

[54] **HYDRAULIC LIFT MECHANISM**

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[58] Field of Search 92/51, 52, 53, 113, 168, 165 PR,
92/177; 91/169

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[57] **ABSTRACT**

Double acting telescoping hoists are coupled by a common fluid control system for raising and lowering a platform connected to the hoists. The hoists have expansion and retraction chambers for inwardly and outwardly telescoping the hoists with the areas on which fluid acts being greater in the expansion chambers than in the retraction chambers. The force created by fluid in the retraction chambers causes each hoist to experience substantially the same load thereby enabling them to expand at substantially the same rate. In one embodiment non-concentric shaped spacers separate the telescoping units of the hoists to prevent their rotation.

5 Claims, 6 Drawing Figures

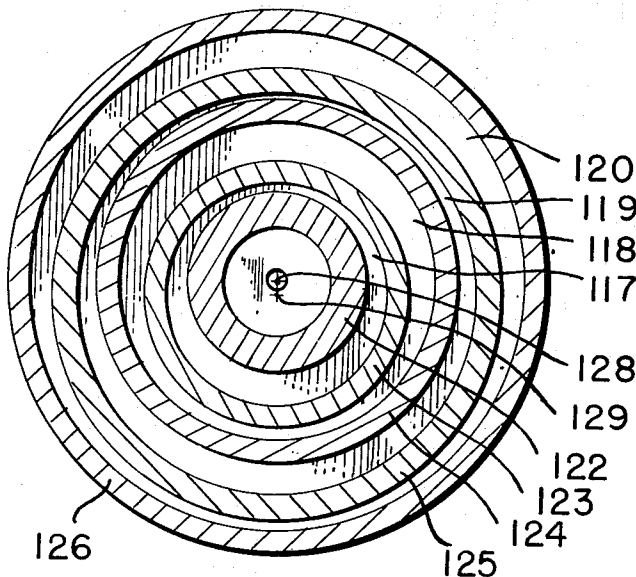


FIG. 1

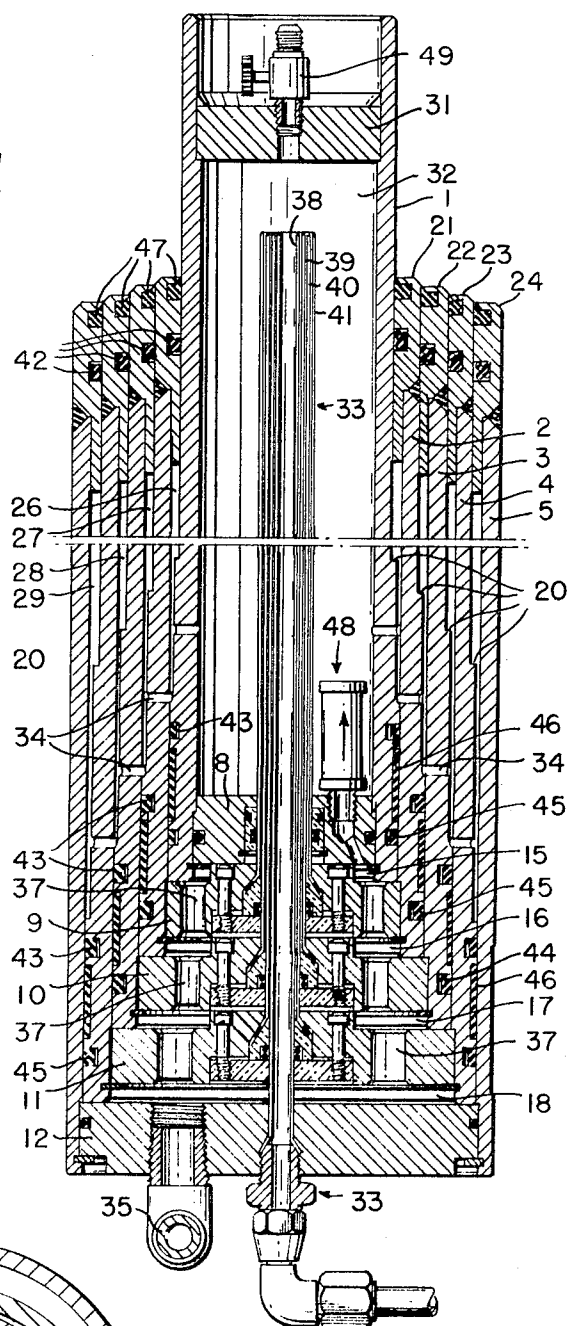
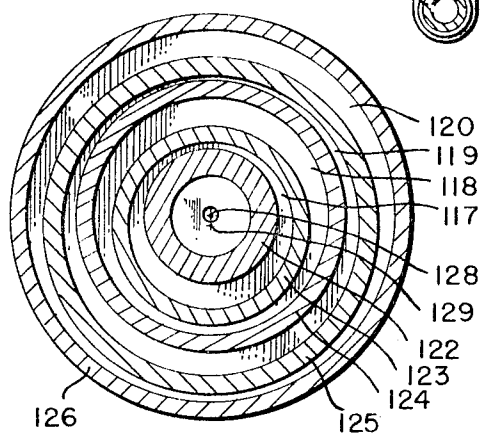


