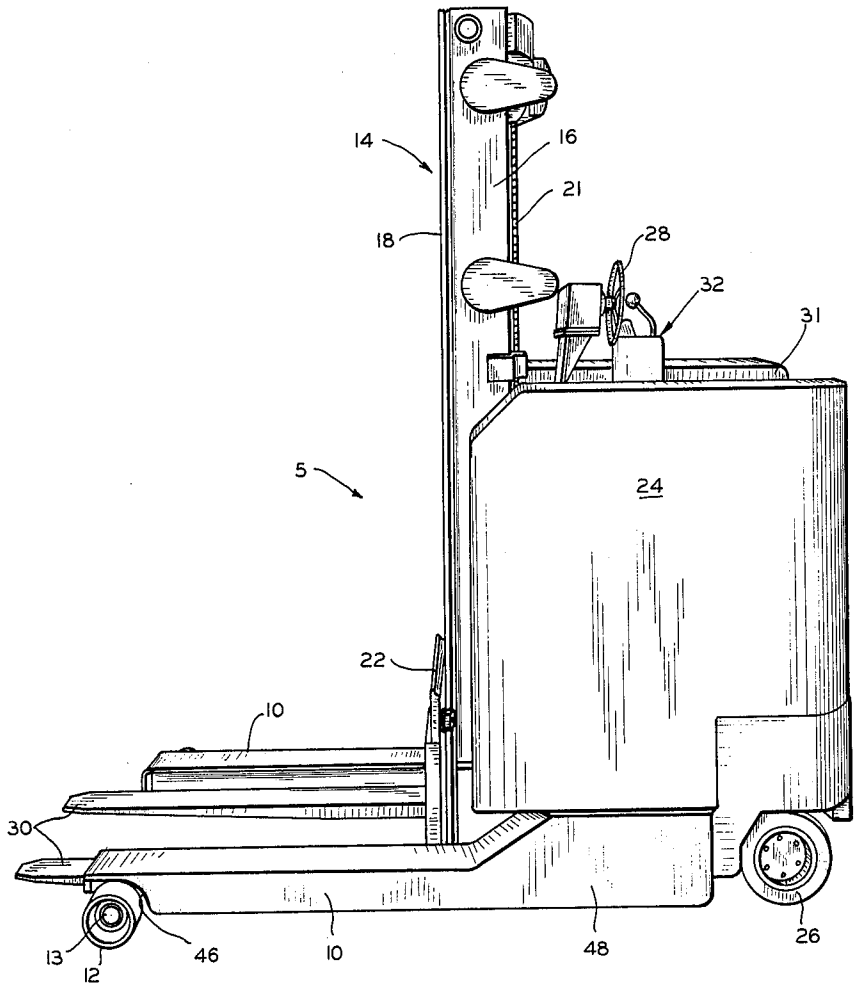
March 15, 1966 J. E. JOYCE ETAL 3,240,372

