Dec. 16, 1941. M. N. NYBERG 2,266,240

ELEVATOR CONTROL MECHANISM

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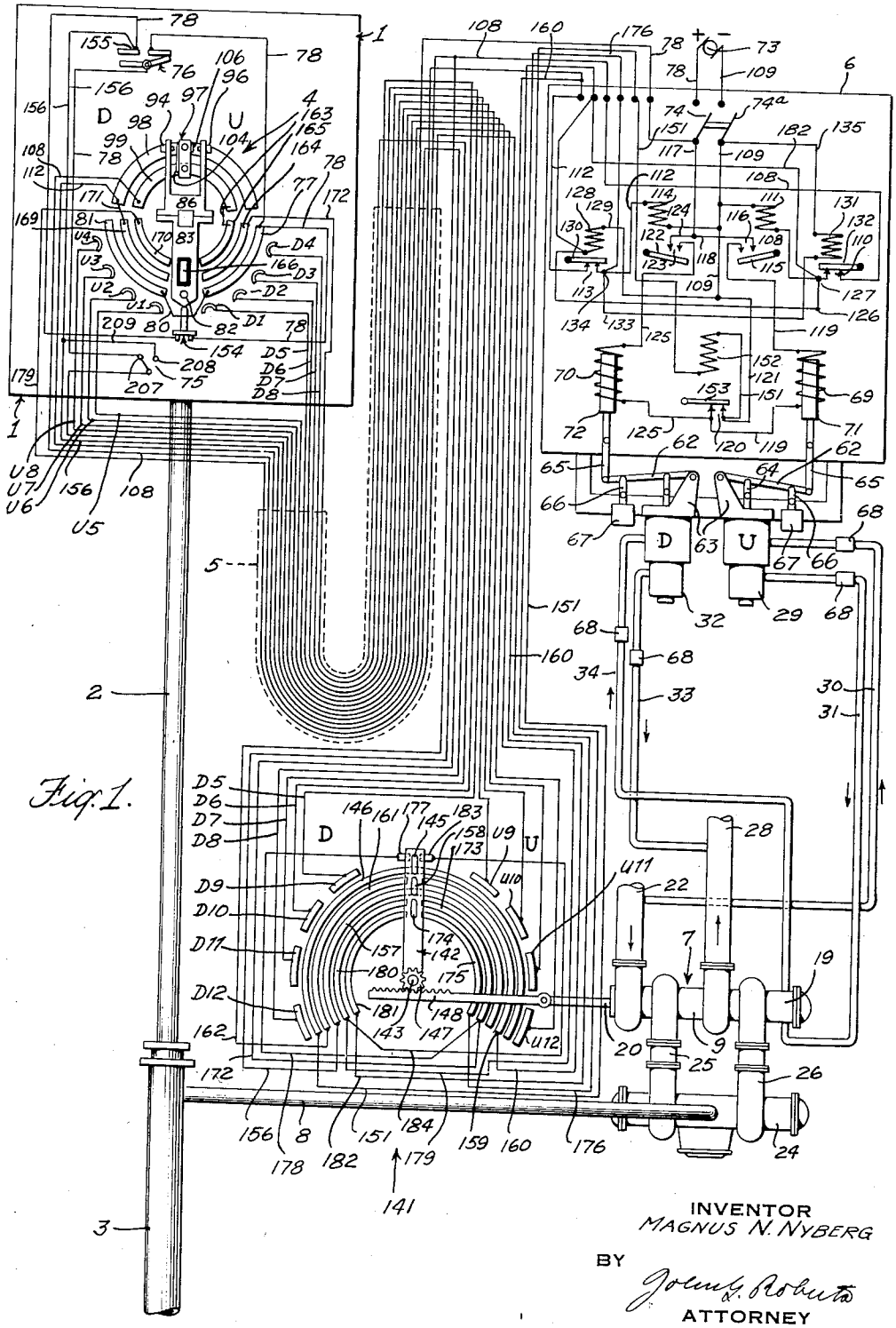


Fig. 1.

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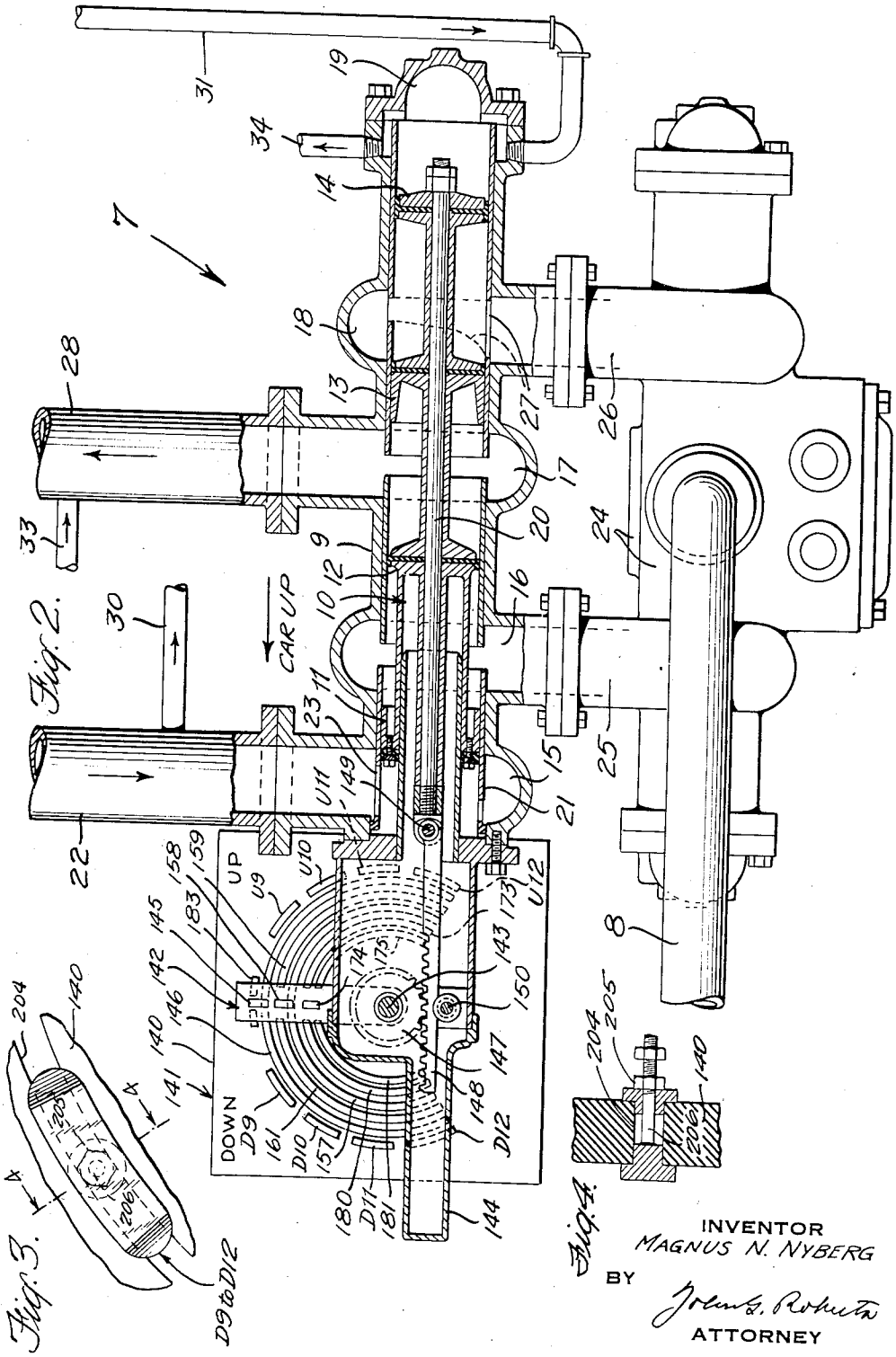


Fig. 2.

Fig. 3.

Fig. 4.

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ELEVATOR CONTROL MECHANISM

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Fig. 5.

