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HYDRAULIC POWER SYSTEM

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Fig. 1.

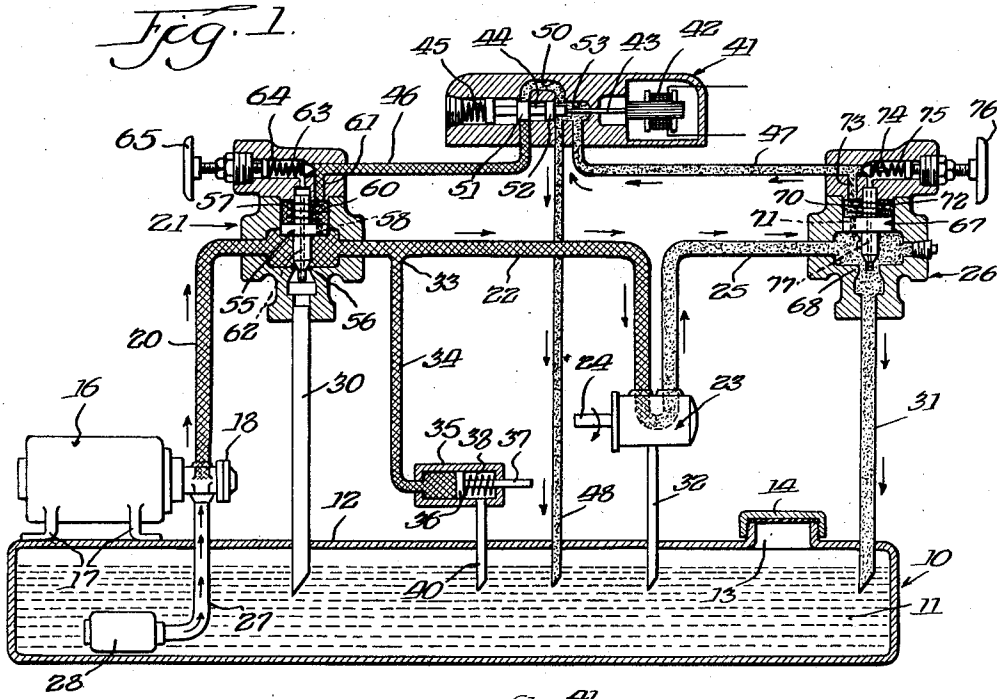
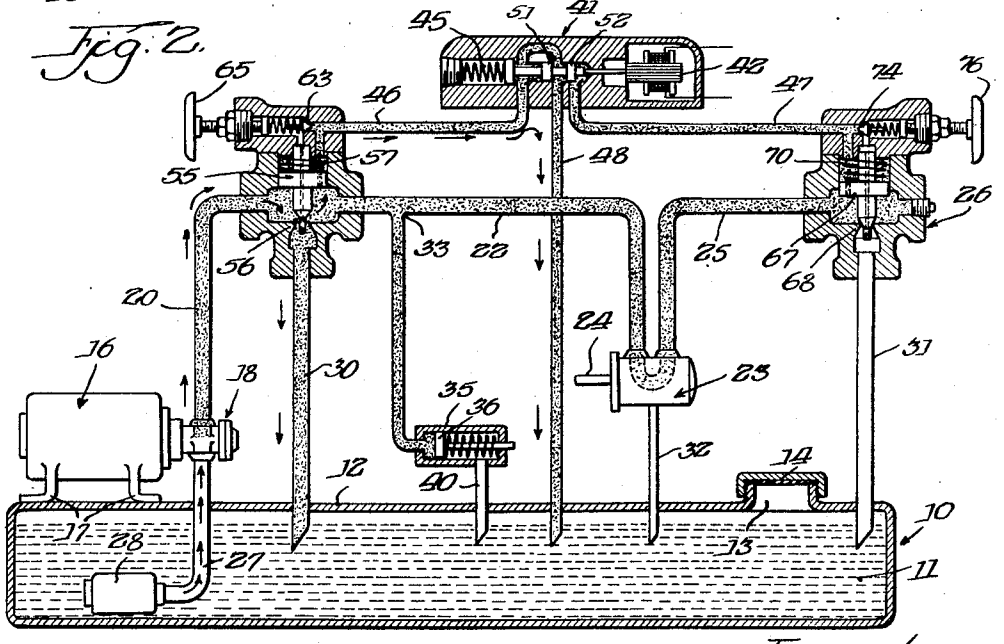


Fig. 2.



HIGH PRESSURE FLUID

LOW PRESSURE FLUID

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HYDRAULIC POWER SYSTEM

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3 Claims. (Cl. 60—53)

The invention relates generally to hydraulic power systems and has reference in particular to a simple hydraulic power circuit including an electrically driven hydraulic pump and an hydraulic motor and wherein flow of the hydraulic fluid in the circuit is controlled by relief valves and by a conventional control valve which may be solenoid actuated.

