Dec. 9, 1969 T. P. SIMOVICH 3,482,722

LIFT TRUCK WITH LATERALLY TILTABLE LIFTING UNIT

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FIG. 1.

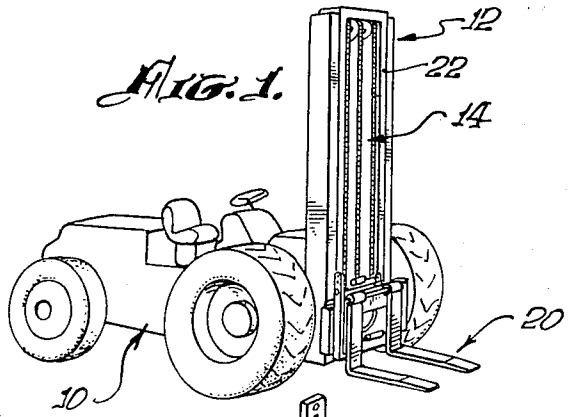


FIG. 5.

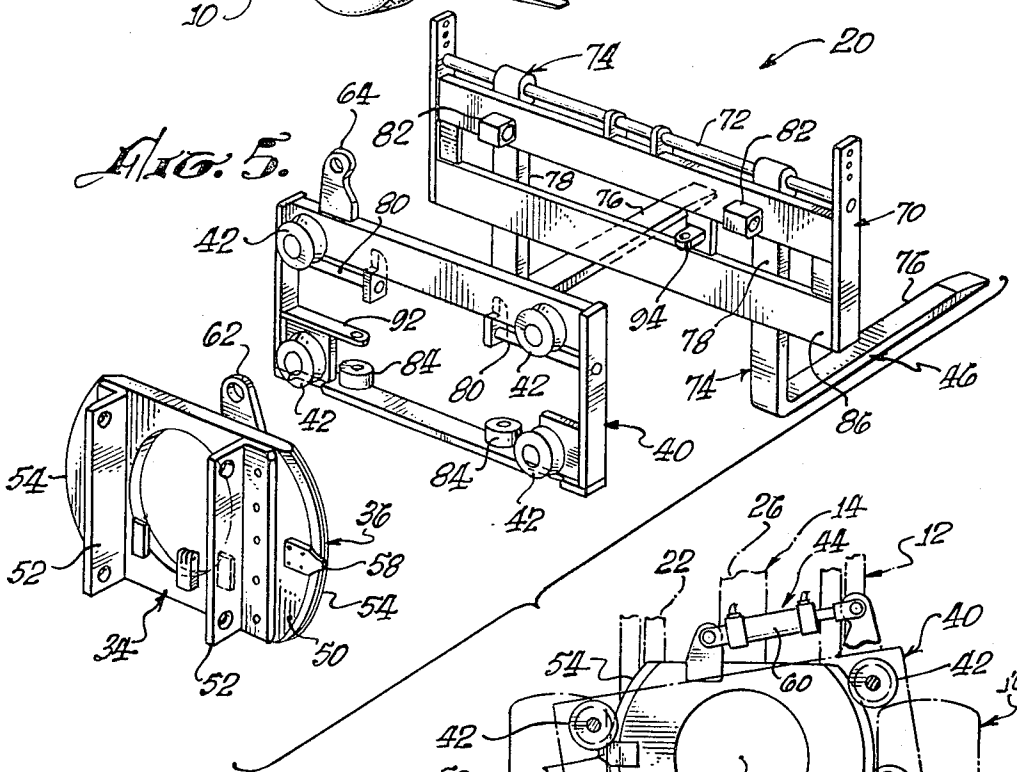


FIG. 6.

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FIG. 3.

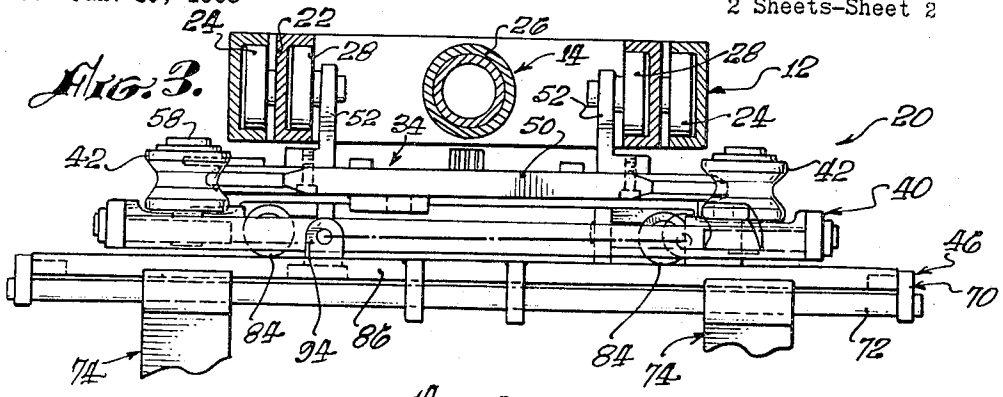


FIG. 2.

