United States Patent [19]

Pulskamp

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[45] **May 21, 1974**

[54] **MULTI-FUNCTION CONTROLLER**

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[73] Assignee: **Crown Controls Corporation,** New Bremen, Ohio

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[21] Appl. No.: **285,755**

[52] **U.S. Cl.** ..... **74/471 XY,** 200/157, 214/674

[51] **Int. Cl.** **G05g 9/04,** B66f 9/06

[58] **Field of Search** ..... 74/471 R, 471 XY; 214/670–674, 653; 200/157, 6 A; 137/636.2

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Primary Examiner—Allan D. Herrmann

Attorney, Agent, or Firm—Biebel, French & Bugg

[57] **ABSTRACT**

A single multi-function controller for an industrial self-propelled materials handling truck incorporates all desired control functions except steering.

11 Claims, 11 Drawing Figures

FIG-4

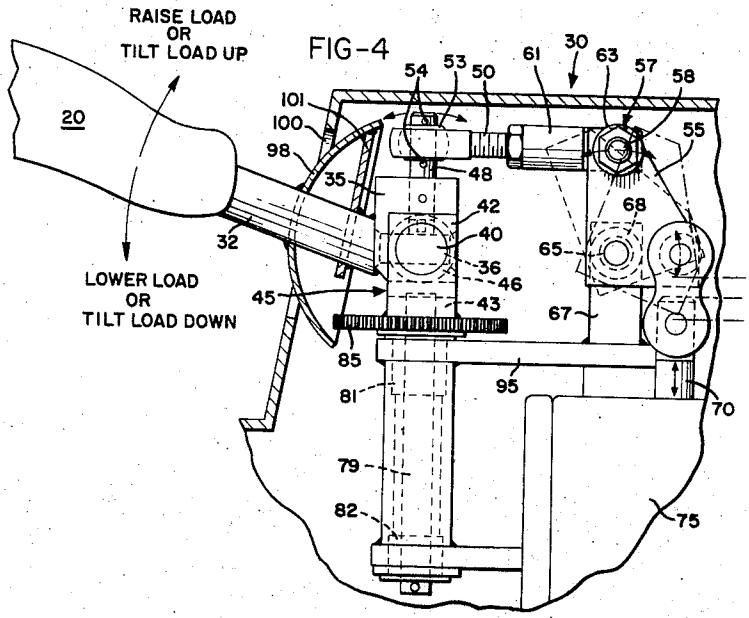


FIG-1

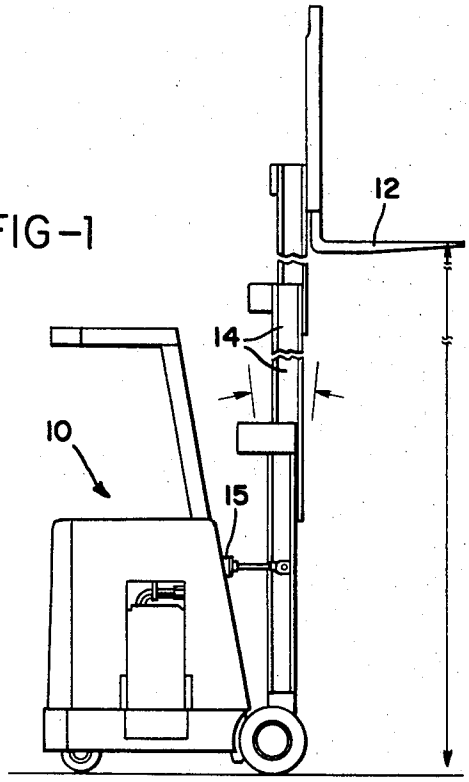


FIG-2

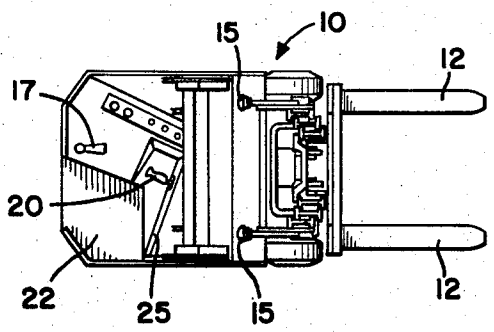


FIG-3

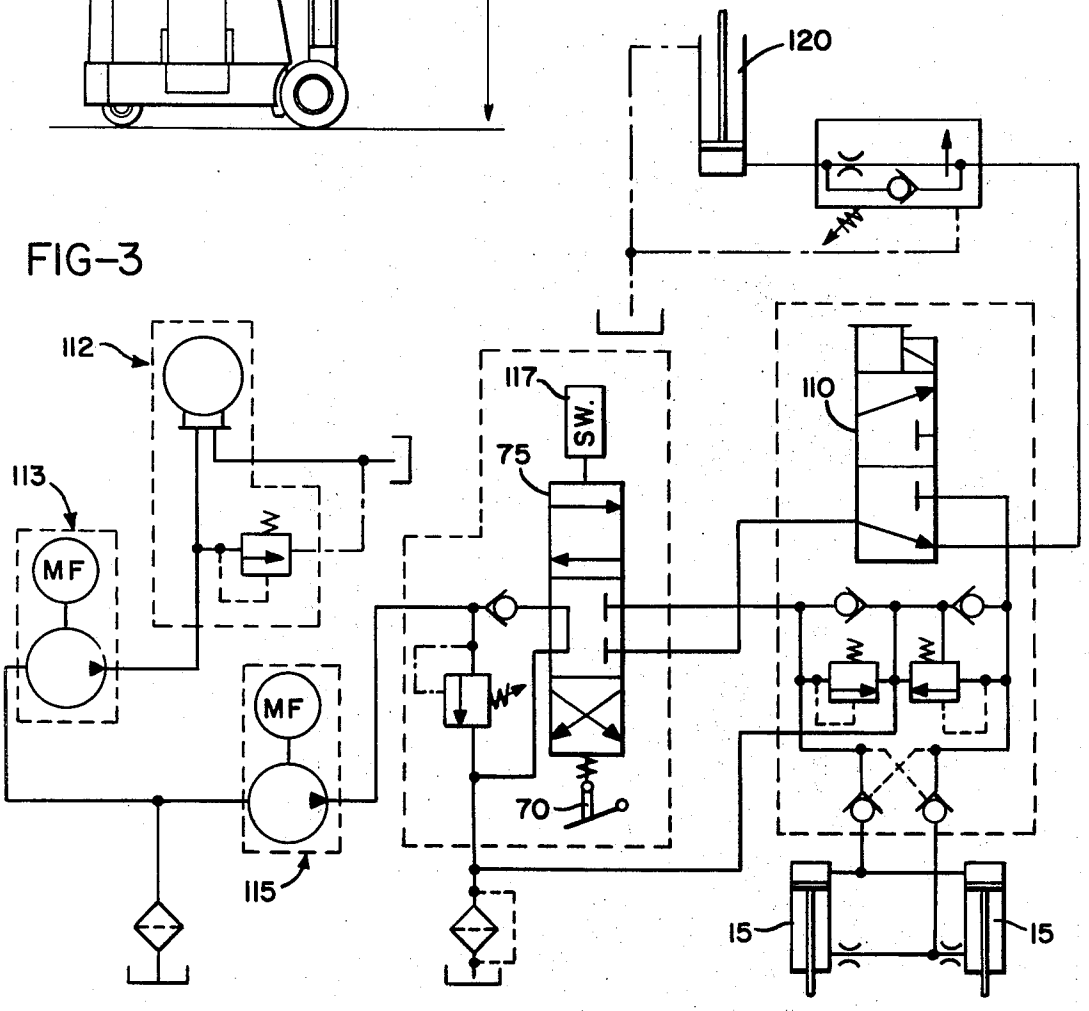


FIG-4

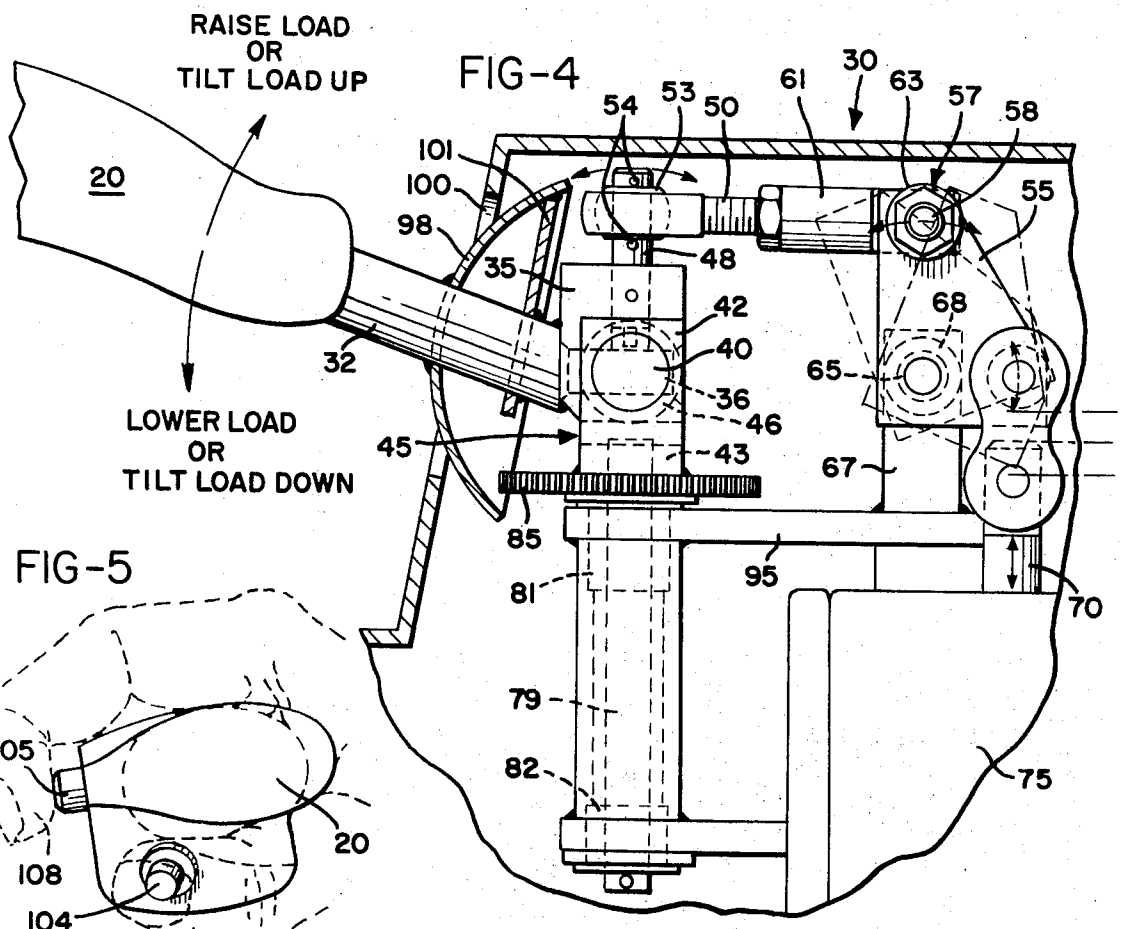


FIG-5

FIG-6

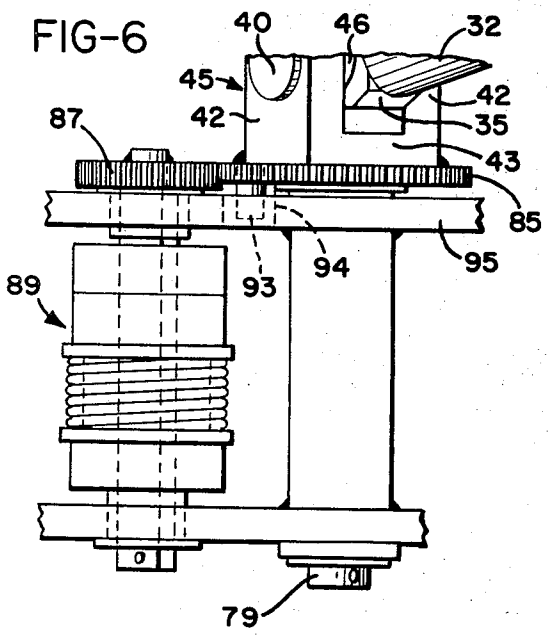


FIG-7

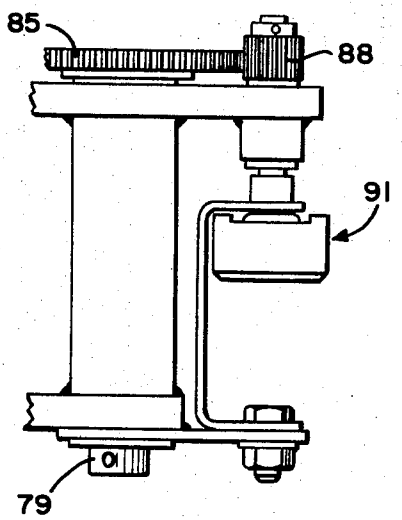


FIG-8

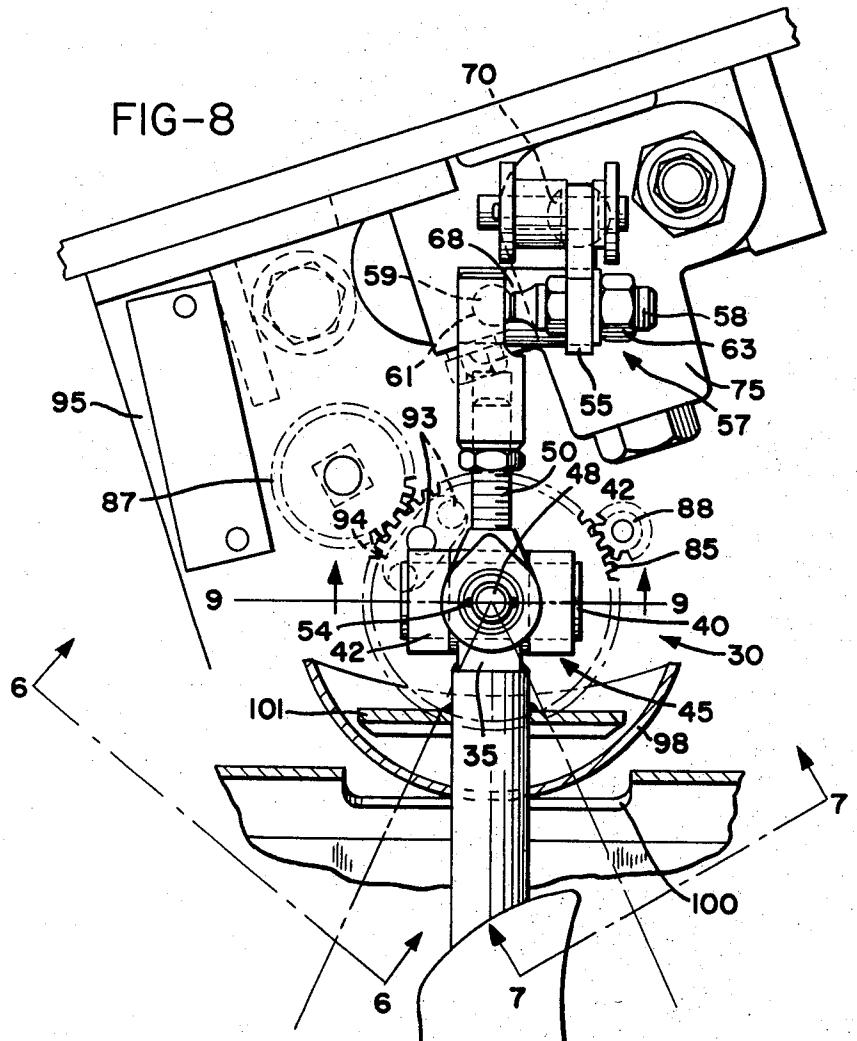
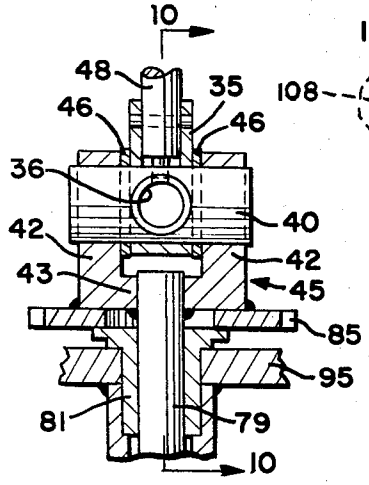


