Jan. 20, 1970 J. M. AVIS ET AL 3,490,633

ASSEMBLY FOR LATERALLY SHIFTING AND PIVOTING A MAST OF A LIFT TRUCK

Filed Feb. 1, 1968 4 Sheets-Sheet 1

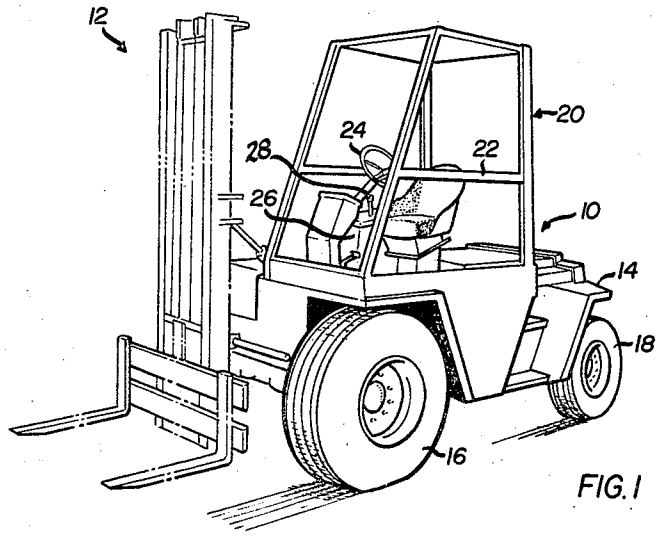


FIG. 1

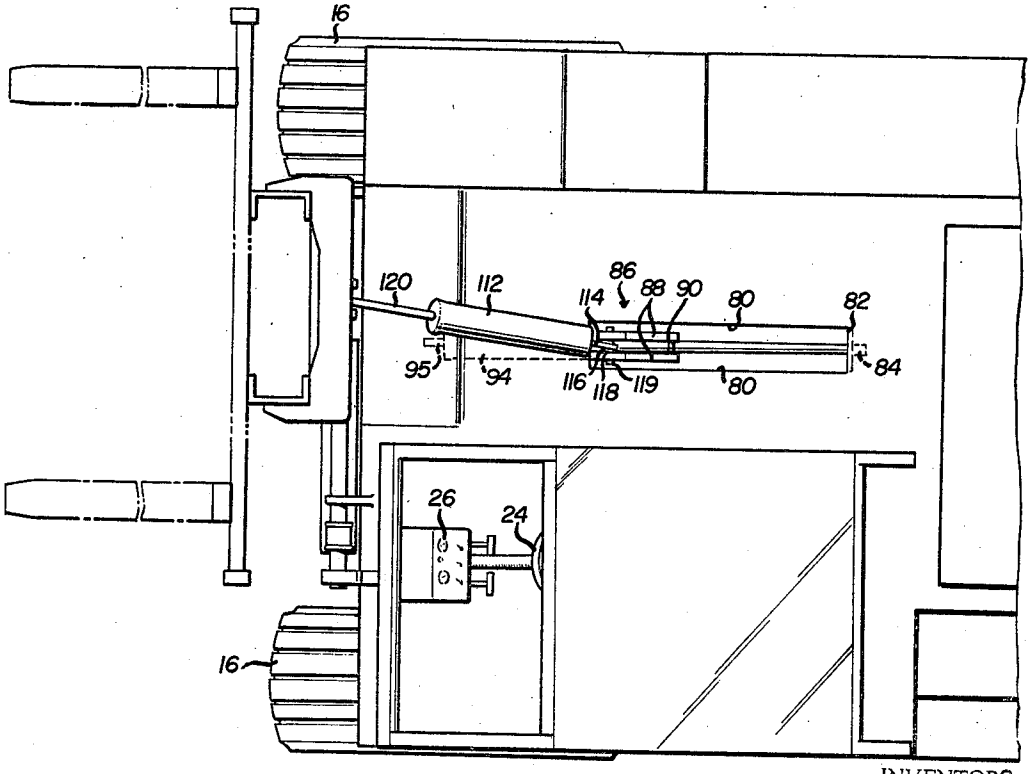


FIG. 3

INVENTORS
JOHN M. AVIS.
HUGH H DORMAN.

BY

SETTLE, BATCHELDER & OLTMAN.

