GIRLING VACUUM SERVO UNITS

The unit is installed in the hydraulic system between the master cylinder and the wheel cylinders, with the outlet pipe from the master cylinder connected to the Servo hydraulic inlet and the Servo hydraulic outlet connected to the wheel cylinders. The force required to augment the driver's effort is obtained by admitting atmospheric pressure to a vacuum cylinder containing a piston.

The pressure difference thus obtained across the vacuum piston produces a thrust load which is used to increase the hydraulic pressure available at the wheel cylinders.

In the Girling Servo Unit, and the "Powerstop", the piston in the vacuum cylinder is normally subjected to vacuum on both sides and this principle is known as "Suspended Vacuum" system.

This method induces a more rapid response than the "direct" or "non-suspended" vacuum type of cylinder, in which the piston is normally subjected to atmospheric pressure on both sides and the vacuum is introduced to one side when a pressure difference is required.

HOW IT WORKS When air is admitted to the vacuum cylinder by the control valve, the piston drives the piston rod and plunger down the hydraulic cylinder, providing a considerable increase in pressure of fluid to the wheel cylinders.

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

Illustration 1 shows diagrammatically the unit in the "at rest" position with no pressure in the hydraulic system. The valve is open to the vacuum tank or inlet manifold and the vacuum on both sides of the piston is equal.

When the foot pedal is applied, hydraulic pressure is exerted throughout the whole system and equally on both ends of the composite valve control piston. As one end of the piston is larger than the other, an equal pressure per square inch on both ends causes a proportionately greater thrust to be exerted on the large end and the piston moves (to the left as drawn), and the "T"-shaped lever opens the valve to the atmosphere. The air admitted to the right-hand end of the vacuum cylinder drives the piston to the left and the piston rod first seals the centre hole in the output piston and, continuing the movement, applies pressure on the fluid proceeding to the wheel cylinders and to the small end of the valve-control piston. See diagram 2.

This movement of the output piston continues until the thrust on the small end of the plunger, by the high fluid pressure, overcomes the thrust by the low pressure fluid on the large end. The valve control piston is thus moved back, closing the air valve. At this point both valves are closed as diagram 3 and the brakes are being held on. If the foot pedal is released the fluid pressure is reduced at the large end of the control piston, which moves to the right, the valve rocker opens the vacuum valve, air is drawn out of the cylinder, the vacuum piston returns and with it the output piston, relieving the pressure to the wheel cylinders as diagram 4. The piston rod is withdrawn from the output piston, allowing flow of fluid between supply tank and wheel cylinders.

If the force on the pedal is increased after arriving at the position shown on diagram 3, the valve gear operates to give additional assistance from the vacuum piston until the thrust on each end of the control piston is balanced or until the limit of available vacuum is reached. Conversely, if the foot pedal force is reduced the valve gear operates to reduce the pressure at the brake cylinders until again a state of balance of the control piston is reached.

The difference in area between the two opposed ends of the control piston determines the proportion of assistance provided by the unit. If, for example, the large end is twice the area of the small end, the hydraulic pressure output is built up to twice that of the input from the master cylinder before the control piston moves back to close the air valve. Such a unit therefore would have an output of twice the pressure of the input, throughout the range of the unit.

In this way, the pressure in the wheel cylinders varies in proportion to the effort at the pedal and full and precise control of the brakes is always at the command of the driver.

Some units have an output of $2\frac{3}{4}$ to 1, some have an output ratio of 2 to 1 and others have an output ratio of $1\frac{1}{2}$ to 1.

Between the engine inlet manifold and the vacuum reserve tank or, if a tank is not fitted, between the manifold and the servo unit, is a non-return valve, Fig. 5. This valve prevents the entry of air and petrol vapour into the tank or servo unit.

In the end cover of the Powerstop is fitted a piston return stop, Fig. 6, which determines the gap between the output piston and piston rod when fully returned. The gap governs the flow of fluid through the unit when at rest and the smoothness of the application of power.

The position of the stop is set and locked during final test and should not be disturbed in service.

A design modification renders unnecessary the external piston stop and units being manufactured at the present time do not incorporate this feature.

