Repair practice

|Cleanliness |Different types of piping|Storage of units |Different methods of Sealing|Hydraulic fluids |

I - CLEANLINESS

To function properly, the hydraulic circuits on these cars require absolute cleanliness of the hydraulic fluid and units.

1) **Cleanliness of work**
Before any work is carried out, protectors must be put in place.

- Covers of cloth or leathercloth on the front wings, the trim panels of the doors, and the seats.
- A steering wheel glove.
- Covers for the sidemember trims (Pallas models).

2) **Cleanliness of the units**
To avoid the ingress of dirt to the units.

a) **Before dismantling**

- Carefully clean the area in which work is to be done.
- Clean the unions and pipe-ends to be disconnected using alcohol for LHS 2 and white-spirit or petrol for LHM circuits.

b) **After dismantling**

- Plug all metal pipe-ends and apertures in units with special plugs sold by the Spare Parts department.
- Protect the flange unions of pipe assemblies with self-adhesive tape ; also the plastic pipes may be dealt with in the same way.
- Protect rubber pipe-ends by plugging with a suitable sized object (e.g. a cylindrical pin).

c) **Rebuilding**

- Clean the pipe assemblies and unions to be replaced with alcohol for LHS 2 and white-spirit or petrol for LHM circuits.
- Do not remove the plugs from pipes and units until the very last moment.

3) **Cleanliness of the fluid**
Never re-use fluid that has been in service.

II - DIFFERENT TYPES OF PIPING

1) **Metal piping**
There are two sizes of metal pipe:

- 4.5 mm external diameter.
- 6.35 mm external diameter.

- Only use standard pipes as supplied by the Spare Parts department; except for the longitudinal pipes running the length of the chassis, all the pipes are pre-shaped ready to be fitted.
- Pipes which have been pressure-tested are marked with a coloured sleeve, Red for LHS 2 systems, and Green for LHM. They must be used only on cars using the appropriate fluid.
- No repairs whatever may be carried out on these pipes, for reasons of safety and reliable service (e.g. brazing, sleeving, non-standard end-fittings)

2) **Plastic Piping**

- These pipes are used for seepage returns (e.g. Suspension cylinder returns, height corrector returns,etc.) and for petrol supply.
- It is permissible to repair these pipes by sleeving, providing that a pipe does not have more than two sleeves which must be at least 800 mm apart. The sleeve must be glued and when the glue has hardened the joint so made, must withstand 5 kg/cm2 (72 psi) pressure from a compressed air line.
- The glue to be used is RILSAN cement. Sold by Etablissements BOYRIVEN, 37 bis Avenue de Villiers - NEUILLY-SUR-SEINE.

3) **Rubber piping**

- These pipes are used for the operational returns from units, the supply from the reservoir to the High Pressure Pump, and some seepage returns.
- All these pipes are marked Red or Green in accordance with the fluid which they are to be used, LHS 2 or LHM respectively.

III- STORAGE OF UNITS

- Units must be stored full of fluid and firmly plugged, protected from dust and knocks. Parts must be used in strict rotation so as to keep parts in stock for the minimum time possible.
- Rubber seals and pipes must be stored away from dust, light, and heat.

IV - DIFFERENT METHODS OF SEALING

1) **Sealing by metal clip**

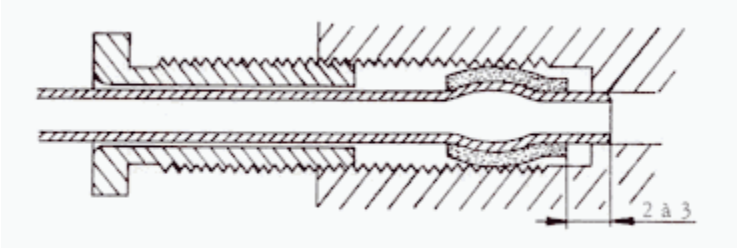
This method of sealing is used to secure rubber pipes onto steel and plastic pipes and unions.

When fitting:

- place a rubber protective ring under the clip.
- take care not to cut the end of the pipe.

2) **Rubber Sleeve Seals**

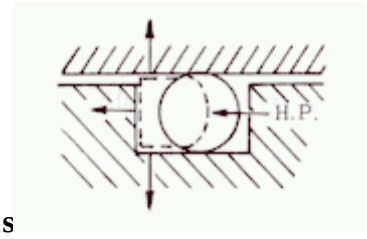
These seals ensure the sealing of steel pipes fitted to hydraulic units.



- Sealing is achieved by the deformation of the sleeve under the action of pressure.
- The seals must be replaced every time a pipe is disconnected.
- Do not forget to remove the old seal, then clean the bore before rebuilding.
- Always fit the seal to the pipe dry, so that about 2 mm of the pipe projects through the seal. Centralise the pipe in the bore and ensure that the pipe goes fully home.
- The swelling near the end of the pipe holds the seal in place.
- Start the union nut by hand and tighten moderately (1 mkg) (15 ft lbs).

Seals to be used with LHS 2 are painted Red.
Those for use with LHM are Green.

