Feb. 15, 1966 G. F. QUAYLE 3,235,033

TRIPLE LIFT TRUCK WITH CONNECTED LIFT CHAINS

Filed Oct. 2, 1962 3 Sheets-Sheet 1

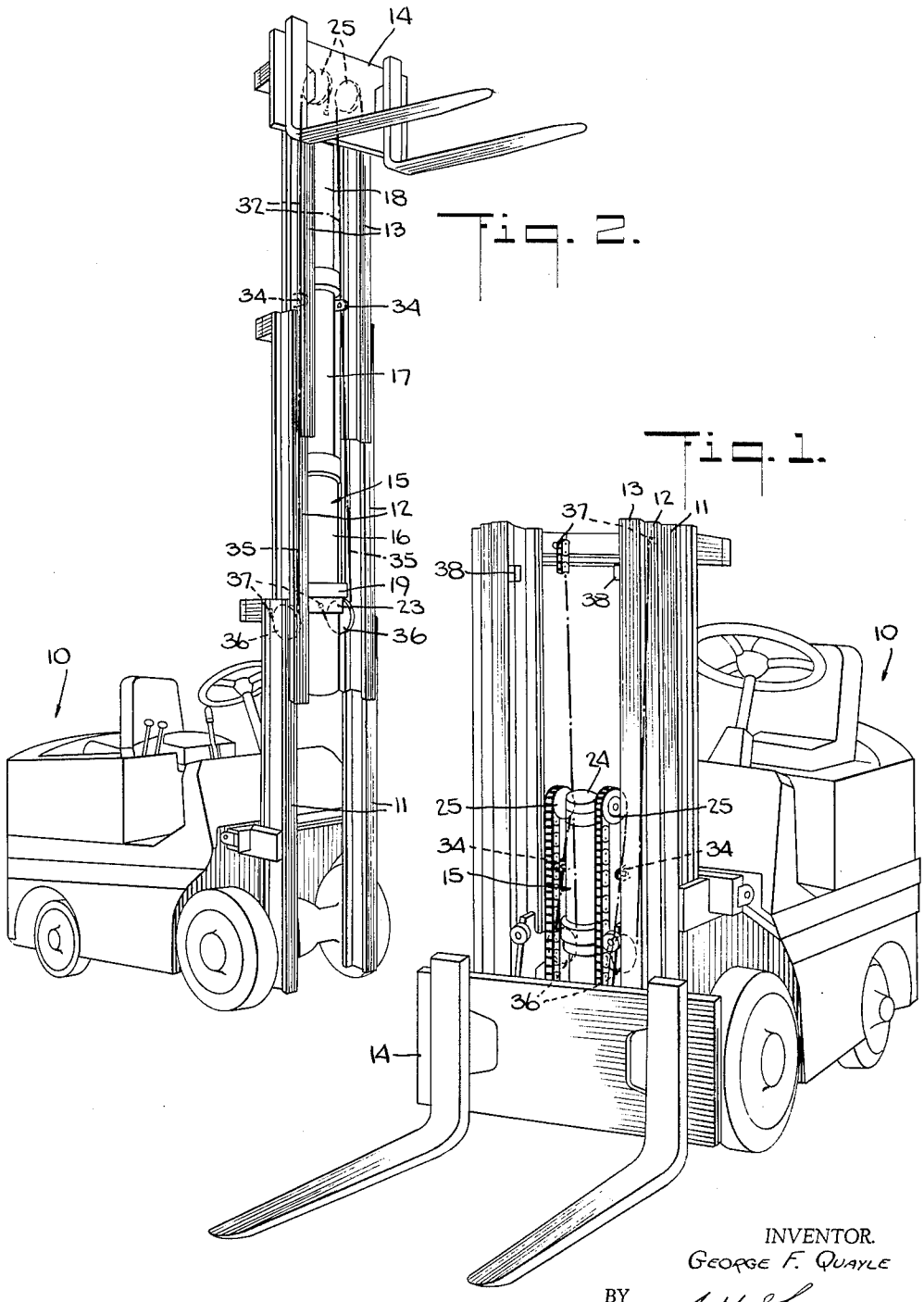


Fig. 2.