ATMOSPHERE

VACUUM

FLUID

LOW PRESSURE FLUID

HIGH PRESSURE FLUID

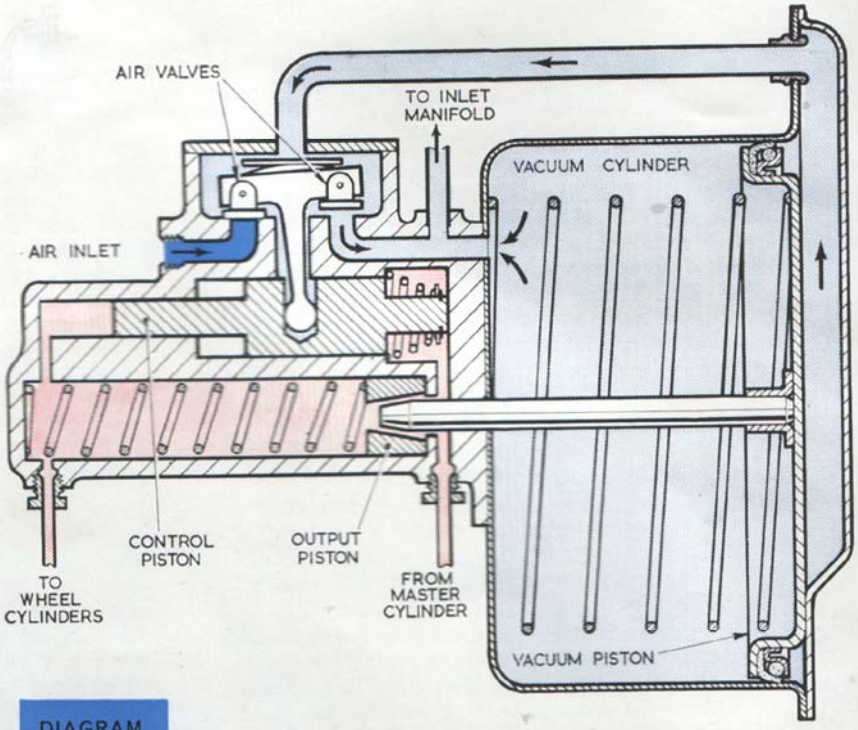
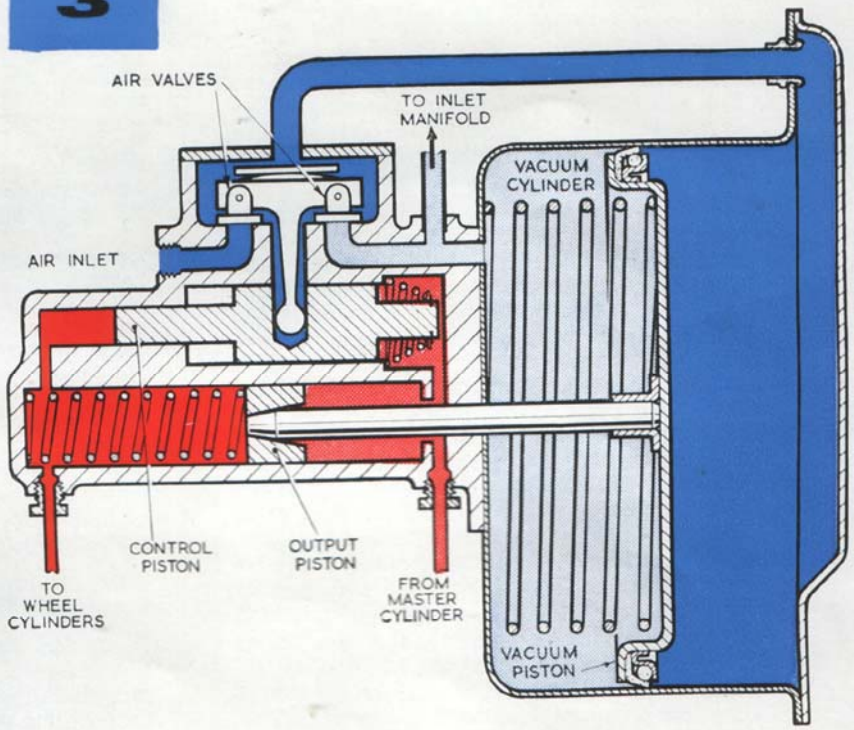


