

June 11, 1957

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2,795,346

LOAD GRIP SIDE SHIFT FOR LIFT TRUCKS

Filed July 16, 1953

4 Sheets-Sheet 1

FIG 9

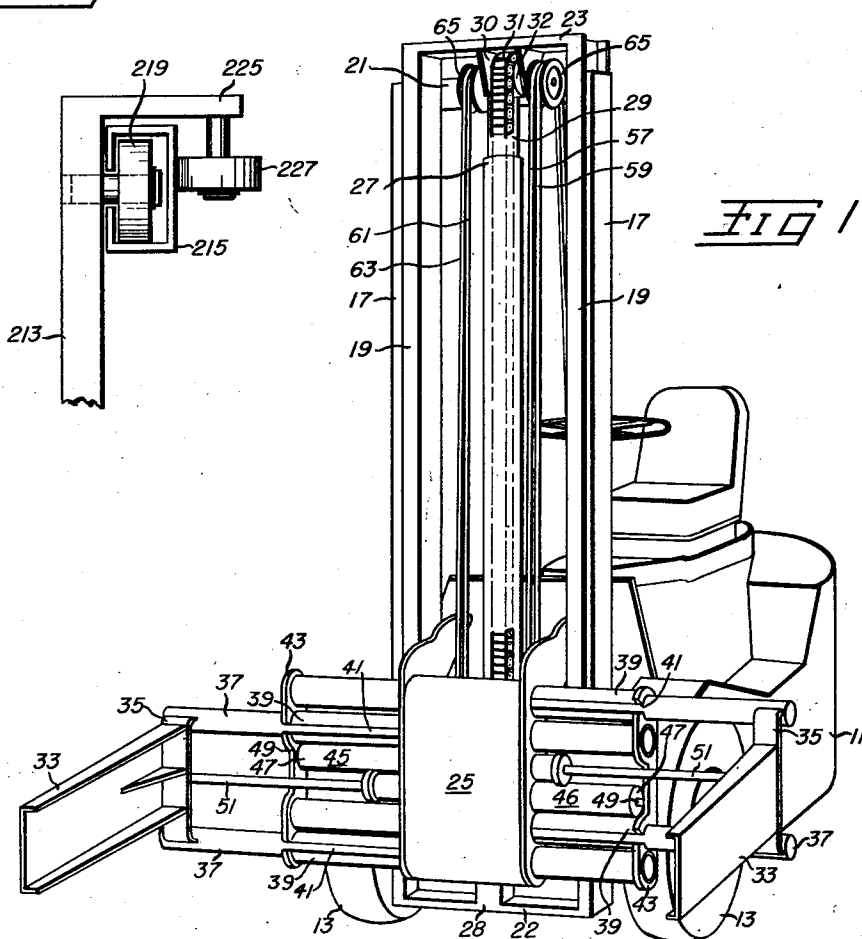


FIG 1

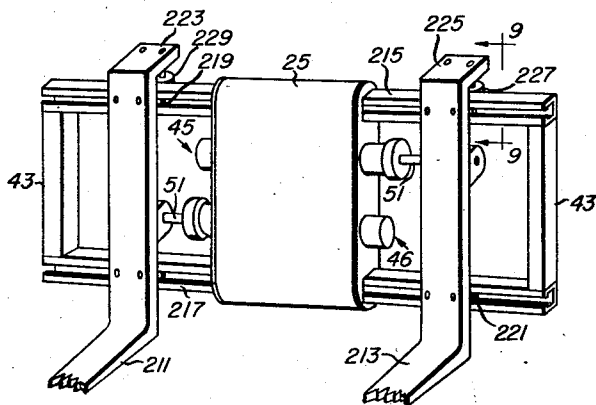


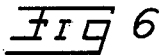
FIG 8

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4 Sheets-Sheet 2



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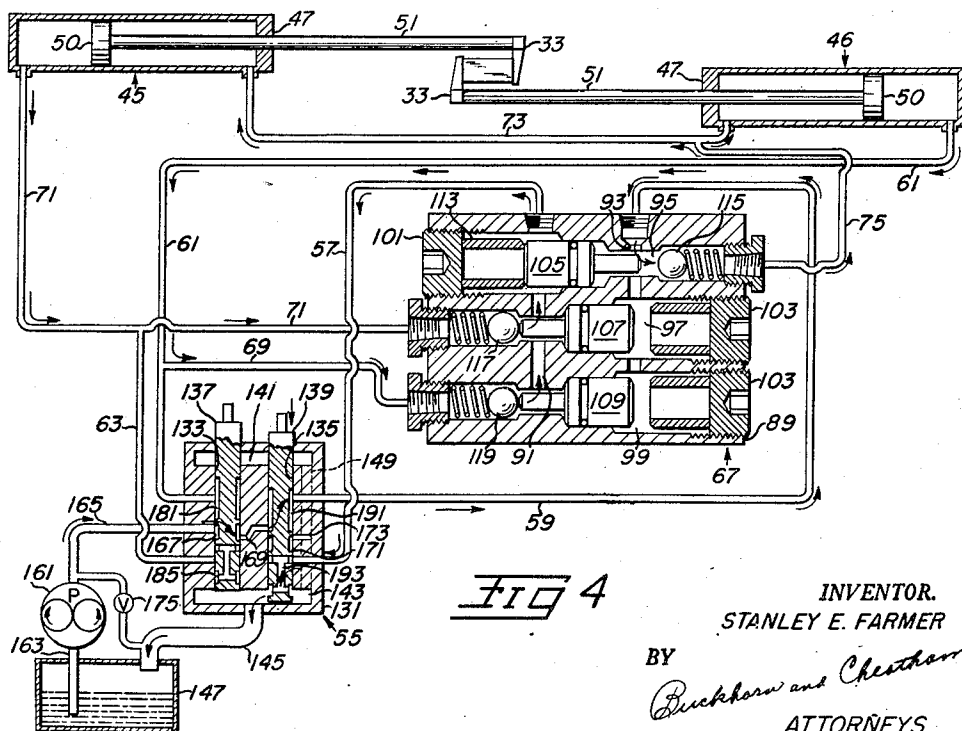
