

PATENT SPECIFICATION (11)

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(54) MAST FOR A LIFT TRUCK

(71) We, TOWMOTOR CORPORATION, a corporation organised and existing under the laws of the State of Ohio, United States of America of 7111 Tyler Boulevard, Mentor, State of Ohio 44060, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a mast assembly for a lift truck, and more particularly, to such an assembly which provides a pair of elongate members extensible relative to a pair of fixed channel members.

In the normal fork-type lift truck, a fork is carried by a vertically extensible mast assembly located at the forward end of the truck. In operation the fork engages a load in a lower position and is thereafter raised to a desired elevation, in which position the load is transported to a desired location, lowered, and unloaded. A mast assembly for supporting a fork carriage preferably includes means for its vertical extension so as to afford a low vertical retracted height, while also providing maximum elevation of the fork carriage.

In general, such extensible mast assemblies of known construction have included a stationary assembly fixed to the truck and a movable section including a pair of slidably extensible rail members movable relative to the stationary assembly, and a fork carriage movably associated with the pair of slidably extensible rail members. Examples of such structures are shown in U.S. Patents Nos. 2,428,223, 2,791,292, 2,505,009, 2,918,143, 3,213,967, 3,506,092 and 2,759,562.

Such previous structures may afford low retracted height and provide means for elevating the fork carriage thereof above the normal vertical dimension of the stationary mast portion.

The present invention seeks to improve the extensible mast structure.

According to the invention, there is provided a mast assembly for a vehical com-

prising first and second upright laterally spaced channel members, each defining a base portion and forward and rearward parallel edge flange portions extending from said base portion and generally perpendicular thereto, with the flange portions of each channel member disposed toward the other channel member, first and second interconnected elongated members positioned laterally inwardly of the first and second channel members respectively and movable therealong, the first elongated member defining a base portion and having only a single edge flange portion extending generally perpendicularly from said base portion toward the first channel member, which flange portion is disposed between the forward and rearward flange portions of the first channel member and adjacent the rearward flange portion thereof, the second elongated member defining a base portion and having only a single edge flange portion extending generally perpendicularly from said base portion toward the second channel member, which flange portion is disposed between the forward and rearward flange portions of the second channel member and adjacent the rearward flange portion thereof, first and second bottom rollers mounted to the lower ends of the first and second elongated members respectively, the edge flange portions of the first and second elongated members defining cutout portions through which portions of the first and second bottom rollers respectively extend, with the first bottom roller positioned between the forward and rearward flange portions of the first channel member, with the rolling portions of the first bottom roller adjacent the forward and rearward portions of the first channel member, and further with the second bottom roller positioned between the forward and rearward flange portions of the second channel member, with the rolling portions of the second bottom roller adjacent the forward and rearward flange portions of the second channel member, first and second top rollers mounted to the upper ends of the first and second channel mem-

bers respectively, with the forward flange portions of the first and second channel member defining cutout portions through which portions of the first and second top rollers respectively extend, with the rolling portion of the first top roller adjacent the edge flange portion of the first elongated member, and with the rolling portion of the second top roller adjacent the edge flange portion of the second elongated member, wherein said first channel member defines an angled portion interconnecting the base portion and the rearward flange portion thereof, so that the rolling portions of the first bottom roller are positioned so as to be able to contact said first channel member angled portion and the forward flange portion thereof, and wherein the second channel member defines an angled portion interconnecting the base portion and the rearward flange portion thereof, so that the rolling portions of the second bottom roller are positioned so as to be able to contact said second channel member angled portion and the forward flange portion thereof, and wherein the first elongated member defines an angled portion interconnecting the base portion thereof and the single flange portion thereof, so that the rolling portion of the first top roller is positioned so as to be able to contact said first elongated member angled portion, and wherein the second elongated member defines an angled portion interconnecting the base portion thereof and the single flange portion thereof, so that the rolling portion of the second top roller is positioned so as to be able to contact the said elongated member angled portion.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a lift truck incorporating apparatus according to the invention;

