Nov. 22, 1960 R. F. PITMAN 2,961,102

HYDRAULIC SWINGING BOOM-TYPE HOIST

Filed Feb. 17, 1959 3 Sheets-Sheet 1

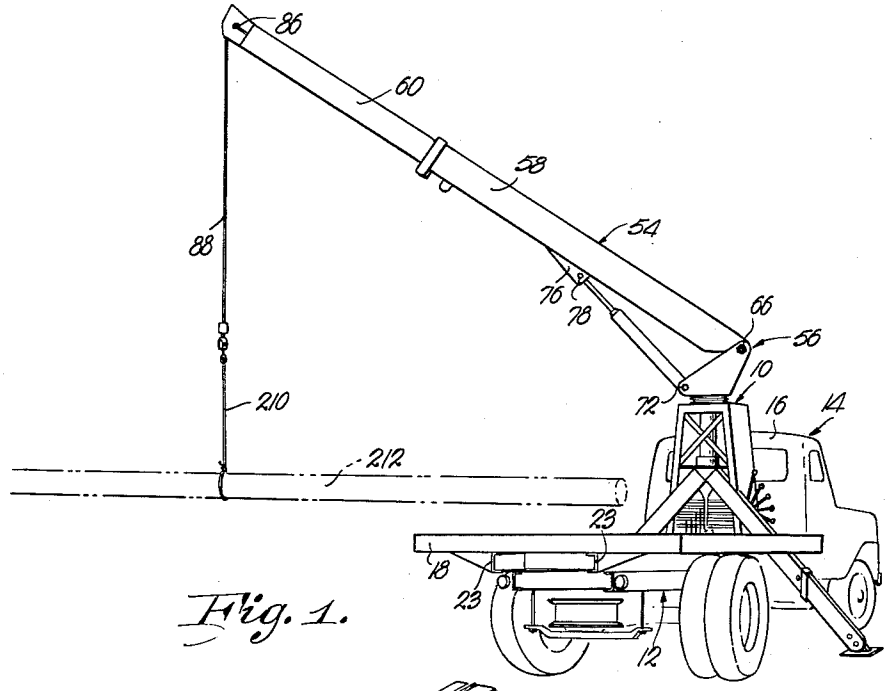

Fig. 1.

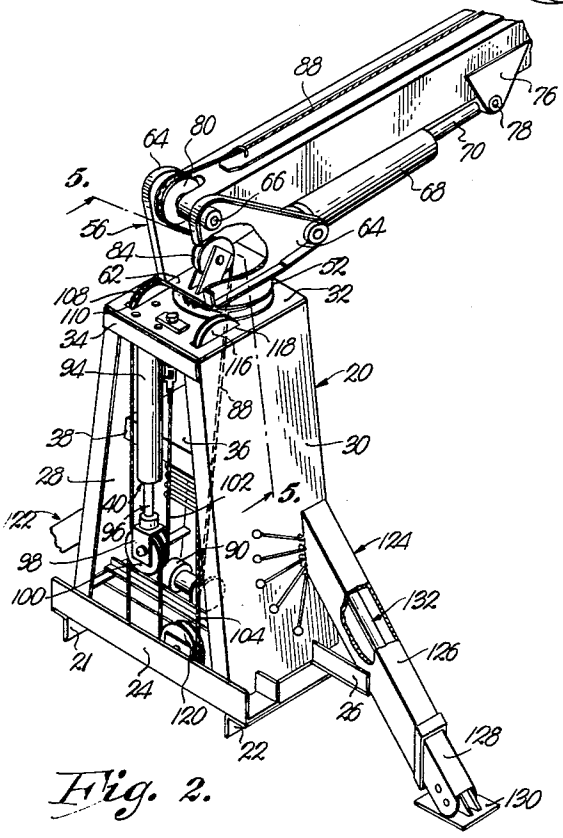

Fig. 2.

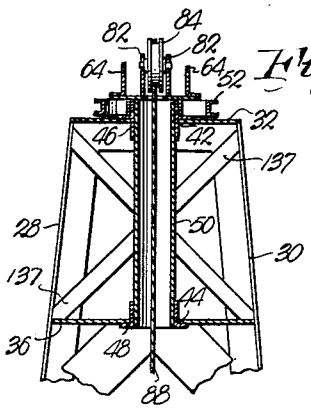

Fig. 5.