EXTENSIBLE MOUNTING APPARATUS FOR HOISTS

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FIG. 1



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EXTENSIBLE MOUNTING APPARATUS FOR HOISTS

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FIG. 2

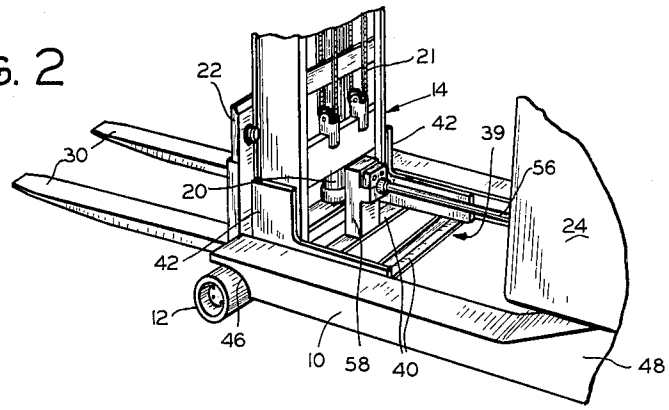


FIG. 3

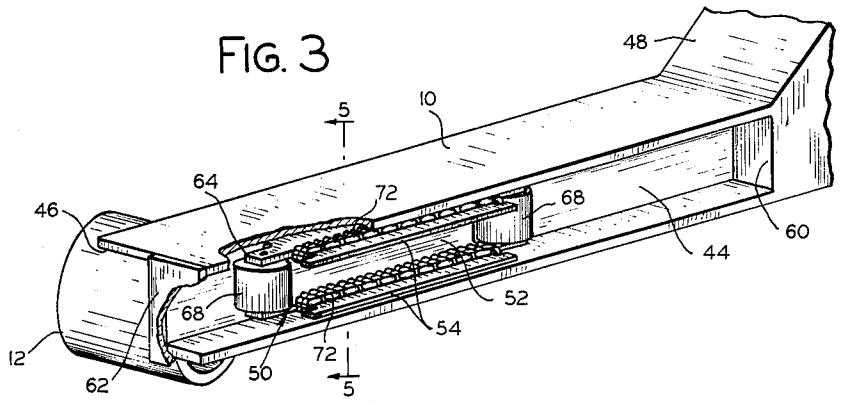
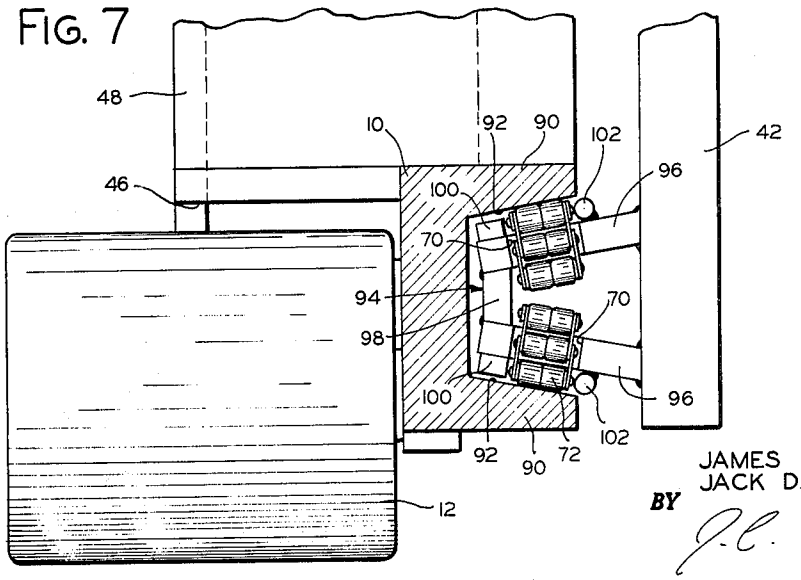


