July 25, 1961 F. C. PARADISE 2,993,703

LIFT TRUCK

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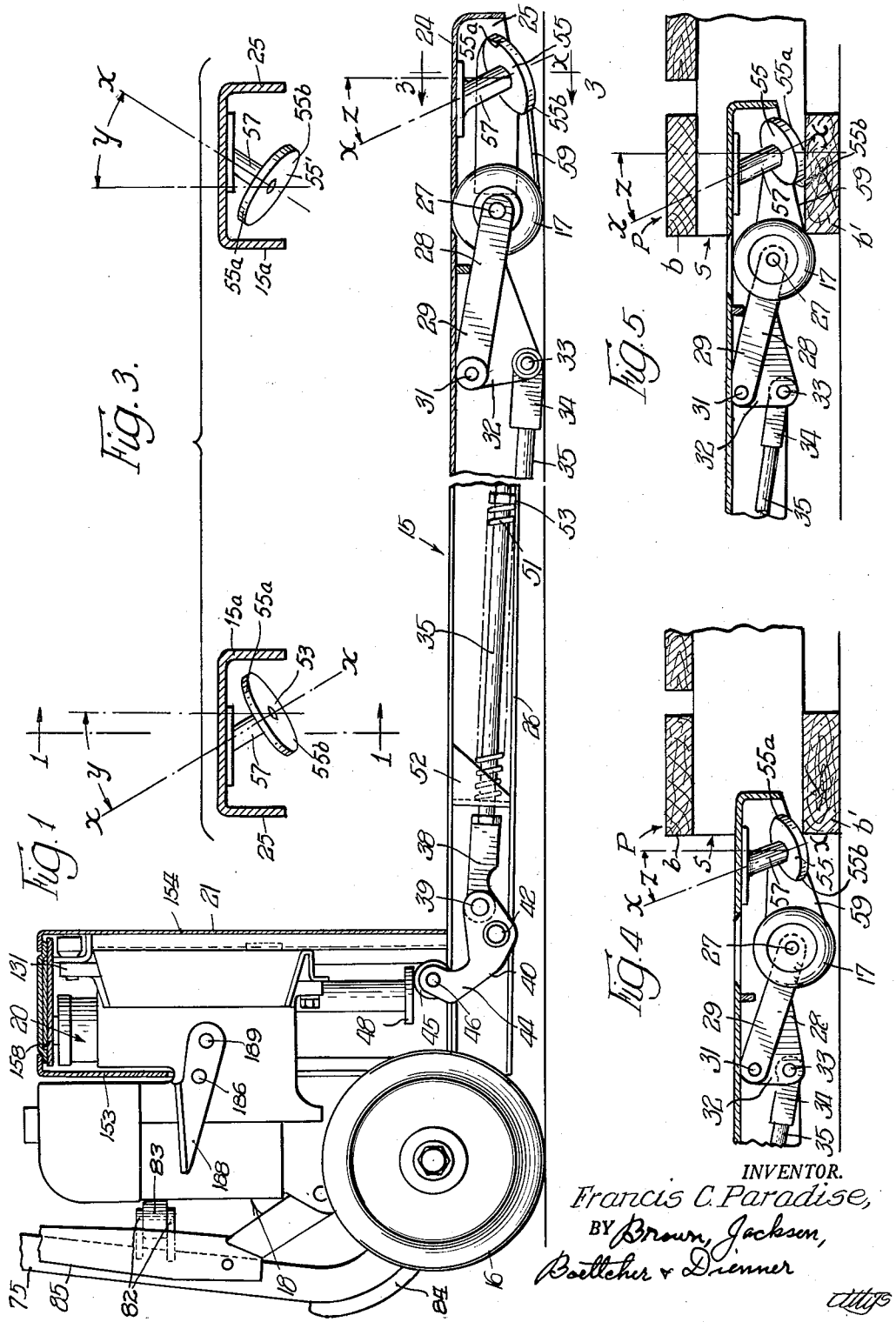


Fig. 1

Fig. 3.

Fig. 5

Fig. 4

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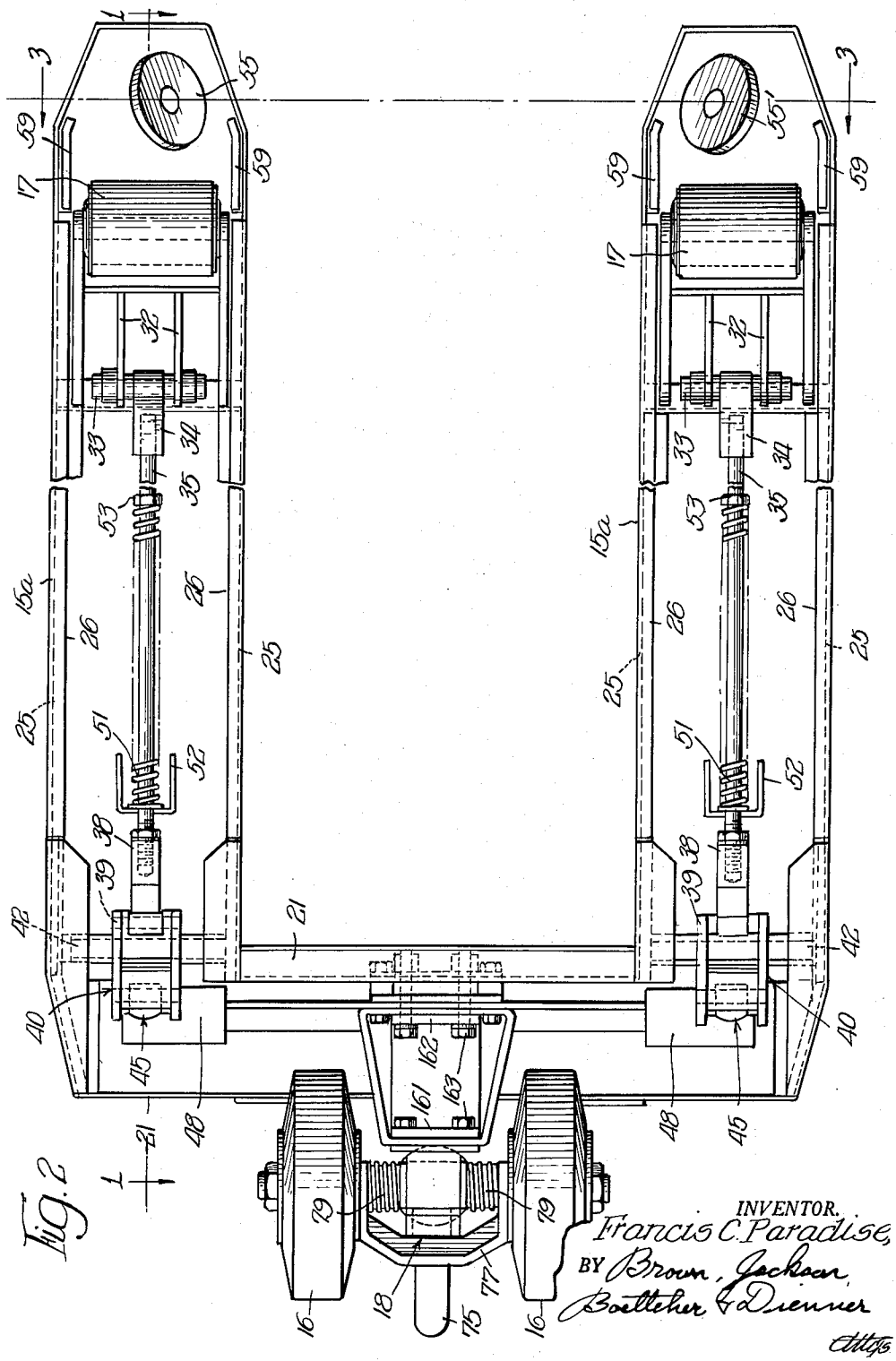


Fig. 2

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Fig. 6.

