Nov. 7, 1961 F. C. PARADISE 3,007,547

LOAD-LIFTING MECHANISM FOR LIFT TRUCK

Original Filed Jan. 8, 1957 2 Sheets-Sheet 1

Fig. 1.

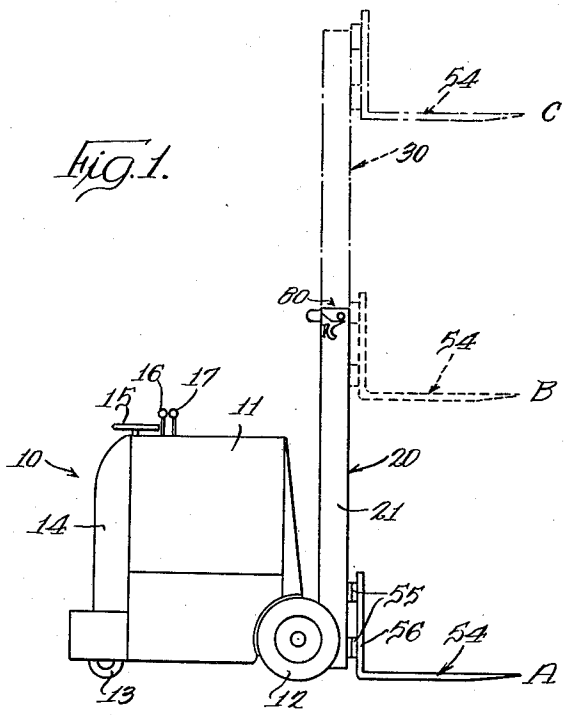


Fig. 3.

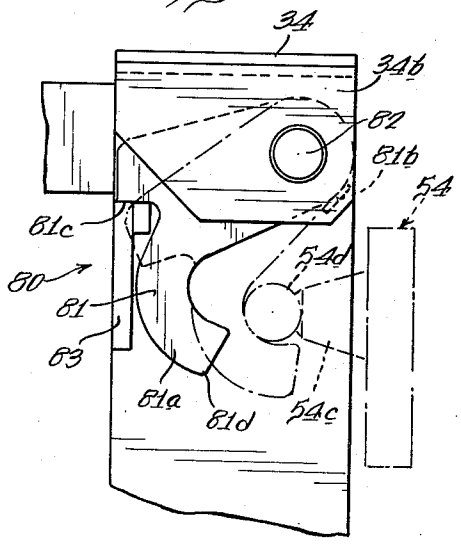
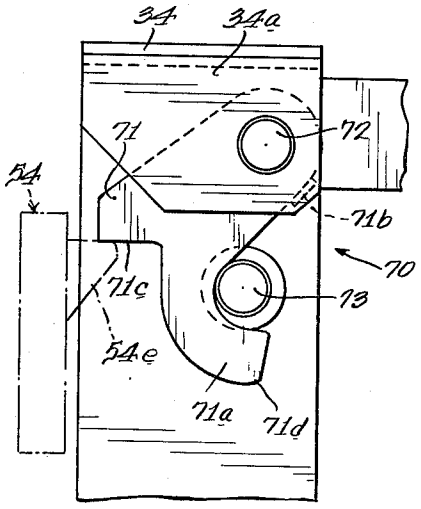


Fig. 4.



