United States Patent

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[54] **CONTROLS FOR HYDRAULICALLY OPERATED ROTARY CRANE**
12 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **212/35,** 212/45, 212/59, 212/145, 214/138, 214/77
[51] **Int. Cl.** **B66c 23/54**
[50] **Field of Search** 212/35, 55, 59, 66, 144, 145; 214/138, 75

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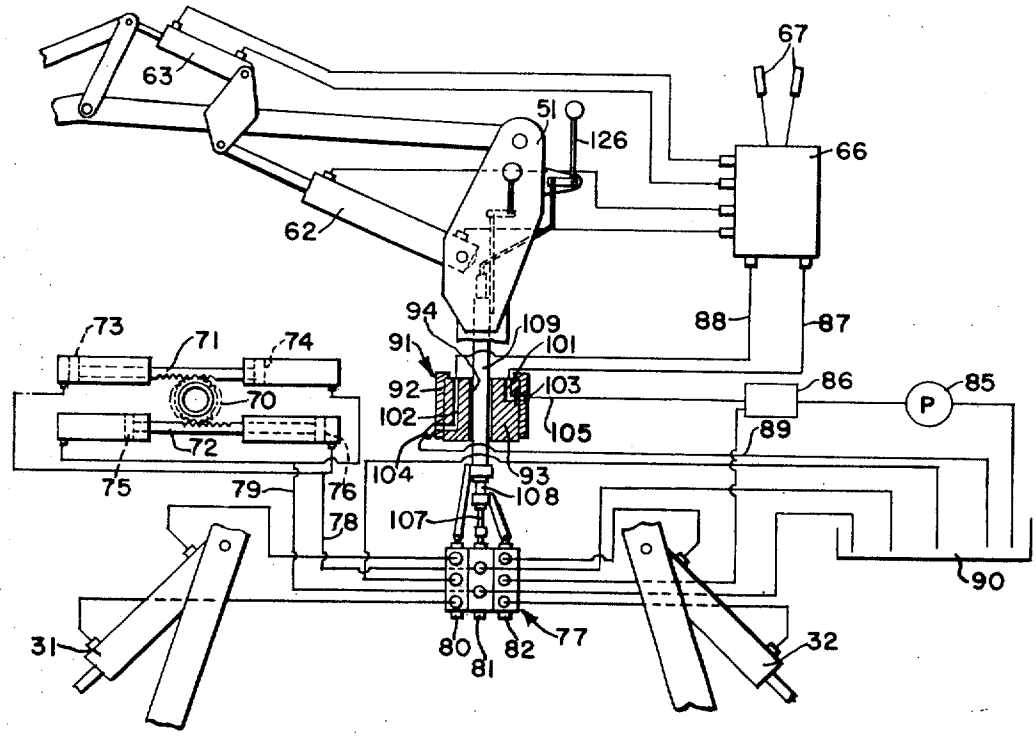
ABSTRACT: A rotary crane in which the operator's station is carried on the boom support and the boom support is mounted for lateral swinging on an upright axis. The hydraulic motors for raising and lowering stabilizer legs and for swiveling the boom support are controlled by a valve bank fixed against rotation. Control rods for the valve bank are carried on the swivel axis of the boom support and have their upper ends connected to control levers at the operator's station and their lower ends connected to the valve bank.



