Dec. 23, 1969 B. I. ULINSKI 3,485,323

LIFT TRUCK MAST AND RAM ASSEMBLY

Filed Sept. 6, 1967 3 Sheets-Sheet 1

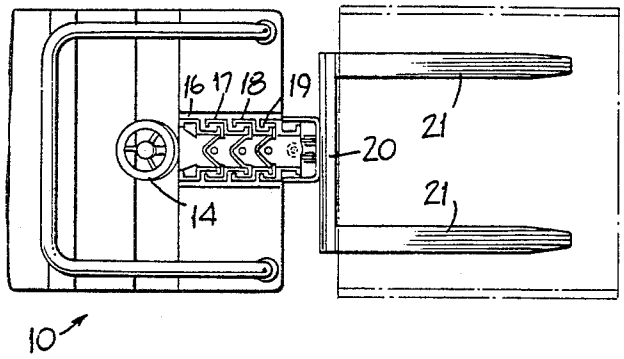


Fig. 2.

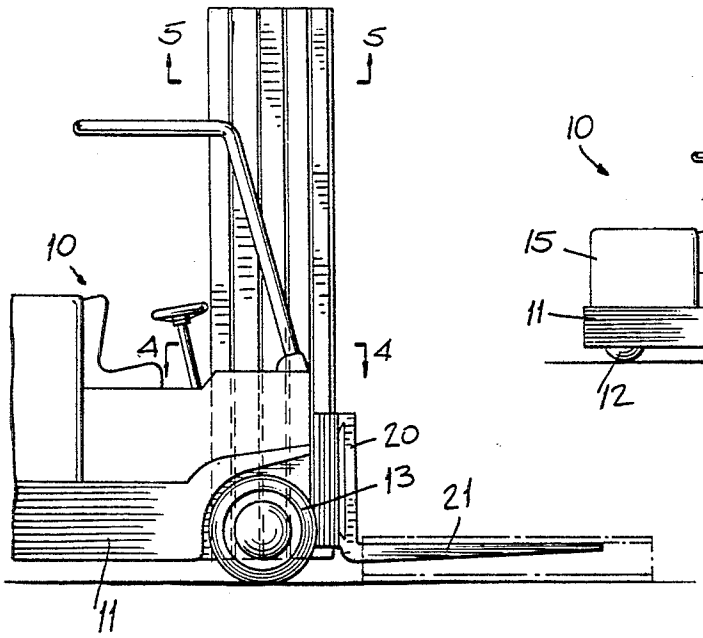


Fig. 1.

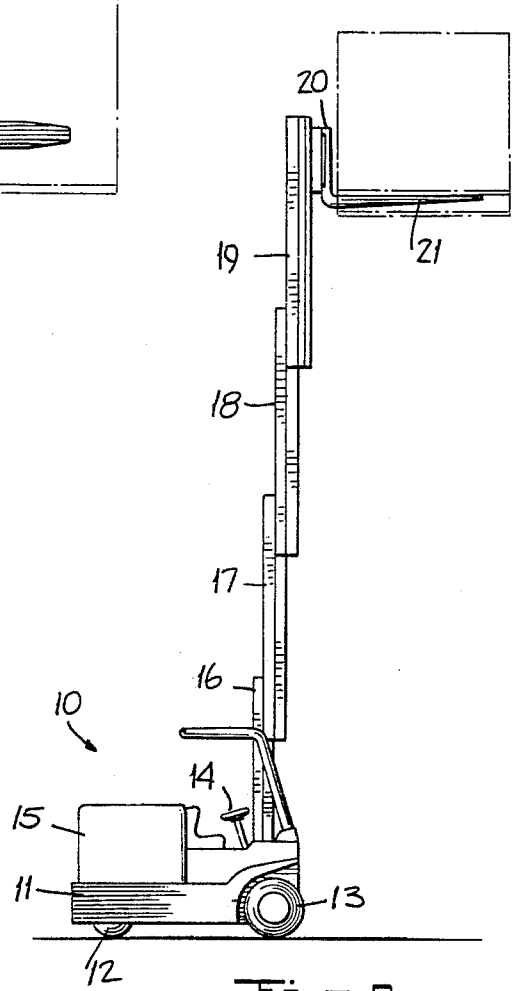


Fig. 3.

