

Feb. 15, 1966

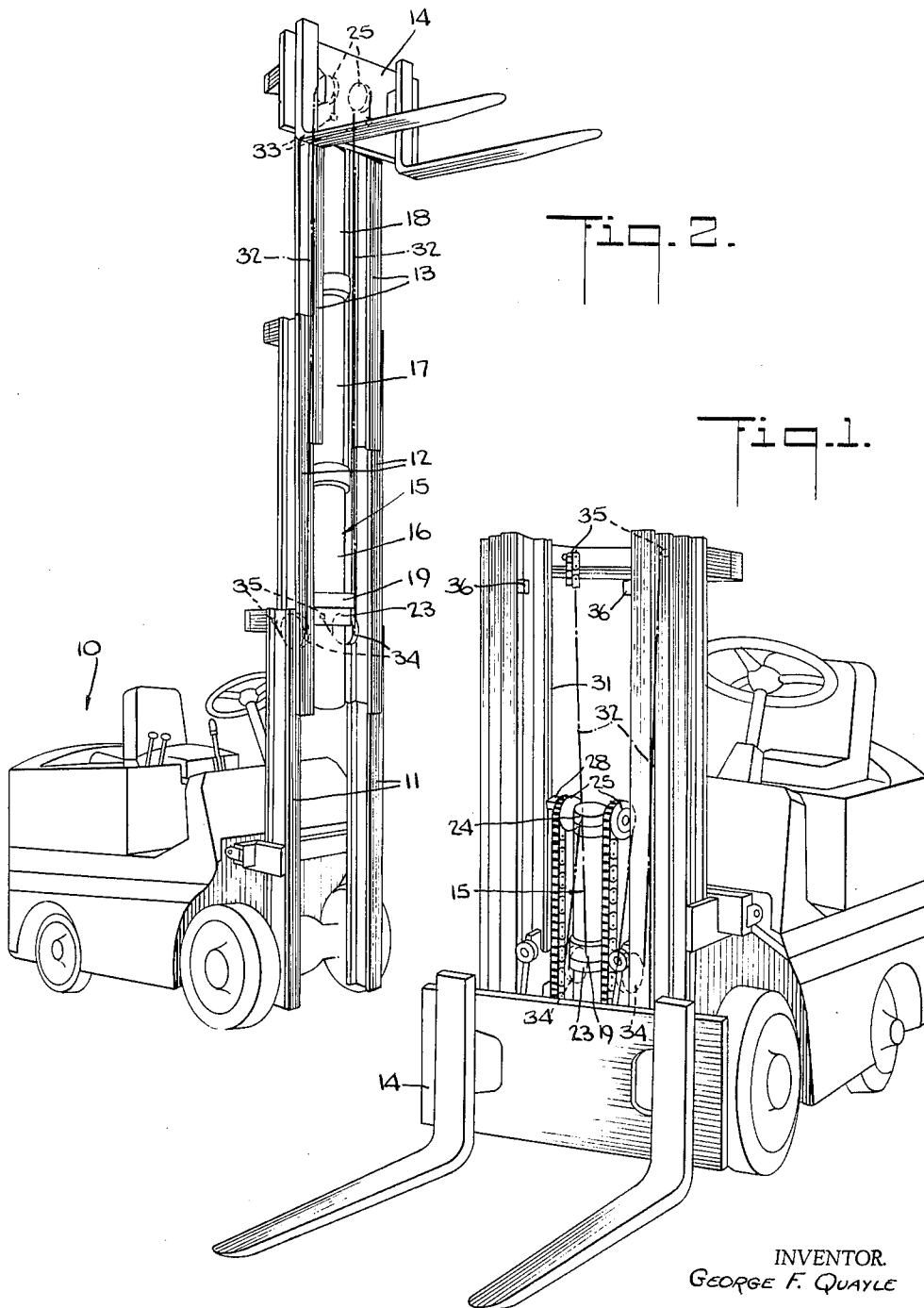
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3,235,034

