

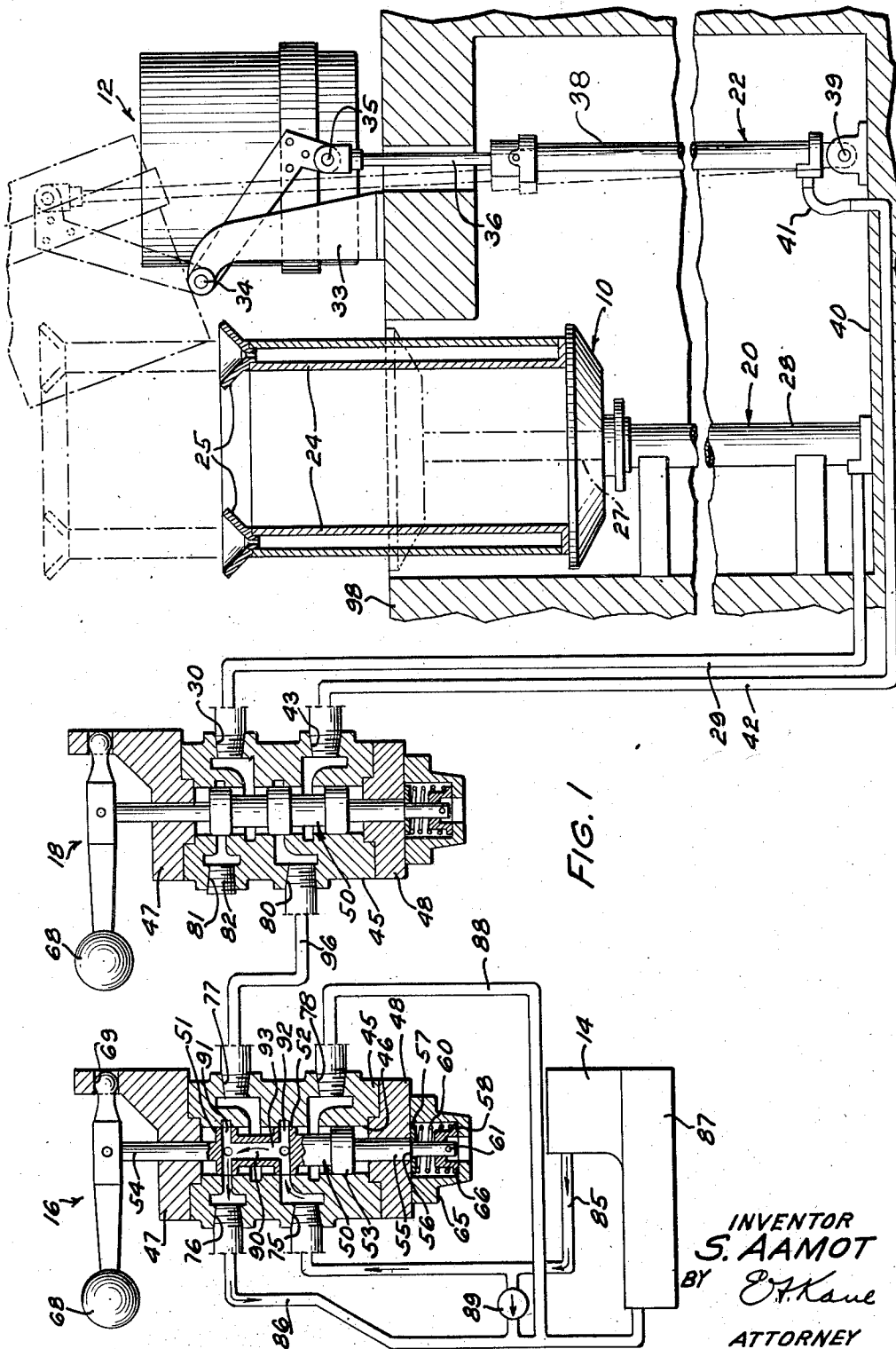
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S. AAMOT
CONTROL APPARATUS