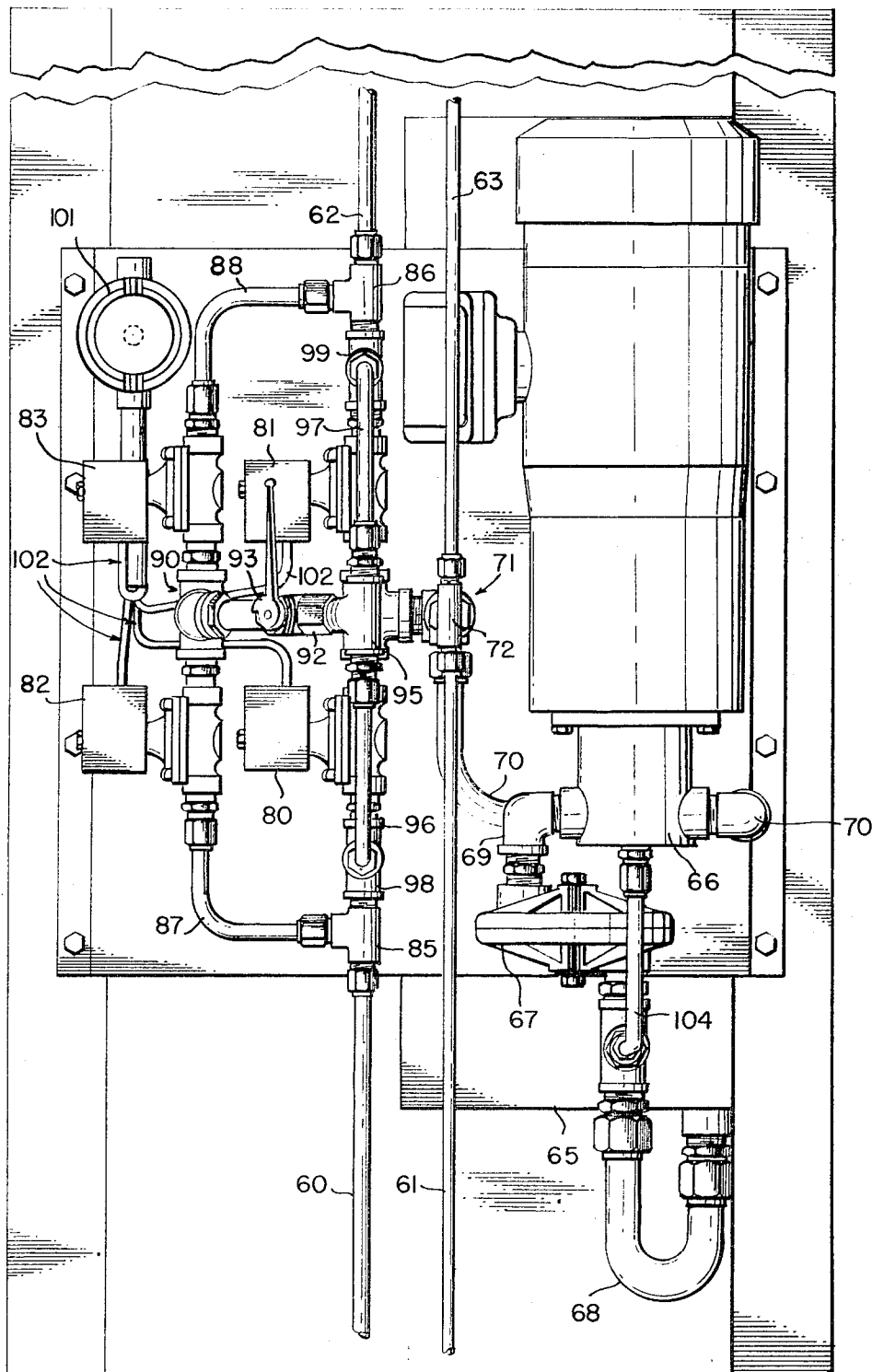
FIG. 6



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FIG. 2

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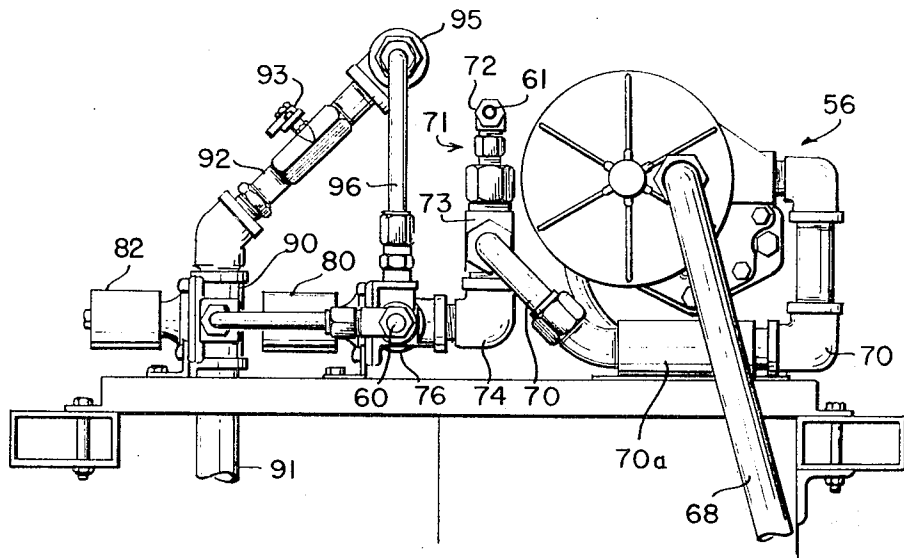


FIG. 3

FIG. 4

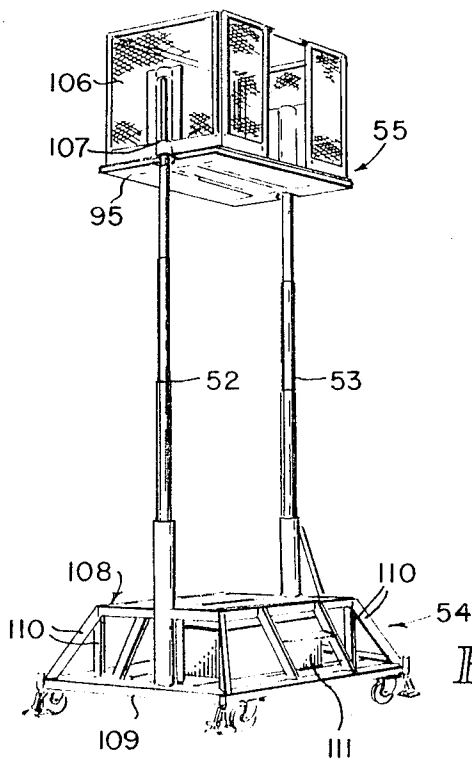
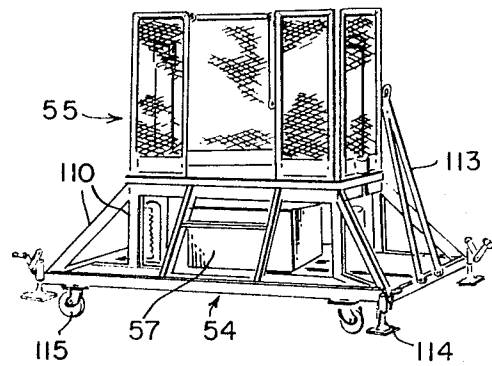


FIG. 5

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HYDRAULIC LIFT MECHANISM

BACKGROUND OF THE INVENTION

The present invention relates to lift mechanisms of the type having an elevating platform for carrying a load which is raised and lowered by a fluid operated hoist located beneath the platform. Specifically, the present invention relates to a portable lift mechanism employing a telescopic hoists and means for balancing the expansion rate of the hoists.

Fluid operated lift mechanisms often employ one or more telescoping hoists which raise and lower the elevator platform. When two or more hoists are powered by a single fluid pump a problem arises in connection with the relative expansion rates of the hoists. An uneven distribution of the load on the platform results in fluid filling the hoist experiencing the lighter load before the other hoist. This causes both hoists to pivot about their bases locking their telescoping elements thereby preventing further expansion or retraction. The problem is overcome by using two pumps to supply fluid independently of the two hoists but this greatly adds to the costs of the lift mechanism.