FIG. 7



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FIG. 4

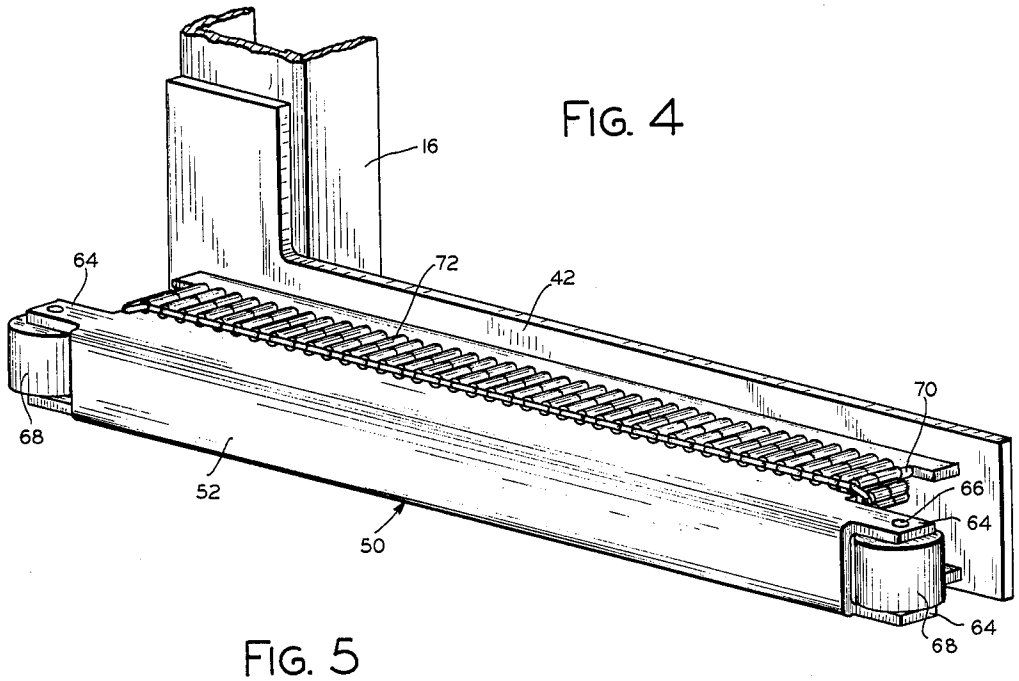


FIG. 5

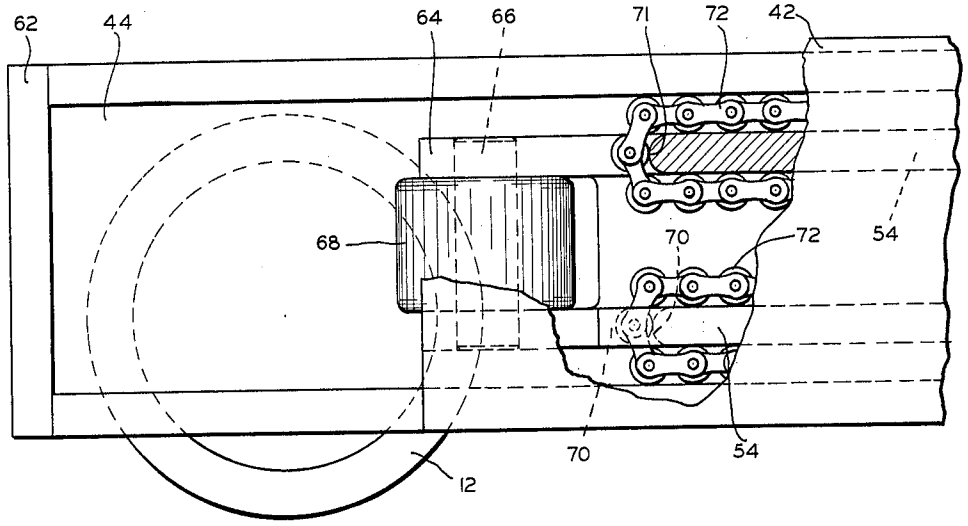
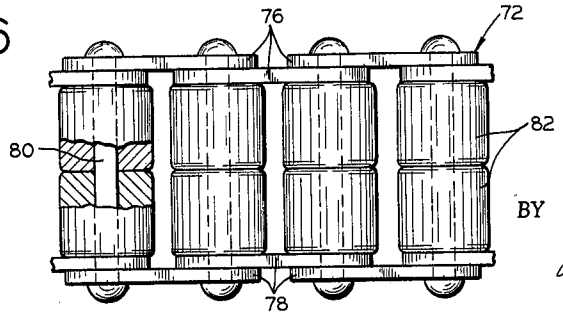


FIG. 6



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EXTENSIBLE MOUNTING APPARATUS FOR HOISTS

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FIG. 8

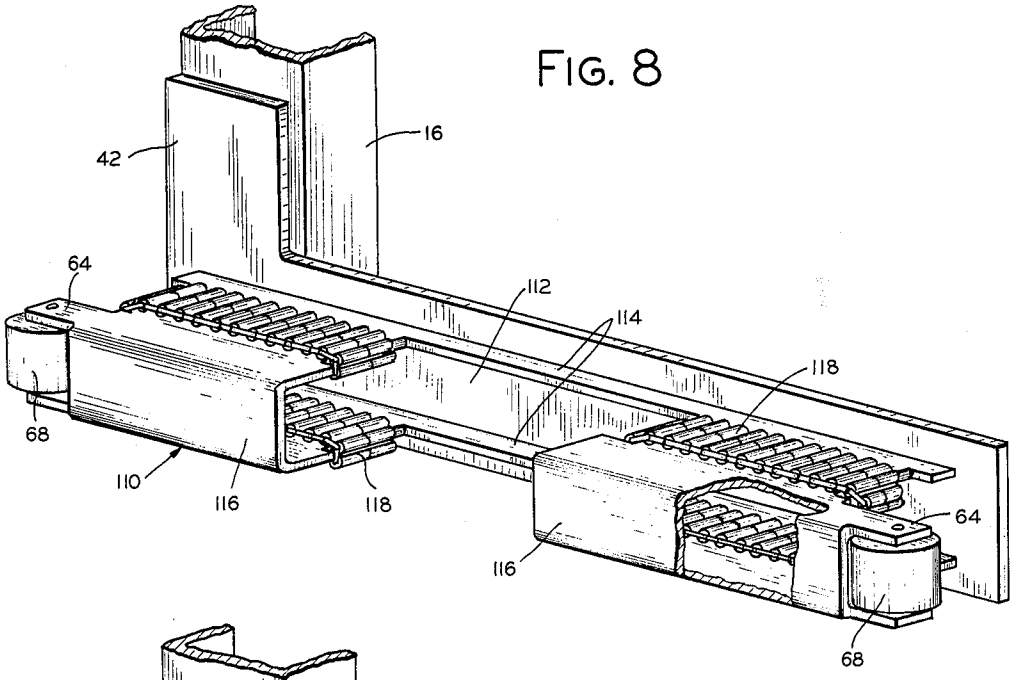
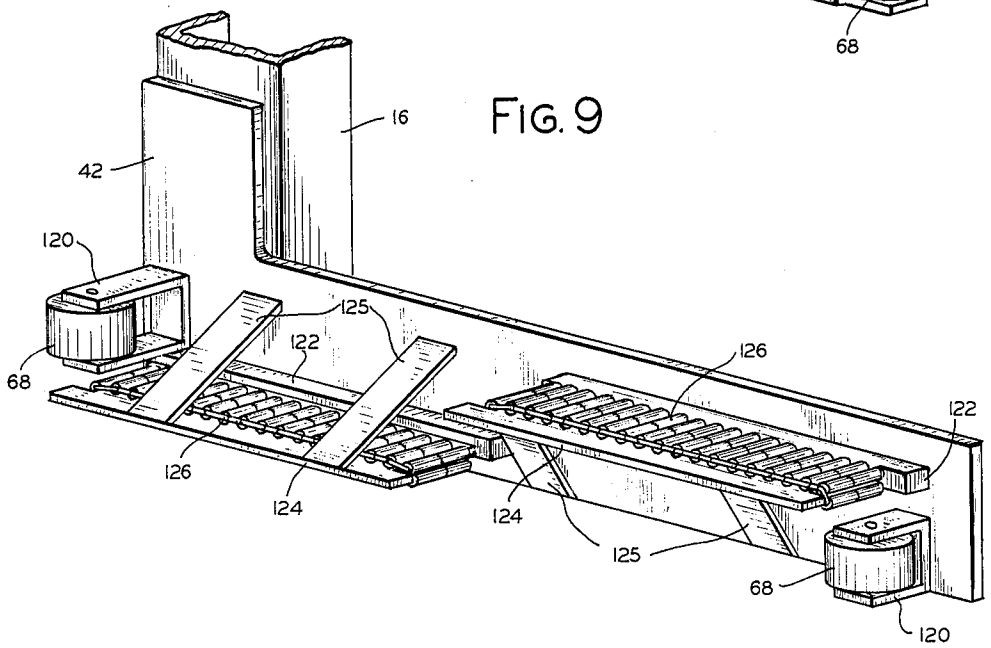


