May 27, 1958 L. L. MYERS 2,836,467

CRANE CONTROL MECHANISM

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Fig. 3

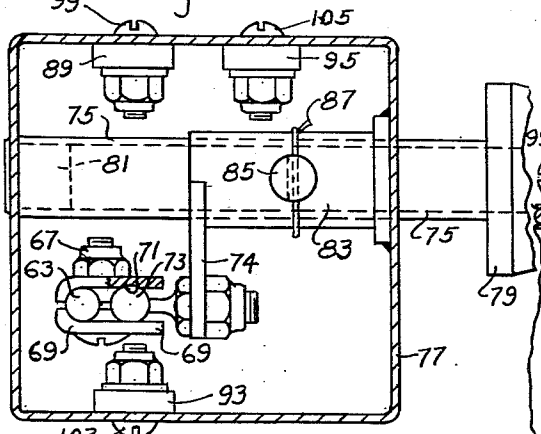


Fig. 2

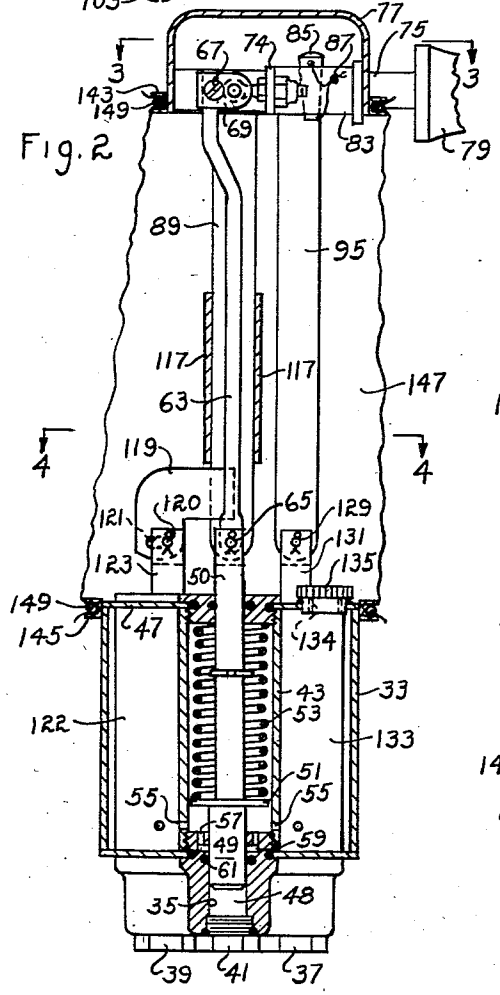
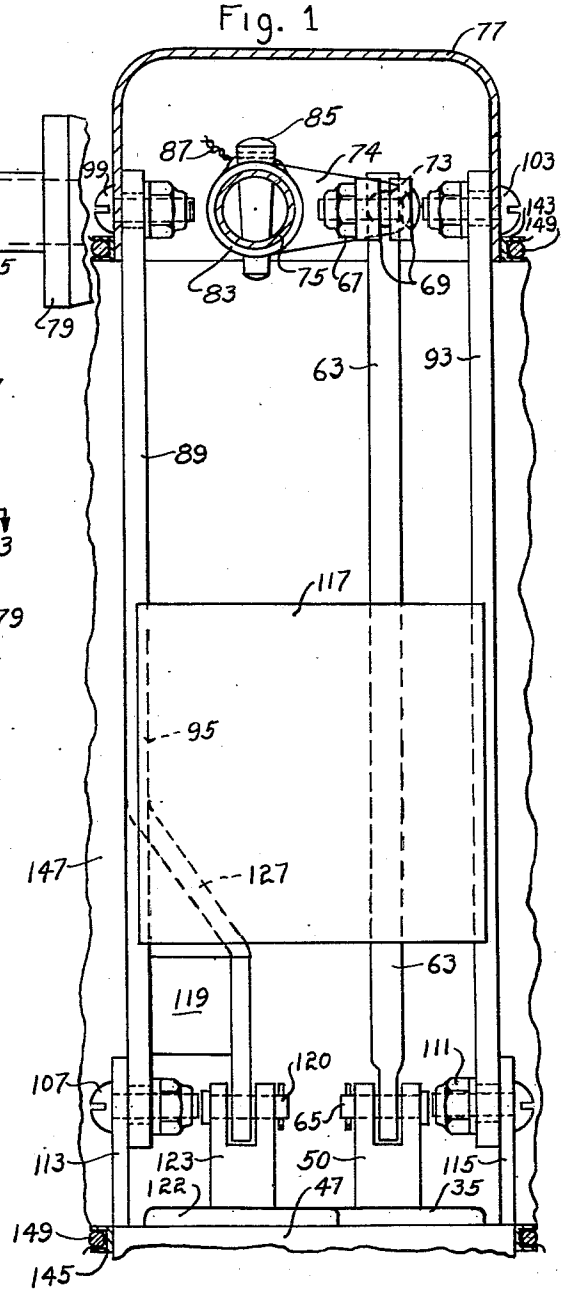


