United States Patent

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[54] CONTROLS FOR OUTRIGGER ASSEMBLIES OF MOBILE CRANES AND THE LIKE
11 Claims, 2 Drawing Figs.

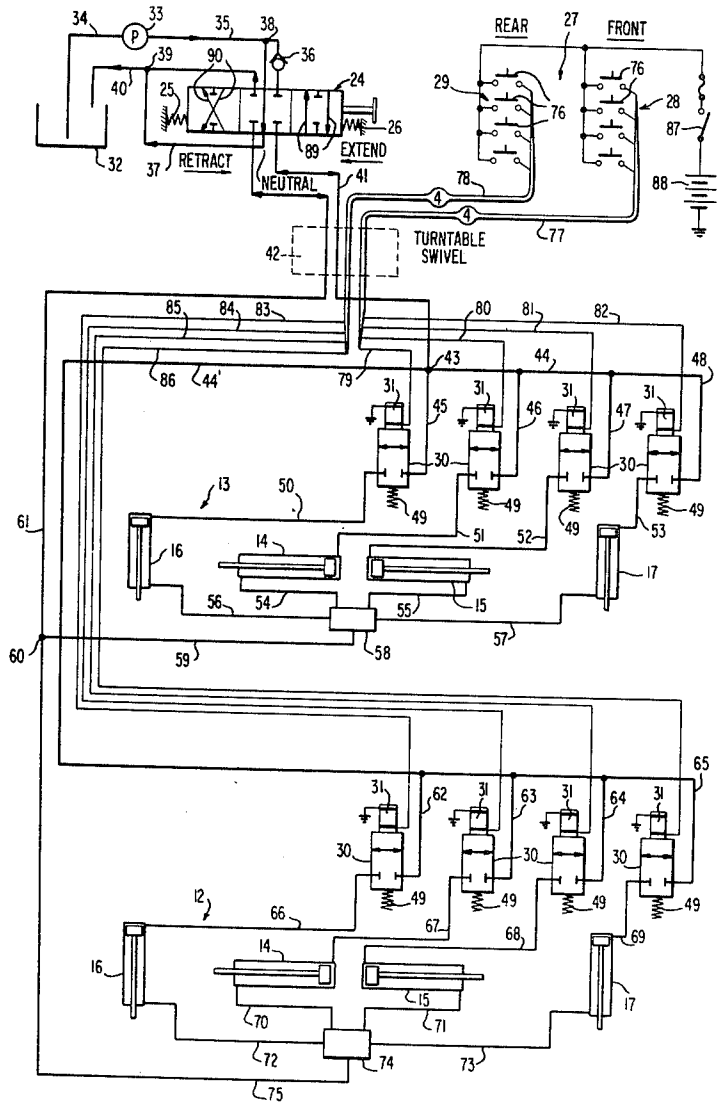
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[50] Field of Search 91/414; 60/E, 97L; 212/145

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ABSTRACT: Simplified controls for the forward and rear outrigger assemblies of mobile cranes or like machines comprise a single control valve having only three positions to enable the crane operator to readily condition the fluid circuit for extension or retraction of the several cylinders of the outrigger assemblies. Coacting electrical controls permit rapid, selective operation of the several cylinders in any desired sequence from a pushbutton console.

