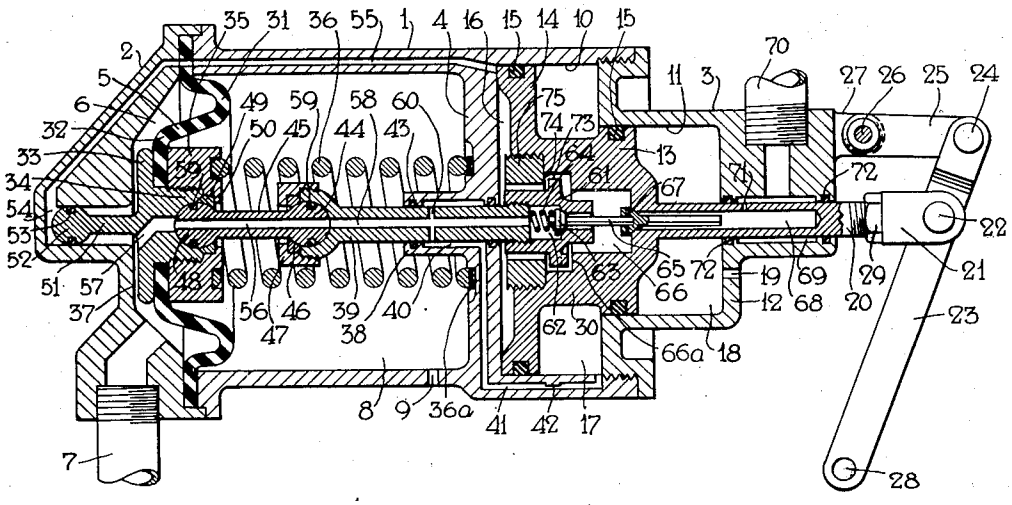
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FLUID PRESSURE MOTOR

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FLUID PRESSURE MOTOR

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4 Claims. (Cl. 137—153)

1

This invention relates to control devices and more particularly to motors of the type adapted to be controlled and operated by fluid under pressure; the present application being a division of our copending application, Serial No. 552,110, filed August 31, 1944, now Patent No. 2,413,380, patented December 31, 1946.

In the copending application of Rankin J. Bush, Serial No. 480,161, filed March 23, 1943, and assigned to the assignee of the present application, there is disclosed a fluid pressure control system for controlling a plurality of internal combustion engines, such as employed for propelling an airplane, said system comprising for each engine a plurality of fluid motors, one for controlling the engine speed, another for controlling the richness of the fuel mixture supplied to the engine, still another for controlling the temperature of the mixture, and a fourth for controlling operation of a blower or supercharger for the engine.

One object of the invention is the provision of an improved fluid motor for controlling devices of the above general type.

Another object of the invention is the provision of a fluid motor embodying fluid operated power piston means and an operator's fluid pressure controlled pilot means which is constructed to be very sensitive to changes in controlling pressure and therefore accurately adjustable in accordance with fine increments of such change, so as to render the power means accurately and positively adjustable in accordance with changes in the pressure of controlling fluid on the pilot means.

Other objects and advantages will be apparent from the following more detailed description of the invention.

In the accompanying drawing, the single figure is a longitudinal sectional view of a fluid motor embodying the invention.

Description

The fluid motor shown in the drawing comprises a cylindrical casing 1 one end of which is closed by a cover 2, while the opposite end is closed by a cover 3, and intermediate the ends of the casing there is provided an internal wall 4. A flexible diaphragm 5 is clamped around its peripheral edge between the casing 1 and cover 2 and has at one side a chamber 6 open to a combined control and fluid pressure supply pipe 7. At the opposite side of diaphragm 5 is a chamber 8 formed between the diaphragm and casing wall 4. The chamber 8 is in constant communication with atmosphere through a passage 9.

