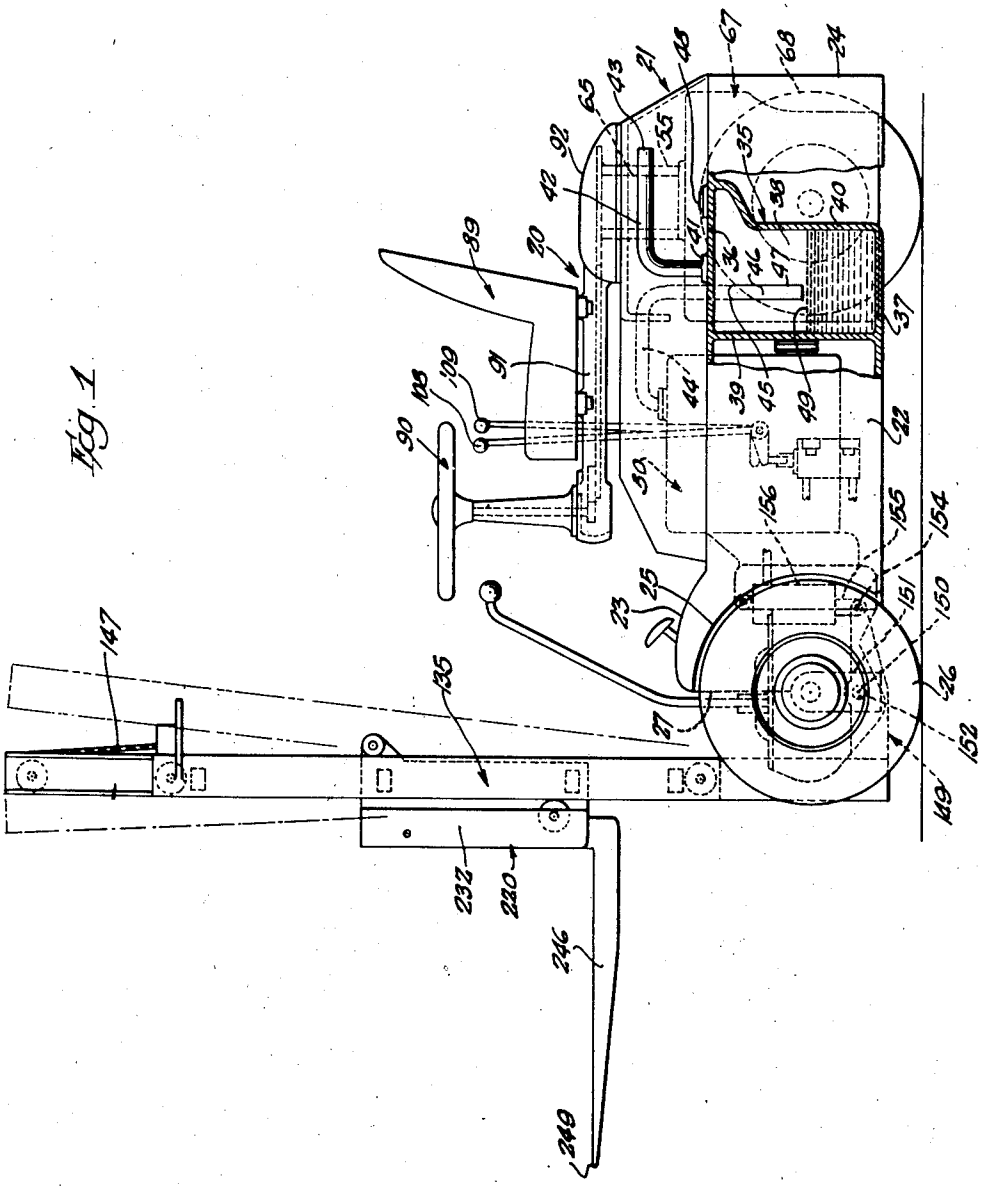
Sept. 30, 1947. G. V. JOHNSON 2,428,223

LIFT TRUCK

Original Filed Dec. 31, 1943 5 Sheets-Sheet 1

Fig. 1



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Sept. 30, 1947. G. V. JOHNSON 2,428,223

