June 2, 1970 C. A. EMKE 3,515,301

LIFT TRUCK WITH A PIVOTAL, SHIFTABLE AND TILTABLE MAST

Filed March 11, 1968 3 Sheets-Sheet 1

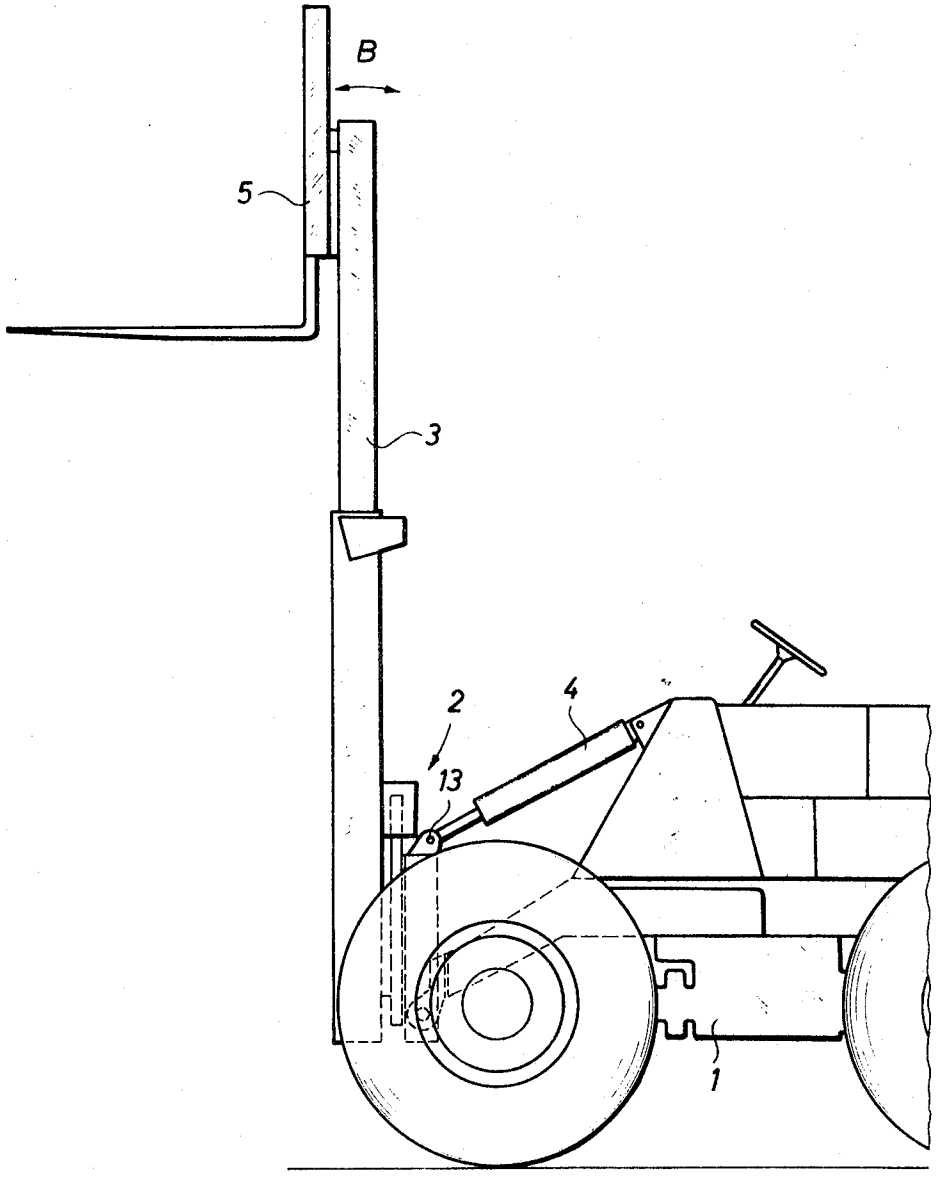


Fig. 1

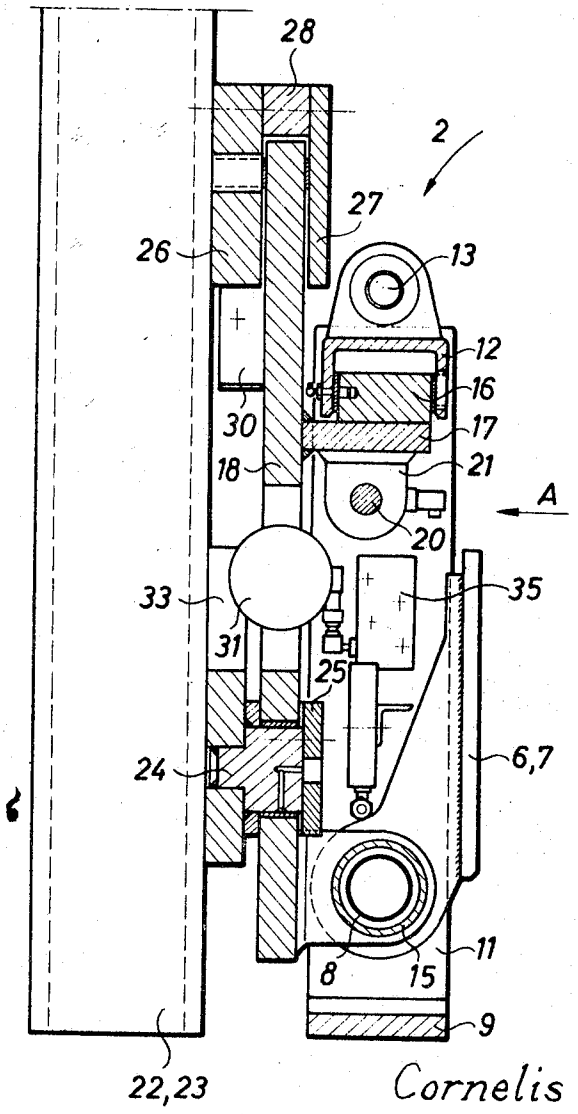
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LIFT TRUCK WITH A PIVOTAL, SHIFTABLE AND TILTABLE MAST