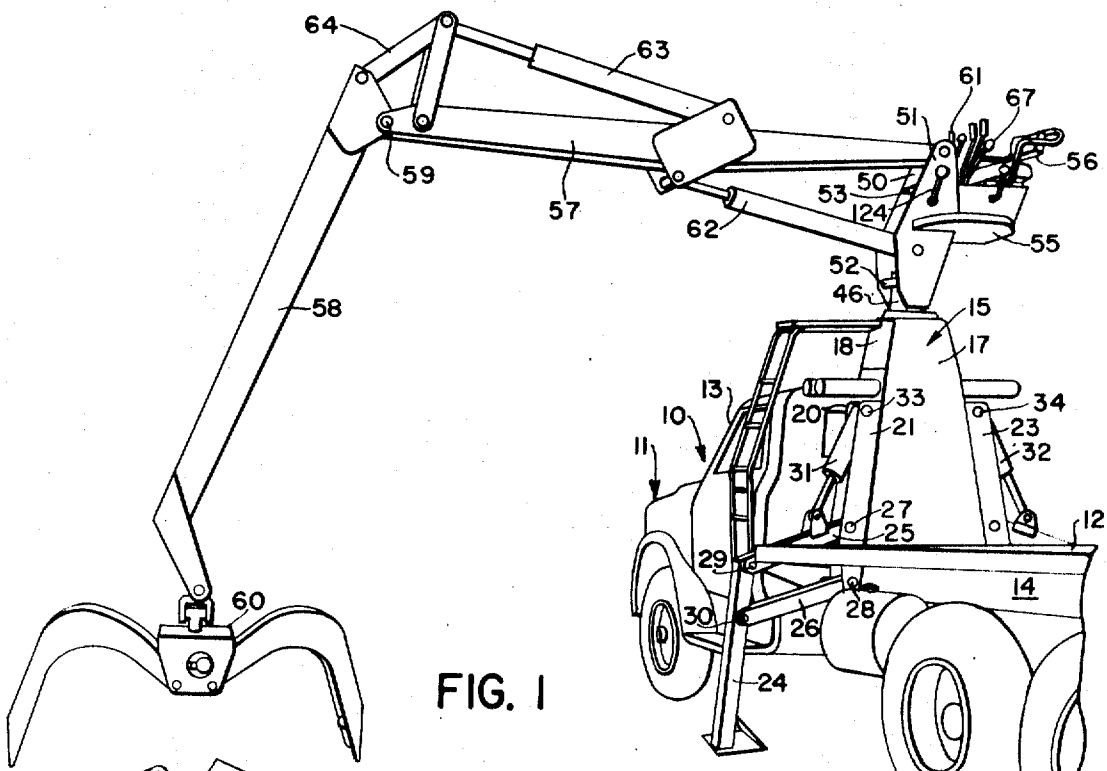


FIG. 1

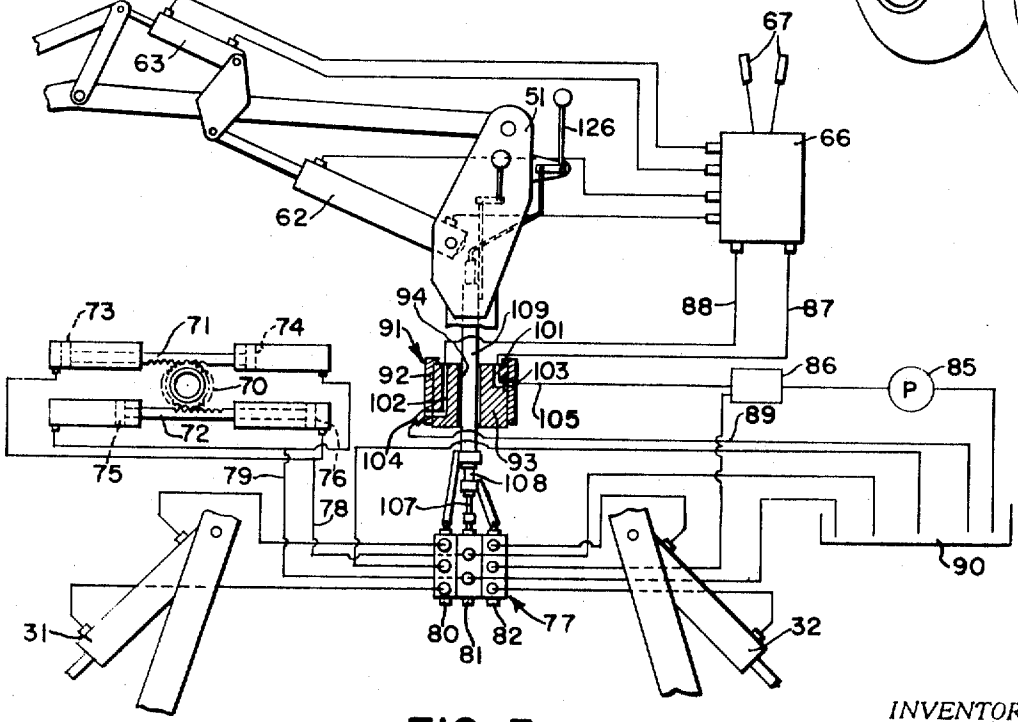


FIG. 3

