Jan. 1, 1963 T. R. BILL 3,071,255

DERRICKS

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Fig. 3.

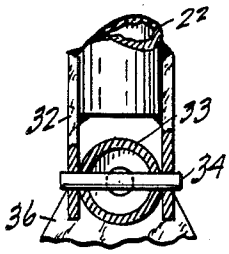


Fig. 4.

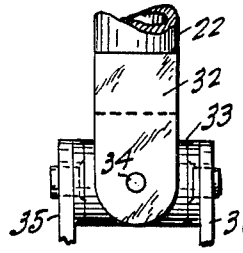


Fig. 5.

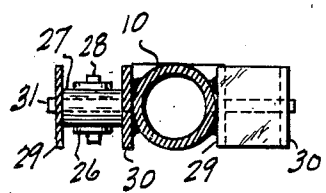


Fig. 1.

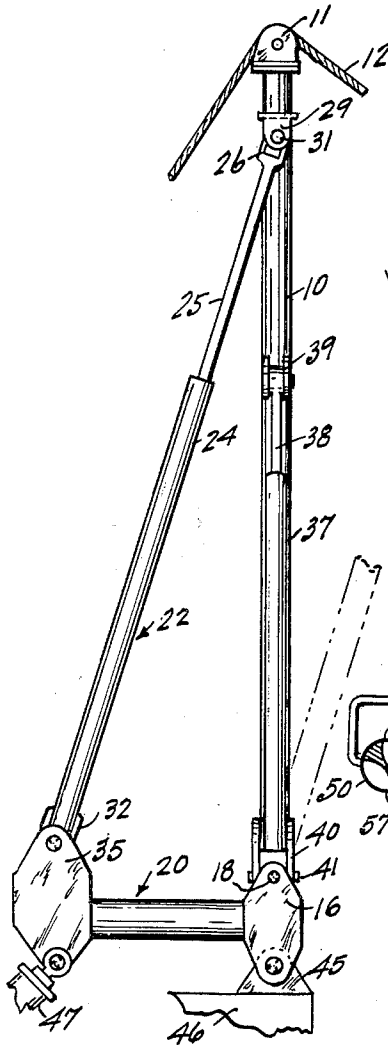
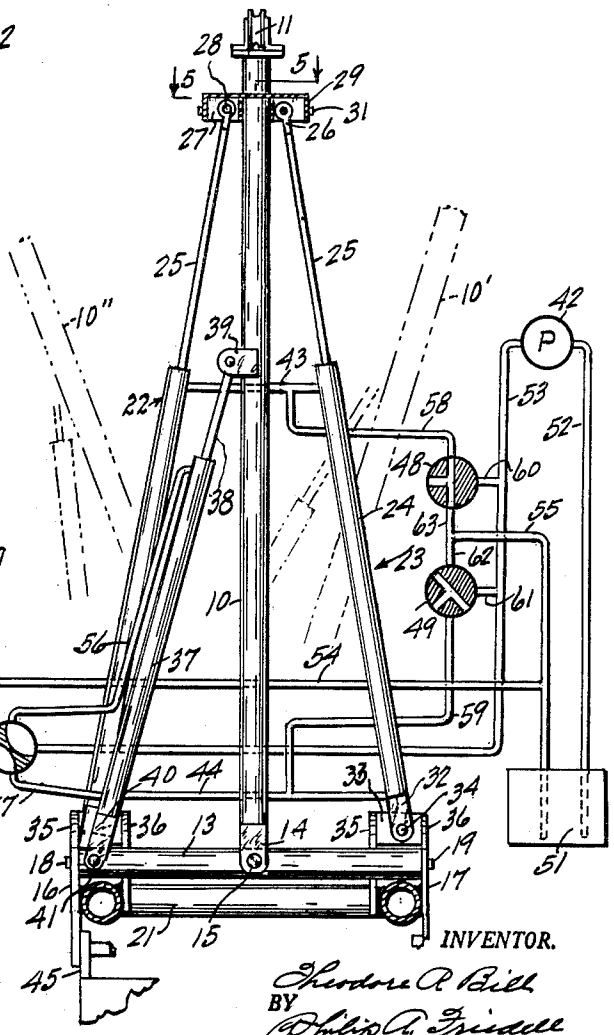


Fig. 2.



