United States Patent

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[54] **HYDRAULIC CONTROL SYSTEM**

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[21] Appl. No.: **37,358**

Related U.S. Application Data

[63] Continuation of Ser. No. 639,360, May 18, 1967, abandoned.

[52] **U.S. Cl.**.....**91/446**, 91/451

[51] **Int. Cl.**.....**F15b 9/08**

[58] **Field of Search**.....91/442, 446, 461, 451, 454, 91/48

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[57] **ABSTRACT**

The present invention relates to hydraulic control systems and in particular to a method and means for improving such systems used in remote control apparatus. The present invention utilizes dump valves positioned relatively close to the apparatus controlled by the hydraulic fluid for quickly removing from the system returning hydraulic fluid, thereby eliminating the problems that would develop in attempting to move this fluid back through a substantial length of the system and providing a faster response time.

15 Claims, 6 Drawing Figures

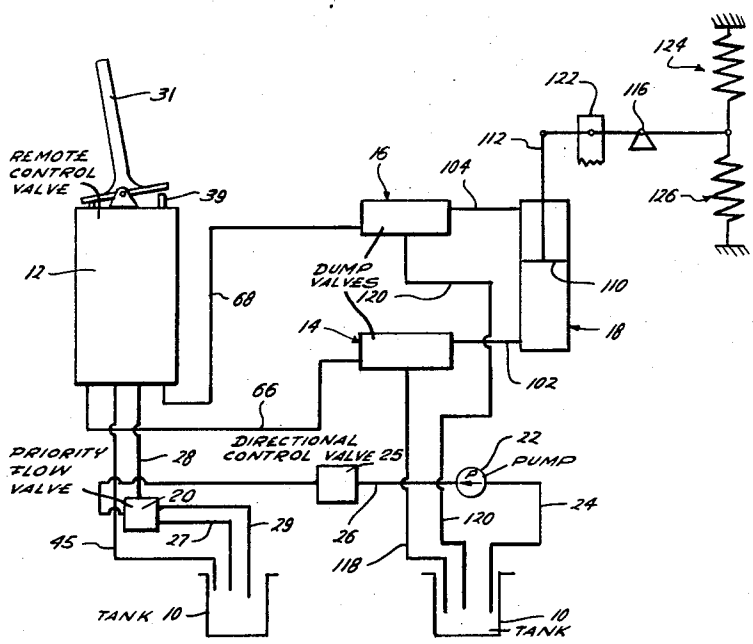
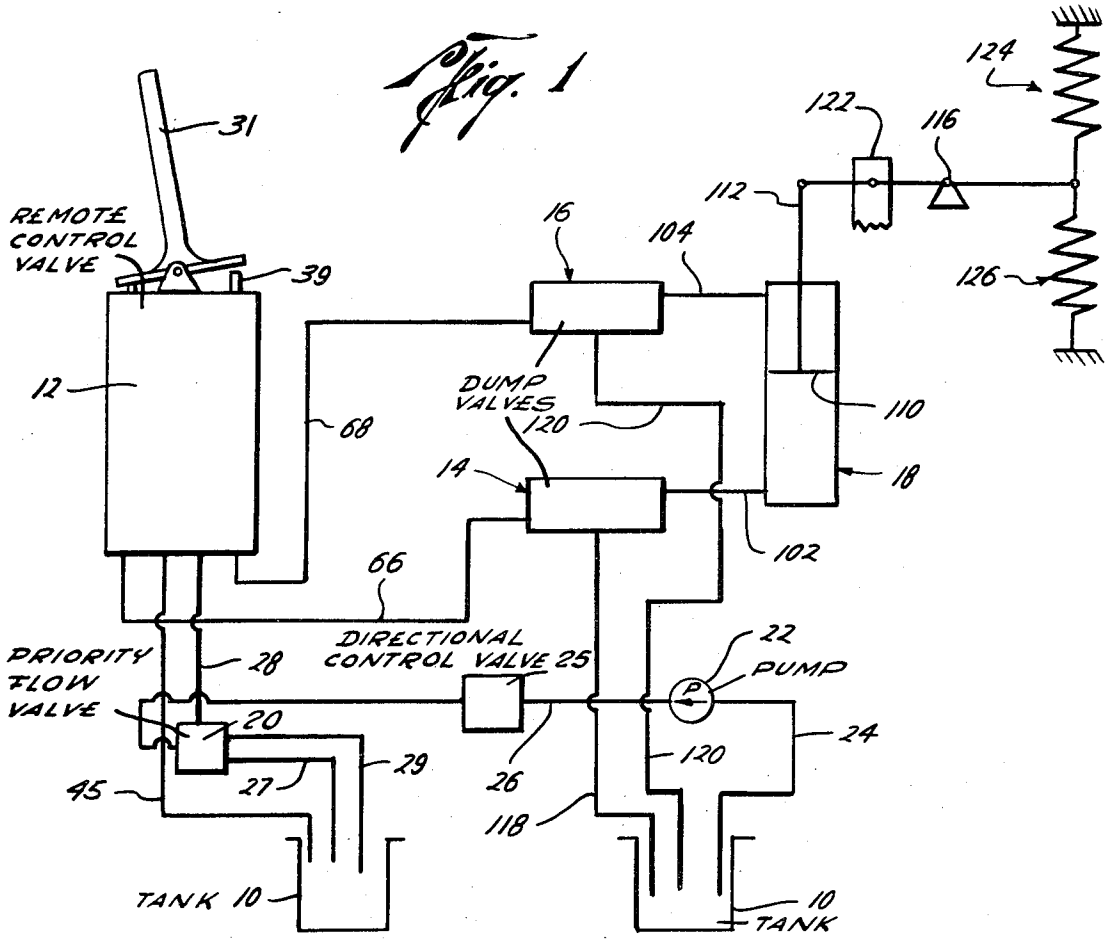


