Oct. 6, 1942. G. G. MORIN ET AL 2,297,975

HYDRAULIC DEVICE

Original Filed April 15, 1938 2 Sheets-Sheet 1

Fig. 1.

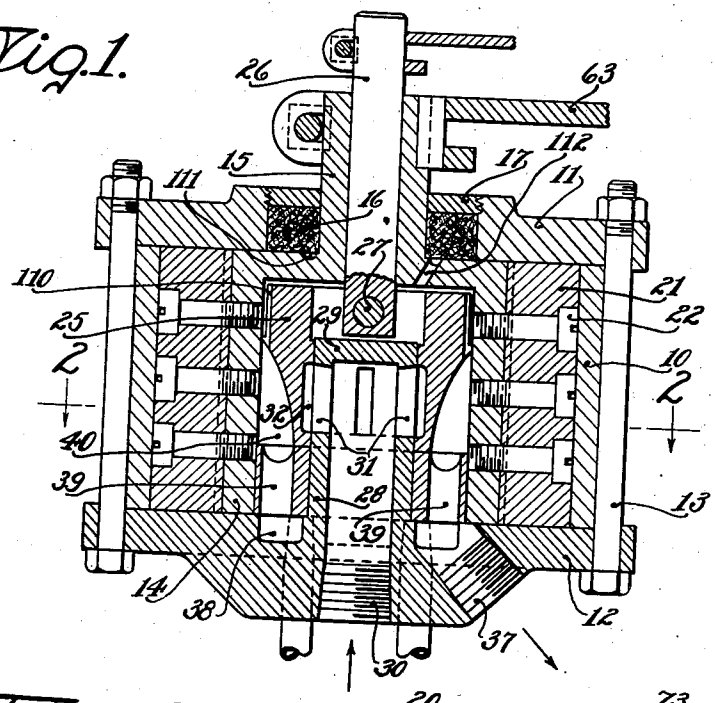
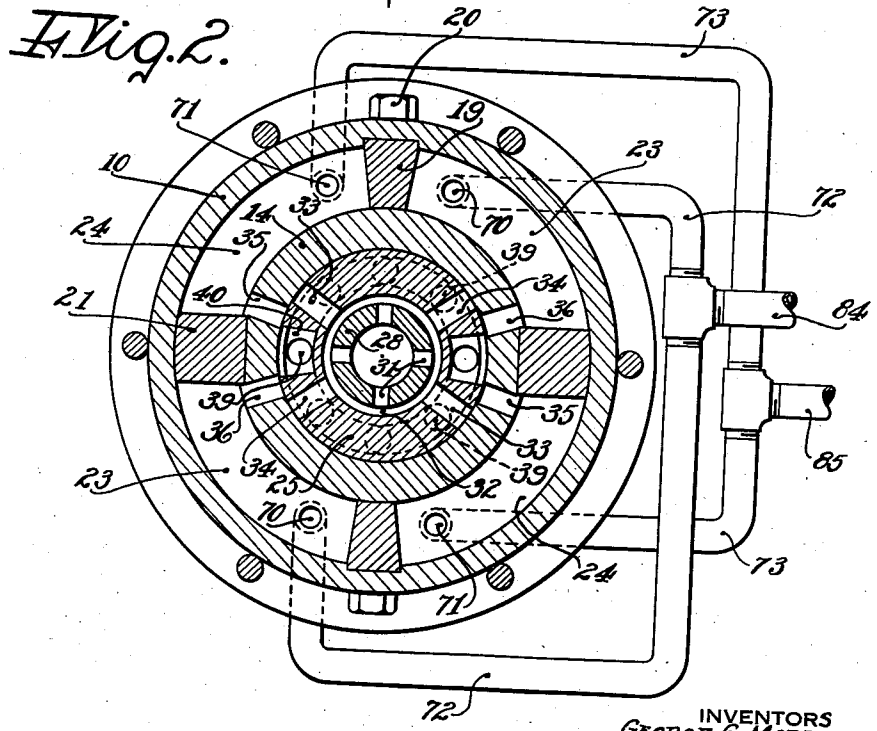


Fig. 2.