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HYDRAULIC SWINGING BOOM-TYPE HOIST

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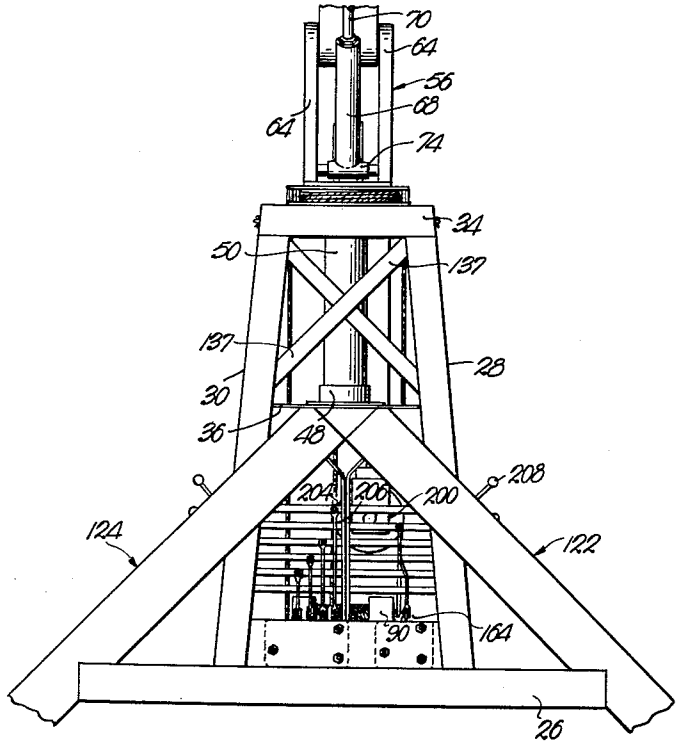

Fig. 3.

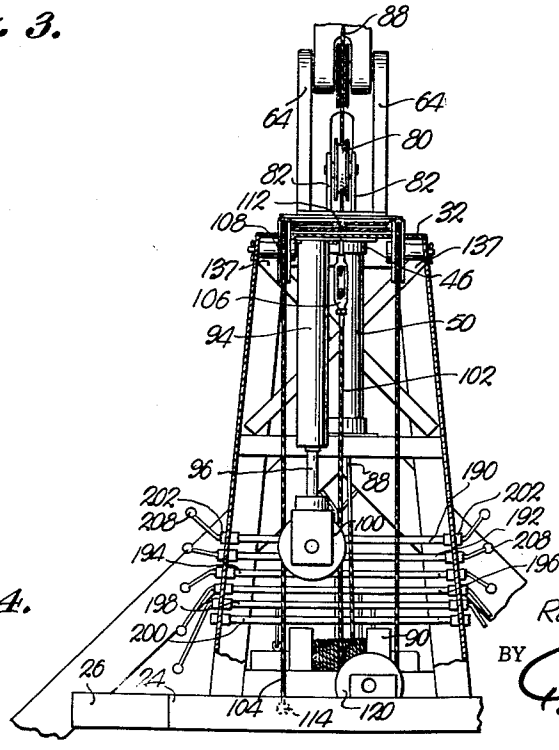

Fig. 4.

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HYDRAULIC SWINGING BOOM-TYPE HOIST

