J. E. BOYCE.

MASTER MACHINE FOR CONTROLLING HYDRAULIC ELEVATORS.

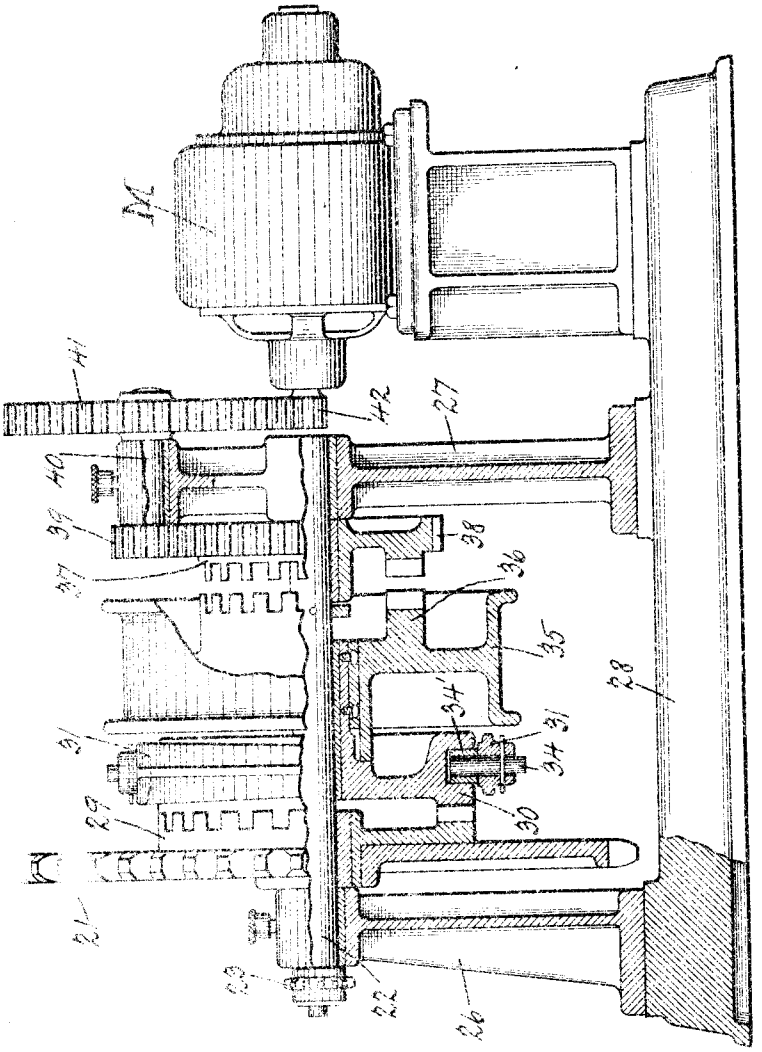
APPLICATION FILED MAY 10, 1910.

1,182,245.

Patented May 9, 1916.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS-SHEET 2.

Fig. 2.