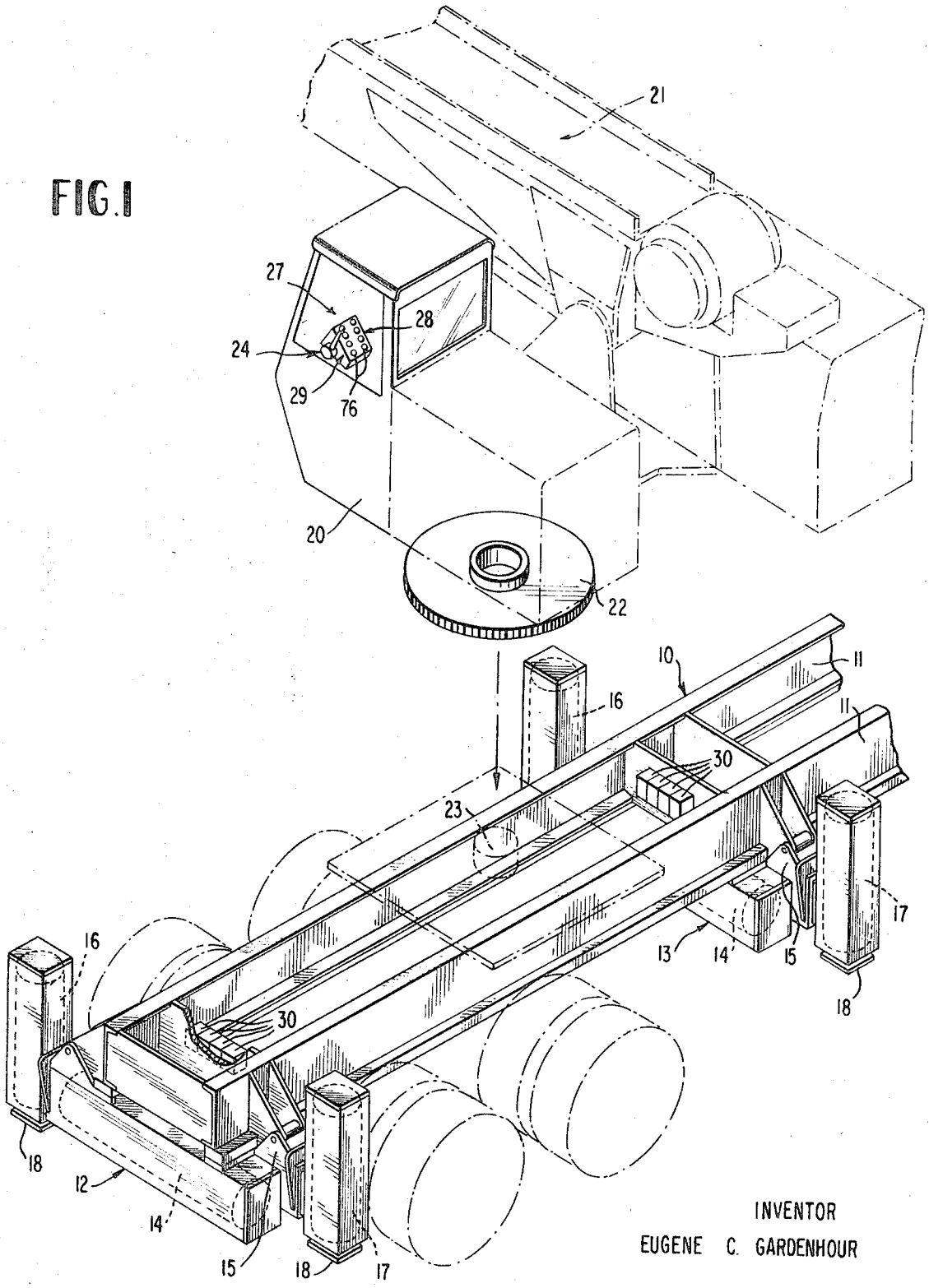


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SHEET 1 OF 2

FIG. 1

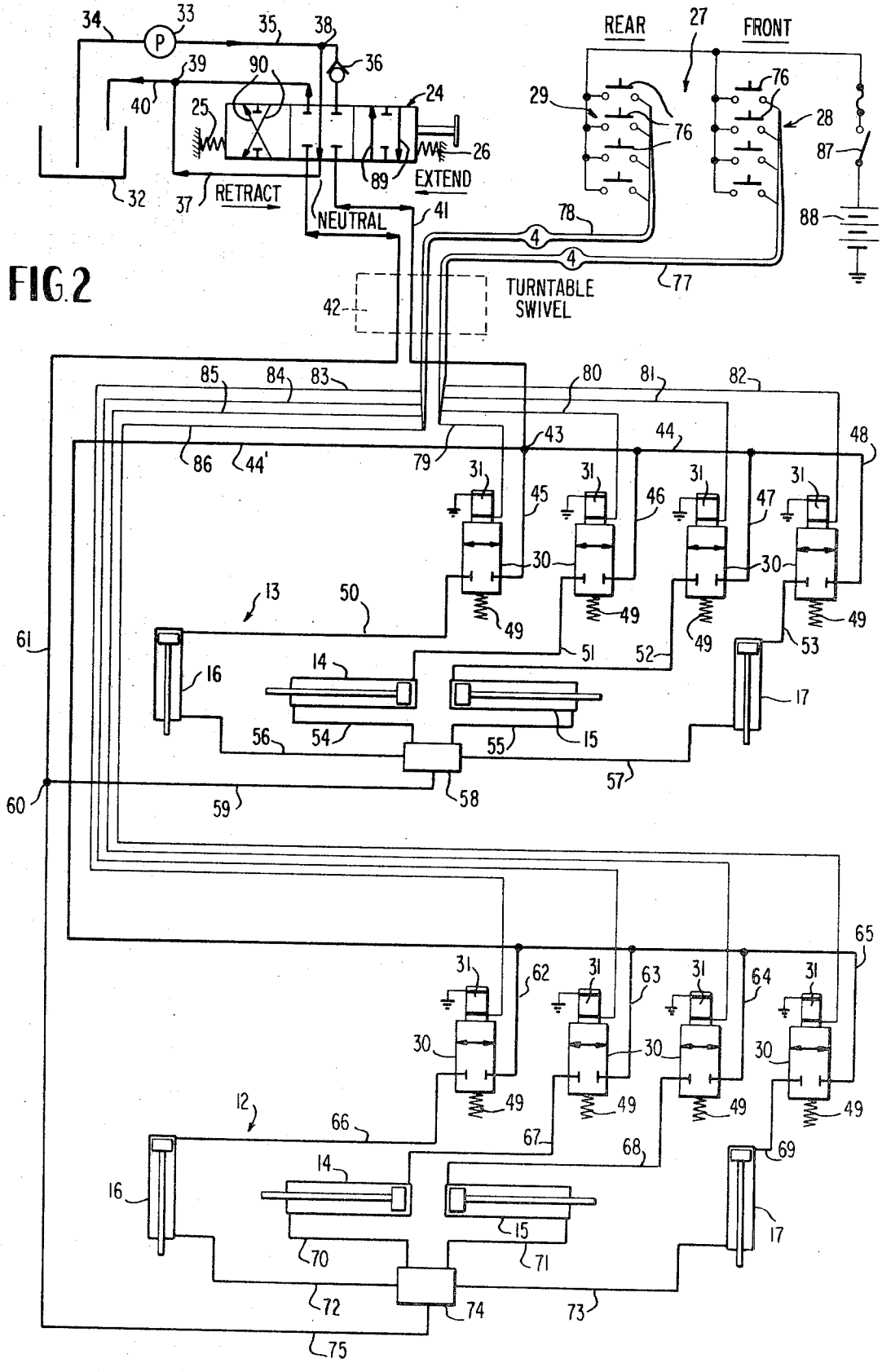


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ATTORNEYS

FIG. 2


34
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35
38
36
39
90
40
25
24
26
89
EXTEND
32
37
RETRACT
NEUTRAL
41
REAR
27
FRONT
29
76
28
87
88
78
4
77
TURNTABLE
SWIVEL
42
85
84
83
80
81
82
86
44'
79
43
44
48
31
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47
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CONTROLS FOR OUTRIGGER ASSEMBLIES OF MOBILE CRANES AND THE LIKE

BACKGROUND OF THE INVENTION

There is an increasing need for more simplified controls for large mobile cranes which are becoming so widely used in building construction and other fields. The crane operator has a very demanding job and one which requires skill and close attention in the interest of safety and prevention of property damage. The crane operator's cab is compact and at best the operator must give attention to a rather large number of control elements and consequently any substantial simplification of controls is of great importance in the overall efficiency of operation of the crane and in furthering safety and economy.

Conventionally, the fluid pressure operated outrigger assemblies of motorized cranes involve eight separate power cylinder units, four each for the front and rear assemblies. It has been customary to provide an independent control valve and control valve lever for the operation of these cylinder units resulting inevitably in crowding the crane operator's cab and control console.

