March 4, 1947. C. S. SCHROEDER 2,417,018

LIFTING MECHANISM FOR INDUSTRIAL TRUCK

Filed Sept. 23, 1942 3 Sheets-Sheet 1

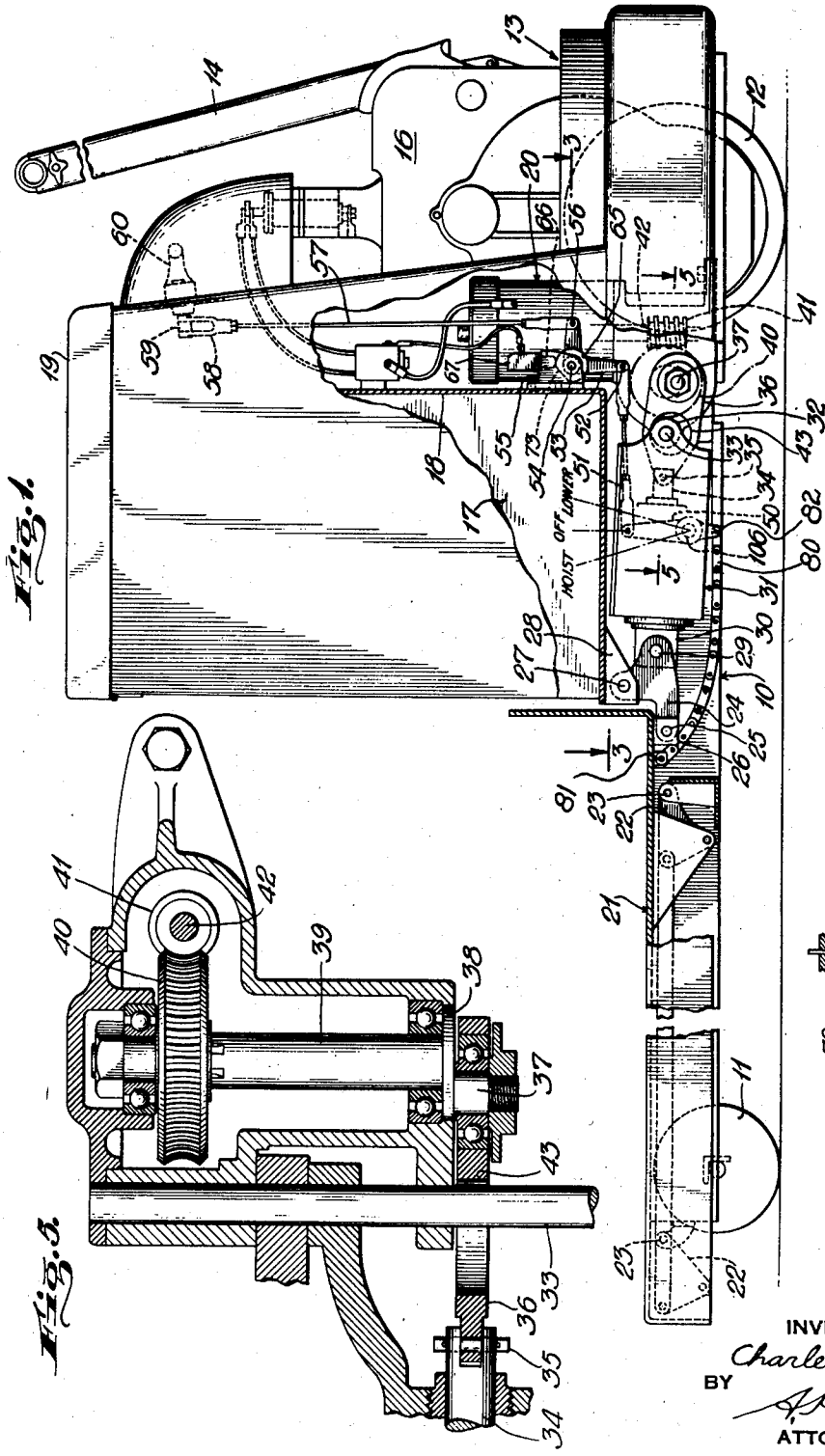


Fig. 1.