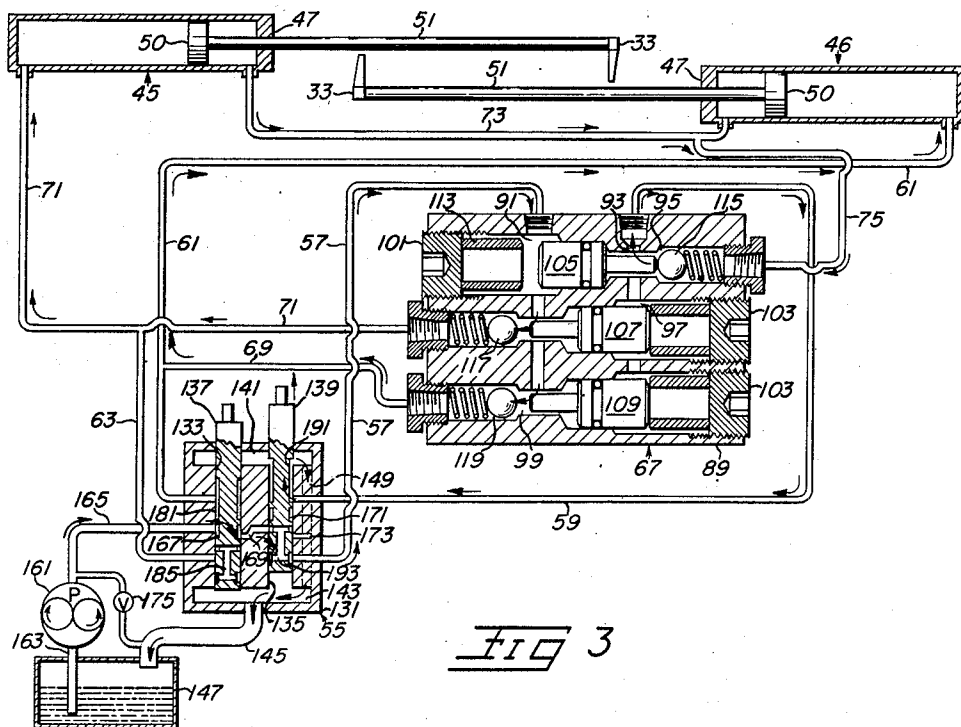
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LOAD GRIP SIDE SHIFT FOR LIFT TRUCKS

Filed July 16, 1953

4 Sheets-Sheet 3



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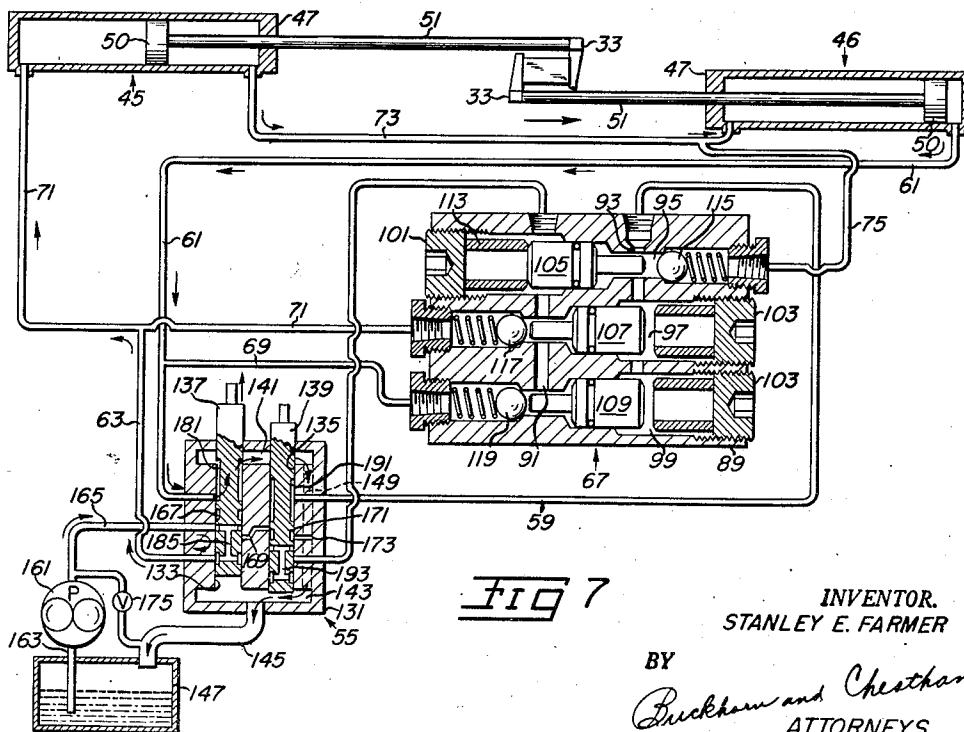
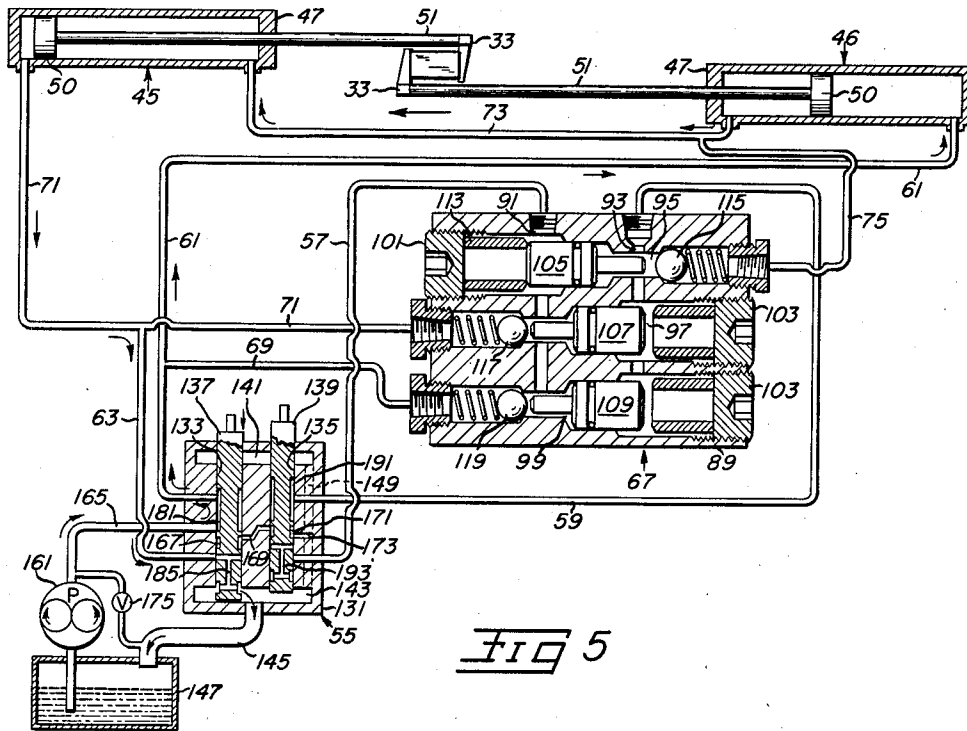
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LOAD GRIP SIDE SHIFT FOR LIFT TRUCKS

