F. C. FURLOW.

MICRO DRIVE HYDRAULIC ELEVATOR.

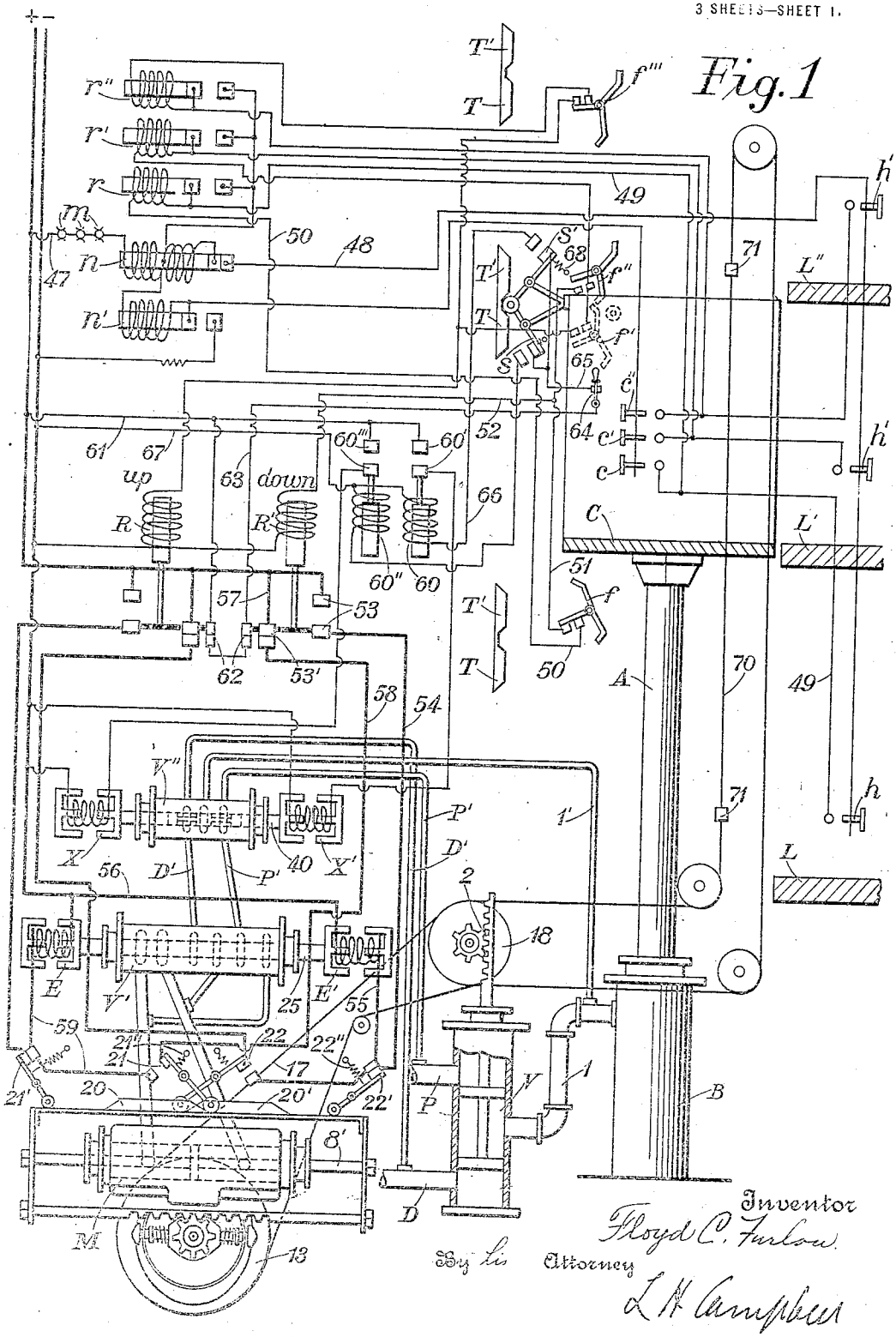
APPLICATION FILED SEPT. 5, 1917.