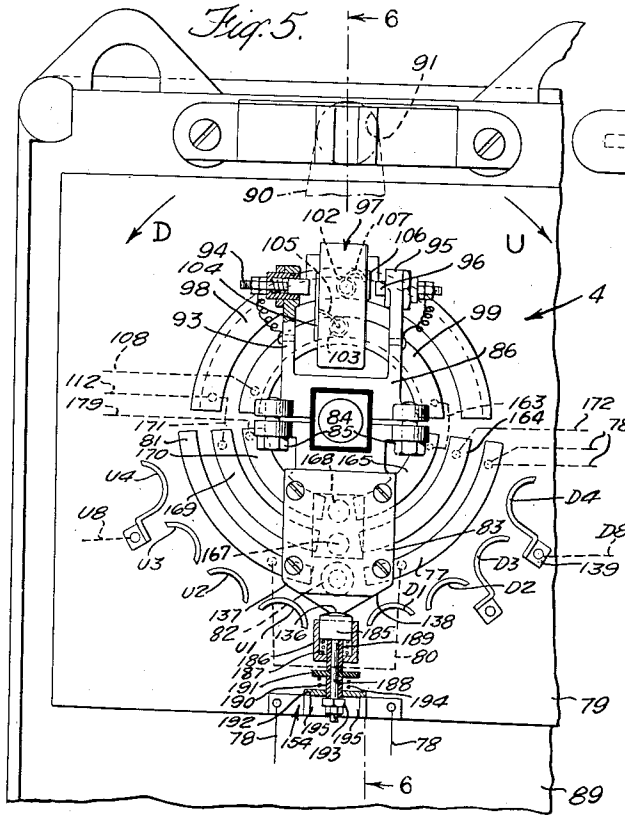


Fig. 6.

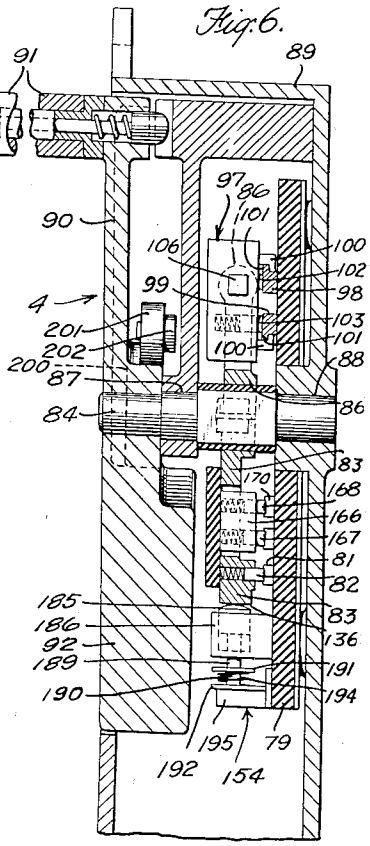


Fig. 7.

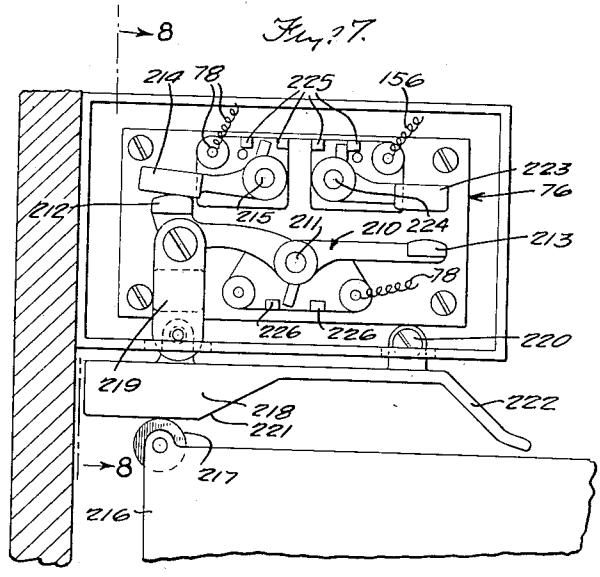
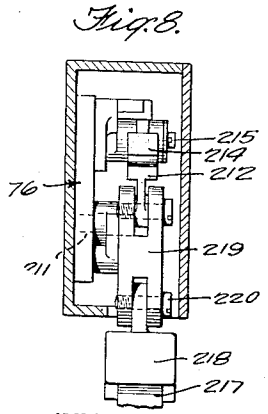


Fig. 8.



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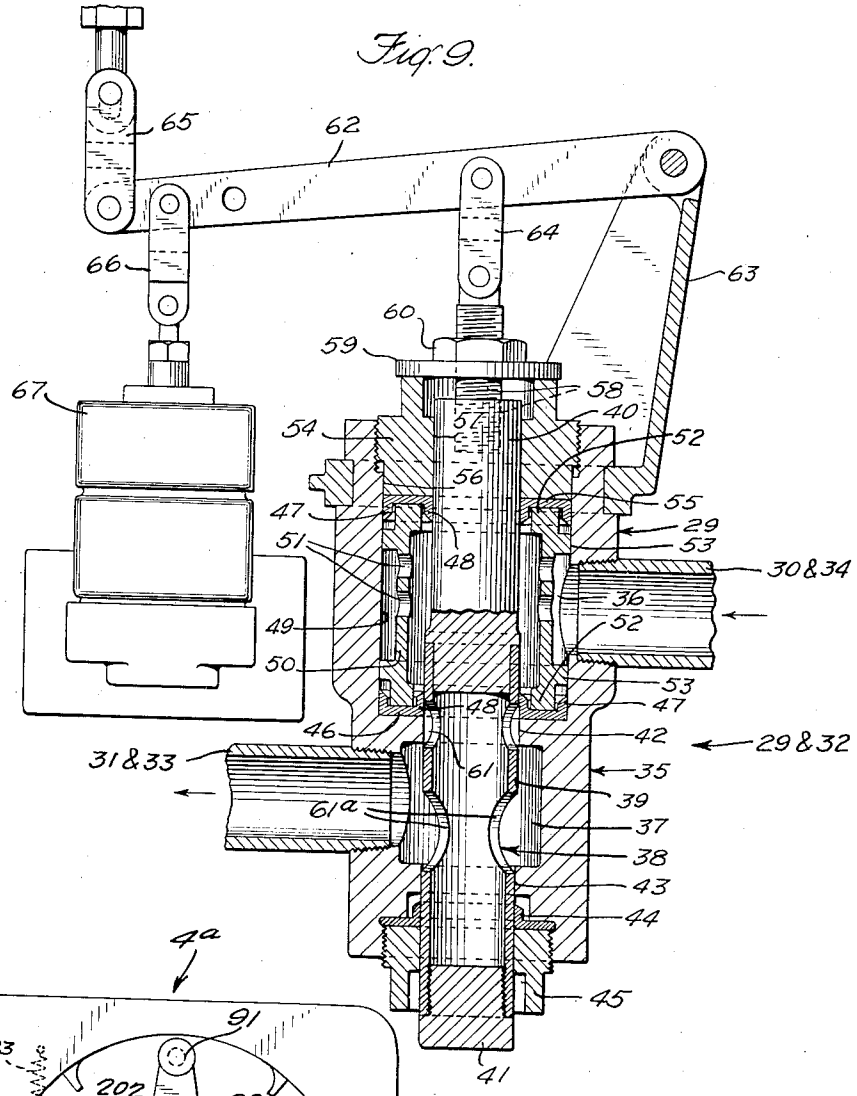
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Fig. 9.



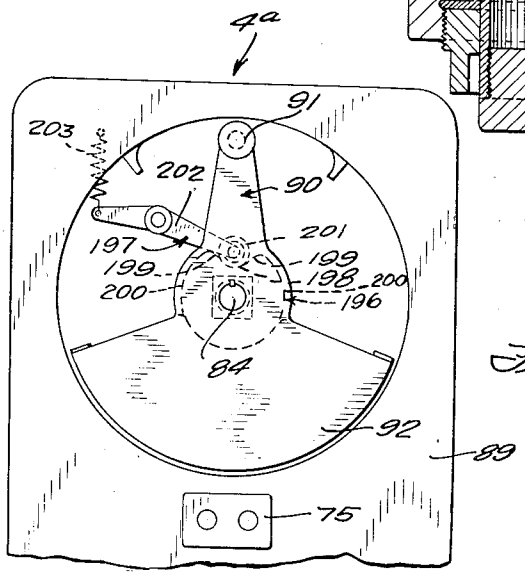


Fig. 10.

