United States Patent

[11] **3,542,227**

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[21] Appl. No. **736,227**
[22] Filed **June 11, 1968**
[45] Patented **Nov. 24, 1970**

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[54] **LIFT TRUCK WITH GROUND-ENGAGING MEANS FOR SUPPORTING BASE OF MAST**
3 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **214/672,** 214/730
[51] **Int. Cl.** **B66f 9/20,** B66f 9/14
[50] **Field of Search** 214/660, 670, 674, 730

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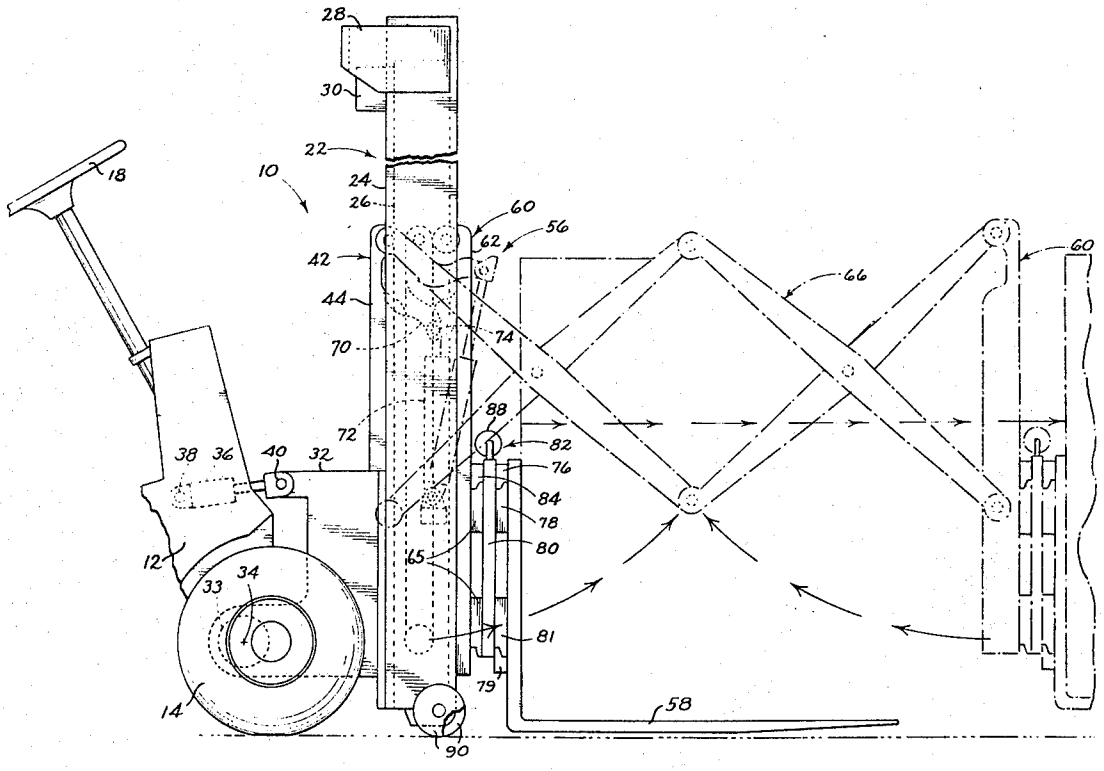
ABSTRACT: A lift truck including a wheel-supported frame and a mast mounted adjacent the forward end of the frame, and beyond the wheels supporting the frame's forward end, for tilting between inclined and upright positions relative to the frame. Wheels are mounted adjacent the base and on opposite sides of the mast. These wheels occupy a position above the ground with the mast inclined, and engage the ground and support the mast with the mast upright.