Fig. 1



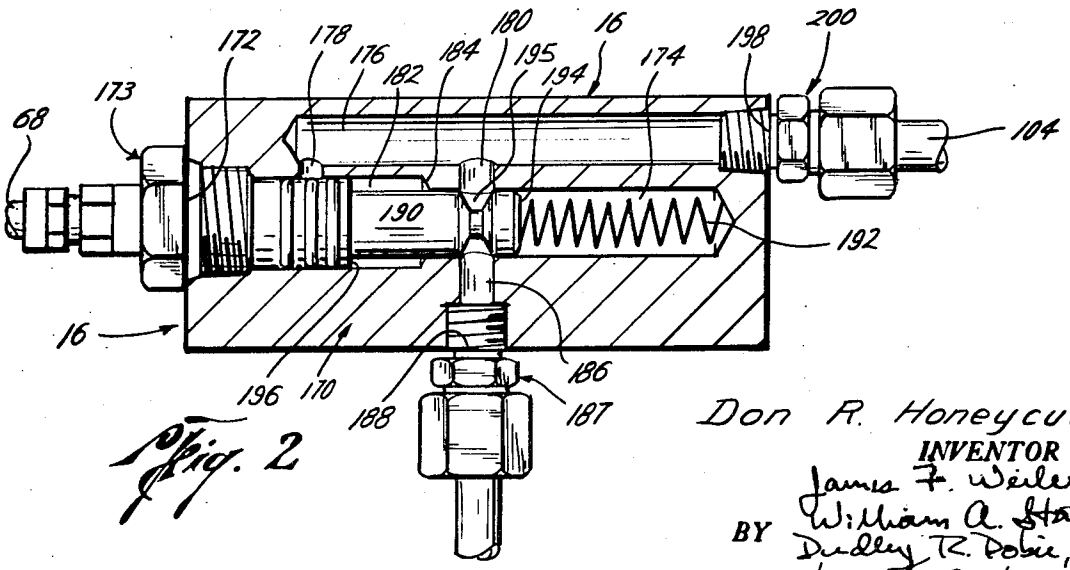


Fig. 2

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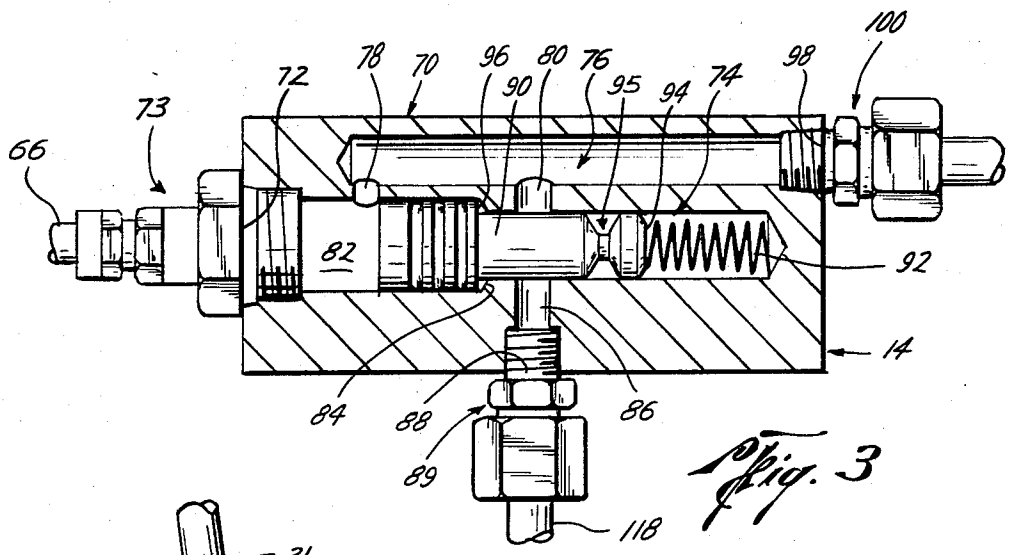


