Dec. 6, 1966 D. R. HOYT 3,289,869

HOSE MOUNTING

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FIG. 1

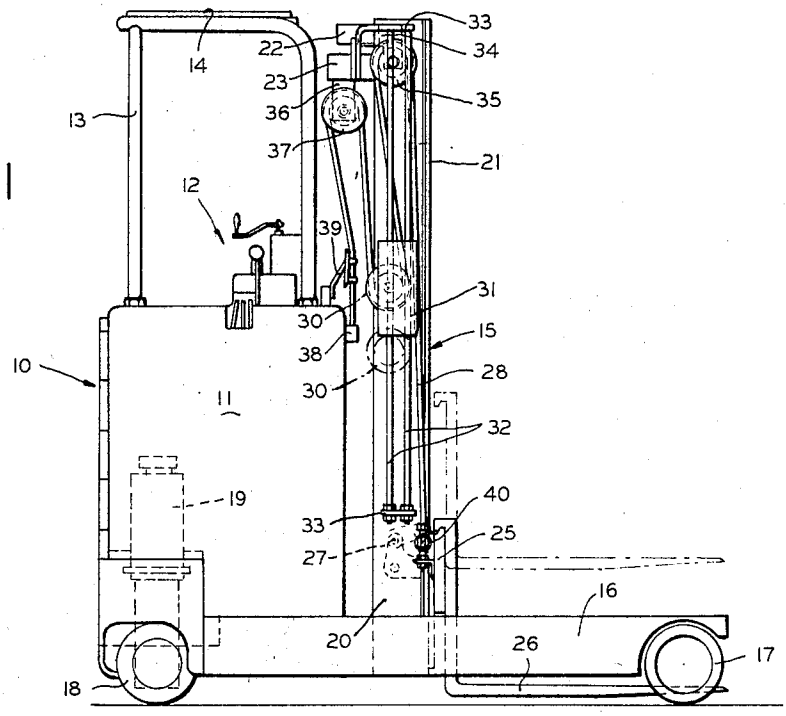
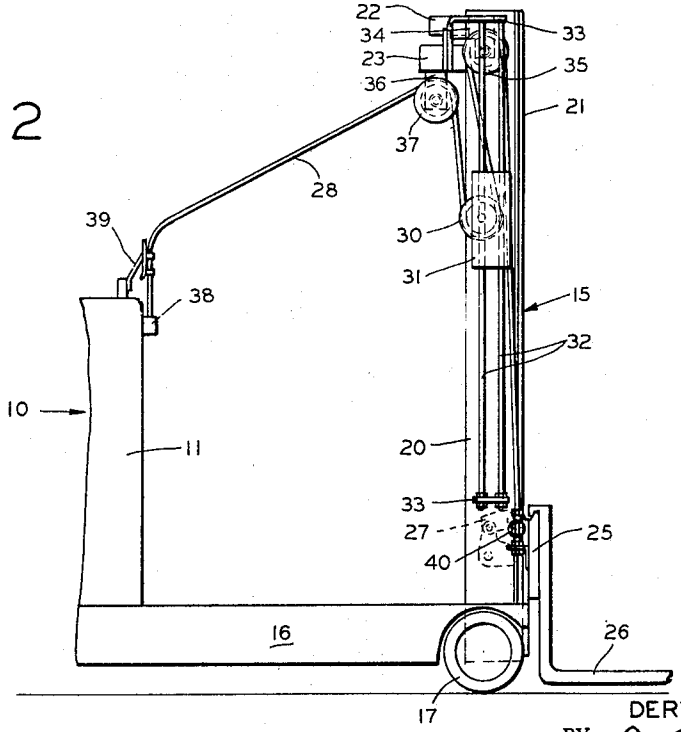