3) **Ring Seals**

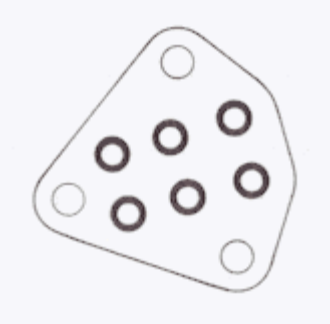


- Sealing is ensured by the deformation of the seal under the influence of the fluid under pressure. In order that the pressure may achieve this, the diameter of the ring is less than the width of the groove and greater than its depth.
- Three types of ring seals are employed:
    - Marked Red for LHS 2
    - Marked Green for LHM
    - Marked White for either.

- Seals with White markings are only used between static components.
- The marking on a seal must always face in the direction from which the pressure is coming. In addition the seals must be soaked in the appropriate fluid before fitting.

4) **Sealing Plates**

These are found at flange joints between pipes and units.



- When fitting, ensure that the holes in the plate correspond with those in the flange.
- The plates and the seals are sold separately.
- The seals are marked with White and are fitted to vehicles using either type of fluid. They must be replaced at each dismantling.

5) **Teflon Seals**

- These ensure sealing of items subject to large or frequent movements (e.g. hydraulic steering-rack piston, suspension cylinder)
- Teflon seals may be used with either type of fluid.

6) **Identification of Seals**

- Workshop sheets, available from the Spare Parts department, show clearly which seals (Red, Green, or White), are necessary in the course of repairs or the over-haul of a hydraulic unit.

V -HYDRAULIC FLUIDS

1) **L.H.S. 2** (FromSeptember1964 to September 1966).

This fluid is almost colourless, having a slightly amber tinge. Its smell is reminiscent of ammonia. it must not be used on vehicles with master-cylinder braking systems, (it causes deterioration of the rubber cups).

For Suppliers, see Technical Bulletin no. 29-**D**.

2) **L.H.M.** (Since September 1966)

This fluid is green in colour. It is of mineral origin, and is similar to engine oil.

L.H.M. fluid is also used on N and P vehicles, and since September 1969, on AMB-3 and AM.3 vehicles fitted with disc brakes, also,since their introduction, on the GS and SM.

For Suppliers, see Technical Bulletin no. 76-**D**.

NOTE : From September 1966 to December 1968, LHS 2 was still supplied in vehicles for the U.S.A. and Canada.

3) **Contents of the systems**

DS = 6 litres or 10.5 Imp. Pints

ID = 5 litres or 8.8 Imp. Pints.

The difference between Max and Min = 1 litre or 1.75 Imp. Pints.

4) **Draining the system**

The system should be drained and refilled with fresh fluid every 30.000 km (18,000 miles).

Drain after causing the greatest possible amount of fluid to return to the reservoir.

(Suspension in low, main and brake accumulators empty).

5) **Cleaning the filter**

The filter must be thoroughly cleaned every 10.000 km (6.000 miles) (A clogged filter leads to inefficiency of the hydraulic system).

The filter should be cleaned in alcohol (LHS 2), and white-spirit or petrol (LHM), and then blown through with compressed air.

6) **Advice in the event of fluids being mixed.** (See Information Bulletins nr. 32 and nr. 72).

An accidental mixture of fluids in the hydraulic systems (LHM in an LHS 2 vehicle, or vice-versa) causes a rapid deterioration of all the rubber parts in the system (Seals, diaphragms, etc.). The severity of this deterioration is a function of the amount of fluid mixed, and the length of time that the vehicle is operated with this mixture.

1) In the event of a recent mixture of fluids, if there appear to be no malfunctions of the hydraulic system, drain the system after returning as much fluid as possible to the reservoir. Then flush the system using Hexylene-Glycol for LHS 2 vehicles, and normal flushing oil for LHM vehicles. Check the suspension spheres, main accumulator and brake accumulator, for pressure and verify that the diaphragms are not deteriorating. If they are within the specified limits, refit these units.

   Refill the reservoir, bleed a large amount of fluid through the braking system do not re-use the fluid bled off. Then check the action of the suspension and the brakes. Allow the vehicle to be used for about a week.

Check at frequent intervals that the suspension and brakes are functioning correctly. After two weeks use, drain, refill and bleed the system again.

2) If a vehicle has been used for a considerable time with a mixture of fluids, malfunctions will be found in the hydraulic system. The majority of the rubber parts will have deteriorated. Take off all the hydraulic units and change all the seals and rubber parts. Change the main and brake accumulators, also the suspension spheres. Flush out all the units and piping with petrol, then alcohol for LHM vehicles and with alcohol, white-spirit or petrol and again with alcohol for vehicles using LHS 2. In both cases, blow through with compressed air. Change all rubber pipes and dust protectors.