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2 Sheets-Sheet 1



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FIG. 3

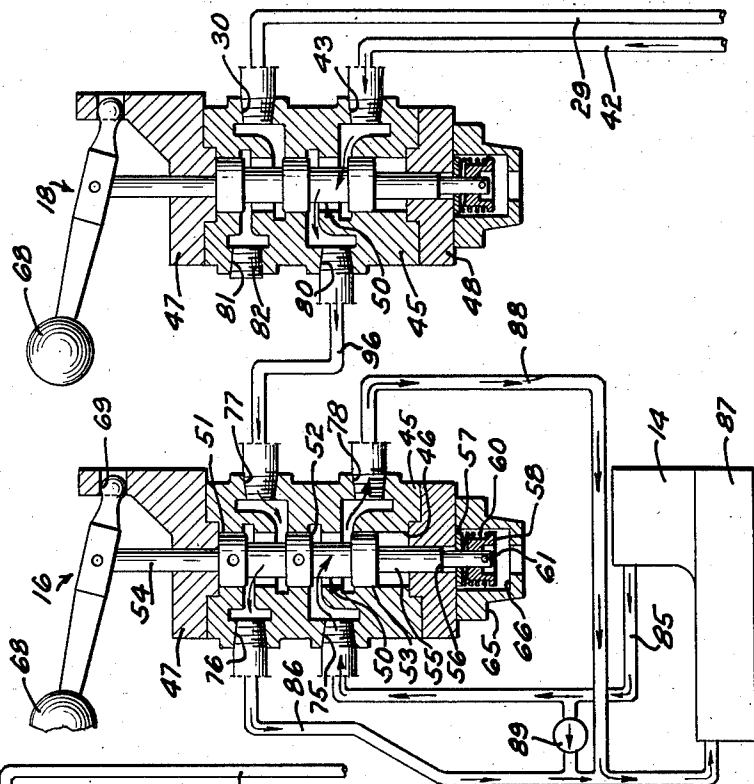
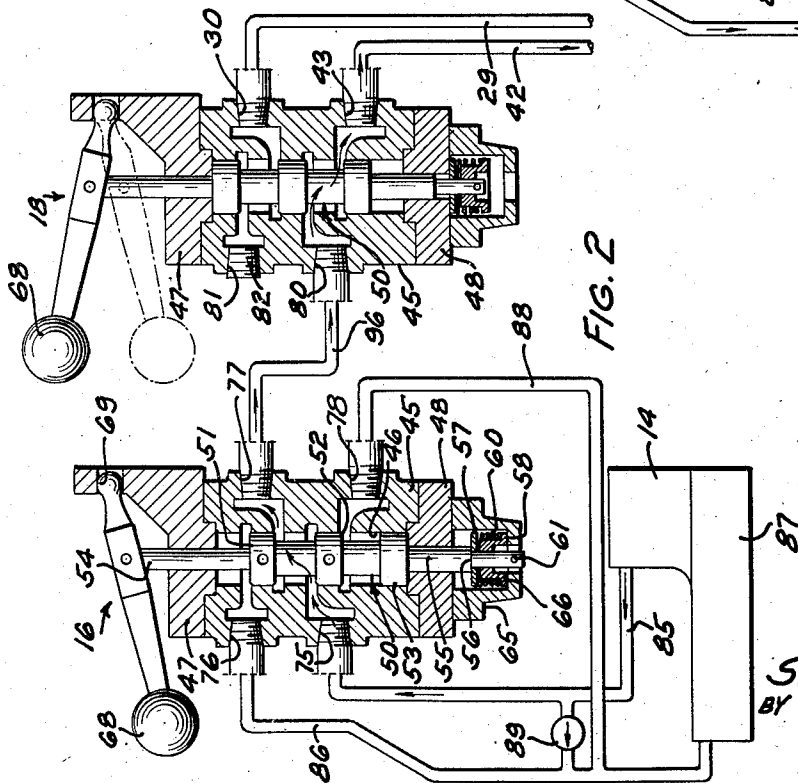


FIG. 2



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CONTROL APPARATUS

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This invention relates to control apparatus and more particularly to hydraulic control systems for selectively operating only a selected one of a plurality of hydraulic actuators.

An object of this invention is to provide a simplified and effective control apparatus for selectively operating any one of a plurality of actuators.

In one embodiment of the present invention, there is provided a hydraulic system in which a pump, a multi-position operating valve, and a multi-position selector valve are connected in series and two hydraulic actuators are individually connected to the selector valve so that the selector valve may be actuated to select which of the actuators is to be actuated and the operating valve may be actuated to determine what kind of operation is to be imparted to the selected actuator.