Fig. 1.

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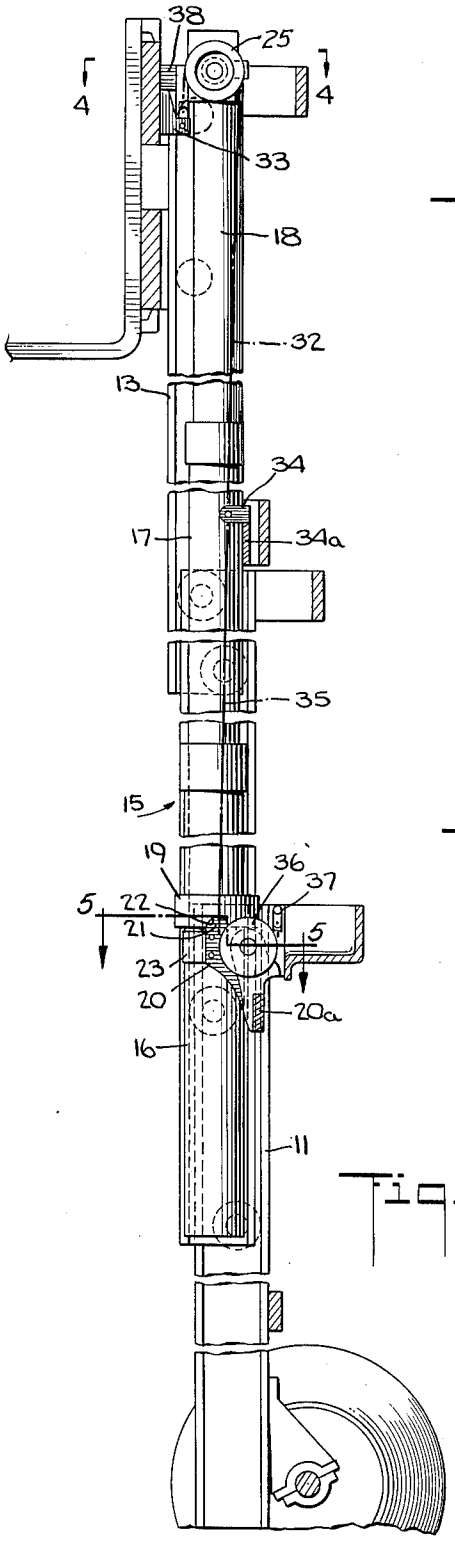


Fig. 8.

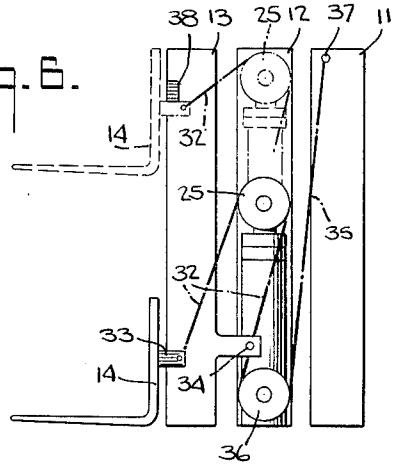


Fig. 6.

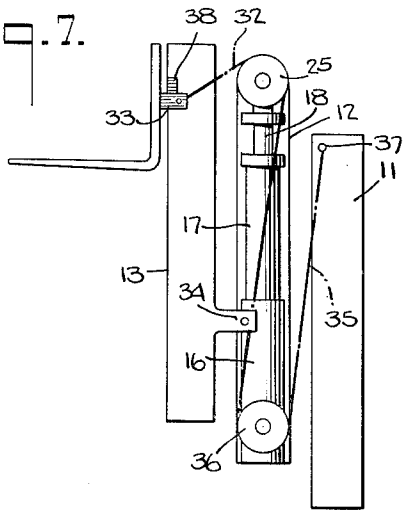


Fig. 7.

