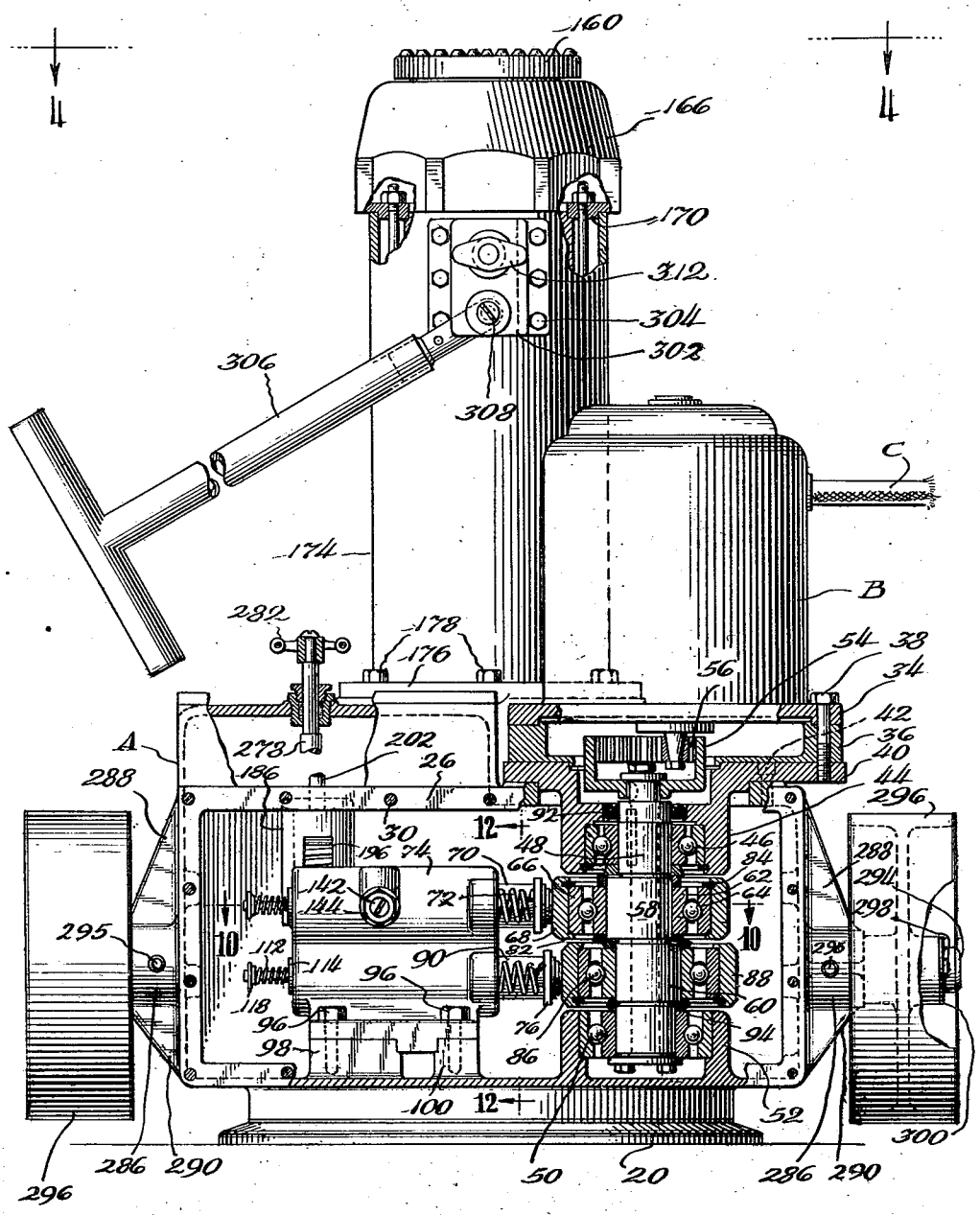
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HYDRAULIC JACK

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Fig. 1.



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Fig. 2.

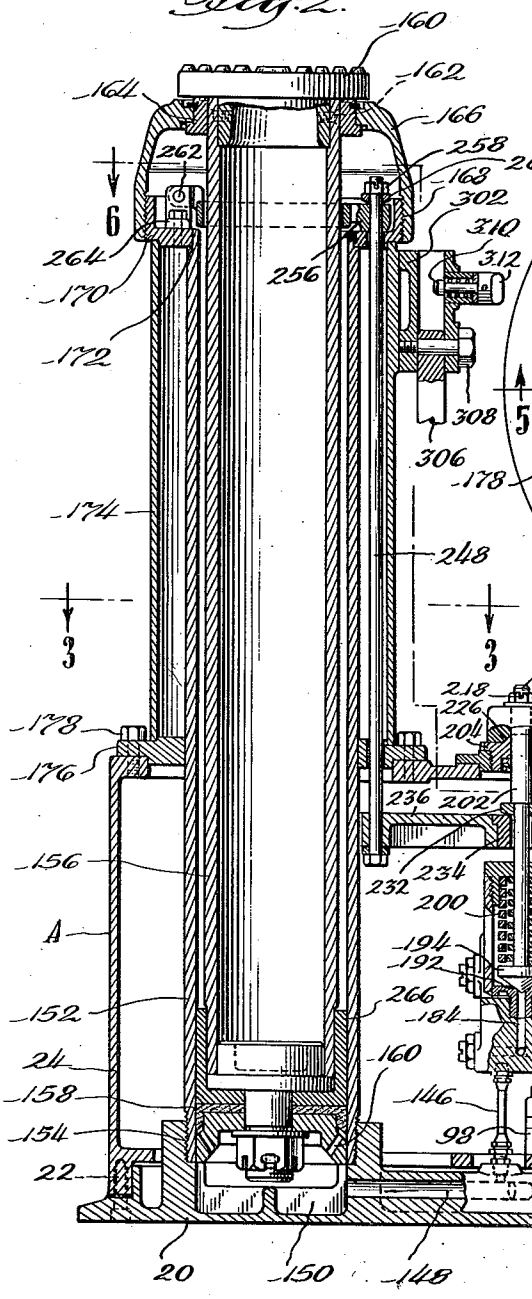
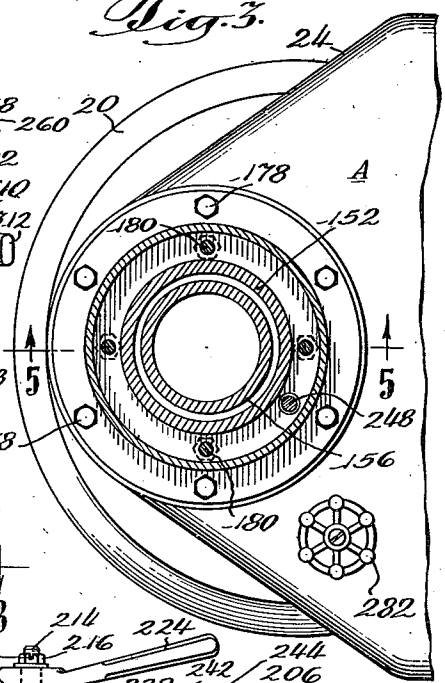


Fig. 3.