1,352,742.

Patented Sept. 14, 1920.

3 SHEETS—SHEET 1.

Fig. 1



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3 SHEETS—SHEET 2.

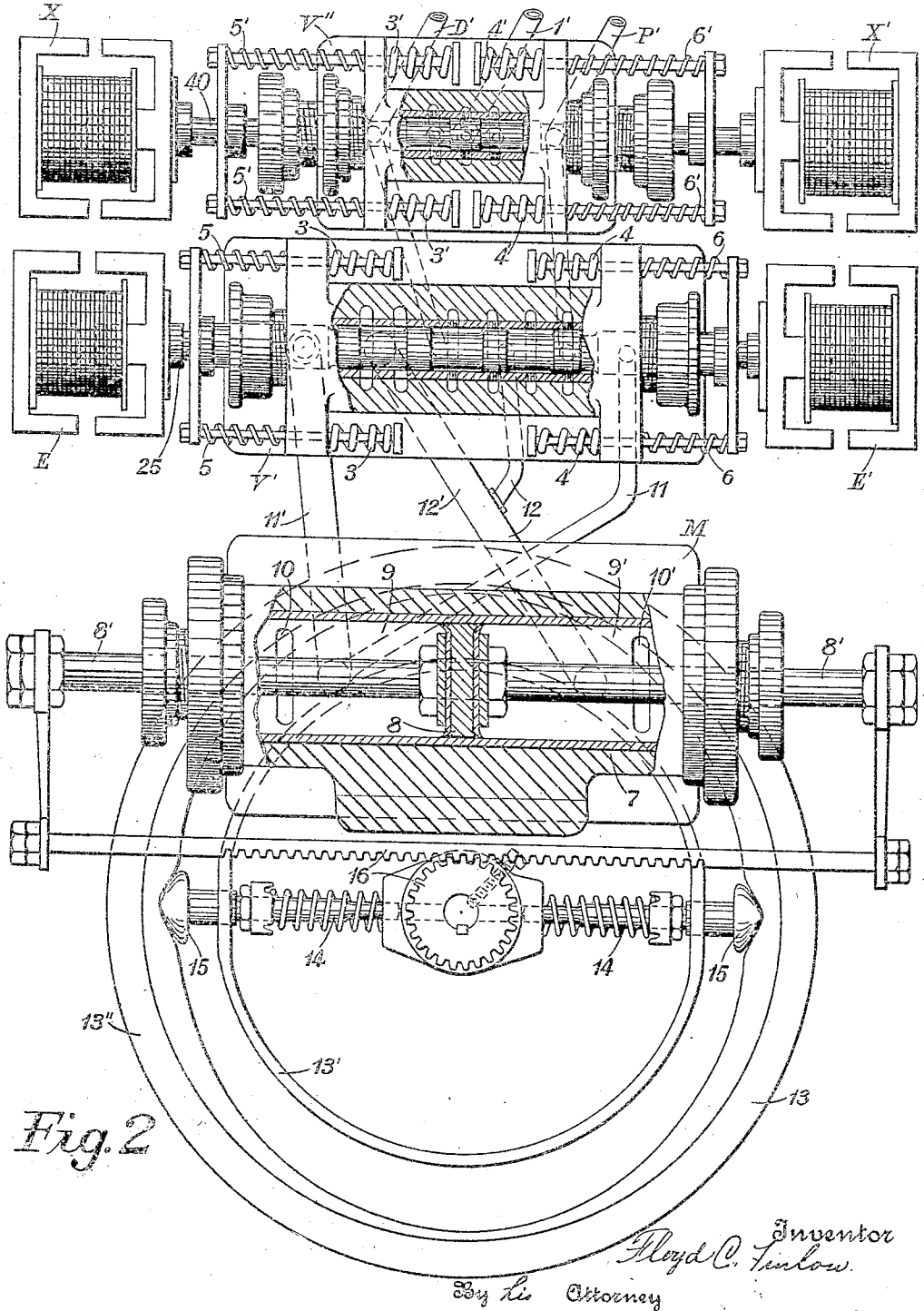


Fig. 2

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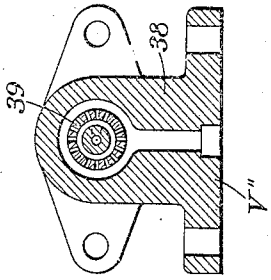
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3 SHEETS—SHEET 3.