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TRIPLE LIFT TRUCK WITH CONNECTED LIFT CHAINS

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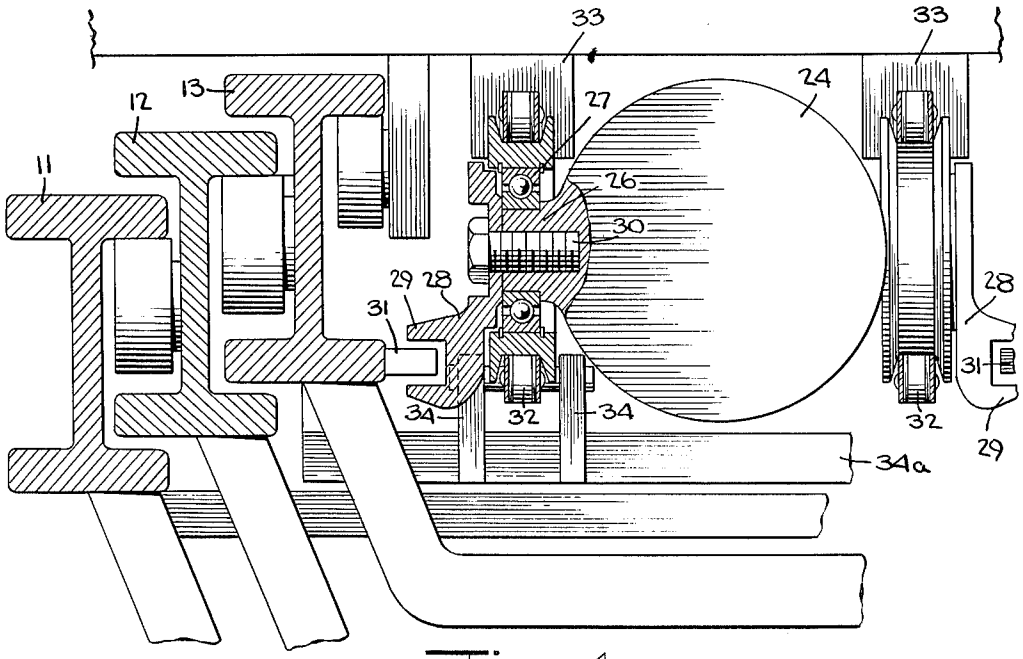


Fig. 4.

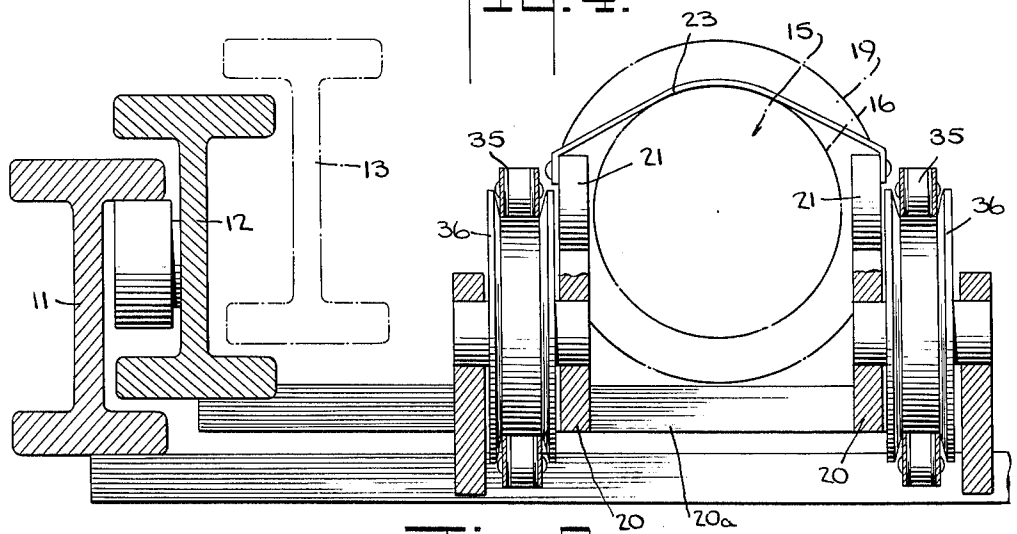


Fig. 5.

