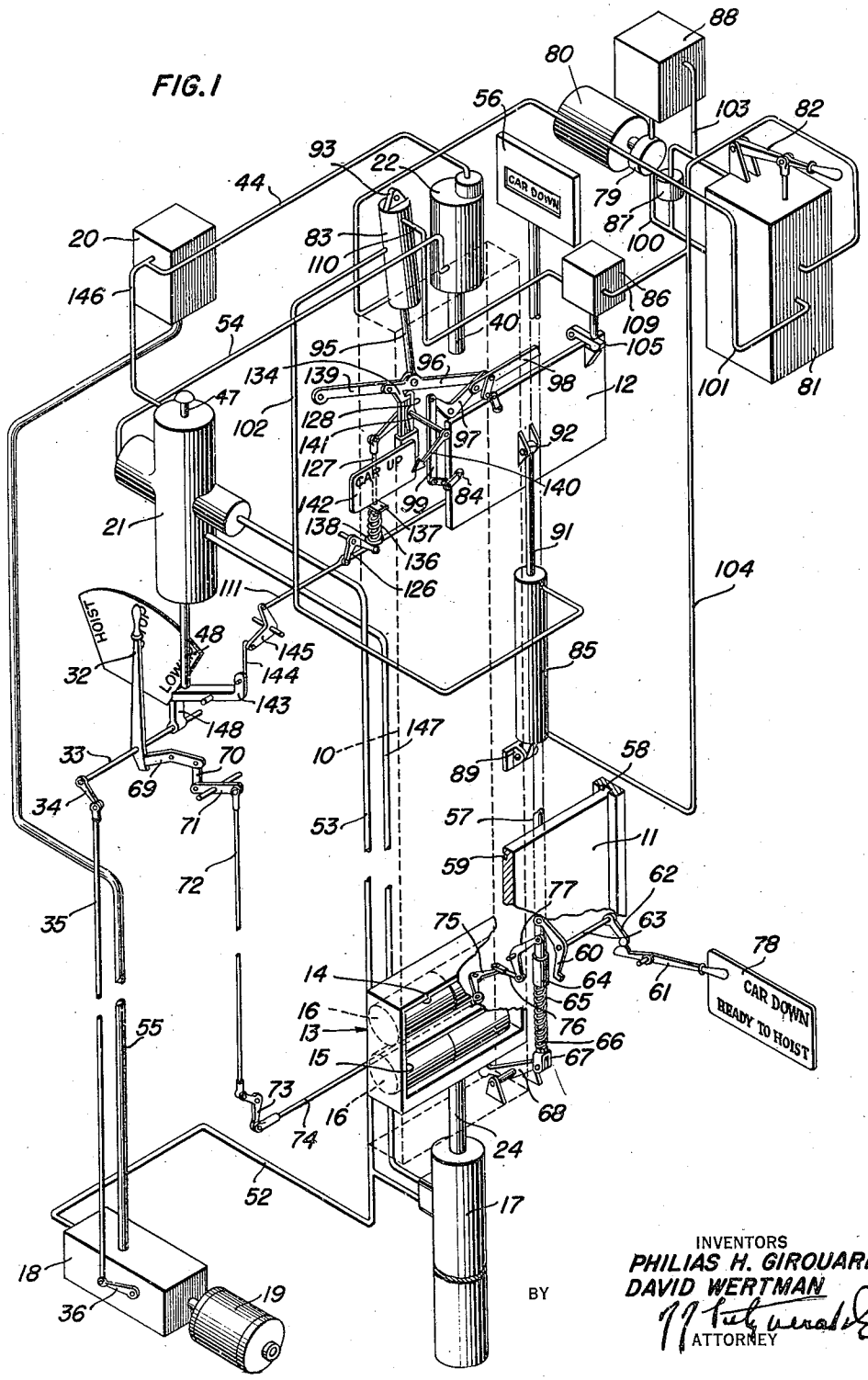
Dec. 13, 1949 P. H. GIROUARD ET AL 2,490,797

HOISTING APPARATUS

Filed Oct. 29, 1942 4 Sheets-Sheet 1

FIG. 1



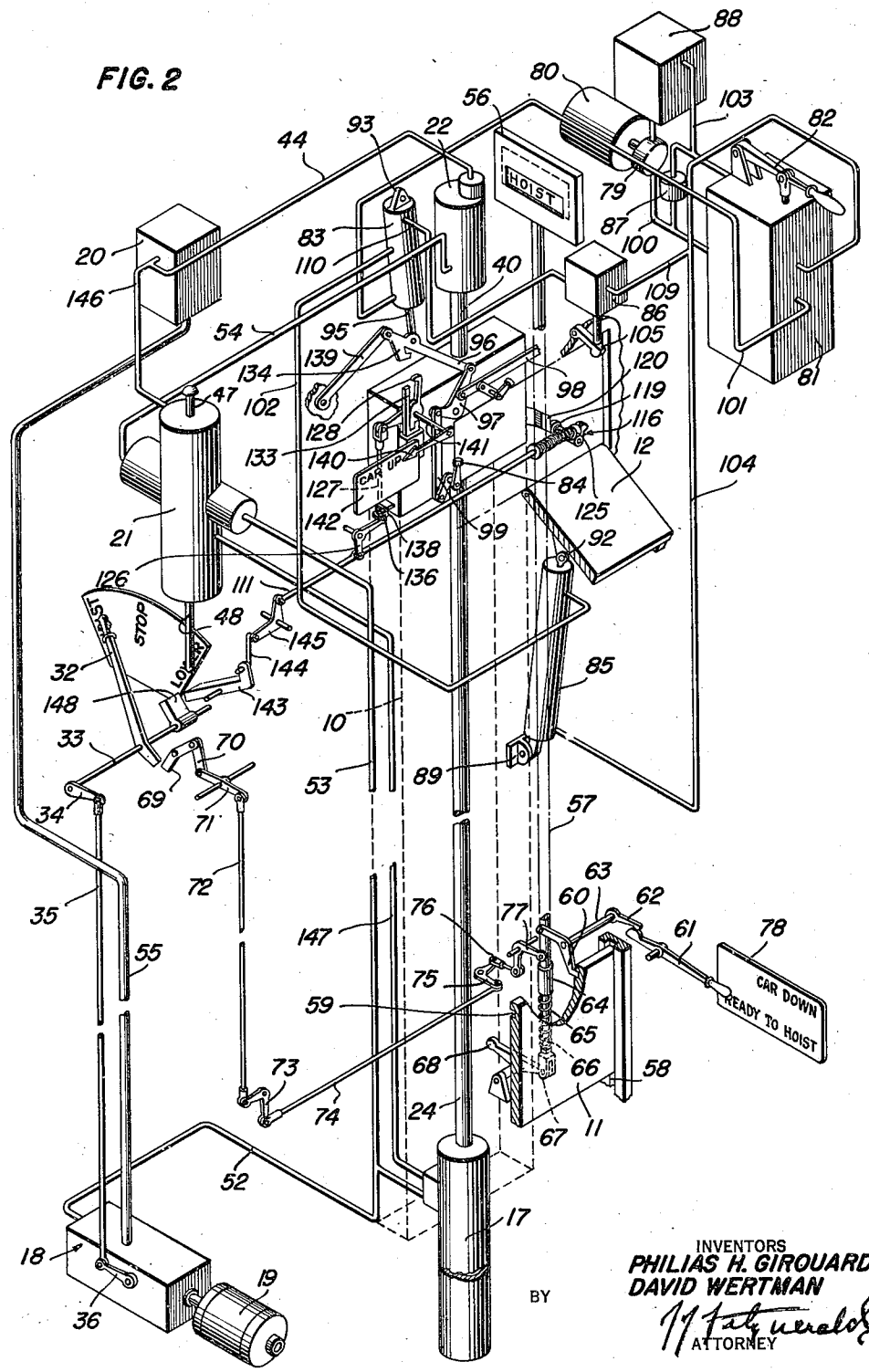
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HOISTING APPARATUS