2

At the opposite side of wall 4 the casing 1 has a piston bore 10. The cover 3 has a piston bore 11 spaced axially from and arranged in concentric relation to the bore 10. One end of bore 11 is open to the bore 10 while the opposite end is closed by a wall 12 constituting a portion of the cover 3. The bore 11 is of smaller diameter than bore 10 and slidably mounted in these bores are pistons 13 and 14, respectively, each having a ring groove in which is mounted a packing ring 15 having sealing sliding contact with the wall of the respective bore. The two piston heads 13 and 14 are axially aligned and connected for movement in unison and constitute a differential area power piston means 30. Between the piston head 14 and wall 4 there is provided a fluid pressure control chamber 16. Between the two pressure heads 13 and 14 is a dash-pot chamber 17. Between the piston head 13 and the end wall 12 of cover 3 is a chamber 18 which is in constant communication with atmosphere through a passage 19.

The wall 12 of cover 3 is provided with a bore axially aligned with the piston heads 13 and 14, and projecting through this bore from the piston head 13 is a piston rod 20. Outside of cover 3 the piston rod 20 is adjustably connected by screw threads to one end of a link 21, a lock nut 29 on said rod being provided for engagement with said link to hold it in an adjusted position. The opposite end of link 21 is operatively connected by a pin 22 to an operating lever 23 at a point between the ends of the lever. One end of lever 23 is connected by the pin 24 to one end of a fulcrum link 25. The opposite end of link 25 is fulcrumed on a pin 26 which is carried by an ear 27 projecting from the cover 3. In the opposite end of lever 23 is an opening 28 which is provided to receive a pin or the like for connecting said lever to a device which it is desired to operate by the motor. The lever 23 has a normal position in which it is shown in the drawing and is movable out of this position by the power piston means 30, as will be later described.

The flexible diaphragm 5 is of the type comprising an annular corrugation 31, an outer flange encircling said corrugation for clamping between the casing section 1 and cover 2, and an inner perforated flange 32. A diaphragm follower 33 contained in control chamber 6 has a stud portion 34 extending through the central opening in diaphragm 5, while a follower 35 contained in chamber 8 is secured to this stud portion by screw threaded engagement for clamping

the central flange 32 of the diaphragm between the two followers. A coil type regulating spring 36 arranged in coaxial relation with the diaphragm 5 and power piston means 30 is contained in chamber 8 and is supported at one end on the casing wall 4 while its opposite end bears against the diaphragm follower 35. This spring is under pressure and therefore effective to deflect the diaphragm and move the followers 33 and 35 against pressure of fluid in chamber 6 and in the direction of a stop 37 provided in cover 2. Shims 36a may be employed between wall 4 and the adjacent end of the spring 36 for adjusting its pressure against diaphragm 5.

The casing wall 4 is provided with a boss 38 which extends into chamber 8 within the regulating spring 36. Extending through the boss 38 and slidably mounted therein in coaxial relation with the piston means 30 and diaphragm 5 is an operating rod 39. One end of the rod 39 projects into chamber 16 at one side of the power piston means 30, while the opposite end is disposed in chamber 8. The boss 38 is provided with an annular chamer 40 encircling the rod 39 and connected by a passage 41 to chamber 17 formed between the two piston heads 13 and 14. A choke or restriction 42 is provided in the passage 41 for limiting the rate of flow of fluid under pressure to chamber 17 and out of said chamber, as will be later described. At opposite ends of the chamber 40 the boss 38 and wall 4 are provided with grooves containing rings 43 having sealing and sliding contact with rod 39 for preventing leakage of fluid under pressure from said chamber.

In the end of that portion of the rod 39 which is disposed in chamber 8 there is provided a semi-spherical socket in which is disposed a ball-like end 44 of a link 45, said end 44 being secured in said socket by a member 46 secured to the end of rod 39 by a nut 47. The link 45 has at its opposite end a ball-like structure 48 which is seated in a socket in the end of the diaphragm follower stud 34, and which is secured to said stud by a member 49 urged into contact with the ball-like end by a flange 50 projecting from the diaphragm follower 35. Projecting from the diaphragm follower 33 into a bore in cover 2 is a member 51 having at its end a ball-like structure 52 of larger diameter than said member and in substantial contact with the wall of said bore. The ball and socket connections between the opposite ends of link 45 and the operating rod 39 and diaphragm follower 33, and between the cover 2 and ball-like end 52 at the end of member 51 are provided to allow the diaphragm 5 to freely rock or tilt relative to member 39 in a direction or directions which will rock the axis of the diaphragm, in order that the diaphragm may freely adjust itself to the regulating spring 36 without causing binding of the operating rod 39 within the boss 38. This structure is adapted to render the diaphragm very sensitive to slight changes in pressure in control chamber 6, and therefore accurately adjustable in accordance with such changes in pressure.