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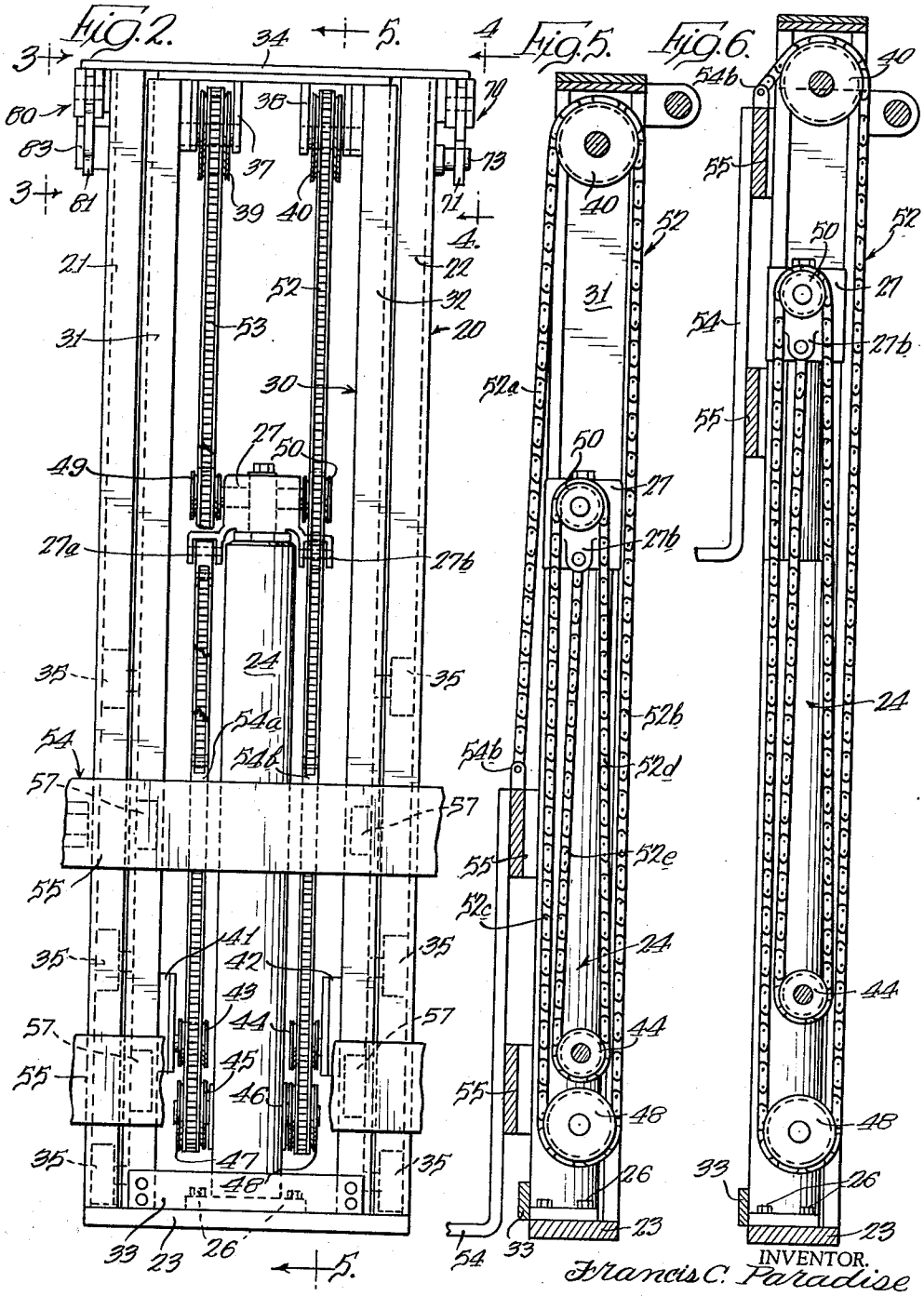
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Nov. 7, 1961 F. C. PARADISE 3,007,547

LOAD-LIFTING MECHANISM FOR LIFT TRUCK

Original Filed Jan. 8, 1957 2 Sheets-Sheet 2



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LOAD-LIFTING MECHANISM FOR LIFT TRUCK

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Continuation of application Ser. No. 633,015, Jan. 8, 1957. This application Oct. 6, 1959, Ser. No. 844,824
9 Claims. (Cl. 187—9)

This invention relates generally to industrial trucks of the load-lifting and transporting type and is more particularly concerned with an improved load-lifting and transporting apparatus of the type conventionally employed in industrial lift trucks, stackers and similar devices for elevating, storing and transporting merchandise to be handled. This application is a continuation of my copending application, Serial No. 633,015, filed January 8, 1957, now abandoned, and assigned to the same assignee as the present application.

