

Oct. 31, 1939.

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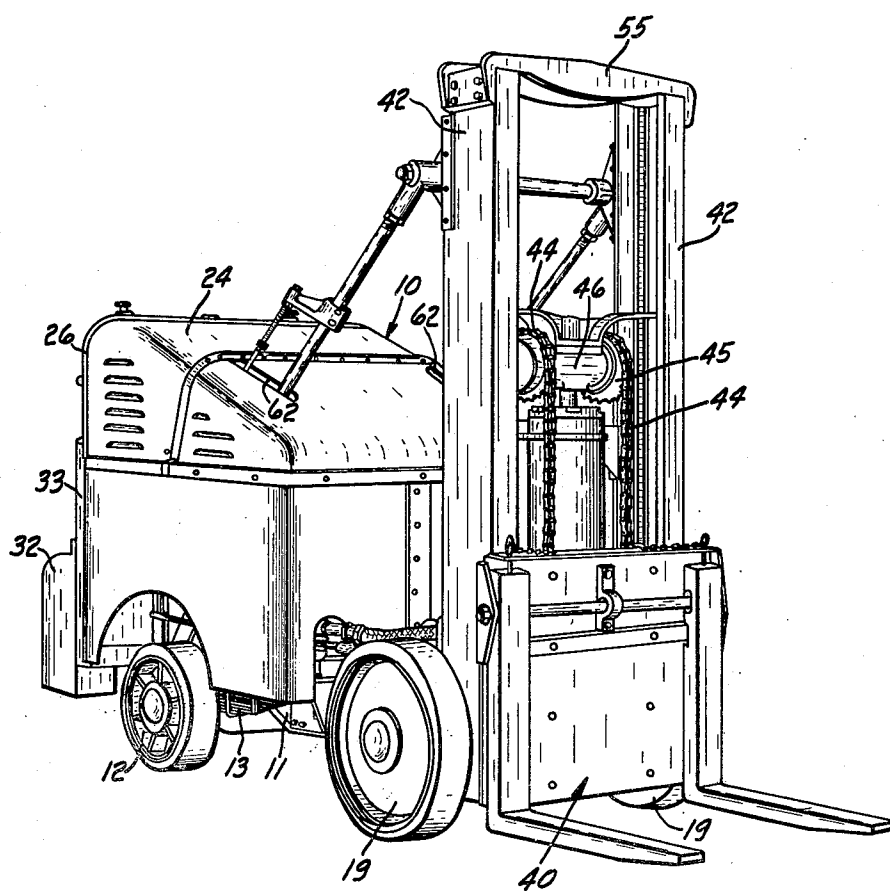
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INDUSTRIAL TRUCK

Filed Feb. 16, 1938

5 Sheets-Sheet 1

FIG. 1.



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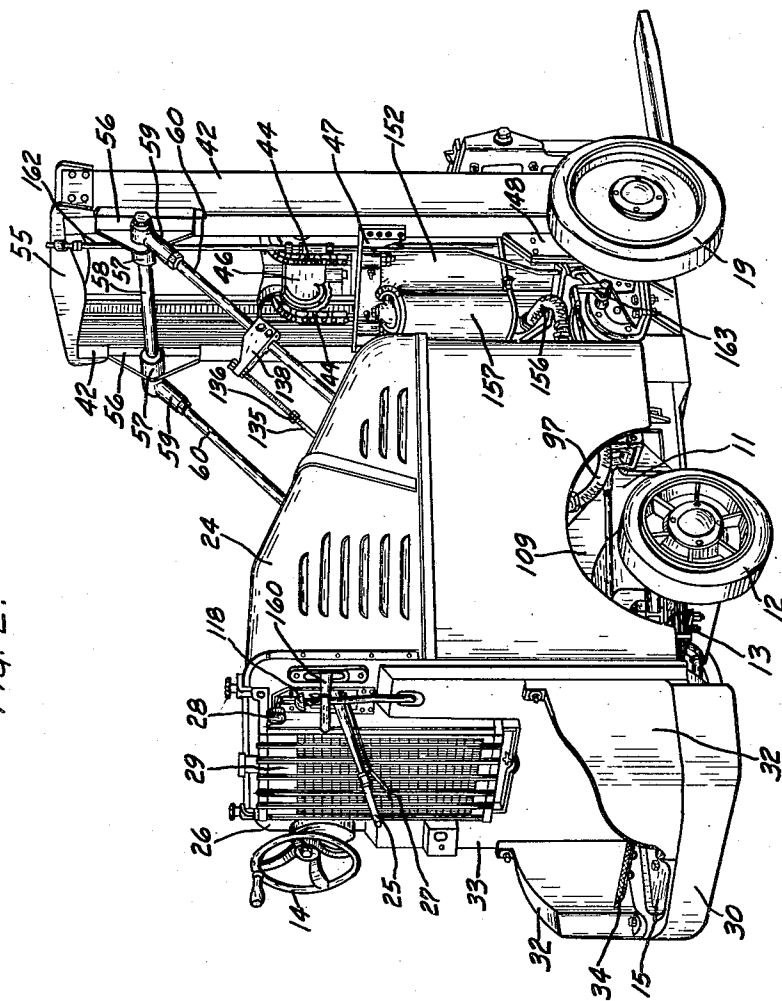
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INDUSTRIAL TRUCK

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FIG. 2.