LIFT TRUCK

Original Filed Dec. 31, 1943 5 Sheets-Sheet 2

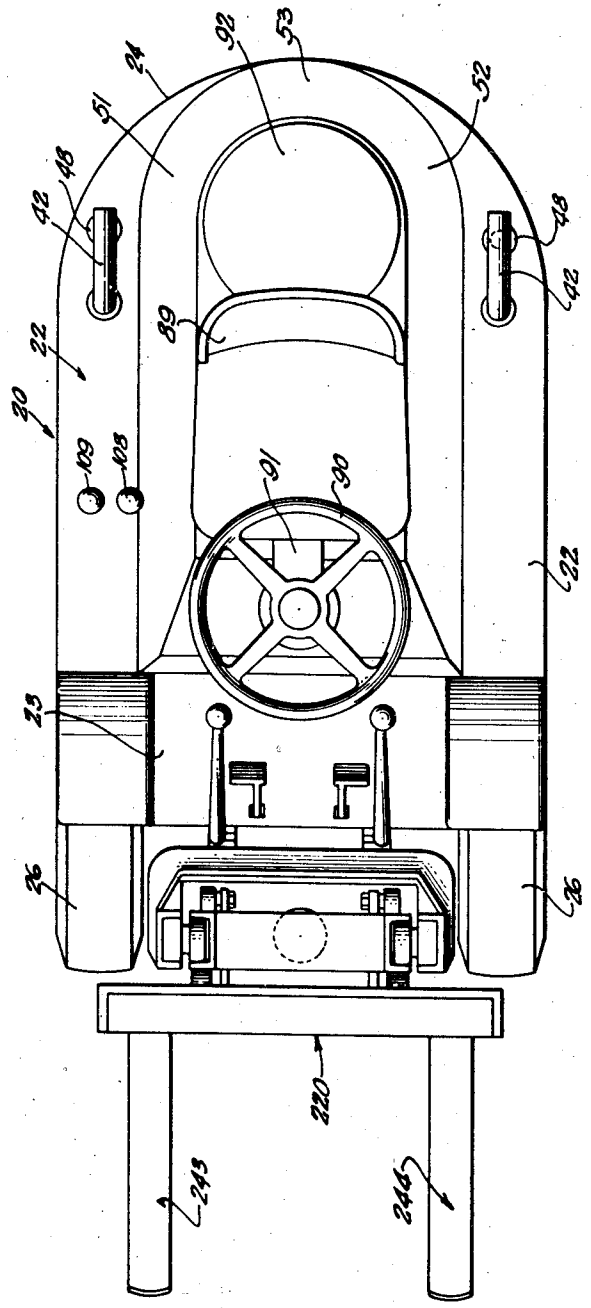


Fig. 2

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Sept. 30, 1947. G. V. JOHNSON 2,428,223

LIFT TRUCK

Original Filed Dec. 31, 1943 5 Sheets-Sheet 3

Fig. 3

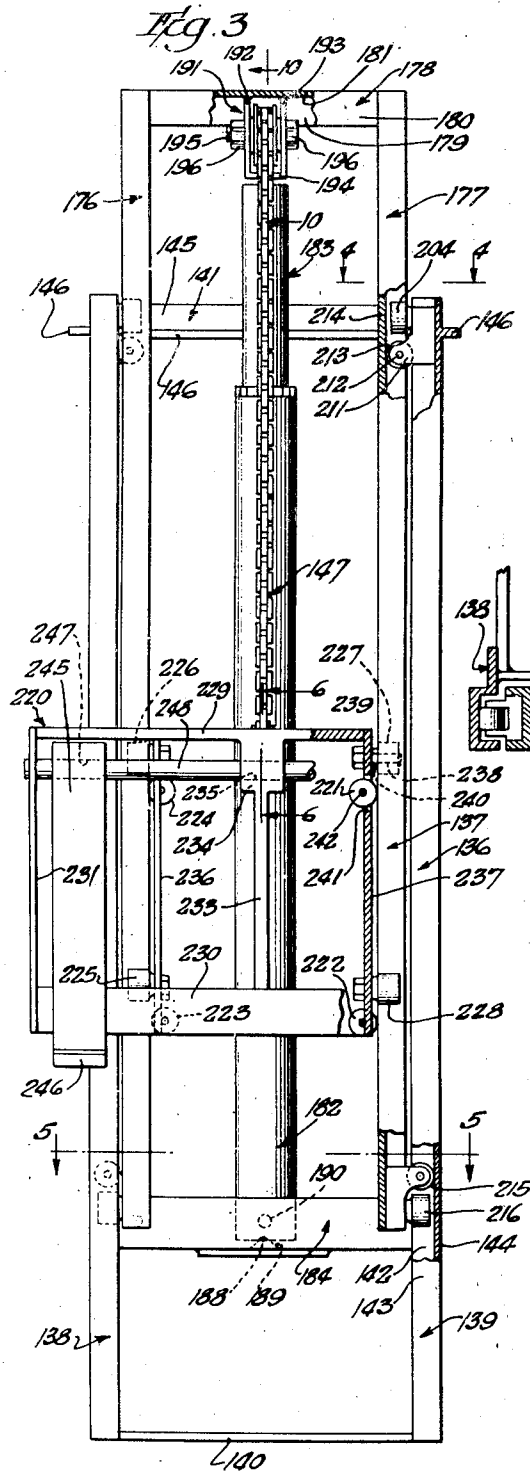


Fig. 4

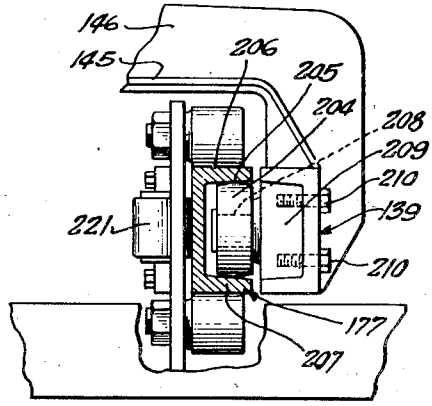


Fig. 5

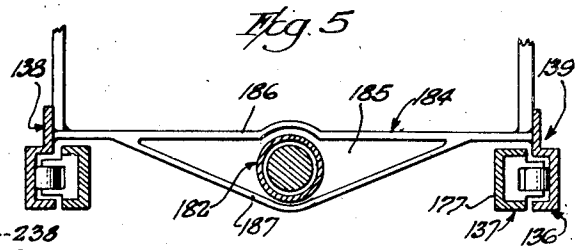


Fig. 6

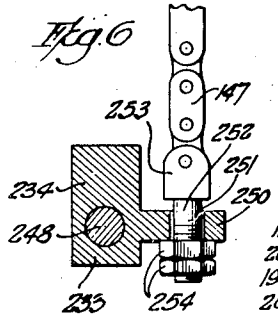
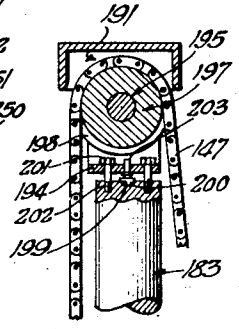