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FIG. 2



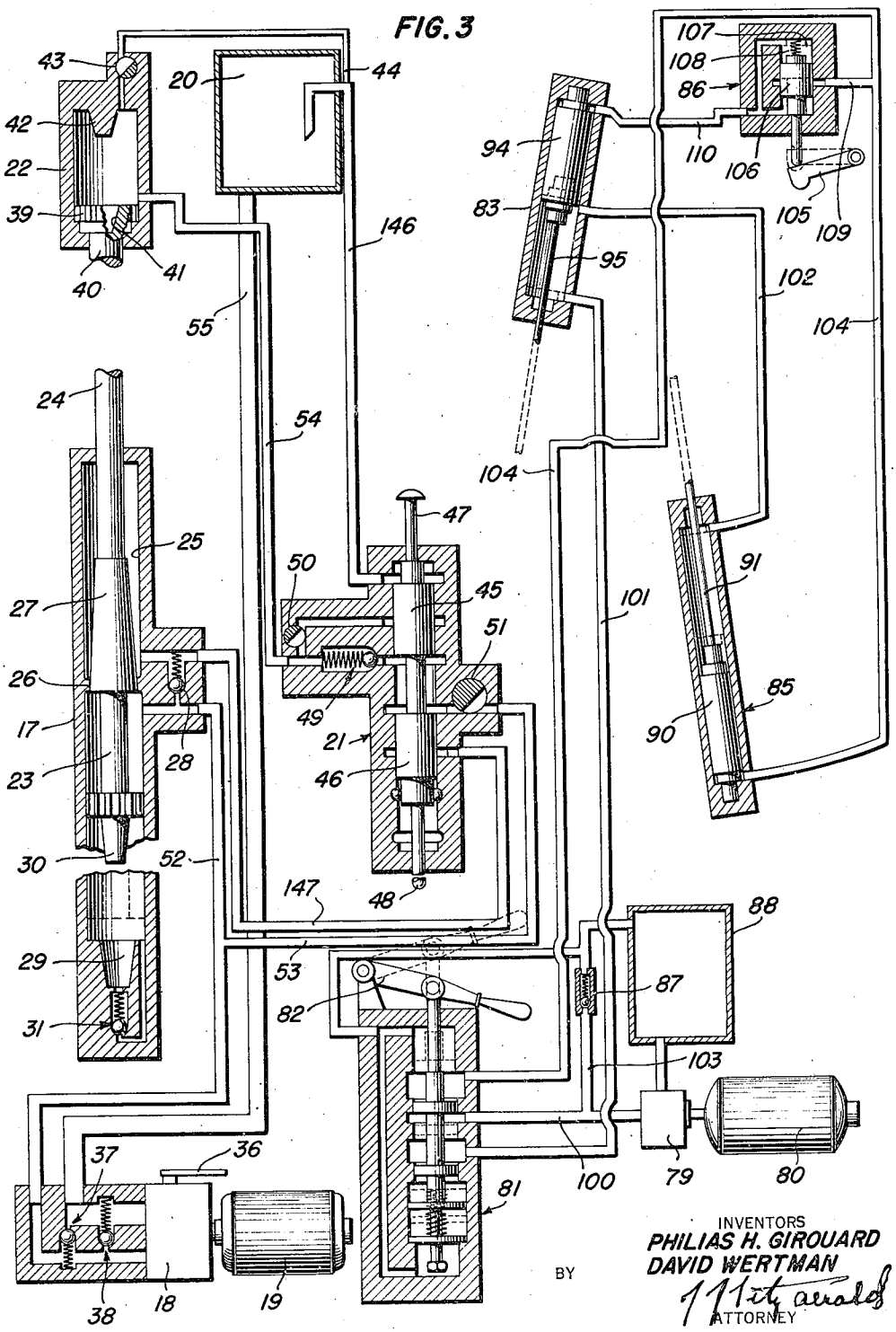
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HOISTING APPARATUS

