Aug. 15, 1961 J. V. WELBORN 2,996,284

SHINNING JACK

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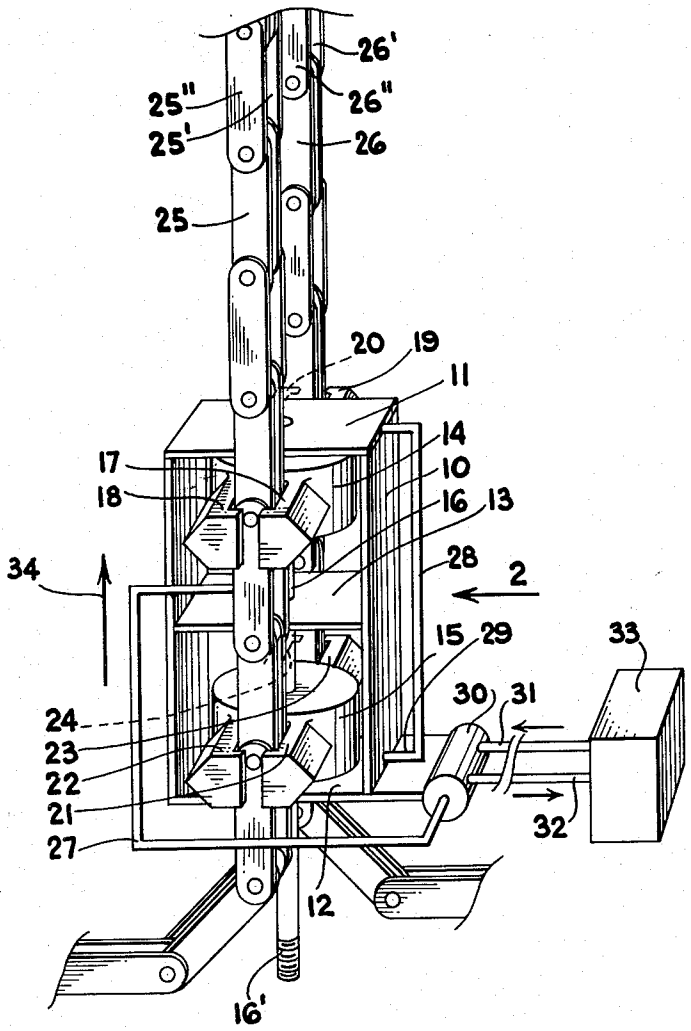


FIG. 1

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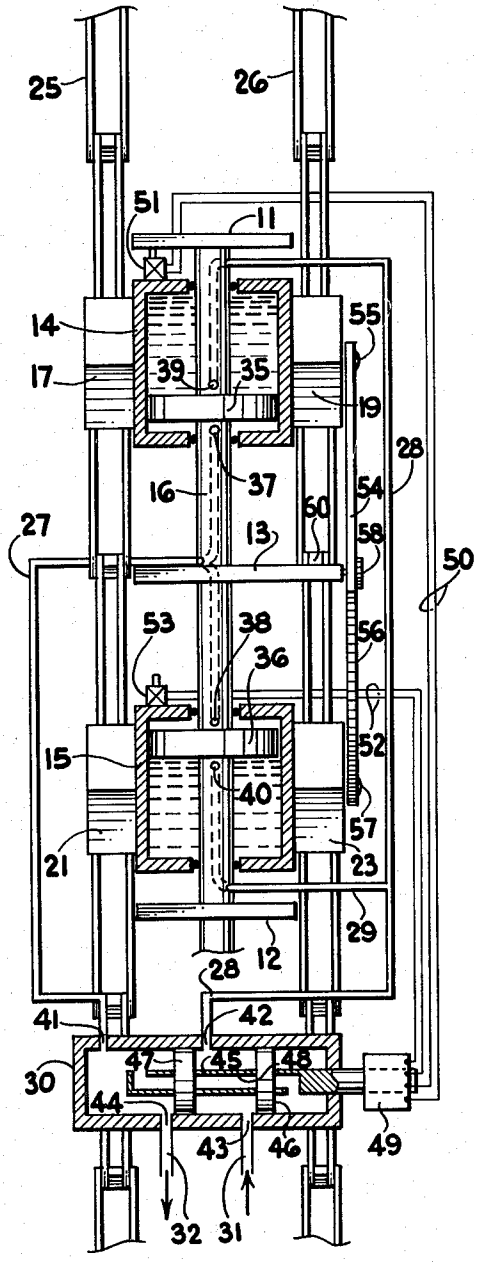