Fig. 2 is a front elevation, with portions broken away, of a portion of the apparatus of Fig. 1;

Fig. 3 is a view taken along the line III-III of Fig. 2;

Fig. 4 is a perspective view of the channel member structure of the apparatus;

Fig. 5 is a perspective view of the elongated member structure of the apparatus;

Fig. 6 is a perspective view of a portion of the fork carriage of the apparatus;

Fig. 7 is a plan view of the apparatus of Figs. 2 and 3;

Fig. 8 is a sectional plan view of the apparatus of Figs. 2 and 3; and

Figs. 9 and 10 are side elevations of a channel member and associated elongated member, showing them being fitted together.

Shown generally in Fig. 1 is a mast assembly 20 in association with a truck 22.

Mast assembly 20 includes a pair of longitudinal, upright, laterally spaced channel members 24, 26 which are fixed to the body of the truck 22. These channel members 24, 26 are rigidly connected together by cross braces 30, as shown in Fig. 4. As best shown in Figs. 4 and 8, channel member 24 defines a base portion 32 and forward and rearward parallel edge flange portions 34, 36 extending from the base portion 32 and generally perpendicular to said base portion 32. Similarly, channel member 26 defines a base portion 38 and forward and rearward parallel edge flange portions 40, 42 extending from the base portion 38 and generally perpendicular to said base portion 38. As will be seen, the flange portions 34, 36 are disposed toward the channel member 26, and the flange portions 40, 42 are disposed toward the channel member 24.

Longitudinal elongated members 44, 46 are rigidly interconnected by cross braces 48 and are positioned laterally inwardly of the channel members 24, 26 respectively (Fig. 8). The elongated member 44 defines a base portion 50 and an edge flange portion 52 which extends from the base portion 50 and is generally perpendicular to the base portion 50. Said flange portion 52 extends toward the channel member 24 and is disposed between forward and rearward flange portions 34, 36 and adjacent the rearward flange portion 36. Similarly, the elongated member 46 defines a base portion 54 and an edge flange portion 56 which extends from the base portion 54 and is generally perpendicular to the base portion 54. Said flange portion 56 extends toward the channel member 26 and is disposed between the forward and rearward flange portions 40, 42, adjacent the rearward flange portion 42.

Bottom roller 58 is mounted to the lower end of the elongated member 44, with the flange portion 52 defining a cutout portion 60 through which a portion of the bottom roller 58 extends. The bottom roller 58 is positioned between forward flange portion 34 and rearward flange portion 36, with the rolling portions of that bottom roller 58 adjacent said forward and rearward flange portions 34, 36.

Bottom roller 62 is mounted to the lower end of the elongated member 46, with the flange portion 56 defining a cutout portion 64 through which a portion of the bottom roller 62 extends. The bottom roller 62 is positioned between forward and rearward flange portions 40, 42 with the rolling portions of that bottom roller 62 adjacent such forward and rearward flange portions 40, 42.

A top roller 66 is removably mounted to the upper end of the channel member 24 (Fig. 7), with the forward flange portion 34 defining a cutout portion 68 through which

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a portion of the top roller 66 extends, with the rolling portion of the top roller 66 adjacent the flange 52 of the elongated member 44. A top roller 70 is removably mounted to the upper end of the channel member 26, with the forward flange portion 40 defining a cutout portion 72 through which a portion of the top roller 70 extends, with the rolling portion of the top roller 70 adjacent the flange portion 56.

The cutout portions 60, 64 are sized so that, with bottom rollers 58, 62 in place the top rollers 66, 70 cannot be moved through cutout portions 60, 64. Similarly, the cutout portions 68, 72 are sized so that, with top rollers 66, 70 in place, the bottom rollers 58, 62 cannot be moved through cutout portions 68, 72. Consequently, with all rollers 58, 62, 66, 70 in place, the mast assembly so far described cannot be assembled if in a disassembled state, or disassembled if in an assembled state.