The invention will be more fully understood when considered in conjunction with the following specification and the appended drawings, in which:

Fig. 1 is a diagrammatic view of a hydraulic system for operating a mold lifting hydraulic actuator and a furnace tilting hydraulic actuator and showing a multi-position operating valve and a multi-position selector valve in the system each in neutral position;

Fig. 2 is a view of a portion of the hydraulic system shown in Fig. 1 with the operating valve in its lower position and the selector valve in its upper position; and

Fig. 3 is a view of a portion of the hydraulic system showing the operating valve in its upper position and the selector valve in its upper position.

The hydraulic system, which is used for raising and lowering a mold supporting table 10 and for tilting a casting furnace 12, comprises a hydraulic pump 14, a multi-position operating valve 16 hydraulically connected to the pump, a multi-position selector valve 18 hydraulically connected to the operating valve, and hydraulic actuators 20 and 22 for actuating the mold supporting table and the casting furnace, respectively, individually hydraulically connected to the selector valve 18.

Mounted on the table 10 are a plurality of elongated hollow molds 24 closed on all sides except at the top end, which is adapted to receive a pouring spout 25 through which the mold is filled. The mold supporting table 10 is mounted on the upper end of a cam 27 mounted for reciprocation within the cylinder 28 of the hydraulic actuator 20 and is movable vertically to

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carry the molds from the pouring position shown in full lines in Fig. 1 to a mold unloading position shown in dot and dash lines in Fig. 1. A single pipe 29 connects the lower end of the cylinder 28 to an outlet port 30 of the selector valve 18.

The casting furnace 12 is supported in a pair of standards 33 and is adapted to be tilted about a pivot 34 at the upper end thereof. On either side of the casting furnace 12 and pivotally attached thereto at 35 is one of a pair of rams 36 mounted for reciprocation within a pair of cylinders 38 of the hydraulic actuator 22. The cylinders 38 are pivotally mounted in brackets 39 supported on the base 40 of a pit in which the hydraulic actuators 20 and 22 are located. The cylinders 38 of the actuator 22 are connected by flexible connections 41 to a single conduit 42, in turn connected to an outlet port 43 of the selector valve 18. The rams or pistons 27 and 36 of the hydraulic actuators 20 and 22 are moved upwardly from their normal positions by the inflow of fluid into the lower ends of the cylinders 28 and 38, respectively, under pressure from the pump 14 and under control of the operating valve 16 and the selector valve 18. The rams 27 and 36 are returned to their normal position under the force of gravity and the outflow of fluid from the lower end of their respective cylinders under control of the valves 16 and 18.

The operating and selector valves are substantially identical and each comprises a body member 45 centrally apertured at 46 to form a valve chamber and is provided with heads 47 and 48 secured thereto. A piston type slide valve member 50, having three enlarged spaced heads 51, 52 and 53, is reciprocally mounted in said valve member 46 and is provided with piston rod portions 54 and 55 extending in opposite directions through apertures in the heads 47 and 48. The lower end of the valve rod 55 is reduced to form a shoulder 56 and is provided with washers 57 and 58 slidably mounted thereon. A compression spring 60 is interposed between the washers, and a pin 61 is provided in rod 55 to retain the washer 58 in a predetermined relation to the washer 57, which normally seats against the shoulder 56. A cup-shaped member 65, secured to the valve head 48, is provided with a seat 66 for the washer 58 and serves, in cooperation with the washers 57 and 58, the spring 60, and the end surface of the head 48, to maintain the valve 50 normally in a neutral position, as shown in Fig. 1. Pivotaly attached to the upper end of the rod 54 is an operating lever 68, one end of which is

slidably fulcrumed in an aperture 69 in the head member 47. The arrangement of the spring 60 and the washers 57 and 58 acts to restore the valve member 50 to its neutral position, shown in Fig. 1, from the operating positions shown in Figs. 2 and 3 after the operating lever 68 has been released by the operator.

The body 45 of the operating valve 16 is provided with an intake port 75 and a plurality of ports 76, 77 and 78, through which the hydraulic fluid may pass from the valve 16. The body 45 of the selector valve 18 is provided with an intake port 80 and the aforementioned outlet ports 30 and 43 and a port 81, which is not used and is closed by a plug 82. Each of the ports has an annular groove communicating with it and encircling and communicating with the central valve chamber 46 of its respective valve and is arranged in a predetermined relation to the enlarged piston heads 51, 52 and 53 of the piston valve 50, as illustrated in the drawings.