The foregoing problem is also overcome by using a level sensing mechanism on the platform to generate a correction signal in a servo loop system to vary the fluid flow to one of the hoists to balance the expansion rate. Also, where a job requirement allows, the foregoing problem is avoided by using a single hoist to bear all the load. A single hoist lift mechanism, however, has the problem of rotating when a torque is applied to the platform. Hoists are commonly made with concentrically fit tubes or barrels which can bear compression loads but not torque because the tubes are loosely fit within one another for telescopic movement.

Accordingly, it is an object of the present invention to devise improved lift mechanisms. This object is accomplished in part by using a double-acting hoist which offers superior control over expansion and retraction. The hoist of the present invention has expansion chambers for outwardly telescoping concentrically fit barrels and retraction chambers for inwardly telescoping the barrels. The surface areas within the expansion and retraction chambers on which fluid exerts a force to either expand or retract the hoist (hereafter called lift areas) are different in the two chambers. The lift area of an expansion chamber is greater than the lift area of a retraction chamber. In connection with the foregoing, it is an object of the present invention to devise telescopic hoists having expansion units or barrels which telescope outwardly in a sequence starting with expansion of the larger outer barrels followed by expansion of smaller inner barrels and which telescope inwardly in the opposite sequence, i.e. starting with retraction of the smaller inner barrels followed by retraction of larger outer barrels.

In the present lift mechanism a plurality of these hoists are operatively tied together by a novel fluid control mechanism. The fluid control mechanism simultaneously supplies pressurized fluid to both the expansion and retraction chambers of each of the hoists. Both outward and inward forces are exerted on the hoists but because the lift areas of the expansion chambers are greater than that of the retraction chamber the telescoping hoists expand. By selecting the downward or inward acting force at the retraction chambers to be substantially greater than the force exerted by the load, unequal distribution of the load among the hoists is minimized. Effectively, the hoists experience the same downward forces and therefore telescope outwardly at substantially the same rate of expansion. Mechanically tying the hoists to the same elevator platform also aids the hoists to expand and retract at the same rate. Accordingly, it is another object of the present invention to devise means for obtaining substantially uniform expansion of a plurality of telescopic hoists.

Yet another object of the present invention is to provide in a multiple lift hoist system a double acting cylinder capable of exerting a force against its own force of expansion. In addition, it is an object of the present invention to devise a double-

acting hydraulic hoist wherein a fluid such as a hydraulic liquid is introduced into both chambers of the hoist through the same end. This latter objective is accomplished by employing one inlet means providing passage directly to the expansion chambers and second inlet means adjacent the first providing passage indirectly to the retraction chambers. The second inlet means being in direct fluid communication with an interior chamber formed within the innermost barrel of a hoist which in turn is in direct fluid communication with the retraction chambers.

It is another object of the present invention to devise a telescopic hoist capable of resisting rotation of its telescoping components. This object is accomplished by employing non-concentrically shaped spacers or headers between the barrels. The nonconcentrically shaped headers permit expansion and retraction of the barrels but prevent rotation. It is also an object to interfit the nonconcentric elements so as to increase the structural strength of a hoist.

Still another object of the present invention is to provide means in a hydraulic hoist for purging air and other gases from the hoist.

Another object of the present invention is to devise a hydraulic lift mechanism having a load carrying platform and at least two hydraulic hoists mounted on a portable carriage.

Another object is to provide a load-carrying platform that is compact when stored in its lowest position.

Another object is to provide a carriage having a hoist-elevated load carrying platform, the personnel supporting floor of which may be lowered to below the top of the retracted hoist.

DESCRIPTION OF THE DRAWINGS

Other objects and features of the present invention will be apparent from a further reading of the present application with reference to the drawings which are:

FIG. 1 is a cross section elevational view of a hydraulic hoist with a break line therethrough shown in the fully retracted position;

FIG. 2 is a plan view of a hydraulic fluid control system for the present lift mechanism;

FIG. 3 is an end elevational view of the hydraulic fluid control system shown in FIG. 2;

FIG. 4 is a perspective view of the present lift mechanism shown in the fully retracted position with an elevator platform resting on a supporting portable carriage;

FIG. 5 is a perspective view of the lift mechanism of FIG. 4 with the elevator platform positioned in a fully extended position; and

FIG. 6 is a plan view of a hoist according to the present invention having nonconcentrically shaped headers for preventing rotation of the barrels.