Fig. 3

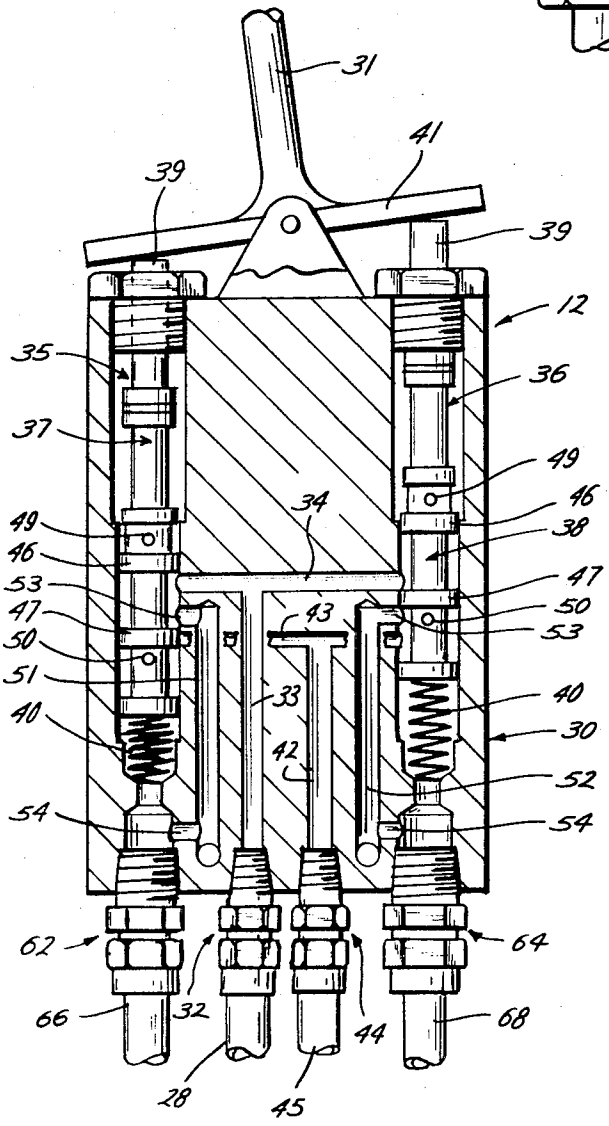


Fig. 4

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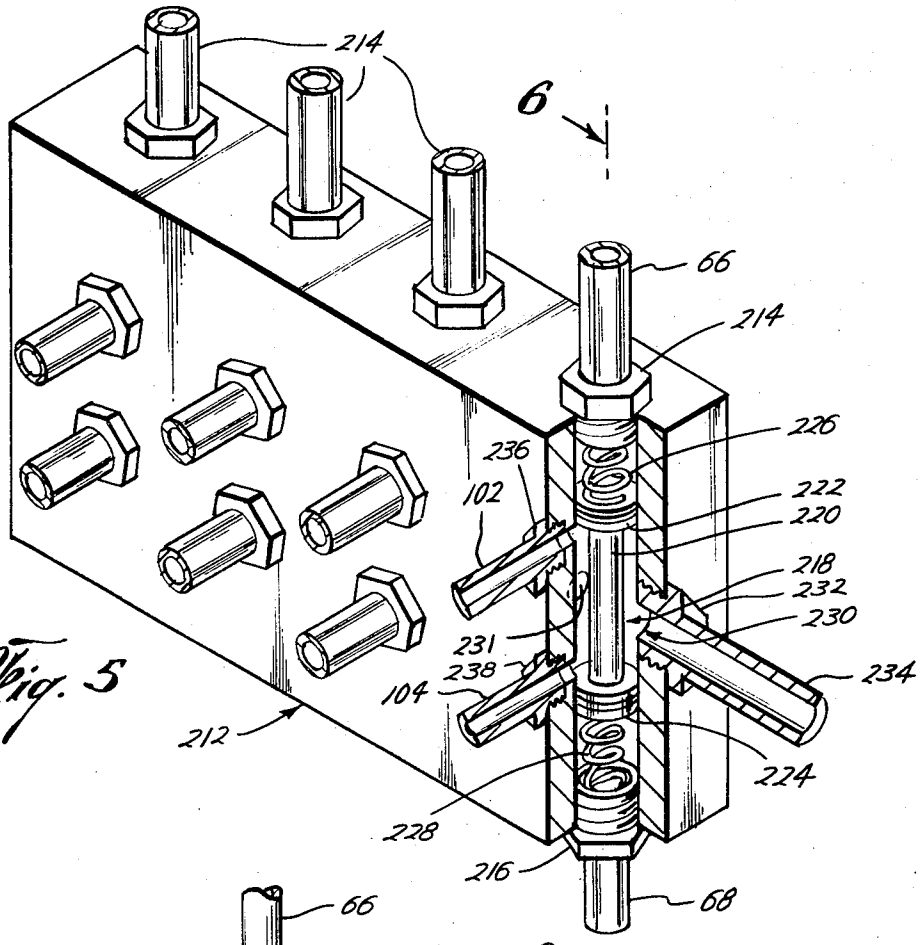


Fig. 5

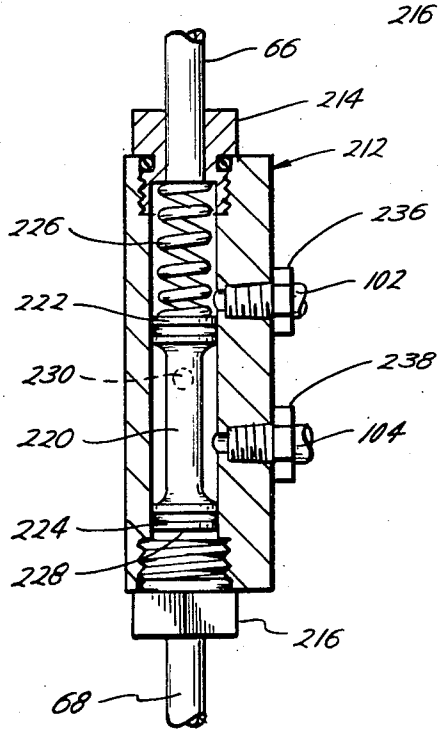


Fig. 6

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HYDRAULIC CONTROL SYSTEM

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of application, Ser. No. 639,360 filed May 18, 1967 and now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to an improvement in hydraulic control systems and more particularly in hydraulic remote control systems. A problem common to such systems is that of pressure build-up in the hydraulic lines. One solution to this problem is the use of lines of sufficient diameter to prevent such build-up. This, however, would require in some installations the use of lines of such size that the unit would no longer be small or portable enough for a man to handle. Furthermore, even with the use of these large lines, response time is not as fast as is desired due to the fluid resistance in the lines.

The use of lines of acceptable size develops a substantial pressure build-up as fluid moves through the system. As the lines increase in length, so does the pressure developed by the fluid flow. This is, of course, unsatisfactory and could be dangerous in some applications due to the fact that this back pressure prevents proper fluid movement and produces a slow response time.

The problem develops due to the fact that these systems are closed systems and the hydraulic fluid must travel from the remote control means to the controlled or activated apparatus and then back as the system returns to neutral or operates in a reverse manner. Where the system utilizes two lines, as in the application of the invention given herein, fluid moving toward the apparatus to be activated must push fluid in the other line back. As one skilled in this art would realize, when the lines are of substantial length, the back pressure built up in the system could become quite large and severely hamper the proper operation of the device.

SUMMARY OF THE INVENTION

The present invention circumvents the above problem by utilizing dump valves to take fluid out of the system, thus preventing the build-up of back pressure and the need for overcoming it due to the fact that the present invention eliminates the necessity of returning the fluid through the lines to the remote control apparatus. The dump valves connect to lines leading to the tank used for the storage of the hydraulic fluid. By locating the dump valves close to the apparatus activated by the hydraulic fluid and to the storage tanks, the fluid returning or being forced from this apparatus is quickly removed.

Since the removal of fluid occurs closely adjacent the activated apparatus, the remainder or substantially all of the hydraulic line remains full of fluid. The result is a quicker response time when fluid is directed to the apparatus to be activated through the line from which returning fluid has been previously dumped.

It is, therefore, an object of the present invention to provide an improvement in hydraulic control systems which will improve their reliability and speed of operation.