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Fig. 4.

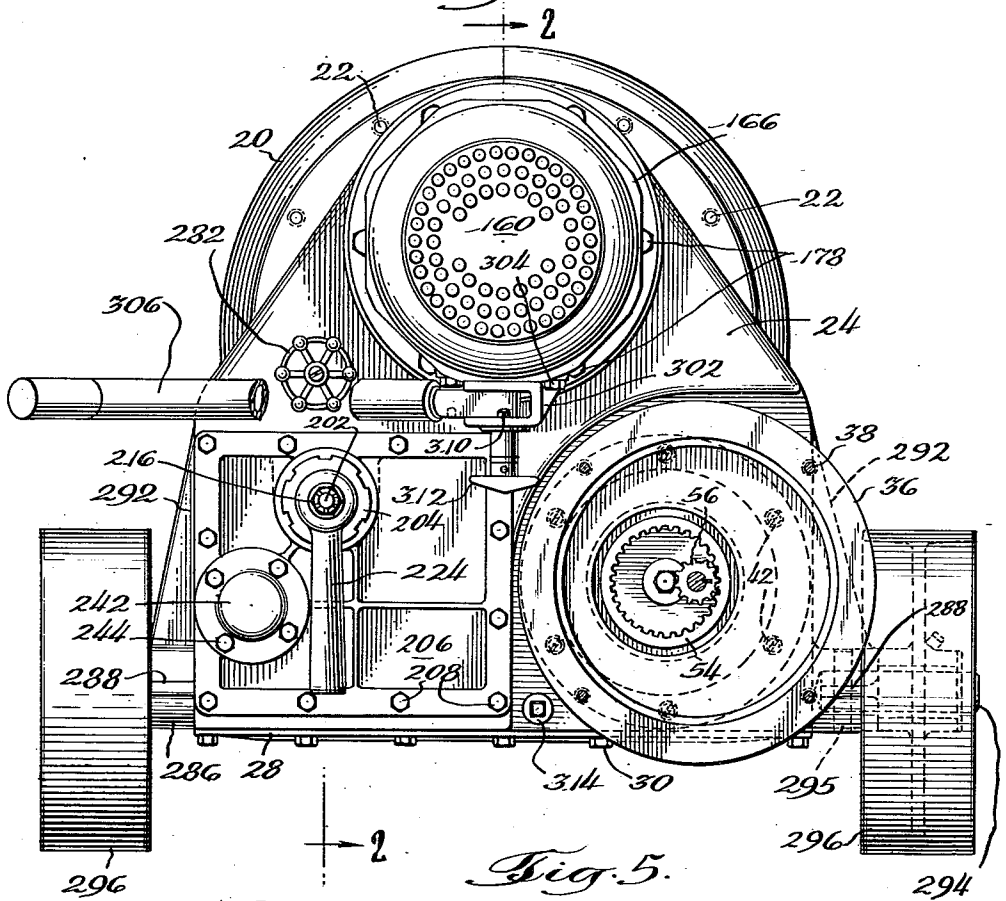
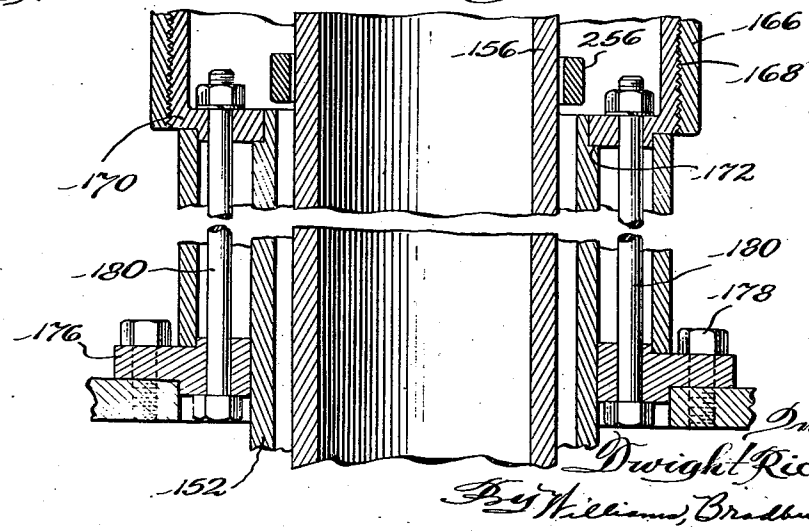


Fig. 5.



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Fig. 6.

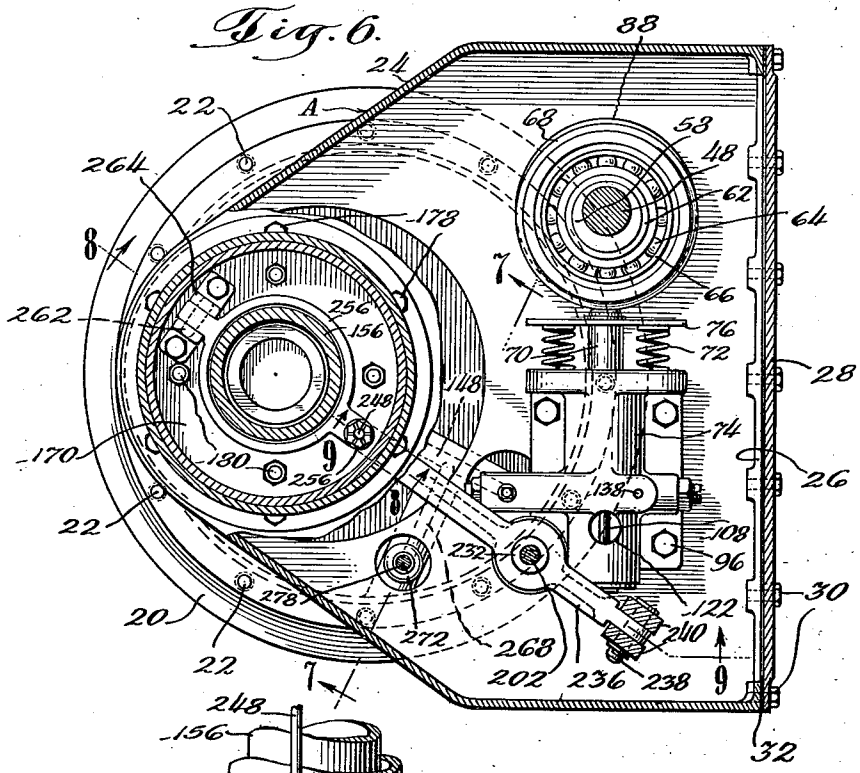


Fig. 7.

