

FLUID OPERATED SYSTEM

5 This invention relates generally to a fluid control system having a fluid pressure relieving arrangement.

10 Relief valves and the like have been employed in fluid operated systems to protect fluid operated motors and associated system componentry from excessive fluid pressure which is detrimental to the life of the motors and componentry. Typically the relief valves are connected to the system reservoir either directly or through a controlling valve of the system. In either situation a continuously open passageway between the relief valve and reservoir must be provided so that fluid flow from the relief valve to the reservoir may be freely passed.

15 Often the fluid operated system is utilized to controllably power an implement; such as provided on a lift truck or earthmover. In these applications, the use of a separate conduit to connect the relief valve directly to the reservoir is undesirable because it reduces visibility past the implement, is subject to damage, and requires additional parts which adds to the cost and complexity of the vehicle.

20 In implements having a plurality of different functions, several fluid operated motors are normally provided. For example, a container handling attachment of a lift truck requires side shift, slew, extend, reach, and leveling functions. In such applications the jacks associated with each function must have the capability of being individually controlled. It has been found that the number of conduits connecting the controlling valve to the jacks can be reduced to two when a selecting valve for each function is provided. The selecting valves

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are mounted on the implement and a single controlling valve for modulating fluid flow is mounted on the vehicle. The pair of conduits connect the controlling valve to the selecting valve and provide flow paths from a pump to the jack and from the motor to the reservoir. In this arrangement the selecting valves block flow between the controlling valve and the respective motors and this isolate the jacks from the reservoir. Locating the relief valves between the selecting valves and the controlling valve prevents communication of the relief valves with the jacks, and locating the relief valves between the jacks and selecting valves isolates the relief valves from the reservoir. Providing a separate conduit to connect each relief valve to the reservoir is not a viable solution for substantially the same reasons as discussed above.

According to a first aspect of the invention, a fluid control system comprises a reservoir; a pump connected to the reservoir; a first fluid operated jack having rod and head ends connected to the pump and arranged to deliver a first signal in response to a pressure within the jack being greater than a preselected magnitude; a controlling valve having first and second passageways, the first passageway being connected to and between the reservoir and one of the ends of the first jack, the second passageway being connected to and between the pump and the other end of the first jack, the controlling valve being movable between a first position at which the first and second passageways are blocked, a second position at which the first passageway is open to the reservoir and one end of the first jack and the second passageway is open to the pump and the other end of the first jack, and a third position at which the first passageway is open to the pump and the one end of the first jack and the

second passageway is open to the reservoir and the other end of the first jack, the controlling valve enabling flow from either jack end to be connected to reservoir through the first or second controlling valve passageway when the controlling valve is in the second or third position; a first selecting valve having a first passageway, the first selecting valve first passageway being connected to and between the controlling valve first passageway and the first jack, the first selecting valve being movable between a first position at which the first selecting valve first passageway is blocked and a second position at which the first selecting valve first passageway is open to the controlling valve first passageway and the first jack; a first relief valve having a passageway and a signal port, the first relief valve passageway being connected to the jack and the controlling valve first passageway in parallel with the selecting valve, the first relief valve being movable between a first position at which the first relief valve passageway is blocked and a second position at which the first relief valve passageway is open to the jack and the controlling valve first passageway, the signal port being connected to the jack and being arranged to receive the first signal, the first relief valve being movable from the first position to the second position in response to receiving the first signal; a bypass valve having a passageway, the bypass valve passageway being connected to and between the first selecting valve first passageway and the reservoir and in parallel with the controlling valve, the bypass valve being movable from a first position, at which the bypass valve passageway is open to the first selecting valve first passageway and the reservoir, to a second position, at which the bypass valve passageway is blocked; means for generating a pilot signal; and

means for directing the pilot signal to both of the controlling and bypass valves and moving the controlling valve from the first position to the second position and the bypass valve from the first position to the second position.

Because the relief valve is connected in parallel with the selecting valve and the bypass valve is connected in parallel with the controlling valve no additional conduits are required to pass fluid flow between the selector and controlling valves.

Since, the bypass is movable from the first position to the second position in response to movement of the controlling valve from the first position to the second position a path from the relief valve to the reservoir will always be available.

Finally, since the relief valve is connected in parallel with the selecting valve, fluid flow is possible by the relief valve between the rod and head ends of the motor when the selecting valve is at the second position.

