

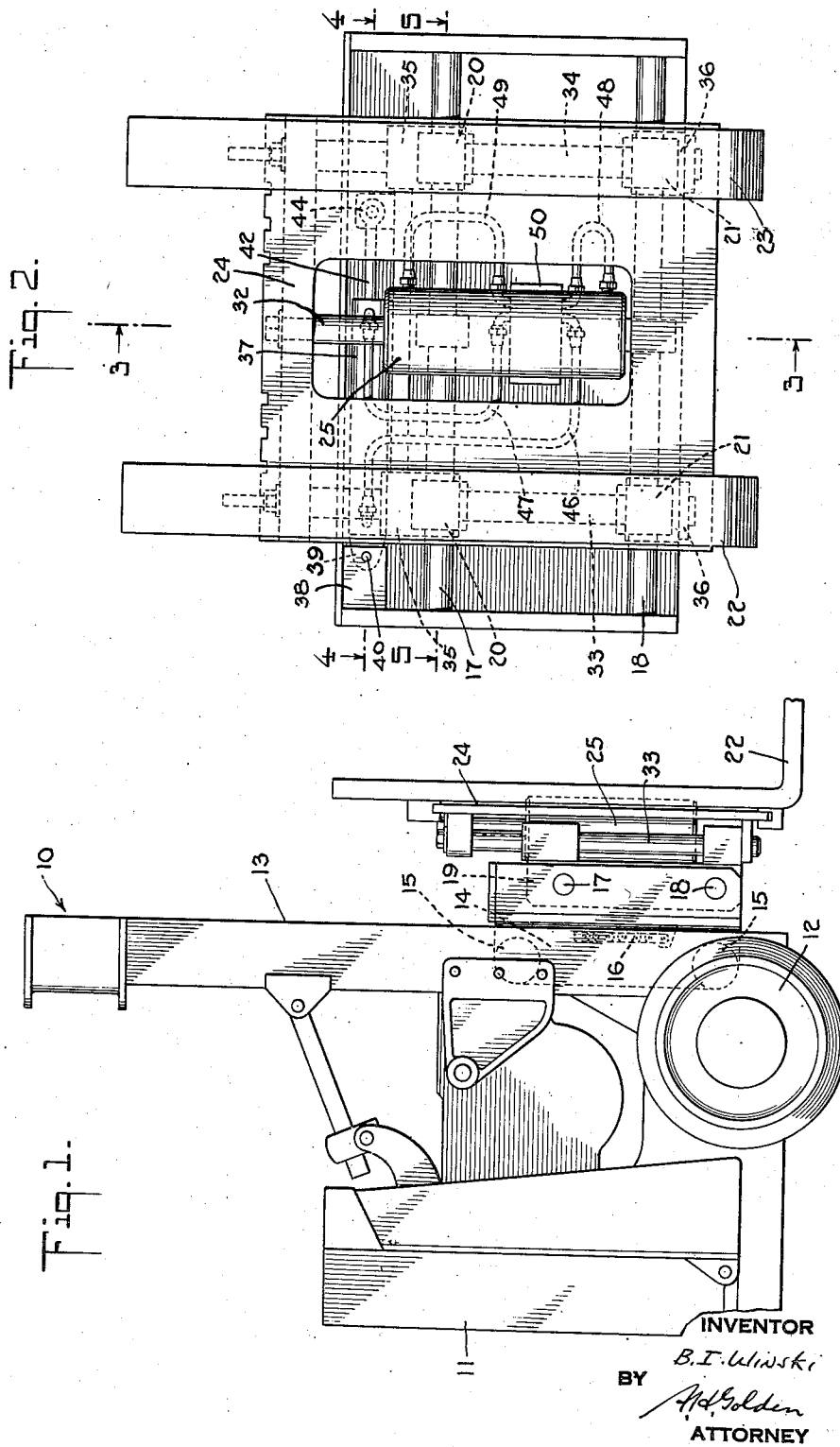
Aug. 10, 1954

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B. I. ULINSKI
HYDRAULIC LOAD MANIPULATING MECHANISM
FOR INDUSTRIAL TRUCKS