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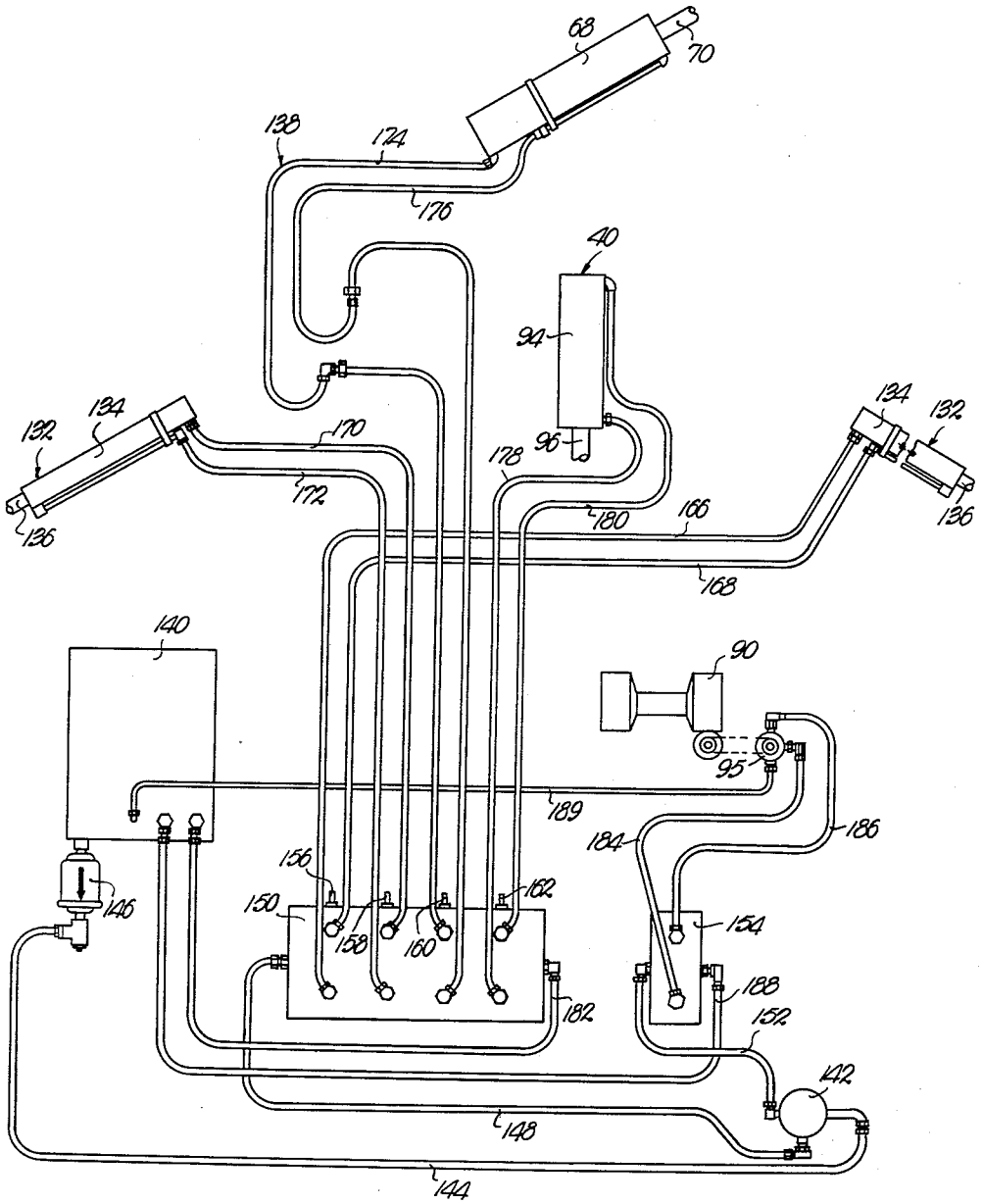

Fig. 6.

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HYDRAULIC SWINGING BOOM-TYPE HOIST

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5 Claims. (Cl. 212—35)

This invention relates to structure for lifting loads and particularly to a portable hoist especially adapted for mounting on a mobile vehicle to permit the hoisting device to be utilized at substantially any desired point.

One of the most important objects of the invention is to provide a hoist adapted to be mounted on the frame of a truck to thereby impart portability to the load-lifting assembly and without occupying a considerable portion of the bed area of the vehicle, and being of relatively lightweight although capable of handling heavy loads by virtue of the provision of novel outrigger assemblies disposed to engage the ground and thereby support the hoist during utilization thereof.

Another equally important object of the invention is to provide a portable hoist of the character defined above having a boom which is extensible and swingable about both vertical and horizontal axes, and adapted to carry a movable load-lifting line with all of the actuatable components, including the outrigger assemblies, being hydraulically operated to permit lifting and moving of loads with the present hoist device without physical effort of any kind, aside from actuation of the hydraulic controls.

A particularly important object of the invention is to provide a hydraulic swinging boom-type hoist wherein such boom is swingable at least 180° in opposite directions from a center line in order to permit loads to be lifted and moved to another point without the necessity of changing the position of the vehicle upon which the portable hoist is mounted.

Another important aim of the invention is to provide a portable hoist having a swinging boom movable through a 360° arc wherein such swinging movement is effected by a single, hydraulically operated piston and cylinder unit connected to the boom in a novel manner to rotate the latter in response to reciprocation of the piston carried by the double-acting cylinder unit.

A still further important aim of the invention is to provide a portable hoist which may be utilized for various lifting jobs, inasmuch as an assortment of attachments may be connected to the outermost end of the boom in order to perform the required work.