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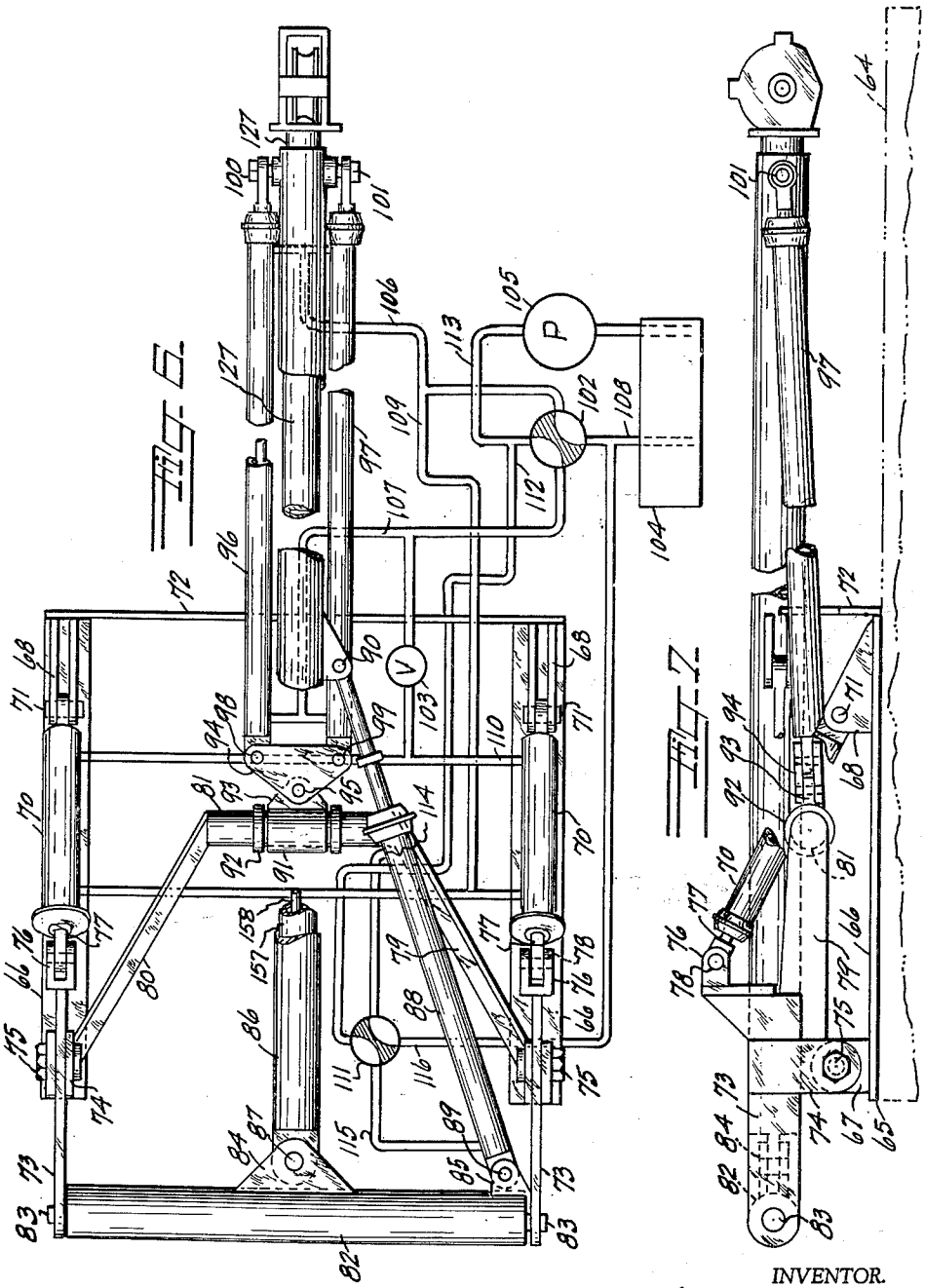