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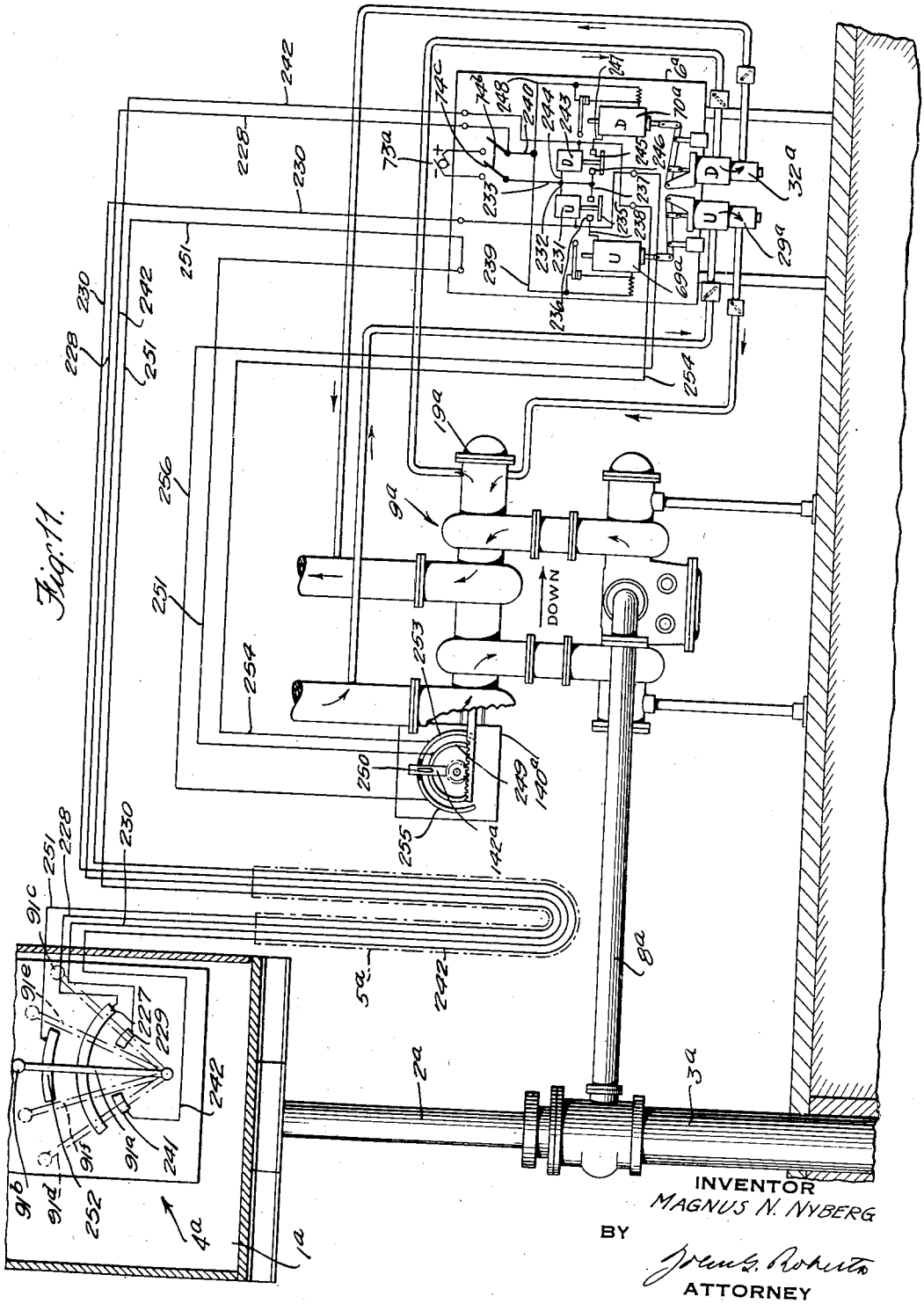


Fig. 11.

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UNITED STATES PATENT OFFICE

2,266,240

ELEVATOR CONTROL MECHANISM

Magnus N. Nyberg, Oceanside, N. Y., assignor to Hydraulic Elevator and Machine Company, Incorporated, Brooklyn, N. Y., a corporation of New York

Application April 16, 1940, Serial No. 329,843

15 Claims. (Cl. 187—29)

This invention relates to electric control systems for elevators but more particularly to such control systems for hydraulic elevators.

The principal object of the invention is to provide an electric control system for a hydraulic elevator, which will enable the elevator to have a plurality of predetermined upward and downward speeds.

A further object is to make such speeds selectable at will for the proper operation of the hydraulic elevator car.

Another object of the invention is to provide such an electric control which will bring about a saving in the amount of water energy used thus reducing the cost of operation.

A still further object is to provide such a system which is efficient in operation, simple in construction, and fool proof in control, so that the operators of electrically driven cars will be able to control hydraulic cars in substantially the same manner as the electrically driven cars.

Another object is to provide an efficient and simple car door switch for the purpose of stopping the car when the door is opened while the car is in motion.

Another object of the invention is to improve the appearance of the interior of a hydraulic elevator car by removing the usual large operating lever and substituting therefore a small and neat control switch such as are used on the electrically driven elevator cars.

Other objects and advantages will hereinafter appear.

Referring to the drawings:

Fig. 1 is a schematic view of the mechanical and electrical variable speed mechanism for hydraulic elevators.

Fig. 2 is a detail view partly in section of the main valve and the pilot switch mechanism controlled thereby.

Fig. 3 is a fragmentary detail view of one of the valve arresting or stop contacts of the pilot switch.

Fig. 4 is a section taken on line 4—4 of Fig. 3.

Fig. 5 is a detail face view showing the internal construction of the car switch with the face plate and operating handle omitted.

Fig. 6 is a cross section taken on line 6—6 of Fig. 5.

Fig. 7 is a fragmentary view of the car door and car door switch.

Fig. 8 is a section taken on line 8—8 of Fig. 7.

Fig. 9 is a sectional view of one of the auxiliary valves.

Fig. 10 is a front view of the car switch.

Fig. 11 is a schematic view of a modified form of the electrical control system for operating a hydraulic elevator.

Referring to the Fig. 1, numeral 1, denotes an elevator car moved by the usual hydraulic motor comprising a plunger 2 attached to said car 1 and a cylinder 3 in which the plunger 2 operates. A control switch 4 mounted in the car 2 controls by a long cable 5 (only schematically indicated), through a panel board 6, preferably installed adjacent the elevator shaft, the main valve 7 which is connected by a pipe 8 to cylinder 3. The main valve 7 is of a type well known in the hydraulic elevator art and will be described only in such detail as is necessary to the understanding of it in connection with the electrical control system involved. The main valve 7, shown in detail in Fig. 2, consists mainly of a long cylinder housing 9 and a reciprocating main valve 10 comprising four spaced pistons 11, 12, 13, and 14 which divide the cylinder 9 into five chambers 15, 16, 17, 18, and 19. The pistons are rigidly mounted on connecting rod 20 one end of which reciprocates in a stuffing box sleeve 21. The water is admitted by supply pipe 22 to chamber 15 and piston 11 by means of port 23 which controls the flow of water to chamber 16 which is connected to another cylinder 24 by a pipe 25. The water flows to and from cylinder 3 by pipe 8 and flows out of cylinder 24 through pipe 26 to chamber 18 and the piston 13 by means of a port 27 which controls the flow of water to chamber 17 and out of discharge pipe 28. When the main valve 10 is in the neutral position shown in Fig. 2, the ports 23 and 27 are closed and the water is locked in the cylinder 3 and the car 1 is stopped. When the main valve 10 is moved to the left the water pressure is admitted through port 23 to raise the car 1 and when it is moved to the right the water escapes through port 27 to pipe 28 to permit the car to descend.

The extent to which the ports are opened controls the speed of the car up or down and the main valve 10 is moved and held in any up car or down car position or neutral position by water which is metered to and from chamber 19.

Water is admitted to chamber 19 by means of an auxiliary valve 29, Figs. 1 and 9, which is connected by a pipe 30 to supply pipe 22 and by a pipe 31 to the chamber 19, and water is permitted to escape from chamber 19 by another auxiliary valve 32 connected by a pipe 33 to discharge pipe 28 and by a pipe 34 to chamber 19.

Both auxiliary valves 29 and 32 are alike in construction. Therefore only one will be de-

scribed. They operate under pressure and are of the balanced pressure type which enable them to be opened and closed with little power. Each valve, Fig. 9, consists of a body 35 divided into an upper large intake chamber 36 and a lower smaller discharge chamber 37 through which reciprocates a sleeve valve 38, comprising a sleeve portion 39, solid portion 40 and a plug portion 41, all connected together.

