July 6, 1943. W. F. BOLDT 2,323,788

CONTROL VALVE MECHANISM

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FIG. 1.

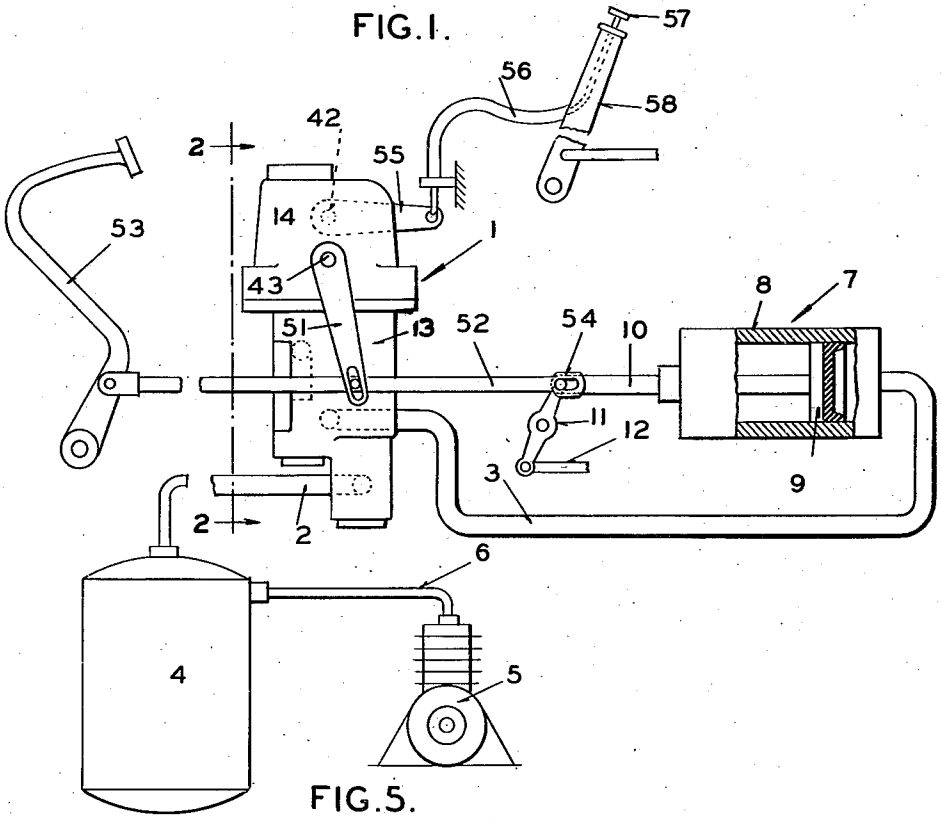
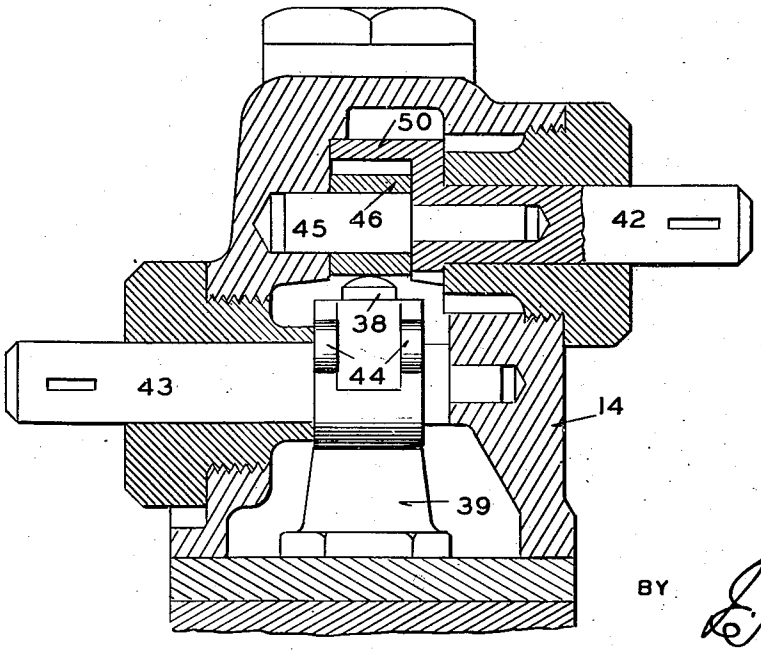


FIG. 5.



