engine to charge the accumulators. Stop the engine but leave the ignition switched on and listen to the solenoid valve whilst switching the system from 'fast' to 'slow' by disconnecting one of the electrical connections at the solenoid valve. A light click should be just audible from the solenoid valve. If this is not apparent then either the valve is at fault or the electrical circuit is faulty.
2. Check the electrical circuit by removing the two leads from the solenoid valve and connecting a jumper lead and lamp across the two leads. When the ignition is switched on the lamp should be illuminated if the wiring circuit is sound.
3. Remove the jumper lead and lamp and connect one of the wires to the solenoid valve. Connect the jumper lead and lamp between the other solenoid valve terminal and the disconnected wire. If the lamp is illuminated when the ignition is switched on then the solenoid windings are sound. If the windings are faulty the solenoid valve must be changed.
4. If during the initial 'fast'—'slow' height control test a 'hissing' noise was evident from the solenoid valve when slow height control was in operation, it indicates a damaged, high pressure valve seat, and the solenoid valve must be changed.
5. If it has been determined that the solenoid valve is electrically operational, that it clicks correctly when actuated and that it does not 'hiss', but 'fast' height control is still not available, then it is probable that the solenoid valve restrictors are blocked and they should be removed and cleaned.

If it has been evident from tests that a leak is occurring in the system then, to determine whether the solenoid is the cause, proceed as follows.

6. De-pressurise the systems.

7. Disconnect the solenoid return pipe from the solenoid valve (white pipe) and blank off the pipe. Insert a union and a length of pipe into the valve port and place the open end of the pipe in a clean container.

8. With 'slow' height control conditions in operation, i.e. solenoid valve electrical leads disconnected, start the engine and charge the systems. If a flow of

more than 10 c.c. per hour (max.) is emitted into the container the valve must be regarded as faulty.

9. If the electrical leads are now connected and then disconnected, placing the system briefly on 'fast' height control a quantity of fluid should rush out of the valve. It must be noted however that if fluid does not rush out it may be that the solenoid valve is not faulty, but that there is an easier leak path for fluid elsewhere in the system or that the restrictors are blocked.

10. If the valve is placed on 'fast' level and held in this condition, the leakage rate out of the valve into the container must not exceed 10 c.c. per minute.

Section G10

THE HEIGHT CONTROL RAMS

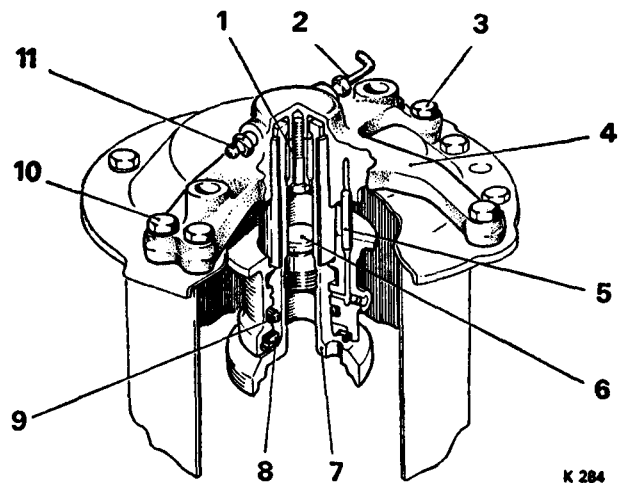
Introduction

Since the introduction of the Rolls-Royce and Bentley T Series cars, there have been three differing piston sealing arrangements of the front and rear height control rams.

At the commencement of production, **three** seals were fitted in the ram housing (*see Fig. G34*), namely the main pressure seal, the secondary seal and the piston wiper seal. On early production cars, after serial numbers SRX 1755 and CBH 1696, the seal arrangement was modified (*see Fig. G37*). The main seal was introduced into the lower groove (formerly occupied by the secondary seal) leaving the upper groove vacant. The seal seepage pipes were discontinued and blanking plugs inserted into the ram seal seepage outlet port and appropriate junction block of the hydraulic system respectively.

Any cars prior to those quoted earlier which require overhaul are modified in a similar manner but on an individual basis. It is not necessary to modify all height control rams to the later arrangement if only one ram is unserviceable.

On later cars, the height control rams fitted to the front and rear of the car though visually appearing to be the same in fact have only one groove and one counterbore machined in them for the necessary seals (main and piston wiper) and no seal seepage outlet port.



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FIG. G31 CUT-AWAY VIEW—FRONT HEIGHT CONTROL RAM—MODIFIED—EARLY CARS

- 1 Travel limiting stop
- 2 Connection to roll restrictor valve
- 3 Extractor screw (item 10)
- 4 'Tee' shaped height control ram cap
- 5 Seal seepage return port (blanked off)
- 6 Ram blanking plug (screwed type)
- 7 Ram piston
- 8 Piston wiper seal
- 9 Main seal
- 10 Extractor screw (item 3)
- 11 Bleed screw

Chapter G

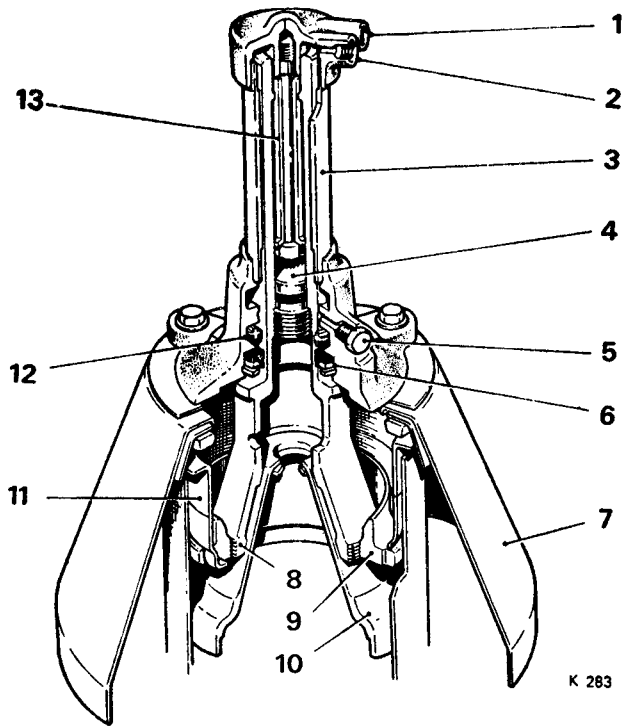


FIG. G32 CUT-AWAY VIEW—REAR HEIGHT CONTROL RAM—MODIFIED—EARLY SALOON

- 1 Port to remote bleed screw
- 2 Inlet port
- 3 Ram housing
- 4 Blanking plug (screwed type)
- 5 Seal seepage port (blanked off)
- 6 Wiper seal
- 7 Rear road spring pot
- 8 Ram piston
- 9 Ram piston lock-nut
- 10 Road spring upper seating and shock damper upper mounting point
- 11 Ram piston lock-nut retainer
- 12 Main seal
- 13 Travel limiting stop

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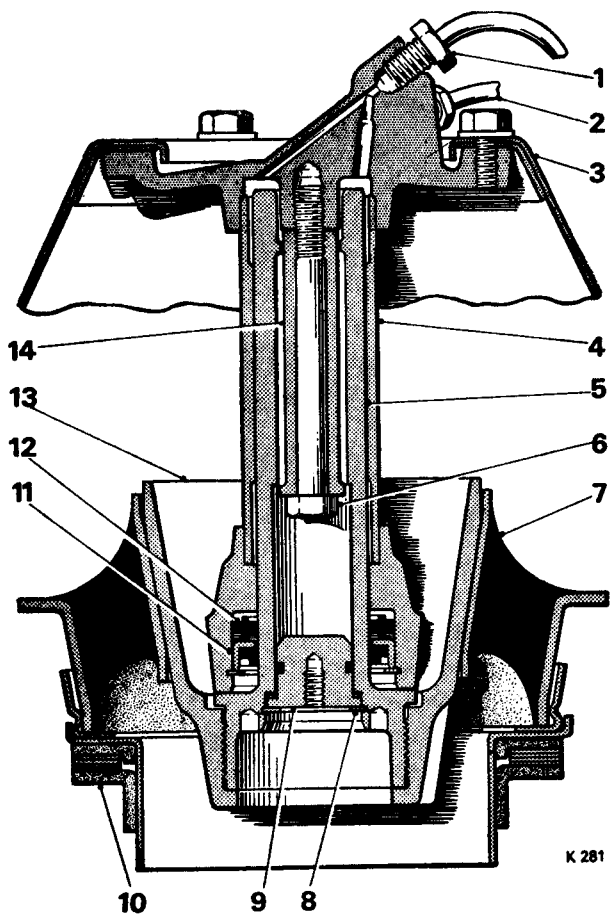


FIG. G33 SECTIONAL VIEW—REAR HEIGHT CONTROL RAM—LATER DROPHEAD COUPE CARS

- 1 Pipe to remote bleed screw
- 2 Inlet port
- 3 Rear road spring pot
- 4 Ram housing
- 5 Ram piston
- 6 Retaining setscrew
- 7 Road spring isolator
- 8 Circlip
- 9 Ram blanking plug (plain type)
- 10 Road spring seating arrangement
- 11 Piston wiper seal (later type)
- 12 Main seal
- 13 Road spring isolator cone
- 14 Travel limiting stop

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On current cars from the following serial numbers, SRH 4129, CRH 4063, SRX 6094 and CRX 6060, a simplified sealing arrangement was introduced (see Fig. G35). Two seals (main and piston wiper) are fitted in a common bore; the wiper seal is of different design and diameter than those of earlier rams.

The height control ram blanking plug of all cars from SRH 3885, CBH 4033, SRX 6018 and CRX 6038 has changed from a screwed type with sealing ring to a plain type with sealing ring, retained by a circlip.

For identification and extraction purposes, the early type screwed plug is provided with a hexagonal recess, the later type plain diameter plug is fitted with a tapped hole.

The rear height control rams of all Drophead Coupé cars are of different external design to suit the body styling (see Fig. G33).

This ram is fitted beneath the stiffened rear shelf which houses the power operated hood when not in use. The internal parts and sealing arrangements of these rams are the same as those of other cars previously described.

Early cars prior to serial numbers SBH 1433 and CRX 1583, were fitted with short stroke shock dampers, identified by the ball joint at their base, having a car height fine adjustment screw arrangement (refer to Chapter H—Suspension), and short stroke rams, the stroke of the ram being determined by the length of the travel limiting stop (see Fig. G31).

When fitting replacement or overhauled rams to cars with short stroke dampers, always ensure that the ram is of the correct type with short stroke action.

On short stroke rams the stroke extension should be $\frac{3}{4}$ in. (1,9 cm.), on long stroke rams, the stroke extension should be 1 in. (2,54 cm.).

To summarise:

(a) It is not permissible to fit a long stroke ram when a short stroke damper is fitted.

(b) It is permissible to fit a short stroke ram to a long stroke damper.

(c) Ideally, long stroke rams should be fitted to long stroke dampers.

(d) Always ensure that when an early type two-groove ram is overhauled, that the seal seepage pipe (white sleeved) is removed and steel blanking plugs are fitted to the exposed ram and connector ports respectively.

Figure G36 shows the method used on early saloon cars to secure the rear height control ram piston to the road spring/shock damper isolator.

Figure G37 shows the method used on later saloon cars onwards, to secure the rear height control ram piston to the road spring/shock damper isolator. The latter arrangement is much simplified and facilitates ease of disconnection and removal.

Front height control rams—To remove

Access to each ram is under the engine bonnet.

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions).

2. Disconnect the two pipes from the hydraulic ram 'T' piece, blanking off immediately on disconnection each exposed pipe or port.

Note Only one pipe is fitted to modified rams, or rams of later cars.

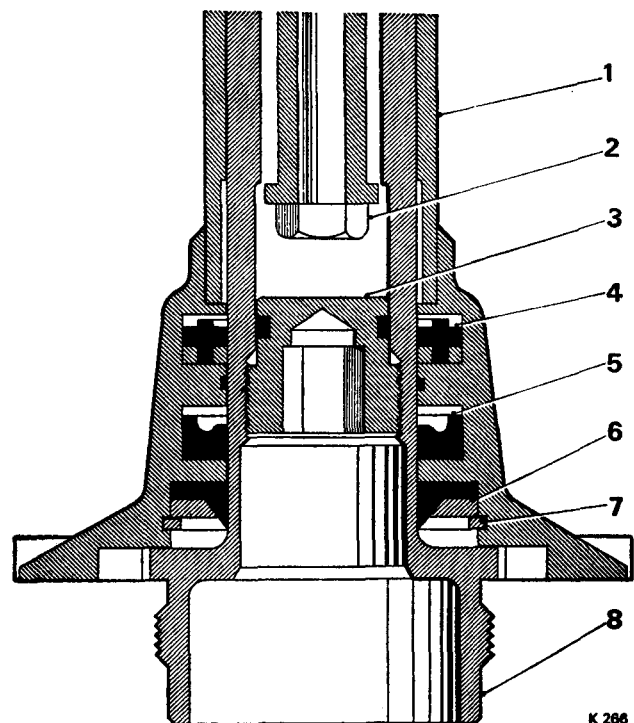


FIG. G34 SECTIONAL VIEW—EARLY SEALING ARRANGEMENT—HEIGHT CONTROL RAMS

- 1 Ram housing
- 2 Retaining setscrew
- 3 Ram blanking plug (threaded type)
- 4 Main seal
- 5 Secondary seal
- 6 Piston wiper seal
- 7 Circlip
- 8 Ram piston

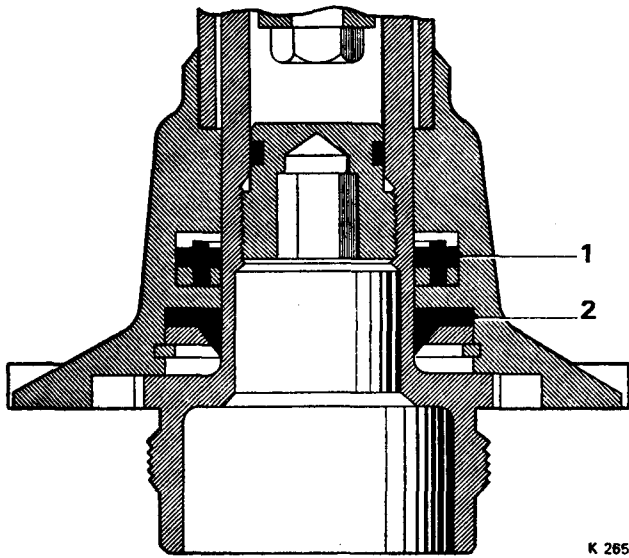


FIG. G35 SECTIONAL VIEW—LATER SEALING ARRANGEMENT—HEIGHT CONTROL RAMS

1 Main seal 2 Piston wiper seal

3. Unscrew and remove the five bolts, nuts and washers which secure the ram to the spring pot.

Note Two of the bolts are provided for removal purposes (see Fig. G31) in that they have extended lengths. These bolts are fitted to allow the ram to be raised slowly and evenly thus allowing the road spring isolator beneath to abut the underside of the spring pot. Always remove the two long bolts last, ensuring that they are unscrewed together, one turn at a time.

4. Remove the hydraulic ram from the car.

Front hydraulic ram—To dismantle

1. Grip the ram piston in a vice fitted with jaw protectors. Ensure that the vice jaws contact only the lower part of the piston.

2. Using a suitable piece of hexagon bar or a transmission sump plug spanner, remove the blanking plug fitted in the piston bore. Remove and discard the plug sealing ring.

Note On later cars, a plain diameter sealing plug with sealing ring is fitted. A $\frac{1}{4}$ in. U.N.F. threaded hole is provided in the end of the plug to facilitate extraction. The plug is retained in position by a circlip.

3. Using a suitable box spanner unscrew the travel limiting stop setscrew and withdraw the ram housing, setscrew and travel limiting stop.

4. Grip the ram housing in the protected vice jaws such that the seals are accessible.

5. Remove the circlip and retaining washer then extract the wiper seal.

6. Using a pointed tool, extract and discard the remaining seal(s) from the groove(s), taking care not to damage the piston bore.

Note On current cars the remaining seal to be removed is the main pressure seal, which seats in a common bore abutting the wiper seal.

7. Place the piston in a lathe (if available) and, using Corolith grit 320 emery cloth (or equivalent), carefully remove any score marks from the piston. Finally polish using a fine emery polishing cloth, polishing from the body end outwards.

8. Thoroughly wash all parts in clean methylated spirits and dry with compressed air.

Front height control ram—To assemble

1. Smear the new main pressure seal with Molytone C grease or equivalent and fit it into position in the ram housing.

Note (a) On two-groove early type housings and one-groove later type housings it is necessary to compress the main pressure seal with the fingers before feeding it into the bore just beyond the appropriate groove.

Feed the seal back into its groove by using a blunt instrument. Ensure that the flat face of the seal faces the open end of the ram housing.

(b) On the simplified ram seal housing, the seal is inserted directly into the bore, compression is not necessary in order to fit it.

(c) On the two-groove ram housing, the main pressure seal **must** be fitted in the lower of the two, leaving the upper groove vacant.

2. Grease a new wiper seal and fit it into position in its bore at the base of the ram housing. The sealing lip must face the open end of the ram housing. Fit the retaining washer and circlip.

3. Slide the piston into position in the ram housing, taking care not to double-back the wiper seal lip.

4. Fit the setscrew and distance piece and torque tighten the setscrew to between 16 lb.ft. and 18 lb.ft. (2,21 kg.m. and 2,49 kg.m.).

5. Smear the new ram blanking plug seal with Molytone C grease or equivalent and fit it to the plug.

(a) Screw the threaded plug (if fitted) into position and torque tighten to between 60 lb.ft. and 65 lb.ft. (8,30 kg.m. and 8,99 kg.m.).

