Oct. 9, 1956 D. R. HILL ET AL 2,765,622

CONTROL MECHANISM FOR PUMP AND MOTOR FLUID SYSTEM

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Fig. 1

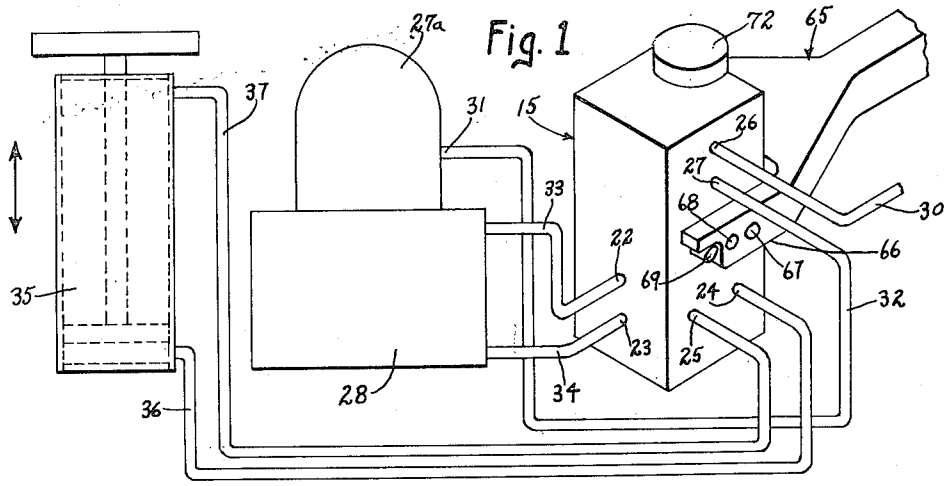


Fig. 2

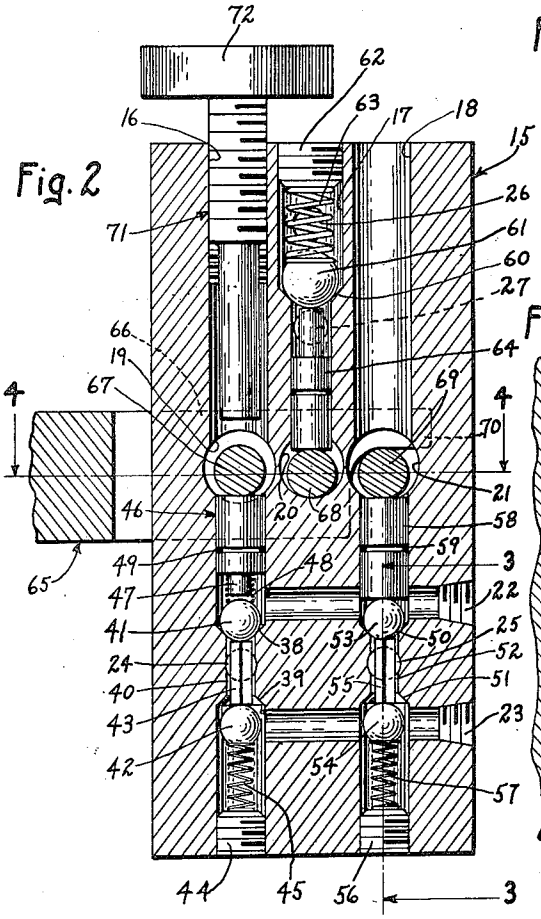


Fig. 3

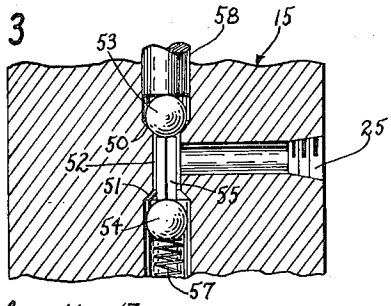
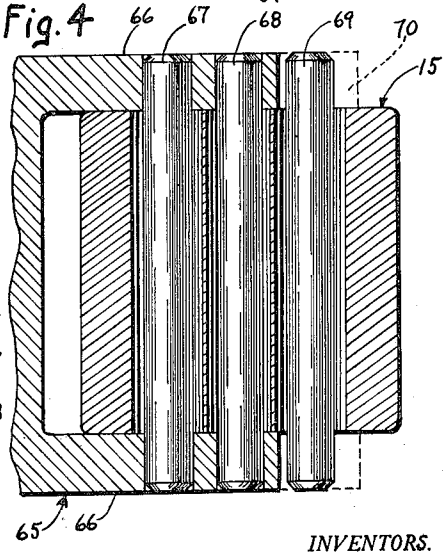