Fig. 10



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LIFT TRUCK

Original Filed Dec. 31, 1943 5 Sheets-Sheet 4

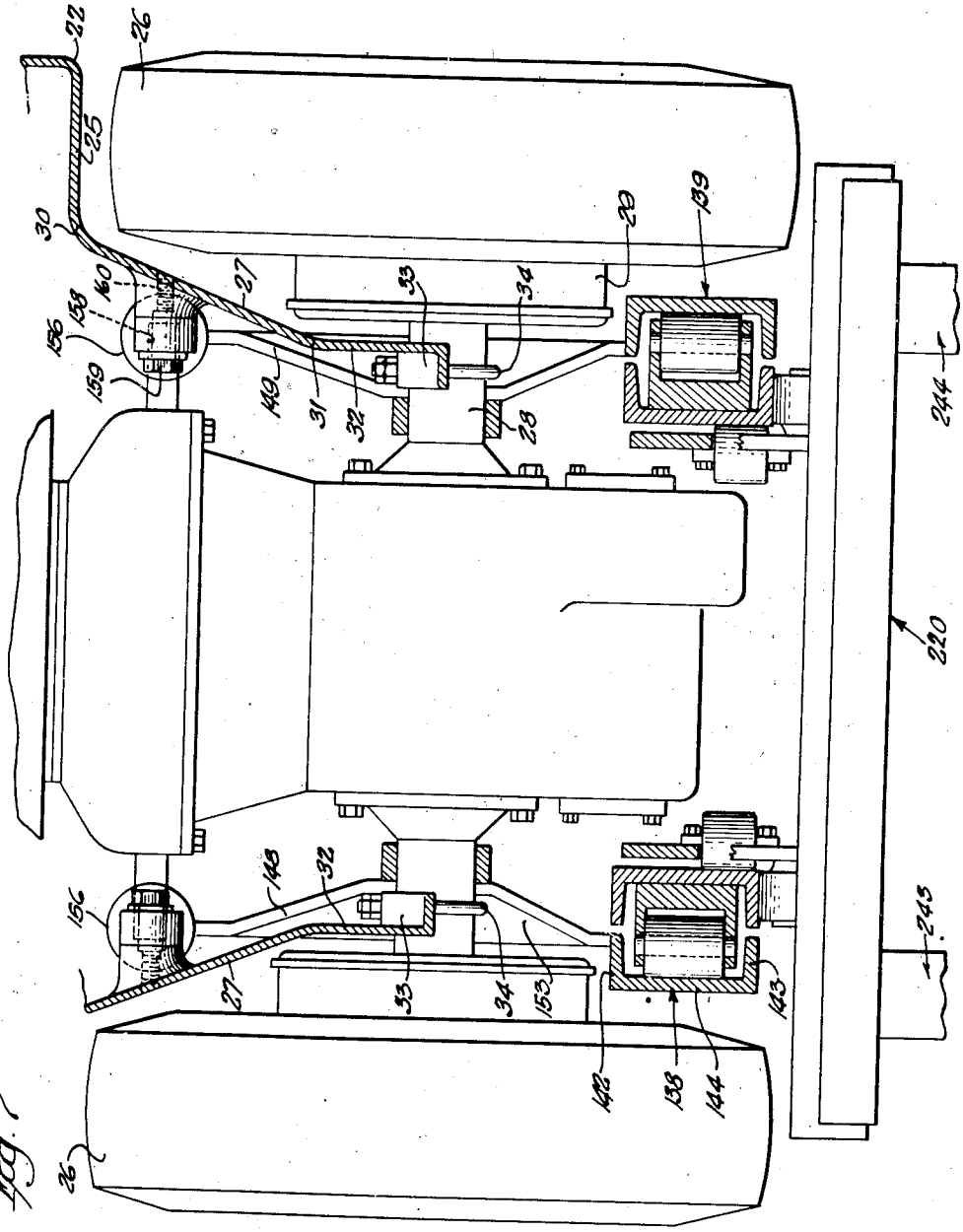


Fig. 7

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LIFT TRUCK

Original Filed Dec. 31, 1943 5 Sheets-Sheet 5

Fig. 9

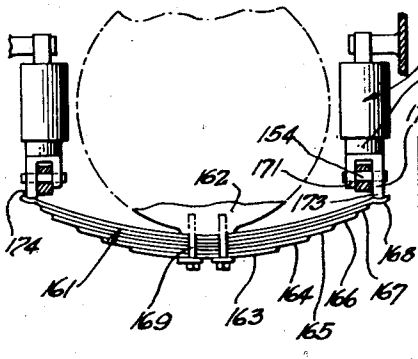


Fig. 8

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Patented Sept. 30, 1947 2,428,223

UNITED STATES PATENT OFFICE

2,428,223

LIFT TRUCK

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Original application December 31, 1943, Serial No. 516,405, now Patent No. 2,387,077, dated October 16, 1945. Divided and this application August 18, 1945, Serial No. 611,347

8 Claims. (Cl. 214—113)

1

The present invention relates to lift trucks and is particularly concerned with lift trucks of the type driven with an internal combustion engine and having at the forward end a pivotally mounted frame acting as a guide and a support for a carriage having a pair of forwardly extending lifting arms.

This application is a division of my prior application Serial No. 516,405, filed December 31, 1943, for Lift trucks, which is now issued as Patent No. 2,387,077, dated October 16, 1945.

One of the objects of the invention is the provision of an improved lift truck of the class described, the structure of which is more compact, sturdy, and makes more efficient use of available space to permit the use of larger pneumatic tires and still retain general over-all dimensions consistent with trucks of equal capacity using smaller diameter solid tires.

Another object of the invention is the provision of a lift truck which is provided with an improved construction for the elevator or load-lifting device employed.

Another object of the invention is the provision of an improved lifting structure for trucks of the class described which permits a greater visibility for the operator, forwardly of the truck, through the elevator and its mechanism.

Another object of the invention is the provision of an improved arrangement of the mechanism of the lift truck upon its chassis by means of which the truck is adequately counter-balanced for supporting a load for which it may have been designed, and by means of which the truck is also made more compact than the devices of the prior art, so that it can be used within freight cars and tight places in warehouses even though it is equipped with large pneumatic tires.