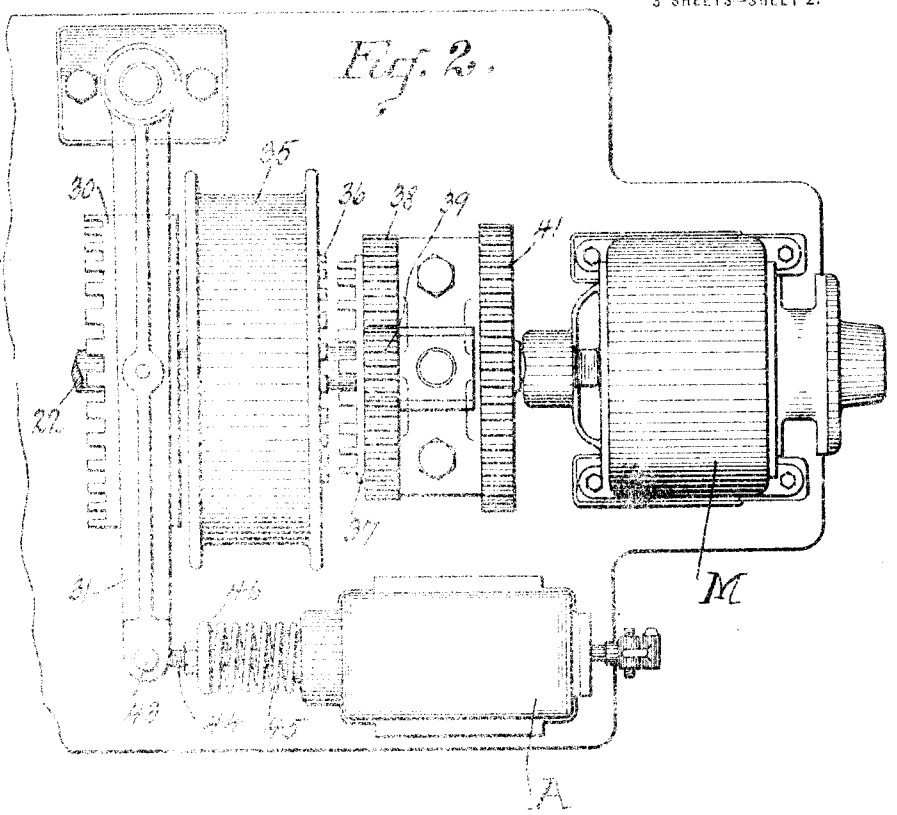
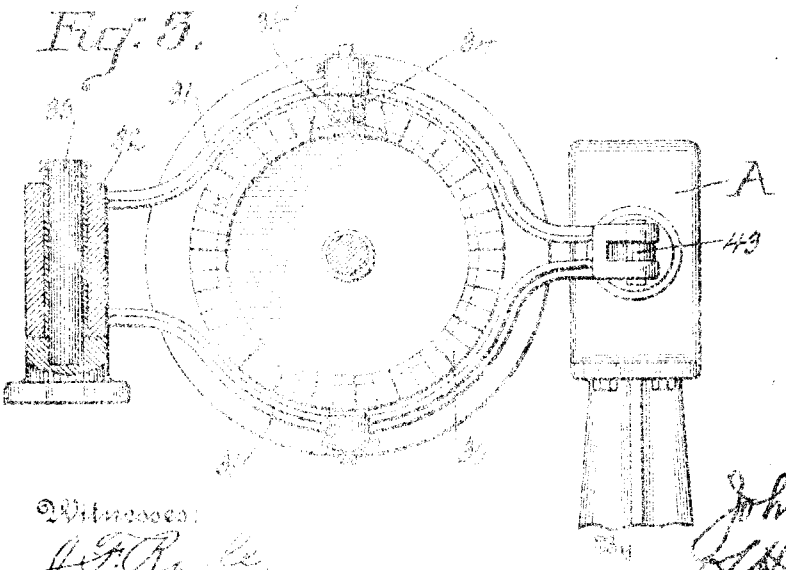


Fig. 3.