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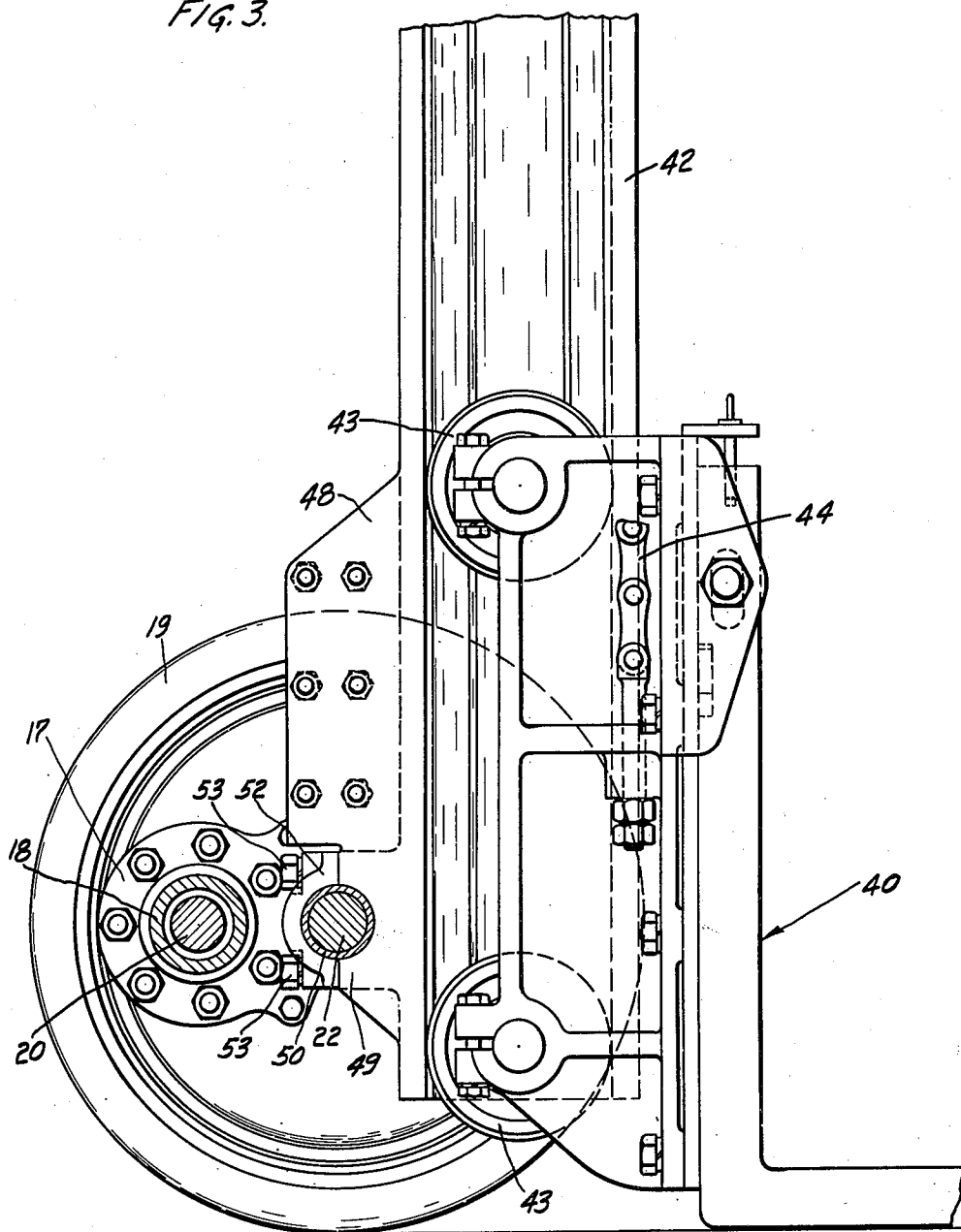
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INDUSTRIAL TRUCK

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5 Sheets-Sheet 3

FIG. 3.



