

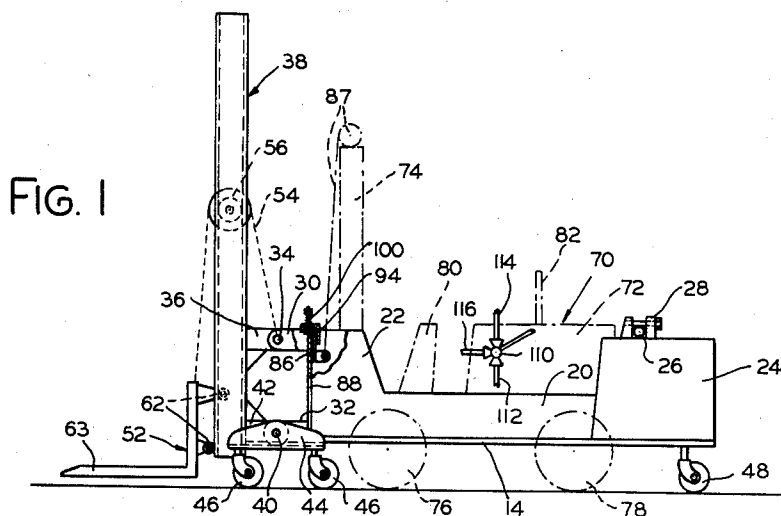
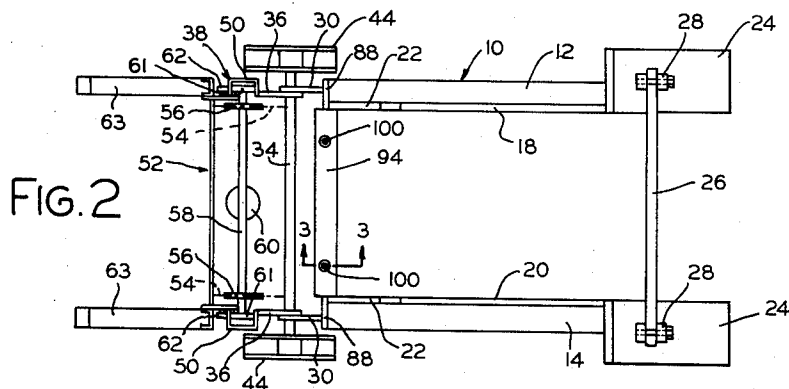
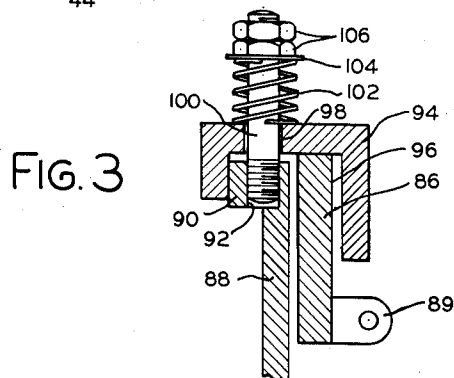
April 23, 1963