FIG. 2

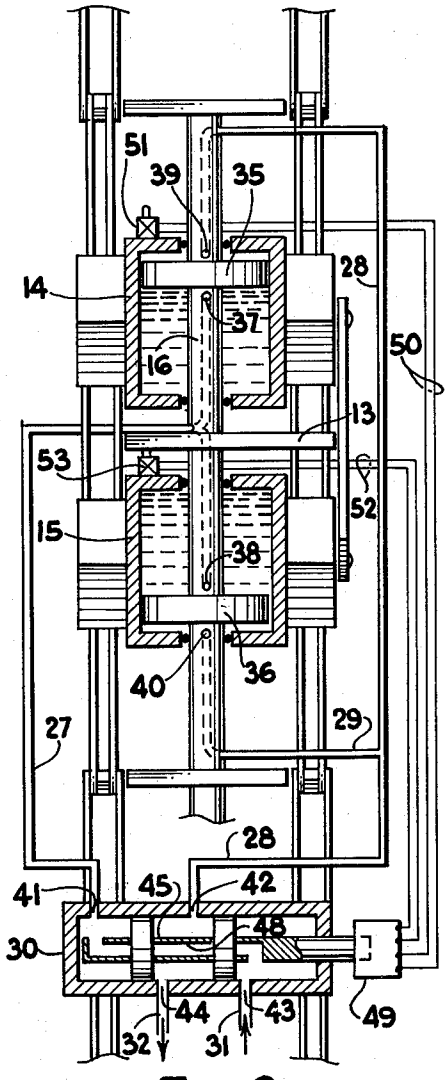


FIG. 3

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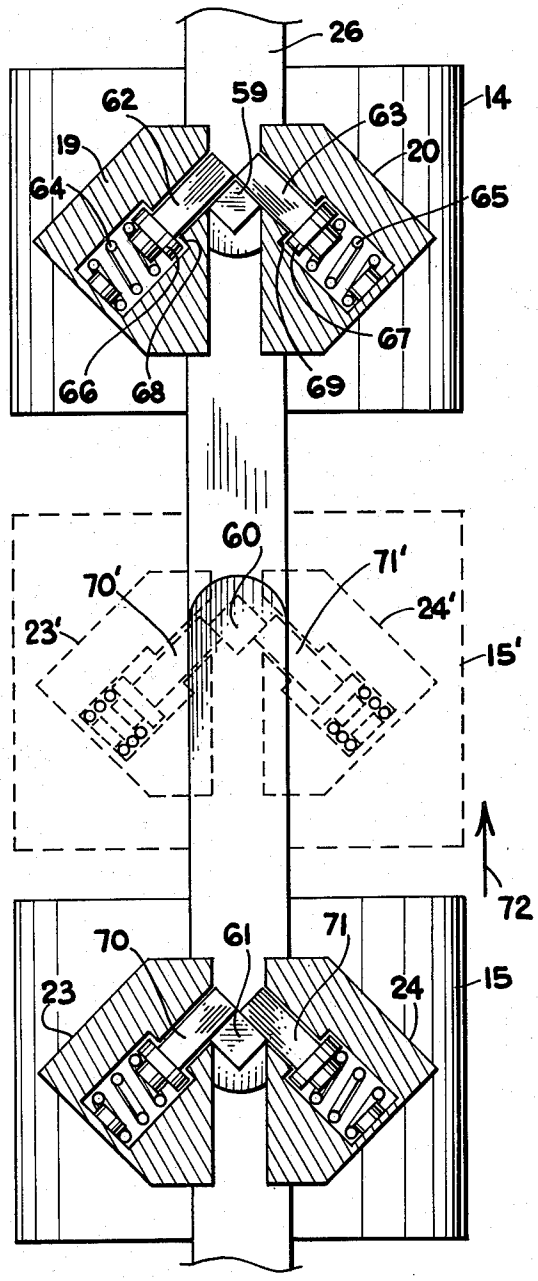