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Fig. 2

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LIFT TRUCK WITH A PIVOTAL, SHIFTABLE AND TILTABLE MAST

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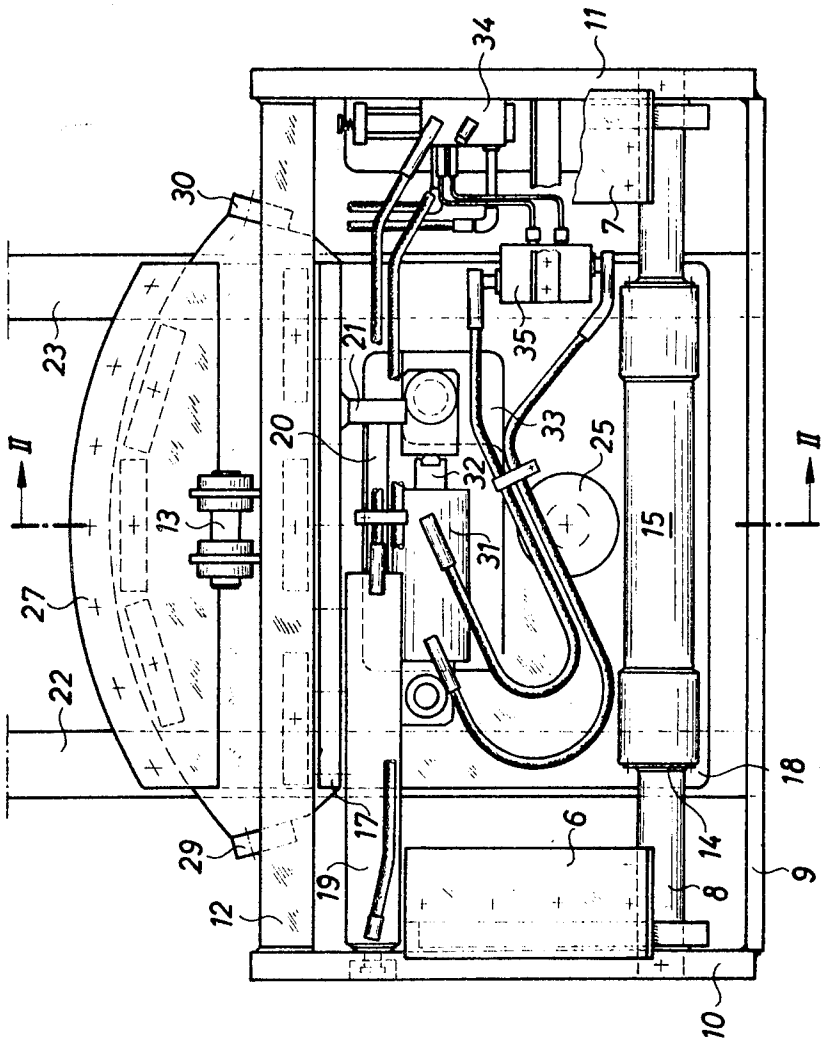