(b) Press the plain diameter plug (if fitted) into position, and fit the retaining circlip.

Front height control ram—To fit

1. Before fitting the ram to the spring pot, ensure that the white sleeved seal seepage pipe (if fitted) of earlier cars, is removed altogether by disconnecting it from its joint on the appropriate connection block. Fit steel blanking plugs to the exposed ports of the ram and connector.

2. Fit the height control ram by reversing the procedure adopted for its removal, noting the following points.

(a) Care must be taken to ensure that the ram piston locates correctly on the suspension isolator.

(b) The two extractor bolts should be fitted first, and tightened down evenly one turn at a time until the other three shorter bolts can be fitted. Torque tighten all bolts to the standard torque figures.

3. After fitting the height control ram, bleed the height control system as described in Section G2—Bleeding the systems. Check the ram and disturbed pipe connections for leaks.

Rear height control ram—To remove

Saloon cars only

The rear height control rams on saloon cars are located in the boot.

1. Repeat Operation 1 of 'Front height control ram—To remove'.

2. Remove the trim from the forward corners of the boot.

3. Disconnect the hydraulic fluid pipes from the ram body and blank off immediately each port and pipe.

Note Unmodified **early** cars have rams fitted with **three** pipe connections.

Modified **early** cars, and **later** cars have **two** pipe connections.

4. Unscrew the three ram securing setscrews one turn at a time to allow the road spring isolator in the spring pot to lift under road spring pressure until it abuts the underside of the spring pot. When this is achieved, remove the screws completely.

5. Ease the ram body upwards as far as possible to gain access to the ram piston slots, then using the

hook wrench (RH 8051) unlock and unscrew the ram piston from the spring isolator. Remove the ram from the car.

Note On some **early** cars, the ram piston when removed can be seen to have a threaded cone shaped lower end; **later** cars have a short straight threaded extension.

Rear height control ram (all cars)— To dismantle and assemble

The procedure for dismantling, cleaning, polishing, and renewing the seals of rear rams is identical to that given for the front height control rams, including, where necessary, the removal of the seal seepage drain pipe (white sleeved) and blanking off of the ram housing seepage drain port, and also the blanking off of the exposed connector block port. The difference in types of ram centre blanking plugs (threaded and plain) also applies.

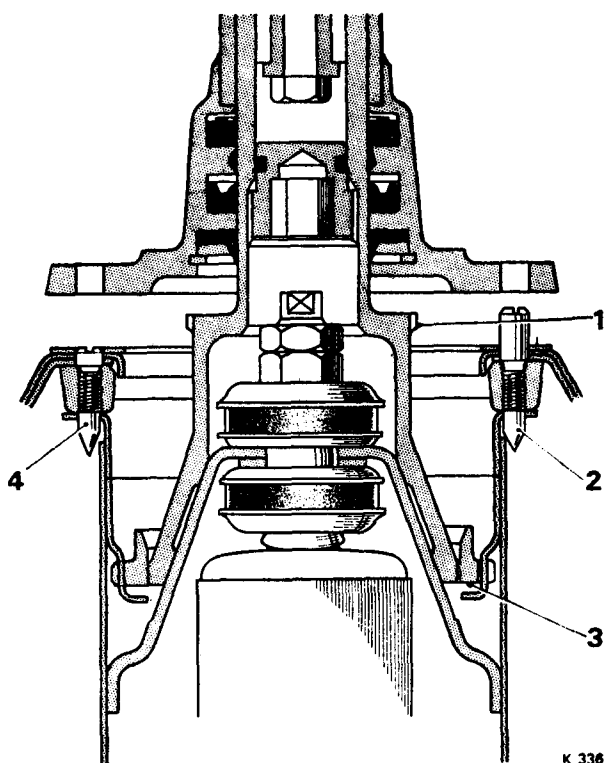


FIG. G36 SECTIONAL VIEW—EARLY LOCKING ARRANGEMENT—REAR RAM PISTON TO ROAD SPRING ISOLATOR

- 1 Spannering slots—ram piston
- 2 Alignment screw (long)—2 off
- 3 Lock-nut—isolator tube
- 4 Alignment screw (short)—1 off

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Rear height control ram—To fit

Saloon cars only

To fit the height control ram of saloon cars, reverse the procedure given for its removal, noting the following points.

Early type height control ram with cone shaped piston

1. Insert the special pointed location dowels (RH 7858—2 off and RH 7859—1 off) into the tapping ring in the top of the spring pot. Ensure that the pointed ends locate in the holes in the spring isolator locating flange and that the threaded portions of the screws do not protrude below the bosses in the spring pot tapping ring (see Fig. G36).

2. Enter the ram assembly, locating the flange over the dowels, pull the ram body upward as far as possible on the dowels to enable the hook wrench (RH 8051) to be located in the piston slots.

3. Screw the piston, with the aid of the hook wrench, into the isolator tube lock-nut. Tighten the piston on to the conical part of the spring isolator.

4. Unscrew and remove each location dowel one at a time, and in their places fit the three ram securing setscrews. Tighten the three screws evenly and together to depress the road spring and isolator until

the ram body flange face is fully seated on the spring pot. Torque tighten the setscrews to the standard torque figures quoted in Chapter P.

5. After fitting the height control ram bleed the height control system, as described in Section G2—Bleeding the systems, and check the ram and pipe connections for leaks.

Later type height control ram with short threaded extension

1. Pull the ram body upward as far as possible from the piston to expose the spannering slots.

2. Fit the ram into position on the spring pot, engaging the threads of the piston with those of the road spring isolator.

Note Ensure that the isolator is concentric with the spring pot bore.

3. Using the hook wrench (RH 8051) tighten the piston to the isolator then push the ram body downward as far as possible on to the piston.

4. Fit and torque tighten the three ram securing screws as described in Operation 4 for the early type height control ram, then carry out Operation 5 also.

Rear height control ram—Drophead coupé cars—To remove

Access to the rear height control rams securing screws and the feed and remote bleed pipe connections, on drophead coupé cars, is beneath the trim on the body combined hood stowage compartment/parcel shelf.

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions).

2. Repeat Operation 3 of 'Rear height control rams—To remove—Saloon cars only'.

3. Position the car on a ramp, and with the aid of the special peg spanner and extension bar (RH 8048) inserted through the road spring, unlock, but do not attempt to unscrew fully at this stage, the ram piston from the road spring isolator cone.

Note When unlocking the ram piston from the isolator cone, the spanner must be turned clockwise.

Alternatively, after Operation 2, proceed with Operation 4 onwards and separate the ram piston from the isolator cone on the workbench.

4. From the top side of the car, remove the ram securing setscrews.

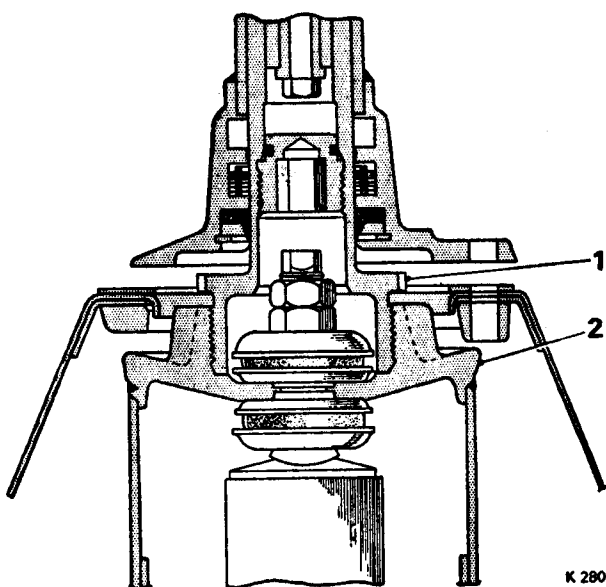


FIG. G37 SECTIONAL VIEW—LATER LOCKING ARRANGEMENT—REAR RAM PISTON TO ROAD SPRING ISOLATOR

- 1 Spannering slots—ram piston
- 2 Road spring isolator—threaded extension

5. Disconnect the shock dampers, disconnect the half-shafts and remove the road spring, etc., of the drophead coupé car as described in Chapter H—Suspension.

Note When removing the road spring from the spring pot, care should be taken because the height control ram and road spring isolator will come down with it as an assembly.

6. Separate the ram assembly from the spring isolator by unscrewing the ram piston from the isolator cone.

Rear height control ram—Drophead coupé cars—To dismantle, To overhaul and To assemble

Refer to the information given earlier for 'Rear height control rams—All cars'.

Rear height control ram—Drophead coupé cars—To fit

Fit the height control ram into position, by reversing the procedure adopted for its removal, noting the following points.

1. Tighten the ram piston to the cone isolator using the special pin spanner and extension (RH 8048) on completion of fitting the ram, road spring, shock damper, etc., assembly to the car. The spanner must be turned **anti-clockwise**.

2. Ensure that the spring isolator seats squarely in its seating on top of the road spring.

3. Ensure that the setscrews securing the height control ram are torque tightened to the standard figures quoted in Chapter P.

4. The pink sleeved pipe (remote bleed) fits to the upper of the two ports, the brown sleeved pipe (from height control valve) to the lower port.

Height control rams—To test

The height control rams should be tested on the car as follows:

The only likely failures on a height control ram are seal failures. If a ram blanking plug seal or main seal of a modified ram or later type ram (two seal type) fails, this will be visually evident as hydraulic fluid will be seen running down the damper casing or the road spring.

To test the main seal of early unmodified rams (three seal type), de-pressurise the systems, remove the seepage return pipe from the ram housing (white pipe) and blank off the pipe. Insert a union and a piece of pipe into the return port and place the open end of the pipe in a container. Disconnect the height control valve operating arm and link from the suspension. Push the arm upward on a rear height control valve, or pull it down on a front height control valve, then, with the gearchange selector in 'Neutral', start the engine.

If there is a continuous flow of fluid into the container the height control ram main seal has failed. Modify the ram to the two seal type as described earlier.

Section G11

BRAKE MASTER CYLINDER

Master cylinder—To remove

1. Place the car on a ramp and remove the under-sheet which covers the pedal linkage assembly.
2. Remove the pipe (green) from the master cylinder, then remove the feed pipe from the rear end of the master cylinder (grey) and blank off the pipe ends and ports.

Note The rearmost pipe is the feed from the rear compartment of the fluid reservoir and consequently has a large head pressure. Therefore, when this pipe is removed it must be blanked off as quickly as possible to minimise any loss of fluid.

3. Remove the two bolts, nuts and washers which secure the master cylinder mounting flange to the rear of the pedal linkage assembly.
4. Slacken the lock-nut on the master cylinder push rod; remove the master cylinder and push rod by unscrewing the push rod from the fulcrum pivot link.

Brake master cylinder—To dismantle

1. Remove the rubber boot from the master cylinder body and push rod.
2. Remove the blanks from the ports.
3. Using circlip pliers, remove the circlip from its location in the master cylinder body.
4. Remove the push rod and its retainer.

5. Remove the plunger, push rod and cut-off valve assembly from the cylinder.

If the seals have completed their 'life' mileage or if either of the seals show signs of deterioration or unserviceability they should both be removed as follows.

6. Using a small screwdriver, ease the depressed prong of the spring retainer out of its recess, until the spring retainer and cut-off valve stem can be disconnected from the plunger (see Fig. G39).

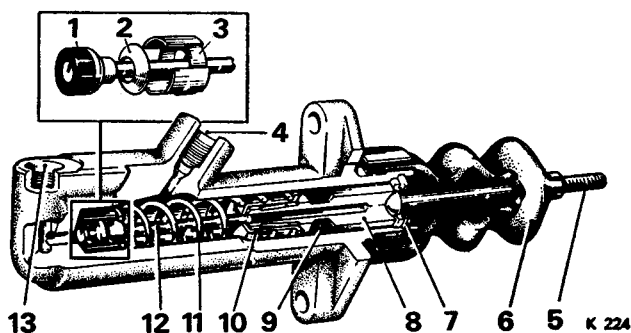


FIG. G38 CUT-AWAY VIEW—BRAKE MASTER CYLINDER

- | | |
|----------------------|---------------------|
| 1 Cut-off valve seal | 7 Retaining circlip |
| 2 Belleville washer | 8 Piston |
| 3 Valve retainer | 9 Piston seal |
| 4 Outlet port | 10 Retainer |
| 5 Operating rod | 11 Spring |
| 6 Sealing boot | 12 Push rod |
| | 13 Inlet port |

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7. Remove and discard the large plunger seal.
8. Remove the cut-off valve spring retainer and the belleville washer which is located behind it.
9. Remove and discard the seal.
10. The belleville washer, which spring-loads the cut-off valve, should also be discarded and, since bending the prong on removal of the spring retainer may have weakened it, the retainer also should be discarded.

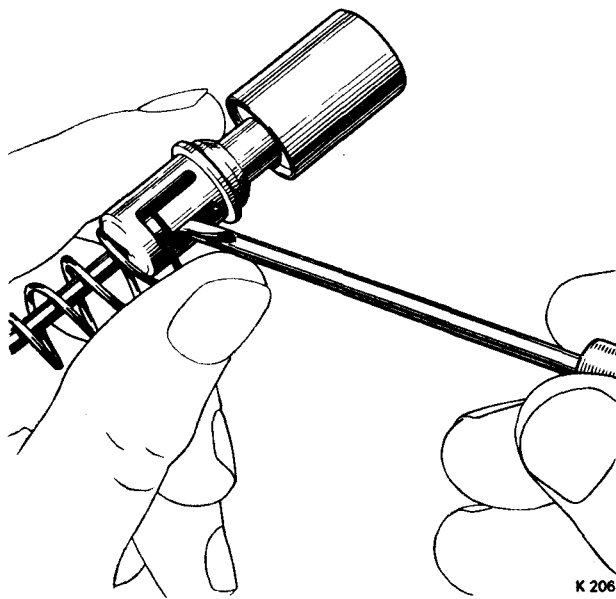


FIG. G39 UNLOCKING THE RETAINER

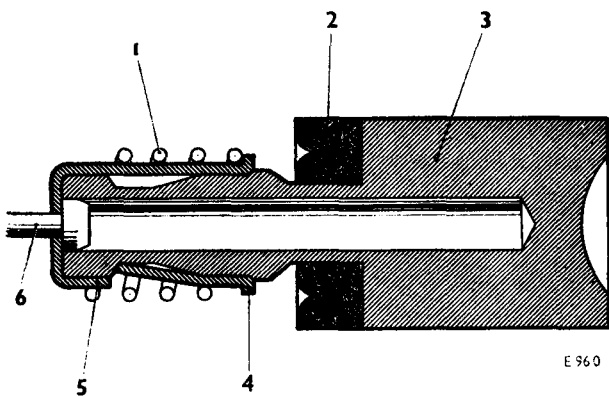


FIG. G40 LOCKING THE RETAINER

- 1 Return spring
- 2 Piston seal
- 3 Piston
- 4 Spring abutment and locking prong
- 5 Retainer
- 6 Connecting rod

Brake master cylinder—To inspect

1. Examine the master cylinder bore for signs of damage or abrasion. Light damage may be removed using fine 'Corolite' tape, lubricated with clean brake fluid of the correct type, but it must be stressed that the good condition of the master cylinder bore is most important and if any doubt exists as to its serviceability, a replacement housing should be fitted.

Note If the master cylinder bore is damaged or marked, this must be borne in mind when inspecting the plunger and seal assemblies for serviceability.

2. Carefully inspect the plunger and cut-off valve assemblies, paying particular attention to the condition of the two rubber seals.
3. The rubber boot should be examined for serviceability, and renewed if necessary.

Brake master cylinder—To assemble

1. Cleanliness is extremely important when assembling the brake master cylinder. All components should be thoroughly cleaned, using methylated spirits, and then dried afterwards with dry, compressed air.
2. Assembly of the whole unit is the reversal of the procedure given for dismantling, noting that the components should be lubricated with clean brake fluid prior to assembly. Renew all discarded items.
3. Care should be taken to ensure that the belleville washer is seated correctly and when the cut-off valve stem and spring retainer have been located on the plunger, the prong on the spring retainer must be depressed into the recess as shown in *Figure G40*.

Brake master cylinder—To fit

1. Fit the master cylinder to the rear of the brake pedal linkage assembly, screwing the stem into the fulcrum pivot link; do not tighten the lock-nut.
2. Tighten both securing nuts to the standard torque figures relative to their size, remove the blanks and fit the pipes.

Brake master cylinder 'ON' stop—To set

1. Refer to Section G15—Brake actuation linkage assembly, for full details.
2. When this setting is correct, tighten the lock-nut on the push rod.
3. After fitting and setting the master cylinder, the hydraulic system for the master cylinder must be bled as described in Section G2—Bleeding the systems.

Section G12

DECELERATION CONSCIOUS PRESSURE LIMITING VALVES

Introduction

Since the introduction of the Rolls-Royce Silver Shadow and Bentley T Series, a modification has been introduced which reduces the brake pedal load necessary to produce any required deceleration; this applies to cars having the following serial numbers.

Standard cars—1899 and onwards.

Coachbuilt cars—1874 and onwards (including numbers 1807 and 1869).

This modification necessitated a revised hydraulic circuit to the rear brake calipers to off-set the increased 'sponge'. The deceleration conscious pressure limiting valve was disconnected from the master cylinder hydraulic circuit and introduced into the high pressure (power braking) circuit, although positionally the valve remained in its original position.

To assist in identifying cars with this modification, the pipes connected to the valve are **blue** coded for the high pressure (power braking) circuit and **green** coded for the master cylinder braking circuit.

It is important to note that before any steps are taken to disconnect or remove the deceleration conscious pressure limiting valve from the high pressure (power braking) circuit, the hydraulic systems are de-pressurised.

Figure G1 of Section G2 gives a diagrammatic layout of the early and later hydraulic circuits.