FIG-9



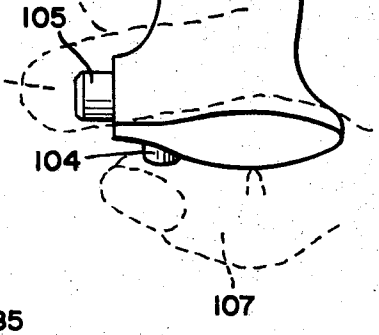


FIG-10

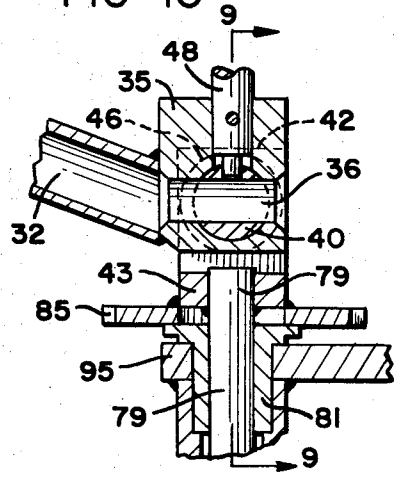
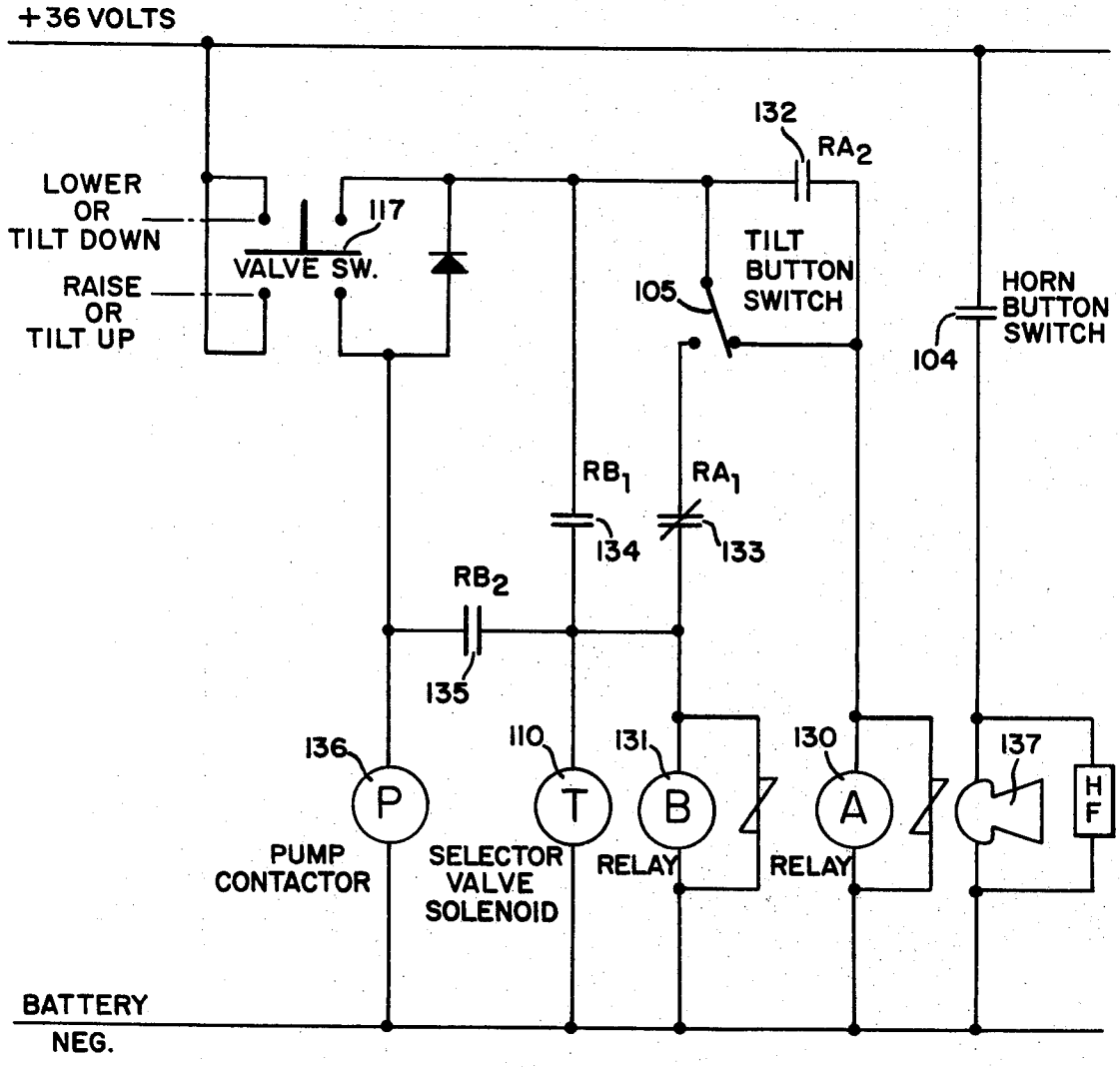