The manner of assembly of the structure is shown in Figs. 9 and 10 and relates to channel member 26 and elongated member 46, it being understood that the operation is the same in relation to channel member 24 and elongated member 44, and is undertaken simultaneously with the operation on the corresponding parts associated with channel member 26 and elongated member 46.

Initially, top roller 70 is removed, and elongated member 46 is positioned as shown in Fig. 9 relative to channel member 26, and moved downwardly relative to channel member 26, removal of top roller 70 allowing such positioning and movement, which would not be possible with top roller 70 in place. Elongated member 46 is moved downwardly until top roller 70 can be fitted to channel member 26, the elongated member 46 being moved sufficiently downwardly to expose the top ends of channel member 26 (Fig. 10).

In such manner, the assembly so far described allows movement of the elongated members 44, 46 together along the channel members 24, 26.

The channel member 24 defines an angled portion 74 which interconnects the base portion 32 and the rearward flange portion 36. The rolling portion of roller 58 is positioned so as to be able to contact the angled portion 74 and the forward flange portion 34, as shown. Similarly, the channel member 26 defines an angled portion 76 which interconnects the base portion 38 and the rearward flange portion 42. The rolling portions of roller 62 are positioned so as to be able to contact the angled portion 76 and the forward flange portion 40.

The elongated member 44 defines an angled portion 78 which interconnects base portion 50 and flange portion 52 so that the

rolling portion of the top roller 66 is positioned so as to be able to contact the angled portion 78. The elongated member 46 defines an angled portion 80 which interconnects base portion 54 and flange portion 56, so that the rolling portion of the top roller 70 is positioned so as to be able to contact said angled portion 80.

In the assembly of said structure, the bottom rollers 58, 62 are shimmed, and then are run over the full length of travel before top rollers 66, 70 are installed, as described above. In this way, the installation of bottom rollers 58, 62 can be checked for proper operation independently of the top rollers 66, 70 subsequently installed in the channel members 24, 26. Proper operation of the top rollers 66, 70 can then be checked by extending and retracting the structure again with all four rollers 58, 62, 66, 70 in place.

Associated with the mast assembly 20 as a part thereof are load lifting means comprising a fork carriage 82. Said fork carriage 82 is made up of a frame 83 and forwardly extending arms 85. Elongated member 44 has a pair of parallel edge flange portions 84, 86 extending from the base portion 50 thereof, and generally perpendicular to the base portion 50 thereof. Said pair of flange portions 84, 86 are disposed toward the elongated member 46, as shown. Elongated member 46 has a pair of parallel edge flange portions 88, 90 extending from the base portion 54 thereof, and generally perpendicular to the base portion 54. Said pair of flange portions 88, 90 are disposed toward the elongated member 44. Said flange portions 84, 88 are actually forward flange portions, and flange portions 86, 90 are rearward flange portions.

The elongated member 44 defines an angled portion 92 which interconnects the base portion 50 and the rearward flange portion 86, and the elongated member 46 similarly defines an angled portion 94 which interconnects the base portion 54 and the rearward flange portion 90.

Mounted to the frame 83 of fork carriage 82 are rollers 96, 98, 100, 102. Rollers 96, 98 are positioned between the flange portions 84, 86, with the rolling portions of the rollers 96, 98 positioned adjacent flange portions 84, 86. The axis of roller 98 is substantially directly below the axis of roller 96. Rollers 100, 102 are positioned between the flange portions 88, 90 with the rolling portions of these rollers 100, 102 adjacent the flange portions 88, 90. The axis of the roller 102 is substantially directly below the axis of roller 100.

A roller 104 is mounted to the frame 83 and is positioned with its axis lower than the axis of roller 96 and higher than the axis of roller 98. A roller 106 is also mounted to the frame 83 and is positioned with its

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axis lower than the axis of roller 100 and higher than the axis of roller 102. The rollers 104, 106 are positioned so as to be able to contact the rearward flange portions 86, 90 of the elongated members 44, 46 respectively, to provide positive lateral location of the fork carriage 82 relative to the elongated members 44, 46.