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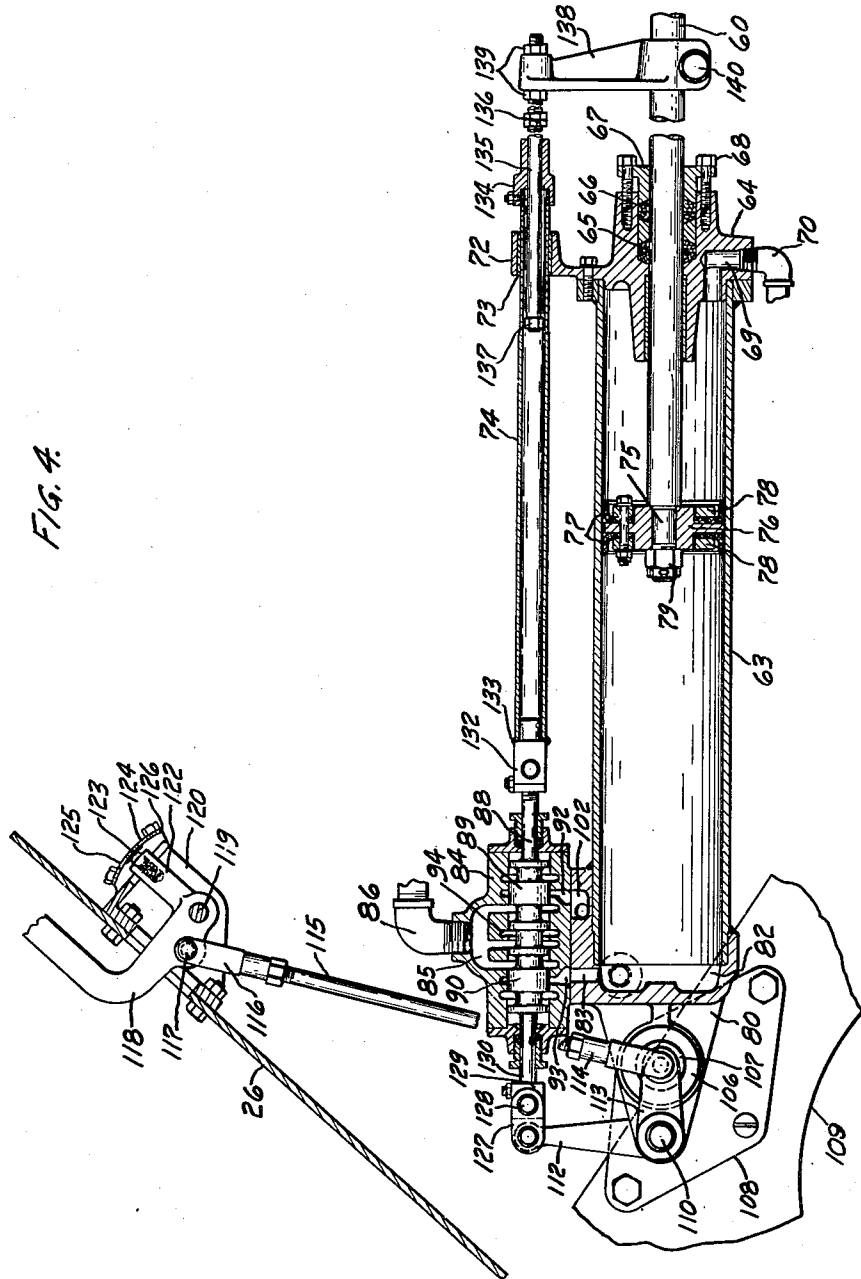
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INDUSTRIAL TRUCK

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5 Sheets-Sheet 4



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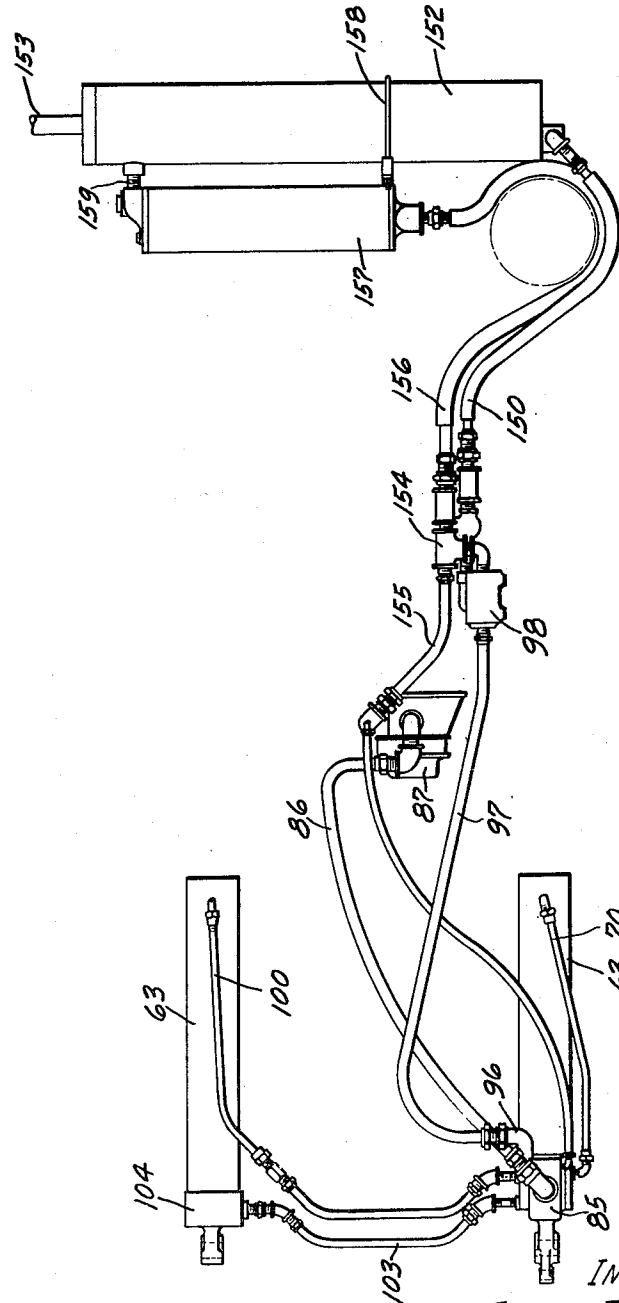
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INDUSTRIAL TRUCK

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5 Sheets-Sheet 5

FIG. 5.



