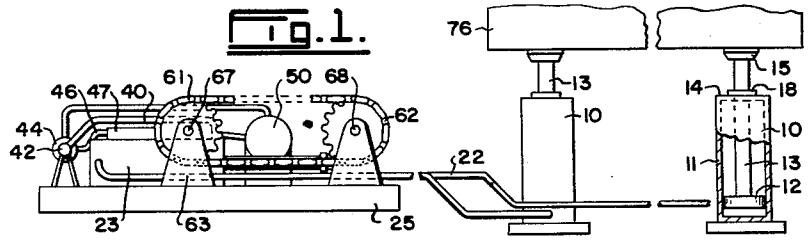
June 28, 1960 P. D. FRIESEN 2,942,848

HYDRAULIC LIFTING APPARATUS

Filed May 31, 1956 2 Sheets-Sheet 1

Fig. 1.



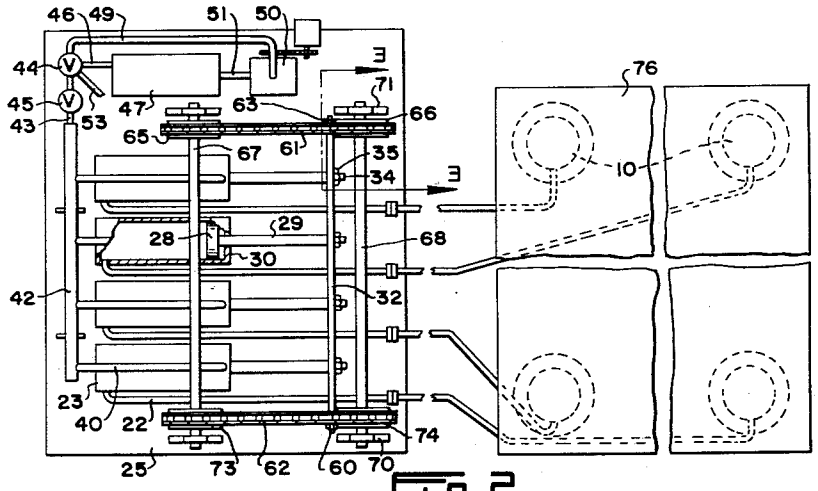


Fig. 2.

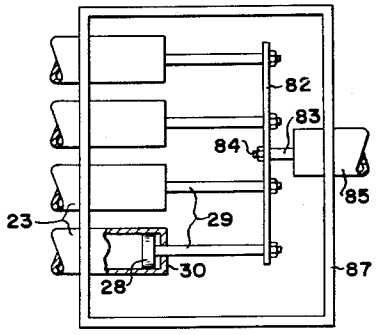


Fig. 5.

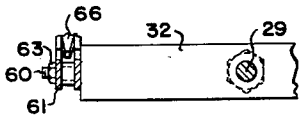


Fig. 3.

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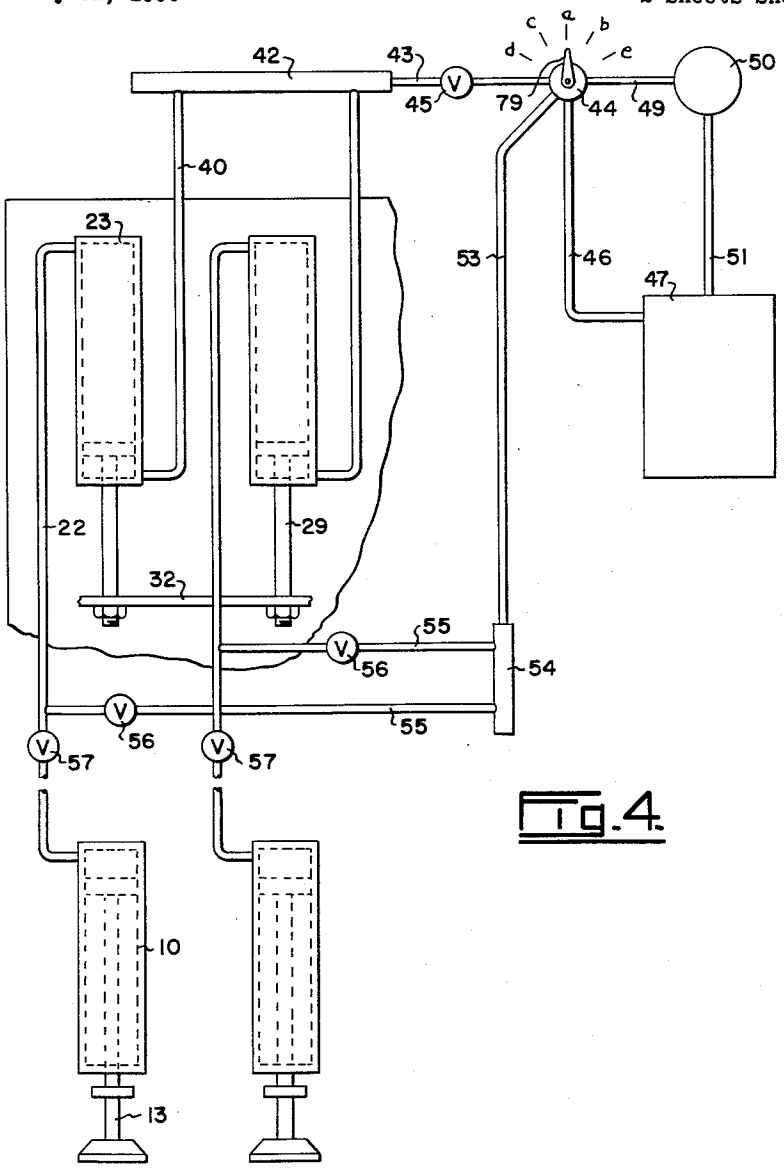


