June 16, 1953 H. E. MILZ 2,642,157

LIFTING MAST ASSEMBLY

Filed May 22, 1951 6 Sheets-Sheet 1

Fig. 2

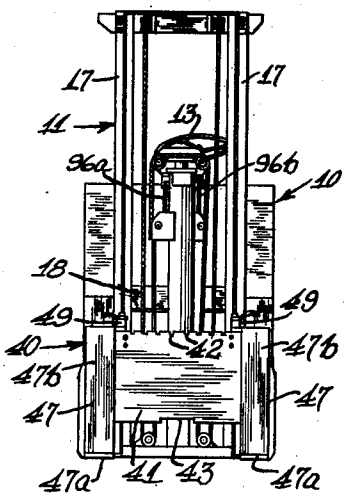


Fig. 1

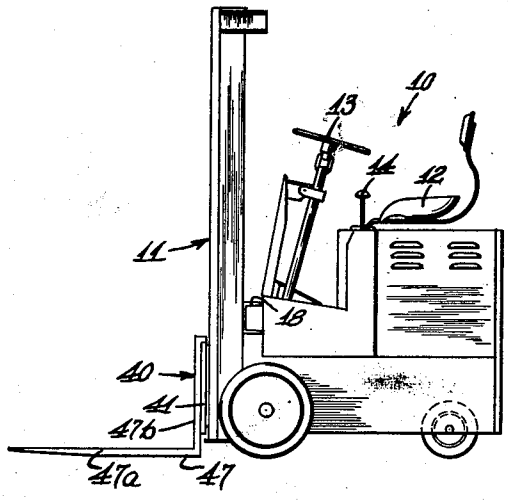
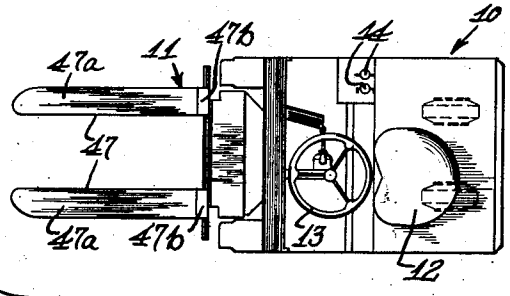


Fig. 3



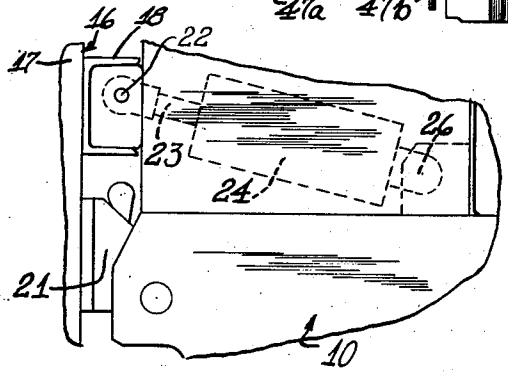


Fig. 4

Inventor

Harold Edward Milz

by Hill, Sherman, Meroni, Gross & Simpson Attys

June 16, 1953 H. E. MILZ 2,642,157

LIFTING MAST ASSEMBLY

Filed May 22, 1951 6 Sheets-Sheet 2

Fig. 5

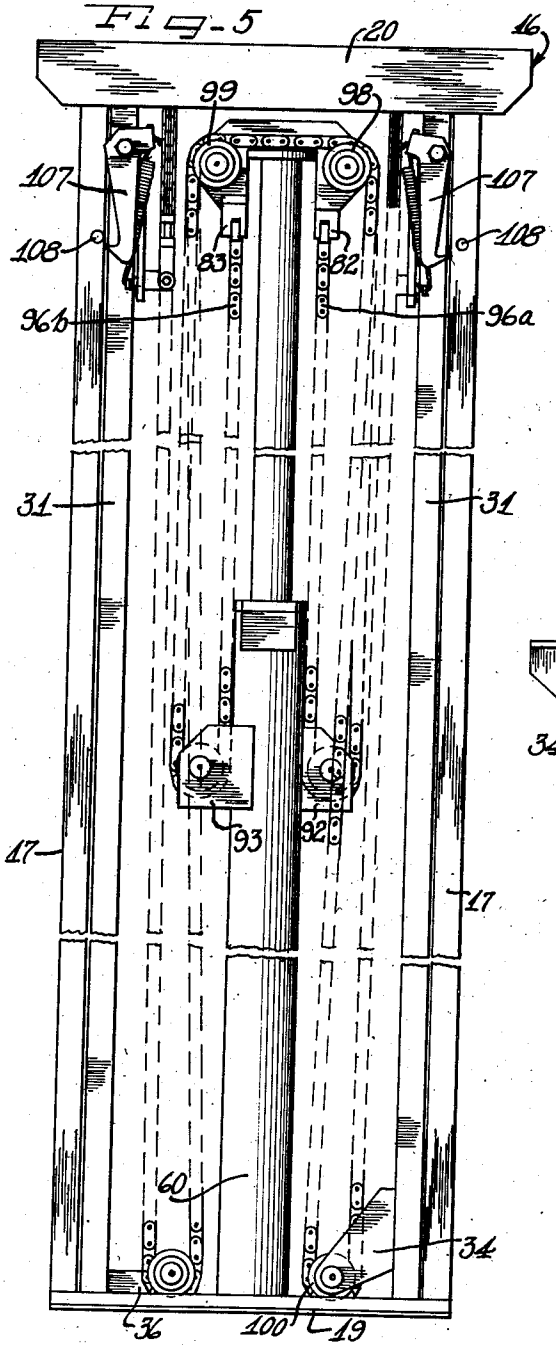
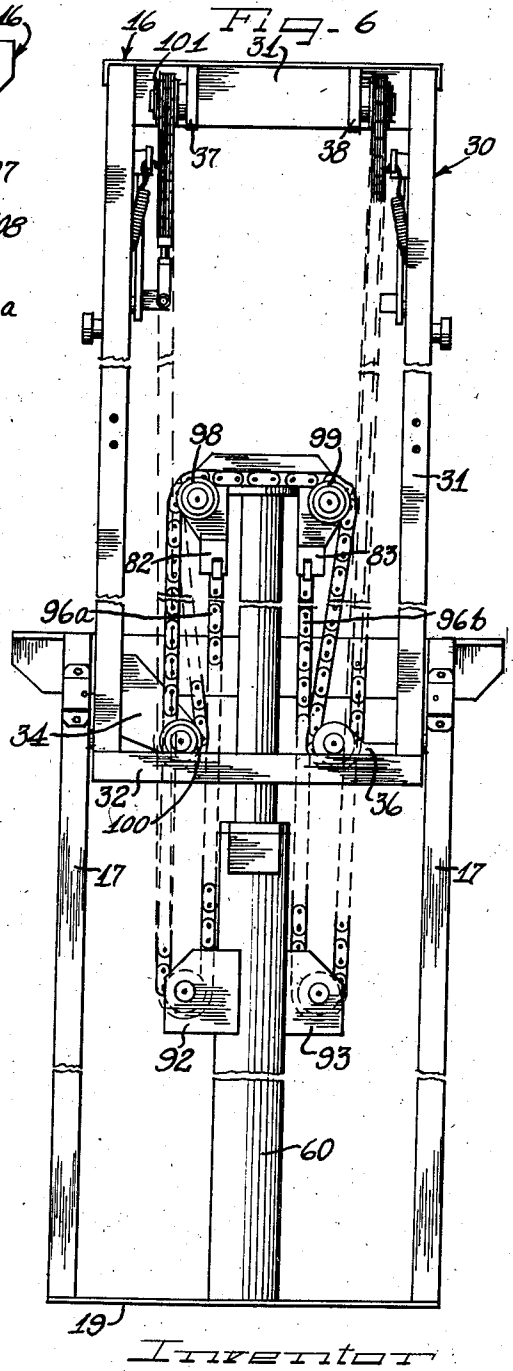