Other objects and advantages will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings, of which there are five sheets,

Fig. 1 is a side elevational view in partial section showing a lift truck embodying the invention;

Fig. 2 is a top plan view of the lift truck;

Fig. 3 is a fragmentary front elevational view showing the load carrying mechanism apart from the vehicle in front elevation and partial section;

Fig. 4 is a fragmentary sectional view taken on the plane of the line 4—4 of Fig. 3 looking in the direction of the arrows;

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Fig. 5 is a fragmentary sectional view taken on the plane of the line 5—5 of Fig. 3 looking in the direction of the arrows;

Fig. 6 is a fragmentary sectional view taken on the plane of the line 6—6 of Fig. 3 looking in the direction of the arrows;

Fig. 7 is a horizontal sectional view showing a plan of the combined transmission and differential housing and driving wheels and the mode of attachment of the load carrying mechanism to the chassis being shown in section;

Fig. 8 is a diagrammatic view in perspective of the hydraulic system by means of which the elevator frame is tilted and the load lifted;

Fig. 9 is a fragmentary elevational view in partial section showing the construction of the tilting cylinders and pistons and a spring which is utilized to urge the elevator frame forward at the top and to urge the pistons inward for effecting their return when hydraulic pressure is removed; and

Fig. 10 is a fragmentary sectional view taken on the plane of the line 10—10 of Fig. 3 looking in the direction of the arrows, showing the mode of attachment of the sheave at the top of the hydraulic ram.

The present vehicle preferably has its chassis in the form of an assembly of cast steel members which are also employed for housing and enclosing the mechanism and for providing the housings for a pair of laterally located mufflers.

Referring to Figs. 1, 2 and 7, the lift truck is there indicated in its entirety by the numeral 20 and its chassis frame by the numeral 21. This chassis frame may comprise a pair of side panels 22 joined at the top under the feet of the operator by a transversely extending frame member 23 which also serves as a floor board, and joined at the rear by a vertically extending partially cylindrical end wall 24.

At the forward end of the vehicle each of the side panels 22 is provided with a transversely extending wall 25, which is curved cylindrically and slightly spaced from each of the front wheels 26 to form a fender, and the wall 25 is joined to a forwardly extending supporting flange 27, Fig. 7, which is secured to the front axle housing 28. In order to clear the wheels 26 and brake drums and brake housing 29, the forwardly extending wall 27 slopes inwardly from 30 to 31, but has its end portions 32 parallel to the side panels 22 (Fig. 7).

The forward end portions 32 are formed with the half cylindrical attaching flanges 33, which are adapted to fit the outside of the axle housing

28, and which are provided with a pair of apertures for receiving the two legs of a U-shaped bolt 34 that embraces the axle housing and passes through the flanges 33 to secure the chassis fixedly to the axle housing 28. At the rear end of the chassis frame the side panels 22 also enclose a muffler chamber 35, which is formed by a top wall 36, bottom wall 37, side panel 22, inner wall 38, and two end walls 39, 40 (Fig. 1).

This muffler has its top wall 36 provided with a threaded bore at 41 for receiving the tail pipe 42, which has a vertical portion threaded into the bore 41 and a horizontal rearwardly extending portion discharging at 43 rearwardly of the chassis frame.

The exhaust is brought to the muffler chamber 35 by an exhaust pipe 44 on each side of the vehicle. The exhaust pipes pass in at an aperture 45 by means of a downwardly extending diagonal portion 46 and the pipes have a downwardly turned portion 47 in the chamber 35.

The top wall 36 of each muffler chamber 35 may also have a threaded filling opening which is closed by threaded plug 48 so that each muffler chamber may be filled with ordinary water to a level 49, which is slightly below the end 47 of pipe 44. The present muffler may under certain conditions be used without water. 50 indicates diagrammatically in Fig. 1 the power unit comprising an internal combustion engine which may be of the V-type so that its cylinders are arranged in two series, one series having its exhaust connected to each of the mufflers on each side of the vehicle.

The operation of these mufflers is as follows: The exhaust gases, sparks, carbon, etc., are discharged from the end 47 to the pipe 44 at high velocity directly toward the free surface of the water 49 and any burning particles are driven into the water and extinguished. As the exhaust gases at high velocity pass out of the pipe end 47 into exhaust chamber 35 they are permitted to expand freely into the larger space provided and the velocity energy is dissipated in this chamber. Successive waves of pressure are created in the chamber which are discharged through the tail pipe 42 to atmosphere and noise of the explosion of the engine is substantially muffled by use of this structure.

Due to the use of water there is assurance that sparks will not pass out of the tail pipes, and the construction is so arranged that the water is not blown from the muffler, thus permitting their use for relatively long periods without refilling.

The side panels 22 are also preferably joined at the rear top by the upwardly extending diagonal walls 51, 52 and at the rear by the frustoconical end wall 53.

The chassis is formed at its rear end with a centrally located and vertically extending bearing housing 55 provided with bearings for rotatably supporting a vertical trunnion 65 that carries at its lower end a counter-weighted wheel supporting member 67 which rotatably supports the rear steered wheel 68. The structure of the wheel and its axle are preferably substantially as disclosed in my prior Patent No. 2,337,109, issued December 21, 1943, relating to industrial trucks.

The chassis supports at its rear top a circular member 92 which is mounted for rotation on substantially the same axis as the trunnion 65 and which supports a forwardly extending arm 91 that houses the steering mechanism and carries the seat 89 for the driver and also supports the steering wheel 90 which directs the steered wheel 68.

The structure of this steering mechanism is covered by my prior application Serial No. 516,405, filed December 31, 1943, on Lift trucks, Patent No. 2,387,077, issued October 16, 1945, of which application this is a division.

Referring to Fig. 1, the front of the vehicle is provided with an extensible elevator frame provided with a load carrying carriage, this assembly being indicated in its entirety by the numeral 135.

The load carrying assembly 135 has a pair of vertical frames 136 and 137 mounted to telescope with respect to each other, the lower frame section being indicated at 136 and the extensible frame by 137. The lower frame section may consist of a pair of vertically extending channeled members 138, 139 which are joined at the bottom by the transverse frame member 140 and at the top by transverse frame member 141. Each of the channeled members 138, 139 is substantially U-shaped having the side flanges 142, 143 joined by web 144 and the lower frame member 140 may fit within the side flanges 142, 143 to engage the web and may be welded to all three of these parts.

