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SAFETY CIRCUIT

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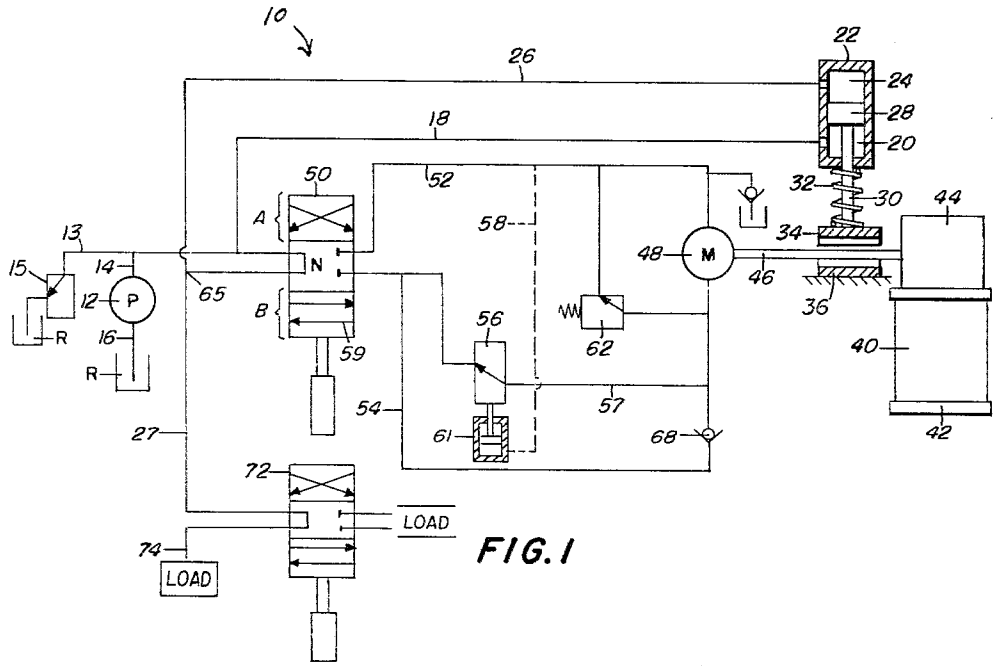


FIG. 1

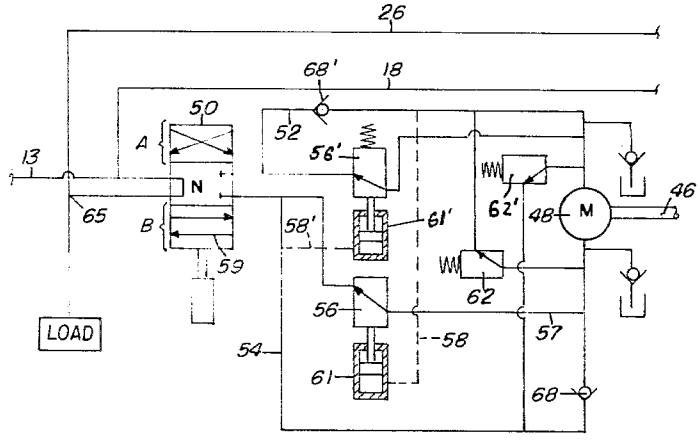


FIG. 2

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SAFETY CIRCUIT

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This invention relates generally to a hydraulic system wherein several loads are placed in series with means to automatically effect a braking of an upstream load upon a loss of pressure in the system or when a downstream load is receiving fluid power.

More specifically, one use of the invention relates to a hydraulic system for operating a hoisting winch in fluid series with other loads in a manner insuring that the hoisting winch is braked during a loss of pressure in the fluid system.

It is desirable from the viewpoint of circuit simplicity and manufacture economy to place several loads in series rather than to require a separate pump output for each load. Although many loads are powered serially, the workers in the prior art have found it necessary to provide a separate fluid supply for winches or similar apparatus because of the extreme danger caused by an uncontrolled load. In the embodiment described, the invention pertains to hydraulic circuitry which permits winches to be hydraulically placed in series with other functions such that a downstream function will not release the brake on upstream winches. It should be understood, however, that the invention is not limited to winch environments.

It is well known to provide safety mechanisms for hydraulically driven hoisting winches to insure that the winch does not rapidly unreel as a result of unwanted power loss. Such safety means are provided in many different ways. The presently described invention provides a mechanism of positive safety which permits a hydraulically driven winch to be in series with downstream loads.

A further objective of this invention is to provide a spring actuated braking assembly for a winch which is under the control of a double acting hydraulic cylinder for releasing the brake, when desired, against the bias of said spring.

A still further objective of the invention is to provide hydraulic circuitry for powering or controlling a winch assembly wherein power losses will cause the winch to automatically brake, and in which control valves for effecting hydraulic braking or retarding are conveniently inserted along with the necessary pressure relief valves.