Fig. 6



Inventor

Harold Edward Milz

by Neil, Sherman, Thomas, Clark & Anglin Attys

June 16, 1953 H. E. MILZ 2,642,157

LIFTING MAST ASSEMBLY

Filed May 22, 1951 6 Sheets-Sheet 3

Fig. 7

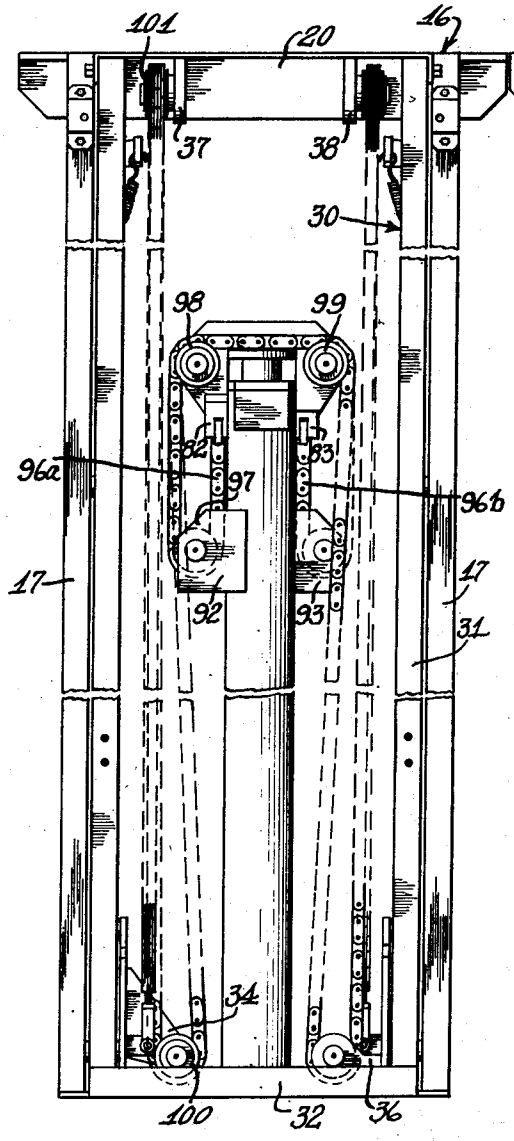
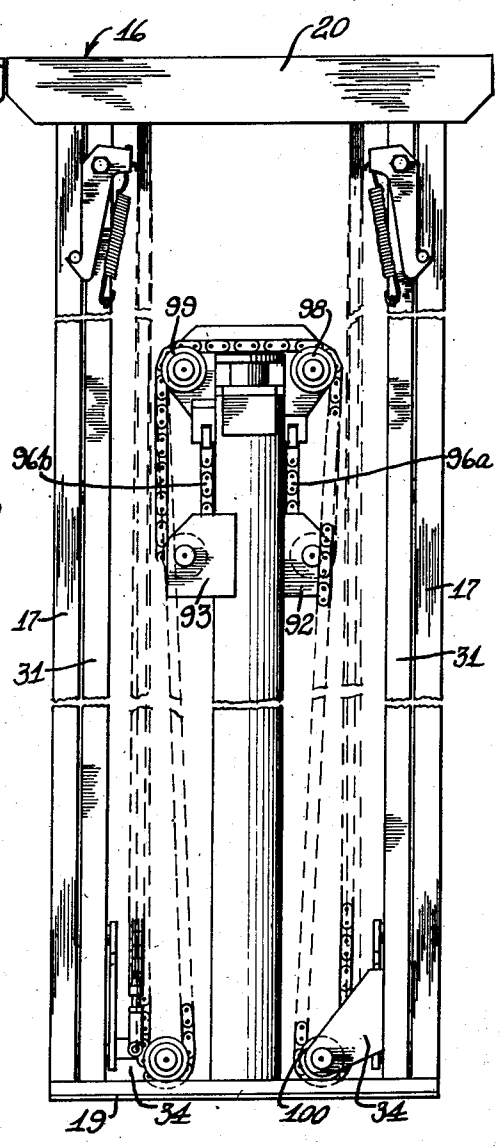