As the extensible section 137 only moves down to the lower frame member 140, this frame member may be placed inside the channels, but the upper transverse frame member 141 must be located outside of the channels 138, 139 to prevent interference between this frame member and the sliding frame 137. Therefore, the upper frame member 141 may consist of an angular member having a vertical flange 145 and a horizontal flange 146, and the horizontal flange frame extends around the outside of each channel 138, 139, as indicated on both sides of Fig. 3, where this horizontal flange is welded to the web 144. It is also welded to the rear side flange 142 of each vertical channel 138, 139, and in addition it holds the upper ends of the channels 138, 139 in proper spaced position. Frame member 141 serves as an anchor for one end of the sprocket chain 147, which may be secured to it by any suitable securing device, such as a terminal link having a screw bolt passing through the flange 146 and provided with lock nuts, as shown in Fig. 6, for the other end of the chain.

At its lower end the vertical frame 136 is also preferably provided with a pair of rearwardly extending arms 148, 149, one of which is seen in Fig. 1, and both of which are seen in plan in Fig. 7. These arms 148, 149 are securely welded to the rear flange 142 of each channel 138, 139 and extend rearwardly at substantially right angles to these channels. Each of the arms 148, 149 may be pivotally mounted by means of a stub shaft or screw bolt 150 on a hanger 151, Fig. 1, which is supported from the front axle housing 28 so that the load supporting assembly 135 is carried by the front axle housing, and is mounted for pivotal movement either on the axle housing or the hanger 151.

One mode of support of the load carrying assembly 135 is to provide a transverse bar which is bolted to the lower side of the transmission housing, the ends of this bar being engaged by rubber torque bushings mounted in bores 152 in the arms 148, 149 to support the tilting frame.

Referring to Fig. 7, each of the arms 148, 149 is formed with an inwardly turned diagonal flange 153 in order to clear the forwardly extend-

ing part 31, 32 of the chassis which is also attached to the axle housing 28.

At the rear end of each arm 148, 149 for the tilting frame, each arm is pivotally connected by means of a rivet or screw bolt 154 to the piston rod 155 of a piston that is mounted for reciprocation in the cylinder 156, Fig. 1, Fig. 8. The cylinder itself is pivotally mounted on the chassis by means of a lug 157 having an aperture 158, Fig. 7, by means of a screw bolt 159 which passes through the bore 158 and is threaded into a threaded bore 160 in the chassis member 27.

The cylinder 156 has a hydraulic piston which is actuated by hydraulic fluid under pressure, as will be further described in detail, to effect a tilting of the frame 135 backward from the full line position in Fig. 1 to the dotted line position as shown at the right-hand of this figure.

The assembly 135 is urged counter-clockwise, Fig. 1, by gravity since it is pivotally mounted at 150 at the right of its center of gravity. In order to assure the return of the titling assembly 135 to the forward dotted line position of Fig. 1 and to assure the emptying of the hydraulic fluid from the cylinders 156 when hydraulic pressure is removed, the arms 148, 149 are also preferably engaged by a leaf spring assembly 161 which is carried by the transmission housing 162.

Leaf spring 161 may consist of an assembly of leaves 163, 168, each leaf being longer than the leaf below it and the leaves being symmetrically arranged between bolts 169 which are threaded into the tapped holes in the flywheel housing 162 and are used to clamp the spring in its proper position. The pistons 170 have a cylinder 156 which shows in Fig. 9, and they are provided with bifurcated lower ends having the spaced flanges 171, 172 for receiving the rivet 154.

Flange 172 may be made slightly longer and may be curved at its lower end 173 to be received in a complementarily curved recess 174 formed in each end of the leaf spring 168. If desired, the engagement may be between a curved formation 175 on the lower side of the end of each arm 148, 149 and the leaf spring end 168, as shown in Fig. 8. The leaf spring assembly is under initial tension urging the pistons 170 upward into the cylinders 156 and the pressure of the spring combined with the weight of gravity of the forwardly extending load supporting assembly 175 is sufficient to drive the hydraulic fluid out of the cylinders 156 quickly when proper valve connections are effected by one of the levers 108, 109, as will be described in detail hereinafter.

Referring to Figs. 1 to 7, the upper extensible frame section 137 preferably comprises a pair of outwardly turned channel members 176, 177, these frame members being joined at the top by a channeled member 178. The channeled member 178 may have its side flanges 179, 180 of sufficient length to fit between the channels 176, 177 and may have its web 181 extended into the channels 176, 177 to effect a close fit between these frame members 176, 177, 178, which may be welded together at all points of contact. Thus the extensible frame section 138 has a rigid frame open at its lower end so that there is nothing to interfere with the central location of a cylinder 182 and piston 183 for actuating or lifting the upper frame section 137.

In order to support the cylinder 182, the lower frame section 136 is provided with an additional transverse frame member 184, Fig. 3, Fig. 5, which is suitabiy attached to each of the side channels 138, 139 and its frame member 184 is widened at its central portion to be provided with a web 185 as well as two reinforcing flanges 186, 187. Web 185 is substantially triangular and is adapted to receive cylinder 182 between its flanges with a clearance.

Adequate stabilization to the lifting frame 237 is provided by rollers 221—224, and eliminates the need of employing two lifting chains as found in the prior art. This permits the use of a single lifting chain 147 located ahead of the hydraulic ram 182—183 so that there will be no lifting chains obstructing the operator's visibility.

The lower end of cylinder 182 is provided with a partially spherical socket 188, Fig. 3, for receiving an upwardly extending lug 189 having a similarly shaped end for permitting a limited universal movement of the cylinder 182 on the frame member 184. In addition, a transverse pin 190 may pass loosely in the cylinder 182 and may be riveted over in each of the flanges 186, 187 to make sure that the lug 189 will not get out of its socket 188.

The piston 183 engages at its upper end with a sheave assembly 191. This cheave assembly comprises a pair of depending side plates 192, 193, Fig. 3, the side plates being integrally secured to a horizontal yoke 194 and also being welded at their upper ends to flanges 179, 181 of the upper frame member 178.