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4 Sheets-Sheet 4



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2,795,346

LOAD GRIP SIDE SHIFT FOR LIFT TRUCKS

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Application July 16, 1953, Serial No. 368,463

14 Claims. (Cl. 214—653)

This invention relates to material handling apparatus, and particularly to improvements in an industrial lift truck of the type having its load elevating carriage equipped with a pair of load engaging members, such as load grip or lift fork arms.

When operating lift trucks of the above type, it is very frequently necessary to maneuver a truck so as to bring the load engaging members thereof into substantial registry with or in symmetrical disposition relative to, a predetermined load pick-up or depositing location, such as, for instance, when removing loads from a stack of material, or stacking material, or conforming to a general predetermined load location pattern. Not infrequently the first attempt at attaining such registry or symmetrical disposition is not successful, necessitating a second or, in some instances, a third try. These extra maneuvering operations obviously add to the cost of handling the material.

It is a main object of the present invention to provide, in a lift truck of the type having a pair of load grip arms mounted for lateral movement on the truck and means for shifting the arms toward or away from one another to enable the arms to clamp a load therebetween, a mechanism operatively connected to the arms and operable after the arms have been brought into clamping engagement with a load to shift the arms laterally of the truck without increase or decrease of the pressure applied to the load by the arms, so that the load is neither dropped nor crushed by the arms, whereby among the advantages attained is the elimination of the extra maneuvering time above mentioned.

A more particular object of the present invention is to provide a lift truck as described immediately above, wherein said mechanism includes means for establishing a hydraulic thrust transmitting connection between the load grip arms after the arms have clamped a load therebetween, so that motion imparted to one arm in a direction to load the hydraulic thrust transmitting connection will cause the other arm to move identically in extent and direction as said one arm, and motion imparted to the other arm in a direction to load the hydraulic thrust transmitting connection will cause said one arm to move identically in extent and direction as said other arm, and means for selectively imparting movement to the arms in a manner to load the hydraulic thrust transmitting connection whereby the arms may be shifted sideways the desired amount one way or the other without increasing or decreasing the grip of the arms on the load.

Another object of the present invention is to provide, in a lift truck of the type having a pair of fork load arms mounted for lateral movement, means operatively connected to the arms to shift them laterally toward or away from one another to enable them to properly fit beneath a pallet, or to fit beneath or in a particular load, and a mechanism operatively connected to the arms and operable after a predetermined spacing of the arms is attained to shift the arms in unison laterally one way or the other

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to dispose the arms at a desired location laterally of the truck.

A further object of the present invention is to provide a lift truck of the type described immediately above wherein said mechanism is of the type described in the paragraph preceding the immediately above paragraph.

A still further object of the present invention is to provide a lift truck having a pair of load engaging members of any desired construction mounted and controlled in movement in the manner explained above with reference to the load grip arm and the fork load arm type of lift truck.

It is another object of the present invention to provide a pair of load engaging members controlled in movement as described above and applicable to the general arts as well as to the lift truck art.

For a consideration of what is believed novel and inventive, attention is directed to the following description taken in connection with the accompanying drawings, while the features of novelty will be pointed out with greater particularity in the appended claims.

In the drawings:

Fig. 1 is a perspective view taken from the front left of an industrial lift truck embodying the concepts of the present invention, said lift truck being of the type having load grip arms, the arms being shown in somewhat extended condition;

Fig. 2 is a schematic view of the hydraulic system for controlling movement of the load grip arms, the system being shown in its neutral condition;

Fig. 3 is a view similar to Fig. 2, but showing the system in condition for releasing a load;

Fig. 4 is a view similar to Fig. 2, but showing the system in condition for gripping a load;

Fig. 5 is a view similar to Fig. 2, but showing the system in condition for shifting a load to the left, as the drawing is viewed;

Fig. 6 is an enlarged, fragmentary view of Fig. 5 showing the principle of operation of the hydraulic thrust transmitting connection between the grip arms, the actuators being longitudinally condensed for convenience in illustration;

Fig. 7 is a view similar to Fig. 2, but showing the system in condition for shifting a load to the right, as the drawing is viewed;

Fig. 8 is a perspective view of a fork arm arrangement embodying the concepts of the present invention; and

Fig. 9 is a sectional view taken along line 9—9 of Fig. 8.

General description of lift truck

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, there is disclosed a lift truck embodying the concepts of the present invention, including a weighted frame generally indicated at 11, which is supported by a pair of driven front wheels 13 and a single steerable rear wheel (not shown). Carried at the front end of the truck is a pair of outer, vertical guides 17 which are mounted on the frame for limited pivotal movement about their lower ends, in a manner not shown, which is of conventional construction. The outer guides telescopically receive a pair of movable, inner vertical guides 19, guides 17 being joined at their upper ends by a rearwardly offset crosspiece 21 and at their lower ends by a crosspiece 22, and guides 19 being joined at their upper ends by a crosspiece 23.

