Feb. 1, 1944. W. F. F. MARTIN-HURST 2,340,817

FLUID PRESSURE SERVO MOTOR

Filed Dec. 29, 1939 2 Sheets-Sheet 1

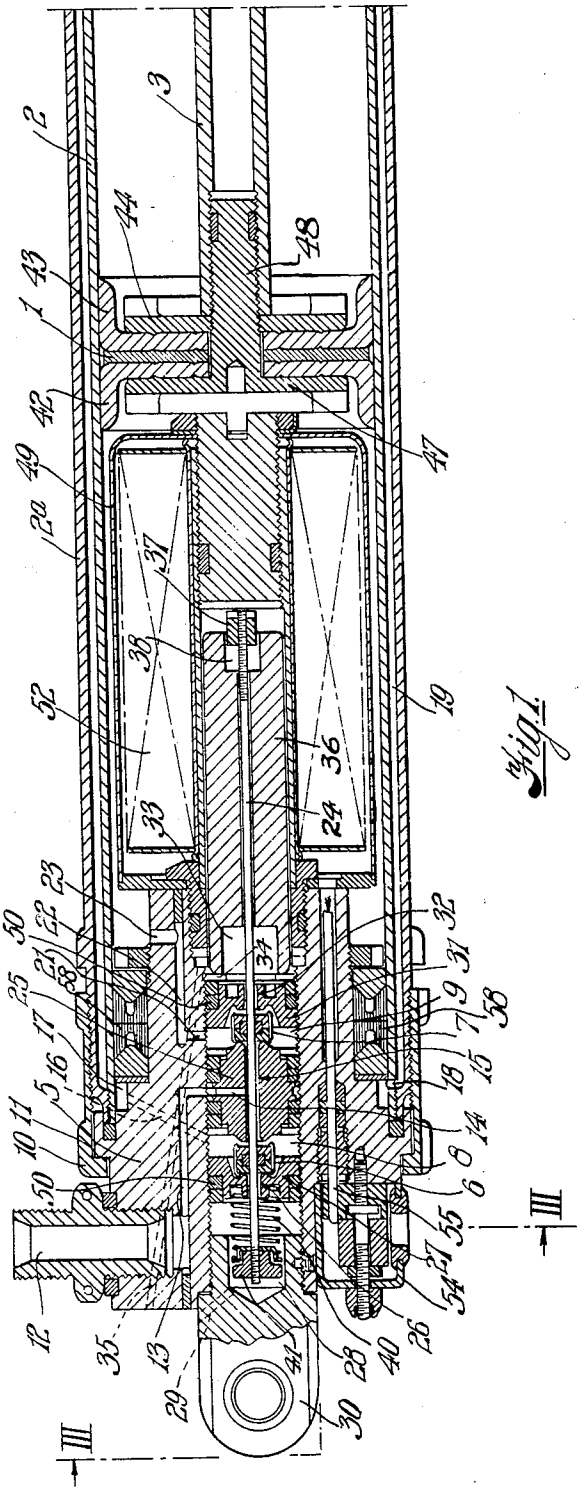


Fig. 1.

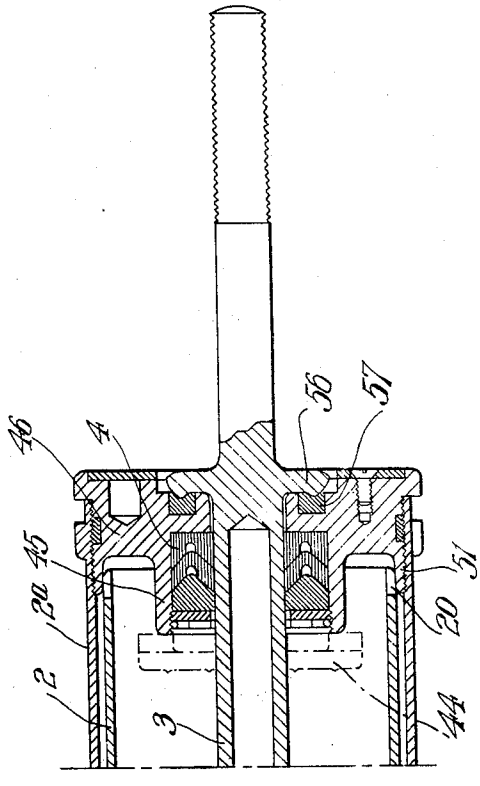


Fig. 1.