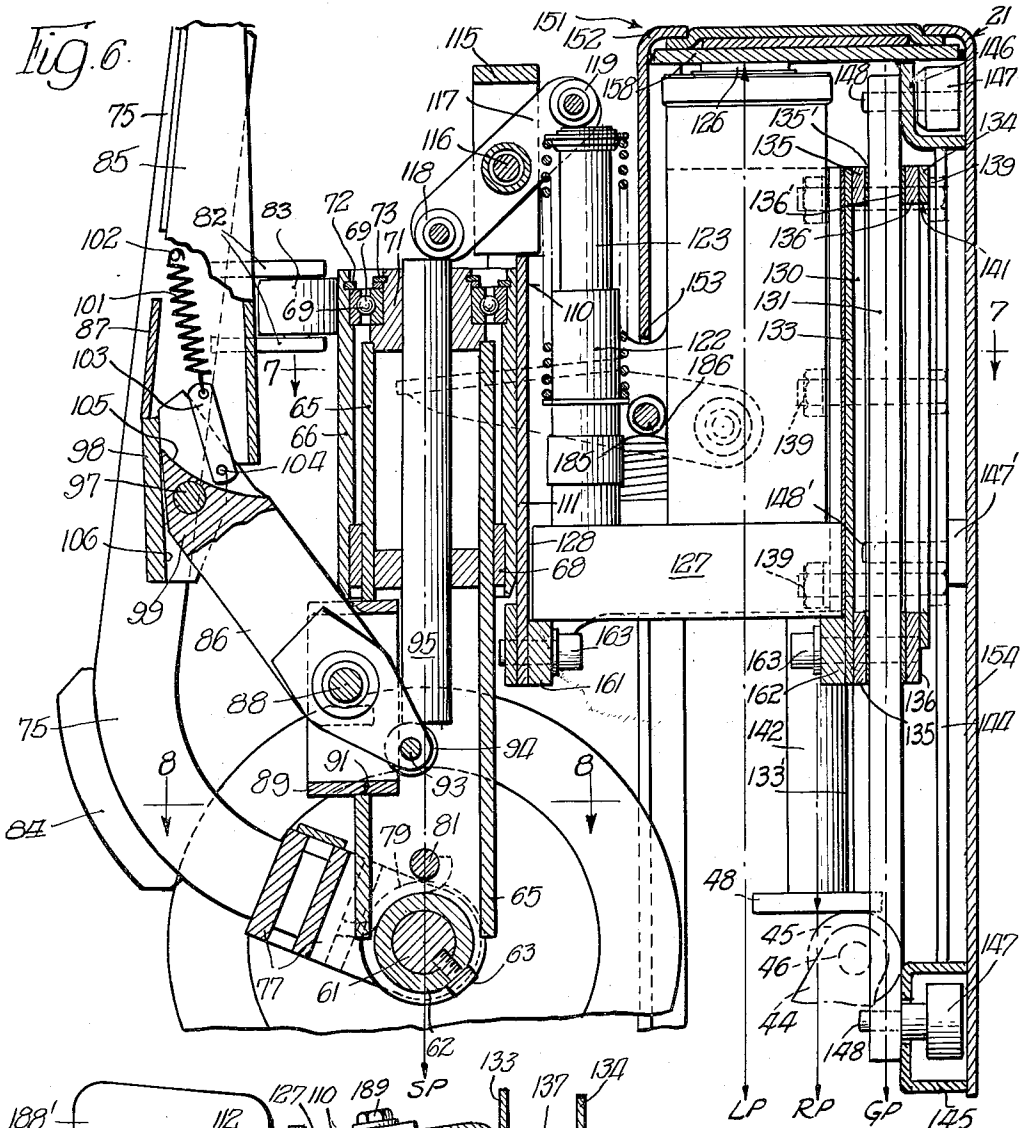
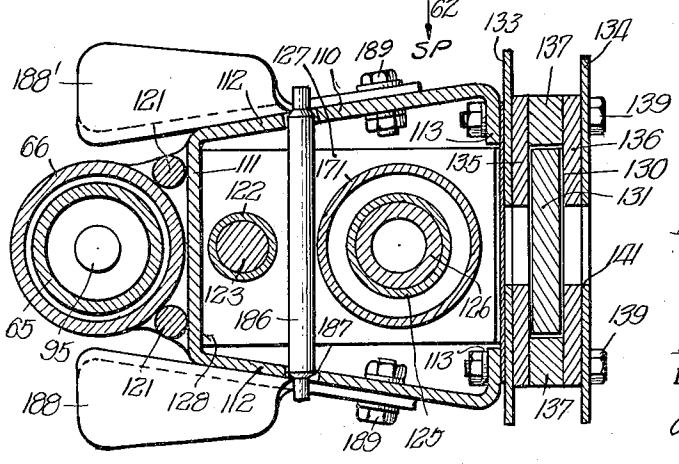


Fig. 7



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LIFT TRUCK

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Fig. 8

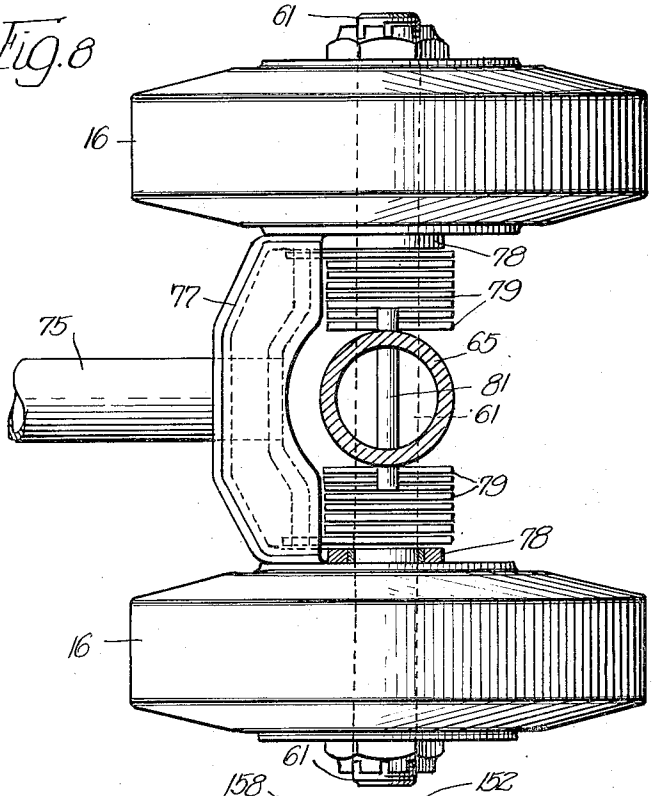
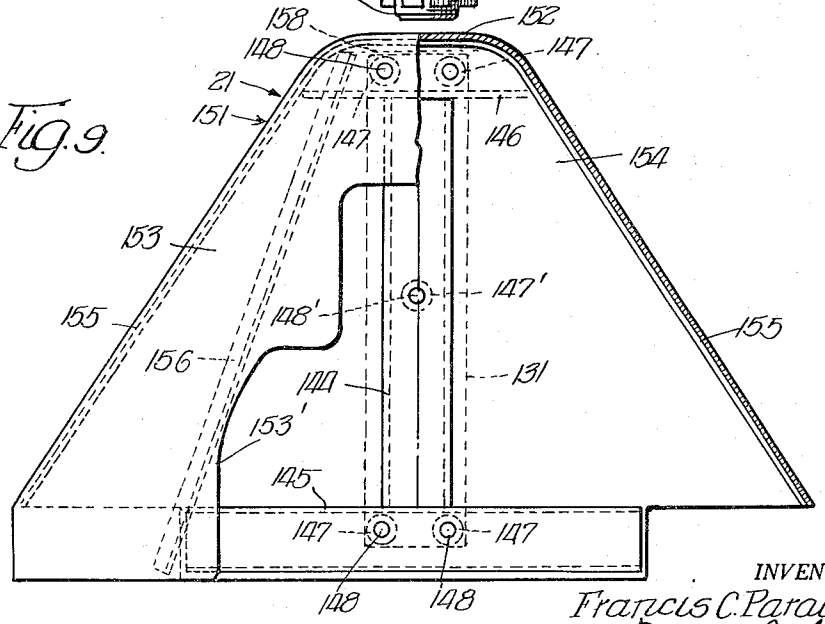


