

GIRLING VACUUM SERVO UNITS Mk. I & II

Manufacturers: Girling Ltd., Kings Road, Tyseley, Birmingham, 11

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WITH the development of the modern motor car and the increase in power output available to propel it at greater speeds, the necessity for providing a very efficient means of stopping has arisen. The scope for the brake designer, so far as the ordinary touring and sports car fields are concerned, is limited. First, there is an obvious limit to brake sizes and, secondly, possibly of more importance to the driver, there is a limit to the extent and amount of pedal pressure which he is able to apply. These approaches have then to be co-related; brake size, type and effort needed to obtain the stopping abilities required by the potency of the car in question.

Hydraulic actuation of brakes is now almost universally applied, and with it the two-leading shoe front brake layout; coupled to leading and trailing shoe rear brakes. Whilst there is a high degree of self-wrapping action of the front brakes which should under ideal conditions absorb some 60 per cent of braking, there is also the tendency towards more rapid shoe wear. This may be offset by the use of harder lining materials but still the characteristics of this braking arrangement have not met with manufacturers' requirements in many cases.

It has been found by a long process of experiment and elimination that, to provide the degree of retardation required within the relatively compact dimensions of the under-12in brake drum normally associated with modern cars, the two trailing shoe front brake arrangement more closely fulfilled the brake designers' ideals. By the complete absence of any wrapping action or self-energizing in any way, this means that an even greater effort on the part of the driver becomes necessary. This, then, is where the servo motor is applied, and in the form described here, is provided to augment pedal pressure to the high degree required by this braking arrangement. In some cases of disc brake applications servo assistance becomes necessary and is of similar general working principle to that set out below:

OPERATION

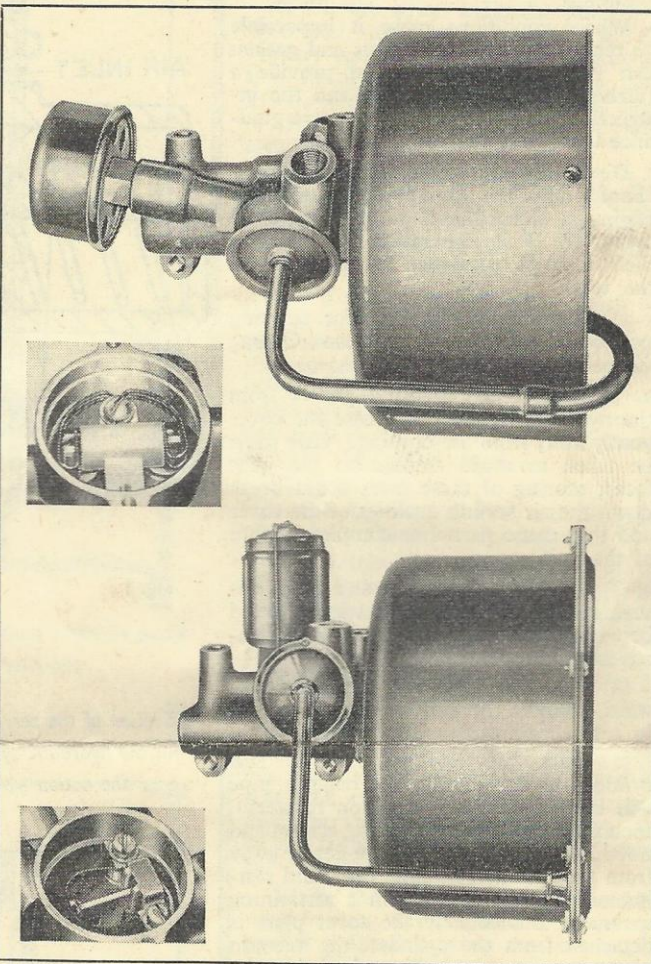
When air is admitted to the vacuum cylinder by the control valve, the piston drives the piston rod and plunger down the hydraulic cylinder providing a considerable increase in pressure on the fluid delivered to the wheel cylinders. The control valve which is operated by the fluid from the master cylinder exercises a precise control over the pressure increase and the brakes are operated exactly in proportion to the effort applied to the pedal. Fig. 1 shows, in diagrammatic form, the unit in the "rest" position,

with no pressure in the hydraulic system. The valve is open to the vacuum tank or to the inlet manifold, and therefore the vacuum on both sides of the piston is equal.