It is still a further object of the present invention to provide an economical and dependable hydraulic remote control apparatus which is simple in both operation and manufacture, and which includes means to eliminate the necessity of overcoming the return back pressure developed within the hydraulic lines.

Another object of the present invention is to provide a hydraulic remote control system which circumvents the problem of back pressure by eliminating the necessity of returning the hydraulic fluid to the remote control apparatus.

An additional object of the present invention is to utilize in such a control system quick dump valves positioned in the hydraulic lines relatively close to the apparatus, which is actuated or controlled by the hydraulic fluid, whereby fluid flowing from this apparatus is removed from the control system by these valves, thus preventing this fluid from traveling through the lines wherein the back pressure has built up.

A still further object of the invention is to provide such an improved valve which will permit only fluid returning from the activated apparatus to exit from the system, whereby the remainder of the hydraulic lines will remain filled with fluid for a quicker response time and to provide for ease of manual operation when necessary.

Further objects, features and advantages will be apparent from the following description of a presently preferred embodiment of the invention, given for the purpose of disclosure, when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following drawings, like character references designate like parts throughout the several views which are as follows:

FIG. 1 is a schematic view of the present invention as utilized in a hydraulic remote control system,

FIG. 2 is a side section view of one of the dump valves utilized in FIG. 1, showing the spool in its normal or spring-biased position,

FIG. 3 is a side section view of the other dump valve of FIG. 1, the spool being in its open position,

FIG. 4 is a side view, in section, of the remote control valve bank of FIG. 1,

FIG. 5 is a perspective view, partially in section, of a modified embodiment of the dump valve, showing the spool in its normal or spring-biased position, and

FIG. 6 is a side view taken along section line 6—6 of FIG. 5, showing the spool in one of its open positions.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, the present invention will be described as utilized in a hydraulic remote control system for the actuation and control of a slave cylinder, the piston of the cylinder being operatively connected to an operating element of a main valve bank. The hydraulic fluid utilized in this system will be hereinafter referred to as oil for purposes of simplicity. It is, of course, understood that any suitable substance may be utilized for the hydraulic fluid.

A remote control system in which the present invention may be utilized is shown in FIG. 1 and is comprised generally of a plurality of common tanks 10 for the

storage of oil, a remote control valve 12, dump valves 14 and 16, and a slave cylinder 18. In addition to these main components, there is also included a priority flow valve 20 and a pump 22, as well as tubing or hydraulic fluid lines to connect the various components.

In particular, the tanks 10 are used to store and as a source of supply of the hydraulic fluid or oil which is used in the system. They are connected by suitable conduit means, which are not shown, to comprise, in effect, a common tank. Accordingly, the system of tanks 10 will hereinafter be referred to in the singular.

Tank 10 is connected by a line 24 to the pump 22, which pulls the fluid from the tank 10 and conveys it by means of a line 26 through a directional control valve 25 and to the priority flow valve 20. This priority flow valve diverts a portion of the fluid through a line 28 which connects the priority flow valve 20 to the remote control valve bank 12. A pressure relief line 27 and return line 29 connect the priority valve 20 to the tank 10.

Referring now to FIG. 4, the remote control valve bank 12 is comprised generally of a casing 30 and a manually-operated handle 31. The line 28 is connected to the casing by means of a coupling member 32. Extending upwardly from the coupling member 32 and in fluid communication therewith is an interior passageway 33. The passageway 33 connects with a horizontally extending passageway 34 which in turn communicates with vertically extending piston valve chambers 35 and 36.

Mounted for sliding motion within the chambers 35 and 36 are the spools 37 and 38, respectively. These spools have lug members 39 at their upper ends. Springs 40 urge the spools upwardly, whereby they assume the position of spool 38 in FIG. 4, in which position the lug member 39 extends out of the top of the valve bank casing 30. An outwardly extending peripheral flange 41 on the handle 31 acts against these lug members 39 to raise and lower the spools 37 and 38 to operate the valve bank, as will be explained.

A drain passageway 42 communicates with the spool chambers 35 and 36 by means of the horizontally extending passageway 43. Coupling member 44 extends out of the bottom of the remote valve bank 12 and connects the drain passageway 42 with the hose member 45 which terminates at the tank 10.

Turning now to the spool members 37 and 38, two sealing flanges 46 and 47 are carried on each of the spools. These flanges 46 and 47 form a sliding peripheral seal with the interior sidewalls of the chambers 35 and 36. Openings 49 and 50 on the spools 37 and 38 are connected by means of a passageway (now shown) extending through the interior of the spools.

The interior passageways 51 and 52 extend substantially parallel to the valve chambers 35 and 36. The passageways 51 and 52 are connected by means of passageways 53 and 54 to the valve chambers 35 and 36, as shown.

Coupling members 62 and 64 extend from the bottom of the valve bank 12 and are in fluid communication with the lowermost portions of the valve cylinders 35 and 36, respectively. Connected to these couplings members are the lines 66 and 68 which are also connected to the dump valves 14 and 16. In this manner, the dump valves 14 and 16 are placed in fluid communication with the valve chambers 35 and 36, respectively.

Turning now to FIGS. 2 and 3 and to the construction of valves 14 and 16, the structure of valve 14 only will be described. The two valves are identical in their construction, and the numerals used to designate corresponding elements in the valves are the same, except that the numerals used with the valve 16 are in the 100 series. For example, the element designated by numeral 70 in the valve 14 would correspond to the element designated by the numeral 170 in valve 16.

Turning now to valve 14 shown in FIG. 3, the line 66 is connected to the valve body 70 at a port 72 by the coupling members 73. Contained in the valve body 70 are two essentially parallel passageways 74 and 76. These passageways are connected by the openings 78 and 80.

Passageway 74 has an enlarged portion 82 adjacent the port 72. As the enlarged portion 82 tapers to form a passageway of a smaller diameter, an annular shoulder 84 is formed. In the narrow portion of the passageway 74, a passageway 86 extends perpendicular to the passageway 74 opposite passageway 80 and terminates at a port 88. Extending outwardly from and communicating with the port 88 is a coupling member 89. The port 88 is connected to the storage tank 10 by a line 118, which is connected to the coupling 89. In like manner, the tubing 120 connects the port 188 of dump valve 16 to the tank 10.