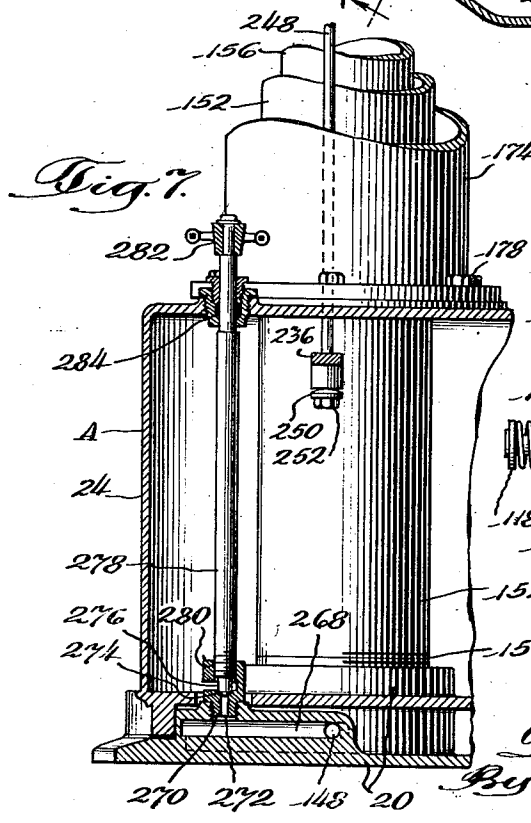
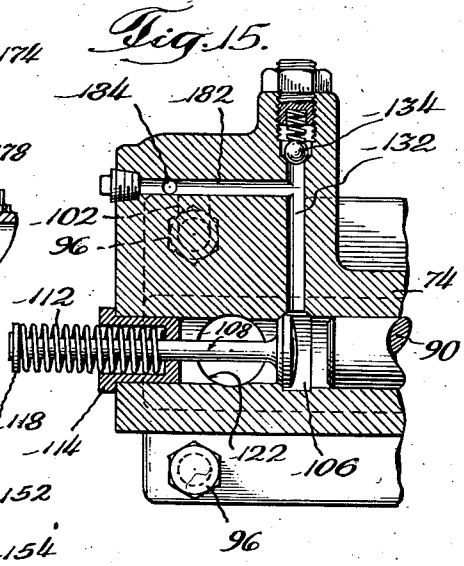


Fig. 15.



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Fig. 8.

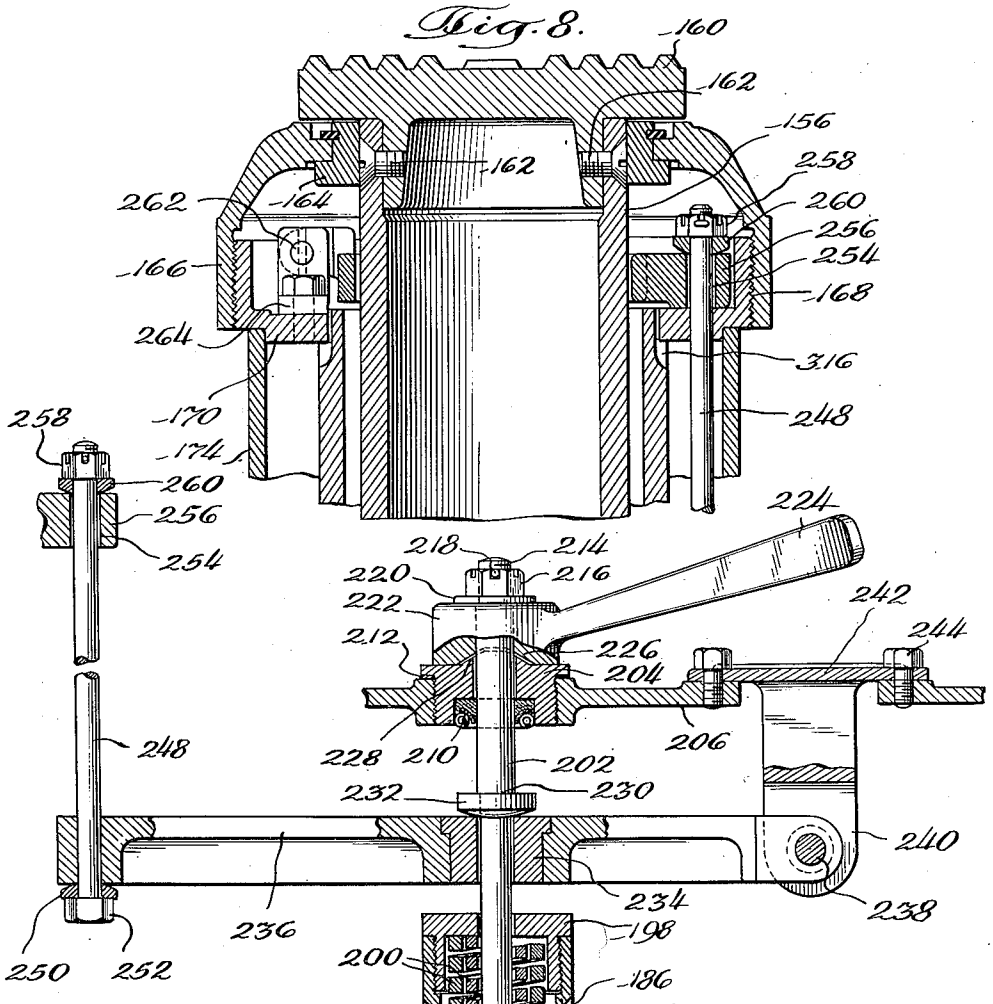


Fig. 9.

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Fig. 10.