Fig. 4



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Fig. 5

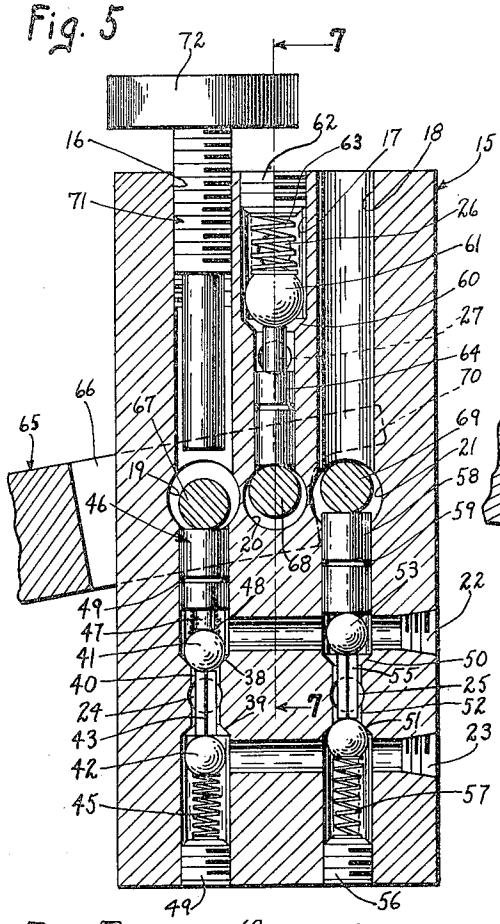


Fig. 6

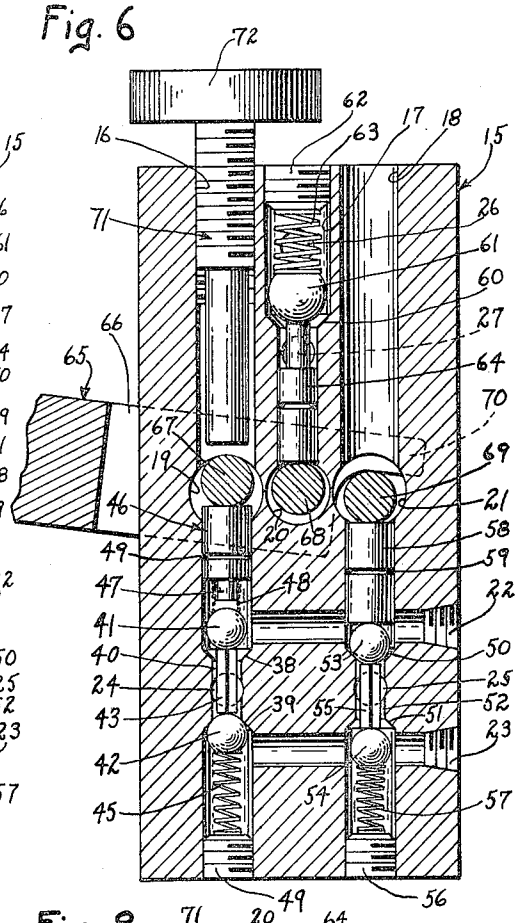


Fig. 7

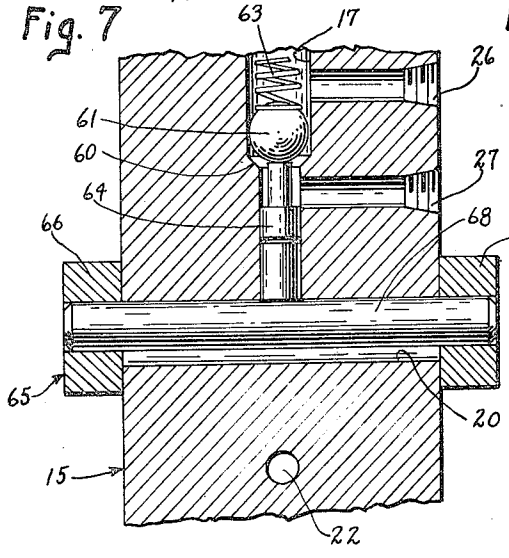
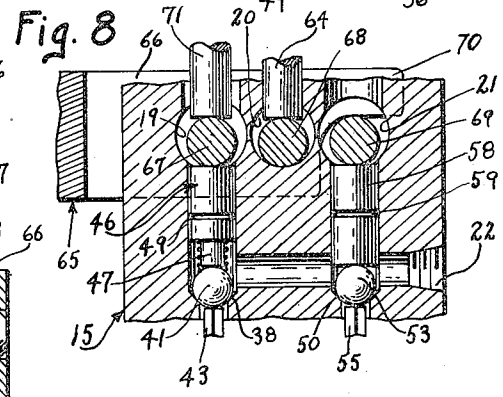


Fig. 8



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CONTROL MECHANISM FOR PUMP AND MOTOR FLUID SYSTEM

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Application April 27, 1950, Serial No. 158,374
4 Claims. (Cl. 60—52)

Our invention relates to control mechanism, particularly to such mechanism as may be used to control an operating motor and a fluid pump operated by such motor, and the principal object of our invention is to provide new and improved control mechanisms of the character described.

In the drawings accompanying this specification and forming a part of this application, there is shown, for purposes of illustration, an embodiment which our invention may assume, and in these drawings:

Figure 1 is a schematic view illustrating our invention in circuit with an operating motor, a fluid pump and a fluid cylinder.

Figure 2 is an enlarged, longitudinal sectional view through control mechanism illustrating an embodiment of our invention.

Figure 3 is a fragmentary, longitudinal sectional view corresponding generally to the line 3—3 of Figure 2,

Figure 4 is a fragmentary, transverse sectional view corresponding generally to the line 4—4 of Figure 2,

Figure 5 is a longitudinal sectional view similar to Figure 2 but with parts in different relation,