Industrial trucks of the character described are generally required to pass through relatively low doorways or the like in going from one section of a warehouse to another, or in depositing merchandise into a boxcar or the like where the overhead clearance is small, after which the articles must be lifted to a height in excess of the clearance provided. To meet this problem, industrial trucks have been designed in which the merchandise or articles to be elevated are picked up or placed on a load-lifting carriage, slidable mounted for vertical movement on an inner mast which is, in turn, telescopically mounted for vertical movement relative to a fixed or stationary mast secured to the truck. In trucks of this character, it is customary to provide a load-lifting mechanism which causes the carriage to move to the top of the inner mast structure, after which the inner mast and the carriage are moved conjointly in order to raise the load to a height sufficient for tiering of the articles being handled. The load-lifting mechanisms presently in use for effecting this result generally comprise a single hydraulic ram or piston and cylinder assembly, a pair of chains each attached at one end to the load-lifting carriage and at the other end to the ram plunger and a number of sprockets or guide members around which each chain is reeved in such manner that actuation of the ram causes the load-lifting carriage to be raised along the inner mast at three times the speed of movement of the ram until the carriage reaches the upper end of the inner mast, after which the inner mast and the carriage are moved together until the inner mast is fully extended from the fixed mast. While a load-lifting mechanism of the type described has been used before, its operation has not been entirely satisfactory due to the fact that the chaining or order of reeving employed has been such that what may be referred to as S type curves are produced by the successive passages of the chains over the sprockets or idler members. With these prior art arrangements the sprockets must be offset one from the other in order to enable their engagement with the proper chain portions rather than being vertically aligned as would be desirable in order to produce a simple, compact structure providing optimum visibility to the truck operator.

In accordance with the present invention the chains are so reeved about the guide members that only oval or generally O curves are produced in which the different runs of the chains form straight lines extending substantially parallel to each other, thereby decreasing the overall length of the chain and also simplifying construction of the various brackets and supports holding the guide members. As a result, the stucture produced by use of the present invention is much more compact and considerably less complex than prior art devices and the guide

members are in substantial vertical alignment so that the visibility is improved.

The primary object of the present invention is, therefore, to provide an improved chaining arrangement for use in load-lifting trucks to achieve the advantages described above.

The invention both as to its organization and method of operation, together with futher objects and advantages, will best be understood by reference to the specification taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view illustrating an industrial truck embodying the features of the present invention;

FIG. 2 is an enlarged, fragmentary, front elevational view illustrating a load-lifting mechanism characterized by the features of the present invention;

FIG. 3 is an enlarged fragmentary view taken along a line substantially corresponding to the line 3—3 in FIG. 2 and illustrating particularly the mechanism for latching the load-lifting carriage to the inner mast structure;

FIG. 4 is an enlarged fragmentary view taken along a line substantially corresponding to the line 4—4 in FIG. 2 and illustrating particularly the latching mechanism for preventing relative movement between the telescoping masts until the load-lifting carriage has been raised to a position near the upper end of the inner mast structure;

FIG. 5 is a sectional view taken along a line substantially corresponding to the line 5—5 in FIG. 2 showing the load-lifting carriage at the bottom of the inner mast and illustrating particularly the order of reeving of the chains in accordance with the present invention; and

FIG. 6 is a view similar to FIG. 5 but illustrating the load-lifting mechanism in a position where the inner mast is partially extended from the fixed or outer mast.

Referring now to the drawings and particularly to FIG. 1 thereof, an industrial truck of conventional construction is generally indicated at 10 and includes a body 11 supported upon driving wheels 12 and steering wheels 13. The body 11 may also include, in accordance with conventional practice, a counterweight 14 which balances the load and prevents tipping of the truck. The driver or operator, of course, stands or sits upon the body 11 to operate the truck. To this end, the body is illustrated as including a steering wheel 15, a control 16 by which the vehicle is moved in forward or reverse directions, and a control 17 for actuating the load-lifting mechanism to control the raising or lowering of the load in the manner described below.