The sleeve 38 moves snugly in a bearing 42 dividing both chambers and in a bearing 43 forming the end of chamber 37. The sliding connection between the lower end of the chamber 37 and sleeve 38 is sealed by a packing ring 44 held in place by a ring nut 45 and the intake chamber 36 is sealed from the discharge chamber 37 by a U shaped packing ring 46 having flanges 47 and 48 engaging under pressure the inside bore 49 of the chamber 36 and the surface of the sleeve valve 38 respectively. A sleeve 50 having perforations 51, thickened ends 52 and ring portions 53 bears down on packing ring 46, and a large ring nut 54 threaded into the valve body 35 bears down on a cup packing ring 55 carried on the thickened top end 52 of the sleeve 50. The large lock nut 54 has a machined cylindrical surface 56 adapted to snugly fit the inside bore 49 of chamber 36 and has a bearing 57 for the solid portion 40 of the sleeve valve 38. The cup packing ring 55 is similar in cross-section to cup packing ring 46 and is oppositely faced so that the pressure in the chamber 36 will cause the similar flanges 47 and 48 to expand and seal the chamber against any leak to atmosphere. The integral rings 53 of the sleeve 50 snugly fit the same into the inside bore 49 and the thickened ends 52 provide a wide sealing and clamping area.

The solid end 40 of the sleeve valve has a thread portion 58 carrying a threaded washer 59 and lock nut 60. The washer is adapted to bear upon the ring nut 54 to control the down and closed position of the sleeve 38 which in Fig. 9 is shown in its lowermost position.

When the sleeve 38 is raised a ring of perforations 61 is brought into alignment with chamber 36 and a ring of perforation 61*a* remain in communication with chamber 37 and the flow of water is permitted from chamber 36 to chamber 37. When the sleeve 38 is lowered the ring of perforations 61 is brought below the upper lip of the flange 48 of cup packing 46 and the water is locked in chamber 36.

The sleeve valve 38 is moved up and down by a lever 62, Figs. 1 and 9, pivoted at one end to a bracket 63 attached to the body 35, and connected by a link 64 to the sleeve valve and by a link 65 to an armature of a solenoid, hereinafter referred to. A link 66 connects the lever 62 with a dash pot 67 which governs the speed of movement of the valve 38, and serves to return the valve 38 to closed position. Each of the pressure lines 30 and 34 connects with the intake chamber of its valve and each of the discharge lines 31 and 33 connects with the discharge chamber of its valve. To prevent a resurge of the water a check valve 68 is carried by each of the lines.

When the auxiliary valves 29 and 32, Figs. 1 and 9, are closed the water is locked in chamber 19 and valve 10, Fig. 2, is likewise locked in position. When valve 29 is opened valve 10 is moved to the left against the lesser pressure on piston 11 and when the auxiliary valve 32 is opened water is forced out of the chamber 19 by the water supply pressure on the same piston 11. As will be seen from the above, chamber 19 and piston 14 serve as a hydraulic motor to move the main valve 10 and valves 29 and 32 serve as controls therefor.

The balance of pressure in these slide valves 29 and 32, Fig. 9, hereafter called up auxiliary valve and down auxiliary valve, respectively, is brought about by extending the sleeve 38 through both chambers into atmosphere and by having water pressure bear equally against the inside blind ends of the same. The specific design of the valves is such as to permit a very fast flow of water when open.

The valves 29 and 32 are carried on the panel board 6, Fig. 1, and are operated by solenoids 69 and 70, respectively, acting on armatures 71 and 72 connected by links 65 to their respective valve levers 62.

When either of the solenoids is energized the associated valve is opened. The up solenoid 69 and down solenoid 70 are a part of an electrical system controlled by the car switch 4 which enables the operator to run the car at different up and down speeds or to stop the car as will be described now.

The electrical system includes a direct current generator 73, Fig. 1, feeding current through a knife switch 74, cable 5, emergency car switch 75, door switch 76, Figs. 1, 7 and 8, to an arcuate down segment 77, Figs. 1 and 5, by means of a line 78. The down segment 77 is carried on a dielectric panel 79, Figs. 5 and 6, of the control switch 4 and is connected by a conductor 80 to an arcuate segment 81 also carried on the panel 79. Both of the segments are adapted to be engaged by a spring pressed contact brush 82 carried on a depending arm 83 secured to a shaft 84 by means of bolts 85 which also serve to secure an upper forked arm 86 to the shaft.

Both of the arms, Figs. 5 and 6, are insulated from the shaft 84 which is journaled in supports 87 and 88 of a housing 89 for control switch 4. The shaft also fixedly carries an upstanding arm 90 having a detent handle 91 of the usual design which is adapted to lock the arm 90 in vertical position and a weight 92 is provided so that when the arm is free the weight will serve to bring the arm back to vertical locking or "off" position.

The upper forked arm 86, Fig. 5, carries in tine 93 a spring pressed contact 94 and in tine 95 a spring pressed contact 96, and both of these contacts are adapted to alternately engage a switch block 97, positioned in said fork and mounted to slide on concentric arcuate segments 98 and 99. The switch block is of dielectric material and carries ears 100 engaging over flanges 101 on the segments and is thereby slidably held to the same. The switch block houses a spring pressed brush 102 for engaging the down segment 98 and a like spring pressed brush 103 for engaging the up segment 99 and also carries an up contact plate 104 adapted to be engaged by contact 94 and connected by a conductor 105 to the brush 103 and a down contact plate 106 adapted to be engaged by contact 96 and connected by a conductor 107 to brush 102.

When the arm 86, Fig. 5, is turned into a right zone or up car position the current in said arm picked up by brush 82 from segment 81 will pass to arcuate segment 99 and when turned into a left zone or down car position the current will pass to arcuate segment 98 from segment 77.

A conductor 108, extending through the cable 5, connects the up segment 99 with the outgoing generator line 109, Fig. 1, through a normally closed relay switch 110 and a relay coil 111, and

a conductor 112 connects the down segment 98 with the outgoing line 109 through a normally closed relay switch 113 and a relay coil 114. Line 109 extends through normally closed knife switch 74a to generator 73. Both switches 74 and 74a move as one.

When relay coil 111 is energized its armature 115 closes a switch 116 which by means of line 117 from conductor 78, line 118, line 119, normally closed switch 120, line 121 and line 109 establishes a circuit through solenoid 69 and causes same to draw up its armature 71 and open up valve 29. Likewise when the relay coil 114 is energized its armature 122 closes switch 123 which by means of line 117, line 124, line 125, normally closed switch 120, line 121 and line 109 closes a circuit through solenoid 70 which causes its armature 72 to rise and open down valve 32.

When either up relay coil 111 or down relay coil 114 is energized the switch 110 or 113 in the unselected circuit is opened as a safety measure to prevent any improper opening of an auxiliary valve. Thus when the up relay coil 111 is energized, a line 126 from the connection 127 of switch 110 will pass current through a relay coil 128 then through line 129 to line 109, thus energizing relay coil 128 and causing it to raise its armature 130 and open switch 113. Likewise when the down relay coil 114 is energized a relay coil 131 raises its armature 132 to open switch 110. A line 133 from the connection 134 of switch 113, to relay coil 131 and a line 135 to line 109 make up the circuit for that purpose.

It is therefore understood that when the control switch handle 91 is turned into the right zone, Figs. 1 and 5, the up auxiliary valve 29 is opened and the car 1 is caused to rise faster and faster as the valve 10 moves to the left under pressure of water admitted to chamber 19 and the converse is true when the control handle is turned into the left zone and valve 32 is opened.

In order to move the car 1 up or down at definite selectable speeds the valve 10 is arrested at different positions to either side of its neutral position. The following wiring and mechanism is provided for this purpose.

The end of arm 83, Fig. 5, is shaped to a point 136 by inclined faces 137 and 138 which point and faces are adapted to brush over and engage curved spring contacts U1, U2, U3 and U4 when the handle 91 is moved in the up or clockwise direction, and adapted to engage contacts D1, D2, D3 and D4 when moved in the down or counterclockwise direction.