DIAGRAM 1

DIAGRAM 3



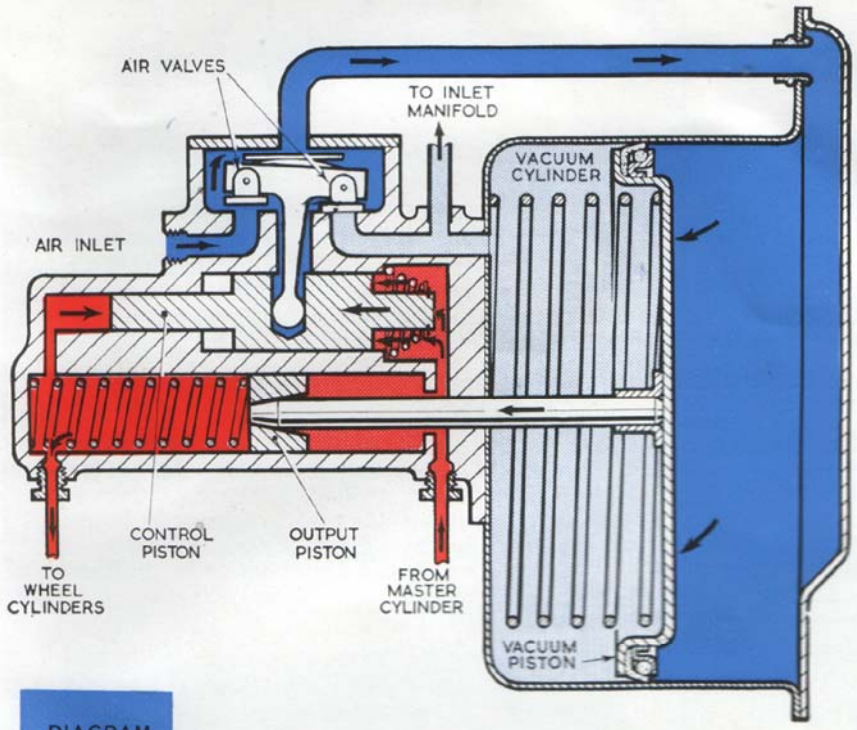
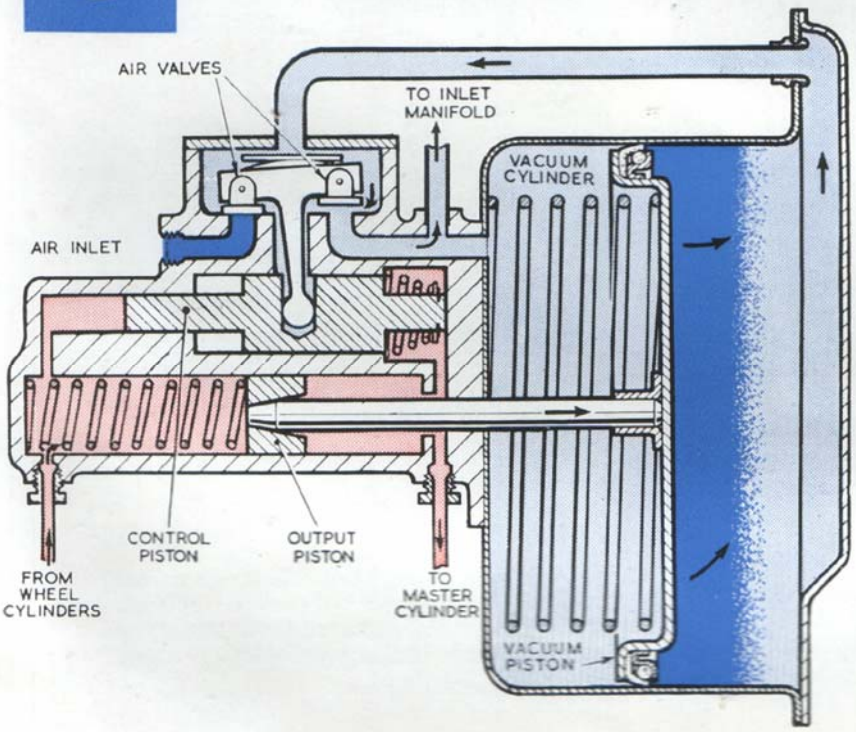