According to a second aspect of the invention, a fluid control system comprises a reservoir; a pump connected to the reservoir; a work implement; a first fluid operated jack having rod and head ends being mounted on the implement, the first fluid operated jack being connectable to the pump, one of the rod and head ends of the first jack being arranged to deliver a first signal in response to pressure within the one of the ^{rod and} head ends being greater than a preselected magnitude; a controlling valve having first and second passageways and being connected to and between the pump, the reservoir, and the jack, the controlling valve being movable between a first position at which the first and second passageways are blocked, a second position at which one of the

first and second passageways is open to the pump and one of the rod and head ends of the first jack and the other of the first and second passageways is open to the other of the rod and head ends of the first jack and the reservoir, and a third position at which the other of the first and second passageways is open to the pump and the other jack end and the one of the first and second passageways is open to the one jack end and the reservoir, the controlling valve enabling flow from either jack end to be connected to reservoir through the first or second controlling valve passageway when the controlling valve is in the second or third position; a first selecting valve having first and second passageways and being connected to and between the controlling valve and the first jack, the first selecting valve being movable between a first position at which the first selecting valve first and second passageways are blocked, and a second position at which the first selecting valve first passageway is open to the one of the rod and head ends of the first jack and one of the control valve first and second passageways, and the first selecting valve and second passageway is open to the other of the rod and head ends of the first jack and the other of the controlling valve first and second passageways; first means for receiving the first delivered signal and passing fluid flow from the one of the rod and head ends of the first jack, the fluid flow being passable by the first selecting valve to the other end of the first jack at the second position of the first selecting valve, and blocked from being passable to the other end of the first jack at the first position of the first selecting valve; and second means for passing fluid flow in parallel with the controlling valve from the first means to the reservoir in response to the controlling valve being at the first position,

and for blocking fluid flow from passing in parallel from the first means to the reservoir in response to the controlling valve being at the second or third position.

5 According to a third aspect of the invention, a work vehicle comprises a frame; a work implement mounted on the frame; a reservoir mounted on the frame; a pump mounted on the frame and connected to the reservoir; a first fluid operated jack having
10 head and rod ends and being mounted on the work implement, one of the rod and head ends of the first jack being adapted to deliver a first signal in response to pressure within the one of the rod and head ends being at a pressure greater than a
15 preselected magnitude; a controlling valve having first and second passageways and being mounted on the frame, the controlling valve having first and second inlets and first and second outlets, the first inlet being connected to the reservoir and the second inlet
20 being connected to the pump, the controlling valve being movable between a first position at which the first and second passageways are blocked, a second position at which the first passageway is open to the first inlet and the first outlet and the second
25 passageway is open to the second inlet and the second outlet, and a third position at which the first passageway is open to the second inlet and the first outlet and the second passageway is open to the first inlet and the second outlet, the controlling valve
30 enabling flow from either jack end to be connected to reservoir through the first or second controlling valve passageway when the controlling valve is in the second or third position; a first selecting valve having first and second passageways and being mounted
35 on the work implement, the first selecting valve having first and second inlets and first and second

outlets, the controlling valve first outlet being connected to the first inlet of the first selecting valve and the controlling valve second outlet being connected to the second inlet of the first selecting valve, the selecting valve first outlet being connected to one of the rod and head ends of the first jack and the selecting valve second outlet being connected to the other of the rod and head ends of the first jack, the first selecting valve being movable between a first position at which the selector valve first and second passageways are blocked and a second position at which the first passageway is open to the selector valve first inlet and selector valve first outlet and the selector valve second passageway is open to the selector valve second inlet and selector valve second outlet; a first relief valve having a passageway and a signal port and being mounted on the work implement, the first relief valve having an inlet and an outlet and being connected at the inlet to the one of the head and rod ends of the first jack and at the outlet to the first inlet of the first selecting valve, the signal port being connected to the one of the head and rod ends of the first jack, and arranged to receive the first signal, the first relief valve being movable between a first position at which the first relief valve passageway is blocked and a second position at which the first relief valve passageway is open to the inlet and outlet of the first relief valve, the first relief valve being movable from the first position to the second position in response to receiving the first delivered signal; and bypass valve having a passageway and being mounted on the frame, the bypass valve having an inlet and an outlet and being connected at the inlet thereof to the first outlet of the controlling valve and at the outlet thereof to the reservoir, the bypass valve being

movable between a first position at which the passageway thereof is open to the first outlet of the controlling valve and the reservoir, and a second position at which the passageway thereof is blocked; a source of pressurized pilot fluid flow; and means for selectively directing the pilot fluid flow to both of the controlling and bypass valves and moving the controlling valve from the first position to the second position and the bypass valve from the first position to the second position.

In accompanying drawings:-

Figure 1 is a diagrammatic partial side elevational view of an embodiment of the present invention showing a view of a lift truck having a container handling attachment mounted thereon and showing the location of the various components of the fluid operated system; and,

Figure 2 is a diagrammatic schematic representation of the fluid operated system of Figure 1 showing the components thereof and their connections relative to each other.

With reference to the drawings, a work vehicle 10, for example, a lift truck, earthmover and the like, has a frame 12 and a work implement 14, for example, a load lifting device, mounted on the frame 12. The work implement 14 is preferably a lift mast 16 having a container handling attachment 18 mounted thereon. However, other work implements such as, buckets, boom mounted devices, and the like are to be considered equivalents.