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FIG. 3



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HOISTING APPARATUS

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FIG. 4

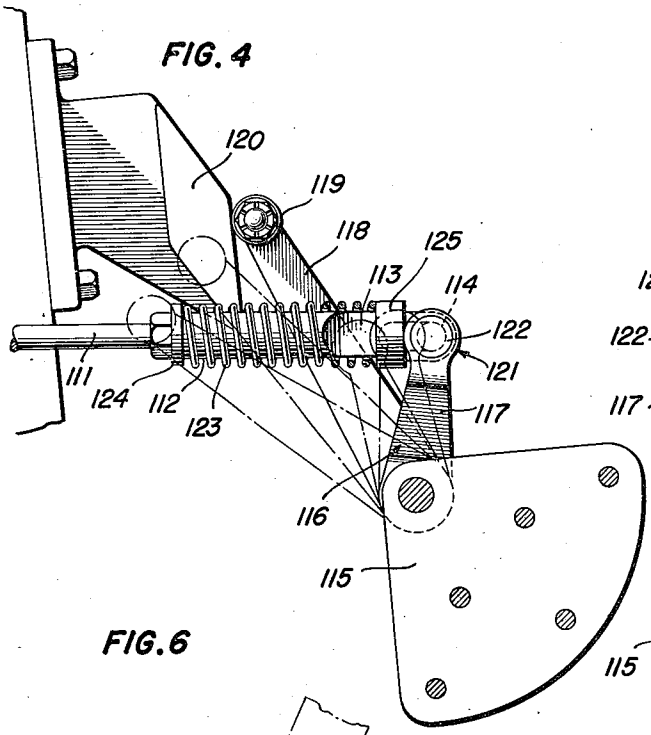


FIG. 5

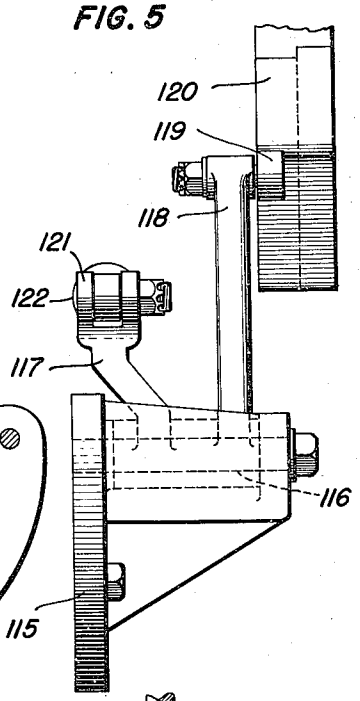


FIG. 6

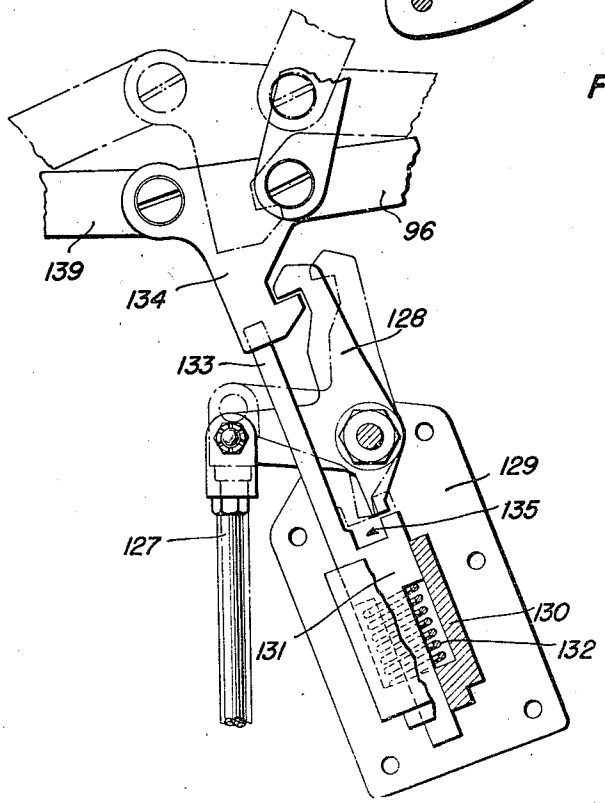
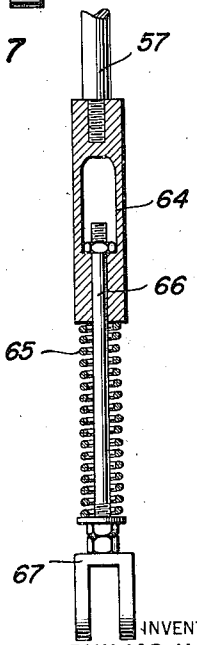


FIG. 7



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UNITED STATES PATENT OFFICE

2,490,797

HOISTING APPARATUS

Philias H. Girouard and David Wertman,
Washington, D. C.

Application October 29, 1942, Serial No. 463,750

13 Claims. (Cl. 187—61)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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Our invention relates generally to hoist apparatus and in particular to a hoist for use in the ordinance art in raising powder bags from a handling room to a gun chamber where it is then removed from the hoist car and loaded into the gun.

In the hoist apparatus incorporating our invention, the hoist car operates in an enclosed passageway (commonly referred to as a powder trunk) which rises from the handling room and terminates in a control room at the same level with, and next to the gun chamber.

The powder bags are loaded on the car at the handling room through a door having locking means therefor and opening into the powder trunk and an operator stationed in the handling room opens and closes the door.

In the control room at the top of the powder trunk, a second operator is stationed. This operator manipulates the control for operating the powder car between the loading and unloading levels.

A door opens from the powder trunk and control room into the gun chamber, this door including locking means and being under the control of a third operator positioned in the gun chamber.

Suitable signal means are utilized to advise the operator in the control room when the powder bags have been loaded onto the car at the handling room and the door from the handling room to the trunk has been closed and locked. Likewise suitable signal means are utilized to indicate to the operator in the gun chamber when the loaded car has reached the top of the trunk and is ready for unloading.

To prevent fire from traveling from the gun chamber to and into the handling room in the event of a "flashback" in the gun chamber caused by fragments of powder bags burning in the gun after it has been fired and the breech opened, it is necessary to arrange the operation of the upper and lower doors so that only one, either the upper or lower, may be opened at any one time and then only when the car is at the door to be opened.

In our apparatus we attain this objective by interlocking the locking means for the lower door with the control for operating the car so that the car cannot be moved upwardly when such locking means are released and similarly interlocking the locking means for the upper door with the car operating control so that the car cannot be moved downwardly when the upper door locking means are released.

The locking means for each of the doors are automatically released by the car as it reaches

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the door. Thus since the car cannot be moved upwardly while the lower door is unlocked or downwardly while the upper door is unlocked, and also since neither door can be unlocked except when the car is opposite the door, it follows that only one of the doors may be opened at any one time and that neither of the doors may be opened while the car is operating between the loading and unloading levels.