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UNITED STATES PATENT OFFICE

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INDUSTRIAL TRUCK

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Application February 16, 1938, Serial No. 190,714

13 Claims. (Cl. 214—65)

This invention relates to industrial trucks, and more particularly is directed to an industrial truck of the high lift type for use in shops, warehouses, loading docks and the like. This type of truck is especially adapted for material handling service and for storing and tiering material or stock in industrial and mercantile establishments.

The present application is a continuation in part of my copending application, Serial No. 179,273, filed December 11, 1937.

In the preferred form of the present invention, I employ a gasoline powered tractor or truck unit capable of rendering continuous service without the necessity of recharging or replacing batteries or the like as is the case with electrically powered units.

One of the main advantages of the construction disclosed herein is the provision of a standard power plant chassis and frame in which the load-carrying mechanism and guides therefor can be quickly and easily mounted or dismounted from the frame without the necessity of disturbing any portion of the power plant of motive parts of the vehicle.

The present invention is capable of use in either a straight lifting and tiering unit or with a telescoping tiering unit employed for extremely high lifting, and while the straight unit is illustrated and described herein, it is to be understood that the present invention is equally applicable to the telescoping type of unit shown in my copending application, Serial No. 211,746, filed June 4, 1938.

It is extremely desirable, in certain situations where odd shaped material or stock is being handled, or where relatively long hauls are required, to provide means for tilting the load supporting carriage in order to insure stability of the load during transport thereof, and also to allow ready removal of the load when it has reached the desired destination.

One of the primary features of the present invention is the provision of a tilting type of upright structure which is hydraulically actuated, and which is under the instant control of the operator for tilting the load-supporting means either forwardly or rearwardly at any time whether the load carriage itself is stationary or is being raised or lowered, and regardless of whether or not the vehicle is in motion.

Another distinct advantage of the present invention resides in the provision of a construction in which means is provided for automatically returning the tilt control mechanism to inoperative position whenever the tilting means has reached

either of its limiting positions. By reason of this arrangement, it is impossible for the load-supporting means to move past a safe tilting position if the operator should leave the vehicle with the tilt control mechanism moved into one of its operative positions, since the tilting means automatically restores the tilt control mechanism to inoperative position when it reaches either of its limiting positions. This is also desirable so that it is unnecessary for the operator to judge where the tilting mechanism should be stopped as the stopping is automatically accomplished by the tilting means.

Still another feature of the present invention is the provision of hydraulically actuated means pivotally supported on the power plant and capable of actuating the tilting mechanism in such manner that the thrust is always transmitted in a straight line to the thrust members connected to the load-supporting means.

Still another feature of the present invention resides in the provision of a single control valve for controlling a pair of hydraulic pistons to actuate the tilting means, the valve being actuated from a remote point by a control lever projecting through the dash-board forming part of the operator's compartment. The valve is of the balanced pressure type and is retained in any of its actuated or neutral positions by a balancing of pressures thereon so that there is no tendency for the valve to move from any of its shifted positions due to unbalanced pressures thereon.

In this connection I provide a fluid pressure pump adapted to be constantly operated whenever the motor of the vehicle is running, and which is so connected to the tilt actuating means and to the load raising and lowering means that the operator is enabled to effect simultaneously tilting of the supporting uprights at the same time that the load as being raised or lowered, and can start or stop either of these operations without affecting the other. The hydraulic means for raising and lowering the load-supporting carriage is also automatically controlled so that the actuating means is returned to neutral position whenever the load-supporting carriage reaches any of its limiting positions.

Another feature of the present invention is the simple design of stop mechanism for controlling the tilt actuating means, and which is carried by the tilting mechanism and can be adjusted with respect thereto so that any desired degree of tilting in either a forward or rearward direction is obtainable.

In the preferred form of the present invention the cylinders containing the tilting pistons are mounted for pivotal movement on opposite sides of the power plant and swing about these pivots as the angle of the piston rods changes due to the change of angularity of the supporting up-
 5 rights. Thus, a straight line thrust is always produced directly upon the pivot bearings of the tilting means and no off-center or angular thrusts are thereby produced.

Other objects and advantages of the present invention will appear more fully from the following detailed description, which, taken in conjunction with the accompanying drawings, will
 15 disclose to those skilled in the art the particular construction and operation of a preferred form of the present invention.