A spool 90 is mounted within the passageway 74 for sliding motion therein. A spring 92 is also contained in passageway 74 and acts against an end 94 of the spool to urge the spool toward the port 72. Closely adjacent the end 94 of the spool is a recessed portion 95.

The passageway 76 terminates in a port 98 which is located in the opposite end of the valve body 70 from the port 72. Extending outwardly from the port 98 is the coupling element 100.

Discussing now both of the dump valves 14 and 16, tubing 102 and 104, respectively, are connected thereto by couplings 100 and 200. The opposite ends of the lines 102 and 104 are connected to the slave cylinder 18 by the couplings 106 and 108. The cylinder 18 is partially broken away to show the piston 110 mounted in the cylinder 18. Connected to the piston 110 is a rod or shaft 112 for movement with the piston. Rod 112 is connected to an appropriate linkage 114 which pivots about point 116. Linkage 114 is connected to a member 122 of the main valve bank (not shown) for the actuation of the member 122 along a reciprocating path as shown by the arrow. Springs 124 and 126 are connected to linkage 114 to keep it centered when it is not being actuated by the slave cylinder 18.

Turning now to the operation of the disclosed system, the priority flow valve 20 diverts a portion of the oil supplied under pressure from the tank 10 by the pump 22 to the remote control valve 12. The pressure of the oil is controlled by the pump 22 and the relief and return lines 27 and 29. The maximum pressure at which the oil is supplied to the remote valve banks 12 is 400 psi.

To control the member 122 on the main valve bank, the operator manipulates the handle 31. In FIGS. 1 and 4 of the drawing, the handle 31 has been pushed to the

left, whereby the flange 41 contacts the left-hand lug 39, forcing it into the housing 30. This pushes the spool 37 down, overcoming the force presented by the spring 40. The lowering of the spool 37 places the passageway 51 into fluid communication with passageway 34. The oil that is fed into passageway 33 from the priority flow valve 20 is now able to flow through passageway 51 to the lowermost portion of chamber 35, and to line 66. This oil flows through the line 66 in the direction of the arrows shown. The line 66 is generally from 30 to 60 feet in length, whereby adequate freedom is provided for the remote control valve bank with respect to movement away from the slave cylinder 18.

The springs 40 normally bias the spools 37 and 38 upwardly into the position in which spool 38 is shown in FIG. 4. In this position, the peripheral sealing surfaces 47 separate the passageway 34 from the passageways 53. As can be seen, therefore, when the spools are in the position of spool 38 in FIG. 4, the oil flowing into the valve chambers would become trapped in the portion of the chamber lying between the sealing surfaces 46 and 47.

A slight amount of leakage will likely occur around the surfaces 46 and 47. Oil passing by the surfaces 46 will flow into the openings 49 and out of the openings 50. Eventually, therefore, any leakage will find its way to the portion of the chamber lying below the sealing surface 47. From there, the leakage may flow through the passageway 42, coupling means 44, line 45 and to tank 10. Since any oil leaking beyond these sealing surfaces would be under no appreciable amount of pressure, there will be no effect on the dump valves 14 and 16 should the leakage flow into the passageways 51 and 52.

When the spools 37 and 38 are pressed down by operation of the lever 31, the sealing surfaces 47 pass by passageways 53, whereby the passageways 53 are placed into fluid communication with their respective passageway 34. When a spool is in its fully open or down position, its sealing surface 47 closes passageway 43 to prevent the escape of oil to tank 10. The volume of oil flowing through the passageways 53 is controlled by movement of lever 31 against lug 39, whereby the position of the surfaces 47 over the passageways 53 can be regulated. In this manner, the operator can control the size of the openings connecting the chambers to the passageways 53, the larger this opening, the greater the amount of oil flowing to the dump valves. This develops a certain "feel" in the lever 31 to enable the operator to have better control. Such would not be the case, for example, in an electrical control system. Another advantage of the hydraulic control system is that the operator is insulated from an electric charge should the mechanism being controlled, for example, a crane, contact a high voltage wire or the like.

Turning now to the operation of the dump valves, and particularly to FIGS. 2 and 3, the spring member 92 normally forces the spool 90 in dump valve 14 against the port 72, thereby closing this entrance into the inner chamber 74. The oil flowing through the line 66 is, however, under pressure and supplies enough force to overcome the resistance of spring 92, thus forcing the spool into the position shown in the drawing. In this position, the opening 78 connecting the passageways 74 and 76 is cleared to allow the flow of oil through the dump valve as shown by the arrows. This oil exits through the port 98 and continues to the slave cylinder 18 by means of the tubing member 102.

Upon entering the slave cylinder 18, the piston 110 will be forced away from the port through which the oil is entering. In the situation shown in the drawing, the piston 110 will be forced to the right. In like manner, the rod 112 will also move to the right, which motion will be transmitted by means of the linkage 114 to the main valve bank element 122 for operation and control of the main bank.

As the piston 110 moves to the right, oil present in the system will be forced out of the cylinder 18, through line 104 to the dump valve 16. Normally, this fluid exiting the cylinder would have to travel the entire length of the lines 104 and 68 to the remote valve 12. This problem is overcome in the present invention by the utilization of a dump valve relatively close to the slave cylinder, for example, 20 to 30 inches.

Since no fluid is being directed through line 68 by the remote control valve bank 12, which would exert a force against the spool 190, the spool is in its normally spring biased position shown in the drawing. In this position, the port 172 is no longer in communication with either of the openings 178 or 180. Because of the recessed portion 195, however, the opening 180 is placed in fluid communication with the passageway 186. As can be readily seen, fluid that is forced to exit from the cylinder 18 by the action of the piston 110 flows through the dump valve 16, line 120 and to the tank 10. This line 120 is, once again, generally no longer than 24 inches. Thus, the oil which is forced from the cylinder 18 is quickly removed from the control system and returned to the supply tank 10.