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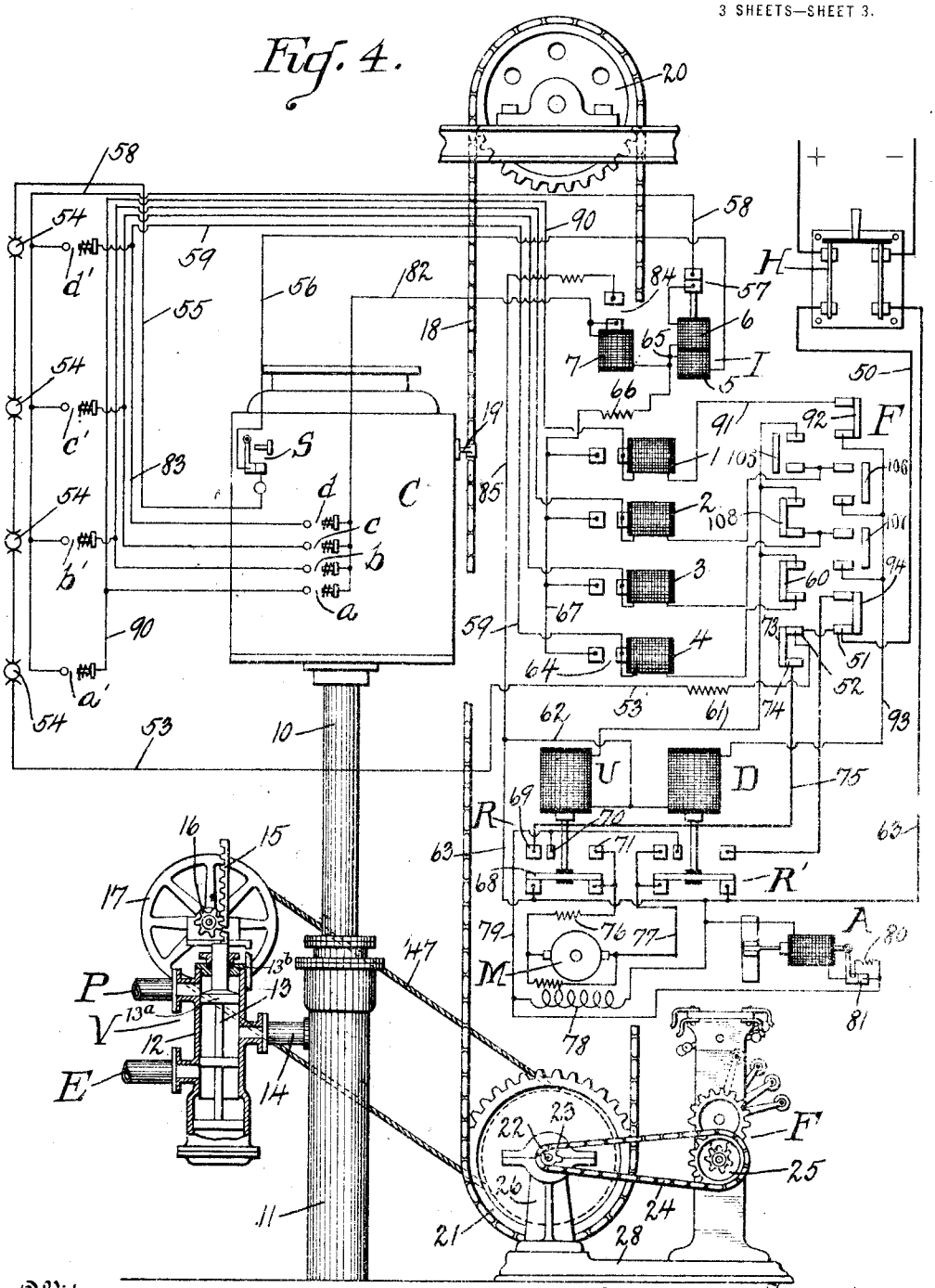
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3 SHEETS—SHEET 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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MASTER-MACHINE FOR CONTROLLING HYDRAULIC ELEVATORS.

1,182,245. Specification of Letters Patent. Patented May 9, 1916.

Application filed May 10, 1910. Serial No. 560,474.

To all whom it may concern:

Be it known that I, JOHN E. BOYCE, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented a new and useful Improvement in Master-Machines for Controlling Hydraulic Elevators, of which the following is a specification.

My invention relates to means for controlling the starting and stopping of elevators or other hoisting apparatus, and is particularly adapted for automatically controlled hydraulic elevators.

In elevators of this type, it is customary to employ a floor controller geared to the elevator car or some other part of the elevator which operates in unison with the car, and to provide in conjunction with the floor controller an electric push-button system, whereby whenever a push-button in the car or at one of the floor landings has been operated, the valve controlling the flow of liquid to and from the plunger cylinder will be automatically operated at a predetermined point in the travel of the car, in order to bring the car to rest at the corresponding floor landing. In this operation it is necessary to commence the movement of the valve before the car reaches the floor at which it is desired to stop. The distance, however, through which the car travels in being brought to rest, when the valve is operated at a given speed, varies with the load and speed of the car, so that with the controlling apparatus usually employed it is impossible to bring the car uniformly to rest at the floor landings with the varying conditions of load and speed of the car found in practice. An object of the present invention is to overcome this defect and bring the car uniformly to rest at any desired floor landing, irrespective of load conditions and speed of the car at the commencement of operation of the valve. This object is attained by providing means for operating the valve at a speed proportional to that of the car.

Other objects of the invention, and the exact nature thereof will appear more fully hereinafter.