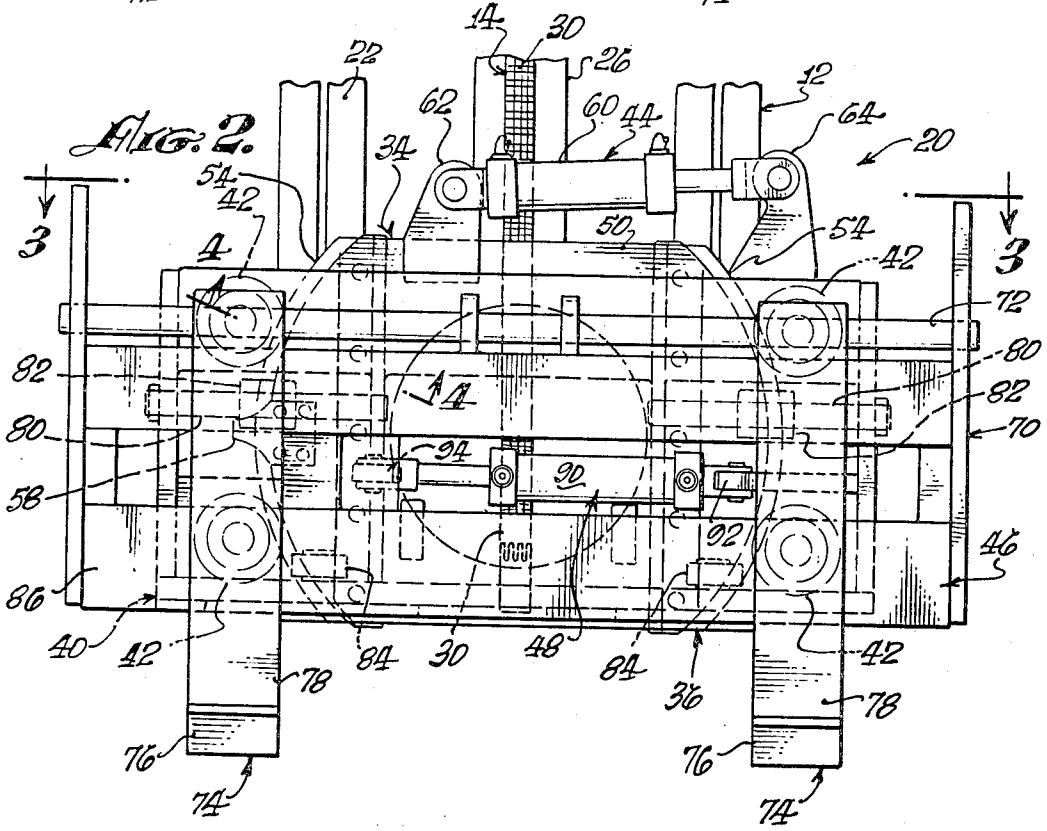
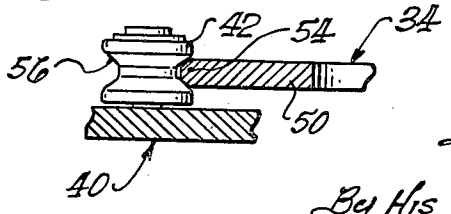


FIG. 4.



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LIFT TRUCK WITH LATERALLY TILTABLE LIFTING UNIT

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U.S. Cl. 214—701 3 Claims

ABSTRACT OF THE DISCLOSURE

A lift truck having a lifting unit which is both laterally tiltable and laterally shiftable. The lifting unit includes a supporting structure connected to the elevating means on the mast of the lift truck. Forwardly of the supporting structure is a laterally tiltable structure which is rendered laterally tiltable by means of rollers thereon in engagement with laterally spaced, arcuate tracks on the supporting structure, such arcuate tracks facing laterally outwardly relative to the forwardly-extending axis thereof. The arcuate tracks are V-shaped in cross section and the rollers have circumferential V-grooves which receive the V-shaped tracks to restrain the laterally tiltable structure against forward and rearward movement relative to the supporting structure. A laterally shiftable lifting structure is carried by the laterally tiltable structure.