Movement of the control handle 31 to the right would reverse the previously described operation. The oil or hydraulic fluid would then be directed through the dump valve 16. The oil would overcome the resistance of the spring 192 and force back the spool 190, thereby allowing the fluid to flow to the cylinder 18.

As is readily understood, line 68 remained full of fluid during the time that fluid was being directed through line 66, only the fluid in line 104 being dumped from the system. As seen, therefore, only line 104 must be filled with fluid during this reverse operation to start the piston 110 moving in the opposite direction. Accordingly, a quicker response time in reversing the control functions is achieved.

Since no fluid would be flowing through the dump valve 14, the spool 190 would return to its normal position due to the action of the spring 92. Fluid that is forced from the cylinder by the action of the piston would then be dumped through valve 14 to the storage tank 10.

A further advantage is found in the fact that it is sometimes desirable to operate the main valve bank by manual movement of the linkage 114. Since any movement of linkage 114 also moves the piston 110, such manual operation of prior art mechanisms would necessitate the forcing of hydraulic fluid all of the way back to the remote control valve bank 12. This would render manual operation extremely difficult, if not impossible, due to the back pressure build-up.

In the present invention, however, when no fluid is being directed from the remote valve bank, the spools

of dump valves **14** and **16** assume the position of spool **190** in FIG. **2**. In this position, both of the dump valves are open to the tank **10**. It is only necessary, therefore, to force the fluid back through the respective dump valve to tank **10**. Manual operation in either direction is, therefore, quite easy.

As an alternative embodiment for the dump valves **14** and **16**, the improved embodiment shown in FIGS. **5** and **6** may be used. The valve arrangement **210** shown in FIG. **5** performs the functions of four sets of the dump valves, i.e., valves **14** and **16**, utilized in FIG. **1**. Each individual valve, shown in FIG. **6**, is equivalent to the two dump valves **14** and **16**, as will be explained.

Turning now to FIG. **5**, the improved valve is made up of a valve body **212**. This valve body **212** is shown having a size sufficient to handle four of the improved valves, but it is to be understood that the valve body may be made of any length and contain any number of the independently functioning valves.

The lines **66** and **68** leading from the remote control valve bank **12** are connected at the top and bottom, respectively, of the valve body **212**. Suitable coupling means **214** and **216** are provided. A spool **220** is mounted for reciprocal movement within a valve chamber **218**. The spool **220** has circular flanges **222** and **224** on its top and bottom, respectively, as viewed in FIGS. **2** and **3**. These flanges **222** and **224** provide a peripheral sealing surface to mate with the sidewalls of the chamber **218**. Acting against the outermost flat surfaces of the flanges **222** and **224** are spring members **226** and **228**. These spring members are of equal strength and cooperate to center the spool **220**, as shown in FIG. **5**, when no fluid is being directed through the dump valve. Passageway **231** extends through the valve body **212** to place the portions of the valve chambers **218** lying between the ceiling flanges **212** and **224** in communication with each other. A passageway **230** extends from the right-hand chamber **218** to the exterior of the valve body **212** and terminates in coupling member **232** to which is attached the line **234**. The opposite end of line **234** (not shown) is connected to the tank **10**. As will be readily understood by an examination of FIGS. **5** and **6**, the passageways **230** and **231** place the above-mentioned portions of each valve chamber **218** in fluid communication with the line **234** leading to the tank **10**.

Turning now to the operation of this embodiment of the dump valve, and assuming for purposes of discussion that this valve has been inserted into the system disclosed in FIG. **1**, fluid flowing through the line **66** will enter the top, as viewed in FIGS. **5** and **6**, of the valve chamber. The pressure exerted by the oil will overcome the force created by the springs **226** and **228** and force the spool **220** into the position shown in FIG. **6**. When in this position, the hose member **102**, which is connected to the valve body **212** by coupling member **236**, is placed into fluid communication with the line **66**. As can be readily seen, the oil moving from the remote valve bank **12** will flow through the valve **210** to the slave cylinder.

As the piston **112** moves, fluid will be returned to the valve chamber through line **104** and coupling means **238**. As is also shown in FIG. **6**, line **104** is now in communication with the passageway **230** which, in turn, communicates with the tank **10**. Oil returning from the slave cylinder **18** will, accordingly, flow to the tank **10**. In like manner, should there be oil returning from other slave cylinders to other valve chambers **218** in the valve body **212**, this oil would flow through the connecting passageways **231** to the passageway **230** and on to the tank **10**.

As shown in FIG. **5**, when the spool **220** is in its neutral or central position, lines **102** and **104** are separated from the inlet feeding lines **66** and **68**. Both lines **102** and **104** are, however, in communication with the outlet passageway **230** to provide for ease of manual operation, as was explained in connection with the dump valves **14** and **16**.

When the handle **31** is returned to its vertical position, and pressurized oil is no longer directed through line **66**, the springs **226** and **228** will act to return the spool to its central or neutral position. The springs **226** and **228** may be both tension and compression springs, whereby they will both urge the spool to its neutral position regardless of whether the spool is, as viewed in FIG. **5**, in its up or down position. In addition, since a reversal of the operation previously described will result in pressurized oil being directed into the chamber **218** from line **68**, there will be an additional positive pressure or force to urge the spool into its proper operating position. Such an arrangement will insure that the spool **220** does not stick.

As can be seen, therefore, the present invention as disclosed herein is well adapted to achieve the objectives set forth at the outset. A relatively inexpensive system which is simple in both manufacture and use, has been devised to provide a reliable and efficient operation. The hydraulic fluid forced from the slave cylinder **18** is quickly removed from the control system. This eliminates the necessity of overcoming the back pressure which could otherwise be necessary if one tried to force the fluid to return to the remote valve bank. The valve structure utilized in the disclosed embodiment dumps returning fluid from the system, but allows advancing fluid to quickly pass to the cylinder, thereby providing quicker response time, both in operation and in centering the piston **110** after an operation has been completed, and ease of manual operation.