TRIPLE LIFT TRUCK WITH CONTINUOUS LIFT CHAIN

Filed Oct. 2, 1962

3 Sheets-Sheet 1



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TRIPLE LIFT TRUCK WITH CONTINUOUS LIFT CHAIN

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3 Sheets-Sheet 2

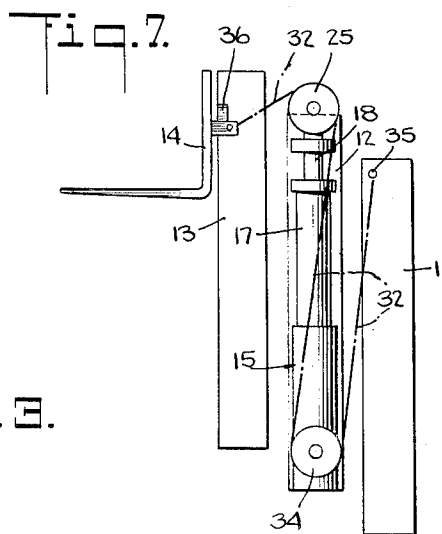
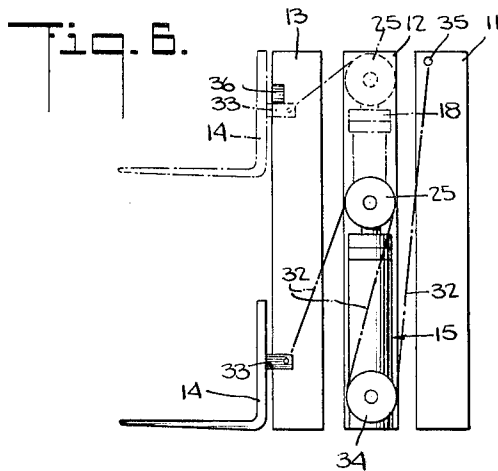
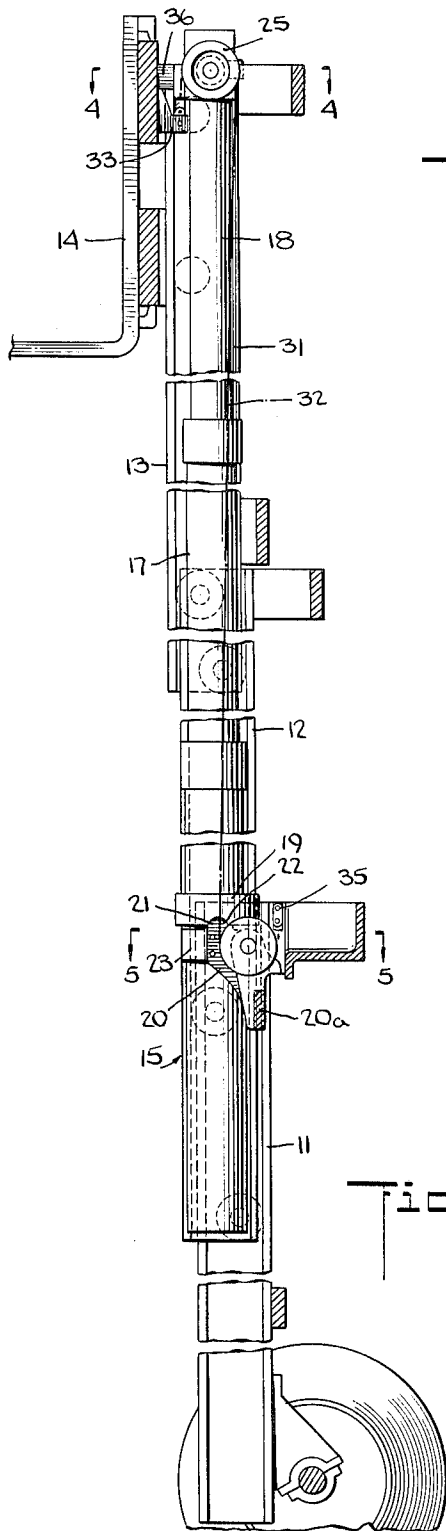


Fig. 6.