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Filed June 27, 1960 4 Sheets-Sheet 3

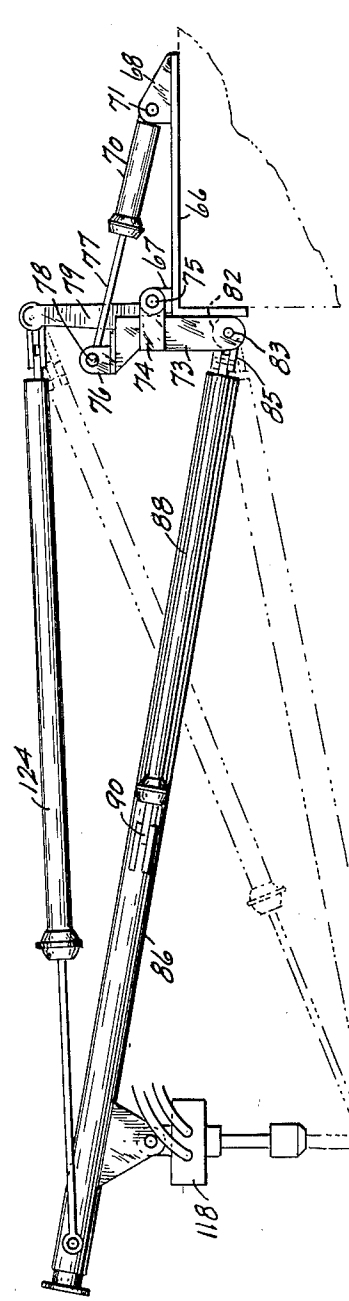


FIG. 3.

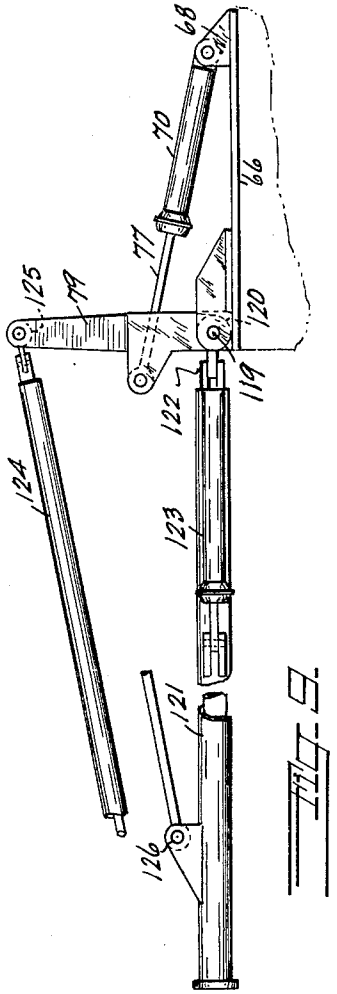
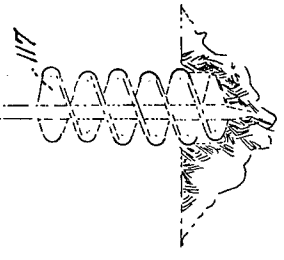


FIG. 4.