INVENTOR.
STANISLAUS I. ULINSKI

BY

Teagno & Toddy
ATTORNEYS

Dec. 23, 1969 B. I. ULINSKI 3,485,323

LIFT TRUCK MAST AND RAM ASSEMBLY

Filed Sept. 6, 1967 3 Sheets-Sheet 2

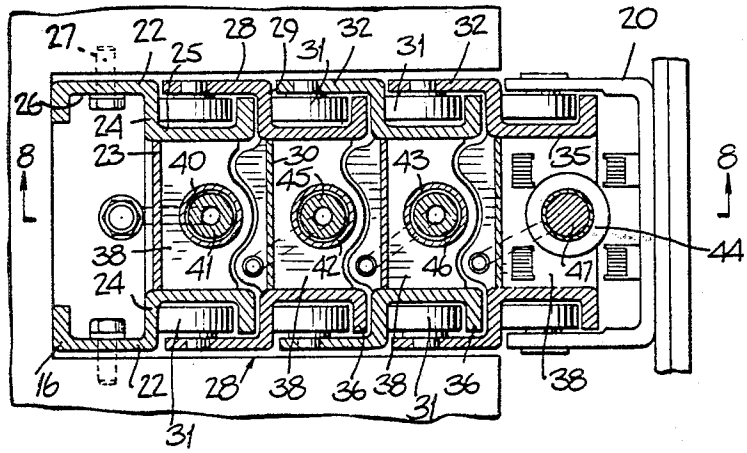


Fig. 4.

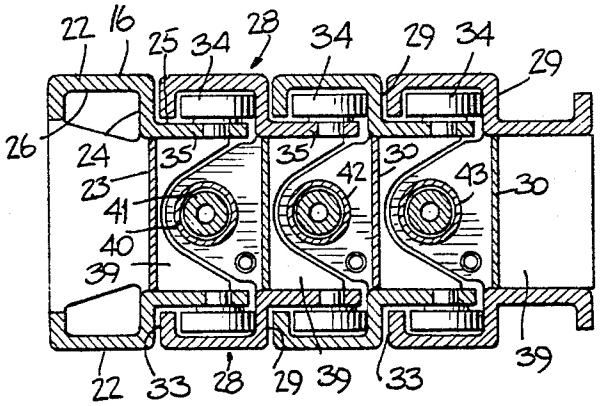


Fig. 5.

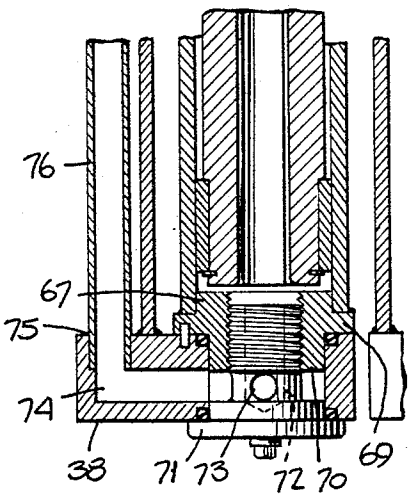


Fig. 6.

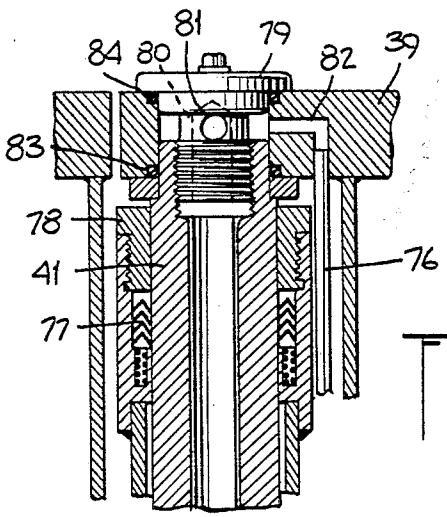


Fig. 7.