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3 Sheets-Sheet 3

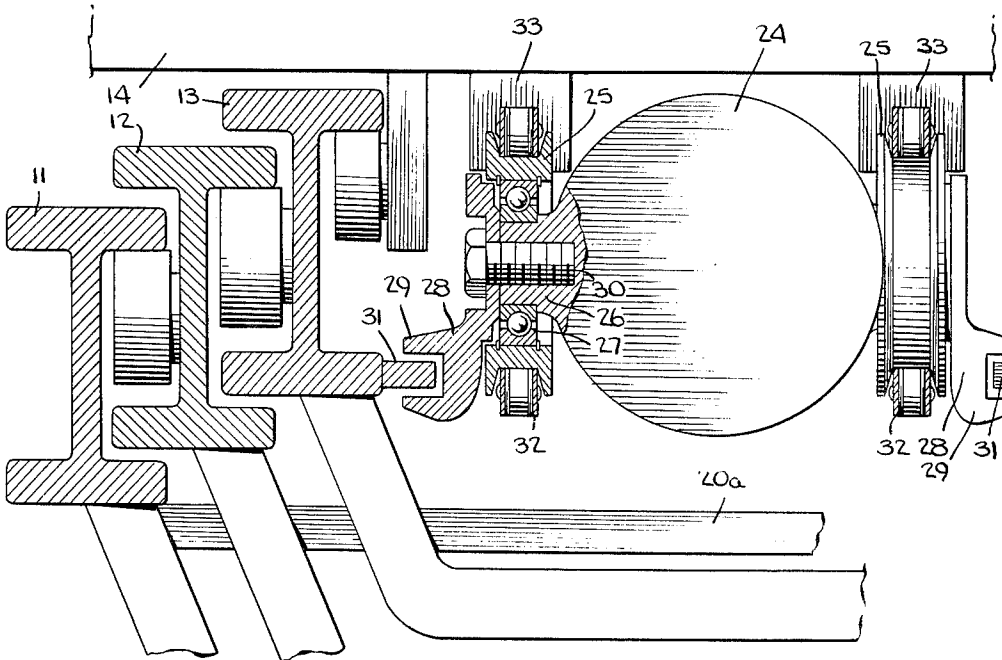


Fig. 4

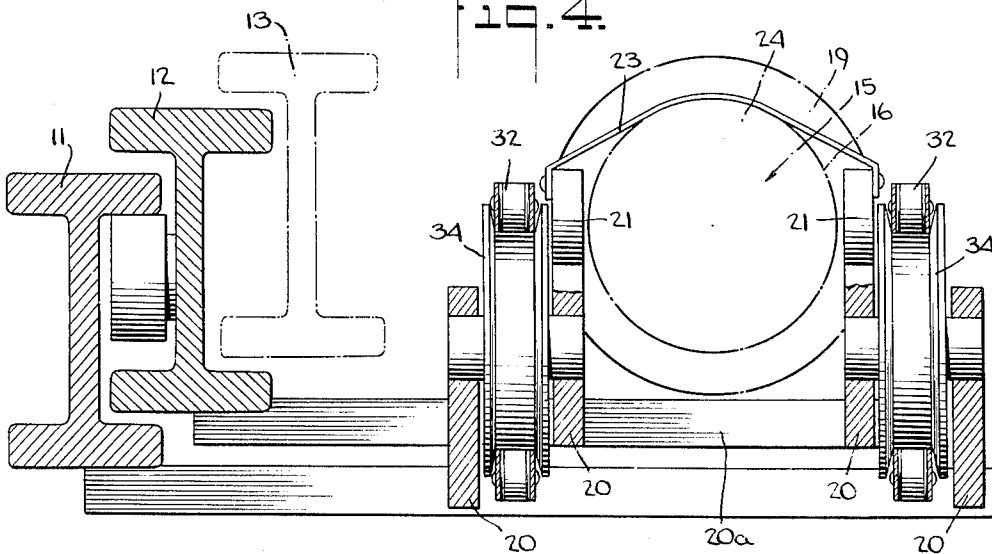


Fig. 5

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TRIPLE LIFT TRUCK WITH CONTINUOUS LIFT CHAIN

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5 Claims. (Cl. 187-9)

This invention relates to a lift truck utilizing a series of telescoping extendible uprights, a lifting load carriage, and a multiple piston lift ram for elevating the extendible uprights and the load carriage.

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

Various arrangements have been heretofore proposed for providing such free lift of a load carriage. One arrangement provides a short telescoping ram on the primary uprights, and through a series of multiplying sheaves and long lengths of lifting chains, effects the free lift of the load carriage and elevation of the uprights. The disadvantage of this arrangement is the necessity of providing long lengths of chain and assembling the large number of multiplying sheaves.

Another arrangement for obtaining free lift provides a specially constructed sequentially operating ram in which one part of the ram moves relatively to the other parts of the ram without increasing the overall length of the ram. This movement of this part of the ram is utilized to effect the free lift, and subsequent extension of the ram is used to effect elevation of the uprights. The disadvantage of such an arrangement is that it requires a very expensive ram structure, and the ram must operate in a particular sequence in which the one part moves relatively to the other parts before the ram extends. In addition, relatively movable parts of the ram must be directly secured to relatively movable parts of the truck, so that there is a fixed relationship between the ram operation and the movable uprights and carriage.

