F. C. FURLOW.

ELEVATOR CONTROLLING SYSTEM.

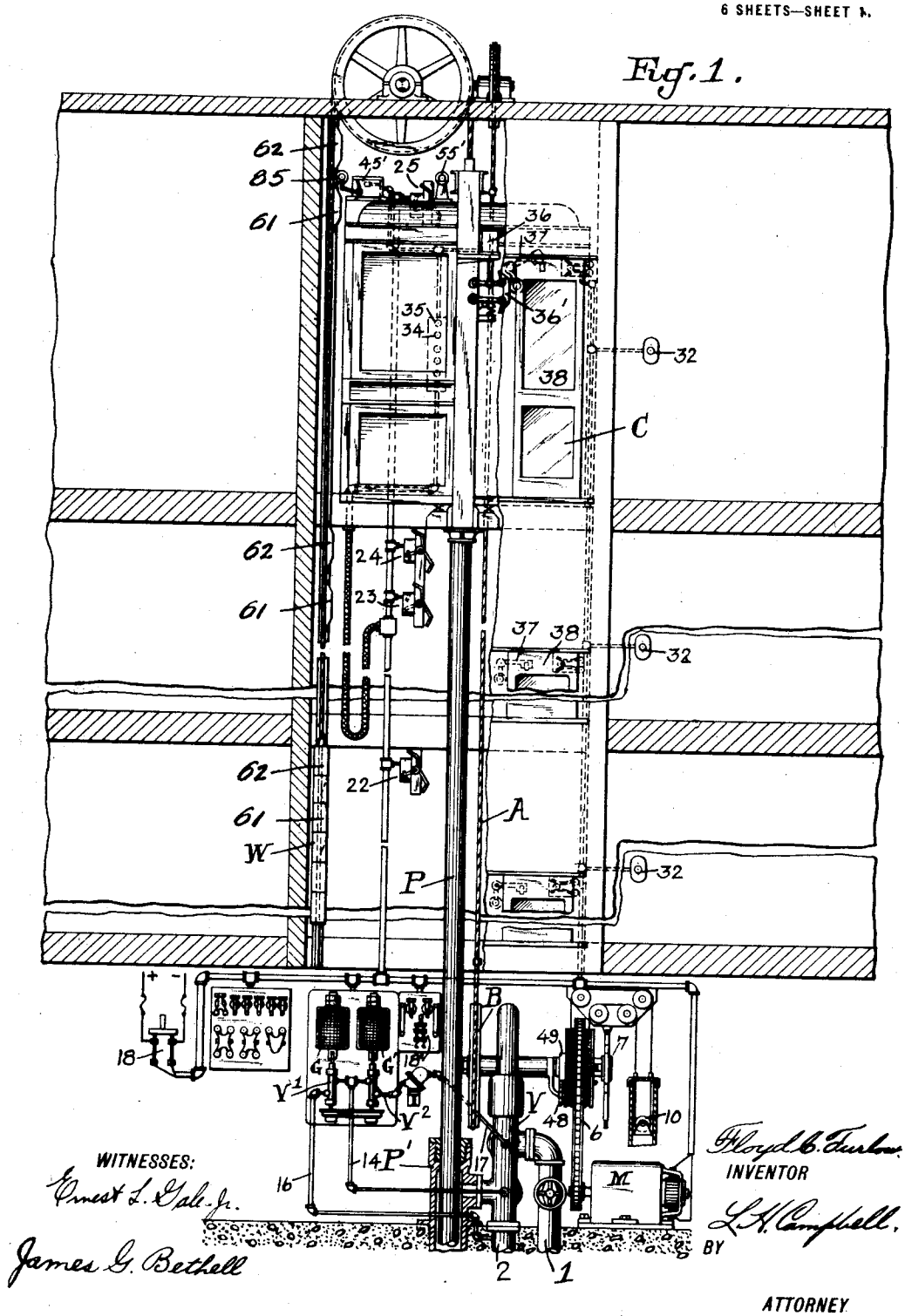
APPLICATION FILED NOV. 5, 1915.

1,268,109

Patented June 4, 1918.

6 SHEETS—SHEET 1.

Fig. 1.