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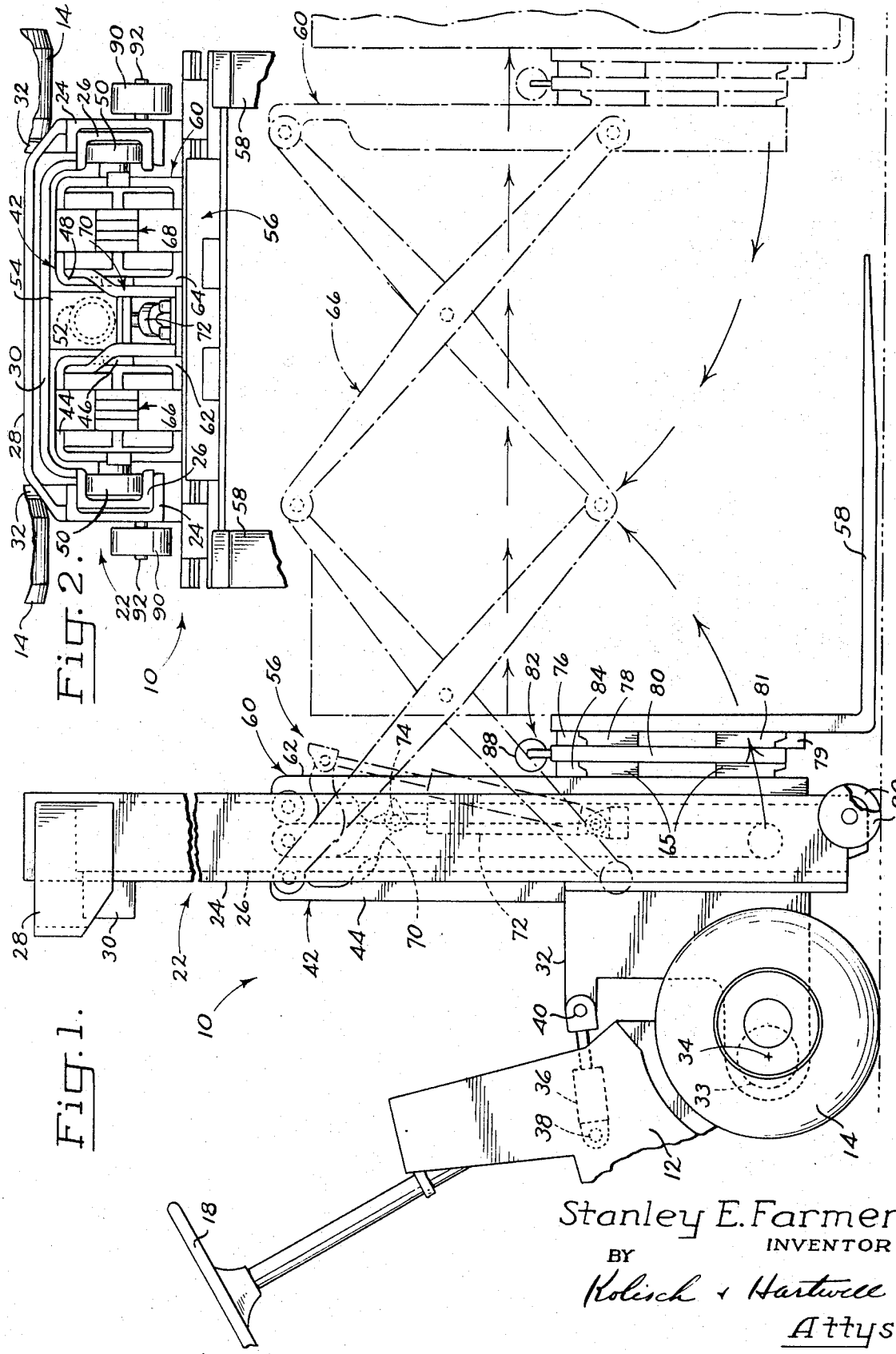

Fig. 2.

Fig. 1.

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Fig. 5.