2,685,976

3 Sheets-Sheet 1



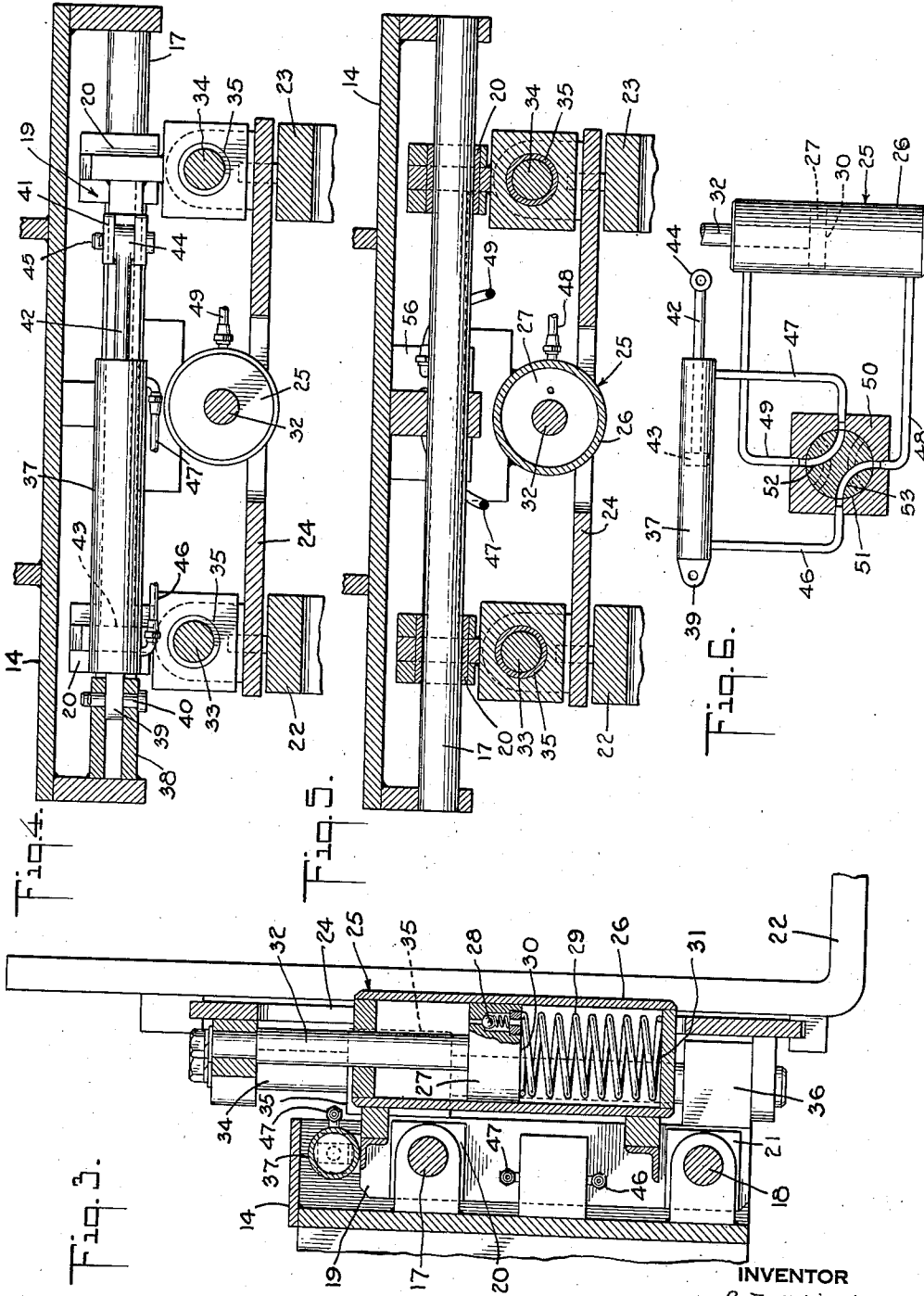
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Fig. 7.

