United States Patent [19]

McGehee

[11] **3,709,393**

[45] **Jan. 9, 1973**

[54] **LIFT TRUCK MAST**

[75] Inventor: **Archie L. McGehee,** Topeka, Kans.

[73] Assignee: **Allis-Chalmers Manufacturing Company,** Milwaukee, Wis.

[22] Filed: **Jan. 7, 1971**

[21] Appl. No.: **104,683**

[52] **U.S. Cl.** **214/674,** 187/9

[51] **Int. Cl.** **B66f 9/06**

[58] **Field of Search** 214/674, 672, 673; 187/9, 95

[56] **References Cited**

UNITED STATES PATENTS

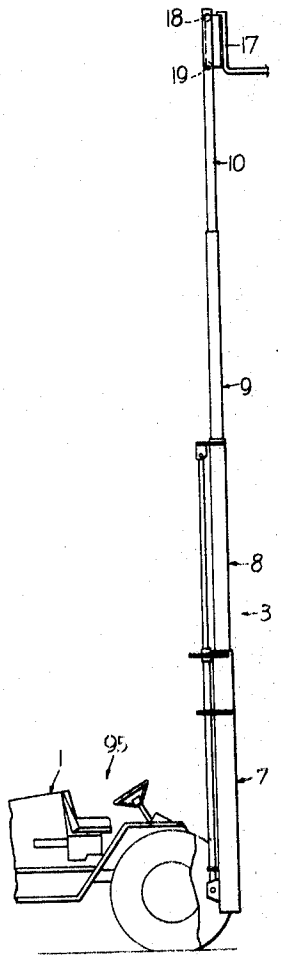
2,480,066	8/1949	Weaver	187/9
2,877,868	3/1959	Gunning et al.	187/9
2,701,031	2/1955	Brumbaugh	187/9
2,940,625	6/1960	Holm	214/660
3,007,593	11/1961	Hancock	214/674

Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Lawrence J. Oresky
Attorney—Arthur L. Nelson, Kenneth C. McKivett and Robert B. Benson

[57] **ABSTRACT**

A lift truck mast having four pairs of channels nestled within each other with two hydraulic cylinders and lift chains to operate as expansion units for extending the mast to its maximum height.