Fig. 3a



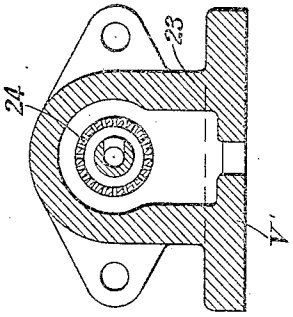
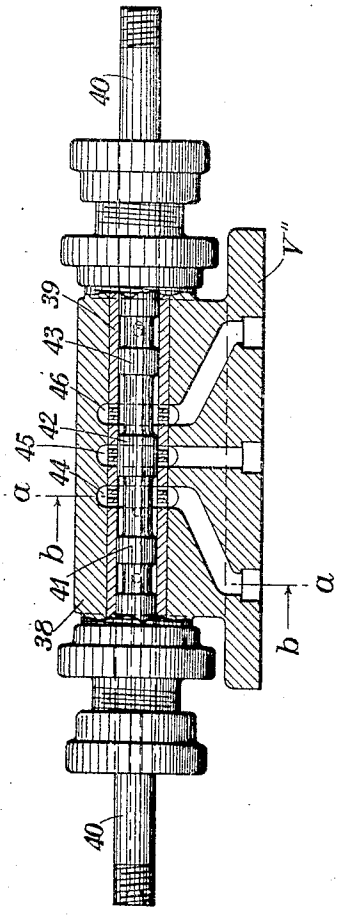


Fig. 4a

Fig. 3



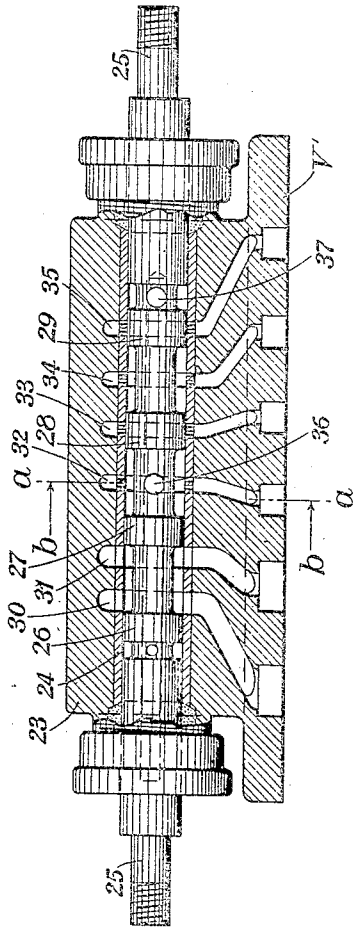


Fig. 4

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L K Cameron

UNITED STATES PATENT OFFICE.

FLOYD C. FURLOW, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MICRO-DRIVE HYDRAULIC ELEVATOR.

1,352,742. Specification of Letters Patent. Patented Sept. 14, 1920.

Application filed September 5, 1917. Serial No. 189,397.

To all whom it may concern:

Be it known that I, FLOYD C. FURLOW, a citizen of the United States, residing in Montclair, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Micro-Drive Hydraulic Elevators, of which the following is a specification.

My invention relates to elevators and more particularly to the type commonly known as hydraulic elevators.

The invention consists in the provision of means to control and level the elevator car with a desired landing, the controlling means involving improved features of construction, arrangement of parts and mode of operation, and being an improvement on my co-pending application, Serial Number 59,736, filed November 5, 1915, Patent #1,268,109, June 4, 1918.