Fig. 1



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Fig. 4

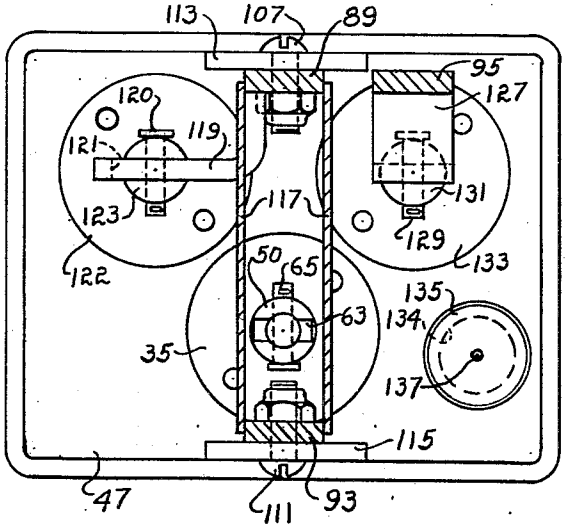


Fig. 5

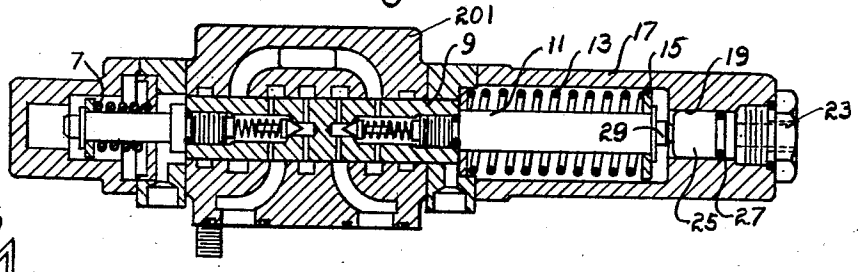
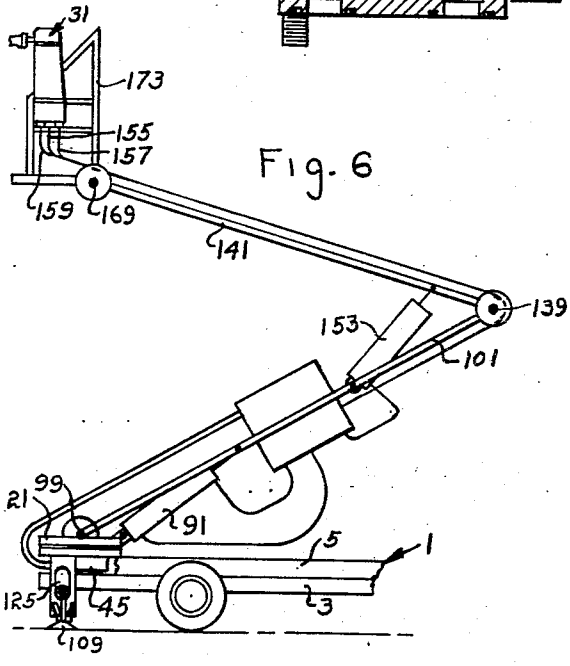