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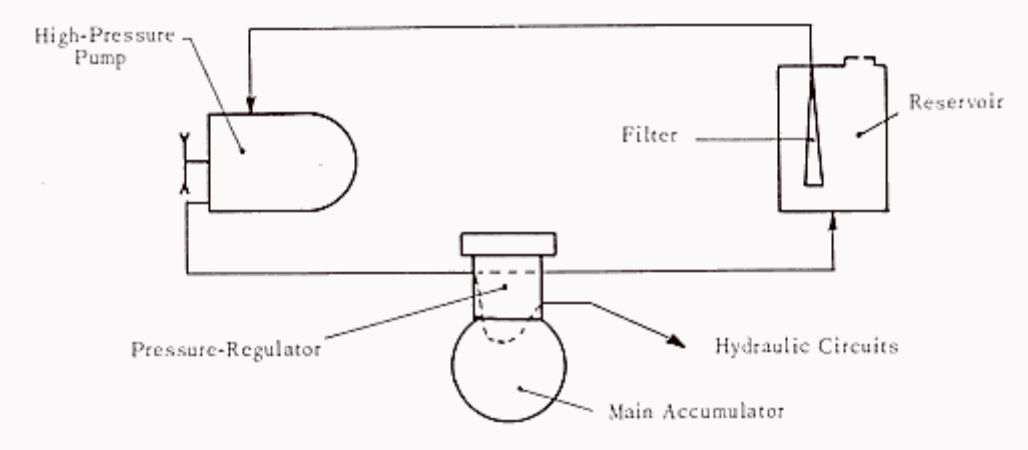
Last updated on : 29.08.1997 by Jint Nijman

Source of pressure

|Circuit Layout|Reservoir|High Pressure Pumps|7-Cyl. High Pressure Pump|Main Accumulator|Pressure Regulator|

I CIRCUIT LAYOUT

- The units comprising the source of pressure are as follows :
    - The hydraulic reservoir.
    - The high pressure pump.
    - The high pressure regulator.
    - The main pressure accumulator.



- To ensure the correct operation of all the hydraulic units a certain minimum pressure must be maintained in their supply circuits.
  To avoid making the pump stop and start for each demand of hydraulic pressure, a certain amount of fluid is stored at a higher pressure than the minimum operating pressure.
- As long as the pressure remains between the storage pressure and the minimum operating pressure then the pump draws fluid from the reservoir and returns it wichout generating any pressure, this is the rest-period for the pump.
- The reserve of pressure is maintened by the main accumulator.
- The maximum and minimum pressures are controlled by the pressure-regulator which causes the flow of fluid to be directed to :
    - either the main accumulator (pumping under pressure)
    - or the reservoir, (pumping without pressure).

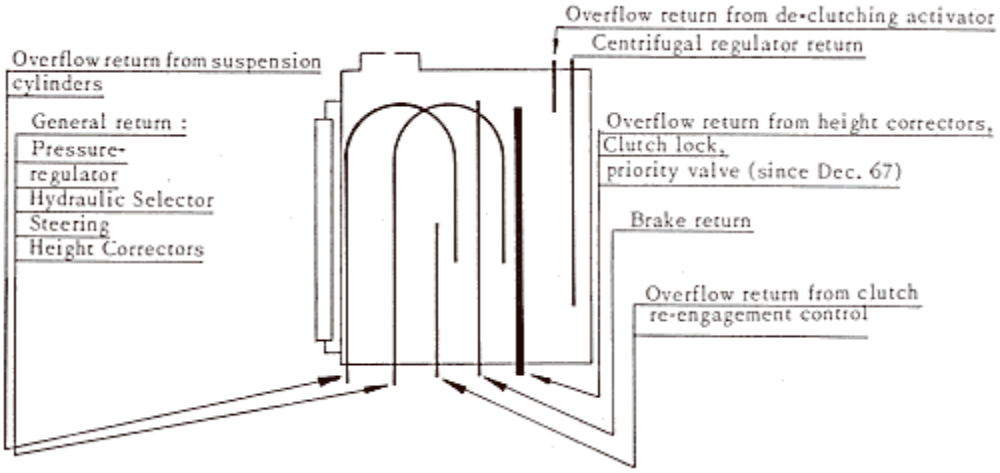
II RESERVOIR

1) **A metal Container with external sight tube showing " max " and " min " levels.**

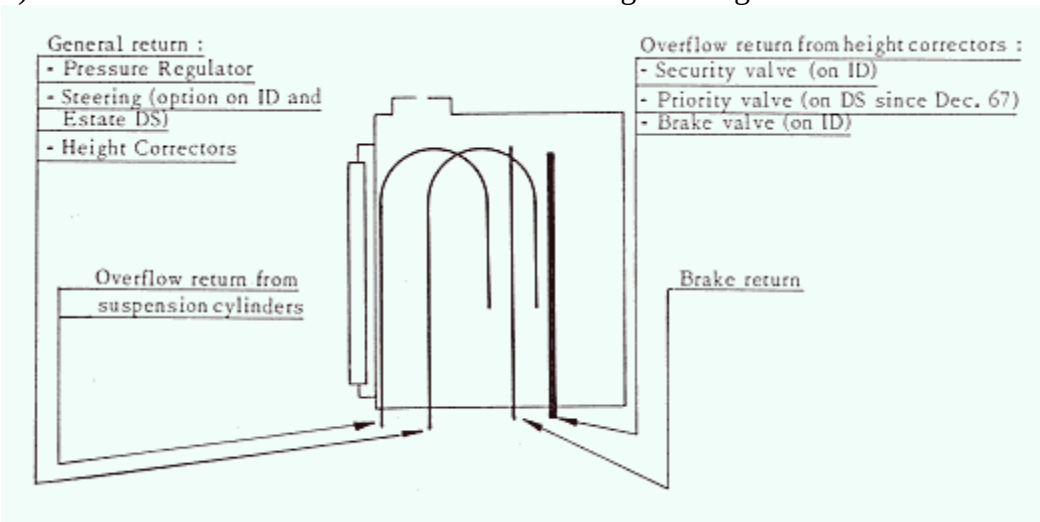
- The reservoir has an internal baffle to allow fluid returning to the tank to settle and deaerate and to prevent surging. It is vented to atmosphere by a small hole in the filler cap.
- A rubber pipe connected to the base of the Container facilitates its draining.
- There are two types of reservoir :
  - One for D models equipped wich hydraulic gearchange and clutch (DS 21 - DS 19A DS 20 - Estate 21 - 19A - 20).
  - The other for D-models wich manual gearchange and clutch.