The powder car is provided with top and bottom trays upon which powder bags are placed for hoisting from the powder room to the gun chamber. In order that the time element for hoisting the car and unloading the powder bags may be made as short as possible, it is necessary to provide means for first automatically stopping the loaded car at the unloading level with the top tray of the car at the correct level for discharging the powder bags onto the loading trays in the gun chamber when the upper door is opened, after which the car can be raised and stopped with the bottom tray at the correct, unloading position. We attain this objective by use of a two-position car stopping cylinder including a piston and piston rod adapted when fully extended to abut and stop the car with the top tray of the car at the unloading position and when fully retracted to stop the car with the bottom tray at the unloading position. Movement of the piston rod of the stop cylinder from its extended to retracted position is under the control of the operator in the control room but the piston rod is automatically extended and thus set to initially stop the car with the top tray of the car at the unloading level.

In the drawings, in which like parts are indicated by like reference characters in the several views,

Fig. 1 is a diagrammatic perspective of our apparatus with the car at the bottom of the powder trunk, the door at the loading level being unlocked and open, and the door at the unloading level closed and locked;

Fig. 2 is a view similar to Fig. 1 but with the car at the top of the powder trunk, the upper door open and the lower door closed;

Fig. 3 is a view of the hydraulic system and controls therefor utilized in the invention;

Figs. 4 and 5 are enlarged detail views of the means operated by the car for unlocking the door at the unloading level as the car ascends in the trunk;

Fig. 6 is an enlarged detail view of the means for locking the door at the unlocking level; and,

Fig. 7 is an enlarged detail view of a portion

of the apparatus associated with the door at the loading level.

Referring now to the drawings, a powder trunk 10 illustrated in Figs. 1 and 2 by broken lines, extends upwardly from a powder handling room and terminates in a control room which is adjacent to the gun chamber. A door 11 opens from the handling room into the trunk 10 and a door 12 opens into the gun chamber from the control room adjacent the top of the trunk 10.

A powder car 13 operates in the trunk between the powder handling room and the control room. This powder car is divided into upper and lower compartments 14 and 15 respectively, and powder bags 16 are carried in each of the compartments.

A hydraulic system is provided for operating car 13 within the trunk 10. This system includes a hydraulic cylinder 17, a hydraulic pump 18, a motor 19 for driving the pump 18, an expansion tank 20, a control valve 21, and a second hydraulic cylinder 22.

Hydraulic cylinder 17, which is single acting, i. e., the car 13 being lowered by gravity, contains a piston 23, and a piston rod 24, connected to the bottom of car 13. The upper end of cylinder 17 terminates in a buffing region 25 formed by an internal collar 26. Piston 23 is provided with an enlarged tapered portion 27. Thus on the upward stroke of the piston 23, as the car 13 approaches its initial unloading position, at which position the upper compartment 14 in car 13 will be directly opposite the door 12, the tapered portion 27 on the piston 23 will enter the buffing region 25 and thereby provide for automatic deceleration of the car 13 due to the throttling action of oil between tapered surface 27 and collar 26. A check valve 28 permits unrestricted flow of oil into the buffing region 25 at the beginning of the upward stroke of the piston 23, but traps the oil in the buffing region 25 as the tapered portion 27 begins to enter this region.

Likewise an internal tapered recess 29 provided at the bottom of cylinder 17 cooperates with a complementary external tapered protuberance 30 provided at the bottom of piston 23 to provide for automatic deceleration of piston 23, and hence car 13, as the latter is lowered.

A check valve 31 is provided at the bottom of cylinder 17 to trap oil in the recess 29 as the tapered portion 30 of piston 23 enters the recess.

The hydraulic pump 18 is provided for operating piston 23 within the cylinder 17. This hydraulic pump is preferably of the positive-displacement, multiple piston, variable discharge type, such as, for example, as described in U. S. Patent No. 1,794,946, and is controlled by a tilting plate operated by means of a handle 32 located in the control room and connected to the tilting plate in the pump 18 by linkage means comprising shaft 33, crank 34, rod 35, and crank 36. The pump 18 is also provided with a replenishing valve 37 to permit flow of oil from the expansion tank 20 to the pump and a relief valve 38 connected between the high and low pressure sides of the pump.

The cylinder 22 containing a piston 39 and piston rod 40 connected thereto is provided at the top of powder trunk 10 and serves to bring car 13 to a positive stop at the correct positions for unloading the powder bags 16.

When piston 39 occupies its downmost position in cylinder 22, piston rod 40 will abut and stop car 13 at its lower unloading position with the upper compartment 14 therein opposite the door 12 so that when the door 12 is opened, the operator in the control room can push the powder bags in the compartment 14 onto a loading tray located in the gun chamber. When piston 39 and rod 40 move to their uppermost position, car 13 will be stopped at its upper unloading position with the lower compartment therein opposite the door 12 so that the powder bags 16 in the lower compartment 15 may likewise be pushed onto the loading tray by the operator in the control room. Piston 39 is provided with a tapered recess 41 which cooperates with a tapered protuberance 42 at the top of the cylinder 22 to provide automatic deceleration for car 13 as it approaches its upper unloading position. Cylinder 22 also includes an orifice 43 which connects with the expansion tank 20 by means of conduit 44 for expelling any air which may be entrapped in the upper end of cylinder 22.

Control valve 21 located in the control room near handle 32 is used to control the porting of oil between cylinder 17, cylinder 22 and expansion tank 20 and thus regulate the stopping of the car 13 at both its lower and upper unloading positions. This valve includes pistons 45 and 46, a push rod 47 for operating the pistons, a rod 48 protruding from the lower end of the valve casing and connected to piston 46, a check valve 49, and orifices 50 and 51.

The control handle 32 is movable to three positions which are labeled respectively "Hoist," "Stop," and "Lower." When handle 32 is moved to "Hoist," the tilting plate in pump 18 is moved so that oil is ported under pressure from pump 18 through conduit 52 to all parts of the cylinder 17 causing piston 23 therein and hence car 13 to move upwardly. At the same time, cylinder 22 is connected to high pressure conduit 52 by conduit 53, orifice 51 in valve 21, check valve 49 and conduit 54. As car 13 rises in the trunk 10 and approaches its initial unloading position, the tapered portion 27 of piston 23 will begin to enter the buffing region 25, causing car 13 to decelerate and finally be brought to rest as the top of the car 13 strikes against the bottom of the extended piston rod 40. When oil can no longer flow into the cylinder 17, relief valve 38 will open and permit the oil to pass therethrough into the low pressure side of the pump 18.

When handle 32 is moved to the "Stop" position, the tilting plate in pump 18 moves to a neutral position and does not pump oil.