Fig. 6



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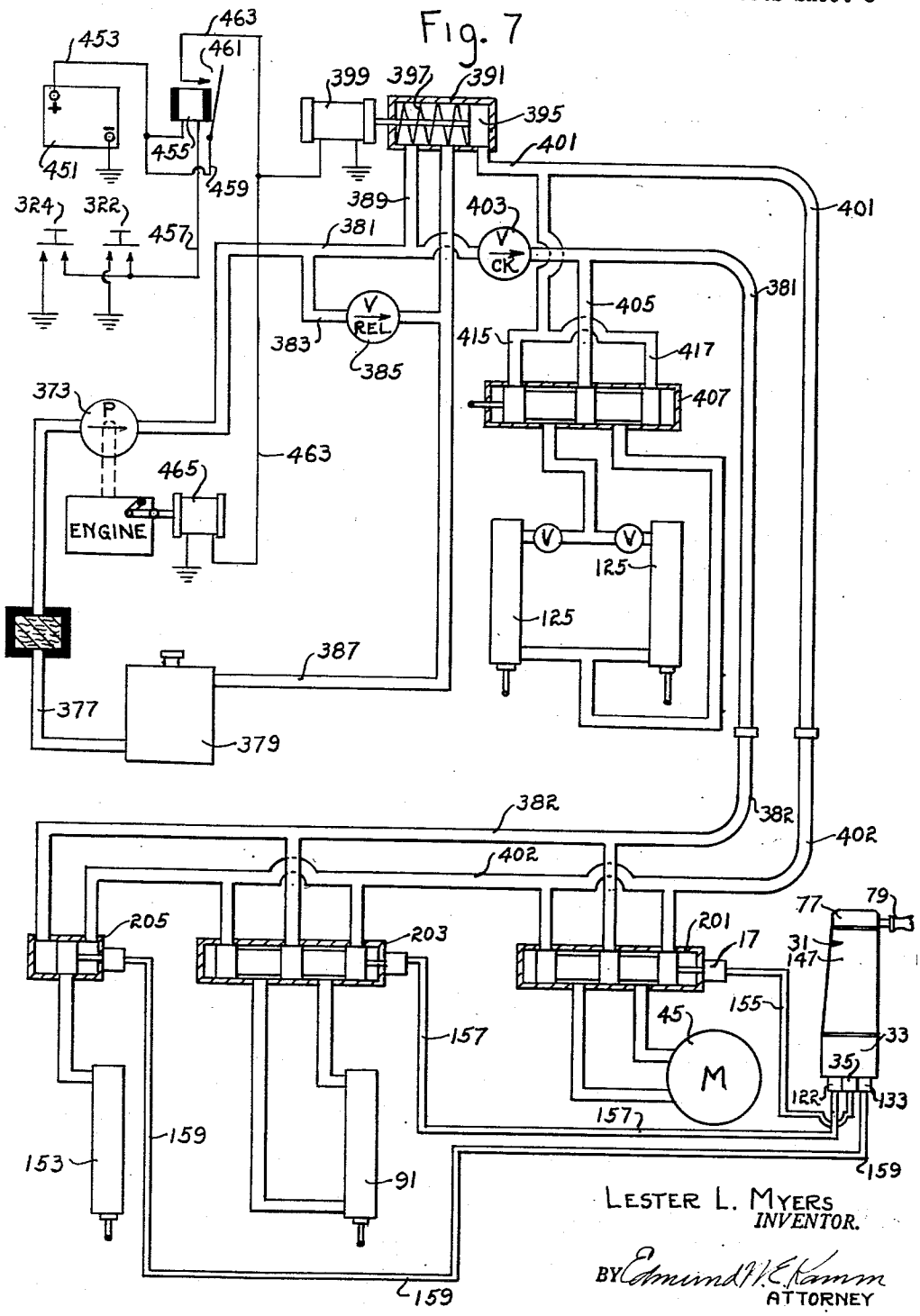
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Fig. 7