Fig. 4.

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HYDRAULIC LIFTING APPARATUS

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Filed May 31, 1956, Ser. No. 588,275

2 Claims. (Cl. 254—89)

This invention relates to lifting apparatus including a plurality of hydraulic jacks.

An object of the present invention is the provision of apparatus including a plurality of jacks which may be used simultaneously to lift a large heavy load while utilizing a single power source.

Another object is the provision of apparatus including a plurality of hydraulic jacks that will lift a load evenly regardless of whether or not the load is evenly distributed over the jacks.

This hydraulic jack apparatus is particularly designed for lifting buildings, but it may be used for other purposes as well. When lifting a building, it is absolutely necessary that it be lifted evenly without any tipping or straining which would result in straining the structure and breaking plaster and glass. At the present time hydraulic jacks are used for this purpose, but each jack is operated independently so that the operator has to move from one jack to another, raising each jack a little to try to lift the load while maintaining it in its proper erect position. This is a very onerous task, and it often results in damage to the building since it is difficult to be sure that the load is evenly spread over the jacks.

The ideal way is to employ a plurality of hydraulic jacks all connected to a single power source. However, the difficulty lies in the fact that under these circumstances a jack carrying a smaller load than another would move before the latter jack. As the weight of a building differs throughout different parts of it, you could not raise it evenly in this manner.

The present invention overcomes this difficulty by providing means for supplying the same quantity of hydraulic fluid pressure to each lifting jack at the same time, although the pressure of the fluid in the different jacks would depend on the load carried by each one. This is accomplished by connecting each lifting jack to one end of a control cylinder having a piston therein. A rod is connected to each piston and slidably extends out of an end of its cylinder. Means is provided for connecting all the piston rods together so that they must move as a unit. Means is provided for moving the pistons together, and they in turn force hydraulic fluid from their respective cylinders to the lifting jacks connected thereto. As the pressure applied to the pistons is the same and they all move exactly the same distance, the jacks must lift together. In other words, no jack can move more or less than the other jacks.

Examples of this invention are illustrated in the accompanying drawings, in which,

Figure 1 is a side elevation of the hydraulic jack apparatus ready to lift a load,

Figure 2 is a plan view of the apparatus of Figure 1, showing for lifting jacks,

Figure 3 is an enlarged fragmentary section taken on line 3—3 of Figure 2,

Figure 4 is a diagram of a control system for the apparatus of Figures 1 to 3, showing only two lifting jacks, and

Figure 5 is a fragmentary plan view of a portion of apparatus similar to that illustrated in Figure 2, but illustrating an alternative form of the invention.

Referring to Figures 1 to 4 of the drawings, the lifting apparatus includes a plurality of lifting jacks **10** of any desired construction. In this example, each jack includes a cylinder **11** having a piston **12** slidably mounted therein. A ram **13** is connected to the piston and slidably extends outwardly through the upper end **14** of the cylinder. The ram may have a head **15** on its outer end. Suitable means is provided for preventing the piston from moving right to the bottom of its cylinder. This may be accomplished by a shoulder **18** suitably connected to the ram outside the cylinder. When the shoulder engages the upper end of the cylinder, the piston is still spaced a little above the cylinder bottom.

The lower end of each jack cylinder **11** is connected by a pipe or hose **22** to one end of a hydraulic control cylinder **23**. There is a control cylinder for each lifting jack **10**, there being four sets in Figure 2, and as the cylinders and their associated elements operate as a unit, these cylinders are preferably placed side by side, as clearly shown in Figure 2. The cylinders are connected together, and in this example, they are all mounted on and attached to a suitable base **25**.