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FIG. 4.

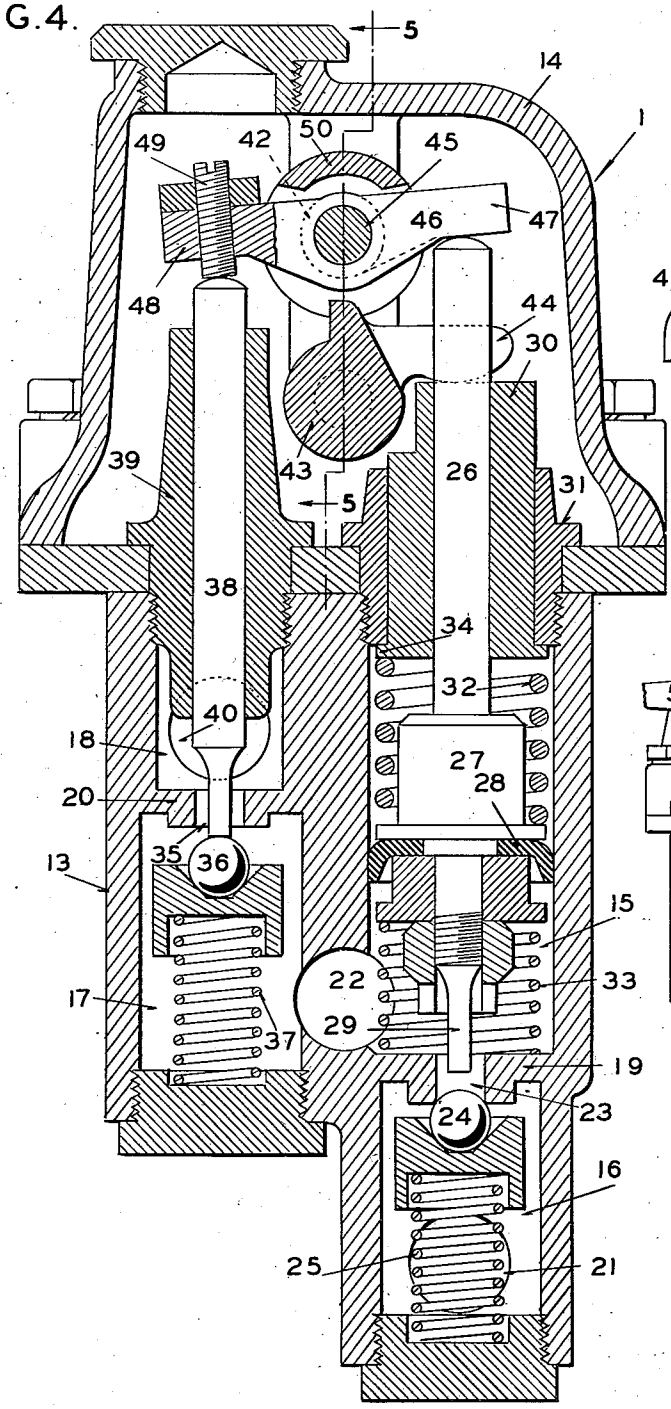


FIG. 2.