O. F. CHRISTIANSEN
METHOD AND MEANS FOR INCREASING THE LOAD
CAPACITY OF LIFT TRUCKS

3,086,618

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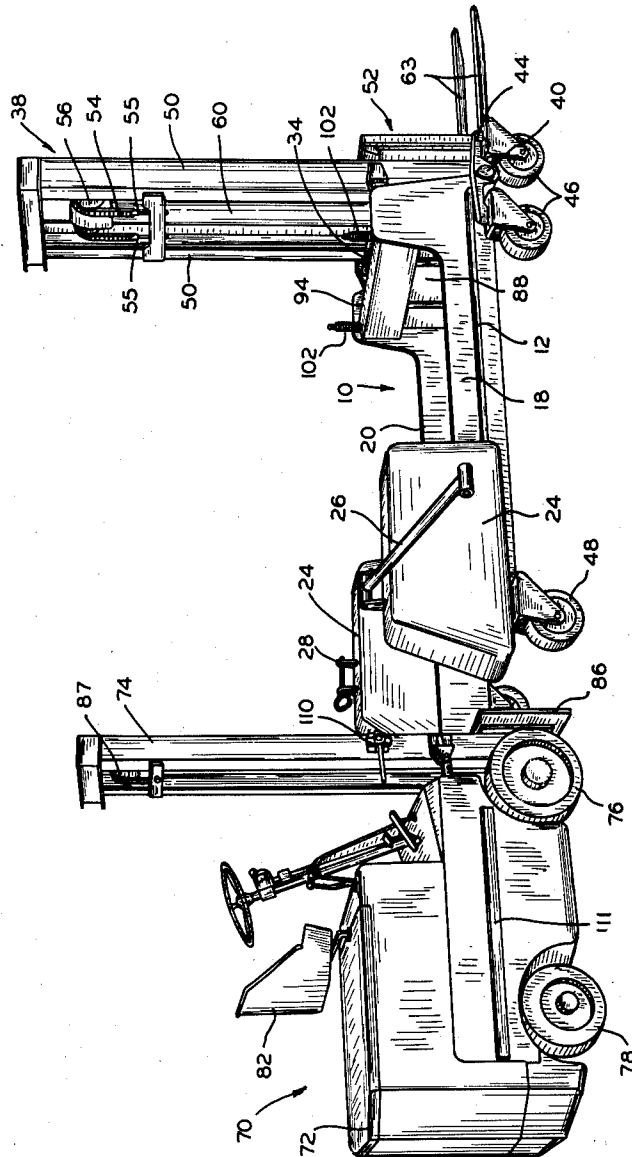
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Fig. 4



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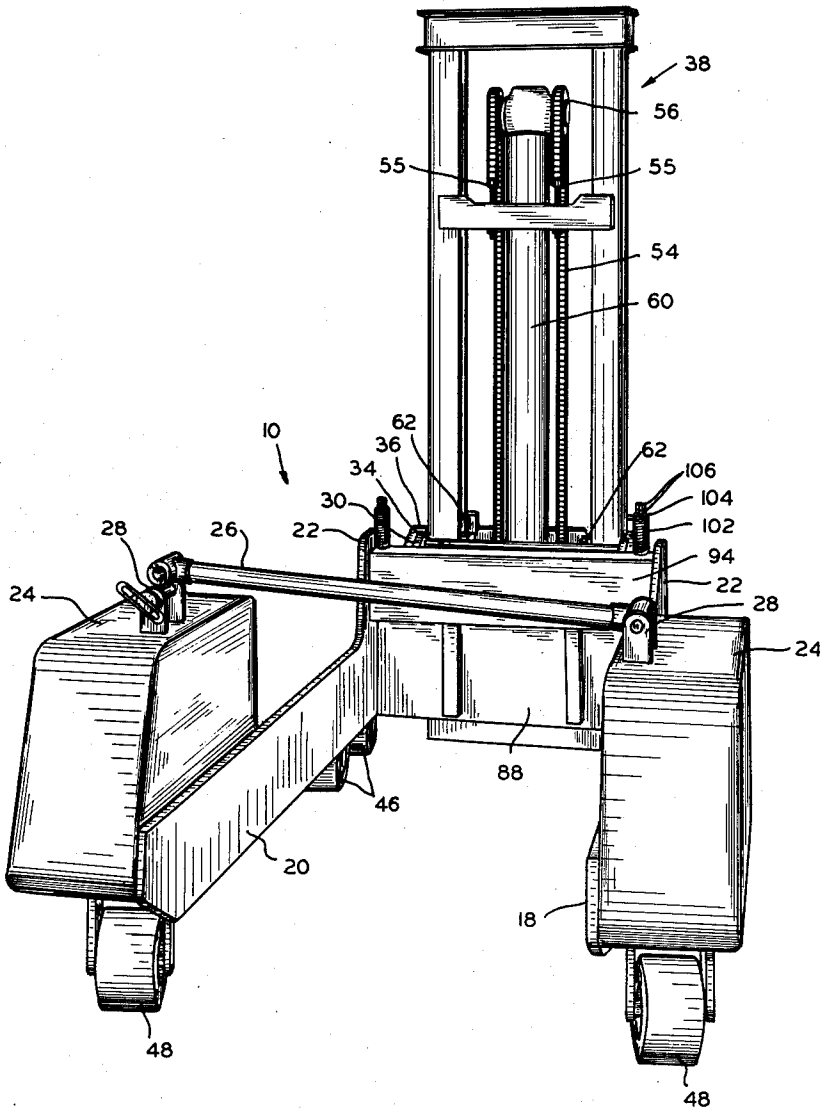
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FIG. 6