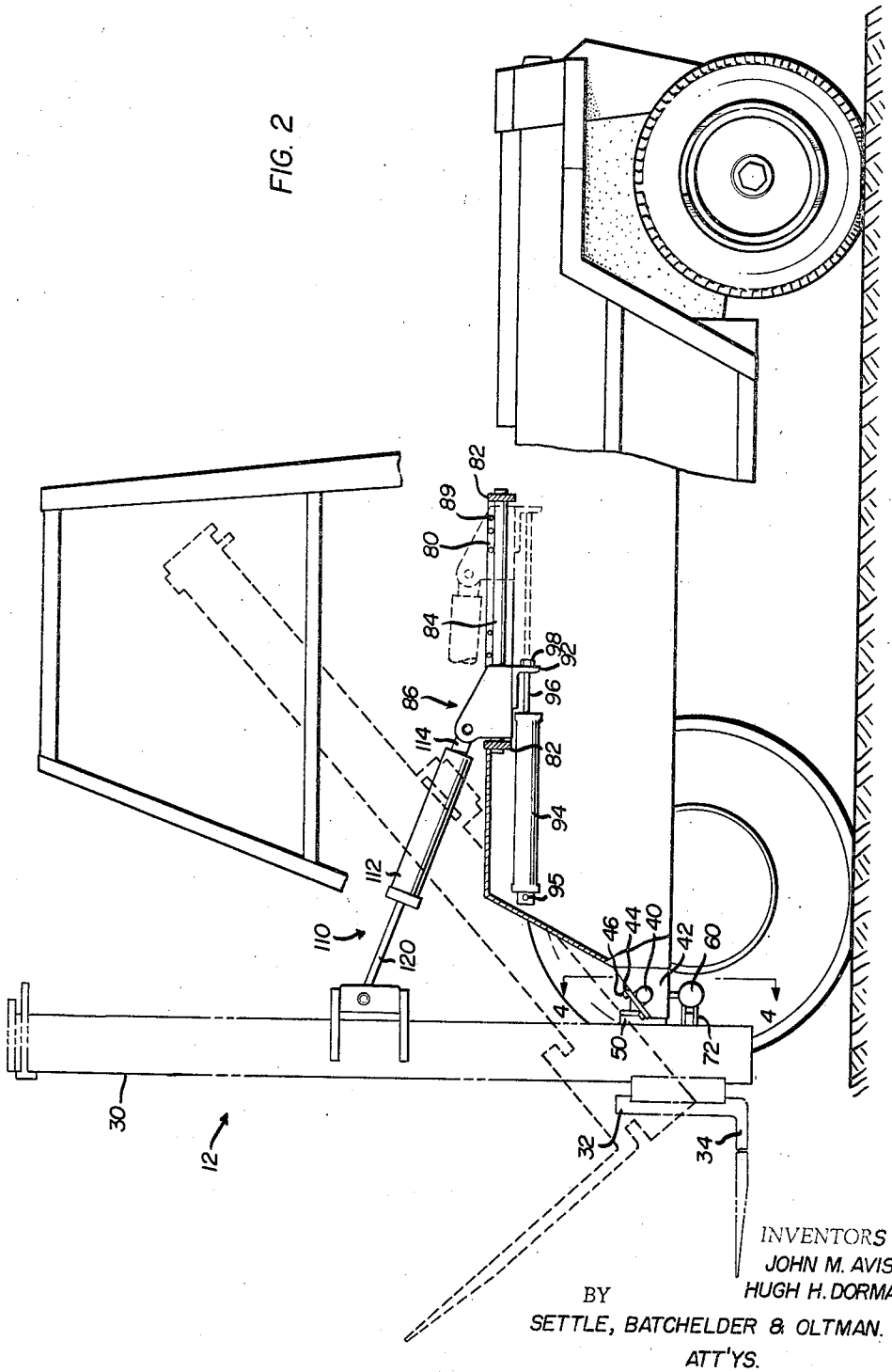
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FIG. 2



INVENTORS
JOHN M. AVIS
HUGH H. DORMAN.

BY
SETTLE, BATCHELDER & OLTMAN.
ATT'YS.

