

March 11, 1930.

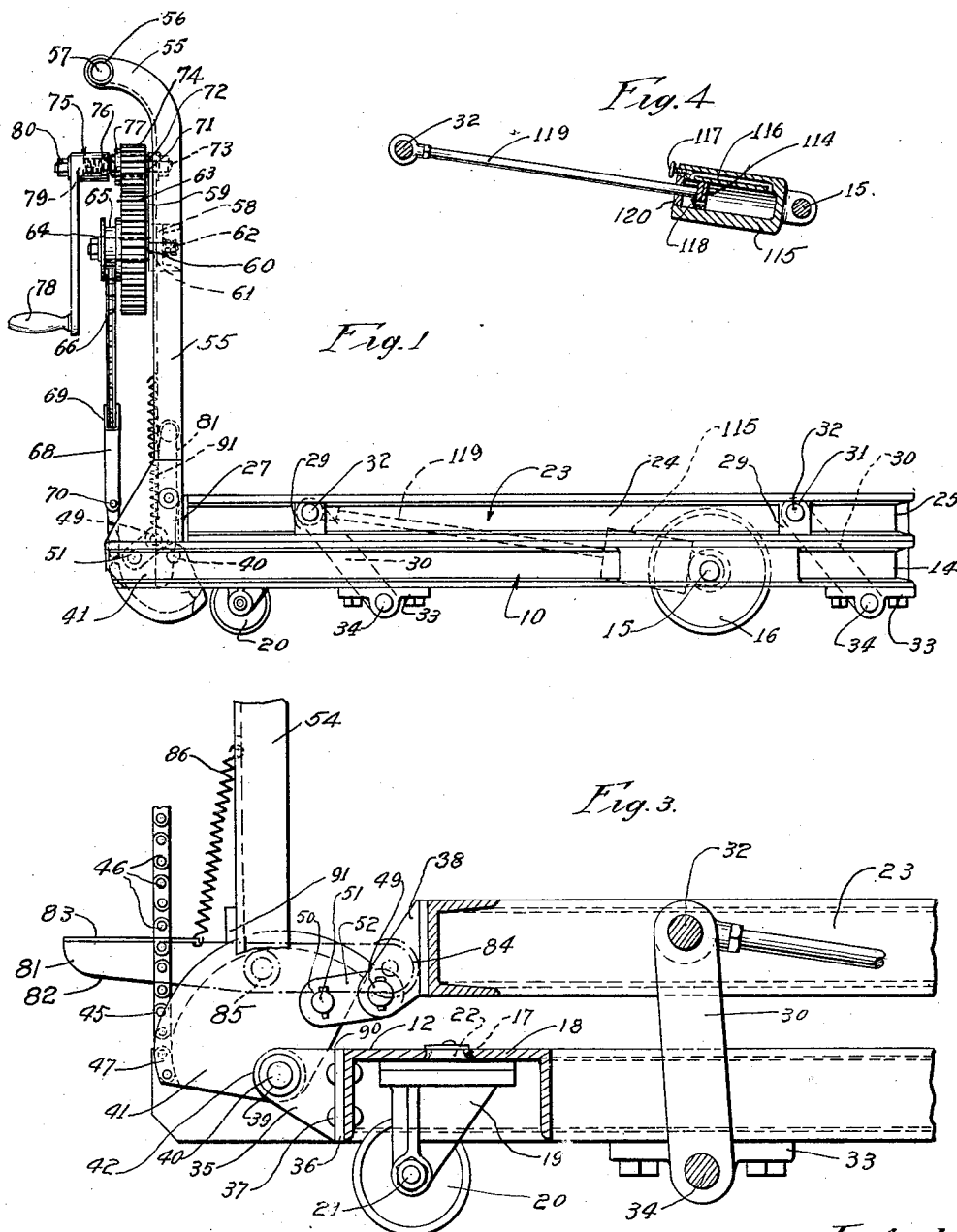
C. L. MOORMAN

1,750,277

LIFT TRUCK

Filed May 9, 1927

2 Sheets-Sheet 1



Inventor:
Charles L. Moorman
By: Williams, Broadbent,
McCaleb & Hinkle
Attys

March 11, 1930.

