

[54] OVERLOAD PROTECTOR FOR CRANE BOOMS

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[22] Filed: June 15, 1970

[21] Appl. No.: 46,224

[52] U.S. Cl. 212/39 R, 212/35 HC

[51] Int. Cl. B66c 13/48, B66c 23/54

[58] Field of Search 212/39 R, 39 MS, 39 B, 39 I, 212/35 HC; 91/426

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UNITED STATES PATENTS

3,489,294 1/1970 Greb et al. 212/39

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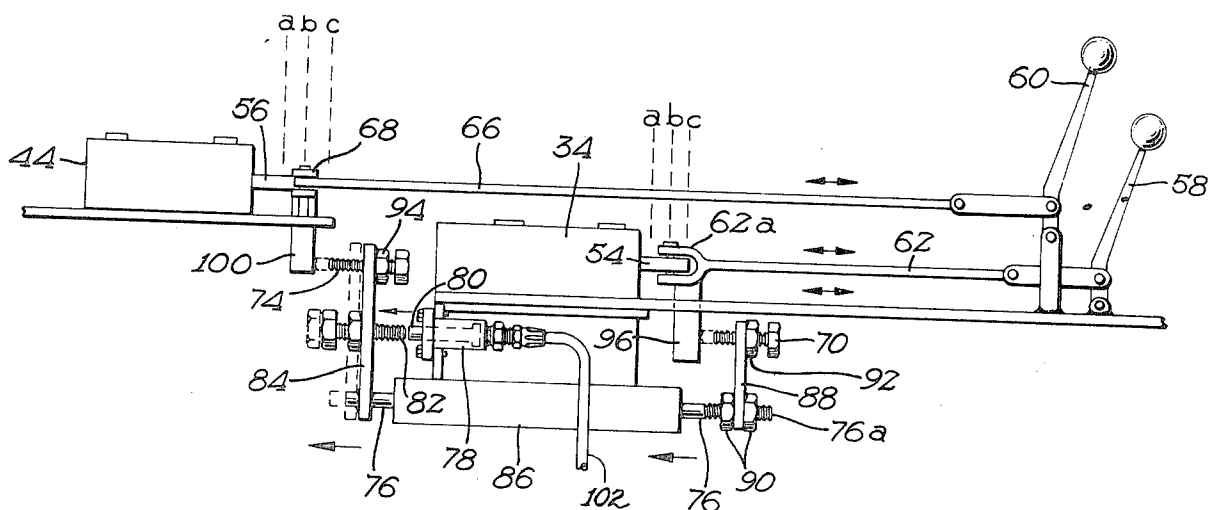
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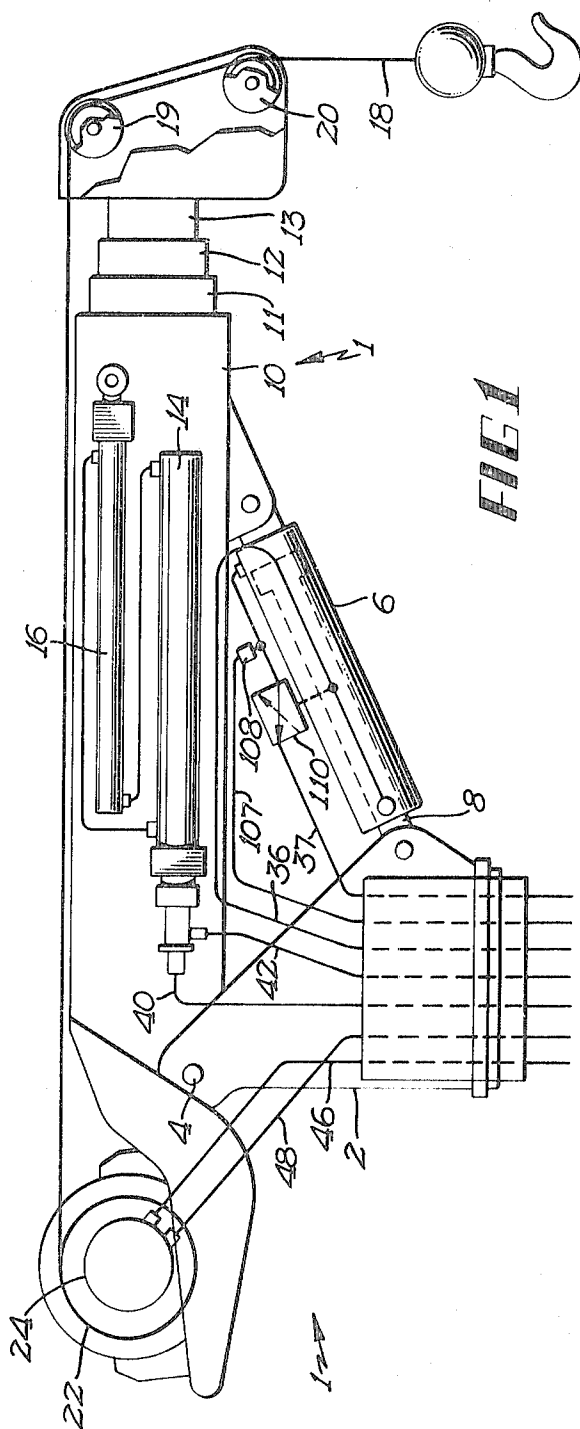
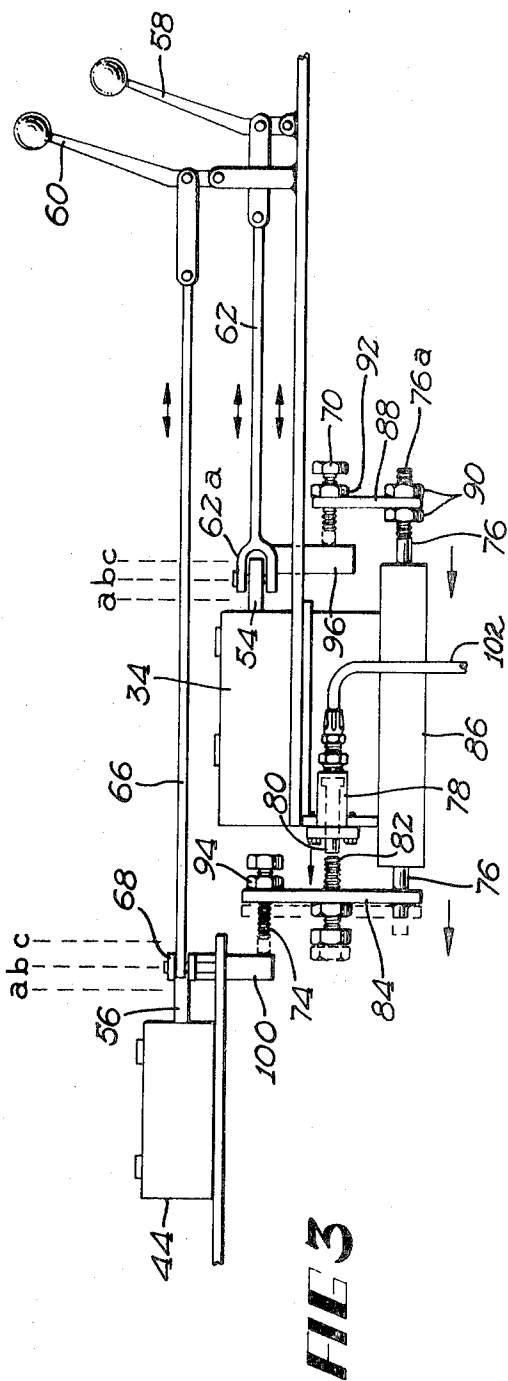
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[57] ABSTRACT