FIG-11


+36 VOLTS
LOWER OR TILT DOWN
RAISE OR TILT UP
117
VALVE SW.
132
RA2
TILT BUTTON SWITCH
105
HORN BUTTON SWITCH
104
RB1
RA1
134
133
RB2
135
136
110
131
130
137
P
T
B
A
H F
PUMP CONTACTOR
SELECTOR VALVE SOLENOID
RELAY
RELAY
BATTERY NEG.

MULTI-FUNCTION CONTROLLER

BACKGROUND OF THE INVENTION

This invention relates to self-propelled industrial trucks, and more particularly to the control systems for a self-propelled fork lift type industrial truck having a plurality of powered functions or operations.

The prior art includes many powered fork lift type trucks, a typical example being disclosed in U.S. Pat. No. 3,465,841, assigned to the assignee of the present invention. Such trucks may be manually or self-propelled. Similarly, the lift function may be performed manually or the truck may include a mechanism for performing the lift function under power. Other functions available for such trucks include means for tilting the forks upwards or downwards, to assist in more safely loading, carrying, and unloading the cargo, means for clamping the forks together, means for shifting the forks sideways, means for rotating the forks, means for extending the forks, and so on.

It has been customary in such vehicles to provide a control for steering the truck, a control for regulating the velocity of the truck, and hydraulic controls for controlling the lifting and lowering function and the various optional operations mentioned above. It has thus been necessary for the truck operator to move his hands from one control to another in order to control the various powered operations of the truck. This has not only been inconvenient and time consuming, but has also had potential for causing accidents, since the operator can always inadvertently operate the wrong control, especially in an emergency situation. Further, even if he selects the correct control in such an emergency, the time required to find the right control and to move his hands to it may prevent him from operating the control in time. Further, this movement of hands requires that the operator relinquish control of either steering or velocity of the truck in order to manipulate the optional controls, which is obviously not in the best interest of safety.

SUMMARY OF THE INVENTION

Briefly, a preferred embodiment of this invention includes a single controller for regulating all normal truck operations, except steering, on a self-propelled materials handling truck such as an industrial fork lift truck. The single controller is independently movable on at least two axes. A controller grip which is shaped to conform generally to the configuration of a human hand is connected to the controller by a control rod.

A combination of control buttons incorporated in the controller grip and actuator means incorporated in the controller and truck hydraulic circuits enables the operator of the truck to use the controller of this invention to control every normal truck operation except steering. Steering is accomplished through a second control handle which the operator holds in his other hand.

The controller includes a first actuator means which responds to movement of the control handle on one of its axes, the movement being generally horizontal movement of the controller grip. The first actuator means generates a first controller function by rotating a yoke within the actuator means to rotate a large speed controller gear. The speed controller gear in turn operates the electronic circuits for regulating the forward and reverse movement and the velocity of the truck.

A second actuator means in the controller responds to movement of the controller grip on the other axis, such movement being generally vertical. This second actuator means generates linear output movement of an arm which provides a control function for operating the spool of an hydraulic valve. The hydraulic valve, in turn, controls the normal hydraulic functions of the truck.

The choice of hydraulic operations ia made easily by means of a plurality of control buttons, conveniently located on the controller grip. One of the buttons is located directly beneath the thumb of the operator, while another is located under the forefinger. The forefinger button, in a typical application, enables the operator to control the lift-lower operations of the forks when not depressed, and to control the tilt operations of the forks when the button is depressed. The thumb button may be used for selecting other hydraulic functions, or, as illustrated in the preferred embodiment herein, to control the truck's warning horn.

To reduce the possibility of inadvertently switching from one hydraulic mode to another by unintentionally pressing a button while the hydraulic valve is actuated, the vertical movement of the controller is interlocked electrically with the buttons in the controller grip in such a manner that the controller must be returned to its neutral position before the selection of an alternate hydraulic operation can take place.