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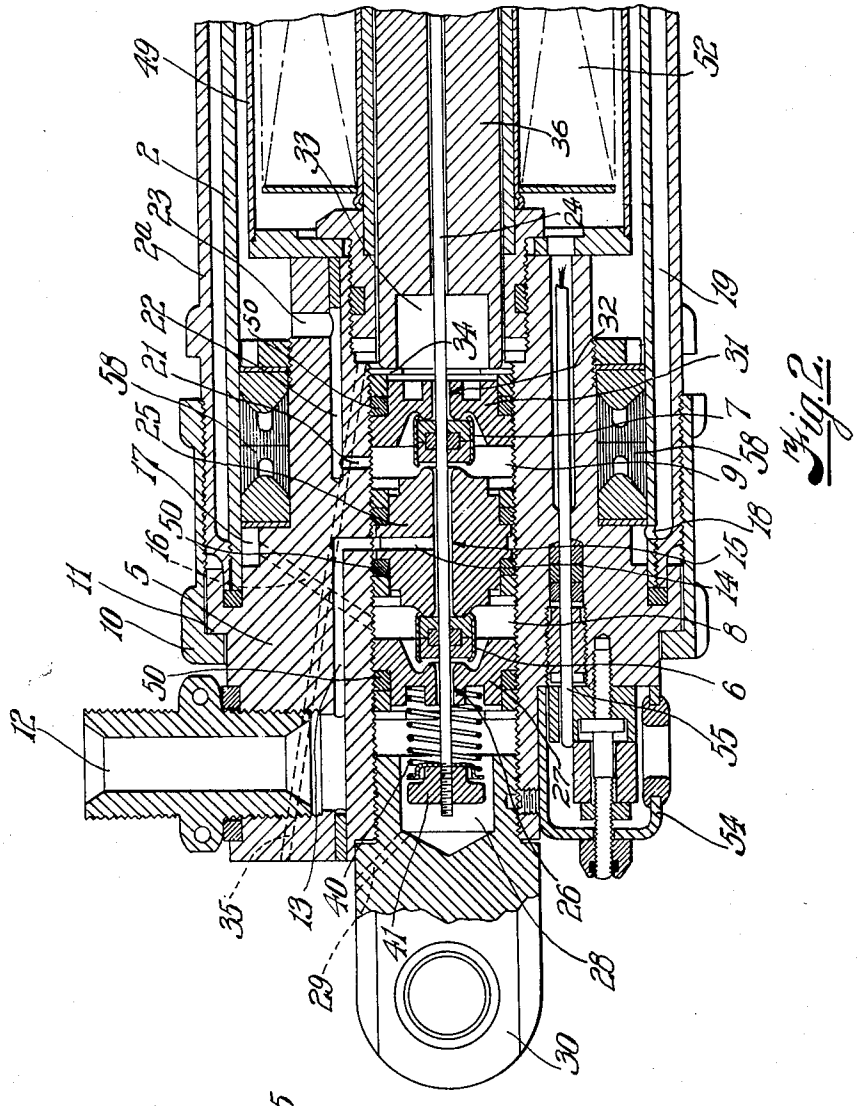


Fig. 2.

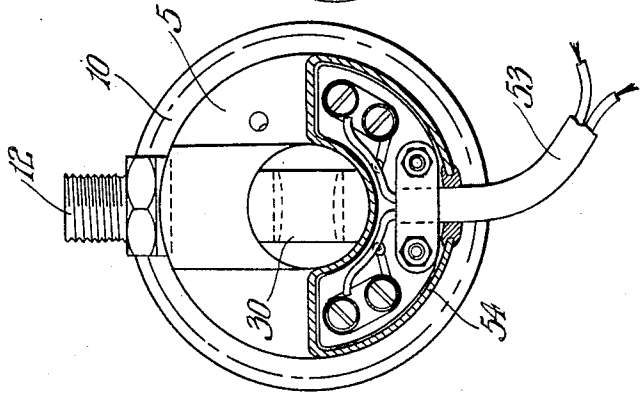


Fig. 3.