The outlet of the pump 14 is connected by a conduit 85 with the intake port 75 of the operating valve 16. A return conduit 86 connects the port 76 of the operating valve 16 with a reservoir 87 associated with the hydraulic pump 14 and a conduit 88 connects the port 78 with the return conduit 86. A pressure relief valve 89, set at a predetermined pressure, is connected between the inlet conduit 85 and the return conduit 86 to by-pass hydraulic fluid therethrough when the pressure within the conduit 85 reaches the predetermined pressure at which the relief valve 89 is set. When the valve member 50 of the operating valve 16 is in its neutral position, the fluid from the pump 14 is adapted to pass through the conduit 85 and into the intake port 75 and to be by-passed through a passageway 90 in the piston valve member 50 and to return through the conduit 86 to the reservoir 87 associated with the pump 14. The passageway 90 comprises radial apertures 91 and 92 in the piston heads 51 and 52, respectively, aligned with port apertures 76 and 75, respectively, and connected longitudinally by a bore 93.

The outlet port 77 of the operating valve 16 is connected by a conduit 96 to the intake port 80 of the selector valve 18. The selector valve 18, as previously mentioned, is connected to each of the hydraulic actuators 20 and 22 through single conduits 29 and 42, respectively.

The piston valve member 50 of the operating valve 16 is adapted to be moved to its lower position, as indicated in Fig. 2, to establish communication between the intake port 75 and the outlet port 77 and to cut off the flow of hydraulic fluid to the return port 76 and in which position the hydraulic fluid applied by the pump 14 passes through the valve 16 to the conduit 96. The operating handle 68 of valve 16 may be moved upwardly to raise the valve member 50 to the position shown in Fig. 3, which establishes communication between the outlet port 77 and the return port 76 and the intake port 75 and the return port 78, respectively. With the operating valve in this position, the fluid from port 77 may pass through the operating valve 16 and the return pipe 86 to the reservoir 87 and the hydraulic fluid from the pump 14 circulates freely through the conduit 85, the operating valve 16 and the return conduits 88 and 86.

The operating handle 68 of the selector valve 18 may be moved upwardly or downwardly to move the piston valve member 50 upwardly or downwardly to establish communication be-

tween the intake port 80 and either the outlet port 30 or the outlet port 42, respectively, and admit fluid into the lower end of the hydraulic actuator 20 or the hydraulic actuator 22, respectively. When the valve member 50 is moved to establish hydraulic communication between the intake port and one of the outlet ports, it also acts positively to block hydraulic communication with the other port so that when the selector valve is moved to select one hydraulic actuator to be actuated, it positively locks out the other. Thus the simultaneous operation of the mold supporting table 10 and the furnace 12 is prevented. With this mechanism, the possibility of injury to an operator and/or damage to the apparatus is minimized since it is impossible to simultaneously operate both actuators.

The operating handle 68 of the selector valve 18 may be moved upwardly to raise the valve member 50 to its upper position, as shown in Fig. 2, to establish communication between the intake port 80 and outlet port 43. With the valve in this position, the conduit 96 is hydraulically connected to the conduit 42 and to the lower end of the actuator 22 for raising and lowering the casting furnace 12. By moving the operating handle 68 of the selector valve 18 downward to the position indicated in dot and dash lines in Fig. 2, the valve member 50 will be moved to its lower position and connect the inlet port 80 with the outlet port 30. With the valve member in this position, the conduit 96 is in hydraulic communication with the conduit 29 and to the lower end of the actuator 20 for raising and lowering the mold supporting table 10.

