Aug. 31, 1965 G. F. QUAYLE 3,203,568

INDUSTRIAL TRUCK WITH A HORIZONTALLY DISPOSED LIFTING RAM

Filed April 5, 1962 4 Sheets-Sheet 1

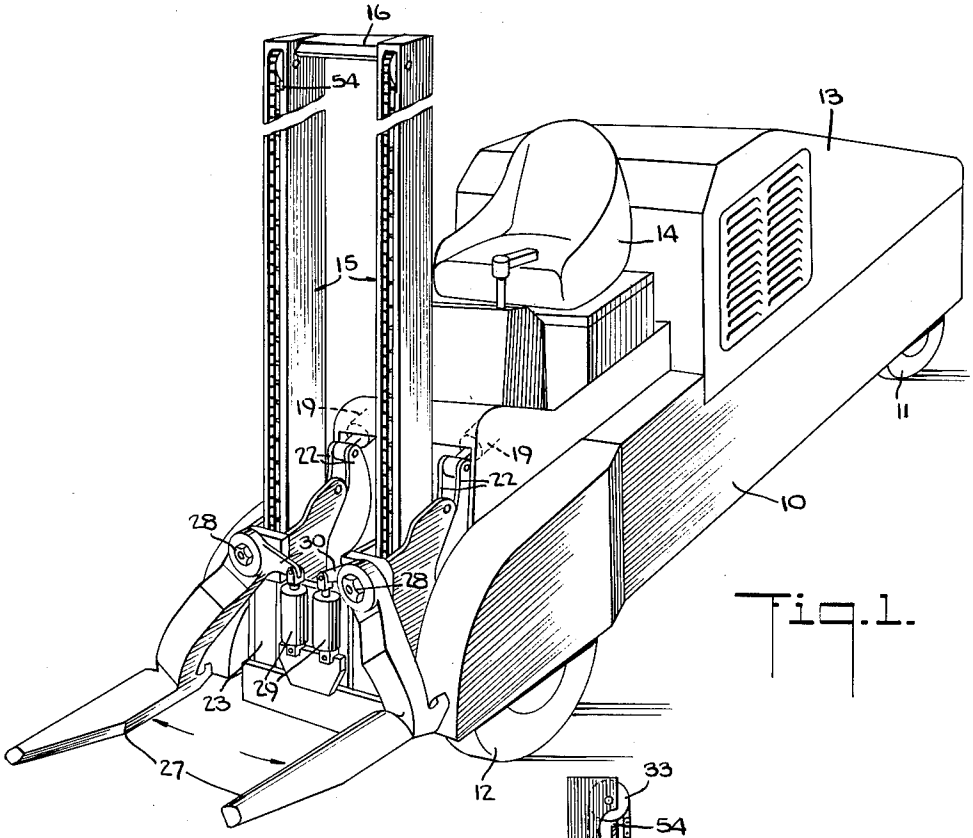


Fig. 1.

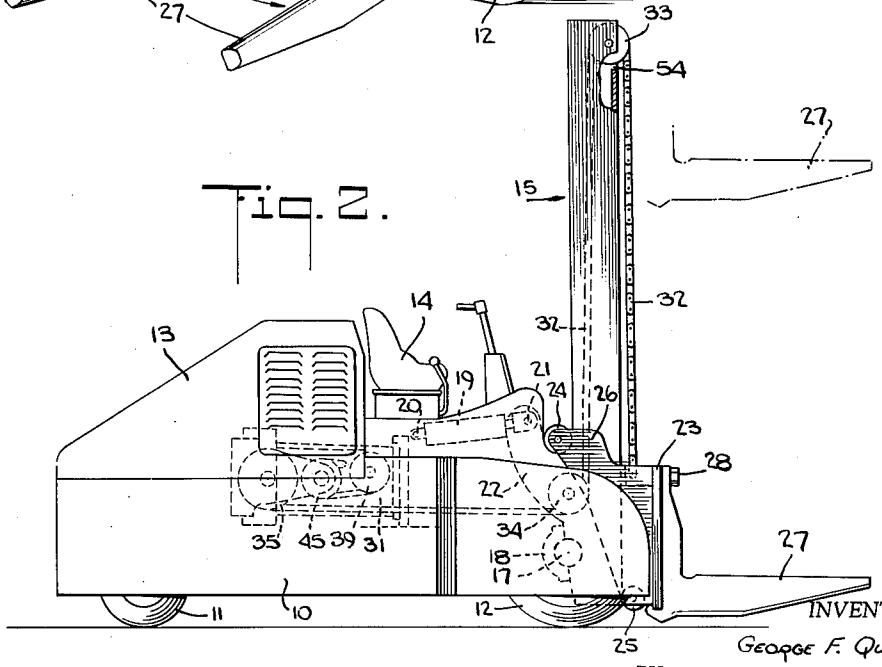


Fig. 2.