Referring to the accompanying drawings, Figure 1, illustrates in a typical manner, a push-button controlled hydraulic elevator system embodying the apparatus arranged in accordance with the present invention; Fig. 2 illustrates in elevation, and with parts broken away, an enlarged detail view of certain of the controlling elements shown in Fig. 1; certain of the elements being partly broken away; Figs. 3 and 4 illustrate in section, plan views of certain elements, and Figs. 3^a, 4^a, illustrate views taken on lines *a—a*, of Figs. 3 and 4 respectively, viewed in the direction of arrows *b—b*.

The various elements comprising the elevator system will first be designated, and their construction will thereafter be described in detail.

The elevator car, C, is supported by a plunger, A, operating in a cylinder, B. A main three-way valve, V, is connected to the plunger cylinder by a to and from pipe, 1. The main valve is actuated through a rack and pinion connection, 2, to admit fluid to the plunger cylinder from a pressure pipe, P, and to discharge fluid from the cylinder by way of discharge pipe, D.

The electrical push-button system comprises electro-magnetic reversing switches, R, R′, car push-buttons, *c*, *c′*, *c″*; hall push-buttons, *h*, *h′*, *h″*, located at the different car landings designated L, L′, L″; floor controller switches positioned in the elevator hatchway and designated *f*, *f′*, *f″*, *f‴*; floor relays *r*, *r′*, *r″*; non-interference magnet *n*; car holding magnet *n′*; and door contacts *m*.

The elements thus far designated are well-known in the art and have a well-known mode of operation, and, it is thought, need no further description.

Coming now to the elements which form more particularly the subject matter of the present invention, they consist more essentially of a hydraulic motor M, to actuate the main three way valve V; a valve mechanism V′ to control the hydraulic motor M, and electro-magnets E, E′ controlled conjointly from the car and by the motor to actuate the valve V′ in either direction from a centered or normal position against the action of springs 3 or 4, which act to return the valve mechanism to centered or central position when the electro-magnets are deënergized. Additional springs, 5, 6, are provided to prevent an over-run movement of the valve mechanism past a centered or central position by the action of the springs, 3 or 4, in centering the valve mechanism.

The elements thus far designated together with the push-button apparatus, control the main valve V to effect operation of the car at its maximum or relatively high rate of speed in an ascending or descending direction.

In addition to the above pointed out mechanism, I provide auxiliary apparatus automatically to control and level the elevator car at any desired landing, this apparatus effecting movement of the car at a definite slow-rate of speed, and functioning independently of the main valve and its controlling elements.

The auxiliary apparatus comprises an auxiliary valve V″, which together with pipe connections, forms a by-pass around the main valve V, to supply pressure to, or exhaust pressure from the plunger cylinder B. The auxiliary valve is controlled to effect the leveling operation of the car, by means of cams and coacting switches controlled by movement of the car. There are two of these cams at each floor landing, offset from each other and fixed in the elevator hatchway, the cams designated T forming one set and being arranged in a common plane, and cams designated T′ forming another set in a common plane, but offset from the cams T. A pair of switches, S, S′, are carried by the elevator car, the

switch, S, being controlled by the cams, T, automatically to control the auxiliary valve V'' to effect operation of the car in an ascending direction and level the same with a landing; the switch S' being controlled by the cams T', automatically to control the auxiliary valve to effect operation of the car in a descending direction and level the same with the landing.

Electro-magnets X, X', are controlled by the leveling cams and switches to actuate the auxiliary valve mechanism against the action of the springs, 3' and 4', in either direction from a centered or normal position, as illustrated in Fig. 2, the valve mechanism being returned by the said springs, and prevented from over-running the centered or normal position by the action of springs 5' and 6'.