Pressure limiting valve—To service

The pressure limiting valve is non-adjustable and should not require servicing other than renewing the valve seals at the recommended mileage. Refer to Chapter D—Service Recommendations.

If a valve is found to be faulty, usually indicated by premature rear wheel locking, it should be removed from the car and overhauled, the seals renewed or an exchange unit fitted.

Pressure limiting valve—To remove

1. Place the car on a ramp and remove the under-shield which protects the brake actuation linkage assembly.
2. **If necessary, de-pressurise the hydraulic systems (see Introduction).**
3. Disconnect the two pipes (green or blue coded) from the valve; blank off the pipe ends and ports.
4. Remove the nuts from the upper three bolts which secure the pressure limiting valve and mounting brackets, leaving the bolts in place.
5. Remove the two lower nuts and bolts, the forward one of which is the master cylinder stop.
6. Remove the support bracket and the two distance pieces from the bolts securing the valve, then remove the valve.

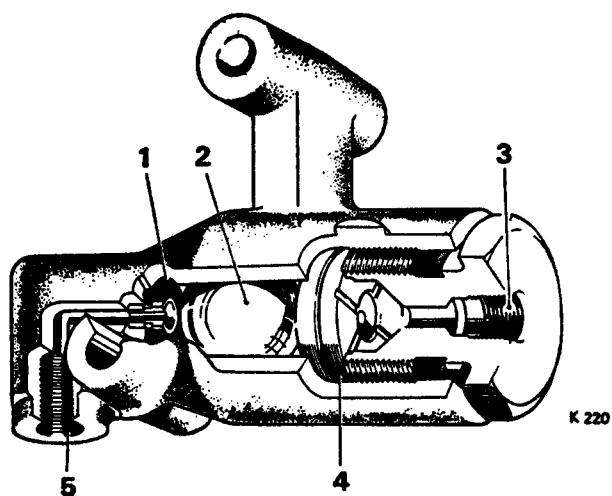


FIG. G41 CUT-AWAY VIEW—PRESSURE LIMITING VALVE

- | | | |
|----------------|---------------|--------------|
| 1 Seal | 2 Steel ball | 3 Inlet port |
| 4 Spacer plate | 5 Outlet port | |

Pressure limiting valve seals—To renew

Remove the pressure limiting valve from the car as described previously.

1. Remove the plug and seal from the valve and then, holding a hand over the open end, invert the valve and catch the ball and spacer.
2. Using an 'Easyout' remove the insert and rubber seal from the bottom of the bore.
3. Fit a new insert and seal, then fit the ball, baffle plate and end plug with a new seal on the plug.
4. Torque tighten the end plug to between 25 lb.ft. and 35 lb.ft. (37 kg.m. and 52 kg.m.).

Pressure limiting valve—To fit

To fit the pressure limiting valve reverse the procedure given for its removal, noting the following points.

1. All nuts must be torque tightened to the standard figure (see Chapter P) and the distance pieces must be fitted after the valve.
2. After fitting the valve, bleed the respective system (see Section G2—Bleeding the Systems).

Section G13

THE BRAKE DISTRIBUTION VALVES

General

Two independent brake fluid distribution valves meter the brake fluid to the braking systems at high pressure. The valves are situated one above the other within the brake actuation linkage assembly and are operated through linkage and a small balance lever connected to the foot brake pedal (see Fig. G48, Section G15).

The valves are identical in operation but are not interchangeable due to differing mounting points and pipe arrangement. Corresponding valves of left-hand and right-hand drive cars are identical.

Brake distribution valves—To service

The valves, formerly classified as sealed units and renewed when necessary on a service exchange basis, may now be dismantled and cleaned, although only certain new parts of the valves are available. These parts are limited to the small seal, the return spring and the end plug joint washer. The remaining working parts are subject to very fine limits and are selectively assembled by the manufacturer thus, complete service exchange units are still available when required.

Note The design of the valves is such that a small leak-off occurs between the operating valve and its bore in order to provide adequate lubrication for the 0.0001 in. (0.003 mm.) clearance. This small leakage is visible and takes the form of a small droplet of fluid hanging from the valve base. This is normal.

When deciding whether a valve is leaking excessively, in order to warrant renewal or overhaul, the following points should be taken into consideration.

1. On early cars, those with fluid return pipes from the front and rear height control rams, leak-off can be increased by Service Personnel working on one of the above cars under the following conditions.

The accumulators fully charged and the car set to fast-levelling. Under these circumstances any suspension movements cause pressure in the return line to be increased, resulting in an above normal leak-off past the distribution valve spindle.

2. If the fluid leak-off does not impair the braking efficiency or result in noticeable differences in the level of fluid in the reservoirs, then the valves should be regarded as satisfactory.

Brake distribution valves on the car — To test

1. Place the car on a ramp, isolate the gearchange selector and de-pressurise the systems.

The distribution valves must be checked for correct operation as follows.

2. Insert a Zero lb/sq.in. to 3,000 lb/sq.in. (Zero kg/sq.cm. to 210,92 kg/sq.cm.) pressure gauge and a length of high pressure pipe into the high pressure outlet port of the valve (blue or mauve pipe) or into any convenient junction between the valve and the brake calipers which it supplies. The gauge may be inserted into a brake caliper bleed screw port if desired.

3. Start the engine then depress the brake pedal. The brake line pressure shown on the gauge should be proportional to the load applied to the pedal; for an 80 lb. (36,28 kg.) load on the pedal, the line pressure should be approximately 1,000 lb/sq.in. (70,307 kg/

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sq.cm.). It should also be possible to achieve a maximum line pressure equal to the fully charged accumulator pressure of 2,500 lb/sq.in. (175,77 kg/sq.cm.) for a pedal pressure of approximately 190 lb. (86,18 kg.).

Also, when the brake pedal load is varied continuously, the brake line pressure gauge should vary accordingly, without any marked lag or jerkiness.

4. If the above effort/pressures are not obtainable, or actuation shows marked lag or jerkiness on the gauge, the distribution valve may be considered faulty and must be overhauled or renewed.

Should a system internal leakage investigation, as described under 'Hydraulic accumulator—To test', show a distribution valve to be the cause of loss of accumulator pressure, the actual leakage can be checked as follows.

5. Disconnect the low pressure return line from the distribution valve port (black or white pipe) and blank the end of the pipe to prevent draining of the reservoir.

6. Insert a union and a length of pipe into the distribution valve low pressure port and place the open end of the pipe into a clean container.

7. Start the engine but do not depress the brake pedal.

8. Top-up the reservoir continuously to prevent the pump from drawing air.

Note For the valve to be acceptable, the leakage should not exceed 60 c.c. per hour with the valve in the 'off' position (i.e. brake pedal not depressed) or 50 c.c. per minute with the brake pedal depressed and held steady under a load of 45 lb. (20,41 kg.) which is equivalent to a brake line pressure of 500 lb/sq.in. (35,15 kg/sq.cm.). If the valve leaks in excess of these figures it must be overhauled or renewed. Refer also to item 2 of 'Distribution valve—To service'.

Brake distribution valves—To remove

1. Place the car on a ramp and de-pressurise the hydraulic systems as described in Section G1—Special Precautions.
2. Disconnect the battery located in the boot.
3. Remove the self-tapping screws securing the brake actuation linkage aluminium protective cover.
4. Disconnect the electrical leads, then remove the stop lamp switch and bracket situated at the forward end of the linkage abutting the heel of the foot brake pedal.
5. Remove the pipes from the side of each valve and promptly blank off each pipe end and valve port.
6. Remove the nuts and bolts securing each valve into position, then move each valve forward and downward to clear the valve operating linkage.

Brake distribution valve—To dismantle

1. Remove the end plug and sealing washer.
2. Collect the return spring.
3. Carefully remove the valve plunger and collar.
4. Carefully remove and discard the small 'Dowty' seal from the valve body insert bore. Do not scratch the valve bore during this operation.
5. Carefully wash all parts in methylated spirits and dry with clean, dry compressed air.

Brake distribution valve—To inspect

1. Carefully examine the fine limit bore of the valve insert and the outside diameter of the valve plunger. Each should be smooth and free from scratches.
2. Lubricate the bore of the valve insert and the valve plunger with clean brake fluid. Carefully fit the valve plunger into the valve insert bore and check for axial wear. There should be hardly any clearance between them, just sufficient clearance to enable the valve to slide freely down the bore.

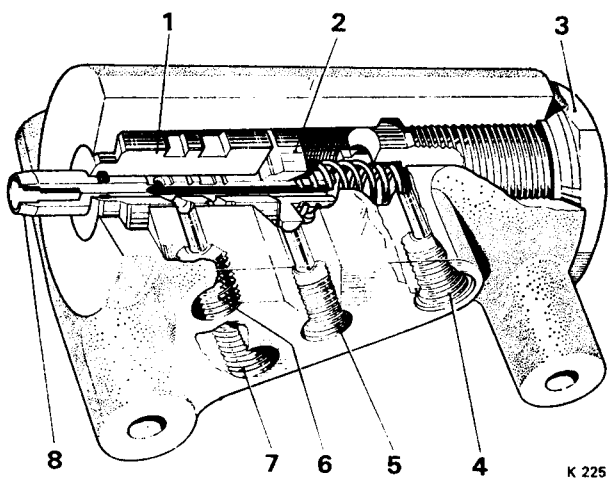


FIG. G42 CUT-AWAY VIEW—BRAKE DISTRIBUTION VALVE

- 1 Valve insert
- 2 Damping collar
- 3 End plug
- 4 Bleed screw port (early cars only)
- 5 Outlet to brake calipers
- 6 Return to fluid reservoir
- 7 Pressure inlet from accumulator
- 8 Valve plunger

3. Re-wash the parts in methylated spirits and air pressure dry as previously stated.

Brake distribution valves—To assemble

1. Carefully fit a new seal into the valve body insert groove, taking great care not to scratch the bore or cause burring on the edge of the groove.
2. Lubricate the bore and valve plunger with clean brake fluid of the correct type (see Chapter D).
3. Carefully fit the valve plunger into the bore until it is fully seated. Fit a new return spring.
4. Fit a new joint washer to the end plug; fit and torque tighten the plug (refer to Chapter P for the torque figure).
5. Check the inward and return movement of the valve plunger. It should be smooth without binding or sticking at any point along its travel.

Brake distribution valves—To fit

In order to fit the brake distribution valves, reverse the procedure adopted for their removal, noting the following points.

1. If a replacement valve is being fitted, remove one of the plastic transportation plugs and allow any fluid from the valve to drain. Re-fit the plug.
2. All blanking plugs should be removed from the valves and pipes immediately prior to them being connected. Do not over-tighten the pipes; this might cause damage to the conical seatings.
3. Fit the stop lamp switch and set as described in 'Stop lamp switch—To set' in Section G15.
4. On completion of fitting the valves, the hydraulic systems must be bled as described in Section G2—'Bleeding the systems'.

Section G14

THE FRONT AND REAR DISC BRAKES

General

Disc brakes are fitted to all four wheels, each front wheel being fitted with two double cylinder calipers (see Fig. G43) and each rear wheel a large four cylinder caliper (see Fig. G44 or G45).

The brake calipers are divided between the two power systems and the master cylinder, providing an integrated braking system in which any of the three systems can operate independently in the event of failure.

Bleed screws are fitted to the inner face of each caliper to facilitate bleeding of both power systems (front brakes only) and power and master cylinder systems (rear brakes only).

The rear brake calipers have small wedge shaped pads hung beneath them which are mechanically operated (refer to Section G16). These hand brake pads, which operate on each side of the rear brake discs, are self-adjusting, but the setting must be physically checked at the specified service intervals (see Chapter D).

Brake pads—To renew

Inspection of all brake pads must be carried out at the specified service intervals (see Chapter D).

The brake pads must be renewed when the pad linings are worn to within $\frac{1}{8}$ in. (3,18 mm.) of the back plate.

Remove the brake pads as follows.

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions) and disconnect the battery.

Note The above operation is not essential for brake pad renewal but is recommended as a safety precaution in case the brake pedal is accidentally depressed whilst the brake pads are removed.

2. Securely chock the rear (front) wheels, then jack up the front (rear) of the car and securely support it on stands. **Ensure that the rebound straps of the rear suspension do not support the full suspension load.**

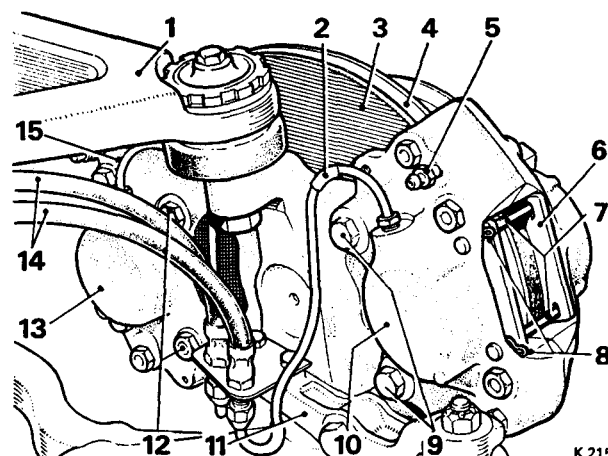


FIG. G43 FRONT BRAKE CALIPERS

- 1 Triangle lever and suspension ball joint—upper
- 2 Caliper feed pipe (blue)
- 3 Brake disc shield
- 4 Brake disc
- 5 Bleed screw
- 6 Brake pad
- 7 Brake pad retaining pins
- 8 Retaining pin spring clips
- 9 Front caliper securing bolts
- 10 Front caliper
- 11 Side steering lever
- 12 Rear caliper securing bolts
- 13 Rear caliper
- 14 Flexible pipe connection from sub-frame
- 15 Caliper feed pipe (mauve)

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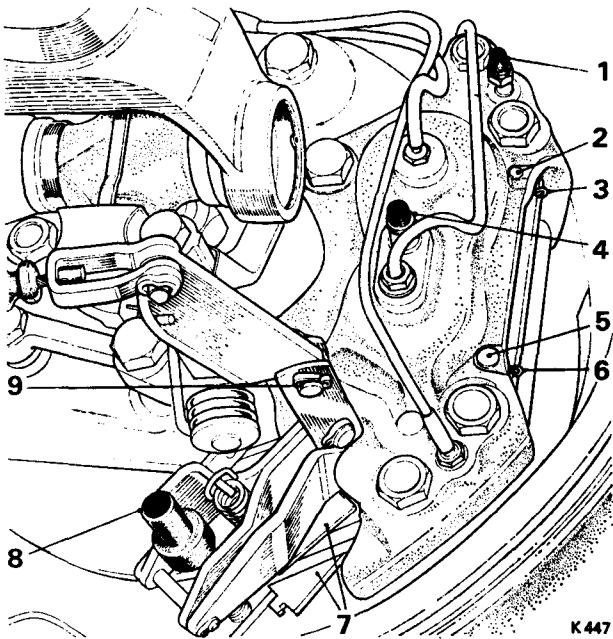


FIG. G44 REAR BRAKE CALIPERS (EARLY CARS)

- | | |
|---------------------------------------|--------------------------|
| 1 Master cylinder circuit bleed screw | 5 Pad locating pin |
| 2 Pad locating pin | 6 Securing clip |
| 3 Securing clip | 7 Hand brake pads |
| 4 Power brake circuit bleed screw | 8 Adjusting ratchet seal |
| | 9 Disconnecting point |

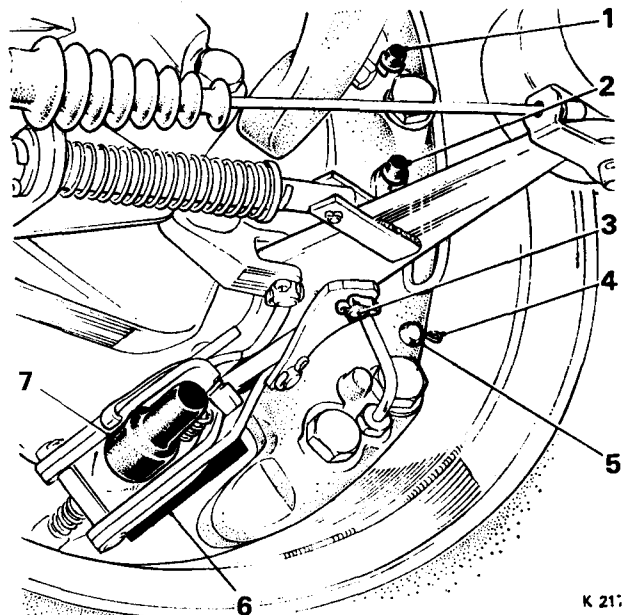


FIG. G45 REAR BRAKE CALIPERS (LATE CARS)

- | | |
|---------------------------------------|----------------------------------|
| 1 Power brake circuit bleed screw | 4 Securing clip |
| 2 Master cylinder circuit bleed screw | 5 Locating pin |
| 3 Disconnecting point | 6 Hand brake pads |
| | 7 Pad adjusting ratchet nut seal |

3. Remove the wheel disc and road wheel.
4. Remove the two spring clips from the brake pad retaining pins (see Fig. G43) then remove the two pins. Collect the anti-rattle spring from the rear brake (if fitted); refer to Figure G47.
5. Remove the brake pads from the calipers; remove the 'D' shaped anti-squeal shims (front wheel calipers only).

Note The brakes must not be re-lined with pads other than those with the specified linings. The only recommended pad materials are Ferodo DC 1 or Mintex M 69.

If the brakes are to be re-lined with pads which have different recommended linings from those previously fitted, the disc faces should be cleaned prior to fitting the new pads. All traces of the old pad material should be removed by hand rotating the disc whilst applying fine emery paper to the faces. Do not emery the faces radially. It must also be stressed that the same type of lining must be fitted to all wheels. Lining material must be the same on all pads fitted.