In the drawings:

Figure 1 is a front perspective view of a vehicle embodying the present invention;

Figure 2 is a rear quarter perspective view of the vehicle shown in Figure 1;

Figure 3 is a side elevational view partly in section, showing the mounting of the load sup-
 25 porting means on the front supporting axle spindles;

Figure 4 is a sectional view through one of the tilting cylinders showing the actuating or control mechanism therefor; and

Figure 5 is a diagrammatic view showing the hydraulic connections from the fluid pressure pump to the tilting means and to the load raising and lowering means.

Referring now in more detail to the drawings, I have shown in Figure 1 an industrial truck indicated generally at 10 having the frame 11, which at the rear end thereof is provided with the wheels 12 mounted on suitable spindles for steering movement, explained in my above-mentioned
 40 copending application Serial No. 179,273. The wheel spindles are secured to the frame 11 by means of the leaf springs 13 in any desired or suitable manner, and steering movement of the wheels is controlled by means of the hand wheel
 45 14 mounted above the operator's platform 15.

Adjacent its forward end the frame members of the vehicle extend forwardly to provide a support for the differential housing indicated at 17 in Figure 3, and from the housing, suitable housing arms 18 extend transversely toward the opposite front driving wheels 19. Axle shafts 20 in the housing arms are adapted to carry at their ends suitable pinions which mesh with internal ring gears carried by the wheels 19 for rotating
 55 these wheels about the dead axle stub shafts 22, also carried by and rigidly secured in the axle housing.

The wheels 19 are non-dirigible, and effect driving of the vehicle in either a forward or reverse direction under the control of the operator through suitable transmission means connected to the internal combustion engine carried within the hood 24. The forward and reverse driving of the vehicle is effected by means of the control lever 25 extending through the dash-
 65 board 26 at the forward portion of the operator's compartment, which lever is vertically movable for engaging suitable clutch means and is laterally shiftable in lowered position for selecting the desired direction of movement of the vehicle.

The lever 25 is also provided with a throttle control member 27 for varying the speed of the motor, and suitable gear shifting means within the transmission is controlled by the gear shift
 75 member 28. Preferably, a vehicle of this type

is provided with a two-speed transmission which is effective for either forward or reverse movement, and the vehicle can be easily operated in either direction. The radiator for the engine is indicated at 29, and is provided with a suitable
 5 guard or grill protecting the operator.

Inasmuch as the center of the load is supported forwardly of the front wheels 19, it is desirable to provide some counter-weighting means to overcome the overturning couple pro-
 10 duced by the load.

In the preferred form of the invention I provide suitable counter-weighting means comprising heavy metal castings such as the casting 30, forming the base of the operator's platform and
 15 the side flange castings 32 which provide additional weight and also serve as guards for the operator in turning corners and the like. In addition to this, a heavy plate 33 may be provided on the outer face of the dash-board 26.
 20 Within the operator's platform there is provided a pivoted brake lever 34 which is normally in raised position with the brake seat but is adapted to be moved downwardly by the operator when he stands on the platform to release
 25 the brake for driving engagement. With such an arrangement it is readily apparent that if the operator should be accidentally knocked from the platform or should leave the same for any reason, the brake will be automatically set, and
 30 consequently the vehicle will be restrained against movement. Preferably, a transmission band brake of the external contracting type is provided which is hydraulically moved to open
 35 position when the operator steps upon the lever 34, and which is returned to closed position by means of heavy springs.

The load supporting carriage, indicated generally at 40, is mounted for vertical sliding movement within the transversely spaced channel
 40 members or uprights 42, which form suitable guideways for the rollers 43 carried by the carriage 40. Suitable chain members 44 are secured at one end to the carriage, and are trained over
 45 sprocket wheels 45 carried by a cross-head 46 and at their opposite ends are secured to the cross member 47 secured across the rear of the uprights 42. At their lower ends, the uprights are provided with bracket members 48 secured
 50 to their rear faces, which bracket members have journal portions 49 formed thereon adapted to engage about a portion of the thrust bearings 50 carried on the axle spindles 22. The uprights are secured for rotation on the bearings 50 by means
 55 of the bearing cap 52 bolted or otherwise suitably secured to the portion 49 of the bracket 48 by means of the bolts 53. This provides for rotatable movement of the uprights about the axis of the spindles 22 as a center.

At their upper ends the uprights 42 are connected together by the cross member 55, which thereby holds the uprights in fixed spaced relationship to provide accurate guiding and supporting means for vertical movement of the carriage
 60 40. Immediately below the cross member 55 the uprights 42 are provided with brackets 56 secured to the rear faces thereof, and provided with suitable flange portions having bosses 57 in which is
 65 journaled a cross shaft 58 projecting through the flanges and connected at its ends to the arms 59 into which the upper ends of the tilt rods 60 are secured and locked by means of suitable lock nuts.
 70 The plunger rods 60 extend downwardly through suitable slots 62 formed in the forward portion of the hood 24, and extend into the upper ends of 75

tilt cylinders 63 shown more clearly in Figure 4.

The cylinders 63 at their upper ends are provided with the closure caps 64 which are suitably recessed to receive sealing means 65 and 66 held in position by the packing gland member 67 secured thereto by means of the cap screw 68. The cap 64 is provided with a passageway 69 formed therein, which communicates with the upper end of the cylinder 63 and which is adapted to receive the conduit 70 threaded therein. Opposite the port 69 the cap 64 is provided with a lateral extension terminating in an apertured boss or sleeve 72 and a suitable bearing sleeve 73 therein for forming a guide for the tube 74 forming part of the stop means.