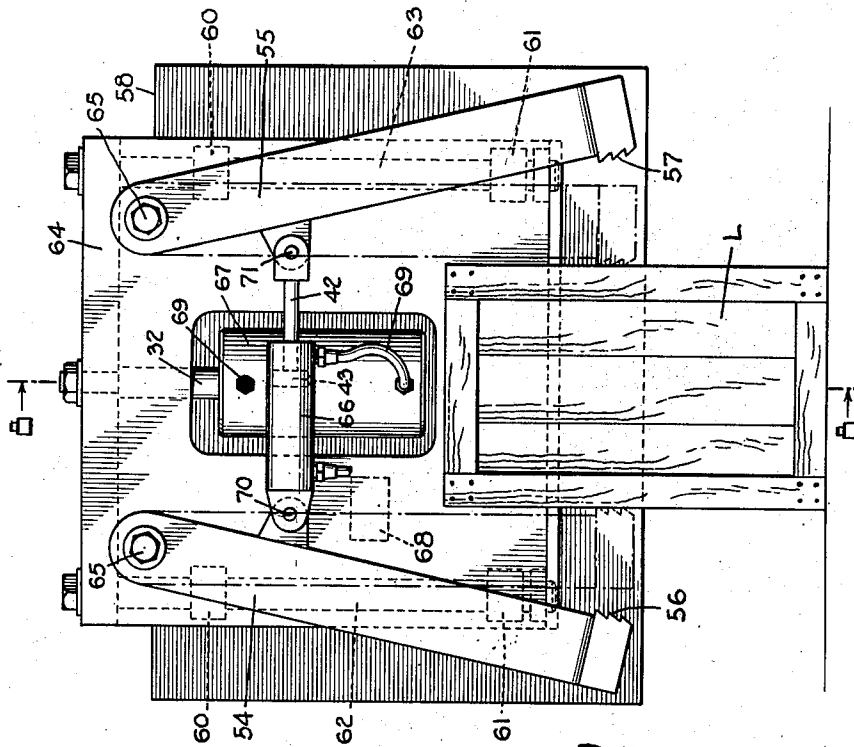
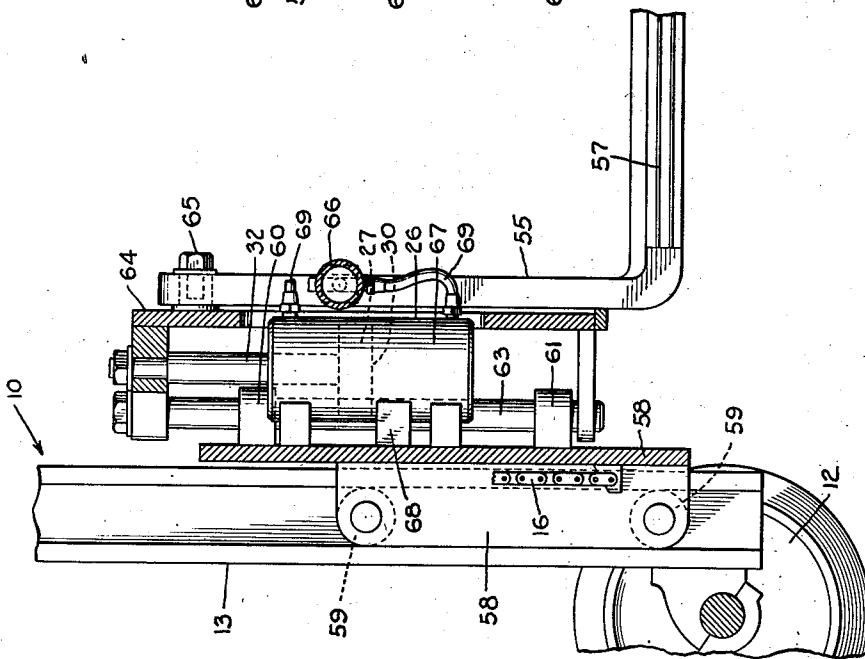


Fig. 6.