A fluid operated system 20, preferably of the type suitable for controllably powering the work implement 14, is mounted on the work vehicle 10. The fluid operated system has a reservoir 22 mounted on the frame 12 and an implement pump 24 mounted on the frame 12 and connected to the reservoir 22.

A controlling valve 26 having first and second inlets 28 and 30, first and second outlets 32 and 34, and first and second passageways 36 and 38, is mounted on the frame 12. A conduit 40 connects the reservoir 22 to the first inlet 28 and a conduit 42 connects the pump 24 to the second inlet 30. The controlling valve 26 is movable between a first position "A" at which the first and second passageways 36 and 38 are blocked, a second position "B" at which the first passageway 36 is open to the first inlet 28 and first outlet 32 and the second passageway 38 is open to the second inlet 30 and second outlet 34, and a third position "C" at which the first passageway 36 is open to the first inlet 28 and second outlet 34 and the second passageway 34 is open to the second inlet 30 and first outlet 32. The controlling valve 26 has a pair of centering springs 41 which normally biases the valve 26 to position "A".

A first selecting valve 44 and second selecting valve 46 are mounted on the work implement 14. Because the selecting valves 44, 46 are identical in construction and movement, they will not be discussed separately. The selecting valves 44 and 46 each have first and second inlets 48 and 50, first and second outlets 52 and 54, and first and second passageways 56 and 58. A first conduit 60 connects the first outlet 32 of controlling valve 26 to the first inlet 48 of the selecting valve 44, and a second conduit 62 connects the second outlet 34 of the controlling valve 26 to the second inlet 50 of the

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selecting valve 44. The selecting valve 44 and 46 are movable between a first position "D" at which the first and second passageways 56 and 58 thereof are blocked, and a second position "E" at which the first passageway 56 thereof is open to the first inlet 48 and first outlet 52, and the second passageway 58 thereof is open to the second inlet 50 and second outlet 54. It is to be noted that the first and second conduits have branch conduits which connect the selecting valves in parallel. Thus, each selecting valve 44,46 has access to the controlling valve 26 at all times. Also, the conduits 62 and 60 are the only fluid carrying conduits which pass fluid between the frame 12 and implement 14. Each of the selecting valves 44 and 46 have a spring 65 which biases the selecting valves 44 and 46 toward the first position "D".

First and seconds jacks 64 and 66 are provided to power the various movements of the work implement 14. The first and second jacks 64,66 each have a rod end 68 and a head end 70, and are mounted on the work implement 14. The rod end 68 of the first jack 64 is connected to the first outlet 52 of the first selecting valve 44 by a third conduit 72 and the head end 70 of the first jack 64 is connected to the second outlet 54 of the first selecting valve by a fourth conduit 74. Similarly, the rod end 68 of the second jack 66 is connected to the first outlet 52 of the second selecting valve 46 via a fifth conduit 76 and the head end 70 of the second jack 66 is connected to the second outlet 54 of the second selecting valve 46 via a sixth conduit 78.

Each of the jacks 44,46 are adapted to deliver a signal in response to an associated pressure within the respective jack being greater than a preselected magnitude. Specifically, each jack is adapted to

deliver a first signal "F" in response to a fluid pressure within the head end 70 being greater than a preselected magnitude, and a second signal "G" in response to a fluid pressure within the rod end 68 being greater than a preselected magnitude.

A first means 80 is provided for receiving the delivered signal and passing fluid flow from one of the rod and head ends 68 and 70 of one of the jacks 64,66 through the first 56 and second 58 passageways of the selecting valves 44,46 to the other of the rod and head ends of the same jack 64,66 only when the associated one of the first and second selecting valves 44 and 46 is at the second position "E".

The first means 80 preferably includes a first relief valve 82 having a passageway 84, an inlet 86, an outlet 88 and a signal port 90. The outlet 88 is connected to the first conduit 60 via conduit 92 and the inlet 86 is connected to the head end 70 via conduit 94. The first means also includes a second relief valve 96 having an inlet 98, an outlet 100, a signal port 102 and a passageway 104. The outlet 100 is connected to the second conduit 62 via conduit 106 and the inlet 98 is connected to the rod end 68 via a conduit 108. Each of the first and second relief valves 82 and 96 are independently movable between a first position at which the respective passageways 84,104 are blocked, and a second position at which the passageway 84 of the first relief valve is open to the inlet 86 and outlet 88 and the passageway 104 of the second relief valve is open to the inlet 98 and outlet 100. It is to be noted that each of the first and second jacks 64 and 66 have first and second relief valves 82,96, as heretofore discussed, associated therewith.

The head ends 70 of the first and second jacks 64 and 66 are connected to the signal ports 90 of the first relief valves, respectively via conduits 110, and the rod ends 68 of the first and second jacks 64 and 66

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are connected to the signal ports 102 of the second relief valves 96, respectively, via conduits 112.

