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Balogh

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[54] **CONTROL SYSTEM FOR A DERRICK**

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[51] **Int. Cl.** **B66f 11/04,** E04g 1/18

[58] **Field of Search** .. 182/2, 141, 148; 91/412, 414; 60/54.5, 36

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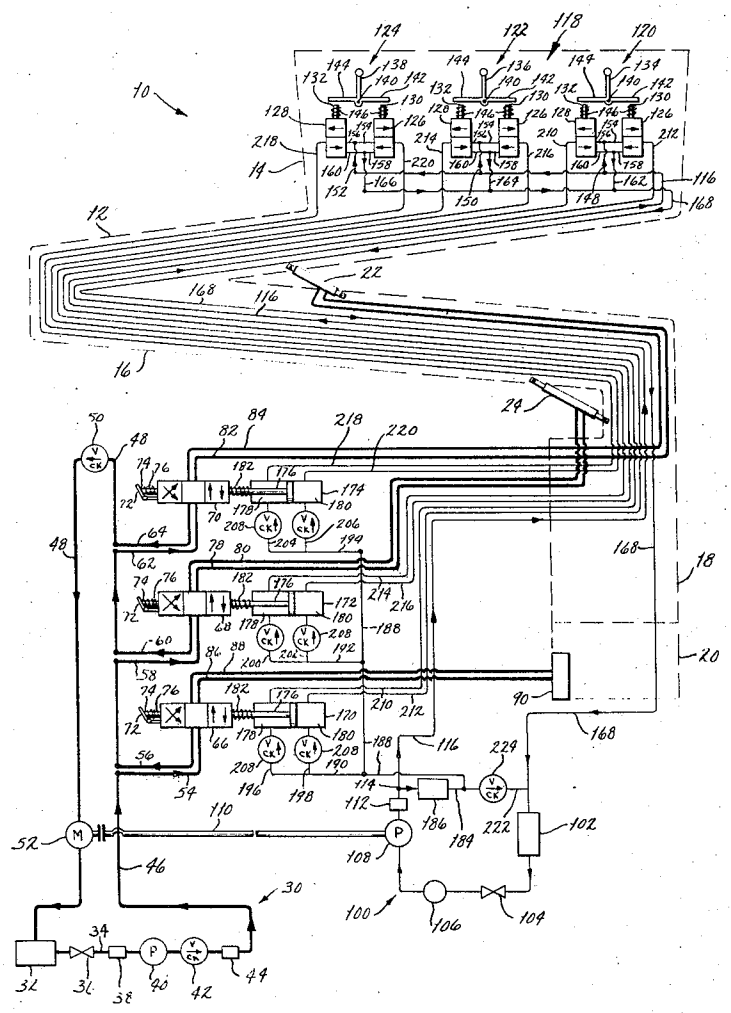
Primary Examiner—Reinaldo P. Machado