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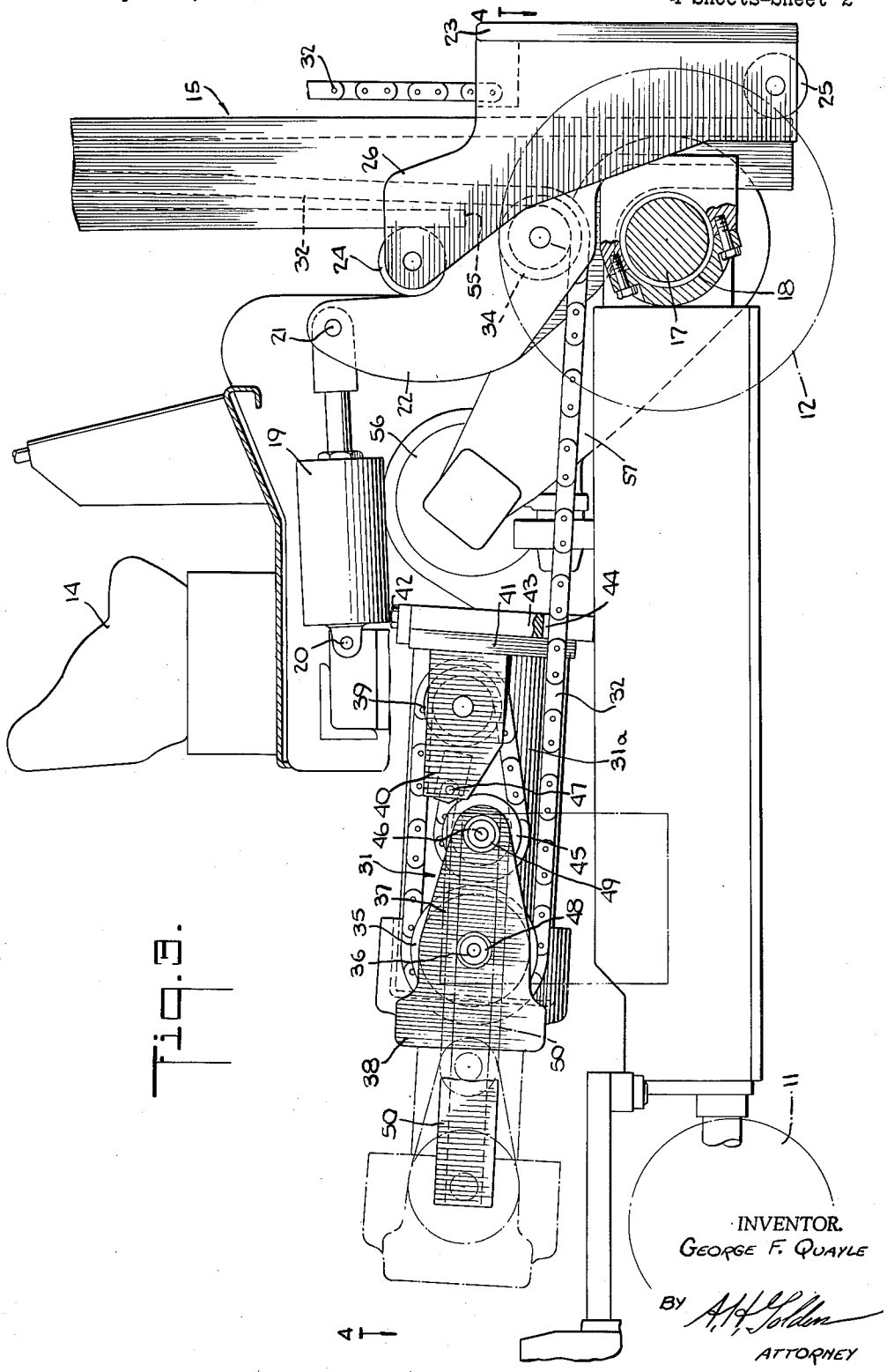


Fig. 1.

