April 22, 1941. M. N. STADLIN 2,239,657

CONTROL VALVE MECHANISM

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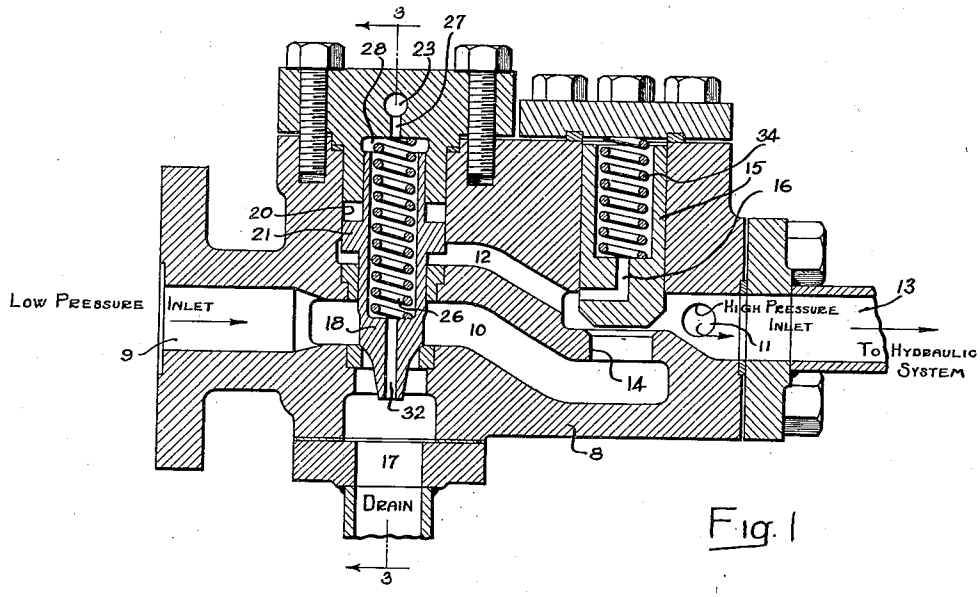


Fig. 1

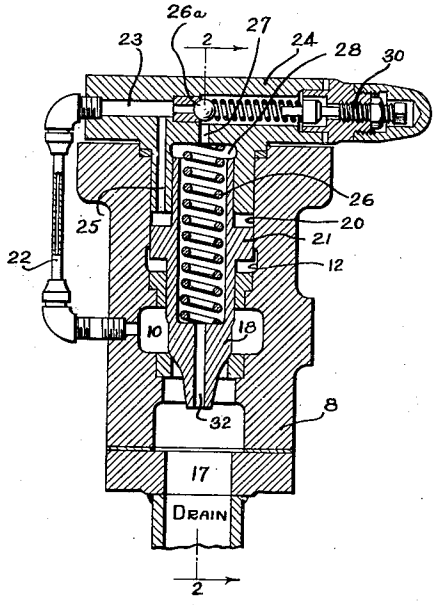


Fig. 2

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CONTROL VALVE MECHANISM

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2 Claims. (Cl. 137—53)

This invention relates to an improved control valve mechanism and more particularly to an improved drain valve mechanism that is adapted for by-passing a low pressure pump when a predetermined pressure is built up in a hydraulic system and for thereupon causing a high pressure pump to supply the system.

The present invention is especially useful in hydraulic press control systems involving relatively high operating unit pressures. In such press systems a platen is ordinarily initially moved into engagement with the work piece under a large volume of fluid of relatively low pressure or the platen moves toward the work piece under gravity after which the low pressure fluid is initially applied to the work piece. After such initial movements in either case, the final pressing stroke of the platen is effected by a relatively small volume of fluid of very high pressure. It is generally more economical to employ one pump for producing the small pressure and a separate pump for producing the high pressure. Various combination by-pass and check valves have heretofore been proposed and used for automatically cutting out the low pressure pump upon occurrence of a predetermined pressure whereupon the high pressure pump then constitutes the sole source of operating fluid for the press. These prior art systems have involved certain deficiencies such as the use of excessively large controlling springs with consequent lack of sensitivity in changing over at the desired predetermined pressure or in adjusting the same.