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CRANE CONTROL MECHANISM

Lester L. Myers, Fort Wayne, Ind., assignor to Mobile Aerial Towers, Inc., Fort Wayne, Ind., a corporation of Indiana

Application March 10, 1953, Serial No. 341,420

13 Claims. (Cl. 304—29)

This invention relates to a crane control mechanism. More specifically, it relates to an hydraulic control system for a crane having two pivotally connected booms mounted on a turntable, wherein the control is disposed on the outer end of the upper boom.

This application is a continuation in part of my previous application, Serial No. 194,049, now Patent No. 2,758,486, filed by me on November 4, 1950 for Mobile Crane.

It is an object of the present invention to provide a control mechanism which is smooth and positive in operation.

Another object is to provide a system which is safe and easy to operate.

Still another object is to provide a system which can be readily adjusted to compensate to temperature variations and leakage to maintain relatively constant the neutral positions of the controls.

A further object of the invention is to minimize drift of the motors responsive to the controls.

These and other objects will become apparent from a study of this specification and the drawings which are attached hereto, made of part hereof and in which:

Figure 1 is a front elevation with parts shown in section of the manually operated portion of the controls.

Figure 2 is a side elevation with parts in section of the structure of Figure 1.

Figure 3 is a sectional view taken substantially on line 3—3 of Figure 2 showing especially the rotative control.

Figure 4 is a sectional view taken on the line 4—4 of Figure 2 showing the control cylinder arrangement.

Figure 5 is a sectional view of the motor control valve and its actuating mechanism.

Figure 6 is a diagrammatic view of the crane showing the various motors controlled by the control system.

Figure 7 is a diagrammatic view of the entire hydraulic system.

Referring first to Figure 6, the crane, which is fully described in my prior filed application, is mounted on a truck 1 having mounted on its frame 3, a bed 5 of the crane which includes a turntable 21. A rotary hydraulic motor 45 is connected to drive the turntable in either direction.

The lower boom 101 is pivoted on the turntable at 99; the upper boom 141 is pivotally mounted on the top of the lower boom at 139 while the platform 173 is pivotally mounted on the end of the upper boom at 169. A suitable cable system (not shown) is employed to keep the platform 173 level.

A double acting motor 91 is connected between the turntable and the lower boom 101 while a single acting motor 153 is connected between the two booms and is arranged so that it will move the booms apart when pressure is applied to the motor.

A pair of outriggers 109 are pivotally mounted on the

truck and are operated by double acting hydraulic motors 125.

The rotary motor 45 is controlled by a valve 201; motor 91 is controlled by a valve 203; motor 153 is controlled by a valve 205 and motors 125 are controlled by a valve 407.

As shown in Figure 7, the hydraulic system comprises a reservoir 379 connected by line 377 to a pump 373 driven by the truck engine. The discharge line 381—383 of the pump 377 is connected through relief valve 385 with the return line 387 to the reservoir and through branch 389 to the master valve 391 which connects the branch 389 to the return.

Valve 391 is controlled by a solenoid 399 which is connected to a battery 451 through the relay 461 and lines 453, 459 and 463. The solenoid 465 which is connected to open the engine throttle is connected in parallel with solenoid 399. The relay winding 455 is energized by the battery 451 through lines 453, 457 and either switch 322 or 324 which are connected in parallel.

The piston 395 of valve 391 is urged, by a spring 397 to a position in which lines 389, 387 are connected so that the pump is discharging to the sump 379.

The pump discharge line 381 continues through a check valve 403 to the inlet 405 of valve 407 and through line 382 to the inlets of the valves 201, 203 and 205.

Valve 391 is connected by line 401 to the exhaust lines 415, 417 of valve 407; the lines 401 and 402 which are connected to each other and of which 402 is connected with the exhausts of the valves 201, 203 and 205.