6. Prior to fitting new pads, inspect the caliper piston dust seals for signs of damage or heat hardening and renew if necessary.

7. Fit the new pads, anti-squeal shims (front wheels only), retaining pins and spring clips, anti-rattle springs (rear wheels only, all cars), ensuring that the clips are located securely, and that the anti-squeal shims fitted to the front wheels are fitted correctly behind the pad back plates with the arrows pointing in the direction of disc rotation (forward movement of the car).

Brake caliper—To remove

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions) and disconnect the battery.
2. Securely chock the front (rear) wheels then jack up the rear (front) of the car and securely support it on stands (refer to Operation 2—Brake pads—To renew).
3. Remove the wheel disc and road wheel.
4. Disconnect the caliper feed pipe(s); securely blank the pipe end(s) and the caliper port(s) against the ingress of dirt.
5. Remove the fitted bolts which secure the caliper to the axle yoke and remove the brake caliper from the car.

6. It is recommended that a distance piece be fitted between the two pads after removing the caliper, to prevent the pistons easing out of the caliper bores.

Brake caliper piston seals—To renew

The brake caliper seals should be renewed at the specified intervals, refer to Chapter D.

The procedure to adopt is as follows.

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions), disconnect the battery and remove the brake caliper as described previously.

2. Remove the brake pads from the brake calipers as described earlier.

3. Remove the split spring ring from around the caliper piston dust seal, then remove the dust seal.

4. Ease the piston carefully out of the bore, taking care not to drop, scratch or damage the piston.

5. Remove the piston seal from the caliper bore.

6. Clean the caliper bore and piston with methylated spirits then dry thoroughly.

7. Immerse the new seal in clean, approved brake fluid (refer to Chapter D), then carefully fit it in the groove in the caliper bore, ensuring that it is correctly seated.

8. Lubricate the piston outside diameter with a small quantity of clean, approved brake fluid, then carefully fit the piston.

9. Fit the dust seal around the piston top, renewing it if necessary, then fit the split spring ring, taking care not to 'pinch' the dust seal with the ends of the ring.

Brake caliper—To fit

Fit the caliper by reversing the procedure given for removal, noting the following points.

1. The securing setscrews **must** be torque tightened to the figures quoted in Chapter P. The blanking plugs should not be removed until immediately prior to connecting the feed pipes.

Note Ensure that the underside of the setscrew heads and the faces onto which they abut are free from contamination, i.e. burrs, paint, etc.

2. Fit the brake pads, then bleed the system(s) as described in Section G2—Bleeding the Systems.

Brake disc—To remove

If the necessity arises to renew a brake disc(s), the procedure to adopt is as follows.

1. De-pressurise the hydraulic systems (see Section G1—Special Precautions) and disconnect the battery.

2. Jack up the front or rear of the car as necessary then remove the appropriate wheel disc, road wheel and brake caliper as described previously (refer to Operation 2—Brake Pads—To renew).

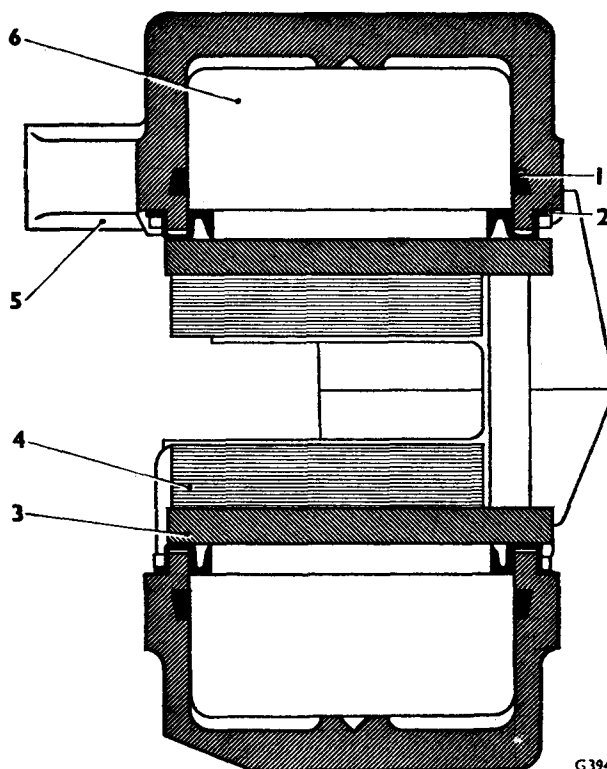


FIG. G46 FRONT BRAKE CALIPER CROSS-SECTION

- 1 Piston seal
- 2 Dirt seal and retaining clip
- 3 Brake pad back plate
- 4 Brake pad lining
- 5 Caliper mounting bosses
- 6 Caliper piston

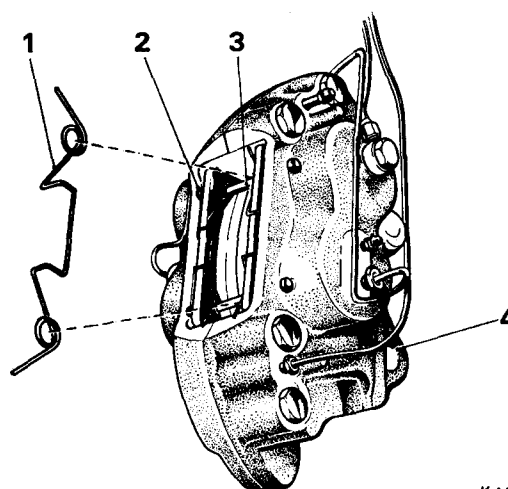


FIG. G47 REAR BRAKES ANTI-RATTLE SPRINGS IN POSITION

- 1 Anti-rattle spring (2 off)
- 2 Locating pin securing clip
- 3 Brake pad locating pins
- 4 Rear brake caliper

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3. Remove the front hub or rear hub (see Chapter H for the front hub and Chapter J for the rear hub).

4. To remove the front brake disc, unscrew the twenty setscrews and washers securing the disc to the hub.

5. To remove a rear brake disc, dismantle the hub as described in Chapter J then unscrew the twenty setscrews which secure the disc to the hub.

Brake disc—To fit

To fit the brake disc reverse the procedure given for its removal noting the following points.

1. The securing setscrews must be torque tightened to the standard figures relative to their size (see Chapter P).

2. The hub(s) must be assembled as described in the respective Chapter, H or J.

3. Fit the hub as described in the respective Chapter, H or J.

Pipework—Rear brake calipers

When a bridge pipe (not colour coded) on the rear brakes is disturbed, great care must be taken when fitting it so that it does not get too close to the brake disc. A minimum clearance of $\frac{1}{8}$ in. (0,79 cm.) should be maintained at all times. Refer to Section G3—Hydraulic Systems Pipework and coloured illustrations, as well as *Figures G44 and G45* of this Section, in order to determine the pipe connections of the power and master cylinder circuits to the rear brakes.

On cars with the following numbers a revised hydraulic circuit associated with reduced footbrake pedal effort was introduced.

Standard cars bearing the serial number 1899 and onwards.

Coachbuilt cars bearing the serial number 1874 and onwards, including those cars with serial numbers 1807 and 1869.

Section G15

BRAKE ACTUATION LINKAGE ASSEMBLY

Introduction

The brake actuation linkage (*see Figs. G48 and G49*) is mounted beneath the car just rearward of the toe-board. On **right-hand drive cars** the linkage is positioned just inboard of the body sill, on **left-hand drive cars** the linkage is fitted further inboard, adjacent to the inner side of the body longeron, due to the positioning of the exhaust silencer system.

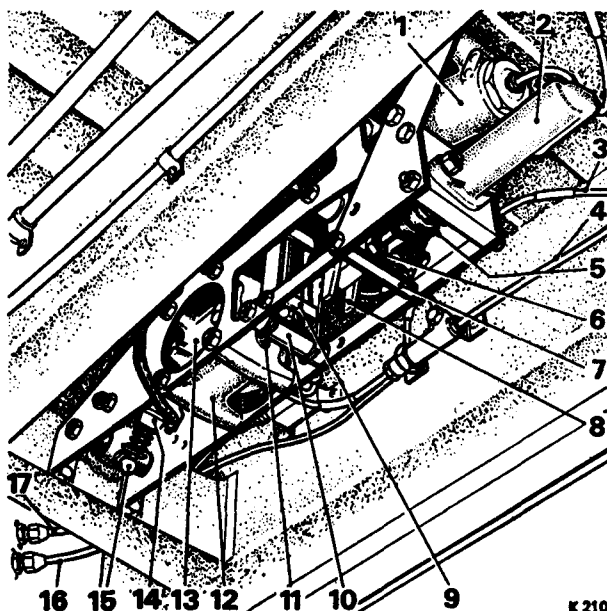
The assembly houses the master cylinder, deceleration conscious pressure limiting valve, brake distribution valves and stop lamp switch.

Since the introduction of the car, there have been certain engineering improvements introduced on the assembly as follows.

On all cars up to serial number 3384, certain pivot points of the assembly (*see Fig. G50*) are retained by spring clips. Later cars from and including this number

FIG. G48 BRAKE ACTUATION LINKAGE IN POSITION (EARLY R.H.D. CARS), (PIVOT PIN RETAINING CLIPS REMOVED)

- 1 Deceleration conscious pressure limiting valve
- 2 Master cylinder
- 3 Pipe—pressure limiting valve to rear brake calipers (green)
- 4 Pipe—lower distribution valve to rear brake calipers (blue)
- 5 Sealing boot—master cylinder
- 6 Lock-nut—master cylinder adjustment
- 7 Master cylinder 'ON' stop
- 8 Master cylinder operating lever
- 9 Distribution valve 'OFF' stop
- 10 Pivot—distribution valve operating lever
- 11 Lower distribution valve plunger
- 12 Lower distribution valve
- 13 Upper distribution valve
- 14 Brake lamp switch
- 15 Brake lamp switch eccentric adjuster
- 16 Pipe—lower distribution valve to front wheel front calipers (blue)
- 17 Pipe—upper distribution valve to front wheel calipers (mauve)



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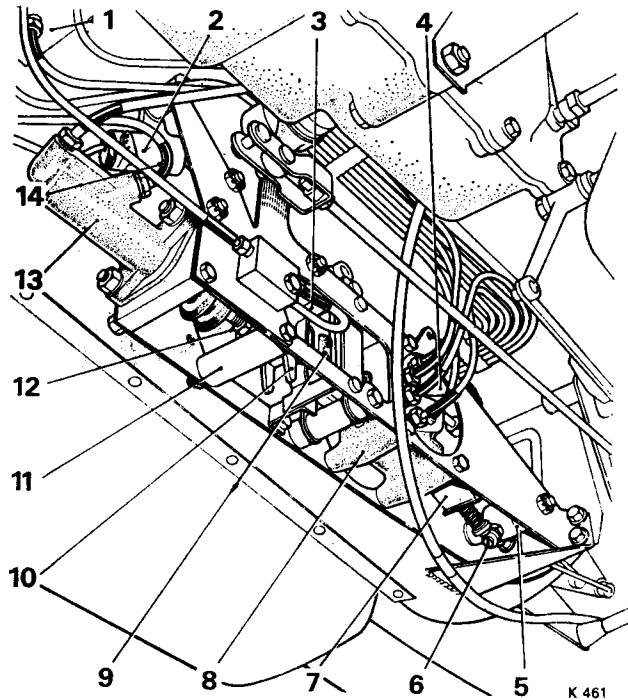


FIG. G49 BRAKE ACTUATION LINKAGE IN POSITION (LATE L.H.D. CARS)

- 1 4-way connection block
- 2 Deceleration conscious pressure limiting valve
- 3 Pipe (blue coded) deceleration conscious pressure limiting valve
- 4 Upper distribution valve
- 5 Brake pedal lever pivot
- 6 Eccentric—Stop lamp adjustment
- 7 Stop lamp switch
- 8 Lower distribution valve
- 9 'OFF' stop
- 10 Master cylinder operating linkage
- 11 'ON' stop
- 12 Master cylinder adjuster
- 13 Master cylinder
- 14 Pipe (green coded) master cylinder

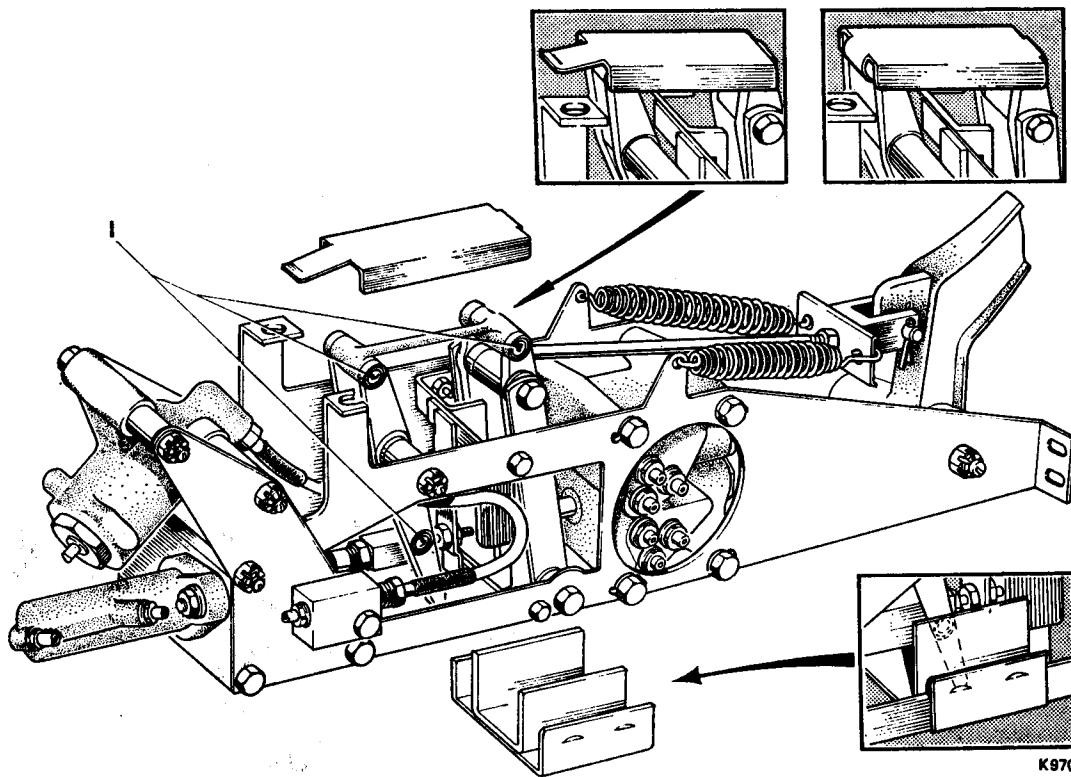


FIG. G50 METHOD OF FITTING LINKAGE RETAINING CLIPS (EARLY CARS)

- 1 Brake linkage pivot pins
- Insets show method of fitting pivot pin retaining clips

have longer pivot pins which are retained by split pins. The distribution valves of all cars are fitted with flush fitting pivot pins but the method of retaining them varies. On early cars prior to serial number 3384 the lower pin is retained by a spring clip; the upper pin does not require retention. On later cars from and including this number, a thin, lipped plate is fitted to each side of both flush fitting pins in order to retain them. Refer to *Figure G51* and insets.

On cars from and including the following serial numbers, 1899 and onwards—Standard cars, 1874 and onwards including 1807 and 1869—Coachbuilt cars, a new footbrake pedal lever was introduced resulting in a higher lever ratio. With the introduction of this lever additional changes were made as follows.

1. An adjustable master cylinder 'OFF' stop due to an increase in pedal free travel.
2. A revised 'ON' stop setting to ensure that the actuation linkage contacts the stop should the master cylinder become inoperative.
3. Additional clearance for the lowered connecting rod between the linkage and heel of the pedal lever.
4. A revised hydraulic systems circuit to the rear brake calipers to offset the increased 'sponge' resulting from the increased pedal leverage (refer to *Fig. G1* of Section G1 and *Figs. G5 and G6* of Section G3). The revised circuit also affects the method of bleeding (refer to Section G2—'Bleeding the hydraulic systems').

Note It is not permissible to fit the increased leverage pedal arrangement to cars produced prior to the number previously mentioned. If necessary, it is permissible to fit the adjustable 'OFF' stop to earlier cars as a means of reducing pedal free travel.

The assembly should not be removed from the car unless it is absolutely necessary as this involves disconnecting a considerable number of pipes involving all three braking systems, with the resultant risk of all systems becoming contaminated.

Brake actuation linkage assembly— To remove

1. Place the car on a ramp, de-pressurise the hydraulic systems as described under Section G1—'Special Precautions', and disconnect the battery, located in the boot.
2. Remove the undersheet from below the assembly. On left-hand drive cars, detach the speedometer cable from the cover.
3. Uncouple the brake pedal return springs.