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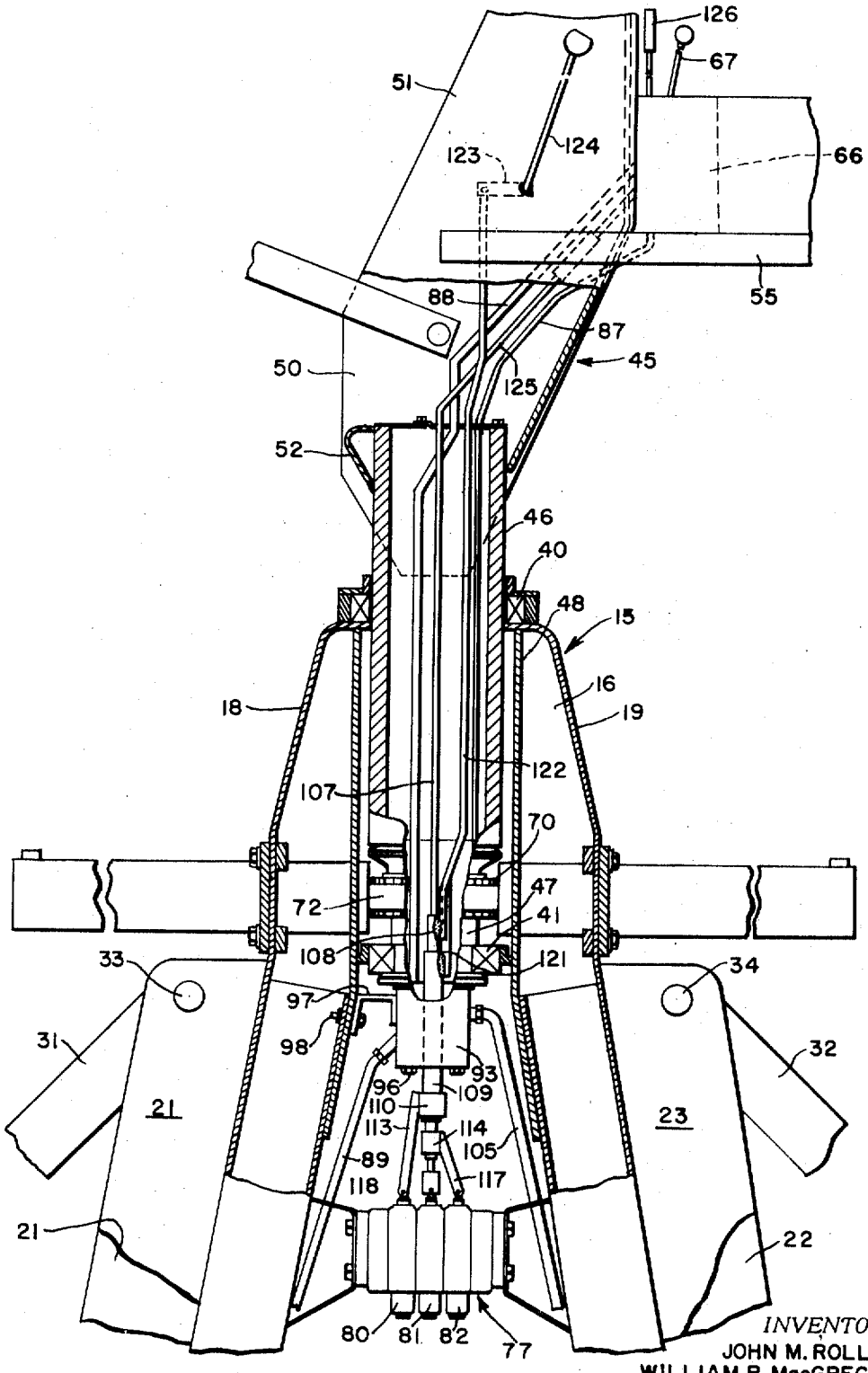

