Feb. 18, 1941. L. T. ARGO 2,232,357

HYDRAULIC CONTROL SYSTEM

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FIG. 1.

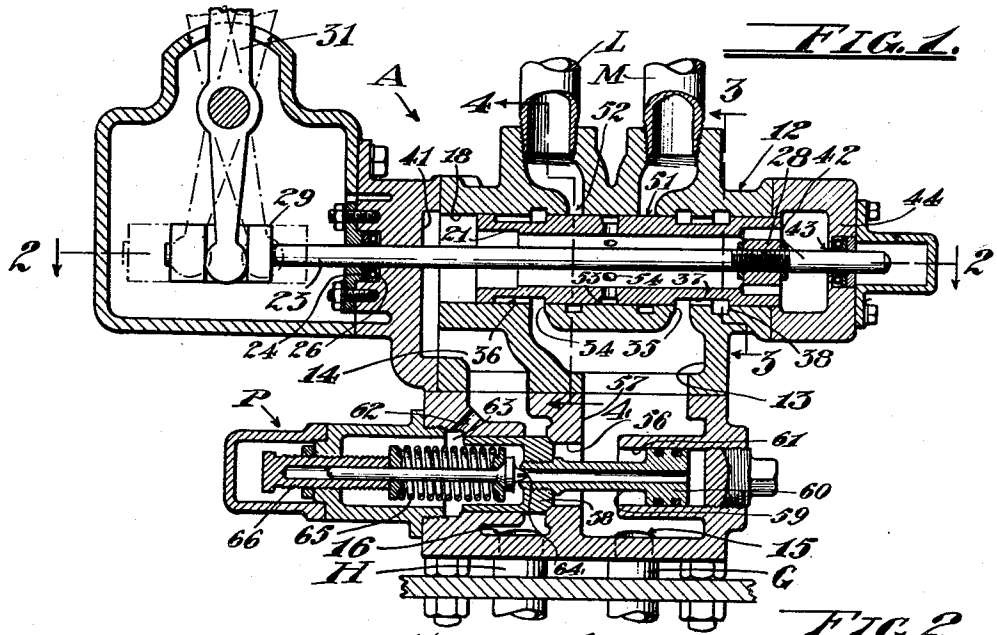


FIG. 2.

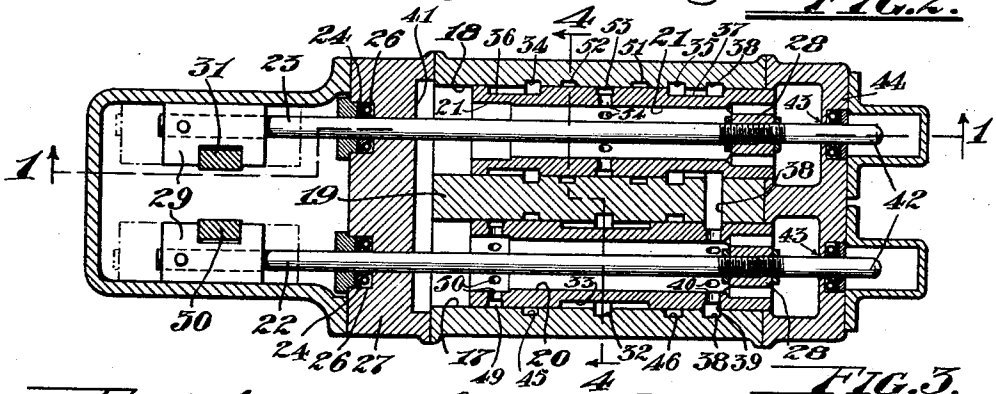


FIG. 4.

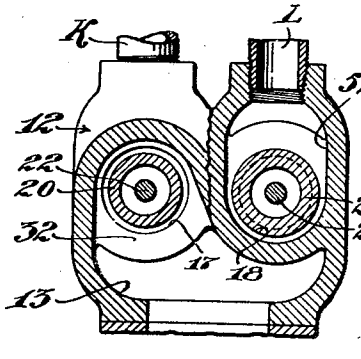


FIG. 5.