BACKGROUND OF THE INVENTION

Industrial lift trucks are commonly provided with lifting units having lifting structures, such as forks, which are laterally shiftable in a horizontal direction, laterally tiltable in a vertical plane and/or laterally swingable in a horizontal plane. Shifting the lifting structure laterally and swinging it laterally are maneuvers which are useful to compensate for minor misalignments of the lift truck and a load to be picked up, or a location on which a load is to be deposited. Consequently, maneuvering of the lift truck to obtain precise alignment is not necessary. Making the lifting structure laterally tiltable provides a way of compensating for any difference between the lateral slopes of the surface on which the lift truck is positioned and the surface on which a load is to be placed, or from which a load is to be removed. For example, sometimes the ground or pavement in front of a load location slopes laterally relative to the load location itself. Being able to tilt the lifting structure laterally about a generally horizontal, forwardly extending axis provides a way of compensating for such a lateral slope differential.

As further background, the invention contemplates a lifting unit, for a lift truck having a mast and having elevating means movable upwardly and downwardly along the mast, comprising: a supporting structure connectible to the elevating means of the lift truck; a tiltable structure pivotally mounted on the supporting structure for lateral tilting movement about a forwardly extending axis; actuating means interconnecting the tiltable structure and the supporting structure for tilting the tiltable structure laterally about such axis; a lifting structure mounted on the tiltable structure for lateral shifting movement of the lifting structure relative to the tiltable sructure; and another actuating means interconnecting the lifting structure and the tiltable structure for laterally shifting the lifting structure relative to the tiltable structure.

One prior lifting unit of the foregoing type with which I am familiar utilizes a simple pivot between the tiltable structure and the supporting structure, to permit lateral tilting of the tiltable structure, together with thrust rollers for offsetting the downward bending moment produced by a load on the lifting structure.

OBJECTS OF INVENTION

A primary object of the invention is to provide a pivotal connection, between the laterally tiltable structure and the supporting structure, comprising: an arcuate track means on one of these structures which is symmetrical about the desired forwardly extending axis and which faces laterally outwardly away from such axis; rollers on the other of the structures in engagement with the track means to provide for lateral tilting of the tiltable structure about the forwardly extending axis; and cooperating means on the track means and the rollers for restraining the tiltable structure against forward and rearward movement relative to the supporting structure.

Another object is to locate the arcuate track means on the supporting structure and the rollers in engagement therewith on the tiltable structure.

A further object of the invention is to provide a track means comprising two arcuate tracks spaced apart laterally of the forwardly extending axis mentioned and each engaged by two of the rollers.

An additional object is to provide a construction wherein the tracks are tapered in cross section and wherein the rollers have circumferential tapered grooves receiving the tracks therein, such rollers and tracks cooperating to restrain the tiltable structure against forward and rearward movement relative to the supporting structure, and serving to oppose the downward bending moment resulting from a load on the lifting structure carried by the tiltable structure.

Still another object is to provide a lifting unit wherein one of the tracks carries a stop which is positioned midway between the ends of such track and which is selectively engageable by the corresponding rollers so as to limit lateral tilting movement of the tiltable structure about its forwardly extending axis.

An important advantage of a lifting unit conforming to the foregoing objects of the invention is that the weight of any load carried by the lifting structure is divided between at least two of the rollers on the tiltable structure in engagement with the tracks on the supporting structure, instead of being supported entirely by a single pivot, thereby avoiding concentrating the stress due to the entire load at one point.

The foregoing objects and features of the present invention, together with various other objects and features which will be evident to those skilled in the lift truck art in the light of this disclosure, may be achieved with the exemplary embodiment of the invention illustrated in the accompanying drawings and described in detail hereinafter.

DESCRIPTION OF DRAWINGS

In the drawings:

FIG. 1 is a perspective vew of a lift truck equipped with a lifting unit which embodies the invention;

FIG. 2 is an enlarged, front elevational view of the lifting unit, and showing also fragments of the mast and elevating means of the lift truck;

FIG. 3 is a fragmentary view taken as indicated by the arrowed line 3—3 of FIG. 2, with actuating means for a laterally tiltable structure and a laterally shiftable lifting structure of the lifting unit omitted for clarity;

FIG. 4 is a fragmentary sectional view taken as indicated by the arrowed line 4—4 of FIG. 2;

FIG. 5 is an exploded perspective view illustrating the supporting, tiltable and lifting structures of the lifting unit of the invention; and

FIG. 6 is a semidiagrammatic front elevational view of the lift truck illustrating the lateral tilting movement of the tiltable structure relative to the supporting structure, the lifting structure being omitted for clarity.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT OF INVENTION

Illustrated generally in FIG. 1 of the drawings is a conventional lift truck **10** provided with a mast **12** at its forward end. Movable upwardly and downwardly along the mast **12** is an elevating means **14** of any suitable type for raising and lowering a lifting unit **20** of the invention.

