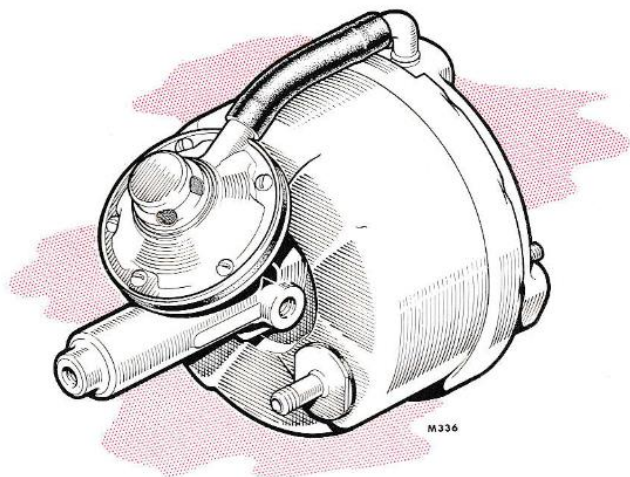


LOCKHEED
type 6 and 7 vacuum servo unit

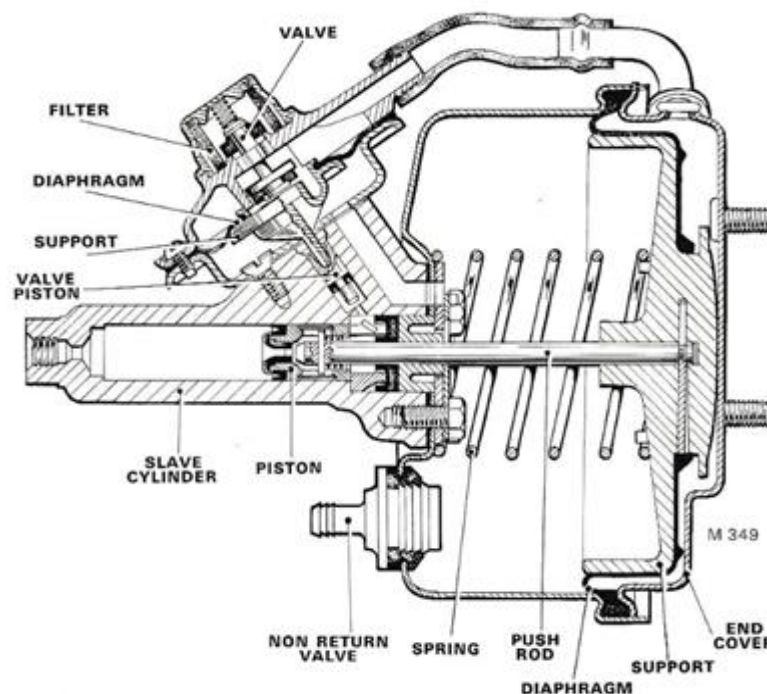
SECTION 5C



DESCRIPTION

The vacuum servo unit is incorporated in the hydraulic braking system as an intermediate stage between the brake master cylinder and the brake assemblies.

The two main parts of the servo unit are the vacuum servo mechanism and a hydraulic slave cylinder assembly. These are bolted together so that the slave cylinder piston is in line with, and is operated directly by, the servo push rod. Pressure of fluid from the brake master cylinder generated by the action of the foot pedal governs the movement of the servo push rod. Servo assistance is gained from the loading on the push rod by a plastic body of



piston shape which supports a rubber rolling type diaphragm forming two chambers in the servo unit's pressed steel shell. In the "brakes off" position, the plastic support and diaphragm are held by a spring against the end cover of the servo unit in a state of suspended vacuum created by exhaustion of air through a non-return valve and hose connected to the engine's induction manifold. The servo unit is designed to give no assistance with very light brake application. Heavier pedal movement permits the controlled entry of air at atmospheric pressure to the rear chamber causing the diaphragm support to move the servo push rod. The rod presses the slave cylinder piston down its bore to boost the fluid pressure for actuation of the brakes with a force much greater in proportion to the effort exerted by the driver on the foot pedal.