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FLUID PRESSURE SERVOMOTOR

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Application December 29, 1939, Serial No. 311,701
In Great Britain December 6, 1938

10 Claims. (Cl. 121—38)

This invention relates to a relay mechanism comprising a plunger or piston working in a cylinder to which pressure fluid is admitted under the control of a valve which may be operated by a thermostat or other device.

The object of the invention is to provide a simple and reliable mechanism of this character.

According to the invention a relay mechanism is provided comprising a plunger or piston working in a cylinder to which pressure fluid is admitted under valve control wherein the construction includes a cylindrical shell having a motor chamber in which the plunger or piston works and a valve chamber in which is disposed a valve mechanism operated electromagnetically from a thermostat or other device and arranged to control the supply and release of pressure fluid to the motor chamber.

According to one form of the invention a relay mechanism is provided comprising a plunger or piston working in a cylinder to which pressure fluid is admitted under valve control wherein the construction includes a cylinder having therein a double acting piston and valve mechanism comprising two double acting valve members operated through a common slidable rod or spindle from an electromagnetic device.

According to another form of the invention a relay mechanism is provided comprising a cylinder containing a double acting piston or plunger, a pair of double acting valve members operating in chambers connected respectively to the cylinder on either side of the piston and an electro-magnetic device for operating the said valve members said cylinder valve chambers and operating device all being contained within a cylindrical outer shell.

Reference will be now be made to the accompanying drawings which illustrate by way of example an electro-pneumatic ram constructed according to the invention and in which:

Fig. 1 is a longitudinal sectional elevation,

Fig. 2 is a sectional view to an enlarged scale of the valve mechanism of the ram shown in Fig. 1 with the valve members in their opposite positions and

Fig. 3 is an end view partly in section looking in the direction of the arrow III, Fig. 1.

In the construction illustrated the ram consists of a double acting piston 1 working within a cylinder 2, the said piston being secured to a rod 3 which passes through a stuffing box 4 at one end of the cylinder. The opposite end of the cylinder is occupied by a housing 5 for valve mechanism which will now be described.

This valve mechanism comprises two double acting valve members 6 and 7 mounted within two co-axial valve chambers 8 and 9 formed in the housing or valve body 5 which is held in position in one end of the cylinder 2 by means of a sleeve 10 having screw threaded engagement with an outer cylindrical shell 2a held in fixed concentric relationship with the cylinder 2. The exterior of the sleeve 10 is formed with notches or flats to facilitate rotation and it has an inwardly directed flange adapted to abut against an annular shoulder 11 on the valve housing to hold the latter in position in the end of the cylinder 2.

The valve housing 5 carries an inlet connection 12 adapted to be coupled to a source of supply of pressure fluid and this inlet communicates through a passage 13, a port 14 and annular passages 15 with the valve chambers 8 and 9. Each valve chamber is in permanent communication with one end of the cylinder 2 and for this purpose the valve chamber 8 communicates through a passage 16 with an annular space 17 from which a port 18 communicates with an annular space 19 formed between the outer shell 2a and the cylinder 2. The space 19 communicates at its end remote from the valve housing through ports 20 with the interior of the cylinder 2. The second valve chamber 9 communicates through port 21, passage 22 and port 23 with the interior of cylinder 2 on the opposite side of the piston to the ports 20.

The two valve members 6 and 7 are fixed to a common operating spindle 24 which passes freely through a plug 25 in which the port 14 is formed and through which extend the passages 15 surrounding the spindle 24 so as to leave a free annular passage from port 14 to the two valve chambers. Thus, the inlet ports to the two valve chambers are at each end of the plug 25 concentric with valve seats also formed at the ends of the said plug so that when the valves are in the position shown in Fig. 1, fluid under pressure is passing to the outer end of the ram cylinder from valve chambers 8, through passage 16, annular chamber 17, port 18, annular space 19 and ports 20 to move the piston 1 towards the position shown in Fig. 1 and maintain it in that position.