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UNITED STATES PATENT OFFICE

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HYDRAULIC LOAD MANIPULATING MECHANISM FOR INDUSTRIAL TRUCKS

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10 Claims. (Cl. 214—653)

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My invention relates to industrial trucks of the type having a load lifting member mounted for elevating movement thereon and equipped with means for manipulating the load relatively to the truck or for gripping the load through utilization of the weight of the load.

It has been the custom in the prior art to utilize power means for directly moving, gripping or shifting a load or load engaging member, such power means being of direct-acting mechanical, hydraulic, and other suitable type. In my invention, I employ a power means that applies the weight of the load lifting member, with or without a load thereon, to a hydraulic mechanism for laterally shifting or otherwise manipulating said load lifting member.

A feature of my invention resides in the directing of fluid from a power storage ram to another ram for moving a load engaging or load gripping member into proper load engaging position, the pressure of the fluid in said power storage ram being developed by the weight of the load engaging member and the weight of the load applied to the load engaging member.

A further feature of my invention resides in a fork shifting mechanism in which the shifting is accomplished by hydraulic pressure developed in a hydraulic system by the weight of the forks, either loaded or unloaded, and in which the fluid pressure may be directed to move the forks selectively in opposed directions.

As a further feature of my invention I utilize means whereby power for shifting the forks may be stored.

Still another feature of the invention resides in so applying and controlling fluid bled from a load supporting ram as to operate a shift ram at the will of the operator.

I have thus outlined rather broadly the more important features of my invention in order that the detailed description thereof that follows may be better understood, and in order that my contribution to the art may be better appreciated. There are, of course, additional features of my invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of my invention. It is important, therefore, that the claims to be granted me shall be of sufficient breadth to prevent the appropriation of my invention by those skilled in the art.

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Referring now to the drawings,

Fig. 1 is a side elevation of the front end portion of an industrial truck, illustrating my invention as embodied in one form of load lifting means.

Fig. 2 is a front elevation of the load lifting means shown in Fig. 1.

Fig. 3 is a section taken along the line 3—3 of Fig. 2.

Fig. 4 is a section taken along the line 4—4 of Fig. 2.

Fig. 5 is a section taken along line 5—5 of Fig. 2.

Fig. 6 is a diagrammatic view showing the hydraulic system of my invention.

Fig. 7 is a front elevation showing a second form of my invention in which the load is adapted to be gripped by swingable arms, the gripping position of said arms being illustrated in broken lines.

Fig. 8 is a section taken substantially along line 8—8 of Fig. 7.

Referring now more particularly to the drawings, and especially to Fig. 1, the front end of a lift truck, which is indicated generally by the numeral 10, has a chassis or frame 11 mounted on wheels, one of the front wheels being designated at 12. The constructional details of the truck are omitted from the drawings and are not described herein as they form no part of the present invention. On the usual uprights 13 which are mounted at the forward end of the frame 11, is a vertically movable elevating carriage 14 having the usual vertically spaced rollers 15 engaged with said uprights. It is to be understood that the elevating carriage 14 may be lifted and lowered on the rollers 15 by any suitable means under the control of the operator, such as a chain 16 (Figs. 1 and 8).

My invention is directed to the load engaging and lifting means carried by the elevating carriage 14 and movable therewith. More particularly, the load engaging structure of my truck 10 comprises a pair of vertically spaced rods 17 and 18 secured in horizontal positions on the carriage 14, upon which pair of rods is slidably mounted a fork frame 19 by means of upper and lower pairs of bearings 20 and 21. As my load engaging members, I use a pair of lifting forks 22 and 23 attached to a connecting cross plate 24. It is to be understood that I do not wish to be limited by the particular type of lifting forks shown herein, and that other types of load engaging members may be employed with my invention.

In order to support the cross plate 24 and the

forks upon the fork frame 19, provision is made of a vertical power storage ram 25, best seen in Fig. 3, which includes a cylinder 26 mounted upon said fork frame, and a plunger or piston 27 vertically movable therein. The piston 27 is provided with a ball spring valve 28 which will permit said piston to be moved upwardly in the cylinder 26 without displacing fluid to or from said cylinder.