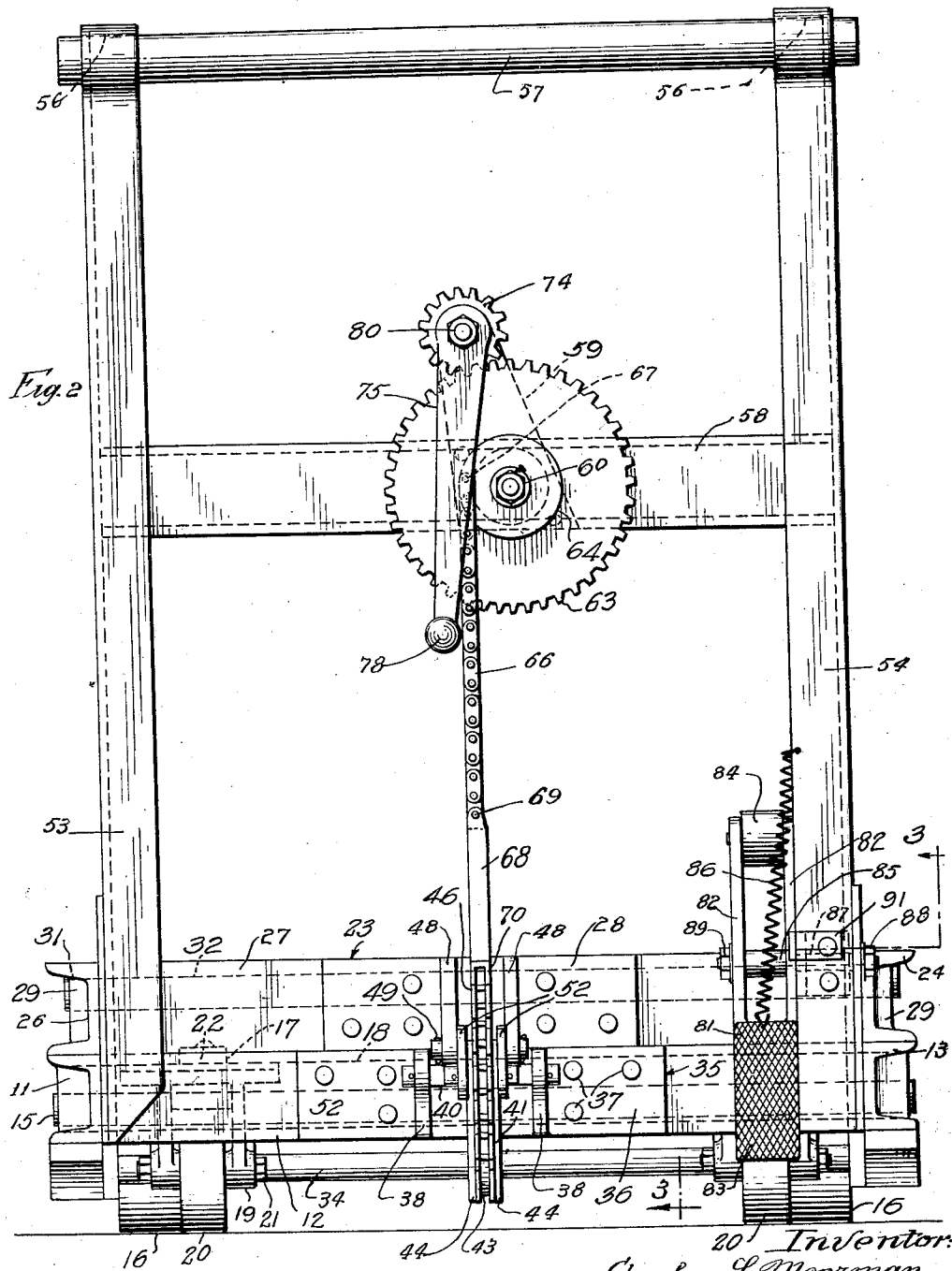
C. L. MOORMAN

1,750,277

LIFT TRUCK

Filed May 9, 1927

2 Sheets-Sheet 2



Inventor:
Charles L. Moorman

By: Williams, Broadbent,
McCauley & Noble Attys.

UNITED STATES PATENT OFFICE

CHARLES L. MOORMAN, OF CHICAGO, ILLINOIS

LIFT TRUCK

Application filed May 9, 1927. Serial No. 189,855.

The present invention relates to lift trucks, being more particularly concerned with that type of lift truck which is especially adapted to be shoved below a low table loaded with merchandise or other material, to lift the table with its load and to convey it to other points.