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INDUSTRIAL TRUCK WITH A HORIZONTALLY DISPOSED LIFTING RAM

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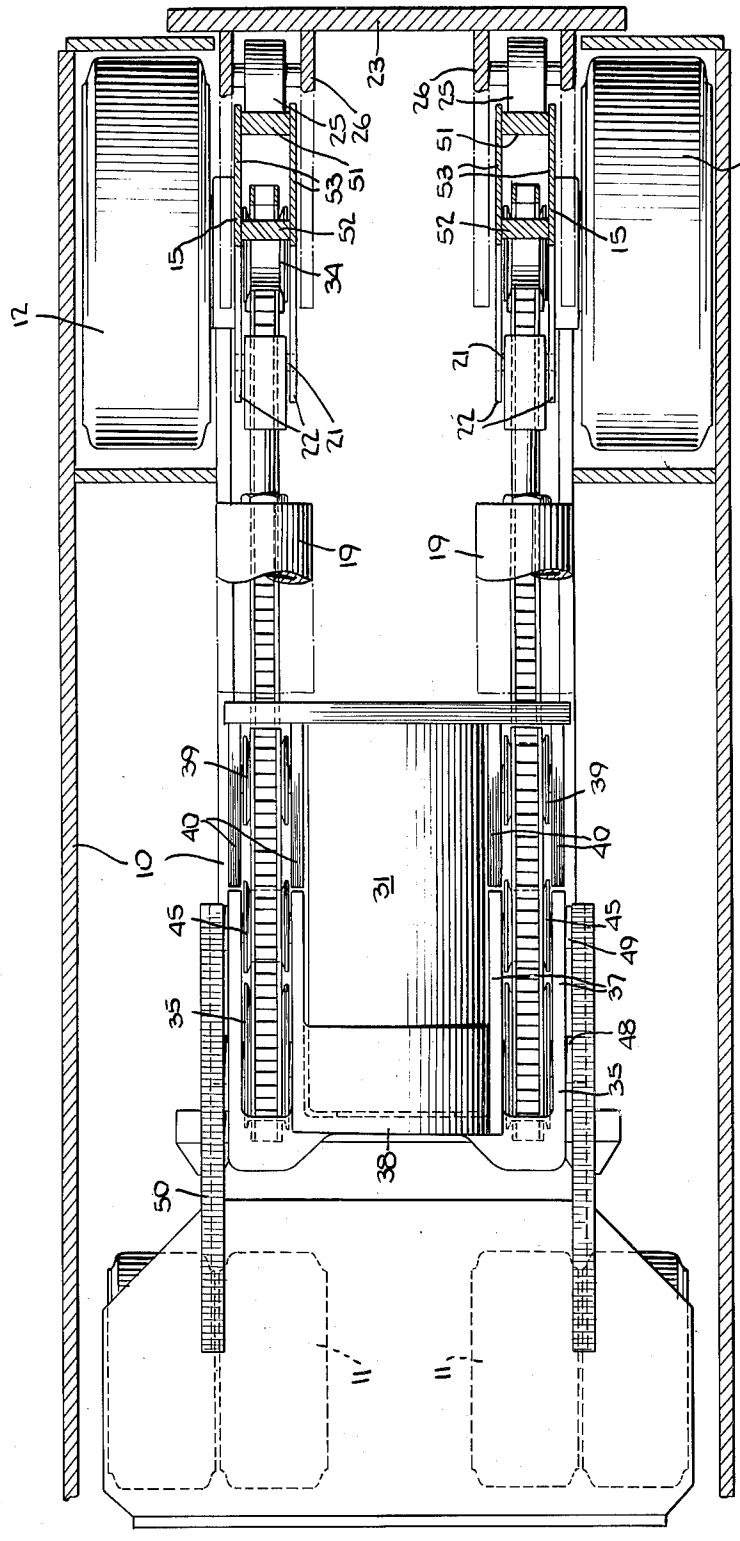


Fig. 4.