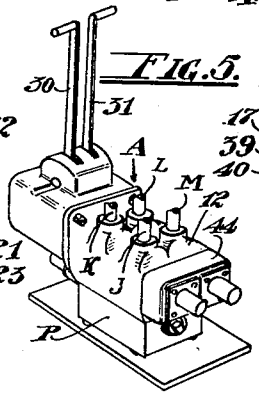
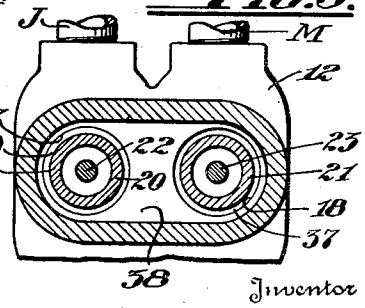


FIG. 3.



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FIG. 6.

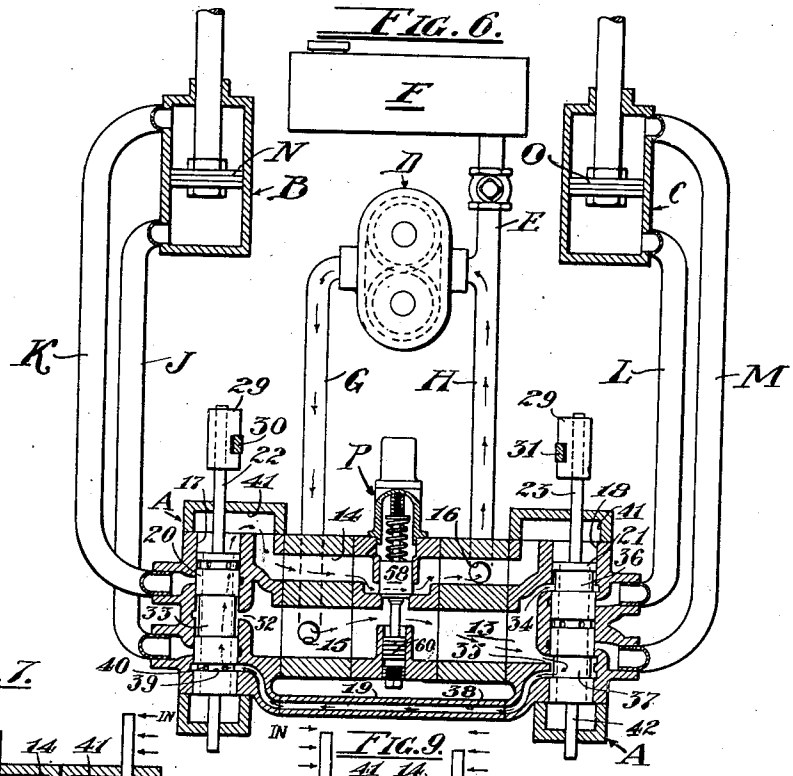


FIG. 7.

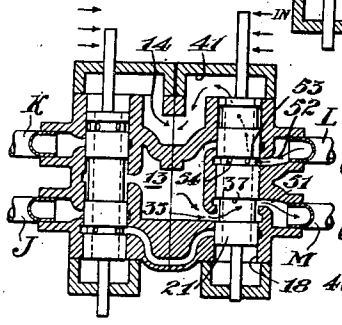


FIG. 9.

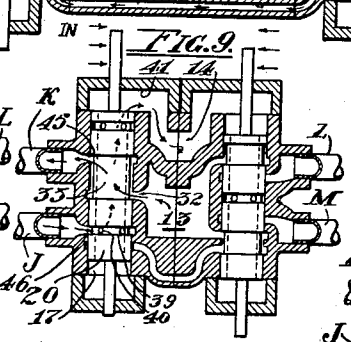


FIG. 11.

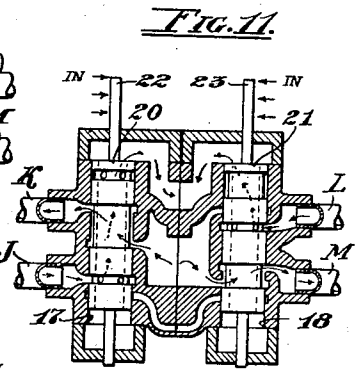


FIG. 8.