Thus, when the switch 322 or 324 is closed, the piston 395 of valve 391 is retracted toward the solenoid, compressing spring 397 and the truck engine is speeded up. The valve piston 395 closes the by-pass 389—387 so that pump pressure is applied to the motor supply pipes and opens the return line 401—402 to the line 387 leading to the sump so that liquid may pass thereto from the various motor exhausts.

The valve 407 controlling the outrigger motors is operated directly and manually, at will.

The above described structure is fully described in the parent application set forth above.

Motor controls

Each of the valves 201, 203, 205 is remotely controlled by an hydraulic system which extends from the platform 173 so that the operator may accurately position the platform, which carries him, in space.

A valve such as 201, is shown particularly in Figure 5, has a self-centering spring 7, which holds it in a neutral position. The valve piston 9 is connected for actuation by a plunger 11 which is urged toward the right by a spring 13 which acts on a collar 15 on the plunger. A cover 17 is fitted to the valve to house these parts. A cylinder 19 is formed in the end of the cover and is provided with a tubing fitting 23. A free floating piston 25, sealed with an O-ring 27 is mounted in the cylinder. The piston acts on a projection 29 on the plunger.

Referring to Figure 6, the controls for the system are disposed on the platform and are indicated generally by numeral 31.

A reservoir 33 for oil or other suitable hydraulic fluid has mounted therein three cylinders 35,, 122, 133. The cylinder 35 is shown in section in Figure 2. It comprises a tubing connection 41, a sleeve 43 which is fixed to the cylinder and to the top 47 of the reservoir. A piston 49 acts in the cylinder and carries a collar 51 which confines a spring 53 between it and the top 47.

The sleeve 43 is perforated at 55 so that oil can reach the groove 57 and pass by way of ports 59 into the

cylinder 48 when the piston is withdrawn therefrom above the ports. An O-ring 61 serves to seal the cylinder and piston.

The upper end 50 of the piston 49, which extends through the top 47 is bifurcated to receive a link 63 which is pivotally connected to it by pin 65. The upper end of the link 63 is offset and has clamped to it by bolt 67, a pair of bearing plates 69 which are recessed at 71 to receive the spherical bearing 73 which is carried by lever 74.

A tube 75 is rotatably mounted for rotation in a cap member 77. One end of the tube carries a handle 79 while the other end receives a guide stud 81 which supports it.

A sleeve or hub 83, to which lever 75 is fixed, is pinned by means of pin 85 to the tube or shaft 75 and bears against the side of the cap opposite the stud 81 and is prevented from substantial axial movement thereby. The pin 85 is held in place by a suitable seal wire 87.

The bearing 73 is disposed so that when the lever 74 extends horizontally as in Figure 1, the center of the bearing lies on the axis of the piston 49.

The cap 77 is pivotally supported on links 89, 93 and 95 by bolts 99, 103 and 105. The lower ends of links 89 and 93 are pivoted at 107, 111 on projections 113, 115 fixed to the top 47 of the tank and are rigidly connected by plates 117.

It should be noted that the pivots 99, 103 are coaxial with each other and with the spherical bearing 73 when they are all in their neutral positions.

The lever 89 carries a forwardly and laterally offset arm 119 which is provided with an elongated slot 121 which is received and pivotally connected by pin 120 in the bifurcated end of the piston 123 of the cylinder 122 which is connected with and controls the valve 203 for the lower boom motor 91. Thus, as the handle 79 is rocked fore and aft links 89, 93 will pivot about the bolts 107, 111 and arm 119 will be moved by link 89 so that it will raise and lower the piston 123.

The cylinder structure is the same as that described in connection with piston 49—50.

Link 95 is offset at 127 and enters the bifurcated end of and is pivotally connected at 129 with the piston 131 of the third cylinder 133 which is connected with the valve 205 which controls the motor 153 of the upper boom.

The top 47 of the tank 33 is provided with a fill opening 134 which is closed by a removable plug 135 which is vented at 137.

A grooved member 143 is fixed adjacent the lower edge of the cap 77 and a similar member 145 is fixed about the top edge of the tank. A canvas tube or sleeve 147 is suitably tied in place by cords or wires 149 so as to enclose and protect the mechanism just described.