Figure 6 is a longitudinal sectional view similar to Figures 2 and 5, but with parts in different relation,

Figure 7 is a fragmentary, longitudinal sectional view corresponding generally to the line 7—7 of Figure 5, and

Figure 8 is a fragmentary, longitudinal sectional view similar to Figures 2, 5 and 6, but with parts in different relation.

Referring to the drawings, the embodiment of our invention herein disclosed comprises a body 15 which, as shown in the several views, may be in the form of an elongated block of metal, rectangular in cross-section.

The body 15, in the present case, is formed with three longitudinally extending bores 16, 17 and 18, only the bores 16 and 18 preferably extending from end to end as shown. The body 15, in the present case, is also formed with three transversely extending bores 19, 20 and 21 which respectively intersect the bores 16, 17 and 18. Spaced cross-bores 22 and 23 establish communication between bores 16 and 18 and also form inlet-outlet ports. Additional inlet-outlet forming ports 24 and 25 communicate respectively with bores 16 and 18, and other inlet-outlet forming ports 26 and 27 communicate with the bore 17.

The control mechanism may be used to control operation of a motor, such as an air motor 27*a*, and also simultaneously control operation of a fluid pump 28, such as a hydraulic pump. The air motor and fluid pump may be a combined unit such as illustrated in a patent application filed by us on December 21, 1948, Serial No. 66,422, and entitled Motor and Control Means, now abandoned.