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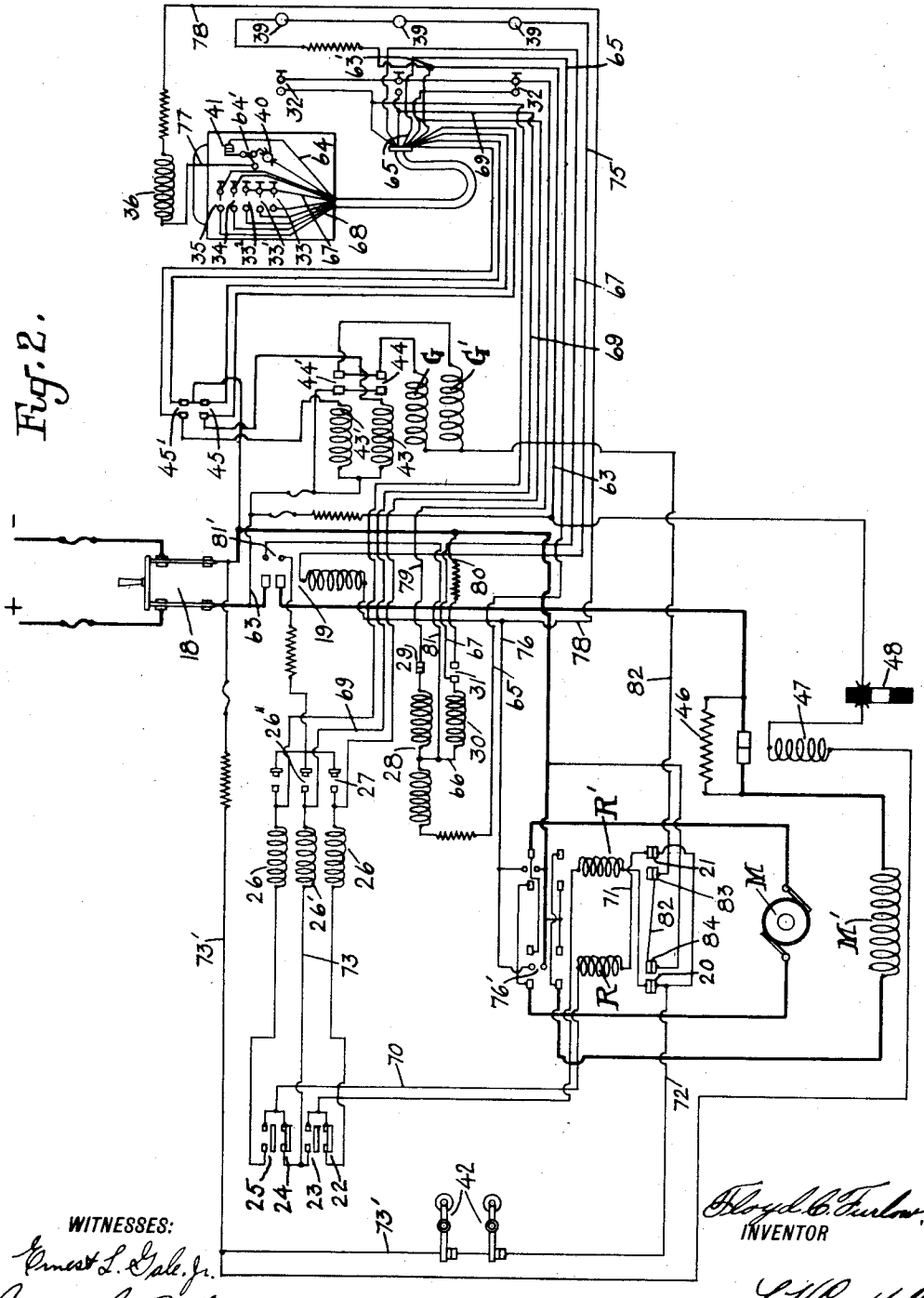
6 SHEETS—SHEET 2.

Fig. 2.