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METHOD AND MEANS FOR INCREASING THE LOAD CAPACITY OF LIFT TRUCKS

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15 Claims. (Cl. 187-9)

This invention relates to a material handling method and means and more particularly to a method and means utilizing a combination of a lift truck and auxiliary apparatus for increasing the normal lifting capacity of the truck.

Lift trucks have long been utilized to lift and transport loads of widely differing kinds, making possible the rapid and safe movement of materials. Lift trucks are produced in a wide variety of sizes and capacities, and the cost of such trucks is roughly proportional to the lifting capacity thereof. Minimum capital expense for such equipment is normally based upon the use of trucks, the capacity of which corresponds to the most frequently occurring load; i.e., the lifting capacity is not appreciably greater than the weight of the loads most frequently transported.

In large material handling operations which require widely differing lifting capacities, a fleet of such trucks is normally maintained in order to expeditiously meet the varying requirements. In relatively small handling operations, on the other hand, where there may be a need only for a single truck or for a very few trucks to transport the most frequently occurring loads, maintenance of a fleet is not economically justifiable. In many such relatively small operations, however, a need frequently arises which requires that loads exceeding the capacity of available trucks be transported. Heretofore this problem has been solved by means of time-consuming and inefficient material handling methods.

The present invention makes available a relatively simple and inexpensive auxiliary apparatus which can be associated in a novel manner with a lift truck for lifting and transporting loads, the weights of which far exceed the capacity of available trucks. The practicality of the present method which uses such apparatus is based in part on the fact that the drive machinery of standard lift trucks is designed with considerable power reserve, making possible operation thereof on inclines, ramps, and the like. In the present invention this reserve power is used to transport heavier loads than is possible with the lift truck alone. In practice, it has been demonstrated that the present invention is capable of lifting and transporting loads which exceed by several times the capacity of the truck itself. In such an operation it is generally necessary that the lift truck and associated apparatus be operated in an essentially horizontal plane.

The apparatus of the invention comprises generally a dirigible framework of generally U-shaped form which is supported by self-adjusting wheels and has an upright lifting mast of relatively large capacity secured adjacent one end thereof. A lift truck of given capacity may be driven into the pocket of the framework and then coupled therewith preferably such that the lifting mast of the lift truck is pre-loaded to rated capacity in order to assure initially full traction at the drive wheels of the lift truck. The larger lifting mast of the framework may then engage and lift a load substantially heavier than the lift truck alone is capable of handling and the lift truck then operated to transport the framework and its load to a desired location at which the load may be deposited at any elevation within the lifting limit of the auxiliary lifting mast. The hydraulic system of the lift truck may be coupled with a lifting motor of the auxiliary mast for elevating

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loads thereon. Auxiliary counterweights are located at the rear of the framework such that operation of the framework with the lift truck corresponds at least in level movement to a lift truck of greater capacity than that used in the invention.

The invention can be sold at a price which is much lower than the price difference between a lift truck of corresponding capacity and the truck used in the invention. In essence, a lift truck of given capacity can be used in combination with one or more auxiliary frameworks to perform in the majority of material handling operations as would two or more lift trucks of varying capacities. No drive machinery, hydraulic, steering or control systems, and the like, independent of the lift truck used is utilized in the auxiliary framework, and the upright lifting mast of the framework can be of standard construction.