DESCRIPTION OF THE INVENTION

The hoist of the present invention as shown in FIG. 1 is comprised of innermost barrel 1, intermediate barrels 2, 3 and 4 and outer barrel 5. As clearly seen each of the barrels are of similar configuration and of successively smaller diameter enabling the barrels to telescope outwardly and inwardly relative to one another. The barrels are made from open ended steel alloy tubes. Pistons 8-11 cap the lower open ends of the tubes and define in the spaces between them and the expansion chambers 15-18. The surface of the lower ends of the barrels provide part of an expansion chamber lift area along with the surfaces of the pistons. All the barrels, except outer barrel 5, are turned on a lathe to form the shoulders 20. Headers 21-24 are welded or otherwise fixed to the barrels 2-5 as shown and define retraction chambers 26-29 along with shoulders 20.

Plug 31 caps the upper open end of inner barrel 1 defining with piston 8 interior chamber 32 within the inner barrel. Fluid communication is established between an external fluid source and the retraction chambers by the telescopic inlet

conduit 33 extending through pistons 8-12 into interior chamber 32 and by holes 34 drilled in the walls of the barrels beneath the shoulders 20. Fluid communication is established between an external fluid source and the expansion chambers 15-18 by inlet conduit 35 and bores 37 drilled through all but the inner piston 8.

Inlet conduit 33 remains in fluid communication with interior chamber 32 as the barrels expand from the fully retracted position shown in FIG. 1 to a fully extended position. The telescoping conduit 33 has four pipes 38-41 of similar configuration and successively larger diameter telescopically interfitted. The lower ends of the two intermediate pipes 39 and 40 and of the inner pipe 37 are anchored to intermediate pistons 9-11 and outer piston 12 respectively. Appropriate fluid seals are incorporated at the anchor points of each pipe. Pipes 39, 40 and 41 start moving upward with upward movement of piston 11, pipes 40 and 41 continue to rise with the movement of piston 10 and pipe 41 continues to rise with movement of piston 9 maintaining a fluid passageway to the interior chamber 32 at all stages of expansion of a hoist.

Piston rings 43 are fitted about each barrel in appropriate slots 44 below the shoulders 20 to form a fluid seal for the retraction chambers. Beneath piston rings 43 are piston rings 45 and wear strips 46 fitted into appropriate slots in the barrels to provide additional sealing and an adequate bearing surface. Wiper strips 47 are seated in appropriate slots in headers 21-24 to create a seal to prevent foreign objects from getting inside the hoist. Seals 42 create a fluid seal for the upper ends of the retraction chambers.

To outwardly telescope the barrels 1-4, fluid is pumped into the hoist through inlet conduit 35. The term fluid is intended to include both liquids and gases since the hoist can be adapted to operate in response either to a gas or liquid. The presently preferred fluid is a hydraulic oil liquid. The fluid fills the outer expansion chamber 18 and flows to the remaining chambers 15-17 through the bores 37 in the pistons 9-12. The force exerted by the fluid on piston 11 is the greatest because of its greater surface area due to its size. Piston 11 is therefore moved upward by the force exerted on it, carrying with it barrel 4 to which it is welded and carrying with it also the successively smaller barrels 1-3. Barrel 4 moves outwardly relative to barrel 5 until its shoulder 20 contacts header 24. As long as fluid is continued to be pumped into the hoist, the force on piston 10 continues to raise barrels 1-3 until the shoulder 20 on barrel 3 contacts header 23. This process of expansion continues until the shoulder on the inner barrel 1 contacts header 21.

Air and other gases are purged or expelled from the expansion chambers during the initial introduction of a hydraulic liquid into the hoist. The fluid, in this case a liquid, forces gases through the check valve 48 into interior chamber 32. Chamber 32 has a venting valve 49 mounted in plug 31 through which the gases escape when the interior chamber is filled with the hydraulic liquid. Valve 49 is closed when chamber 32 is filled with the fluid and remains closed during operation of the hoist.

Retraction or inward telescoping of a hoist begins with the inner barrel 1. Fluid is pumped into interior chamber 32 through telescopic input conduit 33. The fluid flows through the hole 34 in the innermost barrel 1 to retraction chamber 26. The fluid pressure acts on the surfaces of header 21 coupled to the adjacent larger barrel 2 and the shoulder 20 on barrel 1 causing barrel 1 to retract into barrel 2. The surface area in retraction chamber 26 on which the fluid exerts a force, i.e. the lift area, is less than that of the lift area of expansion chamber 15. Likewise the lift areas of the other retraction chambers are less than the lift areas of their corresponding expansion chambers. This is apparent from inspection of FIG. 1 illustrating the larger surface areas of the pistons relative to the headers and shoulders. The manner in which this difference in lift area is employed in a lift mechanism is more fully explained below.