The piston 27 of the storage ram 25 has a piston rod 32 which is fixed to the cross plate 24, and since the forks 22 and 23 are attached to cross plate 24, they will move vertically with the piston 27. A compression spring 29 is interposed between the lower end 30 of the piston 27 and the lower end wall 31 of the power storage ram cylinder 26 to assist upward movement of the piston 27. Preferably, the force of the spring 29 is merely sufficient to counteract a part of the weight of the forks 22, 23 and cross plate 24, for reasons that will be described in due course. The vertical movements of the forks 22 and 23 are guided by a pair of vertical rods 33 and 34 which are secured at their ends to the rear side of the cross plate 24, and which are vertically moveable in upper and lower pairs of bearings 35 and 36 on the fork frame 19.

A horizontal shift ram 37, which will hereinafter be more particularly described, is positioned functionally between the lifting forks 22 and 23, on the one side, and the elevating carriage 14 on the other side, and is adapted to move the fork frame laterally along the rods 17 and 18.

As seen in Fig. 4, an upper side portion of the carriage 14 is provided with a bifurcated bracket member 38 in which an apertured ear 39 on one end of the shift ram 37 is pivoted by a transverse pin 40.

The lifting fork frame 19 also has a bifurcated bracket member 41 horizontally opposite the bracket member 38. A piston rod 42 is connected to a piston 43 within the shift ram 37 and is formed with an eye portion 44 which is pivoted in the bifurcated bracket member 41 by a transverse pin 45. Thus, it will be seen that the lifting forks 22 and 23, and any load thereon, may be shifted laterally of the truck 10 when fluid pressure is exerted selectively upon either face of the piston 43.

In order to supply and control such fluid pressure, the shift ram 37 is provided with a pair of fluid conduits 46 and 47 connected thereto at opposite sides of the piston 43, and the power storage ram 25 is provided with a pair of fluid conduits 48 and 49, connected thereto at opposite sides of the piston 27, a manually operable control valve 50 (Fig. 6) being interposed between said pairs of conduits.

The control valve 50 may be of any suitable type which is adapted to provide selectively reversed connections between the respective pairs of conduits 46, 47, and 48, 49, and also to cut off all flow in said conduits. As shown, the valve 50 comprises a rotor 51 having a pair of curved passages 52, 53, which are so arranged with respect to the conduits that either end of the shift ram 37 may be connected to the top of the power storage ram 25, the opposite end of the shift ram being simultaneously connected to the bottom of the power storage ram. A quarter turn of the valve rotor 51 from the position shown in Fig. 6 will be effective to bring about a reversal of the ram connections, while a one-eighth turn of the rotor will prevent any flow in the conduits.

As a result of the above arrangement, the weight of the cross plate 24, the forks 22, 23, and any load thereon, will place the fluid beneath the piston 27 under pressure and thus will be effective to operate the shift ram 37 when the control valve 50 is open. It will be noted at this point that the compression spring 29 will partially balance the forks 22 and the cross plate 24, and will not prevent the weight of the forks and the cross plate from operating said piston. The direction in which the shift ram 37 is operated will, of course, be determined by the positions of the valve passages 52, 53, with respect to the conduits 46, 47, 48, 49, so that the operator may utilize the weight of the forks 22, 23, and the cross plate 24 for shifting said forks laterally in either direction as desired.

When the control valve 50 is in closed position, the lift truck 10 may be operated in a conventional manner, the lifting forks 22, 23 being movable integrally with the carriage as though the power storage ram were non-existent. At any time, it is possible to develop fluid pressure within the storage ram as will now be set forth.

In order to place the shifting mechanism in condition for operation, it will merely be necessary to locate the forks 22, 23 over a suitable abutment, and then to lower the elevating carriage 14 until said forks engage said abutment, the downward movement of the carriage 14 being continued for a short distance so that the power storage cylinder 26 will descend with relation to the piston 27. This relative movement of the cylinder 26 and the piston 27 will be assisted by the spring 29, which counteracts a portion of the weight of the forks 22, 23, and the cross plate 24. Inasmuch as the control valve 50 will be in closed condition when this operation is taking place, the fluid above the piston 27 will flow downwardly past the ball valve 28 and will be retained in the cylinder 26 below said piston.