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Fig. 3.

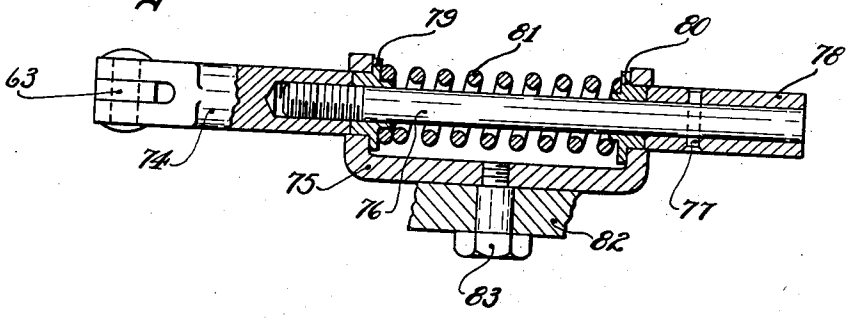


Fig. 4.

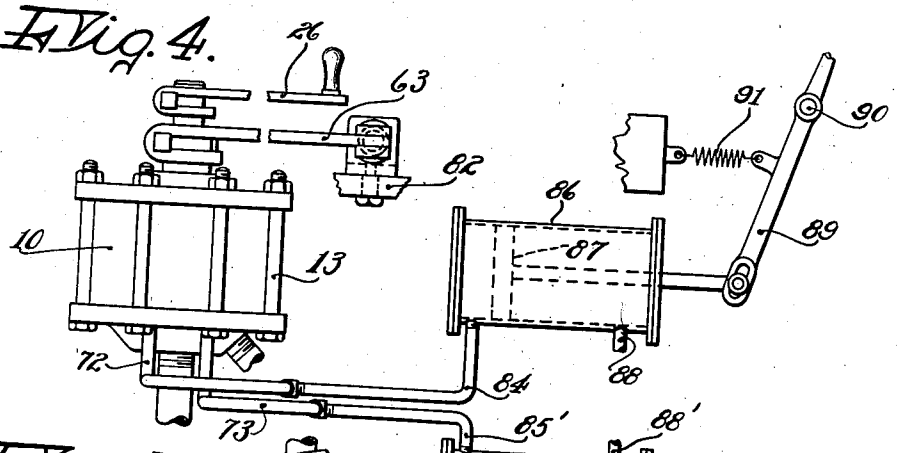
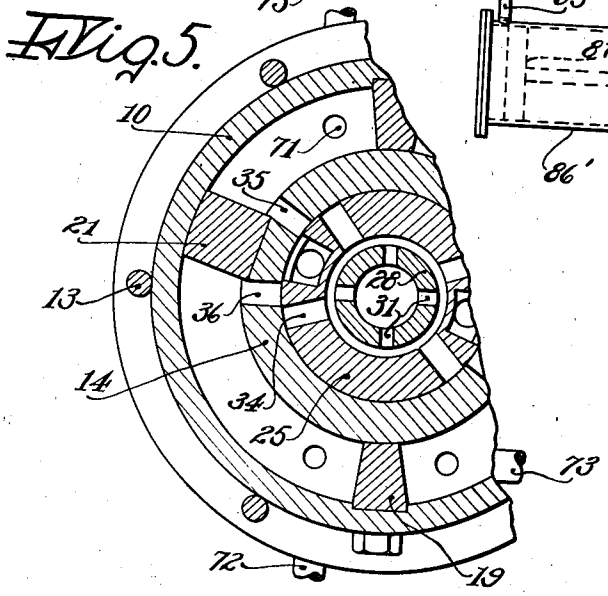


Fig. 5.



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HYDRAULIC DEVICE

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Original application April 15, 1938, Serial No. 202,262, now Patent No. 2,260,979, dated October 28, 1941. Divided and this application January 22, 1941, Serial No. 375,476

2 Claims. (Cl. 121—41)

This invention relates to a hydraulic control device for use with hydraulic servomotors. The structure in this application relates to one form of the hydraulic control device disclosed in our copending application Serial No. 202,262, filed April 15, 1938 (issued as Patent No. 2,260,979) of which the present application is a division.