In the accompanying drawings, which illustrate a construction embodying the present invention—Figure 1 is a part sectional elevation view of a master machine for operating the main valve of a plunger elevator; Fig. 2 is a plan view of a portion of the same; Fig. 3 is a part sectional elevation view of a clutch member forming part of said machine; Fig. 4 is a general view largely diagrammatic of an elevator to which the invention is applied and the electrical controlling circuits therefor.

The invention is herein shown as applied to an automatic or push-button plunger elevator having a direct current system of control, although the invention is equally well adapted for use with alternating current systems.

The elevator car C is carried by a plunger 10, movable up and down in the plunger cylinder 11. The flow of liquid to and from the cylinder is controlled by means of a main valve V which as herein shown is of a well-known construction. This valve comprises a valve cylinder 12 in which is adapted to reciprocate a piston valve 13. This valve when in a central position as shown, cuts off the flow of liquid between the cylinder 11 and the pressure and exhaust pipes P and E, respectively. If the valve 13 is moved upward, the pressure pipe P is connected through the to-and-from pipe 14 to the cylinder 11, supplying pressure beneath the plunger 10 to lift the car. If the valve 13 is moved below central position, the cylinder 11 is connected with the exhaust E permitting the car to descend by gravity the weight of the car and plunger forcing the liquid out from the cylinder 11 through the exhaust. The piston 13 is operated by means of a rack bar 15 in mesh with the pinion 16 rigidly connected with a wheel 17. An endless sprocket chain 18 is connected at 19 to the elevator car and runs over an upper sprocket wheel 20 and a lower sprocket wheel 21. The latter is secured to a shaft 22 on which is also rigidly mounted a sprocket pinion 23 geared through a sprocket chain 24 to a sprocket wheel 25 of a floor controller F. The latter may be of usual or well-known construction and operates in the usual way to control the various circuits of the push-button system.

Referring particularly to Figs. 1, 2 and 3, the master controller machine comprises the shaft 22 already referred to, which is journaled in standards 26 and 27 supported by a bedplate 28. The sprocket wheel 21 is rigidly connected with an annular clutch member 29 formed with clutch teeth adapted to intermesh with corresponding teeth

formed on the clutch member 30. The latter is adapted to be moved into and out of engagement with the clutch member 29 by means of a clutch lever comprising arms 31 rigidly connected with a vertical bearing sleeve 32 pivotally mounted on the pin 33. The arms 31 straddle the clutch member 30 and are provided with pins 34 carrying anti-friction rollers 34' and forming a connection between said arms and the clutch member. Rigidly connected with the clutch member 30 is a pulley 35 formed with an annular flange 36 provided with clutch teeth adapted to mesh with a clutch member 37 formed on a spur gear wheel 38. The latter is journaled for rotation on the shaft 22, but is held against movement longitudinally of the shaft. Gear wheel 38 meshes with a pinion 39 keyed to a stub shaft 40 journaled in the standard 27. On the opposite end of the shaft 40 is a gear wheel 41 in mesh with a pinion 42 on the end of the drive shaft of an electric motor M. The clutch lever 31 is adapted to be operated by an electromagnet A. The outer end of the clutch lever is pivoted at 43 to a screw-threaded rod 44 secured to the armature of the magnet. Coil spring 45 between the magnet frame and a collar 46 adjustably mounted on the rod 44 serves to move the clutch lever to the left, Fig. 2, when the magnet is deënergized. The pulley 35 is geared to the pulley 17 by an endless belt or cable 47.

When the elevator car is at rest, the parts will assume the relative positions shown in the drawings. If now current is supplied to the motor M and electro-magnet A as hereinafter described, the electro-magnet will be energized and move the clutch lever 31 to the right, Fig. 2, thereby disconnecting the clutch members 29 and 30 and connecting the clutch members 36 and 37. The motor M will at the same time be operated and transmit motion through the train of gears 42, 41, 39 and 38, clutch members 37 and 36, pulley 35, belt 47, pulley 17, pinion 16 and rack 15, thereby moving the valve 13 either up or down, depending upon the direction in which the motor M is rotated. When the valve 13 has reached its limit of movement, determined by the upper valve piston 13^a striking the head 13^b of the valve cylinder, or by any other suitable stop device the electric motor will be brought to rest, although the current through the motor may be maintained until the valve is again operated toward central position.