When handle 32 is moved to the "Lower" position, the tilting plate in pump 18 is moved to permit oil to flow outwardly through conduit 55 into the expansion tank 20. Thus as car 13, piston rod 24 and piston 23 are lowered under gravitational forces, oil will be ported under pressure from cylinder 17 through conduit 52 into pump 18 and out of pump 18 through conduit 55 and into expansion tank 20. Oil also flows under pressure through conduit 53, valve 21 and conduit 54 into cylinder 22, moving piston 39 to its initial downmost position.

As piston 23 nears the end of its travel, the tapered portion 30 will begin to enter recess 29 causing car 13 to decelerate and finally be brought to rest at the loading position with car 13 opposite door 11.

A two-position indicator 56 is located also in the control room. At one position this indicator reads "Hoist" and in the other position it reads "Car down." This indicator, which signals the operator in the control room to raise car 13 or to

move the handle 32 to "Stop," is operated by means of a shaft 57 which extends between the control room and the lower powder handling room.

It is desirable to provide interlocking mechanism between the lower door 11 and the handle 32 so that under no conditions can car 13 be raised while the lower door 11 is unlocked. Door 11, manually opened and closed, and which is arranged for sliding movement in guideways 58, is provided with a transverse slot 59 near the top which is adapted to receive a latching lever 60 which is operated by means of a pivoted handle 61 located in the handling room, the end of which rides upon a crank arm 62 which is rigidly secured to a shaft 63, the latter being connected to a midpoint of the latching lever 60. One end of the latching lever 60 is pivotally connected to the shaft 57. The lower end of shaft 57, shown in detail in Fig. 7, terminates in a lost motion coupling consisting of a cylinder 64, a spring 65, and a rod member 66. A bifurcated connecting member 67 is affixed to rod 66 and also connected to one end of a pivot lever 68. The other end of the lever 68 is acted upon by car 13 and serves a function to be described hereinafter in detail.

When in abutting engagement with the lower end of operating handle 32 for pump 18, a pivoted dog 69 serves to prevent handle 32 from being moved to the "Hoist" position. Dog 69 is connected to shaft 57 by suitable linkage means comprising link 70, pivoted lever 71, rod 72, pivoted lever 73, rod 74, pivoted lever 75, rod 76, and pivoted lever 77.

Thus, when car 13 is in the position shown in Fig. 1, with the bottom of the car riding upon the free end of lever 68, which causes shaft 57 to be raised to its uppermost position and thereby draw latching lever 60 out of slot 59, dog member 69 will effectively prevent handle 32 from being moved to the "Hoist" position. However, when the lower door 11 is closed, movement of handle 61 from the "Car down" position inscribed on a plate 78 in Fig. 1 to the "Ready to hoist" position shown in Fig. 2, will cause latching lever 60 to enter slot 59 of door 11 and the shaft 57 to move downwardly through the aforesaid lost motion mechanism, turning pivoted lever 77 and the remaining linkage mechanism 70 to 76 to move the dog 69 out of engagement with the lower end of handle 32. This downward movement of shaft 57 also causes the indicia "Hoist" to show on the indicator 56. Thus the operator in the control room knows that the lower door 11 has been closed and locked and is the signal for him to operate handle 32 to the "Hoist" position.

A hydraulic system is provided for opening and closing the upper door 12. This system includes a hydraulic pump 79 which may be of any suitable type, an electric motor 80 for driving the pump 79, a control valve 81 and operating lever 82 therefor located in the gun chamber, a hydraulic cylinder 83 for operating locking latches 84 on the door 12, another hydraulic cylinder 85 for moving door 12 to its open and closed positions, a valve 86 operated by the door 12, a relief valve 87 and an expansion tank 88.

Cylinder 85 is supported pivotally at 89 and is provided with a double acting piston 90 and a piston rod 91 connected pivotally at 92 to door 12. To open door 12, oil is ported under pressure into the top of cylinder 85, driving piston 90 and piston rod 91 downwardly to the position shown in Fig. 2. To close the door, oil is ported under pressure into the bottom of cylinder 85 driving the piston 90 and rod 91 upwardly to the top, as shown in Fig. 1.

Cylinder 83 is pivotally supported at 93 and is also provided with a double acting piston 94 and piston rod 95 connected pivotally to lever 96. Lever 96 is connected to latches 84 by pivoted lever 97 and links 98 and 99. For unlocking the door 12, oil is ported under pressure into the bottom of cylinder 83, driving piston 94 and piston rod 95 upwardly to the position shown in Fig. 2. For locking door 12, oil is ported under pressure to the top of cylinder 83, driving piston 94 and piston rod 95 downwardly to the position shown in Fig. 1.

It will be evident that when door 12 is to be opened, piston 94 in cylinder 83 must operate to rotate latches 84 out of locking position in advance of the operation of the piston 90 in cylinder 85. To obtain this sequence of operation, we have arranged for the cylinder 83 controlling the latches 84 and the cylinder 85 controlling the opening and closing of door 12 to be connected hydraulically in series.

Thus, when lever 82 on valve 81 is moved to the position shown in full lines in Fig. 3, oil will be ported from pump 79, through conduit 100, through valve 81, and through conduit 101 to the bottom of cylinder 83, causing piston 94 therein to move upwardly. When piston 94 reaches its topmost position, entrance to conduit 102 is uncovered and oil is then ported through this conduit into the top of cylinder 85, driving piston 90 to the position shown in Fig. 3 to open the door 12. When piston 90 reaches the bottom of cylinder 85, the flow of oil will cease, causing its pressure to be built up in conduit 100 leading from pump 79. When the pressure of the oil is equal to the predetermined operating pressure of the relief valve 87, oil will be ported from the pump 79 through conduit 103 and relief valve 87 into expansion tank 88.

When the lever 82 on valve 81 is moved to the position shown in broken lines in Fig. 3, oil will be ported from pump 79 through conduit 100, through the valve 81 and through conduit 104 to the bottom of cylinder 85, causing piston 90 therein to move upwardly and close door 12. As door 12 closes, arm 105 will move to the position shown in broken lines in Fig. 3, in which position the piston 106 in valve 86 is then moved to the upper part of the valve 107 against the opposing force of spring 108, which is operative to connect conduit 109 with conduit 110 leading to the top of cylinder 83. Thus, after the piston 90 in cylinder 85 has moved to its topmost position and closed door 12, oil in conduit 104 will be ported through conduit 109, valve 86, and conduit 110 to the top of cylinder 83, causing piston 94 therein to move downwardly and rotate the latches 84 to their locking position on the door 12.