When the 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 shown in diagram), and the "T" shaped lever then opens the valve to atmosphere. Air is admitted to the right-hand end of the vacuum cylinder and, in driving the piston to the left as shown in the diagram, 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 plunger. (See fig. 2.)

The 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, and in doing so closes the air valve. At this position in the system of operation, both valves are closed (as shown in fig. 3) and the brakes are held "on." If the pedal is released, the fluid pressure is reduced at the large end of the control piston, which moves to the right, as depicted in the diagram, the valve rocker opens the vacuum valve, air is drawn out of the cylinder and the vacuum piston returns, together with the output piston, thus relieving the pressure to the wheel cylinders (as in fig. 4). The piston rod is withdrawn from the output piston, and this action allows a flow of fluid between the supply tank and the wheel cylinders.

If the force on the pedal has been increased, after arriving at the position as shown in fig. 3, the valve gear would operate to give additional assistance from the



Top, shows the Mk. I version, which has the cover pressed into the end of the cylinder, secured by screws and nuts, and the vacuum pipe curves over and is riveted into the cover. This model has a wire element air filter. Below is shown the Mk. 2 unit, with a different piping arrangement and air filter. Insets beside each show detail of the valve chest for each unit.

vacuum piston until the thrust on each end of the control piston was balanced or until the limit of available vacuum was reached. Conversely, if the pedal force had been reduced, the valve gear would operate to reduce the pressure at the brake cylinders until a state of balance of the control piston was reached again. So, it is seen that the pressure in the wheel cylinders varies in proportion to the effort at the pedal, and full control of the brakes is always available to the driver.

A restrictor is inserted in the connecting pipe from the valve chamber to the vacuum cylinder, and its purpose is to prevent the piston receiving a "shock" impulse as the result of sudden and violent applications of the brake pedal; it does not in any way affect the normal working of the unit. A non-return valve is also fitted, and this may be sited in one of two places; either between the engine inlet manifold and the vacuum reserve tank, or if a tank is not fitted, between the manifold and the servo unit. Its function is to prevent

the ingress of air and/or petrol vapour into the tank or servo unit.

To Dismantle

No attention should be needed in the first three years or 40,000 miles, whichever is the shorter period, and the makers recommend that the unit should then be changed for a factory reconditioned assembly.

Where conditions make it impossible to replace the unit, new seals and gaskets can be fitted which should provide a further period of useful life and the instructions included here are to give guidance under these circumstances.

Dismantling and assembly of the unit should only be attempted by qualified engineers accustomed to this type of assembly. It is imperative that absolute cleanliness is preserved at all stages of the work.

(1) Remove the air filter for cleaning purposes, and wash in clean Girling Crimson brake fluid.

(2) Remove the securing screws from the nylon valve cover and ease the cover gently away from the housing. Care must be taken to avoid damage to the joint faces; scoring of these faces could break down the air sealing qualities of the cover and thus cause partial or complete failure of the unit.

(3) Withdraw the cover and pipe, ensuring that the restriction washer fitted between the two balance pipes is not inadvertently lost.

(4) With the cylinder extending upward, support the body of the servo unit in a vice having suitably protected jaws.

(5) Mark the end cover plate and cylinder to ensure that the balance pipe will be properly positioned on refitment, then remove the three securing screws and nuts. Ease the end cover plate gently away from the cylinder, keeping one hand resting on top of the cover in a restraining manner. Immediately the cover plate is detached from the cylinder, the vacuum piston return spring will tend to eject the piston assembly with appreciable force and this tendency must be guarded against to prevent possible injury to the operator. Damage to the joint faces must be guarded against when removing the cover.