Fig. 8



Inventor

Harold Edward Milz

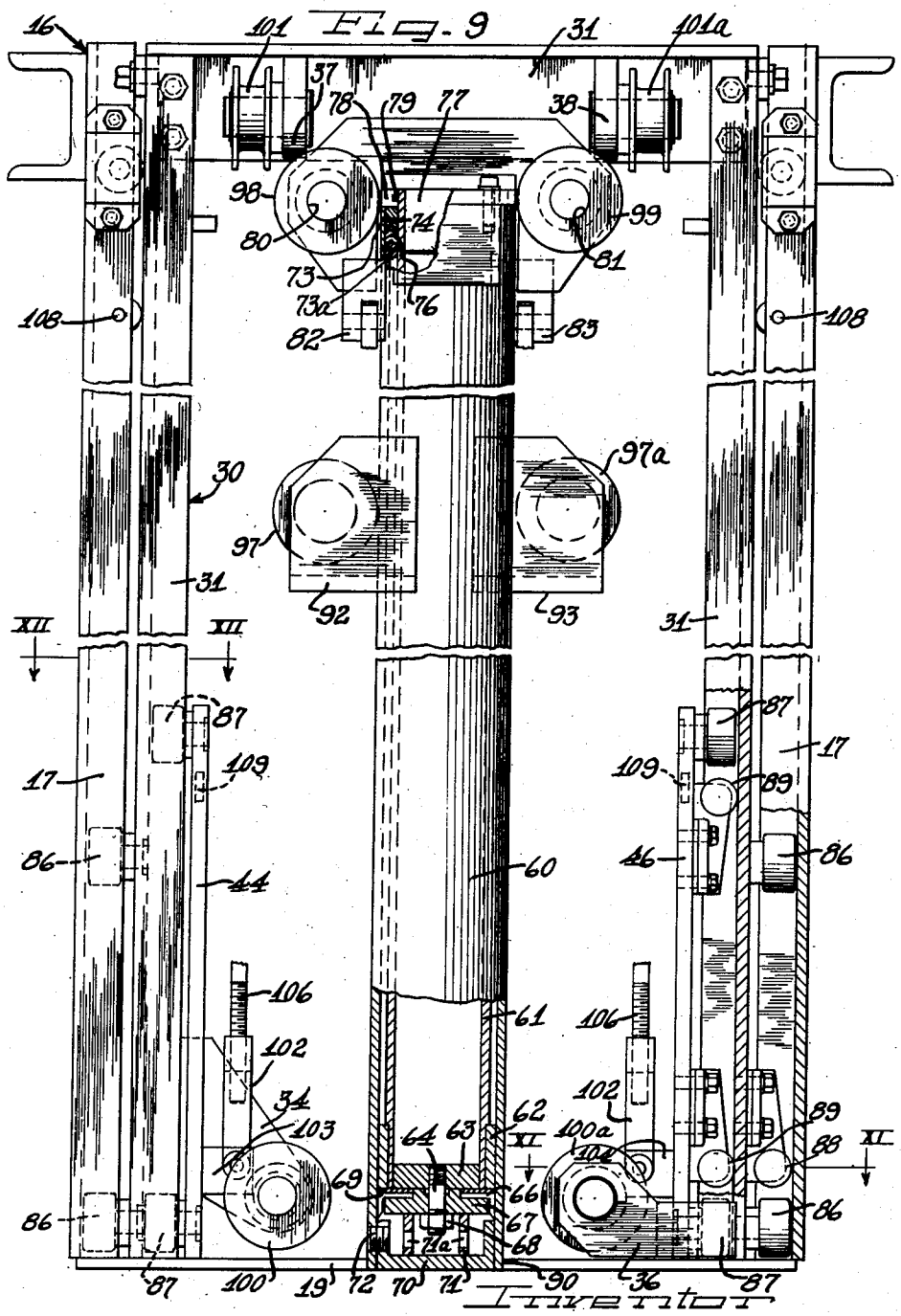
by Kelly, Sharman, Morris, Cass & Simpson Attys