Guided by the inner guides is an elevator generally indicated at 25 having rollers (not shown) riding along the inner guides. A ram is provided for elevating elevator 25, said ram having a cylinder 27 which is mounted in a manner not shown on a block 28, fixed to crosspiece 22, the plunger 29 of the ram being connected at its upper end to a bracket 30 fixed to cross piece 23. A chain 31

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is trained over a sheave 32 rotatably carried by bracket 30 and is connected at one end to the elevator, in a manner not shown, and at its other end to the truck, in a manner not shown, both being conventional connections.

Mounted on elevator 25 is an assembly including a pair of load grip arms 33, each having a generally C-shaped base portion 35 secured at its ends to a pair of tubular slides 37 which are slidably received within tubular guides 39. The guides of one arm are interspaced with respect to the guides of the other arm, as shown, the arms being arranged on their bases to compensate for this arrangement of the guides, in a manner such that the arms are disposed at the same horizontal level. Tubular guides 39 extend through and are fixed to elevator 25. These tubular guides are slotted at 41 to accommodate the ends of C-shaped base portion 35, to thus allow for a considerable amount of travel of the arms and to enable the arms to be brought into fairly close proximity to one another. Each pair of adjacent ends of tubular guides 39 is connected by a crosspiece 43.

Associated with each arm 33 is a hydraulic actuator, the upper actuator in Fig. 1 being indicated by reference numeral 45 and the lower actuator being designated by reference numeral 46. Each actuator includes a cylinder 47 connected at 49 to the crosspiece 43 remote from the associated arm. Each cylinder guide contains a piston 50 (see Fig. 2) having a piston rod 51 extending from the cylinder and connected to the base portion 35 of the associated arm.

The structure so far described is old and shown in the patent to Ehmann, 2,571,550. The novel structure of the present invention includes in combination with at least part of the structure heretofore described a hydraulic system for controlling the movement of the arms. The hydraulic system of the invention will now be described with reference mainly to Figs. 2 through 7, with only incidental reference made to Fig. 1.

Hydraulic system

The hydraulic system includes a control valve unit, generally indicated at 55 in Fig. 2, which is mounted on the truck body at a place (not shown) accessible to the operator of the truck, and has extending therefrom four flexible, hydraulic conduits 57, 59, 61 and 63 (compare Figs. 1 and 2) which are trained upwardly over sheaves 65 (see Fig. 1) said sheaves being rotatably supported by bracket 30, previously mentioned, and then led downwardly to elevator 25. Mounted behind elevator 25, in a manner not shown, is a check valve unit generally indicated at 67 (see Fig. 2) to which conduits 57 and 59 are directly coupled, in a manner to be presently explained, while conduit 61 is directly connected to the right-hand end of the cylinder of actuator 46, as the parts are depicted in Fig. 2, and to the check valve unit 67 by a conduit 69, and conduit 63 is connected to a conduit 71 connecting the check valve unit 67 to the left-hand end of the cylinder of actuator 45.

Connecting the adjacent ends of the cylinders of actuators 45 and 46 is a thrust transmitting conduit 73 which is connected by a conduit 75 to the check valve unit 67.

In order to attain equal outward and inward movement of the load grip arms, when fluid pressure is applied to urge the arms to so move, it is contemplated that an orifice-type arrangement, of the type described in the Ehmann patent above identified, will be provided at the connections between the conduits 73 and the actuators. To simplify the drawings, such an orifice-type arrangement has been omitted.

The detailed construction of check valve unit 67 will now be explained, then the detailed explanation of the construction of control valve unit 55 will follow, and thereafter the relation of the two will be set forth.

Check valve unit

Referring to Fig. 2, check valve unit 67 comprises a body

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89 having two vertical passages 91 and 93, having lower blind ends and upper ends opening through the top of the body. Body 89 also has three spaced, horizontal through passages 95, 97 and 99. The vertical passages intersect the horizontal passages as shown. Horizontal passage 95 is closed at its left-hand end by a plug 101, and horizontal passages 97 and 99 are closed at their right-hand ends by plugs 103. Precluding communication between vertical passages 91 and 93 via the horizontal passages are three pistons 105, 107 and 109 slidably and sealingly fitting within counterbored portions of passages 95, 97 and 99, respectively.

Each piston includes a ball check valve actuating stem, the stem of piston 105 extending to the right and the stems of the other piston extending to the left, as the parts are depicted in Fig. 2. The stems are of smaller diameter than the portions of the passages within which they are disposed so as not to block the flow of fluid through the vertical passages. A tubular spacer 113 is disposed between the head of each piston and the associated plug to limit movement of the piston.

Provided in the right-hand end of horizontal passage 95 is a spring-loaded ball check valve 115, and disposed within the left-hand ends of horizontal passages 97 and 99 are spring-loaded ball check valves 117 and 119, respectively. An appropriate seat is formed in each horizontal passage against which the associated ball check valve may seat and block communication between the outer portion of each horizontal passage and the associated vertical passage.

The connection of the conduits to the check valve unit is as follows. Conduit 75 is coupled to passage 95, conduit 71 is coupled to passage 97, conduit 69 is coupled to passage 99, conduit 57 is coupled to vertical passage 91, and conduit 59 is coupled to vertical passage 93.

Control valve unit

Control valve unit 55 includes a body portion 131 having two vertical passages 133 and 135 within which are slidably and sealingly received a pair of spool-shaped control valve members 137 and 139, respectively. Control valve member 137 is a side shift control member, and member 139 is a load grip and release control member. Both control valve members 137 and 139 protrude from the upper ends of body 131 and are formed at their upper ends with handles by which they may be readily manipulated.

Connecting vertical passages 133 and 135 adjacent their upper ends is a horizontal discharge passage 141, and connecting the vertical passages at their lower ends is a horizontal discharge passage 143, connected by a conduit 145 to a sump 147. Horizontal passages 141 and 143 are connected and communicate at all times with one another by a third vertical passage 149.