Fig. 9

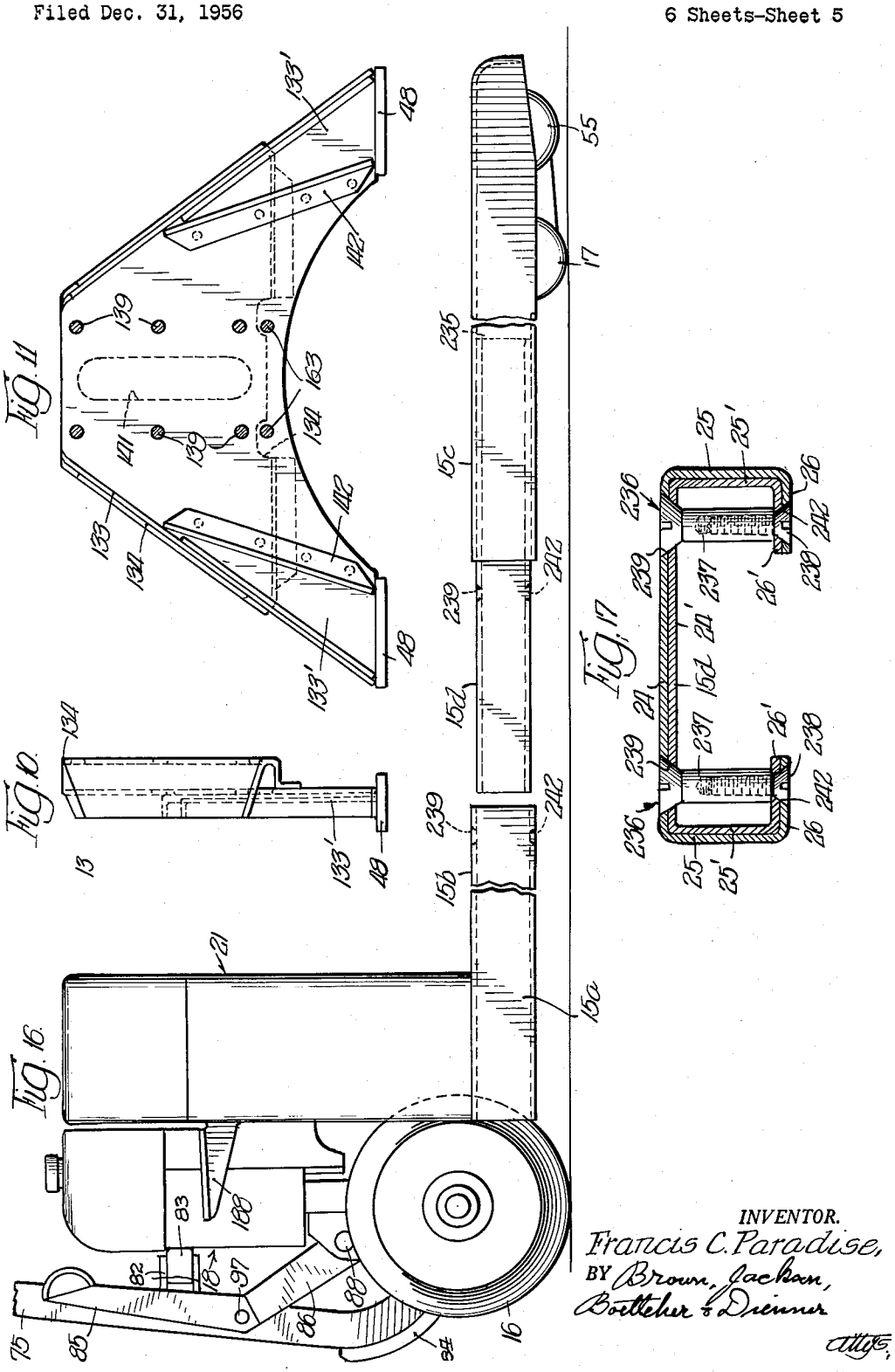


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Fig. 12

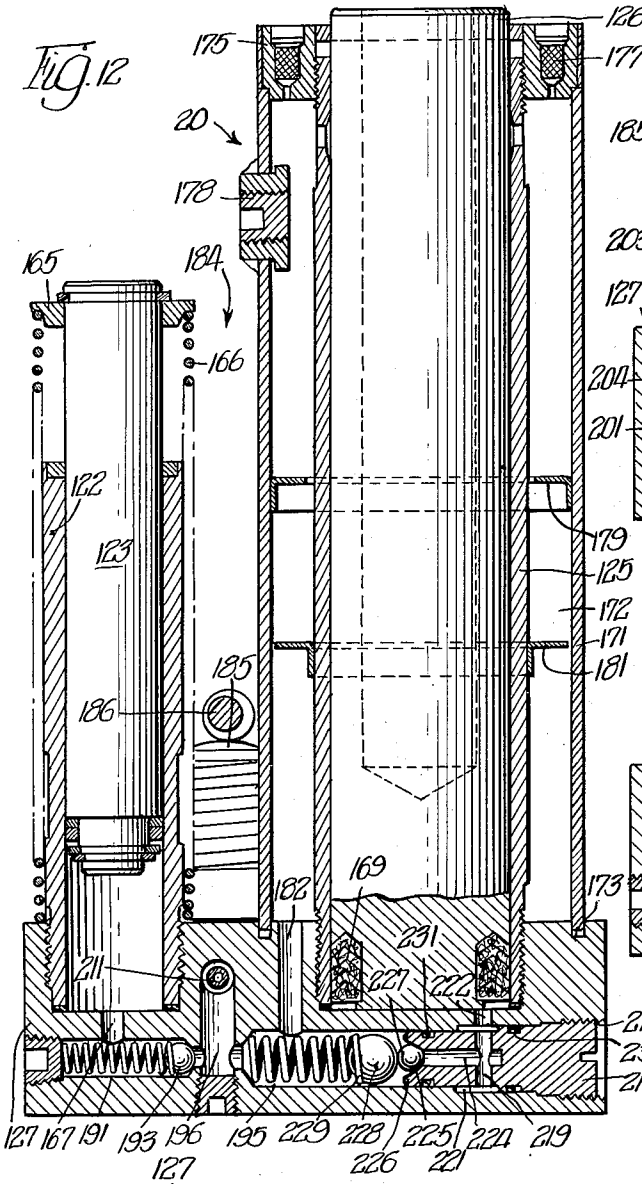


Fig. 13

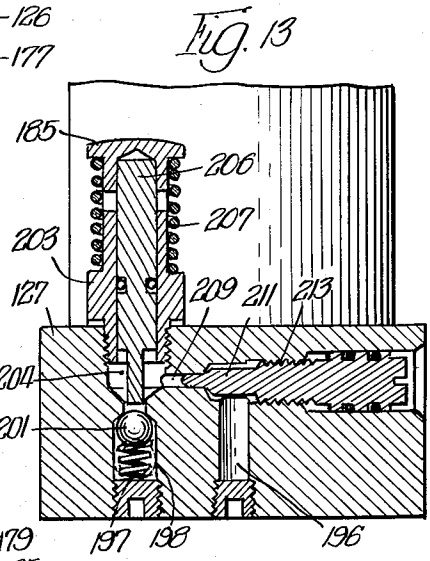


Fig. 14

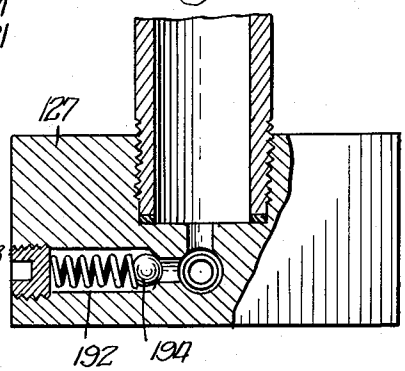
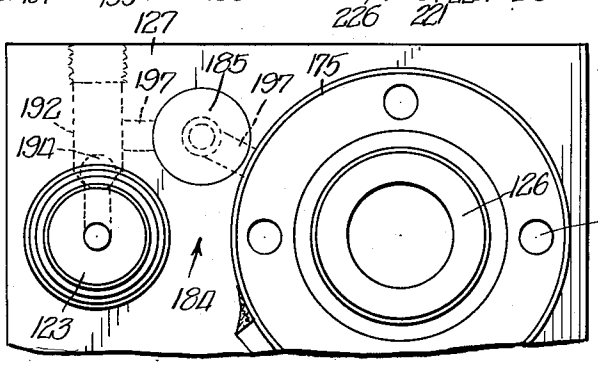


Fig. 15



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2,993,703

LIFT TRUCK

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Filed Dec. 31, 1956, Ser. No. 631,798
16 Claims. (Cl. 280—43.12)

The present invention relates to lift trucks adapted for lifting loaded pallets or skids and transporting them from place to place. The preferred embodiment of the invention herein disclosed is directed to the low level single frame type of pallet lifting truck, but certain features of the invention are not necessarily limited to this type of lift truck.

In the disclosed embodiment, the truck comprises a lifting fork which is adapted to enter the open space at the end of the pallet between the top and bottom pallet boards.

One of the objects of the invention is to provide the entering ends of the fork arms with improved pallet entry wheels which facilitate the entrance of the fork arms into the pallet by easing the climb of the fork ends over the bottom pallet board. These improved pallet entry wheels comprise large diameter wheels which are set on laterally inclined axes, whereby by reason of their inclined positions they present a foreshortened dimension of the wheel to the low height of the pallet entry space. By reason of their being mounted in an inclined position, it is possible to employ large diameter entry wheels which would be much too large to enter the pallet if mounted in upright positions. These large diameter entry wheels afford in effect a rolling surface inclined plane of a very gradual slope for easing or facilitating the climb of the entering end of the truck over the edge of the bottom pallet board.

Another object of the invention is to provide an improved lifting connection between the front end of the lifting fork and the front wheel supported truck. The lifting operation is performed by a hydraulic system comprising a hydraulic lifting ram mounted on the front wheel supported truck. This ram transmits vertically acting lifting force to a raising frame secured to the front end of the lifting fork, thereby lifting the front end of the fork. Concurrently therewith, the rear end of the fork is also lifted by the forward swinging of crank mounted rear lifting wheels located under the rear ends of both fork arms. The crank mountings of these rear lifting wheels are connected by forwardly extending links to front bell crank levers which are pivotally mounted on the front portion of each fork arm. As the front end of the lifting fork rises under the lifting action of the hydraulic ram, forwardly extending arms of these front bell crank levers strike stationary reaction stops or plates fixedly secured to the front wheeled truck frame, thereby transmitting a downward reaction force to these front bell crank levers for transmitting lifting movement to the crank mounted rear lifting wheels. Hence, a downwardly acting reaction force is thus transmitted from the front wheeled truck frame to the front bell crank levers concurrently with the transmission of the upwardly acting lifting force from the hydraulic cylinder to the front end of the lifting fork. This upwardly acting lifting force of the hydraulic ram and the downwardly acting reaction force of the stationary stops both occur in approximately the same vertical plane, and these two oppositely acting forces tend to balance each other out. Spaced in rear of this vertical plane of oppositely acting forces, and in immediate proximity thereto, is an improved arrangement of a vertically sliding guide and guide way for joining the front end of the lifting fork with the front wheeled truck. This improved guide and guide way provide for free sliding lifting movement of the front end of the lifting fork relatively to the front wheeled truck. The vertical guide and guide way lie in a vertical plane, and by disposing this vertical plane in extremely close proximity to the above described vertical plane of oppositely acting forces there is a minimum tendency for binding action to occur in the lifting and lowering operations of the lifting fork.

Another object of the invention is to provide improved foot treadle construction and operation for actuating the pump of the hydraulic lifting mechanism. This foot treadle turns to right or left with the towing and steering handle of the truck, whereby the foot treadle is operable to actuate the hydraulic lifting mechanism at any angle of the steering handle, substantially within a range of approximately 190°. Another feature of this foot treadle is the provision of a folding outer treadle section which is spring biased to swing up out of the way when not in use.