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TRIPLE LIFT TRUCK WITH CONNECTED LIFT CHAINS

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4 Claims. (Cl. 187—9)

This invention relates to a lift truck of the type utilizing a series of telescoping uprights, and more particularly, three sets of telescoping uprights, which, when extended, permit high lifting of a load while allowing the truck to have relatively low overall height when the uprights are lowered.

In trucks of this type, it is desirable that the load carriage have substantial "free lift," i.e., vertical movement without corresponding vertical extension of the uprights. This allows a load to be lifted from the floor without increasing the overall height of the truck, thereby permitting operation of the loaded truck in areas of low overhead.

In order to obtain this "free lift" of the load carriage, it is important that the tertiary uprights be prevented from being lifted by the load carriage through binding or friction between the load carriage and the tertiary uprights.

It is also important when lowering the tertiary uprights and load carriage from an elevated position that sufficient force be applied to the tertiary uprights to overcome binding or friction between the tertiary uprights and secondary uprights. This assures that the tertiary uprights move downwardly with the load carriage during the lowering of the load and do not remain elevated and then drop suddenly with substantial damage to the truck, when the load on the carriage effecting the binding or friction is removed.

Heretofore, movement of the tertiary uprights by the load carriage during "free lift" and independent movement of the load carriage relatively to the extended tertiary uprights has been prevented by either the use of a complicated, rather expensive system of latches, or by the use of a complicated, expensive hydraulic lift ram structure which keeps the tertiary uprights down until the load carriage has achieved "free lift," and which prevents independent lowering of the load carriage relatively to the tertiary uprights until the tertiary uprights have been completely lowered.

The purpose of this invention is to provide a simplified lift arrangement which prevents movement of the tertiary uprights during "free lift" and prevents independent downward movement of the load carriage relatively to the tertiary uprights when the tertiary uprights are elevated, without the use of latches or the use of a special ram structure. Thus, the lift arrangement of the invention eliminates the expense of fabricating and assembling special latches, and permits the use of a simple, relatively inexpensive lift ram having an overall collapsed length substantially less than the collapsed uprights, thereby improving operator visibility through the uprights. This is accomplished in accordance with the invention by a novel arrangement of the lift ram, lift chains and uprights in which the left ram is mounted on the secondary uprights and the lift chains connected to the tertiary uprights, whereby the weight of the secondary uprights, tertiary uprights and ram is effective to hold the tertiary uprights down during "free lift," and to pull the tertiary uprights down with the load carriage during lowering of a load.

Other objects and advantages of the invention will become apparent from the following description when

read in conjunction with the accompanying drawings wherein:

FIG. 1 is perspective view of a lift truck constructed in acordance with the invention, showing the uprights and load carriage in the lowered position;

FIG. 2 is a perspective view, similar to that of FIG. 1, but showing the uprights and load carriage in an elevated position;

FIG. 3 is a sectional view of the uprights and load carriage in the elevated position;

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

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 3; showing the mounting of the lift ram;

FIG. 6 is a schematic drawing of the uprights, load carriage lift ram and lift chains, showing in full lines the fully lowered position of the load carriage and showing in broken lines, the position of the load carriage and lift ram after "free lift" of the load carriage; and

FIG. 7 is a schematic drawing, similar to that of FIG. 6, but showing tertiary uprights and secondary uprights partially elevated.

Referring to the drawings and in particular to FIGS. 1 and 2, the lift truck 10 of the invention includes stationary or primary uprights 11, secondary uprights 12 mounted for vertical movement on the primary uprights 11, tertiary uprights 13 mounted for vertical movement on the secondary uprights 12, a load carriage 14 mounted for vertical movement on the tertiary uprights 13, and a lift ram 15 for elevating the secondary uprights 12, the tertiary uprights 13 and the load carriage 14.