It is a primary object of the present invention to provide a method and means which utilizes a lift truck and which substantially increases the normal lifting capacity thereof.

It is another object of the invention to provide apparatus which can be coupled with a lift truck for operation as an integral part thereof for the purpose of increasing the load capacity normally transportable by the truck alone.

Another object of the invention is to increase the versatility of the lift trucks by providing a method and means which uses the lift truck to transport loads substantially above the capacity which the truck is normally capable of handling.

Other objects, features, and advantages of the present invention will appear to persons skilled in the art in view of the following description when taken in conjunction with the drawings wherein:

FIGURE 1 illustrates, somewhat schematically, an exemplary embodiment of the invention in side elevation shown in coupled relation with a lift truck;

FIGURE 2 shows a plan view of the auxiliary framework of the invention as shown in FIG. 1, but without the lift truck being coupled thereto;

FIGURE 3 is an enlarged sectional view taken along line 3-3 in FIG. 2;

FIGURE 4 shows the actual construction of the invention in side perspective view with the lift truck in position to enter the U-shaped dirigible framework;

FIGURE 5 shows the construction of FIGURE 4 taken from the opposite side and with the lift truck embraced by and coupled to the U-shaped framework; and

FIGURE 6 is a rear perspective view of the U-shaped framework.

Referring now in detail to the drawing, a generally U-shaped frame is designated at numeral 10 and includes a pair of spaced parallel legs 12 and 14 which are connected rigidly together at the forward ends thereof by a transverse frame or plate member 88. Frame members 12 and 14 are of generally L-shaped or T-shaped section, as shown in FIGS. 1 and 5, respectively, the upwardly extending legs 18 and 20 of which increase in height at the forward ends 22 thereof. Transverse frame member 88 is preferably about equal in height to forward leg portions 22 and is secured, as by welding, adjacent the forward ends of portions 22 for providing a relatively rigid U-shaped frame. A pair of counterweight members 24 are secured to the rearwardmost portions of frame members 12 and 14 and are adapted to be connected by a removable rod 26 which is secured to the counterweight members by means of bolts and brackets 28.

A pair of transversely spaced forwardly projecting upper lugs 30 are welded to the upper forward surface of member 88 and a pair of similarly projecting lower lugs 32 are welded to the lower forward surface of member

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88. An upper transverse support rod 34 is rigidly secured to the forward ends of lugs 30 and to the after ends of a pair of laterally spaced rearwardly extending lugs 36 which are secured at their forward ends, as by welding, to a pair of transversely spaced mast channel sections 50 of an upright lifting mast 38. Similarly, a lower transverse support rod 40 is secured to forwardly and rearwardly extending lower pairs of lugs 32 and 42, respectively.

A pair of laterally spaced wheel support brackets 44 are journaled upon opposite end portions of rod 40 for pivotal movement in a vertical plane transversely outwardly of frame members 12 and 14. A pair of self-adjusting or caster wheels 46 are mounted in opposite ends of each of the brackets 44. The rearwardmost ends of the frame are supported also by a pair of self-adjusting or caster wheels 48. The wheels 46 and 48 thus serve to support the entire unit comprising the frame 10 and mast 38 with the lifting device connected thereto as described below. Mast 38 can be of any conventional standard upright construction. It is shown schematically in FIGS. 1 and 2, and the actual construction thereof is shown in FIGS. 4 to 6. Generally, it comprises the pair of laterally spaced vertical channel sections 50 which serve to guide the vertical movements of a lifting carriage assembly 52. Carriage assembly 52 is suspended from a pair of laterally spaced chains 54 which are anchored at their one ends to the carriage assembly and at their opposite ends to a stationary part of the frame assembly, such as rod 34, FIG. 1, or rods 55, FIG. 6. The chains are reeved over a pair of sprockets 56 which are mounted on a transverse shaft 58 connected at the center thereof to the piston rod of a hydraulic hoist motor 60 and guided at its opposite ends by means of a pair of rollers 61 in the channel sections 50 as shown in FIGS. 1 and 2. The carriage assembly 52, including a pair of fork tines 63 supported thereon, is elevated in mast 38 in the usual manner by energizing hydraulic motor 60 to actuate sprockets 56 upwardly with shaft 58 and thereby elevate the carriage assembly which is mounted for guided movement in channels 50 by means of pairs of vertically spaced rollers 62 disposed on opposite sides of the forward flange of the channel sections, as shown in FIGS. 1 and 2. The actual construction of the mast 38 is somewhat different in detail, but is conventional and need not be described further herein.