Another object of the invention is to provide an improved overload release for the hydraulic lifting mechanism. This comprises an improved factory sealed bypass valve which automatically operates at a predetermined load setting to prevent the lift truck being overloaded beyond a safe capacity.

Another object of the invention is to provide an improved sectionalized construction of fork arms whereby different lengths of lift trucks may be readily obtained. These different lengths are obtained by merely inserting different lengths of intermediate inserts in the sectionalized construction of the fork arms, or by utilizing different bolt holes in the intermediate inserts or in the fork arms.

Other objects, features and advantages of the invention will appear from the following detailed description of one preferred embodiment thereof. In the accompanying drawings illustrating such embodiment:

FIGURE 1 is a fragmentary side sectional view of my improved lift truck, corresponding to a longitudinal section through the near fork arm along the section planes 1—1 of inverted FIGURE 2 and of transverse FIGURE 3.

FIGURE 2 is an inverted fragmentary plan view looking upwardly from the underside of the truck.

FIGURE 3 is a transverse sectional view through both fork arms taken on the planes of the lines 3—3 of FIGURES 1 and 2, illustrating the improved pallet entry wheels mounted in the rear ends of both fork arms.

FIGURE 4 is a fragmentary longitudinal section through the rear end of one of the fork arms, showing the pallet entry wheel just starting to lift the fork arm in the act of entering a pallet.

FIGURE 5 is a similar view showing the next step of transferring the weight of the fork arm to the lifting wheel disposed forwardly of the pallet entry wheel.

FIGURE 6 is a fragmentary longitudinal section through the front end of the lift truck, showing the front wheeled truck and also showing the slide and guideway connection between this front wheeled truck and the lifting fork.

FIGURE 7 is a horizontal sectional view through the front wheeled truck and through the slide and guideway connection, corresponding to a section taken approximately on the plane of the line 7—7 of FIGURE 6.

FIGURE 8 is a horizontal sectional view of the steerable front axle, taken approximately on the plane of the line 8—8 of FIGURE 6.

FIGURE 9 is a fragmentary front elevational view of the A-frame extending upwardly from the front end of the lifting fork.

FIGURES 10 and 11 are side and front elevational views of the plates carried by the wheel supported front frame for mounting the guide-way on the front frame.

FIGURE 12 is a longitudinal vertical sectional view of the hydraulic lifting unit.

FIGURES 13, 14 and 15 are detail sectional views of the hydraulic lifting unit.

FIGURE 16 is a fragmentary side view showing a variable length construction of fork arm, and

FIGURE 17 is a transverse sectional view through such a fork arm.

In its preferred embodiment, my invention is constructed in the form of a low single frame or pallet type of lifting truck comprising a single main frame **15** which serves to connect the front wheels **16** with the rear wheels **17**, and which also serves as the lifting element. This pallet type of lift truck is particularly adapted for use with the relatively low pallet type of load carrying platforms. While this is the preferred embodiment of my invention, nevertheless I wish it to be understood that certain features of the invention can also be embodied in other types of lift trucks and pallet trucks. The front wheels **16** have steerable mounting on a front wheel truck **18** which carries the hydraulic lifting mechanism **20**. The single main frame **15** is preferably of the fork type comprising two spaced fork arms **15***a*, as shown in FIGURE 2. The front ends of the fork arms **15***a* are joined together by an upwardly extending A-shaped frame **21** which receives the upward thrust of the hydraulic ram of the hydraulic lifting mechanism **20**, as will be later described.

As shown in FIGURE 3, each fork arm **15***a* is of channel shaped cross-section comprising an upper web portion **24** and depending side flanges **25**. Mounted under the rear end of each fork arm **15***a* is the rear lifting wheel or roller **17** which is rotatably mounted on shaft **27** extending transversely between the rearwardly projecting arms **28** of a bell crank **29**. The bell crank **29** is pivotally mounted on a transverse pivot shaft **31** which has its ends secured between the depending side flanges **25** of its respective fork arm. The bell crank **29** comprises laterally spaced downwardly extending arms **32** which carry a pivot pin **33** therebetween. Pivotally mounted on this pin is a tie rod coupling **34** which connects with a forwardly extending tie rod **35**. The forward end of the tie rod has adjustable threaded engagement in a pivot coupling **38** pivotally mounted on the rear pivot pin **39** of a front bell crank lever assembly **40**. This bell crank lever assembly comprises two laterally spaced bell crank plates which are secured to a transverse bearing sleeve that is rotatably mounted on the stationary pivot pin **42** extending between the side flanges **25** at the front end of each fork arm. The bell crank assembly comprises forwardly extending arms **44** carrying a roller **45** journaled on a pin **46** extending between their outer ends. Each roller **45** is adapted to have reaction pressure engagement against a reaction plate **48** mounted at each side of the truck, these reaction plates **48** being secured to the wheel supported front truck **18** and being operable through the front bell cranks **44** to transmit lifting movement to the rear lifting wheels **17**, in a manner which will be later described. Mounted on each of the tie rods **35** is a compression spring **51** which is confined at its front end against a bracket **52** depending from the web **24** of the fork arm channel, and confined at its rear end by a nut or collar **53** mounted on the tie rod. These springs **51** aid in lowering an unloaded truck to normal position against the slight retarding effect of the hydraulic lift mechanism **20**, by tending to return the two rear lifting wheels **17** into their truck lowered positions illustrated in FIGURE 1. The parts are preferably so constructed that the top surface of each fork arm slopes upwardly in a very gradual slope from the rear end of the fork arm to the front end, when the truck is in its lowered position.

Referring now to the improved pallet entry wheels, designated **55**, **55'**, one of these wheels is mounted in the rear end of each fork arm at a point beyond the rear lifting roller **17**. As shown in FIGURE 3, each of these pallet entry wheels is journaled on an inclined axis *x*—*x* which is inclined transversely with respect to its particular fork arm, the entry wheel **55** of the right hand fork arm being inclined at one angle and the entry wheel **55'** of the left hand fork arm being inclined at the opposite angle, these two transversely inclined angles having the same displacement from the vertical, as indicated at *y*—*y* in FIGURE 3. Each inclined axis or shaft is carried by a bearing bracket **57** which is rigidly secured to the web **24** of the channel. If desired, each transversely inclined axis *x*—*x* may also be inclined slightly in a fore and aft direction with the upper end of the axis inclined in a direction away from the pallet entering end of the fork arm, i.e., in a direction toward the front wheeled truck **18**, such fore and aft angles of the pallet entry wheel axes being indicated at *z*—*z* in FIGURE 2. These entry wheels **55**, **55'** are of relatively large diameter, but by reason of their mounting on the inclined axes *x*—*x* they present a foreshortened dimension to the entry space in the load bearing pallet. This is illustrated in FIGURES 4 and 5, which show a conventional pallet P comprising upper and lower boards *b* and *b'* respectively which define an entry space *s* therebetween. It will be observed from FIGURE 4 that as the fork arms enter the pallet, initial contact is established between the leading edge **55***a* of the inclined entry wheels **55**, **55'** and the upper edge of the lower pallet board *b'*, it being noted that this leading edge **55***a* is at a higher level than the trailing edge **55***b* of each pallet entry wheel. Thus, the lower peripheral surface of each entry wheel presents in effect a rolling surface inclined plane of relatively long obtuse slope which eases the climb of the fork arms over the lower pallet board and through the entry space *s* of the pallet. The above described feature of having the transversely inclined axis *x*—*x* also inclined slightly fore and aft, with the higher end of the inclined axis pointing away from the pallet entering end of the fork arm, is a preferred feature because it places the leading or pallet entering edge **55***a* of the wheel periphery at a higher level than the trailing edge **55***b* of the wheel periphery, thereby increasing the upwardly sloping angle of the rolling surface inclined plane which the periphery of the pallet entry wheel presents to ride over the bottom base board *b'* at the entering edge of the pallet. FIGURE 5 shows the fork arms raised into entering position, with the rear lifting wheels or rollers **17** engaging the bottom pallet board *b'*. Stationary inclined tracks **59** are secured to the channel flanges **25**, these tracks defining sloping surfaces extending from approximately the lower level of the entry wheel substantially to the lower level of the lifting wheel **17**, and effecting the transition of contact from the entry wheel to the lifting wheel. By virtue of the above construction and mounting of the pallet entry wheels **55**, **55'**, it is not necessary to bevel or chamfer off the upper edges of the bottom pallet boards *b'*. As is well known to those skilled in the art, in the lifting operation the rear lifting wheels **17** swing downwardly into engagement with the floor in the clearance space between end bottom boards *b'*, or swing downwardly into engagement with the floor at a point beyond the other end of the pallet P.

Referring now to the front wheeled truck **18**, the steerable front wheels **16** are rotatably journaled on a transverse front axle **61** which has its central portion anchored in a mounting sleeve **62** by a set screw **63** (FIGURE 6). This sleeve is welded to the lower end of a vertical kingpin sleeve **65** which has rotatable steering mounting in a vertical outer housing sleeve **66** constituting part of the front truck frame **18**. Bearing support for steering rotation of the kingpin sleeve **65** within the

stationary housing sleeve 66 is afforded by a plain lower sleeve bearing 68 and by an upper thrust sustaining anti-friction bearing 69. The inner race of the anti-friction bearing seats on a cylindrical head block 71 which is welded to the upper end of the inner steering sleeve 65. An outer snap retaining ring 72 transmits the downward thrust load from the housing sleeve 66 through the bearing 69, and an inner snap retaining ring 73 prevents the steering sleeve 65 and head block 71 from dropping down out of the assembly.