To stop the car, the current supply is cut off from the motor and electromagnet as the car approaches the desired floor landing. The magnet A being deënergized the spring 45 moves the clutch lever 31 to the left disengaging the clutch members 36 and 37 and engaging the clutch members 29 and 30. This operation connects the sprocket wheel 21 and pulley 35 for operation as a unit and the motion is transmitted through the belt 47 to the valve mechanism and moves the valve to central position, thereby cutting off the flow of liquid between the main valve and plunger cylinder, so that the car is brought to rest. As the peripheral speed of the wheel 21 is equal to the speed of the car, the valve 13 will be moved to central position at a speed directly proportional to that of the car and the latter will therefore be brought to rest in a given distance of travel, which will be the same whether the car is moving slowly or at a high rate of speed when the magnet A is operated. The clutch members are so spaced that only one pair of clutch faces can be engaged at a time thereby preventing interlocking of the two trains of gearing extending from the pulley 35. Sufficient lost motion is also provided between the intermeshing clutch teeth to permit the clutch members readily to engage.

The electrical controlling apparatus and circuits will now be described. This apparatus as shown is designed for an elevator operating between four floor landings. The apparatus comprises the floor controller F already referred to, a series of floor magnets, 1, 2, 3 and 4, a differentially wound magnet I comprising coils 5 and 6, a car safety magnet 7, car push-button switches a, b, c, d, a car safety switch S, floor landing switches a', b', c', d', reversing switch magnets U and D and reversing switches R and R'. The circuits and controlling devices are shown in the position assumed when the car is at rest at the second floor landing. Current is supplied from any suitable source through the positive and negative mains designated + and —, respectively. If a person at the fourth floor, for example, desires to bring the car up to said floor, the push-button d' is operated and establishes a controlling circuit which may be traced from the positive main, through the main line switch H, conductor 50, contacts 51, 52, conductor 53, hatchway door switches 54, conductor 55, safety switch S, conductor 55, coils 5 and 6 of the magnet I, switch 57, conductor 58, landing switch d' which has been operated, conductor 59, floor magnet 4, switch 60 of the floor controller, conductor 61, reversing switch magnet U and conductors 62 and 63 to the negative main. This circuit therefore includes the coils 5 and 6 of the magnet I, the floor magnet 4 and the up magnet U for the reversing switch R. As the magnet coils 5 and 6 are wound in opposition to each other, the magnet I is not energized sufficiently to open the switch 57 while the current is confined to the circuit just traced. The floor magnet 4, however, closes the switch 64 and establishes

a circuit in parallel to the magnet coil 6, which circuit may be traced from the junction 65 between the coils 5 and 6, through a resistance 66, conductor 67, and contacts 64. This parallel circuit permits a divided current, thereby reducing the strength of the coil 6, so that the magnet I may operate to open the switch 57. The opening of this switch prevents any interference at the floor landing switches as the circuit for the latter remains open until the magnet I has again been deënergized. As the magnet U is energized the contact plate 68 is lifted into engagement with the contacts 69, 70 and 71, thereby establishing a circuit for the motor M and magnet A, which circuit may be traced through the conductor 50, contacts 51 and 52, contacts 73 and 74, conductor 75, reversing switch contacts 69, 68, 71, resistance 76 to the armature of the motor M. From the latter the circuit extends through conductor 77, lower switch contacts of reversing switch R′ and conductor 63 to the negative main. A circuit is also established through the field coil 78 of the motor M, which circuit may be traced from the contact plate 68 of reversing switch R, through contact 70, conductor 79, field coil 78, and conductor 63. The coil of the clutch magnet A is also connected across the mains, the circuit being shown in parallel with the field coil 78. A resistance 80 is introduced into the clutch magnet circuit when the switch 81 is opened by the operation of the magnet. This resistance 80 is for the purpose of reducing the amount of current consumed after the magnet has operated and while it remains energized. As the motor M and clutch magnet A now receive current, the clutch will be operated as before described to connect the valve-operating mechanism with the motor M. The latter is rotated in a direction to cause an upward movement of the valve 13, so that liquid under pressure is admitted through the pipe P, valve cylinder 12 and pipe 14 to the plunger cylinder, and operates in the usual way to lift the car. As the car approaches the floor landing corresponding to the push-button *d′* which has been operated, the switch 60 of the floor controller is automatically opened, thereby opening the controlling circuit through the floor magnet 4, magnet I and reversing switch magnet U. These magnets being deënergized, the switches controlled thereby are restored to their initial positions and the current supply cut off from the motor M and clutch magnet A. The clutch is therefore shifted by means of the spring 45, and the pulley 35 connected to the sprocket 21 so that the valve 13 will be returned to its central position as before described. As the floor controller F is geared to and acts in unison with the car, the switch 60 of the floor controller is opened at a predetermined point in the car travel which is always the same regardless of the speed of the car. The point at which the switch 60 is opened and the clutch operated is such that the main valve will be fully closed and the car brought to rest directly opposite the floor landing.