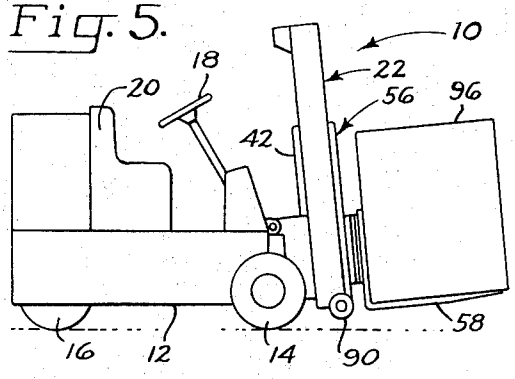


Fig. 4.

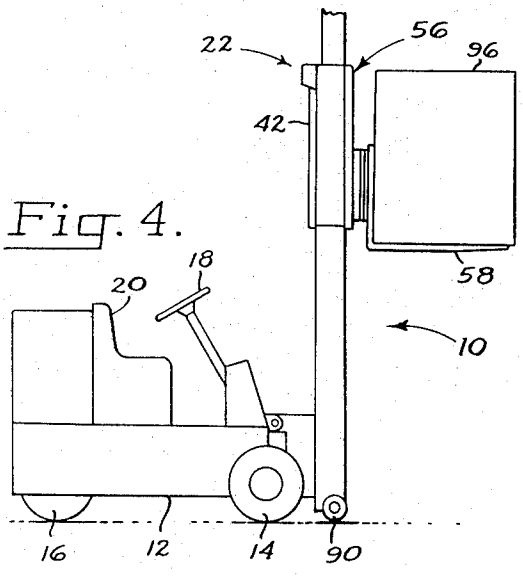


Fig. 3.

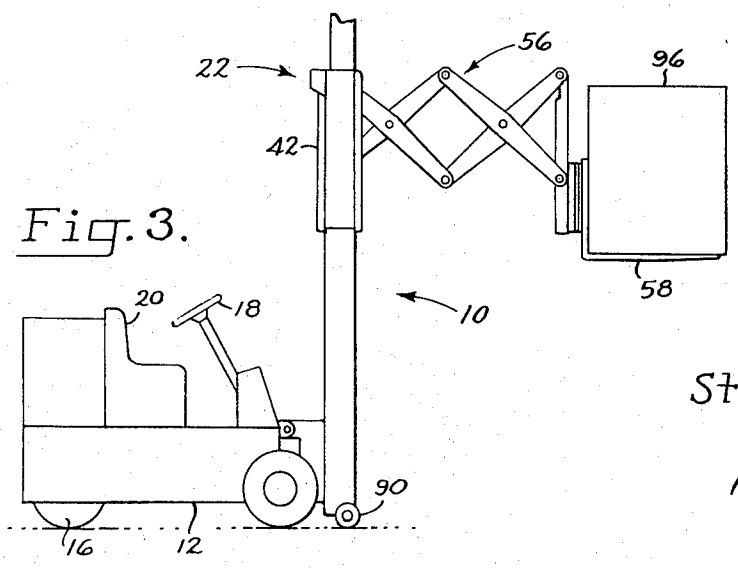
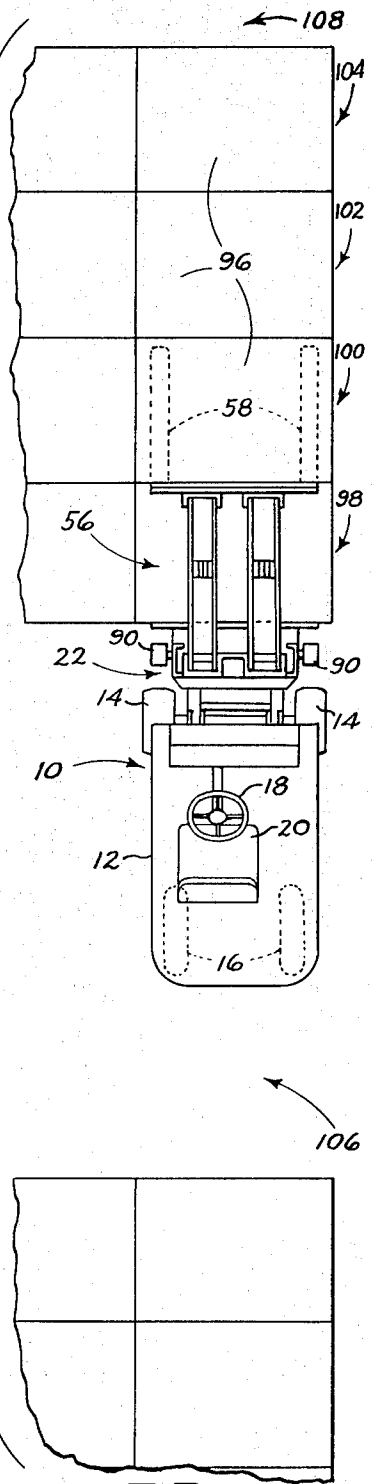