The elevating means **14** per se forms no part of the present invention and may be of any suitable construction. Briefly, the particular elevating means **14** shown includes an elevating frame **22** movable upwardly and downwardly relative to the mast **12** on rollers **24**. A hydraulic cylinder **26** interconnecting the elevating frame **22** and the mast **12** produces the upward and downward movement of the elevating frame. The lifting unit **20** is equipped with rollers **28** which permit the lifting unit to move upwardly and downwardly relative to the elevating frame. A chain **30** is connected at one end to the lifting unit **20** and is trained over a sprocket at the top of the elevating frame **22**, the other end of the chain being anchored relative to the mast **12**. Thus, as the hydraulic cylinder **26** extends the elevating frame **22** upwardly, the chain **30** moves the lifting unit **20** upwardly relative to the elevating frame. However, as previously indicated, the lifting unit **20** of the invention may be employed with any desired type of elevating means.

Considering the lifting unit **20** generally, it includes a supporting structure **34** connectible to the elevating means **14** of the lift truck **10** and provided with an arcuate track means **36** which is symmetrical about an axis **38**, FIG. 6, extending forwardly from the lift truck and which faces laterally or radially outwardly away from such axis. Forwardly of the supporting structure **34** is a structure **40** which is tiltable laterally, i.e., which is tiltable in a generally vertical plane, about the forwardly extending axis **38**. More particularly, the laterally tiltable structure **40** is provided with rollers **42**, preferably four in number, which engage the track means **36** to permit the structure **40** to tilt laterally relative to the supporting structure **34**. As will be described hereinafter, the track means **36** and the rollers **42** have cooperating means for restraining the tiltable structure **40** against forward and rearward movement relative to the supporting structure **34** and for resisting the downward bending moment produced by a load on the lifting unit **20**. An actuating means **44** interconnects the tiltable structure **40** and the supporting structure **34** and serves to tilt the structure **40** laterally about the forwardly extending axis **38**. Forwardly of and carried by the tiltable structure **40** is a laterally shiftable lifting structure **46**, the latter being shifted laterally, along a generally horizontal path, by an actuating means **48** interconnecting the tiltable and lifting structures.

Considering the foregoing basic components of the lifting unit **20** in more detail, the supporting structure **34** comprises simply a heavy plate which is oriented generally vertically and which is provided on its rear side with rearwardly extending flanges **52** carrying the rollers **28**. The plate **50** is provided with laterally horizontally spaced arcuate edges respectively forming arcuate tracks **54** which constitute the arcuate track means **36**. The arcuate tracks **54** face laterally outwardly from the forwardly extending axis **38**, and are tapered in cross section, as best shown in FIG. 4.

The tiltable structure **40** is shown as comprising a rectangular frame on which the four rollers **42** are mounted in laterally spaced pairs, the rollers of the respective pairs engaging the respective tracks **54**. As shown in FIG. 4, each roller **42** is provided with a circumferential tapered groove **56** complementary to the corresponding track **54**. Thus, the flanges on the rollers **42** and the arcuate tracks **54** cooperate to resist forward and rearward movement of the tiltable structure **40** relative to the supporting structure **34**, and to resist the downward bending moment created by a load on the lifting structure **46**.

With the foregoing construction, the structure **40** can tilt laterally relative to the supporting structure **34** about the forwardly extending axis **38**, as clearly shown in FIG. 6 of the drawings. Tilting of the structure **40** is limited by a stop **58** mounted on the plate **50** of the supporting structure **34** midway between the ends of one of the arcuate tracks **54**. The laterally outer end of the stop **58** projects into the paths of the corresponding rollers **42** and is selectively engageable by such rollers to limit tilting of the structure **40** in both the clockwise and counterclockwise directions. The rollers **42** may be provided with suitable thrust bearings, not shown, resisting the axial loads imposed thereon.

The actuating means **44** for tilting the structure **40** comprises simply a hydraulic cylinder **60** pivotally connected at its ends to brackets **62** and **64** respectively mounted on the plate **50** of the supporting structure **34** and on the tiltable structure **40**.