The load-lifting mechanism comprises a fixed mast or frame structure indicated generally at 20 and including a pair of upright legs 21 and 22 (FIG. 2) in the form of channel members which are secured to a base 23 on the body 11 and which extend parallel to each other with their channels opening inwardly, or toward each other. The mast structure 20 may, of course, be mounted for tilting or pivotal movement relative to the base 23 but this forms no part of the present invention and hence is not illustrated.

As illustrated in FIG. 2, the base 23 also supports a ram or cylinder and piston assembly indicated generally at 24 and suitably secured to the base as, for example, by means of bolts 26. The piston or ram of the assembly 24 carries a cross-head or ramp structure 27 so that the introduction of fluid to the lower end of the piston results in raising the ramp 27. Telescopically mounted within the fixed mast structure 20 is an inner mast structure indicated generally as 30 and including a pair of upright channel members 31 and 32 secured together in facing relationship by means of a lower support brace 33 and an upper support 34. To facilitate sliding movement of the inner mast 30 relative to the

outer mast 20, the former is provided with a plurality of spaced apart rollers which are received within the channel members 21 and 22. Any desired number of such rollers may be provided and each is dimensioned to be closely received within its associated channel member in order to prevent the inner mast structure from rocking or vibrating about the fixed mast. Each of the rollers 35 is, of course, suitably journaled within appropriate brackets provided on the uprights 31 and 32.

The upper support 34 is provided with depending, downwardly extending brackets 37 and 38 respectively mounting guide members or sheaves 39 and 40. Each of the sheaves 39 and 40 is mounted upon a stub shaft journaled within its associated bracket and, as a result, these sheaves are carried near the upper end of the inner mast structure 30. The inner mast also carries a pair of fixed brackets 41 and 42 mounted near its lower end for rotatably supporting a pair of guide members or sheaves 43 and 44, respectively. Brackets 45 and 46 are secured to the lower end of the fixed cylinder of the ram assembly 24 for the purpose of rotatably supporting sheaves or guide members 47 and 48. Therefore, the latter sheaves are mounted in fixed positions adjacent the lower end of the outer or fixed mast 20. The ramp or crosshead 27 includes appropriate trunnions for supporting a pair of sheaves or guide members 49 and 50. The various brackets described are so dimensioned that the sheaves 39, 43, 47 and 49 are co-planar, that is, these sheaves are aligned in a vertical plane extending normal to the plane of the masts 20 and 30 as illustrated in FIG. 2. The sheaves 40, 44, 48 and 50 are similarly aligned. In addition, as will be apparent from FIGS. 5 and 6, these sheaves are also substantially aligned in a vertical plane extending in the plane of the masts 20 and 30 although the sheaves 49 and 50 obviously lie a small distance beyond the latter plane, so that the corresponding sets of sheaves 39, 43, 47 and 49, and 40, 44, 48 and 50 are respectively arranged substantially linearly.

As will be evident from FIGS. 5 and 6, a pair of flexible members or chains 52 and 53, which are respectively secured at one end to anchors 54*b* and 54*a* on a load-lifting carriage or carriage structure 54, are reeved over the guide members of sheaves described above and are respectively secured at their other ends to anchors 27*b* and 27*a* carried on the ramp 27. Specifically, the flexible member 52 extends from the anchor 54*b* upwardly in substantially a straight line as indicated by portion or run 52*a*, where it passes around sheave 40 and extends downwardly in a straight line as indicated by portion 52*b*, passes around sheave 48, extends upwardly in a straight line as indicated by portion 52*c*, is trained over sheave 50, extends downwardly in substantially a straight line as indicated by portion 52*d*, is trained over sheave 44 and extends upwardly in substantially a straight line as indicated by portion 52*e* where it is suitably secured to the trunning anchor 27*b*. In a similar manner, the chain 53 is trained over the sheaves 39, 47, 49 and 43 in the order named and is then secured to anchor 27*a* on the ramp 27. Thus, the chains 52 and 53 are reeved or wound in such manner that a plurality of substantially concentric O or oval-shaped curves are produced, in which all of the runs of the chain lie in a single plane as indicated in FIG. 2 and in which each run is substantially a straight line. Thus, the described chaining arrangement avoids the use of so-called S curves as employed in all prior constructions and also avoids crossovers between the different chain runs, thereby reducing the length of chain employed, considerably simplifying both the chain itself and the various brackets and supports for the sheaves around which the chain is reeved. The use of a shorter chain also reduces frictional losses and insures more efficient load-lifting action. This chaining arrangement also permits the favorable sheave alignment described above and, hence, reduces the width of the frame structure thereby increasing the visibility so that the operator is better able to manipulate the vehicle and handle the load.