The rollers 98, 102 are shimmed to be positioned so as to be able to contact the angled portions 92, 94 respectively. Such means allow movement of the fork carriage 82 along the elongated members 44, 46 upwardly and downwardly, meanwhile providing positive forward-and-rearward location of the fork carriage 82 relative to the elongated members 44, 46.

In the operation of the mast assembly 20, a cylinder, chains and sheaves may, of course, be utilized to provide proper raising and lowering of the elements.

Side thrusts on the fork carriage 82 are taken by the rollers 104, 106 which contact flange portions 86, 90 respectively, and the rollers 98, 102 which are properly shimmed to bear on angled portion 92, 94. With an off centre load, the side thrust roller 104 or 106 on one side of fork carriage 82 and the lower roller 98 or 102 on the other side of the fork carriage 82 handle the turning moment placed on the fork carriage 82. With side thrusts in either direction, because of the placing of the rollers 104, 106 to contact the rearward flange portions 86, 90 and the placing of rollers 98, 102 to contact angled portions 92, 94 which are themselves rearward, loads are applied to the elongated members 44, 46 as closely as possible to the rear portions thereof, where the cross braces 48 are fixed, so that there is little tendency for the elongated members 44, 46 to open up or spread apart upon such application of side thrust thereto. The particular placing of the rollers 104, 106 relative to rollers 98, 96 and rollers 102, 100 respectively, aids in such stability and strength. In addition, rollers 104, 106 can be used as stops for the fork carriage 82, if desired, eliminating the need for separate parts.

It will be seen that herein is described a mast assembly which is of compact arrangement in the fully lowered position, while being raisable to allow sufficient extension thereof. The roller system incorporated and the particular positioning thereof ensure that eccentric loading is properly carried, meanwhile also ensuring smoothness of operation under this and all other conditions. Such design, as will be seen, is also simple, and lends itself to ease of manufacture.

WHAT WE CLAIM IS:—

1. A mast assembly for a vehicle com-

prising first and second upright laterally spaced channel members, each defining a base portion and forward and rearward parallel edge flange portions extending from said base portion and generally perpendicular thereto, with the flange portions of each channel member disposed toward the other channel member, first and second interconnected elongated members positioned laterally inwardly of the first and second channel members respectively and movable therealong, the first elongated member defining a base portion and having only a single edge flange portion extending generally perpendicularly from said base portion toward the first channel member, which flange portion is disposed between the forward and rearward flange portions of the first channel member and adjacent the rearward flange portion thereof, the second elongated member defining a base portion and having only a single edge flange portion extending generally perpendicularly from said base portion toward the second channel member, which flange portion is disposed between the forward and rearward flange portions of the second channel member and adjacent the rearward flange portion thereof, first and second bottom rollers mounted to the lower ends of the first and second elongated members respectively, the edge flange portions of the first and second elongated members defining cutout portions through which portions of the first and second bottom rollers respectively extend, with the first bottom roller positioned between the forward and rearward flange portions of the first channel member, with the rolling portions of the first bottom roller adjacent the forward and rearward portions of the first channel member, and further with the second bottom roller positioned between the forward and rearward flange portions of the second channel member, with the rolling portions of the second bottom roller adjacent the forward and rearward flange portions of the second channel member, first and second top rollers mounted to the upper ends of the first and second channel members respectively, with the forward flange portions of the first and second channel member defining cutout portions through which portions of the first and second top rollers respectively extend, with the rolling portion of the first top roller adjacent the edge flange portion of the first elongated member, and with the rolling portion of the second top roller adjacent the edge flange portion of the second elongated member, wherein said first channel member defines an angled portion interconnecting the base portion and the rearward flange portion thereof, so that the rolling portions of the first bottom roller are positioned so as to be able to contact said first channel mem-



axis lower than the axis of roller 100 and higher than the axis of roller 102. The rollers 104, 106 are positioned so as to be able to contact the rearward flange portions 86, 90 of the elongated members 44, 46 respectively, to provide positive lateral location of the fork carriage 82 relatively to the elongated members 44, 46.