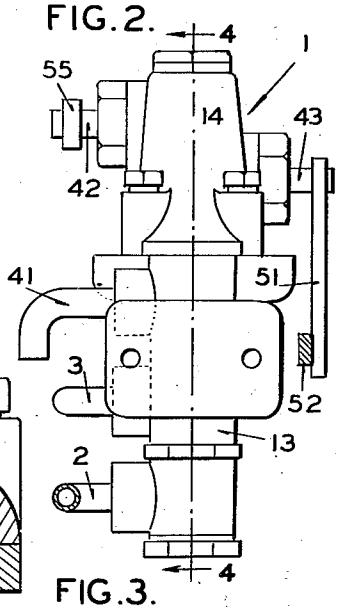
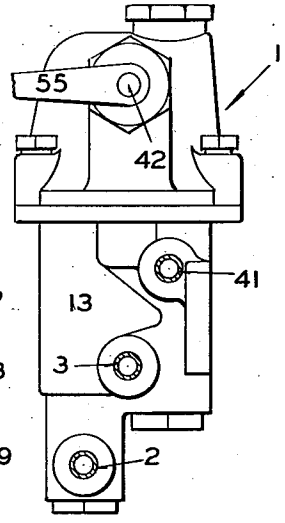


FIG. 3.



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UNITED STATES PATENT OFFICE

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CONTROL VALVE MECHANISM

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Application April 20, 1942, Serial No. 439,631

11 Claims. (Cl. 137—139)

My invention relates to control valve mechanism and particularly to such a mechanism for controlling the flow of fluid to and from a device to be actuated.

One of the objects of my invention is to produce an improved control valve mechanism which can be actuated by independent operating means.

Another and more specific object of my invention is to produce a foot and hand-actuated control valve mechanism which, when actuated by the foot of an operator, will function as an automatic metering valve and when independently actuated by the hand will function without the automatic metering valve but will permit metering to be accomplished by proper manipulation of the portion of the hand performing the actuation.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawings in which Figure 1 is a schematic view of a fluid pressure system embodying my improved control valve mechanism; Figure 2 is a view of the valve mechanism as viewed from line 2—2 of Figure 1; Figure 3 is a view of the valve mechanism as viewed from the left side of Figure 2; Figure 4 is an enlarged sectional view taken on the line 4—4 of Figure 2; and Figure 5 is a sectional view taken on the line 5—5 of Figure 4.

Referring first to Figure 1, there is disclosed a fluid pressure actuating system in which is embodied my novel control valve mechanism generally indicated by the reference numeral 1. This control valve mechanism is interposed between conduits 2 and 3, conduit 2 being connected to a source of air pressure comprising a storage tank 4 receiving air under pressure from a compressor 5 through a conduit 6. The other conduit 3 is connected to a power cylinder 7 comprising a cylinder 8 and a piston 9. The piston 9 is provided with a piston rod 10 for connection with a lever 11 which is capable of actuating any desirable mechanism as by a rod 12.

My improved control valve mechanism 1 is shown in detail in Figures 2, 3, 4, and 5 and is embodied in a lower casing member 13 and an upper casing member 14. The lower casing member is formed with four cylindrical chambers 15, 16, 17, and 18, chambers 15 and 16 being in axial alignment and separated by a partition 19 and chambers 17 and 18 being in axial alignment and separated by a partition 20. Chamber 16 is provided with a port 21 to which is connected conduit 2 leading from the storage tank 4. A port 22 in the wall between chambers 15 and 17 places these chambers in communication with each other and also connects both of them to conduit 3 leading to the power cylinder 7.

The partition 19 between chambers 15 and 16 is provided with a passage 23 and controlling this passage is a ball valve element 24 normally biased to closed position by means of a spring 25. When this valve is closed, communication is cut off between chamber 16 and chambers 15 and 17, and when it is open, fluid under pressure may flow from the storage tank to the power cylinder.