My invention provides a lift truck in which substantial "free lift" is obtained without the use of a large number of multiplying sheaves and long lengths of lifting chain, and in which free lift is assured without regard to the sequence of operation of the parts of the ram. As a further feature, the extension of the ram, while functioning to effect free lift and full lift, is not mechanically particularly related to the lifting sequence of the carriage and uprights.

To this end, the truck of the invention includes a simple, multiple piston telescoping ram having one part, normally the cylinder, mounted on the secondary uprights of the truck with the other parts, normally the telescoping pistons, adapted to be extended upwardly relatively to the part mounted on the secondary uprights. A sheave is mounted on that part of the ram which extends furthest from the part mounted on the secondary uprights, and a lift chain extends over the sheave on the ram and down around a sheave secured to the bottom of the secondary uprights. The chain is attached at one end to the load carriage and at the other end to the upper end of the primary uprights. The collapsed ram is substantially shorter than the uprights and on initial extension of the ram, the load carriage is lifted on the tertiary uprights while the uprights remain in the lowered position, whereby full free lift of the load carriage is obtained. Further extension of the ram results in lifting of the tertiary uprights relatively to the secondary uprights and lifting of the secondary uprights relatively to the primary uprights.

As a feature of the invention, the ram is mounted for slight rocking or pivotal movement on the secondary uprights, and the upper end of the ram is guided on the tertiary uprights, so that the ram is not subjected to bending or buckling due to deflection of the uprights under 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 a perspective view of a lift truck constructed in accordance 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 the 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 ram 15 may be of the construction shown in my co-pending application, Serial No. 227,772, filed October 2, 1962.

As shown in FIG. 1, the ram 15, when unextended, has an overall length substantially less than that of the lowered uprights, thereby improving the visibility of the operator through the uprights. 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 16 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 20a 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 in a fore and aft direction relatively to the secondary uprights 12. A strap 23 connecting the projecting portions 21 on each side of the ram 15 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 if the uprights deflect under load.

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, and 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 each guide member 28 extends on each side of a vertical guide rail 31 secured to the inner flange of each of the tertiary up-
rights 13 to guide the outer end of the inner piston 18 of the ram 15 during extension of the ram 15. 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, extend downwardly around a pair of sheaves 34 carried by the secondary uprights 12 adjacent the lower ends thereof, and are anchored at their opposite ends to the upper ends of the primary uprights 11 at 35. As shown in FIG. 5, the sheaves 34 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 is obtained.

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 36, 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, the secondary uprights 12, together with the lift ram 15, are lifted through the sheaves 34 and the chains 32 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 uprights 13, until the load carriage is in the position shown in solid lines in FIG. 6.

From the preceding description, it can be seen that there is provided a lift truck in which free lift and full lift of the load carriage is obtained through the use of only two sets of sheaves, a pair of lifting chains having an overall length which is not substantially greater than twice the overall height of the uprights in the lowered position, and a very simple telescoping ram having a collapsed length substantially shorter than the overall height of the uprights in the lowered position. Further, no direct physical connection is necessary between the relatively movable parts of the lift ram and the uprights, while at the same time, the load carriage and uprights are elevated in the proper sequence, without regard to the sequence of movement of the parts of the ram. Thus, the load carriage and the uprights are elevated in the

proper sequence whether both pistons of the ram are first extended together, or whether the inner piston extends first and the outer piston extends thereafter.

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 now claim:

1. A lift truck comprising,
 - 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 carriage directly engaging said stop member when said carriage reaches an upward limit of movement relative to the tertiary uprights,
 - an extensible lift ram having a series of relatively extensible telescopic parts including a piston, and adapted to collapse to a length substantially less than the collapsed height of said uprights,
 - means mounting one of said parts of said ram on said secondary uprights in a position in which the other parts of the ram extend upwardly relatively to said one part when said ram is operated, said upwardly extensible other parts of the ram being unsecured to said uprights so as to allow extending movement of said ram without moving any of said uprights,
 - a sheave mounted on the part of said ram which extends furthest from said one part mounted on said secondary uprights,
 - a lift sheave secured to said secondary uprights adjacent the lower end thereof, and
 - a flexible lift element secured at one end to said load carriage, extending over said sheave on said ram, down around said lift sheave on said secondary uprights and attached at the other end to said primary uprights adjacent the upper end thereof, whereby initial extension of said ram effects free lift of said load carriage to the stop member on said tertiary uprights and further extension of said ram lifts said tertiary uprights relatively to said secondary uprights and lifts said secondary uprights together with the lift ram relatively to said primary uprights.
2. A lift truck comprising,
 - 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 carriage directly engaging said stop member when said carriage reaches an upward limit of movement relative to the tertiary uprights,
 - a lift ram having a collapsed length substantially less than the collapsed height of said uprights and having at least three telescoping parts extensible relatively to each other,
 - means pivotally mounting one of said parts of said ram on said secondary uprights in a position in which the other parts of the ram extend upwardly relatively to said one part when said ram is operated, said upwardly extensible other parts of the ram being unsecured to said uprights so as to allow extending movement of said ram without moving any of said uprights,
 - a sheave mounted on the part of said ram which extends furthest from said one part mounted on said secondary uprights,
 - cooperating guide means on said tertiary uprights and on the upper end of said part of said ram which extends furthest from said one part, whereby the upper end of said ram is guided and supported during