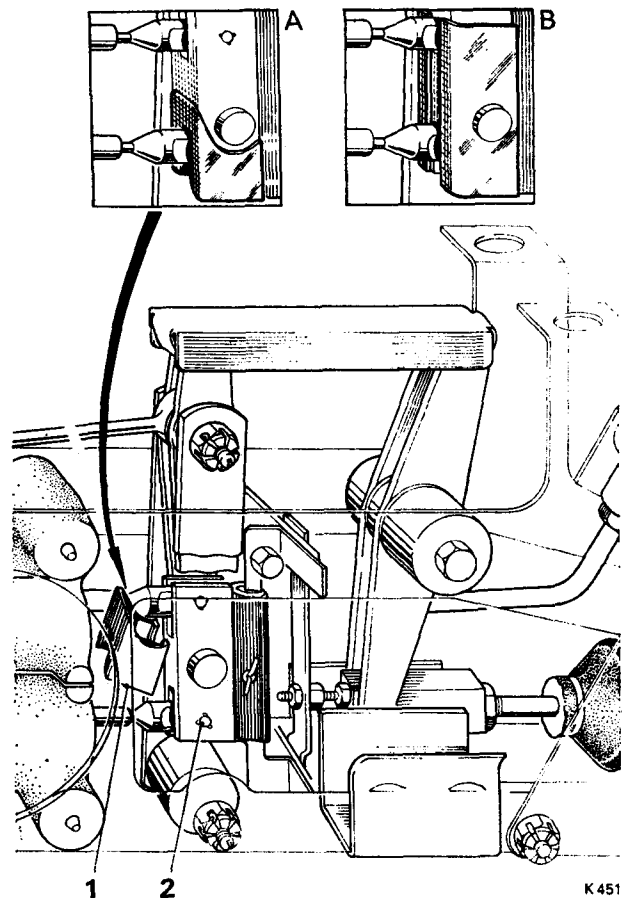


FIG. G51 METHOD OF FITTING THE FULCRUM PIN RETAINING CLIPS—EARLY CARS AND RETAINING PLATES—LATER CARS

- 1 Retaining clip 2 Fulcrum pin (lower)
Inset A retaining clip position (early cars)
Inset B retaining plates (2 off) in position (late cars)

4. Release the stop lamp switch and bracket from the side support plate; remove the electrical connections and remove the switch and bracket.
5. Remove the feed pipe from the reservoir to the master cylinder (grey) and remove the outlet pipe from the pressure limiting valve to the rear brake calipers (green, early cars) (blue, later cars); securely blank the pipes and ports.
6. Remove the six hydraulic pipes from the brake distribution valves one at a time, again blanking off all apertures quickly and securely.
7. Remove the brake pedal stem pinch bolt from the upper end of the brake pedal lever and ease the pedal stem out of the lever.
8. Release the side support plates at the forward mounting points, then release the two rear mountings from the floor and lower the assembly from the car.

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**Brake actuation linkage assembly—
To fit**

To fit the brake actuation linkage assembly, reverse the procedure given for its removal, noting the following points.

1. To facilitate fitting, the assembly may be offered up to the car and the pipe connections made whilst it is supported slightly below its fixed position, it should then be secured to the car body.
2. Torque tighten all nuts, setscrews and pipe unions (refer to Chapter P).
3. When the assembly has been fitted correctly, the master cylinder 'ON' stop, adjustable 'OFF' stop (if fitted), the brake pedal rod and the stop lamp switch must be set (see under appropriate headings in this Section).
4. Bleed the systems as described under Section G2—'Bleeding the systems'.

Brake actuation linkage—To dismantle

The following gives a procedure to adopt in order to remove the lever and linkage from a right-hand drive car, without disturbing the remainder of the assembly. Due to the positional difference of the linkage assembly on left-hand drive cars, it is not possible to partially dismantle it in situ; the complete assembly must be removed from the car and a side plate removed.

Prior to dismantling the linkage, note should be taken of the relative positions of the nuts, bolts and distance pieces.

1. Carry out Operations 1 to 3 inclusive, as given under 'Brake actuation linkage—To remove'.
2. On early cars, remove the brake linkage pivot pin retaining clip from the underside of the linkage assembly.
3. Remove the 'OFF' stop bracket from behind the balance lever which operates the brake distribution valves.
4. Remove the split pin and clevis pin from the operating rod pivot on the brake pedal.
5. Remove the master cylinder 'ON' stop.
6. Slacken the lock-nut on the master cylinder operating rod and unscrew the rod from its pivot.
7. Remove the bolt which supports the master cylinder operating lever between the side support plates. Ease the lever downward to the aperture in the side support plates then remove the distance pieces and tube from the pivot.
8. Repeat Operation 7 on the pivot at the lower end of the distribution valve operating lever.

Note Care should be taken to keep the individual distance pieces with their relative pivots.

9. Ease the levers downward and manoeuvre them from between the side support plates, valves and master cylinder.

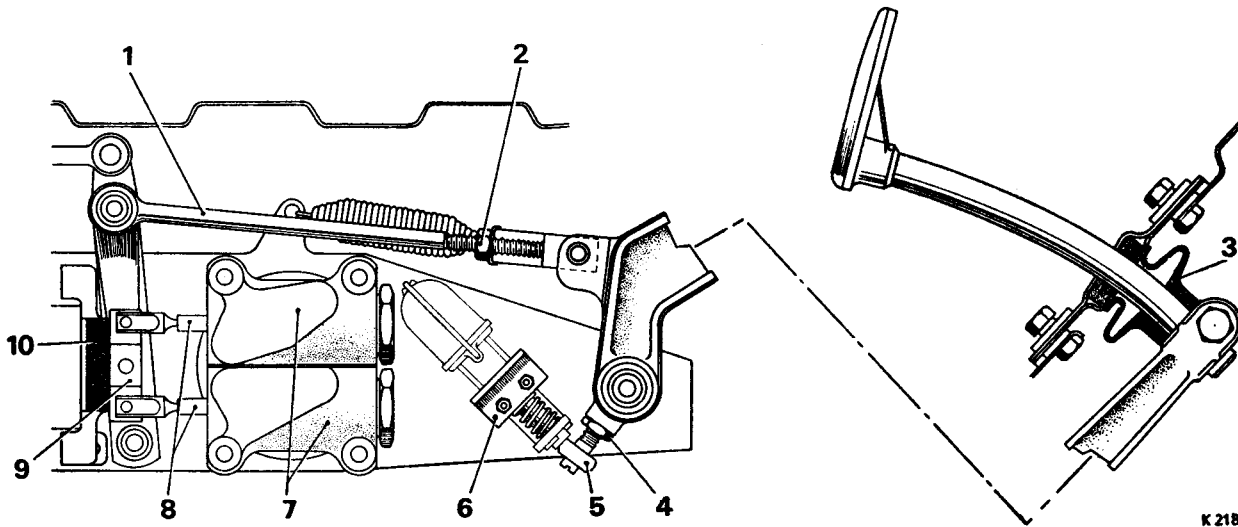


FIG. G52 VIEW OF BRAKE LINKAGE

- | | |
|-------------------------------------|---|
| 1 Brake pedal—linkage operating rod | 6 Stop lamp switch mounting bracket |
| 2 Lock-nut | 7 Brake distribution valves (upper and lower) |
| 3 Pedal seal | 8 Distribution valve plungers |
| 4 Switch adjuster lock-nut | 9 Distribution valves balance lever |
| 5 Eccentric adjuster | 10 Distribution valve 'OFF' stop |

Brake linkage assembly bushes and pivot pins—To renew

1. Remove and dismantle the brake levers from the car as described previously. The levers and pins are clearance fits in the bushes and are quite easily removed.
2. Carefully press bushes requiring renewal out of their locations and replace them with new ones. The bush bores are machined to final size, therefore final reaming or boring is not necessary.
3. **On early cars**, some pivots are flush fitting and are retained by spring clips. If the need arises to renew a pin(s), remove the retaining clip, press out the existing pin(s), then press in the new pin, with the serrations arranged so that they do not align with grooves made by the original pin. The pin(s) should be pressed in to give equal protrusions on each side of the lever.
4. Fit, where necessary, the pin retaining clips.
5. **On later cars**, bearing the serial number 3384 and onwards, some pivot pins have extensions and are retained by split pins. If the need arises to renew a pin(s), remove the split pin from either end of the pivot pin, press out the existing pin, insert the new pivot pin(s) and new split pins.

Brake linkage assembly—To assemble

To assemble the linkage, reverse the procedure adopted for its dismantling, noting the following points.

1. Clean all components prior to assembly and, using an approved grease (see Chapter D), lubricate all pivot points.
2. All bolts and nut must be torque tightened to the standard figures quoted in Chapter P.
3. The linkage should be free to operate when located between the assembly side support plates, without any tight spots or excessive side play.

Brake pedal lever—To remove

1. Place the car on a ramp and remove the undersheet below the actuation linkage assembly.
2. Release the two setscrews securing the stop lamp switch bracket to the side support plates; move the switch away from the pedal lever.
3. Unhook the pedal return springs.
4. Remove the split pin and clevis pin from the operating rod pivot on the pedal lever.
5. Remove the brake pedal stem pinch bolt from the top of the lever and ease the pedal stem out of the lever.

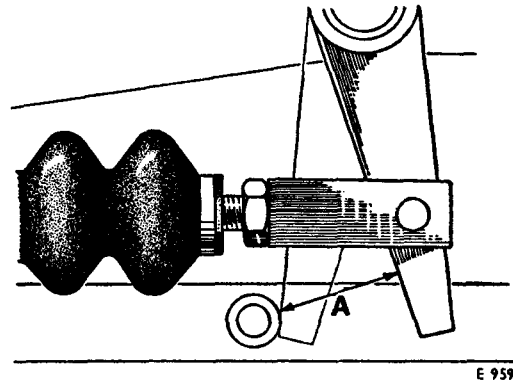


FIG. G53 MASTER CYLINDER SETTING (EARLY CARS)

A 'ON' stop setting

6. Remove the bolt and nut from the pedal lever pivot between the side support plates; remove the lever.

Brake pedal lever—To fit

In order to fit the brake pedal lever, reverse the procedure given for its removal, noting the following points.

1. All nuts must be torque tightened to the standard figures quoted in Chapter P.
2. The pedal lever and the stop lamp switch should be checked and adjusted if necessary (see under appropriate headings in this Section).

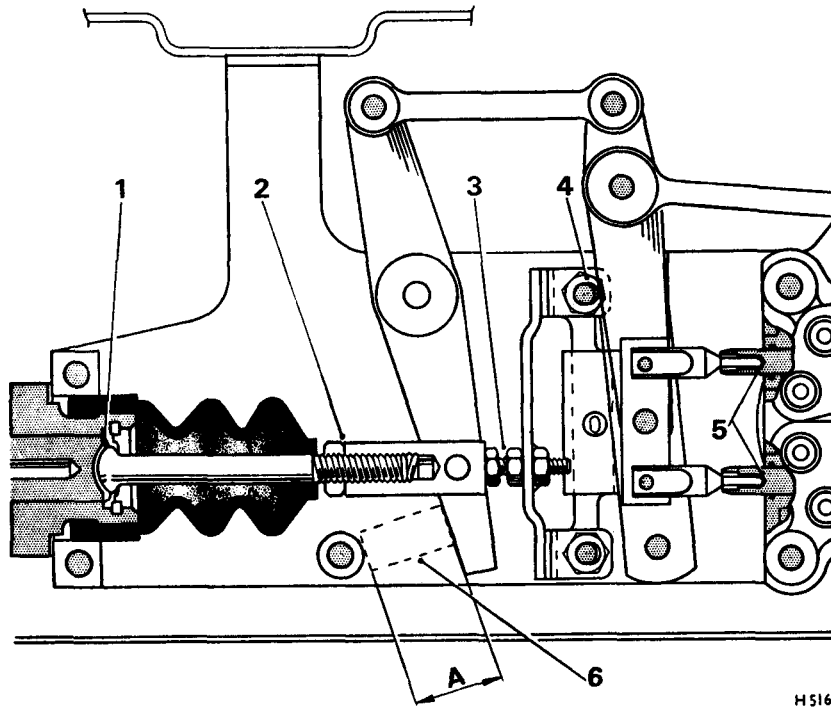
Brake linkage assembly

('ON' stop and 'OFF' stop)—To set

This procedure is to be carried out with the complete assembly in position on the car and must be applied on any occasion in service when either a distribution valve or brake master cylinder is disturbed or renewed.

1. Unscrew the four 2 B.A. bolts which secure the 'OFF' stop bracket to the side support plates sufficiently to enable the bracket to be moved on its slots.
2. Turn the head of the 'OFF' stop screwed adjuster (when fitted) until clearance exists between the screw head and the master cylinder operating linkage (i.e. the master cylinder push rod fully seated against its circlip and retaining washer).
3. Position the correct size distance piece between the 'ON' stop and master cylinder (see Figs. G54 and G55).

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FIG. G54 EARLY ARRANGEMENT—MASTER CYLINDER AND DISTRIBUTION VALVES WITH ADDITION OF ADJUSTABLE 'OFF' STOP

- | | |
|--|---|
| <p>1 0.005 in. to 0.010 in. (0,13 mm. to 0,25 mm.) clearance—push rod
 2 Adjuster 'ON' stop setting
 3 Adjuster—reducing master cylinder push rod free travel ('OFF' stop)</p> | <p>4 Elongated holes—adjusting distribution valve push rod clearance
 5 Zero clearance
 6 Gauge</p> |
|--|---|
- A 1.000 in. minus 0.025 in. (2,54 cm. minus 0,64 mm.)

4. Adjust the master cylinder push rod screwed adjuster until the distance piece is just contacted by the operating lever on one side and the 'ON' stop on the other.

5. Tighten the adjuster lock-nut and remove the distance piece.

Note The 'ON' stop setting should now be correct with the brake pedal in its fully 'off' position.

6. Slide the 'OFF' stop backward or forward along its elongated holes until the distribution valve push rods just contact their seats in the valve spindles (see *Figs. G54 and G55*). **Do not push the spindles into their respective valves.**

7. With the push rods just contacting the distribution valve spindles as in Operation 6, secure the 'OFF' stop bracket by tightening the four 2 B.A. screws.

8. To remove free play in the master cylinder push rod, screw the 'OFF' stop threaded adjuster (when fitted) until all free play is just eliminated. Turn the

adjuster one quarter of a turn to permit a 0.005 in. to 0.010 in. (0,13 mm. to 0,25 mm.) axial free play (see *Figs. G54 and G55*) to exist between the master cylinder push rod and piston. Tighten the adjuster lock-nut.

Note 1. The 'OFF' stop with integral adjuster is intended only to reduce pedal free travel which results from master cylinder push rod free travel, and any clearance which exists between the distribution valve spindles and their push rods. This adjuster will not and should not be used to reduce pedal free travel which originates from other sources (i.e. rear brake pad to brake disc clearance, pivot clearance, etc.).

2. Early cars fitted with an 'OFF' stop not having an integral threaded adjuster may be fitted with the later type adjuster from an available kit comprising an 'OFF' stop bracket, 2 B.A. nut and bolt.

Brake pedal operating rod—To adjust (see Fig. G56)

1. Disconnect and remove the brake pedal from the operating lever and remove the convoluted seal situated beneath the toeboard seal.
2. Disconnect the pedal operating lever return spring and stop lamp switch and ensure that the brake actuation linkage is in the 'OFF' position.
3. Disconnect the pedal lever operating rod by removing the split pin and clevis pin.
4. Position the setting template as illustrated in Figure G56 into the brake pedal operating lever and raise the lever complete with template until it touches the underside of the toeboard seal housing.
5. Adjust the jaw of the lever operating rod until the hole in the rod jaw aligns with the hole in the brake lever.
6. Remove the template from the lever, then connect the rod to the lever by inserting the fulcrum pin and split pin.

7. Tighten the lock-nut on the operating rod and fit the operating lever return spring.
8. Fit the convoluted seal between the brake pedal operating lever and toeboard seal.
9. Insert the brake pedal through the toeboard seal and convoluted seal, to enter the hole provided in the brake pedal operating lever.
10. Fit and tighten the pinch bolt to secure the pedal to the lever.
11. Check that the convoluted seal does not hold the actuation linkage from the required setting and that the brake pedal stem does not foul the seal housing at any point along its travel.

Note Should a car be fitted with a second layer of carpet it is important that it is fitted so that it does not reduce the clearance between the brake pedal pad and the toeboard. If necessary the additional carpet should be cut away in the area beneath the pedal to ensure that the set clearance is not reduced.