The hydraulic motor consists more essentially of a casing, 7, and a piston, 8, adapted to move therein; the piston being secured to a piston rod, 8', and forming independent chambers, 9, 9', in the casing. An aperture 10, connects the chamber, 9, with a pipe, 11, the latter serving to admit pressure to, and exhaust fluid from, the chamber 9. An aperture 10' connects the chamber 9' with a pipe 12, the latter serving to admit pressure to, and exhaust fluid from the chamber 9'. A shipper sheave, 13, is made in two sections, an inner section, 13', and an outer section, 13'', the outer section being supported by spring pressed rods, 14, carried by the inner section, the rods at their outer ends having knobs, 15, engaging grooves provided on the inner periphery of the outer section. The inner section, 13', is positively connected with the hydraulic motor, M, through a rack and pinion connection, 16, and under ordinary conditions the outer section, 13'', is operated with the inner section; but under certain conditions, hereinafter pointed out, the connection as herein provided between the two sections, permits the outer section to be moved upon application of power thereto, while the inner section may remain stationary. A rope or cable, 17, connects the sheave, 13, with the main valve sheave, 18.

A pair of off-set cams, 20, 20', are movable with the piston rod, 8', the cam 20 being adapted to actuate switches, 21, 21', and the cam 20', being adapted to actuate switches, 22, 22'. These cams and the coacting switches function to control circuits for the electro-magnets, E, E'.

The valve mechanism, V', consists more essentially of a valve casing, 23, having an interior perforated sleeve, 24, in which the valve stem, 25, is adapted to slide, the valve stem having enlarged heads or pistons, 26, 27, 28, 29, which control the circulation of fluid between the fluid chambers, 30, 31, 32, 33, 34, and 35, formed in the casing 23. The valve stem is made hollow for a portion of its length, communication between the interior and exterior of the stem being made by the openings, 36, 37.

The auxiliary valve mechanism, V'', consists more essentially of a valve casing, 38, having an interior perforated sleeve, 39, in which the valve stem, 40, is adapted to slide, the valve stem having enlarged heads or pistons, 41, 42, and 43, which, control the circulation of fluid between the fluid chambers or passages, 44, 45, 46.

An auxiliary pressure pipe, P', connects with chambers 46 and 34, in the valve mechanisms, V'', V', respectively. An auxiliary discharge pipe D' connects with chambers 44 and 32 in the valve mechanisms V'', V', respectively. An auxiliary to-and-from pipe, 1', forms a junction with the to-and-from pipe 1, and connects with the chamber 45 in the valve mechanism V''.

Pipes 11' and 12', form a junction with pipes 11, 12 respectively, and connect with chambers 30, 31 respectively in the casing 23.

Operation of the parts through a complete cycle of operation will now be described. Let us assume that the push-button, *h*, is pressed to bring the car to the first floor landing, L. Operation of the button, *h*, closes a circuit to the operating winding of the reversing switch, R', which circuit may be traced as follows: + main to wire 47, door contacts *m*, both windings of the non-interference magnet *n*, and its contacts, wire 48, button *h*, wire 49, winding of the floor relay *r*, wire 50, floor controller switch *f*, wires 51, 52, thence the reversing switch winding to the — line. The reversing switch R' now operates to close a circuit for the electro-magnet E', which circuit may be traced as follows: + main, reversing switch contacts 53, wire 54, switch 22', to wire 55, winding of the electro-magnet E', and wire 56 to the — line. The winding E' now receiving current, moves the valve stem 25 toward the right, thereby establishing communication between the auxiliary pressure pipe P' and the chamber 9, via the chambers 34, 35 and pipe 11, and connecting the chamber 9' with the auxiliary exhaust pipe D', via the pipes 12, 12' and chambers, 33, 32. Pressure being admitted to the chamber 9, effects movement of the piston 8 toward the right, the latter thereby actuating the main valve to connect the plunger cylinder with the discharge pipe D. In this manner operation of the car in a descending direction is effected at a relatively high or maximum rate of speed.