The pulley shaft 195 passes through apertures in both of the flanges 192, 193 where it is secured by nuts 196 on its threaded ends and a pulley 197 provided with a groove 198 is rotatably mounted on the shaft 195. The upper end of the piston 183 is also preferably provided with a partially spherical socket 199 for receiving the ball-shaped end of a headed member 200, which has its stem 203 mounted in the yoke 194.

The piston 183 has its upper end provided with two screw bolts 201 which pass loosely through large apertures in the yoke 194, and the screw bolts are fixedly mounted in threaded bores 202 in the piston 183. The screw bolts 201 are long enough to provide a lost motion between the sheave assembly 191 and the piston 183, and the sheave engages the piston 183 through the ball and socket 199, 200 which provides a limited universal movement. The bolts 201 in their enlarged apertures in the yoke 194 merely guide the sheave and define the limits of the pivotal movement of the sheave assembly 191 relative to the piston 183.

The lower frame section 136 is preferably provided at its upper end with a roller 204 which is preferably formed with a crowned periphery 205 for engagement with the internal surfaces of the flanges 206, 207 on the channels 176, 177. Roller 204 is rotatably mounted on a trunnion 208 carried by a block 209 which is shaped to fit in each channel 138, 139. Block 209 may be secured in the channel by means of screw bolts 210 which pass through apertures in the web 144 and are threaded into threaded apertures in block 209.

Block 209 may have at its lower end a pair of forwardly extending bearing flanges 211 provided with apertures for supporting the pin 212, which pivotally supports a second roller 213 of substantially the same shape. Rollers 213 are located to engage the web 214 of each channel 176, 177 to guide the upper frame 137 against lateral movement in the lower frame 136 in the plane of these frames. Rollers 204 guide the inner and upper movable frame 137 against movement out of the plane of the frame 136.

At the lower end of each channeled member 176, 177, the inner frame 137 is also provided with

a similar block 209 similarly secured and provided with the roller 215 for engaging the web 144 of each channel 138, 139 and with the roller 216 for engaging between the side flanges 142, 143 of each channel 138, 139.

It should be noted that these guiding rollers are located at the extreme lower end of the upwardly moving frame 137 and at the extreme upper end of the lower frame 136. Thus, the two frames are supported to be guided for telescoping movement with a minimum amount of strain because the spaced rollers are as far apart as possible in most of the positions of this frame, and the roller assemblies on each side only come close together when the frames are fully extended.

The upper movable frame section 137 supports a carriage indicated in its entirety by the numeral 220 which is guided on the upper movable frame 137 by a plurality of rollers 221, 228.

The carriage 220 preferably comprises a rectangular frame which may consist of the horizontal frame members 229, 230 and the vertical frame members 231, 232 secured together at their corners to provide a rectangular frame. The horizontal frame members 229, 230 are preferably longer than the width of the tilting frame assembly 136, 137 so that they project beyond each side of the tilting frame assembly, and these frame members may be joined at the middle by an intermediate vertical frame member 233, which is provided with an enlargement 234 having a horizontal bore 235. As the carriage frame is wider than the tilting frame assembly, the carriage frame is preferably provided with another pair of vertically extending frame members 236, 237 for carrying the rollers 221—228 which engage the movable frame section 137.

Rollers 225—228 may be of substantially the same shape as rollers 204 but are carried by a stub shaft 238 which has a reduced threaded portion passing through the frame members 237 or 236 and secured with a nut 239, there being an annular shoulder 240 on each shaft on the opposite side of the frame members 236 or 237.

The frame members 236, 237 are provided with slots 241 adjacent the shafts 238 for passing the other rollers 221—224 which are also mounted upon shafts 242 that are suitably attached to the frame members 236, 237 on each side of the shaft 241. Rollers 221—224 engage the outside of the webs 214 of the vertical channels 176, 177 and guide the carriage frame against tilting in the plane of the extensible frames 136, 137.

Rollers 225—228 keep the frame of the carriage substantially parallel and closely adjacent to the extensible frame 137 so that the carriage may move from the bottom end to the top end of the extensible frame 137 in lifting a load, or it may be moved from the bottom to the top or vice versa, to place the carriage in position to take on a load or to discharge a load. Rollers 225, 228 are located in front of channels 176, 177, while rollers 226, 227 are located behind these channels.

The load supporting arms 243, 244, Fig. 3, are preferably adjustably mounted on the carriage 220, and each arm may comprise a vertically extending frame member 245 and a horizontally extending frame member 246. The vertically extending frame members 245 may be substantially as wide and as thick as the depth of the carriage frame, and they are provided with through bores 247 for receiving a rod or shaft 248 by means of which they are supported.

The shaft 248 is carried by the frame by being located in bores in the end frame members 231, 232 and the intermediate frame member 233. The shaft may be secured by a tight frictional fit or by cotter pins or any other convenient fastening means.

The load supporting arms 243, 244 have their bores 247 provided with a sliding fit on the shaft 248 so these may be moved laterally on the shaft 248 as desired to lift a wide or narrow load or to locate them centrally of the load when the vehicle is in a predetermined position. These load lifting arms are preferably spaced as widely as possible in order to provide a more stable support for the load which they carry, but they may be adjusted for various particular purposes.

The lower frame member 230 of the carriage frame is preferably located at the rear side of the frame members 231, 232, so that the vertical frame members 235 of the load supporting arms 243, 244 may rest against the frame member 230 when they carry a load and still be located within the boundaries of the carriage frame.

Frame member 230 is preferably disposed with its flat side extending vertically so as to provide a wider bearing surface to engage the rear side of the vertical frame members 245 of the arms 243, 244.

The horizontally extending portions 246 of the load supporting arms may be tapered toward their outer ends 249 since they act as cantilevers and their depth may be proportioned to the moments imposed upon them at any point.

Also the thin tapered end 249 is thus adapted to be slid or wedged under some types of loads to take the load by its direct engagement with the floor or the ground.