In lift trucks of the prior art it has been customary to employ a supporting frame carried by pivoted links upon a framework in such manner that the frame may be pivoted upon the links from a lower position to an elevated position, but the amount of weight which could be lifted by such trucks has been limited by the fact that a very great physical effort is required at the beginning of the lifting movement, although the same decreases as the links approach the vertical position. The linkage has also been arranged so that the weight is shifted forward toward the handle upon the small pivoted wheels provided near the handle, removing much of the weight from the larger wheels at the rear, thereby greatly increasing the effort required in guiding and propelling the truck to its destination.

The actuating mechanism for the lift trucks has also customarily included a long forwardly projecting lever which serves both as a lifting lever and as a propelling handle, but which prevents the close piling of the merchandise due to the excessive length of the projecting handle required to lift heavy loads.

One of the objects of my invention is the elimination of the foregoing difficulties and the provision of a lift truck of the class described, having an improved operating mechanism without any projecting handles requiring excessive operating space, and which is adapted to lift the load and place it principally upon the larger rear wheels, and which at the same time requires a practically constant physical effort to raise the load from the floor to the elevated position.

Another object of my invention is the provision of a lift truck of the class described having an improved operating mechanism comprising a plurality of pivoted supporting links for a frame, an operating linkage adapted to compensate in part for the variation in the force required to actuate said frame to the elevated position, and a hoisting cam to further compensate for said variation, together with appropriate force multiplying means so that a substantially constant operating force may be applied throughout the major portion of the lifting movement.

Another object of my invention is the provision of a simplified construction of lift truck adapted to lift and transport greater loads with a minimum of physical effort and which is durable, efficient, economical, and easy to manufacture and assemble.

Other objects and advantages of my invention will appear more fully from the following description and from the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings:

Figure 1 is a side elevational view of my improved lift truck in its lower position;

Figure 2 is an elevational view of the same;

Figure 3 is a detail cross sectional view on the lines 3—3 of Figure 2;

Figure 4 is an enlarged cross sectional view of the descent retarding means.

Referring to Figures 1 and 2, the supporting frame of my lift truck comprises a substantially rectangular frame 10 which may be made of a plurality of channeled metal members 11, 12, 13 and 14, secured together with the channel outwardly turned by welding, riveting or other convenient fastening means. The supporting frame 10 may be provided with a shaft 15 near its rear end and supported between the frame members 11 and 13, and the shaft 15 may rotatably support a pair of relatively large wheels 16.

The frame member 12 at the front of the supporting frame may comprise a channeled member of the shape shown in Figure 3 having an aperture 17 centrally located in the web 18 of the channel, at each side of the frame 10 for pivotally supporting a bracket 19 for the front wheels 20. The front wheels 20 are journaled in the brackets 19 upon a shaft 21 offset relative to the stem 22 of the bracket 19 in such manner that the wheels 20 are adapted to follow the movements of the

truck, automatically adjusting themselves to the direction of motion of the truck at any time.

The lifting frame 23 comprises an open rectangular frame, which may be formed of a plurality of channeled metal members 24, 25, 26 and 27, the frame 23 being preferably of similar size and shape to the supporting frame 10. The channels 24, 25 and 26 may also be disposed with their web inward for convenient attachment to the supporting links further to be described, while the channel 27 is preferably turned inward presenting a smooth outward surface for attachment of the bracket 28 of the operating mechanism. The channeled members 24 to 27 may be secured together by riveting, welding or other convenient fastening means, and the side channel members 24 and 26 may be provided with reinforcing lugs 29 for providing bearings for the lifting links 30, two of which are disposed upon each side of the supporting frame and lifting frame.

The opposed lugs 29 in the channeled members 24 and 26 may be provided with aligned bores 31 adapted to receive the shafts 32 for pivotally supporting the upper end of the links 30. The supporting frame 10 may also be provided with a pair of bearing brackets 33 supported upon the frame members 11 and 13 by bolts or other convenient fastening means, the opposed bearing brackets 33 upon these frame members being aligned for supporting the shafts 34 upon which the lower end of the links 30 may be pivoted. The bearing brackets 33 are disposed upon the frame members 11 and 13 at such points in the length of these frame members that when the lifting frame 23 rests upon the supporting frame 10 the lifting links 30 may be diagonally disposed between the shafts 32 and 34, and the respective frames rest squarely one upon the other.