The opening in the U-shaped frame 10 of the apparatus is such that a fork truck of given dimensions (shown generally in broken lines at numeral 70 in FIG. 1 and in full perspective view in FIGS. 4 and 5) and comprising the usual engine and counterweight section 72, an upright lifting mast 74, a pair of transversely spaced drive wheels 76, a pair of transversely spaced steer wheels 78, a cowl section 80 and an operator's seat 82, can be driven between the frame members 12 and 14 with sufficient clearance on either side to permit steering movement of wheels 78. A coupling between the lift truck and the apparatus of the present invention, as described below, is effected with the fork tines of the lift truck removed from the lifting carriage thereof as shown in FIG. 4. The carriage is connected for vertical guided movement in mast 74 in the usual manner, such as is, for example, carriage 52 mounted in mast 38. The lift truck 70, the lifting capacity of which is considerably less than the lifting capacity of mast 38 and carriage assembly 52, may be coupled with the framework 10 by means of the exemplary mechanism best illustrated in FIGS. 3 and 4.

The usual carriage plate or fork bar of the lift truck (to which the fork tines are normally connected) is illustrated at numeral 86. Carriage member 86 extends transversely of the mast 74 and is supported for elevating movement in mast 74 by means of a chain and sprocket mechanism 87 which is connected to the carriage member by a bracket 89 and which is elevatable by means of a hydraulic lifting motor 91 mounted in the usual man-

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ner in mast 74. A forwardly projecting flange 90 is provided at the upper end of flange 88 and at least a pair of transversely spaced threaded openings 92 are formed therein. An inverted generally U-shaped transverse rail 94 embraces projecting portion 90 of flange 88 and provides a space 96 between its rearward downwardly extending leg and flange 88 which is adapted to receive carriage member 86. Transversely spaced enlarged openings 98 are formed in the upper base portion of rail 94 coaxial with openings 92 and through each of these passes a heavy bolt 100 which is secured in the aligned opening 92. With each bolt 100 is preferably associated a heavy spring 102 which abuts the upper base portion of rail 94 at its one end and a flange 104 at its opposite end held in position by a pair of lock nuts 106.

Lift truck 70 may be coupled with the apparatus 10 by driving the truck forwardly within the opening of the apparatus with the carriage member 86 lowered below rail 94 until member 86 abuts flange 88, whereupon member 86 is raised in mast 74 into the space 96 between flange 88 and the one leg of rail 94, as shown. The member 86 is actuated upwardly against rail 94 and springs 102 preferably until the springs are compressed to an extent which establishes a vertical load on mast 74 corresponding approximately to the lifting capacity of truck 70.

When the lift truck and apparatus 10 are thus coupled it will be seen that apparatus 10, including mast 38 and carriage assembly 52, can be driven in all directions of movement of which the lift truck 70 is capable when it is uncoupled from the apparatus 10 and operating normally. Forward and reverse movements of the truck are transmitted through flange 88 and rail 94 to actuate the apparatus 10 forwardly and rearwardly, while steering movements in lateral directions are transmitted to apparatus 10 by abutment of one or the other of the sides of the lift truck with one or the other of frame members 12 and 14. If desired, the side walls of truck 70 may be provided with projecting guide facings 111 of brass or other suitable material for this purpose.