The towing, backing and maneuvering of the lift truck are performed through the manipulation of a handle 75 which has an improved spring mounting on the front axle 61. The lower end of the handle curves rearwardly and is anchored in a vertically swiveling yoke 77 which has yoke arms 78 that have pivotal mounting on the axle shaft 61 adjacent to each of the wheels 16 (FIGURE 8). The handle is normally biased into the upright inactive position shown by two torsion springs 79, which are coiled around the axle shaft sleeve 62 between the rotatable kingpin sleeve 65 and the yoke arms 78. A transverse pin 81 passes through the kingpin sleeve and has its ends projecting therefrom to form stops against which the hook-shaped inner ends of the springs 79 engage. Hook-shaped outer ends of the two torsion springs have engagement with the cross bar portion of the yoke 77. These two torsion springs merely overcome the weight of the handle so as to hold it upright when not in use; they yield to downward pressure on the handle when the truck is to be maneuvered. A pair of spaced bracket arms 82 project rearwardly or upwardly from the handle 75 and have a roller 83 journaled therebetween on an axis extending substantially parallel to the handle 75. When the handle is in the raised position shown, this roller 83 has rolling contact with the surface of the stationary housing sleeve 66 or with the surface of the sheet metal cover enclosing said housing. Thus, this roller prevents scratching of these surfaces; it also provides for easy steering with the handle in raised position; and it furthermore prevents interference between the handle 75 and the hydraulic release pedals 188, 188', which will be later described. The curved lower neck portion of the handle 75 moreover has a floor brake consisting of a formed steel shoe 84 welded to the curved neck of the handle.

Referring now to the improved foot treadle 85 for actuating the pump of the hydraulic lifting mechanism 20, this treadle is arranged to turn with the steering movement of the handle 75 so that the foot treadle is operable to actuate the hydraulic lifting mechanism at any angle of the steering handle, over a range of approximately 190°. To this end, the treadle is pivoted on a horizontal pivot pin 88 which is mounted at its ends in a rectangular bearing frame 89 that is welded into a vertical slot 91 cut in the front wall of the rotatable kingpin sleeve 65. Thus, the lower end of the treadle extends into the kingpin sleeve, where its forked extremity carries a pivot pin 93 mounting a roller 94. The roller 94 is adapted to have upward thrusting rolling engagement with the bottom end of a vertical plunger 95 which is guided for vertical sliding movement in the head block 71 of the steering sleeve 65. The upper end of the plunger 95 is adapted to transmit motion to the plunger pump of the hydraulic mechanism through an upper rocker lever, which will be presently described.

The foot treadle 85 comprises two relatively folding sections which enable the treadle to be folded upwardly into a position alongside the handle 75 when the treadle is not in use. This enables the truck to be maneuvered and stored in more compact quarters. The two relatively folding sections comprise an inner section 86 and an outer section 87, hinged together on a transverse hinge pin 97. These two sections swing up and down in a vertical plane disposed directly alongside the handle 75. The upper treadle portion 87 is of channel section terminating at its lower end in a box-like portion 98 which embraces the upper tongue-shaped end 99 of the lower treadle portion 86. When the treadle is not in use it normally occupies the raised folded position shown in FIGURE 6. In this raised position, the outer treadle section 87 is folded upwardly and rearwardly into substantial parallelism with the upwardly extending handle 75 through the action of a tension spring 101. The upper end of this tension spring is hooked to a pin 102 carried by the outer treadle portion 87, and the lower end of this spring is hooked to a flat plate link 103 which has its inner end pivoted to a pin 104 carried by the inner treadle section 86. The tongue portion 99 of the lower treadle section 86 is provided with a longitudinal slot 105 to accommodate the swinging motion of the link 103. The tension exerted by the spring 101 acts along the line disposed above or rearward of the hinge pin 97 so that this tension normally tends to hold the upper or outer treadle section 87 folded rearwardly. When the treadle is pressed downwardly by the operator's foot, the outer treadle section hinges about the inner treadle section until it is substantially in prolongation thereof, when a stop surface 106 on the outer section comes into engagement with the underside of the inner section at a point disposed inwardly of the hinge pin 97, thereby locking the hinged joint so that the two treadle sections work up and down together as a unit.

Referring now to the frame structure of the wheel supported front truck 18, it will be seen from FIGURE 7 that the vertical stationary housing sleeve 66 is welded to the front wall 111 of a U-shaped main frame 110. This main frame comprises the vertically extending front wall 111, outwardly divergent side walls 112, 112, and inwardly bent rear flanges or lips 113, 113. Welded in a notched out front portion of the front wall 111 is a rectangular bearing frame 115 which carries a transversely extending bearing shaft 116. Rockably mounted on the shaft 116 is a rocker lever 117 bearing rollers 118 and 119 at its opposite ends. The front roller 118 bears upon and receives upward thrusting movement from the axial pumping plunger 95, and the rear roller 119 beats against the top of the pump plunger 123 of the hydraulic mechanism 20. Reinforcing the weld between the front wall 111 and the two sides of the vertical housing sleeve 66 are rods 121 which have their upper ends welded to the underside of the bearing frame 115 for reinforcing the mounting of this frame. The hydraulic lifting unit 20 comprises a pump cylinder 122 in which reciprocates the pump piston 123, and a lifting cylinder or ram 125 in which reciprocates a lifting piston 126, the pump cylinder and the ram cylinder both extending upwardly from a common base block 127. The base block and cylinders set in a pocket or chamber area 128 defined within the walls 111, 112 and flanges 113 of the front truck frame 110. The details of the hydraulic lifting unit 20 will be described later.

Bolted to the inwardly bent flanges 113, in immediate proximity to the hydraulic lifting ram 125, is a vertical guide-way 130 in which slides a vertical guide bar 131 secured to the A-shaped frame 21 of the lifting fork 15. The guide-way 130 (FIGURES 6 and 7) comprises spaced front and rear plates 133, 134 having spaced front and rear guide-way defining bars or frames 135, 136 secured to their inner surfaces. If desired, the opposing inner faces of the bars or frames 135, 136 may be provided with renewable hardened shims 135', 136'. The vertical sides of the guide-way 130 are defined by vertical bars 137 which intervene between the members 135 and 136 (FIGURE 7). Vertical rows of bolts 139 pass through the spaced plates 133, 134, the spaced bars or frames 135, 136, the intervening side bars 137, and thence through the inwardly extending frame flanges 113 for rigidly joining the guide-way defining members to the frame 110 of the front truck. A vertical slot 141 extends down medially of the rear plate 134 for accommodating a center

point of attachment of the vertical slide **131**. The front plate **133** has downwardly extending side legs **133'** (FIGURE 11) for mounting the stationary reaction plates **48** at their lower ends, these downwardly extending side leg portions being reinforced by front angle bars **142**.

As shown in FIGURES 6 and 7, the vertical slide **131** consists of a flat rectangular bar having a snug sliding fit in the guide-way **130** and having rigid attachment to the A-frame **21** of the lifting fork **15**. Referring to FIGURES 6 and 9, the A-frame comprises a vertical rearwardly facing channel iron **144** which is welded at its lower end to a horizontal rearwardly facing channel iron **145**, and which is welded at its upper end to a horizontal rearwardly facing angle bar **146**. Bushings or sockets **147** are mounted at laterally spaced points in the lower channel bar **145** and in the upper angle bar **146** for receiving bolts or pins **148** which pass through holes in the lower and upper ends of the slide bar **131** and serve to rigidly secure the slide bar to the A-frame **21**. The slide bar attaching surfaces of the channel **145** and angle **146** space the slide bar **131** forwardly of the web of vertical channel **144** so as to provide space for accommodating the rear guide-way defining members **134**, **136** and **136'**. The vertical angle bar strut **144** also carries a bushing or socket **147'** substantially at its center for receiving a centrally located bolt or pin **148'** which fastens in the slide bar **131** at its center. The vertical central slot **141** in the rear plate **134** accommodates vertical sliding movement of the central bolt or pin **148'** in the up and down movement of the slide **131** in the guide-way **130**.

