Feb. 18, 1941. G. G. MORIN ET AL 2,232,467

COMPOUND VALVE

Filed Sept. 5, 1940

Fig. 1.

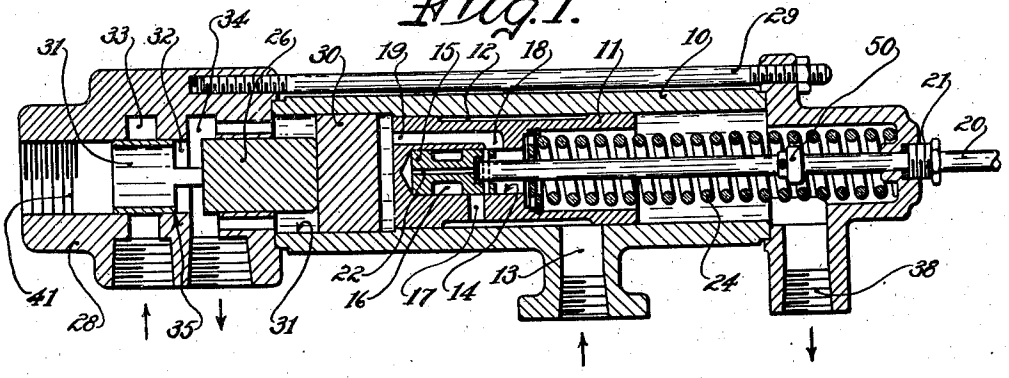


Fig. 2.

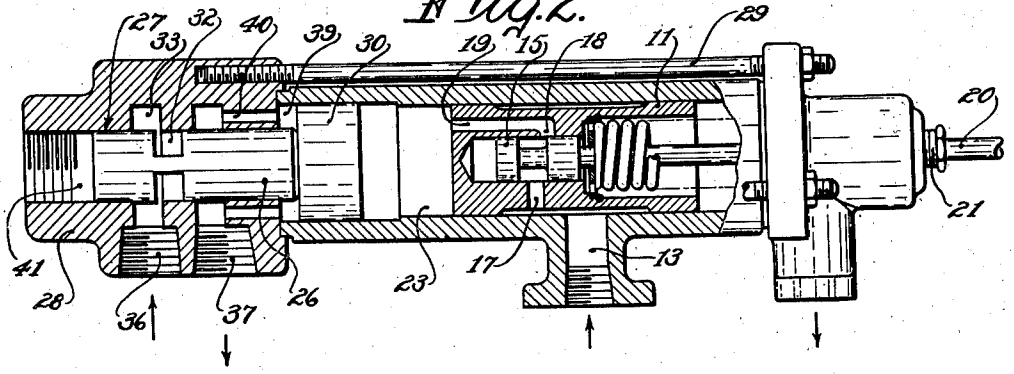
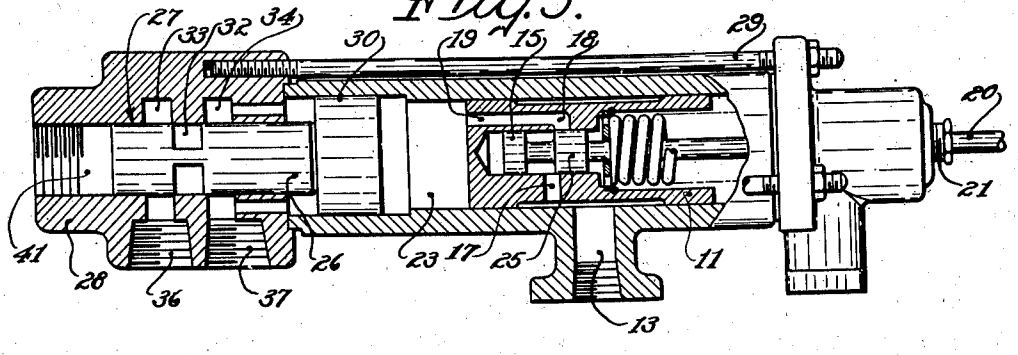


Fig. 3.



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COMPOUND VALVE

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Application September 5, 1940, Serial No. 355,432

6 Claims. (Cl. 303—54)

This invention relates to hydraulic control valves of the general type shown in our Patent 2,121,389, June 21, 1938. The valve described in that patent received fluid under pressure from a constant pressure source and delivered it at a pressure which could be regulated accurately to any degree desired under both static and moving conditions. The regulation of pressure in that valve depended upon the compression of a spring which maintained the fluid pressure at all times when the source was cut off by the regulating valve. In many instances it has proved desirable to use a higher pressure than can economically be controlled by a compression spring mounted as described in that prior patent since the heavier types of springs are harder to make and more difficult to maintain in accurate condition.

It is the object of the present invention to provide a valve by which a relatively high unit hydraulic pressure at the delivery end of the valve may be controlled by a compression spring of moderate size. A further object is to produce a valve of this character of simple construction and in which those valve parts which have to be made in concentric relation can be kept large enough to permit accurate and ready machining. Additional objects will appear from the following description and claims.