FIG. 5

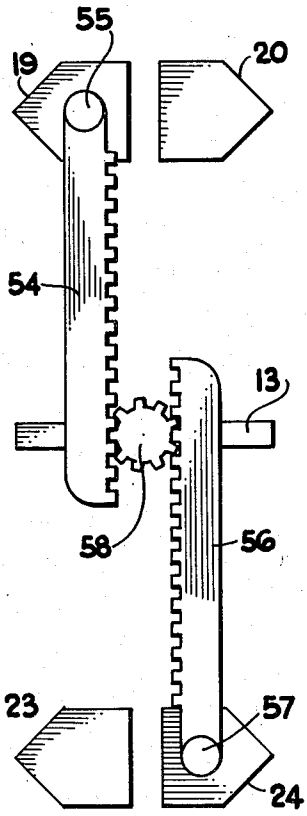


FIG. 4

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SHINNING JACK

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This invention relates generally to lifting jacks and more particularly to an improved shinning jack for climbing one or more chains.

Conventional shinning jacks usually require an elongated rigid column or rack upon which the jack can climb during a lifting operation. Such racks must thus extend to a height at least equal to the operating range of the jack itself. As a result, in certain construction operations such as the raising of concrete slabs, the jacks used can become relatively bulky and expensive. Further, the versatility of such jacks is considerably limited by the requirement of the rigid racks or the like upon which the jack can climb. For example, the jack must be disposed to the side of a slab or load or a hole must be made in the slab so that the rack or column of the jack will not interfere with the load during lifting.

To avoid the necessity for rigid vertical members extending at least to a height to which the jack is capable of operating, resort has been had to telescoping structures. While this type of arrangement will enable loads to be lifted through relatively large vertical heights by a jack which in its collapsed position is relatively compact, the required telescoping components themselves are relatively expensive to maintain and operate.

Bearing the foregoing in mind, it is a primary object of the present invention to provide a novel shinning jack for use with a flexible chain. The jack itself can thus be relatively small and compact and yet employed for lifting relatively heavy loads through any desired vertical height depending upon the length of chain available. Since the chain is flexible, its lower end can extend laterally and thus not interfere with a concrete slab or other load of relatively large area.

Other objects of this invention are to provide a shinning jack which is extremely adaptable to different situations, which is capable of lifting relatively heavy loads, and yet which is simple in construction, relatively inexpensive to manufacture, readily portable, and requires minimum maintenance.

Briefly, these and many other objects and advantages of the present invention are attained by providing a basic frame structure incorporating a vertical guiding means preferably in the form of a piston rod. Upper and lower ratchet means are in turn mounted to the rod and provided with ratchet dogs arranged to engage a flexible chain. The arrangement is such that when the upper ratchet means engages the chain, the lower ratchet means may be moved upwardly along the piston rod towards the upper ratchet means carrying the frame with it. The lower ratchet means is then caused to engage the chain and the upper ratchet means can then move upwardly away from the lower ratchet means to engage a higher point on the chain. Each of the ratchet dogs is biased towards the chain at an angle to the vertical so that upon upward movement of the ratchet means, the ratchet dogs will be retracted by the chain, but upon engagement with the chain, the ratchet dogs will overlap a portion of the chain to hold the ratchet means stationary while the total frame structure is caused to move upwardly relative to the chain. By employing two ratchet means alternately moving upwardly, the upper and lower ratchet dogs will alternately engage the chain so that the frame and entire jack structure will climb the chain with a minimum of lost motion.

In a preferred embodiment of the invention, hydraulic cylinders are employed as part of each of the ratchet means co-operating with stationary piston heads secured at spaced vertical points to the piston rod. Hydraulic fluid supplied under pressure together with proper valving to interchange the supply and return lines will affect a reciprocating movement of the cylinders and ratchet dogs with respect to the piston rod. The same cylinders may be employed for driving additional ratchet means extending laterally on diametrically opposite sides for engaging an additional chain. Thus, the lifting load may be balanced with respect to the axis of the piston rod. The chains themselves may be of any length and need only be secured at their upper ends to depend downwardly. The jack structure may thus be kept relatively compact and simple in design, and yet serve to lift loads over relatively great distances.

A better understanding of the preferred embodiment of the invention will be had by referring to the accompanying drawings in which:

FIGURE 1 is a schematic perspective view of the entire jack structure coupled to a pair of depending chains;

FIGURE 2 is an enlarged schematic diagram partly in cross section looking generally in the direction of the arrow 2 of FIGURE 1 showing the ratcheting mechanism in one extreme position;

FIGURE 3 is a view similar to FIGURE 2 illustrating the ratcheting mechanism in a second extreme position;

FIGURE 4 is a fragmentary elevational view of part of the mechanism illustrated in FIGURES 2 and 3; and,

FIGURE 5 is another schematic diagram partly in cross section illustrating certain of the ratcheting dogs in detail.