As will be evident to those familiar with this art, when hydraulic fluid is delivered to the ram assembly 24 by means of the control 17, the ramp or crosshead 27 is raised thereby lengthening the runs 52*c*, 52*d* and 52*e* of the chain 52 and also lengthening the corresponding runs of the chain 53. This lengthening is, of course, compensated for by a reduction of length of the run 52*a* and the corresponding run of chain 53 as the carriage 54 is lifted along the inner mast 30. Obviously, therefore, the speed of upward movement of the load-lifting carriage is three times that of the ramp 27. When the anchors 54*a* and 54*b* reach positions adjacent the sheaves 39 and 40, respectively, the feeding of chain into the system from the carriage end is terminated. Consequently, as the sheaves 49 and 50 on the ramp 27 continue to rise, the upper and lower sheaves on the inner mast and the inner mast itself begin to move upwardly thereby shortening the chain runs 52*d* and 52*e* while the runs 52*b* and 52*c* are lengthened. As a result of the described action, the load-lifting carriage 54 is first moved from position A illustrated in FIG. 1 to position B located near the upper end of the inner mast 30 at a speed equal to three times the speed of movement of the ramp 27 after which the carriage and the inner mast are moved conjointly at a speed which is also equal to three times the speed of movement of the ramp. When the inner mast is fully extended, the carriage 54 is located at position C illustrated in FIG. 1. Obviously, when the control 17 is actuated to lower the ramp 27 the inner mast is retracted within the fixed mast 20 at a speed equal to three times the speed of descent of the ramp 27 and, after the two masts are fully telescoped, carriage 54 is lowered along the mast 30 also at a speed equal to three times the rate of descent of the ramp 27.

The load-supporting carriage, as indicated in FIGS. 1 and 2, comprises a body member 55 including a pair of cross arms or braces extending generally transverse to the uprights 31 and 32 of the inner mast and this body member carries a pair of generally L-shaped lift fingers or forks 56. The body member 55 also has rearwardly extending brackets (not shown) on each side thereof extending between the uprights 31 and 32 for the purpose of carrying suitable rollers 57. These rollers are accommodated within the channels of the members 31 and 32 in order to guide the carriage for vertical movement relative to the inner mast 30.

As indicated above, FIG. 1 illustrates the load-lifting carriage 54 at three positions designated A, B and C. Position A, of course, is the lowermost carriage position in which the load is adapted to be deposited upon the fingers 56. Position B illustrates the carriage as it reaches the upper end of the inner mast 30, and position C represents the position of the carriage with the inner mast fully extended relative to the fixed mast 20. Since the ram assembly 24 in collapsed position is approximately two-thirds of the height of the fixed mast 20, the movement of the ramp 27 to a position adjacent the upper end of the fixed mast 20 results in raising the load-lifting carriage 54 to position B illustrated in FIG. 1. Further movement of the carriage 54 relative to the mast 30 is prevented by suitable latching mechanism described below and, consequently, from this time on the carriage 54 moves conjointly with the inner mast 30 as the latter slides vertically out of the fixed mast 20. Further movement of the ramp 27 through a distance of approximately one-third of the length of the inner mast 30 results in the inner mast being raised to its fully extended position by virtue of the three-to-one lifting ratio described above.