These U and D contacts are secured by screws 139 to panel board 79 and are connected by lines U5, U6, U7, U8, D5, D6, D7 and D8 to contacts U9, U10, U11, U12, D9, D10, D11 and D12 which are carried by a panel 140 of a pilot switch 141, Fig. 3, controlled by valve 10. The lines U5 to U8 and D5 to D8 extend through the cable 5 to reach the pilot switch 141. This switch 141, Figs. 1 and 2, comprises the last mentioned U and D contacts and a brush arm 142 carried by a shaft 143 journaled in a housing 144 secured to valve cylinder 9. The panel 140 may also be carried by the housing 144. A brush 145 insulated from and carried by arm 142 is adapted to brush over and engage the U and D contacts and carry the current to a long contact segment 146 which spans all the U and D contacts on the board 140. The shaft 143 carries a gear 147 which is meshed by gear rack 148 pivotally secured by stud 149 to the exposed end 20 of the connecting rod 20 of the valve 10. This rack is held in engagement with the gear by riding on an idler roller journaled on a shaft 150.

With the switch 74 closed and the handle 91 moved, for example, to the 3rd up position the switch arm 83 will engage with its point 136 the U3 contact so that a connection will be "set" for up from segment 81, through brush 82, arm 83, contact U3 and line D7 to contact U11 of the pilot switch 141. At the same time the valve 10 has been caused to move to the left by connections involving line 78, segment 81, brush 82, arms 83 and 86, contact 94, "up" contact plate 104, conductor 105, brush 103, segment 99, line 108, closed relay switch 110, line 109, which connections energize "up" relay coil 111 on panel board 6. The coil 111 closes its armature switch 116 and by connections, line 78, (with switch 74 of course in closed position) line 117, line 118, line 119, closed relay switch 120, and line 109 closes the circuit through "up" solenoid coil 69, which by its armature 71 opens the up auxiliary valve 29 causing water pressure to enter chamber 19 and move the valve 10 to the left.

The valve 10 moves to the left until the brush 145 of pilot arm 142 engages the contact U11 and carries the current from contact U11 to segment 146 which by a line 151, the line 121, and the line 109, closes a circuit through a relay coil 152 which raises its armature 153 and thereby opens the switch 120 and breaks the circuit through "up" solenoid coil 69 causing valve 29 to close and arrest the valve 10 at third "up" speed position as long as the control switch handle 91 remains at this position.

To stop the car 1 it is necessary to force the valve 10 back to neutral or car stopping position. By moving the handle 91 back towards neutral position the contacts between switch block 97 and contact plungers 94 and 96 are changed so that the circuits through "up" relay coil 111 and the down safety relay coil 128 are broken and the circuits through up safety relay coil 131 and "down" relay coil 114 established to open the down auxiliary valve 32 and permit the water to escape from chamber 19 and cause the valve 10 to move to the right, Fig. 2, under the water supply pressure.

The specific connections which open the "down" auxiliary valve 32 as soon as the handle 91 is moved towards its central position involve, line 78, segment 77, brush 82, arms 83 and 86, contact 96, "down" contact plate 106, conductor 107, brush 102, segment 98, line 112, closed relay switch 113 on panel board 6, and line 109, which connections energize down relay coil 114 so that its armature 122 closes switch 123. At the same time lines 133, 135 and 109 energize safety up relay 131. This closed switch 123 by means of line 78, line 124, line 125, closed switch 120, line 121, and line 109 closes the circuit through down solenoid coil 70 so that its armature 72 opens down valve 32 which permits water to escape from chamber 19. As the water escapes the valve 10 is moved to the right, Fig. 2, towards neutral car stopping position and to arrest the valve 10 at its neutral position after arm 83 passes U1 contact the following wiring and mechanism is provided.

When the handle 91 has reached its central position the point 136, Fig. 5, of the arm 83 has closed a switch 154 in the line 78 which leads to a car door switch connection 155. From connection 155 a line 156 extends through cable 5 to a segment 157 in the pilot switch panel board 140. This segment is contacted by a

brush 158 on arm 142 in all its "up," "down" and neutral positions. The brush 158 in its up positions will carry the current to a segment 159. A line 160 from segment 159 leads the current to line 112 and through connections already known keeps "down" relay coil 114 energized when the brush 82 leaves the current supply segment 81.

The "down" relay coil 114 will remain energized until the pilot arm 142 reaches neutral position at which point it will have broken the circuit between segment 159 and brush 158. When the coil 114 is thus deenergized the down valve 32 will be permitted to close and thereby lock the valve 10 in its neutral car stopping position.

Should the arm 142 overthrow to the left of neutral position the brush 158 will contact with a segment 161 which by a line 162 connects with the line 108 which through connections already mentioned will energize the "up" relay coil 111 so that the "up" valve 29 is again opened and valve 10 thrown back to neutral position while at the same time the contact is broken between segment 161 and brush 158.

It is understood, of course, that as soon as the arm 83 leaves its U3 contact by the return movement of the handle 91 from the third speed position the circuit is immediately broken through the common arresting coil 152 so that its armature 153 will close switch 120 and thereby permit the circuit be closed through "down" relay coil 114.

Should the handle 91 be stopped, for example, at U1 position after being moved from U3 position the arm 83 will still be getting current from segment 81 so that when pilot arm 142 reaches the U9 contact it will cause the valve 10 to be arrested at first "up" speed position by connections already described.

Should any leaks occur in any of the pipe lines or valves which would displace the valve 10 while the handle 91 is in neutral position, the arm 142, by moving in one direction or the other depending on the location of the leak, will close a circuit through one or the other of the auxiliary valves and cause the valve 10 to be again neutralized. The arm 142 by moving slightly to the right from neutral will close a circuit, through down solenoid 70 by means of brush 153 bridging segments 159 and 157 and through connections already described. The auxiliary valve 70 will therefore be opened and the valve 10 restored to neutral and the circuit broken across segments 159 and 157. The converse will happen when the brush 158 bridges segments 157 and 161. If the leak is continuous it will constantly cause the valve 10 to reciprocate and thereby draw attention to it so that the leak will be attended to. If the leak causes the car 1 to creep "up" or "down" by increments that will also be a signal to the operator or maintenance man to repair the defect.

From the foregoing it will be understood how the car operator will be able to run the car, at will, at different up and down speeds or to stop the same.

The operator may move the handle 91 step by step to accelerate the car up or down, in which case the selected up or down auxiliary valve will be opened and closed intermittently. If, however, the control is moved immediately to higher up or down speed positions the selected auxiliary valve will remain open until the main valve 10 arrives at the high speed position and by its pilot switch arm 142 causes the open auxiliary valve to be closed, and the valve 10 arrested.

This is, of course, due to the fact that the movement of the valve 10 lags behind the more readily movable control switch 4 and therefore the selected "up" or "down" auxiliary valve will remain open during any of the speed positions that have been passed over rapidly by the handle 91 moving in one direction or the other.

The flexibility of the control mechanism also accommodates sudden movements of the handle from any up speed position to any "down" speed position. For example, a movement of the handle from U3 to D4 position will open the down auxiliary valve 32 and keep it open until the pilot switch arm 142 moves from U11 to D12.

If in addition to this sudden movement, the handle is immediately moved back towards neutral position and the pilot switch arm 142 still finds itself, for example, in U10 position, safety mechanism is provided to keep the down auxiliary valve 32 open. Otherwise, with the parts heretofore described, the up auxiliary valve 29 would be opened and the valve 10 would be moving in an up direction whereby its pilot arm 142 could meet no U contact through which a circuit had been set by the control switch 4.

This safety mechanism, Figs. 1, 2 and 5, includes a conductor 163, connected with a safety segment 165, adapted to pass current to an outer safety concentric segment 164 through metallic brush block 166 carried by and insulated from the arm 83 of control switch 4. The brush block 166 carries brushes 167 and 168 adapted to engage segments 164 and 165, respectively, when its arm 83 is in a down position, and adapted to engage, when in an up position, outer and inner safety segments 169 and 170, the former of which is connected by a conductor 171 to down segment 98. The segment 164 is connected by a line 172, through the cable 5 to a segment 173 on the pilot switch panel board 140. When the arm 142 is in an up position under circumstances hereinbefore stated, a brush block 174 (similar to brush block 158) carries the current to a segment 175 which by a line 176 connected at 134 to line 112, energizes the down relay coil 114 on panel 6 and the line 133 from connection 134 also energizes the safety coil 131. The down valve 32 thereby remains open to move the main valve 10 from its "up" position toward neutral car stopping position, and the circuits, that are usually made through the "up" relay coil 111 and coil 128 by reason of the handle 91 moving in an "up" direction, are broken by the energized coil 131 opening switch 110.