As barrel 1 retracts into barrel 2 the piston ring 43 on barrel 1 passes hole 34 of barrel 2 allowing fluid to flow into retraction chamber 27. The fluid in retraction chamber 27 causes barrels 1 and 2 to retract into barrel 3. Fluid passes to the remaining retraction chambers in like manner until the barrels reach the fully retracted position of FIG. 1.

In the lift mechanism of the present invention as illustrated in FIGS. 4 and 5, two of the foregoing described hoists 52 and 53 are coupled to carriage 54 and operate together to raise and lower platform 55. A fluid control system 56 is located on the carriage in housing 57. The fluid control system is in fluid communication with hoists 52 and 53 causing them to expand and retract at substantially the same rate to avoid locking of their telescoping components, i.e. the barrels. Platform 55 being mechanically tied to the two hoists aids in helping to maintain their expansion and retraction rates substantially the same. During expansion of the hoists fluid is simultaneously supplied to the expansion and retraction chambers of the hoists. The force generated by the fluid in the retraction chambers of the two hoists are substantially the same giving the hoists equal loads against which fluid in the expansion chambers work. The force created in the retraction chamber is designed to be generally much larger than the force exerted by the load. Therefore, unequal distribution of a load between the two hoists does not cause a substantial difference in the expansion rate of the two hoists.

The fluid control system includes conduits 60-63 coupled to the expansion and retraction chamber inlet conduits 33 and 35 on hoists 52 and 53. Conduits 60 and 62 are coupled to the expansion chamber inlets on the two hoists. Reservoir 65 contains the fluid for the lift mechanism and may be any suitable hydraulic oil as commonly employed. The fluid is pumped from the reservoir by an appropriate constant displacement pump and motor 66 first passing through filter 67. The pump maintains the pressure of fluid delivered to the system at a predetermined constant level. Conduit 68 couples the filter to the intake of pump 66. Conduit 70 couples the outlet of pump 66 to mixer joint 71. Check valve 70a is coupled to conduit 70 to limit the direction of fluid flow solely to the direction from the pump to the mixer joint. Mixer joint 71 is coupled to the retraction chamber inlet conduits 61 and 63. The mixer joint is constructed from output T-joint 72, input T-joint 73 and output elbow 74. The output elbow of the mixer joint is coupled to passive joint 76. The passive joint is a T-joint pipe connector coupled at its stem to output elbow 74 and at its arms to the expansion chamber inlet conduits 60 and 62.

Switching means are provided to control the direction of fluid flow to and from the expansion and retraction chambers of the hoists and thereby control their inward and outward expansion. The switching means includes the four solenoid operated spool or diaphragm valves 80-83. The spool or diaphragm valves are two position valves which are normally closed preventing fluid flow through them. When the solenoids on the valves are energized by a suitable electrical energy source the valves open to pass fluid. Spool valves 80 and 81 are coupled in series with inlet conduits 60 and 62 between the hoists and passive joint 76. Spool valves 82 and 83 are coupled to reservoir 65 in parallel with the conduits 60 and 62. T-joints 85 and 86 are coupled to conduits 60 and 62 and to conduits 87 and 88. Conduits 87 and 88 are coupled in series with the spool valves 82 and 83 and meet at venting joint 90. The venting joint is coupled to the expansion chambers of the two hoists in parallel with the passive joint.

Venting joint 90 is a four-way pipe connector with left and right orifices coupled to the conduits 87 and 88 respectively. The lower orifice is coupled to conduit 91 which terminates at reservoir 65. The upper orifice of the venting joint is coupled to conduit 92 having hand operated valve 93 coupled in series with it with its handle in its normally off position. The valve prevents passage of fluid when the handle is in the off position and passes fluid when the handle is turned clockwise 90° to an on position.

Conduit 92 terminates in by-pass joint 95. The by-pass joint is a T-joint connector connected to conduit 92 at its stem and to conduits 96 and 97 at its arms. Conduits 96 and 97 are in turn connected to the stems of T-joints 98 and 99 connected by their arms to the expansion chamber inlet conduits 60 and 62 between T-joints 85-86 and spool valves 80 and 81. The by-pass joint is coupled to the expansion chambers of the two hoists in parallel with both the passive and venting joints. Hand operated valve 93 is coupled between the by-pass and venting joint and provides an auxiliary means for retracting the hoist by providing a passage for bleeding fluid from the expansion chambers that by-pass the spool valves 80-83.