The rollers 98, 102 are shimmed to be positioned so as to be able to contact the angled portions 92, 94 respectively. Such means allow movement of the fork carriage 82 along the elongated members 44, 46 upwardly and downwardly, meanwhile providing positive forward-and-rearward location of the fork carriage 82 relative to the elongated members 44, 46.

In the operation of the mast assembly 20, a cylinder, chains and sheaves may, of course, be utilized to provide proper raising and lowering of the elements.

Side thrusts on the fork carriage 82 are taken by the rollers 104, 106 which contact flange portions 86, 90 respectively, and the rollers 98, 102 which are properly shimmed to bear on angled portion 92, 94. With an off centre load, the side thrust roller 104 or 106 on one side of fork carriage 82 and the lower roller 98 or 102 on the other side of the fork carriage 82 handle the turning moment placed on the fork carriage 82. With side thrusts in either direction, because of the placing of the rollers 104, 106 to contact the rearward flange portions 86, 90 and the placing of rollers 98, 102 to contact angled portions 92, 94 which are themselves rearward, loads are applied to the elongated members 44, 46 as closely as possible to the rear portions thereof, where the cross braces 48 are fixed, so that there is little tendency for the elongated members 44, 46 to open up or spread apart upon such application of side thrust thereto. The particular placing of the rollers 104, 106 relative to rollers 98, 96 and rollers 102, 100 respectively, aids in such stability and strength. In addition, rollers 104, 106 can be used as stops for the fork carriage 82, if desired, eliminating the need for separate parts.

It will be seen that herein is described a mast assembly which is of compact arrangement in the fully lowered position, while being raisable to allow sufficient extension thereof. The roller system incorporated and the particular positioning thereof ensure that eccentric loading is properly carried, meanwhile also ensuring smoothness of operation under this and all other conditions. Such design, as will be seen, is also simple, and lends itself to ease of manufacture.

WHAT WE CLAIM IS:—

1. A mast assembly for a vehicle com-

prising first and second upright laterally spaced channel members, each defining a base portion and forward and rearward parallel edge flange portions extending from said base portion and generally perpendicular thereto, with the flange portions of each channel member disposed toward the other channel member, first and second interconnected elongated members positioned laterally inwardly of the first and second channel members respectively and movable therealong, the first elongated member defining a base portion and having only a single edge flange portion extending generally perpendicularly from said base portion toward the first channel member, which flange portion is disposed between the forward and rearward flange portions of the first channel member and adjacent the rearward flange portion thereof, the second elongated member defining a base portion and having only a single edge flange portion extending generally perpendicularly from said base portion toward the second channel member, which flange portion is disposed between the forward and rearward flange portions of the second channel member and adjacent the rearward flange portion thereof, first and second bottom rollers mounted to the lower ends of the first and second elongated members respectively, the edge flange portions of the first and second elongated members defining cutout portions through which portions of the first and second bottom rollers respectively extend, with the first bottom roller positioned between the forward and rearward flange portions of the first channel member, with the rolling portions of the first bottom roller adjacent the forward and rearward portions of the first channel member, and further with the second bottom roller positioned between the forward and rearward flange portions of the second channel member, with the rolling portions of the second bottom roller adjacent the forward and rearward flange portions of the second channel member, first and second top rollers mounted to the upper ends of the first and second channel members respectively, with the forward flange portions of the first and second channel member defining cutout portions through which portions of the first and second top rollers respectively extend, with the rolling portion of the first top roller adjacent the edge flange portion of the first elongated member, and with the rolling portion of the second top roller adjacent the edge flange portion of the second elongated member, wherein said first channel member defines an angled portion interconnecting the base portion and the rearward flange portion thereof, so that the rolling portions of the first bottom roller are positioned so as to be able to contact said first channel mem-



ber angled portion and the forward flange portion thereof, and wherein the second channel member defines an angled portion interconnecting the base portion and the rearward flange portion thereof, so that the rolling portions of the second bottom roller are positioned so as to be able to contact said second channel member angled portion and the forward flange portion thereof, and wherein the first elongated member defines an angled portion interconnecting the base portion thereof and the single flange portion thereof, so that the rolling portion of the first top roller is positioned so as to be able to contact said first elongated member angled portion, and wherein the second elongated member defines an angled portion interconnecting the base portion thereof and the single flange portion thereof, so that the rolling portion of the second top roller is positioned so as to be able to contact the said elongated member angled portion.