The taper on these arms is preferably on the lower side, so that the tapered side may extend parallel to the floor or ground when the frames 136, 137 are tilted forward to take on a load.

The chain 147 which is anchored at its right end, Fig. 1, to the transverse frame member 141 of the lower frame section 136, passes through the sheave 197 from the back and passes down parallel to the piston 183 and cylinder 182 and has its other end anchored to the carriage 220. The form of anchorage is shown in Fig. 6 where the enlargement 234 on vertical frame member 233 has a rearwardly extending lug 250, provided with an aperture 251 for receiving the shank 252 of a special link 253. Shank 252 has a threaded end which is provided with a pair of nuts 254, so that the chain may be employed in lifting the carriage 220.

It should be noted that when the piston 183 is driven upward by hydraulic fluid under pressure in the cylinder 182, it engages the movable frame section 137 through the intermediary of the sheave assembly 191 and lifts the upper frame section 137 as well as the sheave. Since the rear end of the chain 147 is anchored to the lower section 136, the raising of the sheave with its pulley simultaneously extends both the forward and rearward bight of the chain, and the carriage 220 is raised twice as fast as the upper frame 137.

Referring to Fig. 8, this is a diagrammatic illustration of the hydraulic system for controlling the raising and lowering of the carriage and the tilting of the load supporting elevator assembly. The system preferably includes a reservoir 255 for hydraulic fluid such as a suitable oil, and the reservoir 255 may comprise a cast metal container provided with a filling spout 256 having a cap 257.

A compressor pump 258 preferably of the gear

type is located in the reservoir 255 and has its intake opening 259 downwardly turned at a point spaced from the bottom of the reservoir so as to utilize the supply of oil or other hydraulic fluid which is contained in the reservoir without actually taking the sediment which might collect on the bottom. Pump 258 is driven by a shaft 260 which projects from the reservoir at its forward wall and carries the drive pulley 261 preferably of the V-type. This pulley may be driven by means of a rubber V-belt 262 which also passes over a pulley 263 carried by a rearward extension of the motor drive shaft 264, or some other shaft driven by a motor 50.

The reservoir 255 may be pivotally supported for a limited pivotal movement by means of an angle bracket 265, bolt 266 and a bracket 267 carried by the chassis. Another angle bracket may be fixedly secured to the chassis and to the reservoir 255 by bolt 269 in slot 270 so that the tension of the belt 262 may be adjusted by tilting the reservoir and securing it in place.

The pump 258 discharges through pipe 271 into a valve housing 272 which has a valve of the piston type 273 for controlling the flow of the hydraulic fluid under pressure to the tilting cylinders 156. Valve housing 272 is connected by pipes 274—276 to the upper ends of the cylinders 156 for this purpose.

The piston valve 273 is connected by a link 277 to a bell crank arm 278 by pivotal pins so that lever 109 may be used to open or close the valve 273. Thus a forward push on the lever 109 permits hydraulic fluid under pressure to enter cylinders 156 to push the pistons 155 downward, pivoting the arms 148, 149 downward and tilting the load lifting assembly 135 backward. When the lever 109 is pulled backward, the valve 273 is closed against admission of further hydraulic fluid to the cylinders 156, and another port is opened leading backward into the reservoir 255 so that the cylinders 156 are emptied.

The weight of the carriage 220, the load and the frames 136, 137 and the pressure of the spring assembly 161 cause the pistons to move into the cylinders 156 permitting the load carrying assembly 135, to tilt forward to desired position.

In the same way, the other lever 108 controls a similar valve which is adapted to admit hydraulic fluid from the pump 258 through the pipe 279 to the lifting cylinder 182 acting on piston 183, or the valve may be closed and the hydraulic fluid be passed back to the reservoir by moving lever 108 to the rearward position.

The system is preferably provided with a spring-loaded bypass to relieve the hydraulic system of excessive pressure that might develop through any cause.

It will thus be observed that I have invented an improved construction for lift trucks which is simple, sturdy and capable of being manufactured at a low cost and adapted to handle relatively heavy loads for its size and to transport them at a greater speed than the devices of the prior art. The present elevator construction is very stable and flexible in its handling and provides a maximum degree of visibility for the operator since only a single chain is used which is disposed in alignment with the piston and cylinder.

The vehicle needs only a single power plant, and by means of the hydraulic pump, cylinders and pistons, the power derived from it is used not only for driving the vehicle in two speeds, forward and reverse, but for tilting the elevator and lifting the load.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In an industrial truck, the combination of a chassis supported upon steering and drive wheels with an upwardly extending frame having at its lower end a pair of rearwardly extending supporting arms pivotally mounted with respect to such chassis, hydraulic means carried by said chassis and engaging each of said arms and adapted to urge the arms downward to tilt the upwardly extending frame backward, and spring means carried by said chassis and urging said arms upward to return the hydraulic means to its initial position, the said upwardly extending frame being provided with an extensible section movably mounted with respect to said frame and a load carrying means adapted to travel upward or downward on said movable section, and hydraulic means for simultaneously extending said extensible section and lifting said load carrying means, said hydraulic means comprising a ram having a sheave engaging a cable anchored on the frame at one end and passing over the sheave and secured at its opposite end to the load carrying means.

2. In an industrial truck, the combination of a chassis provided with front drive wheel means and rear steering wheel means, a tiltable vertically extending frame having a pair of rearwardly extending supporting arms pivotally mounted with respect to said chassis, a pair of hydraulic cylinders, each cylinder having its closed end pivotally mounted on said chassis and having a piston projecting from its other end pivotally connected to each of said arms beyond the point of support of the arms on said chassis, and spring means comprising a leaf spring having a plurality of leaves symmetrically arranged and secured together at a central point, said leaf spring being fixedly secured with respect to said chassis and having its free ends arranged to urge said pistons into said cylinders for tilting the upper end of said frame forward when hydraulic pressure is released from said cylinders, said truck including a driving engine having a housing, and said leaf spring having its central portion secured to said latter housing.