2) **Connections**

a) Reservoir for vehicles wich hydraulic control of gearchange and clutch.



b) Reservoir for vehicles wich manual control of gearchange and clutch.



3) **Reading the hydraulic fluid level**

- The hydraulic fluid level is checked wich the engine running and the manual height control lever in the "high" position.

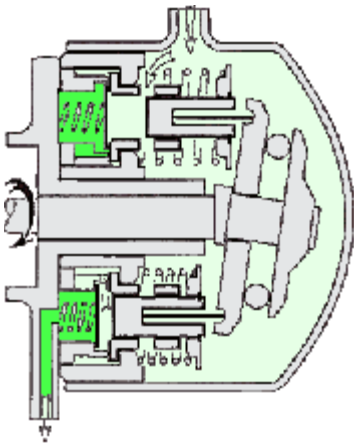
III - HIGH PRESSURE PUMPS

- There are two types of pumps :
  - **A single-cylinder pump** : Fitted to ID 19 and ID 20 models in standard trim. It is fitted on the LH side of the cylinder block.
  - **A seven-cylinder pump** : Fitted to all other D models, also to ID 19 and ID 20 models if fitted with the optinal power steering. It is fitted on the RH side of the gearbox bellhousing, driven at 1/2 engine speed by a pair of belts and pulleys.
- Only the seven-cylinder pump will be studied in detail. The single piston of the ID pump is driven by an eccentric on the camshaft, and functions in a way similar to that of a single DS piston.

IV-SEVEN-CYLINDER HIGH PRESSURE PUMP

1) **General Details :**

- This is a volumetric pump : the swept volume remains the same whatever the pressure.
- It comprises several pistons arranged in such a way as to provide a continuous flow of fluid and at the same time provide the necessary pressure on the fluid.
  - The odd number of pistons is due to consideration of hydraulic factors. (Smoother fluid flow).
  - The number 7 was chosen for reasons of manufacture (diameter of pistons for example) and size.



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  - The odd number of pistons is due to consideration of hydraulic factors. (Smoother fluid flow).
  - The number 7 was chosen for reasons of manufacture (diameter of pistons for example) and size.

2) **Description :**

- The pump comprises 7 identical elements disposed in a circle. A swashplate controls the movement of the pistons by small push-rods.
  - The wall of each cylinder has 4 holes : these are the inlet ports.

3) **Operation :**

- Each element has a non-return valve held on its seat by a spring. All the outlets are inter-connected and are in turn connected to the supply outlet of the pump.
- So that the push rods are not drawn round, the swashplate is prevented from turning. It gives only an oscillating movement.

a) **Inlet and filling**

- During its return travel imparted by the return spring, the piston causes a depression in the cylinder. When the inlet ports are opened, fluid in the pump body enters the cylinders.
- This depression is communicated to the pump body, ensuring the supply of fluid from the reservoir.

b) **Compression and delivery**

- Compression starts when the inlet ports are closed.
- When the pressure in the cylinder is greater than that in the system, the non-return valve opens and delivery takes place.
- The non-return valve closes by the action of the spring. The pressure existing in the system holds the valve shut on its seating.

c) **Piston Travel**

- While the pump shaft completes a half turn, the piston is made to move a distance which is its total stroke.
- A complete turn of the pumpshaft thus gives a complete cycle. (inlet and Delivery) for each piston.

To see how a 7-piston HP-pump really works click one of the links below:
Animated GIF of a HP-pump (83 kb)
Interactive Java animation of a HP-pump (88 kb)

4) **Delivery :**

- The manufacturing tolerances of the pump parts are such that it is necessary to position the piston accurately in its sleeve to obtain the correct delivery.
  - This setting determines the piston stroke, and thus its maximum delivery.
  - The setting consists of allowing a clearance of 0.5 mm between the disc valve and the piston crown, achieved by the use of pushrods of different lengths.
- The pump delivery is 2.80 cc per turn or 840 cc per minute at an engine speed of 600 rpm with a new pump. (The pump runs at half engine speed).