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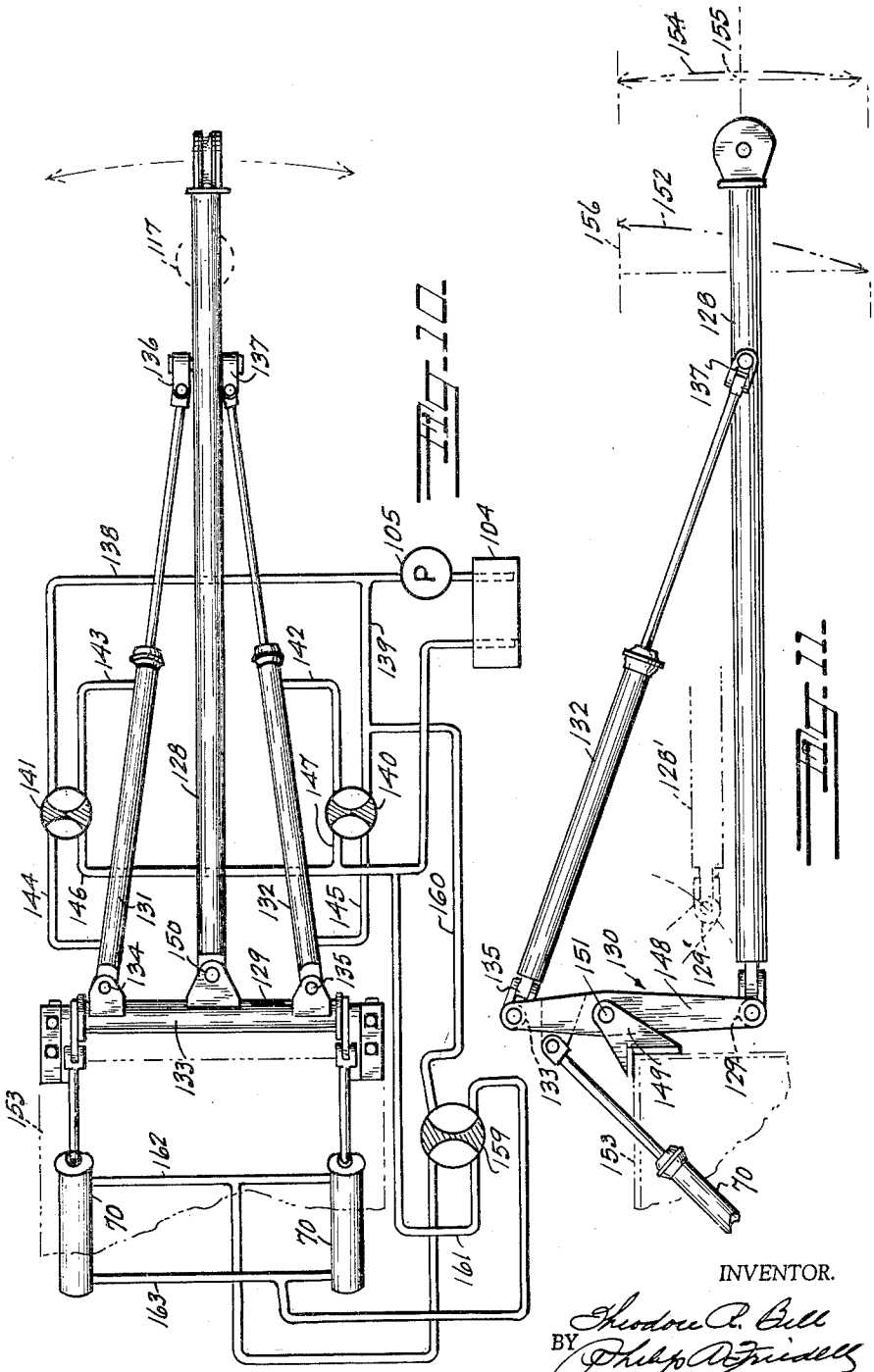

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DERRICKS

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4 Claims. (Cl. 212—35)

This invention relates to improvements in derricks, particularly for use in connection with transmission line installation and maintenance, including the transfer of equipment and materials, boring of pole holes, setting, removing, and replacing poles, installing transformers, and related operations, all of which can be handled expeditiously in view of the versatility of this derrick.

This invention provides a derrick the boom of which can be reclined on top of the maintenance truck when not in use, and operated through an angle in excess of 90 degrees as related to the perpendicular, to and below the extended horizontal for the boom, and can be swung laterally through sufficient angularities to compensate for variations in positioning so that recourse to maneuvering of the maintenance truck is unnecessary, the boom being adjustable in respective directions relative to the horizontal for minimum arcuate movement for pole hole boring operations, and laterally adjustable for positioning of the augur and similar operations. It will readily be seen that the horizontal and lateral operations have advantages for other purposes or operations. Furthermore, this derrick, in spite of its versatility, folds forward on top of the maintenance truck or other support when not required, and can be mounted on any other suitable type of conveyance or on a stationary support.

The objects and advantages of the invention are as follows:

First, to provide a derrick with a universally movable boom for operations in perpendicular and lateral planes.