June 16, 1953 H. E. MILZ 2,642,157

LIFTING MAST ASSEMBLY

Filed May 22, 1951 6 Sheets-Sheet 4

Fig. 9



Inventor

Harold Edward Milz

by Hill, Sherman, Meroni, Gross & Simpson Attys

June 16, 1953 H. E. MILZ 2,642,157

LIFTING MAST ASSEMBLY

Filed May 22, 1951 6 Sheets-Sheet 5

Fig. 10

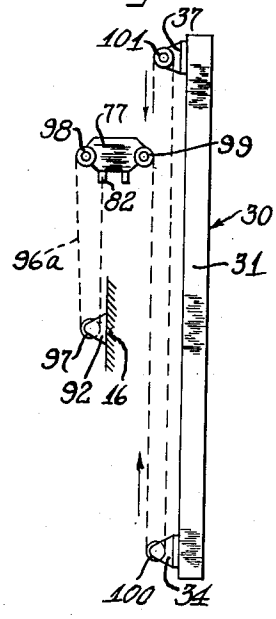


Fig. 11

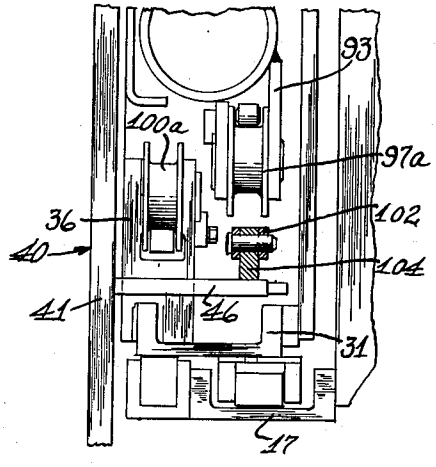


Fig. 12

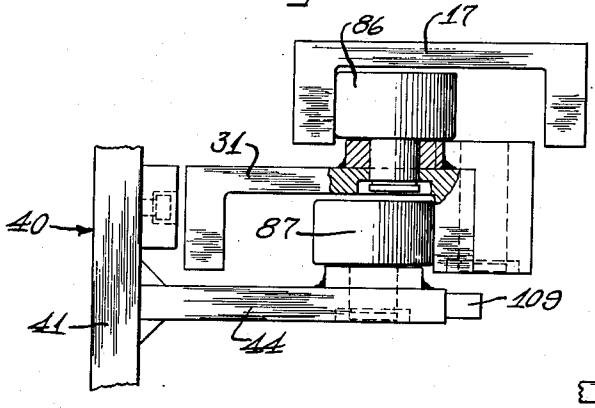
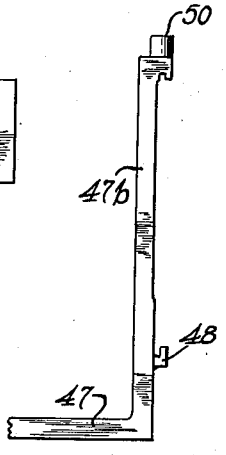


Fig. 17



Inventor

Harold Edward Milz

by Kiel, Sherman, Mesmer, Gould & Hinsen Attys

June 16, 1953 H. E. MILZ 2,642,157

LIFTING MAST ASSEMBLY

Filed May 22, 1951 6 Sheets-Sheet 6

Fig. 13

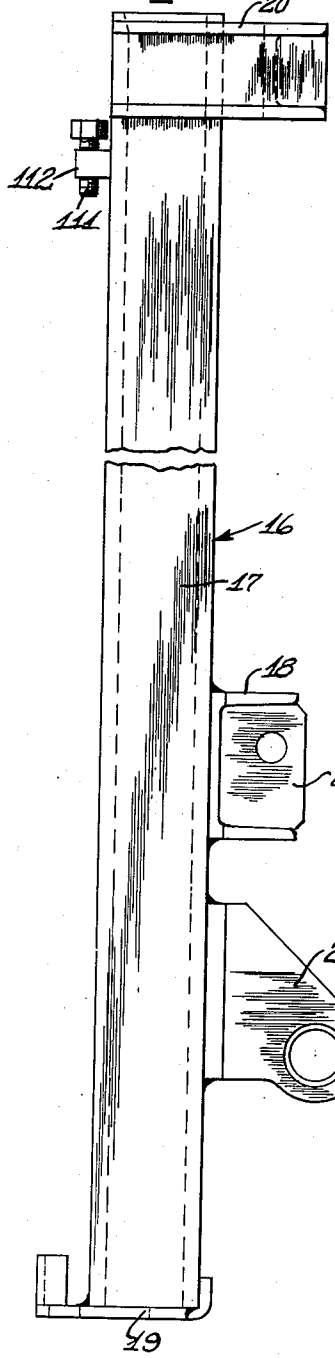


Fig. 14

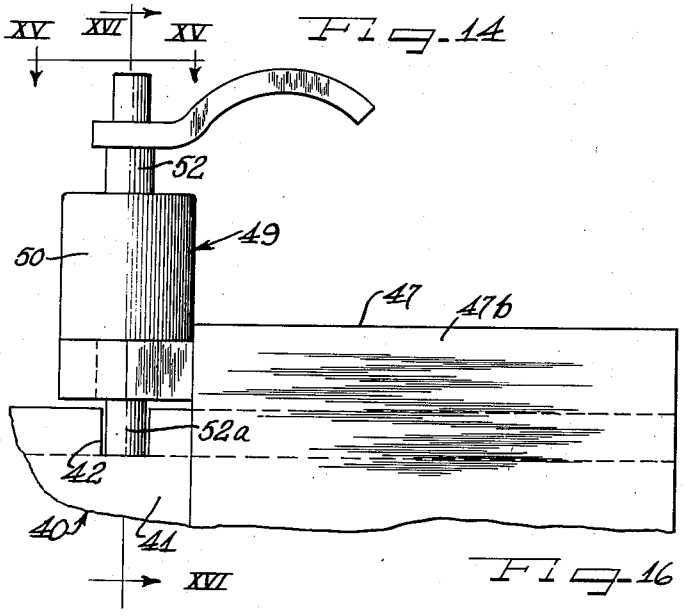


Fig. 16

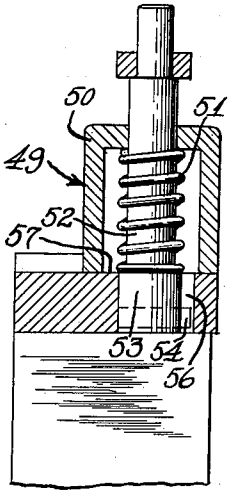
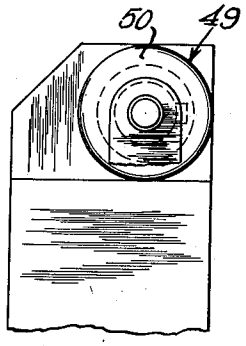


Fig. 15



Inventor

Harold Edward Milz

by Neil, Sherman, Merriam, Chase & Anglin Attys

Patented June 16, 1953 2,642,157

UNITED STATES PATENT OFFICE

2,642,157

LIFTING MAST ASSEMBLY

Harold Edward Milz, Chicago, Ill., assignor to The Mercury Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application May 22, 1951, Serial No. 227,611

11 Claims. (Cl. 187—9)

1

This invention relates generally to lift trucks and more particularly to an improved lifting mast assembly tiltably supported on the front end of a powered motive vehicle and particularly adapted for tiering pallets or other load carrying structures.