Fig. 3.

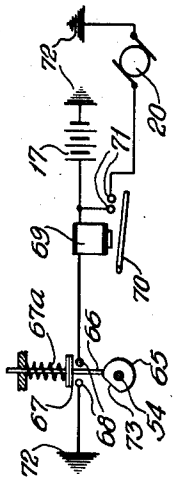


Fig. 4.

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Fig. 3.

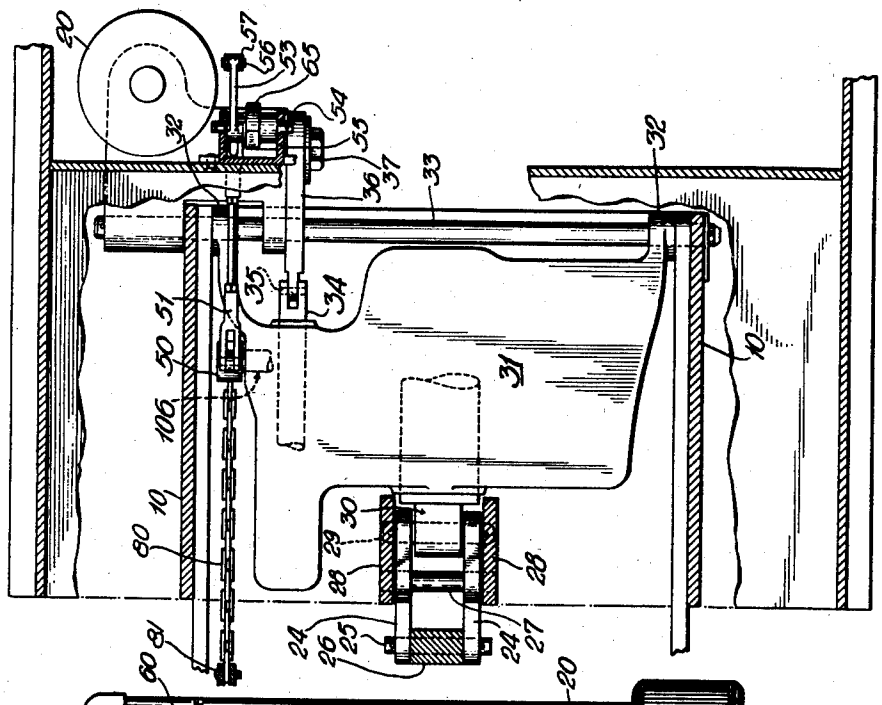
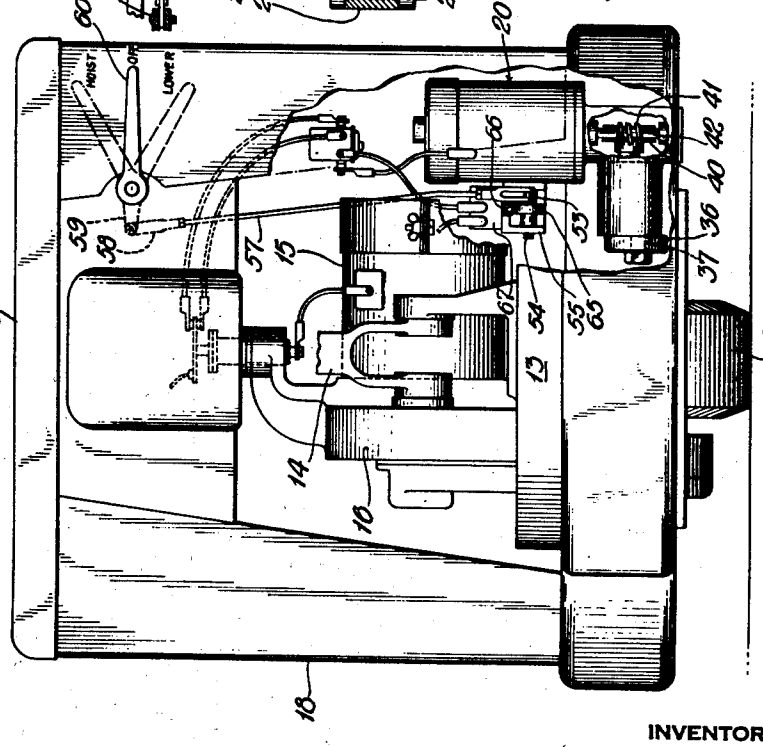