At its lower end the plunger rod 60 is provided with a reduced portion 75 adapted to receive the flanged collar 76 to which is secured the oppositely directed cup leathers 77 fixed thereto by means of the rings 78 secured to the flange portion of the collar 76 by means of suitable bolts or the like. The threaded end of the reduced portion of the rod 60 is adapted to receive a nut 79 for securing the collar 76 against axial movement and for locking the piston assembly thereto.

At its lower end the cylinder 63 is provided with a closure member 80 which has a recess portion 82 forming with the passageway 83 communication with the lower end of the cylinder 63. The member 80 may be welded or otherwise suitably secured over the end of the cylinder 63, and is provided with a machined surface adapted to receive the tilt control valve 84.

This valve is of the balanced pressure type, and has an inlet port 85 connected through the conduit 86 to a fluid pressure pump 87 driven by the motor mounted within the hood 24 in any suitable manner, such as described in my above-mentioned copending application.

With the valve in the position shown with the valve plunger 88 having the enlarged cylindrical portions 89 and 90 thereof disposed in position to close the ports 92 and 93, respectively, no fluid under pressure is being admitted to either end of either of the cylinders 63. However, due to the connection from the outlet port 94, which remains open to the inlet port 85 regardless of the position of the valve plunger, fluid under pressure can be transmitted through the connection 96 secured to the valve body 84 and communicating with the port 94, and thence through conduit 97 to the lift valve structure 98 which controls the load supporting carriage 40.

It will be noted from Figure 5 that the cylinders 63, which are mounted on the frame at opposite sides of the engine within the hood 24, are cross connected, the upper ends of the cylinders being connected through the conduit 70 and the conduit 100, respectively, to the port 102 in the member 80, which port communicates through the passageway 92 with the interior of the valve body 84. The lower ends of the cylinders are adapted to receive fluid under pressure through the ports 93 and 83, and through the cross conduit 103 extending to a cap member 104 secured to the left hand cylinder 63. It will be noted that only one of the cylinders is provided with a valve such as the valve 84, but the cross connections between the respective ends of the cylinders provided by the conduits 70, 100 and 103 insure that both cylinders will receive fluid under pressure equally upon operation of the valve.

Each of the end caps 80 and 104 are provided with rearwardly extending projections forming cylindrical bosses 106, which are adapted to be ro-

tatably mounted on trunnions 107 formed on brackets 108 secured to the side 109 of the upwardly arched rear portion of the frame 11. Upon the bosses 106, the member 80 is provided with a rearward extension carrying a pin 110 on which is mounted the bell crank 112, one arm 113 of which is adapted to receive the clevis 114 connected through the rod 115 to a similar clevis 116. The clevis 116 is connected to a pin 117 carried by the lower end of a lever 118 which extends through the instrument panel 26, as shown in Figure 1, and which, at its opposite end is pivoted on the pin 119 carried by the bracket 120 which is secured to the panel in any suitable manner. A suitable boss 122 on the arm 118 is adapted to carry a spring pressed ball 123 which holds the lever in either of its actuated positions by engagement in the recesses 124 and 125 carried by the arcuate plate 126 supported on the bracket.

The arm 112 of the bell crank is connected at its free end to a pair of links 127, which at their opposite end are secured by a pin 128 carried by a block member 129 secured to the extending end 130 of the plunger 88. The opposite end of the valve plunger 88 is connected by means of the clamp 132 threaded or otherwise suitably secured thereto to the tube 74 which is welded to the clamp as indicated at 133. The tube 74 is supported at its opposite end in the sleeve 72, and is provided with a suitable bearing guide 134 at its free end in which the control rod 135 is mounted for reciprocatory movement. The rod 135 is provided with a pair of nuts 136 which may be adjusted longitudinally of the rod in such a manner that when the plunger rod 60 reaches its inner limiting position the nuts 136 abut against the guide 134 and push the tube 74 longitudinally to move the valve plunger 88 to the neutral position as shown in Figure 4.

The rod 135 has a nut 137 at its inner end which, when the plunger rod 60 moves to its outer limiting position, engages the end of the tube 74 to move the tube longitudinally to the right as shown in Figure 4, and thereby restore the plunger 88 to the neutral position from an actuated position in which the portion 90 of the plunger has uncovered the port 93.

The rod is secured at its outer end to a bracket 138 by means of nuts 139, the bracket 138 being adjustably secured to the plunger rod 60 by means of the split clamp and nut 140. Thus the bracket may be positioned to provide for predetermined return of the plunger valve to neutral position when the plunger rod reaches its outer limiting position, and the adjustment of the nuts 136 will limit the inward movement of the plunger rod. Thus, any predetermined degree of tipping of the uprights may be effected, but in practice I find that a 5 or 6 degree forward tilt is sufficient for picking up articles on the floor by moving the fingers thereunder, while a rear tip of 10 to 15 degrees is sufficient for holding the load in proper position for transporting the same by means of the truck. It will be noted that the uprights rock about the spindle 22 during tilting movement, and consequently the load is always supported on these spindles regardless of the position of the uprights. It will also be noted that the plunger cylinders rotate as the plunger rods 60 moves inwardly and outwardly thereof to accommodate the angular movement of these rods produced by their connection to the uprights. Consequently, a straight line thrust is always effected and the rods 60 are never subjected to any bending action.