In accordance with the invention, the lift ram 15 is a simple multiple piston ram including a cylinder 16, a first telescoping tubular piston 17 mounted for sliding movement in the cylinder 16 and a second telescoping piston 18 mounted for sliding movement in the tubular piston 17. The cylinder 16 of the lift ram 15 is mounted on the secondary uprights 12 through a collar 19 which is secured to the cylinder and which rests on brackets 20 which are secured to the secondary uprights 12. As best shown in FIGS. 3 and 5, the brackets 20 are secured to the secondary uprights through a cross brace 20*a* which is secured at opposite ends to the secondary uprights 12. Each bracket 20 has an upwardly projecting portion 21 providing a cylindrical outer surface which fits into a cylindrical recess 22 formed in the lower side of the collar 19 so that the cylinder 16 may rock slightly relatively to the secondary uprights 12. A strap 23 connecting the projecting portions 21 on each side of the ram prevents accidental displacement of the collar 19 from the projecting portions 21. As will be explained in detail hereafter, this mounting of the cylinder 16 of the ram 15 prevents the ram from being subjected to lateral bending stresses.

As best shown in FIGS. 1 and 4, the innermost piston 18 is provided with a cross head 24 which is secured to the outer end thereof and carries sheaves 25. The sheaves 25 are mounted on integral hub portions 26 extending from opposite sides of the cross head 24. The sheaves 25 are mounted for free rotation on the hubs 26 through suitable anti-friction bearings 27. A guide member 28 having a bifurcated end portion 29 is secured to each of the hub portions 26 of the cross head 24 by suitable bolts 30. The bifurcations of the end portions 29 of the guide members 28 extend on each side of a vertical guide rail 31 secured to the inner flange of each of the tertiary uprights 13 to thereby guide the outer end of the inner piston 18 of the ram 15 during extension of the ram. Thus, the ram cylinder 16 being mounted for pivotal or rocking movement on the secondary uprights 12 through the collar 19 and the brackets 20, and the outer end of the inner piston 18 being guided through cooperation between guide members 28 on the outer end of the piston 18 and the

guide rails 31 on the tertiary uprights 13, the ram 15 may rock or pivot so that the ram 15 is not subjected to lateral bending or buckling due to deflection or bending of the uprights under load.

A pair of lift chains 32 are secured at one end to the load carriage 14 through brackets 33, extend over the sheaves 25 carried by the cross head 24 on the outer end of the inner piston 18 and are anchored at the opposite end to the tertiary uprights 13 through brackets 34 which are secured to the tertiary uprights 13. As best shown in FIG. 4, the brackets 34 are secured to the tertiary uprights 13 through a cross brace 34*a* which is secured at opposite ends to the uprights 13.

As best shown in FIGS. 2, 3, 6 and 7, a second pair of lift chains 35 are anchored at one end to the brackets 34, extend downwardly around a pair of sheaves 36 carried by the secondary uprights adjacent the lower ends thereof, and are anchored at their opposite ends to the upper ends of the primary uprights 11 at 37. The chains 35 may actually be formed as continuations of the chains 32 with the chains connected to the tertiary uprights 13 through the brackets 34 so that the portions of the chains above the brackets and the portions of the chains below the brackets 34 function as separate chains. As shown in FIG. 5, the sheaves 36 are conveniently mounted on the supporting brackets 20 which are secured to the secondary uprights 12 and support the cylinder 16 of the ram 15.

Referring now to FIG. 6, when fluid under pressure is introduced into the cylinder 16 of the ram 15, the pistons 17 and 18 first extend, lifting the load carriage 14 to the top of the tertiary uprights 13, through the chains 32, at twice the speed of the ram 15, while the uprights remain in the lowered position. Thus, full free lift of the load carriage 14 is obtained. During this free lift of the load carriage 14, the weight of the tertiary uprights 13 and the weight of the carriage 14 and load, the ram 15 and the secondary uprights 12, acting through the chains 35, which are connected to the tertiary uprights 13 through the brackets 34, effectively hold the tertiary uprights 13 down to prevent upward movement thereof with the load carriage through binding between the carriage 14 and the tertiary uprights 13.