The objective of this invention is to improve upon and simplify the prior art arrangement for controlling the cylinders of the front and rear outrigger assemblies. This is achieved in the invention by the provision of a single three-position four-way valve which is operable through a single lever to condition the fluid control circuit selectively for extending or retracting the cylinders of the front and rear outrigger assemblies. A neutral valve position is also provided. Associated with the single three-position control valve is a compact pushbutton switch console to be used by the crane operator for quickly and conveniently extending or retracting the several cylinders of the outrigger assemblies in any desired sequence, once the single control valve is set for extension or retraction. The pushbutton switches are electrically connected with stacks of normally-closed solenoid-operated two-way valves individual to the power cylinder units of the front and rear outrigger assemblies. When these solenoid operated valves are closed, the cylinders of the outrigger assemblies are locked and when the valves are opened electrically, the several cylinders will extend or retract depending upon the setting of the single or master control valve.

Other features and advantages of the invention will be apparent to those skilled in the art during the course of the following description.

BRIEF DESCRIPTION OF DRAWING FIGURES

FIG. 1 is a fragmentary exploded perspective view of a mobile crane including outrigger assemblies equipped with the controls of the invention.

FIG. 2 is a schematic view of the electrical-fluid control system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in detail wherein like numerals designate like parts throughout the same, the numeral **10** in FIG. **1** shows a portion of the wheeled carrier or motorized chassis for a hydraulic crane or like machine to the which the invention is applicable. As shown, the carrier includes sturdy longitudinal main frame members **11**, the rear wheels only of the carrier being shown in broken lines. Immediately rearwardly of and some distance forwardly of the carrier rear wheels are rear and forward outrigger assemblies **12** and **13** whose mechanical construction is conventional and needs to be described only briefly for a proper understanding of the invention which resides in simplified controls for the several power cylinder units of these outrigger assemblies.

As shown, each outrigger assembly **12** and **13** comprises a pair of transverse opposed side-by-side extensible and retractable fluid pressure operated cylinders **14** and **15**, each having a housing securely bracketed to the carrier main frame. These cylinders **14** and **15** are commonly termed the left- and right-hand side extension cylinders of the outrigger assemblies.

The rear and forward outrigger assemblies further comprise left- and right-hand vertical stabilizer cylinders **16** and **17** having housings which are firmly anchored to the extensible and retractable components of the cylinders **14** and **15** and bodily carried thereby, so that the vertical stabilizer cylinders will be moved laterally outwardly and inwardly relative to the wheeled carrier main frame at proper times. The stabilizer cylinders **16** and **17** are equipped at the lower ends of their extension elements with stabilizing pads or feet **18**, conventionally constructed. Therefore, each outrigger assembly **12** and **13** consists of one pair of opposed horizontal transverse extension cylinders and one pair of coacting vertical stabilizer cylinders and the purpose of the outrigger assemblies in stabilizing the crane during lifting operations is well known.

Referring to FIG. **1**, the crane operator's cab is shown as an integral part of the turntable structure **20** which carries an extensible crane boom **21** or the like. The turntable structure includes a bull gear **22**, suitably journaled on the wheeled carrier as at **23** and turned in a conventional manner by a power drive, not shown.

The electrical-fluid control means for the outrigger assemblies **12** and **13** is shown schematically in FIG. **2** and certain components thereof are shown in FIG. **1**, as will be described. This control means comprises a single manually-operated three-position four-way fluid control valve **24** of the spool type which is spring-loaded by springs **25** and **26** to a normal neutral position, FIG. **2**. Associated with this master control valve **24** is a pushbutton switch console **27** located with the valve **24** in the crane operator's cab, FIG. **1**. Associated with the front and rear banks **28** and **29** of the pushbutton switches on console **27** are a corresponding number of normally-closed two-way spool valves **30**, each having an operating solenoid **31**, as shown. Referring to FIG. **2**, the solenoid operated valves **30** are individual to the several cylinders **14**, **15**, **16** and **17** of the front and rear outrigger assemblies **13** and **12**. The physical arrangement of the valves **30** in two groups adjacent the outrigger assemblies is depicted in FIG. **1**, although the precise location of the valves is not critical.