It is therefore an object of this invention to provide improved controller means for a self-propelled truck, a controller in which the operator of such a truck is able to control every normal truck operation without having to move his hands from one control to another; in which truck operations including motion control and one hydraulic function may be simultaneously operated and controlled from a single controller grip by combined operation and movement thereof on both axes; in which means are incorporated to discourage accidental engagement of the wrong operation; in which a first actuator means generates a first truck control function in response to movement of the controller input means along one axis thereof; in which a second actuator means generates a second control function in response to movement of the controller input means on another axis thereof; and to accomplish all the above objects and purposes in an inexpensive, uncomplicated, and highly reliable configuration resulting in a maximum of operator convenience and efficiency.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a self-propelled fork lift type industrial truck incorporating the multi-function controller of this invention;

FIG. 2 is a partially broken away top view of the fork lift truck of FIG. 1;

FIG. 3 is a schematic diagram of the hydraulic control system of the FIG. 1 truck;

FIG. 4 is a partial cross sectional view of the controller of this invention, with portions omitted for clarity, as incorporated in the control panel of the fork lift truck illustrated in FIG. 1;

FIG. 5 is an end view of the controller grip illustrated in FIGS. 4 and 8, illustrating in phantom the hand of an operator and showing the finger and thumb positions on the controller grip;

FIG. 6 is a partial view of the controller of this invention illustrating its attachment to a truck direction controller;

FIG. 7 is a partial view similar to FIG. 6 showing the controller engaging a truck speed controller;

FIG. 8 is a partial top view of the controller illustrated in FIG. 4, and showing in phantom the position of an operator's hand on the controller grip;

FIG. 9 is a partial cross sectional view taken generally on line 9—9 of FIGS. 8 and 10;

FIG. 10 is a partial cross sectional view taken generally on line 10—10 of FIG. 9; and

FIG. 11 is a schematic diagram of a portion of the electrical control system of the fork lift truck of FIG. 1, illustrating the electrical interlocking of the controller buttons and the hydraulic valve as described in the preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the drawings and more particularly to FIG. 1, there is illustrated a self-propelled materials handling lift-type truck 10. Lift truck 10 includes lift forks 12 mounted upon a mast 14. The forks 12 may be raised and lowered upon mast 14 by conventional hydraulic means, and the forks may be tilted upwardly and downwardly by hydraulic tilt cylinders 15. The truck is steered by a steering handle 17 (FIG. 2), and the remaining normal truck operations are controlled by a controller grip 20. Controller grip 20 is shaped to conform generally to the configuration of a human hand. Both the steering handle 17 and controller grip 20 are located on an operator control station 22 on the rear of the truck.

A control panel 25 on operator control station 22 houses the multi-function multi-axis truck controller 30 of this invention. Controller 30 includes the controller grip 20 which is connected to controller 30 through panel 25 by means of a hollow control rod 32.

Control rod 32 serves as the input means to the controller 30 and is connected to an actuating block 35 at the end opposite grip 20. A hole or channel 36 connects to this end of rod 32 and extends through block 35 and through a yoke coupling shaft 40. Channel 36 serves as a conduit for electrical wires coming through hollow control rod 32 from grip 20.

Actuating block 35 (FIGS. 4, 9, and 10), on yoke coupling shaft 40, is rotatably mounted between the arms 42 and above the bridge 43 of a yoke 45. Actuating block 35 is thus able to pivot within yoke 45 about the horizontal axis of yoke coupling shaft 40, in response to vertical movememt of grip 20 and rod 32, without moving yoke 45 itself. Washers 46 space the actuating block from the arms 42 of yoke 45.

In the preferred embodiment of this invention, movement of the controller grip 20 in the vertical direction is used to generate an hydraulic control function which may then be used to control any of a number of hydraulic operations on the truck. An actuating block coupling shaft 48 is mounted through actuating block 35 and attached to yoke coupling shaft 40. An arm 50 is connected to the end of shaft 48, opposite block 35, by a ball bearing 53, and pins 54 on either side of ball bearing 53 hold the bearing on shaft 48. When grip 20 is moved vertically to rotate block 35 and yoke coupling shaft 40, the latter move shaft 48 in conjunction therewith to push or pull arm 50 horizontally.

An hydraulic control plate 55 is pivotally attached to arm 50 by a pivotal connection 57. Pivotal connection 57 is a single piece connector having a threaded shaft 58 on one end and a ball joint 59 on the other end. Ball joint 59 is received in a coupling member 61 on arm 50, and connection 57 is held on plate 55 by means of a nut 63 threaded onto shaft 58.

Plate 55 is pivotally supported on a bearing 65, which in turn is supported by a bearing support 67. Plate 55 is held in position on bearing 55 by a bearing spacer 68.

When the controller grip is moved vertically, causing arm 50 to move horizontally, arm 50 in turn pivots plate 55 about bearing 65 causing the plate to move an hydraulic valve spool 70. Hydraulic valve spool 70, in turn, is part of the hydraulic control valve 75 which controls the truck hydraulic operations. By this means, therefore, controller 30 is able to generate a control function to control the truck hydraulic operations.

Horizontal movement of controller grip 20, that is, movement about its other axis, will rotate actuating block 35 and yoke 45 on shaft 79, since yoke coupling shaft 40 is mounted in yoke arms 42. Arm 50, however, will not be moved since ball bearing 53 allows actuating block coupling shaft 48 to rotate about its principal axis relative to arm 50.