When further upward movement of the load carriage 14 relatively to the tertiary uprights 13 is stopped through engagement of the load carriage with stop members 38, which are secured to the upper ends of the tertiary uprights 13, further extension of the pistons of the ram lifts the load carriage 14 and the tertiary uprights 13, through the chains 32 at the same speed that the pistons of the ram 15 are extended relatively to the secondary uprights 12. At the same time, upward movement of the tertiary uprights 13 is transmitted through the brackets 34 to the chains 35 so that the secondary uprights 12, together wtih the lift ram 15, are lifted through the sheaves 36 relatively to the primary uprights 11, as shown in FIG. 7. This movement of the secondary and tertiary uprights 12 and 13 and the load carriage 14 continues until they reach the fully elevated position as shown in FIG. 3.

During lowering of the load carriage, the reverse sequence takes place with the tertiary uprights 13 and the secondary uprights 12 being first lowered, and the load carriage thereafter being lowered relatively to the tertiary upights 13, until the load carriage is in the position shown in solid lines in FIG. 6. Independent downward movement of the load carriage 14 relatively to the tertiary uprights 13 while the tertiary uprights 13 are in an elevated position is effectively prevented through the weight of the load on the load carriage, the weight of the secondary uprights 12 and the weight of the ram acting on the tertiary uprights 13 through the chains 35 and brackets 34 to pull the tertiary uprights downwardly.

Thus, through this arrangement in which the lift chains are connected to the tertiary uprights, movement of the tertiary uprights during free lift of the load carriage 14 and independent downward movement of the load carriage 14 relatively to the elevated tertiary uprights 13 is effectively prevented without the use of special latches for this purpose, and without the use of a special ram construction.

While one embodiment 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 claim:

1. A lift truck comprising fixed vertical primary uprights, vertically movable secondary and tertiary telescoping uprights mounted on said primary uprights, a load carriage mounted for vertical movement on said tertiary uprights, a stop member for said load carriage on the tertiary uprights, said load carriage directly engaging said stop member when said carriage reaches an upward limit of movement relative to the tertiary uprights, a hydraulic lift ram having relatively movable parts extendible relatively to one another upon application of fluid pressure to said ram, means mounting one of said parts of said ram on said secondary uprights in a vertical position for extension of said ram upwardly vertically relatively to said secondary uprights when said ram is actuated, a sheave mounted adjacent the upper end of the uppermost extendible part of said ram, said ram being of such overall length when collapsed that when mounted on said secondary uprights the upper end of said ram and said sheave are below the upper ends of said uprights, and said uppermost part of the ram being unsecured to said uprights for free extension of said ram relatively to said uprights so that free lift extension of said ram is possible without movement of any of said uprights, a first flexible lift element secured at one end to said load carriage, extending over said ram sheave and secured at its other end to said tertiary uprights, a second lift sheave secured relatively to said secondary uprights adjacent the lower end thereof, and a second flexible lift element secured at one end to said tertiary uprights, extending around said second lift sheave and attached at its other end to said primary uprights.

2. A lift truck comprising fixed vertical primary uprights, vertically movable secondary and tertiary telescoping uprights mounted on said primary uprights, a load carriage mounted for vertical movement on said tertiary uprights, a hydraulic ram having relatively movable parts extendible relatively to one another upon application of fluid pressure to said ram, means mounting one of said parts of said ram on said secondary uprights in a vertical position for extension of said ram upwardly vertically relatively to said secondary uprights when said ram is actuated, a sheave mounted adjacent the upper end of the uppermost extendible part of said ram, said ram being of such overall length when collapsed that when mounted on said secondary uprights the upper end of said ram and said sheave are below the upper ends of said uprights, and said uppermost part of the ram being unsecured to said uprights for free extension of said ram relatively to said uprights so that free lift extension of said ram is possible without movement of any of said uprights, a first flexible lift element secured at one end to said load carriage, extending over said ram sheave and secured at its other end to said tertiary uprights, whereby extension of said ram moves said load carriage relatively to said tertiary uprights at twice the speed of said ram, a stop member for said load carriage on the tertiary uprights, said load carriage directly engaging said stop member when said carriage reaches an upward limit of movement relatively to said tertiary uprights whereby continued vertical movement of said carriage by said ram after said limiting means become effective lifts said tertiary uprights together with said carriage relatively to said secondary uprights, a second lift sheave secured relatively to said secondary uprights adjacent the lower end thereof, and a second flexible lift element secured at one end to said tertiary uprights, extending around said second lift sheave and attached at the other end to said