Referring in greater detail to FIG. **2**, the fluid control system embodies a suitable source or reservoir **32** supplying a pump **33** through a line **34**. An output line **35** from the pump has a check valve **36** immediately upstream from three-position valve **24**, the latter being shown in a balanced or neutral position to allow continuous circulation of fluid through a neutral or bypass line **37** having a connection at **38** with the output line **35** and having a second connection at **39** with a fluid return line **40** leading back to the reservoir **32**.

A further fluid supply line **41**, leading downstream from the valve **24**, passes through a conventional turntable swivel **42** shown in broken lines in FIG. **2** and having a connection at **43** with a lateral supply line **44**, common to branch lines **45**, **46**, **47** and **48** leading to ports of the normally-closed two-way solenoid operated valves **30**, as shown. The valves **30** are held closed by suitable springs **49**. The other ports of valves **30** connect with downstream hoses or lines **50**, **51**, **52** and **53**, feeding the piston ends of the respective cylinders **16**, **14**, **15** and **17** of the forward outrigger assembly **13**. The rod ends of these same cylinder units are connected with additional fluid lines **54**, **55**, **56** and **57**, all leading to a common manifold **58** having an outlet line **59** connected at **60** to another line **61** leading back to the swivel **42** and through the same in a conventional manner and, finally, leading back to the return ports of three-position valve **24** and to the return line **40**.

In a similar manner, a supply line **44'** leads from the connection **43** to supply the several branch lines **62**, **63**, **64** and **65** of the two-way solenoid operated valves **30** of rear outrigger assembly **12**. These valves **30** are also held closed by the aforementioned springs **49**. The valves **30** of assembly **12** are connected with downstream lines **66**, **67**, **68** and **69** leading to the piston ends of the respective cylinders **16**, **14**, **15** and **17**. The rod ends of these cylinders are connected through lines **70**, **71**, **72** and **73** with a common manifold **74** having an outlet line **75** leading to the connection **60** and return line **61**.

It may be seen that the console 27 has a separate and independent push button switch 76 for each of the eight solenoids 31 which serve at proper times to open the valves 30. The switches in the two banks 28 and 29 are connected through cables 77 and 78 with the respective wires 79, 80, 81 and 82 leading to the solenoids for the front assembly 13 and to similar wires 83, 84, 85 and 86 extending to the coils of the corresponding solenoids 31 of rear outrigger assembly 12. FIG. 2 also shows the usual ignition switch 87 of the motorized crane carrier ahead of the several switches 76 and being connected with a conventional current source 88 on the carrier. It should also be mentioned that the two cables 77 and 78 also have conventional connections with the turntable swivel 42, the details of which are not important to a proper understanding of the invention.

OPERATION

The simplified control system for the outrigger assemblies operates in the following manner. Assuming the master control valve 24 to be in the neutral position shown in FIG. 2, and with the pump 33 operating, the working fluid simply circulates continuously from the reservoir 32 through the pump and through the neutral ports of the valve 24 and back to the return line 40 at the connection 39, as indicated. There will thus be no pressurizing of the supply line 41 or of any of the branch lines leading to or from the several cylinder units of the two outrigger assemblies. Under these conditions, if the operator closes any of the pushbutton switches 76 and thereby opens the solenoid-operated valves 30, there will be no movement of the cylinder units.