Second, to provide a derrick with operating and control means for lateral operation in addition to the conventional elevating and lowering operations.

Third, to provide a derrick as outlined with a rocker base transversely pivoted to a support, and with the boom pivotally mounted at one end and the elevating and lowering motor or motors connecting from the other end of the rocker base to the boom, with the base adjustable between horizontal and vertical positions.

Fourth, to provide connecting means on the boom for an augur and operating means therefor for boring holes for telephone and transmission line poles and similar operations.

Fifth, to provide a derrick as outlined which can be folded to a reclined position on top of the truck.

Sixth, to provide a derrick as outlined of the simplest possible construction, easy and convenient to operate, and relatively economical to manufacture.

In describing the invention reference will be had to the accompanying drawings, in which:

FIG. 1 is a side elevation of one form of the invention in which a lateral swing motor is provided.

FIG. 2 is a front elevation of FIG. 1 with the fluid control circuit included.

FIG. 3 is a fragmentary enlarged side elevation showing in partial section the universal coupling for the elevating and lowering motors for the derrick illustrated in FIGS. 1 and 2.

FIG. 4 is a front elevation of FIG. 3.

FIG. 5 is an enlarged section taken through the boom on line 5—5 of FIG. 2, showing the universal connections for the raising and lowering motors.

FIG. 6 is a top plan view of another form of the invention, with the derrick folded back on top of a maintenance truck, and with portions of the boom and motors

broken out to reveal otherwise hidden details, and also includes one type of control and compensation for displacement differentials for the motors.

FIG. 7 is a side elevation of FIG. 6.

FIG. 8 is a reduced scale elevational view of the boom in position for operations relative to the horizontal.

FIG. 9 is a side elevation of a modification of the invention in which only one elevating and lowering motor is provided, and with the rocker base pivoted at one end.

FIG. 10 is a top plan view of a modification in which lateral swing is controlled by the spread-leg elevating and lowering motors.

FIG. 11 is a side elevation of FIG. 10.

The invention as illustrated in FIGS. 1 to 5 includes a boom 10 having a sheave 11 for the cable or rope 12 at its terminal end, the support end of the boom being pivotally supported on a transverse axis by the cross member 13, the boom terminating in a yoke 14 which diametrically spans the cross member 13 and is pivotally secured by the pin 15. The cross member 13 is axially pivoted in the bearings 16 and 17 as indicated at 18 and 19, these bearings being mounted on a suitable support such as the frame 20 which includes the cross member 21. Thus the boom can be swung up and down and from side to side, the combination providing a universally operative boom.

Two motors 22 and 23 operate the boom for elevating and lowering, each consisting of a cylinder 24 and a plunger 25, the terminal end of each plunger having a yoke 26 fixed thereon and which spans a pivot 27 the ends of which are pivotally mounted in the bearings 29 and 30, the yoke 26 being connected to the pivot 27 by a pin 28 which passes diametrically through the pivot 27 and is secured therein. The bearings are fixed to the boom, and the pivot shaft is indicated at 31. This arrangement provides universal joints for the plungers.

The lower end of each cylinder is also provided with a yoke 32 which spans a pivot member 33 and is secured by the diametric pivot 34, the pivot member 33 being axially pivoted in the bearings 35 and 36, thus providing universal connections for the lower ends of the cylinders.

A lateral swing motor 37 includes a plunger 38 which is pivotally connected to the boom as indicated at 39, with the cylinder pivotally connected to the cross member 13 in spaced relation to the boom connection, the cylinder terminating in a yoke 40 which spans the cross member and is pivotally secured by the diametric pin 41.

The motors are all operable through the medium of a pump 42, and the elevating and lowering motors have the upper and lower ends of their cylinders cross-connected as indicated at 43 and 44.

The base 20 may be fixedly mounted on a suitable support for conventional operations, and is shown as having the forward end pivoted in bearings 45 which are mounted on a support 46 such as the top of a maintenance truck, with the rearward end controlled by a motor 47 for operating the base between horizontal and vertical positions, to permit the boom to swing through a vertical arc in excess of 180 degrees from a reclined position.