(6) Lift the vacuum piston assembly and return spring clear.

(7) Unscrew the four self-locking nuts from inside the cylinder and withdraw the clamping plate and cylinder. Lift off the gasket and remove the valve body from the vice.

(8) To remove the nylon valves, remove the screw securing the valve retainer and upper valve spring, then withdraw the retainer and upper spring.

(9) Press the mild steel plug—extending slightly from the body—inward to allow the valve rocker lever to reach a neutral position, then lift the rocker lever, valves and lower spring assembly clear. Note particularly the manner in which the valve springs are fitted to valves and body, to ensure correct re-assembly.

(10) Release the pressure on the mild steel plug and withdraw plug and seal.

(11) Withdraw the primary valve operating piston complete with seal, then withdraw the return spring.

(12) To remove the remaining secondary piston and nylon Belleville washer

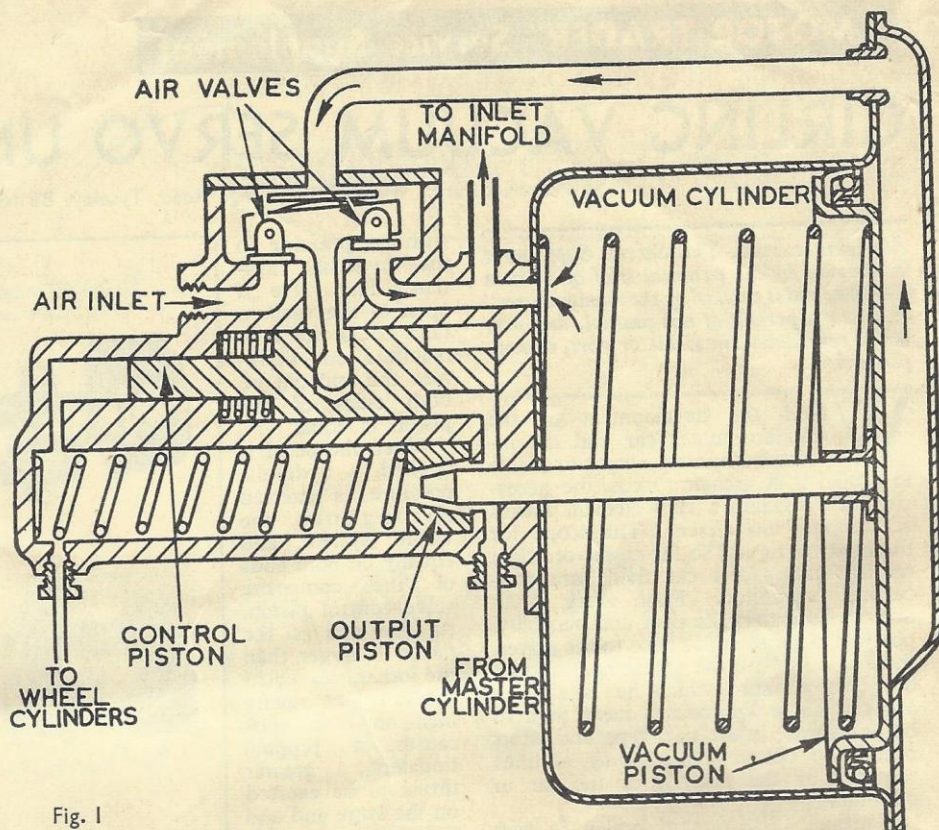


Fig. 1

Section of the servo, which shows above, the unit in the "rest" position, with no pressure in the hydraulic system, air pressure on both sides of the piston is therefore equal. Below, the action when the pedal is applied. Arrows show air and fluid pressure thrust.