Fig. 2.



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Fig. 6.

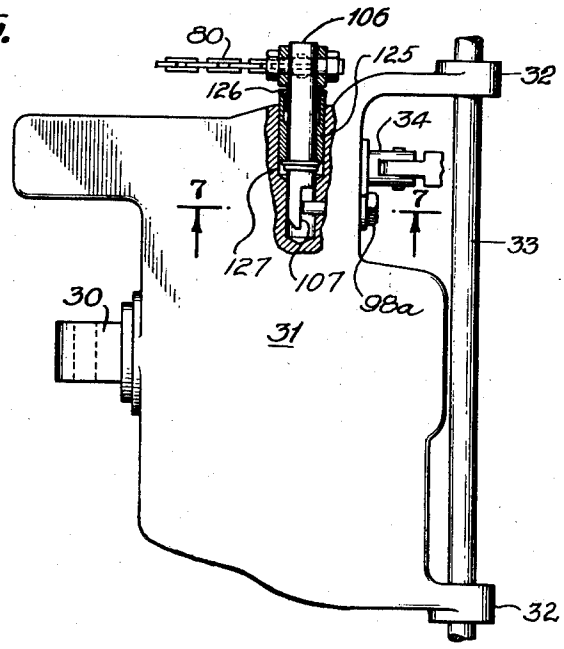
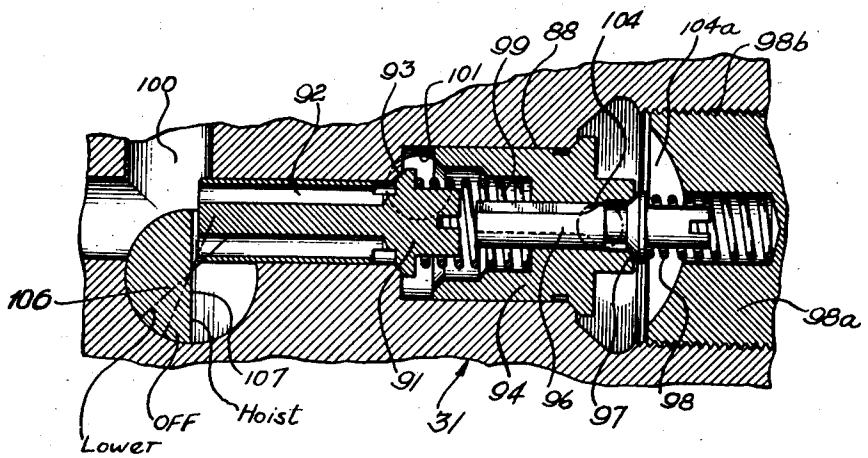


Fig. 7.



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2,417,018

LIFTING MECHANISM FOR INDUSTRIAL TRUCKS

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Application September 23, 1942, Serial No. 459,380

10 Claims. (Cl. 254—2)

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This invention relates to a lift truck and more especially a lift truck of the type in which an elevating platform is raised through the operation of a hydraulic lifting mechanism.