A sealing ring 53 is disposed in a groove provided in the ball-like structure 52 and has sealing and sliding contact with the wall of the bore in which said structure operates, in order to prevent leakage of fluid under pressure between chamber 6 at one side of the structure and chamber 54 at the opposite side. Chamber 54 is in constant communication with the power chamber 16 through a passage 55. The link 45 is provided with an axial passage 56 open at one end to a passage 57 in the diaphragm follower 33 and open at the opposite end to a passage 58 in the operating rod 39. Ring like seal members 59 are provided in the ball-like ends of link 45 and have sealing and sliding contact with the walls of the respective sockets for preventing leakage of fluid under pressure from these passages to chamber 8.

Passage 57 in the diaphragm follower 33 is open to control chamber 6, so that fluid under pressure effective in said chamber may flow through said passage and passage 56 to passage 58 in the operating rod 39. Within boss 38 the operating rod 39 is provided with one or more radial bores 60 connecting passage 58 to the annular chamber 40, whereby the control chamber 6 and dash-pot chamber 17 between the piston heads 13 and 14 of the power piston means 30 are in constant communication.

In the power chamber 16 the operating rod 39 is connected to and supports a valve control member 61 which has a chamber 62 containing a fluid pressure supply valve 63 and a spring 64 acting on said valve for urging it to a closed or seated position in which it is shown in the drawing. The passage 58 in operating rod 39 is open to chamber 62 whereby said chamber is adapted to be constantly supplied with fluid under pressure from the control chamber 6.

The supply valve 63 is arranged in coaxial relation with the power piston means 30 and has a stem 65 projecting through a bore in the valve control member 61 into a chamber 66 in the power piston means 30. The chamber 66 is open at all times past the valve member 61 to the power chamber 16 and contains a fluid pressure release valve 67 arranged in coaxial relation with the supply valve stem 65 and to which said release valve is secured, whereby the two valves are movable in unison.

The release valve 67 is adapted to cooperate with a seat provided on the power piston means 30 around one end of a passage 68 extending into the piston rod 20 for thereby controlling communication between said passage and the power chamber 16. In cover 3 an annular chamber 69 is provided around the piston rod 20 and is connected to a fluid pressure release pipe 70. The piston rod 20 is provided with a radial port 71 connecting passage 68 in the rod to the annular chamber 69. Beyond each of the opposite ends of chamber 69 the cover 3 carries a ring seal member 72 having sealing and sliding contact with said rod to prevent leakage of fluid under pressure from chamber 69 to atmosphere.

The radial release port 71 is of relatively small area constituting in effect a choke for limiting the rate of release of fluid under pressure from chambers 66 and 16 to a degree having a certain relation to the flow capacity of choke 42. Likewise, there is a certain relation between choke 42 and the rate at which fluid may be supplied past the supply valve 63 to chambers 66 and 16 and this relation may be obtained by the supply valve stem 65 reducing the area of the opening through the valve control member 61 in which said stem is disposed, to a degree which provides the required choking effect to obtain said relation. The size of these openings as shown in the drawing are merely illustrative.

The release pipe 70 may lead directly to atmosphere or it may lead to a so-called sump reservoir provided for receiving fluid under pressure after it has been used for effecting a desired operation. The pressure of fluid in the sump reservoir may at times exceed that of the

atmosphere, hence the use of the sealing rings 72. Whether the pipe 70 leads to the atmosphere or to a sump reservoir is however immaterial to the present invention. A sump reservoir of the type under consideration is however shown and fully described in the copending application of Rankin J. Bush hereinbefore referred to and, if desired, reference may be made to that application for a more complete description thereof.

The valve control member 61 is provided with an annular collar or flange 73 for engaging the inner surface 74 of a member 75 provided in the power piston means 30, whereby movement of the valve control member 61 by the operating rod 39 in the direction of the casing cover 2 will pull the power piston means 30 to the position in which it is shown in the drawing. At the opposite side of flange 73 on valve member 61 there is clearance space provided to allow movement of said valve control member relative to the power piston means 30 a distance sufficient to open the supply valve 63 without said member contacting a shoulder or surface 66*a* in chamber 6.