The hydraulic power system of the invention has been devised for use in those installations where it is necessary to frequently start and stop the driving motor. An electric motor is not entirely satisfactory in such installations since excessive starting and stopping leads to rapid deterioration not only of the electric contacts but of the motor itself. In the present hydraulic power system the electrically driven pump has continuous operation and intermittent operation of the hydraulic motor is secured by controlling the delivery of the high pressure fluid to the same. In other words, when the high pressure fluid is delivered to the hydraulic motor the same is operative, and the motor is rendered inoperative merely by diverting the high pressure fluid to the reservoir.

Therefore an object of the invention is to provide a new and novel hydraulic power circuit of simple design, which will be highly efficient in operation, and wherein controlled operation of the hydraulic motor is secured by controlling the delivery to said motor of the high pressure fluid flowing in the circuit.

Another object of the invention is to provide an improved hydraulic power circuit wherein flow of the hydraulic fluid in the circuit is controlled by relief valves and by a conventional control valve which may be solenoid actuated.

Another object of the invention is to provide an hydraulic power circuit including an hydraulic pump and an hydraulic motor and wherein the operating fluid pressures within the system will rise and fall as the work load applied to the rotating shaft of the hydraulic motor may vary in magnitude.

Another object of the invention resides in the provision of an hydraulic power circuit for producing operation of an hydraulic motor, the high pressure fluid inlet to the motor and the low pressure fluid outlet thereof each incorporating a relief valve capable of adjustment for varying the operating pressures as regards the inlet fluid entering the pump and the exhaust fluid leaving the pump.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings which illustrate an embodiment of the device and wherein like reference characters are used to designate like parts:

Figure 1 is a schematic view illustrating the hydraulic system of the invention and showing the solenoid actuated control valve in operative position; and

Figure 2 is a schematic view similar to Figure 1 but showing the hydraulic system with the solenoid actuated control valve in inoperative position.

Referring to the schematic disclosures of Figures 1 and 2, the reservoir for the hydraulic power system is provided by a conventional container 10 which is substantially filled with a fluid medium such as oil 11 to form the sump or reservoir for the hydraulic system, the top 12 of the container being provided with the inlet opening 13 normally closed by the threaded cap 14. The main power source for the hydraulic system comprises the electric motor 16 and by means of the legs 17 the said motor is suitably mounted on and secured to the top wall 12 of the container. The motor 16 drives the hydraulic pump 18 which is connected by means of the conduit or piping 20 with the relief valve designated in its entirety by numeral 21. Relief valve 21 may be additionally described as a by-pass valve. From said relief valve the conduit 22 leads to the hydraulic motor 23 which is provided with the operating shaft 24, the said shaft constituting the power "take-off" for the hydraulic power system of the invention. The conduit 25 leads from the hydraulic motor 23 and connects the same to a second relief valve generally designated by numeral 26. Relief valve 26 may be additionally described as a motor exhaust throttle valve. The fluid pump 18 receives its supply of hydraulic fluid such as oil through tubing 27, which extends into the sump or reservoir within container 10 and has its inlet end provided with the filter 28.

The fluid from relief valve 21 is returned to the sump or reservoir under certain conditions and accordingly said relief valve is provided with the drain pipe 30 which extends through top wall 12 and terminates within the container. In a similar manner the relief valve 26 is provided with a drain pipe or exhaust conduit 31 which also extends through top wall 12 to terminate within the container. The hydraulic motor 23 is provided with a bleed line 32 which is normally closed but which may be opened for draining the motor to the sump. The tubing 22 is tapped as at 33 to provide a connection therewith for the supply line 34 which leads to a cylinder 35 having the piston 36 and piston rod 37. The piston 36 is yieldingly biased in a direction toward the left by the coil spring 38. A bleed line 40 may be provided for connecting that portion of the cylinder 35 beyond the piston 36 with the sump.

The flow of the hydraulic medium within the circuit is controlled by means of a control valve or pilot valve indicated in its entirety by numeral 41 and which includes the solenoid 42 operatively connected through stem 43 with the spool valve 44. The coil spring 45 resiliently urges said spool valve 44 into an idling or inoperative position. Relief valve 21 is connected to the pilot valve 41 by the conduit 46 and a similar conduit 47 connects said pilot valve with relief valve 26. A drain pipe 48 leads from the pilot valve to the sump and the passage 50 formed in the body of the pilot valve connects the conduit 46 with the said drain pipe. The valve members 51 and 52, which form part of the spool valve, operate within the passage 53, and in one position of said members, such as shown in Figure 1, the conduit 46 is closed and conduit 47 is connected through the passage 53 to the drain pipe 48. In the other position of the valve members, such as shown in Figure 2, the conduit 47 is closed and conduit 46 is connected through passage 50 to the drain pipe 48.