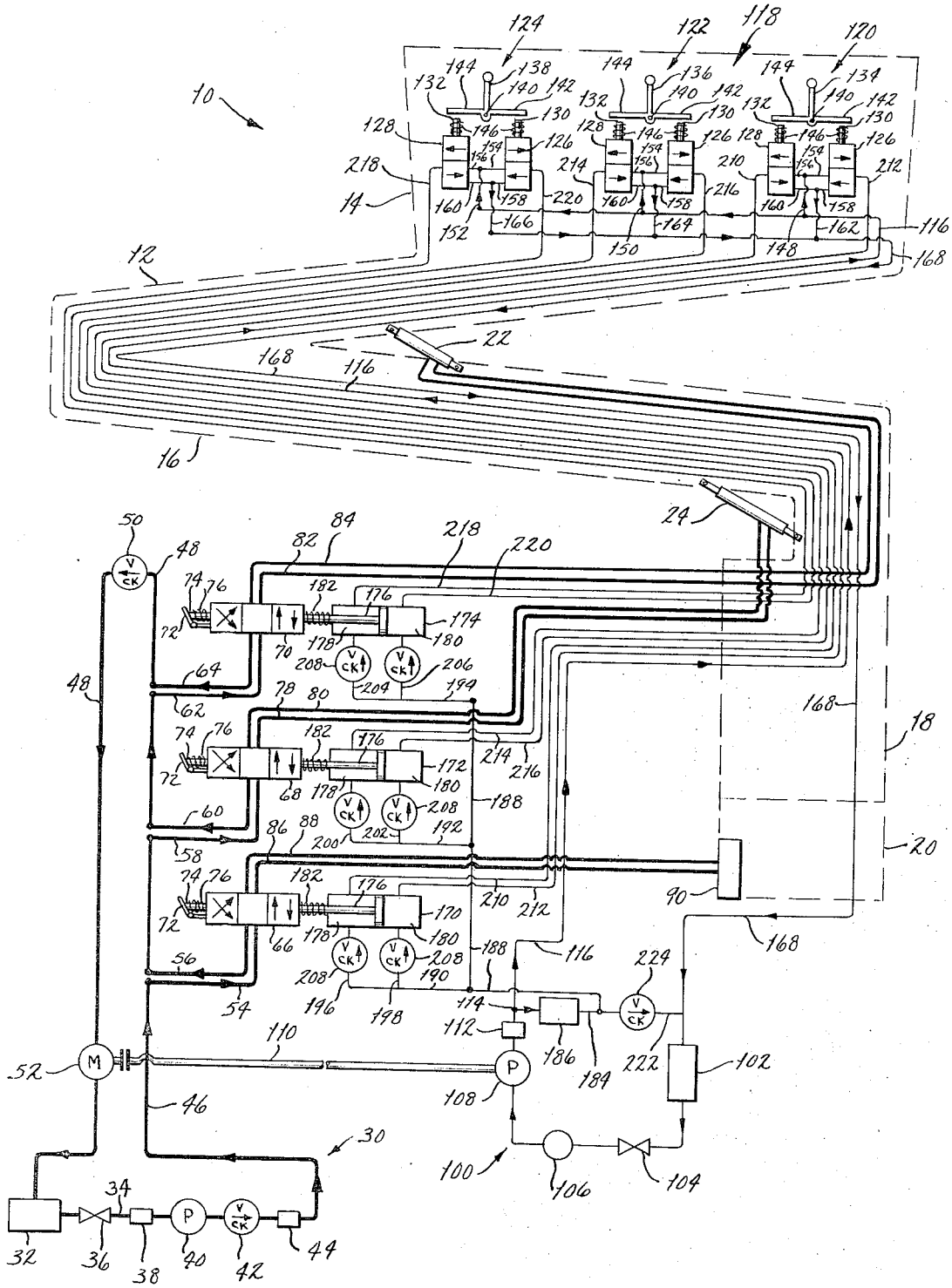
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[57] **ABSTRACT**

A derrick having hydraulically operable remote control and main control systems wherein the remote control system is separate from and hydraulically non-communicative with the main control system. The remote control system employs a hydraulic fluid that differs from that used in the main control system such that the most desirable fluid characteristics for each system can be independently selected.

27 Claims, 1 Drawing Figure




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CONTROL SYSTEM FOR A DERRICK

This invention is directed to new and useful improvements in derricks and more particularly to hydraulic control means for controlling operative movement of a derrick at a work site.

The beam assembly of a derrick is generally hydraulically acutated through hydraulic work cylinders, movement of which is controlled by a hydraulic control system. The beam assembly is generally equipped with one or more hydraulically actuated accessories such as winches, pole pullers, jib booms and augers, to name a few. It is often desirable to rotate the beam assembly and to accomplish this the beam assembly is usually secured to a turret-mounted mast assembly, which turret is ordinarily rotatable by a hydraulic motor. Outriggers which help maintain the derrick in a stable position during movement of the aforementioned components are also usually hydraulically actuated in and out of a desired position.

Generally all the hydraulically operative parts of a derrick are controlled at a main control station accessible to one workman. The main controls normally include a main hydraulic circuit that actuates the work cylinders of the operating components. If the derrick includes a work station such as a basket or elevated platform, one or more of the derrick components usually have a remote control operable by a workman at his work station. The remote controls generally comprise one or more hydraulic fluid lines forming a hydraulic network that is incorporated into the main control hydraulic circuit with both the main and remote control lines being hydraulically communicative with one another and operating from a common fluid source.