Fig. 3

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LIFT TRUCK WITH A PIVOTAL, SHIFTABLE AND TILTABLE MAST

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U.S. Cl. 214—674 3 Claims

ABSTRACT OF THE DISCLOSURE

A lift truck including a frame, with apparatus mounting an upright extensible mast assembly for movement on the forward end of the frame. The mounting apparatus provided accommodates rocking of the mast assembly about a substantially horizontal axis extending transversely of the longitudinal axis of the frame, side-tilting of the mast assembly about another axis extending forwardly away from the forward end of the frame, and side-shifting of the mast assembly toward laterally opposite sides of the frame.

This invention relates to a lift truck, and more particularly, to apparatus for mounting an upright extensible mast assembly for movement on the forward end of the frame in such a truck.

The usual industrial lift truck includes an upright extensible mast assembly mounted adjacent the forward end of the frame in the truck, with the mast assembly supporting a vertically movable carriage. Typically, the mast assembly is mounted on the frame through means accommodating only a certain amount of fore and aft rocking of the assembly relative to the frame.

In certain types of load-handling operations, such an organization is not entirely satisfactory because of the limited amount of relative movement permitted between the mast assembly and the frame in the truck. For example, where such a lift truck operates on the side of a hill, tilting of the mast causes a shifting of the truck's center of gravity. Where such shifting is toward a side of the truck, lateral stability may be seriously impaired, particularly where the carriage, and any load that it carries, occupies an elevated position on the mast. Further, tilting of the mast makes it difficult for lift forks, or other load support means, to handle a load properly.

Another problem sometimes encountered is that of properly centering the load support means laterally relative to the side of a load facing the support means. While side-shift apparatus has been proposed in the past, such apparatus is normally interposed between the carriage and load support means. Thus, it must be raised and lowered with movement of the carriage. In certain applications, such apparatus presents difficulties.

A general object of the present invention, therefore, is to provide, in a lift truck having a frame, novel apparatus for mounting a mast assembly for movement on the forward end of the frame which takes care of the above-mentioned deficiencies in a practical and satisfactory manner.

More specifically, an object of the invention is to provide such apparatus which not only permits rocking of the mast assembly forwardly and rearwardly relative to the truck's frame, but which also accommodates side-tilting of the mast assembly about an axis extending forwardly away from the forward end of the frame.

Another object of the invention is to provide such apparatus which, further, accommodates side-shifting of the mast assembly toward laterally opposite sides of the frame in a truck.

Yet another object of the invention is to provide such mounting apparatus which is relatively compact.

According to a preferred embodiment of the invention disclosed herein, the proposed apparatus features: a novel side-shiftable subframe supported adjacent the forward end of the main frame in a lift truck for shifting laterally toward opposite sides of the frame; and a novel side-tiltable subframe supporting the mast assembly, and pivoted to the side-shiftable subframe for tilting relative to the latter about an axis extending forwardly away from the forward end of the truck frame. Hydraulic rams are provided for shifting the side-shiftable subframe and for tilting the side-tiltable subframe. The side-shiftable subframe is mounted on the truck frame through a rockable subframe which is pivoted to the truck frame for rocking about a substantially horizontal axis extending transversely of the longitudinal axis of the frame.

With such mounting apparatus, the mast assembly is permitted a considerable amount of relative movement with respect to the frame in a truck. For example, even on a hillside the mast may be adjusted to an upright position relative to the horizontal whereby truck stability is maximized. Further, the mast assembly may readily be shifted laterally whereby the forks or other load support means mounted on the carriage may be positioned properly to handle a load.

Another important feature of the mounting apparatus contemplated is that it is relatively compact. More specifically, the side-shiftable subframe and the rockable subframe proposed occupy a pair of closely spaced, substantially parallel planes. The ram provided to shift the side-shiftable subframe occupies the plane of the rockable subframe, and the ram provided to tilt the side-tiltable subframe occupies the plane of the side-shiftable subframe. The various subframes are positioned laterally inwardly of the wheels supporting the forward end of the frame, and are disposed rearwardly of the forward extremities of such wheels.

Further, with the proposed construction, valves and conduits interposed between a source of pressure fluid on the truck and the rams in the apparatus can be mounted in protected positions behind the mast assembly. Since the mounting apparatus is positioned between the truck frame and the mast assembly, such valves and conduits need not travel with movement of the carriage.