10 Claims, 14 Drawing Figures



PATENTED JAN 9 1973

3,709,393

SHEET 1 OF 5

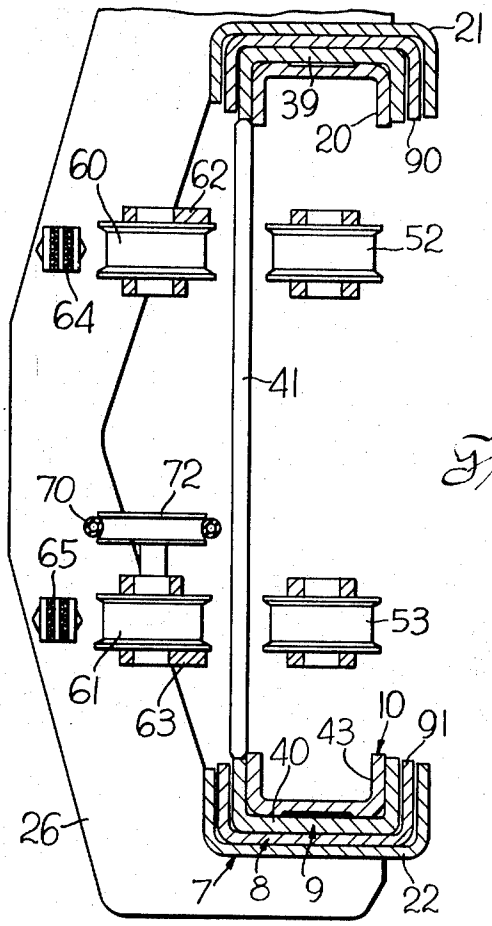


Fig. 9

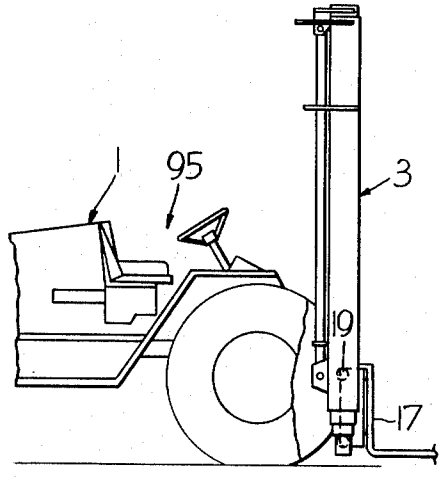


Fig. 1

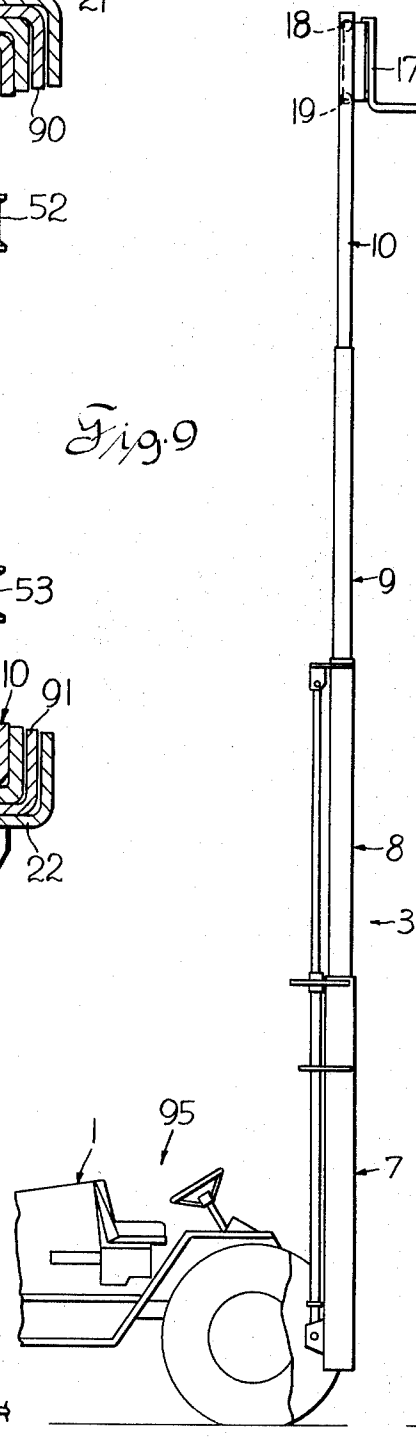


Fig. 2

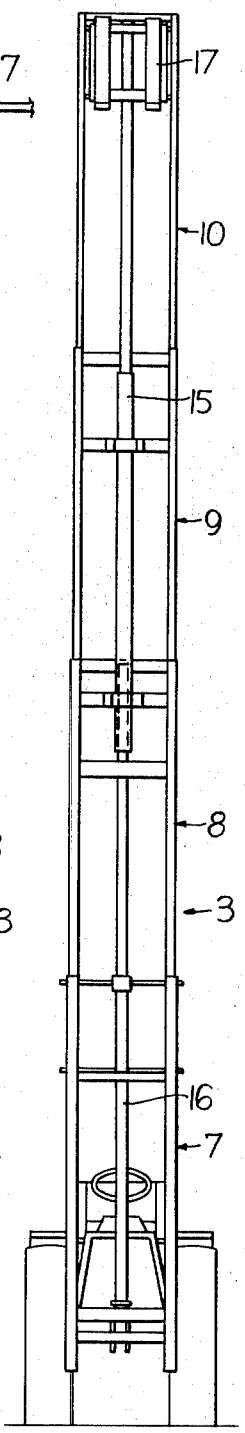


Fig. 3

Inventor
Wyatt L. McGehee
By
Attorneys

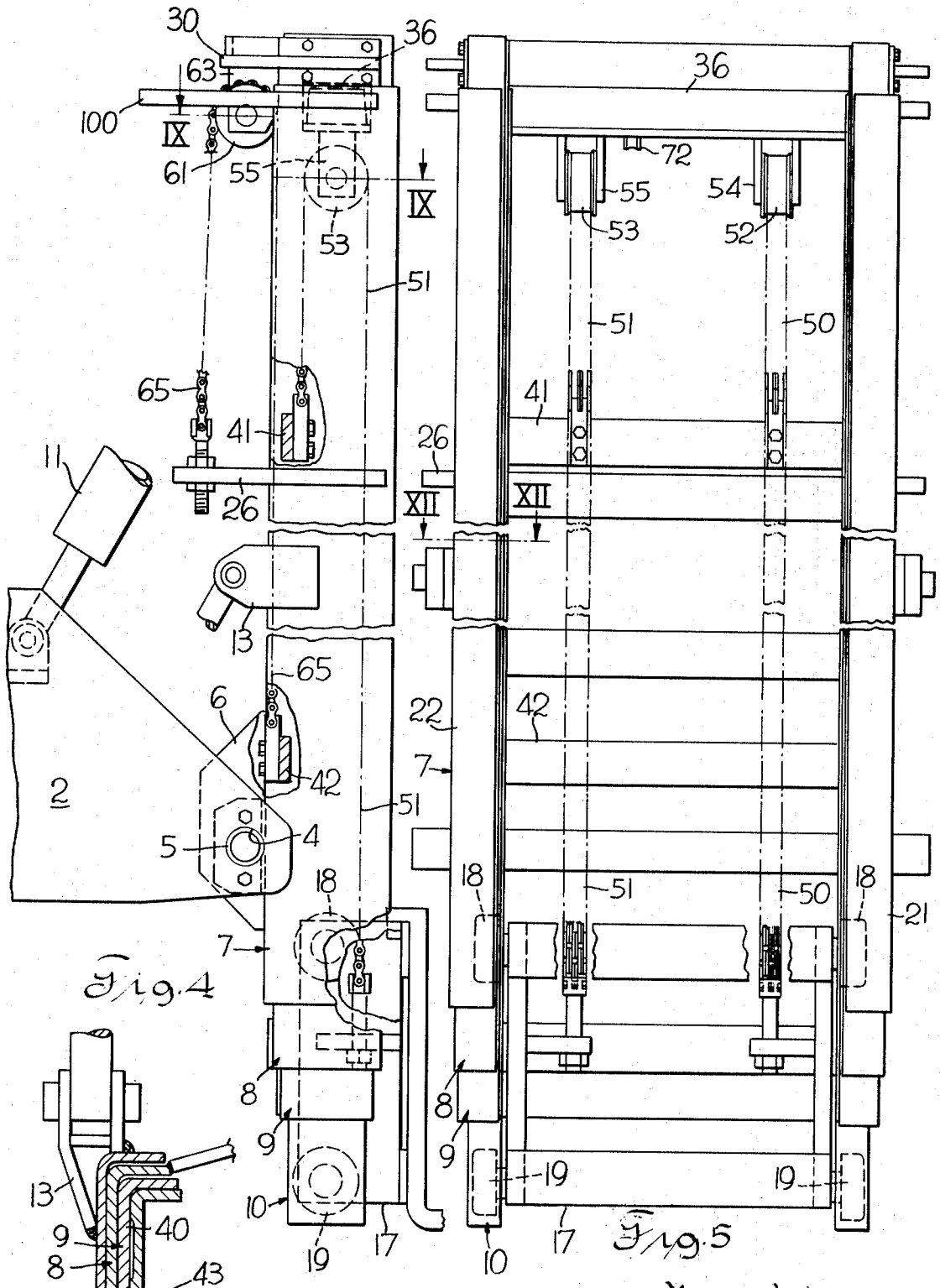


Fig. 4

Fig. 5

Fig. 12

Inventor
Archie L. McGehee
By
Attorney

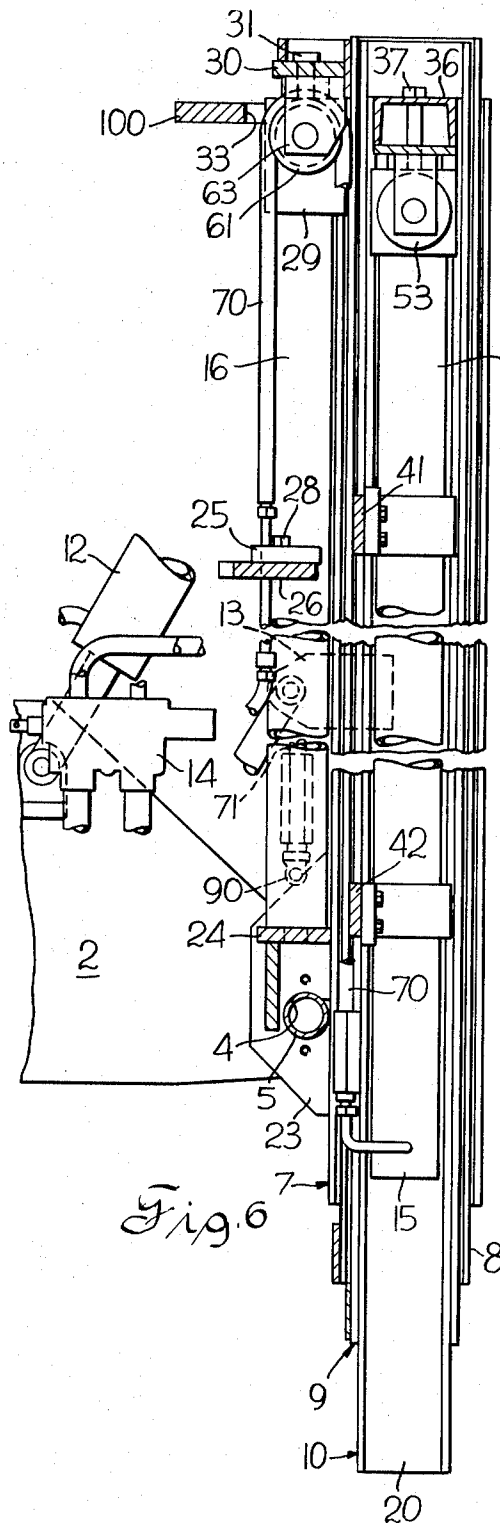


Fig. 6

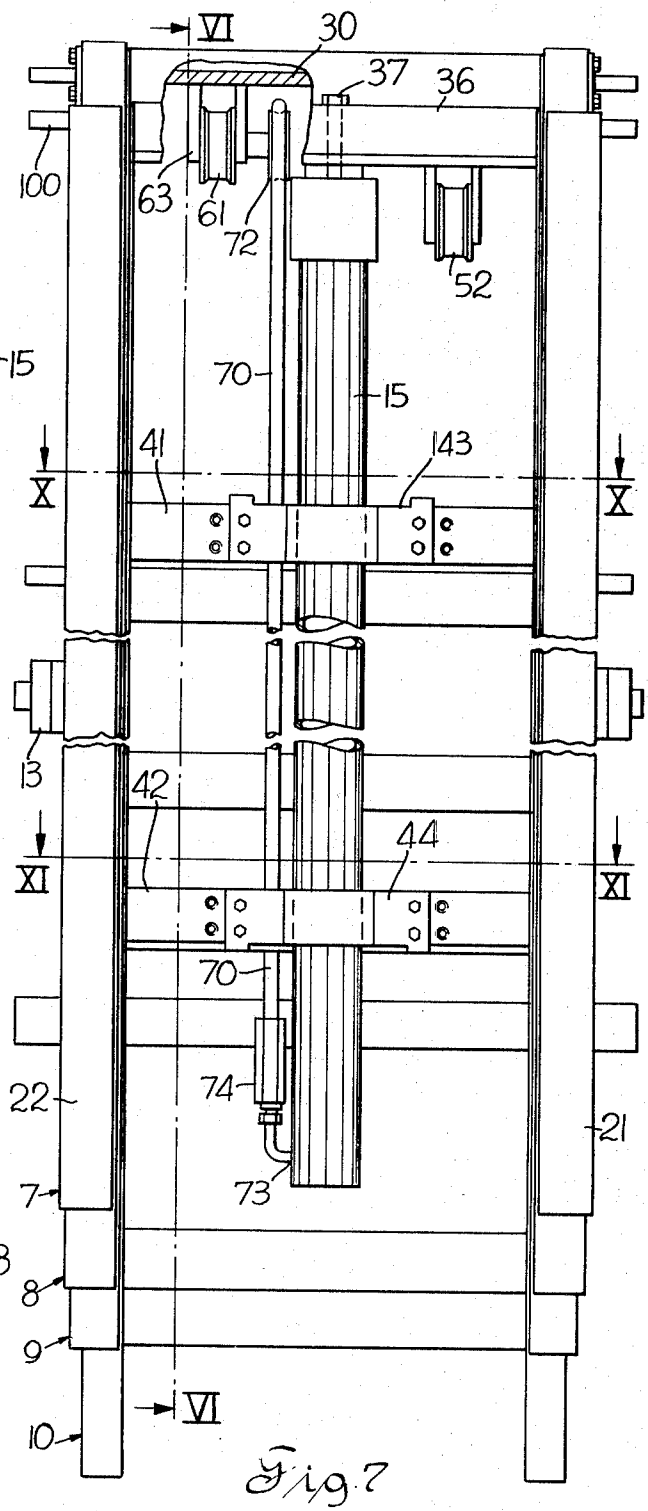


Fig. 7

Inventor
Archie L. McGehee
By Arthur Fulton
Attorney

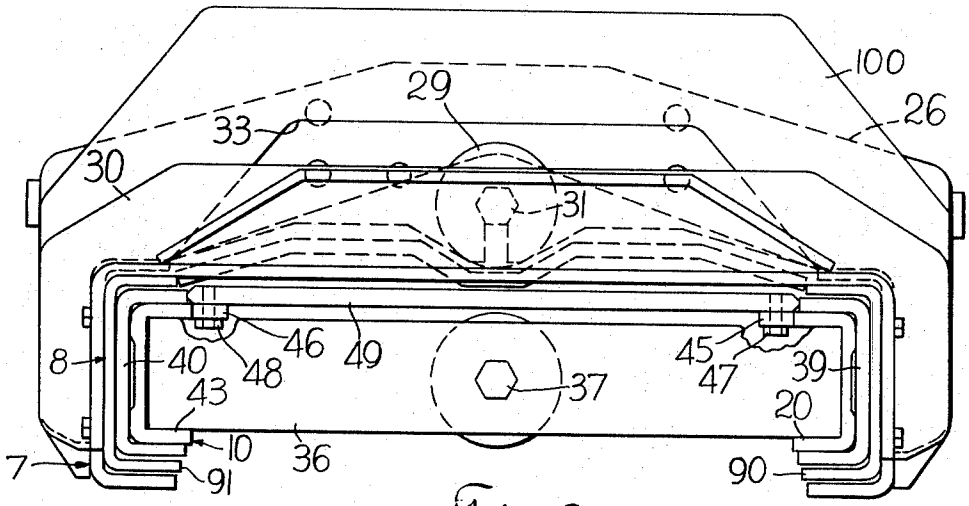


Fig. 8

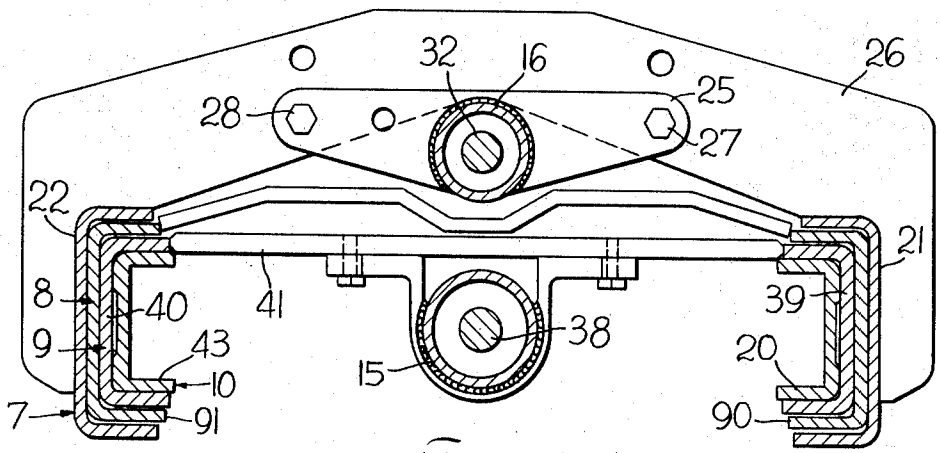


Fig. 10

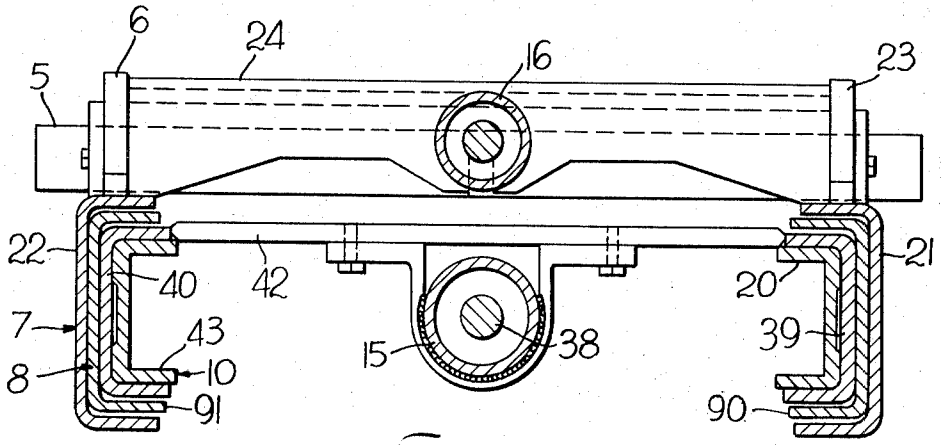


Fig. 11

Inventor
Quinchie L. McGehee
By Arthur de Fulton
Attorney

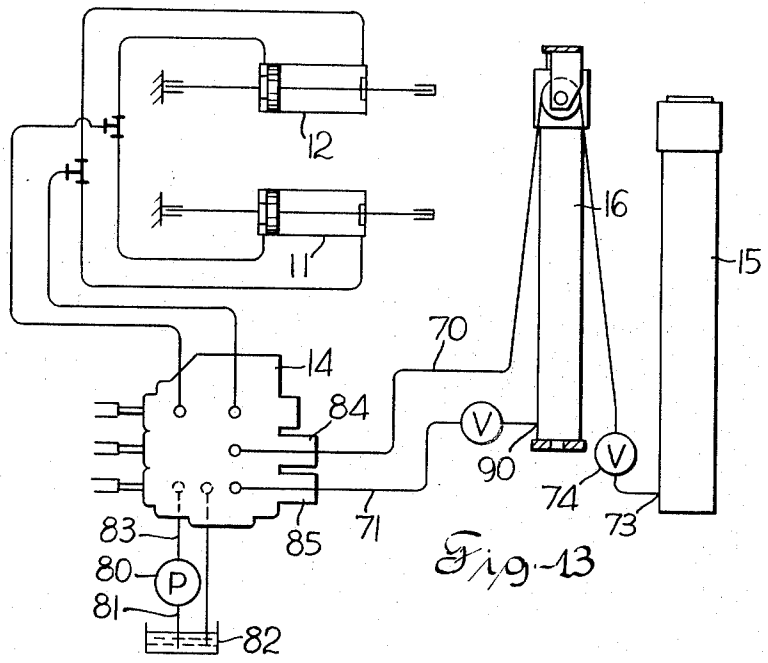


Fig.-13

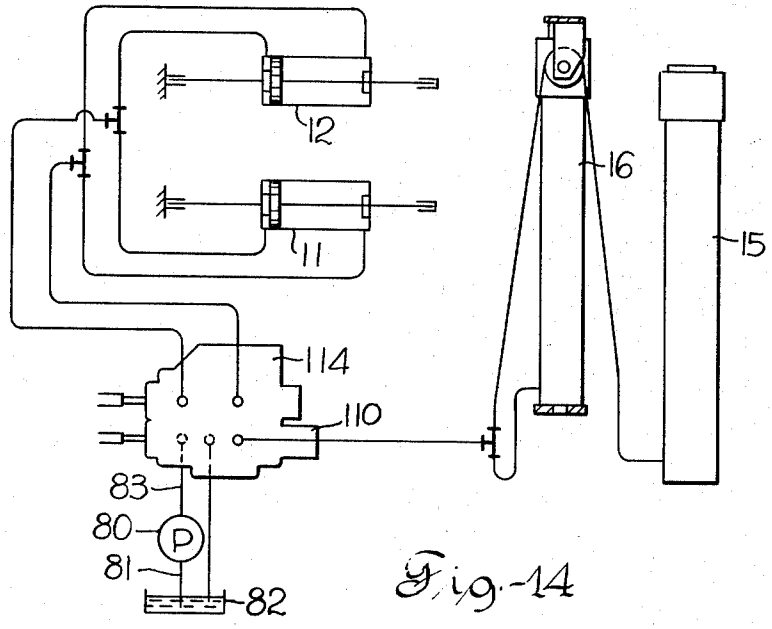


Fig.-14

Inventor
Archie L. McGehee
By
Attorney

LIFT TRUCK MAST

This invention relates to a lift truck mast and more particularly to a mast having primary and secondary pairs of upright sections with a primary and secondary expansion unit each including a hydraulic lift cylinder and a lift chain mechanism to sequentially extend the primary and the secondary upright sections to raise the load lifting carriage to its maximum height.

Industrial lift trucks are primarily used to elevate or lower a load from one level to another level in the process of storing or withdrawing of materials in a warehouse, shipping, or similar area. The industrial lift truck operates primarily on a level surface and consequently can raise the substantial load to a considerable height without danger of overbalancing the lift truck. Naturally when the lift truck is operated within a building such as a warehouse, the clearance