In the operation of the apparatus for casting molten material into bars, the molds 24 and the table 10, on which they are mounted, are moved to their lower position, as indicated in full lines in Fig. 1, where one of the molds 24 is in proper position relative to the casting furnace 12 to receive a charge therefrom. The casting furnace 12, after having been charged with metal and heated to bring the metal to a molten state, is tilted about the pivot 34 to pour the molten metal into the mold 24. To raise the casting furnace 12, the operator moves the operating lever 68 of the operating valve 16 downwardly to establish a flow of hydraulic fluid from the pump to the conduit 96 and then the operator moves the operating handle 68 of the selector valve 18 upwardly to select the furnace actuator 22 and establish communication between the conduit 96 and the conduit 42 of the actuator 22. The hydraulic fluid under pressure from the pump 14 will then flow through the conduit 85 through the operating valve 16, the conduit 96, the selector valve 18, the conduit 42 and into the cylinders 38 of actuator 22 and raise the pistons 36 connected to the casting furnace 12 and move the casting furnace 12 about the pivot 34. When the mold is full, the operator moves the handle 68 of the operating valve 16 upwardly past its neutral position to its upper position to move the piston valve member 50 therein to establish communication between the conduit 96 and the return conduit 86, the handle 68 of the selector valve 18 being maintained in its upward position. The fluid in the cylinders 38 of the actuator 22 is then free to move in a reverse direction, it being forced out by the downward movement of the piston 36 under the downward force of the casting furnace 12 and passes through the conduit 42 through the selector valve 18, the conduit 96, the operat-

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ing valve 16 and through the return conduit 86 to the reservoir 87.

When the casting furnace 12 has returned to its normal position, the operator then releases the handles 68 of the valves 16 and 18, which are automatically returned to their neutral position. The table 10 and the molds 24 thereon may then be rotated to align another mold in receiving position with respect to the casting furnace 12 and the cycle of operation may be repeated to fill the second mold. After all of the molds 24 have been filled and allowed to cool, the table 10, with the molds 24 thereon, is raised out of the pit to the level of the floor 98, as indicated in dotted lines in Fig. 1, where the molds may be opened and the cast bars or ingots removed therefrom. In order to allow time for the removal of the ingots from the molds, the table 10 is automatically hydraulically locked in its upper position by setting the handles 68 and valve members 50 in neutral position until the removal of the ingots from the mold is completed.

The operator, in order to raise the ram 27 and the table 10, moves the lever 68 of the operating valve 16 downward to connect the conduit 96 with the fluid pressure in conduit 85, after which the operator moves the handle 68 of the selector valve 18 downwardly to connect the fluid pressure in the conduit 96 with the conduit 29 connected to the lower end of the actuator 20. Fluid under pressure will then pass from the pump 14 through the conduit 86, the operating valve 16, the conduit 96, selector valve 18, through the conduit 29 to the cylinder 28 of the selected actuator 20 and raise the ram 27, the table 10 and the molds 24 thereon upwardly. When the ram 27 and the table 10 have been raised to the proper height so that the table 10 is on the level with the floor 98, the operator releases the operating handles 68 of the valves 16 and 18, which valves return to their normal neutral position and thereby prevent further movement of the ram 27 and table 10.

In its normal neutral position, the selector valve 18 cuts off the flow of oil to the conduits 42 and 29, which serves to lock the actuators in the position then encountered and in this case serves to maintain the ram 27 and the table 10 in its elevated position. The operating valve 16, with its valve member 50 in its normal neutral position, cuts off the flow of liquid through the conduit 96 and, being in series with the selector valve 18, acts as a double stop to block the flow of hydraulic fluid from either of the actuators 20 or 22 through their respective conduits 29 and 42 and the selector valve 18. Thus the ram 27, the table 10, with the molds 24 thereon, are maintained in their elevated positions, from which position they are prevented from settling by the effective means of the two valves 18 and 16 in series in the hydraulic system.

After the operation of removing the ingots from the molds has been completed and the molds are reassembled, the table 10, with the molds thereon, may be returned to their lower normal position. This is accomplished by the moving of the lever 68 of the operating valve 16 upwardly and moving the lever 68 of the selector valve 18 downwardly, which then establishes communication between the fluid in the actuator 20 and the return conduit 86 to permit the fluid in the cylinder 28 under the downward force of the weight of the ram 27, table 10 and molds 24 to pass through the conduit 29, selec-

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tor valve 18, conduit 86, operating valve 16 and the return conduit 86 to the reservoir 87.