A vertically pivotable crane boom having a plurality of hydraulically extensible boom sections and equipped with a hydraulic lift cylinder for elevating and lowering the boom is provided with a plurality of stop devices automatically movable in response to an overload condition on the boom into blocking position adjacent hydraulic fluid control valves to prevent the manual operation of said valves in such a way as to extend the boom sections, lower the boom or hydraulically raise a lift cable on the boom. Hydraulic fluid from the boom lift cylinder is utilized to actuate a fluid motor which shifts the stop devices into said blocking position when the fluid pressure in said lift cylinder reaches a predetermined high level indicative of an overload condition on the boom.

9 Claims, 3 Drawing Figures





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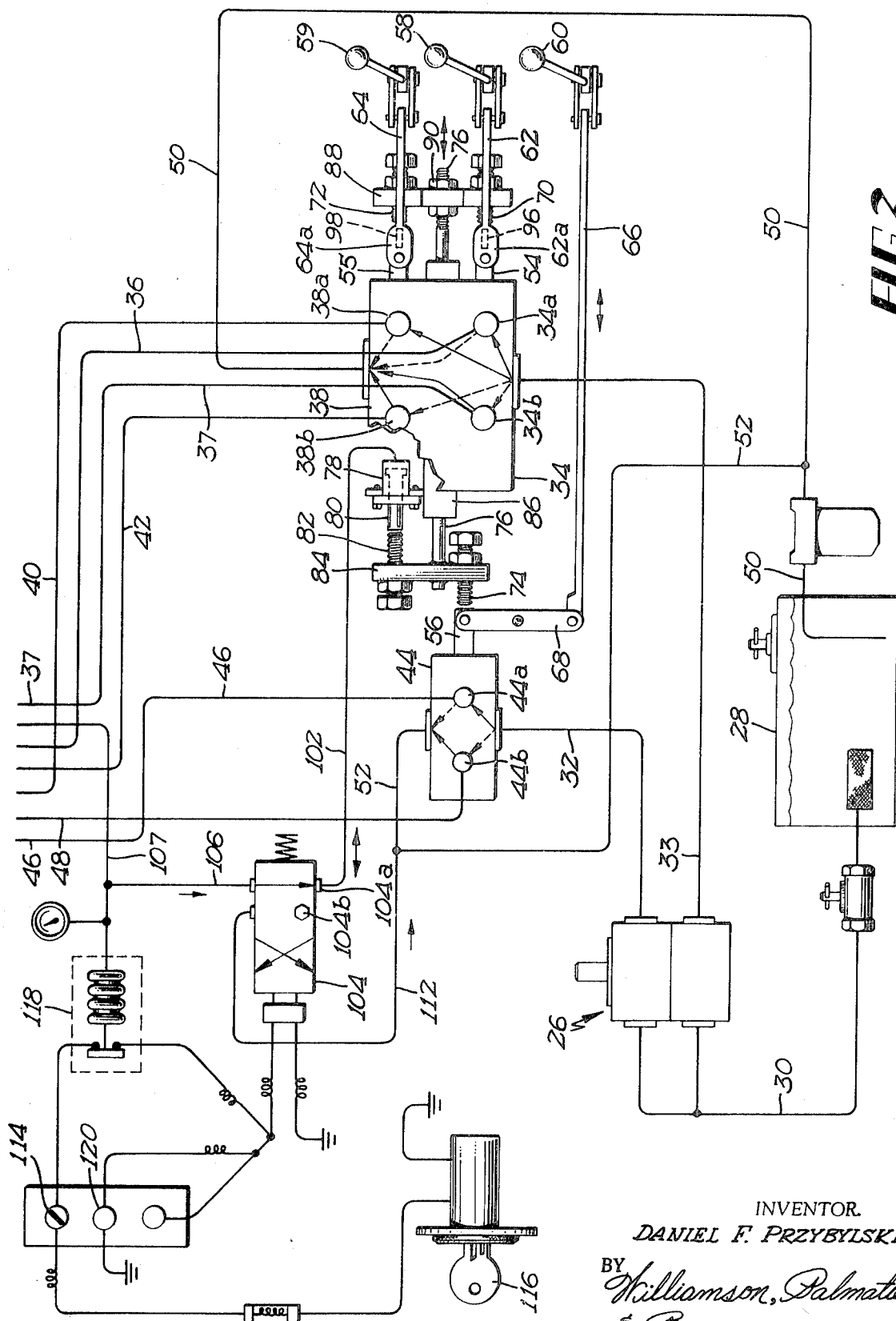