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ASSEMBLY FOR LATERALLY SHIFTING AND PIVOTING A MAST OF A LIFT TRUCK

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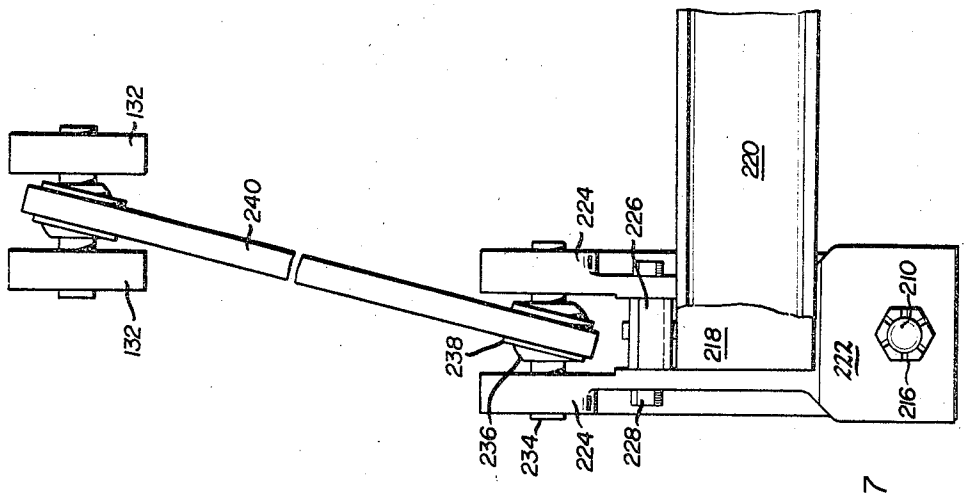


FIG. 7

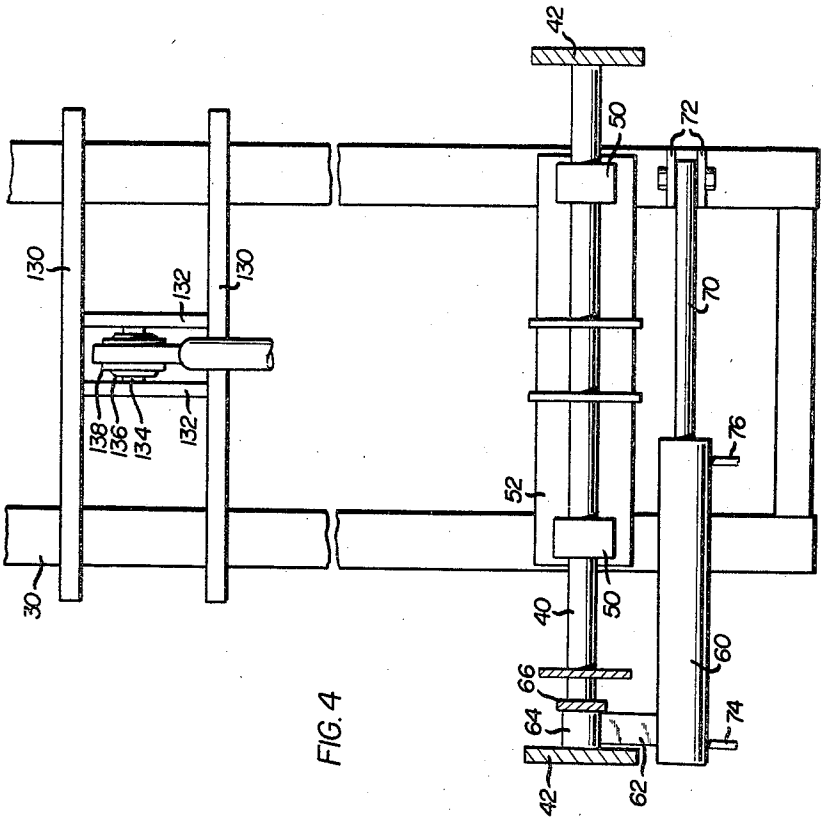


FIG. 4

INVENTORS
JOHN M. AVIS.
HUGH H. DORMAN.

BY
SETTLE, BATCHELDER & OLTMAN.
ATT'YS.