Movement of the piston 8 causes the cam 20 to close switch 21, and when the said piston reaches its limit of movement in the right hand direction, the cam 20' engages and opens the switch 22', the latter thereby opening the circuit for the electro-magnet E'. Since the latter is now deënergized, the

springs, 4, now act to return the valve mechanism V′ to normal or centered position; the motor piston remaining in its actuated position until the car upon approaching to within a predetermined distance of the first floor landing, engages and opens the floor switch *f*, thereby opening the circuit of the winding of the reversing switch R′, which now opens its upper contacts, 53, and closes its bottom contacts, 53′. The contacts 53′ together with switch 21 now being closed, establish a circuit for the electro-magnet E, which circuit may be traced as follows: + main, wire 57, contacts 53′, wire 58, switch 21, wire 59, thence through electro-magnet E to the — line. The electro-magnet E, now receiving current moves the valve stem 25 toward the left hand from its already centered or normal position, thereby admitting pressure from the pipe P″ to the right side of the piston 8, via the chambers 34, 33, pipe 12 and aperture 10′, and connecting the aperture 10 with the discharge pipe D′ for the discharge of fluid from the left side of the piston 8, via pipe 11, to chamber 35, thence through the hollow portion of the stem to chamber 32, via openings 37, and 36, and from the chamber 32, to the discharge pipe D, via the pipe D′.

Pressure now being admitted to the right side of the piston 8, effects movement of the latter toward the left hand, thereby actuating and returning the valve to normal position and in this manner bringing the car to a stop by the action of the main valve mechanism.

Movement of the piston toward the left hand moves the cam 20′ out of engagement with the switch 22′ which is then closed by the action of a spring 22″, and when the piston reaches its center position the cam 20 releases switch 21, which is thereupon operated by the action of a spring 21″. The switch 21 now being opened, opens the circuit heretofore traced for the electro-magnet E, the springs 3 now acting to return the valve mechanism V′ to normal position, thereby cutting off all communication from the pipes P″ and D′, to the chambers, 9, 9′.

Shortly after the car opens the floor switch *f*, which corresponds to the beginning of movement of the main valve to closing position, the switch S′ engages and is closed by the cam T′, thereby closing a circuit for the winding of a relay 60, which circuit may be traced as follows: from the + main to wire 61, two sets of back contacts 62 arranged in series, wire 63, safety switch 64, to a common feed wire 65, switch S′ to wire 66, winding of relay 60, and wire 67 to the — line.

The relay 60 now operates to close its contacts 6′, which close a circuit for the operating magnet X′ of the auxiliary valve mechanism V″. The electro-magnet X′ now operates to move the valve stem 40 toward the right hand, thereby connecting the plunger cylinder with discharge pipe D, via the pipe 1′, chambers 45, 44, and pipe D′.

In this manner the auxiliary valve V″ operates independently of the main valve to continue movement of the car at a relatively slow rate of speed, in a descending direction, and when the car platform is substantially level with the landing L, the cam T′ releases the switch S′, which now opens by the action of a spring 68, thereby opening the circuit for the electro-magnet X′. The latter now being deënergized, the springs will act quickly to center the valve mechanism V″, thereby bringing the elevator car to a stop.

If for any reason the elevator car should over-run or coast past the desired landing, as in this instance the landing L, the switch, S, engages and is closed by the cam, T. The switch S closes a circuit for the winding of the relay 60″, which operates to close its contacts, 60‴, thereby closing a circuit for the electro-magnet X. The electro-magnet X now operates to move the valve-stem 40 toward the left hand, thereby connecting the plunger cylinder B with the auxiliary pressure pipe P″. The car will now ascend at a relatively slow rate of speed, until the car platform is substantially level with the landing L, whereupon the switch, S, is released to open position by the cam, T, thus effecting the deënergization of the electro-magnet X, and the centering of the auxiliary valve mechanism V″, which operation cuts off all communication between the plunger cylinder and the pressure and discharge pipes, P″ and D′. In this manner the elevator car is automatically returned to, and the platform stopped level with the desired landing, the auxiliary valve mechanism together with its controlling elements acting automatically to maintain in effect the car level with the landing after the car is once brought to and stopped level with the landing.