INVENTOR
BRONISLAUS I. ULINSKI

BY

ATTORNEYS

Dec. 23, 1969 B. I. ULINSKI 3,485,323

LIFT TRUCK MAST AND RAM ASSEMBLY

Filed Sept. 6, 1967 3 Sheets-Sheet 3

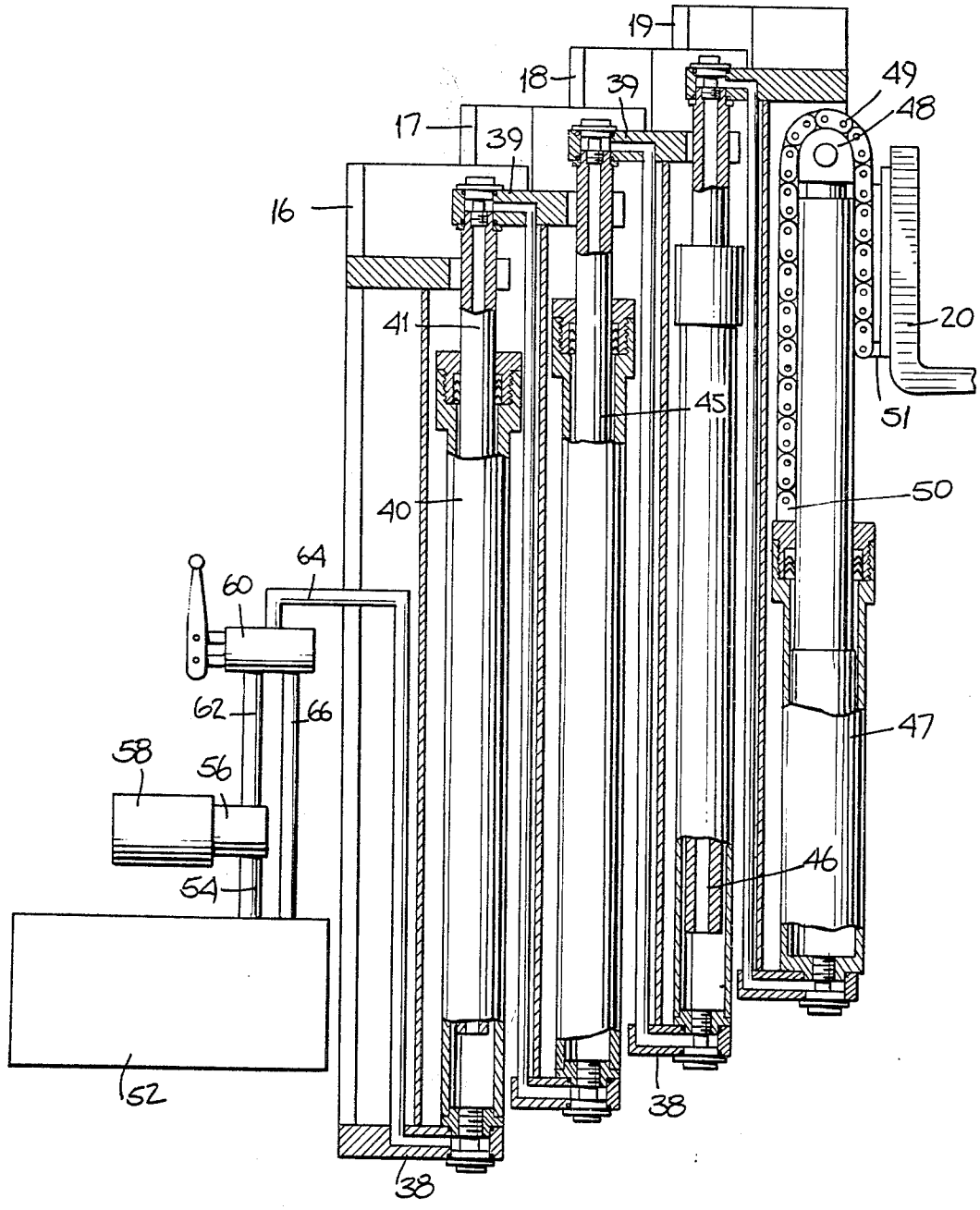


Fig. 8.