FIG 2

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OVERLOAD PROTECTOR FOR CRANE BOOMS

BACKGROUND OF THE INVENTION

Crane booms of the type having an elongated boom pivotal in a vertical plane by means of a hydraulic motor and including a winch-operated lift cable on the boom are subject to the danger of pitching or tipping of the boom assembly if load conditions on the boom approach what is known as the pitching or tipping moment. The effective tipping moment depends upon the load being hoisted by the boom as well as the angular disposition of the boom in a vertical plane, it being well known that for a given load, the moment arm acting to tip or bend the boom increases as the boom approaches a horizontal position. A further variable effecting the length of the moment arm acting to tip the boom at any given time is of course the actual length of the boom, and this factor is subject to variation on crane booms having extensible boom sections.

Since the raising of the lift cable, the further extension of the crane boom or the further lowering of the boom would tend to aggravate an overload condition, various control systems have been suggested and utilized in the past for preventing any one of the aforesaid operations in the event that an overload condition approaching the tipping moment of the boom assembly is reached. The known prior art control systems for preventing the dangerous overloading of crane booms have incorporated expensive and elaborate combinations of hydraulic, electrical and mechanical devices and elements which unduly complicate the hydraulic circuitry utilized to supply hydraulic fluid to the hydraulic motors for raising and lowering the winch cable, elevating or lowering the boom or extending and retracting the boom. For example, U.S. Pat. No. 3,371,800 discloses a crane boom safety control system wherein a plurality of solenoid valves are utilized in the various hydraulic circuits for the hydraulic winch motor, the boom lift motor and the boom extension and retraction hydraulic motor, in combination with a plurality of reverse flow bypass valves to direct the flow of hydraulic fluid in such a way as to prevent the aforesaid operations of raising the winch cable, further lowering the boom or extending the boom when an overload condition is approached. In addition to the undesirability of incorporating such a plurality of supplemental solenoid valves and attendant electrical controls in the control system for a crane boom, the plurality of solenoid control valves utilized in the aforesaid patent suffers from the further disadvantage of imposing an undue restriction and thus an undesirable pressure drop in the fluid supply lines leading to the hydraulic motors for operating the cable winch, extending the boom and raising and lowering the boom.

The crane boom control apparatus of this invention overcomes these prior art defects and disadvantages by a relatively simple control system utilizing only one, main control valve which is not connected in any of the flow lines leading to and from the hydraulic motors for operating the cable winch, extending the boom and elevating or lowering the boom.

BRIEF SUMMARY OF THE INVENTION

The primary objective of this invention is to provide overload control apparatus for a crane boom which responds quickly and effectively to a potential overload condition to positively prevent any operation of the boom or lift cable on the boom which would tend to aggravate the overload condition, and which offers substantially no interference with the normal and proper operation of the hydraulic control circuit for the hydraulic motors employed to elevate or extend the boom and to drive the boom's cable winch.

On a boom equipped with a hydraulic motor in the form of an extensible lift cylinder for elevating and lowering the boom to different angular positions in a vertical plane, the control apparatus is preferably comprised of a movable stop device which is shiftable into an overload or blocking position in cooperative relation to the hydraulic fluid control valve for the boom lift cylinder in response to an overload condition to prevent the manual operation of said control valve in such a

way as to cause the retraction of the boom lift cylinder and the lowering of the boom. As noted above, the lowering of the boom towards a more horizontal position would tend to aggravate the dangerous overload condition by increasing the moment arm acting to pitch or tip the boom assembly.