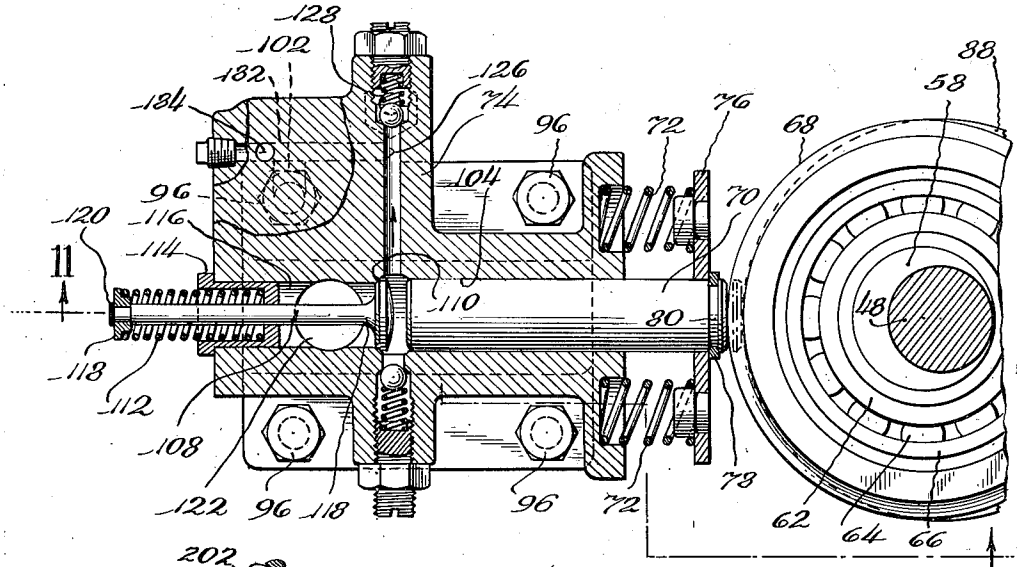
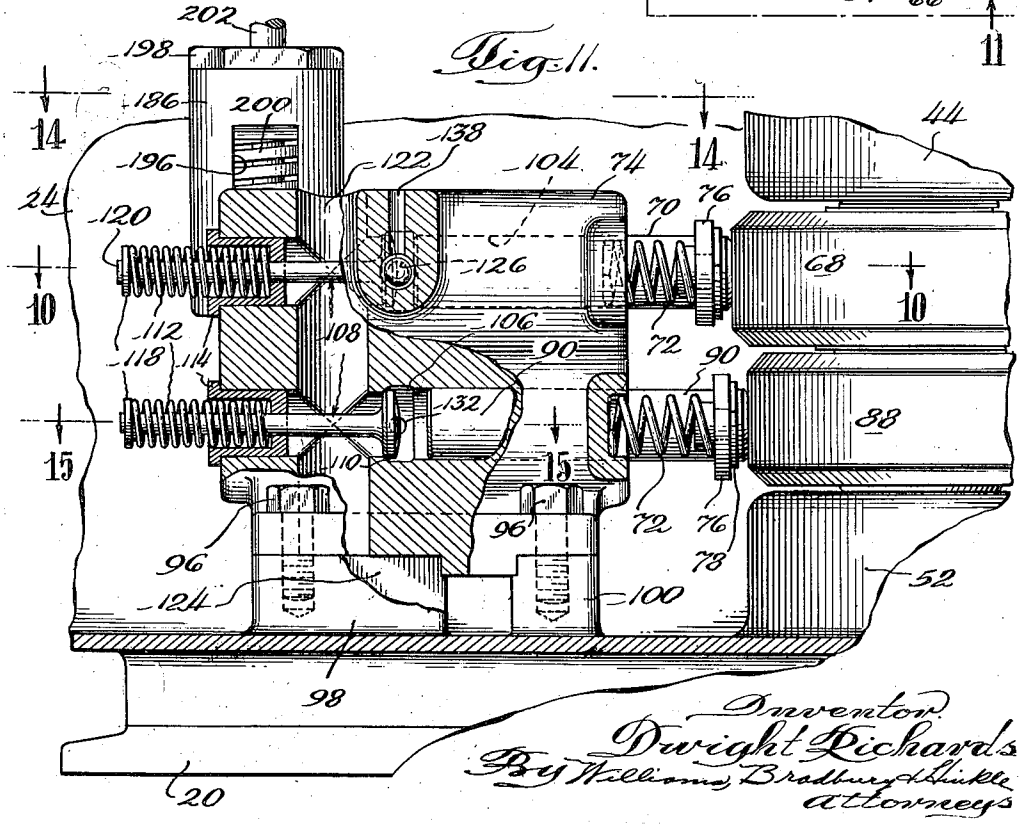


Fig. 11.