It is an object of my invention to provide an improved control valve mechanism of the foregoing type that will have a high degree of sensitivity. A further object is to provide such an improved control valve mechanism that will permit smaller control and operating springs to be employed, thereby facilitating the accomplishment of sensitivity. It is a further object of my invention to provide an improved control valve so constructed and arranged as to be economical in initial cost, operation and maintenance while at the same time being relatively simple in construction and operation whereby the various parts are readily accessible for inspection, repair or adjustment but without in any way sacrificing the desired degree of sensitivity of my improved control mechanism.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawing in which:

Fig. 1 is an enlarged sectional view of the control valve mechanism taken on the line 1—1 of Fig. 2;

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

In the particular embodiment of the invention, such as is disclosed herein merely for the purpose of illustrating one specific form among possible others that the invention might take in practice, my improved control mechanism comprises as shown in Figs. 1 and 2 a casing 8 provided with a low pressure inlet 9 and a low pressure chamber 10 while a high pressure inlet 11 connects with a normally high pressure chamber 12 which in turn is connected by a pipe 13 to a hydraulic system such as hydraulic press controls. Low and high pressure chambers 10 and 12 are also adapted to communicate with each other through a vertical passageway 14 normally closed by a spring pressed check valve 15 which in turn is provided with an equalizing pressure fluid passageway 16. A by-pass drain 17 is adapted to be brought into communication with low pressure chamber 10 when a by-pass drain valve 18 is open, the by-pass drain valve being opened when a predetermined pressure is reached in chamber 10 at which time check valve 15 closes. Thereupon only high pressure is supplied through inlet 11 to the hydraulic system outlet 13.

By-pass drain valve 18 has a cylinder 20 and a piston 21 formed as part of the valve 18. The under side of piston 21 is, as shown in Fig. 1, exposed to the fluid in chamber 12 while the top side of piston 21 is exposed to fluid in chamber 10 through a lateral pipe connection 22, Fig. 2. This pipe connection extends from the chamber 10 to a passageway 23 in a combined pilot valve casing and cylinder head 24 and thence downwardly through a passageway 25. The valve 18 is biased towards its closing position by a spring 26.

To effect opening of the valve 18 in a manner to be shortly described, a pilot valve in the nature of an adjustable spring pressed ball valve 26a is adapted to allow passage 23 to communicate with a vertical passage 27 and thence to a chamber 28 which receives the upper end of the valve 18. A suitable screw 30 is adapted to adjust the spring force on ball valve 26a.

Operation.—Assuming that the hydraulic system is to be initially operated under low pressure, fluid pressure from suitable low and high pressure sources such as pumps (not shown) will be supplied simultaneously to inlets 9 and 11 respectively, although the system pressure in pipe 13 cannot build up above a certain minimum value