DIAGRAM **2**

DIAGRAM **4**



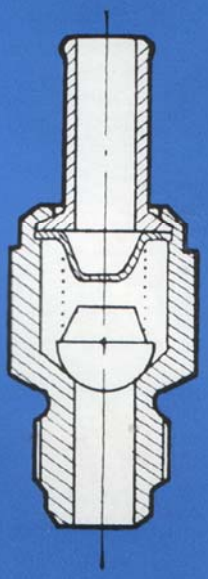


FIG. 5

FIG. 6

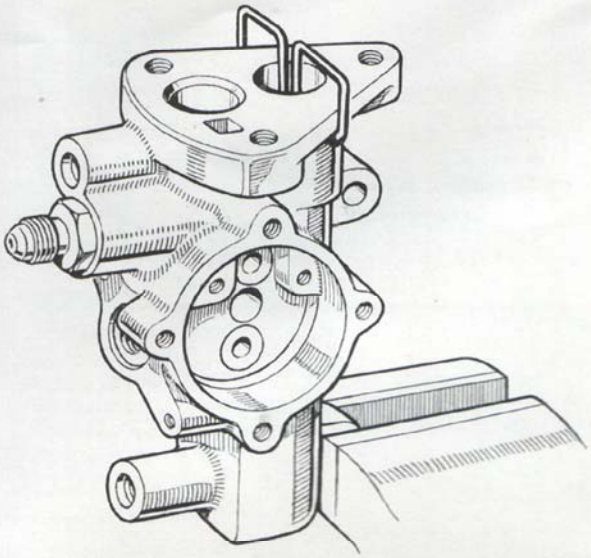


FIG. 16. Removing the output piston.

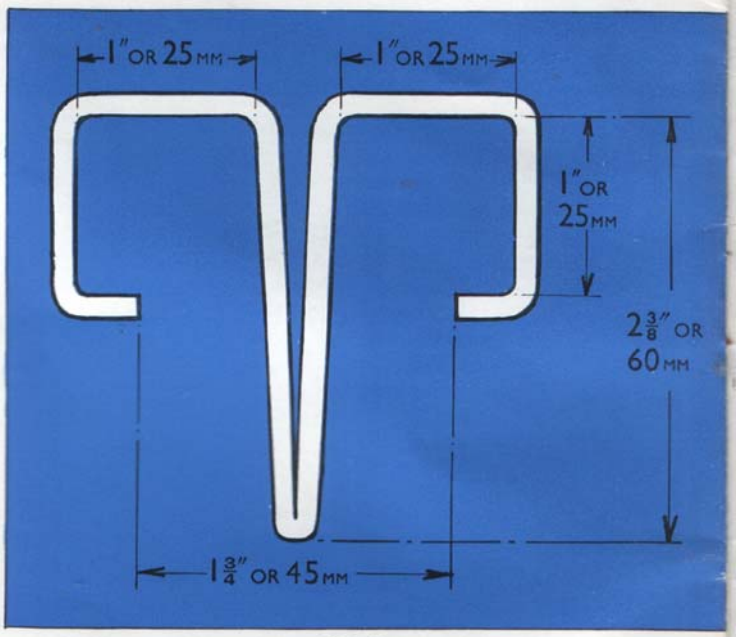


FIG. 17

The compression tool (Fig. 17) for the output cylinder is made from iron wire about $\frac{1}{8}$in. (or approximately 3 mm) in diameter and a piece of 12in. (30 cm) long will be needed. Bend the wire back on itself in the centre making the middle "leg" of the tool. Follow with the other bends as illustrated, finally cutting the two ends so that there is $1\frac{3}{4}$in. or 45 mm between them. The centre "leg" is inserted in the output cylinder bore and pressed down until the two ends can be sprung apart and clipped under the body flange. The tool is then pushed towards the control cylinder opening to allow room to insert the circlip pliers.

ASSEMBLING THE UNIT

THE OUTPUT CYLINDER. Fig. 14

A new piston should be used when overhauling the unit because the piston rod seal is fitted into the piston during manufacture and cannot be replaced. Confirm that the seal around the piston has the larger diameter nearer the reduced end of the piston. Fit the new piston into the end of the spring and smear the piston with Girling Rubber Grease. Insert the spring into the bore, and place the abutment washer on top of the piston. With the round end of the wire spring compressing tool in the end of the piston, ease the piston into the bore. Take care to keep the piston "square" or it will cross-bind. It should be "worked" into the bore so that the seal enters without damage. No undue force should be used. Press the compressing tool down until it can be clipped under the edge of the body as shown. With the circlip around the tool in the bore, fit on to the circlip pliers and compress the circlip fully.

Whilst holding the circlip fully compressed, carefully insert it into the bore and when it is resting on the abutment washer release the pliers. Confirm that the circlip is correctly seated in the groove and remove the wire tool.

This operation should not be hurried; the circlip pliers should be quite secure on the circlip before the circlip is removed or replaced, as there is considerable danger of damaging the bore if care is not exercised. A damaged bore can result in a brake failure.

Drop the seal spacer into the bore, large end first, ease in the gland seal, lips first, and finally fit the bearing bush.