Since the fluid lines in the remote control network do not operate work cylinders, the fluid pressures, fluid line diameters, and fluid capacities are substantially less than the pressures, line diameters, and capacities of the main control fluid lines that feed the work cylinders. For example, a known main control fluid line generally has an internal diameter of one-half inch and experinces fluid pressures of 2,500 p.s.i., whereas the remote control fluid lines incorporated in the main control system generally have an internal diameter of three-sixteenths of an inch and experience fluid pressures of 200 p.s.i. Due to this difference in fluid line cross-section and capacity, the viscosity of the hydraulic fluid used directly affects the response of the remote control system, especially in cold winter temperatures. Thus a control system which can be remotely operated at a given response rate one day often operates at a completely different response rate on another day. This inconsistency of response rate is often unpredictable due to unpredictable changes in temperature and can cause damage and injury to the derrick, the derrick operators, or the equipment being serviced by the derrick.

Among the several objects of the present invention may be noted the provision of a novel control system for a derrick wherein remote control fluid lines are hydraulically isolated and non-communicative with main control fluid lines; a novel derrick having one type of hydraulic fluid for the remote control system and another type of hydraulic fluid for the main control system; a novel derrick having hydraulically operable remote control valves mechanically connected to main control valves of the main control system; a novel derrick having a remote control hydraulic system that includes a pump driven by a hydraulic motor in the main control system; and a novel method for remotely controlling movement of derrick beams and other hydraulically actuable components. Other objects and features will be in part apparent and in part pointed out hereinafter.

The present invention relates to a novel derrick wherein a remote control hydraulic system is hydraulically separate from and hydraulically non-communicative with a main control hydraulic system. A first fluid having one set of fluid characteristics such as fixed viscosity is used in the remote control system whereas a second fluid having another set of fluid characteristics such as excellent lubricity is used in the main control system. The main control system includes a bank of manually operable main valves having movable members, which main valves are connected by fluid lines to hydraulic work cylinders. The main control system also includes a hydraulic motor that is rotatable in response to movement of fluid pumped through the main control system fluid lines by a main power pump. The remote control system includes a bank of manually operable master valves hydraulically connected to a bank of slave valves having movable members mechanically interconnected to the movable members of the main valves. Movement of a remote control master valve member causes movement of a corresponding slave valve member, the slave valve also moving the main valve member to actuate a corresponding work cylinder, thereby moving one of the hydraulically actuated components of the derrick.

The remote control system also includes a pump that is drivingly connected to the hydraulic motor in the main control system such that movement of the remote control pump is attributable to movement of the hydraulic motor, which motor derives its movement from the main power pump.

The invention accordingly comprises the constructions and methods hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawing, in which one of various possible embodiments of the invention is illustrated, the FIGURE of the drawing shows a schematic diagram of the remote control system and main control system of the present invention superimposed on a phantom outline of a derrick beam assembly, mast assembly and turret.

Corresponding reference characters indicate corresponding parts throughout the drawing.

Referring to the drawing, a derrick incorporating one embodiment thereof is generally indicated in phantom outline by reference numeral **10.** Derrick **10** symbolically represents a derrick having an articulated beam assembly such as is disclosed in U. S. Pat. No. 3,378,103.

Derrick **10** includes an outer beam **12** having a work basket **14** at the free end thereof, the opposite end of beam **12** being pivotally secured to an inner beam **16.** Outer beam **12** is of any suitable known construction such as disclosed in U.S. Pat. No. 3,378,103. Work basket **14** is also of any suitable known construction such as is disclosed in U.S. Pat. No. 3,154,199. Inner beam **16** is in turn pivotally secured to a mast assembly **18** that is mounted on a rotatable turret **20.** Inner beam **16,** mast assembly **18,** and turret **20** are of any suitable known construction such as disclosed in U. S. Pat. No.

3,378,103. A first work cylinder **22** of any suitable known construction such as that disclosed in U. S. Pat. No. 3,396,852 is joined to outer and inner beams **12** and **16** for articulation of outer beam **12** with respect to inner beam **16.** A second work cylinder **24** also of any suitable known construction such as disclosed in U. S. Pat. No. 3,396,852 is joined to inner beam **16** and mast assembly **18** for articulation of inner beam **16** with respect to mast assembly **18.**

Derrick **10** further includes a main control system generally indicated by reference numeral **30** and a remote control system generally indicated by reference numeral **100.** Both control systems are hydraulically operable, and for purposes of distinction therebetween the fluid lines of main control system **30** have been represented by the bolder lines in the drawing.