A sheet metal housing **151** covers the slide plate **131** and frame bars **144—146** of the A-frame, this sheet metal housing comprising a crown portion **152**, a notched out vertical front skirt portion **153**, a transversely extending rear skirt portion **154**, and outwardly sloping side portions **155**. The downwardly sloping side portions **153'** of the front skirt **153** are reinforced by sloping angle irons **156**. The notched out portion of this front skirt **153** accommodates the rearwardly extending frame **110** of the front wheeled truck. A sturdy horizontal lifting plate **158** is disposed under the crown portion **152** of the sheet metal housing, this lifting plate being welded to the horizontal angle bar **146** and to the front and rear skirt portions **153** and **154** of the sheet metal housing. This lifting plate **158** extends forwardly directly over the lifting plunger **126** of the hydraulic lifting ram **125**, so as to receive the upward thrusting force of the hydraulic ram, it being noted that this upwardly acting force line through the axis of the hydraulic ram **125** is located intermediate the downwardly acting force line through the axis of the front wheel **16** and the vertical guide plane in which the guideway **130** and guide bar **131** have relative sliding movement. The A-frame channel iron **145** and the lower edges of the sheet metal housing **151** are suitably welded to the fork arms **15***a* so that the A-frame constitutes a rigid part of the lifting frame **15**. Thus, the lifting force exerted upwardly by the hydraulic ram **125** against the upper lifting plate **158** is transmitted directly to the front ends of the lifting fork arms **15***a*, with resultant upward sliding movement of the slide **131** in the guide-way **130**. Concurrently with the upward lifting of the front ends of the fork arms, the stationary reaction surfaces **48** exert downward reaction forces against the reaction rollers **45** at the front ends of the bell crank levers **44** for causing swinging movement of the bell crank levers **40** in a counterclockwise direction to produce lifting movement at the rear ends of the fork arms through the rear lifting wheels **17**. It will be noted that the upward lifting force exerted by the ram **125** on the lifting plate **158**, and the downward reaction force exerted by the stationary stop surfaces **48** against the bell crank levers **44**, both occur in opposite directions in planes located between the front vertical supporting plane passing down through the front wheel **16** and the rear vertical guide plane in which the guideway **130** and slide bar **131** have relative sliding movement. In FIGURE 6 I have designated the planes of the front downwardly acting supporting force lines, the intermediate upwardly acting lifting force lines, and the rear downwardly acting reaction force lines, each with respect to the vertical guide plane in which the guideway **130** and slide bar **131** have relatively sliding movement. The front end of the lift truck transmits downwardly acting force lines through a transverse supporting plane SP which passes downwardly through the axes of the front wheels **16** to the floor. Spaced in rear of this front supporting plane SP is the intermediate lifting plane LP in which the upwardly acting force lines of the hydraulic ram **125** act upwardly against the upper lifting plate **158**. Spaced in rear of this intermediate lifting plane LP is the reaction plane RP in which reaction force lines are exerted or transmitted downwardly from the stationary reaction surfaces **48** to the reaction rollers **45** during the lifting operation, the plane RP representing the approximate mean of the several points of rolling contact of the rollers **45** across the undersides of the stationary reaction pads **48**. Spaced in rear of the reaction plane RP is the guide plane GP designating the center line of the coacting guide surfaces of vertical guideway **130** and vertical slide bar **131**. By virtue of the intermediate location of the upwardly acting force lines in lifting plane LP at a point which is situated between the downwardly acting force lines in front supporting plane SP and the downwardly acting force lines in reaction plane RP, there is a very substantial tendency for these upwardly and downwardly acting force lines to balance each other out. Thus, there is a minimum tendency to produce any cocking or binding stresses between the guide-way and guide bar or slide.

As previously described, the hydraulic lifting unit **20** is mounted in a pocket or compartment **123** defined in the rearwardly extending frame section **110** of the front truck. As shown in FIGURE 6, the bottom of this compartment or pocket is defined by front and rear transversely extending horizontal bars **161** and **162** which are secured by cap screws **163** to the front frame wall **111** and to the front guide-way plate **133**. By the mere removal of the cap screws **163** and transverse bars **161**, **162**, the entire hydraulic lifting unit **20** can be dropped down out of the bottom of the lift truck for inspection, repairs, or the substitution of another hydraulic lifting unit.

Referring now to FIGURES 12 to 15 illustrating the details of this hydraulic lifting unit, it will be seen that the pump plunger **123** carries a collar **165** at its upper end against which bears a compression spring **166** which encircles the pump cylinder **122** and has its lower end bearing against the base block **127**. In the pumping strokes of the foot treadle **85** the roller **119** at the rear end of rocker lever **117** imparts downward reciprocating strokes to the upper end of the pump plunger **123** against the action of the compression spring **166**. The lower end of the pump cylinder **122** is screw threaded into a socket in the base block **127**, with the lower end of the pump cylinder space communicating through passageway **167** with the hydraulic liquid reservoir and with the cylinder of the lifting ram **125**.

The cylinder **125** of the lifting ram is similarly screw threaded at its base end into the base block **127**, with the lower end of the lifting plunger **126** movable down into the base end of the cylinder and provided with a suitable type of hydraulic packing, such as a chevron packing **169**. Surrounding the ram cylinder **125**, in spaced relation thereto, is a reservoir defining shell **171** which defines an annular reservoir space **172** for storing hydraulic fluid. The lower edge of the outer shell **171** seats against a packing ring **173** located in a circular groove formed in the top surface of the base block **127**. Threaded to the upper end of the lifting cylinder **125** is a head ring **175** which bears down against the upper edge of the reservoir shell **171**, and which is provided with suitably packed

breather apertures 177 therein. A filling plug 178 is located in the upper side wall of the reservoir shell 171, through which the hydraulic system is filled with liquid, and turbulence confining rings 179 and 181 are secured to the shell and to the lifting cylinder within the reservoir space 172 for confining upward turbulence of the hydraulic liquid in its entry into the reservoir space during the lowering operation. Inflow and outflow occurs through a passageway 182 leading downwardly from the reservoir space 172 into the base block 127.

It will be observed that the pump cylinder 122 and the reservoir shell 171 are spaced fore and aft from each other to define a transversely extending space 184 therebetween. In line with this transversely extending space 184 is a release valve 185 located to one side of the base block 127. A transversely extending rod 186 extends through this space 184 in position to exert downward force against the release valve 185. As shown in FIGURE 7, the ends of this horizontal rod 186 extend out through vertically enlarged openings 187 in the side walls 112 of frame 110, and the opposite extremities of this rod have mounting in right and left releasing foot treadles 188, 188'. These release treadles extend forwardly along the sloping side walls 112, and have their rear ends pivotally mounted on the side walls on pivot bolts or pins 189. Thus, the lowering of the lift truck may be effected by depressing either one of the releasing treadles located on opposite sides of the stationary kingpin sleeve 66. The notched front skirt portion 153 of the sheet metal cover 151 also extends down part way in this transverse space 184.

Referring now to the fluid passageways in the base block 127 of the hydraulic lifting unit, it will be seen that the passageway 167 extending downwardly from the pump cylinder 122 opens into an intake passageway 191 extending fore and aft, and also opens into a discharge passageway 192 extending transversely. A spring pressed intake ball valve 193 controls the inflow through passageway 191 and a spring pressed exhaust ball valve 194 controls the discharge flow through discharge passageway 192. The passageway 182 leading downwardly from the reservoir 172 opens into a horizontal manifold bore 195 preferably formed in alignment with the intake bore 191, the inner end of the manifold bore opening into a vertical bore 196 which also communicates with the supply side of the intake valve 193. The pump discharge passageway 192 communicates with the fore and aft passageway 197 leading to the lower end of the lifting cylinder 125. The discharge passageway 197 intersects the vertical passageway 198 which is in alignment with the release valve 185. Formed in the upper end of vertical passageway 198 is a release valve port against which ball valve 201 is normally held under spring pressure. The release valve 185 comprises a tubular guide stem 203 which screws down into a counterbore 204 in the top of the base block 127, in alignment with the release ball valve 201. A plunger 206 is vertically slidable in the guide stem 203, and is normally held in the raised position shown by a compression spring 207. When the transverse release rod 186 is moved downwardly by the depressing of either of the release pedals 188, 188', the plunger 206 is forced downwardly with the result that a reduced extension at the lower end of the plunger unseats the ball valve 201 and allows the hydraulic liquid to flow back out of the lifting cylinder 125 and through passageway 198 past the ball valve 201. Leading horizontally from the counterbore 204 is a metering passageway 209 which opens into the upper end of the vertical passageway 196. The return flow from the lifting cylinder thus passes back to the liquid reservoir 172 through bore 196, counterbore 195 and vertical passageway 182. The rate of this return flow is metered or adjusted by the setting given to a metering pin 211 which controls the flow through metering passageway 209. This metering or regulating pin 211 has threaded mounting in a counterbore 213, and can be screwed inwardly or outwardly from the side of the hydraulic unit to predetermine the rate of descent of the lifting fork under load. The provision of the compression springs 51 on the tie links 35 insures depression of the lifting fork, when not under load.

Referring to the improved overload release valve, this is mounted in the horizontal counterbore 195 so as to afford overload pressure communication between the lower end of the lifting cylinder 125 and the return passageway 182 leading back to the oil reservoir 172. Mounted for adjustable screwing inwardly and outwardly in an enlarged threaded end 216 of the counterbore 195 is a valve body or plug 218. Formed in this plug is a transverse passageway 219 which opens at its end into an intermediate counterbore enlargement 221 that communicates with the bottom end of the lifting cylinder 125 by way of passageway 222. Leading from the cross passageway 219 in the plug is a longitudinal passageway 224 which terminates at its inner end in a valve seat 225 surrounded by a protruding lip 226. Seating against the valve seat 225 and confined by the annular lip 226 is a relatively small ball 227. This small ball is held against the valve seat 225 by a large ball 228 which is urged in an outward direction by a compression spring 229 confined in the inner end of the counterbore 195. The parts are so proportioned that the pressure of the spring 229, acting through the large ball 228, holds the small ball 227 in contact with the seat 225 against all normal fluid pressures that may prevail in the lifting cylinder 125. However, upon the occurrence of an abnormally high fluid pressure in the lifting cylinder, resulting from attempts to compel the truck to lift an abnormal overload, the small ball 227 moves off its seat 225 and relieves the excessive pressure in the lifting cylinder so that the hydraulic pump is bypassed. The valve body plug 218 may be given a factory setting, dependent upon the load capacity of the particular design of truck. Sealing means, preferably in the form of O-rings 231 and 232 are provided in the body of the plug 218 to engage the inner counterbore 195 and the intermediate counterbore 221 for preventing oil leakage.