The floor controller F as shown diagrammatically, comprises the "down" or right hand series of contacts, such as 94, 92, etc., and the "up" or left hand series of contacts 73, etc. The right hand series of contacts are opened in succession during the downward travel of the car so that if any one of the floor magnets 3, 2 or 1 has been energized by the operation of a push button, the circuit for said magnet will be opened by the corresponding contact of the floor controller and will bring the car automatically to rest at the floor corresponding to the button pressed. As the car descends, the "up" or left hand series of floor controller contacts are closed in successive order, so that a circuit may be closed therethrough when it is desired to cause the car to go up again. As the car goes upwardly the "up" series of contacts are opened in succession while the "down" series of contacts are in like manner successively closed so as to permit the car again to descend by closing a circuit through these latter contacts. Since the car is shown at the second floor landing, in Fig. 4, both the "up" and "down" contacts 105 and 106 corresponding to the second floor will be in open position so that a circuit cannot be closed to the floor relay 2 by the pressing of either of the buttons *b* or *b′* corresponding to the second floor. The contacts 108 and 60 will be closed so as to permit the car to go up to the third or fourth floors while the contact 107 will be open as shown and will remain open until just after the car leaves the third floor landing, when it will close so as to permit a "down" circuit therethrough and permit the car to return to the third floor if desired.

As the floor controller is not new, having been in extensive use for a number of years and being fully illustrated and described for example in the patent to Carichoff, 783,174, issued February 21, 1905, for system of electrical control, and does not *per se* form a part of the present invention, the structural features thereof have not been shown herein in detail.

If the car push-button *d* had been operated the controlling circuit would be from the positive main through conductor 50, contacts 51, 52, conductor 53, switches 54, conductor 55, safety switch S, conductor 56, winding 5 of magnet F, magnet 7, conductor 82, switch *d*, conductors 83, 59, floor magnet 4, switch 60, conductor 61, magnet U, conductors 62 and 63 to the negative main. The magnet 7 being energized closes the switch

84 and establishes a holding circuit, which circuit is in communication with the one just traced up to and through the magnet I and from thence through switch 84, conductors 85, and 63 to the negative main. As this holding circuit can normally be opened only at one of the hatchway door switches 54 or the safety switch S in the car, the control of the car through the operation of any of the floor landing switches is prevented until the car has been stopped and the hatchway door opened to restore the magnets I and 4 and the hatchway door again closed.

If it is desired to bring the car from the position shown to a lower floor, the push-button a' for example is operated, which establishes a circuit through conductor 50, contacts 51, 52, conductor 53, switches 54, conductor 55, safety switch S, conductor 56, magnet I, switch 57, conductor 58, push-button switch a', conductor 90, floor magnet 1, conductor 91, floor controller switch 92, conductor 93, reversing switch magnet D and conductors 62 and 63 to the negative main. The magnet D being energized the reversing switch R' is operated to establish circuits through the motor and clutch magnet, as before, except that the direction of flow through the motor armature is reversed in a well known manner. The motor will therefore be operated in the reverse direction and effect the downward movement of the valve 13 so that the plunger cylinder is connected with the exhaust E, permitting the car to descend. As the car nears the first floor, the switch 92 of the floor controller is automatically opened to deënergize the clutch magnet and permit the pulley 35 to be connected for rotation with the sprocket wheel 21 as before. The wheel 21, however, is rotating in the opposite direction as the car is descending, and will therefore lift the valve to central position to block the exhaust port and bring the car to rest.

