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Hollenbach

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[54] **MATERIAL HANDLING SYSTEM**

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Related U.S. Application Data

[62] Division of Ser. No. 160,600, July 8, 1971, Pat. No. 3,727,778.

[52] **U.S. Cl.** ..... **214/75 R**, 214/16.4 R, 214/730

[51] **Int. Cl.** **B60p 1/44**

[58] **Field of Search** ..... 214/16.4 R, 75 R, 75 H, 214/75 G, 75 T, 730, 390, 392, 394, 396

[56] **References Cited**

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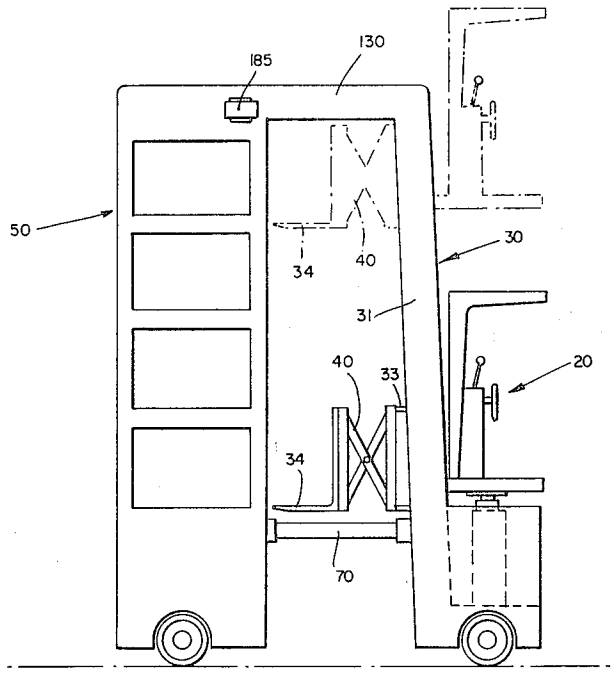
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Assistant Examiner—Lawrence J. Oresky
Attorney, Agent, or Firm—Paul & Paul

[57] **ABSTRACT**

A fork lift truck, in preferred form, has a base frame, a rack frame, a mast, and an operator's platform. There is no center section at the bottom of the vehicle. The assembly is held together at the top with an arch formed by the mast and the truck rack frame. Two tie bars, one on each side on the vehicle, tie the frame together near the bottom. The tie bars are adjustable for height. A rigid mast supports an assembly which includes a carriage having a pivot-and-slide mechanism and a reach mechanism on which the fork is mounted. The pivot-and-slide mechanism permits the reach mechanism and its fork to be rotated and to be slidingly moved transversely from one side to the other. Thus, the mechanism permits the forks to deposit or to withdraw a load in both forward and side positions. An operator's platform is mounted on the truck forward of the mast.