Shaft 79 is supported for rotation on upper and lower bearings 81 and 82, and a speed controller gear 85 is attached to yoke 45 to turn therewith to drive truck direction and speed control pinions 87 and 88. Pinions 87 and 88, in turn, operate respective direction cams 89 and speed control 91 such as are more fully described in U.S. Pat. No. 3,465,841, assigned to the assignee of the present invention. Horizontal movement of the grip 20 thus causes the controller 30 to rotate gear 85 to generate a control function, which, through cams 89, control 91, and the associated circuitries (not shown) controls the movement of the lift truck.

A limit pin 93 depends downwardly from speed controller gear 85 and is received in a slot 94 in a support plate 95 (FIGS. 6 and 8). Limit pin 93 and slot 94 set the maximum range for horizontal movement of grip 20.

A somewhat spherical cover 98 is attached to control rod 32 over the opening 100 in panel 25 through which rod 32 passes. A reinforcing plate 101 at the rear of cover 98 strengthens the attachment thereof to rod 32. Cover 98 serves to improve the appearance of this invention, and also prevents foreign material from entering into the mechanism of controller 30.

A pair of buttons 104 and 105 is mounted on the end of grip 20 such that button 104 is accessible to the thumb 107 of an operator and button 105 is under the forefinger 108 when holding grip 20.

In the embodiment which is illustrated herein, button 104 may be connected to operate a warning horn for the truck 10, and is thus always immediately accessible to the truck operator. Button 105 serves as a selector means for selecting which of the truck hydraulic operations will be controlled by verticla movement of grip 20. When button 105 is not depressed, vertical movement of the grip will control the lift-lower operation of forks 12. When button 105 is actuated, a selector valve

110 (FIG. 3) transfers the hydraulic function to the lift truck tilt cylinders to control the tilt operation of the lift truck.

The hydraulic system of this invention is illustrated schematically in FIG. 3. Steering handle 17 controls a power steering unit 112 which in turn is driven by an hydraulic pump 113. The remaining hydraulic functions for truck 10 are driven by a main hydraulic pump 115. Pump 115 is controlled by a pump switch 117 attached to valve 75. Switch 117 and the flow of hydraulic fluid from pump 115 are thus both regulated by hydraulic control valve 75, which in turn is governed by hydraulic control valve spool 70. Thus, when controller grip 20 is displaced vertically from its neutral position, moving plate 55 from its respective neutral position and operating spool 70 and hydraulic control valve 75, pump switch 117 is closed to activate the main hydraulic pump 115. When grip 20, plate 55, valve 75, and so on, are in their respective neutral positions, however, pump 115 is not activated. Power and energy are thus conserved since pump 115 is operated only when an hydraulic demand is present. When pump 115 is operating, the hydraulic fluid passes to control valve 75, and then to the hydraulic selector valve 110, which in turn routes the fluid either to the lift cylinder 120 (FIG. 3) which lift the forks 12, or to the tilt cylinders 15.

The electrical interlock of the control buttons and hydraulic valve is shown in FIG. 11, where all switches and contacts are shown in an "at rest" position.

Whenever the controller grip 20 is moved in a vertical direction, spool 70 slides in valve 75 to determine direction of flow of hydraulic fluid. At the same time it operates a switch 117. When switch 117 is actuated in either direction, current can flow to the forefinger switch 105. If switch 105 has not been depressed prior to actuation of switch 117, current will flow to relay 130*a*, causing it to actuate, thereby opening contacts 133 and closing contacts 132. The closing of contacts 132 insures that relay 130*a* will remain closed even though switch 105 may be depressed. Relay 130*a* will deactuate when switch 117 is returned to neutral position.

To operate the alternate function, switch 105 must be depressed prior to actuating switch 117. Once this has been done, current can flow through contacts 133 to relay 131*b*, causing it to actuate, thereby closing contacts 134 and 135. Current is now flowing through selector valve solenoid 110, pump contactor 136 and relay 131*b*. If switch 105 is now released, current will still continue to flow in the circuit because of contacts 134 and unit will remain in this mode until switch 117 is neutralized.

From the above, it can be stated that no matter which vertical function is selected, due to the design of the circuit, one cannot erroneously fall into another function. Everything must neutralize before a new function can be selected, and the electrical interlock positively locks the selector means onto a pre-selected hydraulic function as long as the controller grip is displaced vertically from its neutral position.

As may be seen, therefore, this invention has numerous advantages. The controller serves as a control function differentiating means whereby all of the normal truck operations may be controlled by an operator from but a single pair of controls. The controller differentiates between horizontal and vertical movement of the control rod to provide independent control functions enabling the operator to control every normal truck function quickly, positively, and with a maximum of convenience, while never removing his hands from any of the controls. Further, the electrical interlock provides positive protection against accidental transfer from one hydraulic function to another unless valve 117 is in neutral.

In the embodiment which has been illustrated, button 104 operates the lift truck horn. However, where additional hydraulic functions are to be performed this button may be used instead to select those additional functions. Similarly, additional buttons may be provided, or the buttons may operate a sequence selecting mechanism, to select the appropriate functions.

As will readily be appreciated, this arrangement is also advantageous in that it reduces operator fatigue. The operator is not required constantly to shift his vision back and forth between the lift truck controls and the external environment, nor need he worry about accidentally engaging the wrong control. Similarly, since the control is a multi-functional control, the operator is able to put the truck in motion immediately after the load has cleared, and to continue controllably lifting or tilting the load while simultaneously steering and driving the truck, all with great precision.