height is of primary importance and it is desirable to have the lowest down height for the mast when the mast is in a retracted position. It is also an advantage to construct the mast for minimum space requirements while also providing the greatest visibility possible for safety reasons.

Accordingly this invention is intended to provide an extendible lift truck mast which has a minimum height in the down position and to also provide a maximum left height. This is accomplished by providing a four sectioned mast with a pair of primary upright sections having a primary expansion unit initially lifting the load carriage to a predetermined height and subsequent operation of a secondary expansion unit lifting the secondary upright sections. The four sections of the lift truck mast provide for greatest clearance in the down position and yet provide a means for extending the load carriage to a maximum height. Each section includes a pair of channels nestled within an adjacent pair of channels to reduce the space requirements of the mast. The expansion units for the primary and secondary sections operate through a manual control valve. A secondary expansion unit includes a hydraulic lift cylinder of smaller cross sectional area than the hydraulic lift cylinder for the primary expansion unit which in a sense is a safety measure since the load lifted by the secondary expansion unit is smaller than the load capable of being lifted by the primary expansion unit with a predetermined pressure. This provides a more versatile lift truck mast since heavier loads are usually carried to lower levels without danger of overturning the lift truck.

It is an object of this invention to provide a four section lift truck mast with dual hydraulic lifting cylinders for lifting a load carriage.