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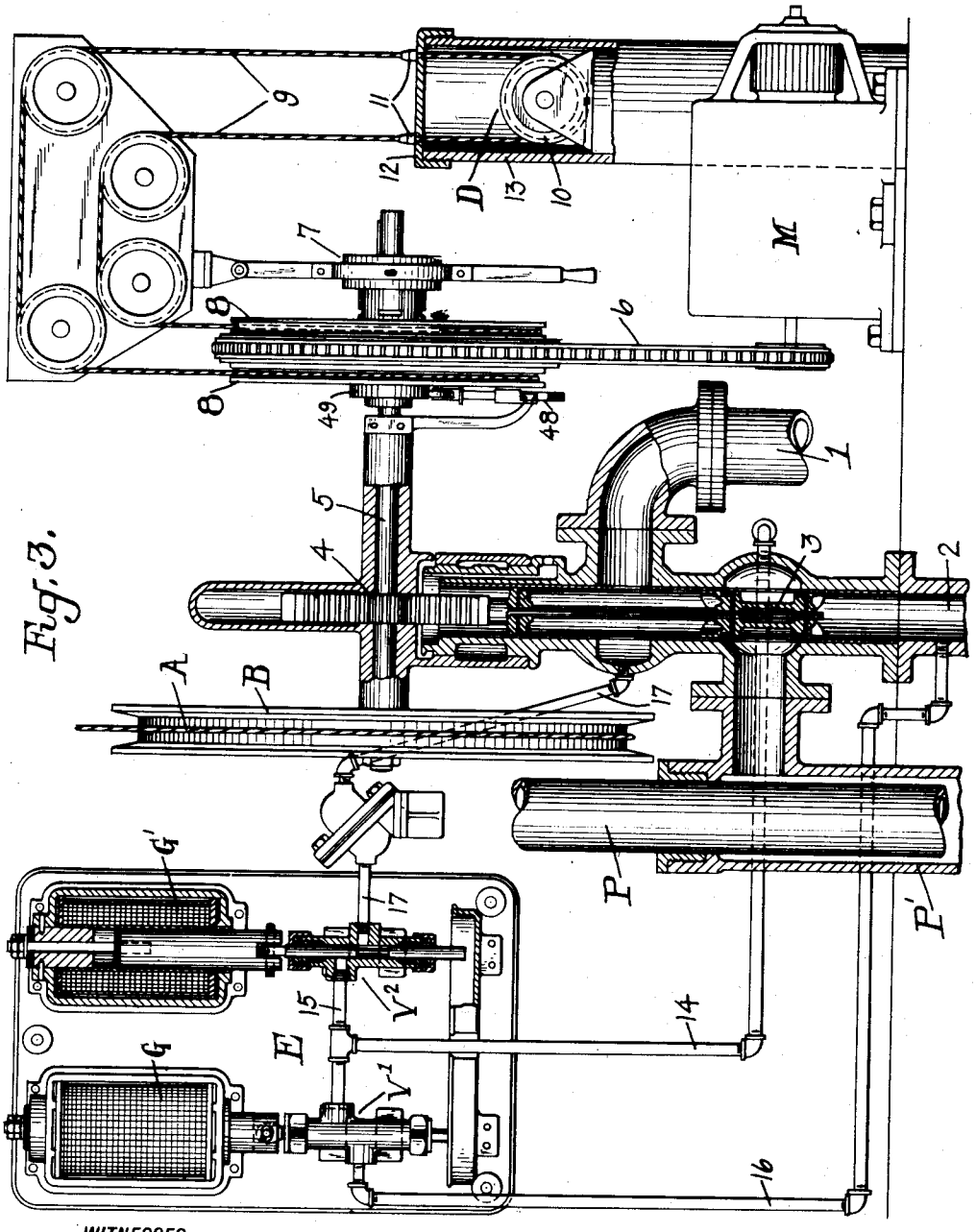

Fig. 3.

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6 SHEETS—SHEET 4.

Fig. 4.

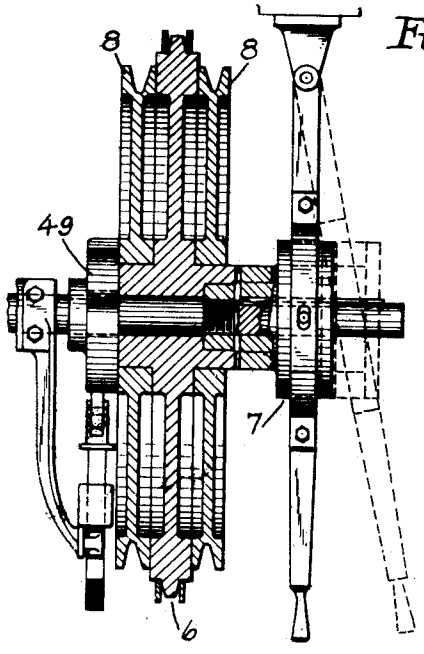


Fig. 5.