5) **Pressure :**

a) Minimum Pressure

b) Maximum Pressure :

- While the pump is idling, the pressure is only enough to return the fluid to the reservoir through the pressure-regulator.

- Theoretically there is no limit to the maximum pressure.
- In practice, the maximum pressure is controlled by the pressure-regulator.

V-MAIN ACCUMULATOR

1) General Details :

- The accumulator improves the flexibility of the system.
  - By immediately supplying fluid in the event of a heavy demand.
  - By allowing the pump to idle and eliminating repeated cutting-in and out.
  - By eliminating shocks in the hydraulic system. (As a damper.)
- Since April 1969 the D models may be equipped with either of two types of main accumulator.
  - Machined, forged steel accumulator. - Pressed steel accumulator

2) **Description :**

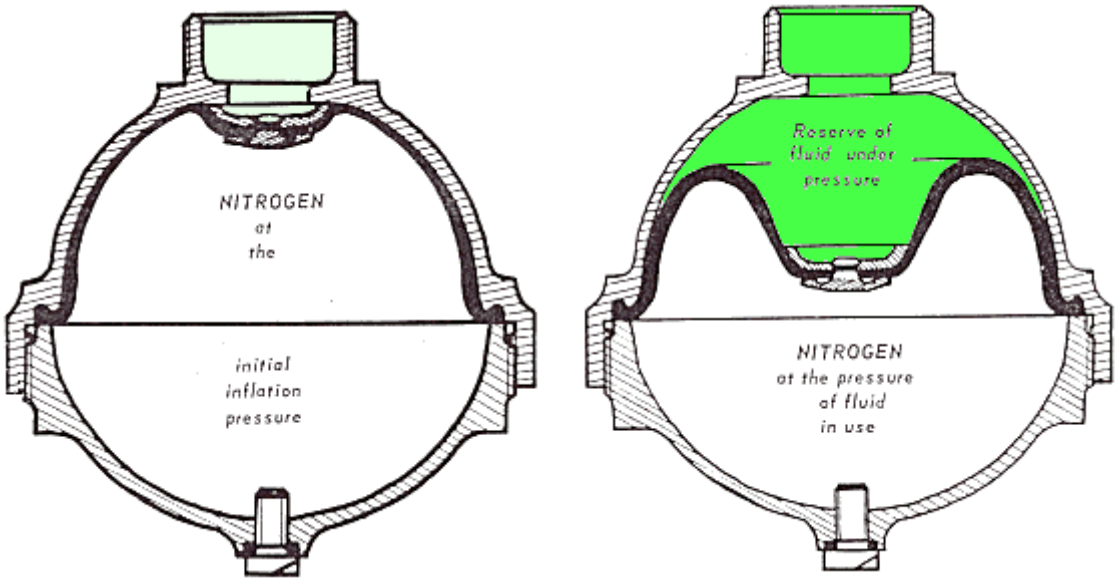
a) **Forged steel accumulator**

- This is a sphere divided internally in two portions by a flexible diaphragm, one of These portions is filled with nitrogen under pressure, the other, connected to the pressure regulator, receives the fluld.
- The sphere comprises two halves screwed together, the force which rends to separate the two halves is taken by a straight-sided thread.
- **The diaphragm** : made of synthetic rubber, is held between the two half-spheres which ensure a good seal. A metal cup is fixed in the centre of the diaphragm.
- **The nitrogen** : is fed in by way of the hollow filler screw. When no fluid is present it occupies the sphere's whole volume, holding the diaphragm against the sphere and the cup against its seat. The gas pressure is thus the initial inflation pressure of the accumulator.

3) **Particular points**

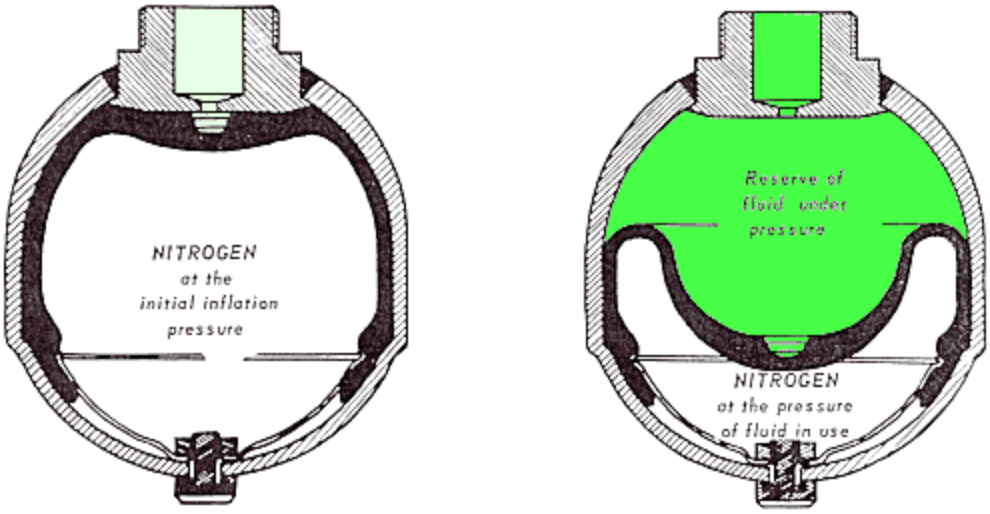
- When the accumulator contains a reserve of fluid under pressure, the diaphragm is in a certain position and the gas is compressed to a pressure higher than that of its initial inflation. On either side of the diaphragm, gas and fluid are at the same pressure and the diaphragm is in a state of equillbrium.
- When fluid is used (a drop in volume and pressure of the fluid), the compressed gas expands to compensate for these changes and the flexible diaphragm takes up a different position of equilibrium. The gas and fluid are still at identical pressures, but of a lower value.