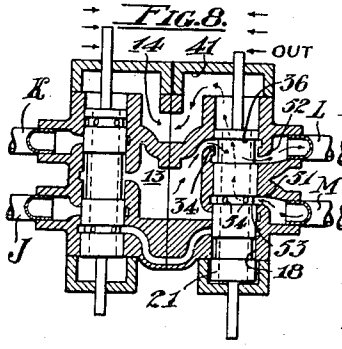
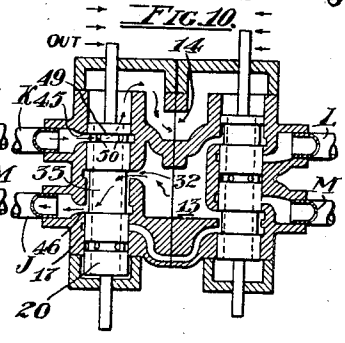


FIG. 10.



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2,232,357

HYDRAULIC CONTROL SYSTEM

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Application November 21, 1938, Serial No. 241,651

2 Claims. (Cl. 60—52)

The present invention relates to improvements in hydraulic control apparatus which embodies a new hydraulic system for effecting and controlling the operation of various machines and devices such, for example, as the earth moving implements of road building, excavating and similar machines.

It has been the practice to control the operation of such implements with a plurality of hydraulic rams, pumps and valves in an arrangement wherein a pump and a valve means are required for each ram and thus each ram unit constitutes a complete hydraulic system independent of the other rams.

While such an arrangement affords selective operation of the rams and a nicety of control therefor, it is objectionable in requiring a great number and a costly duplication of parts, as well as in being bulky and space consuming and comparatively expensive, and also difficult of operation, as to its multiple units.

It is therefore an important object of this invention to provide a hydraulic control system such as described, wherein a single pump or other source of pressure fluid, together with valves of special construction and arrangement, and a single circulatory system for the pressure fluid, are inter-connected with one another and a plurality of hydraulic rams so as to constitute a complete system or unit affording the same selective operation and control as the systems having a plurality of pumps, but consisting of fewer parts and being more compact, less expensive and easier of installation and operation than such multiple pump systems.

Another object of this invention is to provide a control system of the character described by means of which a positive and quickly responsive operation of the rams is insured, due to the particular manner here provided of applying the fluid pressure thereto from a single pump through selectively operable valves and a single closed system of pipes and conduits, and due further, to the fact that the pump continuously circulates the pressure fluid at operating pressure, between it and said valves while the control system hereof is subject to operation.

A further object is to provide a system of the character described wherein the valves are so constructed and arranged as to make possible a continuous circulation of the operating fluid between them and the pump at operating pressure and without being influenced as to movement by said fluid, the fluid pressure on the valves being equalized in all positions of the latter.

Yet another object of this invention is to provide a control device which primarily embodies a valve assembly and valve operating means as a small and compact unit subject to easy installation and readily adapted for connection by means of standard piping, with a plurality of standard rams and a single pump, whereby to provide an improved hydraulic system in accordance with this invention.

In the accompanying drawings, which illustrate one embodiment of my invention,

Figure 1 is a fragmentary vertical sectional view of one form of valve assembly and valve operating means which makes possible the system hereof, being taken on the plane of line 1—1 of Fig. 2.

Fig. 2 is a sectional view taken on the plane of line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on the plane of line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken on the plane of lines 4—4 of Figs. 1 and 2.

Fig. 5 is a perspective view of the valve assembly shown in Fig. 1.

Fig. 6 is a schematic view of the complete system hereof showing two hydraulic rams subject to independent and simultaneous operation, upon appropriate valve manipulation.

Figs. 7, 8, 9, 10 and 11 are schematic sections of the valves shown in the various positions assumed during the operation of the system shown in Fig. 6.