It will be understood that the sides of the truck are adapted to be closely embraced by frame members 12 and 14 of apparatus 10; space 96 provides sufficient clearance with the front rear surfaces of member 86 so that member 86 can twist within space 96 a sufficient amount to permit the guide facings 111 on the sides of the truck to first abut one or the other of frame members 12 or 14, depending on the direction of steering movement of the truck. Thus, steering movement of the truck is transmitted to apparatus 10 without transmitting the steering torque loads through member 86 and rail 94.

It will be noted that the U-shaped frame is dimensioned such that frame members 12 and 14 have relatively little torsional and bending rigidity, while the forward portion of the frame to which rail 94 and flange 88 are connected has relatively great rigidity. This arrangement assures that all of the wheels of frame 10 and of the lift truck will maintain contact with the ground in driving over uneven terrain with a distribution of load appropriate to the terrain. It will be understood that the novel manner of coupling the apparatus 10 with the lift truck whereby the lift truck is pre-loaded essentially to capacity assures full traction between the supporting surface of the truck and drive wheels 76 during operation with a load on carriage assembly 52.

On the lift truck 70, as shown in FIG. 1, there is mounted a three-way valve 110 which has an inlet conduit 112 communicating with the hydraulic pump of the truck, and outlet conduits 114 and 116 which are connected with the lift cylinder of mast 74 and the lift cylinder of mast 38, respectively. Conduit connections 112 and 114 may be standard hydraulic connections associated with the lift truck, while the conduit 116 and its connection with cyl-

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inder 60 is demountable so that it can be coupled and uncoupled therefrom. In the hydraulic coupling the three-way valve 110 is first adjusted such that inlet conduit 112 communicates with conduit 114, whereby the carriage member 86 can be raised until the desired preliminary load is established on the truck. The valve 110 is then actuated to communicate conduit 112 with conduit 116, whereby the fork truck lift cylinder is blocked so that the oil pressure therein and the preliminary load on the truck is maintained, while the lift cylinder 60 and carriage assembly 52 may be elevated with its load under pressure from the hydraulic system of the lift truck.

With the apparatus of the present invention it is possible to lift and transport over an essentially level course loads which weigh several times that normally transportable by the fork truck 70. As pointed out previously, this is possible because of a power surplus designed into lift trucks which affords them the capability of climbing ramps and the like with a full load, and it is this power surplus which is utilized for the lifting and transportation of much greater loads with the present apparatus.

It is preferable to utilize a lifting mast 38 having a capacity comparable to that which would be normally associated with a lift truck of correspondingly greater capacity than truck 70. Inasmuch as the oil pressure normally used in various sizes of lift trucks is essentially constant, it will be apparent that the hydraulic system of lift truck 70 can without difficulty provide the necessary pressure to hoist motor 60. Since hoist motor 60 requires a greater volume of oil than the normal quantity of oil carried by lift truck 70, it is desirable to provide the lift truck with an oil container of correspondingly greater volume. Similarly, it will be expedient to provide for extra cooling of the machinery of the truck, in view of the increased load to be transported thereby. This can be accomplished, for example, by increasing the diameter or rotating velocity of the ventilator fan blades.