Therefore, the first signal "F" is passed by the

conduits 110 to the first relief valves 82 and the

5 conduit 112 passes the second signal "G" to the second relief valves 96. Each of the relief valves 82 and 96 are movable from the first position to the second position in response to receiving their respective signals "F" and "G".

10 A second means 114 is provided for passing fluid flow passed by the first means 80 from one of the rod and head ends 68 and 70 to the reservoir 22 in response to the control valve 26 and the selector valves 44 and 46 being at their first position "A" and
15 "D", respectively. The second means 114 preferably includes a bypass valve 116 having an inlet 118, an outlet 120 and a passageway 122 operatively associated with the inlet 118 and outlet 120. The inlet 118 is connected to the first outlet 32 of the controlling
20 valve 26 by conduit 124 and the outlet 120 is connected to the reservoir 22 by conduit 126. The bypass valve 116 is movable between a first position "H" at which the passageway 122 is open to the inlet 118 and outlet 120 and a second position "J" at which the passageway
25 122 is blocked. The bypass valve passes fluid flow passed by first conduit 60 to the reservoir when at the first position "H". It should be noted that a spring 123 normally biases the bypass valve to the first position "H".

30 A pilot system 128 includes a first pilot valve 130 and a second pilot valve 132 both mounted on the frame 12 of the vehicle 10 and both identical in construction. The first and second pilot valves 130 and 132 each have a pair of inlets 134 and 136, a pair
35 of outlets 138 and 140, and a pair of passageways 142

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and 144. The pilot valves 130 and 132 are each selectively manually movable between a first position "K" at which passageway 142 is open to the inlet 134 and outlets 138 and 140, and passageway 144 is blocked, a second position "L" at which passageway 142 is open to inlet 134 and outlet 140 and passageway 144 is open to inlet 136 and outlet 138, and a third position "M" at which passageway 144 is open to inlet 136 and outlet 140 and passageway 142 is open to inlet 134 and outlet 138. Inlets 136 are connected to a pilot pump 146, inlets 134 are connected to the reservoir 22 and the outlets 138 and 140 are connected to a shuttle valve arrangement 148.

The shuttle valve arrangement 148 has a first, second and third 150, 152 and 154 shuttle valves each having a first and second inlets 156 and 158 and an outlet 160. Outlet 138 of the first pilot valve 130 is connected to the inlet 156 of the first shuttle valve 150, outlet 138 of the second pilot valve 132 is connected to inlet 158 of the first shuttle valve 150, and outlet 160 of the first shuttle valve is connected to a first pilot port 162 of the controlling valve 26. Similarly, outlet 140 of the first pilot valve 130 is connected to inlet 156 of the second shuttle valve 152, outlet 140 of the second pilot valve 132 is connected to the inlet 158 of the second shuttle valve 152, and outlet 160 of the second shuttle valve 152 is connected to a second pilot port 164 of the controlling valve 26. The outlet 160 of the first shuttle valve is also connected to inlet 156 of the third shuttle valve 154, the outlet 160 of the second shuttle valve 152 is also connected to the inlet 158 of the third shuttle valve 154, and the outlet 160 of the third shuttle valve is connected to the pilot port 166 of the bypass valve 116.

The first and second shuttle valves 150,152 are provided to block pilot fluid flow from passing between the pilot valves 130 and 132 and direct pilot fluid flow, at the highest pressure, to the pilot ports 162 and 164 as inferred by the heretofore discussed connections. The third shuttle valve 154 blocks pilot fluid flow from passing between the outlets 160 of the first and second shuttle valves and directs the pilot fluid flow at the greatest pressure to the pilot port 166 of the bypass valve 116.

It is to be noted that pilot system 114 may be replaced by an electrical equivalent.

A means 168 for delivering a control signal to the selecting valves 44 and 46, and a means 170 for receiving the delivered control signal and moving the selecting valves 44 and 46 from the first position "D" to the second position "E" is provided. Specifically, means 168 includes a source of electrical power 172, first and second switches 174 and 176 and connecting circuitry 178. Means 170 includes first and second solenoids 180 and 182 connected to the first and second selecting valves 44 and 46, respectively. The connecting circuitry 178 connects the first switch 174 to the first solenoid 180 and the second switch 176 to the second solenoid 182. Each switch 174 and 176 is movable between a first position at which electrical current is blocked from passing from the source to its respective solenoid 180,182 and a second position at which electrical current is passed from the source to its respective solenoid 180,182. The first solenoid 180 is adapted to move the first selecting valve 44 to the second position "E" at the second position of the first switch 174, and the second solenoid 182 is adapted to move the second selecting valve 46 to the

second position "E" at the second position of the second switch 176. It should be noted that means 170 and 168 may be substituted by equivalent mechanical or hydraulic devices without departing from the spirit of the invention.