This feature is of considerable practical importance in this type of elevators, since any movement of the car away from the landing, which for example may be caused by leaking valve mechanism, causes the auxiliary valve mechanism and its controlling parts to function and bring the car back to the landing.

The mode of operation of the various elements for ascending direction of car travel, and by car push button operation, is substantially the same as has just been described for the descending direction of car travel as effected by the hall push button operation.

In order to control the main valve mechanism in case of emergency, I provide a hand rope, 70, operable from the elevator car and permanently connected to the shipper sheave, 18.

In order to permit free movement of the hydraulic motor piston, 8, by operation of

the hand rope, 70, and with the valve mechanism V′ in normal position, and the motor piston, 8, in either a normal or actuated position, I provide the fluid passages 30 and 31, which with the valve stem in normal position as shown, allows free circulation of fluid from the chamber, 9, to the chamber 9′ when the piston, 8, is moved toward the left hand, and vice versa for movement of the piston in the opposite direction.

On the other hand if the valve mechanism V″ or hydraulic motor should stick, say for example in actuated position, or otherwise fail properly to function, the inner section 13′ of the shipper sheave thus becomes locked against movement, but the connection provided between the inner and outer sections 13′ and 13″, allows the outer section to release itself by a pull on the cable 70. In this manner the main valve mechanism V may be operated to control the elevator car by operation of the hand rope, upon failure of the main valve controlling mechanism properly to function, the arrangement eliminating any need for clutch mechanism or connections to disconnect the locked elements from the hand rope connection to the main valve mechanism; the essential feature being, that the only operation necessary is for the operator to perform the usual, or what may be considered a habitual operation, which is to simply actuate the hand cable.

The arrangement furthermore, provides an automatic shut-off for the main valve mechanism, when the car approaches either limit of travel, the car in its movement engaging the stop-balls 71 on the cable 70.

The electrical apparatus herein provided is shown as applied to a source of single phase alternating current supply, and for this purpose, the cores and armatures of the various magnets such as E, E′, etc., are preferably constructed of laminated material, but it will be understood that the electrical system may as well be applied to a direct current source of supply.

Having thus described my invention, and without limiting myself to the precise details of construction and arrangement of parts, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. In a hydraulic elevator system, the combination with the car, a main valve, a hydraulic motor to actuate the valve, and means automatically controlled from the car and by the motor, to control the said motor the said means comprising cams actuated by the motor, electric circuits, and switches in the said circuits actuated by the cams.

2. In a hydraulic elevator, the combination with the car, a main valve, a hydraulic motor device to actuate the valve, valve mechanism to control the hydraulic motor, electro-magnets to actuate the second named valve, manually controlled switches each controlling circuits to both electro-magnets, normally open switches controlled by the motor, in one of the circuits from each manually controlled switch to the electro-magnets, and normally closed switches controlled by the motor, in the other of the circuits from each manually controlled switch to the electro-magnets.

3. In a hydraulic elevator system, the comcination with the car, a main valve, a hydraulic motor device to actuate the valve, valve mechanism to control the hydraulic motor, electromagnets to actuate the second named valve, electro-responsive switches controlled from the car, each controlling circuits to both electro-magnets, additional switches included in each of the said circuits, and cams operable by the motor and adapted to actuate the latter named switches.

4. Controlling apparatus for hydraulic elevators comprising a controlling valve, a motor device, and a shipper sheave, the said sheave comprising an inner section positively connected with the motor device, an outer section positively connected with the main valve, and a connection between the inner and outer sections whereby operation of the sections as a unit, by the motor device is effected, but allowing the release of one section from the other if the motor device is at rest.

5. In a hydraulic elevator system, the combination with the car, a main valve, a motor device to actuate the valve, valve mechanism to control the motor, electro-magnets to actuate the latter named valve mechanism, connected to opposite ends of the valve stem, a single auxiliary valve to effect operation of the car independently of the main valve, and electro-magnets to actuate the auxiliary valve mechanism, connected to opposite ends of the valve stem.