It is another object of this invention to provide a four upright section extendible lift truck mast with sections nestled within each other and having dual hydraulic lift cylinders connected for sequentially lifting of the upright sections of the mast.

It is a further object of this invention to provide an extendible lift truck mast having four upright sections assembled for operation by dual hydraulic lift cylinders having different effective lifting areas for raising and lowering of the load carriage in response to hydraulic control valves in the hydraulic system.

It is a further object of this invention to provide an extendible lift truck mast having a pair of primary upright section and expansion unit having a hydraulic lift cylinder of predetermined effective piston area and a pair of secondary upright sections with a secondary expansion unit having a hydraulic lift cylinder of a smaller effective piston area to provide sequential lifting by said cylinders.

The object of this invention are accomplished by providing a four section lift truck mast. The primary sections consisting of the inner two upright sections are connected to a primary hydraulic lift cylinder. The hydraulic lift cylinder is connected through the control valve to receive pressurized fluid. Included in the primary section is a pair of chain drives riding over sheaves carried on the innermost section. As the primary hydraulic lift cylinder is expanded, the sheaves are carried upward the lift chain mechanism connected between the section supporting the primary hydraulic lift cylinder and the load lifting carriage on the inner rail is guided around the sheave while simultaneously lifting the load carriage from the lower end to the upper end of the carriage supporting section. When the primary section is fully extended