FIG. 9



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United States Patent Office 3,240,372 Patented Mar. 15, 1966

3,240,372

EXTENSIBLE MOUNTING APPARATUS FOR HOISTS

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Filed Aug. 27, 1962, Ser. No. 219,611
3 Claims. (Cl. 214—660)

This invention relates to mounting apparatus for load lifting hoists and the like, and more particularly to mounting apparatus for hoists of a type which are extensible in a horizontal plane such as for upright masts of industrial lift trucks of the type generally known as "reach" or "narrow-aisle" lift trucks.

Warehousing of stacked palletized loads in rows with access aisles between rows necessitates insertion and removal of individual palletized loads in a direction transverse of the aisle and between adjoining stacks. To conserve space, narrow-aisle lift trucks have been marketed heretofore which can be turned in an aisle only slightly larger than the truck wheel base and whose lifting fork can be retracted during normal truck travel and projected during loading and unloading operations with the components so arranged that the weight of the over-hanging projected fork and its load is properly balanced to preclude tipping of the vehicle. Such trucks normally provide a U-shaped pocket at the one end, the legs or outriggers of which are supported at their free ends on ground engaging wheels, and an upright and lifting fork assembly mounted for longitudinal movement relative to said legs such that the lifting fork can be retracted within and extended beyond the U-shaped pocket. A truck framework extends rearwardly of the base of the U-shaped pocket and provides traction means for the truck, as well as operator and truck control means. With the fork in retracted position the load may be transported above the main frame and between the front and rear wheels. A truck of the aforementioned type is disclosed in detail in copending application Serial No. 818,869, filed June 8, 1959, in the name of Russell Hastings, Jr. (common assignee), now Patent No. 3,080,019.

In some job applications of lift trucks of the above-described type, which, it will be understood, merely exemplifies one of many uses which may be found for the present invention, it is required that the outrigger legs, as well as the fork tines, be insertable beneath pallets and the like. In such applications it has been found that the height of the outrigger legs is as high or higher than the fork pockets of many pallets so that the outrigger legs cannot be inserted beneath such pallets when the pallet is resting on the floor. As a result, there are certain applications of such trucks wherein the truck cannot work efficiently because of the above-mentioned limitation. The depth or vertical dimension of the outrigger legs of the U-shaped frame has been heretofore largely determined by the relatively large diameter of horizontally spaced rollers which are conventionally mounted within the channel sections which comprise said legs and are connected by suitable bracket means to the upright for supporting the upright for movement longitudinally of the legs. Use of relatively small diameter upright supporting rollers of the above-mentioned type reduces the load carrying capacity of the truck. It has, therefore, become important to devise other means for supporting the upright during translation thereof longitudinally of the outrigger legs while, at the same time, retaining the full load carrying capacity of the truck and reducing substantially the vertical dimension of the outrigger legs.

We have devised a mounting assembly utilizing roller type chains which are combined in a novel manner in outrigger legs of the above-mentioned type for supporting an upright mast or other construction which is translatable along said legs, and by means of which the vertical height of such legs may be minimized while the load carrying capacity of the upright remains substantially unaffected. Our invention provides a mounting assembly for translatable load lifting uprights wherein small diameter roller chain mechanism functions as relatively friction-free bearing means for transmitting the load to the outrigger legs along the planes of contact of the chain mechanism with said legs.

It is therefore a primary object of the present invention to provide a lift truck having improved mounting means for translatable load handling hoists or uprights.

Another object of the invention is to provide a lift truck having improved mounting means for the lift truck upright which may be accommodated in outrigger legs of substantially less height than heretofore without adversely affecting load lifting capacity of the truck.