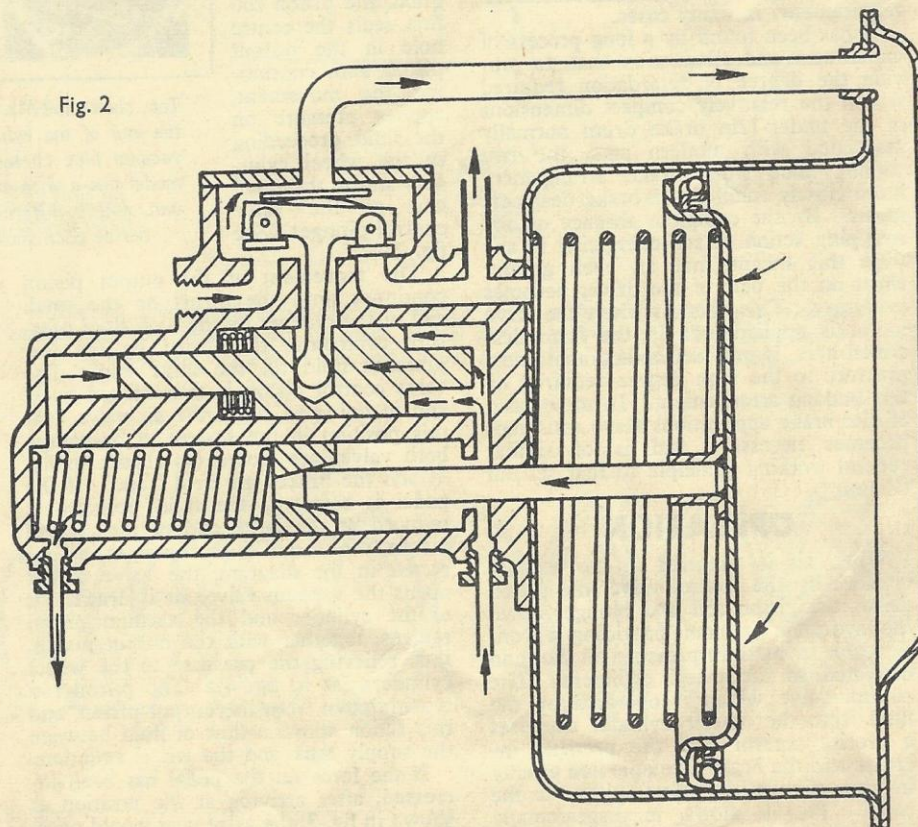


Fig. 2

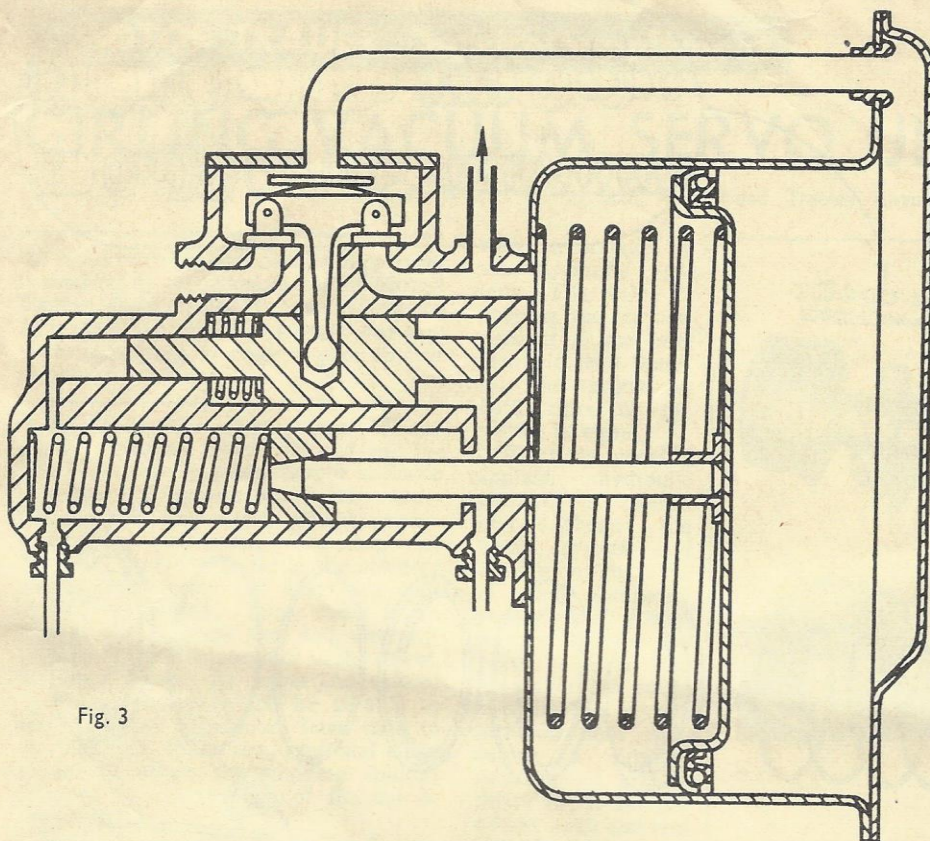


Fig. 3

Intermediate position is shown above, and below, the action which takes place when the pedal is released. Again, the arrows show fluid and air pressure reactions.

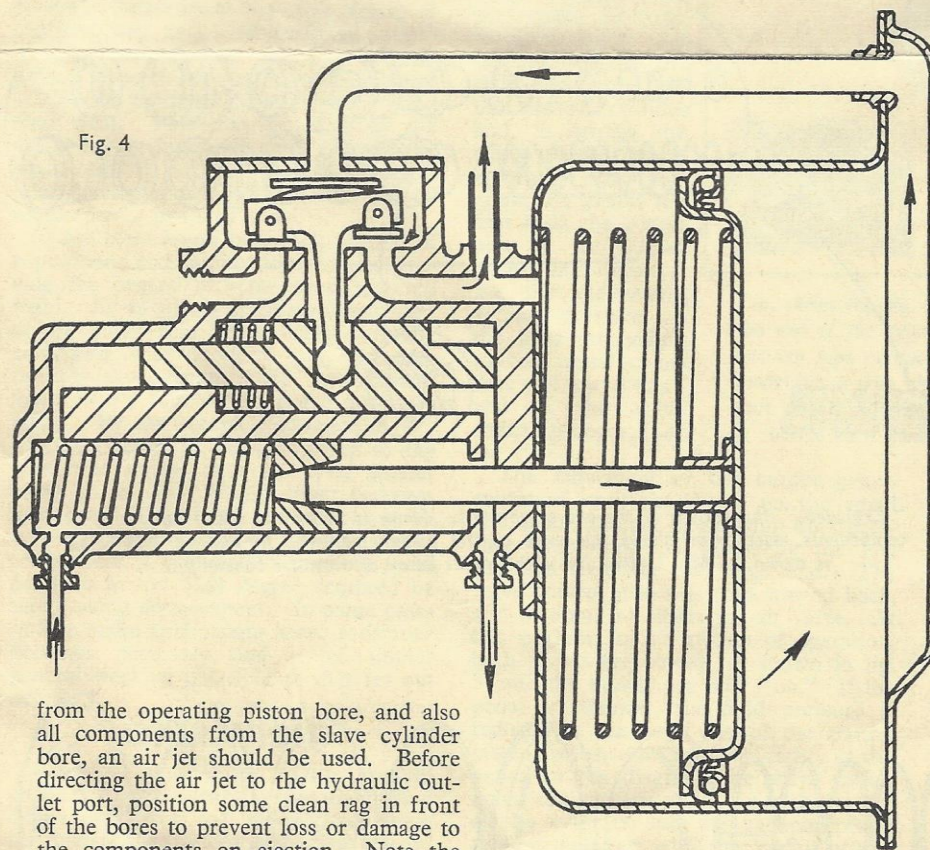


Fig. 4

from the operating piston bore, and also all components from the slave cylinder bore, an air jet should be used. Before directing the air jet to the hydraulic outlet port, position some clean rag in front of the bores to prevent loss or damage to the components on ejection. Note the sequence of components.