Referring more specifically to the embodiment of the invention shown in the accompanying drawings, it is seen with reference to Figs. 1 to 5, inclusive, that an especially constructed valve device or assembly A makes possible the novel system hereof, as illustrated in Fig. 6, when connected with a plurality of standard hydraulic rams B and C and a single pump D of suitable design and having a supply connection E with a source F of fluid, such as oil. As shown in Fig. 6, pressure and suction lines G and H respectively lead from the pump to the valve assembly, and lines J and K lead from said assembly to the ram B, whereas lines L and M lead from said valve assembly to the ram C, whereby the pistons N and O of said rams may be extended and retracted as desired during the operation of the system, as will be hereinafter more fully described.

Before specifically describing the valve assembly it should be noted that the hydraulic system hereof, provides for continuous operation of the pump D whereby the fluid is circulated through the valve assembly at operating pressure during the time the system is in readiness for operation. For example, if the system hereof is installed on road building or earth working vehicles or apparatus for the purpose of determining and varying the position of the blade or other earth moving implement thereof, the pump may be connected with the motor unit of the vehicle or apparatus so as to be operated simultaneously therewith. It is thought unnecessary to furtner illustrate this or any other typical applications of

the system, inasmuch as it is sufficient to point out that the pump D may be operated continuously in any suitable manner, to prepare the system for operation. With this provision the fluid operating pressure is more quickly and effectively applied to the rams upon appropriate manipulation of the valves embodied in the valve assembly A, and therefore a better control of the rams is made possible.

As particularly shown in Figs. 1 to 5, inclusive, the valve assembly A comprises a housing 12 of sectional construction and suitably partitioned to define therein, a pressure chamber 13 and a suction chamber 14. The pressure chamber has a fluid intake opening 15 with which is connected the line G from the pump D, whereas the suction chamber has an outlet opening 16 with which is connected the suction line H of said pump. As here shown the housing 12 is provided with valve chambers 17 and 18 extending side by side and separated by a common wall or partition 19. Hollow cylindrical or other suitable constructed valves 20 and 21 are reciprocally mounted in the chambers 17 and 18 and provide for control of the rams B and C respectively.

Valve operating rods 22 and 23 are slidable through suitable oil seals 24 and openings 26 in the wall 27 of the housing 12 and extend through the valves 20 and 21 so that the inner ends thereof may be threadedly secured to the apertured members 28 at certain corresponding ends of the valves. The outer ends of these rods are provided with yokes 29 engaged in the usual manner with valve operating levers 30 and 31, which latter provide for selective operation of the valves.

The valve chambers 17 and 18 and the valves are identical as to construction, except for the arrangement of ports and passages therein, and may best be described in the following description of the operation of the system.

Assuming that both valves are in neutral position, as shown in Fig. 6, and the system is ready for operation with the pump circulating the operating fluid through the valve assembly, it is seen that the fluid passes from the pump through the line G and opening 15 to pressure chamber 13 and after entering said chamber, will pass through a single port 32 (see Figs. 4 and 6) in the valve chamber 17 into an annular groove 33 formed exteriorly of the valve 20, but as this groove is not in communication with any port or outlet at this time, the fluid will be ineffective at this point. Also, at this time, fluid will pass from the pressure chamber 13 through ports 34 and 35 in the valve chamber 18. Fluid passing through port 34 enters an annular groove 36 in the exterior of valve 21 but this groove is now closed. However, the fluid passing through port 35 enters a groove 37 in the valve 21, corresponding to groove 36 but which is in registration with a passage 38 extending through the partition 19 into the valve chamber 17, whereby to conduct the fluid to the latter. Fluid thus entering the chamber 17 enters an annular groove 39 in the valve 20 and thence flows through openings 40 in said groove, into the bore of said valve and then flows through said bore into an extension 41 of the suction chamber 14 and thence through opening 16 and return or suction line H back to the pump D.

It is now seen that the fluid circulates continuously through the valve assembly but does not tend to move the valves, due to the construction and arrangement of the latter. In this connection it should be noted that to insure equal fluid pressures on the valves 20 and 21, the end members 28 thereof are provided with pilot rods 42 slidable in suitably packed openings 43 in the wall 44 of the valve assembly housing 12, these extensions being of the same diameter as the valve operating rods 22 and 23 which extend through the other ends of the valves and serving in effect, as extensions of said operating rods.