According to the features of the present invention, an improved lifting mast assembly is provided whereby a main frame assembly telescopically carries a sub-frame which in turn telescopically carries a lifting member having fork elements thereon for underlying a load supporting structure. The lifting member, the sub-frame and the main frame assembly are coupled together by a pulley system which is actuated through a hydraulic ram of novel construction.

The structure thus provided permits an extreme lift which exceeds that ordinarily available and provides a particularly advantageous free lift accommodating full tiering wherever overhead clearances are restricted. The physical relationship of the movable portions of the lifting mast assembly also insures that an operator can obtain maximum visibility during operating procedures, thus affording accuracy in handling and minimizing damage.

The pulley system of the present invention employs a cross chain assembly operable to distribute lifting effort evenly despite uneven loading of a lifting platform.

It is an object of the present invention to provide an improved lifting mast assembly whereby a greatly increased extreme lift may be obtained.

Another object of the present invention is to provide an improved lifting mast assembly whereby the amount of available free lift will be increased.

Yet another object of the present invention is to provide a lifting mast assembly for a powered motive vehicle affording the operator maximum visibility during all operational procedures.

A further object of the present invention is to provide an improved ram head assembly to furnish a thrust force for a pulley system associated with telescoping elements of a lifting mast assembly.

Yet another object of the present invention is to provide a lifting mast assembly wherein balanced load lifting may be accomplished while maximizing available free lift and extreme lift.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of

2

drawings in which a preferred embodiment of a lifting mast structure incorporating the principles of my invention is shown.

On the drawings:

Figure 1 is a side elevational view, somewhat diagrammatic, of a motive vehicle having a lifting mast assembly according to the present invention associated therewith;

Figure 2 is a front elevational view, somewhat diagrammatic, of the vehicle shown in Figure 1;

Figure 3 is a plan view, somewhat diagrammatic, of the vehicle shown in Figure 1;

Figure 4 is an enlarged fragmentary cross-sectional view with parts shown in elevation showing the details of the connection between the lifting mast assembly according to the present invention and the vehicle shown in Figure 1;

Figure 5 is a rear elevational view with parts broken away and showing the lifting mast assembly according to the present invention after the lifting element has moved through the first stage of travel;

Figure 6 is a front elevational view with parts broken away and showing the lifting mast assembly according to the present invention after the components thereof have moved through the second stage of travel.

Figure 7 is a front elevational view with parts broken away showing the lifting mast assembly in its collapsed condition;

Figure 8 is a rear elevational view of the lifting mast assembly of the present invention showing the component thereof in collapsed condition;

Figure 9 is a broken elevational view with parts removed for the sake of clarity and with parts broken away to illustrate additional details of construction showing the lifting mast assembly of the present invention as well as details of structure of the ram head assembly thereof;

Figure 10 is a diagrammatic view showing the pulley arrangement employed in the lifting mast assembly of the present invention;

Figure 11 is a cross-sectional view taken substantially on line XI—XI of Figure 9 and with added parts shown in elevation;

Figure 12 is a fragmentary cross-sectional view with parts shown in elevation taken substantially on line XII—XII of Figure 9;

Figure 13 is a side elevational view broken away in part of the main channel assembly incorporated in the lifting mast structure according to the present invention;

Figure 14 is an enlarged fragmentary elevational view of the locking element employed on the lifting member of the present invention;

Figure 15 is a fragmentary cross-sectional view with parts in elevation taken substantially on line XV—XV of Figure 14;

Figure 16 is an enlarged fragmentary cross-sectional view taken substantially on line XVI—XVI of Figure 14; and

Figure 17 is a fragmentary elevational view of one of the fork members according to the present invention.

As shown on the drawings:

The present invention contemplates the provision of any improved lifting mast assembly for a truck indicated generally by the reference numeral 10, the lifting assembly being indicated generally by the reference numeral 11.

The truck 10 is of the type having a seat 12 to accommodate a driver and can be manipulated through steering controls 13 and lifting controls 14 so arranged as to be readily accessible to the truck operator.

The main support structure for the lifting mast assembly is provided by a main channel assembly 16 (Figure 13) comprising a pair of upright channels 17 having their leg portions facing inwardly toward one another and spaced apart from one another by a cross channel 18, a bottom tie 19 and a top tie 20.

A fulcrum bracket 21 is provided near the lower portion of the main channel assembly 16 and pivotally supports the main channel assembly 16 on the front end of the truck 10.

There is also provided a pivot support bracket 22 which is connected to the cross channel 18 to provide a pivotal connection for a piston rod 23 having a piston on the end thereof actuatingly movable in a piston cylinder 24 pivotally connected to the truck 10 as at 26.

By proper control of the introduction of a pressured hydraulic medium into the cylinder 24, the main channel assembly may be selectively moved from its normal vertical position relative to the truck 10. Although not limited thereto, the preferred embodiment herein shown by way of illustrative example accommodates approximately a three degree forward tilt and a ten degree rearward tilt of the main channel assembly 16.

A telescopic channel assembly is indicated generally by the reference numeral 30 and includes a pair of upright channels 31 arranged with their leg portions extending inwardly toward one another, the upright channel 31 being assembled in spaced-apart relationship by means of a cross member 32 and a top cross member 33. A sheave bracket 34 is connected to one upright channel 31 and a sheave bracket 36 is connected to the other upright channel 31 of the telescopic channel assembly 30. A pair of sheave brackets 37 and 38 are also provided on an upper portion of the telescopic channel assembly.