In the absence of servo assistance due to loss of vacuum, an unrestricted

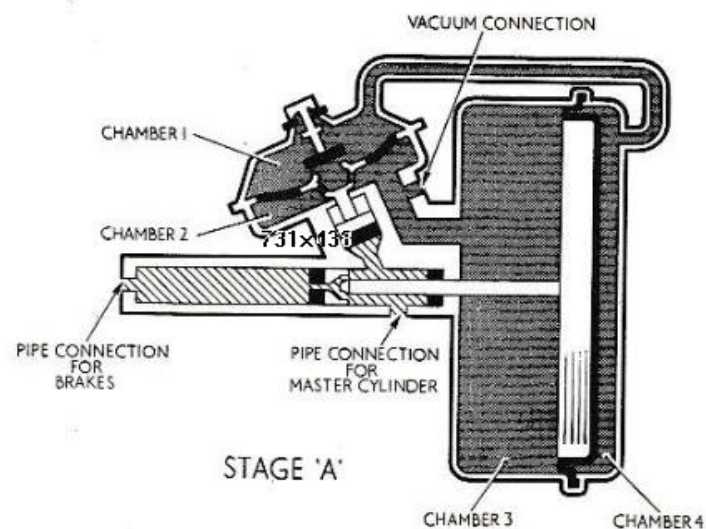
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passage for the fluid will exist. The brakes can still be applied, therefore, by the normal action of the pedal on the brake master cylinder, but this obviously would demand heavier foot pressure to achieve the same degree of braking as with servo assistance.

OPERATION

The schematic illustrations opposite show the action of the servo in five selected stages:

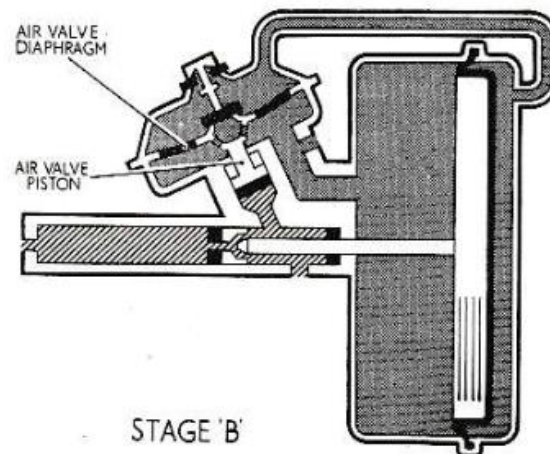
- A. Servo unit in the 'brakes off' position.
- B. Light brake pedal application.
- C. Brake pedal applied sufficiently to gain some servo assistance.
- D. Brake pedal pressure held steady. Action of the servo unit suspended to retain desired amount of braking effect.
- E. Sustained maximum servo assistance following full and rapid foot pressure on the brake pedal.



STAGE A

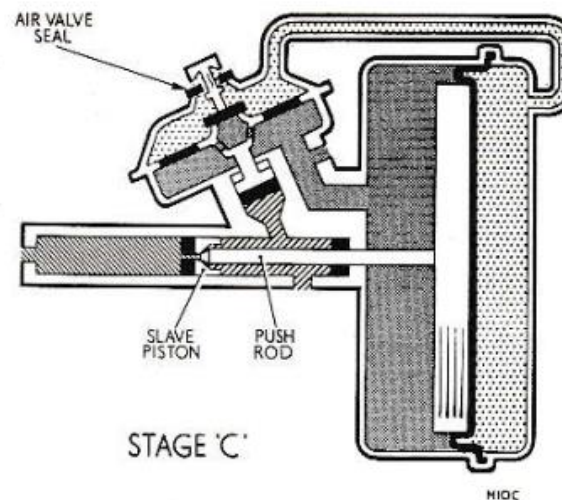
In stage 'A' the servo is at rest.

The diaphragm and support are held close to the end cover of the shell by the action of the return spring. With the engine running to provide the source through a non-return valve, the same degree of vacuum exists in chambers 1, 2, 3 & 4 owing to the interconnecting passages. Atmospheric air pressure, aided by a small spring, keeps the air valve closed on its seat.