Other important objects of the invention relate to the provision of a swinging boom-type hoist wherein all of the movable components are hydraulically actuated, with operation of the same being controlled through easily manipulated, hand-actuatable control arms disposed in a convenient position at one side of the truck or other mobile vehicle; to a hoisting device as described above wherein the hydraulically operated structure is controlled by commercially available valve units which are opened and closed with improved mechanism, serving to permit selective opening and closing of the valves at a point remote therefrom and without frequent breakdown of the components, all of the above serving to materially decrease the overall cost of the hoist while maintaining the dependability of the same at a maximum; to the provision of a hoist having improved frame means supporting

the swingable boom which is of relatively lightweight construction, yet of sufficient strength and rigidness to permit lifting of relatively heavy loads; and to other important objects and details of construction of the present portable hoist which will become obvious or be explained in greater detail as the following specification progresses.

In the drawings:

Figure 1 is a rear perspective view of a truck having the present portable hoist mounted in operable position thereon, with the outrigger assemblies disposed in engagement with the ground and illustrating the way in which the boom is employed to lift a load;

Fig. 2 is an enlarged, fragmentary, perspective view of the portable hoist taken slightly above the same and certain parts thereof being broken away and in section to reveal details of the structure thereunder;

Fig. 3 is an enlarged, fragmentary, rear elevational view of the hoist referred to above.

Fig. 4 is an enlarged, fragmentary, front elevational view of the opposite side of the hoist as shown in Fig. 3, with certain parts thereof being broken away;

Fig. 5 is an enlarged, fragmentary, vertical, cross-sectional view taken substantially on the line 5—5 of Fig. 2 and looking in the direction of the arrows; and

Fig. 6 is a schematic representation of the hydraulic system and components actuated thereby constituting a part of the present portable hoist.

A portable load-lifting device in the nature of a hoist is illustrated in its preferred form in the drawings, and generally designated by the numeral 10. As indicated in Fig. 1, hoist 10 is especially adapted to be mounted on the frame 12 of a mobile vehicle in the nature of a truck 14 and normally positioned immediately behind the cab 16 thereof. As will be described in greater detail hereinafter, hoist 10 occupies a minimum of space and therefore a conventional rectangular bed 18 may be positioned over the rearmost portion of frame 12 for receiving loads picked up from the ground by hoist 10.

Frame 20 of hoist 10 preferably comprises a pair of angle irons 21 and 22 normally spaced apart a distance equal to that between opposed, parallel, inwardly facing channels 23 of truck frame 12, with suitable means (not shown) being employed for securing angle irons 21 and 22 to respective channels 23 in complementally engaging relationship thereto. Angle irons 21 and 22 mount a pair of parallel, upwardly facing channels 24 and 26 welded to the upper, normally horizontal legs of angle irons 21 and 22. Transversely U-shaped panels 28 and 30 are carried at the lowermost ends thereof by channels 24 and 26, with the trough-like portions of panels 28 and 30 facing inwardly and converging toward each other as the uppermost ends of the same are approached. The laterally extending, opposed end sections of each of the panels 28 and 30 are disposed in abutting relationship to respective outer, substantially upright legs of channels 24 and 26 and are welded to the latter in order to impart rigidity to frame 20.

A U-shaped mounting plate 32 welded to the uppermost ends of each of the panels 28 and 30, has a pair of downwardly turned end segments 34 in abutting relationship to corresponding, opposed, laterally extending end sections of panels 28 and 30 with end segments 34 being welded to the defined inturned end sections of panels 28 and 30.

A second mounting plate 36 which is L-shaped transversely thereof in the same direction as mounting plate 32, spans the distance between the inner surfaces of panels 28 and 30 and is connected to the latter in vertically spaced, parallel relationship to mounting plate 32. As illustrated in Fig. 2, the downwardly turned leg 38 of mounting plate 36 is disposed in spaced relationship to proximal, laterally extending end sections of

panels 28 and 30 in order to accommodate a piston and cylinder unit broadly numerated 40.

Mounting plates 32 and 36 are provided with substantially identical, coaxial, vertically aligned openings 42 and 44 therein respectively, an upper mast bearing 46 being mounted on plate 32 in a position with opening 42 receiving the cylindrical collar portion thereof, while the outwardly extending flange segment of the bearing bears flatly against the uppermost end of plate 32. Similarly, a lower mast bearing 48 is secured to plate 36 with the cylindrical collar section thereof extending through opening 44 and the laterally extending flange segment of the same underlying and suitably bolted to plate 36.