4) **Identification of the accumulator**



b) **Pressed steel accumulator**

- This is also of spherical shape, comprising a pressed steel globe, to which is welded a machined base.
- The diaphragm is held between the sphere and a retaining plate. A plastic cup is fixed in the centre of the diaphragm.
- The nitrogen is introduced into the sphere in the same way as for the previous accumulator, and works in exactly the same way.



- This condition continues until the initial inflation pressure of the accumulator is reached. Then the diaphragm comes into contact with the shell of the accumulator.

NOTE : The flexible diaphragm plays a passive role in the work of the accumulator, simply that of separating the gas and fluid.

- The accumulators are marked with a number punched on the head of the filler screw.

40 for vehicles with the ID type brake system ID 19B (DV) & ID 20 (DT)
65 for other D models.

VI - PRESSURE REGULATOR

The Pressure Regulator controls

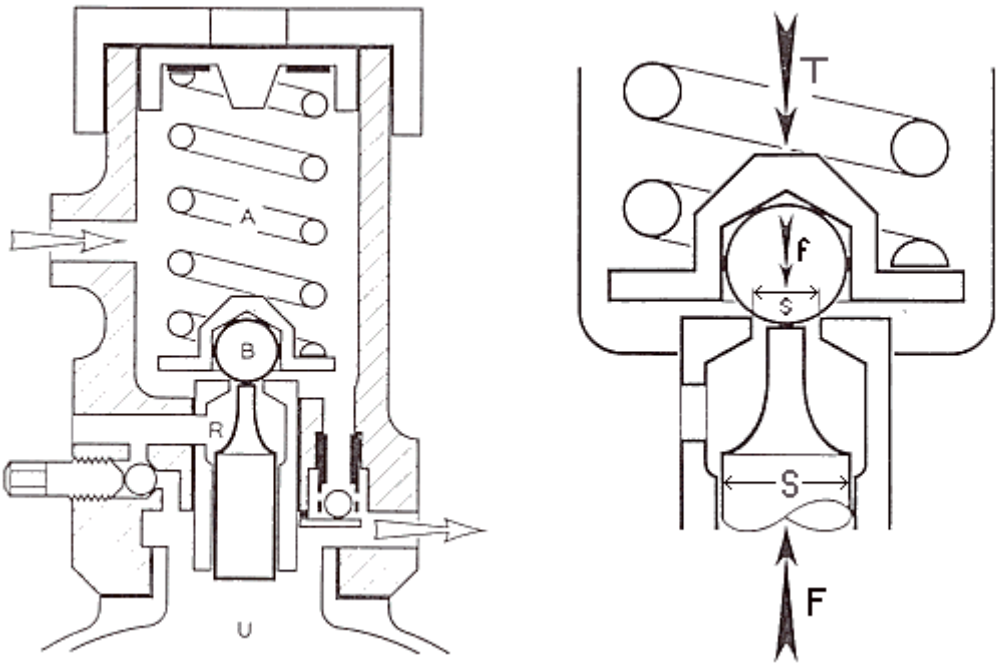
- A minimum pressure necessary for the proper functioning of the hydraulic units.
- A maximum pressure to create a reserve of fluid under pressure in the accumulator, and to limit the maximum pressure supplied by the pump.

A - PRESSURE REGULATOR - up to May 1969.

1) Description

The Pressure Regulator comprises basically three chambers interconnected via two valves.

- Chamber A connected to the feed from the pump.
- Chamber U connected to the accumulator and the supply to the units.
- Chamber R connected to the fluid reservoir.
- Non-return valve : allows fluid to pass only from A to U.
- Valve between chambers A and R : controlled by the pressure in chamber U by way of a piston in contact with the ball B of the valve.
- Pressure-release screw, which permits the fluid in the accumulator and supply circuits to be released back to the reservoir, if required.



2) **Operation :**

a) **Rise of Pressure**

- Pressure rises in the chamber A, lifts the ball of the non-return valve and enters the accumulator U. There is no pressure in chamber R.
- Pressure acting on the surface 's' of the ball creates a force f = P x s which tends to force the ball on to its seat.
- This same pressure acting on the piston head (in chamber U) creates a force F= P x S which tends to lift ball off its seating.
- The surface S being larger than s, the result of F and f : (F - f) would lift the ball off its seat as soon as pressure arrives. To hold the ball on its seat until a certain pressure (cut-out pressure) a spring A is situated under the ball.

b) **Cut-out**

- When the product (F - f) exceeds force T, the ball B is lifted off its seat. Pressure drops in chamber A and the ball of the non-return valve seats again.
- Since the pressure in chamber A drops to nil, the force F also becomes nil thus increasing the strength of F over T which helps to maintain the cut-out condition.
- The pump circulates fluid back to the reservoir without pressure.

c) **Cut-in :**

- The use of fluid leads to a drop in pressure in the accumulator and the force F weakens. When T becomes the stronger it forces the ball B on to its seat.
- Pressure rises in chamber A, creating again a force F which helps the spring T.