A particularly advantageous feature of my improved control apparatus resides in the utilization of a single valve connected to a source of pressurized fluid to direct pressurized fluid to a small fluid motor used to shift the stop device to the aforesaid blocking position with respect to the lift cylinder control valve when an overload condition is encountered. The hydraulic fluid in the boom lift cylinder is conveniently utilized as the source of pressurized fluid for operating the fluid motor connected to the stop device. The single, supplementary valve is automatically operated in response to the attainment of a predetermined, high pressure level in the boom lift cylinder indicative of an overload condition to direct pressurized fluid to the fluid motor actuator for the stop device.

On those crane booms which are extensible and retractable, and which incorporate a lift cable operated by a hydraulic motor driven winch, my improved control apparatus is beneficially utilized to prevent the further extension of the crane boom or the operation of the winch motor to lift the cable when an overload condition is sensed. For this purpose, additional stop devices actuated by the same fluid motor which moves the stop device for the boom lift cylinder control valve are employed to block the operation of additional control valves for the winch motor and boom extension motor to positions which would cause the lifting of the cable or the further extension of the crane boom when an overload condition is encountered.

These and other objects and advantages of my invention will become readily apparent as the following description is read in conjunction with the accompanying drawings wherein like reference numerals have been utilized to designate like elements throughout the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of an extensible crane boom showing the connecting lines for the overload control system of this invention;

FIG. 2 is a schematic illustration of the overload control system and associated apparatus; and

FIG. 3 is a side elevation view of the mechanical overload devices of this invention shown in cooperative association with flow control valves for the hydraulic motors utilized to elevate the boom, extend the boom and to operate the winch for the boom lift cable.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, I have shown in FIG. 1 a crane boom 1 of the type adapted to be mounted on a mobil platform, such as a truck bed (not shown), and for which the overload protector of this invention has been developed. Boom 1 is pivotally supported on a mounting turret 2 for upward and downward movement in a vertical plane about the horizontal axis defined by pivotal connection 4. A hydraulic motor in the form of an extensible cylinder and piston assembly 6, 8 is utilized in a conventional manner to lift or lower boom 1 about pivot connection 4. For purposes of illustrating the full scope of application of my overload system, I have shown boom 1 in the form of an extensible boom assembly having a plurality of telescopically arranged boom sections 10, 11, 12 and 13. Intermediate boom sections 11 and 12, and outer or fly boom section 13 may be telescopically extended and retracted with respect to base section 10 by means of a pair of double-acting hydraulic cylinders 14 and 16, smaller, supplemental hydraulic cylinder 16 being utilized to accomplish the final extension of fly boom section 13. The manner in which hydraulic motors or cylinders 14 and 16 operate to extend and retract the several boom sections forms no part of this invention, and is therefore not illustrated or described in

detail herein. Reference is made to my copending application, Ser. No. 852,850, filed on Aug. 25, 1969 and entitled "Telescoping Hydraulic Cylinder Arrangement for Multiple Section Extendible Booms," for a clear understanding of the construction and operation of boom extension cylinders 14 and 16 with respect to multiple-section crane boom 1.

Boom 1 is also equipped with a lift cable 18 guided around sheaves 19 and 20 at the forward end of the boom assembly and operated by a cable winch 22 mounted at the base end of boom section 10 and driven by a reversible hydraulic motor 24.

A hydraulic fluid control circuit shown in FIG. 2 and incorporating a multiple-stage circulating pump 26 and a hydraulic fluid supply tank 28 is utilized to supply fluid to hydraulic motors 6, 14, 16 and 24. Pump 26 draws hydraulic fluid from supply tank 28 through suction line 30 and discharges pressurized fluid through supply lines 32 and 33 leading to the aforesaid hydraulic motors. The path and direction of the fluid flow to each of the hydraulic motors is controlled by a separate, manually operable valve. A first, boom-elevating control valve 34 is selectively operable to direct the flow of pressurized fluid from supply line 33 to boom lift cylinder 6 through either flow line 36 for lowering boom 1 or through flow line 37 for lifting or elevating boom 1. In like manner, a second control valve 38 is utilized to selectively direct the flow of pressurized hydraulic fluid from supply line 33 to boom extension cylinders 14 and 16 through either line 40 for extending the boom sections 11, 12 and 13, or through line 42 for retracting the boom sections. A third, winch control valve 44 is selectively operated to direct the flow of pressurized fluid from supply line 32 to hydraulic winch motor 24 through either line 46 to operate reversible motor 24 in a direction to raise cable 18 or through line 48 to operate winch motor 24 in a cable down direction. For purposes of convenience, valves 34 and 38 have been shown as a single valve assembly having single connections to supply line 33 and to return line 50 through which hydraulic fluid is returned from hydraulic motors 6, 14, and 16 to tank 28. The hydraulic circuit to and from winch motor 24 is completed by return line 52 leading from control valve 44 to return line 50.