The main object of this invention is to provide a hydraulic control device which will act as a regulating valve to maintain a predetermined hydraulic pressure selectively in either one of a pair of hydraulic servomotors. An additional object is to provide such a hydraulic control device which is constructed to permit hydraulic pressure to be applied in rapid succession first to one servomotor and then the other without danger of fluid under pressure being trapped in that servomotor to which pressure is not then being supplied by the device.

Additional and further objects will appear from the description of the means used to accomplish out main object as disclosed in the following specification and claims.

Referring to the drawings,

Fig. 1 is a median section through a device embodying the invention;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a detail, partly in section, of an auxiliary device used with the structure of Fig. 1 to predetermine the pressure of fluid delivered by that device;

Fig. 4 is a somewhat diagrammatic view showing the device of Fig. 1 being used to supply pressure fluid selectively to a pair of servomotors; and

Fig. 5 is a fragmentary view showing in detail the position of the parts in the control device when the device is being used as in Fig. 4.

Referring first to Figs. 1 and 2, the control device is enclosed within a housing comprising a cylindrical shell 10 and end headers 11 and 12 secured against the end of the shell by tie bolts 13. Fitting snugly between the end headers and spaced radially from the inside of the shell 10 is a cylinder 14 having a shank 15 extending out through a central aperture in the header 11. In order to form a fluid-tight joint a packing 16 is placed around the shank 15 and is held in place by a collar 17 threaded into the header 11. The annular space between the shell 10 and the cylinder 14 is bridged by blocks 19 held by screws 20 to the shell and by blocks 21 held by screws 22 to the cylinder. There are thus formed two opposed pairs of arcuate spaces 23 and 24. Fitting snugly within the cylinder is a control member 25 having a handle 26 secured to it as by a pin 27 and extending outwardly through the shank 15 of the cylinder.

The port structure of the device will now be described. The header 12 has a hollow inward extension 28 closed at its inner end 29 and having its outer end 30 threaded for reception of a pipe connection from a suitable source of pressure. Near its inner end the extension 28 is provided with one or more ports 31 communicating with an annular chamber 32 formed within the control member. The latter chamber communicates with opposed ports 33 and 34 which in certain positions of rotation of the control member will become aligned with ports 35 and 36 formed in the cylinder 14 on opposite sides of the blocks 21. The header 12 also has a threaded connection 37 for connection with a pipe leading to a sump or the inlet of the source of fluid pressure, and opening into an annular chamber 38. Holes 39 in the control member 25 open at one end into this annular chamber and at the other end into ports 40; which, as shown in Fig. 2, communicate with both ports 35 and 36 when the control device is in neutral position.

Before considering the application of the device as a regulating valve in connection with hydraulic servomotors, the operation of the parts thus far considered will be described briefly. Assuming the fluid pressure to be supplied as indicated by the arrows in Fig. 1 and the control member to be rotated a slight amount in a clockwise direction as viewed in Fig. 2, the fluid will pass through ports 31 into the annular chamber 32 and then through ports 34 and 36 into the arcuate chambers 23. At the same time the arcuate chambers 24 will be connected by the ports 35 and 40 with the outlet pipe 37. The blocks 19 cannot move, as they are fastened to the stationary shell 10; but the blocks 21 are formed with a running fit inside the shell and will be moved clockwise, carrying the cylinder 14 with them. This motion will continue until the ports assume the relative positions shown in Fig. 5, and will then cease. The cylinder can be moved in either direction again by shifting the control member to a corresponding position. The result is that the control member can be moved manually, with no substantial resistance, to any desired position, and the cylinder 14 will follow it with the full force of the fluid pressure. As thus far described, the device operates to shift the cylinder by power into any predetermined position, the degree and direction of this motion be-

ing wholly under the manual control of the operator through the control member.