Referring first to FIGURE 1, there is shown a basic frame structure **10** including a top frame plate **11** and bottom frame plate **12**. Intermediate the frame plates **11** and **12** is a third frame plate **13** dividing the frame generally into upper and lower open sections.

Within these upper and lower frame sections there are provided upper and lower ratchet means including cylinders **14** and **15**, respectively arranged to move along a vertical guide means in the form of a piston rod **16**. The lower end of rod **16** extends below the lower plate **12** and may be threaded as at **16** for connection to a load. The upper ratchet mechanism includes ratchet arms **17** and **18** extending from the upper cylinder **14** in a generally lateral direction. From the diametrically opposite side of the cylinder **14** there are also provided additional ratchet arms **19** and **20**. The lower cylinder **15** similarly includes ratchet arms **21** and **22** extending laterally therefrom on one side and additional ratchet arms **23** and **24** extending laterally from the diametrically opposite side.

The upper pair of ratchet arms **17** and **18** and lower pair of ratchet arms **21** and **22** are arranged to straddle vertically spaced portions of a chain **25** as shown. Similarly, the upper additional ratchet arms **19** and **20** and lower additional ratchet arms **23** and **24** are arranged to straddle vertically spaced portions of an additional chain **26**. The chains **25** and **26** each include articulated links **25'**, **25''**, and **26'**, **26''** as shown and are identical in construction. The provision of two chains **25** and **26** permits any load secured to the lower end of the piston rod **16** to be shared between the two chains and thus directed along the axis of the rod.

It will be noted that the lower portions of the chains **25** and **26** passing from the lower pairs of ratchet arms **21**, **22**, **23**, and **24** may flex to the side and if desired could extend upwardly to connect to the top portions of the chains so that endless chains are provided. The principal advantage in having the lower ends of the chains free to extend laterally is in the event the jack is employed for lifting a large concrete slab. In such opera-

tion, the threaded portion 16' of the piston rod is bolted to the concrete slab and the same lifted, the chairs simply extending along the top surface of the slab as the jack climbs up the chains. By this arrangement, the jack can be secured to the center of gravity of the slab and no openings or the like are required in the slab to accommodate the chains.

In order to move the upper and lower ratchet means along the piston rod 16, hydraulic fluid is preferably used. Thus, there is provided a first hydraulic line 27 which is arranged to pass fluid into the lower end of the cylinder 14 and the upper end of the cylinder 15. A second hydraulic line 28 in turn is arranged to pass fluid into the upper portion of the cylinder 14 and through a branch line 29 to the lower portion of the cylinder 15. As shown in FIGURE 1, the hydraulic lines 27 and 28 connect into a valve means 30 provided with hydraulic fluid supply and return lines 31 and 32. The lines 31 and 32 in turn are connected to an hydraulic pressure source and reservoir indicated generally by the block 33. The arrangement is such that movement of the cylinders 14 and 15 together with the corresponding upper and lower ratchet arms will serve to alternately cause the ratchet mechanism in the upper and lower arms to engage and disengage the chains to lift the frame structure 10 relatively to the chain as indicated by the arrow 34. The manner in which this operation is achieved will best be understood by now referring to FIGURES 2 and 3.

Referring first to FIGURE 2, the cylinders 14 and 15 are shown in approximately the same position as illustrated in FIGURE 1. The vertical piston rod 16 includes upper and lower piston heads 35 and 36 rigidly secured thereto in vertically spaced relationship. The cylinders 14 and 15 in turn surround the piston heads and are arranged to reciprocate over the piston heads. To effect this motion by the hydraulic means, the interior of the upper piston 14 below the piston head 35 is supplied with hydraulic fluid from the line 27 through a small outlet port 37 connecting with an internal passage shown in dotted lines within the piston rod 16. Similarly, the upper interior of the lower cylinder 15 above the piston head 36 is provided with hydraulic fluid through a port 38 connecting through an internal passage as indicated in dotted lines to the hydraulic line 27. In a similar manner, the upper interior of the upper piston 14 is supplied through a port 39 with hydraulic fluid connecting through an internal passage in the piston rod 16 to the hydraulic line 28, and the lower interior of the lower cylinder 15 is provided with fluid through a port 40 in the piston rod 16 connected through an internal passage to the branch line 29.