Industrial Applicability

In operation and with reference to the drawings, the operator of the vehicle 10 actuates a desired one of the first and second pilot valves 130 and 132 by manually shifting one of the pilot valves 130, 132 to position "L" or "M" to position the work implement 14. Assuming that the operator desires to extend jack 64 he would shift selecting valve 130 to second position "L" and depress switch 174 to connect the source 172 to the first solenoid 180. Because the pilot valves 130 and 132 are capable of modulating fluid pressure delivered from the pilot pump to the controlling valve 26 and thereby control the amount of movement of the controlling valve 26 the speed of extension or retraction of the jacks 64 and 66 may be accurately controlled.

At the first position "L" of pilot valve 130, flow from pilot pump 146 is passed through passageway 144 from inlet 136 to outlet 138 and to inlet 156 of first shuttle valve 150 which causes the first shuttle valve 150 to block inlet 158 from outlet 160 and pass the fluid flow from inlet 156 through outlet 160 to the first pilot port 162 of selecting valve 26. The pressure of the fluid at the first pilot port 162 acts on the controlling valve 26 and moves the controlling valve toward second position "B". At the same time a portion of the pilot flow passed by outlet 160 of the first shuttle valve 150 is directed to the inlet 156 of the third shuttle valve 154. The third shuttle valve 154 responds to this pilot fluid flow by blocking the

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second inlet 158 from the first inlet 156 and outlet 160, and passes the pilot fluid flow through outlet 160 to the pilot port 166 of bypass valve 116. The bypass valve 116, as a result of the pilot fluid pressure acting thereon, moves to the second position "J".

With the controlling valve in position "B", fluid flow from implement pump 24 is directed by the second passageway 38 of the controlling valve 26 from the first inlet 30 to the first outlet 34 and to the second inlet 50 of the first and second selecting valves 44 and 46. This is achieved because the selecting valves 44, 46 are in parallel with each other relative to the controlling valve 26.

With the first switch 174 in the depressed or closed position electrical current is passed to the first solenoid 180. The first solenoid 180 responds to this electrical current by moving the first selecting valve 44 to the second position "E". At second position "E", implement pump flow at the second inlet 50 of the first selecting valve 44 is passed by passageway 58 to the second outlet 54 of the first selecting valve 44 and through conduit 74 to the head end 70 of first jack 64.

Fluid flow from the rod end 68 of the first jack 68 is exhausted therefrom through conduit 72, past outlet 52 of the first selecting valve 44, through the third passageway 56, past inlet 48, through conduit 60 and to outlet 32 of controlling valve 26. Because the first passageway 36 is open to the first inlet 28 and the first outlet 32 the rod end flow is directed therethrough to reservoir 22.

It is noted that when the first selecting valve 44 is at the second position "E" the first and second relief valves 82 and 96 associated with the first jack 64 are connected through the first and

second passageways 56 and 58 of the first selecting valve 44 to the rod and head ends 68 and 70 of the first jack 64. Therefore, the first relief valve 82 will pass fluid flow from the head end 70 of the first jack 64 through the first selecting valve 44 to the rod end 68 of the first jack 64 whenever the pressure in the head end 70 is greater than the preselected magnitude, and the second relief valve 96 will pass fluid flow from the rod end 68 of the first jack 64 through the first selecting valve 44 to the head end 70 of the first jack whenever the pressure in the rod end 68 is greater than the preselected magnitude.

In the instant situation the controlling valve first passage 36 is open to the reservoir 22 and the bypass valve passage 122 is blocked to the reservoir 22. Therefore, return flow from the rod end 68 of the jack 64 must pass through the first passageway 36 to the reservoir 22.

Because the bypass valve 116 is at the first position "H" when the controlling valve 26 is at the first position "A" and at the second position "J" when the controlling valve 26 is at either of the second "B" or third "C" positions a path from the outlet 88 of the first relief valves 82 to the reservoir 22 is always open. Also, because the bypass valve 116 blocks flow from the first outlet 32 to the reservoir 22 in response to the controlling valve 26 being at the third position "C" pressurized fluid flow is passable by conduit 60 to the jacks 64 and 66 to move the jacks.

To retract first jack 64, first pilot valve 130 must be shifted to the third position "M" and first switch 174 must be depressed. At position "M" pilot pump flow is directed by the shuttle valve arrangement 148 to pilot ports 164 and 166 which moves the controlling valve 26 to third position "C" and the

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bypass valve 116 to blocking position "J". Thus
implement pump flow is directed by second passageway 38
from inlet 30 to outlet 32, through conduit 60, through
third passageway 56, and conduit 72 to the head end of
5 the jack 64. Return fluid flow from the head end 70 of
the first jack 64 is passed by the second passageway 58
and first passageway 36 to reservoir 22.