Jan. 20, 1970 J. M. AVIS ET AL 3,490,633

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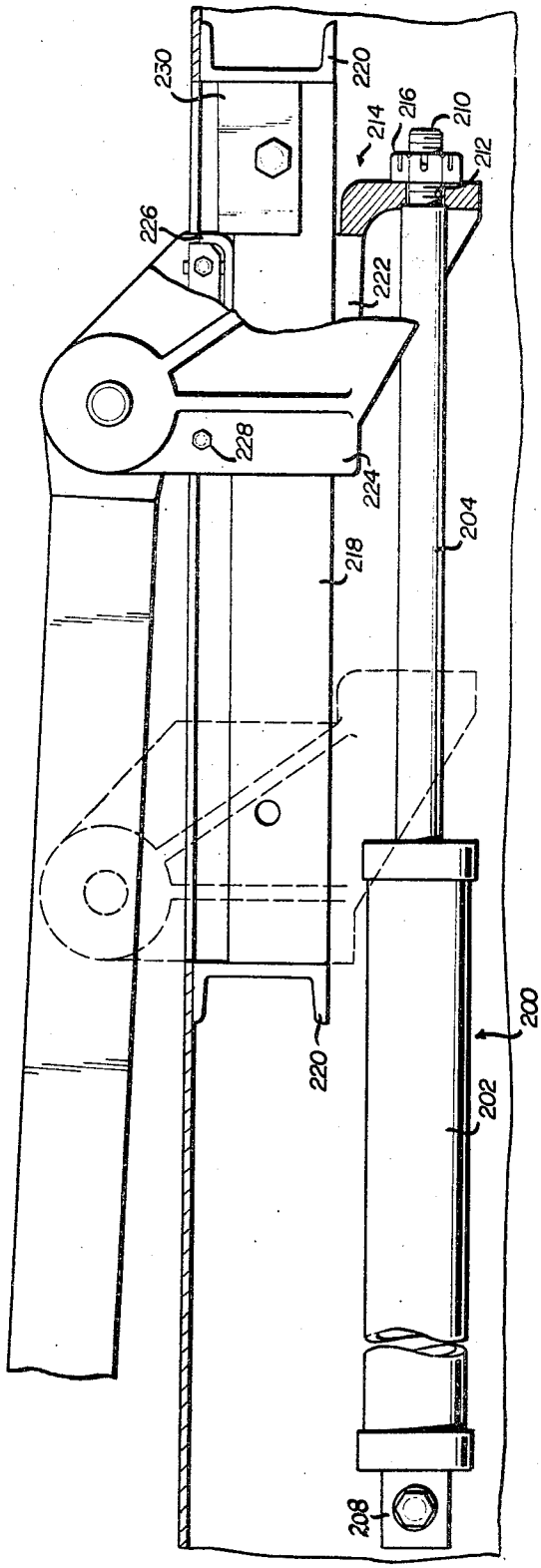


FIG. 5

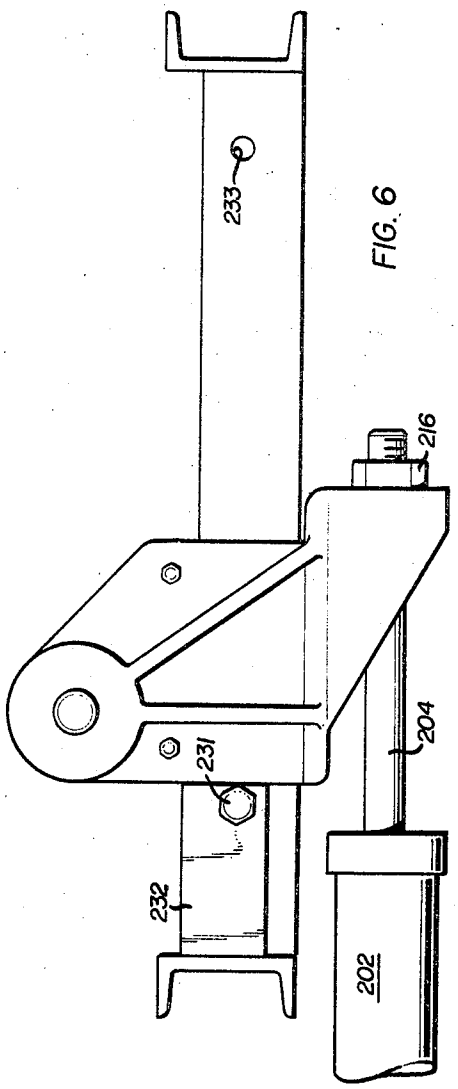


FIG. 6

INVENTORS
JOHN M. AVIS.
HUGH H. DORMAN
BY
SETTLE, BATCHELDER & OLTMAN.
ATT'YS.