Referring particularly to Figure 1, the port 26 may be connected to a source of air under pressure by means of a conduit 30 and the port 27 may be connected to the inlet 31 of the air motor 27*a* by means of a conduit 32. The exhaust of the air motor, as in the case of the construction shown in the hereinbefore mentioned application, may be to the atmosphere.

The port 22 may be connected to the reservoir of the hydraulic pump 28 by means of a conduit 33 and the port 23 may be connected to the pressure side of the hydraulic pump 28 by means of a conduit 34. The port 24 may be connected to the lower end of a hydraulic cylinder 35 by means of a conduit 36, and the port 25 may be connected to the upper end of the hydraulic cylinder by means of a conduit 37. The terms "upper" and "lower" used with respect to the cylinder 35 refer to disposition of parts shown in Figure 1, and it will be appreciated that generally the conduits 36 and 37 may be connected to opposite ends of a cylinder or the like.

The bore 16 is formed with spaced valve seats 38 and 39 intermediate the cross-bores 22 and 23. The valve seats are oppositely faced and are in communication by means of a reduced section 40 of the bore 16. Ball valves 41 and 42 are disposed within the bore 16 for cooperation with respective valve seats 38 and 39, and a pusher pin 43 provides for solid connection between the ball valves 41 and 42. The pusher pin 43 may be in the form of a metal rod that is square in cross-section and of such cross-sectional size that it will remain aligned with the bore section 40 yet will permit flow of fluid therepast.

The lower end of the bore 16 (with respect to the disposition of parts in the drawings) is closed by a plug 44 and a coil spring 45 is interposed between the inner end of the plug 44 and the ball valve 42 to urge such valve in a direction toward its seat. A reciprocable plunger 46 is disposed within the bore 16, the upper end of this plunger communicating with the transverse bore 19 and its lower end 47 being reduced in cross-section. A coil spring 48 is interposed between the ball valve 41 and the shoulder formed by the reduced end 47 of the plunger 46. To prevent leakage of fluid, the plunger 46 may be formed with an undercut groove to receive an O-ring packing 49. As shown in the position of parts in Figure 2, the lower extremity of the reduced end 47 of the plunger is spaced from abutment with the ball valve 41, the spring 48 establishing engagement between the plunger and the ball valve.

The bore 18 is formed with spaced valve seats 50 and 51 intermediate the cross-bores 22 and 23. The valve seats 50 and 51 are also oppositely faced and are in communication by means of a reduced section 52 of the bore 18. Ball valves 53 and 54 are disposed within the bore 18 for cooperation with respective valve seats 50 and 51, and a pusher pin 55, similar to the pusher pin 43, is interposed between the ball valves 53 and 54.

The lower end of the bore 18 is closed by a plug 56 and a coil spring 57 is interposed between the inner end of the plug and the ball valve 54 to urge such valve in a direction toward its seat. A reciprocable plunger 58 is disposed within the bore 18, the upper end of the plunger communicating with the transverse bore 21 and the lower end of such plunger bearing against the ball valve 53. An O-ring packing 59, seated in a groove in the plunger 58, prevents leakage past the plunger. The packings 49 and 59 need not be of excessive size since they are not called upon to hold fluid pressure but merely prevent leakage past respective plungers 46 and 58.

The bore 17 is formed with a valve seat 60 disposed intermediate the ports 26 and 27 and a ball valve 61 is cooperable with this seat. A plug 62 closes the upper end of the bore 17 and a relatively powerful coil spring 63 is interposed between the inner end of the plug and the ball valve 61 to urge such valve to its seat.

A plunger 64 is movable within the bore 17 and has its lower end in communication with the transverse bore 20. The upper end of the plunger 64 is reduced in cross-sectional size so as not to interfere with air flow through port 27 and the extremity of this upper end bears against the ball valve 61. An O-ring packing may be seated in a

groove in the plunger 64 to prevent leakage of air therepast.