Because of the interaction between the
controlling valve 26 and bypass valve 116, because the
10 bypass valve 116 is connected to the controlling valve
26 at outlet 32 on the vehicle frame 12, and because
the selecting valves 44 and 46 are provided on the
implement 14 only two conduits 60 and 62 are required
to carry fluid flow between the controlling valve 26
15 and the selecting valves 44 and 46 while providing a
continuously open passageway between the first relief
valve 82 and the reservoir.

Operation of the second jack 66 is achieved
through actuation of the second pilot valve 132 and
20 second switch 176 in a manner similar to that of the
first pilot valve 130 and first switch 174 and may be
understood through a study of the drawings and previous
discussion.

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CLAIMS

1. A fluid control system comprising a reservoir;
a pump connected to the reservoir; a first fluid
5 operated jack having rod and head ends connected
to the pump and arranged to deliver a first signal in
response to a pressure within the jack being greater
than a preselected magnitude; a controlling valve
having first and second passageways, the first
10 passageway being connected to and between the
reservoir and one of the ends of the first jack, the
second passageway being connected to and between the
pump and the other end of the first jack, the
controlling valve being movable between a first
15 position at which the first and second passageways
are blocked, a second position at which the first
passageway is open to the reservoir and one end of
the first jack and the second passageway is open to
the pump and the other end of the first jack, and a
20 third position at which the first passageway is open
to the pump and the one end of the first jack and the
second passageway is open to the reservoir and the
other end of the first jack, the controlling valve
enabling flow from either jack end to be connected to
25 reservoir through the first or second controlling
valve passageway when the controlling valve is in the
second or third position; a first selecting valve
having a first passageway, the first selecting valve
first passageway being connected to and between the
30 controlling valve first passageway and the first
jack, the first selecting valve being movable between
a first position at which the first selecting valve
first passageway is blocked and a second position at
which the first selecting valve first passageway is
35 open to the controlling valve first passageway and
the first jack; a first relief valve having a
passageway and a signal port, the first relief valve



passageway being connected to the jack and the
controlling valve first passageway in parallel with
the selecting valve, the first relief valve being
movable between a first position at which the first
5 relief valve passageway is blocked and a second
position at which the first relief valve passageway
is open to the jack and the controlling valve first
passageway, the signal port being connected to the
jack and being arranged to receive the first signal,
10 the first relief valve being movable from the first
position to the second position in response to
receiving the first signal; a bypass valve having a
passageway, the bypass valve passageway being
connected to and between the first selecting valve
15 first passageway and the reservoir and in parallel
with the controlling valve, the bypass valve being
movable from a first position, at which the bypass
valve passageway is open to the first selecting valve
first passageway and the reservoir, to a second
20 position, at which the bypass valve passageway is
blocked; means for generating a pilot signal; and
means for directing the pilot signal to both of the
controlling and bypass valves and moving the
controlling valve from the first position to the
25 second position and the bypass valve from the first
position to the second position.

2. A fluid control system according to claim 1,
wherein the first selecting valve has a second
30 passageway which is connected to and between the
controlling valve second passageway and the first
jack, the first selecting valve second passageway
being blocked at the first position of the first
selecting valve and being open to the controlling
35 valve second passageway and the first jack at the
second position of the first selecting valve; a first
conduit connecting the first passageway of the



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controlling valve to the first passageway of the first selecting valve; and a second conduit connecting the controlling valve second passageway to the selector valve second passageway, the first
5 relief valve having an inlet and an outlet, the first relief valve inlet being connected to the first jack and the first relief valve outlet being connected to the first conduit, the first relief valve passageway connecting the first relief valve inlet to the first
10 relief valve outlet at the second position of the first relief valve.

3. A fluid control system according to claim 2, wherein the selecting valve first passageway is
15 connected to one of the rod and head ends of the first jack and the selecting valve second passageway is connected to the other of the rod and head ends of the first jack, the first relief valve inlet being connected to the one of the rod and head ends; and
20 the first signal being delivered from the one of the rod and head ends of the first jack.

4. A fluid control system according to claim 3, including a second relief valve having a passageway
25 and a signal port, the second relief valve passageway having an inlet and an outlet and being connected at the inlet of the second relief valve to the other of the rod and head ends of the first jack and at the outlet of the second relief valve to the second
30 conduit, the second relief valve being movable between a first position at which the second relief valve passageway is blocked and a second position at which the second relief valve passageway is open to the the other of the rod and head ends of the first
35 jack and the second conduit, the other rod and head ends of the first jack being adapted to deliver a second signal in response to a pressure within the



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the other rod and head ends of the first jack being greater than a preselected magnitude, the signal port of the second relief valve being connected to the other rod and head ends of the first jack and being adapted to receive the second signal, the second relief valve being movable from the first position towards the second position in response to receiving the second signal.