Main control system **30** comprises a fluid supply tank **32** containing a suitable hydraulic fluid such as oil derived from petroleum, tank **32** being connected in series on a fluid line **34** to a known shutoff valve **36** which is in turn connected in series to a known fluid filter **38.** The output of filter **38** is connected in series to any suitable known main power pump **40** for pumping fluid such as a Vickers part No. V210-8-1G-12-S49. A known check valve **42** and a known fluid filter **44** are connected in series on the output side of pump **40.** Fluid in line **34** is pumped by pump **40** through a main control valve inlet line **46** that is connected to a two-way, three-position main control valve **66** of any suitable known construction. A main control valve outlet line **56** connects valve **66** to a main control valve inlet line **58** that joins to a two-way, three-position main control valve **68.** Similarly, a main control valve outlet line **60** connects valve **68** to a main control valve inlet line **62** that joins a two-way, three-position main control valve **70.** A main control valve outlet line **64** connects valve **70** to a tank return line **48** having a check valve **50** and a hydraulic motor **52** connected thereto.

Main control valves **66, 68, 70,** are identical and include a manually operable control handle **72** for actuating a movable valve mmber **74** which extends inside valves **66, 68, 70.** Control handles **72, 72, 72,** can be maintained in a predetermined neutral reference position by biasing means such as a spring **76.**

Pairs of operating lines **78, 80** and **82, 84,** interconnect main valves **68** and **70** with work cylinders **24** and **22.** A similar pair of operating lines **86, 88,** interconnect main valve **66** with a rotation motor **90** on turret **20.**

In operation of main control system **30** shutoff valve **36** is opened and pump **40** is set to operate. Fluid from tank **32** is drawn through filter **38** and pumped through check valve **42** and filter **44** into main control valve inlet line **46.** When movable members **74, 74, 74,** of main control valves **66, 68, 70,** are in a neutral or unactuated position operating lines **78, 80, 82, 84** and **86, 88** are blocked at their respective valves **68, 70,** and **66.** Fluid in line **46** then enters main control valve **66** and flows directly into outlet line **56.** Similarly fluid in outlet line **56** flows to inlet line **58,** valve **68** and outlet line **60.** Fluid in outlet line **60** then flows to inlet line **62,** valve **70** and outlet line **64** which feeds tank return line **48.**

If it is desired to articulate outer beam **12** away from inner beam **16,** control handle **72** of main valve **70** is pivoted in one direction, thereby moving valve member **74** to a first predetermined position. This first position of movable valve member **74** enables fluid to enter valve **70** through feeder line **62** and to pass outwardly of valve **70** to cylinder **22** through operating line **82.** Fluid in line **82** causes cylinder **22** to be movably actuated in a manner such as disclosed in U. S. Pat. No. 3,396,852, which actuation causes fluid to pass from cylinder **22** back to main control valve **70** through operating line **84.** This returning fluid passes outwardly of main valve **70** through outlet line **64** into tank return line **48.**

If it is desired to articulate beam **12** in a reverse direction, control handle **72** of main valve **70** is pivoted in a second direction to move movable valve member **74** to a second predetermined position enabling feeder line **62** to pass fluid outwardly of valve **70** through operating line **84.** Fluid returns from cylinder **22** to main valve **70** through operating line **82** and passes outwardly of main valve **70** through outlet line **64** into tank return line **48.** Main valve **68** operates cylinder **24** in an identical manner. Main valve **66** also operates the same as valves **68** and **70** but fluid passing out of valve **66** into operating line **88** causes hydraulic motor **90** to rotate in one direction, fluid returning from motor **90** to valve **66** through line **86.** Motor **90** is rotatable in a reverse direction when the flow paths in operating lines **86** and **88** are reversed by main control valve **66.** Under this hydraulic circuit arrangement it is desirable to operate only one of the main valves **66, 68** and **70** at a time although the circuit can be modified to permit simultaneous operation thereof. In the present hydraulic arrangement, when one of the main valves **66, 68,** or **70** is being actuated, the other unactuated main control valves permit fluid to flow therethrough without entering the associated operating lines.