The valve chambers 8 and 9 have connections with atmosphere arranged in the following manner:

The valve chamber 8 communicates through an annular port 26 surrounding spindle 24 in a plug member 27 with a chamber 28 having a vent to atmosphere at 29. This vent is formed

in a plug member 30 which closes the outer end of a screw threaded passage in which the plugs 25 and 27, and a third plug 31 are mounted in spaced relationship to form the valve chambers 8 and 9. The plug 31 is also formed to provide an annular port or passage 32 around the spindle 24 which communicates with a chamber 33 from which ports 34 and a vent passage 35 communicate with atmosphere. With the valves in the position shown in Fig. 1 the valve chamber 9 is in free communication with the atmosphere as the passage 32 is uncovered owing to the valve member 7 being on its seating on the plug 25. When the valve members 6 and 7 are in the positions shown in Fig. 2, the valve member 6 is in engagement with its seating on the plug 25 and consequently the valve chamber 8 is in communication with atmosphere through annular port 26, chamber 28 and vent 29. At the same time valve member 7 is in engagement with its seating on the plug 31 so that pressure fluid entering through port 14 passes through passage 15 into valve chamber 9 from which it passes through port 21, passage 22 and port 23 into the cylinder 2 to move the piston 1 from the position shown in Fig. 1 to the outer end of the cylinder.

The valve members 6 and 7 are, as already stated, double acting and in the form illustrated each includes discs of resilient material adapted to engage the seatings on the plug members 25, 27 and 31. The said discs may be made of an india-rubber or like compound, for example, the substance known under the trade name "neoprene," each valve member consisting of two of such discs mounted on each side of a rigid element fixed to the spindle 24 and surrounded by a piece of light metal tubing spun down at each end. Alternatively, metal valve members may be employed with "neoprene" or like washers to act as seatings mounted on the plug members 25, 27 and 31. The construction of the valve chambers by using the plugs 25, 27 and 31 which are screwed in position enables accurate adjustment to be made of the various ports and passages formed in the housing 5 with respect to the valve chambers and the port 14. Each of these plugs is sealed in position by thick washers 50 which are also preferably made of a material such as "neoprene" and which, whilst they allow some latitude in the axial adjustment of the plugs, maintain sealed joints between the plugs and the valve body 5.

The operation of the valve members 6 and 7 and their spindle 24 is effected by the following mechanism:

One end of the spindle 24 carries the armature or core 36 of an electro-magnetic device. The core 36 is freely mounted over the spindle 24 the outer end of which carries a nut 37 whereby a recess 38 in the core member allows an amount of free movement before the base of the recess engages the nut to cause operative movement of the rod. A control spring 40 for retracting the spindle 24 and the core 36 is mounted within the chamber 28 and abuts at one end against the fixed plug 27 and at the other end against a collar 41 fixed to the end of the spindle 24. A housing 49 encloses the electro-magnetic coil 52, this housing being fixed at its opposite end to the valve housing 5.

The piston 1 consists of the central metal distance piece on each side of which are mounted oppositely directed cup washers 42 and 43. The cup washer 43 is supported and held in position against the member 1 by a metal washer 44, the bore of which is screw threaded to enable it to engage a screw threaded stem 48 of a metal washer 47 which engages and supports the cup washer 42. The outer edges of the two washers 44 and 47 are outwardly turned and their inner surfaces are serrated so that when the washer 44 is screwed tightly in position the two cup washers are forced eightly against the distance piece 1 before assembling this unit on to the shaft 3 which operation is effected by screwing the end of stem 48 into an internal screw thread in the end of the shaft as shown in Fig. 1. At the conclusion of the outward movement of the piston its progress is arrested by the engagement of the outwardly turned portion of the washer 44 with a stop 45 consisting of a cylindrical projection from the end plate 46 of the cylinder which projection surrounds the stuffing box 4 (see broken line position in Fig. 1). The end plate 46 has a peripheral sleeve 51 which has screw threaded engagement within the outer end of the cylindrical shell 2a and within the sleeve 51 the end of cylinder 2 also engages so that the sleeve holds cylinder 2 and shell 2a in concentric spaced relationship.

When pressure is on the magnetic valve side of the piston, there is no need to provide a seal other than that provided by the cup washers 42 and 43 to prevent loss of air as if the cup washers do not provide such a seal and the gland 4 remains operative as a seal, pressure would equalise on both sides of the piston and there would be no control over the element connected to the shaft 3. When pressure is on the right hand end of the cylinder, however, it is desirable to provide an additional seal when the ram is fully contracted (the position shown in Fig. 1) and this seal is provided by a shoulder 56 formed on the shaft 3 outside the end plate 46 and adapted to engage with an annular "neoprene" or like seating 57 mounted in an external annular recess in the said end plate.