Fig. 6.



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LIFT TRUCK WITH GROUND-ENGAGING MEANS FOR SUPPORTING BASE OF MAST

This invention pertains to a lift truck, and more particularly, to such a truck including a mast with ground-engaging means provided for supporting the base of the mast with the latter in an upright position.

This invention is bottomed on the concept that good utilization of warehouse storage space may be achieved if packages are stacked in four adjacent rows, and aisle space is provided for shifting packages in such rows on each side of these four adjacent rows. In such a system, a lift truck having forks which may be extended from its mast may be employed to pick up and deposit packages, on inside rows, by reaching over outside rows. Further explaining, to pick up a package in the row nearest an aisle, the truck operates in the usual fashion. To pick up a package in a row inwardly from an aisle row, the forks in the truck are extended over the aisle row. The aisle space provided, therefore, permits the handling of packages in two rows instead of one.

Lift trucks to be employed in this manner must be constructed to have suitable stability under conditions when the forks are extended from the mast and support a load. With the ordinary truck, when a heavy load is held far out in front of the truck, the mass of the truck is not sufficient to keep the wheels supporting the rear end of the truck's frame from lifting off the ground. This invention contemplates a truck which solves this problem, without interfering with ordinary truck handling capability.

Therefore, a general object of the present invention is to provide a novel lift truck which features means stabilizing it when heavy loads are carried.

More specifically, an object of the invention is to provide such a truck which includes novel ground-engaging means increasing the truck's stability with the mast upright and in the position it occupies in the picking up or the depositing of a load.

According to a preferred embodiment of the invention, the truck includes a frame with opposite ends supported by wheels, and a mast assembly mounted adjacent the forward end of the frame and positioned forwardly of the wheels supporting the frame's forward end. The mast assembly is mounted on the frame through means permitting tilting of the assembly between inclined and upright positions. Lift forks for supporting a load are mounted through reach mechanism on a carriage which can move up and down on the mast assembly. Mounted adjacent the base and on lateral sides of the mast assembly are wheels which augment the support for the mast with the mast upright. With the mast in an inclined position (as when the truck moves with a load) the latter-mentioned wheels are above the ground and in no way interfere with truck mobility.

These and other objects and advantages attained by the invention will become more fully apparent as the description which follows is read in conjunction with the accompanying drawings wherein:

FIG. 1 is a fragmentary side elevation illustrating a lift truck constructed according to the invention, with various parts in the truck shown in dash-dot outline with these parts in an extended position;

FIG. 2 is a fragmentary plan view, further illustrating the truck of FIG. 1;

FIGS. 3, 4 and 5 are simplified side elevations, on a smaller scale than FIGS. 1 and 2, illustrating the proposed lift truck with parts therein shown in different positions during a load-handling operation; and

FIG. 6 is a simplified fragmentary plan view illustrating how the truck proposed herein may be employed in a warehouse to handle packages stored therein.