Valves 34, 38 and 44 are four-way spool-type valves of conventional, two position design. Valve spools 54, 55 and 56 are shifted back and forth longitudinally to the desired positions of operation by means of levers 58, 59 and 60 connected thereto by linkage mechanisms which may best be understood by reference to both FIGS. 2 and 3. Spool 54 of control valve 34 is attached to a connecting rod 62 at bifurcated end 62a thereof, rod 62 being connected at its opposite end to control lever 58. A similar lever and linkage mechanism is utilized to actuate spools 55 and 56 of valves 38 and 44. Thus, connecting rod 64 serves to connect lever 59 with spool 55 of valve 38; and rod 66 extends between lever 60 and a connecting link attached to spool 56 of winch control valve 44. Connecting rods 62, 64 and 66 are longitudinally shiftable by levers 58, 59 and 60, as is indicated by the directional arrows in FIGS. 2 and 3. As is illustrated with respect to valves 34 and 44 in FIG. 3, each of the valve spools is reciprocally shiftable from a neutral position *b* to either an outwardly extended position *c* or an inward or closed position *a*. Control valve spools 54 and 56 are shown in their neutral positions in FIG. 3. When spool 54 of control valve 34 is shifted inwardly to position *a* by lever 58, it directs pressurized fluid from supply line 33 through port 34b (FIG. 2) and into supply line 37 to operate boom lift cylinder 6 in a boom-elevating direction. Hydraulic fluid returns from cylinder 6 through line 36 to port 34a of valve 34 from which it is directed to return line 50 leading to supply tank 28. With valve spool 54 shifted to outward position *c*, it reverses the flow of hydraulic fluid to boom lift cylinder 6 by directing pressurized fluid from supply line 33 through port 34a and line 36 to cylinder 6, whereby cylinder 6 is operated in the reverse direction to lower boom 1. With spool 54 of control valve 34 in position *c*, hydraulic fluid will be returned from cylinder 6 through line 36 and port 34a to valve 34 to return line 50.

Valve 38 is operated in a substantially identical manner by control lever 59 with the inward shifting of valve spool 55 serving to direct pressurized fluid from supply line 33 through valve port 38b to line 42. With hydraulic fluid flowing to boom extension cylinders 14 and 16 through line 42, these cylinders will be operated to retract boom sections 11, 12 and 13. The return flow of hydraulic fluid from boom extension cylinder 14 will take place through line 40 to valve port 38a and thence to return line 50. When valve spool 55 is shifted outwardly by control lever 59, it will direct pressurized fluid to boom extension cylinder 14 through line 40 to reverse the operation thereof in order to extend boom sections 11, 12 and 13. With valve spool 55 shifted to its outward position, fluid will be returned from cylinders 14 and 16 through line 42 and valve port 38b to return line 50. Likewise, the shifting of valve spool 56 of control valve 44 between its inward position *a* and its outward position *c* serves to alternately operate cable winch motor 24 in cable-lowering and cable-raising directions respectively. When valve spool 56 is shifted inwardly to position *a*, it will direct pressurized fluid from supply line 32 through valve port 44b and supply line 48 to operate hydraulic winch motor 24 in a cable-lowering direction. The raising of cable 18 is accomplished by shifting valve spool 56 outwardly to reverse the direction of operation of hydraulic winch motor 24 by supply pressurized fluid through valve port 44a and supply line 46. In either position of operation, valve spool 56 directs the return flow of hydraulic fluid from winch motor 24 through return line 52 to supply tank 28.

In order to positively prevent any unsafe handling of loads being lifted by cable 18, or overloading of crane boom 1, I provide a plurality of movable stop devices 70, 72 and 74 arranged in cooperative association with control valves 34, 38 and 44 to prevent the operation of these valve in such a way as to exceed the pitching moment of the boom assembly when a dangerous, overload condition has been reached on cable 18 and boom 1. The arrangement of the stop devices in combination with control valves 34, 38 and 44 is shown as a top, plan view in FIG. 2 and as a side elevation view in FIG. 3. Stop devices 70, 72 and 74 are connected to a common slide bar 76 for simultaneous actuation by a fluid motor 78, which preferably takes the form of a small, single acting hydraulic cylinder. Reciprocal piston 80 of hydraulic cylinder 78 is positioned in alignment with a contact member in the form of an adjustable bolt 82 threadedly secured to an upright mounting plate 84. Mounting plate 84 carries stop device 74 on its upper end and is attached at its lower end to slide bar 76. Sliding support for lateral movement of slide bar 76 is provided by guide housing 86 through which bar 76 extends, a second mounting plate 88 being secured to threaded end 76a and bar 76 by locknuts 90 as shown. Each of the adjustable stop device 70, 72 and 74 preferably takes the form of a threaded bolt. Bolts 70 and 72 are adjustably attached to the upper end of mounting plate 88 and held in place by means of locknuts 92. Adjustable stop bolt 74 is adjustably secured to the top of mounting plate 84 in a similar arrangement utilizing locknut 94. Each of the lever and linkage mechanisms for operating valves 34, 38 and 44 includes a portion of member constructed and arranged for cooperative engagement with adjustable stop devices 70, 72 and 74. Depending downwardly from inner, bifurcated ends 62a and 64a of connecting rods 62 and 64 are stop members 96 and 98 utilized for this purpose. A similar stop member 100 is attached to the underside of link 68 of the lever mechanism for control valve 44. Stop members 96, 98 and 100 are disposed in horizontal alignment with adjustable stop bolts 70, 72 and 74 respectively, as is clearly indicated in FIG. 2, to insure contact therebetween when a potential overload condition is encountered as hereinafter explained. Threaded stop bolts 70, 72 and 74 are initially adjusted relative to their mounting plates 84 and 88 so that when piston 80 of hydraulic cylinder 78 is retracted to the position shown in FIG. 3, the stop devices will not interfere with the operation of control valves 34, 38 and 44. Thus, as is clearly indicated in FIG. 3, valve spools 54, 55 and 56 may be shifted outwardly to