In order to separate the air which passes through the outlet 16 and port 18 to the annular space between the cylinder 2 and outer shell 2a from the air space within the cylinder 2 on the left hand side of the piston, a large diameter packing gland 58 is fitted between the internal surface of the cylinder 2 and the exterior of the valve body or housing 5.

The electrical connections 53 (see Fig. 3) enter a terminal box 54 fixed to the outer end of the housing 5 and pass as shown at 55 (Fig. 1) through the said housing to the coil housing 49.

The outer end of the rod 3 may be connected to any movable part to be controlled. For example, it may be arranged to operate a flap controlling the flow of air through the radiator of an aeroplane so as to regulate the cooling system according to requirements.

The motor device is intended to be operated by compressed air. It may, however, be adapted to work with other pressure fluids. The solenoid may be supplied with current under the control of the thermostatic switch so that the flap or other device actuated by the motor piston will be set automatically to a position determined by the temperature round the thermostatic switch.

The construction is particularly light, compact and reliable and is specially suitable for use on aircraft.

I claim:

1. A relay mechanism comprising an outer cas-

ing, a fluid pressure operated motor device extending longitudinally within said casing, two valve members substantially alined with said motor device for controlling the supply and release of pressure fluid to said motor device, an inner valve seat located between the two valve members, an outer valve seat located on the side of each valve member remote from the other, said valve seats being formed on plug members individually adjustable longitudinally in a passage disposed longitudinally within the casing, and providing spaced valve chambers between them and controlling communication between said motor device and a source of pressure fluid supply and the atmosphere, and an electro-magnetic device having its axis extending in substantially the same direction as the axes of said motor device, valve members and valve seats for operating the two valve members.

2. A relay mechanism comprising an outer casing, a fluid pressure operated motor device extending longitudinally within said casing, two valve members substantially alined with said motor device for controlling the supply and release of pressure fluid to said motor device, an inner valve seat located between the two valve members, an outer valve seat located on the side of each valve member remote from the other, said valve seats being formed on plug members individually adjustable longitudinally in a passage disposed longitudinally within the casing, and providing spaced valve chambers between them and controlling communication between said motor device and a source of pressure fluid supply and the atmosphere, a spindle movable longitudinally of said casing and passing freely through said plug members and carrying said valve members, and a solenoid device disposed longitudinally within said casing and having its axis extending in substantially the same direction as the axes of said motor device, valve members and valve seats, for operating said spindle.

3. A relay mechanism comprising an outer casing, a fluid pressure operated motor device extending longitudinally within said casing, two valve members alined with said motor device for controlling the supply and release of pressure fluid to said motor device, an inner valve seat coaxial with and located between the two valve members, an outer valve seat coaxial with and located on the side of each valve member remote from the other, said valve seats being formed on plug members screw threaded in axial alinement in a passage disposed axially within the casing for individually adjusting said outer valve seats axially of the casing, and providing spaced valve chambers between them and controlling communication between said motor device and a source of pressure fluid supply and the atmosphere, and an electro-magnetic device coaxial with said motor device, valve members and valve seats for operating the two valve members.

4. A relay mechanism comprising an outer casing, a fluid pressure operated motor device extending longitudinally within said casing, two valve members alined with said motor device for controlling the supply and release of pressure fluid to said motor device, an inner valve seat coaxial with and located between the two valve members, an outer valve seat coaxial with and located on the side of each valve member remote from the other, said valve seats being formed on plug members screw threaded in axial alinement in a passage disposed axially within the casing for individually adjusting said outer valve seats axially of the casing, and providing spaced valve chambers between them and controlling communication between said motor device and a source of pressure fluid supply and the atmosphere, a spindle movable axially of said casing and passing freely through said plug members and carrying said valve members, and a solenoid device coaxial with said motor device, valve members and valve seats and disposed coaxially within said casing for operating said spindle and valve members.

5. A relay mechanism comprising an outer casing, a fluid pressure operated motor device extending longitudinally within said casing, two valve members alined with said motor device for controlling the supply and release of pressure fluid to said motor device, an inner valve seat coaxial with and located between the two valve members, an outer valve seat coaxial with and located on the side of each valve member remote from the other, said valve seats forming chambers between them, and said motor device including a motor cylinder spaced concentrically within said casing and forming an annular passage between said cylinder and casing, ports communicating between one of said valve chambers and one end of said motor cylinder, and ports communicating between the other of said valve chambers and said annular passage and between said annular passage and the other end of said motor cylinder, means for individually adjusting the two outer valve seats axially of said casing, and an electro-magnetic device coaxial with said motor device, valve members and valve seats for operating the two valve members.