FIG. 2

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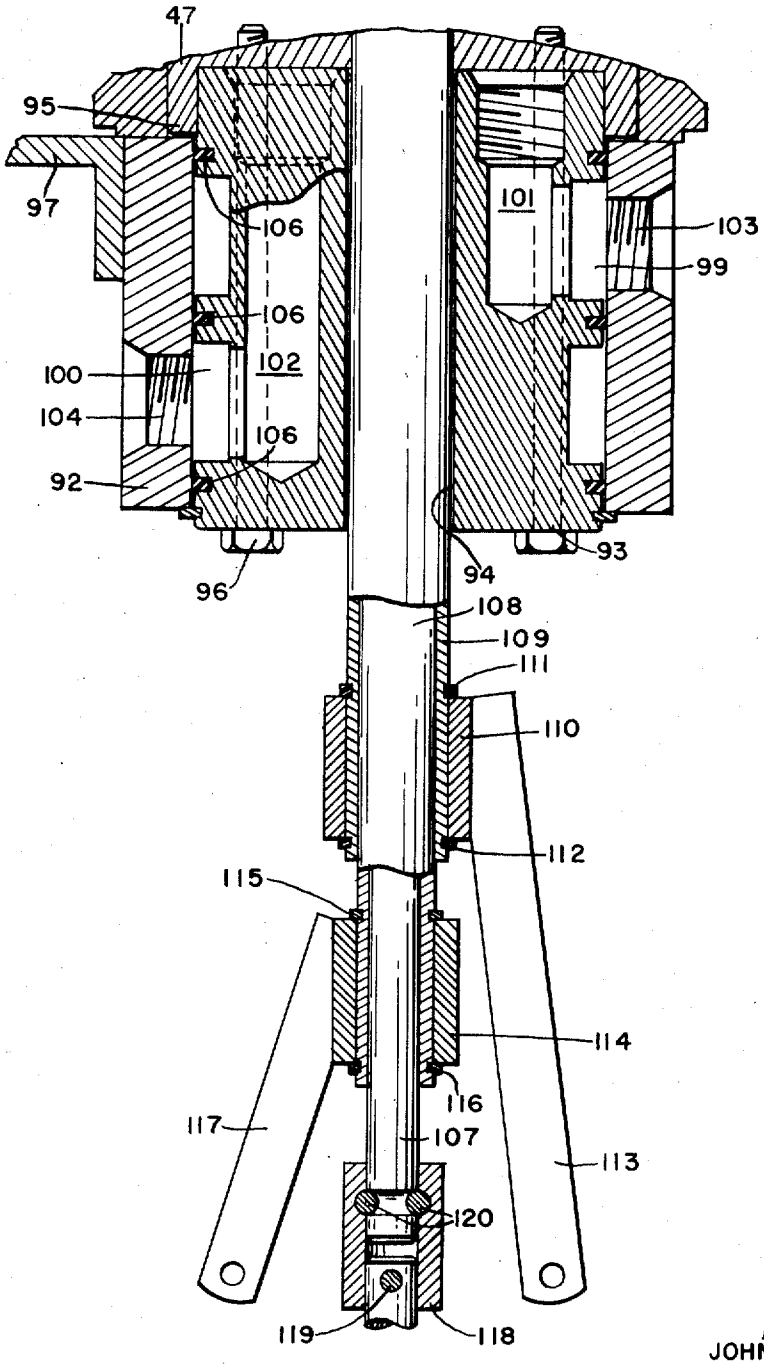