Positioned in chamber 15 is a stem 26 provided with a piston portion 27 and a packing 28. The lower end of this stem has a portion 29 projecting beyond the piston for engaging the ball valve element 24 to unseat it. The upper end of the stem extends through a sleeve 30 into the upper casing 14, said sleeve being guided in a hollow nut 31 which serves to clamp the upper casing 14 to the top of the lower casing 13. Interposed between the piston 27 and sleeve 30 is a relatively strong spring 32 which normally is in a substantially uncompressed condition. A second and weaker spring 33 is interposed between piston 27 and the partition 19, said spring biasing the piston upwardly and to a position where the lower portion 29 of the stem is out of engagement with the ball valve element 24. The sleeve 30 is prevented from being moved upwardly beyond a predetermined position by means of a flange 34 abutting the lower end of the hollow nut 31.

The partition 20 between chambers 17 and 18 is provided with a passage 35 and controlling this passage is a ball valve element 36 normally biased toward a position closing the passage by means of a spring 37. A stem 38 is positioned in chamber 18 and extends into the upper casing 14, said stem being employed for controlling the opening and closing of the ball valve element 36. This stem is guided in a hollow nut 39 which also serves to clamp the upper casing 14 to the lower casing 13. Chamber 18 is provided with an exhaust port 40 which is connected to the atmosphere by a short conduit 41.

Within the upper casing 14 are journaled two shafts 42 and 43 for controlling the stems in the desired manner. The upper shaft 42 extends to the exterior of the casing on the rear side as viewed in Figure 1 and shaft 43 extends to the forward side of the casing as viewed in Figure 1. Shaft 43 carries a forked arm 44 which overlies the upper end of sleeve 30 whereby said sleeve may be actuated when shaft 43 is rotated. As best seen in Figure 5, the upper shaft 42 has

pivotally mounted thereon, by means of a pin 45, a lever 46, said lever having one arm 47 adapted for engagement with the upper end of stem 26 and another arm 48 adapted for engagement with the upper end of stem 38, said arm 48 carrying an adjustable screw 49. The shaft 42 is capable of actuating the lever 46 by means of a projection 50 which overlies said lever.

The shaft 43 carries on its outer end an arm 51 which has connected thereto a rod 52 (Figure 1), said rod forming a connection between a pedal 53 and the previously referred to lever 11 which is actuated by the power cylinder. A lost motion connection 54 is provided between the rod and lever 11. The outer end of shaft 42 is provided with an arm 55 which is adapted to be actuated from any remote point by a Bowden wire 56 having a thumb-controlled button 57. As shown in Figure 1, the button may be positioned on the end of a lever 58 used to control some other mechanism. It is thus seen that there is a foot pedal control for shaft 43 and a hand control for shaft 42.

When the valve mechanism is in its inoperative condition as shown in Figure 4, the ball valve element 24 will be held seated and the lower end of stem 26 will be held away from said ball element by the spring 33. The sleeve 30 will be held in its upper position where flange 34 engages the hollow nut 31 by the force transmitted through spring 32. When stem 26 is held in this position, the other stem 38 will be pushed downwardly by means of the force transmitted through lever 46, and it will hold the ball valve element 36 off its seat against the force of spring 37, said spring 37 being weaker than spring 33 which acts upon plunger 27 and stem 26. When the valve element 24 is closed and the valve element 36 is open, the storage tank will be disconnected from the power cylinder and said power cylinder will be in communication with the atmosphere.