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Filed April 5, 1962 4 Sheets-Sheet 4

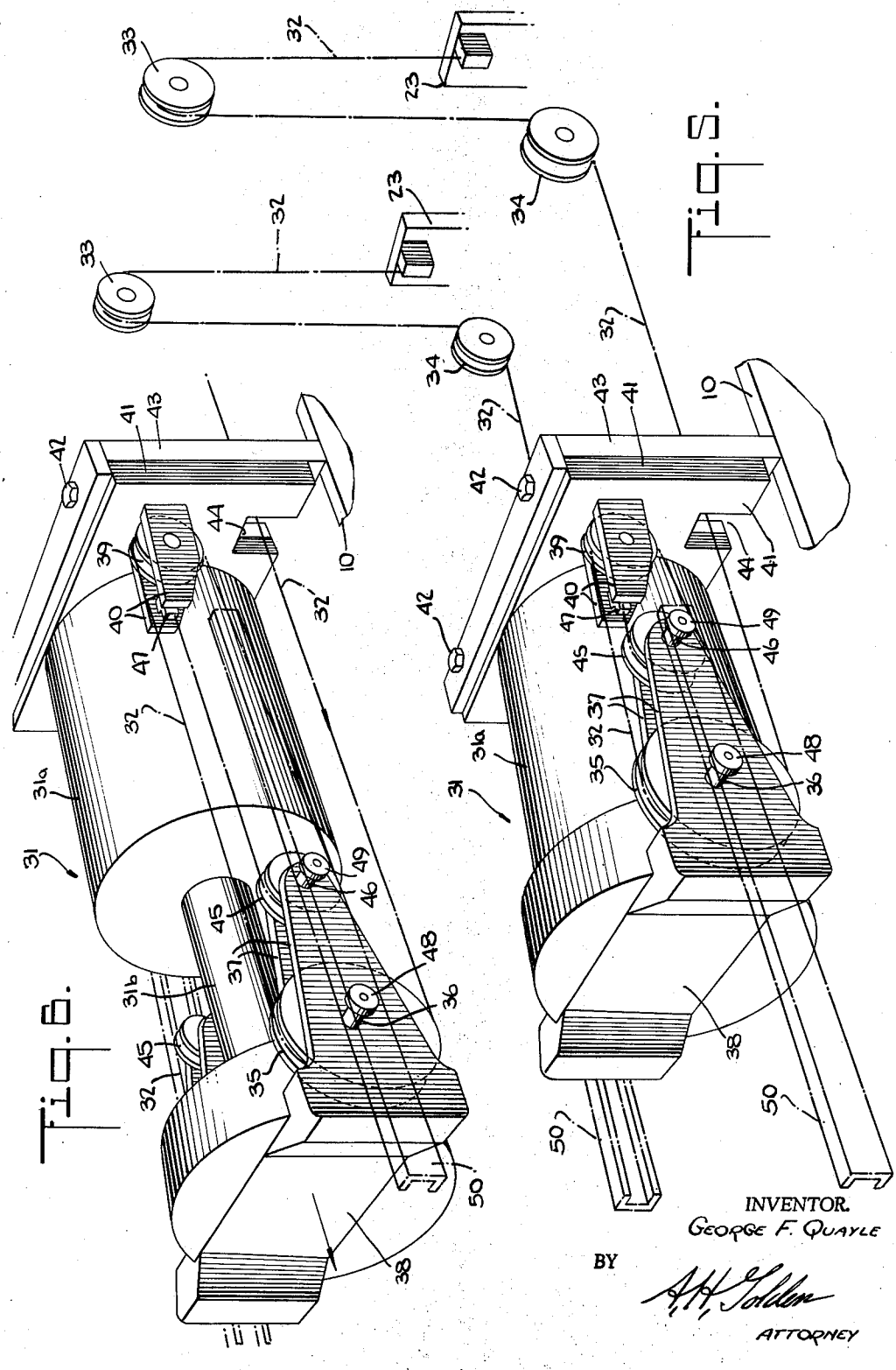


Fig. 5.

Fig. 6.