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extension of said ram while allowing the ram to rock on the pivotal mounting as the uprights deflect,
 a lift sheave secured to said secondary uprights adjacent the lower end thereof, and
 a flexible lift element secured at one end to said load carriage extending over said sheave on said ram, down around said lift sheave on said secondary uprights and attached at the other end to said primary uprights adjacent the upper end thereof, whereby initial extension of said ram effects free lift of said load carriage to the stop member on said tertiary uprights and further extension of said ram lifts said tertiary uprights relatively to said secondary uprights and lifts 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,
 a load carriage mounted for vertical movement on said tertiary uprights,
 a stop member for said load carriage on the tertiary uprights, said carriage directly engaging said stop member when said carriage reaches an upward limit of movement relative to the tertiary uprights,
 a lift ram having a collapsed length substantially less than the collapsed height of said uprights and having a cylinder and at least two telescopic pistons extendible from one and the same end of said cylinder, means mounting said cylinder of said ram on said secondary uprights in a position in which said pistons extend upwardly relatively from said cylinder when said ram is operated, said telescopic pistons being unsecured to said uprights so as to allow extending movement of said ram without moving any of said uprights,
 a sheave mounted on the piston of said ram which extends furthest from said cylinder mounted on said secondary uprights,
 a lift sheave secured to said secondary uprights adjacent the lower end thereof, and
 a flexible lift element secured at one end to said load carriage, extending over said sheave on said secondary uprights and attached at the other end to said primary uprights adjacent the upper end thereof, whereby initial extension of said ram effects free lift of said load carriage to the stop member on said tertiary uprights and further extension of said ram lifts said tertiary uprights relatively to said secondary uprights and lifts 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,
 a load carriage mounted for vertical movement on said tertiary uprights,
 a lift ram having a collapsed length substantially less than the height of said uprights and having a cylinder and at least two pistons telescopically extendible in one direction from said cylinder,
 means pivotally mounting said cylinder of said ram on said secondary uprights in a position in which said pistons extend upwardly relatively to said cylinder when said ram is operated,
 a sheave mounted on the piston of said ram which extends furthest from said cylinder mounted on said secondary uprights,

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cooperating guide means on said tertiary uprights and on the upper end of said piston which extends the furthest from said cylinder, whereby the upper end of said ram is guided and supported during extension of said ram while allowing said ram to rock on said secondary uprights as the uprights deflect,
 a lift sheave secured to said secondary uprights adjacent the lower end thereof, and
 a flexible lift element secured at one end to said load carriage, extending over said sheave on said ram, down around said lift sheave on said secondary uprights and attached at the other end to said primary uprights adjacent the upper end thereof, whereby initial extension of said ram effects free lift of said load carriage on said tertiary uprights and further extension of said ram lifts said tertiary uprights relatively to said secondary uprights and lifts said secondary uprights together with the lift ram relatively to said primary uprights.

5. 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 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 series of relatively moveable telescopic 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 the other parts of said ram upwardly vertical relatively to said secondary uprights when said ram is actuated, said upwardly extendible other parts of the rams being unsecured to said uprights to allow extending movement of said ram without moving any of said uprights, a sheave mounted adjacent the upper end of the uppermost extendible part of said ram when collapsed, said ram being of such overall length that when mounted on said secondary uprights the upper end of said ram and said sheave are considerably below the upper ends of said uprights so that free lift extension of said ram is possible, a second lift sheave secured relatively to said secondary uprights adjacent to the lower end thereof, and a flexible lift element secured at one end to said carriage, extending over said ram sheave and downwardly under said second lift sheave and then upwardly to said primary uprights and fixed to said primary uprights.

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