1 Claim, 6 Drawing Figures



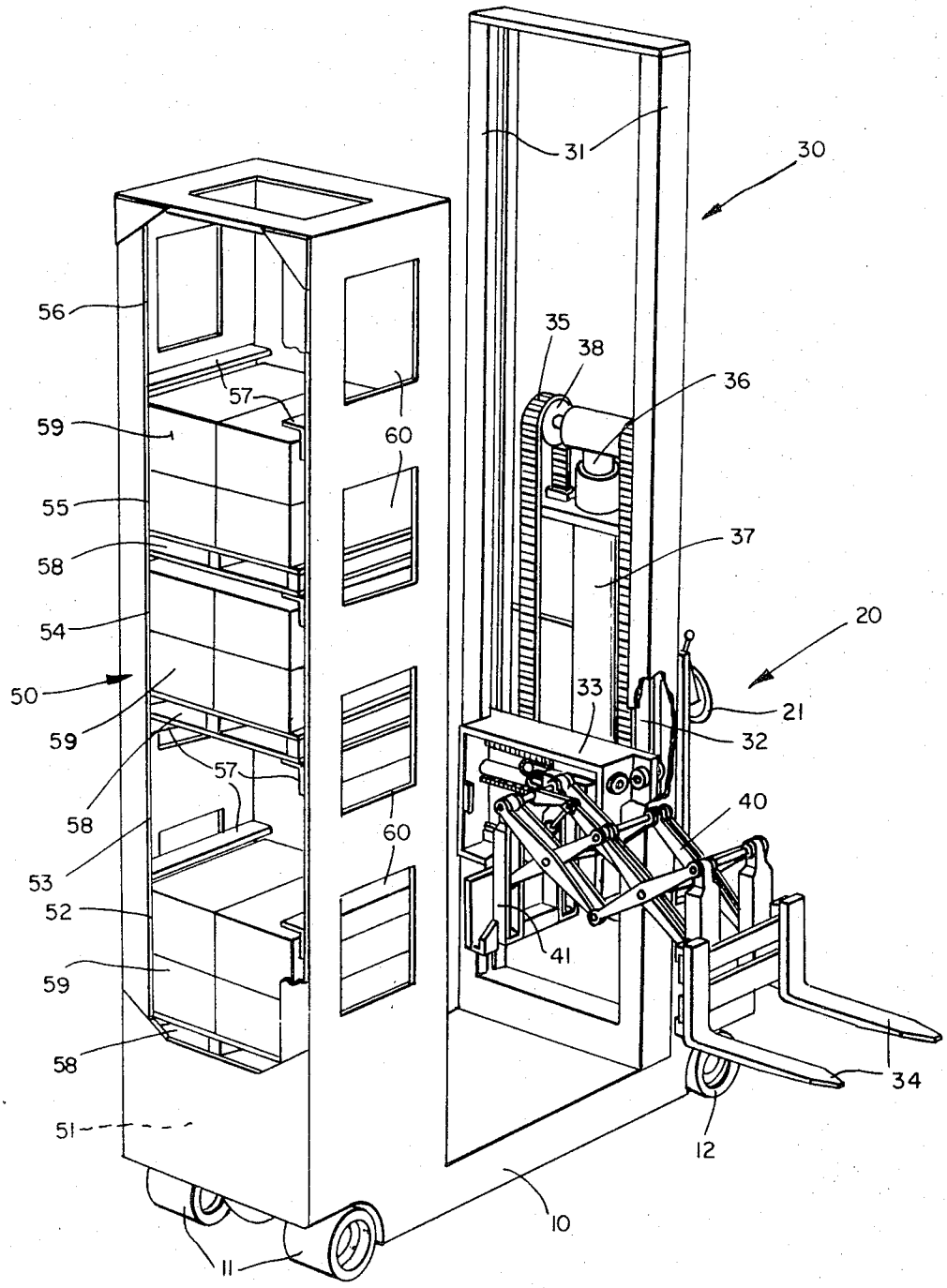

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Fig. 1

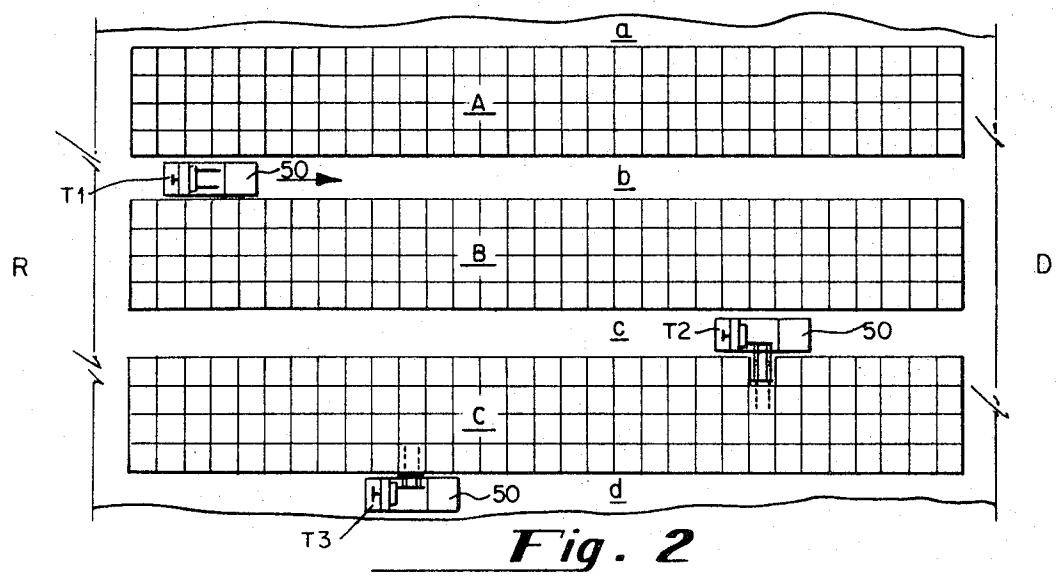


Fig. 2

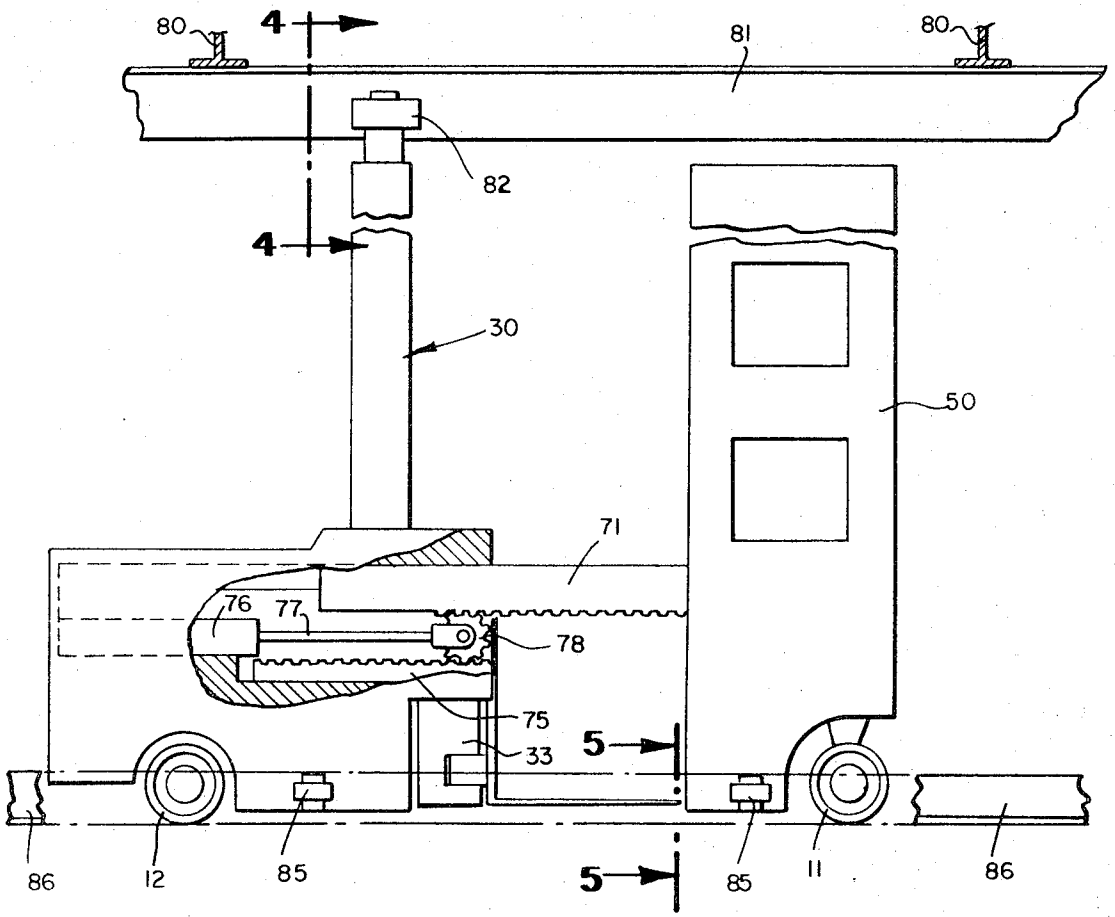


Fig. 3

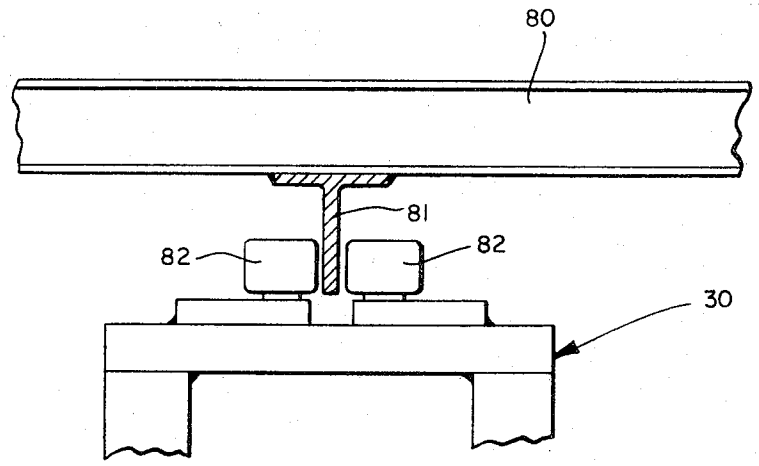


Fig. 4

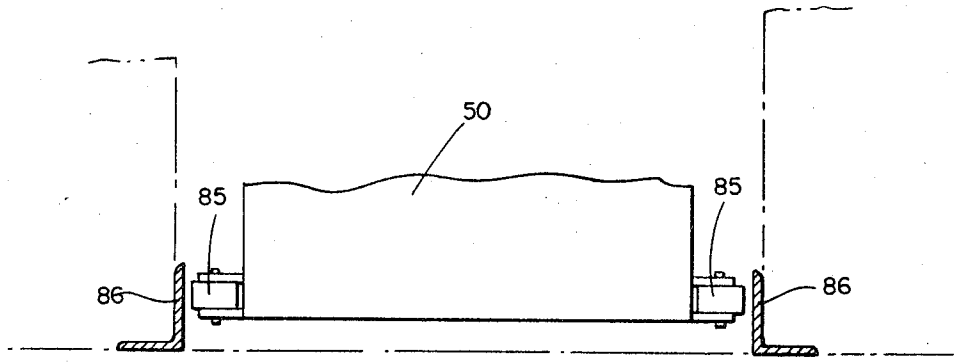


Fig. 5

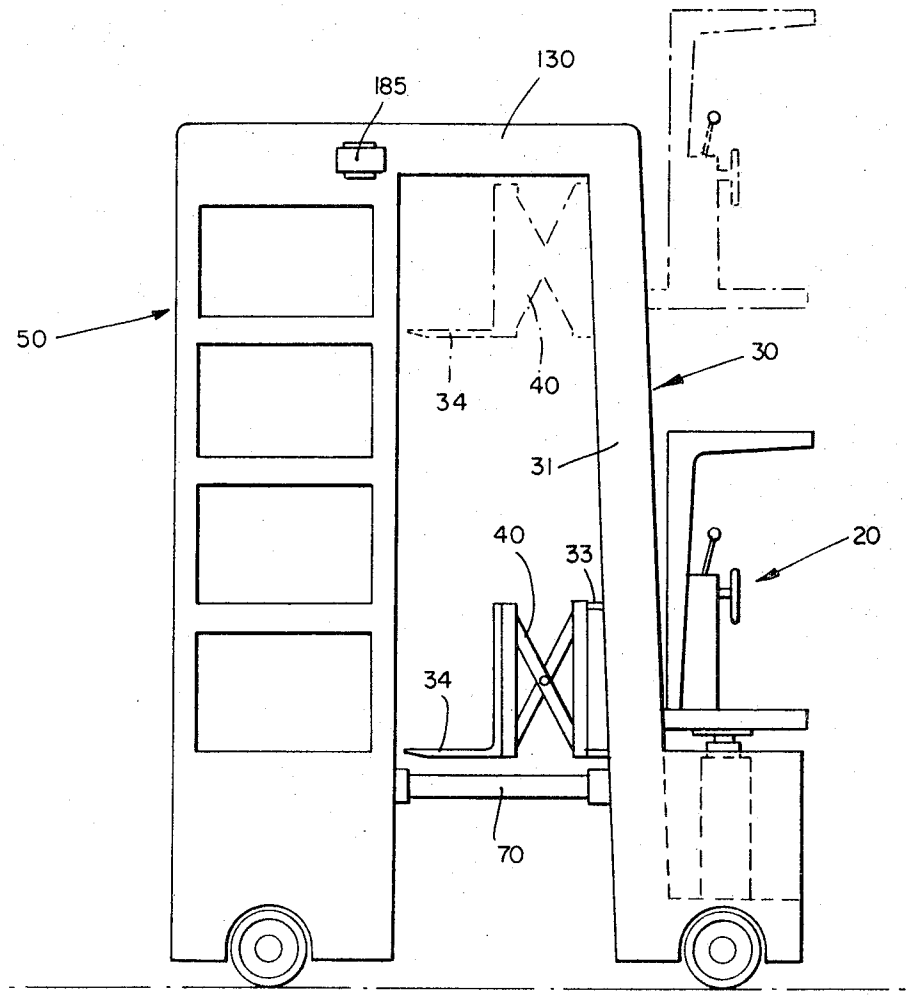


Fig. 6

MATERIAL HANDLING SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

This application is a division of application Ser. No. 160,600 filed July 8, 1971, entitled Material Handling System, now U.S. Pat. No. 3,727,778, granted Apr. 17, 1973.

BACKGROUND OF THE INVENTION

This invention relates to material handling vehicles and systems, and particularly to fork lift trucks and fork lift truck systems.

It is, of course, well known to use fork lift trucks for stacking palletized loads. However, prior art fork-lift material-handling trucks have not been sufficiently flexible, and a good deal of time is lost in unnecessary travel and motions.

SUMMARY OF THE INVENTION

An important object of the present invention is to provide a fork-lift material-handling system in which one fork lift vehicle does the work of up to five prior art vehicles.