One feature of my invention embodies the utilization of a novel form of mounting for a hydraulic lift unit in a lift truck, the type of mounting that I have devised being especially useful in those lift trucks of the type in which the truck is hand steered and employs power driving mechanism, the power source for which is an electric storage battery. Thus, it is a feature of my invention that the hydraulic lift unit is mounted under the battery compartment and is pivotally secured between the main frame of the truck, or the lifting head as it may be called, and the elevating platform.

A further feature of my invention resides in novel means whereby the hydraulic pump of my hydraulic lift unit is actuated by a motor. This feature of my invention embodies means whereby a rigidly secured motor is adapted to reciprocate, through suitable means of connection, the pump of my hydraulic lift unit.

A further feature of my invention resides in control means whereby the motor that operates the pump is suitably controlled, and whereby the valves of the hydraulic lift unit are controlled.

The controlling means for the hydraulic lift unit are arranged for particular cooperation with a hydraulic lift unit of the type disclosed in the Quayle Patent No. 2,309,138, issued January 26, 1943. In the said patent there is disclosed in much detail a hydraulic lift unit utilizing a ram and a pump, the reciprocation of the pump being adapted to move the ram when the valves of the hydraulic unit are in a particular predetermined position. The valves of the hydraulic unit are so arranged that when placed in a second or intermediate position, the reciprocation of the pump will not effect the movement of the ram, but rather, the fluid will simply be moved back and forth between the ram and reservoir without in any way actuating the ram. The valves of the hydraulic unit are movable to a still further position in which the ram is adapted to be lowered, with the fluid flowing from in back of the ram into the reservoir.

For a full understanding of my valve mechanism and its construction, reference should be made to the Quayle patent supra. A sufficiently clear understanding of the valve mechanism and the controls exercised thereby will, however, be had from a reading of the specification of this application.

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In cooperation with the valve positioning means of my invention, I employ means for controlling the driving of the motor that actuates the pump of the hydraulic lift unit, and the particular relationship between the controls for the motor and the controls of the valves, is a basic and important feature of my invention.

I have thus described generally the more important features of my invention in order that the operation and construction thereof may be better appreciated after a reading of the specification that follows. Naturally, those skilled in the art will readily conceive variations of the structure that I shall describe without departing from the conception on which my structure is based. It is therefore important that I obtain claims that will prevent the appropriation of the conception of my invention by those skilled in the art.

Referring now to the drawings, Fig. 1 is a vertical view and partial section of a truck showing my invention embodied therein. Fig. 2 is a view of the front end of the truck of Fig. 1 while Fig. 3 is a view taken along lines 3—3 of Fig. 1. Fig. 4 is a schematic wiring diagram of the lift motor circuit of my truck. Fig. 5 is a partial section taken along lines 5—5 of Fig. 1 and illustrating particularly the means whereby the lift motor reciprocates the pump of the hydraulic unit. Fig. 6 is an enlarged view of the hydraulic lift unit with a portion thereof broken away. Fig. 7 is a view illustrating the valve mechanism actuated by the control shaft.

Referring now more particularly to the drawings, and especially Figs. 1 and 2, the main frame of my truck is designated by reference numeral 10, and in this case, is of that type which is supported at its rear end by wheels 11 and at its front end by wheels 12 forming part of a steering head 13. The truck is steered by a lever 14 that is pivoted to the steering head in the usual manner. The particular truck herein shown and described is of the motorized type in which a motor 15, best illustrated in Fig. 2, is adapted through certain gearing contained within the gear casing 16, to drive the steering wheel 12, all as is particularly well set forth in my earlier application for a Motorized lift truck, Serial No. 431,356, filed on February 18, 1942, now Patent No. 2,399,605, dated April 30, 1946.

For supplying power to the motor 15, I utilize a battery 17 mounted within a suitable metal compartment 18 having a lid 19 whereby access to the battery 17 may be had. This same battery 17 is utilized by me as a source of power for

a lift motor 20 that is used to reciprocate the pump of my hydraulic lift unit to be described shortly.