If the truck should now be operated for lifting a load upon the forks 22, 23, the weight of the load, and at least a part of the weight of the forks and the cross plate 24 as well, will be borne by the fluid below the piston 27. This fluid will be utilized for shifting the forks 22, 23 laterally whenever the operator finds that said forks are not in the desired lateral alignment with a load to be picked up thereby, or when a load on the forks is not properly aligned with the space in which it is to be deposited. It will be remembered, of course, that the spring 29 below the piston 27 preferably does not counteract entirely the weight of the forks 22, 23 and cross plate 24, and this weight can therefore be utilized to shift the forks when no load is present on the forks.

If movement of the fork members to the left of the truck is wished, the valve rotor 51 will be rotated into the position shown in Fig. 6, wherein the conduits 46 and 48 will be connected so that the fluid under pressure in the lower portion of the power storage ram 25 will be effective to move the shift ram piston 43 toward the left of the truck 10 (or to the right as viewed in Fig. 6). When the valve rotor 51 is in the position described, the conduits 47 and 49 are connected so that the fluid at the opposite end of the shift ram 37 will be exhausted to the top of the power storage ram cylinder 26. It will be understood that the operator may readily control the speed and the extent of the shifting movement by proper manipulation of the control valve.

When it is desired to shift the forks 22, 23,

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laterally to the right (to the left as viewed in Fig. 6), the valve rotor 51 will be turned so that the conduit 46 is in communication with the conduit 49, and the conduit 47 is in communication with the conduit 48. Thus, the fluid under pressure in the power storage ram 25 will move the shift ram piston 43 to the right (to the left in Fig. 6), and the idle fluid from the shift ram will be exhausted to the top of the power storage ram 25.

The power storage ram cylinder 26 preferably is adapted to contain a volume of fluid which is large with respect to the capacity of the shift ram 37, thus permitting repeated operation of the shift ram before the power storage ram piston 27 reaches the bottom of its stroke. When said piston does reach the bottom of its stroke, or at any other desired time, it may be restored to its upper position in the manner hereinbefore described, thus making available the fluid under pressure which is necessary for operation of the shift ram 37.

In the second form of the invention (Figs. 7 and 8), provision is made of a pair of load engaging members or forks 54, 55, having toothed or serrated opposed portions 56, 57, for clamping a box or other load L. The forks 54, 55, are mounted upon the lift truck 10 by means of an elevating carriage 58 to which the lifting chains 16 are connected, and which has guide rollers 59 engaged with the uprights 13 of said truck.

The front of the elevating carriage 58 is provided with upper and lower pairs of bearings 60, 61 which slidably hold a pair of laterally spaced vertical rods 62, 63 attached to the back of a cross plate 64. The forks 54, 55 are mounted for lateral swinging movement upon the cross plate 64 by a pair of pivots 65 at the upper ends of said forks.

In order to operate the forks 54, 55, for clamping and releasing the load L, provision is made of a hydraulic system comprising a shift ram 66, a power storage ram 67, and a control valve 68, which are connected by a plurality of conduits 69 and constructed in the same manner as described above in connection with the shift ram 37 in the first form of the invention.

The shift ram 66, however, is pivotally connected between upper portions of the swingable forks 54, 55 by means of transverse pins 70, 71, and the power storage ram 67 is mounted in a vertical position upon the front of the carriage 58, the piston rod 32 of said power storage ram being connected to an upper portion of the cross plate 64.

In the second form of the invention, the power storage ram 67 will be prepared for operation merely by locating the swingable forks 54, 55, above a suitable abutment and lowering the carriage 58, thus causing the power storage ram cylinder 26 to descend with respect to the piston 27, and, in effect, storing power in said cylinder.

When the carriage 58 is raised, the fluid below the piston 27 in the power storage ram 67 will be under pressure by virtue of the fact that said fluid supports the weight of the cross plate 64 and the forks 54, 55, and the operator may manipulate the control valve 68 so as to admit said fluid to the left-hand end of the shift ram 66 (as viewed in Fig. 7), and thus spread the forks 54, 55 apart.