FIG. 4

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CONTROLS FOR HYDRAULICALLY OPERATED ROTARY CRANE

BACKGROUND OF THE INVENTION

It has heretofore been known to provide a rotary crane-type implement in which the boom support is carried to swivel on an upright axis about a base structure and to have an operator's station positioned on the boom support. There are hydraulic motors that operate to swivel the boom support and its boom and also hydraulic motors on the base structure that are utilized to adjust stabilizer units on the base structure. Such hydraulic motors are, in many instances, controlled by control levers on the base structure or, in many instances, are controlled by control elements adjacent the operator's station, there being provided a valve bank at the operator's station and hoses extending from the valve bank down to the hydraulic motors that are fixed against movement with the boom structure.

There are many problems that exist with these types of hydraulic controls. In the first instance, by providing the controls on the base structure, an operator must dismount to raise or lower the stabilizer legs. In the second instance, the hoses that extend between the boom support and the base structure limit the amount of rotation that may occur by the boom structure. Further, fatigue failure can often occur in the hoses that extend from the base structure to the valve controls on the boom structure due to the flexing which occurs as the boom is rotated.

SUMMARY OF THE INVENTION

With the above in mind, it is the primary object of the present invention to provide in combination with a base structure and a boom support that is swiveled on the base structure, a control system that is not in any manner affected by the swiveling action of the boom support.

Specifically, it is an object of the present invention to provide a valve bank on the base structure that controls the various hydraulic motors on the base structure. A valve bank is provided on the boom support for controlling the hydraulic motors carried on the boom support. Controls for both valve banks are provided at an operator's station on the boom support. Fluid is fed to the upper valve bank, or the one controlling the motors on the boom support through a rotary-type manifold carried concentric with the axis of swivel. The manifold is composed of two parts, one being fixed to the boom support and the other being fixed to the base structure. The parts have communicating passages therein that permit swiveling between the two parts.

Controls for the lower valve structure are composed of a series of concentric or telescoping push rods concentric with one another and with the axis of swivel. The lower ends of the push rods are connected by links to the valves of the lower valve bank. The upper ends of the links are swiveled on the respective push rods so that as the push rods are adjusted vertically along the axis, the valves are adjusted. The upper ends of the push rods are connected through linkages to control elements at the operator's station. Control elements for the upper valve bank are also adjacent the operator's station. Thus, the entire hydraulic controls for the units on both the base structure and the control structure are available to the operator at his station and there are no external hoses that extend from the base structure to the boom support.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side rear perspective view of a rotary-type crane implement using the structure of the present invention.

FIG. 2 is a vertical sectional view through the upper portion of the base support and the lower portion of the boom support.

FIG. 3 is a schematic view of the hydraulic system and the controls therefor utilized in the implement shown in FIGS. 1 and 2.

FIG. 4 is a vertical sectional view through the swivel manifold structure and a portion of the control mechanism for the hydraulic system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The implement of the present invention is a rotary crane-type composed of a base structure, indicated in its entirety by the reference numeral **10**. The base structure includes a truck **11** having a rear flat bed **12**, cab **13**, and a fore-and-aft extending main beam structure **14** that extends under the flat bed **12**. The forward portion of the bed **12** terminates rearwardly of the cab **13**. Supported on the fore-and-aft extending main frame **14** forwardly of the forward edge of the flat bed **12** and adjacent the rear side of the cab **13** is an upright main support structure **15** of boxlike construction that includes a front wall **16**, a rear wall **17** and a pair of sidewalls **18, 19**. Transversely extending upright plates **20, 21** and **22, 23** project outwardly from the side plates **18, 19** and provide supporting structure for stabilizer legs, one of which is shown at **24**. The leg **24** is carried on a linkage that includes an upper link **25** and a lower link **26** pivoted at **27, 28** on the plates **20, 21** and pivoted at **29, 30** to the upper end portion of the stabilizer leg **24**. A similar stabilizer leg construction is provided on the opposite side and consequently a description of it is not believed necessary. The stabilizer legs are raised and lowered by means of hydraulic cylinders **31, 32** extending between the upper of the links and pivotal connections **33, 34** respectively on the plates **20—23**.