INVENTOR.
BRONISLAUS I. ULINSKI

BY Wagner & Toalson

ATTORNEYS

United States Patent Office 3,485,323 Patented Dec. 23, 1969

3,485,323

LIFT TRUCK MAST AND RAM ASSEMBLY

Bronislaus I. Ulinski, Palm Beach, Fla., assignor to Eaton Yale & Towne Inc., Cleveland, Ohio, a corporation of Ohio

Continuation-in-part of application Ser. No. 601,638, Dec. 14, 1966. This application Sept. 6, 1967, Ser. No. 665,826

Int. Cl. B66b 9/20; F01b 1/02

U.S. Cl. 187—9 20 Claims

ABSTRACT OF THE DISCLOSURE

A mast construction for a lift truck in which each upright assembly is moved by a ram supported on a base plate and acting against a thrust plate of an adjacent upright assembly. The rams are connected in series through a hydraulic circuit including the respective base and thrust plates and rigid piping extending from the base plate to the thrust plate of each upright assembly. Further, the particular construction of the upright assemblies and the position of the rams provides an extremely compact combination protecting the rams from lateral bending forces applied to the mast.

This application is a continuation-in-part of my application Ser. No. 601,638, filed Dec. 14, 1966.

This invention relates to the assembly of a ram relatively to an upright assembly or load lifting mast. More particularly, my invention relates to means for assembling either one end of a hydraulic ram to an upright, or the opposed ends of a ram to two telescoping uprights, whereby the extension of the ram will lift either a second upright relatively to a first upright, or will lift a load carriage relatively to an upright.

As those skilled in the art well appreciate, it is extremely important to utilize a minimum of hose or piping for bringing fluid to a hydraulic ram. This is due to the fact that the fluid pressures used in industrial trucks are extremely high so that the longer the hose or other passage through which the fluid moves, the greater the risk of breakage and loss of fluid. Further, industrial trucks must be extremely compact and it is highly desirable, therefore, to limit the amount of hose or pipe required, and the resulting hydraulic friction.

Those skilled in the art are also fully aware of the fact that while it is desirable to obtain maximum throw or extension of a hydraulic ram, this maximum extension should be obtained through a ram having a minimum overall length. As a matter of interest, inventors have been attempting for many years to achieve maximum extension with minimum length of ram.

My invention contributes a ram for a mast having an extremely long throw in proportion to its overall length, all because of the manner in which it is assembled to one upright or to a pair of telescoping uprights in which one upright slides on another upright.

As a further feature of my invention, I contribute a mast assembly utilizing one ram for each movable upright of an extremely compact construction highly resistant to lateral bending forces applied to the mast, and thus prevents such forces from affecting the operation of the rams.

It is a further feature of my invention that through the ram mounting means I have conceived, it is possible to have a minimum of piping for the hydraulic fluid, with the further feature that none of this piping need be flexible, thereby making possible the use of rigid piping.

As still a further feature of my invention, I contribute a mast assembly utilizing more than one ram, in which

all of the rams may be identical in construction and in which all of the mounting means for securing the rams in position may be identical.

As a particular feature of my invention, the ram thereof is formed with an open end adapted to fit against an open surface on the base plate that supports the ram. Actually, the open end of the ram is adapted to fit into a bore in the plate that supports it and to receive fluid from passage means carried by the plate and preferably internal of the plate.