Remote control system **100** comprises a fluid tank **102** containing a suitable silicone oil such as Dow Corning **50** centistokes. This type of silicone oil is a synthetic compound having a relatively flat viscosity curve for wide ranges of temperature when compared with the viscosity curve of oil derived from petroleum. It should be noted that silicone oil has relatively poor lubricating qualities in comparison with the lubricity of oil derived from petroleum. Also at present silicone oil is very much more expensive than petroleum-derived oil. Nevertheless the viscosity characteristics of silicone oil make it highly desirable for the purposes of the present invention.

Fluid tank **102** is connected in series with a known shutoff valve **104** and a known suction filter **106,** the outlet of which is fed into a suitable pump **108** such as Eastern part No. 102-F21-Q1A. A flexible coupling **110** interconnects pump **108** with hydraulic motor **52** in main control system **30.** A known filter **112** is connected to the output side of pump **108,** which filter passes fluid to a line junction **114.**

A master valve distribution line **116** interconnects junction **114** to a bank **118** of three master valves **120, 122** and **124.** Each master valve **120, 122, 124,** comprises a pair of two-way, two-position valves **126, 128,** of known construction, valves **126, 128,** having movable members **130, 132,** projecting from an end thereof toward a respective valve acutator handle **134, 136, 138.** Actuator handles **134, 136, 138,** are pivoted intermediate each pair of valves **126, 128,** at a pivot point **140** and include oppositely extending valve member displacer arms **142, 144,** arranged to engage movable members **130, 132.** Movable members **130, 132,** are

maintained in a predetermined reference position by a biasing means such as a spring **146**. Distribution line **116** includes three feeder lines **148, 150, 152,** each having inlet lines **154, 156,** arranged to pass fluid into valves **126** and **128,** respectively.

Remote control system **100** also includes return line means for returning fluid from valve bank **118** to tank **102**. The return line means comprise a pair of outlet lines **158, 160,** extending from valves **126, 128,** to junction lines **162, 164, 166,** that are respectively connected to a main return line **168** connected to tank **102**.

Remote control system **100** further includes a bank of three identical slave valves **170, 172, 174,** having a movable piston member **176** and two valve chambers **178** and **180**. Movable piston members **176, 176, 176,** are mechanically connected (not shown) to movable members **74, 74, 74,** of main control valves **66, 68,** and **70** and maintained in a predetermined neutral reference position by biasing means such as a spring **182** provided on member **176**.

Remote control system **100** additionally includes a first bridge line **184** having a pressure relief valve **186** thereon, which line interconnects junction **114** to slave valve distribution means for distributing fluid to slave valves **170, 172** and **174**. The slave valve distribution means include a main distribution line **188** having feeder lines **190, 192, 194,** that connect to pairs of inlet lines **196, 198, 200, 202,** and **204, 206,** which inlet lines pass fluid to slave cylinder chambers **178** and **180,** respectively. Known check valves **208** are provided on each inlet line. A first operating line **210** connects slave cylinder chamber **178** of slave valve **170** with valve **128** of master valve **120** and a second operating line **212** connects slave cylinder chamber **180** with valve **126**. Operating line pairs **214, 216,** and **218, 220,** similarly connect slave valves **172, 174,** to master valves **122, 124,** respectively.

Remote control system **100** also includes a second bridge line **222** having a known check valve **224** thereon, which bridge line extends from first bridge line **184** and main distribution line **188** to return line **168**.

In operation of remote control system **100** shutoff valve **104** is opened and pump **108** is set into operation. Movement of pump **108** is attributable to rotation of hydraulic motor **52** in main control system **30,** the rotation of motor **52** being transmitted to pump **108** through flexible shaft **110**. Fluid from tank **102** is drawn through filter **106** and pumped through filter **112** to master valve distribution line **116** and first bridge line **184**. Fluid in first bridge line **184** passes through pressure relief valve **186** and thereafter flows through slave main distribution line **188** and second bridge line **222**. Fluid in second bridge line **222** passes through check valve **224** to return line **168** for passage to tank **102**.