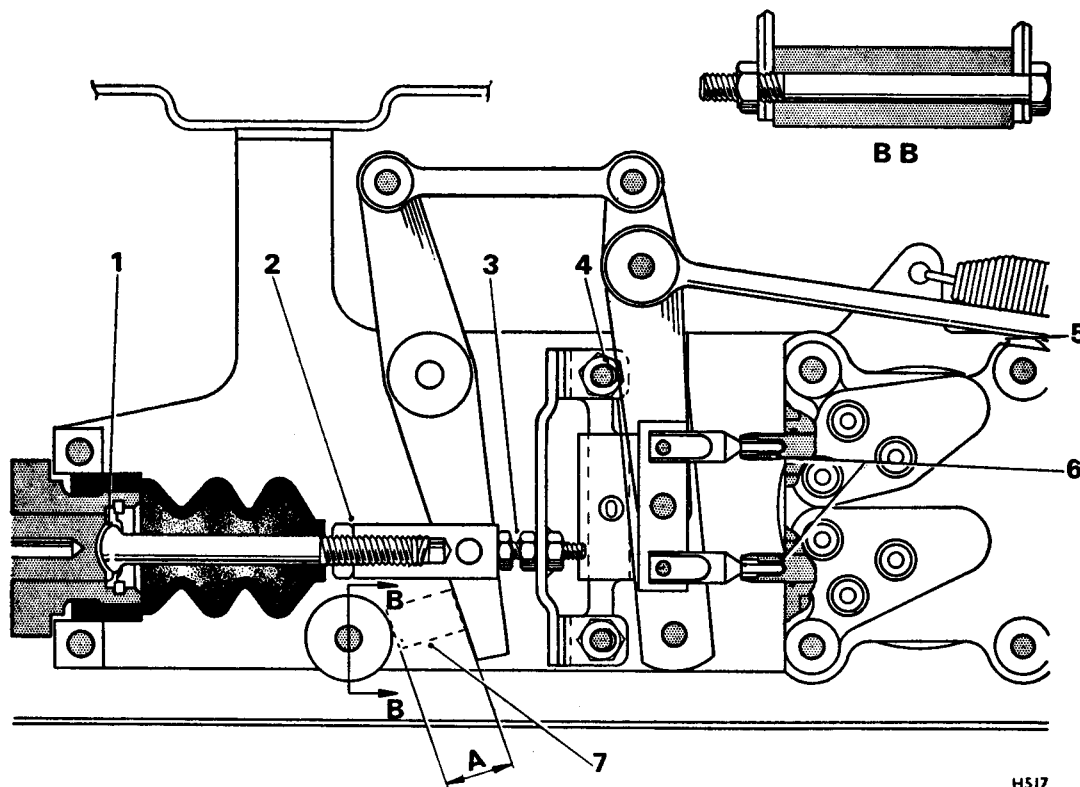


FIG. G55 CURRENT ARRANGEMENT—ADJUSTABLE 'OFF' STOP—MASTER CYLINDER AND DISTRIBUTION VALVES WITH LARGER DIAMETER 'ON' STOP

- | | |
|--|---|
| 1 0.005 in. to 0.010 in. (0.13 mm. to 0.25 mm.)
clearance—push rod | 4 Elongated holes—adjusting distribution valve
push rod travel |
| 2 Adjuster—'ON' stop setting | 5 Zero clearance |
| 3 Adjuster—reducing master cylinder push rod
free travel ('OFF' stop) | 6 Groove—upper face of valve |
| | 7 Gauge |
| A 0.800 in. minus 0.025 in. (2.032 cm. minus 0.64 mm.) | |

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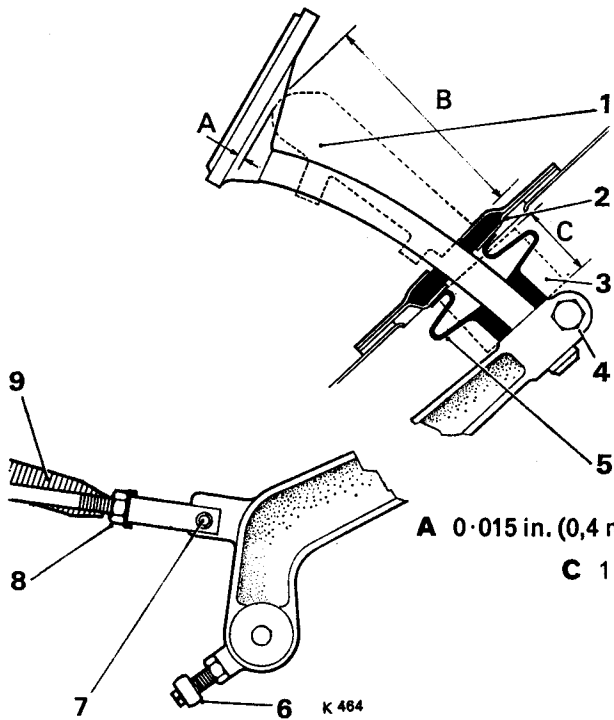


FIG. G56 SETTING THE BRAKE PEDAL AND BRAKE OPERATING LEVER

- 1 Checking template
- 2 Toeboard seal
- 3 Setting template
- 4 Brake lever
- 5 Convoluted seal
- 6 Stop lamp switch adjuster
- 7 Clevis pin
- 8 Lock-nut
- 9 Return spring

A 0·015 in. (0,4 mm.) B 4·400 in. to 4·390 in. (11,176 cm. to 11,151 cm.)
 C 1·145 in. to 1·150 in. (2,908 cm. to 2,921 cm.)

Brake pedal—To check (see Fig. G56)

1. Using the checking template as illustrated in *Figure G56*, positioned between the underside of the pedal and the toeboard seal, check that there is at least 0·015 in. (0,40 mm.) clearance with the brake actuation linkage in the 'OFF' position.
2. If there is less than 0·015 in. (0,40 mm.) clearance, the brake pedal operating rod will have to be adjusted as already described (see 'Brake pedal operating rod—To adjust').

Stop lamp switch setting—To adjust

When all other adjustments to the brake actuation linkage and brake pedal have been completed, set the stop lamp switch as follows.

1. Ensure that the switch is securely fitted into position between the brake actuation linkage side plate.
2. Unlock the eccentric screw which is fitted to the bottom of the brake pedal lever.
3. Adjust the eccentric to ensure that it contacts the switch in order to operate the brake lamps during **initial** movement of the brake pedal.
4. Tighten the lock-nut to retain the eccentric screw in the set position.

Section G16

THE HAND BRAKE LINKAGE

Introduction

Since the introduction of the Rolls-Royce Silver Shadow and Bentley T Series car, two types of hand brake cable arrangement have been incorporated on early and later right-hand and left-hand drive cars; these are fully illustrated in *Figures G59 to G62 inclusive*.

Briefly, the differences are as follows.

The addition of two pulleys to the front cable run, a longer cranked operating lever at the centre, and a re-positioned return spring.

It will be noticed also that later left-hand drive cars have an identically positioned operating lever to that of right-hand drive cars; the front cable crosses the car forward of the body centre member via the additional pulleys to connect to the hand brake.

The *illustrations G59 to G62* also show the difference in the run of the front hand brake cable between right-hand and left-hand drive cars.

On **all right-hand drive cars**, the forward end of the front cable rises **inboard** of the body right-hand longeron then over two pulleys before connecting to the hand brake handle mechanism. On **all left-hand drive cars**, the forward end of the cable is directed beneath the body left-hand longeron then rises **outboard** of the longeron then over two pulleys to

connect to the hand brake handle mechanism. This difference is due to the positioning of the exhaust system silencer and the footbrake actuation box.

If an early car is returned for service through complaint of excessive hand brake apply load, kits of parts are available comprising low-friction cables, hand brake pads and, if required, the latest type of operating lever. The cable run of any car having new parts fitted remains unaffected.

Hand brake warning lamp

A warning lamp is fitted on the facia to indicate that the hand brake is either 'ON' or 'OFF'.

For the warning lamp to function correctly it is essential that, when the hand brake is pulled 'ON', the microswitch, which operates the warning lamp, is actuated **before** the hand brake reaches the first notch on the ratchet. The microswitch is located at the forward end of the hand brake ratchet assembly and is actuated by one of the ratchet assembly guide rollers.

1. Set the microswitch so that when the hand brake is in the 'OFF' position there is a nominal gap of 0.025 in (0.06 mm.) between the roller and the switch face (*see Fig. G57*).

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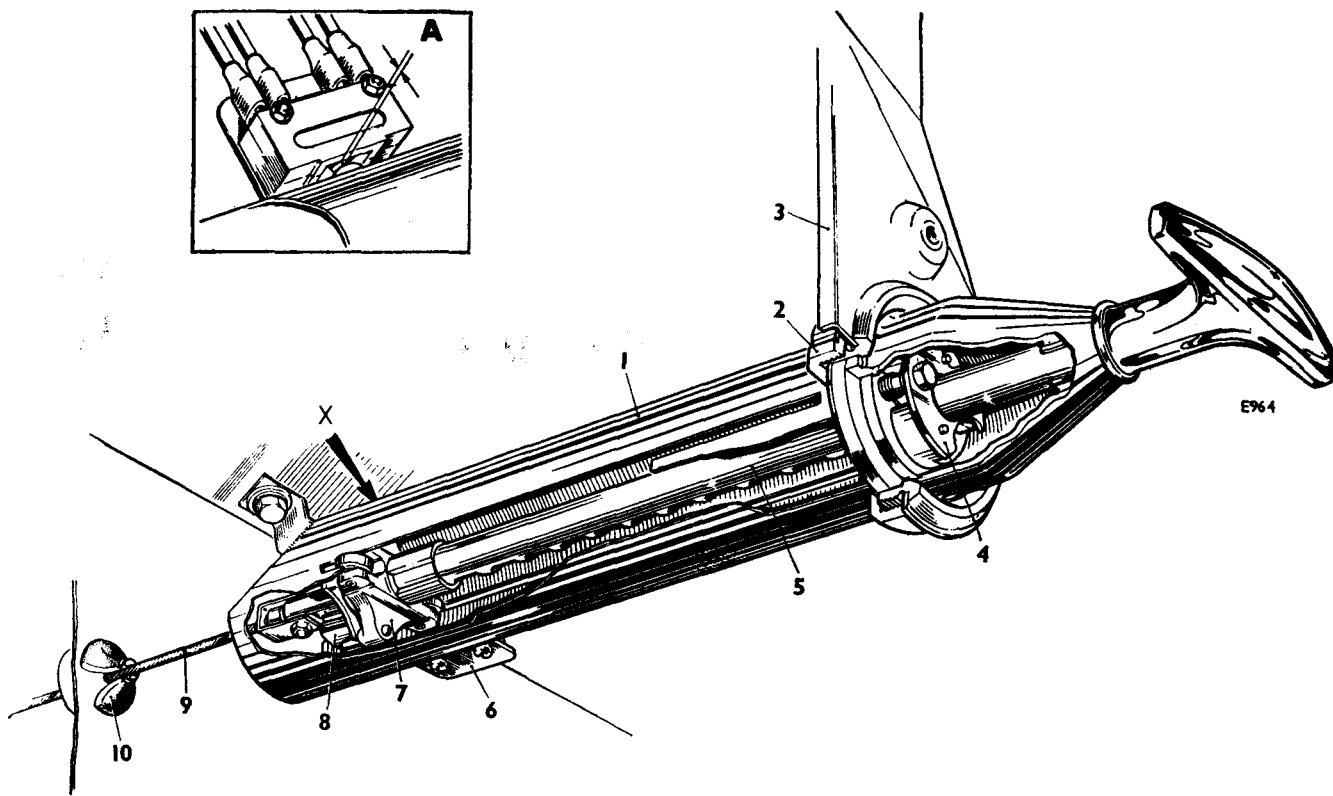


FIG. G57 HAND BRAKE RATCHET ASSEMBLY

- | | |
|-------------------------|---------------------------------|
| 1 Cover tube | 6 Micro-switch mounting bracket |
| 2 Serrated nut | 7 Roller and guide assembly |
| 3 Support bracket | 8 Spring |
| 4 Ratchet pawl assembly | 9 Operating cable |
| 5 Slide rod | 10 Cable seal |

A 0.025 in. (0,6 mm.)

Inset shows view of micro-switch in direction of arrow X.

Hand brake ratchet assembly—To remove

1. Securely chock the road wheels, then release the hand brake to the 'OFF' position.
2. Remove the electrical connections from the microswitch mounted at the lower end of the ratchet cover tube.
3. Release and remove the setscrews securing the upper support bracket to the fascia structure.
4. Remove the setscrews securing the lower support bracket.
5. Ease the ratchet assembly downward and remove the hand brake cable from the 'U' piece bolted to the bottom of the operating rod; remove the assembly.

Hand brake ratchet assembly—To dismantle

It is unlikely that the hand brake ratchet mechanism should ever require attention other than occasional

lubrication. If, however, it should require attention, it should be removed from the car as previously described and dismantled as follows.

1. Remove the 'U' sectioned cable retainer from the lower end of the operating rod.
2. Remove the cheese headed screw from the upper end of the cover tube.
3. Unscrew the large locking nut from behind the upper support bracket.
4. Remove the cover tube and nut from the assembly.

Note The roller assembly must be extracted from the cover tube by pulling the assembly to the top of the tube then tipping the tube and carefully manipulating first one and then the other roller out of the slots.

5. Remove the shaft from the upper housing and separate the housing and ratchet components.

6. All assemblies and components should be inspected for signs of wear or damage, paying particular attention to the bushes, ratchet assembly and springs; new parts should be fitted where necessary.

Hand brake ratchet assembly— To assemble

To assemble the ratchet assembly reverse the procedure given for its dismantling, noting the following points.

1. The hand brake ratchet mechanism is 'handed'; a right-hand drive car hand brake lever is turned clockwise from the horizontal position to release it and conversely a left-hand drive car hand brake lever is turned anti-clockwise to release it.

2. The lever is spring-loaded by a coiled spring fitted beneath the roller assembly and located on a pin. This keeps the lever horizontal and the ratchet engaged.

3. The position of the stop plate beneath the coil spring determines whether the hand brake is left or right-handed and therefore care must be taken when assembling the roller assembly, stop plate and spring, to ensure that the hand brake lever is spring-loaded against the direction in which it rotates (see Fig. G58).

4. Care must also be taken when entering the roller and control rod into the cover tube; careful manipulation is necessary and the tube should be tipped at an angle to the control rod, as is the case when removing the roller assembly.

Hand brake ratchet assembly—To fit

To fit the hand brake ratchet assembly reverse the procedure given for its removal, noting the following points.

1. All setscrews should be torque tightened to standard figures (see Chapter P).

2. Care should be taken to ensure that the hand brake cable end is located correctly.

3. Before fitting the rubber boot, remove any existing grease from the rubber boot and ratchet mechanism, then fill the rubber boot with Castrol grease H. 140/59 (colour brown) allowing sufficient air space inside the boot for the adjusting wheel.

Hand brake cables—To renew

Early cars, built prior to car serial number 3264

If a car included in the above group is brought in for service with reported difficult hand brake application (heavy handle load) on complaint from the customer, a new set of low-friction cables, new centre operating lever (if not already fitted) and new hand brake pads may be fitted from the available kits.

The kits available are coded as follows.

Kit 6c Right-hand drive cars	} car serial numbers 1001 to 2138
Kit 6d Left-hand drive cars	
Kit 6a Right-hand drive cars	} car serial numbers 2138 to 3264 inclusive
Kit 6b Left-hand drive cars	

The latter kits comprise a set of cables and new hand brake pads only.

Note The hand brake cable arrangement for left-hand drive cars is symmetrically opposite to that of right-hand drive cars (see Figs. G61 and G62).

Front cable—To remove

1. Disconnect the battery.
2. **On right-hand drive cars only**, remove the electrical relays box (refer to Chapter M). It is not necessary to remove the loom connector plugs from the printed circuit.

3. Remove the hand brake ratchet assembly as described earlier under 'Hand brake ratchet assembly—To remove'.

4. Detach the forward end of the cable from the hand brake ratchet connector.

Remove the seal from the toeboard through which the cable passes, as follows.

5. Remove the circlip retaining the seal in position on the outer side of the toeboard and the two set-screws which secure the seal housing to the engine side of the toeboard.

6. Remove and dismantle the two hand brake cable pulleys.

7. Remove the cable securing clips and disconnect the rear of the cable from the centre operating lever. Remove the front cable from the car.

Centre operating lever—To remove

The following operations apply only to cars which may require the later type cranked centre operating centre lever fitted, i.e. cars built prior to serial number 2138.

1. Disconnect the pair of rear cables at the equalising linkage on the centre operating lever assembly.

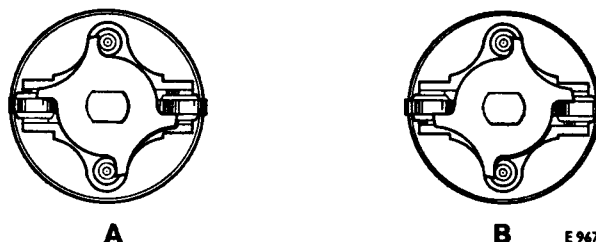


FIG. G58 HAND BRAKE STOP PLATE IN POSITION
A Right-hand assembly B Left-hand assembly

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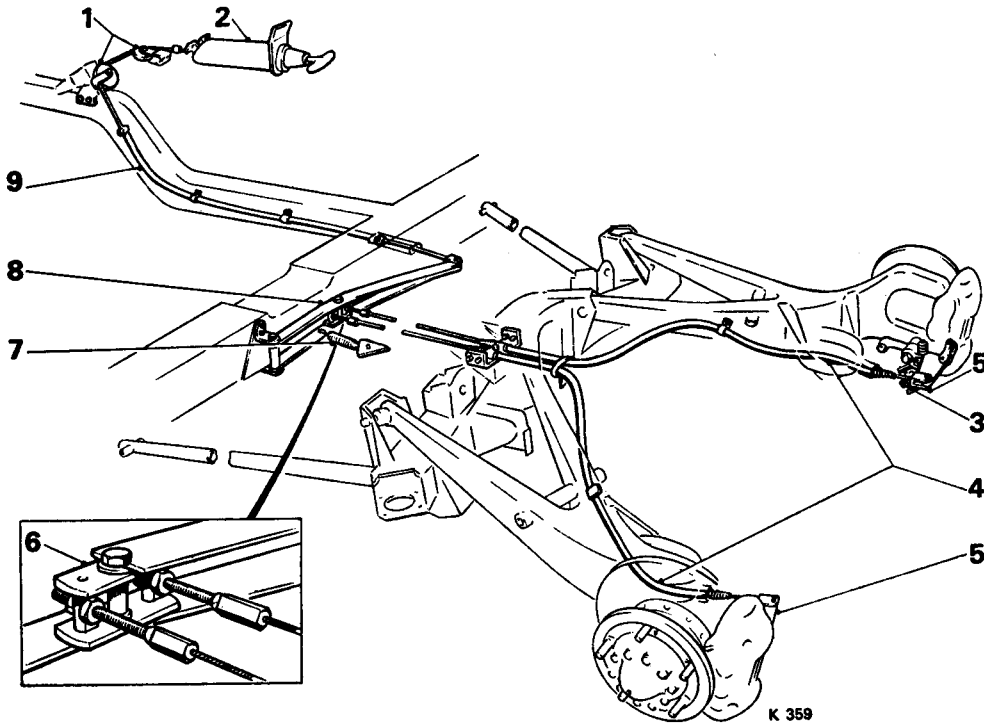


FIG. G59 HAND BRAKE LINKAGE—EARLY R.H.D. CARS

- | | | |
|---------------------------|--|--------------------------|
| 1 Cable pulleys | 4 Hand brake rear cables | 7 Return spring |
| 2 Hand brake | 5 Hand brake operating mechanism | 8 Operating lever |
| 3 Hand brake pad adjuster | 6 Inset—cables equalising linkage length adjusters and cable | 9 Hand brake front cable |