The frame member 12 of the supporting frame 10 may support at a point near its middle a cam bracket 35 having a flat attaching flange 36 for attachment to the frame member 12 by rivets 37 or other fastening means and a pair of forwardly extending flanges 38 having aligned bores 39 for supporting a shaft 40. The shaft 40 may pivotally support a hoisting cam 41 comprising a segmental member of varying radius having a hub 42 which is adapted to receive the shaft 40 and maintain the hoisting cam 41 spaced between the flanges 38.

The hoisting cam 41 may be provided with a groove 43 extending about its periphery and bounded on either side by outwardly extending flanges 44. The tension member 45 may consist of a chain having a plurality of pivoted links 46, the lower link 47 being pivotally secured to the hoisting cam 41 at its lower corner within the groove 43.

The bracket 28 comprises a bracket of simi-

lar form to the cam bracket 35 having outwardly projecting flanges 48 which are adapted to provide bearings for a shaft 49. The hoisting cam 41 is also provided with a bearing 50 at its upper corner which is adapted to support a stub shaft 51, and the shafts 49 and 51 may be connected by a pair of push links 52 disposed between the flanges 48 on the shaft 49 and on each side of the hoisting cam 41 on the shaft 51. It will be understood by those skilled in the art that the shafts 15, 21, 32, 34, 40, 49, and 51 and any others herein described, may be provided with means for retaining the shafts in their bearings such as cotter pins or nuts threaded upon the ends of the shafts.

Referring to Figure 1, it will be noted that by means of the open frames 10 and 23 I am enabled to use rear wheels 16 of considerable size, as the wheels are disposed within the frame between the channel members. At the same time the front wheels 20, which are pivoted to follow the movement of the truck, are limited in size to that size which is adapted to be supported beneath the supporting frame 10. It is desirable to use large wheels wherever possible and to support the load as far as possible upon the larger wheels in order to reduce the rolling friction and to enable the truck to roll over obstacles in its path. In order to place the greater part of the load upon the larger wheels, the links 30 are disposed as shown in Figure 1 in such manner that as the lifting frame 23 is actuated to elevated position, the load is carried backward upon the rear wheels 16 instead of forward upon the small wheels 20, as has been customary heretofore.

Furthermore, the relative positions and sizes of the links which comprise the actuating linkage, namely the links 30, the hoisting cam 41, and the links 52, are so arranged that the actuating force employed approaches a constant value throughout the major portion of the lifting movement. When the links 30 are in the position shown in Figure 1, the horizontal force required to actuate the lifting frame 23 is of a much greater value than when the links are almost in the elevated position as shown in Figure 3, the force required decreasing from the lower position to the elevated position.

In order to compensate for this variation in the force required, the push links 52 have been so disposed upon the hoisting cam 41 that the moment arm of the force acting at the shaft 51 on the link 52 is a minimum when the links 30 are in the lower position. It will thus be observed that the hoisting cam 41 is adapted to provide a greater lifting force when the links 52 are in the position shown in Figure 1, because the force applied by the cam at the shaft 51 acts at a distance from the center of the shaft which is equal to the perpendicular drawn from the shaft 40 to the link 52. It

will be obvious that the shorter the leverage, the greater the force which the hoisting cam 41 is capable of exerting. Referring to Figure 3, the moment arm of the force with which the hoisting cam 41 acts upon the shaft 51 and links 52 is of course the perpendicular distance between the shafts 40 and the links 52, and it will be observed that this moment arm has been greatly increased in the elevated position, thereby increasing the distance through which the links 52 will be moved and decreasing the force with which the cam 41 acts upon the links in this position. The hoisting cam 41, may also be regarded as one of the links 41, of a linkage which comprises five links, 23, 30, 52, 41, and 10, pivotally joined end to end.

It will thus be observed that the arrangement of the links 52 with the lifting frame 23, supporting frame 10, hoisting cam 41, and links 30, is such that the leverage of the hoisting cam 41 or force which the hoisting cam exerts on the links is a maximum when the maximum force is required to lift the frame 23, that is in the position of Figure 1. Also the actuating force exerted by the hoisting cam 41 on the links 52 is adapted to vary, increasing as the lifting frame moves from its lower position to the elevated position. The relative proportions, therefore, of the operating linkage employed are such that the linkage compensates in part for the variation in the force required to be exerted upon the push links 52 so that this force may be made substantially constant throughout the entire range of movement of the lifting frame 23.