Elongated, tubular mast 50 has a master sheave 52 secured to the uppermost end thereof and which rotatably rests on bearing 46, with the latter and mast bearing 48 rotatably receiving mast 50 to thereby cause the latter to be positioned in a substantially upright location when frame 20 is disposed on the chassis frame 12 of truck 14.

A boom assembly 54 is mounted on sheave 52 and thereby mast 50 for rotation on the axis of the latter, and includes a head unit 56 mounted directly on sheave 52 for rotation therewith and carrying a pair of booms 58 and 60 disposed in telescoped relationship. The normally horizontal, polygonal bottom plate 62 of head unit 56 is secured directly to sheave 52 and thereby mast 50, and mounts a pair of parallel, horizontally spaced, triangular supports 64 with the normally lowermost end of boom 58 positioned between the upper apices of supports 64 being swingable relative thereto on a horizontal axis by virtue of pivot pin 66 carried by supports 64 and extending through the defined lower end of boom 58.

A double-acting hydraulic cylinder 68 is secured at the end thereof opposed to the reciprocable piston rod 70 of the same, through a pivot pin 72 carried by the lower, outwardly projecting apices of supports 64 and rotatably received by suitable sleeve structure 74 secured to cylinder 68. The outermost end of piston rod 70 remote from cylinder 68 is pivotally connected to a pair of triangular, horizontally spaced brackets 76 secured to the underside of boom 58 through a pivot pin 78 spanning the distance between brackets 76 and rotatably carrying the outermost end of piston rod 70. As will be explained in greater detail hereinafter, cylinder 68 is of the double-acting type to permit controlled reciprocation of piston rod 70 to thereby swing booms 58 and 60 about the axis of pivot pin 66.

The lowermost end of boom 58 receiving pivot pin 66 is bifurcated to provide clearance for a sheave 80 mounted thereon for free rotation relative to pin 66. Parallel, horizontally spaced, upright brackets 82 secured to the upper face of plate 62 rotatably carry another sheave 84 disposed for rotation on an axis parallel with pin 66 and located forwardly of sheave 80 in a direction toward cylinder 68. A sheave (not shown) rotatably carried by pin 86 adjacent the outermost end of boom 60 away from head unit 56 receives a load line 88 trained thereover and in turn passed over sheave 80 and under sheave 84 before passing to winch drum 90 disposed at the lowermost portion of frame 20 for rotation on a horizontal axis. As indicated in Figs. 2 and 4, the lowermost end of load line 88 is wrapped around winch drum 90 in a manner to effect taking in or paying out of line 88 during rotation of drum 90. Hydraulic motor 95 carried by suitable support means spanning the distance between channels 24 and 26 is operably coupled with winch drum 90 for rotating the same in opposite directions through suitable gearing, not illustrated in detail.

Means for rotating sheave 52 above the vertical axis thereof to thereby swing boom assembly 54, includes piston and cylinder unit 40 referred to above and comprising a cylinder 94 provided with a reciprocable piston rod 96 with the end of cylinder 94 away from rod 96 being secured to the underface of mounting plate 32 adjacent leg segment 38 of plate 36, with the axis of cylinder 94

being in a vertical position and the entire unit 40 thereby being suspended from mounting plate 32. Yoke 98 secured to the outermost end of piston rod 96 rotatably carries a double sheave 100 rotatable about an axis perpendicular to the axis of rotation of main sheave 52. A pair of cables 102 and 104 are provided for effecting rotation of boom assembly 54 in response to reciprocation of piston rod 96 of double-acting cylinder unit 40. One end of cable 102 is secured to the underface of mounting plate 32 adjacent cylinder 94 by a turnbuckle assembly 106. Cable 102 then extends over one of the grooved segments of double sheave 100 before passing upwardly and over a sheave 108 rotatably mounted on the underface of plate 32 and extending upwardly therethrough through a suitable clearance slot 110 in plate 32. Note should be taken of the fact that sheave 108 is rotatable about an axis perpendicular to the parallel axes of cylinder 94 and mast 50. The remaining length of cable 102 is trained around the horizontally disposed groove of sheave 52 more than one complete turn and is secured to the latter by suitable connecting means 112.