When it is desired to tilt the uprights forwardly the lever 118 is rocked in a clockwise direction about the pivot 119, and consequently produces a rearwardly pull of the extension 130 of the valve plunger. This moves the plunger to the left as seen in Figure 4, placing the port 93 in communication with the inlet port 85 and admitting fluid under pressure to the lower end of each of the cylinders 63. As the rods 80 move outwardly of the cylinders, the nut 137 on the rod 135 engages the end of the tube 74 and pulls the same to the right, thereby restoring the lever to the neutral position by depressing the ball 123 from the recess 124.

When it is desired to tilt the uprights rearwardly, the lever 118 is rocked in a counterclockwise direction and moves the valve plunger 88 in such position as to place the port 92 in communication with the inlet port 85. As a result, fluid under pressure passes to the upper end of each of the cylinders to the conduits 70 and 100. Upon the rods 80 moving to their inner limiting position, the nuts 136 engage the bracket 134 and restore the valve to neutral position.

With such a construction it will be apparent that the operator may actuate the lever 118 and then leave the machine unattended, but the stop means will positively prevent movement of the uprights past a predetermined limiting position in either direction.

The mechanism is so designed that the uprights can be tilted in either direction from any intermediate position without requiring any predetermined sequence of movement.

The lifting mechanism has been described in detail in my copending application referred to above, and it is not believed necessary to describe the same fully herein. Suffice it to say that the control valve mechanism indicated at 98 in Figure 5 is connected through the conduit 150 to the lower end of the lift cylinder 152 which is supported between the uprights 42 as shown in Figure 2, and which at its upper end has the plunger 153 projecting therefrom upon which the cross head 46 is mounted. Upon operation of the valve 98, fluid under pressure is admitted to the lower end of the cylinder and raises the piston rod 53 which, through the sprocket wheels and chains, effects raising of the load supporting carriage 40. When it is desired to lower the load supporting carriage, the valve 98 is operated to a position cutting off the flow of fluid under pressure to the conduit 150, and in turn connecting the valve with the T connection 154 which has one line 155 leading to the low pressure side of the pump 87 and has the opposite line 156 connected to the lower end of the reservoir 157 which is supported by means of the band 158 on the rear of the cylinder 152. From the reservoir 160 the fluid passes through the connection 159 into the upper end of the cylinder 152, and fluid from beneath the piston is transmitted through the conduit 150 and valve 98 back to the low pressure side of the pump.

The valve 98 is controlled by means of the lever 160 extending through the dash of the vehicle, and which is raised to effect movement of the valve 98 in one direction and lowered from a neutral position to effect movement of the valve in the opposite direction. A suitable control member 162 is carried by the uprights and is adapted to be engaged by the cross head for effecting actuation of a rock lever 163 shown in Figure 2, which in turn restores the valve 98 to

neutral position when the cross head reaches either its upper or lower limiting position.

It is therefore believed apparent that I have provided an industrial truck in which the uprights are adapted to tilt about a load supporting axis under the control of hydraulically actuated tilting mechanism, which has predetermined limiting positions and is provided with suitable stop means for restoring the mechanism to neutral position upon the uprights reaching either of their limiting positions. The hydraulic cylinder arrangement with the valve mounted thereon, and with the cylinders trunnioned for swinging movement in order to obtain a direct line of thrust results in a very efficient structure which is simple in design and operation.

I am aware that various changes may be made in certain of the details herein shown and described, and I therefore do not intend to be limited except as defined by the scope and spirit of the appended claims.

I claim:

1. In an industrial truck, a truck frame, means at the forward end of said frame including a drive axle assembly, wheels rotatably mounted on dead axle spindles and driven from said assembly, a pair of uprights at the forward end of said frame detachably mounted on said spindles adjacent said wheels and rotatable thereabout, an engine supported at the rear end of said frame, trunnions secured to the rear portion of said frame on opposite sides of said engine, tilt cylinders journaled at one end for rotation on said trunnions, plungers in said cylinders having extending rods pivotally connected directly at their outer ends to the rear of said uprights adjacent the top thereof, and means driven by said engine for simultaneously actuating said plungers to tilt said uprights about said spindles.

2. In an industrial truck, a frame having an upwardly arched rear portion, an engine mounted in said arched portion, a drive axle assembly at the forward end of said frame driven from said engine including a pair of axle spindles having drive wheels rotatably mounted thereon, a pair of uprights rotatably mounted at their lower ends on said spindles, trunnions secured to the arched portion of the frame on opposite sides of the engine, tilt mechanisms pivotally mounted at one end on said trunnions and pivotally connected at the opposite ends thereof to the rear faces of said uprights, said mechanism forming straight line thrust members between said pivotal frame mountings and said uprights and means driven from said engine for lengthening and shortening said tilt mechanism to rock said uprights about said spindles.