The electrical energy source for operating the solenoids on valves 80-83 is contained in housing 101. The four electrical connector bundles 102 extend from the circuitry in housing 101 to the solenoids on the valves 80-83. The solenoids on valves 80 and 81 are electrically coupled in series to simultaneously energize them and the solenoids on valves 82 and 83 are likewise coupled in series. The electrical circuitry includes a switch to alternately couple the energy source to either of the two pairs of solenoids. The operation of this switch is controlled from a manually operated switch preferably located on platform 55 of the lift mechanism. Placing the manual switch to one position energizes the solenoids of valves 80 and 81 and deenergizes solenoids of valves 82 and 83 for outward telescoping the hoists. Placing the manual switch to a second position deenergizes the solenoids of valves 80 and 81 and energizes the solenoids of valves 82 and 83 for inward telescoping the hoists.

With valves 80 and 81 open (their solenoids energized) and valves 82 and 83 closed (their solenoids deenergized), fluid is pumped from conduit 70 to mixer joint 71 and passive joint 76 enabling fluid pressure to build up in the expansion and retraction chambers of hoists 52 and 53. With the hoists fully retracted, the fluid pressure in the expansion chambers causes the barrels to begin movement in the sequence discussed earlier. The fluid in the retraction chambers is displaced by the upward movement of the barrels. The displaced fluid is not vented to the reservoir but is combined with the fluid from conduit 70 at mixer joint 71. Therefore, pressure is developed in the fluid in the retraction chamber which exerts a force on the barrels against which the fluid in the expansion chamber works to telescope the hoists outwardly. The force in the retraction chamber is less than that of the expansion chambers. The forces are proportional to pressure and lift area and because the lift areas of the expansion chamber are greater the hoists expand. Conduits 61 and 63 are smaller in diameter than conduits 60 and 62 and conduit 70 is larger in diameter than any of the conduits 60-63.

The lift mechanism is designed such that the force generated in the inner retraction chambers of hoists 52 and 53 is at least as large as the greatest load expected to be elevated. During expansion, therefore, each hoist works against a sufficiently large force such that any unequal distribution of the load on platform 55 has a negligible effect on the expansion rate of the hoists.

Pump 66 is shut off when the platform is raised to the desired elevation. Conduit 104 is coupled to a pressure release valve in pump 66 to release excessive pressures.

The platform is retracted by opening valves 82 and 83 (energizing their solenoids) and closing valves 80 and 81 (deenergizing their solenoids). Fluid is pumped into mixing joint 71 but flows only to the retraction chambers of the hoists because valves 80 and 81 are closed. The pressure of the fluid in the retraction chambers creates a force which retracts the barrels of the hoists in the sequence of inner barrels first as described earlier. The fluid in the expansion chambers is displaced and vented through valves 82 and 83 and vent joint 90 to the reservoir. Platform 55 includes a floor 105 for supporting personnel and protective upright side walls 106 which may be of heavy wire mesh or the like. The hoists 52 and 53 are mounted in inverted generally U-shaped brackets 107 such that the floor 105 is suspended below the upper ends of the

hoists. As is readily apparent, the floor of the platform can be raised and lowered over a wide range of vertical positions. One particular advantage is that by lowering the floor below the top ends of the hoists workmen are able to work comfortably beneath low structures or machines, such as aircraft or the like.

Carriage 54 includes upper frame 108, lower frame 109 interconnected by welded support struts 110. Ladder 111 assists an operator to enter the platform. The motor and other hydraulic pumping of the fluid control system 56 is contained in the housing 57 supported by the lower carriage frame 109. Tongue 113 pivots downwardly to permit attachment to a towing vehicle. Floor jacks 114 are lowered to the ground raising the carriage off casters 115 to stabilize the lift mechanism during operation. The entire lift mechanism can be installed on the bed of a truck or other vehicle if desired.

FIG. 6 is a plan view of a hoist such as that in FIG. 1 wherein headers 117-120 corresponding to headers 21-24 are nonconcentrically shaped to resist rotation of the barrels relative to one another. Barrels 122-126 correspond to barrels 1-5 in FIG. 1 and have shoulders corresponding to shoulders 20 in FIG. 1 beneath headers 117-120 similarly nonconcentrically shaped to define the retraction chambers. The nonconcentric inner and outer walls of the headers have centers 128 and 129. The hoist is readily constructed from stock tubing merely by turning the barrels 122-126 on a lathe about the nonconcentric center 129 to form the nonconcentric shoulders. The pistons in this case cap the lower end of each barrel and form, along with the nonconcentrically shaped lower ends of the barrels, the surface on which fluid acts to expand a hoist. Likewise, the headers are turned on a lathe to obtain their nonconcentric shape. A non-rotating hoist is therefore made possible using simple components adapted to ease of construction. Aligning the interfitted barrels such that the thickest side of the barrels and headers are positioned in line to one side of the hoist creates not only a non-rotating hoist but a hoist with superior structural strength. This hoist is capable of bearing greater loads when oriented away from vertical because the thickness of the materials in the hoist is greater on one side.