- The pump circulates fluid under pressure to the chamber A and U.

3) **Identification of Pressure Regulators**

Pressure Regulators fitted to cars with the 7-cylinder type pumps and the single cylinder pumps are different. They differ only by their operating pressures :

- P.R. for single-cylinder pumps : up to mid-February 1969.

  Marking : No groove on the lower part of the end cap.

  Pressures : cut-out 130 - 140 bars (1850 - 1990 psi)

  cut-in 100 - 110 bars (1420 - 1560 psi)
- P.R. for 7.cylinder pumps, and for single cylinder types from mid-February 1969

  Marking : a circular groove on the lower part of the end cap.

  Pressures : cut-out 150 - 175 bars (2130 - 2490 psi)

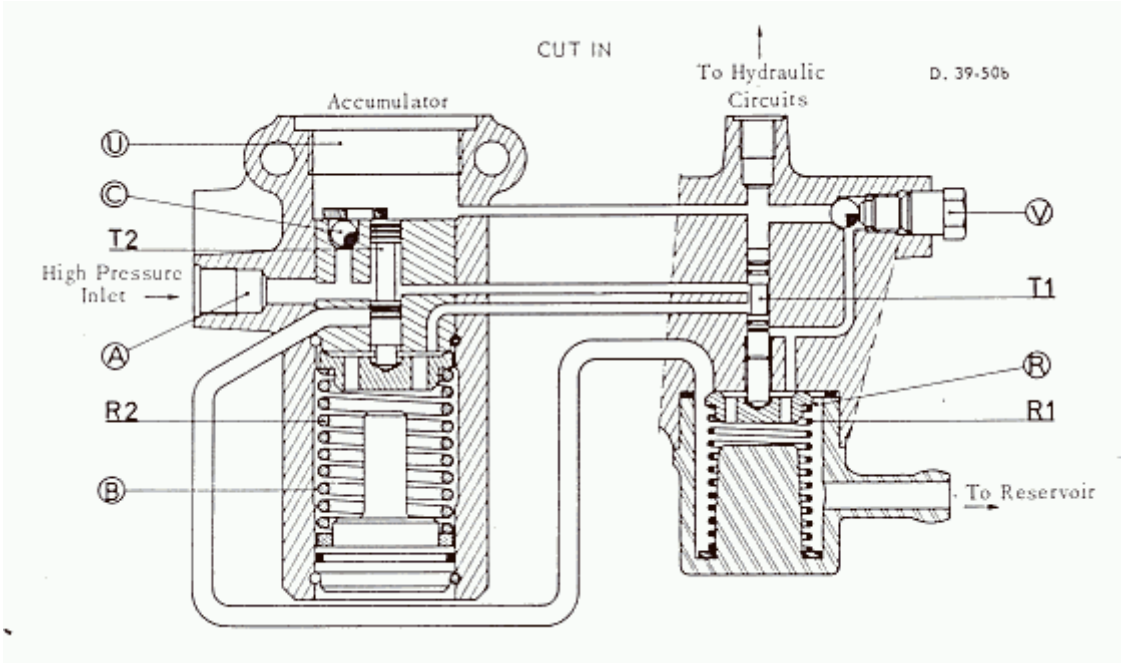
  cut-in 125 - 140 bars (1775 - 1990 psi)

B - PRESSURE REGULATOR - since May 1969. Pilot-Valve Regulator

1) **Description**

The Pilot-Valve Regulator comprises basically 4 chambers interconnected via a non-return valve and two slide valves.

- Chamber A : connected to the feed from the pump.
- Chamber U : connected to chamber A, the accumulator and supply to units.
- Chamber B : connected to chamber A or chamber R depending on the position of the pilot valve T1.
- Chamber R : connected to the fluid reservoir.
- Pilot Valve T1 : allows the fluid to flow into chamber B or from chamber B to chamber R. It is controlled by the pressure of the fluid in chamber U
- Slide Valve T2 : allows fluid to flow from chamber A to chamber R depending upon its Position. It is controlled by the pressure of the fluid in chambers U and B.
- Non-return Valve C : allows fluid to pass only from chamber A to chamber U.
- Pressure-release screw V : allows the fluid in chamber U to escape back to the reservoir via chamber R, if required.