The lifting member of the present invention is indicated generally at 40 and includes a substantially rectangular plate 41 having a plurality of spaced-apart notches 42 along one edge thereof and an enlarged medial notch 43 along the opposite edge thereof (Figure 2). A pair of vertical members 44 and 46 are firmly assembled on one side of the plate 41 (Figures 9 and 12).

A pair of fork members 47, 47 may be adjustably positioned on the plate 41, each of the fork members 47, 47 including a horizontal leg 47*a* adapted to underlie a pallet or other load-carrying device and a vertical leg 47*b*. The vertical leg 47*b* includes a lug 48 (Figure 17) which is adapted to pass through the medial notch 43 and

engagingly abut the edge of the plate 41 to either side of the medial notch 43.

The upper portion of the vertical leg 47*b* is provided with a lock to selectively engage one of the notches 42. The lock is indicated generally by the reference numeral 49 and includes (Figures 14, 15, 16 and 17) a housing 50 containing a coil spring 51 normally urging a lock pin 52 downwardly so that a protruding end 52*a* will be seated in the notch 42 placed in registry therewith. The pin is further provided with a barrel portion 53 having a slide pin 54 movable in a groove 56 formed in the housing 50 thereby to guide the lock pin along its path of vertical movement. The housing 50 is provided with a shoulder 57 against which the slide pin 54 may abut to keep the lock pin 52 in an inactive retracted position, if so desired.

The ram assembly of the present invention includes a generally tubular cylinder 60 preferably made of a steel tubing having a honed internal bore to receive a piston comprising a tubular piston body 61 recessed at one end to seat a bushing 62 made of a suitable wear-resistant bearing material which is adapted to slidingly engage the walls of the cylinder.

The end of the piston body 61 is closed by a cap 63 which, in turn, carries a double-ended stud 64. A flexible washer 69 and a flexible cup-shaped packing member 66 is retained by a retainer ring 67 secured on the stud 64 by a fastening nut 68 (Figure 9).

The end of the cylinder 60 is closed by a cap member 70 and a stop ring 71 suitably apertured as at 71*a* is firmly attached to the cap member 70 to limit the downward movement of the piston assembly in the cylinder 60. An inlet 72 is provided through the walls of the cylinder 60 and through the flange portion of the cap member 70 whereby a hydraulic medium suitably pressurized by any well known means (not shown) may be introduced into the cylinder 60 to move the piston assembly toward the other end thereof.

The opposite end of the ram assembly is characterized by the provision of a counterbored enlarged step 73 formed in the cylinder 60 to receive a bushing ring 74 shaped on its lower face to retain a plurality of packing rings 76 against the shoulder 73*a*.

The end of the piston body 61 pilots a cylindrical portion of a ram head assembly indicated generally by the reference numeral 77. A ring cap 78 closes the end of the cylinder 60 and is suitably recessed to position a wiping ring 79 in wiping engagement with the piston body 61.

The ram assembly thus far described is particularly efficient because both the piston and the cylinder comprise closed tubular elements which are telescopically related and so sealed with respect to one another as to permit the piston body 61 to function efficiently as a piston even if the packing elements at the bottom of the piston body 61 deteriorate or are subjected to an operational failure. The seal provided by the packing rings 76 and the ring cap 78 is capable of resisting normal operating pressures established within the bore of the cylinder 60, thereby permitting a full coaxial thrust to be imparted to the piston body 61.

In lifting mast assemblies heretofore provided, hoisting mechanisms incorporating separate pulleys arranged to lift opposite sides of a lifting platform have been seriously deficient because lifting effort is not distributed equally, particularly when a lifting platform is subjected to

an unevenly distributed load. As a consequence, users of the heretofore provided structures have experienced difficulty in maintaining proper seals in hydraulic ram assemblies due to the twisting couples and reaction forces produced in the lifting mast assemblies.

According to the principles of the present invention, a cross chain arrangement is provided to afford balanced load lifting by the lifting mast assembly. Thus, lifting effort is distributed evenly despite the unevenness of a load distribution on the platform so that hydraulic seals are easily maintained.

The cross chain arrangement contemplated by the present invention not only affords balanced load lifting, but affords an increased amount of free lift to accommodate full tiering wherever overhead clearances are restricted.

The ram head assembly 77 includes a cross head member having a pair of spaced-apart sheave pin apertures 80 and 81, respectively, and a pair of lug portions each forming a chain anchor 82 and 83, respectively.

To effect telescopic movement of the telescopic channel assembly 30 relative to the main channel assembly 16, a plurality of vertically spaced-apart rollers 86 are firmly connected to the upright channels 31 of the telescopic assembly and are arranged to engage the leg portions of the upright channels 17.

The lifting member 40 is also provided with a plurality of vertically spaced rollers 87 which are firmly connected to the vertical members 44 and 46 and are arranged to engage the leg portions of the upright channels 31 of the telescopic channel assembly 30. It will be understood that the rollers 86 and the rollers 87 are arranged both as to number and location as to properly stabilize the operation of the telescopic channel assembly 30 and the lifting member 40 with respect to the lifting function developed by the lifting mast assembly.

The telescopic channel assembly 30 and the lifting member 40 are also provided with side thrust rollers, there being a plurality of side thrust rollers 88 between the upright channels 31 and the upright channels 17 of the main channel assembly and there being a plurality of side thrust rollers 89 between the lifting member 40 and the upright channels 31.

The bottom tie 19 of the main channel assembly 16 is provided with a centrally disposed aperture 90 to pilot the cylinder 60. The cylinder 60 is connected in firm assembly with the cross channel 18 of the main channel assembly 16 by means of brackets (not shown) thereby to further support the cylinder 60 uprightly on the lifting mast assembly 11. The cylinder 60 is further provided with a pair of sheave brackets 92 and 93, respectively, the utility of which will become manifest presently.