United States Patent Office

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3,490,633

ASSEMBLY FOR LATERALLY SHIFTING AND PIVOTING A MAST OF A LIFT TRUCK

John M. Avis, Terre Haute, Ind., and Hugh H. Dorman, Huntington, N.Y., assignors to J. I. Case Company, Racine, Wis., a corporation of Wisconsin

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Int. Cl. B66f 9/22
U.S. Cl. 214—672 3 Claims

ABSTRACT OF THE DISCLOSURE

A vehicle having a mast supporting carriage. The vehicle includes an operating mechanism capable of laterally shifting the mast on the vehicle as well as tilting the mast forward and rearwardly of the normal vertical position. The operating mechanism also is capable of moving the mast to a laydown position for transportation purposes or for passing through relatively small openings.

BACKGROUND OF THE INVENTION

The present invention relates generally to load handling mechanisms and more particularly to an improved control mechanism for positioning a forklift on a vehicle.

In accordance wtih normal practices, a lift truck conventionally includes a mast structure supported adjacent one end of the vehicle. The mast structure has a load supporting carriage reciprocated thereon and the carriage usually supports fingers which engaged the load. Conventionally, the mast is capable of being tilted relative to the vehicle by a pair of rams or fluid cylinders with the cylinders secured to the vehicle frame and the piston rods thereof attached to the respective sides of the mast.

This arrangement has in practice found to be far from satisfactory in that the amount of tilt forwardly and rearwardly of the vertical position of the mast is generally limited to approximately 10°. Another problem which is generally encountered is in the alignment of the fingers with respect to the load. In general practice, this is normally accomplished by merely continuing to maneuver the vehicle until accurate alignment is obtained.

Of course, in the normal vehicle the view of the operator is partially obstructed by the mast generally located between the operator and the load being picked up. While several methods have been proposed for laterally shifting the mast with respect to the vehicle, the amount of lateral shifting is generally very small and the mechanism required for performing this is generally expensive as well as cumbersome to install and maintain.

Also, for efficient utilization of floor space, it is desirable to stack loads vertically upon each other and these materials generally are stacked to a height approaching 30 feet or more, and proper alignment of the respective stacks is extremely important. Again, this is very difficult to accomplish with the mast structure interposed between the operator and the load.

A further objection to the prior art devices is the transportation height of the entire vehicle with the mast structure supported thereon. Thus, the mast structure for lifting a load to the heights mentioned above is generally manufactured in three different sections which are collapsible to a single height of approximately 10 feet. However, in transporting the vehicle to different job sights it is of course highly desirable to reposition the mast so that it does not obstruct the driver's view in any manner and is well supported in such a position.

Also, many times it is necessary to move the vehicle through an opening of rather limited height and many prior art devices require complete disassembly of the mast from the vehicle to allow the vehicle to be moved into a building with a relatively small opening.

Thus, it is readily apparent that the present needs of industrial vehicles of the above type require a machine which is capable of eliminating all of the above objections while still being capable of being operated efficiently.

SUMMARY OF THE INVENTION

The present invention provides such a machine. Generally speaking, the present invention provides a control system for repositioning a mast structure on a vehicle and in which the control system incorporates means for shifting the mast a considerable distance laterally of the vehicle so as to be capable of being moved to a position where the operator's view is not obstructed. The control system further incorporates mechanism for tilting the mast relative to the vehicle to maximum positions which heretofore have not been obtainable. Furthermore, the mechanism includes additional means which will allow the mast structure to be moved to a laydown or transport position in which the overall height of the vehicle is considerably reduced.

Thus, the primary object of the present invention is to provide a simple and effective mechanism for laterally shifting and tilting a load supporting structure on a vehicle.

Another object is to provide an improved mechanism of the above type which can readily be actuated to reposition the load supporting member to an inoperative supported position for transportation between job sights.

Other objects of this invention will appear in the following description and appended claims forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

ON THE DRAWINGS

FIGURE 1 shows a perspective view of a load supporting vehicle incorporating the present invention;

FIGURE 2 is a side elevation, partly in section, view showing the control system for the load supporting vehicle;

FIGURE 3 is a fragmentary plan view of the control system with parts of the vehicle being sectioned and parts in phantom;

FIGURE 4 is a vertical sectional view taken generally along lines 4—4 of FIGURE 2;

FIGURE 5 is a fragmentary elevation view similar to FIGURE 2 showing a slightly modified type of tilt control mechanism;

FIGURE 6 is a fragmentary elevation view of the mechanism shown in FIGURE 5; and

FIGURE 7 is an end view partly in section of the mechanism of FIGURE 5.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring particularly to FIGURE 1 of the drawings, there is shown a vehicle generally designated at **10**, having a load supporting member **12** attached to one end thereof. The vehicle includes a body **14** supported by driven wheels **16** and steering wheels **18**.