A further object of the invention is to provide a lift truck having improved mounting means for elevating hoists of the type contemplated which includes revolvable roller chain bearing structure through which at least the forward thrust of a load carried by the hoist is transmitted to an elevator support assembly in which the elevator is translatable.

Other objects, advantages and features of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a side view in perspective showing the general arrangement of an industrial lift truck of a type which is well suited to utilize the present invention;

FIGURE 2 is a partial view in perspectice of the lift truck shown in FIGURE 1 taken from one side and slightly to the rear thereof with the load lifting mast illustrated in an extended position;

FIGURE 3 is a broken-away perspective view of one of the outrigger legs of the truck showing one of the lifting mast mounting assemblies in mounted position within the outrigger leg;

FIGURE 4 is a perspective view of one roller chain mounting assembly per se taken from the outer side thereof;

FIGURE 5 is an enlarged broken-away partial longitudinal section of the roller chain mounting assembly and outrigger leg of the present invention;

FIGURE 6 is a partial assembly view of the roller chain used in the lifting mast mounting assembly;

FIGURE 7 is an enlarged broken-away front elevational view of an outrigger leg such as shown in FIGURE 3, but which embodies a modified construction of the roller chain mounting assembly as shown in FIGURE 3.

FIGURE 8 is a perspective view similar to FIGURE 4 which shows a modification of the roller chain mounting assembly; and

FIGURE 9 is another perspective view similar to FIGURE 4 showing another modification of the roller chain mounting assembly.

Referring now in detail to FIGURES 1–5, the main frame of the wheeled truck **5** is generally in the form of a U-shape, the projecting legs of which are transversely spaced apart. Each outrigger leg consists of a longitudinally extending and inwardly opening channel construction **10** upon each of which is mounted at its one end a trail wheel **12** upon a stub shaft **13**. The opposite ends of the legs are secured together by means of a transverse frame member, not shown. A lifting mast mechanism of known construction is illustrated at numeral **14**; it comprises generally a pair of laterally spaced apart outer fixed channel members **16**, a pair of laterally spaced I-beams **18** suitably nested within the channel members for vertical telescoping movement, a hydraulic cylinder lifting

motor 20, and a lifting carriage 22 mounted in known manner for vertical movement relative to members 18 and connected to the hoist motor by means of conventional chain and sprocket mechanism, part of which is shown at numeral 21. A pair of fork tines 30 are supported upon carriage 22 and project forwardly thereof for engaging, transporting and depositing loads in conjunction with horizontal movement of the truck 5 and mast 14, and vertical movement of the carriage 22 within the mast. The mast construction 14 is disclosed in detail and claimed in copending U.S. continuation application Serial No. 111,070, filed May 18, 1961, in the names of Hastings and Backofen (common assignee), now Patent 3,213,967.

Suitably mounted within the framework of the truck and housed within the rear corner portions of a body 24 is a pair of dirigible traction wheels 26, one of which is shown, controllable by means of an operator's steering wheel 28. The wheels 26 are driven by a pair of counter-rotating electric motors, not shown. A generally U-shaped operator station 31 is located at the rear end of the truck and is formed between rearwardly extending vertical leg portions of control and body housing 24. Various operator controls in addition to steering wheel 28 are represented at numeral 32, and include control means for operating the truck at various speeds, for braking the traction wheels 26, for elevating carriage 22 in mast 14, and for translating the mast longitudinally of outrigger legs 10.

The construction of the lift truck has been described above in general terms inasmuch as such construction per se does not comprise a part of the present invention, except as combined with the mounting construction of the upright 14. The truck per se is exemplary only of one embodiment in which the present invention may be utilized to advantage.

Upright mechanism 14 is mounted upon a trolley 39 which spans the space between legs 10 and comprises a pair of longitudinally spaced transverse brace members 40 secured, as by welding, to a pair of transversely spaced longitudinally extending L-shaped mounting members 42 which are secured at the vertical legs, as by welding, to the outer surfaces of the webs of upright channel members 16 the latter being located laterally between legs 10. Each of the legs 10 comprises a longitudinally extending channel section 44 having a cutout 46 at the forward end thereof for the reception of a wheel 12, the channel portion of the outrigger leg being of relatively small vertical dimension. Extending rearwardly of channel portion 44 is a box-shaped longitudinal frame portion 48 which is of substantially greater vertical dimension than the channel portion and which may be integral with the channel portion, as shown, or secured thereto at rear mating surfaces thereof, as by welding. Transverse frame members, not shown, extend between and are secured to portions 48 of legs 10, and the upwardly extending legs of body 24 are secured to the upper sides of leg portions 48.