Another object is to provide a fork-lift material-handling system in which the travel time of the fork lift vehicle is greatly reduced in comparison with prior art fork-lift material-handling systems.

A further object is to provide a fork-lift material-handling system capable of handling loads stacked two deep in floor racks on each side of the aisle.

Another object is to provide a material-handling system having flow-through characteristics, with material being received at one end and shipped out at the other end.

A more specific object is to provide a fork lift truck having a truck rack on which the palletized loads are carried, and wherein any pallet may be randomly selected.

A broad object is to provide a material handling system having flow-through characteristics which is applicable to both fork lift floor vehicles and overhead-rail crane stackers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one form of fork lift vehicle embodying the present invention.

FIG. 2 is a diagramatic plan view to illustrate how the fork lift truck of the present invention may be employed to carry out its purposes.

FIG. 3 is an elevation view, partly broken and partly in section, illustrating a modified version of fork lift vehicle according to the present invention.

FIG. 4 is a view looking along the line 4—4 of FIG. 3.

FIG. 5 is a view looking along the line 5—5 of FIG. 3.

FIG. 6 is a side elevational view of a presently preferred form of fork lift vehicle in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a perspective view of a fork lift vehicle embodying one form of the present invention. FIG. 6 is a side elevational view of a presently preferred form of

fork lift vehicle embodying the present invention. The principal difference between the vehicles shown in FIGS. 1 and 6 is that in the vehicle of FIG. 6 the truck chassis has no center section. The vehicle of FIG. 6 is tied together at the top by an arch 130 formed by the top of the mast 30 and the top of the truck rack 50. The lower portion of the truck is tied together at the center by a pair of tie bars 70, one on each side of the chassis. The tie bars 70 are adjustable vertically as to position. In other respects, the vehicle of FIG. 6 is similar to that shown in FIG. 1. The vehicle of FIG. 1 will first be described.

The vehicle shown in FIG. 1 includes a chassis 10 having at one end, arbitrarily designated the front end, a pair of front wheels 11 and at the other or rear end a pair of rear wheels 12. At least one of the pairs of wheels is ordinarily steerable. An operator's control position 20, evidenced in FIG. 1 by the steering wheel 21, is provided at the rearward end of the chassis. The vehicle is provided with known forms of power drive and control mechanisms for driving and controlling the vehicle and for operating the fork lift assembly.

At the forward end of the chassis 10 there is provided, in accordance with the present invention, a rack in the form of a columnar structure or tower 50. Rack tower 50 contains a plurality of individual material-receiving compartments arranged one above the other. In FIG. 1, six such individual compartments are shown, identified by reference numerals 51 through 56, wherein 51 is the bottom-most compartment and 56 is the upper-most. Each of the compartments 51–56 is provided with a pair of angle support members 57, one at each side of the compartments. These angle members 57 function as side rails for supporting the pallets 58 bearing the loads 59. Windows 60 may be provided in the side walls of the rack tower 50 to facilitate identification of the palletized loads in the compartments.