It will be noted that the operating rod 39, valve control member 61, and the supply and release valves 63 and 67, respectively, are supported by the casing wall 4, independently of the pilot means including diaphragm 5 and followers 33 and 35, and also independently of the power piston means 30, whereby said rod, member and valves will at all times be maintained in operative relation to the diaphragm 5 and will prevent binding of said rod within the boss 38 in case of tilting of said diaphragm relative to said member or, if for any reason the power piston means 30 should tend to bind in the bores in which it is disposed.

Operation

It is intended that the control pipe 7 and thereby the control chamber 6 be normally charged with fluid at a pressure in excess of atmospheric pressure, such as eighty pounds, and that the operation of the motor to adjust lever 23 will be obtained by varying the pressure through a range, such as seventy pounds, above the eighty pounds.

Now let it be assumed that pipe 7 and the control chamber 6 are charged with fluid at the normal pressure of eighty pounds. This pressure, effective on diaphragm 5, will move said diaphragm, the followers 35 and 33, the link 45, the operating member 39 and valve control member 61 against the opposing pressure of the regulating spring 36 to a position in which the pressure of said spring will have increased to a degree to counterbalance the pressure of fluid in chamber 6, whereupon such movement will cease. This position may be adjusted toward or away from the stop shoulder 37 in cover 2 by the use of shims 36*a*, as will be apparent.

Fluid at the normal pressure of eighty pounds in pipe 7 and chamber 6 will equalize through passage 57 in the diaphragm follower 33, passage 56 in link 45, passage 58 and ports 60 in the operating rod 39, chamber 40 and passage 41 into the dash-pot chamber 17 between the two piston heads 13 and 14. The pressure of fluid thus obtained between the two piston heads 13 and 14 will create a force, equal to said pressure times the difference in areas of the two piston heads, which will act to urge the power piston means 30 in the direction of the diaphragm 5. The position which the diaphragm 5 assumes when subject in chamber 6 to the normal pressure of eighty pounds is preferably so adjusted by the shims 36*a*, that the power piston means 30 moving under the pressure of fluid in the dash-pot chamber 17, will contact the casing wall 4 at the same time it moves into seating engagement with the release valve 67 and hence without opening the supply valve 63. In the drawing the parts of the motor are shown in the positions just described, which will be assumed to be their normal positions, and with the power piston means 30 thus positioned, the lever 23 will also assume a normal position in which it is shown in the drawing.

If the operator now desires to rock the control lever 23 out of its normal position in a counterclockwise direction, as viewed in the drawing, he will increase the pressure of fluid in chamber 6 through pipe 7 to a degree above the normal pressure of eighty pounds. This increase in pressure on diaphragm 5 will deflect said diaphragm against the opposing force of the regulating spring 36 to a new position in which the pressure of said spring is increased to a degree sufficient to counterbalance the pressure of fluid in said chamber whereupon the diaphragm will cease moving. This deflection of diaphragm 5 will act through rod 39 to move the valve control member 61 relative to the power piston means 30, and with the release valve 67 closed holding the supply valve 63 against movement in this direction, the valve control member 61 will move out of seating engagement with said supply valve. Fuid under pressure will then flow from the supply valve chamber 62 to the power piston chamber 16, and when the pressure of fluid in chamber 16 is thus increased sufficiently with respect to the opposing pressure of fluid in chamber 17 will move the power piston means 30 in the direction of the right-hand and rock the lever 23 in a counterclockwise direction out of its normal position

After the diaphragm 5 ceases movement in response to the increase in pressure of fluid in chamber 6, the movement of the power piston means 30 by the pressure of fluid in chamber 16 will be relative to the valve control member 61. The supply valve 63 will move with piston means 30 relative to the valve control member 61 until said valve seats against said valve control member to cut-off further flow of fluid under pressure to power piston chamber 16. When the supply of fluid under pressure to chamber 16 is thus cut off the power piston means 30 and lever 23 will stop, in a position determined by the position of the diaphragm 5 and thus by the increase in pressure of fluid in pipe 7 and control chamber 6.