The body **14** supports a cab **20** surrounding the operator's compartment of the vehicle. The operator's compartment, of course, includes a seat **22**, a steering mechanism **24** and control means **26** having having control handles **28** respectively adapted to operate various portions of the implement.

The load supporting structure **12** comprises a mast or carriage assembly **30** and a carriage **32** supported for vertical reciprocal movement on a mast structure **30**. The carriage **32** has a pair of adjustable fingers or tines **34** which are adapted to engage or support a load.

As shown in FIGURES 2 and 4, the load supporting member **12** is carried on a shaft **40** supported on spaced brackets **42** and maintained in the recesses of the spaced brackets by plates **44** removably secured to the brackets by bolts **46**. The shaft **40** extends across substantially the entire width of the vehicle between the two driving wheels **16**, for a purpose to be described later. A pair of spaced trunions or brackets **50** are fixedly secured to a plate **52** carried by the mast structure **30** with the brackets **50** having openings receiving the shaft **40** for sliding and pivotal movement thereon, as will become apparent hereinafter.

According to one aspect of the invention, means are provided for laterally shifting the load supporting mechanism **12** with respect to the vehicle **10**. This is accomplished by a simple and efficient mechanism comprising a fluid cylinder **60** having an integral attachment **62** defining a tubular member **64** at one end thereof which is received on the shaft **40**. The tubular member is maintained in a fixed position relative to the shaft **40** by having one end in engagement with one of the brackets **42** and the second end in engagement with a bracket **66** also fixedly secured to the frame of the vehicle. The piston rod **70** reciprocated within the cylinder **60** has its free end removably secured to plates **72** carried by the mast structure **30**. Suitable fluid conduits **74** and **76** are connected to opposite ends of the cylinder **60** to extend or retract the piston **70**.

Thus, it can readily be appreciated that the amount of lateral shifting of the mast structure with respect to the vehicle is only limited by the length of the shaft **40** and the width of the mast. Furthermore, the simple arrangement for supporting the laterally shifting means provides an inexpensive mechanism which is substantially free of any required maintenance.

According to another aspect of the invention, the mast **30** is capable of being tilted with respect to the vehicle **10** by tilting means which will now be described. The tilting means is shown in FIGURES 2 and 3 and includes a pair of spaced plates **80** interconnected at opposite ends by plates **82** and fixedly secured to the frame structure or forming a part of the frame structure of the vehicle. A guide rod **84** is supported at its opposite ends on the plates **82** and slidably receives bracket means **86**. The bracket means **86** includes a pair of spaced plates **88** interconnected by guide members **90** slidably received on the guide rod **84**.

The lower ends of the spaced plates **88** have a bracket **92** fixedly secured thereto for connection to a cylinder assembly. The cylinder **94** of cylinder assembly is secured by a lug **95** to the frame of the vehicle while the piston rod **96** has a reduced threaded position received through an opening in the bracket and maintained thereon by a nut **98**. The bracket means **86** is interconnected with the mast structure so that relative movement between the piston rod **96** and the cylinder **94** is transmitted through the connection to pivot the mast on the shaft **40** while also accommodating lateral shifting of the mast on the shaft **40**.

Thus, according to a further aspect of this invention, the interconnection between the bracket means **86** and the mast **30** comprises a link or adjustable strut in the form of a cylinder assembly or fluid ram **110**. The cylinder assembly **110** includes a cylinder **112** having a bracket **114** fixedly secured thereto which in turn supports a socket **116**. The socket **116** is supported on a ball **118** carried by a pin **119** on the bracket means **86**. Thus, the interconnection between the cylinder **112** and the bracket means **86** is in the form of a swivel joint, for a purpose to be described later.

The piston rod **120** of the cylinder assembly is secured to the mast **30** through a swivel connection similar to the swivel connection **116–118**. Thus, the vertical surface of the mast **30** has a pair of vertically spaced horizontally extending reinforcing members **130** with a pair of vertically extending plates **132** connected to the respective members **130**. The plates **132** carry a pin **134** supporting a ball **136**. The ball **136** supports a socket **138** carried by the piston rod **120** to complete the swivel connection between the piston rod **120** and the mast **30**.