Referring more particularly to the relief valves, it will be seen that valve member 55 of relief valve 21 is adapted to engage the the valve seat 56, being resiliently urged in that direction by the coil spring 57 whereby to close off the drain pipe 30, thus preventing flow of the

hydraulic medium such as oil through said drain pipe into the reservoir. The passage 58 provided in the flange of the valve member 55 is open at all times and thus the oil can flow through the passage into chamber 60 above the flange portion of the valve member, and said oil will continue its flow through channel 61 into the conduit 46. From said conduit 46 flow of the oil is controlled by the members 51 and 52 of the pilot valve. The valve member 55 is additionally provided with a small passage 62 extending centrally thereof in a longitudinal direction from end to end of the member and this passage in conjunction with the poppet valve 63 provides means for regulating the operating pressures within the hydraulic circuit for producing actuation of the hydraulic motor 23. The poppet valve 63 is held against its seat by coil spring 64 and thus the conduit 46 is closed off by said poppet valve. The pressure exerted by the coil spring 64 can be adjusted by hand wheel 65. When the hydraulic pressure within conduit 46 is sufficient to cause release of the poppet valve 63, the hydraulic medium is permitted to flow through passage 62 in valve member 55 and into drain pipe 30, being eventually delivered to the reservoir.

The relief valve 26 is constructed similarly to relief valve 21, the same including a valve member 67 adapted to contact valve seat 68, being resiliently urged in this direction by coil spring 70, whereby to close off the drain pipe 31. The passage 71 in the flange portion of the valve member permits the oil to flow into chamber 72 located above the flange portion and said oil will continue its flow through passage 73 which connects with the conduit 47. The end of said conduit 47 is similarly closed by poppet valve 74 and which is held closed by coil spring 75. The pressure exerted by the coil spring can be adjusted by hand wheel 76 and the poppet valve 74 thus functions in a manner to regulate the exhaust pressure from motor 23 of the oil flowing through the circuit.

Energization of the solenoid 42 of the pilot valve 41 moves the valve members 51 and 52 to the left against the tension of coil spring 45, as shown in Figure 1, and the passage for the conduit 46 is closed to thereby prevent flow of the oil from conduit 46 through 50 to the drain pipe 48. As a result the pressures above and below the flange portion of valve member 55 are balanced and said valve member is caused to move against its valve seat 56, thus closing off the drain 30. Accordingly, the oil instead of returning to the reservoir through the drain 30 is now caused to flow through the conduit 22 to the hydraulic motor 23 and eventually the pressure of the oil will reach a value high enough to cause rotation of the operating shaft 24 and actuation of whatever mechanism is to be driven by said shaft. The oil discharging from the motor 23 is delivered by the conduit 25 to the relief valve 26. Since conduit 47 is open to the drain 48 the valve member 67 of the relief valve 26 is unbalanced and is lifted off of its seat 68 to open drain pipe 31. The oil exhausting from the motor 23 is thus discharged through the drain pipe to the reservoir.

As long as the solenoid 42 remains energized the hydraulic circuit will operate to drive the motor 23. Upon deenergization of the solenoid the coil spring 45 will function to return valve members 51 and 52 to their inoperative positions, in which positions the conduit 46 is open through passage 50 to drain 48, whereas, conduit 47 is now closed by valve member 52. Since the hydraulic medium is now able to flow through conduit 46, the valve member 55 will be unbalanced and the valve will lift from its seat 56 to cause opening of the drain 30. With the drain pipe open the hydraulic medium from the motor driven pump 18 is delivered back to the reservoir and the hydraulic motor 23 is not operative so that the main operating shaft 24 thus remains idle. The non-operating position of the parts is disclosed in Figure 2.

In view of the foregoing, it will be understood that the hydraulic pressures within the system will vary from a maximum during operation of the hydraulic motor 23 to a minimum when the said hydraulic motor is not operative. Also the operating pressures may vary somewhat, depending on the work load applied to operating shaft 24. For the maximum work load applied to shaft 24 the highest operating pressures will be required to effect operation of the motor 23 and rotation of the said shaft. Any reduction in the work load will permit a corresponding reduction in the hydraulic medium within the system. Since the pressures of the hydraulic medium within the circuit will vary, use can be made of these variable pressures to effect control of associated mechanism. For this purpose the supply line 34 has connection with conduit 22 and the said supply line connects with the piston and cylinder combination 35, 36. When the pressures are a maximum the piston 36 will be forced in a direction toward the right as shown in Figure 1. Conversely, when the pressures are a minimum, the piston 36 will be actuated by coil spring 38 into a position toward the left, as shown in Figure 2. For example, this movement of the piston as affected by the variable hydraulic pressures within the circuit can be employed to hydraulically apply and release friction brake means forming part of material feeding mechanism such as may have utility in the feeding of metal or other material in continuous strip form to punch presses and the like. For a more complete disclosure of such automatically controlled friction brake mechanism reference is made to the copending application of Frederick M. Littell and Chester M. Wiig, Serial No. 343,206, filed March 18, 1953 and entitled Hydraulically Powered Rack and Pinion Feeding Mechanism, now Patent No. 2,758,837 of which this application is a division.