A single operating means is provided for synchronous operation of the valves hereinbefore described, and as herein shown such means comprises a lever 65 terminating in a bifurcated end, the furcations 66 being disposed on opposite sides of the body 15, as best seen in Figures 1 and 4.

Each furcation 66 is provided with a pair of apertures, respective apertures being axially aligned to receive cross-pins 67 and 68 which respectively extend through transverse bores 19 and 20. A cross-pin 69 extends through transverse bore 21. As seen in the drawings, the cross-pins 67, 68 and 69 are of less cross-sectional size than the respective transverse bores 19, 20 and 21 so that the pins may have movement in the respective bores. The terminal end of each furcation 66 is formed with a notched portion 70 providing ledge surfaces for cooperation with the adjacent extremities of the cross-pin 69. It will be appreciated that the cross-pin 69 may be prevented from dropping from assembly with the body 15 in any suitable manner, such as by means of exterior snap rings, or the like.

In operation, and assuming that connections have been made as illustrated in Figure 1, with the lever 65 in neutral position as shown in Figure 2, flow of air from the source to the air motor is blocked since the spring 63 urges the ball valve 61 to its seat. Therefore, the air motor 27*a* and the fluid pump 28 remain inoperative. The fluid load in the cylinder 35 is lost, in this relation of parts, since fluid under pressure may return from the lower end of the cylinder 35 through conduit 36, cross-bore 24, unseat valve 41, and pass through cross-bore 22 to the reservoir of fluid pump 28.

In the event it is desired to elevate the piston in the cylinder 35, an operator depresses the lever 65 (with relation to disposition of parts shown in the drawings). Such operation is illustrated in Figure 5. During movement of the lever, certain of the cross-pins 67, 68 and 69 act as pivot points to effect swinging movement of the lever 65.

For example, when the lever 65 is depressed, cross-pin 67 is first moved downwardly since the relatively powerful coil spring 63 opposes movement of cross-pin 68. When cross-pin 67 has been moved downwardly an amount sufficient to overcome spring 63 such as, in this case, when the lower end of plunger 46 firmly seats ball valve 41, cross-pin 68 will move upwardly to engagement with the upper defining surface of the cross-bore 20. Thus, cross-pin 68 initially provides pivot for the lever 65 until cross-pin 67 is stopped in its downward movement, at which time cross-pin 67 forms the pivot for the lever. The short lever arms from cross-pin 68 to cross-pins 67 and 69 makes actuation of the valve very sensitive so that only a small movement of the lever 65 is necessary to effect operation of the parts.

In Figure 5, the cross-pin 67 has been moved downwardly, such movement being arrested when the plunger directly engages the ball valve 41 and firmly holds such valve to its seat. The plunger 46 is moved downwardly through its engagement with the cross-pin 67 an amount to further compress the spring 48 or to bring the plunger 46 into firm engagement with the ball valve 41, depending upon the amount of movement of the lever 65.

Upward movement of the cross-pin 68, through corresponding movement of the plunger 64, causes unseating of the ball valve 61, so that air may flow from a pressure source, through ports 26 and 27 to the air motor 27*a* and thus cause operation of the motor. Simultaneously with the unseating of the ball valve 61 the ball valve 41 is firmly held to its seat by downward movement of the cross-pin 67 and plunger 46.

Also, simultaneously with the unseating of ball valve 61, the ball valve 53 is unseated and the ball valve 54 is seated through upward urging force of the spring 57.

Such upward movement is permitted by the lever 65 by reason of the fact that the notched portion 70 is moved out of engagement with the adjacent ends of the cross-pin 69 and permits plunger 58 and cross-pin 69 to move upwardly. Thus, fluid under pressure from the pump 28 may flow through conduit 34, port and cross-bore 23, past ball valve 42, through bore section 40, cross-bore 24, conduit 36 to the lower end of cylinder 35, to move the piston of this cylinder upwardly. Fluid in advance of the piston may return through conduit 37, port 25, bore section 52, cross-bore and port 22, conduit 33, to the reservoir of fluid pump 28.