If the handle 91 should be stopped at the D1 speed position on its move towards neutral position the "down" auxiliary valve 32 will remain open until pilot switch arm brush 174 leaves segments 173 and 175 near neutral position. This will break the circuits through "down" relay coil 114 and safety coil 131 and as the arm 142 overthrows an increment past neutral its brush 145 will engage a contact 177 which by a line 178 is connected to line 172. The brush 145 being in engagement with segment 146 will cause relay 152 to be energized and open switch 120 and thus prevent either of the auxiliary valves from being opened. Had the handle 91 been moved directly to its neutral position from its "down" position, (under the above conditions), the neutralizing of the main valve 10 would have been brought about by the circuit closed by the

switch 154 and by the brush 158, segments 157 and 159, through "down" relay coil 114 which coil 114 closed circuit through solenoid 70 and opened "down" valve 32.

The converse of the condition set forth hereinbefore requires additional mechanism such as, line 179 connected to outer safety segment 180 on panel 140, an inner safety segment 181, a line 182 therefrom to connection 127, a contact 183 and a line 184 therefrom to segment 180.

From the foregoing it will therefore be understood that when the control handle is moving towards neutral from a "down" position and the pilot switch is in an "up" position the pilot switch will be moved towards its neutral position so long as contact 94 and contact plate 104 are in engagement.

Resistances may be interposed between coil 114 and line 109, coil 111 and line 109, coil 128 and line 109, coil 131 and line 109, when necessary in order to prevent the improper energization of any coils by stray currents.

Switch 154, Fig. 5, has a plunger with a head 185 adapted to be engaged and depressed by the pointed end 136 of the arm 83. The head 185 is slidably guided in a cup 186 carried on the board 79 and acts against a compression spring 187 housed in the cup. The head has a stem 188 carrying insulating sleeves 189 and 190 and washer 191 and a slidable metallic washer 192 which is urged against nuts 193 by a spring 194 between the washers. When the switch is in the position shown in Fig. 5, the spaced contact bars 195 of the line 78 are electrically connected by the washer 192 and the spring 194 slightly compressed. When the arm 83 is moved from the vertical position the spring 187 will raise the plunger and the washer 192 and break the circuit. The speed selector contacts U and D on the board 79 are curved and positioned relative to the faces and pointed end of the arm 83 so that the arm will always be in engagement with the next contact before it breaks with the last one. This arrangement prevents the valve 10 from getting out of the control of control switch 4. The pilot switch arm 142 will always be moving towards a "set" U contact or D contact on the pilot board 140 in order to arrest the valve 10.

The position of the switch 154 in relation to the up and down segments 77 and 81 is such that the switch 154 is opened before the brush 82 contacts with either of its segments and to prevent the handle 91 from being arrested anywhere between its neutral and its first speed positions a cam 196 and follower 197 are provided. The cam 196, Figs. 6 and 10, is formed on the arm 90 and has a low point 198 and rises 199 connecting with dwells 200 on either side.

The follower 197 comprises a roller 201 mounted upon the free end of an arm 202 which is acted upon by a spring 203. The rises 199 and dwells 200 meet at a point coinciding at the first speed positions of the switch so as to bring about the centralizing of the switch between first up and down speed positions.

The U9, U10, U11, U12, and D9, D10, D11, and D12 stop contacts or valve arresting contacts are adjustably mounted on the panel board 140. Each contact plate, Figs. 3 and 4, has a portion of it riding in a slot 204 in the pilot board 140 with a nut 205 threaded onto its stem 206 to hold the contact in position. By shifting these contact plates towards or away from the neutral position of the arm 142 the arrested positions of the valve 10 are changed and thereby the speeds of the car.

The emergency car switch 75 is used to stop the car 1 or prevent its starting and is normally connected to contact 207 in order to have the car 1 under the control of the switch 4, but to stop the car the switch is thrown to contact 208 which by a line 209 is connected to the line 156. This movement breaks the circuit through the control switch 4 and brings the car to a stop by causing the current to pass to contact 208, line 209, line 156, segment 157, brush 158 and by either segments 159 or 161 to relay coil 114 or 111, depending upon the up or down position of pilot arm 142. The position of the arm 142 will determine whether solenoid 69 or 70 is to be energized in order to cause the valve to return to neutral car stopping position.

The door switch 76, Figs. 1, 7 and 8, accomplishes the same purpose as switch 154, that is, when an elevator door is opened, the car 1 is brought to a stop. Also, whenever the door is open, the elevator is prevented from starting. The line 78 leads to a rock lever 210 pivoted at 211 and having contact arms 212 and 213. The arm 212 is normally raised into engagement with a raised contact arm 214 pivoted at 215 and line 78 leads from this raised contact arm 214. The contacts 212 and 214 are held in engagement by a car door 216 having a roller 217 holding up a weighted arm 218 connected by a link 219 to arm 212.

The weighted arm 218 is pivoted at 220 and has a weighted cam end 221 and a safety arm 222. When the door 216 is opened the roller 217 allows the weighted arm 218 to drop and should the arm 218 fail to drop the roller 217 by striking the safety arm 222 will force the weighted arm down. Thereby the lever 210 is rocked to break the contacts 212 and 214 and bring arm 213 into contact with a contact arm 223 which is pivoted at 224 and connected at 155 to line 156.

The contact arms 214 and 223 move between limit stops 225 and lever 210 between stops 226. The arrangement of the contact arms is such as to produce a quick shifting of circuit and at the same time produce large gaps between the separated contacts. When the arm 212 falls the arm 214 will fall with it until the arm 214 is arrested by one of its stops 225 at which point the arm 213 will just about engage the contact arm 223 and then raise it.

The modified form of the invention shown in Fig. 11 has to do with the electrical control and whatever parts correspond to the hereinbefore described invention will carry similar reference characters but with exponents added.

The control switch 4*a* comprises a handle 91*a* adapted to assume a neutral car stopping position 91*b*, and to be moved into up and down speed zones. The up zone comprises a full up speed position 91*c* and an intermediate variable up speed position 91*e*. The down zone comprises a full down speed position 91*d* and an intermediate variable down speed position 91*f*. When in either of these variable speed positions, the car may be moving in any of an infinite number of speeds, between zero and full speed.

When the handle 91*a* is moved to any of the above mentioned positions it is constantly in engagement with a segment 227 which receives current from a direct current generator 73*a* through a knife switch 74*b* by means of a line 228. To cause the car 1*a* to rise the handle 91*a* is moved to dotted position 91*c* wherein the handle engages a contact 229 which is connected by a line 230 to up relay switch coil 231 and the

coil 231 is connected by a line 232 to a line 233 which passes through a knife switch 74c to direct current generator 73a.

The coil 231 is therefore energized and attracts its armature 235 in order to close a switch 236 which by means of lines 237, 238, 239, 240 energizes a solenoid 69a which opens its up auxiliary valve 29a which will remain open while handle 91a is in 91c position during which the valve 10 will start the car 1a and accelerate it to full upward speed if the handle 91a is held in that position long enough.

Full "down" speed may be attained by holding handle in 91d position wherein it engages contact 241 which by a line 242, coil 243, line 244 and line 233 completes the circuit to the generator and thereby energizes the "down" coil 243. The down coil therefore raises its armature and closes switch 245 which causes the energization of a solenoid 70a by means of lines 246, 247 and 248, and bring about the opening of the "down" auxiliary valve 32a.

The opening of the auxiliary valve 32a will cause the main valve 10 to move to the right and cause the car 1a to move down. If the handle 91a is held in position 91d long enough the car will move down at full speed.

The main valve controls the car 1a in the same manner as in the preferred form and in the same manner it moves a pilot switch arm 142a.

The arm 142a moves over a panel board 140a and in all its positions contacts a segment 249 by means of a brush block 250. The segment 249 is connected by a line 251 with a stop contact 252 adapted to be engaged by handle 91a when in car stopping position 91b.

When the valve 10 is moved to the left or in up direction from its neutral car stopping position, the arm 142a is moved from its neutral position to the right and its brush 250 engages a segment 253, which is connected by a line 254 to line 242 at the down coil 243.

Therefore when it is desirous to stop the car from going up the handle 91a is moved from 91c to 91b position wherein through connections 228, 91a, 252, 251, 249, 250, 253, 254, 242, 244, 233, the coil 243 is energized and switch 245 is closed and its associated down valve 32a is opened so that the valve 10 is moved from its up position towards neutral car stopping position. The valve 10 is then arrested in its neutral position by reason of the above circuit being broken when the brush 250 leaves segment 253 at neutral position. This circuit break deenergizes down coil 243 and thereby closes (indirectly through connections already described) the valve 32a thereby stopping the valve 10 at neutral position.