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3,203,568

INDUSTRIAL TRUCK WITH A HORIZONTALLY DISPOSED LIFTING RAM

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4 Claims. (Cl. 214—653)

This invention relates to a heavy duty hydraulic lift truck for lifting and handling extremely heavy loads.

Hydraulic lift trucks are commonly provided with vertically extending uprights on which a load supporting carriage is guided for vertical movement. The uprights are pivotally attached to the truck adjacent their lower ends so that they may be tilted a few degrees from the vertical in the fore and aft direction of the truck to facilitate engagement of the load and to stabilize the load on the load carriage during transit. The load carriage is adapted to be raised or lowered on the uprights by means of a hydraulic ram or rams, mounted in a vertical position between the uprights and connected to the load carriage through chains or cables.

In heavy duty trucks of this type, very large rams, or a pair of rams, must be used in order to provide sufficient lifting capacity to handle the heavy loads. Because, however, of the position of the large rams, or pair of rams, between the uprights, they present a substantial obstruction to the view of the operator through the uprights, making it difficult, if not impossible, for the operator to have a clear view of the load carriage. This, of course, makes it very difficult for the operator to properly maneuver the truck, particularly during engaging or depositing a load.

The purpose of this invention is to provide a lift truck having a lift ram and lift chain arrangement which presents no obstruction to the view of the operator, while at the same time providing essentially the same lifting action as in trucks in which the rams are mounted in a vertical position between the uprights. This is obtained without increasing the overall length of the truck.

To this end, the lift ram of the truck of the invention is mounted in a generally horizontal direction extending in the fore and aft direction of the truck. The uprights of the truck are of hollow construction and the lift chains or cables extend upwardly from the load carriage around sheaves mounted adjacent the upper ends of the uprights, then downwardly through the hollow uprights and around sheaves mounted adjacent to the point of pivotal attachment of the lower ends of the uprights to the truck.

The lift chains or cables extend from the lower sheaves in a generally horizontal direction and are connected through multiplying sheaves to the horizontally disposed lift ram so that substantial lift may be obtained with a very short ram. The multiplying sheaves are so secured to the piston and cylinder of the ram that they extend along the sides of the ram cylinder when the piston is retracted so that the assembly of the multiplying sheaves and ram is not substantially longer than the ram by itself. No increase in the overall length of the truck, therefore, is necessary to accommodate the ram assembly, even though the ram assembly is disposed horizontally.

The position of the lower sheaves adjacent the point of pivotal attachment of the uprights to the truck allows fore and aft tilting of the uprights with substantially no

movement of the load carriage, and the running of the lift chains or cables down through the hollow uprights insures that they present no additional obstruction to the view of the operator through the uprights.

The invention and its advantages having been broadly described, a more detailed description of one embodiment of the invention is given hereafter by reference to the accompanying drawings, wherein:

FIG. 1 is a perspective view of a lift truck constructed in accordance with the invention;

FIG. 2 is a side elevational view of the truck;

FIG. 3 is a partial side elevation view of the truck with parts broken away to show the arrangement of the lift ram and lifting chains relativley to the pivotal mounting of the uprights on the truck frame;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 3;

FIG. 5 is a perspective view of the lift ram in a retracted position showing schematically its connection to the load carriage; and

FIG. 6 is a perspective view similar to that of FIG. 5, but showing the lift ram in an extended position.

Referring to the drawings and in particular to FIGS. 1 and 2, the truck includes a frame **10** supported for movement on steerable rear wheels **11** and front drive wheels **12**. The engine and hydraulic pump (not shown), for supplying fluid under pressure to the hydraulic rams of the truck and also to hydraulic motors for driving the front wheels **12**, are enclosed in a suitable housing **13** provided on a rear portion of the frame **10**. A seat **14** is provided forwardly of the housing **13** in which the operator of the truck sits while operating the truck.

A pair of laterally spaced, vertically extending uprights **15** are secured together at their upper ends by a suitable brace **16** and are pivotally attached at their lower needs to the axle **17** of the front wheels **12** by means of suitable bearings **18** (best shown in FIGS. 2 and 3) so that the uprights may be tilted a few degrees in each direction from the vertical. The uprights **15** are adapted to be so tilted by a pair of rams **19**, positioned one on each side of the truck, with one end of each ram pivotally attached at **20** to the truck frame and the other end of each ram pivotally attached at **21** to a pair of lever arms **22** which are welded, or otherwise rigidly secured, to each of the uprights **15**. The uprights **15**, therefore, may be tilted in the fore and aft direction about the axle **17** by operation of the rams **19**.