As shown in Figure 7, the cylinder 35 is connected by a conduit 155 to the cylinder 19 of the valve 201. Similarly, cylinder 122 is connected by conduit 157 to the corresponding cylinder of valve 203 and cylinder 133 is connected by conduit 159 to the cylinder of valve 205. Suitable flexible joints are made in order to enable the conduits to be passed around the necessary bends. The conduits are fixed to and follow the booms.

Operation

The control handle 79 normally occupies a position parallel to the platform as shown in Figures 1 to 3. The springs 13 in the valves are counterbalanced by the springs 53 and the associated valve is accordingly centered in a neutral position by its centering spring 7 as well as the mechanism just described.

Assuming that the booms are in the positions shown in Figure 6, if it is desired to rotate the turntable the operator will rotate the handle 79 clockwise Figure 1 to secure a similar rotation (looking down at the turntable) and vice versa. He merely releases the handle and the motion stops.

More specifically, the clockwise rotation depresses the lever 74, link 63 and plunger 50—49. The hydraulic fluid displaced from cylinder 35 flows through conduit 155 and displaces piston 25 and the valve control rod 11—29 of the valve 201. The valve admits high pressure fluid from line 382 to the proper side of the turntable motor 45 while the other side is connected with the exhaust line 402.

As soon as the handle is released, the springs 53—13 center their pistons and the motor connections just described are closed.

If the handle 79 is rotated counterclockwise (Figure 1) the rod 63 and piston 49—50 are lifted and spring 53 is compressed by collar 51. As the piston 49 rises the spring 13 moves piston 25 to the right, displacing liquid from cylinder 19 into conduit 155 and cylinder 35. The pressure fluid is admitted from line 382 to the valve 201 and to the other side of motor 45 while the former pressure side is connected to exhaust line 402. Release of the handle 79 permits springs 53—13 to neutralize the controls as described above.

The boom 101 is rotated counterclockwise to extend it by pulling the handle 79 to the right (Figure 2). This action pivots links 89—93 about their pivots 99, 103, 107, 111 and raises the free end of arm 119, thereby lifting piston 123. The corresponding spring in valve 203 moves the valve to admit pressure fluid from line 382 to the bottom end of motor 91 to extend the piston rod. The other end is connected to the exhaust line 402.

A release of handle 79 permits the springs corresponding to 53 and 13 to centralize the valve.

A reverse pull on the handle 79 depresses piston 123 and reverses the action of motor 91 as will be obvious.

In a like manner if the handle 79 is depressed, the cap 77 will tilt about pivots 99, 103 and link 95 will be depressed to depress piston 131. The liquid displaced by the piston will pass through conduit 159 and the corresponding piston 25 will shift valve 205 to connect the bottom end of motor 153 to the exhaust line 402 so that the weight of the boom will collapse the motor. The boom will pivot in a counterclockwise direction (Figure 6).

A reverse movement of handle 79 will lift piston 131 and valve 205 will be shifted in the opposite direction (right Fig. 7) to admit pressure liquid from line 382 to the cylinder to extend the motor and raise the boom 141 in a clockwise direction.

It will be noted that so long as the various conduits 155, 157, 159 are properly filled and the handle 79 extends horizontally, the operation of the handle to actuate one of the pistons will not move any of the other links. Accordingly, there can be no creep or drift of the other motors while one is being operated. The pivots 120, 65 and 129 all lie in a common plane when the controls are neutralized. Similarly, the pivots 99, 103, 105, 73 and the axis of shaft 75 all lie in a common plane when the controls are neutralized.

Should expansion or contraction of the fluid in the conduits 155, 157, 159 and associated cylinders occur, the amount of fluid can be quickly normalized by merely actuating the handle 79 to lift each of the pistons 49, 123, 131 beyond the ports 59 in their associated cylinders and let liquid run into or out of the cylinders through the ports and channel 57 into the reservoir 33. The pistons 11 on the valves will be moved by their springs 13 until they are stopped by the cap 17. When the pistons 49, 123, 131 are released, the control handle 79 will be brought to the normal horizontal position with lever 74 also horizontal.