until sufficient resistance in the system builds up. In the case of a hydraulic press, the foregoing minimum pressure occurs during the initial work stroke or movement of a press platen. During this operation drain valve 18 is closed and check valve 15 will open by reason of the low pressure pump circulating a larger volume of fluid than does the high pressure pump through inlet 11 whereby the low pressure fluid in chamber 10 flows upwardly through passage 14 to raise check valve 15. As the system resistance increases, the pressure in chambers 10 and 12 will gradually increase until a predetermined minimum pressure of say 450 pounds per square inch is obtained. During this increase of pressure which is present in both chambers 10 and 12 and also beneath piston 21, Fig. 1, valve 18 is held to its seat by reason of the pressures on the top and bottom of piston 21 being equal, thereby allowing spring 26 to exert the principal closing force on the valve. The foregoing equalization of fluid pressures is obtained because low pressure chamber 10 is in communication with the top side of piston 21 through passages 22, 23 and 25. When a predetermined minimum pressure is obtained in chambers 10 and 12 as above mentioned, ball valve 26a, Fig. 2, opens, thereby connecting the upper end of cylinder 20 through passages 25, 23 and 27 to the interior 28 of valve 18 and thence with a passage 32 leading to drain 17. By reason of passages 25, 27 and 32 being relatively large compared to a very restricted passageway in pipe connection 22, the pressure on the top side of piston 21 is relieved sufficiently so that the pressure in chamber 12 acting on the under side of piston 21 will raise valve 18 and allow unrestricted flow of pump fluid from low pressure inlet to drain 17. Simultaneously with the relief of pressure in chamber 10, check valve 15 automatically closes by virtue of pressure in chamber 12 being communicated through passage 16 to the upper side of check valve 15 whereupon the spring 34 causes closure of the check valve. As a result of the foregoing opening of the valve 18 and closure of check valve 15, the supply of low pressure is effectively disconnected from the hydraulic system so that thereafter high pressure fluid is the sole source of fluid supply for the system. As the system resistance builds up due to increasing force required to move say a press platen against the work piece, the high pressure pump will generate the increasing pressure. This increasing pressure will continuously bear on the under side of piston 21 to hold the valve 18 open. After the valve 18 has opened so that the interior thereof is in communication with atmosphere through passage 32 and drain 17, ball valve 26a closes, but regardless of any minimum pressure that may accumulate in the upper end of cylinder 20, the increasingly high pressure in chamber 12 will positively hold valve 18 open.

When the system pressure drops below a predetermined value, spring 26 will ultimately be sufficient to close valve 18 against the pressure in chamber 12 whereupon the low pressure pump 3 will supply its relatively large volume low pressure fluid to chamber 10 and accordingly open check valve 15 so that the low pressure supply is again in communication with the hydraulic system through pipe 13. As the pressure in chamber 10 increases it will gradually increase in passages 23 and 25 and this increasing pressure will act on the upper side of piston 21 until a predetermined pressure is reached to open ball valve 26a to again repeat a high pressure operation as already described.

From the foregoing disclosure it is seen that I have provided a control valve mechanism suitable for dual pressure sources of supply for sequentially connecting the low pressure source and the high pressure source respectively to a hydraulic system, all with a control valve mechanism that has a high degree of sensitivity for effecting the changeover from low to high pressure and which involves relatively light operating and control springs but without in any way sacrificing the positiveness or dispatch of operation. Also the structure for accomplishing the foregoing is not only economical in construction, operation and maintenance but is also arranged so as to have maximum convenience in accessibility of the parts for inspection or repair. The predetermined pressure at which the hydraulic system is changed over from low to high pressure can be readily adjusted merely by adjusting screw 30 whereby the responsiveness of pilot valve 26a is varied accordingly.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A drain valve mechanism comprising, in combination, a casing having a fluid chamber provided with a supply inlet and a main outlet and a drain outlet for supplied fluid, a valve for closing said drain outlet, a spring normally biasing said valve to its closed position, a valve operating piston and a cylinder therefor having heads at each end thereof to provide opening and closing chambers each separate from said fluid chamber, means for supplying pressure present in said chamber to the opening end of said cylinder, means for supplying operating fluid to the opening end of said cylinder independently of the fluid chamber, means for supplying operating fluid from said fluid chamber to the closing end of said cylinder and for exhausting fluid from said closing end, said latter means including two communicating passages of different cross-sectional area the smaller one of which communicates with said fluid chamber and the larger one of which communicates with said closing end of the cylinder and also an exhaust port communicating directly with said passage of larger cross-sectional area, said exhaust port being of larger cross-sectional area than said smaller passage, and a spring pressed valve for normally closing said port, whereby said spring pressed valve opens in response to a predetermined pressure in said fluid chamber thereby to relieve pressure in the closing end of said cylinder and allow the by-pass valve to open and remain open under the influence of fluid pressure in the opening end of said cylinder.

2. The combination set forth in claim 1 further characterized in that an exhaust passage also of larger cross-sectional area than said smaller passage is provided axially through said valve which closes said drain outlet, and said exhaust port communicates with said axial passage.

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