Immediately in front of the operator's control position 20, and spaced rearwardly from the rack tower 50, is a mast lift assembly 30. The mast lift assembly includes, among other things, a pair of stationary vertical guide channels or rails 31, movable guides 32 which are slidable up and down in the stationary vertical guide channels 31, and a carrier frame 33 which is movable up and down relative to both the guide rails 31 and the guides 32. The carrier frame 33 carries the lift fork 34. A pair of chains 35 are shown trained over a pair of pulleys 38 carried at the upper end of a piston 36 of a hydraulic lift cylinder 37. One end of the chains 35 is fixed to the carrier frame 33 while the other end is fixed to the stationary guide rails 31. Thus, when the piston 36 is extended, the carrier frame 33 is lifted through a distance equal to twice that of the distance through which the piston 36 is moved. The mast lift assembly 30 used in the vehicle of the present invention may be a well known form of mast lift assembly, and need not be further described.

The fork 34 is supported on a scissor-like extension or reach mechanism 40 which in turn is supported on a transverse carriage 41 which is supported on the elevatable carrier 33. Carriage 41 is movable back and forth transversely on the elevatable carrier 33. The extension or reach mechanism 40 is pivotably mounted on the transversely movable carriage 4, and is pivotable through 180°. Thus, the fork 34 may be directed laterally in either one of the two side directions, i.e., either toward the left or toward the right side of the chassis.

Or, the fork 34 may be directed forwardly toward the rack tower 50. The pivotally mounted scissors-like extension or reach mechanism 40 used in the fork lift vehicle of the present application is known in the art and need not be described in detail. Suitable reach mechanisms may, for example, be obtained from The Raymond Corporation, Greene, New York, or from Long Reach Manufacturing, a division of Anderson-Clayton Company (Inc.), Houston, Texas, or from Cascade Corporation, Portland, Oregon, or from others.

The vehicle shown in FIG. 6 is generally similar to that of FIG. 1 except that there is no center section at the bottom of the vehicle. The truck assembly is held together at the top by means of an arch 130 formed by the mast 30 and rack tower 50. Two tie bars 70, one on each side of the vehicle, are located near the bottom, preferably at the height or level of the first rack cross frame. The tie bars 70 are adjustable for height. This arrangement, as compared with the vehicle shown in FIG. 1, permits the carriage assembly and the forks 34 to reach the floor on both sides of the vehicle and to handle loads which rest on the floor.

Another modification is illustrated in FIG. 3. The truck of FIG. 3 differs from these of FIGS. 1 and 6 primarily in that the truck of FIG. 3 is not equipped with a scissors extension or reach mechanism 40, but is instead provided with a "pull-together" mechanism. Like the trucks of FIGS. 1 and 6, the truck of FIG. 3 includes a transverse carriage mounted on an elevatable carrier 33. The fork 34 is mounted on the carriage 41 to be pivotable through 180° so that the fork 34 may be directed either to the right or to the left of the chassis or forwardly toward the compartments in the rack tower 50.

When facing forwardly toward the rack tower 50, the load on the fork 34 may be deposited in a selected compartment of the rack tower 50 (or a load may be removed from a compartment of the rack tower 50) by "pulling-together" the two ends of the truck chassis, i.e., by moving the rack tower end of the truck closer to the mast assembly. The means for doing this will now be described.

In the chassis of FIG. 3, the rack tower section of the truck is separated from the mast assembly section except for a pair of connecting racks 71. The forward ends of the racks 71 are fixed to the rack tower section. The rearward ends of the racks are free to move relative to the mast assembly section of the truck. The mast assembly section is provided with a pair of fixed racks 75, one on each side of the vehicle located in the same vertical planes as the racks 71. Cylinders 76 having pistons 77 carry at their forward ends gears 78 which are adapted to engage the teeth of the racks 71 and 75. It will be seen from FIG. 3 that, when the pistons 77, one on each side of the vehicle, are retracted, the gears 78 will be caused to move counterclockwise, as viewed in FIG. 3, thereby causing the rack tower section 50 and the mast assembly section 30 to move toward each other, thereby causing the fork 34 to enter into one of the compartments of the rack tower 50. Since the modified form of the vehicle illustrated in FIG. 3 does not have an extensionscissors reach mechanism 40, the form of vehicle shown in FIG. 3 is not capable of handling loads which are located two deep in the floor stacks.