The elevating and lowering motors are shown as controlled by 3-way valves 48 and 49, while the lateral swing motor is shown as controlled by a 4-way valve 50.

Any suitable circuit and valves may be used, and as shown consists of a supply of fluid under pressure and including a supply tank 51 and pump 42 which is in communication with all three valves through the connections 52 and 53, and all three valves have communication with the supply tank 51 through connections 54 and 55, the

terminal end of the discharge and suction connection 55 extending substantially to the bottom of the tank 51.

The valve 50 has communication with the upper and lower ends of the lateral swing operating motor 37 as indicated at 56 and 57, and the valves 48 and 49 have communication with the upper and lower cross-connections 43 and 44 through the connections 58 and 59.

With the valves in the position shown, valve 50 delivers fluid to the upper end of the lateral swing motor, with the lower end discharging to the supply tank through the connection 54, causing the boom to swing laterally toward the dotted position 10''. By reversing the valve, the boom will be swung toward the dotted position 10'.

The valves 48 and 49 are independently operated, and in the position shown, fluid under pressure is being delivered through the line 53 through connections 60 and 61 which are blocked by both valves, the discharge 62 also being blocked by valve 49, locking the lower ends of the elevating and lowering motors. However, the upper ends of the cylinders are in communication with the supply tank through cross connection 43, connection 58, valve 48 and connection 63 to line 55, thus permitting compensation for differential volumes at the respective ends of the cylinders to permit lateral operation of the boom, fluid passing between the upper ends of the cylinders and the supply tank, from which fluid will be suctioned or delivered to compensate for variations in displacement as the boom is swung laterally. By reversing the valves, the same compensation will result for the lower ends of the cylinders.

FIGS. 6, 7 and 8 illustrate a derrick incorporating a simplified method of compensation for displacement differentials, and a preferred form of rocker base which is intermediately pivoted on a support such as the rear edge of the top 64 of a transmission line maintenance truck, as indicated at 65, the drop provided by this intermediately pivoted base for the pivotal connection of the boom being essential in connection with the boring of pole holes and similar operations.

The base is supported by a support 66 which is mounted on the top of the maintenance truck, there being one mounted on each side and each has an upstanding bearing 67 at the rearward end, and a swivel bearing 68 at the other end for the rocker base tilting motors 70 which are pivoted thereto at 71. A rest for the boom in retracted and reclined position on top of the truck is indicated at 72.

The rocker base includes side members 73 each having a drop bearing 74 pivotally supported in the bearings 67 as indicated at 75, the side members terminating in upwardly projecting bearings 76 to which the plungers 77 of the motors 70 are pivotally connected as indicated at 78.

Arms 79 and 80 have each one end fixed to the side members and converge forwardly with the forward terminal ends fixed to the cylindrical cross member 81.

A cross member 82 which may be of any suitable cross sectional form, and is shown as cylindrical, is pivoted in the rear terminal portions of the side members as indicated at 83, and this cross member has pivotal connections for the boom and for the lateral swing operating motor as indicated at 84 and 85, the boom 86 being pivoted in the ear 84 as indicated at 87, and the lateral swing operating motor 88 being pivoted in the ear 85 as indicated at 89, the plunger of the motor 88 being pivotally connected to the side of the boom as indicated at 90.

When the cross member 81 is fixed to the ends of the arms 79 and 80, it will be necessary to install the motor pivot bearing 91 and end thrust collars 92 before welding or otherwise fixing the arms thereto, this motor pivot bearing having an ear 93 to which a singletree 94 is pivotally connected centrally of its length as indicated at 95, the motors 96 and 97 being pivotally connected to the respective ends of the singletree as indicated at 98 and 99 and to the boom as indicated at 100 and 101. Thus the singletree provides the means for compensating for differentials in displacement in the respective ends of the motor cylinders irrespective of the spacing between the pivotal connections 98 and 99, resulting in a simplified fluid circuit for the motors, requiring only one four-way valve 102 for the elevating and lowering motors and for the rocker base motors if the rocker base is to be used only in the vertical position when operating the boom, and if the rocker base is to be controlled, merely requiring a shut-off valve 103, which, if closed, will retain the rocker base in the reclined position, and if open, the rocker base will remain in the reclined position until the boom has passed the vertical center, after which, the rocker base will gradually move to the vertical position with the boom pivotal connection in a dependent position below the top of the truck and which is important in connection with certain operations, such as boring pole holes.