Of course, the respective cylinders **60**, **94** and **112** have opposite ends thereof connected to the hydraulic system of the vehicle through suitable conduits (not shown). Thus, the piston rods or first elements are extendible and retractable within the cylinders or second elements. Furthermore, the valve controls (not shown) for the respective cylinders are connected to the levers **28** disposed in the operator's compartment of the vehicle.

The operation of the control mechanism can readily be appreciated from the above description. Thus, the load supporting member **12** may readily be shifted laterally of the vehicle on the shaft **40** by supplying fluid to the respective conduits **72**, **74** to extend and retract the piston rod **70** within the cylinder **60**. In the completely extended position of the cylinder **60** and piston rod **70**, the mast structure is disposed on one side of the vehicle and thus the operator has a clear view from the compartment of the vehicle since the operator's compartment is also offset from the center of the vehicle.

The tilting of the mast on the shaft **40** is preferably accomplished through the first cylinder and piston rod **94**, **96**. Extension and retraction of the piston rod **96** within the cylinder **94** will move the bracket means **86** along the guide rod **84**. During this movement, the link or cylinder assembly **110** acts as a fixed strut to transmit movement of the bracket means **86** to the mast to thus pivot the mast on the shaft **40**. As can readily be appreciated, the control means provides a simple and efficient manner of tilting the mast structure and all of the weight from the mast and the load supported thereon is supported by the bracket means **86** on the guide rod **84**. This eliminates any undue stress on weight on the tilt control cylinder assembly **94**, **96**. This is of extreme importance since this substantially reduces the required size of the cylinder assembly **94**.

If it is desired to move the mast structure of its transport position, it is only necessary to completely retract the piston rod **120** within the cylinder **112** thus moving the mast structure to the laydown position in which the overall height of the vehicle is substantially reduced. By way

of example and not of limitation, movement of the cylinder **94** and piston rod **96** between the complete retracted position and extended position allows a 20° forward tilt and 15° backward tilt with respect to the vertical position of the mast on the vehicle. This figure is based on link or strut **110** being its completely extended position. Furthermore, fully retracting the piston rod **120** within the cylinder **110** and moving the piston rod **96** into its extended position will move the mast structure approximately a 50° rearward tilt position or laydown position.

As an additional feature of this invention, in the laydown position of the mast, the mast is supported directly on the vehicle body and frame. This arrangement is highly desirable when the vehicle is to be transported or driven on a highway. Of course to move the mast to the laydown position, the mast must be shifted laterally to a position offset from the cab and in longitudinal alignment with the recess formed in the housing of the vehicle. It can readily be appreciated that the offset laydown position of the mast, shown in FIGURE 2, will give the operator an unobstructed view in front of the vehicle.

Adjustable limit stops are preferably provided to limit the forward and backward tilt of the mast during normal operation of the load supporting structure. This is of extreme importance in an implement which is capable of raising a load to a height approaching 30 feet. Thus, for example, if a load is to be raised the maximum height it is desirable to limit the tilt to 3° in each direction.

According to a further aspect of the invention, the limits are readily established and changed by a simple adjustment which can be quickly varied by the operator. The spaced plates **80** supporting the bracket means **86** have a plurality of aligned longitudinally spaced holes **89** along the upper edges adjacent the opposite ends thereof. These holes are located so as to correspond to varying maximum limits of forward and backward tilt. If it is advisable to limit the tilt of the mast, the operator places pins in the holes corresponding to the maximum tilt desired. It should be noted that the apertured plates are located so as to be readily accessible to the operator without leaving the cab of the vehicle.

A slightly modified tilting mechanism is disclosed in FIGURES 5 to 7. The modified tilting mechanism incorporates many of the features of the tilting mechanism described hereinabove. Thus, the modified tilting mechanism (FIGURE 5) comprises a cylinder assembly **200** including a cylinder **202** and a piston rod **204**. The cylinder **202** is fixedly secured by a bracket **208** to the vehicle frame (not shown). The piston rod **203** has a reduced portion **210** received in an opening **212** of bracket means **214** and maintained thereon by a nut **216**.