The modified truck in FIG. 3 is illustrated as having several features which may also be applied to the fork lift trucks of FIGS. 1 and 6. Where the warehouse ceiling is high, the mast lift assembly 30 may be so tall as to make stabilization desirable. In such case, a track or rail 81, illustrated in FIGS. 3 and 4, may be secured to the ceiling beams 80, and the upper end of the mast assembly 30 may be provided with bearings 82 which ride along the rail 81 thereby providing the necessary stabilization of the tall mast assembly 30. In some cases, it may also be desirable to provide an equally high rack tower 50 and to also provide the rack tower 50 with bearings for riding along the guide rail 81.

An alternate form of stabilization is illustrated in the vehicle of FIG. 6 where the arches portion 130 at the top of the vehicle is provided with side stabilization rollers for bearing against the floor racks. The stabilization rollers are identified 185.

In some cases, in order to relieve the operator of the necessity of steering the truck up and down the aisles, the chassis of the truck may be provided with side guide rollers 85 just above the floor level, such as are illustrated in FIG. 5 of the drawing. These side guide rollers 85 may engage rails 86 which may be provided along the sides of the aisles at the floor level.

OPERATION

The fork lift vehicle provided by the present invention, a preferred form of which is illustrated in FIG. 6, and other forms of which are illustrated in FIGS. 1 and 3, enables the material to be handled on a flow-through basis, with receiving at one end and shipping or delivery at the other end. This system will now be described with reference to FIG. 2. FIG. 2 illustrates a fragment of a floor plan of a warehouse. Three stacking areas are shown identified as A, B and C. Each of the areas is assumed to consist of four rows of palletized loads. The outside row of each area borders along a narrow aisle. The aisles are identified as *a*, *b*, *c* and *d*. As seen, the aisles extend from a receiving area, identified by the letter R, to a shipping or delivery area, identified by the letter D. The product may be received and handled by a standard truck in area R. Sorting into a feed rack may be provided at the end of each aisle. Such feed racks may be capable of holding vertically the same number of pallets as the rack of the fork lift truck is capable of handling, so as to match positions with the truck racks. The feed truck is driven up to the truck rack of the fork lift truck, and the truck racks are loaded, either by power or gravity feed. This permits simultaneous loading of all levels of the truck rack.

The fork-lift truck is driven down an aisle from left to right, as viewed in FIG. 2. En route, it may deposit and/or pick up palletized loads in a variety of sequences. For example, assume that all six of the compartments 51–56 of the vehicle rack are filled with palletized loads at the beginning of its travel from area R. This should be the case if no load is to be picked up from the floor stacks before a load is to be deposited. If, on the other hand, a palletized load is to be picked up from the floor stacks before a palletized load on the truck is deposited, the truck should, of course, have a vacant compartment in its rack at the beginning of its run. In general, the number of vacant compartments in the truck rack at the beginning of a run should correspond to the number of floor-stack loads which are to be picked up en route to the drlivery area D which exceed the number of palletized loads which are to be deposited before reaching the delivery area D.

In FIG. 2, a truck T1 is shown entering aisle b. A second truck T2 is shown in aisle c picking up (or depositing) a "two-deep" palletized load in the second row of area C. The palletized load which had been in the first row of area C has been picked up and deposited temporarily in one of the rack compartments of the rack tower 50 of the truck T2. After the "two-deep" load is picked up from (or deposited in) the second row of area C, the palletized load which had been in the first row will be returned from the truck T2 to its position either in the first row or in the now vacant spot in the second row. In FIG. 2, a third truck T3 is shown in aisle d depositing a load in (or picking up a load from) the fourth row of area C. It is believed that from the description and explanation given thus far, the versatility of the operation which is available will be apparent.