If the truck 10 should now be maneuvered to bring the forks 54, 55 into positions at opposite sides of the load L, as illustrated in Fig. 7, the control valve 68 may be operated to cause the fluid under pressure from the power storage ram

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67 to enter the opposite end of the shift ram 66 and thus cause the forks 54, 55 to grip the load L, as shown in broken lines in Fig. 7.

The elevating carriage 58 and the truck 10 may now be operated to lift and transport the load L to the desired location, the control valve 68 preferably being left in such a position that the fluid pressure in the right-hand end (Fig. 7) of the shift ram 66 will be maintained by the power storage ram 67. When the control valve is in this position, it will be seen that the added weight of the load L will act through the power storage ram 67 and will increase the clamping force of the forks 54, 55.

When it is desired to release the load L, it will merely be necessary to reverse the action of the fluid in the shift ram 66 by manipulating the control valve 68.

When the piston 27 approaches the bottom of the power storage ram 67, as will occur after the shift ram 66 has been operated a number of times, the operation of engaging the forks over an abutment and lowering the carriage 58 will be repeated in the manner hereinbefore described, thus restoring the lower portion of the power storage ram with a quantity of fluid which will be available for operating the shift ram.

Having thus described the invention, what is claimed as new and for which it is desired to secure Letters Patent is:

1. In a lift truck of the class described, a lifting carriage, a load engaging member, means mounting said load engaging member on said carriage for movement relatively thereto, a hydraulic power storage ram having a piston, means for applying the weight of a load on the load engaging member to the piston, a shift ram for shifting the load engaging member, a valve, fluid passage means between said valve, said shift ram and said power storage ram whereby fluid under pressure of the load may be directed from one end of said storage ram toward one end or the other of said shift ram, said valve directing to the other end of the power storage ram the fluid from that end of the shift ram opposite the end to which said fluid under pressure is directed, and a passage through which fluid flows from one end of said storage ram piston to the other end of said storage ram piston when the load engaging member moves upwardly on its mounting means relatively to the lifting carriage.

2. In a lift truck of the class described, a lifting carriage, a load engaging member, means mounting said load engaging member on said carriage for movement relatively thereto, a hydraulic power storage ram having a piston, means for applying the weight of a load on the load engaging member to the piston, a shift ram for shifting the load engaging member, a valve, fluid passage means between said valve, said shift ram and said power storage ram whereby fluid under pressure of the load may be directed from said power storage ram toward one end or the other of said shift ram, said valve directing to the power storage ram the fluid from that end of the shift ram opposite the end to which said fluid under pressure is directed, and said power storage ram having a fluid capacity that is large relatively to the fluid capacity of the shift ram whereby to allow the fluid while under pressure of the load to effect repeated movements of the shift ram.

3. In a lift truck of the class described, a load engaging member, a frame, means mounting said load engaging member for vertical movement

relatively to said frame; a lifting carriage, means mounting said frame for lateral movement relatively to said carriage whereby said load engaging member also moves laterally; a ram interposed between said load engaging member and said frame with fluid in said ram placed under pressure by said load engaging member; a second ram interposed between said frame and said carriage for imparting relative movement between said frame and carriage; fluid passage means through which fluid flows from the first ram toward one end or the other of the second ram and is exhausted from that end of the second ram opposite the end to which the fluid flows; and a valve for the fluid in said passage means to control lateral movements of the load engaging member.

4. In a lift truck of the class described, a lifting carriage, a first hydraulic ram, means whereby said first hydraulic ram supports a load relatively to said lifting carriage, a second hydraulic ram, means mounting said second hydraulic ram on said lifting carriage whereby said second ram is adapted to operate load manipulating mechanism on said carriage, fluid passage means through which fluid is directed from the first ram toward one end or the other of the second ram whereby the weight of the load on the carriage acts through said fluid for actuating the second ram and operating said load manipulating mechanism, said fluid passage means returning to the first ram exhaust fluid from that end of the second ram opposite that end to which the fluid flows from the first ram, and a valve for the fluid in said passage means to control the movements imparted by the weight of the load to the second ram.