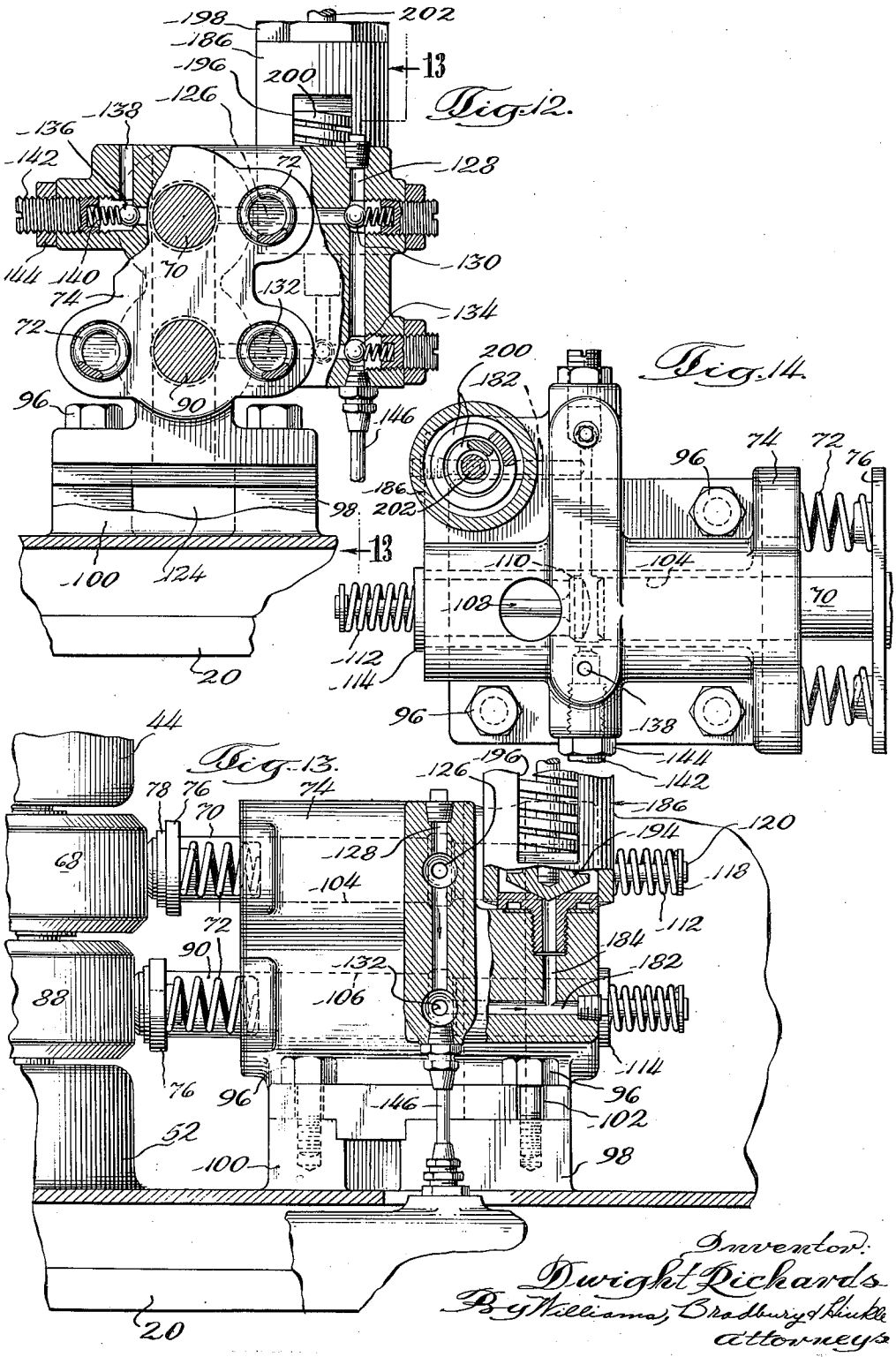


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HYDRAULIC JACK

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Patented May 20, 1947

2,420,910

UNITED STATES PATENT OFFICE

2,420,910

HYDRAULIC JACK

Dwight Richards, Harvey, Ill., assignor to The Buda Company, Harvey, Ill., a corporation of Illinois

Application March 27, 1944, Serial No. 528,301

2 Claims. (Cl. 254—93)

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My invention relates to hydraulic jacks and more particularly to hydraulic jacks designed to lift heavy loads.

An object of my invention is to provide a new and improved hydraulic jack which may be quickly and easily operated by a single operation to raise and lower heavy loads.

Another object of my invention is to provide a new and improved hydraulic jack which may be easily moved from place to place to raise or lower heavy loads.

Another object of my invention is to provide a new and improved hydraulic jack which may be quickly and efficiently operated to raise a heavy load to any desired height and which may be operated with equal facility to bring a heavy load into vertical alignment with any desired object.

Another object of my invention is to provide a hydraulic jack having new and improved mechanism for preventing overtravel of the ram.

Another object of my invention is to provide a hydraulic jack having a new and improved automatic pressure release valve.

Another object of my invention is to provide a hydraulic jack having new and improved pumping mechanism.

Another object of my invention is to provide a new and improved hydraulic jack which may be designed to lift heavy loads falling within a wide weight range.

Another object of my invention is to provide a new and improved hydraulic jack which may be operated by different kinds of motors.

Another object of my invention is to provide a new and improved hydraulic jack adapted either for motor or hand operation.

Other objects and advantages will become apparent as the description proceeds.

In the drawings:

Fig. 1 is an elevation partially in section showing a preferred form of my invention;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 4;

Fig. 3 is a horizontal sectional view through the ram structure and is taken on the line 3—3 of Fig. 2;

Fig. 4 is a top plan view showing the jack with the motor removed;

Fig. 5 is a partial vertical section taken on the line 5—5 of Fig. 3;

Fig. 6 is an irregular horizontal section taken on the line 6—6 of Fig. 2;

Fig. 7 is a partial vertical section taken on the line 7—7 of Fig. 6 and showing particularly the

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control valve for lowering the load to a predetermined elevation;

Fig. 8 is a partial vertical sectional view of the load supporting structure and is taken on the line 8—8 of Fig. 6;

Fig. 9 is a partial vertical sectional view taken on the line 9—9 of Fig. 6 and showing the automatic pressure release valve and the manual control for this valve;

Fig. 10 is a horizontal sectional view of the pumping mechanism and is taken on the line 10—10 of Fig. 1;

Fig. 11 is a vertical sectional view of the pumping mechanism and is taken on the line 11—11 of Fig. 10;

Fig. 12 is a sectional view showing the port arrangement of the pumping mechanism and is taken on the line 12—12 of Fig. 1;

Fig. 13 is a sectional view of the pumping mechanism taken on the line 13—13 of Fig. 12;

Fig. 14 is a plan view of the cylinder block and associated parts of the pumping mechanism and is taken on the line 14—14 of Fig. 11; and

Fig. 15 is a fragmentary sectional view of the high pressure pumping cylinder and associated mechanism and is taken on the line 15—15 of Fig. 11.

Referring particularly to Fig. 1, it will be seen that I have provided a hydraulic jack comprising a main housing or reservoir A forming a support for an operating motor B which may be either an electric motor or a pneumatically operated motor and which is connected with a suitable source of electricity or air under pressure by means of an electrical conductor or flexible hose C. As shown more clearly in Fig. 2, the housing A comprises in general a base casting 20 attached by bolts 22 to a triangular casting 24. This triangular casting 24 has a side opening 26 normally closed by a plate 28 secured to the casting 24 by bolts 30. A sealing gasket 32 is interposed between the plate 28 and casting 24 to prevent the leakage therebetween of the oil or hydraulic fluid with which the housing A is substantially filled.

The motor B is illustrated as having a flange 34 resting upon a ring 36. The motor and ring are secured by screws 38 to a motor support 40 attached to a recessed portion of the triangular casting 24 by means of screws 42. The motor support 40 has a boss 44 carrying a roller or other suitable bearing 46 for the upper end of a drive shaft 48. The lower end of the drive shaft 48 is mounted in a second roller or other suitable bearing 50 carried in an upstanding boss 52 provided by the base 20.