The electrical system of control has been above described somewhat in detail for the purpose of giving a complete understanding of the operation of the invention. It will be apparent however that the invention is adapted for use in various other systems of electrical control, both for direct current and alternating current.

Another feature of the invention is the operation of the mechanism to prevent the settling of the car which is a common defect with plunger elevators. That is when the valve with the methods of control in common use is closed and the car left to stand for some time, any leakage of the liquid from the plunger cylinder through the valve mechanism permits a gradual settling of the car. This is particularly objectionable in automatic elevators which are designed to be left at upper or intermediate floors without an operator in the car. In such cases the leakage which is commonly present in the valve permits the car in a short time to settle so that it cannot be entered from the landing at which it was left until it has again been brought back to the landing. There is also frequently leakage from the pressure port through the valve to the cylinder, causing the car to be gradually lifted while the valve is in closed position. In the present invention this objection is overcome. The slight downward movement of the car due to leakage will cause a rotation of the sprocket wheel 21 in a direction to raise the valve 13, opening the pressure port a slight distance and admitting an amount of liquid under pressure equal to the leakage into the exhaust pipe, and thereby preventing further settling of the car. In a similar manner if the car tends to move upward due to leakage the valve will be opened to the discharge pipe sufficiently to discharge the leakage from the pressure pipe and prevent the car from being carried upward beyond the floor landing.

It will be understood that the principles of my invention may be embodied in many specific forms of apparatus other than herein set forth, and also that various changes in the details of construction and arrangements of parts could be made without departing from the spirit and scope of the invention. I wish therefore not to be limited to the particular features of construction herein disclosed.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In an elevator, the combination of a car and plunger, a plunger cylinder, a change valve, an electric motor for actuating the valve, driving connections comprising an electromagnetic clutch between said motor and the valve, and electroresponsive means to operate the said clutch independently of the movement of the car.

2. In an elevator, the combination of a car, hydraulic means for operating the car, a change valve, mechanism for operating the valve, an endless driving member connected to the car, electromagnetically operated clutch mechanism for connecting and disconnecting said driving member and valve operating mechanism, and a motor to operate the valve independently of said driving member.

3. In an elevator, in combination, a car, hydraulic driving means, a change valve, mechanism for opening and closing the valve, a motor, and means comprising a clutch for connecting said mechanism alternately to the car and motor.

4. In an elevator, the combination of a car, a change valve, hydraulic means for operating the car, mechanism for operating the valve, an electric motor, gearing between the motor and said mechanism for

moving the valve from closed to open position, and gearing for connecting said mechanism to the car and disconnecting it from the motor to return the valve to closed position.

3. In an elevator, the combination of a car, a plunger and cylinder, a change valve, an electric motor, and driving connections extending from the motor and car to the valve, a compensating clutch mechanism operable to connect the valve alternately with the car and motor.

6. In an elevator, the combination of a car hoisting apparatus, a controller therefor, an electric motor, means for connecting the motor to the controller and operating the latter in either direction from an initial position in which the car is held stationary, and means for connecting the controller to a movable part of the elevator and disconnecting the controller from the motor for returning the controller to initial position.

7. In an elevator, the combination of a car power mechanism for driving the car, a controller for said mechanism, a drive wheel, power transmitting means connecting the drive wheel with the controller, a motor, a clutch between the motor and said drive wheel, an endless driving member connected to the car, a clutch between said driving member and said drive wheel, and means for operating the clutches.

8. In combination, an elevator car, operating means therefor, a controller, a drive sheave, connections between said sheave and controller for operating the latter, an electric motor and gearing comprising a clutch between said sheave and the motor, an endless driving member connected to the car, driving mechanism comprising a clutch between said endless member and said drive sheave, and means for operating the clutches.

9. The combination with a driving sheave, of clutch members carried thereby, an electric motor, a clutch member geared to the motor and adapted to be engaged by one of said first named clutch members, an elevator car, a clutch member geared thereto and adapted to be engaged by the other of said first named clutch members, an electromagnet, a clutch lever connected thereto and to said drive sheave for moving the latter and shifting the clutch members carried thereby, means for supplying current to the electromagnet and said motor, a controller for the car, and driving connections between said controller and said sheave.