Mounted within each channel portion 44 is an upright mounting and load bearing assembly 50 comprising a longitudinally extending channel-shaped member 52 nested within channel 44 such that it faces inwardly the same as channel 44 and is of substantially smaller dimensions than the U-shaped opening formed by channel 44. The horizontal leg portion of each L-shaped support member 42 is secured, as by welding, to the inner edges 54 of the legs of the adjacent mounting channel 52, whereby the mast assembly 14 and fork carriage 22 is supported in channel portions 44 of legs 10 for movement in extension and retraction along the legs 10. A hydraulic cylinder and piston assembly, the piston rod of which is shown at numeral 56 (FIG. 2) extends centrally and longitudinally of the truck having the cylinder or base end thereof pivotally connected to a transverse frame member within body 24 and the rod end thereof pivotally connected to a mounting member 58 which is secured centrally of the forward transverse member 40 of trolley 39. When the cylinder is energized from the base end piston rod 56 is extended which causes the mast and carriage to be actuated in a forward direction from the FIG. 1 to the FIG. 2 position thereof, whereas retraction of the piston rod causes the mast and carriage to be actuated in a reverse direction, the limits of movement being determined by the available stroke of rod 56 and the length of mounting assemblies 50 relative to the length of channel portions 44. The length of the track in each channel portion 44 is fixed by end plates 60 and 62 at the opposite ends thereof.

Referring now in greater detail to the construction of the mounting assemblies 50, as shown in FIGURES 3–6, each channel member 52 includes at each of the ends thereof a bifurcated extension 64 contiguous to the web of the channel and in each of which is mounted for rotation about a vertical pin 66 a side thrust roller 68, the periphery of which extends outwardly somewhat beyond the web of channel 52 so that said web clears the web of channel 44 which engages the rollers 68 at all times. At each end of each flange of each channel section 52 and located transversely intermediate each edge 54 and the adjacent bifurcated portion 64 is a slot 70 having a rounded bearing surface 71. An endless roller chain 72 of known construction is looped around each flange portion of each channel member 52 and is threaded in slots 70 at the opposite ends of each said flange so that each said loop of roller chain is relatively taut when mounted as specified. The roller chain associated with each flange of mounting channels 52 has the outer run of its loop situated between the contiguous flanges of channels 52 and 44 so that it functions as a roller thrust bearing which minimizes the friction encountered during movement in either direction of channel 52 relative to channel 44. During such movement each loop of roller chain 72 is permitted to revolve in a continuous circuit with the cut-away portion or slot 70 at opposite ends of each flange of channels 52 forming a track which contains the loop of roller chain, the rounded ends of said slots permitting the individual rollers of the roller chains to revolve readily from one side of the flange to the other.

The construction of the roller chain is best illustrated in FIG. 6. It comprises a series of links 76 and another series of links 78. The links 76 are pinned together in end to end relationship and in a similar fashion links 78 are joined in end to end relationship. The pins for the links 76 and 78 are illustrated at numeral 80 and rollers 82 are journaled on these pins. Two such rollers 82 may be journaled on each pin 80 to reduce skidding of the rollers due to variations in manufacturing tolerances for the channels 44 and 52.

The roller chains 72 accommodate loads in a fore and aft direction, and end rollers 68 of the pair of channels 52 accommodate loads in a transverse direction. This is true in the construction above described which contemplates use of square channel sections wherein the flanges of each channel 44 and 52 form approximately right angles with the webs thereof so that the weight of the upright 14, carriage 22, and any load carried by fork tines 30 is transmitted to the flanges of the pair of channels 44 by way of trolley 39 through the pairs of upper and lower loops of roller chain 72, thus producing a counterclockwise moment which is resisted by channel 44, as viewed in FIG. 3. Eccentric loading of the fork tines, as when the greater part of a load carried thereby is carried by one of the fork tines, produces side thrust or transverse loading which tends to twist upright 14 about a vertical axis. Such transverse loading is transmitted through trolley 39 and diagonally related side thrust rollers 68 of opposite ones of upright mounting assemblies 50, the resulting transverse moment being resisted by opposite ones of the webs of channels 44. For example, as viewed in FIGS. 2 and 3, an off-center load carried by the right hand fork tine produces a twisting moment which tends to rotate mast 14 in a clockwise direction about a vertical axis, thereby producing a twisting moment which is transmitted to the webs of channels 44 through the forward roller 68 of the right hand mounting

assembly 50 and through the rearward rollers 68 of the left hand mounting assembly 50. Since all four of rollers 68 are preferably in continuous abutment with the webs of respective channels 44, mast 14 remains in fixed transverse relation to legs 10 except possibly for slight twisting movement thereof which may result from a small amount of deflection of the mounting assembly comprising trolley 39, channels 52 and outrigger legs 10. However, in a properly designed construction such deflection will be negligible and rollers 68 cooperate as aforesaid with legs 10 to maintain upright 14 in its desired position.