The other cable 104 is secured to the inner surface of one leg of channel 24 by a connector 114 and then passes around the other grooved segment of sheave 100 in a direction opposite to the way in which cable 102 is trained thereover, and then extends upwardly and over a sheave 116 coaxial with sheave 108, carried by plate 32 on the opposite side of cylinder 94 and extending upwardly through a slot 118 in plate 32 parallel with slot 110. The end length of cable 104 is also trained around sheave 52 in a direction opposite to that of cable 102 and after passing therearound more than one turn, is also secured to the main sheave 52 by connecting means 112. Because of the way in which the portion of cable 104 trained over sheave 100 passes downwardly therefrom, it is necessary to provide another sheave 120 rotatably mounted on channel 24 for rotation on an axis parallel with the axis of rotation of sheave 100 and having cable 104 trained under the same, as best shown in Fig. 4. Sheave 120 is located intermediate sheave 100 and sheave 116 to thereby cause the stretches of cable 104 passing to the same to be disposed in substantially parallel alignment.

A pair of substantially identical outrigger assemblies 122 and 124 are connected to frame 20 for stabilizing hoist 10 during lifting of loads and particularly when booms 58 and 60 are extended outwardly from bed 18 in substantial parallelism therewith. Each of the assemblies 122 and 124 includes a pair of transversely rectangular, elongated legs 126 and 128, with the latter being telescoped in the normally lowermost open end of a respective leg 126. The uppermost ends of legs 126 of assemblies 122 and 124 converge and abut the lower face of plate 32 adjacent the laterally extending sections of panels 28 and 30 remote from piston and cylinder unit 40. Each of the legs 126 is welded to a corresponding panel 28 and 30 as well as to plate 36, and is also secured to respective outer ends of channels 26 which extend beyond the ends of channel 24, as indicated in Figs. 2, 3 and 4. Outrigger shoes 130 pivotally connected to the lowermost ends of each of the legs 128 are disposed to engage the ground as indicated in Fig. 1, upon extension of legs 128 relative to respective legs 126.

Means for automatically shifting legs 128 relative to legs 126 comprises a hydraulically actuated piston and cylinder assembly 132 located within each of the outriggers 122 and 124 and surrounded by legs 126 and 128. Assemblies 132 are of the double-acting type and thereby include a cylinder 134 and a reciprocable piston rod 136 with the end of cylinder 134 remote from rod 136 being suitably connected to a corresponding leg 126, while the outermost ends of each of the piston rods 136 are secured to legs 128 for reciprocating the latter in response to actuation of assemblies 132.

Inasmuch as considerable stress is placed on frame 20 during utilzation of boom assembly 54, it is preferred

to provide a number of cross braces spanning the distance between panels 28 and 30 and connected to the same, suitable braces being bars 137 disposed in crossed relationship, as best shown in Fig. 3, above plate 36 and joined to panels 28 and 30 at opposed, inwardly extending end sections thereof.

The hydraulic system 138 for hoist 10 and schematically illustrated in Fig. 6, is adapted for permitting selective operation of the hydraulic cylinder and piston assemblies. Hydraulic fluid reservoir 140, adapted to be disposed at the lower part of frame 20 in a convenient position, is operably coupled with a suitable multidistribution connector 142 through a conduit 144 having a filter 146 therein. One fluid supply line 148 leading from connector 142 passes into the inlet of a master control valve unit 150, while the other fluid supply line 152 coupled with connector 142 passes to a secondary control valve unit 154. As shown in Fig. 6, unit 150 has control valves therein for each of the cylinders 134 of assemblies 132, and cylinders 68 and 94, with such valves being controlled by reciprocable stems 156, 158, 160, and 162 respectively. Control unit 154 likewise has a stem 164 reciprocable in a plane parallel with a plane through stems 156 to 162 inclusive.

Conduits 166 and 168 coupled with unit 150 and associated with the valve controlled by stem 156, lead to opposed ends of cylinder 134 of one of the assemblies 132, while similar conduits 170 and 172 communicate with opposed ends of the other cylinder 134 and are operably connected to unit 150 for flow of fluid therethrough in response to operation of the valve controlled by stem 158. Supply lines 174 and 176, permitting fluid to flow therethrough in response to actuation of the valve moved by stem 160, are connected to opposite ends of cylinder 68 to thereby permit selective reciprocation of piston rod 70. The final valve in unit 150 controlled by stem 162, permits selective flow of fluid through lines 178 and 180 coupled with opposite ends of cylinder 94. Fluid return line 182 coupled with the outlet of unit 150 directs fluid back to reservoir 140. The fluid supply lines 184 and 186 coupled with secondary unit 154 for directing fluid in either direction to hydraulic motor 95, permit fluid to pass therethrough in response to the valve actuated by stem 164, while the return line 188 interconnecting control unit 154 and reservoir 140 permits fluid to by-pass lines 184 and 186 during selected intervals. An additional return line 189 intercommunicating motor 95 and reservoir 140, directs fluid back to the latter during actuation of the defined hydraulic motor for rotating winch drum 90.