When remote control handles **134, 136, 138,** are not being actuated, the fluid in master valve distribution line **116,** feeder lines **148, 150, 152,** and inlet lines **154, 156,** is blocked from entering valves **126, 128,** of master valves **120, 122** and **124**. During such blockage the fluid in slave valve main line **188** passes through feeder lines **190, 192, 194,** inlet lines **196, 198, 200, 202, 204, 206,** and their respective check valves **208** into slave cylinder chambers **178,180**. Fluid exits from slave cylinder chambers **178, 180,** into operating lines **210, 212, 214, 216, 218, 220,** for passage into a respective valve **128, 126,** of master valves **120, 122, 124**. Fluid exits from valves **126, 128,** to outlet lines **158, 160,** junction lines **162, 164, 166,** and main return line **168**. During this movement of fluid through slave cylinder chambers **178, 180,** and valves **126, 128,** of master valves **120, 122, 124,** movable members **130, 132,** thereof are maintained in a fixed reference position by springs **146**. This fluid movement continuously bleeds slave valves **170, 172, 174,** and master valves **120, 122, 124,** even when main control handles **72, 72, 72,** of main control valves **66, 68, 70,** are being operated. Thus there is complete purging of air in remote control system **100** and any oil which may have been lost, as in periods of inactivity, is restored. This bleeding function occurs automatically with the starting of power pump **40** and continues as long as pump **40** is running. Further the back pressure of the bleed flow is not high enough to overcome biasing springs **76** or **182** and cause movement of movable members **74** or **176** should pressure fail in either slave cylinder chamber **178** or **180**. The main control and remote control systems **30, 100,** are automatically indexed to a predetermined neutral reference position by springs **76** and **182**.

If it is desired to articulate outer beam **12** away from inner beam **16** through remote control system **100,** handle **138** of master valve **124** is pivoted to permit arm **144** to move member **132** of valve **128** to a predetermined position. This moved position of member **132** prevents fluid from passing outwardly of valve **128** into outlet line **160,** junction line **166** and return fluid line **168**. Fluid enters valve **128** of master valve **124** from main distribution line **116,** feeder line **152,** and inlet line **156,** and passes outwardly thereof to operating line **218** for transmission to cylinder chamber **178** of slave valve **174**. Fluid accumulates in cylinder chamber **178** due to the presence of check valve **208** on line **204,** which fluid accumulation causes movable member **176** to displace. Since movable members **176** and **74** are mechanically interconnected, member **74** also displaces, thereby enabling fluid to pass through operating line **82** to actuate cylinder **22** in a manner previously described.

It should be noted that when valve **128** is actuated and arm **142** of remote control handle **138** is not in engagement with movable member **130** of valve **126** there is continuous bleeding of valve **126** and cylinder chamber **180** of slave valve **174** in a manner previously described.

To articulate outer beam **12** toward inner beam **16,** remote control handle **138** is pivoted in a reverse direction such that arm **142** moves movable member **130** of valve **126** to a predetermined position wherein valve **126** prevents fluid from passing outwardly thereof into lines **158, 166** and **168**. Fluid enters valve **126** through main distribution line **116,** feeder line **152** and inlet line **154,** and passes outwardly of valve **126** to operating line **220**. The fluid in operating line **220** feeds cylinder chamber **180** of slave cylinder **174,** accumulating therein due to the presence of check valve **208** on line **206**. This fluid accumulation displaces slave valve member **176** and control valve member **74** while slave cylinder chamber **178** and valve **128** are being continuously bled. Movement of member **176** enables fluid to pass through control valve **70** through operating line **84** to actuate cylinder **22** in a reverse direction. Master valves **122, 120,** can also be actuated in an identical

manner by moving remote control handles **136** and **134** to respectively articulate inner beam **16** with respect to mast assembly **18** and to bi-directionally rotate hydraulic motor **90** for rotation of turret **20.**

As will be apparent to those skilled in the art the present hydraulic control system can be arranged to control hydraulic actuation of outrigger cylinders as disclosed in U. S. Pat. No. 3,378,103 by including in the hydraulic circuit control valves and cylinders which correspond to the outriggers. Similar provisions can be made for hydraulic control of displaceable booms, winches, pole pullers, jib booms, augers, etc., and any other derrick components that can be hydraulically actuated.

If desired, a bypass relief valve (not shown) can be connected to hydraulic motor **52** to enable fluid flow rates beyond a predetermined level to pass through the bypass relief valve instead of hydraulic motor **52.** This will insure that motor **52** and pump **108** run within a predetermined speed range regardless of the rate of fluid flow in the main control system. As an alternative to the motor **52** — pump **108** arrangement, remote control system **100** can be independently powered by a separate power pump (not shown).