A load carriage **23** is guided for vertical movement on the pair of uprights **15** by upper rollers **24** (best shown in FIGS. 2 and 3) which engage the rear surfaces of the uprights and lower rollers **25** which engage the front surfaces of the uprights **15**. Each of the upper rollers **24** is rotatably supported between a pair of brackets **26** which are secured to the load carriage **23** and extend past each side of their respective upright **15**, as shown in FIG. 4. The lower rollers **25** are rotatably mounted between the brackets **26** adjacent the connection thereof with the load carriage **23**.

The load carriage **23** is provided with load engaging members which, in the particular truck illustrated, are in the form of adjustable forks **27**, each of which is pivotally attached at **28** to the load carriage so that the spacing between the forks may be adjusted by pivotal movement of the forks toward or away from each other. The forks are adapted to be pivoted through operation of a pair of

rams 29, each of which is pivotally attached at one end to the load carriage and at the other end to a lever arm 30 which is secured to or formed integrally with the forks 27. Other types of load engaging members can, of course, be used.

In accordance with the invention, the lift ram 31, best shown in FIGS. 2, 3, 5 and 6, is disposed horizontally below the operator's seat 14 so that it provides no obstruction to the view of the operator through the uprights 15 and the operator has a clear view of the load carriage 23 at all times. The position of the lift ram 31 below the operator's seat 14 insures that the operator has a clear view to each side of the truck during maneuvering of the truck.

The lift ram 31 is connected to the load carriage 23 through a pair of lift cables or chains 32 which are secured to the load carriage 23 adjacent each side thereof and extend upwardly in front of the uprights 15 and around sheaves 33 rotatably mounted on the upper ends of the uprights 15. From the sheaves 33, the chains 32 extend downwardly and around sheaves 34 which are rotatably mounted between each pair of the lever arms 22 adjacent the axle 17. From the sheaves 34 the chains 32 extend generally horizontally along each side of the cylinder 31*a* of the lift ram 31 and around sheaves 35. Each sheave 35 is rotatably mounted on a shaft 36 carried by spaced flanges 37 which extend along each side of the cylinder 31*a* of the ram when the piston and piston rod 31*b* of the lift ram 31 are retracted, and are formed integrally with a cross head 38 which is secured to the outer end of the piston rod 31*b*.

From the sheaves 35 the chains 32 extend around sheaves 39 which are rotatably mounted between a pair of brackets 40 which also extend along each side of the cylinder 31*a* and are secured to a base plate 41. The cylinder 31*a* is secured to the base plate 41 and the base plate 41, in turn, is secured by bolts 42 to a frame plate 43 which is welded, or otherwise rigidly secured, to the main frame 10. The base plate 41 and frame plate 43 are cut away at 44 to permit passage of the chains 32 from the sheaves 34 to the sheaves 35.

From the sheaves 39, the chains 32 extend around sheaves 45 which are rotatably mounted on shafts 46, secured to the outer ends of the flanges 37 of the cross head 38, and the ends of the chains are anchored at 47 to the brackets 40. The sheaves 35, 39 and 45 together form a set of multiplying sheaves providing a 4:1 ratio whereby relatively small movement of the cross head 38 by the piston rod 31*b* of the ram 31 results in substantial movement of the chains 32 and resulting lifting of the load carriage 23 on the uprights 15. This allows the lift ram 31 to be very short so that it is not necessary to increase the overall length of the truck to accommodate the ram, even though the ram is mounted in a horizontal position. Tilting forces exerted on the lift ram 31 during operation thereof are effectively resisted by rollers 48 and 49 which are mounted on the outer ends of the shafts 36 and 46 and ride in channel guides 50 provided on each side of the ram assembly and secured to the main frame 10.

Mounting of the multiplying sheaves 35 and 45 between flanges 37 which extend along each side of the cylinder 31*a* and the mounting of the multiplying sheaves 39 between the brackets 40, which also extend along each side of the cylinder 31*a*, as best shown in FIG. 5, further contributes to the shortness of the lift ram assembly, so that the assembly including the multiplying sheaves 35, 49 and 45 requires substantially no greater space in the longitudinal direction of the truck than the lift ram 31 by itself.