STAGE 'B'

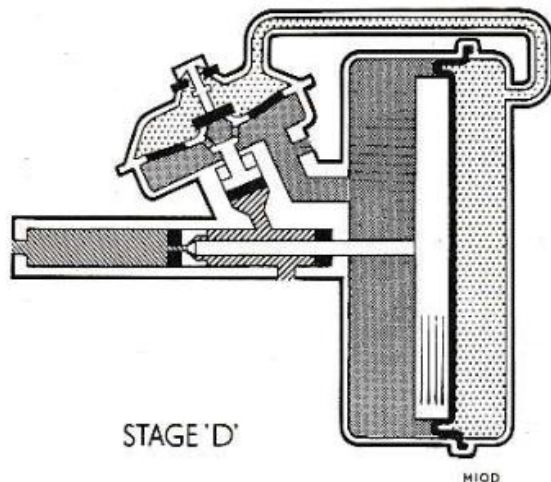
Very light application of brakes only slightly alters Stage "A" situation since the fluid under pressure created by the brake master cylinder passes un-hindered through the hollow centre of the slave piston to the wheel cylinders, but without servo assistance. However, the fluid pressure is sufficient to move the air valve piston which partially deflects the air valve diaphragm, isolating the vacuum source from Chambers 1 and 4 in preparation for servo assistance. Stage B refers.



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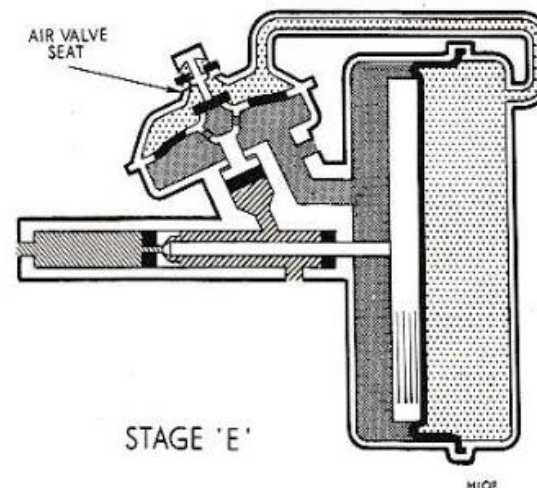
STAGE C

If the pressure on the foot pedal is increased and then held steady, Stage C becomes relevant. The greater fluid pressure from the master cylinder moves the air valve piston to further deflect the air valve diaphragm. Simultaneously, the air valve diaphragm support lifts the air valve plunger and allows atmospheric air to enter Chambers 1 and 4 past the restriction of the stem supporting the rubber seal of the air valve. The pressure differential thus created in the servo shell between Chambers 3 and 4 causes the servo diaphragm to roll on its support towards the slave cylinder, thereby imparting a load on the servo push rod. The initial travel of the servo push rod seals the hollow centre of the slave piston, then moves the piston down the slave cylinder bore to increase the fluid pressure to the wheel cylinders much greater in proportion to the pressure generated by the brake master cylinder



STAGE D

If the loading on the foot pedal is not further increased, the pressure of fluid behind the slave piston instantly start to diminish as the slave piston moves into the cylinder bore. When the fluid pressure reduces to the point at which the pressure of atmospheric air on the air valve diaphragm overcomes the lift of the air valve piston, a state of balance will occur. The valve piston retracts along its bore, allowing the air valve diaphragm to flex in the same direction. This movement in turn causes the air valve to close, thus cutting off further entry of atmospheric air to Chambers 1 and 4 but with the vacuum still maintained in Chambers 2 and 3. The brakes are then partially held on as shown in Stage "D"



STAGE E

Stage 'E' shows the action of the servo to give maximum assistance having passed instantaneously through Stages 'B' and 'C'. On rapid and full application of the foot brake pedal as for an emergency stop, the correspondingly higher fluid pressure built up in the slave cylinder, moves the air valve piston to the limit of full deflection of the air valve diaphragm. The entry of air past the air valve, now unseated, is then unimpeded to Chambers 1 and 4. Since the pressure differential between Chambers 3 and 4 is thereby increased to, and sustained at, the designed maximum, full and unrestricted servo assistance is provided. Similar unseating of the air valve also occurs initially when the pedal is 'stabbed' quickly, yet not to full travel, for rapid response of the brakes. However, unless heavy, loading is subsequently applied on the foot pedal, only partial braking commensurate with the held pedal position would then ensue, the servo unit having reverted to Stage 'D' as soon as the rapid surge in fluid pressure in the rear compartment of the slave cylinder is reduced by movement of the slave piston.