The source of fluid under pressure is indicated as including a supply tank 104 and a pump 105 which delivers the fluid to the valve 102 for selective communication with the respective ends of the elevating and lowering motors through the connections 106 and 107, with return to supply through the connection 108, the branch connection 109 to the head ends of the rocker base operating motors being connected to the connection 106 and to the lower ends of the motors through the connection 110 to the connection 107, the connection 110 having a shut-off valve 103 for retaining the rocker base in any desired adjusted position between reclined and vertical.

With the valve 102 in the position shown, fluid passes simultaneously from the pump to the lower ends of the elevating and lowering cylinders 96 and 97 and to the valve 103. If this latter valve is open, the motor will not initially tilt the rocker base because of the load of the boom and motors in the retracted or folded forward position shown in FIGS. 6 and 7, but after the boom has been raised just beyond the perpendicular, the motors 70 will gradually swing the rocker base to the vertical position shown in FIGS. 8, 9, 10 and 11. However, if the valve 103 is closed, the rocker base will remain in the inclined position on top of the truck, and operation of the boom will be conventional.

The lateral swing motor is operated independently and controlled by the valve 111 which has a connection 112 to the pump discharge 113 and to the respective ends of the cylinder through the connections 114 and 115, and to the supply through the connection 116.

FIG. 8 shows the rocker base moved to the vertical position and the boom operative relative to the horizontal, so that a device such as the auger 117 will be substantially unaffected for vertical boring through arcuate movement of the motor 118 as the boom follows from a position 86 to position 86', and in view of the lateral control of the boom, no special maneuvering of the maintenance truck will be necessary.

A modification is illustrated in FIG. 9 in which the rocker frame is quite similarly constructed with the exception that it is pivotally mounted at the rear end as indicated at 119 on the same pivot as the cross member 120 to which the boom 121 is pivotally connected at 122 centrally of the cross member, and the lateral swing motor 123 is pivoted adjacent one end of the cross member as previously shown in other views.

This modification is also shown with only one elevating and lowering motor 124 which is pivotally connected between the cross member 125 and the top side of the boom at 126.

A single motor has one advantage, that of requiring no compensation for differential displacement, but has other disadvantages, particularly with respect to folding forward in the reclined position on top of the truck with the motor beneath the boom, preventing the complete collapse obtainable with two spaced motors, and

also causes interference with the hoisting cable **12** indicated in FIG. 1. The rocker bases illustrated in FIGS. 1 and 9 are not suitable for pole hole boring operations since in that elevated position boring would start with the boom in the horizontal position as will be further explained.

Another modification is shown in FIGS. 10 and 11 in which the boom **128** is similarly connected to the rear cross member **129** of the rocker frame **130**, with the two elevating and lowering motors **131** and **132** connected to the front or top cross member **133** as indicated at **134** and **135**, the plungers of these motors being pivotally connected to the boom through universal joints or connections **136** and **137**, there being no lateral swing operating motor, this swing being controlled by the two elevating and lowering motors through two 4-way valve circuits for separate control of the respective motors.

As shown, the circuit is complete to the head ends of both motors, from the supply **104** through the pump **105** through connections **138** and **139** to the 4-way valves **140** and **141**, thence through connections **142** and **143** to the head ends of the cylinders, with the lower ends of the cylinders draining through the connections **144** and **145**, valves **141** and **140**, and connections **146** and **147** to the supply tank **104**. This circuit would cause elevating of the boom. If the valves are turned to the other position, the boom would be lowered, and closing one valve would cause the boom to move laterally. The use of the lateral swing motor is however preferable because of the more positive control afforded and the easier and more convenient manipulation.