FIG. 2



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FIG. 4

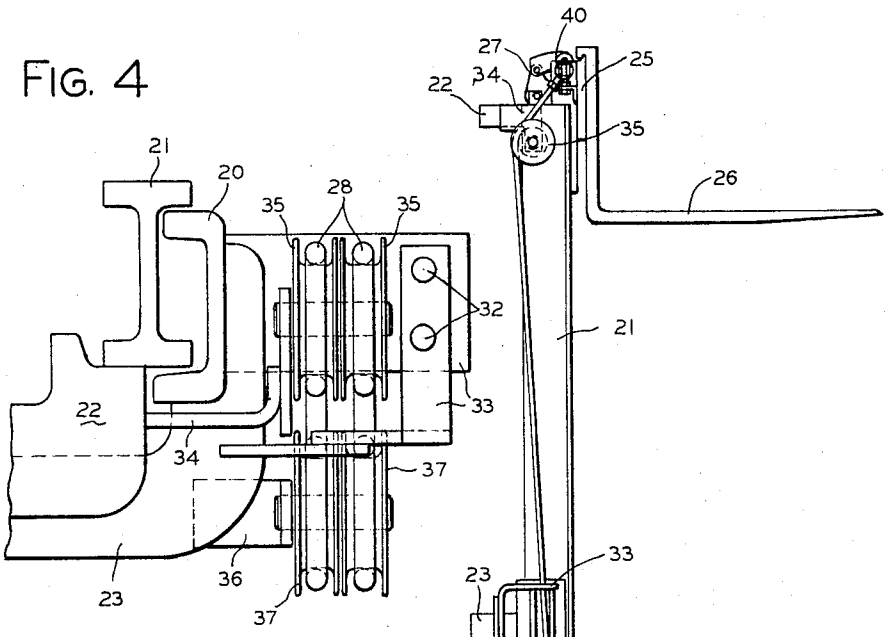


FIG. 3

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HOSE MOUNTING

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3 Claims. (Cl. 214—670)

My invention relates to a mounting arrangement for hydraulic hose and other power-transmitting lines for actuation of mast-carried devices on lift trucks, and more particularly to such arrangements for lift trucks having retractable masts, that is, vertically positioned masts movable horizontally relative to the truck proper.

To provide for the protection of hoses or the like employed in lift trucks for tilting or otherwise actuating a carriage movable vertically of the mast, or load-engaging means caried by the carriage, and to prevent interference of the hoses or the like with the operation of the truck by being caught in the operating mechanism, take-up means have been provided in lift trucks to maintain the hoses substantially taut and take up the slack therein resulting from the various movements of the carriage vertically of the mast. The take-up means, as shown for example in the Broersma Patent No. 2,611,498, issued Sept. 23, 1952, commonly comprises a pulley or sheave mounted for vertical sliding movement on the mast, and sufficiently weighted to draw slack in the hoses downwardly, and thus maintain the hoses in taut, non-fouling condition, the hoses being trained under the vertically movable sheave and also being trained over another sheave provided on the mast, so as to pass to the carriage or load-engaging means. Such an arrangement is simple and effective for this purpose in lift trucks having non-retractable masts, but cannot be used on retractable-mast lift trucks because in the latter the hoses must be of greater length in order to reach from the truck body to the mast in the projected position thereof, and the increased length cannot be effectively accommodated by the construction described. One manner in which this difficulty may be overcome is by the use of the conduit arrangement disclosed in the Cook Patent No. 3,084,765, issued Apr. 9, 1963, in which conduits extending from the mast and from the truck body are joined by an intermediate connector which is raised thereby as the mast is projected, and is lowered by gravity as the mast is retracted. The combination of the conduit arrangement of the Cook patent with the conduit take-up arrangement of the Broersma patent, however, constitutes a relatively complicated means for avoiding fouling and unnecessary slack in the hoses or similar power-transmitting lines in lift trucks with horizontally retractable masts.

The present invention provides a simple construction for maintaining in substantially taut, non-slacking, non-fouling condition the extended hoses or other power-transmitting lines of a retractable mast lift truck, avoiding any cumbersomeness or complication of structure, and requiring no modification of the truck or mast structure or any complicated additions thereto. My invention therefore is of great practical utility in solving a problem in this particular field in a manner advantageous over and not suggested by the prior art.