Where the fluid is adapted to flow from one ram toward a second ram for sequential operation of the rams, that end of the ram opposite the support plate and operating against the thrust plate of the next upright, may have the same construction as that just described. Therefore, the thrust plate may be constructed as is the base plate with the relatively moving portion of the ram assembled thereto as is the relatively stationary portion assembled to the base plate.

Where a series of uprights are to be utilized, I am able to secure a series of rams for lifting the series of uprights. Each upright functioning in the assembly will have, where necessary, a base plate and a thrust plate, and preferably the base plates and thrust plates will have the same construction although that is not essential. The relatively movable portions of the ram, which are a cylinder and a piston, may be applied between the thrust plate and the base plate. Then, through suitable means such as will be described hereinafter, and which preferably take the form of a hollow nut, the piston and cylinder may be secured to the thrust and base plates. Where the piston is secured to the thrust plate, it will supply fluid to the passage in the thrust plate, this fluid then moving through a rigid pipe downwardly to the base plate of the secondary upright and to a second ram, and so on as may be desired.

I have thus outlined rather broadly the more important features of my invention in order that the detailed description thereof that follows may be better understood. There are, of course, additional features of my invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the concept on which my disclosure is based may readily be utilized as a basis for the design of other structures for carrying out the several purposes of my invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of my invention in order to prevent the appropriation of my invention by those skilled in the art.

In the drawings:

FIGURE 1 is a vertical side elevational view showing schematically the arrangement of my fork lift truck to which the mast assembly of the present invention is applied.

FIGURE 2 is a plan view of FIGURE 1.

FIGURE 3 is a vertical side elevational view showing the truck of FIGURE 1 in a full lift position.

FIGURE 4 is a cross-sectional view through the mast taken along the lines 4—4 of FIGURE 1.

FIGURE 5 is a cross-sectional view similar to FIGURE 4 but taken along the lines 5—5 of FIG. 1.

FIGURE 6 is an enlarged fragmentary sectional view showing the lower end of the upright assembly and ram.

FIGURE 7 is an enlarged fragmentary sectional view showing the lower end of the upright assembly and ram.

FIGURE 8 is an enlarged elevational view partly in section and partly in parts broken away showing the hydraulic rams for each of the uprights and the hydraulic circuitry for supplying power to each of the rams.

Referring to the drawings and more particularly to

FIG. 1, a fork lift truck **10** comprises a main frame **11** having rear wheels **12** and front wheels **13** controlled by means of steering wheel **14**. A suitable power plant is enclosed within the housing **15**.

Supported from the main frame **11** is a primary upright assembly **16** and one or more secondary or movable upright assemblies **17**, **18** and **19** mounted for vertical movement relative to the primary or fixed upright assembly **16**. The secondary upright assembly **17** is mounted for movement directly on the primary upright assembly **16** and the remaining secondary upright assemblies **18** and **19** are mounted for relative vertical movement in telescoping relationship, as shown in FIG. 3.

A load carriage **20** is mounted for vertical movement on the forward secondary upright assembly **19** so that a load can be moved from a lower position to the top of the forward secondary upright **19**, as shown in FIG. 3. The three secondary or movable upright assemblies can be moved relative to one another and relative to the primary upright assembly **16**. The load carriage **20** includes a pair of horizontal forks **21** adapted to engage and lift a load such as a pallet, as shown in FIG. 2.

As best seen in FIGS. 4 and 5, the primary upright assembly **16** is constructed of a pair of channel uprights **22** of generally block-S cross-sectional configuration joined together by a vertical plate **23** which is welded or otherwise secured to the transverse web **24** of each upright. It is important to realize that the plate **23** extends through a very substantial part of the length of the channel uprights **22** and act with those uprights to form an integral unit that has a very high degree of rigidity. Each of the channel uprights **22** have an outwardly facing channel **25** and an inwardly facing channel **26**. I secure the primary upright assembly **16** to the truck body by bolts **27** which extend through the inwardly facing channel **26**.