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 the front part of a lift truck including a frame and a mast assembly mounted thereon through apparatus constructed according to the invention;

FIG. 2 is a cross-sectional view taken along the line II—II in FIG. 3 illustrating details of construction of the proposed mounting apparatus; and

FIG. 3 is a view, on a smaller scale than FIG. 2, taken in the direction of arrow A in FIG. 2.

Turning now to the drawings, and referring first to FIG. 1, the forward end of an industrial lift truck is illustrated including the usual main frame 1. Each side of the forward end of the frame (the left end in FIG. 1) is supported for movement over the ground by means of a wheel, such as the wheel shown fully in side elevation in FIG. 1.

Supported on the forward end of frame 1 through mounting apparatus indicated generally at 2 constructed according to the invention is an upright extensible mast assembly 3. Referring for a moment to FIGS. 2 and 3, mast assembly 3 comprises a pair of laterally spaced uprights 22, 23 which form part of an outer mast section in the assembly. Suitably mounted for vertical movement on

the mast assembly is a conventional carriage 5 which supports a pair of lift forks, such as the fork shown projecting to the left of the carriage in FIG. 1. The mast assembly is extended, and the carriage raised, through the action of a suitable hoist ram (not shown).

Turning now to FIGS. 2 and 3, mounting apparatus 2 comprises a rockable subframe formed from a pair of upright laterally spaced side parts 10, 11, a crossbar 9, and a channel 12. Bar 9 and channel 12 substantially parallel one another, are suitably anchored at vertically spaced points to parts 10, 11, and extend transversely of the longitudinal axis of frame 1. Channel 12 is disposed above bar 9, and has its recessed side facing downwardly toward the bar.

This subframe is mounted for rocking on frame 1 through a pair of laterally spaced brackets 6, 7 and an elongated cylindrical rod 8. More specifically, opposite ends of rod 8 are suitably anchored to side parts 10, 11, with the rod substantially paralleling bar 9 and channel 12. The rod is supported on brackets 6, 7 for rotation about its longitudinal axis, which is also referred to herein as a rock axis. The rockable subframe is rocked, as indicated by double-headed arrow B in FIG. 1, by a ram 4 (FIG. 1). Ram 4 has its cylinder pivoted to frame 1 and its rod pivoted at 13 to the web in channel 12.

Slidably mounted on rod 8 is a sleeve bearing 15. Bearing 15 is provided adjacent its opposite end with wipers, such as wiper 14, that prevent dirt and other foreign matter from collecting in the space between the bearing and the rod. Bearing 15 supports an upright plate 18 which extends upwardly from the bearing. The upper marginal portion of plate 18, as such is viewed in FIG. 3, has a convex, arcuate outline, the reason for which will be explained more fully later. Plate 18 shifts laterally with sliding of bearing 15 on rod 8, and constitutes a side-shiftable subframe herein. As can be seen clearly in FIG. 2, plate 18 occupies a plane disposed closely adjacent, forwardly of, and substantially parallel to the plane occupied by the rockable subframe.

Joined to the back face of plate 18, at some distance above bearing 15, is an elongated bar 17 on top of which is mounted a slide member 16. Member 16 extends upwardly into the recess in channel 12. The front and rear sides of member 16 are covered by a suitable bearing material which rides against the inside surfaces of the flanges in the channel.

A hydraulic ram, or side-shift motor means, including a cylinder 19 and a rod 20 is provided for shifting plate 18 laterally. Cylinder 19 is suitably anchored to side part 10 in the rockable subframe, and rod 20 is connected through a bracket 21 to the underside of bar 17. It will be noted in FIG. 2 that this ram occupies the plane of the rockable subframe, and is disposed intermediate rod 8 and bar 17. Such positioning for the ram contributes a compact construction.

Also forming part of mounting apparatus 2 is a plate 33 which constitutes a side-tiltable subframe. Referring to FIG. 2, it will be noted that plate 33 occupies a plane spaced closely adjacent, forwardly of, and substantially parallel to the plane of plate 18. Plate 33 is pivoted to plate 18 through a pin, or pivot means, 24 which is anchored to plate 33 and rotatably received in a suitable accommodating bore provided adjacent the base of plate 18. Retraction of pin 24 from the bore in plate 18 is prevented by a member 25 joined to the right end of the pin in FIG. 2. The pivot connection formed by pin 24 and the receiving bore in plate 18 accommodates tilting of plate 33 about a tilt axis extending forwardly away from the forward end of frame 1. This tilt axis is substantially normal to the planes of plates 18, 33. Mast uprights 22, 23 are suitably anchored to the front face of plate 33, and as a consequence the mast assembly tilts as a unit with plate 33.