Adapted to supply hydraulic fluid under pressure to the control valve is a positive displacement pump 161 connected at the low pressure side thereof to sump 147 by a conduit 163, and at its high pressure side to control valve unit 55 by means of a conduit 165. A number of conduits, including conduit 165, which communicate with control valve unit 55, have extension passages formed in the valve body. For convenience in description, these continuation passages will be merely considered as end portions of the conduits.

Control valve member 137 is provided with a central, annular groove 167 therearound disposed in communication with supply conduit 165 when control valve member 137 is disposed in its neutral position, as shown in Fig. 2. In such position, annular groove 167 communicates with a horizontal passage 169 formed in valve body 131, passage 169 communicating with a central, annular groove 171 formed in control valve member 139. Annular groove 171 communicates with a passage 173 formed in valve body 131, the latter-named passage communicating with vertical discharge passage 149 which, as

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previously mentioned, communicates with sump 147 through discharge passage 143.

With the parts arranged as shown in Fig. 2, fluid supplied by line 165 flows through control valve unit 55 to sump 147. A relief valve conduit 175 connects the high pressure side of pump 161 to sump conduit 145. This conduit is operative to conduct fluid to sump conduit 145 when the control valves are moved so as to temporarily obstruct the flow of fluid from supply conduit 165 through the control valve unit, or at any other time when the pressure in conduit 165 exceeds a predetermined value.

Control valve member 137 is formed above annular groove 167 with an upper annular groove 181 of a width to communicate conduit 61 with discharge passage 141, when the valve member is shifted from its neutral position to its up position (compare Figs. 2 and 7) or to communicate conduit 61 with supply conduit 165 when control valve member 137 is shifted from its neutral position to its down position (see Fig. 5). When control valve member 137 is disposed in its neutral position, groove 181 is inactive.

Control valve member 137 is provided with an I-shaped passage 185 terminating at its upper and lower ends in annular grooves extending around member 137. Passage 185 is inactive when the control valve member is in its neutral position, but is operable when the control valve member is shifted to its up position (see Fig. 7) to communicate supply conduit 165 with conduit 63. When the control member 137 is shifted to its down position (see Fig. 5), passage 185 communicates conduit 63 with discharge passage 143.

Formed in control valve member 139 is an upper annular groove 191 of a width to communicate conduit 59 with discharge passage 141 when the control valve member is shifted to its up position (see Fig. 3), or to communicate passage 169 with conduit 59 when the control valve member is shifted to its down position (see Fig. 4). The upper annular groove is inactive when the control valve member 139 is disposed in its neutral position as shown in Fig. 2.

Control valve member 139 is also formed below annular groove 171 with an I-shaped passage 193 which is operable when the control valve member is shifted to its up position (see Fig. 3) to communicate passage 169 with conduit 57, and when control valve member 139 is shifted to its down position (see Fig. 4) passage 193 functions to communicate conduit 57 with discharge passage 143.

Operation

The operation of the hydraulic system is as follows. As previously mentioned, when both control valve members 137 and 139 are disposed in their neutral positions, hydraulic fluid under pressure supplied by conduit 165 is forced through the control valve into discharge passage 149 from whence it flows into discharge passage 143 and through sump conduit 145 to sump 147.

Beginning with the parts in the position shown in Fig. 2, it may now be assumed that it is desired to impart separating movement to the load grip arms so as to release a load or to dispose the arms in position for gripping a load. Referring to Fig. 3, this is accomplished by shifting control valve member 139 to its up position, leaving control valve member 137 in its neutral position. By this action passage 193 functions to communicate passage 169 with conduit 57 to supply fluid under pressure to vertical passage 91 of the check valve unit 67. Simultaneously, upper annular groove 191 functions to communicate conduit 59 with discharge passage 141. Fluid under pressure in passage 91 of the check valve unit operates to shift piston 105 to the right to unseat check valve 115, and further functions to directly unseat check valves 117 and 119 so that fluid under pressure is supplied to conduits 71 and 69. Hydraulic fluid under pressure is conducted by conduit 71 to the left-

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hand end of the cylinder for actuator 45, and by conduits 69 and 61 to the right-hand end of the cylinder for actuator 46. At this time, conduit 63 and the lower portion of conduit 61 are inactive since the control valve member 137 blocks communication of the lower ends thereof with any of the passages of the control valve unit.

By the above operation, hydraulic fluid being supplied to the remote ends of the cylinders of actuators 45 and 46 forces the actuator pistons toward one another to urge a separation of the load grip arms. Such separation is permitted because the fluid in the adjacent ends of the cylinders of actuators 45 and 46 may be forced through thrust transmitting conduit 73 to conduit 75, and through the check valve unit 67 to conduit 59, through control valve unit 55 via annular groove 191, discharge passages 141, 149 and 143, to sump conduit 45.

Upon separation of the grip arms the desired distance, control valve member 139 is returned to its neutral position, which action stops movement of the grip arms by cutting off the supply of fluid under pressure to the actuators. It is pointed out at this time that the springs associated with ball check valves 115, 117 and 119 are strong enough to immediately return the ball check valves to their seated positions any time the fluid pressure on the inner sides thereof falls below the value of the fluid pressure on the outer sides of the ball check valves.

It may now be assumed that it is desirable to grip a load, and it may be further assumed that the truck is so positioned that the load is substantially symmetrically disposed relative to the arms and between the arms. A gripping operation is accomplished by shifting the control valve member 139 to its down position (see Fig. 4) and leaving control valve member 137 in its neutral position. By this action groove 191 is brought into position to communicate passage 169 with conduit 59 to supply fluid under pressure to passage 93 of the check valve unit, and simultaneously passage 193 is brought into position to communicate conduit 57 with discharge passage 143.