Each of the secondary or movable upright assemblies is of similar construction to the primary upright and each includes a pair of block-S cross-sectional channel uprights **28** having a web **29** with a vertical plate **30** welded to a transverse web **29** to form integral units that have a very high degree of rigidity.

The channel uprights of each of the upright assemblies are interdigitated as shown in FIGS. 4 and 5. I secure upper rollers **31** to the rear longitudinal web **32** of each of the uprights which bear against the forward face of the transverse webs **24** or **29**. A portion of the transverse flange **33** of each of the uprights adjacent to each of the upper rollers **31** is cut away to enable the rollers to engage the transverse webs. In like manner, each of the uprights is provided with a lower roller **34** rotatably mounted on the front longitudinal web **35** of each upright and mounted to engage the rear side of the webs **24** or **29**. A portion of the transverse flange **36** of each of the uprights is cut away adjacent each of the lower rollers **34** to permit the rollers to engage the transverse web **24**. Thus, all of the upper rollers **31** and all of the lower rollers **34** respectively engage the forward and rear faces of the transverse webs **24** or **29** of an adjacent upright. Additionally, each upper roller **31** is surrounded or bounded by the sides of adjacent uprights. Thus, the upper rollers **31** are surrounded by three surfaces or flanges of an adjacent upright as well as to the surface to which it is secured and the lower rollers **34** are likewise so surrounded or nested on all four sides. This novel upright construction provides a mast construction of exceptional rigidity. Moreover, I can achieve this rigid construction while actually arranging the primary channel uprights **22** in close relationship to one another with the channel uprights **28** of each of the movable uprights correspondingly close to one another. Therefore, I am able through my novel inventive concept to contribute an upright assembly that is very narrow and enables the truck driver to have a better view from his position on the truck when manipulating a load.

As best seen in FIG. 4, each of the pairs of channel uprights **22** and **28** are connected near the bottom end thereof by the plate **38** which is welded or otherwise secured to the front longitudinal web **35** of each of the uprights and extends a slight distance rearwardly thereof beyond the transverse webs **24** or **29** and the vertical plates **23** or **30** for purposes which I will explain hereinafter. At the upper end of each of the channel uprights **22** and **28**, I mount a thrust plate **39** which is welded or otherwise secured to each of the forward webs **35** of the channel uprights with each of the thrust plates extending rearwardly of the vertical plates **23** or **30** into overlapping relationship with the bottom plate **38** of an adjacent upright.

Thus, it will be seen when considering FIGS. 4 and 5 that I can utilize the space between the channel uprights and each of the vertical plates **23** and **30** for a ram cylinder **40** mounted on the bottom plate **38** of the primary upright with the piston **41** thereof engaging the thrust plate **39** of a movable upright assembly **17**. In like manner, I mount ram cylinders **42**, **43** on each of the bottom plates **38** of the movable upright assemblies **18** and **19** as well as a ram **44** for the load carriage **20**. Each of the ram cylinders **42**, **43** and **44** have a piston **45**, **46** and **47** respectively connected to the thrust plate of the next adjacent upright assembly. The piston **47** of ram **44** is provided with a sprocket **48** about which a pair of chains **49** are reeved. The chain ends **50** are fixed to the ram **47** and the other end **51** is connected to the load carriage **20**.

The hydraulic circuit for operating the rams includes a reservoir **52**, connected by a pipe **54** to a pump **56**. The pump **56** is driven by a suitable motor **58**, and is connected to a two-way control valve **60** by a pipe **62**. The two-way control valve **60** is connected by a pipe **64** to the bottom end of the first primary ram **40**. A pipe **66** is also connected between the two-way control valve **60** and the reservoir **52**.

By this arrangement, fluid is drawn from the reservoir **52** by the pump **56** and moved under system pressure to the two-way control valve **60**. From the two-way control valve **60**, the pressurized fluid can be moved to the ram system for lifting purposes. Also, the two-way control valve **60** is effective to dump fluid from the ram system back into the reservoir **52** for purposes of lowering the rams **40** and **42** through **44**.