10. In combination, an elevator car, power mechanism for operating the car, a controller for said power mechanism, a drive sheave, gearing connecting said sheave to the controller, a shaft on which said sheave is slidably mounted, clutch members carried by said sheave, a sprocket wheel mounted on said shaft, an endless chain extending over said sprocket wheel and connected to the car, a clutch member carried by said sprocket wheel and adapted to be engaged to one of said first named clutch members when the drive sheave is moved in one direction, a motor, gearing connected to said motor and comprising a clutch member adapted to be engaged by the other clutch member carried by the drive sheave when the latter is shifted in an opposite direction, and means for shifting the latter.

11. In an elevator system, the combination of a car, means for operating the car, a controller for said means, an electric motor, electroresponsive mechanism for operatively connecting the said controller to the car and motor respectively, and an automatic system of control for automatically effecting the operation of said electroresponsive mechanism at predetermined points in the travel of the car.

12. In an elevator, the combination of a car, means for operating the car, a controlling device for said means, a master controller comprising a driving member, gearing connecting said driving member to said controlling device, gearing connected to the car, a clutch between said last named gearing and the said driving member, an electric motor, a clutch between the motor and said driving member, electroresponsive means for effecting the operation of said clutches, and means for automatically operating said electroresponsive means at predetermined points in the travel of the car.

13. In an elevator system, the combination of a car, means for operating the car, a controlling device for said means, a master controller comprising a driving member geared to said controlling device, an electric motor, electroresponsive means for effecting driving connections between the motor and said driving member, and between the car and said driving member, and an automatic system of electrical controlling circuits and apparatus for effecting the automatic operation of said motor and electroresponsive means.

14. In an elevator system, the combination of a car, a plunger, a plunger cylinder, a change valve, mechanism for operating the change valve, an electric motor, gearing comprising a clutch between the motor and said mechanism, gearing comprising a clutch between the car and said mechanism, an electromagnet operable when energized to operate said first named clutch and operatively connect the motor with the valve operating mechanism, means operable when the magnet is deenergized to open said first named clutch and operate said second named clutch to operatively connect the valve operating mechanism with the car, means to

supply current to the motor and electromagnet to effect an operation of the valve to open position and thereby start the car, and means to automatically cut off the current supply from the motor and magnet when the car has reached a predetermined point in its travel, and thereby effect a return of the valve to closed position.

15. In an elevator system, the combination of a car, a valve, mechanism for operating the valve, an electric motor, means for connecting and disconnecting the motor to and from said mechanism, reversing switches controlling the direction of current flow through the motor, and thereby controlling the direction in which the valve is operated from central position, and means for gearing the car to said valve operating mechanism and thereby effecting a return of the valve to central position.

16. In a hydraulic elevator, the combination of a car, a plunger, a cylinder, a change valve controlling the flow of liquid to and from the cylinder, a running connection permanently secured to the car and forming a connection between the car and valve for moving the latter toward its closed position when the car is moving in either direction, a magnetically operated clutch for making and breaking said connection, a motor operable independently of the car, and means to form an operating connection between the motor and valve.

17. In a hydraulic elevator, the combination of a car, a plunger, a cylinder, a change valve, an electric motor geared to the valve for operating the valve to open position, and means for gearing the valve to the car and for interrupting the geared connection between the valve and motor so as to return the valve to closed position by power transmitted from the car.

18. In an elevator, the combination of a car, a plunger, a cylinder, a change valve, an electric motor, gearing between the valve and car and between the valve and motor, and means for connecting the valve through said gearing to the motor, and for disconnecting the valve from the motor and connecting it to be operated by the car.

19. In a hydraulic elevator, the combination of a car, a plunger, a cylinder, a valve controlling the flow of an operating fluid to and from the cylinder, an electric motor for opening the valve, gearing comprising clutch mechanism forming an operative connection between the car and valve and between the motor and valve, a floor controller, and means controlled thereby for operating the clutch mechanism to disconnect the motor and valve and to connect the car and valve and thereby effect the return of the valve to closed position while the valve is disconnected from the motor.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN E. BOYCE.

Witnesses:
CHAS. H. BUTTNER,
JOHN J. PEARSON.