The high pressure fluid in passage 93 of check valve unit 67 functions to unseat check valve 115 in passage 95 so that fluid under pressure is supplied through conduit 75 to thrust transmitting conduit 73 which supplies hydraulic fluid under pressure to the adjacent ends of the hydraulic actuator cylinders. Simultaneously, high pressure fluid in passage 93 drives pistons 107 and 109 to the left to unseat check valve elements 117 and 119. Therefore, hydraulic fluid from the right-hand end of the cylinder for actuator 46 may flow through conduit 61 and conduit 69 into passages 99 and 91 of the check valve unit and thence outwardly through conduit 57, through passage 193 into discharge passage 143 of control valve unit 55. Also, hydraulic fluid from the left-hand end of the cylinder for actuator 45 may be forced through conduit 71 into passages 97 and 91 of the check valve unit and thence through conduit 57 to passage 193 and discharge passage 143. Control valve member 137, being still disposed in its neutral position, serves to block the flow of fluid from conduits 61 and 63 through the control valve.

After the load grip arms have been brought into engagement with the load and the desired pressure applied to the load to enable the arms to support it, control valve member 139 is returned to its neutral position, at which time check valve 115 snaps shut, trapping fluid under pressure in conduit 75, in thrust transmitting conduit 73 and the adjacent ends of the cylinders of the actuators, and thus retaining the applied pressure on the load.

Referring particularly to Fig. 6, it is apparent that the hydraulic fluid under pressure in thrust transmitting conduit 73 and the adjacent ends of the cylinders forms an incompressible hydraulic thrust transmitting medium between the pistons of the actuators so that any movement imparted to the piston of actuator 46 to the left is transmitted through the hydraulic thrust transmitting medium to the piston for actuator 45 to cause a movement of the

piston of actuator 45 identical in magnitude and direction to that imparted to the piston of actuator 46. Conversely, any movement imparted to the piston of actuator 45 to the right will load the hydraulic thrust transmitting medium in the opposite direction to cause an identical movement of the piston of actuator 46 in magnitude and direction to that imparted to the piston for actuator 45. To state the above matter in another way, movement of the piston for actuator 46 to the left, or movement of the piston of actuator 45 to the right, can occur only by forcing a quantity of hydraulic fluid from the cylinder of the piston to which movement is imparted into the thrust transmitting conduit 73, from which an equal quantity of liquid is forced into the other cylinder. The cylinders of actuators 45 and 46 are made to have equal interior diameters, and the piston rods of the actuators are made of equal external diameters, so that an identical movement of the pistons will occur whenever the piston for actuator 45 is forced to the right or when the piston for actuator 46 is forced to the left. Since the load grip arms are connected to and movable with the pistons of the actuators, the load grip arms are locked for movement in unison whenever movement is imparted to the pistons of the actuators in the directions above indicated, which movement will cause identical movement of the load grip arms without loss or increase of gripping pressure on the load so that the load is neither dropped nor, if of a somewhat fragile nature, crushed.

It is pointed out that the trapped thrust transmitting fluid restrains, as contrasted to locks, the load grip arms against relative movement toward one another. The force required to cavitate the fluid restrains the arms against movement toward one another, apart from any resistance offered by the load.

The overall operation of shifting load grip arms to the left will now be explained with particular reference to Figs. 5 and 6. Control valve member 139 is left in its neutral position and control valve member 137 is shifted to its down position. This action brings groove 181 in position, placing conduit 61 in communication with supply conduit 165, and brings passage 185 in position placing conduit 63 in communication with discharge passage 143. Hydraulic fluid from supply conduit 165 is thus permitted to pass through conduit 61 to the right-hand end of the cylinder of actuator 46, urging the associated piston to the left. Check valve 119 prevents high pressure fluid from entering check valve unit 67 and opening check valve 115. Fluid in the left-hand end of the cylinder of actuator 45 may be forced through conduits 71 and 63 to the control valve unit 55 and pass through the control valve via passage 185 and discharge passage 143. As previously indicated, when motion is imparted to the left to the piston of actuator 46, the two pistons must move in unison because they are in effect locked against relative motion under these conditions, and thus the load grip arms will be moved to the left in unison without increase or decrease of pressure applied to the load.

After the desired degree of shifting movement of the load grip arms to the left has been accomplished, control valve member 137 is shifted back to its neutral position, this action cutting off the supply of fluid under pressure to the right-hand end of the cylinder of actuator 46 but in no way affecting the trapped thrust transmitting fluid under pressure within conduit 73 and the adjacent ends of the cylinders of actuators 45 and 46.

To shift to the right, control valve member 137 is shifted to its up position, control valve member 139 being left in its neutral position (see Fig. 7). This action brings groove 181 in position to place conduit 61 in communication with discharge passage 141 and brings passage 185 in position to place supply conduit 165 in communication with conduit 63. Pressure is thus applied through conduits 63 and 71 to the piston of actuator 45, urging the piston to the right. Check valve 117 in passage 97

prevents entrance of high pressure fluid into the check valve unit. Movement of the piston of actuator 45 to the right again loads the thrust transmitting fluid medium in the adjacent ends of the cylinders and in thrust transmitting conduit 73 so as to force the piston of actuator 46 to the right an extent equal in magnitude and direction to the movement of the piston for actuator 45. This movement of the piston causes a corresponding movement of the load grip arms without increase or decrease of pressure on the load.

The load may be released by raising or shifting control valve member 139 to the position shown in Fig. 3.

Figs. 8 and 9 show the application of the concepts of the present invention to a fork-type lift truck, Fig. 8 showing only the elevator assembly which is adapted to be mounted on the vertical guide unit of a lift truck in a manner similar to that shown in Fig. 1. As is apparent from Fig. 8, the assembly includes a pair of load arms 211 and 213 mounted for movement toward and away from one another on channel-shaped guides 215 and 217 by means of upper and lower pairs of rollers 219 and 221 supported at the rear of the vertical portions of the load arms and riding within the channel-shaped guides 215 and 217 (compare Figs. 8 and 9). The guides 215 and 217 extend through and are fixed to elevator 25.

The upper ends of arms 211 and 213 have rearward horizontal extensions 223 and 225, respectively, from which are supported for rotation about vertical axes pairs of rollers 229 and 227, respectively, engaging the rear face of upper guide 215 to take the counterclockwise thrust imposed on the load arms, as the parts are depicted in Fig. 9. Actuators 45 and 46 are provided and extend through and are supported by elevator 25, and have their piston rods 51 connected respectively to load arms 213 and 211 for moving the same.