The pressure of fluid required in power chamber 16 to operate the power piston means 30 and lever 23 will depend upon the resistance to movement of the device being controlled, so that at one time a relatively small increase in pressure in chamber 16 may be adequate to effect such movement, while at another time or under a different condition a greater pressure will be required in said chamber. The pipe 7, being however charged with fluid at a pressure in excess of eighty pounds, constitutes a source of fluid at adequate pressure to insure operation of the power piston means 30 to actuate lever 23 as intended.

It is desired to point out that the position to which the power piston means 30 is moved corresponds to the position of the diaphragm 5, and thus the increase in pressure in pipe 7 over the

normal pressure, and the structure provides for obtaining fluid in chamber 16 at a pressure sufficient to ensure such positioning of the power piston means.

If the operator now desires to cause rocking of the lever 23 to a greater degree from its normal position, he will increase the pressure in pipe 7 and diaphragm chamber 6 to a degree corresponding to the desired new position of lever 23, and the motor will again operate in the same manner as above described, to move said lever and then stop it in the new position, which position again corresponds, to the position of diaphragm 5.

It will now be apparent that the lever 23 can be moved out of its normal position shown, to any other desired position, by providing fluid at the proper pressure in control pipe 7 and diaphragm chamber 6. This movement may be made in steps, if desired, or in a single step, according to the degree of increase in pressure in pipe 7 and chamber 6. When a maximum pressure of fluid is provided in pipe 7 and chamber 6, deflecting the diaphragm 31 against the opposing force of the diaphragm regulating spring 36 to a maximum degree, the lever 23 will be moved to a maximum extent away from its normal position, as will also be apparent.

The movement of the power piston means 30 as above described is opposed at all times by pressure of fluid in the dash-pot chamber 17, which is in constant communication with the control pipe 7 through the choke 42. It will thus be seen that when the pressure of fluid in pipe 7 is increased, the pressure in chamber 17 will also increase to provide a greater force for opposing movement of the power piston means.

This pressure in chamber 17 may even momentarily increase to a greater degree than that in pipe 7 since movement of the piston head 14 by pressure of fluid in chamber 16 will reduce the volume of chamber 17 and choke 42 will restrict outflow of fluid under pressure from said chamber, the degree of such increase depending upon and varying in proportion to the rate of movement of the power piston means 30 by pressure of fluid in chamber 16. If the rate of movement of the power piston means is relatively slow there may be substantially no increase in pressure in chamber 17 incident to the restricting effect of choke 42, however, if the piston means 30 tends to jump or move rapidly upon supply of fluid to the power chamber 16, the pressure in chamber 17 will suddenly increase to such a degree as to effectively dampen and reduce the rate of movement of said piston means. This damping effect acting in conjunction with the limited or restricted rate of supply of fluid under pressure to the power piston chamber 16 by way of the supply valve will then cause the power piston means 30 to positively stop as soon as the supply valve 63 seats, and hence in a position corresponding to the position of diaphragm 5 and the pressure of fluid in the control pipe 7, as above described. As soon as the power piston means 30 ceases moving, the pressure in chamber 17 will equalize with that in the control pipe 7 by way of choke 42, as will be apparent.

If the operator now desires to rock the lever 23 back toward its normal position he will reduce the pressure of fluid in pipe 7 and diaphragm chamber 6. The regulating spring 36 will then act to move the diaphragm 5 to a position in which the pressure of said spring is counterbalanced by the reduced pressure of fluid in chamber 6, whereupon the diaphragm will cease moving. This movement of the diaphragm and thereby of the operating rod 39 and valve control member 61 will be relative to the power piston means 30, and with the supply valve 63 seated, said valve will draw the release valve 67 away from its seat. Fluid under pressure will then be released from the power piston chamber 16 past the release valve 67 to bore 68 in the piston rod 20 and thence to the release pipe 70.