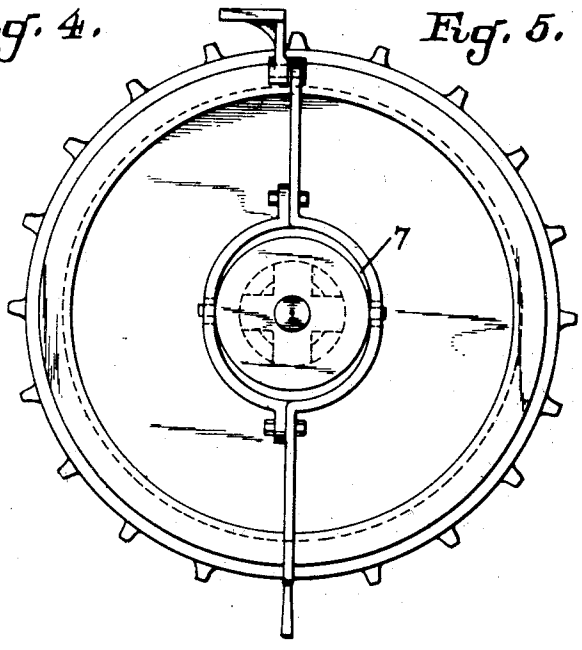


Fig. 6.

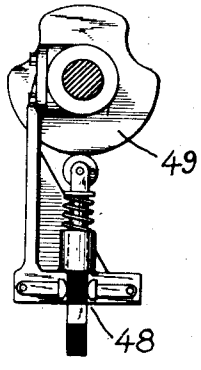
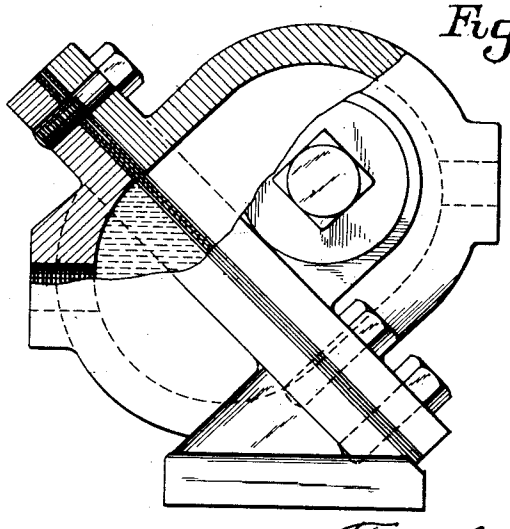


Fig. 7.



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6 SHEETS—SHEET 5.

Fig. 8.