Each cylinder **23** has a piston **28** slidably mounted therein, and a rod **29** is connected to this piston and slidably extends out from an end **30** of the cylinder. The rods **29** of the cylinders lie parallel to each other and are connected in any convenient way so that they will move together. One way of doing this is to provide a rigid connector **32**, said connector having a plurality of holes therein through which threaded ends **34** of the rods extend. A nut **35** on each threaded end may be tightened firmly to secure the rod to the connector. The piston rods are of the same length so that the pistons **28** are aligned laterally or, in other words, the pistons are all spaced the same distance away from the connector. The main thing is that the piston rods must move together as a unit.

Suitable means is provided for moving piston rods **29** and connector **32** together. In Figures 1 and 2, this is done by means of a single hydraulic pump arrangement. A pipe **40** is connected to the end of each cylinder **23** opposite that to which its pipe **22** is connected. The pipes **40** extend to a common header **42**, and one end of the latter is connected by pipe **43** to a control valve **44**, said pipe having a shut-off valve **45** therein. This valve is connected by a pipe **46** to a reservoir **47**, and by another pipe **49** to the outlet of a fluid pump **50**, the inlet of which is connected by a pipe **51** to the reservoir.

Valve **44** is connected by a pipe **53** to a header **54**, see Figure 4. A pipe **55** having a shut-off valve **56** therein extends from this header to each pipe **22**, and each of the latter pipes has a shut-off valve **57** therein between its lifting cylinder **10** and said pipe **55**. Pipe **53** has been broken off, and pipes **55** and valves **56** and **57** have been omitted in Figures 1 and 2 for the sake of clarity, but they are all clearly shown in Figure 4.

It is desirable to provide means for preventing the conector **32** from bending or otherwise permitting the piston rods **29** to move out of their cylinders unevenly with respect to each other. This may be accomplished by providing a threaded pin **60** projecting outwardly from each end thereof, said pins being connected to a spaced pair of endless chains **61** and **62**. Each pin may extend through the adjacent chain, and is connected thereto by a nut **63**. Chain **61** extends around sprockets **65** and **66** mounted respectively on shafts **67** and **68** journalled in bearings **70** and **71** mounted on base **25**. These shafts extend parallel to each other. Chain **62** ex-

tends around sprockets 73 and 74 mounted respectively on shafts 67 and 68. With this arrangement, chains 61 and 62 must move together, and as the opposite ends of connector 32 are secured to said chains, these ends must move so that the connector will move piston rods 29 exactly the same distance each time it is moved.

The operation of this apparatus is very simple and effective. The required number of lifting jacks 10 are placed beneath the load 76. Then pump 50 is started, and with valves 56 closed and valves 45 and 57 open, valve 44 is turned to direct pressure fluid into header 42. From here the fluid passes through pipes 40 into control cylinders 30. This moves pistons 28 away from the cylinder ends. Piston rods 29 move with the pistons, and connector 32 with its connection to chains 61 and 62 keeps the rods moving as a unit so that they all travel exactly the same distance. As the pistons move towards the opposite ends of the cylinders, hydraulic fluid is expelled from the cylinders through pipes 22 into the lower ends of the jack cylinders 11. This forces pistons 12 and, consequently, rams 13 and heads 15 upwardly to raise load 76. As exactly the same amount of fluid is directed into each jack cylinder, the rams thereof must move outwardly exactly the same distance. Therefore, regardless of the weight on any one of the jack rams, the load is lifted evenly. Valve 44 may be operated to direct fluid from cylinders 23 back to the reservoir, thereby allowing the lifting means to move downwardly in their cylinders.

A simple control system for this appartus is illustrated in Figure 4. Valve 44 has an operating lever 79 that may be moved to a neutral setting position *a*, two release positions *b* and *c*, and two pressure positions *d* and *e*. When the lever is moved to position *d* with valves 45 and 57 open and valves 56 closed, pump 50 directs fluid to control cylinders 23 to raise the lifting rams. If any lifting cylinder is not required, it may be cut out by closing its valve 57. When the control lever is moved to position *b*, fluid flows from the control cylinders back to the reservoir.

If it is desired to raise any one or more of the lifting rams independently of the others, valve 45 is closed, the valves 56 and 57 of each lifting cylinder involved are opened, and the control lever 79 is moved to position *e*. This causes fluid to be directed by the pump into each of the involved lifting cylinders. If the lever is moved to position *c* with this valve setting, the fluid is directed from the lifting cylinders back to the reservoir.

If it is necessary to return the pistons of the control cylinders back to their normal positions independently of the lifting cylinders, valves 57 are closed, valves 45 and 56 opened, and lever 79 moved to position *e*. Fluid from the pump is directed into the control cylinders to move the pistons therein, and the fluid on the opposite sides of these pistons is directed back to the reservoir.