a secondary control valve diverts hydraulic fluid to the secondary hydraulic cylinder in the secondary expansion unit, which includes a lift chain mechanism similar to that of the primary section. The secondary hydraulic cylinder is connected between the base section which is mounted on the lift truck chassis and the secondary lift section carrying the secondary sheaves. The sheaves guide the lift chain mechanism which is connected between the secondary base section and the primary base section. As the sheave carrying upright section is moved upwardly in response to expansion of the secondary hydraulic cylinder the lift chain mechanism lifts the primary section carrying the primary cylinder to fully extend the four upright sections of the mast.

Referring to the drawings the preferred embodiment of this invention is illustrated.

FIG. **1** illustrates a side elevation view of the lift truck with the mast in the down position.

FIG. **2** illustrates a side elevation view with the mast in the extended position.

FIG. **3** is the front elevation view with the mast in the extended position.

FIG. **4** is a more detailed side elevation view with the mast in the down position and fragmentary sections illustrating the related positions of the components of the mast.

FIG. **5** is a more detailed front elevation view showing the lift chain mechanism.

FIG. **6** is a side section view taken on line VI—VI of FIG. **7** of the mast showing the hydraulic cylinders and related parts of the mast.

FIG. **7** is a front elevation view with portions broken away showing a hydraulic lift cylinder of the mast.

FIG. **8** is a top view of the mast.

FIG. **9** is a cross section view taken on line IX—IX of FIG. **4**.

FIG. **10** is a cross section view taken on line X—X of FIG. **7**.