The servo returns to the 'at rest' position when the foot pedal is released completely to destroy the fluid pressure in the rear compartment of the slave cylinder. The air valve piston retreats fully down its bore by the loading of atmospheric air pressure on the air valve diaphragm, in turn allowing the air valve to close and to seal the servo unit against further entry of air. The deflection of the air valve diaphragm re-opens the vacuum passage to Chambers 1 and 3, destroys the pressure differential, and allows the servo

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diaphragm and support to be forced back to the end cover aided by the action of the main return spring. Consequently, the push rod and attached slave piston withdraw along the slave cylinder bore to accommodate the fluid displaced from the wheel cylinders which rapidly loses its pressure. Displacement of fluid beyond the capacity of the slave cylinder is compensated by the residual movement of the servo push rod which uncovers the hollow centre of the slave piston to provide a through passage for the excess fluid on return to the brake master cylinder.

overhaul procedure

SECTION 5C

The exchange service operated by the Automotive Products Company Limited ensures a factory-tested and correct replacement. However, if it is decided to overhaul the assembly, the procedure detailed below must be followed.

DISMANTLING

Before the servo is removed from the vehicle, clean the unit thoroughly and particularly at pipe connections, using ethyl alcohol (commercial methylated spirit) as a solvent

Plug the hydraulic pipes after separating the connections to the servo slave cylinder to prevent loss of fluid and entry of dirt.

Grip the slave cylinder firmly in a soft jawed vice with the air valve uppermost.

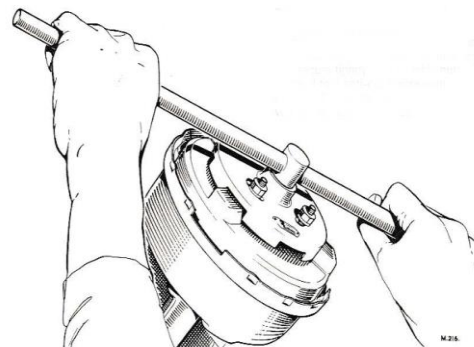
Disconnect the rubber pipe from the elbow on the end cover.

Extract the five self-tapping screws holding the plastic valve cover to the valve housing and remove the cover complete with air valve subassembly. Except to gain access to the filter by taking off the snap dome, the air valve should not be further dismantled. Suspect functioning of the air valve must be remedied by fitting a new component comprising cover, filter and air valve available as an assembled part of the relevant repair kit.

Remove the rubber diaphragm and plastic support to expose the three screws securing the valve housing to the mounting flange on the slave cylinder. Extract the screws and take off the housing followed by the gasket.

With a finger, seal off one of the fluid ports of the slave cylinder and apply a **low pressure** air line to the remaining port to expel the air control valve piston from its bore. Remove the rubber cup from the valve piston.

Prise out the vacuum non return valve from the servo shell using thumb pressure. Extract the rubber valve mounting.



Reposition the servo firmly in the vice so that the end cover is uppermost but angled at 45° to horizontal. Locate removal tool **AP Part No 3525-424** over the three mounting studs and securely tighten with suitable nuts. Turn the cover removal tool anti-clockwise with a ½ inch square drive socket "T" bar as far as the stops on the cover will allow. Lift off the cover.



Free the edge of the rubber servo diaphragm from the rim of the servo shell. With the fingers only, ease the centre of the diaphragm out of the groove in the plastic diaphragm support.

Turn the diaphragm support so that the support for the push rod retaining key faces downwards. Light fluctuating pressure on the support into the shell will release the key and permit the support to lift clear of the push rod under the influence of the main return spring. Extract the spring from the servo shell.

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Bend back the tabs of the exposed locking plate. Remove the three bolts used for mounting the slave cylinder, and extract the locking plate followed by the abutment plate. Lift off the servo shell and retrieve the gasket from the mounting face of the slave cylinder. Withdraw the servo push rod and attached piston assembly from the slave cylinder bore by pulling gently on the rod. Slide off the plastic bearing, rubber clip and plastic spacer noting their relative positions for subsequent refitting.

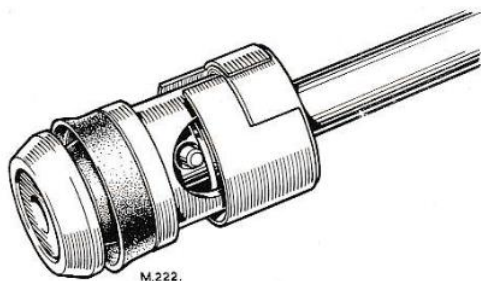


Fig. 1

With the fingers, prise off the rubber seal from the head of the slave piston. The push rod can be separated from the piston by opening the retaining clip with a small screwdriver to expose and then drive out the connecting pin (fig 1). If this is done a new retaining clip and pin are necessary for reassembling.

Examination

Carefully inspect all parts for faults and wear. Be prepared to fit new rubber parts throughout. These and the slave piston, retaining clip, pin and gaskets are available in repair kit form.