In a load-lifting mechanism of the type described, it is desirable that the inner mast 30 be prevented from moving relative to the fixed mast 20 until the load-lifting

carriage has reached the upper end of the inner mast, thereby to prevent both the load-lifting carriage **54** and the inner mast from being moved upwardly simultaneously at the start of the load-lifting operation. Moreover, in lowering the load-lifting mechanism from the fully extended position indicated at C in FIG. 1, it is important that the carriage **54** be prevented from moving along the inner mast until the latter has been fully retracted into the fixed mast **20**. The latching mechanism illustrated in FIGS. 2, 3 and 4 is adapted to achieve the desirable results described. This latching means actually comprises a first latching mechanism indicated at **70** and best shown in FIG. 4, which functions to lock the inner and outer masts together until released by the upward movement of the carriage **54** when the latter is elevated to the top of the mast **30**, together with a second latching mechanism **80** best shown in FIG. 3, which is effective when the masts **20** and **30** are in their nested positions. Specifically, the latching mechanism **70** comprises a latch member **71** mounted for pivotal movement about a pin **72** supported by depending flange member **34***a* on the upper support **34** of the inner mast **30**. The latch member **71** includes a latching finger **71***a* which is adapted to engage a dogging pin **73** secured to the upright **22**. The latch member **71** is gravity-operated and is so weighted that it normally tends to pivot about the pin **72** to the position illustrated in FIG. 4 wherein it engages the dogging pin **73** and prevents relative movement between the masts **20** and **30**. Counterclockwise rotation of the latch member **71** is limited by engagement of a stop **71***b* with a portion of the bracket **34***a*. The latch member **71** therefore remains in engagement with the dogging pin **73** until upward movement of the carriage **54** causes an operating element **54***e* attached to the carriage to engage surface portion **71***c* of the latch member **71**. When the member **54***e* engages surface portion **71***c*, the continued upward movement of the carriage **54** causes the latch member **71** to pivot in a clockwise direction as viewed in FIG. 4 about the pin **72**, thereby to release the masts **20** and **30** in order to permit the carriage **54** and the inner mast to be moved upwardly together.

The stop **71***b* makes the operation of the latch mechanism **70** foolproof. Thus, if the latch member **71** should happen to be rotated in a clockwise direction and held in this position while the inner mast and the carriage are simultaneously raised, the stop **71***b* so positions the latch member that a camming surface **71***d* on the finger **71***a* engages the pin **73** when the inner mast is lowered to its nested or fully retracted position. The camming surface **71***d* and the pin **73** coact to pivot the latch member **71** in a closkwise direction as viewed in FIG. 4 to reset the latch mechanism and prevent movement between the inner and outer masts.

The second latching mechanism **80** includes a latch member **81** which is in all respects similar to the member **71** described above. Thus, the latch member **81** is mounted for pivotal movement about a pin **82** carried by a bracket **34***b* secured to the upper support **34** and, accordingly, this latch member is mounted for pivotal movement about a point near the upper end of upright **31** of the inner mast. When the inner mast **30** is nested within the fixed mast **20** the latch member **81** is held in the solid line position illustrated in FIG. 3 due to the fact that the surface portion **71***c* is in engagement with an arm **83** fixedly secured to the upright **21** of the fixed mast. When the inner mast is extended upwardly from the fixed mast in the manner described above, the surface **81***c* moves out of engagement with the arm **83** and as a result the latch member **81**, which is gravity-operated, pivots about pin **82** and engages a dogging pin **54***d* carried upon fixed structure **54***c* of the carriage **54**. Thus, shortly after the inner mast begins to extend, the latch member pivots by gravity to the broken line position illustrated in FIG. 3 whereupon the finger **81***a* embraces the pin **54***d* and prevents movement between the load-lifting carriage **54** and the inner mast **30**. When the inner mast is fully retracted within the fixed mast during lowering movement, the arm **83** again strikes the surface position **81***c* to pivot the latch member **81** in a clockwise direction in order to release the carriage for lowering movement along the inner mast **30**. A stop **81***b* carried by the latch member **81** engages a portion of the bracket **34***b* to limit the counterclockwise rotation of the latch member **81** as viewed in FIG. 3, thereby making the latch mechanism **80** foolproof in operation. Thus, if the latch member **81** is held in the broken line illustrated in FIG. 3 it is automatically reset by engagement of the pin **54***d* with surface portion **81***d* of the finger **81***a* when the carriage is raised to the top of the inner mast **30**. In this manner, proper operation of the latching mechanism **80** is assured.