To Assemble

Before beginning the re-assembling, the main body and internal components must be thoroughly cleaned in Girling Crimson brake fluid.

The vacuum piston leather is impreg-

nated with a special lubricant and requires no further attention throughout its life.

New seals, as supplied in the repair kit, should be fitted to internal components.

(1) Fit new rubber seals to components. Where applicable, ensure that the edge

of the seals face the hydraulic fluid side.

(2) Refit the components of the slave cylinder bore, using the sectioned view of the servo unit as a guide.

(3) Fit the secondary operating piston complete with "O" ring into its bore, ensuring that the extension of the piston faces toward the outlet port of the main body.

(4) Fit the nylon Belleville washer, as illustrated, and return spring; fit the primary operating piston, with the extension facing the plug end of the bore. Ensure the housing for the rocker lever in the piston is visible from the valve compartment.

(5) Fit the plug, complete with seal, into the bore. The edge of the seal must face the step in the side of the groove around the plug; this side to be adjacent to the primary operating piston.

(6) To refit the nylon valves, attach the valves to the rocker lever by means of the lower spring. Press the mild steel plug inward and fit the rocker lever and valves into position. Fit the retainer and upper spring, locating the retainer on to the small dowel. Ensure the springs are fitted in the correct manner.

(7) Place a gasket to the main body face and fit the cylinder and clamping plate, fully tightening the locknuts.

(8) Position the return spring in the vacuum cylinder and carefully fit the vacuum piston assembly to the cylinder; ensuring that the piston rod and slave cylinder components move freely in their bore by pressing the vacuum piston as far as possible against spring pressure several times.

(9) With a new rubber sealing ring fitted to the end cover plate, carefully align the end cover plate to the marks made previously when dismantling, and fit the cover plate, securing with screws and nuts.

(10) Fit the nylon cover and pipe to the valve housing, ensuring that the restriction washer is fitted between the two balance pipes. Tighten the screws retaining the nylon cover, ensuring that the cover is not distorted or otherwise damaged.

(11) Fit the air cleaner, the element of which should be clean and moistened with Girling Crimson brake fluid.