To summarize, in the system proposed by the present invention, using a fork lift truck of the type or types shown in the present application, any pallet may be randomly selected on the truck rack 50. The reach mechanism 40 will extend forward and the fork 34 will lift the pallet from the rack 50. The load is then withdrawn from the rack by closing the reach mechanism. The loaded fork is then rotated to either one side or the other, as selected. The loaded fork is then slidingly transferred to the side on the transverse carriage 33. This permits unloading (or loading) in the front or "one-deep" position of the floor rack. If the "two-deep" or second position in the floor rack is involved, the reach mechanism 40 is extended and the load placed at (or picked up from) the second depth. The motion is reversed to withdraw a load from the floor racks.

Whenever a load has been removed from the truck rack 50, the space made available in the truck rack may now receive a load from the floor rack for delivery at the shipping or delivery end D. If two spaces are kept open on the truck rack 50, a "one-deep" or front load from the floor rack may be stored in the one open space, and the "two-deep" or second load from the floor stack may now be withdrawn and placed in the second open compartment in the truck rack 50. The first or original load may then be returned to the second position in the floor rack, and the second load on the truck may be delivered to the shipping or delivery area D.

It will be seen that the equipment shown and described permits effective handling of loads which are two deep in the floor aisle, without excessive traveling back and forth on the part of the truck. Long, narrow aisles (up to 600 feet) now become feasible because multiple loads can be handled without doubling back and forth or passing other trucks in the aisles. The material-handling system described eliminates approximately two-thirds of the travel time presently used by fork lift vehicles for placing and withdrawing loads using conventional prior art fork lift equipment.

In the proposed system, one vehicle and its driver may replace up to five prior art vehicles and their drivers. Thus, both equipment and manpower are saved. The reduced travel time permits one operator to do the work of up to five operators in about the same time. The fact that loads stored two deep in the floor aisles may now be handled efficiently permits savings on total rack space requirements. No passing of trucks in the narrow aisles is required under the presently described proposed method. Moreover, with the vehicle shown in FIG. 6, loads can be handled from the floor all the way to the top of the rack.

Stability of the truck, both longitudinally and transversely, may be maintained by either over-head guides or roller stabilizers at the floor level or at the top of the assembly.

It is to be noted that the material handling system proposed in the present application is applicable to crane stackers as well as to fork lift trucks, since it is immaterial whether the vehicle be supported by wheels which ride on the floor of the warehouse or on overhead rails.

In the claims which follow the term "fork lift vehicle" is intended to include elevatable fork vehicles which are supported on overhead rails as well as elevatable fork vehicles which are supported on the floor.

What is claimed is:

1. A material handling fork lift vehicle for handling palletized loads in a room having a ceiling, said vehicle comprising:

a. a divided wheeled chassis having a forward section and a rearward section spaced apart from each other;

b. a high-rise rack tower on said forward section of said chassis;

c. said rack tower including a plurality of greater than three receiving compartments arranged vertically one above the other;

d. a high-rise mast of fixed height secured in fixed position on said rearward section of said chassis and spaced rearwardly from said rack tower;

e. the upper end portion of said mast being connected by a horizontal bridge portion to the upper end of said rack tower, whereby said rack tower, mast and bridge portion form an arch-like structure having a through opening from the bridge portion down to the surface on which said wheeled chassis is supported;

f. two horizontally disposed tie bars, each connected between one side of said mast and the corresponding side of said rack tower, each tie bar being vertically adjustable to provide structural support to said arch-like structure at any selected vertical level;

g. roller means at said bridge portion adapted to cooperate with guide rail means supported from the ceiling to provide lateral support for said high-rise rack tower and mast;

h. a carriage arranged for vertical guided movement along said mast, said carriage including an operator station which projects outside of said mast from that side of said mast which is opposite said rack tower;

i. hydraulic cylinder means for raising and lowering said carriage;

j. an overhead protective guard for said operator station and movable therewith;

k. a fork lift assembly supported on said mast and having forks projecting therefrom;

l. said fork lift assembly including pivot means for pivoting said fork through 180° to direct said fork toward either side of said chassis or toward said rack tower;

m. said pivot means being mounted on said carriage and positioned between said mast and said rack tower;

n. said fork lift assembly also including scissors-like extension and retraction means for moving said fork into and out of any selected one of said rack tower compartments and for moving said fork laterally outwardly to either side of said chassis through said opening in said arch-like structure, said arch-like structured chassis allowing said fork to engage a load on either side of said chassis at the level of the supporting surface for said wheeled chassis.

* * * * *