We provide an interlock to prevent the upper door 12 from being opened while car 13 is below the proper level for unloading. A shaft 111 is provided with a rounded stub portion 112. This stub portion is flattened on opposite sides at 113 and provided with a slot 114.

A support member 115 is provided for mounting a bell crank lever 116 having arms 117 and 118. Arm 118 is provided with a roller 119 which is adapted to move over the top and bottom faces of a diamond shaped cam member 120 which is carried by car 13. The other arm 117 terminates in a forked portion 121 and the latter is con-

nected to the flattened portion of stub 112 by means of a pin 122 which extends between the forks 121 through the slot 114.

A helical spring 123 is carried in compression between a fixed collar 124 on the stub 112 and a movable collar 125 which is slidable transversely upon stub 112. Since the spring 123 is under compression, movable collar 125 will always be urged to the right and against the forked portion 121 of lever 117, and thereby tends to keep pin 122 at the righthand side of slot 114.

As car 13 ascends in the trunk 10, the top face of cam 120 rides against roller 119, causing bell crank 116 to rotate clockwise from its rest position (the middle position shown in Fig. 4) to the position shown in full lines, thereby moving shaft member 111 to the right.

When car 13 descends, the bottom face of cam 120 will ride against roller 119 causing the bell crank 116 to rotate counterclockwise from its rest position to the position shown in broken lines in Fig. 4. However, at this time, the shaft 111 cannot move to the left but movement of the lever 117 is taken care of by movement of pin 122 to the left in slot 114, which causes the spring 123 to be further compressed.

Shaft 111 is coupled through linkage means to a pivoted lever 126 and rod 127 to a pivoted latching lever 128 shown in detail in Fig. 6, which is carried by a support member 129. The support 129 includes a cylinder 130, a piston 131 operable within cylinder 130, and a helical spring 132 carried in compression between the end of piston 131 and the bottom wall of the cylinder 130. Piston 131 includes an extension 133 which abuts a latch portion 134 on lever 96 and a recess 135 which coacts with the end of the latching lever 128.

Rod member 127 is biased downwardly by means of a spring 136 carried in compression between a stop 137 and a collar 138 affixed to rod 127.

When car 13 reaches the unloading position shaft 111 will be moved to the right, causing rod member 127 to move upwardly, and turn latching lever 128 clockwise to the position shown by the broken lines in Fig. 6. This disengages the latching portion 134 on lever 96. As lever 128 rotates, the lower end thereof moves in alignment with recess 135 which permits piston 131 and its extension 133 to move upwardly to the position shown by the broken lines under the restoring force embodied in the spring 132. Upward motion of the extension 133 gives lever 96 and lever 139 connected thereto a positive thrust in an upward direction.

As latching lever 128 rotates, a pointer 140 connected with latching lever 128 by means of a shaft 141 will be moved to a position opposite indicia reading "Car up" inscribed on a suitable plate 142 located in the gun chamber. The operator in the gun chamber then knows that car 13 is up to the proper level to be unloaded and can then open door 12 at will, since, as previously explained, release of the levers 96 and 139 from the latching lever 128 frees piston rod 95 for upward movement in cylinder 83.

It is not desirable to have the door 12 open automatically as car 13 reaches the unloading position because the loading tray for the gun (not shown) on which the powder bags 16 are discharged through the doorway closed by the door 12, must occupy a certain position relative to the door 12 as the latter is opened. Since operation of car 13 is independent of operation of the loading tray, it necessarily follows that control over the door must be under the operator positioned in the gun chamber.

To insure that car 13 as it rises in the trunk 10 will always first come to a stop with the upper compartment 14 at the unloading position, we prefer to provide a mechanical interlock. This interlock comprises a pivotally mounted rocker plate 143 which is operable while the car 13 is below the level of the upper door 12 to prevent the operator in the control room from manipulating push rod 47 on control valve 21. As clearly shown in the drawings, rocker plate 143 is connected for operation with the shaft 111 by means of a link 144 and a pivoted lever 145.

When the car 13 is below the level of the upper door 12, shaft 111 will occupy an extreme left position since rod 127 is biased downwardly under the restoring force of spring 136 acting against stop member 137. This places rocker plate 143 in the position shown in Fig. 1, with the end thereof abutting rod member 48 which is secured to piston 46. This holds valve 21 in the position shown in Fig. 3, in which position, piston rod 48 occupies its downmost position, stopping car 13 with compartment 14 at the proper unloading position.

After car 13 has thus been stopped, which is effective to move shaft 111 to the right, plate 143 is moved to the position shown in Fig. 2, which then allows the operator in the control room to operate pistons 45 and 46 within valve 21 by downward movement of push rod 47.

When push rod 47 is moved downwardly, cylinder 22 is connected to expansion tank 20 through conduit 54, orifice 59 in valve 21 and conduit 146. Also the buffing region 25 in cylinder 17 is connected to the high pressure conduit 53 through conduit 147 and orifice 51 in control valve 21.

To prevent car 13 from being lowered while door 12 is unlocked and therefore free to open at will of the operator in the gun chamber, we have provided further interlocking mechanism for the operating handle 32 controlling pump 18 consisting of a rocker arm 148 fixedly secured to shaft 33 to which handle 32 is also fixedly secured. As previously explained, when car 13 reaches its initial unloading position shaft 111 is caused to move to the right, rotating latching lever 128 and rocker plate 143 to the positions shown in Fig. 2. With rocker plate 143 in this position, operating handle 32 cannot be moved to the "Lower" position, due to the fact that as handle 32 is moved back from the "Hoist" position to the "Stop" position, rocker arm 148 will abut the end of rocker plate 143 and prevent further movement of handle 32 in this direction. This interlock is not released until latching lever 128 is reset to the position shown in Fig. 1 by the operator in the gun chamber as door 12 is closed.

Rocker arm 148 performs the additional function of preventing car 13 from creeping downwardly due to loss of oil in cylinder 17. This is accomplished by arranging the position of rocker arm 148 on the shaft 33 so that when the latter abuts the end of rocker plate 143, handle 32 and hence the tilting plate in pump 18 will be held slightly towards the "Hoist" position. This is effective to port oil to cylinder 17 in an amount sufficient to offset the leakage.