position c with no contact taking place between stop members 96, 98 and 100 and adjustable stop bolts 70, 72 and 74 when hydraulic cylinder 78 is not under pressure and piston 80 is retracted, as would normally be the case when crane boom 1 is operating within safe load limits.

My overload control apparatus for actuating fluid motor 78 to shift stop devices 70, 72 and 74 into blocking positions with respect to valves 34, 38 and 44 includes a fluid line 102 for supplying hydraulic fluid to hydraulic motor 78 and a directional control valve 104 connected in line 102. Valve 104 is connected by a fluid line 106 with a source of hydraulic fluid under pressure for operating hydraulic cylinder 78; and, for this purpose I have found it convenient to use the hydraulic fluid within lift cylinder 6. Connecting line 107 extends between fluid line 106 and lift cylinder flow line 37 by means of which fluid is conducted from cylinder 6 when an overload condition is encountered. A safety restrictor 103 is located in line 107 to prevent an undue pressure buildup at directional control valve 104. It is to be noted that the control circuit for lift cylinder 6 also includes a lockout valve 110 which functions to hold the necessary operating pressure within lift cylinder 6 in the event of a malfunction in the hydraulic control circuit.

Directional control valve 104 is preferably a four-way, spool-type solenoid valve which is normally spring biased to a position permitting flow through fluid lines 106 and 102 to hydraulic cylinder 78 when it is deenergized. Port 104b of valve 104 is plugged and port 104a is connected to fluid line 102 leading to hydraulic cylinder 78. Hydraulic fluid return line 112 connects valve 104 with return line 52 and supply tank 28. When energized by a control circuit explained below, solenoid valve 104 connects fluid line 106 with plugged port 104b and directs hydraulic fluid from cylinder 78 and line 102 to return line 112. The deenergizing of solenoid valve 104 serves to place pressurized fluid supply line 106 in fluid flow communication with port 104a and line 102 leading to cylinder 78. At this time, there will be no flow through return line 112. An electrical control circuit including ignition switch 114 operated by ignition key 116 for the truck or other vehicle on which crane boom 1 is mounted is utilized to energize solenoid valve 104 when switch 114 is closed and the vehicle and crane boom are in operation. The electrical control circuit further includes a pressure switch 118 which is normally closed as is indicated in FIG. 2 to complete the electrical circuit through solenoid valve 104. Pressure responsive switch 118 is connected to fluid line 107 leading from boom lift cylinder 6. A signal light 120 is also connected in the electrical control circuit. It will thus be seen that during normal operation under safe load conditions, pressure switch 118 will be closed and with truck ignition switch 114 closed when ignition key 116 is turned on, solenoid valve 104 will be energized to a position normally blocking fluid flow through lines 106 and 102 to hydraulic cylinder 78. Under such conditions, fluid line 102 will be connected to return line 112 so that fluid from hydraulic cylinder 78 can be returned to supply tank 28. Pressure switch 118 is set to respond automatically to open the electrical circuit to solenoid valve 104 in response to a pressure rise within hydraulic lift cylinder 6 to a predetermined maximum level indicative of a potentially dangerous overload condition on crane boom 1. The fluid pressure within hydraulic lift cylinder 6 is a relatively accurate indicator of load conditions on boom 1 since the hydraulic pressure within cylinder 6 will increase as the load being hoisted by cable 18 increases or the effective length of the boom moment arm increases due to an extension of boom sections 11, 12 and 13 or a lowering of boom 1 towards a horizontal position. Thus, load conditions as reflected by the pressure of hydraulic fluid within lift cylinder 6 are transmitted to pressure switch 118 through connecting line 107.

On the basis of the foregoing description it will be understood that during normal boom operation under safe load and handling conditions, my overload protector apparatus and system will not restrict the movement and operation of