Similarly, in difficult maneuvering situations not only is the operator able to perform the above functions simultaneously and with very precise control, but he is also able to shift from one function to another without ever taking his eyes off the work itself. For example, in depositing an elevated load upon a high stack, the operator can maneuver the truck in a narrow aisle while simultaneously bringing the load into position, both horizontally and vertically, without ever taking his eyes off the load. With this invention such a maneuver may be conducted easily, continuously, and smoothly: abrupt, awkward, and jerky movements are entirely eliminated.

The controller grip itself reduces fatigue and increases operator comfort and confidence by carefully conforming to the configuration of the human hand.

While the form of apparatus herein described constitutes a preferred embodiment of this invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. F or improving safety and convenience in a industrial self-propelled materials handling lift truck having power actuated lift means, a controller input means movable on at least two independent axes, for controlling the truck speed, direction of travel, raise and lower and other hydraulic functions such as tilt and reach, all with one hand, comprising:

a. a first actuator means for controlling forward and reverse motion of the truck in response to movement of the controller input means along one of the independent axes thereof,

b. a second actuator means for generating a control function in response to movement of the controller input means on another of the axes thereof,

c. a plurality of truck operations including a lift-lower operation, at least two of the truck operations being selectably controllable by said control function, and

d. selector means located on the movable controller input means and operable by the same hand controlling the said input means for selecting which one of the plurality of truck operations shall be controlled by said control function and for controllably changing from one of said operations to another.

2. The controller of claim **1** further comprising:

a. a control rod attached to the controller input means for moving the input means,

b. a controller grip on the end of said control rod, said controller grip being shaped to conform generally to the configuration of a human hand,

c. a first control button being conveniently located on said controller grip for operation by the thumb of an operator, and

d. a second control button on said grip being conveniently located thereon for actuation by a finger of the operator, at least one of said buttons being said selector means located on the movable controller.

3. The controller of claim **2** further comprising a tilt operation, and wherein horizontal movement of said controller grip will control forward and reverse motion of the truck, wherein vertical movement of the grip will control the lift-lower operation of the truck when said at least one control button is not actuated, and wherein vertical movement of said grip will control said tilt operation when said at least one control button is actuated.

4. The controller of claim **3** further comprising an interlock between said at least one control button and said selector means to lock said selector means whenever said second actuator means is displaced from its neutral position.

5. A multi-axis multi-function controller generating at least two independent output control functions in response to movement of a control rod on at least two axes, comprising:

a. an actuating block receiving the control rod therein, and said control rod being attached thereto,

b. a yoke movable in response to movement of the control rod on one of the axes,

c. means interconnecting said actuating block and said yoke for moving said yoke only in response to movement of the control rod on said one axis,

d. means including a coupling shaft interconnecting said yoke and said actuating block to pivot said actuating block relative to said yoke in response to movement of the control rod on the other axis thereof,

e. an actuating block coupling shaft attached to said actuating block,

f. an arm movably attached to said actuating block coupling shaft at a distance removed from said actuating block,

g. means attaching said arm to said actuating block coupling shaft to allow said actuating block coupling shaft to rotate relative to said arm, said rotation being about the principal axis of said actuating block coupling shaft, and to move said arm when said actuating block coupling shaft is displaced by movement of said actuating block about said yoke coupling shaft,

h. a first output means attached to said yoke to provide a first output function in response to movement of said yoke, and

i. a second output means attached to said arm to provide a second output function in response to movement of said arm.

6. In an industrial self-propelled materials handling truck having a control system including a control rod movable on at least two independent axes, the improvement comprising:

a. an actuating block receiving the control rod therein, and said control rod being attached thereto,

b. a yoke movable in response to movement of the control rod on one of the axes,

c. means interconnecting said actuating block and said yoke for moving said yoke only in response to movement of the control rod on said one axis,

d. a first output means attached to said yoke to provide a first output function in response to movement of said yoke, and

e. a second output means attached to said actuating block to provide a second output function in response to movement of said control rod on the other axis thereof.

7. The truck of claim **6** further comprising:

a. a controller grip on the end of the control rod, said controller grip being shaped to conform generally to the configuration of a human hand,

b. a first control button being conveniently located on said controller grip for operation by the thumb of an operator, and

c. a second control button on said grip being conveniently located thereon for actuation by a finger of the operator.

8. The truck of claim **6** further comprising:

a. at least two independent hydraulic operations, each operation being independently controllable by one of said output functions, and

b. a selector means for selecting which of said hydraulic operations shall be controlled by said output function.

9. The truck of claim **8** further comprising a control grip on the control rod, said selector means being located on said control grip for convenient operation by an operator.

10. The materials handling truck of claim **6** further comprising means including a coupling shaft interconnecting said yoke and said actuating block to pivot said actuating block relative to said yoke in response to movement of the control rod on the other axis thereof.

11. The materials handling truck of claim **10** wherein said second output means includes:

a. an actuating block coupling shaft attached to said actuating block, and

b. means connecting said actuating block coupling shaft to control said second output function in response to linear movement of said coupling shaft.

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