6. In a hydraulic elevator system, the combination with the car, a main valve, a hydraulic motor device to actuate the valve, valve mechanism to control the motor, electro-magnets to actuate the latter valve mechanism, connected to opposite ends of the valve stem, means operable from the car and by the motor, jointly to control circuits for the electro-magnets, a single auxiliary valve to effect operation of the car independently of the main valve, electro-magnets to actuate the auxiliary valve mechanism, connected to opposite ends of the valve stem, and means operable by the car movement to control circuits for the latter named electro-magnets.

7. In a hydraulic elevator system, the combination with the car, a main valve, a hydraulic motor device, a sheave operable by the motor and connected to the main

valve, said sheave comprising sections one of which is movable independently of the other, a single valve mechanism to control the motor device, said valve mechanism when in normal or centered position establishing communication for free circulation of fluid around the motor piston, means controlled from the car to actuate the latter named valve, an auxiliary valve to control the car to raise and lower, and means to control the auxiliary valve.

8. In a hydraulic elevator system, the combination with the car, a main valve, a hydraulic motor comprising a cylinder having a piston movable therein, a single valve mechanism to supply pressure to and exhaust fluid from both sides of the motor piston, said valve mechanism when in a normal position establishing communication for free circulation of fluid around the said motor piston, means controllable from the car and by the motor device, to actuate the latter named valve, and an auxiliary valve to control the car to raise and lower level with a desired landing.

9. In a hydraulic elevator system, the combination with the car, a main valve, a hydraulic motor to actuate the said valve, valve mechanism to control the hydraulic motor, electro-responsive means to actuate the second named valve mechanism, means controllable from the car and by the motor device conjointly to control the electro-responsive means, a single auxiliary valve mechanism, and electro-responsive apparatus controlled by movement of the car to operate the auxiliary valve to raise or lower the car and level the same with a desired landing.

10. In a hydraulic elevator system, the combination with the car, a main valve, a motor device, a sheave operable by the motor and connected to the main valve, said sheave comprising sections one of which is releasable from the other, a single valve mechanism to control the motor device, said valve mechanism when in normal position establishing communication for free circulation of fluid around the motor piston, electro-magnets connected to the stem of the second named valve, a push-button system of circuits and motor operated means, conjointly to control the said electro-magnets, a connection operable from the car and connecting with one of the said sheave sections, a single auxiliary valve to raise and lower the car independently of the main valve, electro-magnets at opposite ends of the valve stem to actuate the latter, and cams and switches operable by movement of the car, to control the electro-magnets and effect operation of the auxiliary valve to level the car with a landing.

11. In a hydraulic elevator system, the combination with the car, a main valve, a motor device, a sheave operable by the motor and connected with the main valve, said sheave comprising sections, one of which is releasable from the other, valve mechanism to control the motor device and establish communication for free circulation of fluid around the motor piston, electro-magnets having armatures connected to opposite ends of the valve stem, comprising a part of the second named valve, switches controlled from the car, each controlling circuits to both of the said electro-magnets, switches controlled by the motor device, in each of the circuits to the said electro-magnets, a cable operable from the car and connecting with one of the sheave sections, an auxiliary valve to control the car to raise and lower the car independently of the main valve, and means to control the auxiliary valve to effect operation of the car in an ascending and descending direction, and maintain in effect the car level with a desired landing.

12. In a hydraulic elevator system, the combination with the car, a main valve, a hydraulic motor device to actuate the valve, a valve mechanism to control the hydraulic motor, electro-magnets to actuate the said valve mechanism, circuits for the electro-magnets, switches controlled from the car, controlling the circuits to the electro-magnets, normally open switches and normally closed switches controlled by the motor, the said switches being in the circuits to the said electro-magnets, an auxiliary valve mechanism to control the car to raise and lower the car, electro-magnets to actuate the auxiliary valve, and means to control the said last named electro-magnets, said means also controlling the circuits to the first named switches controlled by the car.

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

F. C. FURLOW.

Witnesses:
WALKER O. NETTLETON,
HAZEL R. GATES.