It is accordingly the main object of my invention to provide a simple yet effective mounting arrangement for power-transmitting lines in fork lift trucks having horizontally retractable masts carrying mechanisms to be actuated from the body of the tractor by means of said

lines, the arrangement maintaining the lines in non-slacking, non-fouling condition to avoid damage thereto or interference with the lift truck operation.

Other and further objects, advantages and features of the invention will be apparent to those skilled in the art from the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a somewhat diagrammatic side elevational view of a retractable mast truck incorporating the present invention, with the mast in retracted position;

FIGURE 2 is a view similar to FIG. 1, but showing the mast in its horizontally projected position;

FIGURE 3 is a view similar to FIG. 2, with the mast in its fully vertically extended position and the carriage in its uppermost position on the mast; and

FIGURE 4 is an enlarged plan view of a portion of the mast as shown in FIG. 1.

Referring to the drawings, there is shown a lift truck of substantially conventional construction, generally designated **10**, having a body portion **11** providing an operator's station with controls generally indicated at **12**. An appropriate framework **13** extending upwardly from the body supports a guard **14** which protects the operator's station from falling loads. A mast generally indicated at **15** is mounted forwardly of the body for forward projection and rearward retraction between a pair of parallel longitudinally extending out-riggers **16**, only one of which is shown, supported at the forward ends by wheels **17** and secured at their rear portions to the body. The body is supported by a pair of wheels **18**, only one of which is shown, at least one of these wheels being driven in known manner by any suitable motor **19**, and at least one of the wheels **18** being a steerable wheel. The means for movably mounting the mast **15** and for effecting the horizontal projection and retraction thereof are not shown, any suitable means known to the art being employable for this purpose. The mast **15** comprises a pair of transversely spaced vertical base uprights **20**, only one of which is shown in the drawings, and a pair of slidable or projectable uprights **21**, of which also only one is shown, disposed between or within the base uprights and telescopically related thereto for vertical movement to and form a projected or elevated position increasing the height of the mast above that of the base or outer uprights. The uprights may be in the form of I-beams or channel members, as is well known in the art, the outer uprights **20** in this instance being channels, and the inner uprights **21** being of I-section each with one flange disposed outwardly of the associated channel-section upright **20**. The inner or projectable uprights are connected by any suitable cross members, including an upper cross member **22**, and the outer uprights are tied together at their upper ends by a suitable cross member or brace **23**, and are also suitably held in the desired spaced relation by any suitable means at their lower portions.

Mounted for vertical movement on the inner uprights **21** by any conventional means is a load carriage **25**, on which may be supported suitable load-engaging means, such for example as the lift forks **26** illustrated in the drawings. The means for raising and lowering the inner uprights **21** on the outer uprights **20**, and for moving the load carriage **25** with its load-engaging means vertically along the inner uprights, are not shown, since a number

of suitable mechanisms are available for this purpose, and any desired arrangement may be employed.

It is usual in lift trucks to provide for tilting the mast slightly in either direction from the vertical, so as to dispose lift forks inclined downwardly and forwardly for "chisel" operation in engaging under a load on a floor, or upwardly and forwardly so as to compensate for downward deflection of the load-engaging means under the weight of a load which otherwise might drop from an elevated position. In retractable-mast lift trucks, however, the fact that the mast is movable horizontally relative to the body of the truck complicates such tilting of the mast, and instead, therefore, the carriage **25** is commonly arranged to be tiltable on the inner or projectable uprights **21**, by any of a number of known devices or mechanisms, one of which is illustrated generally at **27**, mounted for movement with the carriage. The tilting mechanism **27** is designed for operation by hydraulic fluid, which is supplied thereto from any suitable source (not shown) in the truck body **11** by means of a pair of flexible conduits or hoses **28**. Obviously, the movability of the carriage **25** and tilting mechanism **27** associated therewith results in disposition thereof at varying distances from the truck body at different times, and the hoses **28** must be of sufficient length to reach from the body to the tilting mechanism **27** in any position of the latter, including that most remote from the body. When the carriage and tilting mechanism are in a less remote position, the hoses would have varying amounts of slack therein if provision were not made to maintain them substantially taut, to minimize wear thereon, and to prevent damage thereto and interference thereby with the lift truck mechanism by reason of becoming fouled therein due to excessive slack.