During extension of mast 14 in legs 10 it will be noted that the rolling friction between roller chains 72 and the respective flanges of channels 44 causes each upper chain 72 to revolve in a clockwie direction, as viewed in FIGS. 2 and 3, and each lower chain 72 to revolve in a counterclockwise direction. Retraction of mast 14 reverses the direction of rotation of each roller chain, as well as the direction of rotation of each roller 82 in each roller chain. It is desirable that in the construction of my invention the flanges of channels 52 be spaced from the flanges of channels 44, when the same are assembled in nested relation, such that rollers 82 of each roller chain 72 fit rather snugly in the space provided so that a maximum number of rollers 82 of each roller chain transmit a portion of a load carried by the fork tines to the outrigger legs, whereby to maximize the area of bearing surface between rollers 82 and the flanges of channels 44 when mast 14 is subjected to loading.

In light of the foregoing description it will now be apparent that our invention provides a translatable mounting structure for load hoists which tends to maximize the bearing surface area between the load support platform, such as outrigger legs 10, and the surface area of roller chains 72 in abutment therewith, while at the same time it provides for rolling engagement between the bearing surfaces with relatively little friction. Also, our invention permits the use of a supporting construction of relatively small vertical dimension in which the hoist is translatable without reducing the load carrying capacity of the hoist. In prior constructions used for this purpose, particularly in narrow-aisle type lift trucks as previously noted, it has been necessary to utilize upright mounting means consisting of longitudinally spaced pairs of rollers mounted for rotation in the outrigger legs and supporting the upright by suitable connecting means. Such prior construction results in a relatively small bearing area between the thrust rollers and the outrigger legs as determined by the points of contact therebetween, which necessitates the use of relatively large diameter thrust rollers with a consequent large vertical dimension of the outrigger legs in which the thrust rollers are mounted. Prior conventional design in this regard appears in the above-identified copending application of Hastings et al. which discloses outrigger legs comparable to legs 10 hereof but having a vertical dimension substantially equal to the vertical dimension of rearward portion 48, as seen in FIG. 1 hereof.

A modification of my invention is shown in FIG. 7, in which parts similar to those described above are similarly numbered. In the construction of FIG. 7 side thrust rollers 68 and the bifurcated end 64 of the upright mounting channel assembly have been eliminated. The inner channel configuration of flanges 90 of legs 10 includes inner longitudinal surfaces 92 which slope in converging relation towards the web of the channel section. Each upright mounting assembly includes a built-up channel section 94 having flanges 96 sloping at the same angle as surfaces 92 and located in inwardly spaced relation thereto for receiving roller chains 72. An L-shaped bracket 42 is secured to the inner edges of flange 96 and a short web section 98 is secured between the outer ends thereof. Slotted and rounded ends 70 are preferably formed in flanges 96 the same as in the flanges of channels 52 for receiving the roller chains in a similar manner. Secured at the transverse outer end of each flange 96 is a longitudinal bar 100 which prevents any tendency of the upper loop of roller chain to sag towards the web of leg 10 and of the lower loop of roller chain to skid towards said web as a result of side thrust imposed thereon by a load on the fork tines. Likewise, a pair of longitudinally extending bars 102 extend along the opposite sides of the roller chains and are secured to the upper and lower surfaces of flanges 96 to prevent any tendency of the lower loop of roller chain to sag towards bracket member 42 and of the upper roller chain to skid under side thrust loading towards said bracket. Pairs of bars 100 and 102 thus form with flanges 96 pairs of tracks for the loops of roller chain.

The roller chains in FIG. 7 are capable of accommodating loads in either a transverse or a fore and aft direction as a result of the channel design, thus eliminating the need for extra side thrust rollers 68. Since, in the embodiment of the invention herein described in use with a narrow-aisle type lift truck, it is contemplated that the principal forces which act in a fore and aft direction will be substantially greater than the forces acting in a transverse direction the angle formed by the flanges of the respective channels with the web portions thereof is less than 135°. If it is desired to increase the transverse or lateral stability of the upright relative to the stability in a fore and aft direction, the angle of the flanges of the channels relative to the web sections thereof can be increased as required. The same advantages over the prior art inhere in both embodiments herein described. It will be appreciated that, depending upon the particular application of the invention, the embodiment of either FIG. 3 or 7 may be preferred.

FIGURE 8 shows a modification of the construction shown in FIG. 4 wherein like parts have been similarly numbered. The embodiment of our invention illustrated in FIG. 8 differs from the FIG. 4 embodiment in the use of a channel section 110 having a cut-out center portion 112 such that a narrow portion 114 of the flanges of the channel section connect longitudinally spaced channel portions 116, each of which carries a pair of upper and lower roller chains 118 mounted on and cooperating with the flange portions of each section 116 in a manner similar to the mounting of the roller chain 72 on the flanges of channel section 52. Side thrust rollers 68 are mounted for rotation in bifurcated end bracket portions 64 the same as in FIG. 4. It will be understood that channel connecting flange portions 114 may be readily eliminated, if desired, and the roller chain mounting structure be constructed of two separate and independent channel sections 116 connected along the inner edges thereof to L-shaped bracket 42. Also, the embodiment disclosed in FIG. 7 may be readily modified as disclosed in FIG. 8 to provide separate longitudinally spaced channel sections having biased flange portions in order to eliminate the requirement of side thrust rollers 68.