The relative positions of the ports 33, 35, and 34, 36 is a matter of some importance, and should be regulated in accordance with the use to which the device is to be put. In the neutral position of Fig. 2 the ports 33, 34 should have passed completely beyond their respective ports 35, 36, so that communication between them is cut off; and the outlet port 40 should be in communication with ports 35, 36. By this arrangement, the pressure fluid is cut off from chambers 23 and 24 which are themselves open to the exhaust. On the other hand in the operative position of Fig. 5, communication between ports 33, 34, and 35, 36, should be cut off while port 35 is open to the exhaust port 40 and port 36 is blocked. The reason for this arrangement of ports is to allow for proper control of the servomotors as will be explained in detail.

The ports 31 are located entirely within the casing, and no leakage can occur from them to the outside. Every place where leakage can occur is directly or indirectly vented to the exhaust chamber 38, so that no oil is lost but is maintained within the recirculating system. The surface of the member 25 is preferably somewhat relieved, as at 110, to permit any leakage between the members 29 and 25 to vent back to the exhaust line. An annular recess 111 may be provided in the member 14, vented as at 112 to the space between the members 14 and 25, so as to vent off any oil flowing past the end of member 14 near the extension 15. Any flow past the other end will of course find its way directly to the exhaust channel 38.

In using the device to control two hydraulic servomotors the opposed chambers 23 and 24 are preferably provided with ports 70 and 71 joined by pipes 72 and 73 which intermediate their ends are respectively joined to pipes 84 and 85 as by suitable T connections. Pipes 84 and 85 are connected to the hydraulic servomotors 86 and 86', which through pistons 87 and 87' are to be operated to exert pressure as in Fig. 4.

An arm 63 is attached to the shank 15 of the cylinder 14 and is connected to some device which displays a resistance to the motion of the arm roughly proportional to the displacement of the arm or some function thereof. One suitable device for this purpose is shown in Fig. 3.

A member 74, to which the arm 63 is pivoted, is mounted to slide through a stationary yoke 75. A rod 76 is threaded into one end of this member, and is secured as by a pin 77 to an opposed member 78 slidable in the opposite side of the yoke. The rod 76 also slides freely through collars 79 and 80 pressed against the inside of the yoke by a spring 81 and having reduced portions extending into the holes in the yoke. The yoke may be secured to a stationary frame 82 by a bolt 83. If the arm 63 be swung in either direction by rotation of cylinder 14 one of the collars 79 or 80 will be moved inwardly out of contact with the yoke by the contact of the corresponding member 74 or 78 with its outer surface. The opposing collar, being larger than the hole in the yoke, will be held against movement and will act as an abutment for the spring. The advantage of this construction is that as but a single spring need be used, the action in opposite directions is exactly the same, there being no need for matching pairs of springs.

With the device arranged as just described in which the spring 81 or some equivalent device is used, a given setting of the control member 25 corresponds to a definite compression of the spring. If the control member be moved to some predetermined position as for instance that of Fig. 5, the arm 63 will be moved by fluid pressure in the cylinder 14 to a corresponding position and the supply of fluid cut off as previously described. At the time when the fluid pressure supply is cut off by closing off of the ports, the resistance offered by the mechanism upon that one of the servomotors 86 or 86' which is operating to exert pressure is balanced by the reaction of spring 81. This spring tends to assume its neutral position, and thus exerts a back pressure on the fluid through arm 63, cylinder 14, and blocks or vanes 21. Thus in Figs. 4 and 5 the resistance to movement of the piston 87 in cylinder 86 is offset by the reaction of spring 81 while piston 87' is free to move to the left because of the open exhaust connection through chamber 24, port 35 and port 40.

If, due to the operation of the mechanism to which the cylinder and piston device 86 is connected, the piston is permitted to move so as to increase the volume available for the fluid, the spring 81 can shift the cylinder 14 in a direction to uncover the ports and admit more fluid. By this means the pressure within the chambers and the connected cylinder 86 will be maintained constant at a degree dependent upon the setting of the handle 26.