The means provided to prevent slackness of the hoses **28** comprises a pair of sheaves **30** carried by a slide bracket **31** for rotation about a horizontal axis. The bracket **31** is mounted to slide vertically on one of the base uprights **20** by means of a plurality of parallel rods **32** secured in outwardly spaced relation on the upright by suitable angle brackets **33** or the like at their upper and lower ends. Mounted for rotation about a horizontal axis on the upper end of the inner uprights **21**, as by a bracket **34** secured to the laterally outer end of cross member **22**, in the same vertical plane as the sheave pair **30**, is a second pair of sheaves **35**. A bracket **36** is secured to the cross member **23** of the outer uprights **20** to mount thereon, rearwardly of the sheaves **30** and **35** and in the same vertical plane, a third pair of sheaves **37**. The hoses **28**, which make connection with conduit means within the body **11** through connecting means **38** secured to the body at a point considerably below the level of sheaves **37**, and which are provided adjacent the body with a strain relief device of any suitable type, generally designated **39**, are trained over the sheaves **37**, passing therefrom about the lower portions of the sheaves **30**, and thence upwardly over the sheaves **35**, from which they extend to the tilting mechanism **27**. The connections of the hoses **28** to the tilting mechanism are preferably made by means of suitable swivel joints **40**, for a purpose hereinafter explained. It will be understood that two hoses are employed for flow of operating fluid in either direction so that the mechanism **27** may be actuated as desired. It will also be understood that instead of the hoses, other flexible lines might be employed, as an electrical cord or cable for electrical actuation of the tilting mechanism or of any electrical device which might be mounted on the carriage **25**, or a winch cable or the like for mechanical actuation of the mechanism **27** or other desired device. For example, current might be supplied from a suitable source in the body **11** of the truck through an electrical cable to an electrically operable load-handling attachment mounted on the carriage **25** for movement along the mast **15**. Any flexible lines for transmitting power from a source in or on the body to the carriage or a device mounted thereon may be trained about the sheaves in the manner described as to the hoses for the same purpose of preventing slack therein.

In the position illustrated in FIG. 1, the inner uprights are lowered, telescoped within the outer uprights **20**, and the carriage **25** is substantially in its lowermost position, with the lift forks **26** ready to engage under a load upon movement with the mast **15** upon forward projection thereof. In this position of the carriage and mast, the sheaves **30** are disposed at a point intermediate the upper and lower ends of the rods **32**, as shown in full lines in FIG. 1. Raising of the carriage and lift forks on the inner uprights **21** to the position shown in dotted lines results in downward movement of the sheaves **30** and sliding bracket **31** on the rods **32** to the position indicated in dotted lines. Loads when transported by lift trucks normally are carried at a height sufficiently great to avoid obstructions, but as low as possible so as to maintain a low center of gravity and allow the truck operator to see over the load, and with the mast retracted so as to have the load center of gravity fall within the plan confines of the truck, for stability and safety. Similarly, when the the load is to be elevated for stacking or like operations, the carriage is moved upwardly on the inner uprights **21**, and the inner uprights are moved upwardly relative to the base or outer uprights **20**, while the mast is in its retracted position adjacent the truck. When the carriage and forks have reached the elevation desired for the load, the mast is moved horizontally away from the truck body to bring the load to its desired stacked position, and the mast is then retracted and the carriage and forks are lowered. FIG. 2 shows the load pick-up position of the lift forks, adjacent the floor and projected by reason of the projection of the mast. As already indicated, from this position the carriage and forks would be raised slightly and retracted by retraction of the mast so as to bring the load to the desired transporting position. FIG. 3 shows the carriage raised to the limit of its vertical movement at the top of the inner uprights, the inner uprights having been projected to the limit of their upward movement. At the same time, the carriage is at its farthest forward projected position, by reason of the forward projection of the mast to the limit of its movement. The carriage **25** is thus shown at its position most remote from the body of the truck, requiring the maximum hose length to be utilized. It will be noted that in this position, the connections of the hoses to the tilting mechanism **27** are above the level of the sheaves **35**, and it will be evident that such positioning, in contrast to the positions in which the tilting mechanism is below the level of the sheaves **35**, would produce sharp flexing of the hoses detrimental thereto, were it not for the provision of the swivel joints **40**, which allow the junctures of the hoses with the tilting mechanism to rotate about a horizontal axis, in effect, to avoid any sharp bending or kinking of the hoses which might otherwise be occasioned.