Turning now to the drawings, and referring first to FIG. 6, indicated generally at **10** is a lift truck as contemplated herein comprising a vehicle frame **12** supported for travel over the ground by means of the usual front and rear wheel assemblies, or means, shown at **14, 16**, respectively. Wheels **16** are dirigible, and steering is performed by turning such wheels utilizing

steering wheel **18** which is located in front of an operator's seat **20**. The usual drive motor (concealed) is drivingly connected to front wheels **14** to power them.

Considering FIGS. **1** and **2**, the lift truck further comprises a vertically extensible mast assembly indicated generally at **22** and disposed forwardly of front wheels **14**. The mast assembly is shown in an upright position in FIG. **1**. Assembly **22** comprises a pair of laterally spaced outer channel members **24** and a pair of inner channel members **26** telescopically received within the outer channel members for extension upwardly from the outer channel members. The upper ends of channel members **24** are joined by a crossmember **28**, and member **28** together with outer channel members **24** constitute an outer mast section in assembly **22**. Similarly, the upper ends of the inner channel members are joined by a crossmember **30**, and this crossmember together with the inner channel members constitute an inner mast section. As can be seen clearly in FIG. **2**, crossmember **28** bows rearwardly to provide clearance for crossmember **30** with vertical movement of the inner mast section.

The mast assembly is mounted on the forward end of frame **12** through a pair of laterally spaced bracket structures **32** which are joined to the rear sides of outer channel members **24**. Bracket structures **32** are pivoted to frame **12** through means such as the pivot connection shown at **33**. The pivot mounting accommodates tilting of the mast assembly (between upright and rearwardly inclined positions) about a substantially horizontal axis **34** (see FIG. **1**) that extends transversely of the longitudinal axis of the truck. The mast assembly is tilted by means of a pair of laterally spaced fluid-operated rams, such as the one shown at **36** in FIG. **1**. The butt end of the ram's cylinder is pivoted through a pivot connection **38** to the frame of the vehicle, and the outer end of the rod in each ram is connected to a bracket structure through a pivot connection **40**. FIG. **5** shows the mast assembly in its rearwardly inclined position.

Mounted for vertical movement on inner channel members **26** in the inner mast section is a carriage **42**. The carriage comprises three upright, elongated, substantially parallel channel pieces **44, 46, 48**. Channel pieces **44, 48** are laterally spaced apart from one another with their recessed sides facing downwardly in FIG. **2**. Channel piece **46** is positioned between and joined to pieces **44, 48**. The recessed side of piece **46** faces upwardly in FIG. **2**. Also forming part of the carriage are rollers, such as rollers **50**, suitably journaled on the outer flanges in channel pieces **44, 48**. Such rollers are freely received within the elongated channels that extend along the recessed sides of channel members **26**, and guide the carriage for vertical movement on the inner mast section.

The inner mast section in assembly **22** is raised and lowered by an upright hydraulic hoist ram indicated in dashed outline at **52** in FIG. **2**. The butt end of the cylinder in ram **52** is suitably supported adjacent the base of the mast assembly, and the upper end of the rod in the ram is anchored to a bracket **54** which is secured to crossmember **30** in the inner mast section. With extension and contraction of ram **52** the inner mast section moves as a unit with the rod in the ram.

Carriage **42** is raised and lowered by means of a conventional chain and pulley mechanism which has been omitted from the drawings in order to obtain better clarity therein.

Further describing truck **10**, mounted on the carriage through an extensible reach mechanism indicated generally at **56**, is a pair of laterally spaced lift forks **58**. In FIG. **1**, in solid outline, the reach mechanism is shown in a contracted state, with the lift forks positioned closely adjacent the mast assembly and extending forwardly from frame **12** in the truck. In dash-dot outline the reach mechanism and forks are shown in positions extended forwardly from their retracted positions.