As a result, improved mobility results due to the relatively long, but small diameter, lines that may be used and to the resulting remote valve bank which weighs less than five pounds. In addition, an improved dump valve has been devised to provide a more reliable operation as well as a more economical and compact unit.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the invention has been given for the purpose of disclosure, numerous changes in the details of construction and combination, size, shape and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as herein claimed.

What is claimed is:

1. A hydraulic control system for operating and controlling equipment including,

a remote control valve bank,

a cylinder,

a piston operatively connected to said equipment and being mounted for reciprocating movement in said cylinder,

tube means connecting the remote valve bank to the cylinder for the transmission of hydraulic fluid from the valve bank to and from such cylinder for movement of the piston, said tube means being further defined as including,

two tubes, each connecting the remote valve bank to the cylinder on opposite sides of said piston, whereby fluid may flow into and exit from the cylinder as the piston moves in either direction,

valve means connected to at least one of said tubes adjacent the cylinder for diverting out of said one tube fluid flowing from from the cylinder,

tank means for the storage and supply of hydraulic fluid to the remote valve bank, and

a return line connecting said valve means to said tank means for the return to said tank means of fluid diverted from said one tube.

2. A hydraulic control system for operation and controlling equipment including,

a remote control valve bank,

a cylinder,

a piston operatively connected to said equipment and being mounted for reciprocating movement in said cylinder,

tube means connecting the remote valve bank to the cylinder for the transmission of hydraulic fluid to and from such cylinder for movement of the piston, said tube means being further defined as including,

two tubes, each connecting the remove valve bank to the cylinder on opposite sides of said piston, whereby fluid may flow into and exit from the cylinder as the piston moves in either direction,

valve means connected to each of said tubes adjacent the cylinder for diverting out of its respective tube fluid flowing from the cylinder, each of said valve means further including,

a valve in each of said tubes, each of said valves having first, second and third ports in fluid communication with each other, and

a spool normally seating against and sealing the first port, and having a second position in which it seats against and seals the second port.

3. A hydraulic control system for operating and controlling equipment including,

a remote control valve bank,

a cylinder,

a piston operatively connected to said equipment and being mounted for reciprocating movement in said cylinder,

tube means connecting the remote valve bank to the cylinder for the transmission of hydraulic fluid from the valve bank to and from such cylinder for movement of the piston, said tube means being further defined as including,

two tubes, each connecting the remote valve bank to the cylinder on opposite sides of said piston, whereby fluid may flow into and exit from the cylinder as the piston moves in either direction,

valve means connected to each of said tubes adjacent the cylinder for diverting out of its respective tube fluid flowing from the cylinder,

tank means for the storage and supply of hydraulic fluid to the remote control valve bank, and

return lines connecting each of said valve means to said tank means for the return to said tank means of fluid diverted from said tubes.

4. A hydraulic control system including,

a slave cylinder having a piston,

a remote control valve bank,

a fluid source and means to supply hydraulic fluid under pressure to said remote bank,

tube means connecting the remote bank, said tube means being further defined as including,

a first tube means connecting the remote bank to the cylinder on one side of said piston, and

a second tube means connecting the remote bank to the cylinder on the opposite side of said piston, and

valve means located in each of said tube means adjacent said cylinder for diverting hydraulic fluid flowing from the cylinder out of the tube means, said valve means being further defined as including,

a valve on each of said first and second tube means to allow fluid flowing from the cylinder to exit from the tube means, each of said valves being comprised of,

a valve body having first, second and third ports communicating with an inner valve chamber,

a spool slidably mounted within said chamber and having at least two positions within said chamber, said first port being closed and the second and third ports being in communication when the spool is in its first position; and said second port being closed and the first and third ports being in communication when the spool is in its second position.

5. The invention of claim **4**, wherein,

the first port in said valves is connected in fluid communication with the remote bank by said tube means,

the second port in each of said valves being connected in fluid communication to said supply means,

said third port being in fluid communication with said cylinder, and,

the spool is biased against said first port, whereby said first port is normally closed.

6. A hydraulic control system including,

a slave cylinder having a piston,

a remote control valve bank,

a fluid source and means to supply hydraulic fluid under pressure to said remote bank,

tube means connecting the remote bank, said tube means being further defined as including,

a first tube means connecting the remote bank to the cylinder on one side of said piston, and

a second tube means connecting the remote bank to the cylinder on the opposite side of said piston, and

valve means located in each tube means adjacent said cylinder for diverting hydraulic fluid flowing from the cylinder out of its respective tube means, each valve means including a valve comprised of,

first, second and third ports in fluid communication with each other,

said first port being connected by said tube means to said remote bank for receiving hydraulic fluid,
said second port being an outlet from said system, and,
said third port being connected by said tube means to said cylinder for the transmission of fluid thereto and,
a spool normally biased to seat against and close said first port and having a second position in which it seats against and closes said second port, the control system further including,
conduit means other than said tube means connecting the second ports to the fluid source

7. The invention of claim 6 wherein said spool is biased against said first port by a force which is less than the force exerted by the hydraulic fluid, whereby when fluid flows from said remote bank to one of said valves, the spool will be forced away from said first port.

8. The invention of claim 7 wherein the second position is further defined as the position assumed by said spool when forced away from said first port by the force exerted by the hydraulic fluid.

9. A hydraulic control system including,
a slave cylinder having a piston,
a remote control valve bank,
a fluid source and means to supply hydraulic fluid under pressure to said remote bank,
tube means the transmission of fluid from connecting the remote bank to the slave cylinder said tube means being further defined as including,
a first tube means connecting the remote bank to the cylinder on one side of said piston, and
a second tube means connecting the remote bank to the cylinder on the opposite side of said piston, and
valve means located in one of said tube means adjacent said cylinder for diverting hydraulic fluid flowing from the cylinder out of said one tube means,
tank means for the storage and supply of hydraulic fluid to the remote valve bank, and
a return line connecting said valve means to said tank means for the return to said tank means of fluid diverted from said one tube means.