Referring to the lower portion of FIGURE 2, the two main hydraulic lines 27 and 28 pass into suitable inlet ports 41 and 42 in the valve means 30. The supply and return lines 31 and 32 from the source 33 of FIGURE 1, on the other hand, pass into laterally off-set ports 43 and 44 in the valve means 30. As shown, the interior of the valve means 30 is essentially cylindrical and includes a valve stem 45 provided with partitions 46 and 47 in the form of piston heads. The valve stem 45 includes a hollow passage 48 connecting the interior region to the right of the partition 46 with the region to the left of the partition 47. The stem itself extends from the right hand side of the valve body to a solenoid 49 arranged to cause the valve stem 45 to move in one direction or the other within the valve body.

In order to control the position of the valve stem, the solenoid 49 is arranged to be energized through a first pair of leads 50 passing upwardly to a micro-switch 51 secured to the top outside surface of the upper cylinder 14. The connection is such that when the micro-switch is closed the solenoid 49 will be energized to move the valve stem 45 from the position shown in FIGURE 2 to the position shown in FIGURE 3; that is, to the left. There are also provided a pair of leads 52 leading from the solenoid 49 to a second micro-switch 53 secured to the top part of the lower cylinder 15. This connection is such that when the micro-switch 53 is closed the solenoid 49 will be energized to retract the valve stem 45 to the right from the position illustrated in FIGURE 3 back to the position illustrated in FIGURE 2.

In FIGURE 2, the valve stem is shown in a position such that fluid passing from the inlet port 43 from the supply line 31 will pass out the port 42 to the hydraulic line 28 thereby passing hydraulic fluid up through the line 28 to the outlet port 39 above the piston head 35 in the cylinder 14. Simultaneously fluid will pass through the branch line 29 to the outlet port 40 to the region under the piston head 36 in the cylinder 15. The presence of this fluid will move the upper cylinder 14 upwardly and simultaneously move the lower piston head 36 upwardly within the lower cylinder 15 to the positions shown in FIGURE 2.

As the upper cylinder 14 moves towards its extreme uppermost position, the micro-switch 51 will engage the underside of the frame plate 11 thereby moving the valve stem 45 by means of the solenoid 49 to the left, that is, to the position illustrated in FIGURE 3. Referring to FIGURE 3, in this position, hydraulic fluid from the line 31 entering the port 43 of the valve 30 will pass through the internal passage 48 of the valve stem to the hydraulic line 27 through the port 41. Hydraulic fluid will thus be supplied to the outlet ports 37 and 38 in the cylinders 14 and 15, respectively, thereby moving the upper piston head 35 upwardly within the upper cylinder 14 and the lower cylinder 15 upwardly towards the positions illustrated in FIGURE 3. The fluid already in the upper and lower portions of the cylinders will be returned through ports 39 and 40 to line 28, inlet opening 42 of the valve body to the return line 32. When the lower cylinder 15 reaches its uppermost position, the micro-switch 53 will engage the underside of the center plate 13 thereby energizing the solenoid 49 to retract the valve stem 45 back to the position illustrated in FIGURE 2. The hydraulic fluid will then pass through the hydraulic lines 27 and 28 in a reverse direction as described in connection with FIGURE 2 thereby causing the upper cylinder to again move upwardly from the lower cylinder. This process continues repeatedly so that the upper and lower cylinders and associated ratchet arms move upwardly in a completely automatic manner.

In order to maintain exact out of phase synchronism of the upper and lower cylinders, a mechanical interlinkage may be provided. As shown in FIGURES 2 and 4, this linkage includes a first rack 54 secured to the end of the upper ratchet arm 19 as by a rivet 55, and a second rack 56 secured to the end of the lower ratchet arm 24 as by rivet 57. Between the teeth of the racks 54 and 56 there is provided an idler gear 58 secured for rotation to one end of the center plate 13 of the frame. By this arrangement, it will be evident that as the upper cylinder 14 and associated ratchet arms 19 and 20 moves relative to the frame, the center idler gear 58 will be rotated in a counterclockwise direction thereby driving the rack 56 upwardly together with the ratchet arms 24, 23 and lower cylinder 15. Therefore, at all times the cylinders are caused to move in opposite directions relative to the frame.