Figure 5 illustrates an alternative form of the invention. The piston rods 29 project from the ends of cylinders 23 in the manner described above, but the outer ends of said rods are connected together by a rigid connector 82. In this example, pistons 28 are moved through pressure applied to the connector, and this pressure may be applied in any convenient manner. One way of doing this is to connect a piston rod 83 to the connector centrally thereof, as indicated at 84, this rod slidably extending from the end of an hydraulic cylinder 85. The rod is connected to a piston, not shown, in the cylinder in the usual manner. Fluid under pressure is supplied to the opposite end of cylinder 85. For example, pipe 43 of Figure 2 may be connected to the outer end of said cylinder. Cylinders 23 and cylinder 85 are so mounted that they cannot move relative to each other. A frame 87 is shown as an example for this purpose.

The apparatus of Figure 5 operates in much the same manner as the previously-described apparatus. The fluid is directed under pressure to the outer end of cylinder 85, piston rod 83 is moved outwardly, moving connector 82 and the piston rods 29 in the same direction. Said rods move as a unit, and pistons 28 in cylinders 23 force the fluid through pipes 22 to the lifting jacks 10, said jacks operating in the manner described above.

What I claim as my invention is:

1. Lifting apparatus comprising a plurality of hydraulic lifting jacks, each jack including a cylinder with a piston slidably mounted therein and a lifting ram connected to the piston and slidably extending through the upper end of the cylinder, a hydraulic control cylinder for each of said jacks, said control cylinders being uniform in size, conduit means connecting the lower end of each jack cylinder to one end of its corresponding control cylinder, means for rigidly mounting said control cylinders in a row in uniformly spaced side-by-side relationship with the adjacent ends thereof in alignment, each of said control cylinders including a piston slidably mounted therein and a rod connected to the piston and slidably extending through an end of the cylinder, hydraulic fluid filling each of the hydraulic circuits defined by said conduit means between said one end of each control cylinder and the lower end of its corresponding jack cylinder, means for admitting hydraulic fluid under pressure to the opposite ends of all of said control cylinders whereby to cause upwardly movement of said lifting rams, and means for insuring simultaneous and equal upward movement of said lifting rams upon the admission of fluid under pressure to said opposite ends of said control cylinders despite any variance in the loads encountered by said plurality of lifting rams comprising, an elongated rigid connector bar secured to the outer ends of all of said piston rods of said control cylinders for controlling the movement of said rods, a pair of sprocket chains disposed one alongside each of the outer control cylinders in said row, each of said chains extending around sprockets fixedly mounted on parallel shafts disposed at right angles to the piston rods of said control cylinders, which shafts are rotatably mounted in bearings fixedly supported relative to said control cylinders, whereby movement of one chain results in simultaneous and equal movement of the other chain, and means connecting the ends of said connector bar to aligned links of said chains whereby to retain said bar at right angles to said control cylinder piston rods, thus insuring simultaneous and equal movement of said control cylinder piston rods and simultaneous and equal movement of said lifting rams.

2. Apparatus for raising up a building comprising a plurality of hydraulic lifting jacks adapted to be positioned at different positions beneath a building to be raised, each jack including a cylinder with a piston slidably mounted therein and a lifting ram connected to the piston and slidably extending through the upper end of the cylinder, a hydraulic control cylinder for each of said jacks, each of said control cylinders including a piston slidably mounted therein and a rod connected to the piston and slidably extending through an end of the cylinder, means for rigidly mounting said control cylinders in a row in uniformly spaced side-by-side relationship with the piston rod ends thereof in alignment, conduit means connecting the lower end of each jack cylinder to one end of its corresponding control cylinder, hydraulic fluid filling each of the hydraulic circuits defined by said conduit means between said one end of each control cylinder and the lower end of its corresponding jack cylinder, a fluid pump, a header communicating with the opposite ends of all of said control cylinders, a conduit for directing the fluid output of said pump under pressure directly to said header whereby to urge each of said control cylinder pistons toward said one end of its cylinder with a resulting up-

ward movement of said lifting rams, an elongated rigid connector bar secured to the outer ends of all of said piston rods of said control cylinders for equalizing the movement of said rods, a pair of sprocket chains disposed one alongside each of the outer control cylinders in said row, each of said chains extending around sprockets fixedly mounted on parallel shafts desposed at right angles to the piston rods of said control cylinders, which shafts are rotatably mounted in bearings fixedly supported relative to said control cylinders, whereby movement of one chain results in simultaneous and equal movement of the other chain, and means connecting the ends of said connector bar to aligned links of said chains whereby to retain said bar at right angles to said control cylinder piston rods, thus insuring simultaneous and equal movement of said control cylinder piston rods and simultaneous and equal movement of said lifting rams despite any variance in the loads encountered by said plurality of rams.

References Cited in the file of this patent

UNITED STATES PATENTS

1,831,238	Ferris	Nov. 10, 1931
2,237,167	Skavinsky	Apr. 1, 1941
2,499,563	Bill	Mar. 7, 1950