Should it be desired to retract or move inwardly the plunger or piston N of the ram B, as shown in Fig. 6, the operator manipulates the operating lever 30 to move the valve 20 into the position shown in Fig. 9 while the valve 21 remains in neutral position. The operating fluid now flows from pump D through line G, opening 15, pressure chamber 13, port 32, groove 33, port 45 and pipe line K to the outer end of the ram B. The plunger N now moves inwardly and fluid between it and the inner end of the ram is expelled from the ram back to the pump D (see Fig. 9) through pipe line J, port 46 of the valve chamber 17, groove 39 and its associated openings 40 in valve 20, bore of said valve extension 41 of suction chamber 14 and thence through chamber 14 outlet opening 16 and line H to the pump. Thus it is seen that the operating fluid circulates continuously during the operation of the ram as well as when the ram is at rest.

To extend the plunger N of ram B outwardly, as seen in Fig. 6, the operator manipulates the lever 30 to position the valve, as shown in Fig. 10, and the course of the operating fluid is from pressure chamber 13, port 32, valve groove 33, port 46, pipe line J to the inner end of the ram, whereby to extend said plunger. The fluid between said plunger and the outer end of the ram is returned to the pump through the line K, port 45, groove 49, openings 50 leading from said groove to the bore of the valve 20, and from said bore to the suction chamber 14 and thence through the return line H.

To operate the ram C whereby to retract the plunger O shown in Fig. 6, the operator manipulates the lever 31 whereby to position the valve 21, as shown in Fig. 7, and the operating fluid flows from the pressure chamber 13 through the then open port 35, groove 37, port 51 of valve chamber 18, pipe line M to the outer end of the ram. As the plunger O moves inwardly the fluid between it and the inner end of the ram returns to the pump through the line L, port 52 of valve chamber 18, groove 53 in valve 21, openings 54, the bore of the valve, and thence through an extension 41 of the suction chamber 14, the suction chamber proper, opening 16, and line H to the pump D.

To extend the plunger O of ram C, the valve 21 is moved to the position shown in Fig. 8, and the operating fluid now flows from the pressure chamber 13, through port 34, groove 36 of valve 21, port 52, pipe line L to the inner end of the ram C. As the plunger O moves outwardly, the fluid between it and the outer end of the ram returns to the pump D through the line M, port 51, groove 53, openings 54, bore of the valve 21, and then through the return chambers 41 and 14, opening 16 and line H to the pump.

As shown in Fig. 11, the valves 20 and 21 are positioned to bring out a simultaneous inward or retractive movement of the plungers N and O of the two rams and in this case the flow of fluid is the same as described in connection with Figs. 7 and 9. By positioning both valves as per Figs. 8 and 10, the plunger of the rams will be simultaneously extended in the same manner as hereinbefore described in connection with Figs. 8 and

10. It is obvious that the valve may also be set to retract the plunger of one of the rams while the plunger of the other is extended.

A pressure relief valve P is embodied in the valve assembly for the purpose of automatically relieving to the suction chamber 14 excessive pressure which may build up in the pressure chamber 13 and passages and lines in communication with the latter. As here provided this pressure relief valve includes a port 56 in the partition 57 separating the pressure and suction chambers, and a normally closed valve member 58 closing said port on the suction chamber side of the latter, as shown in Figs. 1 and 6. The valve 58 is cup-shaped and from its closed or seat end a tubular stem 59 projects through the port 56 into the pressure chamber. On the outer end of this stem is a piston 60 slidable in a dash-pot cylinder 61. The tubular stem communicates the cylinder with the interior of the cup-like valve 58, whereby a supply of the operating fluid from the suction chamber 14 may pass through a port 62 in a chamber 63 in which the skirt of the valve 58 is slidable, and enter the cylinder 61 through said tubular stem. A slotted valve member 64 is at all times seated against the end of the tubular stem which extends through the valve 58 and so held by a spring 65 having suitable tension adjusting means 66. The slot in the valve permits of a restricted flow of fluid through the stem. The spring 65 and the valve member 64 serve to hold the pressure relief valve 58 seated, the tension of said spring determining the pressure at which said relief valve will function. This dash-pot device operates to prevent chattering of the relief valve 58. The pressure exposed area of the piston 60 is smaller than that of the valve 58 so that at pressures beyond safe limits the piston 60 will not interfere with or retard due opening of the relief valve. Should the relief valve open the fluid in the pressure chamber 13 will pass through the port 56 into the suction chamber 14. As the piston 60 moves outward during opening of valve 58 the fluid will be drawn from the chamber 14, port 62, chamber 63, valve 58, and tubular stem 59 into the cylinder 61.