The chain assembly of the present invention constitutes a pulley system having pulley rope means taking the form of chains arranged to provide a plurality of parallel load supporting ropes, thereby to afford a substantial mechanical lifting advantage. The preferred embodiment herein described provides a three-to-one travel ratio between the piston of the ram assembly and the load carried on the fork members 47 on the lifting member 40. In order that the arrangement of the chain elements may be fully understood, a length of chain will be traced from end-to-end with respect to the relation of the chain to the various elements of the lifting mast assembly 11. It may be noted that the chain elements are indicated by the reference numerals 96*a* and 96*b* and each comprises a roller link chain which can be employed with pulley blocks or sheave wheels instead of sprockets.

One end of the chain element 96*a* is connected to the chain anchor 82 on the ram head assembly 77 and is threaded over a sheave wheel 97 journaled in the sheave bracket 92 whereupon the chain element 96 is brought back over the top of the ram head assembly 77 and threaded over a sheave wheel 98 journaled in the sheave pin aperture 80 and a sheave wheel 99 journaled in the sheave pin aperture 81. The chain element 96*a* is then led downwardly and threaded over a sheave wheel 100 journaled in the lower sheave bracket 34 of the telescopic channel assembly and is carried back over a sheave wheel 101 journaled in the upper sheave bracket 37 of the telescopic channel assembly 30. The other end of the chain element 96 is firmly connected to the lifting member 40 by means of a clevis 102 (Figure 9) connected to a chain anchor 103 formed on the vertical member 44. The clevis 102 may be provided with a threaded adjusting pin 106 whereby the connection of the chain element 96*a* to the chain anchor 103 may be readily adjusted to take up any slack.

It will be understood that the other chain element 96*b* will be threaded in a similar manner, one end being firmly connected to the chain anchor 83 and the chain being threaded over the cylinder sheave wheel 97*a*, the ram head assembly sheave wheels 98*a* and 99*a*, the lower telescopic assembly sheave wheel 100*a*, and the upper telescopic assembly sheave wheel 101*a* and the opposite end of the chain element 96*b* being connected to the chain anchor 104 on the lifting member 40 by means of a clevis 102 having a threaded adjusting stem 106.

In operation, the lifting mast assembly 11 develops a lifting function which can be broken down into several stages of movement. The first stage of movement comprises a so-called free lifting stage whereby the lifting member 40 together with the fork members 47 thereon are moved from their lowermost position to the top of the free lift position. The amount of free lift, of course, corresponds to the amount of lift available before it is necessary to increase the overall height of the lifting mast assembly 11. Because of the chain reversal arrangement provided according to the teachings of the present invention, the lifting mast assembly 11 provides a maximum free lift dimension so that full tiering can be expedited even though overhead clearances are restricted.

In the first stage of movement, pressurized hydraulic fluid is introduced in the inlet 72 of the cylinder 60 and the piston body 61 drives the ram head assembly upwardly so that the lifting member 40 guided by the rollers 87 will move upwardly relative to the telescopic channel assembly 30 and the main channel assembly 16.

In order to insure that no movement of the telescopic assembly 30 occurs during this first stage of lifting, suitable locking elements may be provided between the telescopic channel assembly 30 and the main channel assembly 16. In this embodiment, the locking elements take the form of pivotally mounted hooks 107 carried on the upright channels 31 of the telescopic channel assembly 30 and engageable with lugs 108 formed on the upright channels 17 of the main channel assembly 16.

As soon as the lifting member 40 approaches the top of the lifting mast assembly 11, a pair of lugs 109 engage the hooks 107 and move same out of registry with the hook lugs 108 on the main channel assembly 16. The top rollers of the rollers 87 provided on the lifting member are so arranged as to concurrently engage the top cross member 33 of the telescopic channel assembly 30. The lifting mast assembly is thus readied for the second stage of movement.

In the second stage of movement, the telescopic channel assembly 30 is carried upwardly and moved relative to the upright channels 17 of the main channel assembly until a stop block means 110 on the telescopic channel assembly 30 engages a cap screw 111 adjustably carried in a stop block boss 112 formed on the upright channels 17 of the main channel assembly 16. It will be understood that the cap screw means may be adjusted to vary the stop position of the telescopic channel assembly relative to the main channel assembly.

Although various minor modifications might occur to those versed in the art upon making reference to the detailed description set forth herein for the sake of clarity, it should be understood that I wish to embody within the scope of this patent all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In a lifting mast assembly, a lifting member comprising a substantially flat support member having a plurality of spaced-apart notches along one edge and an elongated medial notch along its opposite edge thereof, a fork member having a vertical support member, a lug on said vertical support member adapted to pass through said medial notch and to engage behind said opposite edge, and a lock device spaced from said lug or said vertical support member to selectively engage one of said notches.

2. In a lifting mast assembly, a lifting member comprising a substantially flat support member having a plurality of spaced-apart notches along one edge and an elongated medial notch along its opposite edge thereof, a fork member having a vertical support member, a lug on said vertical support member adapted to pass through said medial notch and to engage behind said opposite edge, and a lock device spaced from said lug or said vertical support member to selectively engage one of said notches, said lock device comprising a housing, a coil spring in said housing, and a lock pin having one end protruding out of said housing, said spring and said lock pin arranged to normally bias said one end into engagement with one of said notches.