6. A relay mechanism comprising an outer casing, a motor cylinder disposed within said casing, a double acting piston mounted to reciprocate in said cylinder, a housing within said outer casing having a passage therein extending axially of said cylinder, plug members screw threaded in axial alinement in said passage and forming valve seats and valve chambers spaced axially between said plug members, two double acting valve members disposed respectively in said valve chambers, communications between said valve chambers and a source of pressure fluid supply, either end of the motor cylinder and the atmosphere controlled by said valve members, a spindle movable axially of said passage and plug members and carrying both of said valve members, and an electro-magnetic device alined axially with said cylinder and plug members for operating said spindle.

7. A relay mechanism comprising an elongated cylindrical outer casing, a motor cylinder disposed coaxially within one end of said casing, a double acting piston mounted to reciprocate axially in said cylinder, a housing within the other end of said outer casing, two double acting valve members disposed in said housing in axial alinement with said cylinder, an inner valve seat located in said housing between said valve members, and an outer valve seat located in said housing on the side of each valve member remote from the other, plug members carrying said valve seats and screw threaded in axial alinement within said housing and forming valve chambers between the inner and outer valve seats, means for individually adjusting the two outer valve seats, means controlled by said valve members for establishing communication between said valve chambers and a source of pressure fluid supply, each end of the motor cylinder and the atmosphere, an axially

movable spindle passing freely through the axes of said plug members and carrying the valve members, and a solenoid device alined axially with the motor cylinder for operating said spindle.

8. A relay mechanism comprising an elongated cylindrical outer casing, a motor cylinder disposed coaxially within one end of said casing, a double acting piston mounted in said cylinder, a housing within the other end of said outer casing, two double acting valve members disposed in said housing in axial alinement with said cylinder, an inner valve seat located in said housing between said valve members, an outer valve seat located in said housing on the side of each valve member remote from the other, plug members carrying said valve seats and screw threaded in axial alinement within said housing and forming valve chambers between the inner and outer valve seats, means for individually adjusting the two outer valve seats, means controlled by said valve members for establishing communication between said valve chambers and a source of pressure fluid supply, each end of the motor cylinder and the atmosphere, an axially movable spindle passing freely through the axes of said plug members and carrying said valve members, and a solenoid device alined axially with the motor cylinder and interposed between the latter and said housing for operating said spindle.

9. A relay mechanism comprising an elongated outer casing, a motor cylinder disposed axially within one end of said casing, a double acting piston mounted in said cylinder, a housing within the other end of said outer casing, two double acting valve members disposed in said housing in axial alinement with said cylinder, an inner valve seat located between said valve members, an outer valve seat located on the side of each valve member remote from the other, plug members carrying said valve seats and screw threaded in axial alinement within said housing and forming valve chambers between them, means controlled by said valve members for establishing communication between said valve chambers and a source of pressure fluid supply, each end of the motor cylinder and the atmosphere, an axially movable spindle passing freely through the axes of said plug members and carrying said valve members, and a solenoid device disposed axially within said outer casing for operating said spindle, said central plug member having a radial passage and a central annular passage communicating with said valve chambers, and the outer plug members each having a central passage for establishing communication between said valve chambers and the atmosphere.

10. A relay mechanism comprising an elongated outer casing, a motor cylinder disposed longitudinally within one end of said casing, a double acting piston mounted in said cylinder, a housing within the other end of said outer casing, two double acting valve members disposed in said housing at one end of said cylinder, an inner valve seat located between said valve members, an outer valve seat located on the side of each valve member remote from the other, plug members carrying said valve seats and mounted within said housing for adjustment longitudinally of the motor cylinder and forming valve chambers between them, means controlled by said valve members for establishing communication between said valve chambers and a source of pressure fluid supply, each end of the motor cylinder and the atmosphere, an axially movable spindle passing freely through said plug members and carrying said valve members, and a solenoid device having its axis disposed longitudinally within said outer casing for operating said spindle, said central plug member having a radial passage and a central annular passage communicating with said valve chambers, and the outer plug members each having a central passage for establishing communication between said valve chambers and the atmosphere.

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