An internal gear 54 is keyed to the upper end of the drive shaft 48 and meshes with the motor pinion 56. It will be noted that the motor pinion 56 has an axis out of alignment with the axis of the drive shaft 48 and internal gear 54 so that the pinion of the particular motor shown engages the right hand side of the internal gear 54, as viewed in Fig. 1. The particular motor shown is a commercial electric motor of conventional design and may be removed to permit the substitution of a commercial pneumatic motor which has its driving pinion differently positioned relative to the base of the motor. The internal gear 54 is of such size that it is adapted to mesh with the pinion of either the standard electric motor or the standard pneumatic motor with which the jack is designed to operate. These motors may, therefore, be used interchangeably without changing of the jack structure and this constitutes an important advantage.

In some instances it may be desirable to utilize my hydraulic jack where neither a suitable source of electric energy nor a suitable source of compressed air is available. Under such circumstances my novel jack may be manually operated by substituting a gear box for the motor B and manually turning a crank which drives the driving shaft 48 through the gearing contained in the gear box which is substituted for the motor B. Any suitable gear box may be utilized for this purpose, the only requisite being that the reduction provided must be adequate to obtain the available manual force to raise the load.

The drive shaft 48 has a pair of eccentrics 58 and 60 adapted to drive separate pistons of the pumping mechanism. The upper eccentric 58 operates the piston of a low pressure cylinder and has a materially greater throw than the eccentric 60 which operates the piston of a high pressure cylinder. The eccentric 58 is surrounded by the inner race 62 of a ball bearing, indicated generally by reference character 64. The inner race of this bearing rotates with the eccentric 58 whereas the outer race 66 is located in and fixed relative to an eccentric sleeve 68 which is free to rotate but is normally held against such rotation by frictional engagement with the adjacent end of its piston 70, best shown in Fig. 10. This piston is urged into engagement with the sleeve 68 by a pair of springs 72 confined between a cylinder block 74 and a cross bar 76 which engages a C ring 78 located in a groove 80 in the piston 70.

The sleeve 68 (Fig. 1) is held against vertical displacement relative to the outer race 66 by an inwardly projecting flange 82 at the lower end of the sleeve 68 and a C ring 84 located in a groove in the upper end of this ring. The high pressure eccentric 60 is similarly provided with a ball bearing 86 located between it and its eccentric sleeve 88, which directly engages the adjacent end of the high pressure piston 90 (Fig. 11). This piston is also provided with compression springs 72, a cross bar 76 and a C ring 78 to hold the end of the piston at all times in engagement with its eccentric sleeve 88.

Since the housing A contains oil or hydraulic fluid, means must be provided to prevent leakage of this fluid around the upper end of the driving shaft 48. This means comprises a sealing gasket 92 interposed between this shaft and a surrounding and cylindrically formed portion of the motor support 40. Metal washers 94 are located along the drive shaft 48 between the ball bearings 46, 64, 86 and 50 to prevent vertical displacement of the inner races of these bearings.

The cylinder block 74 is attached to the base 20 by bolts 96 which screw into bosses 98 and 100 provided by this base. The bolt 96 which is shown in the upper left hand corner of Fig. 10 is covered by an overhanging portion of the cylinder block 74 which prevents unscrewing of this bolt in the same manner in which the other three bolts are unscrewed. The base of the cylinder block 74 is accordingly provided with a slot 102 whereby the cylinder block can be slipped out from beneath the head of this particular bolt after this bolt has been loosened and the other three bolts have been removed.

The cylinder block 74 has an upper or low pressure cylinder 104 and a lower or high pressure cylinder 106. Each cylinder has an inlet valve 108 urged against its valve seat 110 by a spring 112. One end of each spring 112 is located in a recess provided in a spring seat 114 pressed into a reduced bore 116 in alignment with each of the cylinders. The other end of each spring 112 rests against a washer 118 secured by riveting over the end of the valve stem, as indicated by reference character 120.

The inlet valves for the two cylinders control comunication between these cylinders and a vertical inlet passage 122 formed by drilling a hole through the cylinder block 74. Both ends of this passage 122 are in open communication with the interior of the reservoir formed by the housing A. The boss 98 is cut away as indicated at 124 to afford communication between the lower end of the passage 122 and the interior of the reservoir.

The lower pressure cylinder discharges through a passage 126 formed by a bore which intersects a vertical bore 128 (Fig. 12). Communication between these two bores is controlled by a spring pressed check valve 130. The high pressure cylinder also discharges into the vertical bore 128 by way of the passage 132 and communication between this latter passage and the vertical bore 128 is controlled by a second spring pressed check valve 134. The low pressure cylinder may also discharge directly to the reservoir through a pressure relief valve 136 which controls an outlet 138. This pressure relief valve is urged against its seat by a spring 140 confined between the ball valve 136 and a screw 142 threaded into the cylinder block to any extent necessary to give the desired compression of the spring 140. A lock nut 144 holds the screw 142 in adjusted position. The vertical bore 128 into which both high and low pressure cylinders discharge, is connected by a short pipe 146 to a duct 148 formed in the base casting 20 and leading to a cavity 150 which forms a continuation of the interior of the ram cylinder 152. This cylinder is screwed into a boss provided by the base casting 20, as clearly indicated at 154 in Fig. 2.

A ram 156 is located in the ram cylinder 152 and is moved upward therein by fluid pumped into the chamber 150 and lower end of the ram cylinder by the pumping mechanism which I have just described. The lower end of the ram 156 is formed as a piston forming a fluid-tight seal in the ram cylinder 152. This piston includes a hat-shaped sealing gasket 158 of leather, rubber, synthetic rubber or other suitable material. This sealing washer is fluid pressed into sealing engagement with the cylinder walls and ducts 160 in the lower end of the ram structure afford free fluid access to the downwardly projecting edge of this sealing gasket.

The upper end of the ram 156 has a load plate 160 attached thereto by screws 162. This end of the ram is guided by a ring 164 in which the ram freely slides. This ring is supported by and forms a part of a cap 166 threaded at 168 to an annulus 170. The inner edge of this annulus 170 rests on a shoulder 172 provided by the upper end of the ram cylinder 152.

A cylindrical jacket 174 surrounds the upper end of the ram cylinder 152 and is confined between the annulus 170 and an annular plate 176. This plate 176 is attached by screws 178 to the triangular casting 24 and forms a lateral support for the ram cylinder 152 at the point where this cylinder projects from the reservoir A. As most clearly shown in Fig. 5, the annulus 170 and annular plate 176 are connected by tie rods 180 which cooperate with the threads at the lower end of the ram cylinder 152 to attach this cylinder to the reservoir A. These tie rods also form the means for clamping the cylindrical jacket 174 firmly in place.