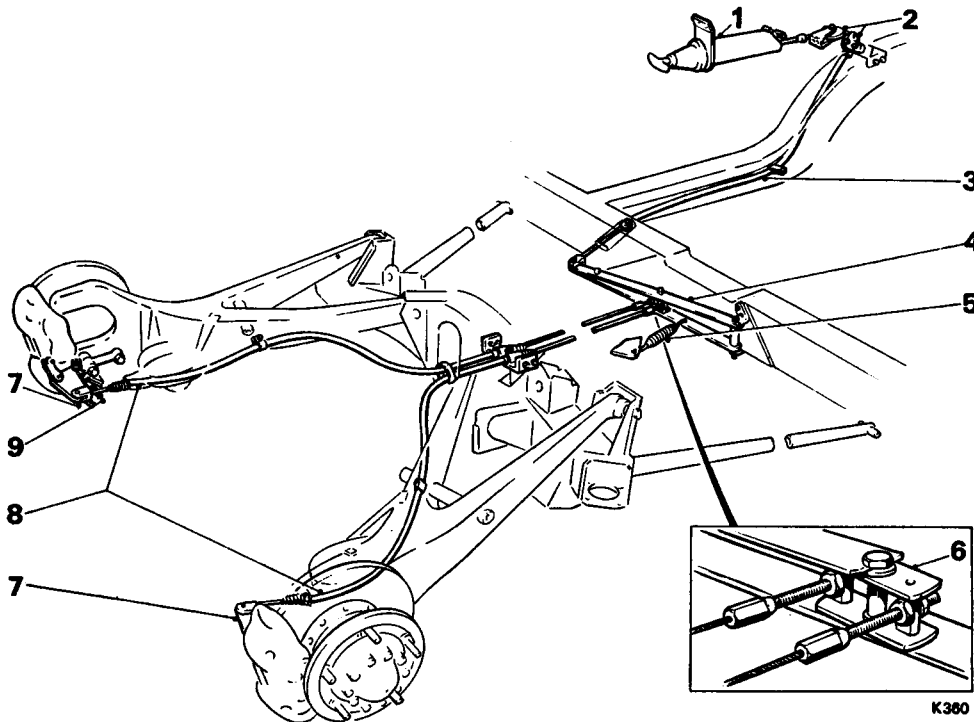


FIG. G60 HAND BRAKE LINKAGE—EARLY L.H.D. CARS

- | | | |
|--------------------------|--|----------------------------------|
| 1 Hand brake | 4 Operating lever | 7 Hand brake operating mechanism |
| 2 Cable pulleys | 5 Return spring | 8 Hand brake rear cables |
| 3 Hand brake front cable | 6 Inset—cables equalising linkage and cable length adjusters | 9 Hand brake pad adjuster |

2. Unscrew the nuts, bolts and setscrews and remove the old centre lever from the car; retain the following items from the old lever.

The nut and bolt which clamps the outer end of the levers, the clevis pin, the return spring and the support bracket bolt (see Fig. G64, inset CC).

Rear cables—To remove

1. Jack-up the rear of the car and remove the road wheels. Support the trailing arms, **do not allow the suspension rebound straps to take the full weight of the rear suspension.**

2. If not previously carried out, disconnect the front end of the rear cables from the centre operating lever at the equaliser.

3. Disconnect the rear end of each cable from the hand brake caliper mechanism.

4. Remove the clips which secure each cable along its run between the centre operating lever and hand brake caliper.

Front cable—To fit

1. Using a 0.375 in. (9.53 mm.) diameter drill, increase the bore diameter of the abutment brackets such that the end fittings of the new cables will fit the brackets.

2. Fit the abutment brackets to each end of the new cable, pass the cable end through the tube in the body underframe cross-member.

3. Tighten the abutment brackets to the cables such that the bolts are nearest to the outside of the car.

4. Temporarily clip the cable into its approximate position and connect it to the centre operating lever.

5. Clean, then lubricate the two pulleys in the following manner. Apply Molytone 265 grease to the pulley centre pivots and Midland Silicones MS 44 grease to the pulley grooves over which the cable passes. Use of any other grease on the pulley groove will have a harmful effect on the inner cable low-friction coating.

6. Check the hand brake ratchet assembly for freedom of movement, then proceed to complete the fitting of the cable, pulleys, hand brake ratchet assembly and toeboard seal by reversing the operations given for their removal.

7. Fit the relay box (if previously removed), reversing the procedure adopted for its removal.

8. Connect the rear end of the front cable to the centre operating lever.

Note This operation is to be carried out after the following Operations 1 to 4 if a new lever is to be fitted.

Centre operating lever—To fit

Refer to introductory note under 'Centre operating lever—To remove'.

1. Assemble and fit the new operating lever to the car as shown in *Figure G64 and inset BB*, utilising the parts retained from the old lever. Ensure that during assembly all pivot points are lubricated with Molytone 265 grease. Also ensure that underseal is removed where necessary from the areas on the member which will accommodate the new lever.

2. Fit the return spring anchor plate to the new position (see Fig. G64, inset AA).

3. Connect the spring to the anchor plate and centre lever.

4. Renew the underseal where necessary on completion of the fitting.

Rear cables—To fit

1. Prior to fitting the new cables, fit the new hand brake pads as described under 'Hand brake pads—To renew'.

2. Fit the new rear cables, reversing the procedure adopted for their removal, noting the following points. Clean and lubricate the hand brake caliper mechanism. Take care not to introduce any sharp bends or twists along their route.

3. Adjust the hand brake cables, referring to 'Hand brake cables—To adjust' for the procedure to adopt.

4. Fit the road wheels, remove the supports from beneath the trailing arms, lower the car and remove the jack.

Note The new hand brake pads require bedding-in. Refer to 'Hand brake pads—To bed-in'.

Hand brake cables—Later cars—To renew

Should the need arise to renew hand brake cables of later cars, those from serial number 3264 onwards, the procedure to adopt is almost identical to that described for early cars, except for the following points.

1. These cars are already fitted with the longer cranked centre operating lever, therefore the information contained earlier for lever replacement does not apply.

2. There are four pulleys to consider when renewing the front cable (see Figs. G61 and G62).

3. On the cars in the above group, the rear cable run and position of the centre operating lever is identical for left-hand and right-hand drive cars.

Hand brake cables—To adjust

The hand brake automatically adjusts itself as wear to the pads takes place (refer to 'Hand brake pads—

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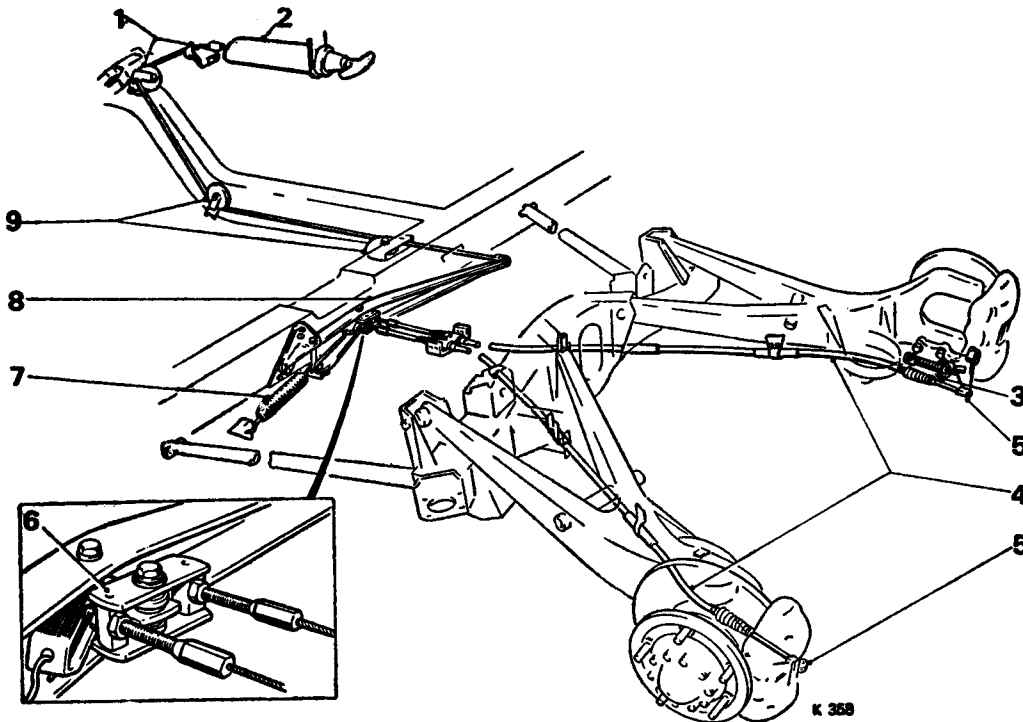


FIG. G61 HAND BRAKE LINKAGE—LATE R.H.D. CARS

- | | | |
|---------------------------|--|-----------------------|
| 1 Cable upper pulleys | 5 Hand brake operating mechanism | 7 Return spring |
| 2 Hand brake | 6 Inset—cables equalising linkage and cable length adjusters | 8 Operating lever |
| 3 Hand brake pad adjuster | | 9 Cable lower pulleys |
| 4 Hand brake rear cables | | |

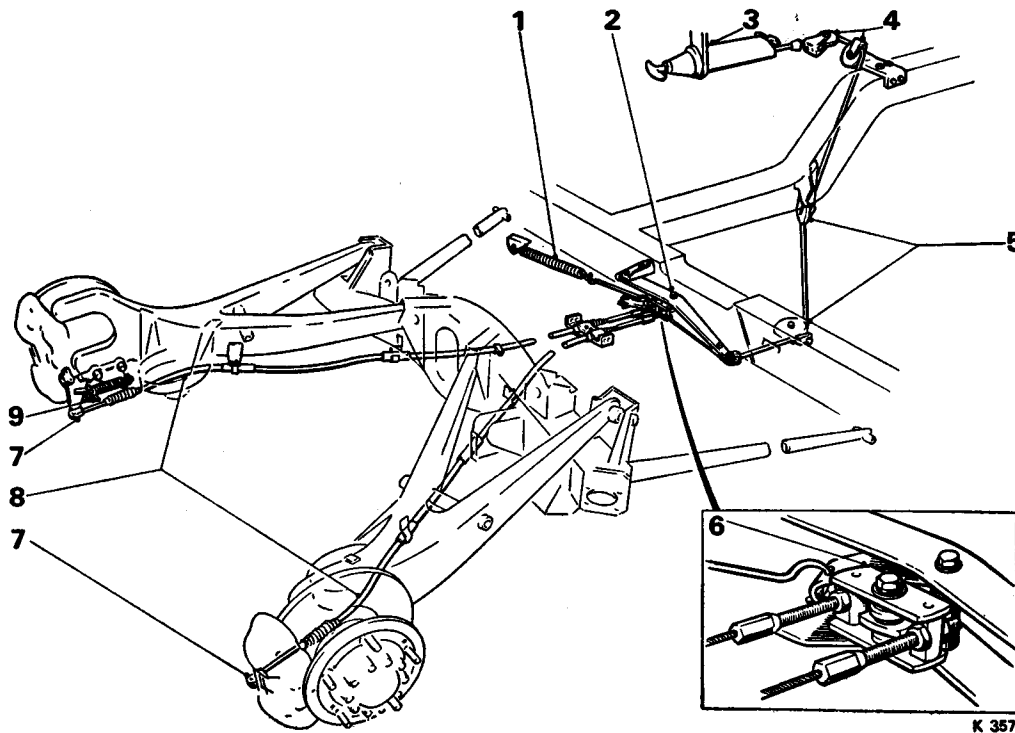


FIG. G62 HAND BRAKE LINKAGE—LATE L.H.D. CARS

- | | |
|-----------------------|--|
| 1 Return spring | 6 Inset—cables equalising linkage and cable length adjusters |
| 2 Operating linkage | 7 Hand brake operating mechanism |
| 3 Hand brake | 8 Hand brake rear cables |
| 4 Cable upper pulleys | 9 Hand brake pad adjuster |
| 5 Cable lower pulleys | |

To set'), and the only other adjustment which may be necessary to the linkage is at the small equaliser lever.

Do not adjust the slack in the rear hand brake cables indiscriminately. When this operation is performed the cables must not be adjusted too tightly.

The procedure is as follows.

1. Hold fully back **both** triangular shaped levers between the ends of the rear cables and the connecting links on the calipers so that the operating levers on the calipers are fully back against their abutments.

If this is not carried out the automatic adjuster on the hand brake will not be able to operate correctly.

2. Ensure that the equaliser of the operating rod lever lies at right angles to the car longitudinal centre line.

3. Take up any excessive slackness in the cables, using the adjusting nuts and lock-nuts provided on the ends of the two rear cables (see Figs. G59 to G62 inclusive).

Hand brake pads—To renew

The hand brake pads should be inspected at the recommended intervals. The pads must be renewed when the friction material has worn to within $\frac{1}{8}$ in. (3.18 mm.) from the back plates.

To renew the hand brake pads proceed as follows.

1. Securely chock the front wheels; release the hand brake to the 'OFF' position.

2. Jack up the rear of the car and place stands under the rear trailing arms. **Do not allow the suspension rebound straps to take the full suspension load.**

3. Remove the rear wheel discs and the rear wheels.

4. Lever the spring steel adjusting prong away from the rubber boot which covers the ratchet wheel; remove the rubber boot (see Fig. G63).

5. With the adjusting prong still held clear, remove the ratchet wheel by unscrewing it anti-clockwise.

6. Move the hand brake operating levers away from the disc, giving access to the pads. Each hand brake pad is retained against its abutment face by a coil spring, one of which is larger and thicker than the other (see Fig. G63).

7. Unhook the coil springs from the operating levers and remove the pads and springs.

8. Fit the spring to the new pads, then fit the pads in position and hook the spring ends over the operating levers.

9. Push both operating levers in towards the disc, then, holding the adjusting prong clear, screw the ratchet wheel onto the reaction rod.

Hand brake pads—To set

1. Screw the ratchet inward until the gap between each pad and the brake disc is 0.003 in. to 0.005 in. then unscrew the ratchet by an amount equivalent to 3 or 4 teeth on the ratchet wheel.

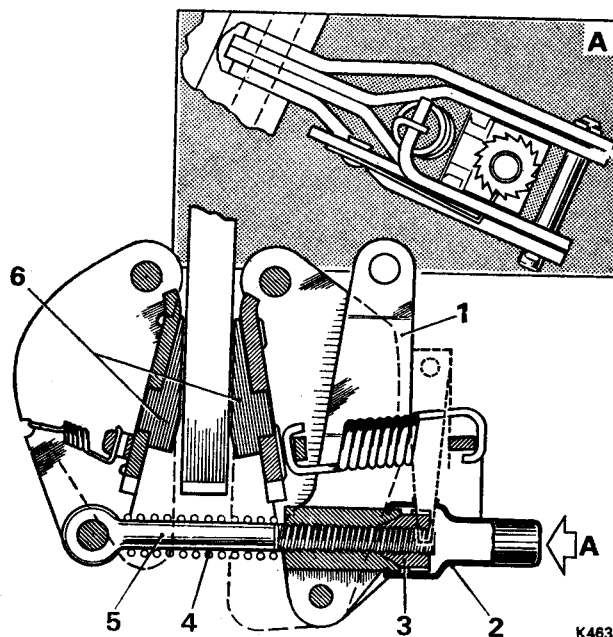


FIG. G63 HAND BRAKE PAD MECHANISM

- 1 Operating lever
- 2 Adjusting ratchet seal
- 3 Ratchet nut
- 4 Reaction rod spring
- 5 Reaction rod
- 6 Hand brake pads and back plates

Inset—View on arrow A, rubber boot removed.

2. When this setting has been obtained, fit the rubber boot over the ratchet wheel and release the adjusting prong, ensuring that the end locates securely in the slot in the rubber boot.

Note The ratchet will automatically adjust the hand brake, as and when necessary, after this initial setting has been carried out, but it is recommended that a check be made of the gap setting at the specified service interval (refer to Chapter D).

Hand brake pads—To bed-in

1. Run the car on the road at approximately 30 m.p.h. (50 k.p.h.) and apply the hand brake firmly for two or three seconds. Release the hand brake.

2. Continue running the car at the above speed and repeat the operation six times, allowing a one-minute interval between each application.

3. On completion and when the brake discs and pads have cooled, manually adjust the hand brake pads to give the required gap setting.