Considering details of the reach mechanism, it may comprise a shiftable frame section **60** formed from a pair of upright laterally spaced channel members **62, 64** (see FIG. **2**) joined together by means including plates **65** (see FIG. **1**). Channel members **62, 64** are similar to previously mentioned

channel pieces **44**, **48**, and are disposed with their recessed sides facing the recessed sides of such channel pieces, respectively.

The reach mechanism further comprises a pair of scissors assemblies **66**, **68** which are similar to one another and which interconnect channel piece **44** with channel member **62**, and channel piece **48** with channel member **64**, respectively. It should be obvious that the particular form of reach mechanism used is subject to some variation. Details of a reach mechanism similar to the one described herein, while not important to an understanding of the invention, may be found in a prior-filed copending application of Warren et al., U.S. Pat. Ser. No. 713,815, filed Mar. 18, 1968, entitled LIFT TRUCK.

The scissors assemblies in reach mechanism **56** are extended and contracted by means of a crank **70** and a hydraulic ram **72**. The butt end of the cylinder in ram **72** is suitably pivotally mounted on channel piece **46** in the carriage, and the outer end of the rod in the ram is pivoted at **74** to crank **70**. Contraction of ram **72** causes contraction of the scissors assemblies, and extension of the ram causes extension of the assemblies.

Lift forks **58** are joined by a hook **76** extending along their back sides in FIG. **1**, and this hook fits over a bar **78** joined to a plate **80**. Each fork is supported additionally by a hook, such as hook **79** in FIG. **1**, disposed beneath hook **76** and engaged with a bar **81** joined to plate **80**. Plate **80** is part of a side-shift mechanism **82** which is actuatable to produce side shifting of the forks relative to frame section **60** in the reach mechanism. Describing further details of this side-shift mechanism as illustrated in FIG. **1**, joined to the back of plate **80** is a hook **84** mounted for side to side sliding movement on upper plate **65** fastened to frame section **60**. A ram **88** is provided for shifting plate **80** laterally as accommodated by sliding movement of hook **84**. One end of the ram is suitably mounted on plate **80**, and its opposite end is suitably connected to frame section **60**. Details of a side-shift mechanism similar to the one just described may be found in a prior-filed copending application of Robert J. Kroupa, U.S. Pat. Ser. No. 662,149, filed Aug. 21, 1967, entitled SIDE-SHIFT APPARATUS FOR A LIFT TRUCK, which was issued as Pat. No. 3,460,700.

According to the present invention, means is provided for supporting the base of mast assembly **22** with the same occupying its upright position. In the preferred embodiment illustrated, such means comprises a pair of wheels, or ground-engagable means, **90**. As can be seen clearly in FIG. **2**, wheels **90** are disposed laterally outwardly of outer channel members **24** in the mast assembly, and are journaled on axles **92** joined adjacent the bases of such members. It will be noted in FIG. **1** that with the mast assembly in an upright position, wheels **90** are in lowered positions where they engage the ground and provide support for the mast. Further, it will be noted that wheels **90** are located well forwardly of front wheels **14** in the truck, near the forward extremity of the mast assembly.

Explaining now how the truck described herein operates, and referring to FIGS. **3—6**, in FIG. **6** there is illustrated at **94** portions of a warehouse floor. In the warehouse, palletized loads, such as packages **96**, may be stored in four adjacent rows, such as the rows shown at **98**, **100**, **102**, **104**. Aisle space **106** is provided on one side of the rows, and aisle space **108** is provided on the opposite side of the rows.

With the lift truck of the invention, a package **96** may be readily picked up from an inner row, such as inner row **100**, where such is not obstructed by packages in an outer row, such as row **98**, without losing stability in the truck, and even though the load may have considerable mass. Further explaining, and assuming that a package **96** in row **100** is present which is above the elevation and not obstructed by any packages in front of it in row **98**, to pick up such a package the truck first is maneuvered with its mast rearwardly inclined to a position directly in front of row **98** and facing the package which is desired to be picked up. Through operation of rams **36**, the mast assembly may then be tilted to an upright position. With the assembly upright the mast assembly may be extended to elevate the carriage and forks, whereby the forks are at a suitable elevation to move over the top of any packages in row **98**.