It will be appreciated that in raising of the carriage **25** and the lift forks **26** or other load-engaging means mounted thereon in the manner indicated in FIG. 1, the sheaves **30** and their brackets **31** might reach their lower limit of movement on the guide rods **32** before the carriage had reached its highest position on the inner upright **21**, that is at the top of such uprights, depending upon the particular dimensions and locations of the several parts. In such case, the hoses are easily prevented from going slack between the carriage **25** and sheaves **35** and between the sheaves **35** and sheaves **30** simply by elevating the inner uprights **21** while raising the carriage **25**, beginning at any appropriate point in the upward movement of the carriage on the uprights **21**. Such movement of the carriage on the uprights might be continued or stopped, depending upon whether the relative rates of movement of the uprights and carriage resulted in slacking of the hoses or not. Similarly, instead of raising the inner uprights **21** to prevent the hoses going slack by

reason of raising of the carriage on the uprights **21**, the mast might be projected horizontally, so that the hoses would be paid out rearwardly over the sheaves **37**, thus counteracting the lowering movement of the sheaves **30** resulting from raising of the carriage **25**. It will thus be evident that the various movements of the mast, carriage, and inner mast uprights, alone or in differing combinations depending upon the particular position to which the carriage is to be moved, will not, by reason of the slack take-up arrangement of this invention, cause slack in the hoses **28** or other power transmitting lines. The additional hose length required in a retractable mast truck over that in a fixed-mast truck is readily accommodated without difficulty and without requiring extensive modifications of the truck structure, or the provision of the complicated or easily damaged devices. The arrangement of sheaves provides as simple, inexpensive, and easily applied slack take-up means for a retractable mast lift truck as can well be expected, the sheaves **37** alone, by reason of their disposition above the connections of the hoses to the body, compensating in large measure for the additional hose lengths employed in a retractable mast truck. This will be evident from a comparison of FIGS. 1 and 2, from which it will appear that the length of hose required to extend from the connection **38** to the sheaves **37** and down to the sheaves **30** represents a large proportion of the hose length required to reach from the hose connection **38** over the sheaves **37** to the sheaves **30** when the mast is projected forwardly of the truck body **11**, as shown in FIG. 2. The sheaves **30** move upwardly only a short distance from the position occupied thereby in the retracted-mast position of FIG. 1, and thus leave a maximum portion of the hose length available for accommodating the upward projection of the inner uprights **21** and the upward movement of the carriage **25** to the upper end of the inner uprights, as in the position shown in FIG. 3. In this latter figure, it will be noted that the sheaves **30** are in an elevated position relative to their position in the condition of FIG. 2, the sheaves in the FIG. 2 position having available for upward movement a large portion of the guide rods **32**, or in other words being sufficiently low to have available relatively long upward movement for allowing location of the load carriage **25** in the maximum height position. At the same time, as has already been pointed out, the sheaves **30** in either the FIG. 1 position or the FIG. 2 position, or, of course, an intermediate position, with the carriage at a lowered position, are allowed considerable downward movement to take up the slack occasioned by upward movement of the carriage on the inner uprights **21** while those uprights are maintained in their lowest or telescoped position. In other words, the take-up arrangement accommodates the movements and combination of movements of the mast as a whole, of the load carriage on the mast, and of the inner uprights **21** relative to the base uprights **20** to maintain the hoses or other power-transmitting line or lines in a substantially taut, non-fouling condition at all times.