The elevating platform of my truck is designated by reference numeral 21, and is suitably pivoted through links 22 to the main frame 10 at points 23 so that pivotal lifting movement may be transmitted to the platform 21 relatively to the said main frame 10. For imparting lifting movement to the elevating platform 21 I employ a pair of duplicate links 24 that are pivoted at 25 to a bracket 26 secured to the elevating platform. The links 24 are pivoted at 27 to a bracket 28 on the main frame and are through a shaft 29 pivoted to the ram 30 of the hydraulic lift unit 31 all as is best shown in Fig. 3. It is now obvious that movement of the ram 30 to the left in Fig. 1, will effect the rotation of the links 24 so as to lift the elevating platform 21 on its links 22 relatively to the main frame.

The hydraulic unit 31, of which the ram 30 is a part, is itself best shown in outline in Fig. 3. There it will be noted that it is formed with ears 32 through which it is pivotally mounted on a shaft 33 extended horizontally across the main frame 10. It is thus perceived that the hydraulic unit is therefore pivotally mounted relatively to the main frame 10, and is also pivotally mounted relatively to the elevating platform 21, so that it may assume different pivoted positions relatively to the platform and main frame to more effectively lift the elevating platform.

The pump piston of the hydraulic lift unit is designated by reference numeral 34, and it is pivotally connected at 35 to a crank lever 36. This crank lever 36 is mounted for actuation on the eccentric pin 37 of a disk 38 that is keyed to the shaft 39 of a worm wheel 40 (Fig. 5). The worm wheel 40 is driven by the screw 41 at the end of the shaft 42 extending from the lift motor 20 (Fig. 1). The crank lever 36 is formed with an enlarged opening 43 whereby it is adapted to move freely relatively to the shaft 33 as it is reciprocated by the eccentric pin 37 incidental to the rotation of the motor 20 and motor shaft 42. It is obvious that reciprocating motion of the lever 36 effects the reciprocation of the pump plunger 34. Naturally, this reciprocation of the pump plunger is adapted to effect the movement of the ram 30 to lift the elevating platform when the valves of the hydraulic unit are in a predetermined position.

Referring now to Figs. 6 and 7, shaft 106 is shown supported through a bushing 125 and a stuffing box 126 for rotation relatively to a bore 127 formed in the hydraulic unit 31. The end of the shaft 106 is formed with a cam surface 107 adapted for moving a valve 91. This valve 91 is mounted within a bore 87 of the hydraulic unit 31 and has a series of longitudinal holes or passages 92 formed therein. Valve 91 is adapted to co-act with a valve seat 93 at the right hand end of the bore 87, and is held against this seat by a spring 99 that extends between it and a plug 94. Plug 94 is mounted within a bore 88 leading to the bore 87, and is adapted to house for sliding movement a further valve 96. Valve 96 is seated relatively to a valve seat 97 formed on the plug 94, and is held against this seat by a spring 98 held in position by an end plug 98a that is threaded into a threaded bore 98b of the hydraulic unit 31.

A passage 100 extends into communication with the valve bore 87 and itself leads from a reservoir formed in the hydraulic unit 31. A bore 101 extends into communication with valve bore 88 from the cylinder housing the pump piston 34. Through a further bore 104, communication is established between the cylinder of ram 30 and the chamber 104a. Thus, it may be said that in Fig. 7 the left end of the combined valve bore 87, 88 communicates with the reservoir, while the central portion communicates through bore 101 with the pump, and the extreme right hand end communicates through bore 104 with the ram.