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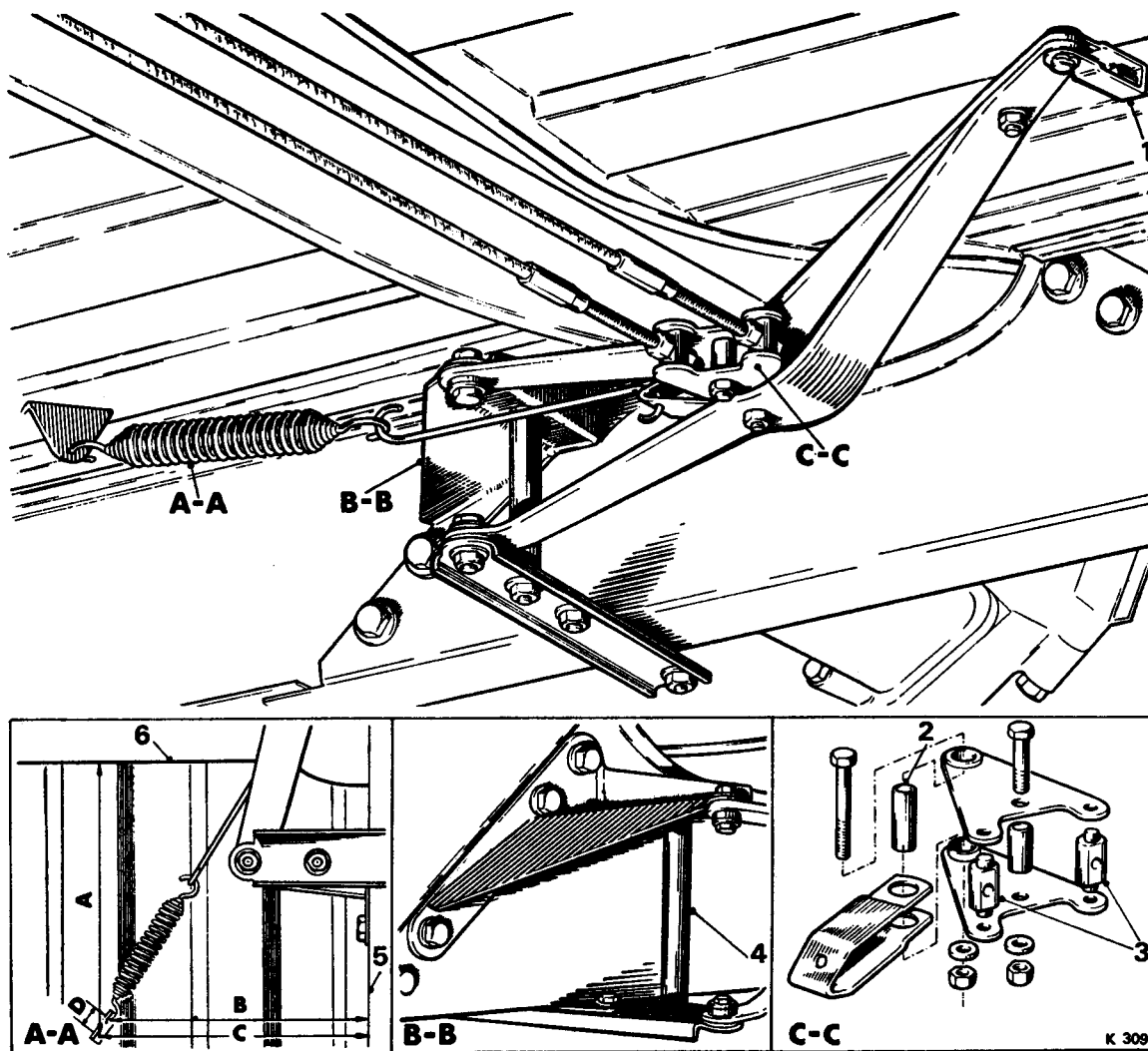


FIG. G64 HAND BRAKE CABLE CONVERSION (EARLY CARS)

- | | | |
|-------------------------------------|------------------------|--------------------------------------|
| 1 Front cable connection jaw | 3 Trunnions | 5 Cross-member |
| 2 Distance piece | 4 Original bolt | 6 Propeller shaft tunnel edge |

A 12·175 in. (30,93 cm.) **B** 8·250 in. (20,96 cm.) **C** 9·00 in (22,86 cm.) **D** 1·40 in. (3,56 cm.)

A-A Inset—Return spring anchorage point positioning

B-B Inset—View of upper and lower pivot bracket

C-C Inset—Exploded view—Equaliser assembly

Section G17

FAULT DIAGNOSIS

Introduction

A number of differing faults, each of which is difficult to diagnose, can cause the 'BRAKE' warning lamps on the instrument panel to illuminate.

To assist in the diagnosis, a systematic check sequence chart has been introduced for the hydraulic circuit associated with each lamp.

The charts are headed 'BRAKE HYDRAULIC CIRCUIT—LEFT-HAND WARNING LAMP' and

'BRAKE AND HEIGHT CONTROL HYDRAULIC CIRCUITS—RIGHT-HAND WARNING LAMP' respectively.

The charts are self-explanatory in nature and consist of main steps situated in the centre of each chart with any additional information shown to the sides.

The checks noted on the charts should be undertaken on every occasion that a hydraulic system fault is encountered.

Printed in Great Britain

Revised Aug. 1969

T.S.D. 2476

**Systematic check sequence chart—
Brake hydraulic circuit**

SYSTEMATIC CHECK SEQUENCE BRAKE HYDRAULIC

LEFT-HAND WARNING LAMP ILLUMINATION (INTERMITTENTLY OR CONTINUOUSLY)

BEFORE CARRYING OUT THIS SYSTEMATIC CHECK, THE FLUID LEVEL SHOULD BE CHECKED AND TOPPED-UP. THE CAR SHOULD ALSO BE CHECKED UNDERNEATH FOR SIGNS OF LEAKAGE FROM HOSES OR HYDRAULIC UNITS. IF NO LEAKS ARE APPARENT FROM THIS BRIEF VISUAL CHECK, CARRY OUT THE FOLLOWING PROCEDURE.

STEP 1

DE-PRESSURISE THE SYSTEM AND INSERT A PRESSURE GAUGE INTO THE FRONT ACCUMULATOR BLEED VALVE.

STEP 2

START THE ENGINE AND ALLOW IT TO IDLE AT APPROXIMATELY 1000 r.p.m. CAREFULLY OBSERVE THE BEHAVIOUR OF THE PRESSURE GAUGE.

DE-PRESSURISING THE SYSTEM NORMALLY REQUIRES BETWEEN 40 AND 90 PUMPS OF THE BRAKE PEDAL.

SYMPTOM 2(1)

THE PRESSURE GAUGE NEEDLE RISES SLOWLY FROM ZERO, OR BOUNCES UP TO AN INITIAL PRESSURE OF LESS THAN 900 lb/sq.in. (63,25 kg/sq.cm.).

CHARGE THE ACCUMULATOR SPHERE WITH NITROGEN TO THE CORRECT PRESSURE OF BETWEEN 900 lb/sq.in. AND 1000 lb/sq.in. (63,25 kg/sq.cm. AND 70,31 kg/sq.cm.). BEFORE REFITTING THE CHARGING CAP ENSURE THAT THE SEALING RING AND NYLON BALL (IF FITTED) IS INTACT AND NOT DAMAGED IN ANY WAY.

AS DESCRIBED OPPOSITE, THE FIGURE TO WHICH THE GAUGE NEEDLE BOUNCES UP TO INITIALLY, INDICATES THE NITROGEN PRESSURE IN THE ACCUMULATOR SPHERE. IF THE PRESSURE RISES SLOWLY FROM ZERO, PULSING AT ENGINE CAMSHAFT SPEED, IT INDICATES THAT THERE IS NO NITROGEN PRESSURE IN THE ACCUMULATOR SPHERE AT ALL AND USUALLY CAUSES THE LAMP TO BE ILLUMINATED AFTER ONLY A FEW PUMPS OF THE BRAKE PEDAL (BETWEEN 2 AND 5 PUMPS). IF THE NEEDLE BOUNCES UP TO A PRESSURE OF BETWEEN 900 lb/sq.in. AND 1000 lb/sq.in. (63,25 kg/sq.cm. AND 70,31 kg/sq.cm.) THIS MEANS THAT THE NITROGEN PRESSURE IS CORRECT.

SYMPTOM 2(2)

THE LAMP REMAINS ON OR GOES OUT BUT THE PRESSURE DOES NOT BUILD UP CORRECTLY.

STEP 3

DE-PRESSURISE THE SYSTEMS. REMOVE THE PRESSURE GAUGE FROM THE BLEED VALVE HOLE AND INSERT IT IN THE BLEED VALVE HOSE. REFIT THE BLEED VALVE. START THE ENGINE AND OBSERVE THE PRESSURE GAUGE BEHAVIOUR.

SYMPTOM 3(1)

PRESSURE DOES NOT BUILD UP AT ALL.

STOP THE ENGINE. CONNECT A BLEED TUBE TO THE BLEED VALVE ON THE ACCUMULATOR. OPEN THE BLEED VALVE. RUN THE ENGINE TO SEE IF FLUID FLOWS OUT. IF FLUID FLOWS OUT, CLOSE THE BLEED VALVE AND CHECK AGAIN. IF PRESSURE STILL DOES NOT BUILD UP, THE HYDRAULIC PUMP IS FAULTY AND MAY REQUIRE OVERHAULING. IF FLUID DOES NOT FLOW OUT, CHECK THAT THE HYDRAULIC PUMP IS NOT AIR LOCKED.

THIS MEANS THAT THE HYDRAULIC PUMP IS NOT FUNCTIONING CORRECTLY BECAUSE EITHER THE PUMP IS AIR LOCKED OR BECAUSE THERE IS DIRT UNDER THE PUMP MAIN DELIVERY VALVE SEAT.

SYMPTOM 3(2)

PRESSURE NOW BUILDS UP NORMALLY AND CUTS OFF AT CORRECT PRESSURE.

STEP 4

DE-PRESSURISE THE SYSTEM AND REFIT THE PRESSURE GAUGE INTO THE BLEED VALVE TAPPING. RECONNECT THE FRONT FLEXIBLE HOSE AND CONFIRM THAT THE FAULT EXISTS AS AT STEP 2.

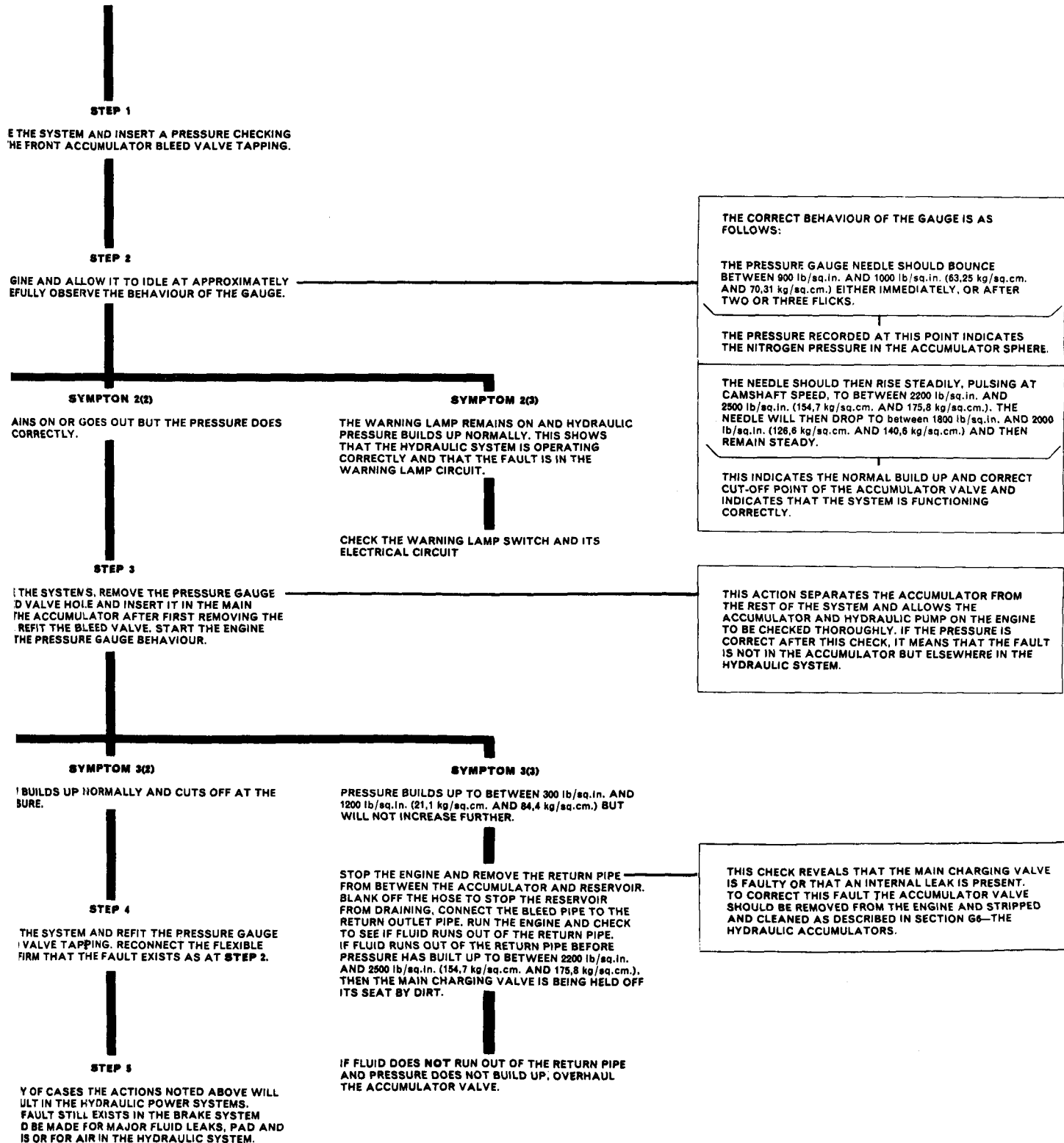
STEP 5

IN THE MAJORITY OF CASES THE ACTIONS NOTED ABOVE WILL RECTIFY THE FAULT IN THE HYDRAULIC POWER SYSTEM. IF, HOWEVER, A FAULT STILL EXISTS IN THE BRAKE SYSTEM, A CHECK SHOULD BE MADE FOR MAJOR FLUID LEAKS, WEAR DISC CONDITIONS OR FOR AIR IN THE HYDRAULIC SYSTEM.

CHECK SEQUENCE CHART HYDRAULIC CIRCUIT

WARNING LAMP ILLUMINATED (INTERMITTENTLY OR CONTINUOUSLY)

BEFORE STARTING THIS SYSTEMATIC CHECK, THE RESERVOIR SHOULD BE CHECKED AND TOPPED-UP IF NECESSARY. THE SYSTEM SHOULD ALSO BE CHECKED UNDERNEATH FOR ANY LEAKAGE FROM HOSES OR HYDRAULIC UNITS, ETC. IF NO FAULTS ARE APPARENT FROM THIS BRIEF VISUAL CHECK, PROCEED WITH THE FOLLOWING PROCEDURE.



THE CORRECT BEHAVIOUR OF THE GAUGE IS AS FOLLOWS:

THE PRESSURE GAUGE NEEDLE SHOULD BOUNCE BETWEEN 900 lb/sq.in. AND 1000 lb/sq.in. (63.25 kg/sq.cm. AND 70.31 kg/sq.cm.) EITHER IMMEDIATELY, OR AFTER TWO OR THREE FLICKS.

THE PRESSURE RECORDED AT THIS POINT INDICATES THE NITROGEN PRESSURE IN THE ACCUMULATOR SPHERE.

THE NEEDLE SHOULD THEN RISE STEADILY, PULSING AT CAMSHAFT SPEED, TO BETWEEN 2200 lb/sq.in. AND 2500 lb/sq.in. (154.7 kg/sq.cm. AND 175.8 kg/sq.cm.). THE NEEDLE WILL THEN DROP TO BETWEEN 1800 lb/sq.in. AND 2000 lb/sq.in. (126.6 kg/sq.cm. AND 140.6 kg/sq.cm.) AND THEN REMAIN STEADY.

THIS INDICATES THE NORMAL BUILD UP AND CORRECT CUT-OFF POINT OF THE ACCUMULATOR VALVE AND INDICATES THAT THE SYSTEM IS FUNCTIONING CORRECTLY.

THIS ACTION SEPARATES THE ACCUMULATOR FROM THE REST OF THE SYSTEM AND ALLOWS THE PRESSURE IN THE ACCUMULATOR AND HYDRAULIC PUMP ON THE ENGINE TO BE CHECKED THOROUGHLY. IF THE PRESSURE IS CORRECT AFTER THIS CHECK, IT MEANS THAT THE FAULT IS NOT IN THE ACCUMULATOR BUT ELSEWHERE IN THE HYDRAULIC SYSTEM.

THIS CHECK REVEALS THAT THE MAIN CHARGING VALVE IS FAULTY OR THAT AN INTERNAL LEAK IS PRESENT. TO CORRECT THIS FAULT THE ACCUMULATOR VALVE SHOULD BE REMOVED FROM THE ENGINE AND STRIPPED AND CLEANED AS DESCRIBED IN SECTION G6—THE HYDRAULIC ACCUMULATORS.

IF IN ANY OF THE CASES THE ACTIONS NOTED ABOVE WILL NOT CORRECT THE FAULT IN THE HYDRAULIC POWER SYSTEMS, THE FAULT STILL EXISTS IN THE BRAKE SYSTEM. REPAIR SHOULD BE MADE FOR MAJOR FLUID LEAKS, PAD AND SHOE WEAR, OR FOR AIR IN THE HYDRAULIC SYSTEM.

Printed in Great Britain

Revised Aug. 1969

T.S.D. 2476

**Systematic check sequence chart—
Brake and height control hydraulic
circuits**

SYSTEMATIC CHECK SEQUENCE BRAKE AND HEIGHT CONTROL

RIGHT-HAND WARNING LAMP ILLUMINATION (INTERMITTENTLY OR CONTINUOUS)

BEFORE CARRYING OUT THIS SYSTEMATIC CHECK, THE RESERVOIR FLUID LEVEL SHOULD BE CHECKED AND TOPPED-UP IF NECESSARY. THE CAR SHOULD ALSO BE CHECKED UNDERNEATH FOR ANY SIGNS OF LEAKAGE FROM HOSES OR HYDRAULIC UNITS, ETC. IF NO LEAKS ARE APPARENT FROM THIS BRIEF VISUAL CHECK, CARRY OUT THE FOLLOWING PROCEDURE.



CHECK SEQUENCE CHART CONTROL HYDRAULIC CIRCUITS

WARNING LAMP ILLUMINATED (CONTINUOUSLY OR CONTINUOUSLY)

BEFORE THIS SYSTEMATIC CHECK, THE RESERVOIR SHOULD BE CHECKED AND TOPPED-UP IF NECESSARY. ALSO BE CHECKED UNDERNEATH FOR ANY LEAKS FROM HOSES OR HYDRAULIC UNITS, ETC. APPARENT FROM THIS BRIEF VISUAL CHECK. FOLLOWING PROCEDURE.