2. A mast assembly as claimed in claim 1 wherein said first and second top rollers are removably mounted to the upper ends of the first and second channel members respectively.

3. A mast assembly as claimed in claim 2 wherein the cutout portions of the edge flange portions of the first and second elongated members are of such a size as to cooperate with said first and second bottom rollers to prevent said first and second top rollers from passing therethrough, and wherein the cutout portions of the forward flange portions of the first and second channel members are of such a size that, with said first and second top rollers in place, said first and second bottom rollers cannot pass therethrough.

4. A mast assembly as claimed in any of claims 1 to 3 further comprising a fork carriage having a frame, first and second rollers mounted to the fork carriage frame and rollingly associated with the first elongated member, with the axis of the second roller being below the axis of the first roller; third and fourth rollers mounted to the fork carriage frame and rollingly associated with the second elongated member, with the axis of the fourth roller being below the axis of the third roller, allowing movement of the fork carriage along the elongated members upwardly and downwardly, meanwhile providing positive forward-and-rearward location of the fork carriage relative to the first and second elongated members; a fifth roller mounted to the fork carriage frame and positioned with its axis lower than the axis of the first roller and higher than the axis of the second roller; and, a sixth roller mounted to the fork carriage frame and positioned with its axis lower than the axis of the third roller and higher than the axis of the fourth roller, the fifth and sixth rollers

being in contact with the rear portions of the first and second elongated members to provide positive lateral location of the fork carriage relative to the first and second elongated members.

5. Apparatus as claimed in claim 4 wherein the axis of the second roller is substantially directly below the axis of the first roller, and wherein the axis of the fourth roller is substantially directly below the axis of the third roller.

6. Apparatus as claimed in claim 4 or 5 wherein the first elongated member comprises a base portion and a pair of parallel edge flange portions extending from the base portion, with the first and second rollers positioned between the pair of parallel flange portions of the first elongated member and having the rolling portions thereof adjacent said pair of flange portions of the first elongated member, and wherein the second elongated member comprises a base portion and a pair of parallel edge flange portions extending from the base portion, with the third and fourth rollers positioned between the parallel flange portions of the second elongated member and having the rolling portions thereof adjacent said pair of flange portions of the second elongated member.

7. Apparatus as claimed in claim 6 wherein the pair of flange portions of the first elongated member comprise forward and rearward flange portions disposed toward the second elongated member, and wherein the pair of flange portions of the second elongated member comprise forward and rearward flange portions disposed toward a first elongated member.

8. Apparatus as claimed in claim 7 wherein the fifth roller is in contact with the rearward flange portion of the first elongated member, and the sixth roller is in contact with the rearward flange portion of the second elongated member.

9. Apparatus as claimed in claim 7 or 8 wherein the pair of flange portions of the first elongated member are generally perpendicular to the base portion thereof, and the pair of flange portions of the second elongated member are generally perpendicular to the base portion thereof.

10. Apparatus as claimed in claim 9 wherein the first elongated member defines a first angled portion interconnecting the base portion and one of the pair of flange portions thereof, so that the rolling portions of the second roller are positioned so as to be able to contact said first angled portion and the other of the pair of flange portions of the first elongated member, and wherein the second elongated member defines a second angled portion interconnecting the base portion and one of the pair of flange portions thereof, so that the rolling portions of the fourth roller are positioned so as to

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be able to contact the second angled portion and the other of the pair of flange portions of the second elongated member.

- 5 11. Apparatus as claimed in claim 10 wherein the first angled portion interconnects the base portion and the rearward flange portion of the first elongated member, and wherein the second angled portion interconnects the base portion and the rearward

flange portion of the second elongated member. 10

12. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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