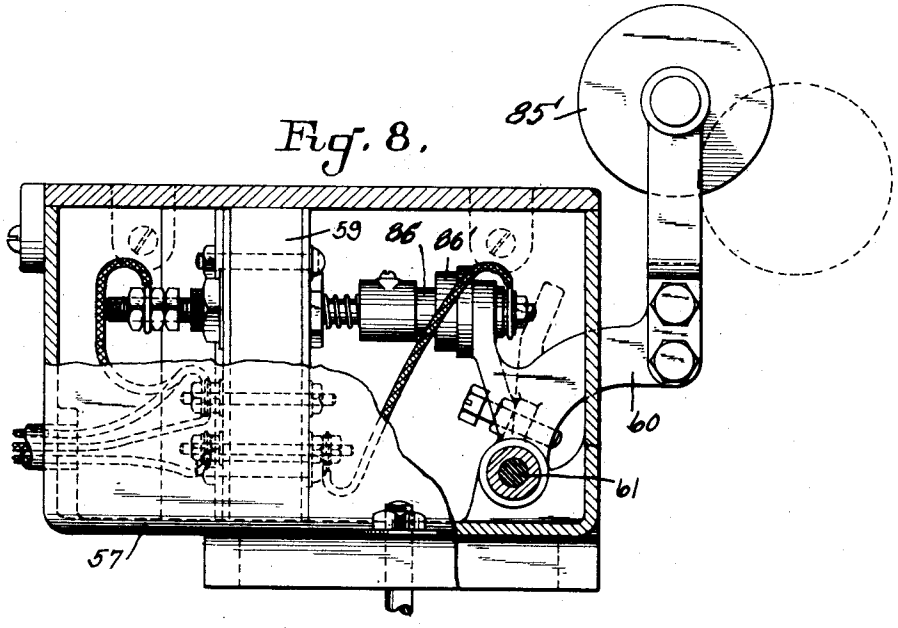
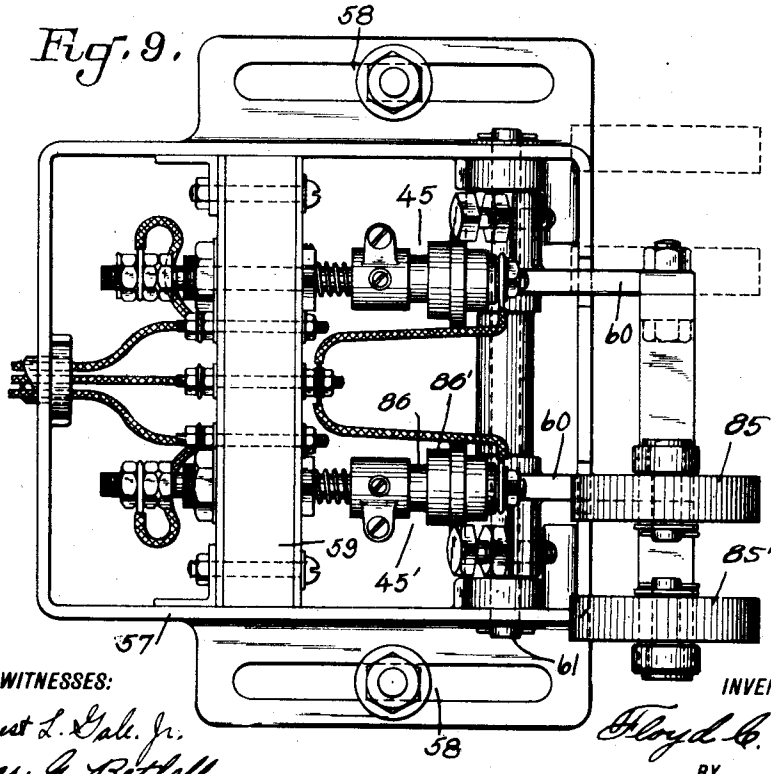


Fig. 9.



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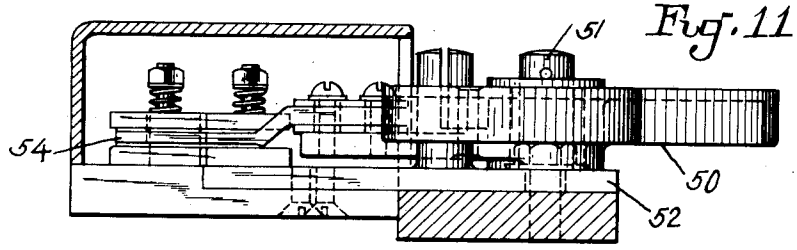
6 SHEETS—SHEET 6.

Fig. 11.



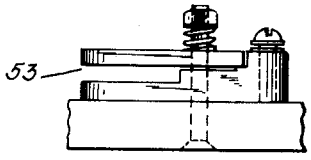


Fig. 12.

Fig. 10.

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UNITED STATES PATENT OFFICE.

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ELEVATOR-CONTROLLING SYSTEM.

1,268,109. Specification of Letters Patent. Patented June 4, 1918.

Application filed November 5, 1915. Serial No. 59,736.

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 Elevator-Controlling Systems, of which the following is a specification.

My invention relates to elevators, and more particularly to an improved system of control therefor, the same having a general application to all the various types of elevators, but being illustrated herein in conjunction with a hydraulic elevator, controllable by an automatic push button system of circuits.

The more essential features of the invention, reside in the provision of means for automatically controlling the operation of the elevator car in stopping, so as to bring the car exactly level with the floor landing, the means so used in accomplishing this result, being operable independently of the car speed and load; another feature resides in the provision of means for overcoming the objectionable crawl or settling of the car away from the floor level.