In order to further compensate for this variation in the force required, the hoisting cam 41 may be provided with a varying radius, the radius decreasing in an irregular manner from the edge of the cam adjacent the shaft 51 to the edge adjacent the link 47. It will be obvious to those skilled in the art that the shape of the cam may easily be determined by force diagrams of the linkage in the various positions, and the shape of the cam shown in Figure 3 is adapted to further compensate for the variation in force required to greatly improve the operating characteristics of the lift truck.

I shall now describe the balance of the truck structure including a force multiplying means for actuating the lifting mechanism either by means of a crank or by means of a step by step ratchet mechanism.

The supporting frame 10 may support at its left end in Figure 1 a pair of channeled standards 53 and 54 which may be forwardly curved as at 55 and provided with aligned bores 56 for supporting a handle 57. The handle 57 may comprise a metal pipe fixedly supported in the upper ends of the standards 53 and 54 and adapted to be grasped in shoving or pulling the truck about. In order to support the standards 53 and 54 the channeled

frame members 11 and 13 may project beyond the frame member 12 on each side and the standards may be secured to the frame members 11 and 13 by rivets or other convenient fastening means. The standards 53 and 54 may also be joined at points intermediate their ends by the cross frame member 58, and the frame member 58 may be provided with a supporting plate 59 extending upward from said frame member.

The frame member 58 may support a pivot pin 60 adapted to pass through said frame member and to be secured thereto by a pair of nuts 62. The pivot pin 60 rotatably supports a gear wheel 63 which has secured thereto a drum 64 having a peripheral groove 65 which is adapted to receive the chain 66. The chain 66 is secured to the drum 64 as at 67, and as the chain 66 winds upon the drum 64 in a plane at right angles to the hoisting cam 41, the chains 45 and 66 may be joined by a link 68 having its ends 69 and 70 pivotally connected to the chains on pins at right angles to each other.

The plate 59 may be supported upon the frame member 58 by means of the reduced portion 61 of the pivot pin and by a plurality of other rivets or fastening means, and the plate 59 may fixedly support a stub shaft 71 between the shoulder 72 on said shaft and the nut 73. The shaft 71 rotatably supports a pinion 74 which meshes with the gear wheel 63 and the shaft 71 also supports a crank 75 for free movement thereon. The crank 75 is provided with a plurality of teeth 76 upon the inner end of its hub, and the pinion 74 may be provided with complementary teeth formed in the hub 77 and adapted to engage the teeth 76 when the handle 78 is rotated in a clockwise direction. A light spring 79 may be interposed between the pinion 74 and the hub of the crank 75, being encased in said hub about the shaft 71 and the crank 75 may be retained on said hub by a nut and washer 80 or other convenient means.

In order to maintain the lifting frame 23 in elevated position, I have provided a latching device which comprises a lever 81 which may be formed with a pair of legs 82 and a flat foot pedal 83 at its outer end. The legs 82 may rotatably support an anti-friction roller 84, and the lever 81 may be pivotally supported by a pivot post 85 upon one of the standards 54. The length of the legs 82 from the pivot post 85 is such that when the lifting frame 23 is in elevated position as shown in Figure 3, the anti-friction roller 84 is adapted to bear against the end frame member 27.

In order to maintain the latching lever in latched position, a spring 86 may be tensioned between the foot pedal 83 and an intermediate point upon the standard 54, tending to pull the latch into the position shown in Figure 3. The pivot pin 85 may be con-

veniently formed of a bolt having a reduced section 87 passing through the standard 54 and secured thereto by the nut 88, the latching lever being retained upon the pivot pin by a washer and nut 89.

Pivotally supported upon the shafts 32 and 15 is a piston 114 and a cylinder 115 in which the piston 114 is adapted to reciprocate. The cylinder 115 is provided with a by-pass 116 and a valve 117, and the piston 114 may be provided with a one-way valve 118. The piston rod 119 may slide in a bore 120, and the interior of the piston may be filled with liquid oil. When the mechanism is in the position shown in Figure 1, the piston is at its extreme left position and when the mechanism is as in Figure 3, the piston 114 is in its extreme right hand position.