If it is now desired to actuate the power cylinder, this can be done by operating either of the two independent operating means, namely, the foot pedal or the button 57 of the Bowden wire. If it is desired to employ the pedal, movement of the pedal forwardly will result in shaft 43 being rotated and sleeve 30 surrounding stem 26, moved downwardly. Since spring 32 is considerably stronger than spring 33, stem 26 will also be moved with the sleeve. As the stem moves downwardly, spring 37 will be effective to cause the seating of the valve element 36 since the pressure is relieved on top of stem 38. When the valve element 36 is closed, the power cylinder will be disconnected from atmosphere. Additional movement of sleeve 30 downwardly, carrying with it the stem 26, will now cause the valve element 24 to be unseated. This will permit air under pressure from the storage tank to flow to the power cylinder and cause the piston thereof to move, which movement will result in actuation of lever 11. Movement of pedal 53 does not directly actuate lever 11 due to the lost motion connection 54. However, if there should be no air pressure in the tank, movement of the pedal would directly actuate lever 11 as soon as the lost motion of the connection 54 is taken up. The lost motion, however, is sufficient to permit valve element 36 to be closed and valve element 24 to be open before there is any direct connection between rod 52 and lever 11. When fluid pressure flows to the power cylinder, it is also effective on plunger 27 and when it has built up sufficiently to compress spring 32, the valve stem 26 will be moved upwardly so that valve element 24 will be reseated. If additional pressure is desired in the power cylinder, it can be secured by further depressing the foot pedal and again unseating valve element 24. When the foot pedal is released, the return of stem 26 to its position shown in Figure 4 will result in the valve element 36 being opened and the air pressure exhausted to atmosphere.

If it is desired to operate the control valve mechanism by hand, the thumb of the operator is employed to actuate the button 57 of the Bowden wire. Such operation will cause shaft 42 and lever 46 to be rotated in a clockwise direction as viewed in Figure 4. Stem 26 will now be moved downwardly and valve element 36 will become closed and valve element 24 will be subsequently opened. It is to be noted that when stem 26 is moved by the Bowden wire there will be no yieldable means in the connection between the manually-moved member and stem 26. Thus the function of the spring is eliminated and there will be no automatic metering action permitted whereby the valve element 24 will close when a predetermined pressure is present in chamber 15. When stem 26 is held down so that the valve element 24 will be held open indefinitely, the entire air pressure of the storage tank will become effective in the power cylinder. The operator, however, is able to ascertain the amount of air pressure which is being transmitted to the power cylinder by "feel." As pressure builds up in the power cylinder it will also build up in chamber 15 and act on plunger 27. This in turn will be transmitted to the thumb of the operator by means of lever 46 and the Bowden wire. Thus, by means of this "feel," the operator can meter in the amount of air under pressure which he desires in the power cylinder.

From the foregoing it is seen that when the foot pedal is employed to control the valve mechanism, the metering will be automatic due to the compressing of spring 32. When the hand control mechanism is employed, the automatic metering is eliminated and the operator will depend upon manual metering which is controlled by the movement of the thumb of the hand of the operator. There has thus been produced a valve mechanism which has two independent manual control means, one of which permits automatic metering and the other of which permits manual metering.

Being aware of the possibility of modifications in the particular structure herein described without departing from the fundamental principles of my invention, I do not intend that its scope be limited except as set forth by the appended claims.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a valve means for controlling the flow of fluid under pressure from a source of fluid pressure to a device to be actuated, said valve means comprising an inlet valve element, means including a pressure responsive means tending to cause the closing of said valve element by the fluid pressure admitted when the valve element is open, actuating means for opening said valve element and comprising a yieldable member, and other actuating means for opening said valve element independently of the yieldable member.

2. In a valve means for controlling the flow of fluid under pressure from a source of fluid pressure to a device to be actuated, said valve means

comprising an inlet valve element, means for opening said valve element, means associated with said last named means for causing automatic closing of the valve element when a predetermined fluid pressure is admitted to the device, and other means for opening said valve element independently of the automatic closing means.

3. In a valve means for controlling the flow of fluid under pressure from a source of fluid pressure to a device to be actuated, said valve means comprising an inlet valve element, foot-operated means for opening said valve element, means associated with the foot-operated means for causing automatic closing of the valve element when a predetermined fluid pressure is admitted to the device, and hand-operated means for opening the valve element and maintaining it open at the will of the operator.