Referring to the drawing:

Figs. 1, 2, and 3 are longitudinal sections through a valve construction in accordance with the invention—Fig. 1 showing the valve in discharging position; Fig. 2 in a position feeding pressure fluid from the inlet line directly to the exhaust; and Fig. 3 showing the valve in balanced or static position.

The valve is composed of two sections, a low pressure section which is constructed substantially in accordance with our prior patent, and a high pressure section connected to and operated by it. The low pressure section is contained within a cylinder 10 within which runs a piston 11 having an annular groove or channel 12 around its central part which in all operative positions overlies an inlet port 13. The piston 11 may have suitable rings to preserve fluid tightness which are not necessary to illustrate in the drawing. Within the piston 11 is a bore 14 in which a pilot valve 15 may slide. The pilot valve has a central circumferential channel 16 which may be shifted into alignment with an inlet port 17 extending from the bore 14 into the channel 12; and which may also come into registration with a delivery port 18 opening at 19 at the end of the piston 11. The pilot valve 15 is fitted with a control handle 20 extending outwardly through a stuffing box 21 at the end of the casing and has a hole 22 through its center so that the pressures on its two ends may be balanced.

If the pilot valve is drawn toward the right as shown in Fig. 2, its right hand end portion, which has been blocking the port 17 as shown in Fig. 1, will be shifted clear of this port and the ports 17 and 18 will be put into direct communication through the channel 16. This admits fluid under pressure into a chamber 23, located at the left hand end of the piston and which may be considered at the present stage of the description as being blocked off in any suitable way so that a pressure may be built up. This will cause the piston 11 to move toward the right against the resistance of a compression spring 24 mounted between the piston and the end of the casing. When the piston has moved into the position of Fig. 3, in which the exhaust port 18 is blocked off by the end 25 of the pilot valve, the total pressure in the chamber 23 will balance the force exerted by the compressed spring 24. The valve will remain in this condition, with the unit pressure in the chamber 23 fixed at the point determined by the setting of the rod 20, unless some outside conditions disturb this equilibrium. In order to prevent the piston 11 being moved so far to the right that the spring 24 will be compressed beyond a safe limit, a stop 50 is preferably secured to the rod 20 to limit its movement.

The arrangement as described above is substantially that covered by our prior patent referred to with the exception that in that prior patent the chamber 23 was directly connected to the delivery line in which the fluid pressure was to be controlled. In the present case it is desirable to achieve a higher unit pressure than can be given in the chamber 23 by the mechanism already described. For this purpose a second piston valve 26 is located within a bore 27 of a casing 28 mounted in fixed relation to the casing 10 as by tie bolts 29. The piston valve 26 is made of a cross-sectional area substantially less than that of the low pressure piston valve 11 and at its end bears against an intermediate piston 30 sliding in a bore 31 which may be a continuation of the bore within the casing 10 if desired. This piston 30 is subjected on one side to a hydraulic pressure within the chamber 23 and at its other side to the mechanical pressure of the piston valve 26. At the end where it contacts with the intermediate piston the high pressure piston valve is solid, but its other end is hollow as shown

at 31 in Fig. 1, and the two pistons 26 and 30 form in effect a single differential piston although made separate for purposes of convenience in manufacture. Between the two sections 26 and 31 there is a ported or slotted portion 32 which may be shifted into registration with an annular inlet port 33, an annular exhaust port 34, or an intermediate unported section of the bore 27. The port 33 is connected to an inlet port 36 which may receive fluid pressure from the same source as the port 13 or from a higher pressure source, if desired; and the port 34 is connected to a discharge line 37 which may join the discharge line 38 into which the chamber 23 is vented when the low pressure valve is in the condition of Fig. 1. By shifting valve 26 successively to the positions of Figs. 1 and 2, a port 41 to which the devices to be operated are connected may be placed in communication with ports 37 and 36 for exhausting or delivering fluid to the devices respectively. If the valve 26 is placed in the mid position of Fig. 3, whatever pressure is already existing in the devices connected to port 41 is maintained. In order to prevent liquid being trapped within the chamber 39 at the left hand end of the intermediate piston 30 this chamber is preferably connected as by passages 40 to the exhaust port 34.

It will be seen that any pressure built up in the discharge port 41 will act against the solid part of the piston 26. This piston is of relatively small area so that the total pressure will not be large. The piston acts mechanically against the intermediate piston 30, which is of larger area so that the relatively low fluid pressure in the chamber 23 may balance a higher unit pressure in the exhaust line 41. As is clear from the drawing, pistons 26 and 30 are always in contact when the valve is admitting or exhausting fluid from the various parts due to the fact that they are always being forced towards each other by whatever pressures exist in port 41 and chamber 23 respectively. Thus in effect the combination of piston 26 and intermediate piston 30 causes piston 26 under working conditions, to act like a differential piston having working faces of large and small areas corresponding respectively to the area of piston 30 and the area of piston 26. The total pressure against the piston 26 is of course ultimately balanced by the compressive force of the spring 24, but the unit pressure in pounds per square inch in the discharge line 41 may by this construction be made substantially greater than that which can be produced directly in the chamber 23. Since the latter chamber represented the connection to the exhaust line in our prior patent there is a very substantial increase in the unit pressure available by this means.