With the parts in relation as shown in Figure 5, if for any reason the operator releases downward pressure on the operating lever 65, the parts will automatically return to neutral relation as shown in Figure 2. Such return is immediately caused by the relatively strong spring 26 which urges the ball valve 61 to its seat and is overcome only by positive pressure on the operating lever 65. Seating of the ball valve 61 moves the plunger 64 downwardly, the latter moving the cross-pin 68 into engagement with the lower surface of the bore 20. Since the cross-pin 68 is secured to the bifurcations 66 of the lever 65, the latter is moved to the neutral position shown in Figure 2.

To return (or lower) the piston of the cylinder 35, the operating lever 65 is moved in an upward direction so that the parts assume the relation shown in Figure 6. As before, if operating pressure is released, the lever 65 and operating parts will automatically return to the neutral position shown in Figure 2, through action of the spring 63.

In the relation of parts shown in Figure 6, the notched ends 70 of the lever furcations 66 press downwardly on adjacent ends of the cross-pin 69 and urge such pin downwardly. The plunger 58 is also urged downwardly, through contact with the cross-pin 69, and firmly seats the ball valve 53 and the latter unseats the ball valve 54 through action of the pusher pin 55. Such action will provide for overpowering of the spring 63 so that the cross-pin 68 will be moved upwardly into engagement with the upper surface of the transverse bore 20. As before, upward movement of the cross-pin 68 effects unseating of the ball valve 61. As shown in Figure 6, the cross-pin 67 is also moved upwardly, thus permitting the spring 45 to seat the ball valve 42 and the latter, through the pusher pin 43, unseats the ball valve 41.

With the parts in the relation shown in Figure 6, air under pressure flows to the air motor 27*a* and operates the same. Fluid, under pressure from the pump 28, flows through conduit 34, port and cross-bore 23, ball valve 59, bore section 52, cross-bore 25, conduit 37, to the upper end of the cylinder 35 to force the piston downwardly. Fluid in advance of the piston will be displaced from the lower end of the cylinder through conduit 36, port and cross-bore 24, ball valve 41, cross-bore 22, conduit 33, to the reservoir of the fluid pump 28.

Means are provided to selectively prevent loss of fluid load when the lever 65 is depressed and then released and also to provide for a selected load pressure. In the embodiment herein disclosed, such means takes the form of a screw 71 which is threaded into the upper end of the bore 16. The outer end of the screw may carry a hand wheel 72 for effecting manual adjustment of the screw.

The screw 71 may be turned downward so that its lower end presses the cross-pin 67 to any selected downward position. Thus, the screw 71 may be turned downward to merely compress the spring 48 a selected amount, in which case the ball valve 41 will act as a relief valve after a predetermined amount of pressure is established in the cylinder 35, or the screw 71 may be turned downward to firmly seat the ball valve 41 so that full pressure will be maintained in the cylinder.

As shown in Figure 8, although the screw 71 has been turned downward to engage the ball valve 41 a selected

amount, the lever 65 will remain in neutral position through action of the spring 63 when no manual downward pressure is exerted on the lever 65. Hence, when the air motor 27*a* is stopped to interrupt pumping operation of the pump, flow of fluid from the lower end of the cylinder 35 backwardly in conduit 36 is prevented by the ball valve 41, either completely or to the adjusted pressure determined by the compression of the spring caused by the adjusted downward position of the screw 71. The screw and body may be provided with pressure indicating means, or a pressure gauge may be inserted in the conduit 36 to provide for visual reading of pressure.

If the screw 71 is threaded to firmly hold the ball valve 41 to its seat and an operator desires to lower the piston by lifting upwardly on the lever 65, the lever will pivot about the cross-pin 67 and tend to swing cross-pin 68 downwardly. Thus, the air motor will not be operated and this will be an indication to the operator that the screw 71 must be backed away from the cross-pin 67.