While this mechanism is only shown diagrammatically, it will be obvious to those skilled in the art that upon the lifting movement of the truck the piston 114 will move to the right, the hydraulic fluid passing freely through the one-way valve 118, but upon the return movement when the lifting frame 23 is descending, the butterfly valve 118 will close and the hydraulic fluid will be forced through the by-pass 116. The speed of descent of the load may then be controlled by means of the valve 117, so that the lifting frame is adapted to descend slowly when released by the latching lever 81, depositing the load without shock.

The operation of my lift truck is as follows:

As the truck has no long projecting handles, it may readily be run in between close piles of merchandise, and the lifting frame 23 being in a position shown in Figure 1, the truck may be slid underneath a table supporting the merchandise. The crank 75 may be shoved inward until the spring 79 is compressed and the teeth 76 engage with the teeth 77 upon the pinion 74. The forward slant of these teeth tends to retain them in engagement and the pinion 74 may be turned by means of the handle 78, actuating the gear wheel 63. The drum 64 which is secured to the gear wheel 63 will then wind up the chain 66 pulling upward the chain 45 and the hoisting cam 41.

During this movement the chain 45 will unwind from the hoisting cam 41 presenting a varying radius at which the chain 45 acts upon the cam. The cam 41 will actuate the push links 52 to the right, causing the lifting frame 23 to rise upon the supporting links 30 until the lifting frame has reached the elevated position shown in Figure 3 where the links 30 are not quite vertical. The links 30 are prevented from a further movement in this direction by the engagement of the hoisting cam 41 with the upper corner 90 of the cam bracket 36, which acts as a stop limiting the movement of the mechanism beyond the point shown in Figure 3.

During this lifting operation the moment arm with which the cam 41 acts upon the link 52 will vary from a minimum in Figure 1 to a maximum in Figure 3, tending to equalize the force which must be applied to lift the lifting frame 23 and its load to the elevated position. The moment arm at which the chain 45 acts upon the hoisting cam 41 will be varied also by the constantly changing radius of the cam which has been so formed as to compensate for the variation in the force required.

When the lifting frame 23 is in the position shown in Figure 1, the latch 81 (Figure 3) will be forced to the vertical position shown in Figure 1 by the engagement of the latching lever with the frame member 27 to force the lever to this position. As the lifting frame 23 rises and moves away from the standard 54, the spring 86 will draw the latching lever down, following the edge of the lifting frame 23 until the latching lever reaches the position shown in Figure 3, where its motion is limited by engagement with the stop 91 carried by frame member 54. The friction roller 84 will then be in engagement with the frame member 27, and the position of the latching lever should be such that the force exerted upon it by the lifting frame 23 will tend to cause the latching lever to bear against its stop. For this purpose the position of the friction roller 84 may be slightly below a horizontal line drawn through the axis of the shaft 85, parallel to the lifting frame 23.

The lifting frame 23 with its load will then be automatically held in the elevated position, and as the load has been shifted backward off the small wheel on the large wheels, the load may be readily transported to any place by means of the handle 57. During the lifting operation the piston 114 is actuated by the shaft 32 and connecting rod 119, passing to the dotted line position shown, the hydraulic fluid passing freely through the one-way valve 118, as well as the by-pass 116.

When it is desired to unload the truck, the crank 75 will be in the position shown in Figure 1, having been forced outward by the spring 79, and the operator need only step upon the foot pedal 83 pivoting the latching lever 81 upward out of engagement with the lifting frame 23. This unloading operation is greatly facilitated by the roller 84, and when the lifting frame is released from the position shown in Figure 3 it will, of course, tend to descend, but its motion will be limited by the movement of the shaft 32 which is attached to the piston 114 by the piston rod 119. The one-way valve 118 will be closed by the pressure of hydraulic fluid, and the movement of the piston will be limited by the restricted opening provided in the by-pass 16 by the valve 117. The piston 114 will then

permit the load to settle slowly until the truck has reached the position shown in Figure 1, and the load has been deposited. If desired, the cross section of the cylinder may be increased beyond the point where the load has been deposited, in order that the piston may move more quickly after the load has been deposited.

It will thus be observed that I have invented a lift truck which embodies a simple and effective operating mechanism, capable of compensating for the variation in force required to operate the usual lift frame to elevated position so that a substantially constant force is required to actuate the lifting mechanism. It will also be observed that by such actuating mechanism greater loads may be lifted with ease as the load characteristic of the truck has no peaks during which the physical effort would have to be greatly increased. My truck also includes lifting mechanism which throws the main portion of the load required upon the large wheels, removing it from the smaller forward wheel and thereby better enabling the truck to be moved from place to place under load due to the decreased rolling friction.