The upper arcuate portion of plate 18 is received within a bearing assembly suitably anchored to uprights 22, 23

above plate 33. More specifically, the bearing assembly comprising a pair of spaced bearing plates 26, 27, joined by a spacing member 28. The confronting faces of plates 26, 27 are lined with a suitable bearing material which rides against the front and rear faces of plate 18. The slide bearing assembly functions to guide the mast assembly during tilting movement thereof. The arcuate upper margin of plate 18 affords clearance between plate 18 and member 28 during side-tilting of the mast assembly.

As can be seen in FIG. 3, mounted adjacent laterally opposite sides of plate 18 are blocks, or stop means, 29, 30. These blocks are positioned to engage opposite sides of plate 26 to limit the amount of relative tilting permitted between the mast assembly and plate 18. Such blocks are thus a safety feature, in that they prevent the mast assembly from swinging too far to a side of the truck.

Considering the means provided for tilting plate 33 and mast assembly 3, this comprises a hydraulic ram, or side-tilt motor means, including a cylinder 31 and a rod 32. The cylinder and rod are received within a suitable accommodating opening provided in plate 18 whereby, as can be seen in FIG. 2, they occupy the plane of plate 18. As shown in FIG. 3, cylinder 31 is pivotally connected to plate 18, and rod 32 is pivotally connected to plate 33.

Hydraulic pressure fluid for operating the various rams described herein may be supplied from an appropriate source provided on truck frame 1 through suitable conduits, and through valves such as those shown at 34, 35. It will be noted that valves 34, 35 are mounted on the guide frame, and occupy the plane of the same. Such a feature further contributes to a compact construction. In addition, because apparatus 2 is mounted closely adjacent the front of frame 1 and behind mast assembly 3, such valves, and any conduits connected therewith are located in protected positions behind the mast assembly where the likelihood of damage during truck operation is minimal.

Thus, the invention provides novel mounting apparatus for a mast assembly which greatly increases the maneuverability afforded the mast assembly relative to the main frame in a lift truck. The mounting apparatus is relatively compact in construction.

With such mounting apparatus, even when a truck is operating on a hill, the mast assembly can readily be adjusted to an upright position to maximize truck stability. In addition, the mast assembly can be shifted laterally to position the load support means whereby the same can properly pick up and deposit a load. Because the novel side-shiftable and side-tiltable subframes are interposed between the truck frame and the mast assembly, the apparatus associated with such subframes need not be raised and lowered with the carriage.

While a preferred embodiment of the invention has been described herein, it is appreciated that variations and modifications may be made without departing from the spirit of the invention. Accordingly, it is desired to cover all such variations and modifications as would be apparent to one skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In a lift truck including a frame, an upright mast assembly and a carriage mounted for vertical movement on said mast assembly,

a rockable subframe pivotally mounted on said lift truck frame for rocking movement about a substantially horizontal axis extending transversely of the longitudinal axis of the truck,

means mounting said mast assembly on said rockable subframe including means accommodating side-tilting of the mast assembly whereby the mast assembly swings laterally of the lift truck about a tilt axis extending longitudinally of the lift truck, and means accommodating side shifting of said mast assembly laterally toward opposite sides of the lift truck,

side-tilt motor means operatively interposed between said rockable subframe and said mast assembly operable to tilt the latter relative to the former about said tilt axis,

and side-shift motor means operatively interposed between said mast assembly and said rockable subframe for side-shifting the mast assembly under power,

said means accommodating side-shifting of said mast assembly comprising a side-shiftable subframe slidably supported on said rockable subframe,

said means accommodating side-tilting of said mast assembly comprising a side-tiltable subframe, and pivot means pivotally mounting the same on said side-shiftable subframe,

said pivot means pivotally mounting said side-tiltable subframe on the side-shiftable subframe being located centrally between the sides of the mast assembly.

2. The lift truck of claim 1, wherein said side-shift motor means comprises a hydraulic ram with one end connected to said rockable subframe and its opposite end connected to said side-shiftable subframe, and said side-tilt motor means comprises a hydraulic ram with one end connected to said side-shiftable subframe and its opposite end connected to said side-tiltable subframe.

3. The lift truck of claim 2, wherein said side-shiftable subframe and said rockable subframe occupy a pair of closely disposed, substantially parallel and vertical planes, the ram forming said side-shift motor means occupies the plane of said rockable subframe, and the ram forming said side-tilt motor means occupies the plane of said side-shiftable subframe.

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