In view of the foregoing description, it will be recognized that the present invention provides a novel chaining arrangement which results in greatly simplified construction and in improvement of visibility to facilitate maneuvering of the truck and manipulation of the load. In addition, the latch mechanism described assures that the movable elements of the truck will be actuated in their proper sequence to effect the desired lifting of the load.

While a particular embodiment of the invention has been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made and it is therefore contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast; a telescopic mast slidable relative to said fixed mast; a load-lifting carriage mounted for slidable movement on said telescopic mast; and means for raising both said carriage and said telescopic mast comprising a ramp and a fluid piston and cylinder assembly controlling vertical movement of said ramp, said means including a first guide member carried near the upper end of said telescopic mast, a second guide member fixedly positioned near the lower end of said fixed mast, a third guide member carried by said ramp, a fourth guide member carried by said telescopic mast at a position near its lower end, and a flexible member connected at one end to said carriage, trained over said first, second, third and fourth guide members in the order named and secured at its other end to said ramp.

2. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast; a telescopic mast slidable relative to said fixed mast; a load-lifting carriage mounted for slidable movement on said telescopic mast; and means for raising both said carriage and said telescopic mast comprising a ramp and a fluid piston and cylinder assembly controlling vertical movement of said ramp, said means including a first guide member carried near the upper end of said telescopic mast, a second guide member fixedly mounted near the lower end of said fixed mast, a third guide member carried by said ramp, a fourth guide member carried by said telescopic mast at a position near its lower end, and a flexible member connected at one end to said carriage, trained over said first, second, third and fourth guide members in the order named and secured at its other end to said ramp, said guide members lying in one common vertical plane and being so positioned that the runs of the flexible member in passing between the different guide members form straight lines extending substantially parallel to each other.

3. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast; a telescopic mast slidable relative to said fixed mast; a load-lifting carriage mounted for slidable movement on said telescopic mast; and means for raising both said carriage and said telescopic mast comprising a ramp and a fluid piston and cylinder assem-

bly reacting upon said first frame structure to control movement of said ramp, said means including a first rotatable guide member carried near the upper end of said telescopic mast, a second rotatable guide member fixedly mounted near the lower end of said fixed mast, a third rotatable guide member carried by said ramp, a fourth rotatable guide member carried by said telescopic mast at a position near its lower end, and a flexible chain connected at one end to said carriage, passing in a first run upwardly and around said first guide member, passing in a second run downwardly and around said second guide member, passing in a third run upwardly and around said third guide member, passing in a fourth run downwardly and around said fourth guide member and passing in a fifth run upwardly to a connection with said ramp, said guide members lying in a common vertical plane and being so arranged that said first, second and fourth runs extend substantially parallel to each other and substantially parallel to said third and fifth runs so that there are no crossover points between the five runs of the flexible member.

4. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast; a telescopic mast slidable relative to said fixed mast; a load-lifting carriage mounted for slidable movement on said telescopic mast; and means for raising both said carriage and said telescopic mast comprising a ramp and a fluid piston and cylinder assembly reacting upon said first frame structure to control movement of said ramp, said means including a first rotatable guide member carried near the upper end of said telescopic mast, a second rotatable guide member fixedly mounted near the lower end of said fixed mast, a third rotatable guide member carried by said ramp, a fourth rotatable guide member carried by said telescopic mast at a position near its lower end, and a flexible chain connected at one end of said carriage, passing in a first run upwardly and around said first guide member, passing in a second run downwardly and around said second guide member, passing in a third run upwardly and around said third guide member, passing in a fourth run downwardly and around said fourth guide member and passing in a fifth run upwardly to a connection with said ramp, said first guide member having a diameter slightly greater than that of the second guide member and said third and fourth guide members having diameters which are less than the diameters of each of said first and second guide members, said guide members lying in a common vertical plane and the axes of said first, second and fourth guide members being in substantially vertical alignment, whereby said first, second and fourth runs extend parallel to each other and substantially parallel to said third and fifth runs so that there are no crossover points between the five runs of the flexible member.