Referring particularly to FIGS. 6 through 8, the bottom end of each of the ram cylinders is closed by head member **67** having a threaded axial passage **68** and a shoulder **69** that supports the cylinder and bears against the bottom plate **38**. A portion **70** of the head member **67** projects part-way into a bore formed in the bottom plate **38** which stabilizes the ram relatively to the bottom plate. The head member **67**, and thus the ram, is secured to the bottom plate **38** by means of a threaded cap **71** threaded into the axial passage **68**. Suitable sealing means, such as O-rings **72** and **73**, are provided between the bottom plate **38** and the flange of the cap **71**, as well as between the shoulder **69** of the head member and the bottom plate **38**. The cap **71** is provided with a bore **72** communicating with axial orifices **73**, so that when the cap is in assembled position the orifices **73** communicate with a passage **74** extending through the bottom plate **38** and connected at **75** to a vertical pipe **76**.

As seen in FIG. 7 of the drawings, each of the pistons for the rams is tubular and extends out through the top of the ram cylinder. The upper end of the ram cylinder is enlarged for receiving a packing seal **77** held in place by a threaded annular retainer **78**. The upper end of the piston **41** is threaded to receive a threaded cap **79** having a counterbore **80** communicating with orifices **81** which in turn communicates with a passage **82** in the thrust plate **39**. Suitable sealing means, such as O-rings **83** and **84**, seal the upper end of the piston to the thrust plate. The passage **82** is connected to the vertical pipe **76** which, of course, extends from the thrust plate **39** of one upright

assembly to the base plate of the same upright assembly, as clearly shown in FIG. 8 of the drawings. It will be understood that the vertical pipe **76** of the primary or fixed upright assembly communicates with the control valve **60**. Also, the ram **44** of the upright assembly **19** is provided with a solid rather than a tubular piston provided with the sprockets **48** which operates the load carriage through the lift chains **49**.

In summary, the present invention provides a novel upright and ram construction in which the uprights are of very rigid and stable construction while at the same time being compact to increase the operator's visibility. Moreover, the upright assembly is actuated by rams which are hydraulically connected in series through a hydraulic circuit employing a minimum of piping with the further feature that none of the piping need to be flexible.

I now claim:

1. A load lifting mast for a truck of the class described, comprising a fixed upright and at least one movable upright, a load carriage vertically movable on said movable upright, each of said uprights comprising a pair of spaced channeled members, transverse means interconnecting said members, the said members of the respective uprights extending in overlapping relationship and aligned longitudinally of the truck, the aligned members being of substantially uniform width in cross section, a base plate interconnecting said members at the lower end of each upright, a thrust plate interconnecting said members at the upper end of each upright, a ram supported by each of said base plates having a movable part adapted to impart lifting forces to said thrust plate of the adjacent upright, and a hydraulic circuit interconnecting said rams hydraulically in series.

2. A mast as claimed in claim **1** in which the thrust plate of each movable upright overlaps the base plate of the preceding upright.

3. A mast as claimed in claim **1** in which said transverse means is connected centrally of said channeled members and the rams are located forward of each of said transverse means and between said pairs of overlapping channeled members.

4. A mast as claimed in claim **1** in which a transverse cross section the uprights and rams are symmetrical with the longitudinal center line of the mast.

5. A mast as claimed in claim **1** in which said hydraulic circuit includes a vertical conduit positioned between said channeled members adjacent each ram which interconnect with conduits in the base plate of each upright and in the thrust plate of the next adjacent upright.

6. A mast as claimed in claim **5** in which the base plates of each movable upright includes a portion which extends rearwardly of the ram supported thereon, said portion including a conduit communicating with said ram and terminating in an opening remotely located in said portion, said vertical conduit communicating with said remote opening.

7. A mast as claimed in claim **6** in which said remote opening is located rearwardly of said transverse means of the movable upright.