The hydraulic system of the second form of the invention is identical to that shown in Figs. 2 through 7, and therefore repetition of this system in the drawings is unnecessary. The operation of the hydraulic system is similar to that previously described so that the arms may be moved away from one another by raising control valve member 139, or moved toward one another by lowering control valve member 139, to enable the fork to properly fit a particular pallet or a particular load. When it is necessary to shift the load arms 211 and 213 one way or the other, they may be shifted to the left, as the parts are depicted in Fig. 8, by shifting control valve member 137 downwardly, or they may be shifted to the right by shifting control valve member 137 upwardly. When shifting either to the left or to the right, the hydraulic thrust transmitting connection between the load arms will serve to maintain them in their original spaced relationship without variation during shifting.

By the present invention, a novel arrangement has been provided whereby two load engaging members which are mounted for movement toward and away from one another may be conditioned for movement in exact unison by means which establishes a hydraulic thrust transmitting connection between the members, so that when one member is moved in a direction to load the hydraulic thrust transmitting connection said connection will cause identical movement in magnitude and direction of the other load engaging member and, conversely, when the other load engaging member is moved in the reverse direction, it loads the hydraulic thrust transmitting connection the opposite way to cause an identical movement in magnitude and direction of said one load engaging member.

Broadly considered, the present invention has provided an arrangement wherein two load engaging members can be moved toward or away from one another, or in unison one way or the other along the path which they move when moving toward or away from one another. Thus, when the concepts of the present invention are embodied in a load grip arm type lift truck, a truck is provided

wherein the load, after being gripped, may be shifted sideways one way or the other without increase or decrease in pressure on the load so that the load is neither crushed nor dropped during such sideways shifting. When the concepts of the present invention are embodied in a fork type lift truck, the forks may be shifted toward or away from one another to establish a desired spacing of the fork arms, and, thereafter, the fork arms may be shifted in unison sideways one way or the other to deposit or pick up a load at a desired location.

It follows from the above discussion that a lift truck embodying the concepts of the present invention substantially reduces the time in handling materials, since the truck may be merely driven up into approximate registry with a load depositing or pick-up station and thereafter the load engaging members may be shifted sideways to exact registry with such location. It is pointed out that the truck may be used, for instance, in places where there is a narrow passageway leading to the materials to be handled, and that material may be removed from or deposited on locations offset from the passageway. Thus the truck is ideally adapted for use where maneuvering thereof into exact registry with a load is not even possible.

It is to be specifically understood that the term "carriage" employed in the following claims is not intended to be limited to the elevator carriage itself but may as well constitute a turret carriage on the type of lift truck having the load engaging members directly carried by a turret carriage. Furthermore, it is apparent that the particular type of load gripping members shown is merely illustrative, and that many other types may be substituted therefor. It is pointed out that the concepts of the present invention may be embodied in a load grip arrangement where the piston rods of the actuators would be placed under compression when a load was gripped. Under such circumstances, the thrust transmitting line would be connected to ends of the cylinders remote from the ends from which the piston rods protrude.

Having described the invention in what are considered to be preferred embodiments thereof, it is desired that it be understood that the specific details shown are merely illustrative and that the invention may be carried out in other ways. It is specifically pointed out that, although the particular check valve unit and control valve unit shown have been found to operate successfully, the invention is by no means limited to these particular valves since many other types of valve arrangements will occur to those skilled in the art without any departure from the basic concepts of the present invention.

I claim:

1. An arrangement of the class described, comprising a support, first power means for moving said support, two load engaging members mounted on said support for movement along a predetermined path, second power means independent of said first power means operatively connected to the members for relatively moving the members toward or away from one another along said path, and for moving said members together in either direction along said path, control means at a control station remote from said load engaging members for causing said second power means to move the members toward and away from each other and control means at said station for causing said second power means to move the members in unison in either direction along said path.

2. In an arrangement of the class described, two load engaging members, means supporting the members for movement along a predetermined path, means including a hydraulic relay for operatively connecting the members to one another for movement in unison along said path, power means for moving said members relative to one another along said path including means for suspending operation of the hydraulic relay during such relative movement, and control means for causing said power means to move said members along the path in unison when the hydraulic relay is operative.

3. In a lift truck, two load engaging members movable in directions toward and away from one another, power means operatively connected to the members for moving the members toward or away from one another, locking means operatively connected to the members to alternatively lock the members against relative movement in at least one of said directions, vertical guide means on the truck, a mechanism movable along the vertical guide means and supporting the members for sideways movement relative to said guide means, said power means also being operatively connected to the members to shift them in unison sideways one way or the other relative to said vertical guide means when said locking means locks the members together, and control means at a control station remote from said power means for controlling the operation of said power means and said locking means.

4. In a lift truck, a carriage, means operatively connecting the carriage and truck to vertically move the carriage, two load engaging members carried by the carriage for movement along a predetermined path relative to the carriage and in directions relatively toward or away from one another, power means operatively connected to the members for urging the members relatively toward or away from one another along said path, locking means operatively connected to the members for alternatively locking them against relative movement along said path in at least one of said directions but not against movement in unison relative to the carriage, said power means also being operatively connected to the members for urging said members along said path in unison relative to the carriage, and control means at a control station remote from said power means for causing actuation of said power means and said locking means.

5. In a device of the class described, two load gripping members movable toward each other into clamping engagement with a load, power means for moving the members into said engagement with said load, means operatively connected to the members to thereafter establish a hydraulic connection for transmitting thrust between the members to prevent movement of the members away from each other so as to lock the members in clamping engagement with said load, said power means including means for urging either one of the members in a direction away from the other of said members to load the hydraulic connection and cause simultaneous movement of the other of said members in the same direction as said one of said members, said connection being operative to cause equal movement of said members during said simultaneous movement.