FIG. **11** is a cross section view taken on line XI—XI of FIG. **7**.

FIG. **12** is a cross section view taken on line XII—XII of FIG. **5**.

FIG. 13 is a schematic diagram of the hydraulic cylinder having individual control valves for the hydraulic lift cylinders.

FIG. 14 is a schematic diagram of a modified hydraulic system having a single control valve for both hydraulic lift cylinders.

Referring to the drawings a vehicle 1 includes a chassis 2 for pivotally supporting a mast 3. The chassis 2 forms openings 4 receiving the sleeve 5 which is carried in the support bracket 6 and 23. The support bracket 6 is mounted in the secondary base section 7. The secondary base section 7 embraces the secondary lift section 8. The primary section including a primary base section 9 which receives the carriage support section 10.

Two tilt cylinders 11 and 12 are connected to the chassis 2. The tilt cylinders are also connected to brackets 13 on the secondary base section 7. The operation of the tilt cylinders 11 and 12 are manually controlled by the control valve 14 which also includes a valve means for the hydraulic lift cylinders, which includes the primary lift cylinder 15 and a secondary lift cylinder 16.

Referring to FIGS. 1, 2 and 3, the mast 3 is in the lowered position as shown in FIG. 1. FIGS. 2 and 3 illustrate the mast in the extended position in which the primary sections 9 and 10 are fully extended by the primary hydraulic cylinder 15. The primary hydraulic cylinder 15 is nestled within the primary sections 9 and 10 which is fully extended to slidably elevate the load carriage 17. The load carriage 17 is guided slidably upward and downward on the rollers 18 and 19 received within the channels 20 and 43 which form a part of the carriage upright section 10. The secondary base section 7 is pivotally mounted on the chassis. The secondary base section includes a pair of channels 21 and 22 which are fastened together on their upper ends by plate 100. The brackets 6 and 23 also support a base plate 24 which supports the base of the secondary lift cylinder 16 and extends between the lower ends of channels 21 and 22. The secondary lift cylinder 16 extends upwardly and is welded to the flange 25 which is bolted to a cross member 26 by means of bolts 27 and 28. The cross member 26 embraces the channels 21 and 22. The plate 26 also maintains a fixed lateral dimension between the channels since it is welded to the channels 21, 22.

The secondary lift cylinder 16 extends upwardly and is received in cap 29 on the end of the cylinder. The secondary lift section 8 including channels 90 and 91 supports a plate 30 carrying the bolt 31 which is connected to the piston 32 of the secondary lift cylinder 16. The secondary lift cylinder 16 extends upwardly through an opening 33 in the plate 100 to permit it to extend upwardly carrying the secondary lift section 8 when the expansion unit for the secondary assembly is extended.

The primary assembly includes the upright sections 9 and 10, which are nestled within the secondary sections 7 and 8. Each of the sections include a pair of channels held in spaced relation to each other. The sections are mounted for slidable telescoping movement relative to each other.

The carriage upright section 10 includes the channels 43 and 20. The upper end of the channels 43 and 20 are maintained in spaced relation by the top plate 36 connected between the top end of the rails 43 and 20. The top plate 36 receives a bolt 37 which is connected to the piston rod 38 in the primary hydraulic lift cylinder 15. A primary base section 9 includes channels 39 and 40 which are maintained in spaced relation by the secondary hydraulic cylinder support plates 41, 42 which support the brackets 143, 44 respectively. The brackets 143, 44 are clamped to the plates 41 and 42. They support the lower end of the primary lift cylinder 15. The carriage upright section 10 is received of the primary base upright section 9 which in turn is nestled within the lift upright section 8 of the secondary section. The carriage consisting of rollers 18 and 19 riding within the channels 20 and 43 and maintain a spaced relationship of the channel 20 and 43 when the carriage is in lowered position. When the carriage is in the upper position or extended position as shown in FIGS. 2 and 3, the spacer blocks 45 and 46 which are fastened by bolts 47 and 48 to the spacer plate 49 and connected between the channels 39 and 40 of the primary base upright section maintain a spaced relationship of channels 43 and 20.

Accordingly, it can be seen that the primary assembly and the secondary assembly, each include two upright sections in which each of the sections are slidably movable within the adjoining connection. The sections are extended relative to each other by means of a hydraulic lift cylinder which include the primary lift cylinder 15 and the secondary lift cylinder 16, which are hydraulically controlled. Together with each hydraulic lift cylinder there is a lift chain mechanism riding over sheaves which are suitably connected between the carriage and sections to provide lifting of the desired section when the hydraulic cylinders are actuated.

The primary expansion unit for expanding the primary sections 9 and 10 include the primary hydraulic lift cylinder 15 and its connection to the primary sections 9 and 10. Together with the hydraulic lift cylinder 15 is included a pair of chains 50 and 51. The lower ends of the chains 50 and 51 are connected to the carriage 17 at symmetrical locations to provide a level lifting force on the carriage 17 as the chains roll over the sheaves 52 and 53. The sheaves 52 and 53 are connected in hanger brackets 54 and 55 mounted on the top plate 36. The top plate 36 being connected to the piston 38 of the primary lift cylinder 15 is lifted when the primary cylinder 15 is expanded. The chains 50 and 51 are also connected to a primary base upright section 9 by plate 41. The lower end of the primary hydraulic lift cylinder 15 is also connected to the base upright section 9 of the primary assembly. Accordingly when the primary hydraulic lift cylinder 15 is expanded the sheaves 52 and 53 move upwardly and as the chains roll over the sheaves the carriage 17 is lifted upwardly.

A primary hydraulic lift cylinder 15 can be expanded completely to its fully extended length and its top limit is determined by a shoulder or snap ring providing a stop for the pistons of the lift cylinder 15. This defines the limits of elevation for the primary assembly as the carriage upright section 10 telescopes upwardly within the primary base section 9.