The passage 132 which connects the high pressure pumping cylinder with the ram cylinder by way of a vertical bore 128, pipe 146 and duct 148 also communicates with a cross bore 182 (Fig. 15) communicating with a short vertical bore 184 leading to a relief valve for relieving pressure in the ram cylinder. This relief valve is best shown in Fig. 9 and comprises a cap 186 having its lower or closed end in the form of a nipple 188 threaded into the cylinder block 74. The nipple 188 has a passage 190 leading to a valve seat 192 which is normally engaged by a tapered valve member 194 to prevent escape of fluid from the passage 190. The cap 186 has openings 196 in its side and is closed at its upper end by a screw plug 198. A pair of heavy springs 200 are confined between the plug 198 and valve member 194 and normally hold the latter firmly against its seat. These springs are designed to compress when the pressure in the passage 190 reaches a predetermined maximum. Such compression permits escape of fluid past valve member 194 and through openings 196 to the interior of the reservoir A and prevents the creation of an excess pressure which would be destructive to the apparatus.

The valve member 194 is also adapted to be manually controlled so that this valve member constitutes the usual control valve for releasing pressure in the ram cylinder and permitting escape of fluid therefrom to lower the ram. This valve member 194 is threadedly attached to the lower end of the valve stem 202 projecting upwardly through a tubular plug 204 threaded into a plate 206. The plate 206 closes an opening in the upper part of the casting 24 and is attached to this casting by screws 208. Sealing means 210 is carried by the plug 204 to prevent escape of fluid around the valve stem 202 and a sealing gasket 212 is preferably clamped between the plug 204 and plate 206.

The upper end of the valve stem 202 is preferably threaded, as indicated at 214, and a castellated nut 216 is screwed onto the threads 214 and locked in position by a cotter pin 218. A metal washer 220 is confined between nut 216 and the hub 222 of a handle 224 which pivots about the valve stem 202. The hub 222 has a diametral recess 226 which is complementary to a diametral ridge 228 provided by the plug 204. When the handle 224 is in the position shown, the ridge 228 is located in the recess 226 and valve member 194 is held in closed position by its springs 200. When the handle 224 is rotated, however, the lowermost portions of the hub 222 ride up on ridge 228 to pull upwardly on the valve stem 202 and lift the valve member 194 from its seat.

From the foregoing description of the valve member 194 and its operating mechanisms, it will be apparent that I have provided a convenient valve control which automatically limits the fluid pressure which can be built up in the ram cylinder and which also affords a convenient manual control for relieving fluid pressure in the ram cylinder. I have also provided novel means to limit travel of the ram and to prevent this ram from being forced out of the ram cylinder. This means also operates through valve member 194 and is most clearly shown in Figs. 2 and 9.

The valve rod 202 has a shoulder 230 forming an abutment for a thrust washer 232 having a rounded lower face adapted to be engaged by the wear resisting sleeve 234 mounted in a lever 236. The right hand end of this lever is pivotally attached by a pin 238 to a pair of downwardly extending arms 240 of a lever support 242 attached by screws 244 to the plate 206. The pin 238 is preferably drilled to receive cotter pins 246 which prevent axial displacement of the pivot pin 238.

The left hand end of the lever 236 is bored to receive slidably the lower end of a bolt 248. A rounded washer 250 is confined between the lever 236 and the head 252 of the bolt 248 whereby upward movement of this bolt will raise the left hand end of the lever 236.

Referring particularly to Figs. 2, 8 and 9, it will be seen that the upper end of the bolt 248 extends through an opening 254 in a second lever 256. The central portion of the lever 256 is annular and surrounds the ram 156 in spaced relation thereto. A castellated nut 258 is attached to the upper end of the bolt 248 and a rounded washer 260 is preferably interposed between this nut and the lever 256 whereby upward movement of the lever will produce a corresponding upward movement of the bolt 248.

The left hand end of the lever 256 is pivotally attached at 262 to a bracket 264 bolted or otherwise secured to the annulus 170. While the annular portion of the lever 256 is spaced from the major portion of the ram 156, this major portion is of reduced diameter. The lower end of the ram is provided with a shoulder 266 which is adapted to engage the lever 256 and raise it upwardly to lift valve member 194 from its seat. This effectively limits upward movement of the ram and prevents overtravel thereof.

While the handle 224 constitutes the usual means for relieving the pressure in the ram cylinder and lowering the load, it is desirable to provide a nicer control where the load is to be brought into exact alignment with the complementary part or other mechanism. The motor for operating the high and low pressure pistons will, of course, be provided with the usual switch or other control but it is not usually feasible to stop the motor with sufficient accuracy to raise the load to an exact position. I have, therefore, provided a separate control which permits the load to be positioned at any exact elevation.

The duct 148 formed in the base casting 20 and which serves to connect the ram cylinder with the pipe 146 leading from the pumping mechanism, also communicates with a substantial cross bore 268 also formed in the base cast-

ing 20. A fitting 270 (Fig. 7) is screwed into the base casting 20 and has a passage 270 communicating with the bore 268. The upper end of the passage 272 terminates in a valve seat 274 which is normally engaged by a needle valve 276 which closes the passage 272. Needle valve 276 is located at the lower end of a valve rod 278, whose lower end threadedly engages the upper part of the fitting 270, as indicated at 280. The upper end of the valve rod 278 projects through the upper wall of the reservoir A and has a hand wheel 282 attached thereto whereby this rod may be rotated to move the needle valve 276 into or out of engagement with its seat 274. Suitable packing 284 prevents escape of liquid around the valve rod 278 where it passes through the wall of the reservoir.

Since my hydraulic jack is too heavy to be carried conveniently by one man, I preferably provide the jack with wheels whereby it may be readily moved from place to place. As clearly shown in Figs. 1 and 4, the triangular casting 24 is provided with bosses 286 and reinforcing webs 288, 290 and 292. The bosses 286 are drilled to receive axles 294 which are held in place by pins 295 or otherwise suitably mounted in these bosses. Wheels 296 are mounted on the axles 294 and may be held in place by cotter pins 298 and washers 300.

A bracket 302 of U-shaped cross section is attached to the jacket 174 by screws 304, as best shown in Figs. 1 and 2. A handle 306 is pivotally attached to the bracket 302 by a screw 308. When the jack is in use the handle can be lowered by swinging it about its pivot 308, but when the jack is being moved from place to place the handle is swung to the position where it forms an upward extension or prolongation of the jacket 174. The handle is locked in this position by a spring pressed lug 310. When the handle is in this position the jack can be pivoted about its base until the wheels 296 engage the ground and thereafter the jack can be moved on its wheels to any desired location. When the new location is reached, the jack is again positioned with its base in contact with the ground and its wheels elevated as shown in Fig. 1. Grip 312 is then grasped to withdraw lug 310 and the handle 306 is then swung to its lower or retracted position.