3. In a lift truck, the combination of a wheel supported chassis with a vertically extending load supporting frame carried by the front end of said chassis and arranged for tilting about a horizontal axis, said vertically extending frame comprising a pair of inwardly turned channelled members, each having a web and two side flanges, upper and lower frame members for securing said two channelled members together, said upper frame member being located outside of the channels, a second movable frame member comprising a second pair of outwardly facing channels rigidly joined together by an upper transverse frame member, roller means carried by the lower end of said second frame for engaging inside the first-mentioned channels against the two flanges and web thereof, roller means carried by the upper ends of the first two mentioned channels for en-

gaging inside the channels of the second frame against the web and two flanges of the channels thereof, whereby the second frame is guided for vertical movement with respect to the first frame, a load carrying means adapted to run upward or downward on said second frame, a hydraulic cylinder carried by the first frame and extending upwardly from a transverse frame member adjacent the bottom of the first frame, said cylinder having a piston engaging a part carried by the second, whereby the second frame may be raised hydraulically, and a single tension means for operating said load carrying means relative to said second frame.

4. In a lift truck, the combination of a wheel supported chassis with a vertically extending load supporting frame carried by the front end of said chassis and arranged for tilting about a horizontal axis, said vertically extending frame comprising a pair of inwardly turned channelled members, each having a web and two side flanges, upper and lower frame members for securing said two channelled members together, said upper frame member being located outside of the channels, a second movable frame member comprising a second pair of outwardly facing channels rigidly joined together by an upper transverse frame member, roller means carried by the lower end of said second frame for engaging inside the first-mentioned channels against the two flanges and web thereof, and roller means carried by the upper ends of the first two mentioned channels for engaging inside the channels of the second frame against the web and two flanges of the channels thereof, whereby the second frame is guided for vertical movement with respect to the first frame, a hydraulic cylinder carried by the first frame and extending upwardly from a transverse frame member adjacent the bottom of the first frame, said cylinder having a piston engaging a part carried by the second, whereby the second frame may be raised hydraulically, said part comprising a U-shaped bracket carried by the upper frame member of the second frame, and said piston having a predetermined universal movement with respect to said bracket.

5. In a lift truck, the combination of a wheel supported chassis with a vertically extending load supporting frame carried by the front end of said chassis and arranged for tilting about a horizontal axis, said vertically extending frame comprising a pair of inwardly turned channelled members, each having a web and two side flanges, upper and lower frame members for securing said two channelled members together, said upper frame member being located outside of the channels, a second movable frame member comprising a second pair of outwardly facing channels rigidly joined together by an upper transverse frame member, roller means carried by the lower end of said second frame for engaging inside the first-mentioned channels against the two flanges and web thereof, and roller means carried by the upper ends of the first two mentioned channels for engaging inside the channels of the second frame against the web and two flanges of the channels thereof, whereby the second frame is guided for vertical movement with respect to the first frame, a hydraulic cylinder carried by the first frame and extending upwardly from a transverse frame member adjacent the bottom of the first frame, said cylinder having a piston engaging a part carried by the second, whereby the second frame may be raised hydraulically, said piston being mounted on said first frame at its lower end for a limited universal movement.

6. In a lift truck, the combination of a wheel supported chassis with a vertically extending load supporting frame carried by the front end of said chassis and arranged for tilting about a horizontal axis, said vertically extending frame comprising a pair of inwardly turned channelled members, each having a web and two side flanges, upper and lower frame members for securing said two channelled members together, said upper frame member being located outside of the channels, a second movable frame member comprising a second pair of outwardly facing channels rigidly joined together by an upper transverse frame member, roller means carried by the lower end of said second frame for engaging inside the first-mentioned channels against the two flanges and web thereof, and roller means carried by the upper ends of the first two mentioned channels for engaging inside the channels of the second frame against the web and two flanges of the channels thereof, whereby the second frame is guided for vertical movement with respect to the first frame, a hydraulic cylinder carried by the first frame and extending upwardly from a transverse frame member adjacent the bottom of the first frame, said cylinder having a piston engaging a part carried by the second, whereby the second frame may be raised hydraulically, said part comprising a U-shaped bracket carried by the upper frame member of the second frame, and said piston having a predetermined universal movement with respect to said bracket, said U-shaped bracket carrying a sheave pulley upon a shaft, a load carriage movably mounted upon said second frame, and a tension member extending over said pulley and having one end anchored to the first frame, the other end being secured to said carriage.

7. In a lift truck, the combination of a tiltable vertically extending load supporting frame with a carriage guided for movement longitudinally of said frame, said carriage comprising a pair of horizontal and a pair of vertical frame members, and said vertical frame members being each provided with a pair of rollers, one of said rollers being located at the top behind said tiltable frame, and the other of said rollers being located at the bottom in front of said tiltable frame, a transverse shaft carried by the upper part of said carriage frame, a pair of load carrying arms, each load carrying arm having a downwardly extending portion with a bore slidably mounted on said shaft and having a forwardly projecting load carrying arm at the lower end of said downwardly extending portion, said frame also having an auxiliary pair of end frame members and a centrally located frame member for supporting said shaft, and a single tension member for operating said carriage frame.

8. In a lift truck, the combination of a tiltable vertically extending load supporting frame with a carriage guided for movement longitudinally of said frame, said carriage comprising a pair of horizontal and a pair of vertical frame members, and said vertical frame members being each provided with a pair of rollers, one of said rollers being located at the top behind said tiltable frame, and the other of said rollers being located at the bottom in front of said tiltable frame, a transverse shaft carried by the upper part of said carriage frame, and a pair of load carrying arms, each load carrying arm having a downwardly

extending portion with a bore slidably mounted on said shaft and having a forwardly projecting load carrying arm at the lower end of said downwardly extending portion, said frame also having rollers extending through apertures in its vertical frame members for engaging said tiltable frame to guide the carriage thereon, and a single tension member for operating said carriage frame.

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