When the pressure of fluid in the power piston chamber 16 is thus reduced sufficiently, the opposing pressure of fluid in chamber 17 will move the power piston means in the direction of the left-hand. After the diaphragm 5 ceases movement, this movement of the power piston means will be relative to the valve control member 61 and to the release valve 67 until the seat for the release valve moves into engagement herewith to prevent further release of fluid under pressure from chamber 16 in a position of the power piston means corresponding to the position of the diaphragm 5, and thus corresponding to the degree of reduction in pressure in the control pipe 7. The power piston means 30 will stop in this position for reasons which will be later described. This movement of the power piston means 30 will move the lever 23 back toward its normal position, but said lever will stop out of its normal position in a position determined by the reduction in pressure in chamber 7 and the position of diaphragm 5, as will be apparent.

In case the operator desires to return the lever 23 further in the direction of its normal position he will effect a further reduction in pressure of fluid in control pipe 7 and in diaphragm chamber 6 and the motor will again operate as above described to correspondingly change the position of lever 23, as will be apparent. Upon reducing the pressure of fluid in pipe 7 and chamber 6 to the normal degree of eighty pounds, the lever 23 will be returned to its normal position as will also be apparent.

It will thus be seen that the operator can cause the lever 23 to be returned toward its normal position and to be stopped in any selected position out of normal position by reducing the pressure of fluid in the control pipe 7 to the proper degree. Such return movement of lever 23 may be made in any desired number of stops or may be continuous, according to the pressure change in pipe 7 as will be seen.

When the pressure of fluid in pipe 7 is reduced to effect return movement of lever 23, the pressure of fluid in chamber 17 will also tend to correspondingly reduce by flow through choke 42. However, as the power piston means moves toward its normal position it will increase the volume of chamber 17 and the choke means 42 is effective, in case the power piston means 30 tends to move too rapidly or to jump toward its normal position, to so restrict inflow of fluid pressure from control pipe 7 to said chamber, that the pressure in said chamber will reduce below that in the control pipe to a degree proportional to the rate of such movement. This reduction in pressure in chamber 17 will reduce the force on piston means 30 tending to return it to its normal position and this action plus the limited or controlled rate of release of fluid under pressure from chamber 16 by way of the relatively small release port 71 is effective to stop the power piston means 30 immediately upon obtaining a position corresponding to that of the diaphragm, and in which the release valve 67 seats.

It will now be seen that due to the use of choke 42, chamber 17 acts in effect like a dash-pot, and it has been determined that this structure effectively prevents the piston means 30 from overtraveling a position corresponding to the pressure of fluid in the control pipe 7, and hence the position of the control or pilot diaphragm 5. This is very important, for in case the power piston means 30 were moving in response to an increase in pressure in chamber 16 and overtraveled, the release valve 67 would be opened and reduce the pressure of fluid in chamber 16, as a result of which, the direction of movement of the piston means would tend to reverse and close the release valve and reopen the supply valve 63, due to which the piston means would tend to again move in the original direction, resulting in what is known as pumping. Such action might even occur on reducing the pressure of fluid in the pipe 7 as above described. It has, however, been found that the dash-pot structure using control pipe pressure in the dash-pot chamber 17 and choke 42, plus the restricting means for limiting the rates of supply and release of fluid under pressure to and from chamber 16 effectively prevents pumping and renders the power piston means 30 stable and accurate in adjustment. Moreover this structure permits the desired prompt change in position of lever 23 in response to a change in pressure in the control pipe 7.

In the above described operation it will be noted that pressure of fluid in the power chamber 16 acting on the operating rod 39 is opposed and offset by the same pressure of fluid acting in chamber 54 on the ball-like structure 52, so as to have no effect upon the controlling pressure in chamber 6 acting on diaphragm 5.

In case of failure of the supply of fluid pressure on an airplane, as to pipe 7, it is desirable that the different controlling devices on the engine automatically operate to insure continued operation of the engine at an adequate speed to maintain the airplane in the air. The motor above described and shown in Fig. 1 of the drawing may be employed for controlling the richness or temperature of the fuel mixture to the engine, and in case of loss of the supply of controlling fluid pressure to pipe 7, it is desirable that the controlling lever 23 be automatically moved back to its normal position, in which it is shown in the drawing, to provide a rich fuel mixture to the engine or a fuel at a temperature which will insure against freezing of moisture in the fuel supply line.