As best shown in FIG. 4, each of the uprights 15 is of a hollow box construction formed by a front plate 51, a rear plate 52 and side plates 53 which are welded, or otherwise secured to the front and rear plates. As best shown in FIGS. 1 and 2, the front plate 51 stops short of the upper ends of the uprights 15 to provide a space 54 for accommodating the upper sheaves 33, and the lift chains 32 extend from the sheaves 33 downwardly within the hollow uprights 15 so that they present no additional obstruction to the view of the operator through the uprights. As best shown in FIG. 3, the rear plate 52 of each upright 15 terminates short of the lower end of the upright 15 to provide a space 55 for accommodating the lower sheave 34 and the lift chain 32 as it passes around the sheave 34 and extends toward the lift ram 31. The position of the lower sheaves 34 adjacent the axle 17, around which the uprights 15 are tilted by operation of rams 19, insures that there is substantially no movement of the lift chains 32 and the load carriage 23 during tilting of the uprights.

Individual hydraulic drive motors 56, best shown in FIG. 3, are provided one on each side of the truck and are connected to each of the front drive wheels 12 by a suitable transmission (not shown) enclosed in a housing 57. The hydraulic drive motors may be driven together at the same speed, or may be driven at different speeds and in different directions to facilitate turning of the truck.

From the preceding description, it can be seen that there is provided an improved lift truck construction which provides a clear view between the uprights while at the same time providing essentially the same lifting action as in a conventional truck in which the lift rams are mounted between the uprights. This is accomplished without increasing the overall length of the truck.

While one form of the invention has been shown and described, it will be appreciated that this is for the purpose of illustration and that changes and modifications may be made therein without departing from the spirit and scope of the invention.

I now claim:

1. An industrial truck comprising

(a) a wheel supported frame,

(b) a pair of vertically extending, laterally spaced uprights,

(c) means pivotally mounting said uprights on said frame adjacent the lower ends of said uprights for fore and aft tilting movement,

(d) means for tilting said uprights,

(e) a load carriage mounted for vertical movement on said uprights,

(f) an operator's seat on said frame behind said uprights,

(g) a hydraulic lift ram having a cylinder mounted on a vertically extending base plate,

(h) a cross head secured to rearwardmost end of said piston rod,

(i) a series of multiplying sheaves,

(j) means mounting certain of said multiplying sheaves on said cross head in a position extending along each side of said cylinder when said piston rod is in its retracted position, and means mounting other of said multiplying sheaves on said base plate in a position also extending along each side of each cylinder whereby extension of the piston rod moves said sheaves on said cross head away from said sheaves on said base plate,

(k) a sheave mounted on each upright adjacent the upper end thereof, and a sheave mounted on each upright at the lower end thereof adjacent the point of pivotal attachment of the uprights to the frame,

(l) a flexible lifting element attached to the load carriage adjacent each side thereof and extending upwardly from the load carriage in front of each upright, around the sheave mounted at the top of each upright, downwardly around the sheave mounted on the lower end of each upright, and around the multiplying sheaves carried by said cross head and base plate associated with the horizontally disposed lift ram, whereby extension of the piston rod of said lift ram results in lifting of said load carriage on said uprights, and

(m) guide means associated with said cross head and

frame of said truck for stabilizing said lift ram during operation thereof.