Operation

As soon as the four powder bags 16 have been placed in the car 13 at the powder room, the

lower door 11 is closed manually and the operator in the powder room moves handle 61 downwardly from the "Car down" position shown in Fig. 1 to the "Ready to hoist" position shown in Fig. 2. As previously explained, downward movement of handle 61 moves shaft 57 downwardly which causes latching lever 60 to rotate and lock door 11 in its closed position. Downward movement of shaft 57 also operates the indicator 56 to read "Hoist" and, through the linkage means described, causes dog 69 to rotate away from the control handle 32 to permit movement of the latter to the "Hoist" position by the operator in the control room at the top of the trunk 10. Oil is now ported from pump 18 to cylinder 17, causing car 13 to rise in the trunk 10. As car 13 nears its initial stop position, it will be decelerated by the buffing arrangement located at the top of cylinder 17 and finally brought to rest as the car abuts the extended piston rod 40 in cylinder 22 with the upper compartment 14 in the correct position for unloading. The operator in the control room now moves control handle 32 back towards the "Stop" position until rocker arm 143 abuts the end of rocker plate 143.

As car 13 reaches this first stop position, shaft 111 will move to the right and effect rotation of latching lever 128 to the position shown in Fig. 2, which unlatches lever 96 therefrom and turns indicator arm 140 in the gun chamber to a position opposite the "Car up" indicia carried on plate 142.

When the operator in the gun chamber is ready to open the upper door, he presses downwardly on operating handle 82 of control valve 81, whereupon oil under pressure will be ported from the pump 79 into cylinder 83 to move piston rod 95 upwardly and thereby rotate the pivoted latches 84 away from door 12. Oil will now be ported from cylinder 83 to cylinder 85 causing piston rod 91 to move downwardly and thus open the door 12. As soon as door 12 opens, the operator in the control room will push the two powder bags 16 in the upper compartment 14 through door 12 onto the loading tray in the gun chamber.

The operator in the control room now pushes downwardly on push rod 47 of the control valve 21 which connects cylinder 22 with expansion tank 20 through valve 21 and once again moves control handle 32 to the "Hoist" position whereupon more oil will be ported from the pump 18 into cylinder 17, causing car 13 to rise further in the trunk 10. As the lower tray 15 in car 13 nears its unloading position, car 13 will be decelerated by the buffing arrangement in the top of cylinder 22 and finally brought to rest. The operator in the control room can now push the two powder bags 16 from compartment 15 onto the loading tray in the gun chamber.

As car 13 moves between its first and second unloading positions, the buffing region 25 in cylinder 17 is connected through valve 21 with the high pressure conduit 53. This arrangement permits the enlarged tapered portion 27 of the piston 23 to move upwardly in the buffing region 25 at a rapid rate since with such connection there is no "buffing" or decelerating action.

As soon as the last two powder bags have been transferred from car 13 to the loading tray, the operator in the gun chamber pulls back on handle 82 whereupon oil will be ported under pressure from pump 79 to the bottom of cylinder 85, moving piston rod 91 upwardly to close door 12. When door 12 is almost completely closed piston 106 in valve 86 will move upwardly to permit oil

under pressure to flow into the top of cylinder 83, moving piston rod 95 downwardly and rotating the pivoted latches 84 into locking position across the face of the door 12.

At this time, the latching portion 134 on lever 96 pushes downwardly upon the projection 133 and drives piston 131 downwardly. As soon as the recess 135 clears the lower end of latching lever 128, the spring 136 acting against its stop member 137 causes rod 127 to move downwardly and rotates latching lever 128 to the position shown in Fig. 1.

Downward movement of rod 127 also causes shaft 111 to move to the left and rotate rocker plate 143 clockwise. This motion pushes rod 48 in control valve 21 upwardly restoring the pistons 45 and 46 thereof to the position shown in Fig. 3 and releasing the interlock on control lever 32.

The operator in the control room can now move lever 32 to the "Lower" position. As previously described, as the car 13 descends oil will now be ported from cylinder 17 through conduits 52 and 53, valve 21, and conduit 54 to cylinder 22, thereby pushing piston 39 and piston rod 40 to their lowermost positions. Oil will also be ported through conduit 52 into one side of the pump 18, out the other side of this pump and through conduit 55 to the expansion tank 20.

When car 13 nears the bottom of trunk 10, the former will be decelerated by the buffing action provided between recess 29 and tapered portion 30. As car 13 reaches the bottom of trunk 10, lever 68 will be rotated to cause upward movement of rod 57. This unlatches lever 60 from slot 59, thus unlocking the lower door 11 and rotating the handle 61 to the position shown in Fig. 2 opposite the "Car down" indicia. Door 11 can now be opened and the loading operation repeated.

In conclusion, we wish it understood that while the embodiment of our invention which has been described herein is to be preferred, many changes and modifications may occur to those skilled in the art without departing from the spirit and scope of the invention, as defined by the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

We claim:

1. In hoist apparatus including a trunk extending between upper and lower levels, a door at each of said levels openable to said trunk, a car operable within said trunk, and movement imparting means for said car, the combination comprising control means for operating said movement imparting means, locking means for each of said doors, means positively retaining said locking means for said upper door in operative position, means operable by said car for rendering said retaining means inoperative and for locking said control means against operation to effect downward movement of said car as said car reaches said upper level, and means operable by said car for releasing said locking means for said lower level door and for locking said control means against operation to effect upward movement of said car as said car reaches said lower level door.

2. In hoist apparatus including a trunk extending between upper and lower levels, a door at each of said levels openable to said trunk, a car operable within said trunk, and movement im-

parting means for said car, the combination comprising control means for operating said movement imparting means, first and second stop means for said control means, locking means for each of said doors, means positively retaining said locking means for said upper door in operative condition, means connecting said first stop means with said retaining means for operation therewith, said first stop means being operable upon a release of its associated retaining means to prevent operation of said control means to effect downward movement of said car, and means connecting said second stop means with said locking means for said lower level door for operation therewith, said second stop means being operable to prevent operation of said control means to effect upward movement of said car upon its associated locking means being rendered inactive.

3. The combination in claim 2 wherein said retaining means for said upper level door locking means is automatically rendered inactive by said car as the latter reaches said upper level and wherein said locking means for said lower level door is also automatically released as said car reaches said lower level.