What is claimed is:

1. In a hydraulic power system, in combination, a container providing a reservoir for a hydraulic medium, a hydraulic circuit including a fluid pump and a fluid motor and conduit means connecting the said elements, a by-pass valve interposed in the conduit means between the motor and the pump and having a drain pipe leading to the reservoir, an exhaust throttle valve having an exhaust conduit leading to the reservoir, other conduit means connecting the exhaust outlet of the motor with the throttle valve, a control valve providing valve members having operative and inoperative positions, a drain pipe connecting the control valve with the reservoir, a first conduit connecting the control valve with the by-pass valve, a second conduit connecting the control valve with the exhaust throttle valve, the valve members of the control valve when operatively positioned closing a passage to the first conduit and opening a passage for connecting the second conduit with the drain pipe of the said control valve, said valve members when inoperatively positioned closing a passage to the second conduit and opening a passage for connecting the first conduit with the drain pipe of the control valve, the by-pass valve and the throttle valve each having a member which is operative to close the inlet to the drain pipe of the by-pass valve and the inlet to the exhaust conduit of the throttle valve respectively, when the member is balanced by pressure of the hydraulic medium within the valve, and said members being operative to open the inlet to the drain pipe and the inlet to the exhaust conduit respectively, when the member is unbalanced by the pressure of the hydraulic medium, the said valve members of the control valve when operatively positioned producing a balanced condition in the by-pass valve and an unbalanced condition in the throttle valve, and when inoperatively positioned producing an unbalanced condition in the by-pass valve and a balanced condition in the throttle valve.

2. In a hydraulic power circuit, in combination, a container providing a reservoir for a hydraulic medium, a hydraulic pump having an inlet leading to the reservoir, a by-pass valve and an exhaust throttle valve each hav-

ing an interior valve chamber, a pipe connecting the outlet of the pump with the by-pass valve, conduit means connecting the respective chambers of the by-pass and throttle valves, a hydraulic motor interposed in the conduit means and located between the valves, said by-pass and throttle valves each having a drain communicating the interior chamber thereof with the reservoir, a member within the chamber of each valve above said drain and having operation to open and close the inlet to the drain depending on whether the member is balanced or unbalanced by the hydraulic pressures prevailing within the chamber of the valve, a flow passage provided in the by-pass valve and in the throttle valve and located above the member therein, each said member having an opening connecting the passage above the same with the chamber below the member, and means for controlling the hydraulic pressures within the chambers of the valves, said means including a control valve also having a valve chamber therein, a drain pipe connecting the valve chamber of the control valve with the reservoir, a first conduit joining the flow passage of the by-pass valve with the valve chamber of the control valve, a second conduit joining the flow passage of the throttle valve with the valve chamber of said control valve, and a valve member operating within the valve chamber of the control valve to control flow of the hydraulic medium from the first and second conduits to the drain pipe of the control valve.

3. In a hydraulic power circuit, in combination, a container providing a reservoir for a hydraulic system, a hydraulic pump having the hydraulic medium of the reservoir supplied to its inlet, a by-pass valve and a throttle

valve each having an interior chamber, a pipe connecting the outlet of the pump with the by-pass valve, conduit means connecting the valves and providing a hydraulic circuit including said valves, the pipe and the pump, a hydraulic motor interposed in the conduit means and having its inlet connected to the by-pass valve and its exhaust connected to the throttle valve, each valve having a drain pipe connecting the interior chamber thereof with the reservoir, a valve member within the chamber of each said valve and having operation to close and open the inlet to the drain pipe thereof depending on whether the valve member is balanced or unbalanced by the hydraulic pressures prevailing within the chamber on the respective sides of the valve member, means for controlling the hydraulic pressures prevailing within the chambers of the valves respectively, said means including a control valve and conduits connecting the said control valve with the by-pass valve and with the throttle valve respectively, on that side of the valve member thereof opposite the drain pipe connection, and a relatively small passage formed in the valve member of the by-pass valve and also in the valve member of the throttle valve for connecting the chambers on respective sides of the members.

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