Another important objective of the invention is to provide a hydraulic system wherein the basic addition of an additional brake valve and an additional relief valve converts the system into one primarily for use with loadings which must be powered in two directions, and which could become dangerously out of control in either direction.

These and other important objectives and advantages of the invention will be more fully understood upon a reading of the following specifications, taken in view of the attached drawings, in which:

FIGURE 1 is a diagrammatic-schematic of one embodiment of the system; and

FIGURE 2 is the embodiment of FIG. 1 including a further refinement.

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Referring now to the drawings, the numeral **10** indicates the system of this invention. The system includes a pump **12** having an output conduit **14** leading therefrom and an input conduit **16** in communication with a reservoir R. A conduit **13** leads from conduit **14** to reservoir R across a high pressure safety relief valve **15**.

The conduit **14** is also communicated with a conduit **18** which leads to a piston rod chamber **20** of a double acting hydraulic cylinder **22**. The cylinder includes a piston head expansion chamber **24** which is communicated by conduit **26** to a conduit **27**, the high pressure carryover or downstream line. The conduits **18** and **26** represent lead and return lines for actuation of a piston **28**.

Extending from piston **28** is a piston rod **30** terminated by a brake shoe **34** at its outer end. A spring **32** around rod **30** normally biases the brake shoe **34** toward a mating brake shoe **36**. A cable **40** is coiled about the winch assembly **42** to which loads of varying types are attached. The brake mechanism operates on the hydraulic motor output shaft ahead of the gear box since this is the area of lowest torque. The winch assembly includes a mechanical gearing box **44** driven by an output shaft **46** of a hydraulic motor **48**.

It can be seen that output conduit **14** leads to a manually operated direction valve **50** comprised of a first segment A, a second segment B, and a neutral segment N. In FIGURE 1 the valve is depicted as being in its neutral position. Leading from valve **50** is a conduit **52** which delivers fluid for driving motor **48** in a first direction and a conduit **54** which delivers fluid for driving the motor in the opposite direction. It should be understood, of course, that directional changes in motor **48** cause either the reeling or unreeling of cable **40**. In FIGURE 1, a load attached to the cable **40** is lifted when the direction of fluid is toward motor **48** in line **54**; that is, when segment A is across lines **52** and **54**.

Assuming for purposes of illustration that segment A of valve **50** is across conduit **14**, forward fluid flow to motor M is through conduit **54** and principal return flow to valve **50** is through conduit **52**. A one-way check valve **68** prevents any return flow via conduit **54**. When segment B of valve **50** is across the conduit system, the winch will unreel as a result of a fluid flow toward motor **48** in conduit **52**. A braking valve **56** across conduit **57** provides a return path for fluid to passageway **59** of valve **50**. When lowering a heavy load, the motor **48** will have a tendency to act as a pump. In order to avoid cavitation and loss of control, a pressure sensing line **58**, from conduit **52** to the expansion head of control cylinder **61**, will control the speed at which the cable is permitted to unreel.

In order to eliminate pressures in excess of circuit design, a relief valve **62** is provided. This valve transmits excess pressures from the fluid line **54** leading from the motor directly back to conduit **52**. Valve **62** relieves excess pressures primarily when valve **50** is in neutral or the load is being lowered too fast.

Regardless of the direction of operation of winch **40**, the returning fluid reaches a point **65** where conduits **26** and **27** are joined. Fluid under pressure at this point is directed toward a direction valve **72** and thence to a further downstream function. Other downstream functions can be sequentially connected in series via the conduit **74**.

With equal pressures in lines 18 and 26, the spring 32 is of sufficient strength to brake the winch. Upon a movement of either of the segments A or B of valve 50 across the line 14, pressure build-up in conduit 18 causes piston 28 to move away from the winch assembly. Since there is a fluid pressure drop caused by powering the winch, there is a corresponding drop in pressure at point 65 which is reflected in chamber 24. Thus, the brake is released during periods in which the winch is reeling or unreeling. When the valve 50 is in neutral, the pressure drop across valve 50 is insufficient to cause spring 32 to reduce its braking function.

When valve 50 is in neutral and pressure is generated by a load controlled by valve 72, such pressure build-up will be reflected in conduits 27, 14, 18 and 26. Upon such a build-up or of a loss of pressure in conduit 27, the brake cylinder 22 will not release the brake because the same pressure loss will occur in 14, 18 and 26. The cylinder 22 is so constructed that the spring 32, the pressure drop across segment N of valve 50, and the pressure area differentials of facing chambers 20 and 24, will prevent the release of the brake upon a movement of valve 50 from neutral.

In other words, the spring 32 and the pressure in chamber 24 (determined by the pressure drop between line 14 and point 65) is sufficient to maintain the brake in its restraining position when the valve 50 is in neutral. When either of the segments A or B is moved across the lines 50 and 54 the pressure drop increases sufficiently to permit the pressure in chamber 24 to overcome the spring 32. Therefore, regardless of variations in downstream pressures, the pressure drop between line 14 and point 65 is determinative of braking or non-braking.