5. A fluid control system according to any one of claims 2 to 4, wherein the bypass valve has an inlet and an outlet, the bypass valve inlet being connected to the first conduit and the bypass valve outlet being connected to the reservoir, the bypass valve passageway connecting the bypass valve inlet to the bypass valve outlet at the first position of the bypass valve.

6. A fluid control system according to any one of the preceding claims, wherein the control and bypass valves each has a pilot port, the generating means includes a pilot pump, and the directing means includes: a pilot valve having a passageway, an inlet and an outlet, the pilot valve inlet being connected to the pump and the pilot valve outlet being connected to the pilot port of each of the bypass and controlling valves, the pilot valve being manually movable between a first position at which the pilot valve passageway is blocked and a second position at which the pilot valve passageway is open to the pilot pump and the pilot ports, the bypass and controlling valves each being movable from their first positions, respectively, toward their second positions, respectively, in response to movement of the pilot valve from the first position to the second position.

7. A fluid control system according to claim



6, wherein the bypass and controlling valves each have a spring, the bypass valve spring biasing the bypass valve towards the first position and the controlling valve spring biasing the controlling valve toward the first position.

8. A fluid control system according to any one of the preceding claims, including a spring connected to the first selecting valve and biasing the first selecting valve from the second position towards the first position; means for delivering a control signal to the first selecting valve; and means for receiving the delivered control signal and moving the first selecting valve from the first position to the second position.

9. A fluid control system according to claim 8, wherein the delivering means includes a source of electrical power; a first switch connected to the source of electrical power, and wherein the means for receiving includes a first solenoid mounted on the first selecting valve and being connected to the first switch, the first switch being movable between an open position at which the power source is blocked from the first solenoid and a closed position at which the power source is connected to the first solenoid, the first solenoid being arranged to move the first selecting valve to the second position in response to the first switch being moved to the closed position.

10. A fluid control system comprising a reservoir; a pump connected to the reservoir; a work implement; a first fluid operated jack having rod and head ends being mounted on the implement, the first fluid operated jack being connectable to the pump, one of the rod and head ends of the first jack being



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arranged to deliver a first signal in response to pressure within the one of the ^{rod and} head ends being greater than a preselected magnitude; a controlling valve having first and second passageways and being
5 connected to and between the pump, the reservoir, and the jack, the controlling valve being movable between a first position at which the first and second passageways are blocked, a second position at which one of the first and second passageways is open to
10 the pump and one of the rod and head ends of the first jack and the other of the first and second passageways is open to the other of the rod and head ends of the first jack and the reservoir, and a third position at which the other of the first and second
15 passageways is open to the pump and the other jack end and the one of the first and second passageways is open to the one jack end and the reservoir, the controlling valve enabling flow from either jack end to be connected to reservoir through the first or
20 second controlling valve passageway when the controlling valve is in the second or third position; a first selecting valve having first and second passageways and being connected to and between the controlling valve and the first jack, the first
25 selecting valve being movable between a first position at which the first selecting valve first and second passageways are blocked, and a second position at which the first selecting valve first passageway is open to the one of the rod and head ends of the
30 first jack and one of the control valve first and second passageways, and the first selecting valve and second passageway is open to the other of the rod and head ends of the first jack and the other of the controlling valve first and second passageways; first
35 means for receiving the first delivered signal and passing fluid flow from the one of the rod and head ends of the first jack, the fluid flow being passable



by the first selecting valve to the other end of the first jack at the second position of the first selecting valve, and blocked from being passable to the other end of the first jack at the first position of the first selecting valve; and second means for passing fluid flow in parallel with the controlling valve from the first means to the reservoir in response to the controlling valve being at the first position, and for blocking fluid flow from passing in parallel from the first means to the reservoir in response to the controlling valve being at the second or third position.

11. A fluid control system according to claim 10, wherein the first selecting valve has first and second inlets and first and second outlets, and the first means includes: a first relief valve having a signal port, a passageway, an inlet and an outlet, the first relief valve outlet being connected to the first inlet of the first selecting valve and the first relief valve inlet being connected to the head end of the first jack, the first relief valve being movable between a first position at which the first relief valve passageway is blocked and a second position at which the first relief valve passageway is open to the head end of the first jack and the selecting valve first inlet, the first relief valve signal port being connected to the head end of the first jack and being arranged to receive the first signal, the first relief valve being movable from the first position towards the second position in response to receiving the first signal.

12. A fluid control system according to claim 11, wherein the rod end is arranged to deliver a second signal in response to pressure within the rod end being greater than a preselected magnitude; and



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including a second relief valve having a passageway and a signal port, the second relief valve having an inlet and an outlet and being connected at the outlet of the second relief valve to the second inlet of the first selecting valve and being connected at the inlet of the second relief valve to the rod end of the first jack, the second relief valve being movable between a first position at which the second relief valve passageway is blocked and a second position at which the second relief valve passageway is open to the rod end of the first jack and the second inlet of the first selecting valve, the second relief valve signal port being connected to the rod end of the first jack and arranged to receive the second signal, the second relief valve being movable from the first position to the second position in response to receiving the second signal.