The preferred ratcheting structure between the various ratchet arms and the chains 25 and 26 can best be understood by now referring to FIGURE 5 which illustrates schematically the upper pair of ratchet arms 19 and 20 and lower pair of ratchet arms 23 and 24 for the chain 26.

Since the various pairs of ratchet arms are identical for the chain 25, only the action of the arms shown in FIGURE 5 with respect to the chain 26 need be described. As shown in FIGURE 5, the links of chain 26 are coupled together by cross bars such as indicated at 59, 60, and 61. These cross bars have a square cross

section with the diagonals of the squares extending horizontally and vertically, respectively, when the chain is hanging in a vertical direction. Associated with the ratchet arms **19** and **20** are ratchet dogs indicated at **62** and **63**, respectively. These dogs are normally biased towards the chain at an angle with the vertical of 45° by suitable biasing springs **64** and **65** within recesses in the arms **19** and **20**. The dogs themselves may include enlarged diameter portions **66** and **67** arranged to abut against annular shoulders **68** and **69** defined by the recesses within the arms **19** and **20** to limit the outward extent of the dogs.

The lower ratchet arms **23** and **24** include biased ratchet dogs **70** and **71** similarly secured within the arms and normally biased outwardly towards the chain at angles of 45° with respect to the vertical. In the positions illustrated in FIGURE 5, it will be noted that both the ratchet dogs **62** and **63** of the upper pair and the ratchet dogs **70** and **71** of the lower pair engage the upper opposite sides of the cross bars **59** and **61**, respectively. In this position, it will be evident that when the lower cylinder **15** is moving upwardly towards the upper cylinder **14**, the upper ratchet arms **19** and **20** and associated cylinder **14** will be blocked from downward movement relative to the chain **26** as a consequence of the upper side faces of the cross bar **59** engaging the dogs **62** and **63**. In other words, as a consequence of the 45° direction of the movement of the dogs **62** and **63**, only forces exerted on the dogs by the lower side faces of the cross bar will retract the dogs. The forces exerted by the upper side faces of the cross bar **59** simply urge the dogs **62** and **63** laterally or at right angles to their normal direction of movement and thus the cylinder **14** and ratchet arms **19** and **20** are anchored and the entire frame of the jack will be lifted relative to the chain **26**.

On the other hand, the upward movement of the lower cylinder **15** and associated ratchet arms **23** and **24** with respect to the upper cylinder **14** as indicated by the arrow **72** will simply cause the ratchet dogs **70** and **71** to leave the lower cross bar **61**. This upward movement will continue until the lower cylinder **15** and associated ratchet arms **23** and **24** reach the dotted line position illustrated in FIGURE 5 wherein the various parts are indicated by the same numerals followed by a prime. Thus, as the dogs **70'** and **71'** reach the next cross bar **60**, their ends will engage the lower opposite side faces of the cross bar and this engagement will retract the dogs **70'** and **71'** within the arms. Continued upward movement of the arms **23'** and **24'** will result in further contraction of the dogs **70'** and **71'** until they are free to snap over the top sides of the cross bar **60** thus assuming the positions illustrated, for example, in solid lines by the ratchet dogs **62** and **63**.

After the dogs **70'** have snapped over the top of the cross bar **60**, the lower cylinder **15'** is closest to the upper cylinder **14**, and as described in connection with FIGURES 2 and 3, the hydraulic lines will then be interchanged to result in pressure urging the cylinder **14** upwardly and the piston head **36** within the cylinder **15** upwardly. The dogs **70'** and **71'** will hold the piston **15'** stationary while the frame is moved upwardly relative to the chain. The ratchet dogs **62** and **63** for the arms **19** and **20**, on the other hand, will simply lift up and leave the cross bar **59** to pass upwardly until they engage the under opposite side surfaces of the next cross bar link in the chain **26**. These dogs will then in turn be retracted until they snap over the top of the said next cross bar. The described action will then repeat with the cylinder **14** held to the chain and the cylinder **15'** moving upwardly resulting in a shinning motion of the jack up the chain.

The other ratchet arms **17**, **18**, **21**, and **22** operate in a similar manner with respect to the chain **25** so that at all times the load is equalized between the two chains and any tilting of the jack is avoided.