FIGURE 2 discloses how the inventive system described herein is adopted for use in environments where it is important to control and brake loads in two directions. For instance, shaft 46 could be the power output to a pedestal of a rotating crane. There are many instances, such as a sloping platform, where the weight of the crane could cause the motor 48 to act as a pump. Because of this it will be noted that a one-way check valve 68' has been placed across conduit 52, an additional braking valve 56' between line 52 and valve 50, a control cylinder 61' for controlling valve 56', and an additional sensing line 58'. The addition of the above elements permits the system to protect itself from excess pressures and uncontrolled loads when segment B is across the power in the same manner as previously described for segment A.

Insofar as the braking action on shaft 46 is concerned, it is identical because the pressure drops through valve 50 and elsewhere remain the same.

In a general manner, while there has been disclosed effective and efficient embodiments of the invention, it should be well understood that the invention is not limited to such embodiments, as there might be changes made in the arrangement, disposition, and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

I claim:

1. A system for operating and braking a work member, a brake having a first position restraining the movement of said member and a second non-restraining position, first means to normally urge said brake to its restraining position, a hydraulic cylinder, a piston slidably received in said cylinder and defining first and second expansion chambers with said cylinder, second means connecting said piston to said brake, a source of fluid pressure, a hydraulic motor for operating said work member, a fluid conduit system communicating said source to said motor, including a first line directing the fluid from said source to said motor and a second line directing said fluid from said motor, a third line communicating the pressures in said first line with said first expansion chamber, and a fourth line communicating the pressures in said second line to said second expansion chamber, a directional valve having a first position permitting fluid to flow to said motor and a neutral position routing said fluid directly to said second line, said first means being of sufficient strength to maintain said brake in said restraining position when said valve is in said neutral position, and insufficient to maintain said brake in its said restraining position when said valve is in said first position.

2. A system for fluid powering and braking a work member and powering a downstream load in series with said work member, a conduit leading to said downstream load, a valve having at least one position for transmitting fluid to said downstream load, a braking member movable from a work member restraining position to a work member non-restraining position, first means normally biasing said member to said restraining position, a source of fluid pressure, a fluid motor drivingly connected to said work member, a conduit network between said source and said motor, a second valve across said network having a first position transmitting fluid to said motor and then to said downstream load and a second position transmitting fluid directly to said downstream load, said first means being of sufficient strength to maintain said brake in said restraining position when said valve is in said neutral position, and insufficient to maintain said brake in its said restraining position when said valve is in said first position.

3. In a system for operating and braking a work member, a brake for impeding movement of said work member, a spring for normally actuating said brake, a fluid pressure cylinder having a piston connected to brake, a fluid pressure source, a fluid motor for driving said member, a downstream load, a conduit leading to said downstream load, a valve having at least one position for transmitting fluid to said downstream load, a valve having a first position sending said fluid to said motor and then to said load and a second position routing fluid directly to said downstream load, a first pressure drop developed when said valve is in said first position, a second pressure drop developed when said valve is in said second position, said first means being of sufficient strength to maintain said brake in said restraining position when said valve is in said neutral position, and insufficient to maintain said brake in its said restraining position when said valve is in said first position.

4. A system for fluid powering and braking a cable drum and powering a downstream load in series therewith, a braking member movable from a drum restraining position to a drum non-restraining position, first means normally biasing said member to said restraining position, a source of fluid pressure, a fluid motor, a conduit network between said fluid source, said motor and said downstream load, a valve across said network having a first position transmitting fluid to said motor and then to said downstream load and a second position transmitting fluid directly to said downstream load, a double acting cylinder responsive to the differential in pressure drops when said valve is in said first and second positions for moving said brake to its restraining position when said valve is in said second position.

5. The system described in claim 4 wherein said cylinder has first and second expansion chambers, a first conduit communicating the fluid pressure at the entrance to said valve to one of said chambers, a second conduit communicating the fluid pressure as it departs from said valve, the pressure at said entrance working in opposition to said first means.

6. A system for fluid powering and braking a work member and powering a downstream load in series with said work member, a braking member movable from a work member restraining position to a work member non-restraining position, first means normally biasing said member to said restraining position, a source of fluid pressure, a fluid motor, a conduit system between said

fluid source, said motor and said downtream load, a valve across said system having a first position transmitting fluid to said motor and then to said downstream load and a second position transmitting fluid directly to said downstream load, second means responsive to the differential in pressure drops when said valve is in said first and second positions for moving said brake to its restraining position when said valve is in its second position, a braking valve in said conduit system between said motor and said first mentioned valve.

7. The system described in claim 6 wherein third means

are provided for adjusting the flow rate of said braking valve in response to fluid pressures at the entrance to said motor.

References Cited by the Examiner

UNITED STATES PATENTS

2,945,572	7/1960	Rye	192—3
3,030,075	4/1962	Kocalis	254—184

DAVID J. WILLIAMOWSKY, *Primary Examiner.*