Light dust deposits on the air filter, which is otherwise found to be in good condition, can be removed by blowing through with a **low** pressure air line. Do not use a cleaning fluid or lubricant of any description on the filter.

A separate repair kit for the air control valve contains a complete sub-assembly of cover, filter and air valve. The rubber air valve diaphragm is the other item included in this special kit.

Before reassembling the servo unit, wash all other original parts in clean brake fluid. Wipe dry with a lint free cloth.

Light deposits on the surface of the slave cylinder bore may be removed with clean brake fluid. If blemishes or scoring are apparent after this gentle treatment, a new slave cylinder will be required.

Sequence

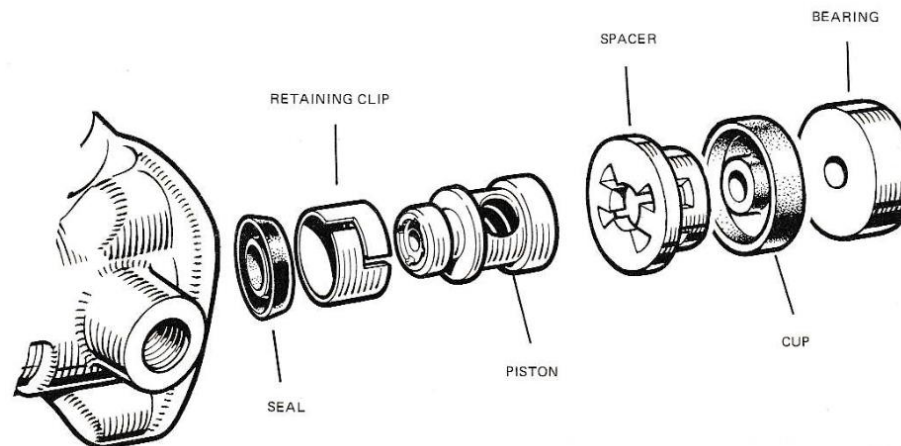
Scrupulous cleanliness of all parts of the servo unit is essential. Make sure that hands are free of grease and dirt. Lay out the parts to be assembled on a clean sheet of paper spread over the work bench.

Use clean brake fluid as a lubricant for assembling components of the hydraulic parts of the servo.

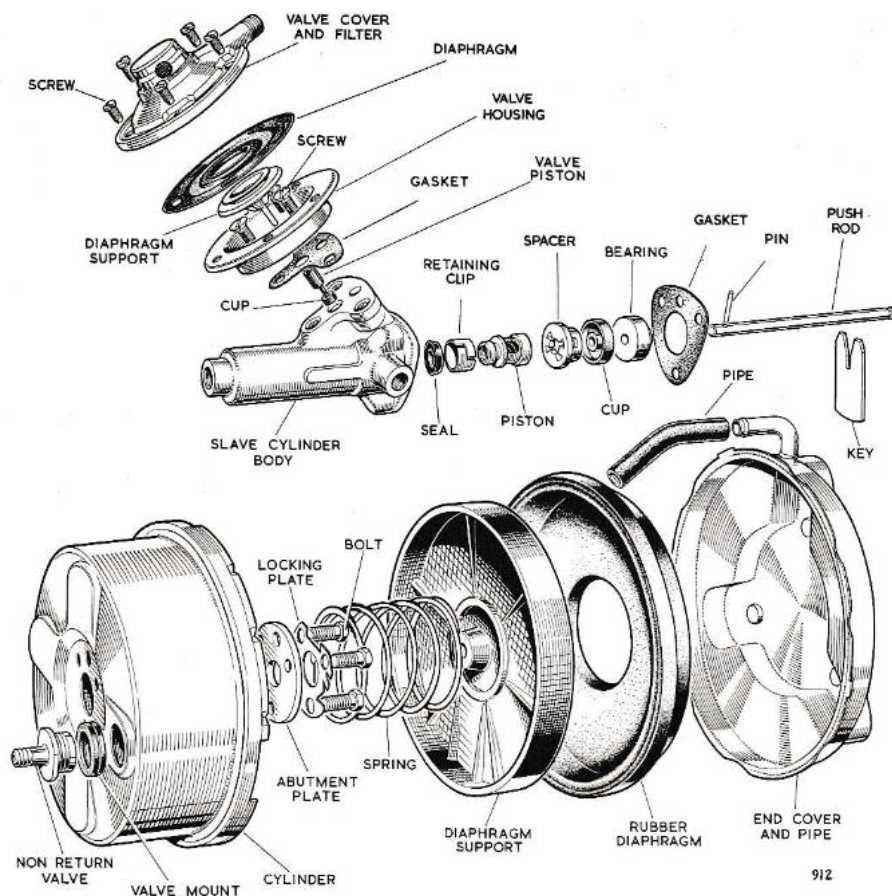
Insert the push rod, chamfered end first, into the skirt in the rear of the slave piston. Depress the spring inside the piston to uncover the hole through the rod. Fit the retaining pin and release the spring to bear on the protruding end of the spring. Slide on the pin retaining clip ensuring it is positioned snugly and not exceed the outer diameter of the outer diameter of the piston, otherwise the bore will be scored.