In FIGURES 16 and 17 I have shown an improved sectional construction of fork arms, whereby the fork arms 15*a* can conveniently be made of various lengths in the construction of various lengths of lift trucks. Each fork arm is of three section construction comprising: (1) a front section 15*b* extending rearwardly from the front truck and A-frame 21; (2) a rear section 15*c* extending forwardly from the rear lifting wheels 17; and (3) an intermediate adjusting section 15*d* adapted to have telescopic mounting in the front and rear sections 15*b* and 15*c*. The intermediate section 15*d* is of corresponding but smaller channel shaped section, comprising a corresponding upper web 24', side flanges 25' and inwardly bent lower flanges 26'. The ends of this intermediate section 15*d* have telescopic sliding fit within the front and rear sections 15*b* and 15*c* respectively. The intermediate section 15*d* has one end fixedly secured within one of the end sections, such as within the rear section 15*c*, as by riveting, bolting, or welding, the latter being indicated at 235. The opposite end of the intermediate section 15*d* is then telescopically fitted into the other end section, such as the front section 15*b*, and is secured therein by the vertical countersunk screws 236. These screws comprise upper internally threaded shells 237 into which thread lower screw shanks 238. Registering countersunk holes 239 in the upper web portions 24, 24' receive the countersunk heads of the upper shells, and registering countersunk holes 242 in the lower flanges 26, 26' receive the countersunk heads of the lower screw shanks 238. Different sets of holes 239 and 242 may be provided at different points along the length of either the end section or the intermediate section, or both, to accommodate the intermediate section 15*d* at different degrees of extension, i.e. different effective lengths of the fork arm 15*a*. When assembling the lift trucks of different lengths through the

use of these intermediate extensible sections 15*d*, corresponding adjustment must also be made in the effective lengths of the tie links 35 which actuate the rear lifting wheels 17.

While I have illustrated and described what I regard to be the preferred embodiment of my invention, nevertheless it will be understood that such is merely exemplary and that numerous modifications and rearrangements may be made therein without departing from the essence of the invention.

I claim:

1. In a lift truck of the class described, the combination of a dirigible wheel supported front frame, a rear lifting frame, rear lifting wheels mounted under the rear end of said lifting frame on forwardly swinging crank arms, forwardly extending pull links connected with said crank arms, bell crank levers pivotally mounted on the forward end of said rear lifting frame and operatively connected with said pull links, said bell crank levers comprising reaction lever arms, reaction stops carried by said front frame against which said reaction lever arms bear in the upward movement of the front end of said lifting frame whereby said rear lifting wheels are actuated to cause simultaneous upward movement of the rear end of said lifting frame, hydraulic lifting mechanism mounted on said front frame comprising a lifting ram disposed substantially at the rear of said front frame, an A-frame secured to the front end of said rear lifting frame and through which said hydraulic ram transmits lifting movement to said rear lifting frame, the line of upward lifting thrust of said lifting ram on said A-frame and the line of downward reaction thrust of said reaction stops on said reaction lever arms both lying in closely adjacent vertical planes, a vertical guide carried by one of said frames, and a slide carried by the other of said frames having sliding guided movement in said guide, said guide and slide being disposed in a vertical plane in close proximity to said lines of upwardly and downwardly acting thrusts.

2. In a lift truck of the class described, the combination of a front frame, a substantially vertical tubular kingpin journaled in said front frame for steering movement, dirigible front wheels supporting said front frame through said vertical tubular kingpin, a rear lifting frame, means operatively connecting said front and rear frames together permitting lifting movement of said rear frame relatively to said front frame, rear lifting wheels supporting the rear end of said rear lifting frame, a towing and steering handle connected with said front wheels, for steering the latter, hydraulic lifting mechanism mounted on said front frame, a foot operated treadle for actuating said hydraulic lifting mechanism, pivot means mounting said treadle on said tubular kingpin for lateral swinging movement concurrently with the swinging steering movement of said handle, and motion transmitting mechanism for transmitting actuating motion from said treadle to said hydraulic lifting mechanism, said motion transmitting mechanism comprising a motion transmitting member having vertically reciprocable motion through said tubular kingpin.

3. In a lift truck of the class described, the combination of frame means, a substantially vertical tubular kingpin journaled in said frame means for steering movement, dirigible front wheels supporting the front end of said frame means through said tubular kingpin, a towing and steering handle having steerable connection with said front wheels, hydraulic lifting mechanism on said frame means, a foot operated treadle for actuating said hydraulic lifting mechanism, means pivotally mounting said treadle on said tubular kingpin for lateral swinging movement concurrently with the sidewise steering movement of said handle, and motion transmitting mechanism for transmitting actuating motion from said treadle to said hydraulic lifting mechanism, said motion transmitting mechanism comprising a motion transmitting part extending substantially concentrically within said vertical tubular kingpin.

4. In a lift truck of the class described, the combination of frame means, dirigible front wheels supporting the front end of said frame means on a vertical steering axis, a towing and steering handle having steerable connection with said front wheels, hydraulic lifting mechanism on said frame means, a foot operated treadle for actuating said hydraulic lifting mechanism, means mounting said treadle for lateral swinging movement concurrently with the steering movement of said handle, motion transmitting mechanism for transmitting actuating motion from said treadle to said hydraulic lifting mechanism, said motion transmitting mechanism comprising a vertically reciprocable motion transmitting part disposed coaxially of said vertical steering axis, said treadle comprising an outer section having hinged mounting for swinging upwardly into a raised inactive position, and spring means normally biasing said outer treadle section into said raised inactive position.

5. In a lift truck of the class described, the combination of frame means, dirigible front wheels supporting the front end of said frame means on a vertical steering axis, a towing and steering handle having steerable connection with said front wheels, hydraulic lifting mechanism on said frame means, a foot operated treadle for actuating said hydraulic lifting mechanism, means mounting said treadle for lateral swinging movement concurrently with the steering movement of said handle, motion transmitting mechanism for transmitting actuating motion from said treadle to said hydraulic lifting mechanism, said treadle comprising an outer section having hinged mounting for swinging upwardly into a raised inactive position, and means for normally retaining said outer treadle section in said raised inactive position.

6. In a lift truck of the class described, the combination of a front wheel supported frame, a rear lifting frame, hydraulic lifting mechanism supported by said front frame, said hydraulic lifting mechanism comprising a lifting ram and a plunger pump for supplying hydraulic pressure to said lifting ram, manually operated means for actuating said plunger pump, a first vertically separable operating connection between said lifting ram and said lifting frame, a second vertically separable operating connection between said plunger pump and said manually operated means, and releasable supporting means for releasably supporting said hydraulic lifting unit in said front frame enabling said hydraulic lifting unit to be dropped down out of the bottom of said lift truck, with accompanying separation of said first and second vertically separable operating connections.

7. In a lift truck of the class described, the combination of a lifting frame, a vertical king bolt having steering mounting at the front end of said frame, a front axle secured at its center to said king bolt and having its ends projecting outwardly from opposite sides thereof, wheels on the outer ends of said axle, a towing and steering handle having yoke arms at its lower end journaled on the outwardly projecting ends of said axle for permitting vertical swinging movement of said handle, counterbalancing springs coiled on the ends of said axle between said king bolt and said wheels and acting on said handle for normally holding it in a substantially upright position, and anti-friction means carried by said handle adapted to have anti-friction contact with said frame when said handle is in said substantially upright position.

8. In a lift truck of the class described, the combination of a frame structure, steerable front wheels for said frame structure, a towing and steering handle connected with said front wheels for towing and steering the truck, means hingedly mounting said handle on said truck for vertical swinging movement of said handle between a forwardly extending position and a substantially upright position, and anti-friction means carried by said handle adapted to have anti-friction contact with said frame structure when said handle is in said substantially upright position.

9. In a lift truck of the class described, the combination of a rear lifting fork, rear lifting wheels mounted adjacent the rear ends of the fork arms of said fork, pallet entry wheels mounted on said fork arms rearwardly beyond said rear lifting wheels, said pallet entry wheels being of rela-

tively large diameter and being mounted on axes which are inclined relatively to said fork arms, a front frame, dirigible front wheels supporting said front frame on a dirigible steering axis, a towing and steering handle connected with said front wheels through said dirigible steering axis, a vertical slide and vertical guide-way connecting said rear lifting fork with said front frame, hydraulic lifting mechanism mounted on said front frame and operatively connected to impart lifting movement to the front end of said rear lifting fork, a foot operated treadle for actuating said hydraulic lifting mechanism, means mounting said treadle for lateral swinging movement concurrently with the swinging steering movement of said handle, and motion transmitting mechanism for transmitting actuating motion from said treadle to said hydraulic lifting mechanism, said motion transmitting mechanism comprising a motion transmitting member having vertically reciprocable motion concentrically of said dirigible steering axis.