The secondary assembly also includes an expansion unit including a secondary hydraulic cylinder 16 and its connection to the secondary base upright section 7 and

the lift upright section 8. The secondary lift cylinder 16 is connected to the base plate 24 and flange 25 which supports the lift cylinder 16. The effective area of the secondary hydraulic lift cylinder 16 is of a smaller diameter than the primary hydraulic lift cylinder 15 and consequently will carry a lesser load for predetermined pressure. The piston end of the secondary lift cylinder 16 is connected to the rod 32 and the plate 30 which is connected to the lift upright section 8 of the primary assembly. A pair of chain sheaves 60 and 61 are mounted on the hanger brackets 62 and 63 of the plate 30. Since the plate 30 is also connected to the piston of the secondary hydraulic lift cylinder 16, when the hydraulic lift cylinder 16 is expanded, the sheaves 60, 61 also move upwardly with the plate. The chains 64 and 65 ride over the sheaves 60, 61 respectively. The fixed end of the chains 64 and 65 are connected to the cross member 26 which fixes this end of the chain to the secondary base upright section 7. The opposite end of the chains 64, 65 are connected to the cross member 42 which holds the channels 39 and 40 of the primary base section 9 in spaced relation to each other. As the secondary lift section 8 is lifted, the sheaves 60, and 61 move upwardly and chains 64, 65 roll over the sheaves 60, and 61 causing a lifting movement of the primary base section 9 relative to the secondary sections thereby causing a telescoping action of the secondary sections and the primary base section relative to each other.

It is noted that hydraulic connections must be provided for to supply the primary and secondary hydraulic lift cylinders during the telescoping movement of the upright sections. A hose 71 connects the control valve 14 to the secondary hydraulic lift cylinder 16 and also a hose 70 is provided for connection to the primary hydraulic lift cylinder 15. As shown in FIG. 6 two separate hoses 70 and 71 are provided to make these connections between the control valve 14 and each of the lift cylinders. The illustrations shown in FIG. 6 employs a double spool valve arrangement whereby each spool is selectively operated by a single lever to supply fluid to the corresponding hydraulic lift cylinder. In other words when the hydraulic fluid is passed through the valve 14 to the hose 70, the primary hydraulic lift cylinder 15 is expanded. Since the primary base section 9 remains in its lower position and operates as a supporting base for the carriage section 10, there is no change of the positioning of the hose 70 as it is suspended over the hose sheave 72. The primary upright sections are expanded to their fully extended height by the primary hydraulic lift cylinder 15 without changing the position of the lower connection of fitting 73 of the hose 70. A pressure control valve 74 is positioned immediately adjacent the fitting 73 and is connected to the hose 70 to provide a limited orifice flow in the return direction in case of failure of the hose 70.

When the secondary upright sections are activated by the expansion unit controlled by the secondary hydraulic lift cylinder 16, then the primary base section 9 lifts relative to the secondary lift section 8 of the secondary assembly. When this movement is initiated, the hose 70 is guided on the sheave 72 as the primary section 9 and the lift section 8 of the secondary upright section moves relative to the secondary base upright section 7. The upward movement of the fitting 73 is accommodated through the movement of the hose over the sheave 72 until lower end of the primary hydraulic lift cylinder 15 is positioned in its extended position as shown in FIGS. 2 and 3. The primary sections are permitted to extend fully by a telescoping movement relative to the secondary sections 7 and 8.

For the purpose of illustration, the hydraulic systems are illustrated in FIGS. 13 and 14. The pump 80 is connected through conduit 81 to a reservoir 82. The pump pressurizes fluid in the conduit 83 which is connected to the control valve 14. The hose 70 is in communication with the primary hydraulic lift cylinder 15 as the spool 84 is actuated. The primary hydraulic lift cylinder 15 causes a telescoping action between the primary sections 9 and 10. When the primary sections are retracted, pressurized fluid is permitted to drain from the primary lift cylinder 15 into the reservoir 82. When secondary spool 85 of control valve 14 is actuated secondary cylinder 16 is expanded and the secondary upright sections 7 and 8 are telescoped relative to each other. Accordingly, when the secondary spool 85 is operated to retract the secondary hydraulic lift cylinder 16 the secondary assembly of the mast is contracted to its lowered position.

A third spool is also provided in the valve assembly as shown in FIG. 13 which provides operation of the tilt cylinders 11 and 12. Two tilt cylinders are employed and each is connected to a mating side of the mast to tilt the mast evenly as pressurized fluid is supplied to the tilt cylinders 11 and 12. A reverse action is also permitted by retracting the spool and permitting pressurized fluid to flow in the opposite side of the tilt cylinders 11 and 12 thereby uprighting the mast from a tilted position.

It is understood that the preferred embodiment of this invention employs a spool valve for each of the lift cylinders 15 and 16. It is however possible to use a single spool 110 in control valve 114 for both the primary lift cylinder 15 and secondary lift cylinder 16 with a single connection from the spool valve to both of the cylinders as shown in FIG. 14. The reason for this being that the primary lift cylinder 15 has a larger cross sectional area of the piston and the cylinder than the secondary hydraulic lift cylinder. Accordingly, with an equal pressure in each cylinder the primary hydraulic lift cylinder will lift first, and when it is fully extended then the secondary hydraulic lift cylinder will extend. The size of the cylinder controls which lift cylinder will lift first.

This feature of a difference in the cross sectional area provides a measure of safety in that only one cylinder can lift a predetermined load to a predetermined height. If a heavier carriage load than a predetermined weight is on the carriage then the secondary cylinder will not lift since the area is too small for the pressure of the hydraulic fluid. Accordingly, if the cylinders were the same size the same load would be carried to the extreme height of the fully extended mast which has a greater tendency to be overbalanced.

The preferred embodiments of this invention has been illustrated and described and its operation will be set forth in the following paragraphs.

When the vehicle is in operation pressurized fluid is supplied to a control valve 14 by the pump 80. The control valve 14 of FIG. 13 directs the flow of pres-

surized fluid to a primary hydraulic lift cylinder **15**. The pressurized fluid flows through spool **84** of the valve **14**, through the hose **70**, the pressure regulator valve **74**, and the fitting **73** to the base end of the primary lift hydraulic cylinder **15**. Pressurized fluid in the primary hydraulic lift cylinder **15** expands the cylinder causing the carriage section **10** to slide upwardly relative to the primary base section **9**. The chains **50, 51** ride on the sheaves **52** and **53** as the carriage **17** slides upwardly within the channels **20** and **43** of the carriage section **10**. So long as the primary hydraulic cylinder continues to expand, the carriage **17** continues to move upwardly until the hydraulic cylinder has reached its limits of expansion.