6. In a device of the class described, supporting means, two load engaging members carried by the supporting means for movement relative thereto along a predetermined path and relative to one another along said path, means operatively connected to the members to urge them to move along said path relatively toward or away from one another, axially incompressible hydraulic thrust transmitting means operatively connecting the members to one another to thereafter positively and simultaneously transmit movement of one member similar in magnitude and direction to the other member in at least one direction of movement of said one member relative to said other member along said path, and to positively and simultaneously transmit movement of said other member similar in magnitude and direction to said one member in at least the reverse direction of movement of said other member relative to said one member, and means operatively connected to said members to thereafter shift said members in unison along said path.

7. In a lift truck, a carriage, means operatively connecting the carriage and truck to vertically move the carriage, two load engaging members carried by the carriage for movement along a predetermined path relative to said carriage and relatively toward and away from one another, power means operatively connected to the members for

urging said members toward or away from one another along said path, said power means including means operatively connected to the members to selectively impart movement to one member in one direction along said path and alternatively to impart movement to the other member in the reverse direction along said path, and including hydraulic thrust transmitting means operatively connecting said members and containing an incompressible hydraulic fluid through which stress is transmitted between said members to cause movement of said members in the same direction and at the same rate whenever said power means selectively imparts movement to one of said members.

8. In an arrangement of the class described, a pair of load engaging members, means supporting the members for movement along a predetermined path, power means operatively connected to the members for relatively moving the members along said path in directions toward or away from one another, means operatively connected to the members to alternatively establish an axially incompressible hydraulic thrust transmitting connection between the members to lock the members against relative movement in at least one of said directions, and means operatively connected to the members to impart movement to one member in a direction to transmit thrust through the connection to cause simultaneous movement of the members in the same direction and at the same rate along said path or to impart movement to said other member in the opposite direction so as to transmit thrust through the connection to cause movement of the members at the same rate in the opposite direction along said path.

9. In an apparatus of the class described, a pair of hydraulic actuators controlling the movement of a pair of load engaging members and operable when supplied with fluid under pressure to certain ends thereof to cause said load engaging members to move toward one another and when supplied with fluid to the opposite ends thereof to cause said members to move away from one another, means placing said certain ends in communication with one another, and hydraulic valve means operatively connected to the hydraulic actuators to supply fluid to said opposite ends while releasing fluid from said certain ends to cause a separating movement of the load engaging members, or to supply fluid to said certain ends while releasing fluid from said opposite ends to cause approaching movement of the load engaging members, or to preclude release of fluid from said certain ends without interrupting communication between said certain ends, and selectively supplying fluid to one or the other of said opposite ends, while releasing fluid from the end of said opposite ends not being supplied with fluid, to cause movement of said members in unison one way or the other.

10. In a load grip device of the type including a pair of hydraulic actuators controlling the movement of a pair of load gripping members adapted to clamp a load therebetween, and means for supplying fluid under pressure to the hydraulic actuators to cause a clamping movement of the members and for retaining the clamping fluid pressure constant while the actuators and load are bodily lifted or lowered; the improvement which comprises closed circuit fluid passage means connecting the actuators so as to place the clamping fluid pressure of one actuator in communication with the clamping fluid pressure of the other, and adapted to be filled with fluid under pressure when the load is being clamped to provide a motion transmitting medium between the movable members of the actuators to constrain the movable members and therefore the load gripping members to move in unison one way or the other without increase or decrease of pressure on the load, and means for shifting the load gripping members one way or the other along the path in which they move to clamp a load.

11. An arrangement of the class described, comprising two load engaging members, means operatively con-

nected to the members to urge the members to move relatively toward or away from one another along a predetermined path of travel, means operable for thereafter locking the members against relative movement in at least one of the ways above mentioned, the last-named means including a double-acting hydraulic actuator operatively connected to each load engaging member, and closed circuit fluid filled means communicating the actuators with one another at places to which the supply of fluid under pressure would tend to cause said members to move in different directions along said path, and means operable for thereafter supplying fluid under pressure to at least one of the hydraulic actuators at a place remote from the place of communication therewith of said closed circuit fluid filled means to cause movement of said members in unison along said path.

12. In a load gripping device of the class described, a pair of double-acting hydraulic actuators controlling the movement of a pair of load gripping members, and operable when supplied with fluid at certain ends thereof to urge the load gripping members to move along a predetermined path and clamp a load therebetween, means for supplying fluid under pressure to said ends, a passageway communicating said ends with one another and adapted to be filled with fluid under pressure when fluid under pressure is supplied to said certain ends, whereby the movement of one member along said path in one direction will cause a discharge of fluid from the associated actuator into the passageway and an equal discharge of fluid from the passageway into the other actuator and thus cause movement of said members in unison one way along said path, and when the other member is moved in the reverse direction the members are similarly caused to move in unison the opposite way, and means for selectively supplying fluid under pressure to the operatively remote end of the hydraulic actuator associated with said one member to cause said members to move in unison said one way or to supply fluid to the operatively remote end of the hydraulic actuator associated with the other member to cause movement of said members said other way.

13. In an arrangement of the class described, first and second load engaging members, a first means operable to move the first load engaging member one way or the other along a predetermined path of travel, a second means operable to move the second load engaging member one way or the other along said predetermined path of travel, means operatively connected to the first and second means to cause the load engaging members to move toward or away from one another along said predetermined path of travel, means operable thereafter to inactivate the first and second means in their capability to cause movement of the load engaging members away from one another while locking the load engaging members against relative movement away from one another, and means for thereafter operating the first-named means in the remaining way that it is active to cause movement of the load engaging members in unison one way along said path of travel, or for operating the second-named means in the remaining way that it is active to cause movement of the load engaging members in unison the opposite way along said path of travel.

14. In combination, a pair of load engaging members mounted for movement along a predetermined path, power means for moving the members toward each other into clamping engagement with a load positioned therebetween and for shifting said members in the same direction and at the same rate along said path while maintaining said clamping engagement, said means including a mechanism for transmitting the clamping thrust between the members due to said clamping engagement after a load has been clamped between said members, and means for applying a shifting thrust to one of said members only during shifting of said members so that the thrust for

shifting the other of said members is transmitted through said mechanism.

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