Carried on the upper end of the upright structure **15** is a bearing **40**. Spaced downwardly from the upper bearing **40** is a lower bearing **41**, also carried on the upright structure **15**. Supported for angular movement on the bearings **40, 41** is an upright boom support, indicated in its entirety by the reference numeral **45**. The support **45** includes a lower upright cylindrical-shaped pillar **46** that has its outer surface journaled on the upper bearing **40** and a smaller lower projecting portion **47** journaled on the bearing **41** so that the entire boom support **45** may swivel about the upright axis of the respective bearings **40, 41**. The upright structure **15** has an internal rectangular-shaped liner **48** that fits about the lower end of the cylinder **46** and its projecting portion **47**. The upper end of the boom support **45** includes a pair of parallel upright plates **50, 51** extending upwardly and to one side of the axis of rotation of the lower cylindrical portion **46**. The plates **50, 51** are welded to opposite sides of the cylinder **46** and are also interconnected by gussets **52, 53**.

Fixed on the plates **50, 51** is a U-shaped platform **55** that is the lower portion of an operator's station on which is carried an operator's seat **56**. Carried on the boom support **45** is a main boom **57** and a second boom **58** that extends downwardly from an upper pivot pin **59** between the two booms to a lower grapple **60**. The boom **57** is supported on the boom support by a pivot pin **61** and is raised and lowered on the support by means of a hydraulic cylinder **62** that extends from the support to the lower side of the boom **57**. A hydraulic cylinder **63** extends from the top of the main boom **57** to a linkage **64** that connects to the secondary boom **58**. Separate hydraulic motors, not shown, are used on the grapple **60** for opening and closing the grapple forks.

All the hydraulic motors or cylinders for the boom structure are controlled by valves in a valve bank **66**, there being suitable control levers at **67** for operating the valve means **66**.

Provided on the small or reduced end portion **47** of the boom support is a spur gear **70** having a pair of rack gears **71, 72** in engagement with opposite sides thereof. The rack gears **71, 72** have opposite ends connected to suitable pistons **73, 74** and **75, 76** contained in hydraulic cylinders on opposite sides of the spur gear **70**. Moving the rack gears in their lengthwise directions will cause the gear **70** and the entire boom support **45** to rotate about the axis of the bearings **40, 41**.

Fixed to the base of the immovable base structure **15** is a hydraulic valve bank **77**. As can best be seen from viewing FIG. **3**, hydraulic lines **78, 79** extend from the valve bank to

the respective ends of the cylinders retaining the pistons 73—76. The lines 78, 79 are so related in respect to their respective valves that the pistons control their rack gears so as to apply accumulative rotational force on the spur gear 70. The valve bank 77 is composed of slide valves 80, 81, 82. The central valve 81 is utilized to shift the pistons 73—76 and the two outer valves 80, 82 are utilized to adjust the hydraulic cylinders 31, 32 respectively that control the stabilizer legs. The valves are arranged, as is clearly apparent from viewing FIG. 3, so that they may independently adjust their respective stabilizer legs to the position that each requires.