3. The combination of claim 2 further characterized in the provision of means responsive to predetermined movement of said mechanism for stopping further movement of said mechanism in the same direction.

4. In an industrial truck, a frame, uprights rotatably journaled at their lower ends on one end of said frame, a fluid pressure developing pump adjacent the opposite end of said frame, a pair of cylinders journaled for vertical swinging movement on opposite sides of said frame at said opposite end thereof, tilt rods pivotally connected to the upper ends of said uprights and extending into said cylinders, valve means on one of said cylinders for selectively admitting fluid under pressure from said pump to opposite ends of said cylinders, and means connected between said valve and one of said rods for returning said

valve to inoperative position upon predetermined movement of said rod.

5 In an industrial truck of the type having uprights at one end thereof with a load supporting member guided for vertical movement therein, a fluid pump at the opposite end of said truck, tilting mechanism for said uprights including tilt rods pivotally connected to the rear faces of said uprights, hydraulic cylinders pivotally mounted to the frame adjacent said opposite end of said truck and including pistons axially connected to said rods, and valve means on one of said cylinders selectively operable to admit fluid from said pump simultaneously into both cylinders.

15 6. Tilt mechanism for an industrial truck of the type described comprising a cylinder pivotally mounted at one end on said truck, a tilt rod extending from the opposite end of said cylinder, valve means on said cylinder adjacent said end for selectively admitting fluid under pressure to opposite ends of said cylinder to move said rod axially with respect to said cylinder, and means carried by and extending parallel to said rod and having lost motion connection with said valve means for moving said valve means to inoperative position upon predetermined movement of said rod in either direction from a neutral position.

7. The combination of claim 6 further characterized in the provision of lever means connected to said valve means for actuating the same and including spring pressed means normally holding said lever means in valve shifted position, said lever means having pivotal support on the pivoted end of said cylinder.

35 8. Tilt mechanism for the uprights of a lift truck comprising a cross shaft extending transversely across the rear edge of the uprights above the lower ends thereof, a pair of tilt rods pivotally connected to the opposite ends of said shaft, tilt cylinders journaled at their lower ends on opposite sides of the truck frame and receiving said rods, and fluid pressure control means on one cylinder operable to simultaneously admit fluid under pressure to corresponding ends of both said cylinders for actuating said rods.

45 9. The mechanism of claim 8 wherein said fluid pressure control means includes a valve mounted on one of said cylinders with connections therefrom to the opposite ends of both cylinders, and a second rod connected to said valve having a lost motion connection with the associated tilt rod for returning said valve to neutral position when said associated tilt rod moves beyond a predetermined point.

55 10. In combination, a rigid frame including a transverse shaft member, a vertical guide member rotatably mounted at one end on said shaft member, a cylinder trunnioned at one end on said frame and lying in the plane of rotation of said guide member, a piston in said cylinder having an arm pivotally connected to the opposite end

of said guide member, a fluid pressure pump, valve means mounted on said cylinder including a valve member, means for shifting said valve member in opposite directions from a neutral position to admit fluid under pressure from said pump to opposite ends of said cylinder, and means on said arm having lost motion connection with said valve member for returning the same to neutral position upon predetermined longitudinal movement of said arm in either direction.

11. The combination, with rotatably mounted guide uprights for a lift truck of the class described, of tilting mechanism therefor including laterally spaced tilt cylinders trunnioned for rotation in the respective planes of rotation of the associated uprights, pistons in said cylinders having arms pivotally connected directly to said uprights, means connecting corresponding ends of said cylinders together, valve means on one cylinder including a valve member shiftable in opposite directions from a neutral position to selectively admit fluid under pressure to opposite ends of said cylinders, and means on one of said piston arms having lost motion connection with said valve member for returning the same to neutral position upon predetermined movement of said arm in either direction.

12. In combination, in a lift truck, a vertical guide member journaled for rotation about its lower end, a tilt cylinder having a bracket at one end journaled on the truck frame, a valve carried on said bracket, a bell crank pivotally mounted on said bracket and having one end connected to said valve, remotely disposed actuated means connected to the opposite end of said bell crank, a piston having an arm projecting from the opposite end of the cylinder and pivotally connected to said guide member, and fluid pressure developing means selectively connected through said valve to opposite ends of said cylinder.

13. In combination, in a lift truck having a vertical guide member pivotally mounted at its lower end on one end of said truck, a tilt cylinder having a bracket at one end thereof pivotally supporting said cylinder for rotation in the plane of rotation of the guide member, a piston in said cylinder having a rigid rod projecting from the opposite end of said cylinder and pivotally connected to the upper end of said guide member, means for selectively admitting fluid under pressure to opposite ends of said cylinder including a valve mounted on said bracket, an arm clamped to said piston rod intermediate its ends, a rod paralleling said piston rod and connected to said valve, said rod having a lost motion connection with said arm whereby it is actuated at opposite limiting positions of said piston rod to actuate said valve.

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