To return the valve 10 to neutral car stopping position from a down position, the following connections are provided; a segment 255 is adapted to be engaged by the brush 250 when the valve 10 is in a down position, a line 256 from the segment 255 connected to line 230 at the up relay coil 231.

To run the car 1a at different up and down speeds it must be understood that the movement of the valve 10 lags behind the more readily moved handle 91a. Therefore by moving the handle 91a to 91c position (for example), holding it only momentarily in engagement with contact 239 and then moving the handle into the variable speed or operative position 91e, the upward speed may be determined. To slow down the upward speed all that is necessary is to bring the handle 91a into momentary engagement with the contact 252. By oscillating the handle 91a between positions 91b and 91c the upward speed of the car may be accelerated or retarded to any desired extent. Means is thus provided for causing the valve 10 to come to rest in any of an infinite number of positions in either of the up or down zones and the car to be moved accordingly at an infinite number of speeds between zero and full speed.

The downward speed of the car is controlled in the same manner by oscillating the handle 91a between positions 91d and 91b and then holding it at rest in position 91f after the desired speed is attained.

I claim:

1. In an elevator, a car, a hydraulic motor for moving said car, an electro-responsive device for causing said motor to raise said car, another electro-responsive device for causing said motor to lower said car, a control switch for energizing at will either of said electro-responsive devices, a pilot switch caused to be moved by either of said electro-responsive devices, and an electro-responsive switch connected to said electro-responsive devices and adapted when energized by said pilot switch to deenergize said electro-responsive devices.

2. In an elevator, a car, a hydraulic motor for said car, a main valve for controlling said motor movable in one direction to raise said car and in the other direction to lower said car, an up electro-responsive device adapted to move said valve in one direction when energized, a down electro-responsive device adapted to move said valve in the other direction, a control switch movable in one direction to raise said car and movable in the other direction to lower said car, a circuit adapted to be closed through said up electro-responsive device when said switch is moved in an up car direction, a circuit adapted to be closed through said down electro-responsive device when said switch is moved in a down car direction, an electro-responsive switch for opening said circuits when energized, a pilot switch moved by said main valve into car raising direction or into car lowering direction, a circuit adapted to be closed through said electro-responsive switch by said pilot switch when said pilot switch is moved into car raising position, a circuit adapted to be closed through said electro-responsive switch by said pilot switch when said pilot switch is moved into car lowering position, and a means for causing said down electro-responsive device to remain energized when said control switch is moved in a down direction from an up position and when said pilot switch is in an up position.

3. In an elevator, the combination of a car, a hydraulic motor therefore, a main valve for controlling said motor, an up electro-responsive means for moving said valve in one direction to cause said car to move up when said up electro-responsive means is energized, a down electro-responsive means for moving said main valve in the other direction to cause said car to move down when said down electro-responsive means is energized, a control switch movable at will in an up car direction and in a down car direction, a circuit adapted to be closed through said up electro-responsive means when said switch is moved in an up car direction, a circuit adapted to be closed through said down electro-responsive means when said switch is moved in a down car direction, an electro-responsive switch adapted

to open either of said circuits when energized, and a pilot switch arm controlled by said main valve adapted to close a circuit through said electro-responsive switch when said pilot switch arm is moved into an up or down car position.

4. In an elevator, the combination, of a car, a hydraulic motor therefore, a main valve to control said motor adapted to assume a neutral car stopping position and car raising and lowering positions, a hydraulic motor for positioning said main valve comprising an up auxiliary valve and a down auxiliary valve for controlling the up, down and neutral positions of said valve, an up electro-responsive device for opening said up auxiliary valve when energized, a down electro-responsive device for opening said down auxiliary valve when energized, means for closing said auxiliary valves, an up relay for closing a circuit through said up electro-responsive device, a down relay for closing a circuit through said down electro-responsive device, a control lever in said car adapted to assume a neutral and car raising and lowering positions, a circuit adapted to be closed through said up relay by said lever when in car raising position in order to energize said up electro-responsive device and cause said car to rise, a circuit adapted to be closed through said down relay by said lever when in car lowering position in order to energize said down electro-responsive device and cause said car to descend, a pilot switch arm moved by said main valve and adapted to assume a neutral car stopping position and a car raising position when said valve is in car raising position and a car lowering position when said valve is in car lowering position, a circuit adapted to be set by said pilot arm through said up relay when said car is descending, a circuit adapted to be set by said arm through said down relay when said car is ascending, and means for closing either of said last two mentioned circuits by said control lever when said lever is in neutral position in order to stop said car in its upward or downward movement.

5. In an elevator, the combination of a car, a hydraulic motor therefore, a main valve for controlling said motor and adapted to assume a neutral car stopping position and up car accelerating positions when moved in one direction and down car accelerating positions when moved in the other direction, and up electro-responsive device for causing the main valve to move in an up direction when energized, an up electro-responsive switch for closing a circuit through said up electro-responsive device when energized, a down electro-responsive device for causing the main valve to move in a down direction when energized, a down electro-responsive switch for closing a circuit through said down electro-responsive device when energized, a control switch movable at will adapted to assume a neutral car stopping position and when moved in one direction to assume a number of definite up car accelerating positions and when moved in the other direction to assume a number of definite down car accelerating positions, a common electro-responsive switch adapted when energized to deenergize either of said energized up and down electro-responsive devices, means for energizing said up electro-responsive switch when said control switch is moved in an up direction, means for energizing said down electro-responsive switch when said control switch is moved in a down direction, a pilot switch moved by said main valve into positions corresponding to the positions assumed by said main valve, a number of selective contacts adapted to be engaged successively by said control switch when moved in an up direction or in a down direction, a corresponding number of definitely positioned stop contacts adapted to be engaged by said pilot switch when moved in one direction or the other by said main valve, means connecting said selective contacts with said corresponding stop contacts, means connecting said pilot switch with said common electro-responsive switch in order that said common electro-responsive switch will be operated when said pilot switch engages the said stop contact selected by said control switch so that either of said electro-responsive devices will be deenergized and said valve arrested, a neutralizing switch adapted to be closed by said control switch when said control switch is in neutral position, and means controlled by the closing of said neutralizing switch to neutralize said main valve.

6. In an elevator, a car, a hydraulic motor for said car, a main valve for controlling said motor movable in one direction to raise said car and movable in the other direction to lower said car and having a neutral car stopping position, an up electro-responsive device adapted to move said valve in one direction when energized to raise said car, a down electro-responsive device adapted to move said valve in the other direction when energized to lower said car, a control switch movable in one direction to raise said car and movable in the other direction to lower said car and having a neutral car stopping position, a circuit adapted to be closed through said up electro-responsive device when said control switch is moved in an up car direction, a circuit adapted to be closed through said down electro-responsive device when said control switch is moved in a down car direction, a common electro-responsive switch for opening either of said circuits when energized, a pilot switch moved by said main valve into car raising direction or into car lowering direction and having a neutral car stopping position, a circuit adapted to be closed through said common electro-responsive switch by said pilot switch when said pilot switch is moved into car raising position, another circuit adapted to be closed through said common electro-responsive switch when said pilot switch is moved into car lowering position, a neutralizing switch adapted to be closed by said control switch when in neutral car stopping position, a circuit adapted to be closed through said down electro-responsive device by said neutralizing switch and by said pilot switch when said control switch is in neutral position and when said pilot switch is in an up position, a circuit adapted to be closed through said up electro-responsive device by said neutralizing switch and by said pilot switch when said control switch is in neutral position and when said pilot switch is in down position, means for deenergizing either of said up or down electro-responsive devices when said pilot switch reaches neutral position, means for causing said down electro-responsive device to remain energized when said control switch is moved in an up direction from a down position and when said pilot switch is in an up position, and means for energizing said common electro-responsive switch when said pilot switch reaches neutral car stopping position.