I shall now explain the operation of the several valves thus described, it being reiterated that the operation is more particularly set forth in the Quayle patent, in which will be found the parts bearing the same reference numerals as are used to describe the parts of Fig. 7. It will be well to point out at this time that the functioning of my valves will be the same if a rotary or other type pump is utilized, but that I prefer a piston type pump. Upon the suction stroke of the pump piston 34, pressure against the valve 91 will naturally be relieved whereby to move it away from its seat at 93 against the force of spring 99, so that fluid will flow from the passage 100 through the holes 92 of the stem of valve 91 and through the passage 101 into the pump. At the beginning of the pumping stroke, the valve 91 will become seated at 93, and all of the pump pressure will be introduced against the end of the valve 96. This will unseat valve 96 relatively to its seat at 97 against the resistance of spring 98, whereby to force the fluid through the passage 104 into the ram cylinder whereby to move the ram 30 to lift the elevating platform. Through a series of strokes the ram will be moved to its completely extended platform elevating position.

If the shaft 106 is rotated into its dotted line position "off" of Fig. 7, the valve 91 will be moved off its seat at 93 so as to establish low pressure communication between the pump and the reservoir by bringing passages 101 and 100 into communication. Thereafter, actuation of the pump will have no effect whatsoever as the fluid will merely flow between the reservoir and the pump, and thus will be true regardless of the pump construction.

If shaft 106 is rotated to the position "lower" of Fig. 7, the right hand end of the valve 91 will impinge against the end of the valve 96 so as to move that valve off its seat at 97. Communication will then be established between the ram and the reservoir through the several valve passages because of the unseating of the valves 96 and 91 relatively to valve seats 97, 93 respectively, and the ram piston will move into a position corresponding to the lowered position of the elevating platform.

In my invention shaft 106 is adapted for rotation to its control position by a lever 50 (Fig. 1), that is pivoted to a compound rod 51 that is in turn pivoted at 52 to a bell crank lever 53. The bell crank lever 53 is pivoted through shaft 54 on a bracket 55. It is also pivoted at 56 to a substantially vertical rod 57 that is connected through a bifurcated part 58 to a lever 59 that extends away from a handle 60 as probably best seen in Figs. 1 and 2. In the position of the handle 60 in Figs. 1 and 2, the lever 50 holds the valve adjusting shaft 106 in what I term the "off" position. In this position, as above outlined, the valves are set so that activation of the pump effects no lifting of the ram. When the handle 60 is moved to the "hoist" position, it is obvious that the shaft 106 will be placed in the "hoist" position and that operation of the pump will then effect

lifting movement of the ram. When the handle 60 is in its "lower" position of Fig. 2, the shaft 106 will be rotated to position the valves as described earlier so that the ram will lower with the platform 21, all as is now quite apparent.

The motor 20 that effects the reciprocation of the pump plunger 34 as already described, is so controlled that when the handle is in its "off" position or in its "lower" position, the motor will be de-energized and will be maintained stationary. On the other hand, when the handle 60 is in its "hoist" position, the motor will be energized. It is important to know that should the handle be placed in its "off" position and should the motor 20 be energized accidentally, the reciprocation of the pump will not effect the movement of the ram, because the valves will have been placed in the position wherein the reciprocation of the pump will merely cause an idling movement of the fluid back and forth between the pump and reservoir as has been set forth.

The electric circuit of the motor is controlled by a circuit making cam 65 keyed to the shaft 54, and therefore adapted for movement integrally with the bell crank 53 as the bell crank is rotated by the handle 60. The cam 65 cooperates with a pin 66 of the spring pressed contact member 67 as best illustrated diagrammatically in Fig. 4. Ordinarily, the member 67 is depressed by the spring 67*a* so as to maintain closed a circuit at points 68. With the circuits at 68 closed, current will flow through the relay 69 from the battery 17. The relay 69 will exert a force on its armature 70 effecting a closing of a circuit at points 71. Current will now flow from the battery 17 through the circuit at points 71, and through the motor 20 to the ground 72, all as is quite apparent.