As will be apparent, the foregoing construction provides a very simple way of making the structure **46** tiltable relative to the supporting structure **34**, only simple parts being required which can be manufactured relatively inexpensively. Further, it will be noted that the weight transferred from the tiltable structure **40** to the supporting structure **34** is divided between two of the rollers **42**, instead of being concentrated on a single pivot, and that the downward bending moment due to the load is divided among all four of the rollers **42**, thereby further avoiding stress concentrations.

Turning now to the lifting structure **46**, it is shown as including a rectangular frame **70** having adjacent the top thereof a transversely extending shaft **72** to which L-shaped tines **74** are pivotally connected. The tines **74** have forwardly extending portions **76** which are capable of supporting a load, such as a palletized load, and the downward bending moment resulting from the load is resisted by engagement of upright portions **78** of the tines with the front side of the frame **70**. Also, the tines **74** may be shifted laterally along the shaft **72** to vary the spacing therebetween to accommodate a particular load.

The lifting structure **46** is connected to the tiltable structure **40** by means of transverse shafts **80** carried by the tiltable structure **40** and rearwardly extending blocks **82** carried by the lifting structure frame **70** and slidable on the respective shafts **80**. The downward bending moment produced by a load on the forwardly extending portions **76** of the tines **74** is resisted by horizontal rollers **84** on the tiltable structure **40** in engagement with the rear surface of a transverse member **86** of the frame **70**.

The blocks **82** are laterally slidable on the shafts **80**, and the rollers **84** are in rolling engagement with the frame member **86**, to permit lateral shifting of the lifting structure **46** relative to the tiltable structure **40**. The actuating means **48** for producing such lateral shifting comprises simply a hydraulic cylinder **90** pivotally connected at one end to a bracket **92** on the tiltable structure **40** and at its other end to a bracket **94** on the lifting-structure frame **70**.

It will be understood that the various hydraulic cylinders hereinbefore described are powered by hydraulic fluid supplied by a suitable pump, not shown, on the lift truck **10**.

Although an exemplary embodiment of the invention has been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiment without departing from the spirit of the invention.

I claim as my invention:

1. In a lifting unit for a lift truck having a mast and having elevating means movable upwardly and downwardly along the mast, the combination of:

(a) a supporting plate having front and rear sides and having laterally spaced, upright, tapered arcuate edges symmetrical about a fore-and-aft tilt axis;

(b) means on said rear side of said supporting plate

for mounting it on the elevating means of the lift truck;

(c) a laterally extending, tiltable, rectangular frame on said front side of said supporting plate;

(d) four rollers mounted on said tiltable frame equal distances from said tilt axis in a rectangular pattern and rotatable about axes parallel to said tilt axis;

(e) there being two of said rollers adjacent each end of said tiltable frame in vertically spaced relation;

(f) said rollers having tapered circumferential grooves complementary to said tapered arcuate edges;

(g) the two rollers adjacent one end of said tiltable frame engaging one of said tapered arcuate edges and the two rollers adjacent the other end of said tiltable frame engaging the other of said tapered arcuate edges, whereby said tiltable frame may pivot about said tilt axis as said rollers roll along said tapered arcuate edges, and whereby said rollers and said tapered arcuate edges cooperate to prevent downward and forward tipping of said tiltable frame relative to said supporting plate;

(h) actuating means interconnecting said supporting plate and said tiltable frame for pivoting said tiltable frame about said tilt axis; and

(i) lifting means carried by said tiltable frame.

2. A lifting unit as defined in claim 1 wherein said lifting means includes:

(a) a laterally extending, rectangular lifting frame on the front side of said tiltable frame;

(b) transverse shaft means on said tiltable frame adjacent the upper edge thereof;

(c) bearing means on said lifting frame and slidable laterally along said shaft means to permit lateral shifting of said lifting frame;

(d) thrust rollers carried by said tiltable frame adjacent the lower edge thereof and rotatable about

upright axes and engageable by the lower portion of said lifting frame to prevent downward and forward tipping of said lifting frame; and

(e) actuating means interconnecting said lifting and tiltable frames for shifting said lifting frame laterally relative to said tiltable frame.

3. A lifting unit according to claim 2 including:

(a) transverse rod means on said lifting frame adjacent the upper edge thereof; and

(b) L-shaped tines having upright portions the upper ends of which are pivotable on and slidable laterally along said rod means, which bear intermediate their ends against the front side of said lifting frame adjacent the lower edge thereof, and which terminate at their lower ends in forwardly extending portions.

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