2) **Operation**

a) **Rise of pressure**

- Fluid from the HP pump (in chamber A) rises in pressure in chamber U and the supply circuits by lifting the non-return valve C.
  This pressure rises simultaneously in chamber B via pilot valve T1.

b) **Cut-out**

- The rising pressure in chamber U creates an increasing force F on the upper face of the pilot valve T1 which tends to force the slide valve downwards. As soon as this force F becomes stronger than force of spring R1, the pilot valve T1 moves downwards slightly, cutting off the supply of high pressure fluid to chamber B.
- Meanwhile the pressure continues to rise in chamber U and the pilot valve T1 is forced further down and connects chamber B to the reservoir via chamber R.
- When the pressure in chamber B drops to nil, the slide valve T2, now subjected to the pressure in chamber U, moves down and compresses the spring R2. This slide valve connects the feed from the HP pump (chamber A) to the chamber R and to the return to the reservoir.
- The pressure existing in chamber U closes the non-return valve C.
- The pump circulates fluid back to the reservoir without pressure.

c) **Cut In**

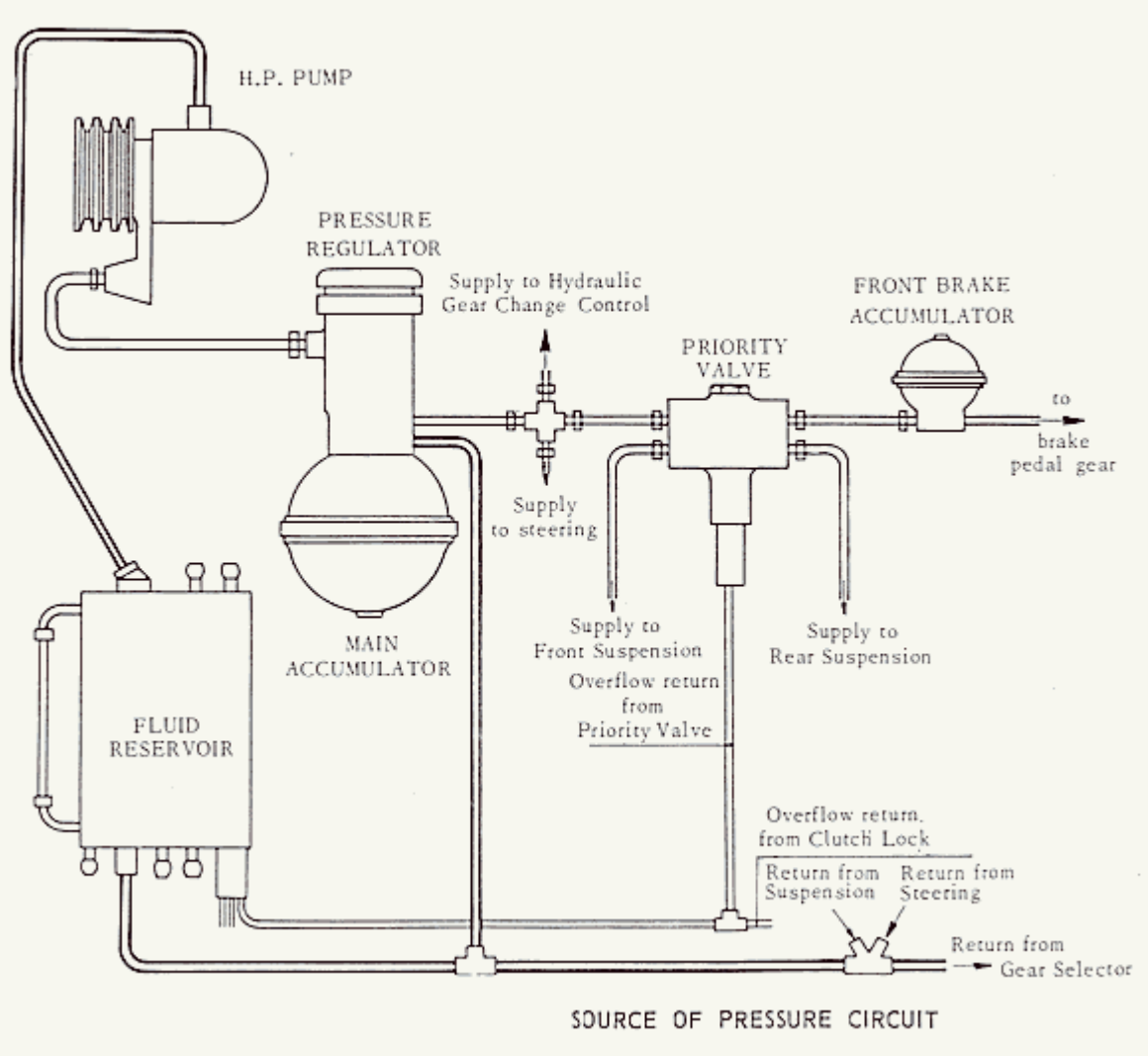
- The use of fluid leads to a drop in pressure in the accumulator and chamber U.
- The pilot valve T1 moves up under the influence of the spring Rl. First it closes the port leading to chamber R, then connects the fluid feed from the pump to chamber B.

d) **Operating Pressures**

- At this point, the slide valve T2 under the influence of spring R2 moves up and closes the return to the reservoir via chamber R.

The pump circulates fluid under pressure to chamber U.

Cut Out Pressure : 162 - 175 bars (2305 - 2490 psi)
Cut In Pressure : 140 - 147 bars (1990 - 2090 psi)



SOURCE OF PRESSURE CIRCUIT

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