As has already been pointed out hereinabove, the invention is not restricted to use with hose lines, but may be employed with other flexible power-transmitting lines, or for that matter with flexible lines not necessarily provided for the transmission of power. In the present instance, the two hoses **28** are disclosed as the flexible lines, and accordingly the sheaves are provided in pairs, preferably independently rotatable on a common pin or shaft, but also possibly in the form of a single sheave with two parallel grooves in its periphery. Obviously, however, the invention embraces the use of one or any plurality of lines, instead of two. It will also be understood that instead of the sheaves, non-rotatable means might be employed if they provided for substantially frictionless guidance of the hoses or other lines and free movement of the lines thereabout.

It will be understood that the single embodiment of the invention illustrated herein is exemplary of the inventive concept that the invention is not limited to such embodiment, since modifications and variations thereof, may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. In a retractable-mast lift truck, a vertically extensible mast projectable and retractable horizontally in substantially vertical position and comprising base upright means and movable upright means slidable vertically on said base upright means, a source of power on the truck, a load carriage slidable vertically on said movable upright means adapted to support load-engaging means and having a position most remote from said power source determined by location thereof at its uppermost position on the mast in fully vertically extended and fully horizontally projected position, flexible power-transmitting line means extending from said power source to said carriage, first sheave means mounted on the movable upright means, second sheave means mounted on the base upright means, and third sheave means vertically slidable on the base upright means, said sheave means extending in substantially the same vertical plane and each being rotatable about a horizontal axis, said line means extending from the power source over said second sheave means, under the third sheave means, and over the first sheave means and to said carriage and having a length sufficient to connect the power source to the load carriage in said most remote carriage position, said sheave means maintaining said length of line means substantially taut in the lowermost position of the carriage and fully retracted position of the mast, in said most remote carriage position, and during movement of the mast between its retracted and projected positions and of the carriage between said two positions thereof.

2. In a retractable-mast lift truck, a source of power on said truck, a vertically extensible mast movable in substantially vertical position horizontally toward and from said power source and comprising first upright means and second upright means slidable vertically on said first upright means, load-carrying means slidable vertically on said second upright means, said carrying means having a position most remote from said power source determined by the uppermost position thereof on said mast in the position of the mast farthest horizontally removed from the power source and fully upwardly extended, a flexible power-transmitting line extending between the power source and the carrying means, first and second sheaves mounted respectively on the second and first upright means, and a third sheave vertically slidable on the first upright means and lowermost of said sheaves in all positions of the carrying means on the mast, said sheaves extending in substantially the same vertical plane, said line extending over said first and second sheaves and under said third sheave and having a length sufficient to connect the load-carrying means in said most remote position thereof to the power source, said sheaves maintaining said length of line substantially taut in the lowermost position of the first sheave and second upright means and rearmost position of the mast and during movement of the mast between its forward and rear positions and of the carrying means between the uppermost and lowermost positions thereof.

3. In a lift truck having an upwardly extensible mast projectable and retractable horizontally in a substantially vertical position and comprising base upright means and movable upright means slidable vertically on said base upright means, a source of power on the truck, load engaging means slidable vertically on said mast and movable to an uppermost position at the top of the fully extended mast, first, second, and third sheaves mounted on the mast, each rotatable on a horizontal axis, said first sheave being mounted on said movable upright means, said third sheave being vertically slidable on the mast below said

first sheave, and said second sheave being spaced from the third sheave in the general direction of the power source, a flexible power-transmitting line connecting said power source and said slidable means extending over said second sheave, under the third sheave, and over the first sheave and having a length sufficient to extend from the power source to the slidable means in all positions thereof on the mast and all positions of the mast, said sheaves maintaining said length of line substantially taut in all said positions of the slidable means and during movements of the slidable means between positions.

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