Pump means 85 are mounted on the truck and receive fluid from a reservoir 90. The pump means 85 moves fluid through a flow divider 86 to the valve means 66 on the operator's station via a pressure line 87. Fluid is returned from the valve means 66 by a fluid line 88. Positioned between the divider 86, the line 87 and the line 88 and a return line 89 to the reservoir 90 is a manifold structure 91. The structure 91 is composed of inner and outer concentric members 92, 93, concentric with the axis of rotation of the boom-supporting structure. The inner member 93 has a hollow center 94. The member 93 is fixed to rotate with the upright supporting structure by means of a collar 95 that is integral with the lower end 47 at the base of the cylindrical member 46. Suitable tie bolts 96 are provided to lock the collar 95 to the inner member 93. The outer member 92 has affixed to its upper end lug elements 97 that are bolted at 98 to the inner wall 48 of the upright structure 18. Thus, the inner member 93 is fixed to rotate with the upright boom-supporting structure and the outer member 92 is fixed against rotation and to the lower base structure 11. The inner member 93 is provided with upper and lower angular grooves 99, 100 respectively which feed to vertically extending fluid passages 101, 102 that open upwardly for connection to the respective lines 87, 88. The outer member has upper and lower fluid inlets 103, 104 respectively that are aligned radially and in registry with the annular grooves 99, 100. The upper inlet 103 is connected to an upper hose 105 that receives fluid from the flow divider 86. The lower inlet 104 is connected to the return line 89. Suitable oil seals 106 are provided above and below the grooves 99, 100. Therefore, with the inner member 93 being connected to rotate with the boom support and the hydraulic valve means 66, there will be no twisting or flexing of the respective hoses 87, 88 or the hoses 105, 89 when the boom support structure is swiveled.

Concentric with the vertical axis of rotation of the entire boom structure are inner, central and outer control rods 107, 108, 109, respectively. The rods extend axially through the opening 94. The lower ends of the rods 107, 108, 109 are positioned above the valve bank 77. The outer control rod 109 is connected to the outer valve 80 by means of a collar 110 that is held on the outer surface of the rod 109 by upper and lower rings 111, 112 to permit the collar 110 to rotate or swivel on its control rod 109. An inclined link 113 is fixed to the outer surface of the collar 110 and has its lower end pivotally connected to the valve 80. The central control rod 108 has its lower end portion projecting beneath the end of the outer rod 109 and has mounted thereon a collar 114 that is restrained against axial movement by rings 115, 116 so that the collar 114 may swivel on the outer surface of the rod 108. A link 117 is fixed to the outer surface of the collar 114 and is inclined downwardly to a lower end pivotally connected to the outer valve 82. The inner control rod 107 is positioned vertically above the upper end of the central valve 81 and is connected thereto by a collar 118 that is pinned at 119 to the upper end of the valve 81 and is swivelly connected by two pins 120 extending through the collar 118 and resting in an annular recess in the lower end of the rod 107.

Just as the lower ends of the rods 107, 108, 109 are offset axially from one another, so are the upper ends. The upper end of the rod 109 is axially offset downwardly from the inner and central rods 107, 108 and has connected thereto a control link 121 that extends upwardly through the hollow cylinder portion 46. The upper end of the control rod 108 has welded to its outer surface an upwardly extending control link 122. Except for the extreme lower ends, the control links 121, 122 are substantially parallel to one another and terminate at upper ends between the plates 50, 51 where they are connected to levers, one of which is shown at 123, that are pivotally mounted on and adjacent the respective plates 50, 51, the latter levers being adjustable by control levers, one of which is shown at 124 outwardly of the respective plates 50, 51. Thus, one lever 124 controls the stabilizer valve 82 and the other control lever which is not shown, controls the stabilizer valve 80. The central control rod 107 extends upwardly through the cylinder 46 and is bent to have an inclined section 125 and an upper terminal end 126 at the operator's station. Raising and lowering of the terminal end 126 raises and lowers the central valve 81 that controls the pistons 73—76.

It will thus be seen that the control means for operating the lower bank of valves 77 extends upwardly along the axis of swivel of the entire boom support and by providing the swivel collars 110, 114, 118, the upper boom support and the boom structure itself may swivel on the axis without in any manner affecting the positioning of the valves 80—82. By providing the slip-type manifold 91, fluid may be transferred from the pump 85 to the main valve means 66 through lines 87, 88 with disregard to the angular position of the boom structure in relation to its base support. The lines 87, 88 may be rigid since the position of the boom structure has no effect on the lines 87, 88. They may therefore be hidden within the boom-supporting structure where they will not be subject to damage by catching on foreign objects or by having them come in contact with material being handled by the boom structure.