THE AIR FILTER

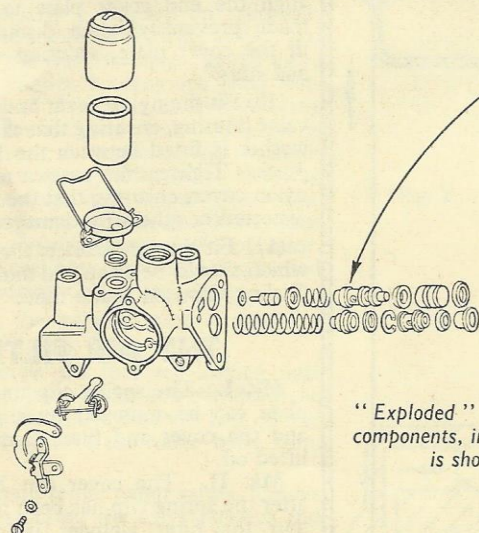
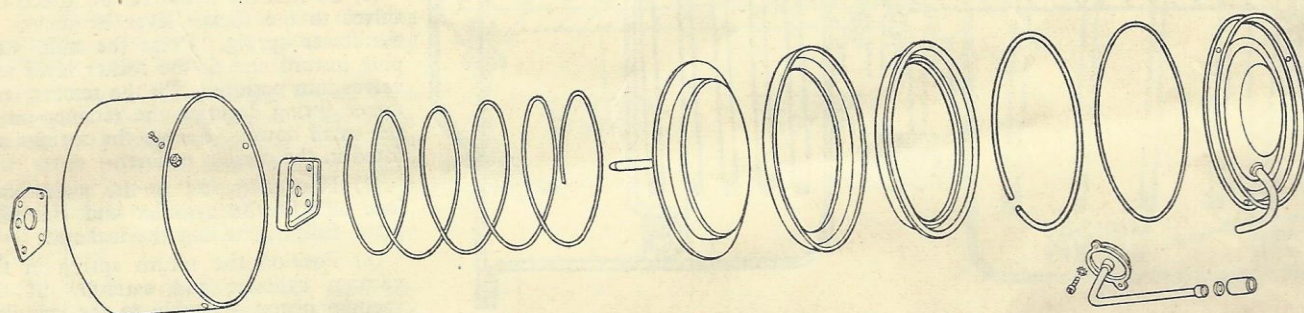
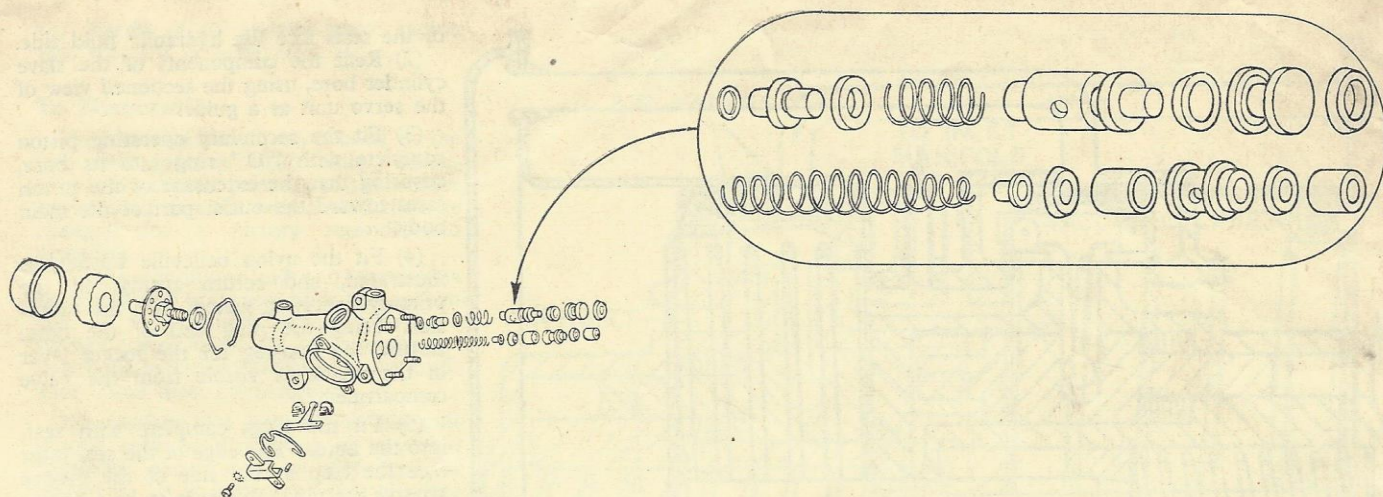
Mk. I. The spring clip under the end plate can be removed by a screwdriver, and the cover and filter element can be lifted off.

Mk. II. The cover can be removed after the spring clip has been pushed aside and the filter element is quite loose. There is no point in further dismantling.

The **Mk. I** has a wire element which should be cleaned in methylated spirit and dipped in brake fluid. **Mk. II** has a moulded cellular element which should be replaced when new brake shoes are fitted.

The main differences between the two models is that in the **Mk. I** two valve return springs are used and the two ends of the lower spring form the pivots for the nylon valves.

The **Mk. II** has a flat spring and two separate clips retain the valve plates. The valve chest on **Mk. I** has a moulded nylon cover with pipe attached, and on some late models it is covered by an extra metal plate. **Mk. II** has a metal cover and pipe assembly, with gasket.



"Exploded" illustrations of the two servo units. Above is shown the Mk. 1 unit, with its components, inset detail shows the valve control piston, enlarged for clarity, and below is shown the Mk. 2 servo unit with similar detail of the valve control piston.