This operation can be readily performed without moving the boom simply by releasing the switch buttons 322—324. It will be remembered that unless one of the buttons is depressed to close its associated switch, the valve 391

will disconnect the pressure fluid from line 382 and the exhaust line 387 from the line 402 so that regardless of the manipulation of handle 79, it will be ineffective.

It is obvious that various changes may be made in the form, structure and arrangement of parts without departing from the spirit of the invention. Accordingly, applicant does not desire to be limited to the specific embodiment disclosed herein primarily for purposes of illustration; but instead, he desires protection falling fairly within the scope of the appended claims.

What I claim to be new and desire to protect by Letters Patent of the United States is:

1. In a crane having a first member movable in right and left directions, a second member mounted on the first and movable in fore and aft directions, and a third member mounted on the second member and movable in up and down directions, first, second and third hydraulic motors connected to actuate the first, second and third members respectively, an exhaust means and a source of fluid under pressure, first, second and third valves connected to said exhaust means and said source, and controlling connection thereof to said motors, a control cylinder and piston for each valve, a control mechanism located remotely from said motors and comprising a base, a pair of links pivotally mounted on coaxial pivots, on the base and extending substantially vertically therefrom, a cap pivotally mounted theron on coaxial pivots, whereby said cap is capable of fore and aft movement, a lever projecting from one of said links, a first piston connected to the lever, a cylinder for the piston communicating with the control cylinder on the second motor to produce a corresponding fore and aft motion of the second member, said cap being capable of up and down pivotal motion about said pivots, a third link connected to the cap to be raised and depressed thereby, a second piston connected for operation by said third link, a cylinder for the piston communicating with the control cylinder of said third valve, to produce corresponding up and down motion of said third member, a shaft rotatably mounted on the cap having its longitudinal axis planar with the axis of the link pivots in the cap, a lever extending laterally from the shaft, a third piston connected for operation by said shaft as the latter is rotated right and left, a cylinder for the piston connected in communication with the control cylinder of the first valve to produce corresponding right and left rotation of said first member.

2. The structure defined in claim 1 wherein each of said pistons and control pistons is fitted with opposing springs to force the pistons to a neutral position when no manual pressure is applied.

3. The structure defined in claim 1 wherein the lever on the rotatable shaft is provided with a projecting ball journal, the center of which is disposed in the line of intersection of the plane containing the axes of rotation of the pivots in the cap and the plane containing the axes in the cap and body of the pivots of said vertical links, and a link connecting the journal with the third piston, the longitudinal axis of said third piston being normally disposed in said second described plane.

4. The structure defined in claim 1 wherein the base includes a liquid reservoir, the cylinders of said control mechanism being in communication with said reservoir through ports, the pistons of said mechanism being movable in the cylinders so as to open said ports whereby liquid in the systems may be normalized so that the pistons will occupy positions which will establish the control mechanism in a position with the cap and shaft lever horizontal.

5. In a three way control system, the combination of a reservoir, first, second and third cylinders mounted thereon and communicating therewith through port means, first, second and third pistons mounted in the cylinders respectively and having normal positions therein, three control valves, a piston disposed in operative relation to each valve, first, second and third cylinders for said last mentioned pistons, each piston having a normal position in its cylinder, said cylinders communicating with respective first mentioned first, second and third cylinders, springs disposed adjacent all of said pistons so as to urge each pair of pistons in communicating cylinders toward each other, means for moving said first, second and third pistons in first and second directions beyond a position established by the springs, motion of any piston in the first of said directions serving to uncover the port means and permit passage of liquid therethrough so that when said moving means are released the communicating pistons will occupy their normal positions under the action of the associated springs.

6. In a three way control system, the combination of a reservoir, first, second and third cylinders mounted thereon and communicating therewith through port means, a piston in each cylinder having a normal position therein in which it closes the port means and movable both ways from said normal position a predetermined distance without opening said port, but movable in one direction a distance greater than said predetermined distance to open said port means.