3. In a lifting mast assembly, a lifting member comprising a substantially flat support member having a plurality of spaced-apart notches along one edge and an elongated medial notch along its opposite edge thereof, a fork member having a vertical support member, a lug on said vertical support member adapted to pass through said medial notch and to engage behind said opposite edge, and a lock device spaced from said lug or said vertical support member to selectively engage one of said notches, said lock device comprising a housing, a coil spring in said housing, and a lock pin having one end protruding out of said housing, said spring and said lock pin arranged to normally bias said one end into engagement with one of said notches, said lock device further including a slide pin on said lock pin, a groove to receive said slide pin in said housing, and a shoulder in said housing to selectively seat said slide pin, thereby to selectively retain said lock pin in an inactive retracted position.

4. In a lifting mast assembly having members to be elevated, a ram to elevate the members comprising a generally tubular cylinder, a piston comprising a closed tube of smaller diameter than the bore of said cylinder and telescopically movable therein, a seal on the end of said piston to sealingly and slidingly engage the ends of said cylinder, and a seal on the opposite end of said cylinder to sealingly and slidingly engage the walls of said piston.

5. In a lifting mast assembly having members to be elevated, a ram to elevate the members comprising a generally tubular cylinder, a tubular piston telescopically slidable in said cylinder, means closing the end of said piston, a first seal on one end of said piston to engage the walls of said cylinder and a second seal on the opposite end of said cylinder to engage the walls of said piston, whereby said ram will operate despite failure of said first seal.

6. In a lifting mast assembly, a main frame including a pair of spaced-apart upright channels, a ram assembly between said upright channels comprising a tubular cylinder, a tubular piston reciprocable in said cylinder, a first sealing member at one end of said piston to engage the walls of said cylinder, a second sealing member at the opposite end of said cylinder to engage the walls of said piston, means to provide pressured fluid into said cylinder to move said piston, a sub-frame telescopically carried by said main frame, a lifting element telescopically carried by said sub-frame and chain means connecting said piston, said sub-frame and said lifting member for sequential movement, said chain means being arranged to first move said lifting member relative to said sub-frame and then to move said lifting member together with said sub-frame relative to said main frame upon movement of said piston.

7. A lifting mast assembly comprising a main frame having a hydraulic cylinder thereon, a piston having a cross head on one end and reciprocable in said cylinder, a chain having one end connected to said cross head, a first sheave wheel means on said cylinder, a second sheave wheel means on said cross head, said chain being threaded over both of said sheave wheel means thereby to double reverse said chain, a sub-frame telescopically carried by said main frame, a third sheave wheel means on said sub-frame, said chain being threaded over said third sheave wheel means to obtain a third reversal thereof, a lifting member telescopically carried by said sub-frame, and a coupling on said lifting member to receive the other end of said chain whereby said lifting member and said sub-frame may be elevated upon movement of said piston, said coupling comprising an adjustable connector having movable elements to take the slack out of said chain.

8. A lifting mast assembly comprising, a main frame, a sub-frame telescopically carried by said main frame, a lifting platform telescopically carried by said sub-frame, and raising means comprising a vertically movable cross head, cables having similar ends thereof attached to the sides of said lifting platform at opposite sides of the center line of said platform, rotatable sheaves carried by said cross head and having the axes thereof disposed longitudinally, said cables being

disposed transversely of said cross head and being trained over said sheaves in opposite directions, the other ends of said chains being connected to said cross head, and rotatable reversing sheaves on said main frame and said sub-frame, said cables being trained over said reversing sheaves to reverse the cables into parallel supporting strands, and means to move said cross head, whereby said platform will be elevated to the top of said sub-frame without increasing the overall height of the assembly, said lifting platform together with said sub-frame being movable to the top of said main frame, said cables being effective to prevent tilting of said platform.

9. An industrial truck of the elevating platform-type including, in combination, a frame, a lifting platform, raising means for said lifting platform including cables having similar ends attached to the sides of said platform on opposite sides of the center line of said platform, a vertically movable cross head, rotatable sheaves on said cross head and on said frame, said sheaves having their axes disposed longitudinally relative to said truck, said cables being transversely trained over said sheaves and having the other ends thereof attached to said cross head on opposite sides of the center line of said cross head to balance the lifting effort delivered to said platform, and means to move said cross head, whereby said platform will be moved to the top of said frame without exceeding the height of said frame.

10. An industrial truck of the elevating platform-type including, in combination, a main frame, a sub-frame telescopically carried by said main frame, a lifting platform telescopically carried by said sub-frame, raising means for said lifting platform including cables having similar ends attached to the sides of said platform on opposite sides of the center line of said platform, a vertically movable cross head, rotatable sheaves on said cross head and on said main frame and said sub-frame, said sheaves having their axes disposed longitudinally relative to said truck, said cables being transversely trained over all of said sheaves and having the other ends thereof attached to said cross head on opposite sides of the center line of said cross head to balance the lifting effort delivered to said platform, and means to move said cross head, whereby said platform will be moved to the top of said sub-frame without exceeding the height of said main frame and said platform together with said sub-frame will be moved to the top of said main frame.

11. An industrial truck of the elevating platform-type including, in combination, a main frame, a sub-frame telescopically carried by said main frame, a platform telescopically carried by said sub-frame, means for raising and lowering said platform comprising a single vertically movable member, at least one pair of sheaves carried by said member and arranged thereon in parallel relation with the axes thereof coincident and extending in the direction of the length of the truck, additional sheaves on said main frame and on said sub-frame, and cables passing over all of said sheaves, each cable having one end attached to said platform and the other end attached to said member, the cable ends which are attached to the platform being connected thereto on opposite sides of the truck center and the cable ends which are attached to said member being attached on opposite sides of the truck center from the other ends of the cables for preventing tilting of the platform while being raised and lowered and means for actuating said vertically movable member, whereby said platform will be moved to the top of said sub-frame without exceeding the overall height of said main frame and said platform together with said sub-frame will be moved to the top of said main frame.

HAROLD EDWARD MILZ.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,419,938	Abbe	May 4, 1947
2,514,052	Gunning	July 4, 1950