Some advantages of the novel derrick evident from the foregoing description include a remote control system that has a consistent rate of response over a wide range of temperatures, a remote control system that is hydraulically separate and non-communicative with the main control system such that a breakdown of the remote control system does not necessitate shutdown of the main control system, and a remote control system and main control system which can each operate with distinctly different hydraulic fluids such that the most desirable fluid characteristics for each system can be independently selected.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions and methods without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An aerial device comprising a movable beam member having a hydraulic cylinder connected thereto, actuation of said cylinder moving said beam, first control means provided at one station on said aerial device for controlling actuation of said hydraulic cylinder, and remote control means provided at a second station on said aerial device for actuation of said first control means, said first control means comprising a first hydraulic circuit having first hydraulic fluid supply means for supplying fluid to said first hydraulic circuit, said remote control means comprising a second hydraulic circuit having second hydraulic fluid supply means for supplying fluid to said second hydraulic circuit, said first and second fluid supply means being noncommunicative with one another, and said first and second hydraulic circuits being noncommunicative with one another such that fluid from said first hydraulic circuit does not flow into said second hydraulic circuit and fluid from said second hydraulic circuit does not flow into said first hydraulic circuit.

2. An aerial device as claimed in claim **1** wherein said first and second hydaulic fluid supply means each contain different hydraulic fluids.

3. An aerial device as claimed in claim **2** wherein the hydraulic fluid of said first hydraulic fluid supply means is petroleum oil and the hydraulic fluid of said second hydraulic fluid supply means is silicone oil.

4. An aerial device as claimed in claim **1** wherein said first hydraulic circuit includes a first hydraulic motor, said second hydraulic circuit including a pump for pumping fluid through said second hydraulic circuit, said pump being drivingly connected to said first hydraulic motor such that pump movement is attributable to movement of said hydraulic motor.

5. An aerial device as claimed in claim **1** further including slave valve means having a valve member mechanically connected to said first control means, said slave valve means having hydraulic communication with said second hydraulic fluid supply means such that fluid in said second hydraulic circuit passes through said slave valve means and movement of said slave valve member by said second hydraulic fluid effects movement of said first control means through said mechanical connection to actuate said hydraulic cylinder thereby moving said movable beam.

6. An aerial device as claimed in claim **1** wherein said first station is spaced from said beam and said second station is associated with said beam.

7. An aerial device as claimed in claim **6** wherein said second station comprises a basket connected to said beam.

8. An aerial device as claimed in claim **1** further including a rotatable turret for supporting and rotating said movable beam, and a second hydraulic motor drivingly connected to said rotatable turret for rotating said turret, said second hydraulic motor being actuable by said first control means and said remote control means.

9. An aerial device comprising rotatable turret means including hydraulic drive means for rotation of said turret means, a mast assembly mounted to said turret means, a beam member joined to said mast assembly, first control means provided at one station on said aerial device for controlling actuation of said hydraulic drive means and remote control means provided at a second station on said aerial device for actuation of said first control means, said first control means comprising a first hydraulic circuit having first hydraulic fluid supply means for supplying fluid to said first hydraulic circuit, said remote control means comprising a second hydraulic circuit having second hydraulic fluid supply means for supplying fluid to said second hydraulic circuit, said first and second fluid supply means being noncommunicative with one another, and said first and second hydraulic circuits being noncommunicative with one another such that fluid from said first hydraulic circuit does not flow into said second hydraulic circuit and fluid from said second hydraulic circuit does not flow into said first hydraulic circuit.

10. An aerial device as claimed in claim **9** wherein said first and second hydraulic fluid supply means each contain different hydraulic fluids.

11. An aerial device as claimed in cliam **10** wherein the hydraulic fluid of said first hydraulic fluid supply means is oil and the hydraulic fluid of said second hydraulic fluid supply means is silicone oil.

12. An aerial device comprising a movable beam member having a hydraulic cylinder connected thereto, actuation of said cylinder moving said beam, first control means provided at one station on said aerial device for controlling actuation of said hydraulic cylinder, remote control means provided at a second station on said device for actuation of said first control means, said first control means and said remote control means each including separate noncommunicative hydraulic circuits, said remote control means including master valve means and said first control means including slave valve means, the hydraulic circuit of said remote control means comprising fluid supply means connected in series to a fluid pump, and first distribution line means connected to said slave valve means for distributing fluid therein, said fluid pump being connected in series to a fluid line junction having second distribution line means connecting said junction to said master valve means for distributing fluid therein and a first bridge line connecting said junction to said first distribution line means, the hydraulic circuit of said remote control means further including return line means connecting said master valve means and said fluid supply means.