hydraulic motor control valves 34, 38 and 44. Under such safe operating conditions, directional control valve 104 will be energized, thereby connecting fluid line 106 with blocked port 104 and connecting line 102 from hydraulic cylinder 78 to return line 52 by way of valve port 104a. With no hydraulic pressure being applied to piston 80 of hydraulic cylinder 78, piston 80 will be retracted in the position shown in FIG. 3 and adjustable stop devices 70, 72 and 74 will be in their non-blocking positions with respect to valve stop members 96, 98 and 100. Upon a pressure increase within hydraulic cylinder 6 to a predetermined maximum level indicative of a dangerous overload condition, pressure switch 118 will be actuated to open the electrical circuit to solenoid control valve 104. When thus deenergized, solenoid valve 104 will be shifted by spring pressure to a position connecting fluid line 106 with port 104a, whereby pressurized fluid will flow from hydraulic cylinder 6 through lines 107, 106 and 102 to hydraulic cylinder 78. The application of fluid pressure to cylinder 78 will shift hydraulic piston 80 to the left as viewed in FIG. 3, whereby piston 80 will contact adjustable strike bolt 82. Piston 80 will thereby serve to shift slide bar 76 to the left as indicated by the arrows in FIG. 3 with a result that stop devices 70, 72 and 74 connected thereto will be shifted to the phantom line position shown in FIG. 3. When shifted to these phantom line blocking positions, adjustable stop devices 70, 72 and 74 will cooperate with valve stop members 96, 98 and 100 to positively prevent the shifting of valve spools 54, 55 and 56 from neutral position b towards position c by levers 58, 59 and 60. Thus, it will be impossible for the operator to manually shift valves 34, 38 and 44 to their outward positions; and it will thus be impossible to direct pressurized hydraulic fluid to cylinders 6, 14 and 16 and hydraulic winch motor 24 through flow paths which would cause these hydraulic motors to further lower boom 1, extend boom sections 11, 12 and 13 or operate winch motor 24 in a cable lift direction. It will be appreciated that any of these operations would tend to amplify the overload condition encountered. However, the location of stop devices 70, 72 and 74 with respect to control valves 34, 38 and 44 is such that valve spools 54, 55 and 56 may be shifted inwardly to positions a wherein they are effective to direct the flow of pressurized fluid from pump 26 to hydraulic motors 6, 14 and 24 in such a way as to elevate boom 1, retract boom sections 11, 12 and 13 or to lower lift cable 18. Any of these operations would tend to relieve the overload condition acting on cable 18 and boom 1. After the operator corrects the overload condition by any of the foregoing operations of elevating the boom, retracting the boom sections or lowering lift cable 18, the fluid pressure in hydraulic cylinder 6 will decrease accordingly. Pressure switch 118 will automatically sense the pressure drop within cylinder 6 below the predetermined maximum operating level and will return to its closed position to energize solenoid valve 104. The flow of pressurized fluid to hydraulic cylinder 78 will thereby be terminated and fluid line 102 will be connected to fluid return line 52 and tank 28. When control levers 58, 59 and 60 are again operated to shift valve spools 54, 55 and 56 to outward position c, the engagement of stop members 96, 98 and 100 with stop devices 70, 73 and 74 will shift slide bar 76, bolt 82 and cylinder piston 80 back to the right to the positions shown in solid lines in FIG. 3. Since hydraulic pressure has been removed from cylinder 78 at this time, there will be no resistance to the retraction of hydraulic piston 80. As piston 80 is retracted, the fluid within cylinder 78 will be expelled through line 102 valve port 104a and return lines 112 and 52 to supply tank 28. It will thus be appreciated that no resetting of the control system and apparatus is required, as this is automatically accomplished when the pressure within cylinder 6 is reduced by relieving the overload condition on crane boom 1.

It is noteworthy that the above described overload control apparatus does not interfere in any way with the normal operation of hydraulic motor control valves 34, 38 and 44 or the hydraulic control circuit in which these valves are located when the boom unit is operating within predetermined safe

limits. The only additional control valve utilized is directional control valve 104 which is not interposed in the hydraulic control circuit for the boom- and cable-operating motors. There are thus no valves or other restrictions of any kind in the fluid lines leading to and from hydraulic motors 6, 14, 16 and 24 which would impose an unnecessary load on supply pump 26 during the normal operation of these motors. The use of stop devices 70, 72 and 74 to restrict the movement of valve spools 54, 55 and 56 serves as a clear and positive indicator to the crane operator that an overload condition has been reached when he tries to move any of the three control valves to a position which would amplify and aggravate a dangerous overload condition. A further advantage in the form of a fail safe feature for the overload control apparatus is derived from the wiring and installation of solenoid control valve 104 in such a way that it directs pressurized hydraulic fluid to actuating motor 78 for the overload control devices when it is deenergized. Thus, if there should be a power failure for any reason in the main electrical circuit for the operation of the crane boom, and in particular for the operation of the electric motor utilized to drive hydraulic pump 26, pressurized hydraulic fluid will be delivered to cylinder 78 by the deenergizing of solenoid valve 104. Piston 80 would thus be extended to shift stop devices 70, 72 and 74 to their blocking positions, and the relatively dangerous operations of lowering the crane boom, extending the crane boom or operating cable winch motor 24 in a cable-lifting direction would be prevented during the emergency situation created by a power failure.

Although I have shown and described my invention in combination with a crane boom having three hydraulic motors for elevating the boom, extending and retracting the boom, and for raising and lowering a boom lift cable, it will be appreciated that my improved overload control apparatus could be effectively utilized to control and limit the operation of any one or a combination of such hydraulic operating motors on a crane boom. I contemplate that those skilled in the art will recognize other changes and modifications which could be made in the overload control apparatus described herein without departing from the spirit and scope of my invention as defined by the following claims.