Assuming further that all of the cylinders of the two assemblies 12 and 13 are retracted as shown in the drawings, and the ignition switch 87 is closed and it is desired to extend or activate the outrigger assemblies, the following operations are performed by the crane operator. The three-position valve 24 has its spool shifted to the left in FIG. 2, compressing the spring 25 and thereby aligning the right-hand or "extend" ports with the lines 35—41 and 40—61. As shown by the flow indicator arrows 89, working fluid from the pump 33 will now flow by the check valve 36 and through the valve 24 to the line 41 and connection 43. From this connection, fluid will flow simultaneously through the lines 44, 45, 46, 47 and 48 to the inlet ports of the now-closed valves 30 of the forward assembly 13. Simultaneously, fluid is delivered through the line 44' and the lines 62, 63, 64 and 65 to the inlet ports of the now-closed two-way valves 30 of rear outrigger assembly 12. As long as the valves 30 of the two assemblies remain closed, no fluid is admitted to the piston ends of the several outrigger cylinders of the two assemblies and the pistons all remain retracted, as shown. The operator, by closing the pushbutton switches 76 of the two banks in the proper order which will be visibly indicated on the face of the console 27, will cause energizing of the solenoids 31 of the center pair of valves 30 for each assembly 12 and 13 and these valves will open and admit working fluid through the lines 51 and 52 and 67 and 68 to the piston ends of extension cylinders 14 and 15 of the two assemblies 12 and 13. This produces immediate lateral extension of the two outrigger assemblies while their vertical stabilizer cylinders are still retracted from the ground.

The fluid displaced by movement of the pistons outwardly in the pairs of cylinders 14 and 15 will pass through the lines 54 and 55 and 70 and 71 to manifolds 58 and 74 and from these manifolds through lines 59 and 75 to the return line 61 leading back through the valve 24 and return line 40 to complete the fluid circuit.

Similarly, the operator now depresses and closes the remaining pushbutton switches on the console 27 and in so doing energizes the outboard pair of solenoids 31 in each outrigger assembly and opens the associated normally-closed valves 30 and admits fluid through the lines 50 and 53 and 66 and 69 to the piston ends of cylinders 16 and 17 of the two outrigger assemblies. This immediately causes downward extension of the two stabilizer cylinders of each assembly so that the pads 18 will engage the ground or suitable shoring placed beneath the pads. When this takes place, fluid is displaced from the rod ends of cylinders 16 and 17 through lines 56 and 57 and 72 and 73 to manifolds 58 and 74, and from these manifolds to lines 59 and 75 and return lines 61 and 40, as previously described.

When it is desired to retract the two outrigger assemblies to their positions as shown in FIG. 1, the following sequence takes place. The operator moves the three-position spool valve 24 to the right against the force of spring 26 and thereby aligns the left-hand or "retract" valve ports with the respective lines 35—41 and 40**61, the direction of flow through the valve 24 being indicated by the flow arrows 90. This causes the pump 33 to deliver fluid through the line 35 and check valve 36 and through the control valve 24 to the line 61 and from this line through the branch lines 59 and 75 to manifolds 58 and 74, and from these manifolds to the several lines connecting with the rod ends of the four cylinder units embodied in the assemblies 12 and 13. At this time, all of the valves 30 are closed and all of the assembly cylinders will still be locked in their extended positions.

The crane operator will now close the pushbutton switches 76 associated with the outboard pair of valves 30 of each outrigger assembly to immediately open these valves and when this occurs, the right- and left-hand stabilizing cylinders 16 and 17 of each outrigger assembly can retract to the positions shown in the drawings and the displaced fluid will pass through lines 50 and 53 and 66 and 69 to the now open outboard pairs of valves 30 and from these valves through the lines 45 and 48 and 62 and 65 into the lines 44 and 44' and the line 41 and through the valve 24 back to the return line 40 and reservoir.

With the vertical stabilizer cylinders retracted, the operator will now close the remaining pushbutton switches 76 to cause opening of the inboard pairs of valves 30 in the two assemblies 12 and 13 and this will in turn allow the pistons of extension cylinders 14 and 15 of the two assemblies to retract. The fluid displaced by this last retraction will flow through lines 51 and 52 and 67 and 68 and through the associated valves 30 to lines 46 and 47 and 63 and 64 and then through lines 44 and 44' and line 41 and through the valve 24 back to the return line 40 because of the flow path arrangement in the three-position valve shown at 90. At this time, all cylinders of the rear and front outrigger assemblies 12 and 13 have been returned to their positions shown in the drawings and, if desired, the three-way valve 24 may be released to the neutral position of FIG. 2 where it is held in valance by the opposing springs the opposing and 26.