10. In a lift truck of the class described, the combination of a wheel supported front frame, a lifting fork rear frame comprising spaced fork arms adapted to enter load carrying pallets for lifting and transporting the same, rear lifting wheels mounted adjacent the rear portions of said fork arms, pallet entry wheels mounted on said fork arms rearwardly beyond said lifting wheels, said pallet entry wheels being of relatively large diameter and being mounted on axes which are inclined relatively to said fork arms, a vertical slide and vertical guide-way connecting said two frames together for lifting movement of said rear frame relatively to said front frame, said front frame comprising dirigible front wheels supporting said front frame on a dirigible steering axis, a towing and steering handle connected with said front wheels for towing and steering the truck, hydraulic lifting mechanism mounted on said front frame and operatively connected to impart lifting movement to the front end of said rear frame, a foot operated treadle for actuating said hydraulic lifting mechanism, means mounting said treadle for lateral swinging movement concurrently with the swinging steering movement of said handle, motion transmitting mechanism for transmitting actuating motion from said treadle to said hydraulic lifting mechanism, said motion transmitting mechanism comprising a motion transmitting member having vertically reciprocable motion concentrically of said dirigible steering axis, said hydraulic lifting mechanism comprising a hydraulic reservoir, a plunger pump receiving liquid from said reservoir and arranged to be actuated by said foot operated treadle, a hydraulic ram receiving liquid from said plunger pump and transmitting lifting movement to the front end of said rear frame, and an automatically operable overload release valve for automatically shunting liquid around said plunger pump when the lift truck is loaded beyond a predetermined maximum.

11. In a pallet lift truck of the class described, the combination of a lifting fork comprising fork arms adapted to enter load carrying pallets for lifting and transporting the same, a load carrying lifting wheel swingably mounted beneath the outer portion of each fork arm for rolling support along the surface of the floor, a pallet entry wheel mounted beneath each fork arm at a point between said lifting wheel and the pallet entering end of the fork arm, each pallet entry wheel being of a disk-like form and having a diameter approximating the diameter of its associated lifting wheel, bearing means carried by each fork arm defining an upwardly inclined, diagonally pointing pivot axis for its respective pallet entry wheel, said upwardly inclined pivot axis lying in a vertical plane which extends partly transversely and partly longitudinally of its respective fork arm, with the high end of said inclined pivot axis pointing in a direction generally away from the pallet entering end of the fork arm, so that the top edge of said pallet entry wheel remains below the top of its respective fork arm and the bottom edge of said entry wheel normally remains out of rolling contact with the floor, and whereby the lower entering edge of said entry wheel defines in effect an upwardly and forwardly inclined rolling surface of relatively long obtuse slope which eases the climb of the fork arm over the lower pallet board.

12. In a pallet lift truck of the class described, the combination of a lifting fork comprising fork arms adapted to enter load carrying pallets for lifting and transporting the same, a load carrying lifting wheel swingably mounted beneath the outer portion of each fork arm for rolling support along the surface of the floor, a pallet entry wheel mounted beneath each fork arm at a point between said lifting wheel and the pallet entering end of the fork arm, each pallet entry wheel being of disk-like form and having a diameter approximating the diameter of its associated lifting wheel, bearing means carried by each fork arm defining an upwardly inclined, diagonally pointing pivot axis for its respective pallet entry wheel, said upwardly inclined pivot axis being rigidly maintained in fixed angular relationship to its respective fork arm and lying in a vertical plane which extends partly transversely and partly longitudinally of its respective fork arm, with the high end of said inclined pivot axis pointing in a direction generally away from the pallet entering end of the fork arm whereby the lower entering edge of said entry wheel defines an upwardly inclined rolling surface which facilitates entry of the fork arm over the lower pallet board and into the pallet.

13. In a pallet lift truck of the class described, the combination of a lifting fork comprising fork arms adapted to enter load carrying pallets for lifting and transporting the same, a load carrying lifting wheel swingably mounted beneath the outer portion of each fork arm for rolling support along the surface of the floor, a pallet entry wheel mounted beneath each fork arm at a point between said lifting wheel and the pallet entering end of the fork arm, each pallet entry wheel being of disk-like form and having a diameter approximating the diameter of its associated lifting wheel, bearing means carried by each fork arm mounting each pallet entry wheel on a sloping pivot axis which is rigidly maintained in fixed angular relationship to its respective fork arm with said pivot axis lying in a vertical plane which extends partly transversely and partly longitudinally of its respective fork arm, and with the high end of said inclined pivot axis pointing in a direction generally away from the pallet entering end of its respective fork arm whereby to facilitate the entrance of each fork arm over the lower pallet board and into the pallet, and a fixed inclined plane track carried by each fork arm and extending substantially from the lower level of each pallet entry wheel to substantially the lower level of the associated lifting wheel for effecting a transition of contact of the lower pallet board between said wheels.

14. In a pallet lift truck of the class described, the combination of a lifting fork comprising fork arms adapted to enter load carrying pallets for lifting and transporting the same, a load carrying lifting wheel swingably mounted beneath the outer portion of each fork arm for rolling support along the surface of the floor, a pallet entry wheel mounted beneath each fork arm at a point between said lifting wheel and the pallet entering end of the fork arm, each pallet entry wheel being of a disk-like form and having a diameter approximating the diameter of its associated lifting wheel, bearing means carried by each fork arm defining an upwardly inclined, diagonally pointing pivot axis for its respective pallet entry wheel, said upwardly inclined pivot axis lying in a vertical plane which extends partly transversely and partly longitudinally of its respective fork arm, with the high end of said inclined pivot axis pointing in a direction generally away from the pallet entering end of the fork arm, so that the top edge of said pallet entry wheel remains below the top of its respective fork arm and the bottom edge of said entry wheel normally remains out of rolling contact with the floor, and whereby the lower entering edge of said entry wheel defines in effect an up-

wardly and forwardly inclined rolling surface of relatively long obtuse slope which eases the climb of the fork arm over the lower pallet board, and a fixed inclined plane track carried by each fork arm and extending substantially from the lower level of each pallet entry wheel to substantially the lower level of the associated lifting wheel for effecting a transition of contact with the lower pallet board between said wheels.

15. In a lift truck of the class described, the combination of a front frame, a rear lifting frame movable substantially vertically relatively to said front frame, a vertical guide carried by one of said frames, a vertical slide carried by the other of said frames engaging in said vertical guide, said guide and said slide having vertical rectilinear sliding movement therebetween in a vertical guide plane located substantially at the juncture of said front and rear frames, front supporting wheels steerably mounted on said front frame and supporting the front end of the lift truck through force lines acting downwardly through a vertical front supporting plane passing through the axes of said front supporting wheels, rear lifting wheels swingably mounted under the outer end of said rear lifting frame on forwardly swinging crank arms, operating linkage for swinging said rear lifting wheels to effect lifting movement of the outer end of said rear lifting frame, bell crank levers pivotally mounted on said rear lifting frame and having their outer ends operatively connected with said linkage, reaction rollers mounted on the inner ends of said bell crank levers, reaction stop surfaces fixedly attached to said front frame and operative in the lifting movement of said rear lifting frame to transmit downwardly reacting force lines to said reaction rollers in a rear reaction plane which extends vertically at a point located forwardly of said vertical guide plane, and a hydraulic lifting ram mounted on said front frame and operative to effect vertical lifting movement of said rear lifting frame through force lines acting upwardly within a vertical lifting plane passing axially through said hydraulic ram, said vertical lifting plane being located at a point intermediate said front supporting plane and said rear reaction plane so that there is a substantial tendency for the upwardly acting force lines in said intermediate lifting plane to be balanced out by the downwardly acting force lines in said front supporting plane and in said rear reaction plane, thereby minimizing cocking or binding stresses between said guide and said slide in the lifting and lowering movements of said rear lifting frame.

16. In a lift truck of the class described, the combination of a front frame, rear lifting frame means movable substantially vertically relatively to said front frame, a vertical guideway carried by one of said frames, a vertical slide carried by the other of said frames engaging in said vertical guideway, said guideway and slide having vertical rectilinear sliding movement therebetween in a vertical guide plane located substantially at the juncture of said front and rear frames, front supporting wheels steerably mounted on said front frame and supporting the front end of the lift truck through the transmission of vertical force lines acting downwardly in a vertical front supporting plane passing through the axis of said front supporting wheels and intersecting the floor, rear lifting wheels swingably mounted under the outer end of said rear lifting frame means, operating linkage for swinging said rear lifting wheels to effect lifting movement of the outer end of said rear lifting frame, levers pivotally mounted on said rear lifting frame means operatively connected with said linkage, reaction rollers carried by said levers, reaction stop surfaces fixedly attached to said front frame and operative in the lifting movement of the front end of said rear lifting frame to transmit downwardly reacting force lines to said reaction rollers in a rear reaction plane located forwardly of said vertical guide plane, such coaction between said reaction rollers and reaction stop surfaces operating to swing said levers and thereby swing said rear lifting wheels for lifting the outer end of said lifting frame means, and a hydraulic lifting ram mounted on said front frame and operative to effect vertical lifting movement of said rear lifting frame means through the transmission of vertical force lines acting upwardly within a vertical lifting plane passing through said ram, said vertical lifting plane being located at a point intermediate said front supporting plane and said rear reaction plane so that there is a substantial tendency for the downwardly acting force lines in said front supporting plane and in said rear reaction plane to be balanced out by the upwardly acting force lines in said intermediate lifting plane, thereby minimizing cocking or binding stresses between said guideway and said slide in the lifting movement of said rear lifting frame means.

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