8. A mast as claimed in claim **1** in which said rams are positioned along the longitudinal center line of said mast at spaced locations and between the overlapping portions of said channeled members.

9. In a load lifting mechanism of the class described,
- a fixed upright,
- a plurality of movable uprights,
- means mounting said movable uprights for movement vertically relative to one another,
- means mounting one of said movable uprights for movement vertically relative to said fixed upright,
- a load carriage,
- means mounting said load carriage for movement vertically relative to the last movable upright most remote from said fixed upright,
- a fluid actuated carriage ram having a hollow fixed member secured to and fixed relative to said last movable upright, said ram having a movable member slidably associated therewith for actuating said load carriage.
- a primary fluid actuated ram mounted on said fixed upright and a primary ram mounted on each movable upright, said primary rams each having a hollow fixed member and a hollow movable member slidably associated with each other,
- said hollow fixed member of each primary ram being secured to and fixed relative to each upright and the hollow movable member of each primary ram being secured to and actuating an adjacent movable upright,
- a pressurized fluid circuit connecting said rams hydraulically in series including conduit means on each movable upright connecting the movable member of each primary ram with the hollow fixed member of the ram mounted on an adjacent upright,
- and means for supplying pressurized fluid to said circuit whereby the load carriage and each of said movable uprights are actuated.

10. The invention according to claim **9** wherein the fixed hollow member of said second fluid actuated ram has a diameter greater than the diameter of said first fluid actuated rams whereby the load carriage and each of said movable uprights are actuated in sequence.

11. The invention according to claim **9** wherein said conduit means are rigid conduit means.

12. The invention according to claim **10** including coupling means at each end of said conduit means, hydraulically interconnecting the upper end of each movable member of the primary rams with the lower end of the hollow fixed member of an adjacent ram.

13. The invention according to claim **9** wherein each movable upright comprises a pair of upright sections and cross head means interconnecting the sections, and with the rams connected to said cross head means.

14. The invention according to claim **9** wherein each fixed member of each ram is a cylinder and wherein the movable member of each ram is a piston.

15. The invention according to claim **9** wherein all of the uprights and rams are aligned and each ram is centrally located between the upright to which it is fixed.

16. In a load lifting mechanism of the class described,
- a fixed upright,
- a movable upright,
- means mounting said movable upright for movement vertically relative to said fixed upright,
- a movable member,
- means mounting said movable member for movement vertically relative to said movable upright,
- a first fluid actuated ram mounted between said fixed upright and said movable upright,
- a second fluid actuated ram mounted between said movable upright and said movable member,
- said first ram comprising a hollow cylinder and having a hollow piston slidably associated.
- said hollow cylinder of said first ram being connected to and fixed relative to said fixed upright and said hollow piston being connected to said movable upright,
- said second ram comprising a hollow cylinder and having a piston slidably associated, said cylinder of said second ram being connected to said movable upright and said piston being connected to said movable member,
- and conduit means connected between the free end of said hollow piston of said first ram and into said second ram cylinder behind the piston thereof.

17. The invention according to claim **16** wherein said conduit means comprises rigid conduit means.

18. The invention according to claim **16** wherein said movable member is a load carriage mounted for movement vertically relative to said movable upright,

the second fluid actuated ram is mounted between said movable upright and said load carriage,

and the piston of said second ram being connected to said load carriage.

19. The invention according to claim **18** wherein said conduit means is a rigid conduit means.

20. The invention according to claim **16**, including means for supplying pressurized fluid to said first ram and thence via said conduit means to said second ram, and wherein the diameter of said second ram is greater than the diameter of said first ram whereby said movable member and said movable upright are actuated in sequence.

References Cited

UNITED STATES PATENTS

2,518,251	8/1950	Quayle	187—9
2,554,930	5/1951	Ulinski	187—9
3,212,604	10/1965	Garnett	182—51

HARVEY C. HORNSBY, Primary Examiner

U.S. Cl. X.R.

92—61