The housing or reservoir A is preferably provided with a suitable filling opening which is normally closed by a removable screw plug 314 (Fig. 4). The reservoir should never be completely filled with oil or hydraulic fluid as the level of this fluid should preferably be about one inch below the recessed portion of the reservoir which forms the mounting for the motor B. It will be understood that the several plates which are attached to the reservoir are made fluid-tight by gaskets or other suitable means so that no leakage will occur between these plates and the reservoir castings. Any fluid which may leak past the piston-like lower end of the ram 156 can return to the reservoir by way of the grooves 316 (Fig. 8) which are cut in the upper end of the ram cylinder. The guide ring 164 fits closely about the ram 156 so that any fluid adhering to the ram will be scraped off.

In operating my novel jack the handle is extended and the jack is trundled into position beneath a load. The handle is then placed in retracted position and the jack tilted over so that it rests on its base with the ram directly beneath the part of the load which is to be engaged by the jack. The motor is connected with a suitable source of current or compressed air and the switch or other control is moved to the power position to start the motor. When the motor starts, both the high pressure and low pressure pistons are reciprocated to force fluid to the ram cylinder. The low pressure cylinder discharges considerably more fluid than the high pressure cylinder for each rotation of the drive shaft, since the eccentric for the low pressure piston gives this piston a greater stroke.

The ram is moved rapidly into engagement with the load and this materially speeds up the operation of the jack. As soon as the ram comes firmly into engagement with a heavy load, the low pressure relief valve 136 opens on each stroke of the low pressure piston so that the fluid discharged by the low pressure cylinder returns to the reservoir. The low pressure relief valve can be adjusted to open at any predetermined pressure which preferably is set high enough to insure firm engagement of the ram with the load but which is not high enough to impose an undue load on the motor during lifting of the load. In this connection it is desirable to point out that the eccentrics are so arranged that the high and low pressure cylinders discharge alternately and thereby impose a minimum load on the motor.

The ball bearings interposed between the eccentrics and the eccentric sleeves materially reduce frictional resistance and insure long life. It is to be noted that the eccentric sleeves are held from rotation solely by frictional engagement with the adjacent ends of their respective pistons. This permits these sleeves to slip so that undue wear does not occur at any one point on either sleeve but is distributed throughout the circumferences of these sleeves. The bearings and pistons operate in oil or other hydraulic fluid which provides adequate lubrication for these parts.

If the load is greater than that for which the jack is designed to operate, the valve member 194 of the main control valve moves upwardly against the tension of its springs 200 and thereby limits the fluid pressure which can be developed by the pumping mechanism. This prevents abuse of the jack and makes it available for operation by unskilled or careless workmen. A further protective feature lies in the provision for opening the main relief valve when the shoulder 266 of the ram engages the lever 256. This relieves the operator of the necessity of watching carefully to see that the ram is not moved farther than is safe and also protects the jack against abuse.

Where it is merely desired to lift the load to an approximate elevation it suffices to stop the motor when the load approaches this elevation. In some instances it may be desirable to lift the load above the desired elevation, stop the motor and then lower the load to approximately the desired position by grasping the handle 224 and manually opening the main control valve. This control valve, however, is designed to give quick relief for the fluid in the ram cylinder when the valve is manually operated so that I have found it desirable to provide other means for accurately adjusting the vertical position of the load.

When it is desired to position the load at some exact height, the motor is ordinarily operated to raise the load slightly above this height where this is permissible. The motor is then stopped and the load lowered to its exact position by opening the needle valve 276. This valve gives a nicety of control which is not readily available

by means of the main control valve. As soon as the load has reached its desired level, the needle valve is closed.

After the load has been lowered to its original position or has been rested on blocks or other supports, the jack can be tilted from its base onto its wheels and the handle moved to extended position. The jack is then ready to be moved to a new location and utilized to raise another load. If the new location is remote from the load which has just been raised, it may be necessary to disconnect the motor cable or hose and reestablish the connection after the jack has reached its new location. Where the jack is operated by manual force through a gear reduction mechanism substituted for the motor, the jack can be used at any location and is not limited to the vicinity of a source of power such as electricity or compressed air.

From the foregoing description taken in connection with the accompanying drawings, it will be apparent that I have invented a simple and effective hydraulic jack which can be utilized to lift heavy loads on the order of fifty tons and which will operate quickly and effectively and can be handled by one man. In referring to a load of fifty tons, it is to be understood that my jack is not limited to such a load but may be designed for lifting lighter or much heavier loads, as desired. It is to be further understood that my invention is not limited to the particular details shown and described but may assume numerous other forms and that my invention includes all modifications, variations and equivalents coming within the appended claims.

I claim:

1. In a hydraulic jack of the class described, a reservoir, a pump supplied with fluid from said reservoir, a ram cylinder connected to said pump, a ram reciprocable in said cylinder, the cylinder projecting through a wall of the reservoir, a cylindrical jacket surrounding that part of the cylinder which is eternal to the reservoir providing an annular space between the jacket and the cylinder, a ring bridging said annular space, tie rods extending from the ring to the reservoir tensioned to clamp the ring against the outer ends of said cylinder and jacket, a pressure relief valve for said ram cylinder within the reservoir with spring means normally holding said valve in closed position, and mechanism for opening the valve including a projection on the ram, means engageable by said projection disposed beyond the end of the ram cylinder and a valve actuating rod extending from said means through said ring

and through the annular space between the cylinder and the jacket into operative connection with the relief valve in the reservoir.

2. In a hydraulic jack which includes a reservoir with pumping mechanism therein, a ram cylinder having a part extending into said reservoir and a part projecting therefrom, a jacket surrounding said projecting part of the cylinder, means securing the jacket rigidly to the reservoir, said reservoir having a base forming a support for the ram cylinder in its upright position, and wheels attached to the reservoir with their treads off the ground when the jack is standing in upright position, said wheels projecting beyond a side of the reservoir to carry the jack when it is tilted over and downwardly at that side, means for pulling the jack on said wheels comprising a tongue pivotally attached to the jacket adjacent its outer end and means disengageably locking said tongue in a position extending beyond the jacket, said tongue being adjustable about its pivot to a position wholly below the outer end of the jacket when the jack is in upright position.

DWIGHT RICHARDS.

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