Mechanism for permitting selective reciprocation of stems 156 to 164 inclusive preferably comprises a number of horizontal, parallel, vertically aligned rods 190, 192, 194, 196 and 198, although an additional rod 200 may be provided if desired for reasons to be set forth. Opposed sleeves 202 mounted on respective panels 28 and 30 rotatably carry opposite ends of corresponding rods 190, 192, 194, 196, 198 and 200.

Each of the rods 190 to 200 inclusive is provided with a laterally extending ear 204 with the latter being disposed in staggered relationship vertically. Ears 204 are disposed in sufficiently horizontally offset relationship to permit operable interconnection of stems 156 to 164 inclusive, with rods 198, 196, 194, 190 and 192 respectively by elongated links 206.

Longitudinally L-shaped control arms 208 are secured to each of the outer ends of rods 190 to 200 inclusive in order to permit actuation of stems 156 to 164, from either side of frame 20 and in order to make rotation of the defined rods easier, it is preferred that arms 208 be disposed in substantially radially extending relationship from the central horizontal rod.

Although rotatable rod 200 has not been illustrated as being connected to any valve control stem, it is preferred that this rod be provided on frame 20 to permit operable connection of the same to a valve operably associated with hydraulic mechanism for reciprocating boom 60 relative to boom 58 if it is desired that this automatic feature be provided on hoist 10. It can be recognized that another secondary valve control unit may be provided adjacent unit 150 and thereby operable from the same fluid reservoir 140 as the remainder of the hydraulic components.

The load-lifting device connected to the outer end of line 88 depending from the uppermost end of boom 60 will depend upon the particular object to be lifted, one example being the relatively short cable 210 removably connected to the outer end of load line 88 and adapted to be looped around an elongated object such as a telephone pole 212 in order to permit lifting of the same. Raising of pole 212 from the ground is accomplished by the operator grasping the control arm 208 connected to either end of rod 190 and rotating the latter in a direction to cause the stem 162 to be reciprocated in a direction to permit hydraulic fluid to flow under pressure through either lines 178 or 180 into cylinder 94 to shift piston rod 96 thereof. The direction of rotation of rod 190 will of course be dependent upon whether or not boom structure 54 is to be swung to the left or right of truck bed 18 in order to pick up the pole 212. Viewing Fig. 2, it can be seen that operation of unit 40 in a manner to move piston rod 96 downwardly relative to cylinder 94, causes the effective length of cable 102 wound around sheave 52 to be decreased while simultaneously therewith, an additional length of cable 104 is wound around the described sheave. The result of movement of piston rod 96 and consequent increase or decrease of the effective lengths of cables 102 and 104 wound about sheave 52, is to effect swinging movement of boom assembly 54 about the vertical axis of mast 50. Movement of piston rod 96 and thereby sheave 100 toward cylinder 94 rotates boom assembly 54 in the opposite direction, inasmuch as the effective length of cable 104 trained about sheave 52 is decreased while a corresponding increase is effected in the effective length of cable 102 wound around sheave 52. It can also be perceived that reciprocation of piston rod 96 in either direction may be effected by virtue of unit 40 being of the double-acting type permitting hydraulic fluid to be directed into either end of cylinder 94, depending upon the disposition of the valve under the control of stem 162 and thereby shifted during rotation of rod 190.

An important feature of the mechanism for swinging boom assembly 54 is the fact that the same may be swung at least approximately 180° in either direction from a center line by virtue of the winding of cables 102 and 104 around sheave 52 so that when the same is in its central position, the cables are wound therearound at least more than one turn.

It has been found advisable to lower legs 128 to positions with shoes 130 thereof engaging the ground prior to lifting of any objects with load line 88, and extension of outrigger assemblies 122 may be quickly and rapidly effected by the operator shifting arms 208 of rods 196 and 198 in directions to rotate the defined rods and thereby reciprocate stems 156 and 158 along their paths of travel to cause hydraulic fluid to be directed into respective cylinders 134 via lines 170 or 172, and 166 or 168 respectively, to move pistons 136 downwardly until shoes 130 engage the ground.