During the return flow of hydraulic fluid from either of the actuators 20 and 22 when the valve member 50 of operating valve 16 is in its upper position, as indicated in Fig. 3, the hydraulic fluid from the pump 14 passes through the valve 16 and the return conduits 88 and 86 connected to the reservoir 87 and circulates freely without imposing a load on the pump. Under ordinary conditions, it is only when the hydraulic actuators are operated to raise either the mold supporting table 10 or the casting furnace 12 that the pump is operating against a high working pressure, while at other times the pump is operating under a minimum idling pressure. With the valve member 50 of the operating valve 16 in the lower position, as shown in Fig. 2, the hydraulic fluid from the pump 14 will be by-passed through the pressure relief valve 89 to the reservoir 87 when the selector valve 18 is in its neutral position or when the selector valve 18 is in either one of its operating positions and the ram of the actuator connected thereby is stopped at its limit of travel.

What is claimed is:

1. An apparatus for controlling the operation of fluid operated actuators comprising a selector valve having a closed normal position and two open off-normal positions, an operating valve having a closed normal position and two open off-normal positions, means in each of said valves tending to maintain it in normal position, a pair of fluid operated actuators, a single conduit connecting one of said actuators to one of said open-off-normal positions of said selector valve, a single conduit connecting the other of said actuators to the other open off-normal position of said selector valve, said actuators being advanced by the flow of fluid therein in one direction and returned by gravity and the flow of fluid therein in the opposite direction, a single conduit connecting said operating valve to said selector valve, a pump, a fluid reservoir associated with said pump, a conduit connecting the pump to said operating valve for conducting fluid thereto, and a conduit for returning fluid from said operating valve to said reservoir, said operating valve in one open off-normal position serving to direct the flow of fluid in one direction from said pump to said selector valve and in the other open off-normal position serving to by-pass the fluid from the pump to the reservoir and to direct the flow of fluid from the selector valve to the reservoir, and said selector valve in one open off-normal position serving to connect the operating valve with one of said actuators and in the other open off-normal position serving to connect the operating valve with the other actuator.

2. A hydraulic apparatus for operating a plurality of hydraulic actuators comprising a hydraulic pump, a reservoir for hydraulic fluid associated with said pump, a multi position operating valve, a conduit for conducting hydraulic fluid from said pump to said operating valve, a conduit for returning said hydraulic fluid from said operating valve to said reservoir, valve means for by-passing hydraulic fluid from said pump to said reservoir when the pressure in said conduit from said pump exceeds a predetermined amount, a multi position selector valve, a hydraulic connection between said valves, a plurality of hydraulic actuators, means for conducting hydraulic fluid between said selector

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valve and each of said hydraulic actuators comprising a single conduit between each actuator and said selector valve, said actuators being movable from a normal position by the flow of hydraulic fluid therein in one direction under control of said valves and being movable to said normal position by gravity and the flow of hydraulic fluid in a reverse direction under control of said valves, said selector valve being operable to establish hydraulic communication between a selected one of said hydraulic actuators and said operating valve, said operating valve being operable in one of said positions to establish hydraulic communication between said pump and said selector valve whereby fluid under pressure may be delivered to said selector valve for distribution to one of said actuators, and said operating valve being operable in another position to by-pass the fluid from the pump to the reservoir and to establish hydraulic communication between said reservoir and said selector valve whereby fluid from said selector valve may be returned to said reservoir.

3. An apparatus for controlling the operation of a pair of fluid operated actuators comprising a hydraulic pump, a hydraulic fluid reservoir associated with said pump, a multi-position operating valve having a closed normal position and two open off-normal positions, a conduit for conducting hydraulic fluid from the pump to the operating valve, a conduit for conducting fluid from the operating valve to the reservoir, a multi-position selector valve having a closed normal position and two open off-normal positions, a single conduit for conducting fluid from one to the other of said valves, a pair of hydraulic actuators, a single conduit connecting one of said

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actuators to one of said open off-normal positions of said selector valve, a single conduit connecting the other of said actuators to the other open off-normal position of said selector valve, spring means for yieldingly retaining said selector valve in normal position, means for moving said selector valve to either one of said open off-normal positions to select either one of said actuators for actuation, spring means for yieldingly retaining said operating valve in said closed normal position, and means for moving said operating valve to either of said open off-normal positions, said operating valve in one of said open off-normal positions serving to direct the flow of fluid from the pump to the selector valve and in the other open off-normal position serving to by-pass the fluid from the pump back to the reservoir and to establish hydraulic communication from the selector valve to the reservoir.

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