5. In an industrial truck, a load-lifting apparatus comprising a first upright frame structure; a second upright frame structure slidably and telescopically mounted within said first frame structure; a load-lifting carriage mounted for slidable movement on said second frame structure; and means for actuating said load-lifting carriage and said second frame structure comprising a fluid clyinder and piston assembly disposed centrally of both of said frame structures; a ramp actuated by said piston for movement centrally of both of said frame structures, a first pair of guide members mounted on opposed sides of said second frame structure near its upper end, a second pair of guide members mounted on opposed sides of said assembly near the lower end of said first frame structure, a third pair of guide members mounted on opposed sides of said ramp, a fourth pair of guide members mounted on opposed sides of said second frame structure at a position near its lower end, and a pair of chains each secured at one end to said carriage and at its other end to said ramp, one of said chains being trained over one of the guide members of the first pair, one of the guide members of the second pair, one of the guide members of the third pair and one of the guide members of the fourth pair in the order named and the other chain being trained over the other guide member of the first pair, the other guide member of the second pair, the other guide member of the third pair and the other guide member of the fourth pair in that order.

6. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast structure; a telescopic mast structure slidable relative to said fixed mast structure; a load-lifting carriage structure mounted for slidable movement on said telescopic mast structure; and means for raising both said carriage structure and said telescopic mast structure comprising a ramp structure and a fluid piston and cylinder assembly controlling vertical movement of said ramp structure, said means including a plurality of guide members carried on selected ones of said structures, and a flexible member connected to certain ones of said structures and trained over said guide members to consist exclusively of substantially concentric, generally O-shaped curves, said guide members being arranged to provide in response to vertical movement of said ramp structure successive movements of said carriage structure and said telescopic mast structure at different rates with said carriage structure first moving along said telescopic mast structure at three times the rate of movement of said telescopic mast structure, and with said telescopic mast structure and said carriage structure then moving upwardly together at the same rate.

7. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast; a telescopic mast slidable relative to said fixed mast; a load-lifting carriage mounted for slidable movement on said telescopic mast; and means for raising both said carriage and said telescopic mast comprising a ramp and a fluid piston and cylinder assembly controlling vertical movement of said ramp, said means including a first guide member carried near the upper end of said telescopic mast, a second guide member fixedly positioned near the lower end of said fixed mast, a third guide member carried by said ramp, a fourth guide member carried by said telescopic mast at a position near its lower end, said members being coplanar and vertically arranged substantially linearly, and a flexible member connected at one end to said carriage and secured at its other end to said ramp and trained over said guide members to form generally O-shaped curves.

8. The industrial truck defined by claim 7 wherein the said first and second guide members are of a larger diameter than said third and fourth guide members.

9. In an industrial truck, a load-lifting apparatus comprising an upright fixed mast; a telescopic mast slidable relative to said fixed mast; a load-lifting carriage mounted for slidable movement on said telescopic mast; and means for raising both said carriage and said telescopic mast comprising a ramp and a fluid piston and cylinder assembly controlling vertical movement of said ramp, said means including a first guide member carried near the upper end of said telescopic mast, a second guide member fixedly positioned near the lower end of said fixed mast, a third guide member carried by said ramp, a fourth guide member carried by said telescopic mast at a position near its lower end, and a flexible member connected at one end to said carriage and secured at its other end to said ramp and trained over said guide members in such manner as to consist exclusively of coplanar, substantially concentric oval-shaped curves.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,007,547 November 7, 1961

Francis C. Paradise

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 36, for "of" read -- to --.

Signed and sealed this 17th day of April 1962.

(SEAL)
Attest:

ESTON G. JOHNSON
Attesting Officer

DAVID L. LADD
Commissioner of Patents