If boom 60 is shiftable relative to boom 58 under the influence of hydraulic structure, rod 200 is suitably rotated to cause extension of boom assembly 54, and then fluid is directed into cylinder 68 via either line 174 or 176 in a manner to cause boom 58 to be swung about the axis of pivot pin 66 to a position with the outwardly extending boom at a predetermined angle relative to the ground. As set forth above, operation of double-acting cylinder 68 is controlled by rotation of the arm 208 connected to rod 194.

With load line **88** directly overlying the pole **212** to be lifted, arm **208** on rod **192** is shifted in a direction to cause stem **164** to be moved and thereby permit hydraulic fluid to be passed into motor **95** for rotating winch drum **90** and thereby play out load line **88**. During unwinding of line **88**, the same passes over sheaves **84** and **80** as well as the sheave on the uppermost end of boom **60**, notwithstanding the relative position of boom assembly **54** with respect to frame **20**.

Lifting of pole **212** from the ground after attachment of cable **210** thereto is readily effected by shifting arm **208** on rod **192** in the opposite direction, whereby hydraulic fluid is permitted to pass into motor **95** from the opposite direction and causing line **88** to be wound upon winch drum **90** as the latter is rotated.

Since all of the hydraulic piston and cylinder assemblies are of the double-acting type, it can be seen that swinging of boom assembly **54** in both vertical and horizontal directions, extension of outrigger assemblies **122** as well as booms **58** and **60**, and taking in or paying out of load-lift line **88** may readily be effected by the simple expedient of the operator shifting arms **208** connected to rods **190** to **200** inclusive in the proper directions.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In a portable hoist, a frame adapted to be mounted on a mobile vehicle, there being a pair of extensible outrigger assemblies secured to the frame each bearing at respective upper ends thereof against a lower support plate of said frame and including a pair of tubular legs disposed in telescoping relationship in each outrigger assembly; hydraulically operated means within each of the assemblies for reciprocating one of the legs thereof relative to the other leg; a member rotatably mounted on the frame for movement on a substantially vertical axis; a tubular element and a boom secured to the member for movement therewith; said tubular element coaxial with the member and depending therefrom; bearing means rotatably receiving the element in vertically spaced relationshsip and vertically spaced support plates secured to the frame nad carrying respective bearing means; mechanism connected to said member for rotating the latter to swing the boom and including a pair of cables having opposite corresponding ends secured to the frame and trained around said member in opposite directions; a single hydraulically operated piston and cylinder unit; manually manipulable means operably coupled with said cylinder for permitting selective direction of fluid to opposite ends of the cylinder to reciprocate the piston along

a path of travel parallel with the axis of rotation of the member; said unit including a sheave mounted on the outer end of the piston and movable therewith; said opposite corresponding ends of said cables being secured to the frame on opposite sides of the path of travel of the piston; certain lengths of the cables intermediate the ends thereof being trained over the member in opposite directions to effect the increasing or decreasing of the lengths of the cables trained over the member in response to reciprocation of the piston and thereby the sheave; and said boom being swingable about a horizontal axis and a load line being movably carried by the boom, there being separate hydraulically operated means for swinging the boom about said horizontal axis of movement thereof and for moving said load line, and manually manipulatable control means for permitting selective actuation of said structure and the hydraulically operated means.

2. A hoist as set forth in claim 1, wherein said manually manipulable control means includes a pair of fluid supply lines to said structure and each of said hydraulically operated means respectively, valve means interposed in each pair of supply lines and controlled by movable valve stems, said stems being disposed in aligned, parallel relationshisp, a plurality of rods carried by the frame in parallel, aligned relationship perpendicular to the path of travel of said stems, links interconnecting each of the rods with a respective stem, and means coupled with each of the rods for actuating the latter to reciprocate said stems.

3. A hoist as set forth in claim 2, wherein said stems are disposed for movement in a vertical plane and said rods substantially overlie the stems, said rods being rotatable on the longitudinal axes thereof and said links interconnecting the rods and said stems to reciprocate the latter in response to rotation of the rods.

4. A hoist as set forth in claim 3, wherein the means for rotating the rods includes an elongated arm secured to corresponding ends of each of the rods, said arm being disposed in substantially radially extending relationship from the central rod.

5. A hoist as set forth in claim 4, wherein is provided an arm on each end of the rods to permit controlled rotation of the same from either side of the frame.

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