13. A fluid control system according to claim 12, wherein the rod end of the first jack is in communication with the head end of the first jack at the second position of the second relief valve and the second position of the first selecting valve.

14. A fluid control system according to any one of claims 10 to 13, wherein the controlling valve has first and second inlets and first and second outlets, and the second means includes a bypass valve having a passageway, an inlet and an outlet and being connected at the bypass valve outlet to the reservoir and at the bypass valve inlet to the first outlet of the controlling valve, the bypass valve being movable between a first position at which the bypass valve passageway is open to the reservoir and the first outlet of the controlling valve, and a second position at which the bypass valve passageway is blocked, the bypass valve being movable from the



38 first position to the second position in response to movement of the controlling valve from the first position to the second or third position.

5 15. A fluid control system according to claim 14,
wherein the bypass and controlling valves each has a
pilot port; and including a pilot pump; a first pilot
valve having a pair of passageways and being
10 connected to the pilot pump, the reservoir, and the
pilot ports of the bypass and controlling valves, the
first pilot valve being movable between a first
position at which one of the pilot valve passageways
is open to the reservoir and the pilot ports of the
15 bypass and controlling valves, and a second position
at which the other first pilot valve passageway is
open to the pilot pump and the pilot ports of the
bypass and controlling valves; and each of the bypass
and controlling valves being movable from their first
20 respective positions to their second respective
positions in response to movement of the first pilot
valve from the first position to the second position.

16. A fluid control system according to claim 14 or
claim 15, including a bypass valve spring connected
25 to the bypass valve, the bypass valve spring biasing
the bypass valve towards the first position; and a
controlling valve spring connected to the controlling
valve, the controlling valve spring biasing the
controlling valve towards the first position.

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17. A work vehicle comprising a frame; a work
implement mounted on the frame; a reservoir mounted
on the frame; a pump mounted on the frame and
connected to the reservoir; a first fluid operated
35 jack having head and rod ends and being mounted on
the work implement, one of the rod and head ends of
the first jack being adapted to deliver a first



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signal in response to pressure within the one of the rod and head ends being at a pressure greater than a preselected magnitude; a controlling valve having first and second passageways and being mounted on the frame, the controlling valve having first and second inlets and first and second outlets, the first inlet being connected to the reservoir and the second inlet being connected to the pump, the controlling valve being movable between a first position at which the first and second passageways are blocked, a second position at which the first passageway is open to the first inlet and the first outlet and the second passageway is open to the second inlet and the second outlet, and a third position at which the first passageway is open to the second inlet and the first outlet and the second passageway is open to the first inlet and the second outlet, the controlling valve enabling flow from either jack end to be connected to reservoir through the first or second controlling valve passageway when the controlling valve is in the second or third position; a first selecting valve having first and second passageways and being mounted on the work implement, the first selecting valve having first and second inlets and first and second outlets, the controlling valve first outlet being connected to the first inlet of the first selecting valve and the controlling valve second outlet being connected to the second inlet of the first selecting valve, the selecting valve first outlet being connected to one of the rod and head ends of the first jack and the selecting valve second outlet being connected to the other of the rod and head ends of the first jack, the first selecting valve being movable between a first position at which the selector valve first and second passageways are blocked and a second position at which the first passageway is open to the selector valve first inlet

and selector valve first outlet and the selector valve second passageway is open to the selector valve second inlet and selector valve second outlet; a first relief valve having a passageway and a signal port and being mounted on the work implement, the first relief valve having an inlet and an outlet and being connected at the inlet to the one of the head and rod ends of the first jack and at the outlet to the first inlet of the first selecting valve, the signal port being connected to the one of the head and rod ends of the first jack, and arranged to receive the first signal, the first relief valve being movable between a first position at which the first relief valve passageway is blocked and a second position at which the first relief valve passageway is open to the inlet and outlet of the first relief valve, the first relief valve being movable from the first position to the second position in response to receiving the first delivered signal; and bypass valve having a passageway and being mounted on the frame, the bypass valve having an inlet and an outlet and being connected at the inlet thereof to the first outlet of the controlling valve and at the outlet thereof to the reservoir, the bypass valve being movable between a first position at which the passageway thereof is open to the first outlet of the controlling valve and the reservoir, and a second position at which the passageway thereof is blocked; a source of pressurized pilot fluid flow; and means for selectively directing the pilot fluid flow to both of the controlling and bypass valves and moving the controlling valve from the first position to the second position and the bypass valve from the first position to the second position.

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18. A work vehicle according to claim 17, wherein the first selecting valve and the first relief valve



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connect the head end of the first jack to the rod end of the first jack at the second position of the first selector valve and the second position of the first relief valve.

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