This automatic return of lever 23 to its normal position is obtained in case of loss of the supply of fluid pressure to the control pipe 7 and diaphragm chamber 6 by means of the regulating spring 36. It will be seen that if the pressure of fluid in chamber 6 is lost, the spring 36 acting through link 45 and rod 39 will move flange 73 on the valve control member 61 into engagement with surface 74 on member 75. This will open the release valve 67 to release any fluid under pressure in chamber 16 and will then pull the piston means 30 to its normal position in which it is shown in the drawing, at which time the follower 33 secured to diaphragm 5 will substantially contact the stop shoulder 37 in the cover. It will be noted that with the parts of the motor in their normal positions, as shown in the drawing, the clearance space between the diaphragm follower 33 and shoulder 37 equals substantially the space between the flange 73 on valve control member 61 and surface 74 on the member 75 secured to the power piston means 30, whereby the above described positioning of the power piston means 30 will be assured in case of loss of fluid pressure in the control pipe 7.

Summary

From the above description it will now be seen that the ball and socket connections between the opposite ends of link 45 and the diaphragm 5 and member 39 renders said diaphragm effective to move said member longitudinally in either one direction or in the opposite direction for controlling operation of the valve control member 61 and valves 63 and 67 to control the pressure of fluid on the power piston 30. This connection is provided to permit deflection of diaphragm 5 relative to member 39 in any direction which would rock the axis of said diaphragm relative to that of said member so that said diaphragm may readily adjust itself to changes in pressure of fluid in chamber 6 without causing member 39 to bind in the wall 4. As a result, the member 39 will be accurately positioned in accordance with even slight changes in controlling pressure in chamber 6 to in turn cause operation of valve 63 or 67 to effect a corresponding change in pressure in chamber 16 for adjusting the power piston 30. The pipe 7 constitutes both a control pipe for diaphragm 5 and a source of fluid under pressure to control operation of the power piston 30, and the link 45 and ball and socket connections at its opposite ends constitute structure for conveying fluid under pressure from said pipe to the supply valve chamber 62 to so control said power piston.

For the purpose intended, the fluid motor is relatively small, compact, light in weight and for the reasons just described, is sensitive to even slight variations in controlling pressure so as to be positive and accurate in adjustment in accordance with such changes in pressure.

Having now described our invention, what we claim as new as desire to secure by Letters Patent, is:

1. A fluid motor comprising a casing, an axially movable member disposed in said casing, means supporting said member against sidewise movement, valve means in said casing arranged for control by said member and operable upon movement of said member in one direction to supply fluid under pressure from one chamber to another chamber, flexible diaphragm means disposed in said casing in coaxial relation with said member, strut means connecting said diaphragm means and member, said diaphragm means being deflectable by fluid under pressure supplied to a third chamber to move said member in said one direction, said strut means comprising a link, and ball and socket-like means connecting opposite ends of said link to, respectively, said diaphragm means and member, said diaphragm means, link and member having cooperating passages provided a fluid pressure supply communication to said one chamber from said third chamber.

2. A fluid motor comprising a casing, a member slidably mounted in a bore in said casing, a flexible diaphragm for operating said member secured around its edge in said casing and comprising a universally movable central portion, an element associated with said central portion for movement therewith, and strut means operatively connecting said member to said element for movement therewith, said strut means and

element comprising interconnecting universal joint operating means.

3. A fluid motor comprising a casing, a member slidably mounted in a bore in said casing, a flexible diaphragm for operating said member secured around its edge in said casing and comprising a universally movable central portion, an element associated with said central portion for movement therewith, a strut, and ball and socket universal joint means connecting opposite ends of said strut to said element and member for moving said member with said element.

4. A fluid motor comprising a casing, a flexible diaphragm secured around its edge in said casing and comprising a universally movable central portion, a bore in said casing at each of the opposite sides of said diaphragm and in coaxial relation therewith, follower means secured to said central position of said diaphragm comprising a member projecting from one side of said diaphragm and having an enlarged spherical like end portion disposed to slide in one of said bores, a member slidably mounted in the other bore, a strut, and ball and socket universal joint means operatively connecting opposite ends of said strut to respectively said member and follower means.

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