10. A hydraulic control system including,
a slave cylinder having a piston,
a remote control valve bank,
a fluid source and means to supply hydraulic fluid under pressure to said remote bank,
tube means for the transmission of fluid from the remote bank to the slave cylinder said tube means being further defined as including,
a first tube means connecting the remote bank to the cylinder on one side of said piston, and
a second tube means connecting the remote bank to the cylinder on the opposite side of said piston, and
valve means located in each of said tube means adjacent said cylinder for diverting hydraulic fluid flowing from the cylinder out of the tube means, said valve means being further defined as including,
a valve on each of said first and second tube means to allow fluid flowing from the cylinder to exit from the tube means,
tank means for the storage and supply of hydraulic fluid to the remote control valve bank, and
return lines connecting each of said valves to said tank means for the return to said tank means of fluid diverted from said tube means.

11. A hydraulic control system comprised of,
a source of hydraulic fluid under pressure,
a manually operated remote valve bank being operatively connected to said fluid source for receiving said fluid,
first and second hydraulic lines connected at one of their ends to the remote bank for receiving said fluid from said bank,
means in and operated by said remote bank for selectively supplying fluid from the fluid source through either of said first or second lines as desired,
a dump valve at the opposite end of each of the first and second lines, each valve being comprised of,
an inner chamber, and,
first, second and third ports in fluid communication with said chamber, said first and second lines being connected to their respective valves at said first ports, and said second ports being in fluid communication with and close to the source of fluid,
a cylinder,
a piston mounted in said cylinder for reciprocal movement therein,
third and fourth hydraulic lines connecting, in fluid communication, the third ports of said valves to said cylinder on opposite sides of said piston, whereby hydraulic fluid flowing through one of said third or fourth lines will cause the piston to move toward the other of the said third and fourth lines, thereby forcing fluid out of the cylinder and through said other lines, and wherein each of the dump valves are further defined as including,
spool means, mounted for movement in said chamber, said spool means being normally biased to seat against and close the first port, said bias being insufficient to resist the force exerted against the spool means by the pressurized hydraulic fluid when said fluid is directed through the first or second lines by operation of the remote valve bank, said spool means assuming a second position when the bias is overcome by the force exerted by the fluid, said second position being defined as the spool means seating against and closing the second port.

12. A hydraulic control system for controlling equipment, including,
a control apparatus operatively connected to said equipment for the control of the equipment, said control apparatus being operated by the transmission of hydraulic fluid to and from said control apparatus,
a control valve remote from the control apparatus
two tubes, each connecting the control valve to said control apparatus, whereby fluid from the control valve may flow into and exit from the control apparatus in a simultaneous manner, and further including,
valve means connected to at least one of said tubes adjacent said control apparatus for diverting out of said one tube fluid flowing from the control apparatus,
tank means for the storage of and supply of hydraulic fluid to the remote valve, and

a return line connecting said valve means to said tank means for the return to said tank means of fluid diverted from said one tube.

13. A hydraulic control system for controlling equipment, including:

control apparatus operatively connected to said equipment for the control of the equipment, said control apparatus being operated by the transmission of hydraulic fluid to and from said control apparatus,

a control valve remote from the control apparatus,

two tubes, each connecting the control valve to said control apparatus, whereby fluid from the remote valve may flow into and exit from the control apparatus in a simultaneous manner, and further including,

valve means connected to at least one of said tubes adjacent said control apparatus for diverting out of said one tube fluid flowing from the control apparatus,

said valve means is connected to each of said tubes adjacent the control apparatus for diverting out of each respective tube fluid flowing from the control apparatus,

tank means for the storage of and supply of hydraulic fluid to the remote valve, and

return lines connecting said valve means to said tank means for the return to said tank means of fluid diverted from said tubes.

14. A hydraulic control system for operating and controlling equipment, including

a remote control valve bank,

a cylinder,

a piston operatively connected to said equipment and being mounted for reciprocating movement in said cylinder,

tube means connecting the remote valve bank to the cylinder for the transmission of hydraulic fluid to and from said cylinder for movement of the piston,

valve means connected to said tube means adjacent the cylinder for diverting out of said tube means fluid flowing from the cylinder,

said tube means being comprised of two tubes, each connecting the remote bank to the cylinder on opposite sides of said piston, whereby fluid may flow into and exit from the cylinder as the piston moves in either direction, and

said valve means being further defined as including,

a valve block being comprised of,

a valve chamber,

first adjacent inlet and outlet for one of said tubes in said chamber,

second adjacent inlet and outlet in said chamber for the second of said tubes,

a drain outlet lying between said first inlet and outlet and said second inlet and outlet,

a first sealing member biased into a position lying between the first inlet and the first outlet, whereby the first inlet is normally sealed from said first outlet, and

a second sealing member biased into a position lying between the second inlet and the second outlet, whereby the second inlet is sealed from said second outlet, the bias on each of said sealing members being insufficient to withstand a predetermined amount of force exerted through its respective inlet, whereby said predetermined force will overcome said bias to move the sealing member from between its respective inlet and outlet.

15. A hydraulic control system for operating and controlling equipment, including

a remote control valve bank,

a cylinder,

a piston operatively connected to said equipment and being mounted for reciprocating movement in said cylinder,

tube means connecting the remote valve bank to the cylinder for the transmission of hydraulic fluid to and from said cylinder for movement of the piston,

valve means connected to said tube means adjacent the cylinder for diverting out of said tube means fluid flowing from the cylinder,

said tube means being comprised of two tubes, each connecting the remote bank to the cylinder on opposite sides of said piston, whereby fluid may flow into and exit from the cylinder as the piston moves in either direction, and

said valve means being further defined as including,

a valve block comprised of,

a valve chamber, and in said valve chamber,

a first adjacent inlet and outlet for one of said tubes,

a second adjacent inlet and outlet for the second of said tubes,

a drain outlet lying between said first inlet and outlet and said second inlet and outlet, and

spool means slidably mounted in said chamber and having two sealing members, said spool means having a first position in which the sealing members seal the inlets from their respective outlets, a second position in which the first inlet and outlet are in fluid communication and a third position in which the second inlet and outlet are in fluid communication.

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