The controlling circuit at points 68 will be closed by the member 67 only when the flat portion 73 of the cam 65 is below the pin 66. The flat 73 will only be below the pin 66 when the handle 60 is rotated to "hoist" position. The high portion of the cam 65 will be opposite the pin 66 at all other times, this being the position of the parts in Figs. 1, 2 and 4, and will maintain the motor circuit open when the handle 60 is in the "off" and "lower" positions.

I believe it will be now obvious that the rotation of the handle 60 into the three positions set forth, will effect the closing and opening of the circuit of the motor 20 and the movement to corresponding desired positions of the valves of the hydraulic lift unit by the shaft 106, all as has been described.

It will also be quite obvious that only when the circuit of the motor 20 is closed, and the valves are properly closed will the platform of the truck be elevated.

For limiting the operation of the motor 20 and the hydraulic lift unit, I provide a novel form of limit means. Thus, a chain 80 is secured at 81 to the platform 21 and at 82 to the lever 50. When the platform is fully elevated, it is obvious that the chain 80 will act on the lever 50 to place the parts in the "off" position, thus simultaneously stopping the operation of motor 20 and placing the valves of the hydraulic unit in non-lifting position. It is important to note that even if the switch mechanism were to fail to break the circuit of the motor, the mere positioning of the valves would protect the truck against damage by continued operation of the hydraulic lift unit. It is also important to note that in describ-

ing and claiming my invention I indicate that the valves are positioned simultaneously with the positioning of the switch mechanism of the motor. The word simultaneously as thus used, needs qualification, because it is probably not possible, nor is it necessary that the valves be positioned at the exact moment that the circuit at 68 is closed. Those skilled in the art will fully appreciate the nature of my contribution to the art.

I now claim:

1. In a truck of the class described having a main frame, an elevating platform mounted for lifting movement relatively to said main frame, a battery compartment at the forward end of said main frame and having a battery therein, a shaft secured horizontally across the main frame of the truck substantially under said battery compartment, a hydraulic lift unit having a ram, means pivoting said hydraulic unit on said shaft for support on said shaft under said battery compartment and with its ram extending substantially horizontally toward said elevating platform, an electric motor for actuating said hydraulic lift unit adapted to be energized from said battery, and means pivotally connecting said ram relatively to said elevating platform for lifting said platform relatively to said main frame.

2. In a truck of the class described having a main frame, an elevating platform mounted for lifting movement relatively to said main frame, a battery compartment at the forward end of said main frame and having a battery therein, a shaft secured horizontally across the main frame of the truck substantially under said battery compartment, a hydraulic lift unit having a pump and a ram, means pivoting said hydraulic unit on said shaft for support on said shaft under said battery compartment and with its ram extending substantially horizontally toward said elevating platform, means pivotally connecting said ram relatively to said elevating platform for lifting said platform relatively to said main frame, a motor for operating the pump of said hydraulic lift unit adapted to be energized from said battery, a crank lever pivoted at one end to said pump, motor driven means pivoted to the other end of said crank lever, and said crank lever having a relatively large opening through which said shaft traverses and whereby said lever may reciprocate relatively to said shaft without interference therefrom.

3. In a truck of the class described having a main frame, an elevating platform mounted for lifting movement relatively to said main frame, a battery compartment at the forward end of said main frame and having a battery therein, a shaft secured horizontally across the main frame of the truck substantially under said battery compartment, a hydraulic lift unit having a pump and a ram, means pivoting said hydraulic unit on said shaft for support on said shaft under said battery compartment and with its ram extending substantially horizontally toward said elevating platform, means pivotally connecting said ram relatively to said elevating platform for lifting said platform relatively to said main frame, a motor fixed to said main frame forwardly of said battery compartment and adapted to be energized from said battery, and means extending downwardly from said motor into connection with the pump of said hydraulic lift unit.