13. An aerial device as claimed in claim 12 wherein the hydraulic circuit of said remote control means further includes a second bridge line connecting said first bridge line and said return line means, said second bridge line having valve means for permitting fluid to flow from said first bridge line to said return line means, said valve means preventing reverse fluid flow.

14. An aerial device as claimed in claim 12 including a pressure relief means on said first bridge line interposed between said junction of fluid lines and said first distribution line means.

15. An aerial device as claimed in claim 12 wherein the hydraulic circuit of said first control means includes a hydraulic motor, said fluid pump being drivingly connected to said hydraulic motor such that movement of said pump is attributable to movement of said hydraulic motor.

16. An aerial device as claimed in claim 12 wherein the hydraulic circuit of said remote control means further includes valve connection line means interconnecting said master valve means and said slave valve means.

17. An aerial device as claimed in claim 16 wherein said master valve means include a two-way, two-position master valve and said slave valve means include a reciprocable slave valve having at least one fluid chamber, one position of said master valve preventing fluid in said second distribution line means from entering said master valve, said one position of said master valve enabing fluid to flow from said first distribution line means into said slave valve, through said valve connection line means into said master valve, and to said return line means for passage to said fluid supply means.

18. An aerial device as claimed in claim 17 wherein said one position of said master valve corresponds to a non-actuated condition of said master valve such that fluid flows through said master valve and slave valve, bleeding said valves and causing no movement of said first control means.

19. An aerial device as claimed in claim 17 wherein a second position of said master valve enables fluid to flow into said master valve from said second distribution line means, through said valve connection line means into said slave valve, said first distribution line means including valve means for preventing fluid flow from said slave valve through said first distribution line means such that fluid flowing into said slave valve from said valve connection line means accumulates in said slave valve.

20. An aerial device as claimed in claim 19 wherein said second position of said master valve corresponds to an actuated condition of said master valve such that fluid accumulating in said slave valve causes movement of said slave valve and corresponding movement of said first control means to actuate said hydraulic cylinder, thereby moving said movable beam.

21. An aerial device as claimed in claim 19 wherein the hydraulic circuit of said remote control means includes a pressure relief means on said first bridge line interposed between said junction of fluid lines and said first distribution line means.

22. An aerial device as claimed in claim 21 wherein the hydraulic circuit of said remote control means further includes a second bridge line interconnecting said first bridge line and said return line means, said second bridge line having valve means for permitting fluid to flow from said first bridge line to said return line, said valve means preventing reverse fluid flow.

23. An aerial device as claimed in claim 19 wherein said slave valve and said first control means include interconnected movable members such that movement of one of said movable members causes corresponding movement of said other movable member and accumulation of fluid in the fluid chamber of said slave valve causes movement of said movable members to actuate said hydraulic cylinder, thereby moving said movable beam.

24. An aerial device as claimed in claim 23 including biasing means connected to said movable members for restoring said movable members to a predetermined reference position when said first control means is unactuated and said remote control means master valve is in said one position.

25. A method for remotely controlling movement of an aerial device beam by a hydraulic cylinder having direct control hydraulic means comprising actuating the movement of the direct control hydraulic means with a remote control hydraulic means, separating the fluid supply means for the remote control hydraulic means from the fluid supply for the direct control hydraulic means, and hydraulically separating remote control hydraulic circuitry from direct control hydraulic circuitry by preventing hydraulic fluid in each respective hydraulic control means from flowing into the other hydraulic control means.

26. The method of claim 25 including using a hydraulic fluid in the remote control circuit having different viscosity characteristics from that of the hydraulic fluid in the direct control hydraulic means.

27. The method of claim 25 including pumping the remote control hydraulic fluid with a pump drivingly connected to rotating means within the direct control hydraulic means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,788,425 Dated January 29, 1974

Inventor(s) Roy Balogh

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The attorney's name should be --John D. Pope III--.
Column 1, line 43, "experinces" should read --experience --.
Column 3, line 41, "mmber" should read --member--.
Column 8, line 64, "cliam" should read --claim--.
Column 9, line 54, "enabing" should read --enabling--.

Signed and sealed this 6th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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