I claim:

1. In combination with a crane boom pivotally mounted at its base and equipped with a hydraulic motor for elevating said boom to different angular positions in a vertical plane, improved overload control apparatus comprising:

a hydraulic circuit including a boom-elevating control valve in fluid flow communication with said hydraulic motor and operable to direct the flow of hydraulic fluid to said motor through alternate flow paths to effect either the elevating or lowering of said boom;

a movable stop device disposed in cooperative association with said control valve;

a fluid motor in fluid flow communication with said hydraulic motor for elevating said boom to different angular positions, whereby said hydraulic motor serves as a source of pressurized fluid for said fluid motor, said fluid motor being connected to said stop device for movement thereof to an overload position wherein said stop device prevents the operation of said control valve to lower said boom; and

control means in the form of a valve in a fluid line between said hydraulic motor and said fluid motor, said valve being automatically operable in response to the attainment of a predetermined pressure level by the fluid in said hydraulic motor indicative of an overload condition on said boom to open said fluid line and permit the flow of pressurized hydraulic fluid to said fluid motor to thereby cause the actuation of said stop device to said overload position.

2. A boom and overload control apparatus as defined in claim 1, and further including:

a load lift cable on said boom operated by a winch driven by a second hydraulic motor;

a second, winch control valve in said hydraulic circuit in fluid flow communication with said second hydraulic motor and operable to selectively direct the flow of hydraulic fluid to said second hydraulic motor to effect either the raising or lowering of said lift cable;

a second stop device disposed in cooperative association with said second, winch control valve and connected to said motor for movement thereby to an overload position preventing the operation of said second, winch control valve to raise said lift cable.

3. A boom and overload control apparatus as defined in claim 2 wherein:

said boom is comprised of a plurality of extensible and retractable boom sections operatively associated with a third hydraulic motor for extending and retracting movement thereof, and further including;

a third, boom extension control valve connected in fluid flow communication with said third hydraulic motor and operable to selectively direct the flow of hydraulic fluid through alternate flow paths to effect either the extension or retraction of said boom sections; and a third stop device disposed in cooperative association with said third, boom extension control valve and connected to said fluid motor for movement thereby to an overload position preventing the operation of said third, boom extension control valve to extend boom sections.

4. A boom and overload control apparatus as defined in claim 2 wherein:

each of said first and second control valves is operated by a lever mechanism having a portion thereof constructed and arranged for cooperative engagement with said stop devices, said first and second stop devices being so connected to said fluid motor as to be simultaneously shiftable thereby to said overload positions when said boom is subjected to said overload condition.

5. A boom and overload control apparatus as defined in claim 4 wherein:

each of said stop devices is adjustable with respect to said portions of said lever mechanisms, whereby said stop devices may be adjusted to thereby insure that they will be properly disposed in said overload positions when moved by said fluid motor to prevent the movement of said valve lever mechanisms in such a direction as to either lower said boom or to raise said lift cable.

6. Overload control apparatus for a vertically pivotable crane boom having a lift cable operated by a winch driven by a hydraulic motor, comprising:

a control valve connected in a hydraulic circuit with said hydraulic motor, said control valve being shiftable between a first, cable-raising position and a second, cable-lowering position in which it operates to direct pressurized hydraulic fluid to said hydraulic motor through alternate flow paths to alternately raise and lower said lift cable;

a movable stop device disposed in cooperative relation to said control valve and movable into an overload position blocking the shifting of said control valve to said first position;

motor means operatively associated with said stop device and operative to move said stop device to said overload position; and

control means automatically operable in response to a predetermined overload condition on said crane boom to actuate said motor means and thereby move said stop device to said overload position.

7. Overload control apparatus for a crane boom as defined in claim 6 wherein:

said motor means comprises a hydraulic cylinder and piston assembly;

said crane boom is vertically pivotable by means of a hydraulic lift motor having extensible means for elevating and lowering said boom in a vertical plane, the raising of the hydraulic pressure in said hydraulic motor to a

predetermined level being indicative of an overload condition on said crane boom; and

said control means includes, a fluid line connecting said hydraulic lift motor with said hydraulic cylinder and piston assembly and a valve in said fluid line, said valve being automatically operative in response to the attainment of said predetermined pressure level in said hydraulic lift motor to direct hydraulic fluid from said hydraulic lift motor to said hydraulic cylinder and piston assembly for the actuation thereof.

8. Overload control apparatus for a crane boom as defined in claim 7 wherein:

said valve is a solenoid valve normally blocking flow through said fluid line to said hydraulic cylinder and piston assembly when it is energized, and shiftable by spring pressure to open said flow line when deenergized; and

said control means further includes a pressure switch elec-

trically connected to said solenoid valve and automatically responsive to the attainment of said predetermined pressure level in said hydraulic lift motor to open the electrical circuit to said solenoid valve, thereby deenergizing said valve and opening said fluid line.

9. Overload control apparatus as defined in claim 7 and further including:

a second control valve in said hydraulic circuit for selectively directing the flow of hydraulic fluid to said hydraulic lift motor for either boom-elevating or boom-lowering operation;

a second stop device disposed in cooperative relation to said second control valve and movable by said hydraulic cylinder and piston assembly to an overload position blocking the movement of said second control valve to a position permitting the boom lowering operation of said hydraulic lift motor.

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