The present invention, is not, of course, intended to be limited to the exemplary embodiment described in detail herein, the construction of which can be rearranged and modified in numerous ways, as will be obvious to persons skilled in the art, within the scope of the invention. For example, the lifting mast 38 can be made tiltable in relation to the perpendicular. The preliminary load on the fork truck, which assures its tractive power and maneuverability, can be established in other ways not herein illustrated as, for example, with the aid of a hydraulic jack. It will also be apparent from the principles of the invention as set forth in the foregoing, that while the resilient coupling provided by bolts 100 and springs 102 is desirable in providing flexibility in the coupling connection between the lift truck and the framework, it is not required. For instance, the bolts and springs could be eliminated and the rail 94 welded to flange 88 to provide the space 96. In such an arrangement carriage member 86 exerts a lifting force against rail 94 as previously, but rail 94 does not move in relation to flange 88. The framework, of course, should be of substantially greater effective weight than the lifting capacity of lift truck 70 so that application of the lifting force against rail 94 which is equal to the capacity of truck 70 will not lift the forward end of the framework about the pivot axis of caster wheels 48. Any other suitable coupling construction may be utilized so long as the carriage member of the lift truck is capable of applying a lifting force to a portion of the one end of the framework for loading the upright of the lift truck and for driving the framework with the lift truck in any desired direction. Lifting means associated with the mast of the apparatus may be of any suitable type depending upon existing material handling problems.

It will now be understood that operation of the lift truck and framework in coupled relation does not affect the basic characteristics of either the lift truck or the framework. That is to say, the lift truck operates in a

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normal manner under load as though it were not coupled to the auxiliary apparatus, and the auxiliary apparatus also operates as an independent lift truck unit to the extent that the framework, mast and wheels thereof support and counterbalance the load on the fork tines 63.

Therefore, while I have shown and described what I believe to be a preferred embodiment of my present invention, it should be fully understood that many rearrangements and modifications may be made therein without departing from the spirit and scope of my invention.

I claim:

1. An apparatus for increasing the normal load capacity of a lift truck comprising a generally U-shaped frame, wheel means supporting said frame, elevatable load carrying means supported adjacent one end of said frame, said frame being adapted to embrace a lift truck having an elevatable load carrying means connected adjacent one end thereof within the open pocket of said frame, and means for coupling said frame with the lift truck for combined operation.

2. An apparatus comprising a generally U-shaped frame, wheel means supporting said frame, elevatable load carrying means supported adjacent one end of said frame, said frame being adapted to embrace a lift truck having an elevatable load carrying means connected adjacent one end thereof within the open pocket of said frame, the load carrying means of said frame being of greater load carrying capacity than the load carrying means of the lift truck, and coupling means connected to said frame for receiving a portion of the load carrying means of the lift truck whereby to couple the lift truck and frame for combined operation.

3. Apparatus for increasing the normal load capacity of a lift truck comprising a generally U-shaped frame, wheel means supporting said frame forwardly and rearwardly thereof, an upright mast assembly for engaging and elevating loads mounted forwardly of said frame, counterweight means mounted rearwardly of said frame, and coupling means mounted adjacent the forward end of said frame, said frame being adapted to embrace a lift truck having elevatable means mounted forwardly thereof within the open pocket of the frame and forming a coupling between the elevatable means and said coupling means.

4. Apparatus for increasing the normal capacity load of a material handling machine comprising a generally U-shaped frame, wheel means supporting said frame forwardly and rearwardly thereof, relatively large capacity elevator means secured to said frame and mounted forwardly of the base end thereof, counterweight means mounted adjacent the end opposite the base end of the frame, said base end including coupling means, said apparatus being adapted to embrace in the open pocket thereof a material handling machine having elevator means connected adjacent the forward end thereof for establishing a coupling relation with said coupling means.

5. Apparatus for increasing the normal load capacity of a material handling machine comprising a wheel supported framework which is adapted to embrace in an open portion thereof a material handling machine having elevator means associated therewith, coupling means connected to said framework adapted to receive a portion of said elevator means when the material handling machine is located in the open portion of the framework, and other elevator means supported from said framework for engaging, lifting and transporting loads, said other elevator means being of greater carrying capacity than said first mentioned elevator means.

6. In combination, apparatus comprising an open ended longitudinally extending frame having a transverse means closing one end thereof, wheel means supporting said frame, a load lifting mast assembly supported forwardly of the closed end of said frame, coupling means connected to the closed end of said frame, and a lift truck

receivable within and embraced by said frame having a lifting mast assembly mounted adjacent one end thereof, a portion of said latter mast assembly being locatable in lifting relation to said coupling means for imposing upon said latter mast assembly a pre-load.