It may now be seen that the crane operator needs only to make two simple adjustment of the spool valve 24 to the "extend" and "retract" positions, followed by the closing of the pushbutton switches on the console 27 in the proper order to extend and retract the several cylinders of the front and rear outrigger assemblies in the desired sequence. As stated, all of the valves 30 are normally closed and open when the associated pushbutton switch is closed by the operator depressing it. The switches themselves are normally open when released. The control system is substantially foolproof and is much more compact and simple than would be the case where no electrical controls are employed and a separate manual control valve and lever is required to operate each of the eight extensible and retractable power cylinders of the system. It is thought that the great advantages of the invention system over the prior art should now be clear without the necessity for any further description.

I claim:

1. A control system for outrigger apparatus on a mobile crane or the like, said outrigger apparatus including at least a pair of horizontally extensible and retractable cylinders and at least a pair of vertically extensible and retractable cylinders, said control system comprising in combination with said cylin-

ders a single multiposition working fluid control valve having use positions to supply working fluid to all of said cylinders to cause extension and retraction thereof, an electrical switch console near said control valve having switches individual to said cylinders for operating the cylinders in a desired sequence, and electrically-operated normally-closed valves intervened between said cylinders and switches with one normally-closed valve in a fluid circuit with one of said cylinders and said control valve, there being a separate electrical connection between one of said switches and the associated normally-closed electrically-operated valve.

2. The structure of claim 1, and wherein said control valve is a three-position four-way valve including a neutral position and extend and retract positions, said three-position valve when in the extend position delivering working fluid to piston ends of said cylinders and said control valve when in the retract position delivering working fluid to the rod ends of said cylinders, and said electrically-operated valves prior to opening maintaining said cylinders locked irrespective of the adjusted position of said control valve.

3. The structure of claim 1, and said outrigger apparatus comprising a forward and a rear outrigger assembly each having a pair of opposed extension cylinders and a pair of stabilizer cylinders carried by the movable elements of the extension cylinders, said switches and electrically-operated valves corresponding in number to the cylinders of the forward and rear assemblies and being disposed in coacting groups with the cylinders of each assembly, electrical circuit means interconnecting the switches and electrically-operated valves in said groups, and fluid circuit means interconnecting the cylinders of each outrigger assembly with one group of electrically-operated valves and with said single multiposition control valve.

4. The structure of claim 3, and said fluid circuit means including a manifold common to the cylinders of each assembly, and a fluid line leading from each manifold to said single multiposition control valve.

5. The structure of claim 4, and fluid conduits leading from the manifold of each assembly to the piston rod ends of the cylinders of such assembly, and additional fluid conduits leading from the piston ends of the cylinders of each assembly to the normally-closed electrically-operated valves of each assembly.

6. The structure of claim 1, and said switches on the console being normally open manually operable switches, and said normally closed valves being solenoid operated valves, and conductors electrically interconnecting said switches with the coils of said normally-closed valves.

7. A control system for a crane outrigger apparatus having lateral extension cylinders and substantially vertical stabilizer cylinders, said control system comprising a single plural-position selector valve means, fluid conduit means interconnecting said selector valve means with the cylinders of said outrigger apparatus, and coacting fluid circuit energizing means connected with the cylinders of the outriggers apparatus including normally-closed valves individual to the cylinders of said apparatus and normally blocking the flow of fluid toward or away from said cylinders.

8. The structure of claim 7, and said energizing means comprising an energizing switch for each cylinder of said apparatus and electrical operators for the normally-closed valves and being electrically connected with said switches.

9. The structure of claim 7, and said electrical operators comprising solenoids for causing opening of the normally-closed valves when the solenoids are energized by closing said switches.

10. The structure of claim 7, and said selector valve means being a three-position selector valve having a neutral position and positions to supply working fluid to said outrigger apparatus cylinders in proper flow direction to selectively extend and retract the cylinders, and said fluid circuit energizing means including manual selector elements individual to said cylinders and to said normally-closed valves and operable to open the normally-closed valves in a desired sequence.

11. The structure of claim 10, and said selector elements comprise selector switches and said normally-closed valves are solenoid-operated valves having coils electrically connected with said switches.