Referring now to FIGURE 9, another modification of our invention is disclosed wherein like parts have been similarly numbered. Side thrust rollers 68 are mounted in longitudinally spaced relation on U-shaped brackets 120 which are secured to the web portions of bracket 42. Upper and lower longitudinally extending L-shaped plate members are secured to bracket 42 in longitudinally spaced relation along short legs 122 thereof. The outwardly extending leg portions 124 may be equivalent to the upper rear flange portion and the lower forward flange portion of the front and rear channel sections 116 of FIG. 8. Support bars 125 add rigidity to the mounting structure, as shown. Roller chains 126 are mounted on each plate 124 in the manner described above previously.

It will be appreciated that in operation roller chains 72, as disclosed in the embodiments of FIGS. 4 and 7, are not normally under thrust loading along the entire length of each roller chain in abutment with the contiguous flange of leg 10. For example, when the fork 30 carries

a load the forward thust imposes on the flanges of legs **10** an upwardly extending force which is transmitted through the rear portion of the upper run of roller chain **72** and a downwardly extending force which is transmitted through the forward portion of the lower run of roller chain **72**. Therefore it may be found desirable in utilizing the present invention to provide multiple roller chains which are of such a length that the loads transmitted thereby are distributed throughout substantially the entire area of the respective lengths of chain in abutment with the contiguous portions of legs **10**. Thus, in FIG. 8, the forward thrust of the mast **14** may distribute thrust loading substantially throughout the area of the upper rear and lower forward runs of chains **118**, whereas a reverse thrust loading will be distributed substantially throughout the area of the lower rear and upper forward runs of chains **118**.

In FIGURE 9, a lower cost roller chain thrust mounting construction is provided wherein chains **126** are adapted to transmit only forward thrust in that only upper rear and lower forward loops of roller chains are provided in longitudinally spaced relation.

Although only a few embodiments of our invention have been illustrated and described in detail, it will be apparent to those skilled in the art that various changes in the structure and relative arrangement of parts may be made to suit individual requirements without departing from the scope of the invention.

We claim:

1. An industrial truck comprising a horizontal wheel supported U-shaped frame, outrigger legs of said frame extending longitudinally forwardly in parallel spaced relation to each other and having channel sections opening inwardly in facing relation to each other, a rear transverse frame portion connecting together the rear ends of said outrigger legs to form said U-shaped frame, the forward portion of said outrigger legs being of substantially less height than said rear ends thereof for facilitating entry of said forward portions beneath low height load supporting pallets and the like, upwardly extending load lifting means mounted within the pocket formed by the U-shaped frame for movement longitudinally thereof, a pair of mounting means of substantially less length than the channel sections of the outrigger legs nested within the respective channel sections of the legs of said frame, each mounting means including relatively closely vertically spaced upper and lower flange members nested within one of the channel sections and extending longitudinally thereof, an endless loop of linked roller chain mounted for revolution longitudinally of each flange member and adapted to transmit forces imposed on the lifting means to the respective channel section, a plurality of rollers in each said roller chain being adapted to divide and distribute to the respective channel section the total force transmitted thereby, the upper roller chain being adapted to transmit an upwardly directed force to each upper portion of the contiguous channel section and the lower roller chain being adapted to transmit a downwardly directed force to the lower portion of said channel section, said chain of rollers which is looped longitudinally of each flange member being revolvable around the flange member in a direction opposite to the direction of revolution of the cooperating chain of rollers during movement of the load lifting means longitudinally of the frame and each roller of each roller chain being revolvable about its own axis, each roller of said roller chains being of relatively small diameter to facilitate the use of said relatively low height forward portions of said outrigger legs, a longitudinally extending generally L-shaped bracket means connected to both upper and lower flange members of each mounting means transversely inwardly of the mounting of the roller chains thereon and secured to opposite sides of said load lifting means for supporting said load lifting means on said mounting means for movement longitudinally of said outrigger legs, means for actuating the load lifting means and mounting means longitudinally of said outrigger legs, and a pair of relatively large diameter truck support wheels mounted at the forward ends of said outrigger legs.

2. A vehicle as claimed in claim **1**, wherein each said mounting means of which said flange members are a part comprises an inwardly opening channel member, said chains of rollers being mounted on said flange members of each channel member, bracket means extending forwardly and rearwardly of each channel member, and a thrust roller mounted in each said bracket means and adapted to transmit thrust forces to the respective vertical portions of the channel sections of said outrigger legs.

3. A vehicle as claimed in claim **1** wherein the channel sections of said outrigger legs include inner flange surfaces which diverge at a predetemined angle in a direction transversely inwardly of the vehicle, the flange members of each said mounting means being located in substantially parallel relation to said flange surfaces, said roller chains being disposed between each said flange member and inner flange surfaces for transmitting to said channel sections both forward and side thrust forces.

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