7. In a three way control system, the combination of a reservoir, first, second and third cylinders mounted thereon and communicating therewith through port means, a piston in each cylinder having a normal position therein in which it closes the port means and movable both ways from said normal position a predetermined distance without opening said port, but movable in one direction a distance greater than said predetermined distance to open said port means and means including a spring for urging said piston to its normal position.

8. In a three way control system, the combination of a reservoir, first, second and third cylinders mounted thereon and communicating therewith through port means, a piston in each cylinder having a normal position therein, a pair of links pivotally mounted on a common pivotal axis on the reservoir and extending upwardly therefrom, a cap pivotally mounted on a common pivotal axis on the upper ends of said links, a lever connecting said links to actuate the first piston as they pivot about the first mentioned pivotal axis, said links and lever being so proportioned that they extend substantially vertically when the first piston is in its normal position, a second link pivotally connected to the second piston and the cap, extending parallel to said first named links, the pivotal axes at the upper and lower ends of all of said links being disposed in common, parallel planes when said first and second pistons are in their netural positions, a rotary shaft mounted in the cap having its axis of rotation disposed in a common plane with the upper pivotal axes of all of said links and disposed perpendicularly thereto, a lever extending laterally from said shaft and having a journal, a link connected to the journal and to the third piston, said journal being disposed with its center on the pivotal axis in the cap of said first mentioned links when said third piston is in its normal position.

9. In a three way control system, the combination of a reservoir, first, second and third cylinders mounted thereon and communicating therewith through port means, a piston in each cylinder having a normal position therein, a pair of links pivotally mounted on a common pivotal axis on the reservoir and extending upwardly therefrom, a cap pivotally mounted on a common pivotal axis on the upper ends of said links, a lever connecting said links to actuate the first piston as they pivot about the first mentioned pivotal axis, said links and lever being so proportioned that they extend substantially vertically when the first piston is in its normal position.

10. In a three way control system, the combination of a reservoir, first, second and third cylinders mounted thereon and communicating therewith through port means, a piston in each cylinder having a normal position therein, a pair of links pivotally mounted on a

common pivotal axis on the reservoir and extending upwardly therefrom, a cap pivotally mounted on a common pivotal axis on the upper ends of said links, a lever connecting said links to actuate the first piston as they pivot about the first mentioned pivotal axis, said links and lever being so proportioned that they extend substantially vertically when the first piston is in its normal position, a second link pivotally connected to the second piston and the cap, extending parallel to said first named links, the pivotal axes at the upper and lower ends of all of said links being disposed in common, parallel planes when said first and second pistons are in their neutral positions.

11. A crane having a member movable in opposite directions, a double acting motor connected to operate said member, a lever movable in first and second directions from a neutral position, a first cylinder, piston and spring disposed for operation by said lever, said spring serving to urge said lever in one direction toward neutral position, a source of pressure fluid, a valve movable in first and second directions from a neutral position for selectively admitting pressure fluid to opposite sides of said motor, a second cylinder, piston and spring, said second spring being disposed to urge said valve in one direction toward neutral position, hydraulic means including a single conduit connecting said pistons, said springs and pistons being connected in opposed relation so that movement of said lever on said first direction from neutral will move said valve in a first direction from neutral against the action of said second spring and so that movement of said lever in said second direction from its neutral position will render said first spring ineffective, thereby freeing said second spring to move said valve in a second direction from its neutral position.

12. The structure defined by claim 11 wherein said valve and motor are connected so as to move said member in directions corresponding with the direction of movement of said lever from its neutral position.

13. The structure defined by claim 12 wherein said crane comprises a second member movable in two different opposite directions and a third member movable in two still different opposite directions, a second and a third motor and valve operating mechanism for said second and third members, a single handle connected to the three levers and means for mounting said handle for movement in any of the six lever movement directions from a neutral position to effect the operation of said levers singly or in combination.

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