5. In a lift truck of the class described, a lifting carriage, a first hydraulic ram, means whereby said first hydraulic ram supports a load relatively to said lifting carriage, a second hydraulic ram, means through which said second hydraulic ram when actuated operates mechanism on the truck, fluid passage means through which fluid is directed from one end of the first ram toward one end or the other of the second ram whereby the weight of the load on the carriage acts through said fluid for actuating the second ram in either of two directions for operating said mechanism, said fluid passage means returning to the other end of the first ram exhaust fluid from that end of the second ram opposite the end to which the fluid flows from the first ram, and valve means for directing the flow of the said fluid in said passage means.

6. In a lift truck of the class described, a lifting carriage, a first hydraulic ram, means whereby said first hydraulic ram supports a load relatively to said lifting carriage, a hydraulic shift ram, means through which said shift ram is adapted to act for shifting the load relatively to said carriage, fluid passage means through which fluid is directed from the first ram toward one end or the other of the shift ram whereby the weight of the load on the carriage acts through said fluid for actuating the shift ram and shifting the load, said fluid passage means returning to the first ram exhaust fluid from that end of the shift ram opposite that end to which the fluid flows from the first ram, and valve means for directing the flow of the said fluid in said passage means.

7. In a lift truck of the class described, a lifting carriage, a first hydraulic ram having a piston, means whereby said first hydraulic ram supports a load relatively to said lifting carriage with the weight of the load placing under pres-

sure fluid at one end of said piston, a second hydraulic ram, means mounting said second hydraulic ram on said lifting carriage whereby said second ram is adapted to operate load manipulating mechanism on said carriage, fluid passage means through which fluid is directed from the said one end of the piston in the first ram toward one end or the other of the second ram whereby the weight of the load on the carriage acts through said fluid for actuating the second ram and operating said load manipulating mechanism, said fluid passage means returning to the first ram exhaust fluid from that end of the second ram opposite that end to which the fluid flows from the first ram, and valve means for directing the flow of the said fluid in said passage means.

8. In a lift truck of the class described, a lifting carriage, a first hydraulic ram having a piston, means whereby said first hydraulic ram supports a load relatively to said lifting carriage with the weight of the load placing under pressure fluid at one end of said piston, a second hydraulic ram, means through which said second hydraulic ram when actuated operates mechanism on the truck, fluid passage means through which fluid is directed from said one end of the piston in the first ram toward one end or the other of the second ram whereby the weight of the load on the carriage acts through said fluid for actuating the second ram in either of two directions for operating said mechanism, said fluid passage means returning to the opposed end of the piston in the first ram exhaust fluid from that end of the second ram opposite that end to which the fluid flows from the first ram, valve means for directing the flow of the fluid in said passage means, and a passage independent of said valve means whereby fluid flows from the said opposed end of the piston to the said one end of the piston to permit free movement of said piston in one direction in said first hydraulic ram.

9. In a lift truck of the class described, a lifting carriage, a first hydraulic ram, means whereby said first hydraulic ram supports a load relatively to said lifting carriage, a hydraulic shift ram, means through which said shift ram is adapted to act for shifting the load relatively to said carriage, fluid passage means through which fluid is directed from one end of the first ram toward one end or the other of the shift ram whereby the weight of the load on the carriage acts through said fluid for actuating the shift ram in either of two directions for shifting the load, and valve means for directing the flow of the said fluid in said passage means.

10. In a lift truck of the class described, a lifting carriage, a first hydraulic ram having a piston, means whereby said first hydraulic ram supports a load relatively to said lifting carriage with the weight of the load placing under pressure fluid at one end of said piston, a second hydraulic ram, means through which said second hydraulic ram when actuated operates mechanism on the truck, fluid passage means through which fluid is directed from the said one end of the piston in the first ram toward one end or the other of the second ram whereby the weight of the load on the carriage acts through said fluid for actuating the second ram in either of two directions for operating said mechanism, said fluid passage means returning to the opposed end of the piston in the first ram fluid exhausted from that end of the second ram opposite that end to which the fluid flows from the said one end of the piston, and

valve means for directing the flow of the said fluid in said passage means.

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