primary uprights, whereby the lifting of said tertiary uprights relatively to said secondary uprights by the lift ram effects lifting of said secondary uprights together with the lift ram relatively to said primary uprights.

3. A lift truck comprising, vertical primary uprights, vertically movable secondary and tertiary telescoping uprights mounted on said primary uprights, with the upper ends of said tertiary uprights and secondary uprights at substantially the same height when said uprights are in a downward position relatively to said primary uprights, a load carriage mounted on said tertiary uprights, an extendible lift ram of the type having relatively extendible parts and adapted to collapse to an overall length substantially less than the height of said uprights, means mounting said ram vertically with one of its parts on said secondary uprights in a position in which its lower end is substantially at the lower end of said secondary uprights, and with another part vertically movable in an upward direction relatively to said first part when said ram is actuated, whereby when said ram is collapsed its uppermost end is spaced from the upper ends of said secondary and tertiary uprights, and said uppermost end of the ram being unsecured to said uprights for free extension of said ram relatively to said uprights so that free lift extension of said ram is possible without movement of any of said uprights, a sheave mounted on said another part of said ram, a first flexible lift element secured at one end to said load carriage, extending over said ram sheave and secured at its other end to said tertiary uprights, whereby extension of said ram moves said load carriage relatively to said tertiary uprights at twice the speed of said ram, a stop member for the load carriage on the tertiary uprights, said load carriage directly engaging said stop member when said carriage reaches an upward limit of movement relatively to said tertiary uprights whereby continued vertical movement of said carriage by said ram after said stop member is engaged by the carriage lifts said tertiary uprights together with said carriage relatively to said secondary uprights, a second lift sheave secured relatively to said secondary uprights adjacent the lower end thereof, and a second flexible lift element secured at one end to said tertiary uprights, extending around said second lift sheave and attached at the other end to said primary uprights, whereby the lifting of said tertiary uprights relatively to said secondary uprights by the lift ram effects lifting of said secondary uprights together with the lift ram relatively to said primary uprights.

4. A lift truck comprising vertical primary uprights, vertically movable secondary and tertiary telescoping uprights mounted on said primary uprights with the upper ends of said tertiary uprights and secondary uprights at substantially the same height when said uprights are in a lowered position relatively to said primary uprights, a load carriage mounted for vertical movement on said tertiary uprights, a stop member for said load carriage on the tertiary uprights, said load carriage directly engaging said stop member when said carriage reaches an upward limit of movement relative to the tertiary uprights, a hydraulic lift ram having a collapsed length substantially less than the collapsed height of said uprights, and comprising a cylinder and at least two telescoping pistons moving in one direction relatively to the cylinder when the ram is actuated, means mounting and supporting the cylinder on said secondary uprights in a position in which said pistons extend upwardly vertically relatively to said cylinder, said telescoping pistons being unsecured to said uprights for free extension of said ram relatively to said uprights so that free lift extension of the ram is possible without movement of any of said uprights, a sheave mounted on the piston which extends furthermost from said cylinder, a first flexible lift element secured at one end to said load carriage, extending over said ram sheave and secured at its other end to said tertiary uprights, a second lift sheave secured relatively to said secondary uprights adjacent the lower end thereof, and a second flexible lift element secured at one end to said tertiary uprights, extending around said second lift sheave and attached at its other end to said primary uprights.

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