It will be evident from the foregoing description that a plurality of jacks of the type described can be used simultaneously on spaced pairs of chains so that an entire slab floor may readily be lifted by operating the respective jacks in synchronism from a single supply of hydraulic fluid. Moreover, it will be evident that while a simple solenoid system for switching the valve stem **45** of the valve means **30** back and forth has been shown and described, purely mechanical means could be employed for effecting the switching of the valve stem in response to the alternate movement of the upper and lower cylinders.

This invention, therefore, is not to be thought of as limited to the particular embodiment set forth since the foregoing, as well as other additional modifications and changes that fall within the scope and spirit of the invention, will readily occur to those skilled in the art.

What is claimed is:

1. A shinning jack comprising, in combination: a chain having link members coupled together by cross bars of square cross section, the diagonals of said square extending horizontally and vertically respectively when said chain is hanging vertically; a frame; a vertical piston rod secured to said frame extending substantially parallel to said chain; upper and lower vertically spaced piston heads rigidly secured to said piston rod; upper and lower cylinders reciprocally mounted on said piston heads for vertical movement along said piston rod; a pair of upper ratchet arms extending laterally from said upper cylinder to straddle an upper portion of said chain; a pair of lower ratchet arms extending laterally from said lower cylinder to straddle a lower portion of said chain; ratchet dogs in each arm of said upper pair and each arm of said lower pair biased for upward and outward movement towards opposite lower sides of the cross bars of said chain straddled by said arms; and hydraulic means for reciprocating said cylinders to move said upper and lower pairs of ratchet arms so that opposite lower side faces of each of said cross bars of said chain retracts the ratchet dogs in the pair of ratchet arms moving upwardly, said ratchet dogs snapping over each of said cross bars respectively to engage the upper opposite side faces of the same during upward movement of the other of said pairs of ratchet arms, whereby said frame is alternately lifted relative to said chain upon movement of said upper and lower pairs of ratchet arms respectively.

2. A shinning jack according to claim 1, including an additional chain of substantially identical construction to said first chain depending vertically in parallel relationship to and on the opposite side of said piston rod; and additional upper and lower pairs of ratchet arms laterally extending from diametrically opposite sides of said upper and lower cylinders respectively to straddle upper and lower portions of said additional chain and lift said frame relatively to said additional chain upon movement of said upper and lower cylinders whereby a balanced total lifting force is provided relative to the axis of said piston rod.

3. A shinning jack for climbing a chain, comprising, in combination: a frame; a vertical guide means secured to said frame; an upper ratchet means coupled to the upper portion of said guide means for movement therealong; a lower ratchet means coupled to the lower portion of said guide means for movement therealong, said upper and lower ratchet means, respectively, including upper and lower ratchet dogs biased for movement against said chain at an angle to the vertical; means for alternately moving said upper and lower ratchet means in an upward direction along said vertical guide means to lift said frame relative to said chain, one of said ratchet dogs engaging said chain to hold the ratchet means of which it is a part against downward movement relative to said chain and disengaging said chain upon upward movement of the ratchet means of which it is a part; and, mechanical means interconnecting said upper ratchet means with said lower ratchet means to maintain movement of said upper and lower ratchet means alternately upwardly

whereby the upper of said ratchet dogs engages said chain while the lower of said ratchet dogs is disengaged from said chain as said lower ratchet means moves towards said upper ratchet means, and the lower of said ratchet dogs engages said chain while the upper of said ratchet dogs is disengaged from said chain as said upper ratchet means moves upwardly away from said lower ratchet means.

4. A shinning jack according to claim 3, in which said chain includes link members; and cross bars coupling said link members together, each of said cross bars having a square cross section with its two diagonals extending horizontally and vertically respectively when said chain is hanging vertically, said angle of movement of said upper and lower ratchet dogs being substantially forty-five degrees whereby the upper side faces of said cross bars are engaged by said upper and lower ratchet dogs when said upper and lower ratchet means are respectively stationary with respect to said chain.

5. A shinning jack according to claim 3, in which said

vertical guide means comprise a piston rod having vertically spaced upper and lower piston heads secured thereto, said upper and lower ratchet means each including cylinders reciprocally mounted on said piston heads respectively, said means for moving said upper and lower ratchet means including: a source of hydraulic fluid; hydraulic fluid supply and return lines connecting said source to the upper and lower interior portions of each of said cylinders on either side of said piston heads; and valve means for alternately interchanging said supply and return lines upon actuation whereby said cylinders are moved by hydraulic pressure in said interior portions; and actuating means responsive to the extreme positions of said cylinders for actuating said valve means.

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