With the fingers only, bed the rubber seal evenly into the groove on the head of the piston, the lips of the seal pointing away from the push rod.

Check that the bores of the slave cylinder are coated with clean brake fluid. Insert the piston, taking care not to bend over the lips of the seal on entering the bore. Follow with the spacer, the rubber cup and bearing by sliding them independently over the push rod into the mouth of the bore. Bed each part evenly and separately ensuring that the lips of the rubber cup point into the bore and are not turned back.



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With the lips pointing away from the drilled head of the air valve piston, use the fingers to position the rubber cup on the piston spigot. Insert the piston fully into its bore, spigot first, being careful to avoid bending over the lips of the cup.

Grip the slave cylinder in a soft jawed vice, at an angle of 45° with the mouth of the bore uppermost. Place the gasket on the mounting face of the cylinder before putting the servo shell in position. Position the abutment plate and locking plate (which need not be replaced if used only once previously) inside the shell and insert the three mounting bolts, tightening them evenly to a torque of 13lb ft. Bend over the ears of the locking plate to secure the bolts.

Insert the main return spring with the first coil spaced around the abutment plate. Pull the push rod out to its limit before fitting the diaphragm support.

Check that the main return spring is located correctly against the diaphragm support, with the central projection of the support inside the end coil and with the key slot uppermost. Gently press the support into the shell against the resistance of the return spring until the groove in the end of the push rod is visible through the slot. Insert the key. When fully home, the key will retain the push rod and will be flush with the groove on the exposed face of the diaphragm support. Make sure that the rubber servo diaphragm is completely dry especially in the vicinity of the centre hole **where there must be no trace of lubricant**. Likewise fit the diaphragm support particularly at the groove.

Fit the rubber diaphragm to the support, carefully bedding the inner edge correctly and evenly in the groove. Gentle stretching of the diaphragm away from the centre will be found helpful in seating the lip. Note that the diaphragm also acts as a retainer for the key.

Smear the outer edge of the rubber diaphragm with LOCKHEED Disc Brake Lubricant where it will contact the rim of the end cover and of the shell. Bed the edge of the diaphragm evenly around the rim of the shell.

Secure Churchill tool No **C.2030** on the end cover. Line up the end cover with the shell so that the elbow is in the correct position relative to the mounting for the air valve. Whilst maintaining a downward pressure on the cover and being careful not to trap the rubber diaphragm with its edge, turn the cover clockwise as far as the stops will allow. Take off the Churchill tool.

Reposition the servo in the vice so that the mounting flange for the air valve assembly on the slave cylinder is facing upwards and horizontal.

Locate the gasket and then the valve housing on the mounting face. Secure firmly with the three screws, tightening them to a torque of 6lb.ft. Insert the diaphragm support, spigot first into the drilled head of the air valve piston.

Carefully position the inner edge of the rubber air valve diaphragm in the groove of the diaphragm support and line up the slots in the outer edge of the diaphragm with the screw holes in the valve housing. Do not use lubricant of any kind when fitting the diaphragm.

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If the filter has been removed for inspection, replace it and snap fit the dome onto the valve cover.

Place the valve cover over the diaphragm making sure that the projections on the under surface of the cover engage in the slots of the diaphragm. Insert the five self-tapping screws through the holes in the cover and firmly tighten them diametrically and progressively. Do not over-tighten. **This is important, as the smallest amount of air leakage into the air valve assembly will impair the action of the servo.**

Reconnect the rubber pipe to join the end cover elbow with the valve cover port. Finally, thoroughly inspect the servo unit to verify correct reassembly.

[See a full copy of the AP Lockheed manual](#)