7. In an elevator, a car, a hydraulic motor for said car, a main valve for controlling said motor movable in one direction to raise said car and

movable in the other direction to lower said car and having a neutral car stopping position, an up electro-responsive device adapted to move said valve in one direction when energized to raise said car, a down electro-responsive device adapted to move said valve in the other direction when energized to lower said car, a control switch movable in one direction to raise said car and movable in the other direction to lower said car and having a neutral car stopping position, a circuit adapted to be closed through said up electro-responsive device when said switch is moved in an up car direction, a circuit adapted to be closed through said down electro-responsive device when said switch is moved in a down car direction, a common electro-responsive switch for opening either of said circuits when energized, a pilot switch moved by said main valve into car raising direction or into car lowering direction and having a neutral car stopping position, a circuit adapted to be closed through said common electro-responsive switch by said pilot switch when said pilot switch is moved into car raising position, another circuit adapted to be closed through said common electro-responsive switch by said pilot switch when said pilot switch is moved into car lowering position, a neutralizing switch adapted to be closed by said control switch when in neutral car stopping position, a circuit adapted to be closed through said down electro-responsive device by said neutralizing switch and by said pilot switch when said control switch is in neutral position and when said pilot switch is in an up position, a circuit adapted to be closed through said up electro-responsive device by said neutralizing switch and by said pilot switch when said control switch is in neutral position and when said pilot switch is in down position, and means for deenergizing either of said up or down electro-responsive devices when said pilot switch reaches neutral position.

8. In an elevator, a car, a hydraulic motor for said car, a main valve for controlling said motor movable in one direction to raise said car and movable in the other direction to lower said car and having a neutral car stopping position, an up electro-responsive device adapted to move said valve in one direction when energized to raise said car, a down electro-responsive device adapted to move said valve in the other direction when energized to lower said car, a control switch movable in one direction to raise said car and movable in the other direction to lower said car and having a neutral car stopping position, a circuit adapted to be closed through said up electro-responsive device when said control switch is moved in an up car direction, a circuit adapted to be closed through said down electro-responsive device when said control switch is moved in a down car direction, a common electro-responsive switch for opening either of said circuits when energized, a pilot switch moved by said main valve into car raising direction or into car lowering direction and having a neutral car stopping position, a circuit adapted to be closed through said common-electro-responsive switch by said pilot switch when said pilot switch is moved into car raising position, another circuit adopted to be closed through said common electro-responsive switch by said pilot switch when said pilot switch is moved into car lowering position, means for causing said down electro-responsive device to remain energized when said control switch is moved in an up direction from a down position and when said pilot switch is in an up position, and means for energizing said common electro-responsive switch when said pilot switch reaches neutral car stopping position.

9. In an elevator, the combination of a car, a hydraulic motor therefore, a main valve for controlling said motor and adapted to assume a neutral car stopping position and up car accelerating positions when moved in one direction and down car accelerating positions when moved in the other direction, and up electro-responsive device for moving said valve in an up car direction when energized, a down electro-responsive device for moving said valve in a down car direction when energized, a control switch movable at will adapted to assume definite up car accelerating positions when moved in one direction and to assume definite down car accelerating positions when moved in the other direction and to assume a neutral car stopping position, a circuit adapted to be closed through said up electro-responsive device when said control switch is moved in an up direction, another circuit adapted to be closed through said down electro-responsive device when said control switch is moved in a down direction, a common electro-responsive switch adapted when energized to break either of said aforementioned circuits, a pilot switch moved by said valve into positions corresponding to said valve, a number of speed selective contacts adapted to be engaged successively when the control switch is moved in an up direction, a number of speed selective contacts adapted to be engaged successively when said control switch is moved in a down direction, an equal number of up speed stop contacts adapted to be engaged successively by said pilot switch when moved in an up direction, an equal number of down speed stop contacts adapted to be engaged by said pilot switch when moved in a down direction, means connecting each selective contact with its corresponding stop contact, means for energizing said common electro-responsive switch when said control switch is in an up position and engaging a selected contact and when said pilot switch engages said stop contact corresponding to the said selected contact in order to arrest said valve, and means for energizing said common electro-responsive switch when said control switch is in a down position and engaging a down selected contact and when said pilot switch engages said stop contact corresponding to said selected contact in order to arrest said valve, a neutralizing switch adapted to be closed by said control switch when in neutral position, means for closing a circuit through said down electro-responsive device when said control switch is at neutral position and said pilot switch in an up position, means for closing a circuit through said up electro-responsive device when said control switch is at neutral position and said pilot switch in a down position, and means for deenergizing either of said electro-responsive devices when said pilot switch reaches neutral position.

10. In an elevator, a car, a hydraulic motor therefor, a valve for said motor movable in one direction to cause said car to rise and movable in the other direction to cause said car to descend and having a neutral car stopping position, an up electro-responsive device for said valve, an up relay for closing a circuit through said up electro-responsive device, a down electro-responsive device for said valve, a down relay for closing a circuit through said down electro-responsive device, a control switch having a neutral car stopping position, an up zone and a down zone, said

control switch being adapted when moved in up direction in an up zone to energize said up relay and cause said valve to move in an up direction and when moved in down direction in the down zone to energize said down relay and cause said valve to move in a down direction, means for causing the neutralizing of said valve whenever the control switch is in the neutral position, means for causing said down relay to be energized when said control switch is moved in a down direction in said up zone, and means for causing said up relay to be energized when said control switch is moved in an up direction in said down zone, in order that the said valve may be arrested in a number of up positions and a number of down positions.

11. In an elevator, a car, a hydraulic motor for moving said car, a main valve for controlling said motor, an electro-responsive device for controlling said main valve to cause upward movement of said car, another electro-responsive device for controlling said main valve to cause downward movement of said car, a control switch having a neutral car stopping position, full up and full down speed positions and variable up and variable down speed positions intermediate said full speed positions and neutral position, circuits adapted to energize one or the other of said electro-responsive devices to cause the car to accelerate upward or downward at will when said control switch is moved into a full speed position, other circuits adapted to energize one or the other of said electro-responsive devices to cause the upward or downward speeds of the car to be retarded when said control switch is moved into neutral position, said control switch being adapted whenever moved into an intermediate speed position to deenergize either of said electro-responsive devices at the moment energized to cause the car to continue to move at a uniform speed which may thus be any of an infinite number of speeds upward or downward between zero and full speed.

12. In an elevator, a car, a hydraulic motor therefor, a valve for said motor having a neutral car stopping position and being movable in one direction or the other therefrom to cause said car to accelerate to full up feed or full down speed, respectively, a valve switch operated by said valve, an up electro-responsive device adapted when energized to cause said valve to move in the up car speed direction, an up relay for energizing said up electro-responsive device, a down electro-responsive device adapted when energized to cause said valve to move in the down car speed direction, a down relay for energizing said down electro-responsive device, a control switch having a neutral car stopping position and an up zone including a full up speed position and an intermediate variable up speed position and a down zone including a full down speed position and an intermediate variable down speed position, and a system of circuits including said control switch and said valve switch adapted when said control switch is moved to full up speed position from the intermediate up zone position or to neutral position from the intermediate down zone position to energize said up relay and when moved to full down position from the intermediate down zone position or to neutral position from the intermediate up zone position to energize said down relay, said control switch being also adapted when moved into either of said intermediate positions to denergize either of said relays at the moment energized in order to stop the movement of said valve, whereby the speed of the car may be arrested at any of an infinite number of speeds between zero and full speed.

13. In an elevator, a car, a hydraulic motor for moving said car, a valve for controlling said motor to cause said car to rise or descend, an electro-responsive device for causing said valve to operate to raise said car, another electro-responsive device for causing said valve to operate to lower said car, a control switch in said car and circuits thereof for energizing at will either of said electro-responsive devices, a pilot switch moved by said valve, other circuits for energizing said electro-responsive devices extending through said pilot switch for causing said valve to operate to retard and stop said car, current supply leads for feeding said circuits, and a safety switch having alternate contacts instantly closable in said leads either to supply current to the said circuits of the control switch or to the said other circuits.

14. The elevator control mechanism according to claim 13, wherein the said elevator is provided with a door and the said safety switch is operated by the opening of said door.

15. In an elevator, a car, a hydraulic motor for moving said car, a valve for controlling said motor to cause said car to rise or descend, an electro-responsive device for causing said valve to operate to raise said car, another electro-responsive device for causing said valve to operate to lower said car, a control switch and circuits adapted to be closed thereby for energizing at will either of said electro-responsive devices, a pilot switch moved by said valve, electro-responsive switching means and circuits therefore controlled in part by said pilot switch and adapted to be energized by said ocntrol switch to deenergize said electro-responsive devices to control the speed of the car, other circuits for energizing said electro-responsive devices and controlled in part by said pilot switch to control the operation of said valve to cause the car to come to a stop, and a safety switch having alternate paths for the closure of the several circuits of said control switch and for the closure of the said other circuits.

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