4. In a fluid pressure control valve mechanism, an inlet valve element, a movable member for opening the valve element and subjected to the fluid pressure admitted by the valve in such a manner as to produce a force for moving said member toward valve closing position, a hand-actuated member, non-yieldable means for directly transmitting manual force from the hand-actuated member to the valve opening member, a foot-actuated member, and means for transmitting force from the pedal to the valve opening member and comprising a yieldable means permitting the movable member to be so moved by the fluid pressure acting thereon that the valve element can be closed thereby.

5. In a fluid pressure control valve mechanism, an inlet valve element, a member for opening the valve element, manually-operated means for opening the valve element and comprising a non-yieldable force transmitting connection between said manually-operated means and the member, other manually-operated means for opening the valve element and comprising a yieldable force transmitting connection between said other manually-operated means and the member, and means for producing a reaction force on the valve opening member in proportion to the fluid pressure admitted by the inlet valve element.

6. In a fluid pressure control valve mechanism, an inlet valve element, a stem for opening the valve element, a movable wall connected to said stem and subject to the fluid pressure passing the valve element, a spring for biasing the stem to a valve-closed position, a second spring between the sleeve and piston, a manually-operated member for actuating the stem through the spring, and another manually-operated member for actuating the stem independently of the second spring.

7. In a fluid pressure control valve mechanism, an inlet valve element, a stem for opening the valve element, a piston carried by said stem and subject to the fluid pressure passing the valve element, a spring for biasing the stem and piston to a valve-closed position, a sleeve slidable on said stem at the rear of the piston, a spring between the sleeve and piston, a manually-operated member for actuating the sleeve, and an independent manually-operated member for actuating the stem.

8. In a fluid pressure control valve mechanism, an inlet valve element, a stem for opening the valve element, a piston carried by said stem and subject to the fluid pressure passing the valve element, a spring for biasing the stem and piston to a valve-closed position, a sleeve slidable on said stem at the rear of the piston, a second spring between the sleeve and piston, a foot pedal connected to actuate the stem through the sleeve, a second spring to thereby open the valve element, and a hand-operated member connected to actuate the stem independently of the sleeve and second spring.

9. In a control valve mechanism, a casing having a normally closed inlet valve and a normally open exhaust valve therein, actuating stems for the valves, independently-operated manual means for so controlling the stems as to open said inlet valve and close said exhaust valve, a movable wall associated with the stem of the inlet valve and acted upon by fluid pressure admitted by the inlet valve to thereby establish a force tending to move the stem to a position permitting the inlet valve to be closed, and spring means interposed between the wall and one of the manual means only.

10. In a fluid pressure control valve mechanism, an inlet valve element, a stem for controlling the valve element, an exhaust valve element, a second stem for controlling the exhaust valve element, a lever for connecting the stems, a spring for normally holding the stems and lever in position where the inlet valve is closed and the exhaust valve is open, a piston carried by the stem of the inlet valve element and capable of being acted upon by fluid pressure admitted by the inlet valve element, manually-operated means for causing the exhaust valve to be closed and the inlet valve to be opened, said manually-operated means when actuated applying a non-yieldable force to the stem of the inlet valve element, and a second manually-operated means for causing the exhaust valve to be closed and the inlet valve to be open and embodying a yieldable element through which force is transmitted to the stem of the inlet valve element.

11. In a fluid pressure control valve mechanism, an inlet valve element, a stem for controlling the valve element, an exhaust valve element, a second stem for controlling the exhaust valve element, a lever for connecting the stems, a spring for normally holding the stems and lever in position where the inlet valve is closed and the exhaust valve is open, a piston carried by the stem of the inlet valve element and capable of being acted upon by fluid pressure admitted by the inlet valve element, hand-operated means for causing the exhaust valve to be closed and the inlet valve to be opened, said hand-operated means being connected to the lever and when actuated applying a non-yieldable force to the stem of the inlet valve element, and a foot-operated means for causing the exhaust valve to be closed and the inlet valve to be open and embodying a spring through which force is transmitted to the stem of the inlet valve element.

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