From the foregoing it will be apparent to those skilled in the art that we have accomplished at least the principal object of our invention, and it will also be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described; hence it will be appreciated that the herein disclosed embodiment is illustrative only, and that our invention is not limited thereto.

We claim:

1. A fluid circuit comprising in combination, a first fluid motor, a fluid pump for effecting operation of said first fluid motor, a second fluid motor for driving said fluid pump, a source of fluid under pressure for effecting operation of said second fluid motor, and valve means for controlling flow of fluid from said source to said second fluid motor and for controlling flow of fluid between said pump and said first fluid motor, in one position of said valve means communication being interrupted between said source of fluid pressure and said second fluid motor and communication being established between the opposite ends of said first fluid motor to effect equalization of pressure therein, in another position of said valve means communication being established between said source of fluid pressure and said second fluid motor and communication between opposite ends of said first fluid motor being interrupted and communication established between said fluid pump and one end of said fluid cylinder.

2. Control mechanism comprising three elongated members in spaced-apart side-by-side relation and providing an intermediate member flanked by two side members, valve means associated with each of said elongated members, each valve means comprising a movable valve member controlling fluid flow through a valve port, and operating means for effecting substantially simultaneous movement of at least two of said elongated members in a direction transversely of their axes and consequent movement of the respective associated valve means, movement of said operating means in one direction from a central position effecting rotation of one of said side elongated members and said intermediate elongated member about the axis of said other elongated member, and movement of said operating means in the opposite direction from said central position effecting rotation of said other elongated member and said intermediate elongated member about the axis of said one elongated member.

3. Control mechanism comprising a body having three side-by-side transverse cross-bores, three elongated cross-pins extending through respective cross-bores and having their extremities projecting from opposite sides of said body, each pin being of smaller transverse size than its bore so that it may move therein in a direction transverse to its axis, the intermediate cross-pin engaging a first plunger working in an upper longitudinal bore, said first plunger being interposed between said intermediate cross-pin and a first ball valve, a relatively strong spring urging said ball valve to seated relation and through said first plunger urging said intermediate cross-pin downwardly in its cross-bore, a pair of second plungers each working in a lower longitudinal bore and each engaging a respective one of the cross-pins flanking said intermediate pin, each of said second plungers being interposed between its respective cross-pin and a second ball valve, relatively weaker springs urging said second ball valves to unseating relation and through said second plungers urging said flanking cross-pins upwardly in their respective cross-bores, and a bifurcated operating handle engaging the projecting portions of said cross-pins, said operating handle being movable through a central position to two operating positions, in one operating position utilizing one of said flanking cross-pins as a fulcrum to overcome said relatively strong spring and move said intermediate cross-pin and the other of said flanking cross-pins upwardly to unseat the respective ball valves, and in the other of its operating positions said operating handle utilizing said other of said cross-pins as a fulcrum to overcome said relatively strong cross-pin and move said intermediate cross-pin and said one cross-pin upwardly to unseat the respective ball valves.

4. A fluid circuit comprising in combination, a hydraulic cylinder including a piston movable within said cylinder toward one end or the other, a hydraulic pump providing liquid under pressure to move said piston, an air motor for driving said hydraulic pump, said air motor being connectable to a source of air under pressure to effect operation thereof, and valve means for controlling flow of liquid under pressure from said pump to said hydraulic cylinder and simultaneously for controlling air under pressure from said source to said air motor, said valve means having a neutral position and two operating positions and in neutral position interrupting flow of air under pressure to said air motor and flow of liquid under pressure to said hydraulic cylinder, and in one operating position providing for flow of air under pressure to said air motor and also providing for flow of liquid under pressure to one end of said cylinder to drive said piston in one direction, and in the other operating position providing for flow of air under pressure to said air motor and also providing for flow of liquid under pressure to the opposite end of said cylinder to drive said piston in the opposite direction.

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