Guide means are provided for the bracket means **214**. The guide means comprises a rectangular beam **218** fixedly secured at opposite ends to transversely extending channels **220** forming part of the vehicle frame. The bracket means **214** is specifically configured so as to be guided for movement along the beam or track **218**. Thus, the bracket means comprises a web portion **222** having a pair of spaced arms **224** extending above the web **222**. The spaced arms **224** receive substantially U-shaped guide plate **226** which has one surface in engagement with the track **216** and is maintained between the arms **224** by spaced bolts **228**. As can readily be appreciated, the specific construction of the bracket beams **214** limits the movement of the bracket along a longitudinal axis defined by the beam or track **218**.

For the reasons set forth hereinabove, it is again desirable to provide limit stops for limiting the extent of movement of the bracket means **214** along the track **218**. In the modified embodiment of the invention, this is accomplished by providing U-shaped spacer members **230**, **232** straddling the opposite ends of the beam or track **216**.

The members **230**, **232** may be secured to the beam by bolts **231** received in openings **233**. A single member or plate **230** may be utilized for providing two limit positions of tilt for the mast. In the position shown in FIGURE 6, the bracket means is at a maximum forward position less than the maximum tilt of the mast. If it is desired to further limit the forward tilt the bolt need only be removed, the position of the bracket reversed and the bolt placed in the same opening. This will of course further limit the forward movement of the bracket means on the track **218**.

The upward portions of the pair of spaced arms **224** of the bracket means **214** have aligned aperatures which receive a pin **234** supporting a ball **236** which in turn supports a socket **238** carried by a fixed strut or link **240**. The opposite end of the fixed strut **240** has a ball and socket swivel connection with the mast similar to the socket connection just described.

Again, the operation of the modified embodiment is substantially identical to that described hereinabove. Thus any expansion or retraction of the cylinder assembly **200** will slide the bracket means along the track **218**. Of course, the sliding movement of the bracket means will be transmitted directly to the mast through the fixed link **240** to thereby pivot the mast on the pivoting shaft **40**.

Of course the fixed strut **240** of the modified embodiment may be a cylinder assembly of the type disclosed in the embodiment of FIGURES 1 through 4.

The present invention therefore provides a simple and efficient manner of combining all of the advantages and features of several prior art load handling apparatus into a single machine which is simple and inexpensive to manufacture and is substantially maintenance free.

While two exemplary embodiments of the invention have been described in detail, it will be apparent to those skilled in the art that the disclosed embodiments may be modified.

We claim:

1. In a load handling vehicle having a frame, a horizontal shaft mounted on said frame and extending transversely of said vehicle, a mast mounted at its lower end upon said shaft for pivotal movement about the axis of said shaft and for sliding movement axially along said shaft, means for positioning said mast upon said shaft, and load elevating means mounted upon said mast; the improvement wherein said mast positioning means comprises first and second elongate longitudinally extending strut means, first pivot means pivotally interconnecting one end of said first strut means to one end of said second strut means, second means mounting the other end of said first strut means on said frame, third pivot means pivotally interconnecting the other end of said second strut means to said mast at a location spaced upwardly of said mast from said shaft, guide means on said frame confining the path of movement of said first pivot means relative to said frame to a substantially horizontal path extending longitudinally of said vehicle, independent control means coupled to each of said first and said second strut means operable to extend or retract said first and said second strut means independently of each other, and means for shifting said mast to selected positions axially along said shaft.

2. In a load handling vehicle as defined in claim **1**, the further improvement wherein said first pivot means comprises a bracket connected to said one end of said first strut means, said guide means comprises means on said frame receiving said bracket for sliding movement to define the path of movement of the first pivot means relative to said frame, and adjustable limit stop means engageable between said frame and said bracket to establish the end limits of said path of movement.

3. In a vehicle as defined in claim **1**, the further improvement wherein said first strut means extends longitudinally of said vehicle and said first and said third pivot means each define a universal connection to accommodate transverse movement of said mast on said shaft, an op-

erator's cab mounted on said frame in transversely spaced relationship from one side of said first strut means, said shaft supporting said mast for movement transversely of said vehicle from a first position in front of said cab to a second position transversely offset from said cab, said strut means being operable by said control means when said mast is in said second position to tilt said mast rearwardly about said shaft to a transport position wherein said mast extends along one side of said cab in overlying relationship to said first and second strut means.

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GERALD M. FORLENZA, Primary Examiner

R. B. JOHNSON, Assistant Examiner

U.S. Cl. X.R.

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