2. In combination with an industrial truck having,
(a) a wheel supported frame,
(b) a pair of vertically extending, laterally spaced uprights,
(c) means pivotally mounting said uprights on said frame adjacent the lower ends of said uprights for fore and aft tilting movement,
(d) means for tilting said uprights,
(e) a load carriage mounted for vertical movement on said uprights,
(f) an operator's seat positioned rearwardly of said uprights,
(g) a hydraulic lift ram having a cylinder mounted on a vertically extending base plate in a horizontal position extending in a fore and aft direction rearwardly of the uprights and a piston rod reciprocable within said cylinder,
(h) a cross head secured to the rearwardmost end of said piston rod,
(i) a series of multiplying sheaves,
(j) means mounting certain of said multiplying sheaves on said cross head in a position extending along each side of said cylinder when said piston is in its retracted position, and means mounting other of said multiplying sheaves on said base plate in a position also extending along each side of said cylinder whereby extension of the piston rod moves said sheaves on said cross head away from said sheaves on said base plate,
(k) a sheave mounted on each upright adjacent the upper end thereof, and a sheave mounted at the lower end of each upright adjacent the point of pivotal attachment of the uprights to the frame,
(l) a flexible lifting element attached to the load carriage adjacent each side thereof and extending upwardly from the load carriage in front of each upright, around the sheave mounted at the top of each upright, downwardly around the sheave mounted at the lower end of each upright, and around the multiplying sheaves carried by said cross head and base plate associated with the horizontally disposed lift ram whereby extension of the piston rod of said lift ram results in lifting of said load carriage on said uprights, and
(m) guide means cooperating with said cross head and frame of said truck for supporting said lift ram during its operation.

3. In combination with an industrial truck having
(a) a wheel supported frame,
(b) a pair of vertically extending, laterally spaced uprights,
(c) means pivotally mounting said uprights on said frame adjacent the lower ends of said upright for fore and aft tilting movement,
(d) means for tilting said uprights,
(e) a load carriage mounted for vertical movement on said uprights,
(f) an operator's seat located rearwardly of said uprights,
(g) a hydraulic lift ram having a cylinder mounted on a vertically extending base plate in a horizontal position extending in a fore and aft direction upwardly of the uprights, and a piston rod reciprocable within said cylinder,
(h) a cross head secured to the rearwardmost end of said piston rod,
(i) a series of multiplying sheaves,
(j) means mounting certain of said multiplying sheaves on said cross head and means mounting other of said multiplying sheaves on said base plate whereby extension of said piston rod moves said sheaves on said cross head away from said sheaves on said base plate,
(k) a sheave mounted on each upright adjacent the

upper end thereof, and a sheave mounted at the lower end of each upright adjacent the point of pivotal attachment of the uprights to the frame,
(l) a flexible lifting element attached to the load carriage adjacent each side thereof and extending upwardly from the load carriage in front of each upright, around the sheave mounted at the top of each upright, downwardly around the sheave mounted at the lower end of each upright, and around the multiplying sheaves carried by said cross head and base plate associated with the horizontally disposed lift ram, whereby extension of the piston rod of said lift ram results in lifting of said load carriage on said uprights, and
(m) guide means operatively connected to said cross head and said frame for limiting tilting movement of said ram during operation thereof.

4. An industrial truck comprising
(a) a wheel supported frame,
(b) a pair of vertically extending, laterally spaced, hollow uprights,
(c) means pivotally mounting said uprights on said frame adjacent the lower ends of said uprights for fore and aft tilting movement,
(d) means for tilting said uprights,
(e) a load carriage mounted for vertical movement on said uprights,
(f) an operator's seat on said frame behind said uprights,
(g) a hydraulic lift ram having a cylinder centrally mounted on a vertically extending base plate in a horizontal position extending in a fore and aft direction below said operator's seat and rearwardly of the uprights, and a piston rod reciprocable within said cylinder,
(h) a cross head secured to the rearwardmost end of said piston rod,
(i) a series of multiplying sheaves,
(j) means mounting certain of said multiplying sheaves on said cross head in a position extending along each side of said cylinder when said piston rod is in its retracted position, and means mounting other of said multiplying sheaves on said base plate in a position also extending along each side of said cylinder whereby extension of the piston rod moves said sheaves on said cross head away from said sheaves on said base plate,
(k) a sheave mounted on each upright adjacent the upper end thereof, and a sheave mounted on each upright at the lower end thereof adjacent the point of pivotal attachment of the uprights to the frame,
(l) a flexible lifting element attached to the load carriage adjacent each side thereof and extending upwardly from the load carriage in front of each upright, around the sheave mounted at the top of each upright, downwardly within each hollow upright, around the sheave mounted on the lower end of each upright, and around the multiplying sheaves carried by said cross head and base plate associated with the horizontally disposed lift ram, whereby extension of the piston rod of said lift ram results in lifting of said load carriage on said uprights, and
(m) cooperating guide elements carried by the cross head and by the frame of the truck for resisting tilting of the lift ram during operation thereof.

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