Reach mechanism **56** may then be extended to shift the forks to a position beneath the package **96** which is in row **100**. Raising of the forks slightly will then operate to pick up the package. FIG. **3** illustrates in side elevation the truck, package and forks as they might appear after picking up such a package. It will be noted with reference to this FIG. that wheels **90** at the base of the mast assembly are lowered, and in a position engaging the ground at a point located forwardly of front wheels **14**. As a consequence, even though the package **96** which has been picked up may have considerable mass and is held in a position relatively far in front of the truck, a stable condition is maintained, with the mass of the truck counterbalancing the mass of the load about wheels **90**.

Reach mechanism **54** may then be contracted to shift the forks and load rearwardly whereby the load becomes positioned close to the mast assembly as shown in FIG. **4**. Either at this time, or perhaps after the truck has been backed off slightly from the row of packages, the mast assembly may be inclined rearwardly from its upright position to tilt the forks slightly whereby the load becomes more firmly lodged on the forks as is conventional with lift truck operation. Also, the forks and package may be lowered to positions closely adjacent the ground through contraction of the mast assembly. With tilting of the mast assembly from its upright to its rearwardly inclined position, wheels **90** move upwardly from the ground to leave the vehicle and load supported entirely by the truck wheels **14**, **16**. This condition of the parts, with the mast tilted, and the forks and package lowered, is illustrated in FIG. **5**, and with such a condition, the load is in position for transport. The vehicle may then be maneuvered in the usual manner.

Thus, the proposed lift truck has a number of important advantages distinguishing it from prior known trucks. Of principal importance is the provision of ground-engaging means mounted adjacent the base of the mast assembly. With such means provided which engages the ground with the mast in an upright position, a load may be supported at a considerable distance from the front of the truck, as in the type of load-handling operation described above, without the truck losing its forward stability. The ground-engaging means engages the ground at a point spaced forwardly of the front wheels supporting the truck frame, and this increases the moment arm through which the mass of the truck acts to counterbalance a load.

Where, as in the preferred embodiment described herein, the ground-engaging means comprises laterally spaced wheels disposed outwardly of the mast assembly, the truck can be moved over the ground with such wheels providing rolling contact between the base of the mast and the ground. The wide lateral spacing present in the wheels ensures good support for opposite sides of the mast.

While a preferred embodiment of the invention has been described herein, it is appreciated that variations and modifications are possible without departing from the spirit of the invention.

I claim:

1. A lift truck comprising:

a vehicle frame having front and rear ends with dirigible wheel means supporting the rear end of the frame and power-driven wheel means supporting the front end of the frame;

a mast assembly and means mounting said assembly on said frame with such disposed forwardly of the power-driven wheel means supporting the frame at said front end, the means mounting said mast assembly accommodating movement of the assembly relative to the vehicle frame between inclined and upright positions;

load-support means and reach mechanism mounting the load-support means on said mast assembly with the load-

support means disposed forwardly of the mast assembly, said reach mechanism being actuatable to thrust the load-support means outwardly in a forward direction from the mast assembly; means mounted on said reach mechanism for moving said load-support means transversely relative to said reach mechanism; and

ground-engagable support means mounted on the mast assembly disposed forwardly of the power-driven wheel means supporting the front end of the vehicle frame, said support means having a raised position where it is above the ground with said mast assembly in its said inclined position, and a lowered position where it engages the ground to provide support for the mast assembly with the latter in its said upright position.

2. The lift truck of claim **1**, wherein said ground-engagable support means comprises a pair of laterally spaced wheels.

3. The lift truck of claim **2**, wherein said mast assembly comprises an outer mast section including a pair of laterally spaced mast members, and said wheels are disposed laterally outwardly of said members.