When the secondary spool **85** is operated, pressurized fluid is supplied to the secondary hydraulic lift cylinder **16**. The pressurized fluid from spool **85** of the control valve **14** passes through hose **71** through the fitting **90** on the base of the secondary hydraulic lift cylinder **16**. The secondary hydraulic lift cylinder **16** expands upwardly carrying the lift section **8** telescoping relative to the secondary base section **7**. Chains **64** and **65** ride over the sheaves **60** and **61** which carry the base section **9** of the primary assembly upwardly relative to the lift section **8** and relative to the base section **7** of the secondary assembly. Continued expansion of the secondary hydraulic cylinder **16** continues to raise the sections **8** and **9** until the lift section **8** is fully extended relative to a base section **7** and the primary base section **9** is fully extended relative to the secondary lift section **8**. In this position the hydraulic cylinder then has reached its limit of expansion and the piston in the cylinder engages the stop which limits its upward movement. Simultaneously with the upward movement of the sections **8** and **9**, the hose **70** rolls on the sheaves **72** and the fitting **73** in the base of the primary hydraulic cylinder **15** moves upwardly with the base section of the primary hydraulic cylinder. When it is desired to lower the mast, the spools in the hydraulic control valve are operated to permit the return of fluid to the reservoir **82** as the sections of the mast contract within each other.

It is noted that the assembly comprises a nestling of pairs of channels within each other which have a very limited obstruction to view of the operator at the control station **95**. The nestling of the channels within each provides a very compact arrangement and a very reliable construction which makes for a rigid mast in either the contracted or extended position. The mast in the lowered position has greater overhead clearance than the conventional type fork lift mast since four units are used which telescope to a lower position. The differential in areas between the primary hydraulic lift cylinder and the secondary hydraulic lift cylinder provides a measure of safety in that an excessive load cannot be lifted to the maximum height on the mast. It may be desirable to lift a heavier load to half the height, and accordingly the larger cylinder is provided in the primary hydraulic lift cylinder to accomplish this.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A load lifting mast for use on a vehicle comprising a pair of primary upright sections and a pair of secondary upright sections telescopingly nestled in slidable relation to each other, said primary upright sections including a base section and carriage section, said secondary upright sections including a base section and a lift section, means supporting said base upright section of said secondary upright sections on said vehicle, a load carriage slidably mounted on said primary carriage upright section, a primary hydraulic expansion unit including a primary hydraulic lift cylinder connected between said primary base section and said carriage section to telescope said primary sections relative to each other, a flexible member connected between said primary base section and said carriage and sheave means on said carriage section for lifting said carriage relative to said carriage section when said primary sections are extended, a secondary expansion unit comprising a secondary hydraulic lift cylinder positioned between said secondary base section and a secondary lift section for telescoping said secondary sections, a flexible member connected between said secondary base section and said primary base section and sheave means on said lift section for lifting said primary sections when secondary sections are extended, a hydraulic system including a control valve mounted on said vehicle, a source of pressurized fluid for supplying pressurized fluid to said control valves, a conduit means connecting said control valve to said primary and said secondary hydraulic lift cylinders, said valve thereby providing means for controlling the expanding of said primary hydraulic lift cylinder and said secondary hydraulic lift cylinder for extending said mast.

2. A load lifting mast for use on a vehicle as set forth in claim **1** wherein each of said upright sections comprise a pair of channels in spaced relation, said upright sections comprising four sections of decreasing longintudinal and lateral dimension to provide a nestling of successive sections within the base section supported on said vehicle.

3. A load lifting mast for use on a vehicle as set forth in claim **1** wherein said secondary base section comprises a plurality of members embracing two channels defining a rigid base supporting structure.

4. A load lifting mast for use on a vehicle as set forth in claim **1** wherein said primary hydraulic lift cylinder includes means supporting said cylinder centrally within said primary carriage upright section.

5. A load lifting mast for use on a vehicle as set forth in claim **4** wherein said secondary hydraulic lift cylinder includes means supporting said secondary hydraulic cylinder adjacent to said primary hydraulic lift cylinder.

6. A load lifting mast for use on a vehicle as set forth in claim **1** wherein said secondary base upright section includes, tilt cylinders, means for connection of said upright section to said tilt cylinders to provide tilting of said mast in response to actuation of said tilt cylinders.

7. A load lifting mast for use on a vehicle as set forth in claim **1** wherein said primary carriage section comprises a pair of channels, means maintaining said channels in spaced relation relative to each other, a carriage including roller means rolling within said channels of said carriage section.

8. A load lifting mast for use in a vehicle as set forth in claim **1** wherein said hydraulic system includes, hose means connected between said control valve and the base of said primary hydraulic lift cylinder, a sheave

means mounted on said secondary lift upright section of said secondary assembly to thereby provide guide means for said hose means for accomodation of movement of said hose means to provide connection between said control valve and said primary hydraulic lift cylinder.

9. A load lifting mast for use on a vehicle as set forth in claim **4** wherein said control valve includes three spool valves comprising a spool for controlling the flow of pressurized fluid to said primary hydraulic lift cylinder, a spool for controlling the flow of hydraulic fluid to said secondary hydraulic lift cylinder, a spool adapted for controlling the flow of hydraulic fluid to a tilt cylinder.

10. A load lifting mast for use in a vehicle as set forth in claim **1** wherein said primary hydraulic lift cylinder defines predetermined effective area exposed to pressurized fluid, said secondary hydraulic lift cylinder defines a smaller predetermined effective area exposed to pressurized fluid, said control valve including a spool adapted for controlling the flow of pressurized fluid simultaneously to said primary hydraulic lift cylinder and said secondary hydraulic lift cylinder to thereby provide initial lifting on said primary hydraulic lift cylinder in response to the differential effective areas of said lift cylinders.

* * * * *