We claim:

1. A controller for fluid pressure devices comprising a casing having a port for connection to the devices, a main inlet port and a main outlet port, a supplementary inlet port and a supplementary outlet port for admitting and exhausting fluid, a differential piston valve having working faces of large and small area respectively and slidable back and forth in the casing for connecting the main inlet and outlet ports selectively with the port for the devices and bodily movable in one direction by and having its working face of smaller area exposed to the pressure supplied to the devices, a pilot piston slidable in the casing adjacent the differential piston and having a channel for connecting the supplementary inlet and outlet ports to deliver fluid to and exhaust fluid from the working face of larger area on the differential piston for moving said differential piston in a direction opposite to that in which it is moved by the fluid supplied to the devices, said pilot piston being movable in one direction by and exposed on one side to fluid supplied to said working face of larger area, yieldable means acting on the other side of said pilot piston for moving it in the opposite direction, a valve element movable back and forth within said pilot piston to alternately connect the supplementary inlet and outlet ports selectively with the channel in said pilot piston and a control rod connected to said valve element and extending through the casing for moving said valve back and forth.

2. A controller for fluid pressure devices comprising a casing having main inlet and outlet ports, supplementary inlet and outlet ports and a port for connection to the devices, a main piston valve slidable back and forth to connect the main inlet and outlet ports with the port for the devices, and connected to be moved in one direction by fluid supplied to said last named port, and a pilot piston valve slidable back and forth to connect the supplementary inlet and outlet ports to move the main piston valve in the opposite direction, said pilot piston valve being moved in one direction by and having one face exposed to fluid admitted to move the main piston in said opposite direction and being moved in the opposite direction by yielding pressure exerted on the second face.

3. A controller for fluid pressure devices comprising a casing having main inlet and outlet ports, supplementary inlet and outlet ports, and a port for connection to the devices, a main piston valve slidable back and forth to connect the main inlet and outlet ports with the port for the devices, and connected to be moved in one direction by fluid supplied to said last named port, a pilot piston valve and a supplementary piston valve both mounted in the casing, said last two valves being relatively slidable back and forth to connect the supplementary inlet and outlet ports to move the main piston valve in the opposite direction from that in which it is moved by fluid supplied to the port for the devices.

4. A controller for fluid pressure devices comprising a casing having main inlet and outlet ports, supplementary inlet and outlet ports and a port for connection to the devices, a main piston valve having oppositely disposed working faces and slidable back and forth to connect the main inlet and outlet ports with the port for the devices and having a channel to direct fluid supplied to the port for the devices against one working face to thereby move the main piston in one direction, a pilot piston valve and a supplementary piston valve both mounted in the casing, said last two valves being relatively slidable back and forth to connect the supplementary inlet and outlet ports to supply fluid to the second working face of the main piston valve to thereby move the main piston valve in the opposite direction.

5. A controller for fluid pressure devices comprising a casing having main inlet and outlet ports, supplementary inlet and outlet ports and a port for connection to the devices, a main piston valve having oppositely disposed working faces of large and small areas respectively and slidable back and forth to connect the main inlet and outlet ports with the port for the devices and having a channel to direct fluid supplied to the port for the devices against the working face of small

area to thereby move the main piston in one direction, a second channel in communication with the working face of large area, a pilot piston valve and a supplementary valve slidable relative to each other to connect the supplementary inlet and outlet ports with said second channel to thereby move the main piston in the opposite direction, said pilot piston valve having oppositely disposed working faces, one of which is in communication with the second channel whereby said pilot piston is moved in one direction by fluid in said channel, a yielding member acting on the other face of said pilot piston to move the pilot piston in the opposite direction, and a control rod connected to said supplementary valve and extending through the casing for moving said supplementary valve back and forth.

6. A controller for fluid pressure devices comprising a body portion and two end portions, a substantially constant diameter cylindrical bore in the body portion, a constricted cylindrical bore in one end portion, an inlet port, an outlet port, and a port for the devices formed in said last named end portion, and in communication with said constricted bore, a supplementary inlet port formed in said body portion and a supplementary outlet port formed in said other end portion, both said last ports being in communication with the bore in the body portion, a main piston valve slidable back and forth in said constricted bore to connect the main inlet and outlet ports to the port for the devices, said main valve having two oppositely disposed working faces, one of large and one of small area, both faces lying in the bore of the body portion, and a channel in the main piston valve connecting the port for the devices with the working face of smaller area, a pilot piston slidable back and forth in the bore of the main body having two oppositely disposed faces the first of which is in communication with the working face of large area on the main piston, a channel in the pilot piston communicating with said first face, a supplementary valve slidable back and forth within the pilot piston to connect the supplementary inlet and outlet ports with the channel in the pilot piston, a yieldable member acting against the second face of the pilot piston, and a control rod connected to the supplementary valve and extending coaxially with said bore in the body out through the end portion remote from the main piston valve for moving said supplementary valve.

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