The rocker base illustrated in FIGS. 10 and 11 disclose an increased drop, the depending leg **148** being of greater length, with the base pivotally mounted in diagonal bearings **149** which permits the base to swing beyond the vertical. With these intermediately pivoted rocker bases it is also possible to adjust the relative horizontal plane of the boom through limitation of the movement of the rocker base toward the vertical as indicated by the dotted positions at **128'** and **129'** since the motors **70** can be locked in any position as indicated by the shut-off valve **103** in FIG. 6. Thus the boom can be adjusted to operate equiangularly above and below its horizontal position for operation of an auger through a minimum or flattest portion of the arc.

The conventional maintenance truck body is too high for use of an end pivoted rocker base to permit the boom to operate equiangularly above and below the horizontal when a conventional pole augur with power drive indicated at **117—118** is used. To illustrate: if the boom connection was located above the top of the truck at **151**, the boom would move through the arc **152** as the augur bored into the earth, while if the boom is pivoted at a level from 2 to 5 feet below the top **153** of the truck, depending on the height of the truck body, the boom would operate only through the flattest part of the arc as indicated at **154** with only the slight lateral movement indicated at **155** instead of the excessive movement indicated at **156**. For positive control of the relative angular position of the rocker base for adjusting the relative height of the boom connection, a separate circuit may be used as shown in FIG. 10, in which a four-way valve is shown at **159** which is in communication with the pump line **139** through the connection **160** and with the supply tank for drainage through the connection **161**, with connections **162** to one end of the rocker base operating motors **70**, and **163** to the other end. Thereby the rocker base can be locked in any position at will.

Any of the types shown may be used with a fixed or with an extensible boom as illustrated in FIG. 6 which shows fragmentarily the main boom **56**, the extension **127**, extension advancing and retracting motor **157** with its plunger **158**, and which features do not form a part of this invention, having been disclosed in previous patents.

I claim:

1. A maintenance truck having a body having a rear end, a base having a front portion and a rear portion and being pivotally mounted on a transverse axis intermediate its length on said rear end and normally maintained in a reclined position, and power means and control means therefor cooperative between said truck and said base for adjusting said base between the reclined and a vertical position, a boom having pivotal connection with the portion of the base projecting rearwardly from said transverse axis for lowering the pivotal connection of the boom to a plane below the top of the truck for operation through the flattest portion of the arc described by the boom during a pole hole boring operation, and fluid motors cooperative between the front portion and the boom for raising and lowering the boom.

2. Mounting means for a derrick having a boom, and motors for elevating and lowering said boom, comprising a support having a rear end, a rocker frame having a rear end and a front end, a pivotal connection at one end for said boom, and pivotal connections on the other end for said motors, and pivotal mounting means on said support for supporting said rocker frame on a transverse axis for adjustment of said rocker frame about said pivotal mounting from reclined to vertical positions, and power means cooperative between the rocker frame and the support, and control means therefor for adjusting said rocker frame between the respective positions, said rocker frame having side members, said pivotal mounting means for said rocker frame comprising a depending member intermediate the length of each of said side members and each having a stub shaft at its lower end and cooperative bearings on said support with said stub shafts rotatable in said bearings, with the depending members fixed to and projecting below the side members, for advancing the rocker frame about the rear end of the support when the rocker frame is adjusted to the vertical position.

3. Mounting means for a derrick having a boom and fluid motors for operation thereof comprising, a support, spaced bearings on said support, a rocker frame having front and rear ends and having pivotal mountings on a transverse axis intermediate the space between the ends in said bearings, and pivotal connection means on the respective ends of said rocker frame for the boom and fluid motors, and power means cooperative between said rocker frame and said support and control means for said power means for operating said rocker frame about said pivotal mountings for varying the plane of the connection for the boom relative to the plane of the support.

4. In a derrick having a boom, and fluid motors for operating said boom,

mounting means comprising
a frame having pivotal connectiong means at its respective ends, with
said boom being pivotally connected to one of said ends,
a single tree having a central pivotal connection to the other of said ends in axial alignment with the pivotal connection for the boom, and
having said motors pivotally connected to the respective ends of the singletree,
thereby compensating for lateral swing of the boom
while maintaining the instant operative conditions of the fluid motors.

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