It is believed that the invention will have been clearly understood from the foregoing detailed description of my now-preferred illustrated embodiment. Changes in the details of construction may be resorted to without departing from the spirit of the invention and it is accordingly my intention that no limitations be implied and that the hereto annexed claims be given the broadest interpretation to which the employed language fairly admits.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A telescopic fluid operated hoist comprising:
 - a plurality of open ended barrels of successively smaller diameter with smaller barrels movably fitted within successively larger barrels, a plurality of pistons of successively smaller diameter for coupling to the bottom open end of corresponding size barrels supporting successively smaller barrels and defining expansion chambers between adjacent pistons and having means for fluid communication between said expansion chambers, a plurality of headers of successively smaller diameter for coupling to corresponding size barrels above corresponding size pistons positioned between adjacent barrels, a shoulder on the outside of all but the largest barrel defining with the header coupled to an adjacent larger barrel a retraction chamber therebetween, said barrels having means for fluid communication between said retraction chambers, first and second inlet means coupled to the largest piston for fluid communication between a fluid pressure source and said expansion and retraction chambers respectively, and wherein said barrels are generally circular in cross-section and are nonconcentrically fitted within each other to prevent rotation therebetween by nonconcentric shaped headers with said shoulders shaped to match generally the shape of said nonconcentric headers.

2. The hoist of claim 1 wherein said barrels and said non-concentrically shaped headers are aligned relative to each other such that the thickest portions of the barrels and headers are positioned to the same side increasing the structural strength of the hoist.

3. A telescopic fluid operated hoist comprising:

a plurality of open ended barrels of successively smaller diameter with smaller barrels movably fitted within successively larger barrels, a plurality of pistons of successively smaller diameter for coupling to the bottom open end of corresponding size barrels supporting successively smaller barrels and defining expansion chambers between adjacent pistons and having means for fluid communication between said expansion chambers, a plurality of headers of successively smaller diameter for coupling to corresponding size barrels above corresponding size pistons positioned between adjacent barrels, a shoulder on the outside of all but the largest barrel defining with the header coupled to an adjacent larger barrel a retraction chamber therebetween, said barrels having means for fluid communication between said retraction chambers, and first and second inlet means coupled to the largest piston for fluid communication between a fluid pressure source and said expansion and retraction chamber respectively, said means for fluid communication between said expansion chambers including bores providing passageways from below larger pistons to above adjacent smaller pistons and wherein said first inlet means includes a fluid conduit coupled to the bore in the largest piston, said means for fluid communication between said retraction chambers including holes in the walls of all but the largest barrel providing passageways between said retraction chambers and an interior chamber in the smallest barrel defined by a plug capping the upper open end

of the barrel and the piston coupled to the smallest barrel, said second inlet means includes a telescoping multi-stage fluid conduit extending through said pistons into said interior chamber for coupling to a fluid source at a position adjacent said first inlet means for fluid communication between a fluid source and said interior chamber throughout expansion and retraction of said barrels, including a check valve positioned in said interior chamber coupled to a bore through the smallest piston and a venting valve coupled to said plug capping said interior chamber, said venting valve being open during initial filling of said system with a fluid introduced through said inlet means forcing unwanted fluids from said expansion chambers through said check valve into said interior chamber and with a fluid introduced through said second inlet means forcing unwanted fluids in said interior chamber through said venting valve thereby purging the hoist of unwanted fluids.

4. A telescopic fluid operated hoist comprising:

a plurality of barrels of successively smaller dimensions with smaller barrels interfitted within larger barrels allowing movement relative to each other for expanding and retracting said hoist, means for defining expansion chambers between adjacent barrels and for establishing fluid communication between said chambers, said expansion chambers having lift areas on which fluid pressure introduced therein acts to move the barrels of said hoist, each of said barrels being eccentrically mounted in said next larger barrels such that rotation of a smaller barrel within a larger barrel is precluded.

5. The hoist of claim 4 said barrels having headers confining the outer surfaces of the next smaller barrels, said next smaller barrels being eccentric to said confining headers.

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