Referring to Fig. 4, in the embodiment shown, pipes 84 and 85 are connected to one end of cylinders 86 and 86' while the opposite end of the cylinders are vented to the atmosphere as by pipes 88 and 88'. The piston rods have a pin and slot connection with levers 89 and 89' diagrammatically shown as pivoted at 90 and 90'. Tension springs 91 and 91' are provided which constantly urge the pistons to the left. The levers 89 and 89' may be connected for operation of friction clutches which may swing the boom of a steam shovel (not shown). Under these circumstances the linkage is such that the springs 91 and 91' urge the clutch levers towards the position in which the clutches are disengaged.

With this arrangement, when the device is in the neutral position of Fig. 2, both servomotors will have their cylinders connected to the exhaust through pipes 84 and 85, chambers 23 and 24 and port 40, and the pistons will both be positioned at the left hand end of the cylinders as is the case of motor 86' in Fig. 4, and both clutches will be disengaged. On the other hand when control member 25 is moved in a clockwise direction to the position of Fig. 5, pressure will be built up in chambers 23 and the piston 87 in motor 86 will move to the right to engage the clutch controlled by lever 89, while piston 87' will remain in its original position. Conversely, if the control member is shifted counter-clockwise from the neutral position, piston 87 will remain at the left hand end of the cylinder while piston 87' will move.

From the above it will be noted that in neutral position of the device both servomotor are vented, and that motion of the control member 25 in either direction from neutral to cause operation of one of the motors opens even wider the exhaust connection of the inoperative motor. Also, when the device has reached an operative position such as Fig. 5 the inoperative motor is still vented to the exhaust. Thus, when as is

frequently the case, it is desired to rapidly and alternately engage the clutches for swinging the boom as when it is desired to shake the boom or to move it to a new position, there is no possibility of both clutches being engaged simultaneously.

We claim:

1. A control valve having a neutral position and comprising a casing, a plurality of vanes secured within the casing and projecting inwardly therefrom, a rotor within the casing bearing against said vanes, vanes secured to the rotor and projecting outwardly into contact with the casing intermediate the first-named vanes to form chambers between the casing and the rotor, ports extending through the rotor on each side of the vanes carried thereby, a control member rotatable within the rotor and having pairs of inlet ports and an exhaust port intermediate each pair, said pairs of inlet ports being out of register with the ports in the rotor when the valve is in neutral position and the ports of each pair being adapted to be brought selectively into register with one or the other of said latter ports on movement of the control member, said exhaust port communicating with both the ports in the rotor in the neutral position of the valve and adapted on movement of the control member to register with the one or other of the ports in said rotor not in communication with an inlet port, means for supplying fluid under pressure to said inlet ports and for removing it from the exhaust ports, spring means for resisting the rotation of the rotor in both directions with a force varying with the displacement from neutral, and means for conducting fluid from said chambers to fluid pressure operated devices.

2. A control valve having a neutral position and a plurality of operative positions and comprising a casing, a plurality of vanes secured within the casing and projecting inwardly therefrom, a rotor within the casing bearing against said vanes, vanes secured to the rotor and projecting outwardly into contact with the casing intermediate the first-named vanes to form chambers between the casing and the rotor, ports extending through the rotor on each side of the vanes carried thereby, a control member rotatable within the rotor and having pairs of inlet ports and an exhaust port intermediate each pair, said pairs of inlet ports being out of register with the ports in the rotor when the valve is in neutral and operative positions, and the ports of each pair being adapted to be brought alternately into register with said latter ports on movement of the control member to shift the valve from neutral to an operative position, said exhaust port communicating with both the ports in the rotor when the valve is in neutral position and adapted, on movement of the control member to shift the valve from neutral to an operative position, to register with the one or the other of the ports in said rotor not in communication with an inlet port and to remain in register with said port in the operative position of the valve, means for supplying fluid under pressure to said inlet ports and for removing it from the exhaust ports, resilient means for resisting the rotation of the rotor in both directions with a force varying with the displacement from neutral, and means for conducting fluid from said chambers to fluid pressure operated devices.

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