While I have illustrated and described a specific embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In a lift truck, the combination of a supporting frame with a lifting frame and a plurality of links connecting said frames, a hoisting cam of variable radius, a link connecting said cam and said lifting frame, a tension member attached to said cam, and a drum for winding said tension member.

2. In a lift truck, the combination of a supporting frame with a lifting frame and a plurality of links connecting said frames, a hoisting cam of variable radius, a link connecting said cam and lifting frame, a tension member attached to said cam, a drum for winding said tension member, and force multiplying means for rotating said drum.

3. In a lift truck, the combination of a supporting frame having wheels, a lifting frame mounted on said supporting frame by a plurality of parallel links, a push link connected to said lifting frame and transversely disposed to said parallel links, and a hoisting cam pivoted on said supporting frame and pivotally connected with said push link, said latter link being so arranged that the distance from said link to the cam pivot increases as the force required to lift the lifting frame decreases.

4. In a lift truck, the combination of a supporting frame having wheels, a lifting frame mounted on said supporting frame by a plurality of parallel links, a push link connected to said lifting frame and transversely disposed to said parallel links, and a hoisting cam pivoted on said supporting frame and pivotally connected with said push link, said latter link being so arranged that the distance from said link to the cam pivot increases as the force required to lift the lifting frame decreases, and said cam having a radius decreasing as said force decreases.

5. In a lift truck, the combination of a supporting frame having wheels, a lifting frame mounted on said supporting frame by a plurality of parallel links, a push link connected to said lifting frame and transversely disposed to said parallel links, a hoisting cam pivoted on said supporting frame and pivotally connected with said push link, said latter link being so arranged that the distance from said link to the cam pivot increases as the force required to lift the lifting frame decreases, and said cam having a radius decreasing as said force decreases, a tension member attached to wind upon the edge of said cam, and force multiplying means for actuating said tension member.

6. In a lift truck, the combination of a supporting frame, with a lifting frame movably mounted on said supporting frame, a hoisting member pivotally supported on one of said frames and a link connecting said member and the other of said frames, said link being so arranged that the effective moment arm of said hoisting member acting on said link increases as the force required to lift the frame decreases.

7. In a lift truck, the combination of a supporting frame, with a lifting frame movably mounted on said supporting frame, a hoisting member pivotally supported on one of said frames, a link connecting said member and the other of said frames, said link being so arranged that the effective moment arm of said hoisting member acting on said link increases as the force required to lift the frame decreases, an upright frame carried by said supporting frame, a tension member adapted to wind on said hoisting member and means carried by said upright frame for applying tension to said tension member.

8. In a lift truck, the combination of a supporting frame, with a lifting frame movably mounted on said supporting frame, a hoisting member pivotally supported on one of said frames, a link connecting said member and the other of said frames, said link being so arranged that the effective moment arm of said hoisting member acting on said link increases as the force required to lift the frame decreases, an upright frame carried by said supporting frame, a tension

member adapted to wind on said hoisting member, and means carried by said upright frame for applying tension to said tension member, said means comprising a drum for winding said tension member and force multiplying mechanism.

9. In a lift truck, the combination of a supporting member with a lifting member, a hoisting member, means connecting said first two members and adapted to raise the lifting member from the supporting member, a link connected to said lifting member and to said hoisting member, said link and hoisting member being so located that the force applied by said hoisting member and said link on said lifting member decreases as the lifting member raises and a tension member adapted to wind on said hoisting member, the radius of application of said tension member being sufficient to compensate for any variation in the amount of force required to actuate the same.

10. In a lift truck, the combination of a supporting member with a lifting member carried thereby, connecting mechanism between said members for raising said lifting member by moving the same longitudinally relative to said supporting member, a pair of links connected with each other and having pivotal connection with the supporting member and lifting member, end to end to form a linkage, the pivots of said links being so located that the moment arm of the link connected to the supporting member varies to compensate for the amount of force required to lift said lifting member, one of said links having a surface of varying radius and a tension member for winding on said surface and actuating said link.

In witness whereof, I hereunto subscribe my name this 27 day of May, 1927.

CHARLES L. MOORMAN.

45

50

55

60

65