4. In a truck of the class described having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said

main frame, a pump, and valves for rendering said pump effective and ineffective to lift said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, manually operated means connected by mechanical linkage to said valves and to said control switch for positioning said valves and for simultaneously positioning said control switch, said manually operated means in one position positioning said control switch to energize the motor to operate said pump while simultaneously positioning said valves for lifting said ram, said manually operated means in a second position positioning said control switch to stop said motor while positioning said valves so that the pump is ineffective to lift said ram, said manually operated means in a third position positioning said control switch to stop said motor while positioning said valves so that the ram may be lowered, and means connecting said platform to said manually operated means whereby said platform when fully lifted, moves said manually operated means to said second position.

5. In a truck of the class described having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said main frame, a pump, and valves for rendering said pump effective and ineffective to lift said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, and manually operated means connected by mechanical linkage to said valves and to said control switch for positioning said valves and for simultaneously positioning said control switch, said manually operated means when in a central position positioning said control switch to stop the motor while simultaneously positioning said valves so that the pump will not lift the ram, said manually operated means when moved to one side of said central position positioning said control switch to energize said motor while positioning said valves so that the pump is effective to lift said ram, means connecting said platform to said manually operated means whereby said platform when fully lifted, moves said manually operated means to said position at one side of said central position, said manually operated means when moved to the other side of said central position positioning said control switch to stop said motor while positioning said valves to allow lowering movement of said ram.

6. In a truck of the class described having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said main frame, a pump, and valve means for rendering said pump effective and ineffective to lift said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, control means for positioning said control switch to energize the motor to operate said pump while positioning said valve means for lifting of said ram, and for positioning said control switch to stop said motor while positioning said valve means so that the pump is ineffective to lift said ram, and for positioning said control switch to stop said motor while positioning said valve means to allow lowering movement of said ram independently

of said pump and motor, and means connecting said control means to said platform whereby said platform when fully lifted moves said control means to position said valve means so that said pump is ineffective to lift said ram.

7. In a truck of the class described having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said main frame, a pump, and valve means for rendering said pump effective and ineffective to lift said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, control means for positioning said valve means and for simultaneously positioning said control switch, said means in one position positioning said control switch to energize the motor to operate said pump while simultaneously positioning said valve means for lifting said ram, said control means in a second position positioning said control switch to stop said motor, said control means in a third position positioning said control switch to stop said motor while positioning said valve means to allow lowering movement of said ram independently of said pump and motor, and means connecting said control means to said platform whereby said platform when fully lifted moves said control means to position said valves so that said pump is ineffective to lift said ram.

8. In a truck of the class described having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said main frame, a pump, and valve means for rendering said pump effective and ineffective to lift said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, means for positioning said valve means and for simultaneously positioning said control switch, and means connecting said platform to said means.

9. In a truck of the class described having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said main frame, a pump, and valve means for rendering said pump effective and ineffective to lift said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, means for positioning said valve means and for simultaneously positioning said control switch, said means in one position positioning said control switch to energize the motor to operate said pump while simultaneously positioning said valve means for lifting said ram, said means in a second position positioning said control switch to stop said motor while positioning said valve means so that the pump is ineffective to lift said ram, said means in a third position positioning said control switch to stop said motor while positioning said valve means to allow lowering movement of said ram, and means connecting said platform to said means whereby said platform when fully lifted moves said means to said second position.

10. In a truck of the class described, having a main frame, an elevating platform, a hydraulic lift mechanism of the type having a ram for lifting said elevating platform relatively to said main frame, a pump, and valve means for rendering said pump effective and ineffective to lift

said ram when said pump is operated and for allowing lowering movement of said ram, an electric motor for operating said pump, an electric control switch for said motor, means for positioning said control switch, means for positioning said valve means, manually operated means connected to both said positioning means for operating both said means simultaneously, and means of connection between said elevating platform and said manually operated means for actuating said manually operated means to stop said motor and to position said valve means so that said pump is ineffective to lift said ram when said elevating platform has been lifted by said ram to a predetermined position, even though said motor continues to operate.

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