4. In hoist apparatus including a trunk extending between upper and lower levels, a door at each of said levels openable to said trunk, locking means for each of said doors, said locking means being operable to secure said doors against opening when in a closed position, means associated with said upper door locking means for positively retaining said locking means in operative condition, a car operable within said trunk, a hydraulic cylinder including a piston therein operatively connected to said car for hoisting and lowering said car, a pump for operating said piston, and a control lever for said pump, the combination comprising first stop means for said control lever, means connecting said stop means with said retaining means for said upper level door locking means for operation therewith, said first stop means being operable to prevent said control lever from being moved so as to effect lowering movement of said car when said retaining means for said upper level door locking means is unfastened, second stop means for said control lever, and means connecting said second stop means with said lower level door locking means for operation therewith, said second stop means being operable to prevent said control lever from being moved so as to effect hoisting movement of said car when said lower level door locking means is unfastened.

5. A hydraulic system for operating a car within a trunk from a lower loading level to first and second upper unloading levels comprising a main cylinder including a piston and piston rod operatively connected to said car, a stopping cylinder including a piston and piston rod adapted when fully extended to abut and stop said car at said first unloading level and when fully retracted to stop said car at said second unloading level, means for operating said main cylinder to raise said car, means for porting fluid to said stopping cylinder to cause the piston rod thereof to become fully extended and therefore operable to stop said car at said first unloading position, said last mentioned means also being operable to permit fluid to be ported outwardly from said stopping cylinder as said car moves upwardly from its first to its second unloading position, and means controlled by said car for preventing porting of fluid from said stopping cylinder until said car has reached its first unloading level.

6. A hydraulic system for operating a car within a trunk from a lower loading level to first and second upper unloading levels comprising a main cylinder including a piston and piston rod operatively connected to said car, a stopping cylinder including a piston and piston rod adapted when fully extended to abut and stop said car at said first unloading level and when fully retracted to stop said car at said second unloading level, a hydraulic pump, conduit means connecting said pump to said main cylinder, means for connecting said main cylinder with said car stopping cylinder whereby fluid may be ported from said main cylinder to said car stopping cylinder during downward movement of said car to cause the piston rod of the stopping cylinder to become fully extended and therefore operable to stop said car at its first unloading position upon the return upward movement of said main cylinder piston and car, and means for porting said fluid outwardly from said stopping cylinder as said main cylinder piston and car move upwardly from said first to said second unloading position.

7. The combination in claim 6 and including means controlled by said car for preventing porting of fluid outwardly from said stopping cylinder until said car reaches said first unloading level.

8. A hydraulic system for operating a car within a trunk from a lower loading level to upper first and second unloading levels comprising a main cylinder including a piston and piston rod operatively connected to said car, a buffing cylinder including a piston, buffing means and a piston rod adapted when fully extended to abut and stop said car at said first unloading level and when fully retracted to stop said car at said second unloading level, a hydraulic pump, means connecting the high pressure side of said pump to said main cylinder, means including a control valve for connecting said main cylinder with said buffing cylinder whereby fluid may be ported from said main cylinder to said buffing cylinder during downward movement of said car to cause said piston rod in said buffing cylinder to become fully extended and therefore operable to stop said car at its first unloading position upon the return upward movement of said main cylinder piston and car, and means including said control valve for connecting said buffing cylinder with the low pressure side of said pump whereby fluid may be ported from said buffing cylinder to the low pressure side of said pump as said main cylinder piston and car move upwardly from the first to the second unloading position.

9. The combination in claim 8 and including means controlled by said car for preventing operation of said control valve to connect the buffing cylinder with the low pressure side of the pump until said car has reached said first unloading position.

10. A hydraulic system for operating a car within a trunk from a lower loading level to first and second upper unloading levels comprising a single-acting main cylinder including a piston and piston rod operatively connected to said car, a buffing cylinder including a piston, buffing means therefor and a piston rod adapted when fully extended to abut and stop said car at said first unloading level and when fully retracted to stop said car at said second unloading level, a hydraulic pump, an expansion tank, a multiple position control valve including check valve means and a by-pass therefor, first conduit means

leading from the high pressure side of said pump to said main cylinder to supply fluid for hoisting the piston in said main cylinder, second conduit means leading from said first conduit to said control valve, third conduit means leading from said control valve through said check valve means to said buffing cylinder, fourth conduit means leading from said control valve to said expansion tank, and fifth conduit means leading from said expansion tank to the low pressure side of said pump, said control valve being operable when in one position to connect said second and third conduit means through said check valve means whereby fluid will be ported from said main cylinder to said buffing cylinder upon a downward movement of said main cylinder piston and car to cause said piston rod in said buffing cylinder to become fully extended and therefore operable to stop said car at its first unloading position upon the return upward movement of said main cylinder piston and car, said control valve being operable when in the other position to connect said third and fourth conduit means through said bypass whereby fluid will be ported from said buffing cylinder to said expansion tank as said main cylinder piston and car moves upwardly from its first to its second unloading position and bringing said car to a stop when said buffing cylinder piston rod is fully retracted.

11. In a hoist apparatus, the combination with a car, a hydraulic cylinder the piston of which is connected to said car for raising said car to a predetermined position, a hydraulic pump, and control means for said pump including an operating handle movable between "Hoist," "Stop" and "Lower" positions, of stop means associated with said handle and operable when said car is raised to its predetermined position for preventing said control means from being returned completely to its "Stop" position thereby porting a relatively small quantity of fluid to said cylinder from said pump to offset any leakage of fluid in said cylinder which would otherwise permit said cylinder piston to creep downwardly.

12. In a hydraulic system for operating a car within a trunk between a lower loading level and first and second upper unloading levels, the combination comprising means for moving said car, hydraulic car position defining means including a piston adapted when fully extended to stop said car at said first unloading level and when fully retracted to stop said car at said second unloading level, control means for said piston normally maintaining said piston in said extended position and operable to release said piston for movement to said retracted position to permit said car to move to said second unloading level, and means operable by said car for assuring that said control means maintains said piston in said extended position until said car reaches said first unloading level.

13. In a hydraulic system for operating a car within a trunk between a lower loading level and first and second upper unloading levels, the combination comprising means for operating said car, a piston adapted when fully extended to stop said car at said first unloading level and when fully retracted to stop said car at said second unloading level, control means for said piston, said piston control means being operable to maintain said piston in said extended position and to release said piston for movement to said retracted position to permit said car to move to said second unloading level, means operably connecting said car operating means with said piston control means and operable to move the piston to its extended position upon downward movement of said car, and means operable by said car during upward movement for assuring that said piston control means maintains said piston in said extended position until said car reaches said first unloading level.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
540,169	Kidder	May 28, 1895
1,959,786	Hodgkinson	May 22, 1934