It will now be apparent that the valve means and associated structures, as described in this specification and illustrated in the accompanying drawings, make possible a hydraulic system which constitutes an improvement in the art, for the following reasons:

1. The use of a single pump for operating and controlling a plurality of hydraulic rams or like devices;

2. The simplicity of arrangement and the reduction of the number of parts and elements as compared to the usual requirements in multiple ram operating devices and systems corresponding to the one of the present inventions;

3. The provision of simple, compact and readily installable valve means wherein the valves are constructed and arranged so that the pressure thereon is equalized in all positions thereof and the valves will not tend to move under the fluid pressure valve in any position.

4. The provision of continuously circulating the operating fluid at operating pressure from a single pump to the valve assembly while the system is in readiness for operation, to provide a quicker response of the hydraulically operated devices upon manipulation of the valve.

I claim:

1. A valve assembly for a hydraulic system, including a housing having a pressure chamber and a suction chamber adapted respectively for connection with the outlet and the inlet of a circulating pump, a first valve chamber, a second valve chamber, extensions providing communicating between the suction chamber and one end of both valve chambers, openings leading to and from each of said valve chambers adapted for circulating fluid pressure to and from hydraulically responsive devices, a single pressure port leading from the pressure chamber to the first valve chamber, a pair of pressure ports leading from the pressure chamber to the second valve chamber, a passage leading from one of said pair of ports to the first valve chamber; a first valve slidable in the first valve chamber, said valve being hollow and having two end peripheral grooves and an intermediate peripheral groove; ports leading into said valve from said end grooves; a second valve slidable in the second valve chamber, said second valve being hollow and having two end peripheral grooves and an intermediate peripheral groove; ports leading into the second valve from said intermediate groove; means for actuating the first valve to selectively place either end groove into registration with one of the openings of the first valve chamber while maintaining the intermediate groove in communication with said single pressure port and the other opening respectively, and to place one of said end grooves in registration with one end of said passage; and means for actuating the second valve to selectively place either end groove into registration with one of the openings and one of the pressure ports of the second valve chamber respectively, while the intermediate groove is placed in registration with the other opening, and to place one of said end grooves in registration with the other end of said passage, whereby when said end groove of the first valve is in registration with said passage, fluid is free to circulate through said pump and housing.

2. A valve assembly for a hydraulic system, including a housing having a pressure chamber and a suction chamber adapted respectively for connection with the outlet and the inlet of a circulating pump, said housing also having a first valve chamber adapted for connection to a hydraulically responsive device, a second valve chamber adapted for connection to a second hydraulically responsive device, both of said valve chambers at one and the same end being at all times in communication with the suction chamber, a single port for placing the pressure chamber in communication with the first valve chamber, a pair of ports for placing the pressure chamber in communication with the second valve chamber, a passage providing communication between the two valve chambers at the other ends thereof; a pair of valves in said chambers each tubular and axially movable in the respective chamber from a neutral position to either of two extreme positions for controlling the application of fluid to said devices through said ports, means on one valve for placing the second valve chamber in communication with one end of said passage through one of said pair of ports when said valve is in neutral position, and means on the other valve for placing the bore of said valve in communication with the other end of said passage when said valve is in neutral position, whereby fluid from the pressure chamber can flow around the first mentioned valve, through said passage, and then through the bore of the second mentioned valve to the suction chamber.

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