We claim:

1. In a swingable boom-type implement, a base structure having vertical journal means; an upright boom support having a boom thereon and mounted on the base structure to swing on the vertical axis of the journal means; a plurality of hydraulic motor means associated with the boom support to swing therewith; a plurality of hydraulic motor means associated with and connected to the base structure to restrain swinging in respect to the boom support; an operator's station mounted on and swingable with the boom support; first and second hydraulic valve means fixedly mounted on the boom support and base structure respectively for operating the respective motor means associated with the boom support and base structure respectively; control elements adjacent the operator's station for controlling the valve means with part thereof being connected to the first valve means; a source of hydraulic fluid on the base structure; a fluid-transferring device including inner and outer relatively rotatable members concentric with the aforesaid axis with one of the members being connected to and rotatable with the boom support and the other being connected to and restrained against rotation by the base structure, with one member having fluid lines in communication with the first valve means and the other member having fluid lines in communication with the source, and with the inner of said members being hollow along said axis; a plurality of axially shiftable control rods extending through the hollow inner member; and means connecting the upper ends of the control rods to a part of the control elements for axial shifting of the rods and the lower ends to the second valve means for adjusting the latter in response to axial shifting of the control rods, said means including swivel connections between said control rod and valve means for accommodating angular movement of the boom support on the base structure without affecting shifting of the control rods.

2. The structure as set forth in claim 1 in which the axially shiftable control rods are concentric with one another and with the aforesaid axis, whereby the rods may be individually shifted axially.

3. The structure as set forth in claim 2 in which the rods have axially offset ends, and the means connecting the lower ends to the second valve means includes connecting links that extend from the lower ends to the second valve means.

4. The structure as set forth in claim 3 in which the swivel connections are between the respective lower ends and the connecting links.

5. The structure as set forth in claim 4 in which the second valve means is a bank of vertically adjustable valves at least a part of which is offset radially from the aforesaid axis and are connected to the connecting links.

6. The structure as set forth in claim 1 in which the swivel connections include collars rotatably supported on the rods but restricted against axial shifting in respect to the rods and having connecting link means extending from the collars to the valves of said second valve means.

7. In a swingable boom-type implement, a base structure having vertical journal means; an upright boom support having a boom thereon and mounted on the base structure to swing on the vertical axis of the journal means; a plurality of hydraulic motor means associated with and connected to the base structure and restrained against swinging with respect to the boom support; an operator's station mounted on and swingable with the boom support; valve means fixedly mounted on the base structure for operating the respective motor means; control elements adjacent the operator's station for controlling the valve means; a plurality of control rods shiftable along the aforesaid axis; and connecting means between the upper ends of the control rods and the control elements for axial shifting of the rods and between the lower ends and the valve means for adjusting the latter in response to axial shifting of the control rods, said means including swivel connections between the control rods and valve means mounted on the control rods for accommodating angular movement of the boom support on the base structure without affecting shifting of the control rods.

8. The structure as set forth in claim 7 in which the control rods are concentric to one another and to the vertical axis with the inner being longer than the outer of the rods.

9. The structure as set forth in claim 7 in which the control rods are concentric to one another and to the vertical axis with the respective proximate ends thereof being axially offset relative to one another.

10. The structure as set forth in claim 9 in which the swivel connections are elements having annular surfaces supported on the ends of the control rods for angular movement and against axial movement with respect to the rods.

11. The structure as set forth in claim 10 in which the connecting means includes links extending from the opposite ends of the control rods to the control elements and valve means with at least part of the links being connected to the rods via the elements having the annular surfaces.

12. The structure as set forth in claim 9 in which the proximate ends that are axially offset are axially offset progressively from the outer to the inner control rods.