7. A combination as claimed in claim 6 wherein counterweight means are mounted at the ends of said frame opposite to the closed end thereof for counterbalancing loads engaged by the mast assembly which is supported from said framework.

8. A combination as claimed in claim 6 wherein hydraulic hoist motor means are associated with each of the mast assemblies, valve means mounted on the lift truck, and conduit means connecting said valve means to each of said hoist motor means, said valve means being adapted to alternately direct pressure fluid through said conduit means to the hoist motor of the lift truck connected mast assembly and to the hoist motor of the frame connected mast assembly.

9. A combination with a lift truck having a load lifting mast assembly mounted at one end thereof and carriage means elevatable in said mast, of an apparatus comprising a generally U-shaped wheel supported frame adapted to receive in the open pocket thereof the lift truck, counterweight means located on said frame adjacent the open end thereof, a load lifting mast assembly supported from said frame forwardly of the closed end thereof, said latter mast assembly having greater load lifting capacity than the lift truck mast assembly, coupling means associated with the closed end of said frame and forming an upwardly extending recess for receiving a portion of the lift truck carriage means for coupling said apparatus with the lift truck such that said apparatus can be driven by the lift truck for engaging, lifting and transporting loads upon the mast assembly connected to said frame, said carriage being actuated upwardly in said recess to impose upon the mast assembly of the lift truck a load providing traction at the drive wheels thereof.

10. A combination as claimed in claim 9 wherein each of said mast assemblies includes a load actuating hoist motor means, valve means mounted on the lift truck, conduit means connecting said valve means to each of the hoist motors, said valve means being operable to first direct pressure fluid to the hoist motor of the lift truck for establishing a pre-load on the mast assembly thereof upon engagement with the coupling means and to subsequently direct pressure fluid to the other hoist motor.

11. A combination as claimed in claim 9 wherein said coupling means comprises a vertical transverse member closing the one end of the U-shaped frame, a movable member forming therewith said recess, and means urging said movable member in a downward direction, said carriage member when received in said recess being actuable to move said movable member in an upward direction.

12. A method for increasing the normal load capacity of a lift truck having drive wheels and a load lifting member at one end comprising the steps of driving the lift truck inside an open wheel supported framework having one closed end, elevating the load lifting member to form a coupling with the closed end of the framework and to impose a pre-load on the lift truck whereby to increase traction at the drive wheels thereof, and driving said lift truck and said framework together in coupled relation for engaging a load at the forward end of the framework.

13. A method for increasing the normal load capacity of a lift truck having drive wheels and a load lifting member at one end, by disposing the lift truck in coupled relation with a wheel supported framework having one open end and one closed end and a load engaging elevator mounted adjacent the closed end, comprising the steps of driving the lift truck inside the open framework until the lifting member thereof abuts the closed end of the framework, elevating the lifting member to form a coupling with the closed end and to tend to lift the framework whereby to impose a pre-load on the lift truck for increasing traction at the drive wheels thereof, and driving said lift truck and framework together in coupled relation for engaging a load on the frame supported elevator.

14. A method for increasing the normal rated load of a lift truck having drive wheels and a load lifting member at one end, by combining same with a wheel supported and counterweighted framework having one open and one closed end and a hydraulically actuated load lifting means mounted adjacent the closed end and of greater lifting capacity than the load lifting member of the lift truck, comprising the steps of driving the lift truck into the open end of the framework until the load lifting member abuts a portion of the closed end thereof, elevating the load lifting member to form a couple with the closed end and to impose a pre-load on the lift truck for increasing traction at the drive wheels thereof, locking said load lifting member in said elevated position, and directing pressure fluid to the hydraulic load lifting means of the framework.

15. A method as claimed in claim 14 plus the step of raising a load on said load lifting means of greater weight than can be safely carried by said load lifting member, and driving the lift truck and apparatus together in coupled relation.

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