In the control of elevators, a certain defect has long existed, which has been the cause of serious accidents, inconvenience and expense, as well as delay in the elevator service or schedule. This defect is the inability automatically to control the elevator car in stopping, so as to bring the car floor at an exact level with the landing, this being more particularly so, in the case of an automatic push button controlled elevator, in which system, a well known form of floor controlling device is employed, in stopping the car. The present day floor controlling device proves inadequate for the reason that it can only be set once, for a given speed, and for an approximated load. Thus it will be evident that the floor controller will, for any load or speed above or below the approximated, tend to stop the car some distance either above or below a desired floor landing.

I propose to overcome these defects in a simple and most practical manner, by using what I will term an improved automatic car leveling system, the same being operable independently of the car speed or load, and more essentially by means which bear a certain fixed relation to the elevator car when at a landing.

Referring now to the drawings, Figure 1 illustrates in general arrangement, a typical hydraulic elevator system, together with improved controlling apparatus therefor, arranged in accordance with the present invention; Fig. 3 illustrates with certain parts in section, an enlarged view of certain parts illustrated in Fig. 1, these parts comprising a main valve together with a main and auxiliary controlling apparatus therefor; Fig. 2 illustrates diagrammatically, a typical push button electrical control system, as applied to Fig. 1; Figs. 4, 5, 6 and 7 illustrate more in detail and in different views, certain of the parts illustrated in Fig. 3, and Figs. 8, 9, 10, 11, 12, illustrate different views somewhat enlarged, of the details of construction of certain of the switch apparatus, illustrated in Fig. 1.

Referring now more particularly to Fig. 1, I will first designate the parts in general, and thereafter describe certain of the parts in detail.

An elevator car C, counterweight W, plunger P, plunger cylinder P', main valve V, and a hand rope A, operating the valve sheave B, are well known parts having well known functions.

A supply or pressure pipe 1, and a discharge pipe 2, connect the apparatus with a source of water under pressure for supply and any suitable receptacle for exhaust of the fluid.

The main valve V consists more essentially of a piston 3 (see Fig. 3) connected through a rack and pinion connection 4 to a valve shaft 5, at one end of which is keyed the sheave B, adapted for operation from the elevator car by means of the hand rope A; the valve piston 3 is operated either upwardly or downwardly from its normal position (as shown in Fig. 3) depending on the direction of rotation of the sheave B, the upward movement thereof causing the car to descend, by connecting the plunger cylinder with the discharge pipe 1, and the downward movement thereof, causing the car to ascend, by connecting the supply or pressure pipe 1 with the plunger cylinder.

In the present instance, the hand rope operation is intended for emergency only, it being purposed to ordinarily control the

main valve by means of a small electric motor designated M, the motor in turn being controlled by a well known push button system of electrical circuits, such as illustrated in Fig. 2. The motor M is connected to the valve shaft 5, through a comparatively high speed reduction mechanism as by means of the sprocket and chain connection 6, and a manually operable clutch mechanism 7, the larger sprocket wheel being loose on the shaft 5 and being rotatable therewith with the clutch in the position as indicated in Fig. 1. The electric motor M is reversible and is adapted to actuate the main valve, in either direction from its normal position, there being provided for the purpose of automatically centering the valve, a valve centering device, designated D. This device comprises a pair of sheaves 8, having a force fit on the hub of the large sprocket wheel. A cable 9 forms a loop around a weighted sheave 10, opposite ends of the cable passing around opposite faces of the sheaves 8, the ends being connected to the sheaves. Stops 11, normally bear on the top 12 of a casing 13, containing the weighted sheave 10. With this arrangement the weighted sheave 10 will act automatically to center the valve, from either of the two actuated positions given thereto by rotation of the sprocket wheel in one direction or the other.

In addition to the motor and hand rope control of the car, there is provided in addition thereto, what may be termed, a master car leveling device, designated E, which is for the purpose of automatically controlling the car to effect an exact landing. This device comprises two auxiliary by pass valves V′, V², each valve being operable independently by means of electromagnets G, G′, respectively. The electrically operated valve V′ operates to by pass pressure from the cylinder P′ by way of a pipe 14, valve V′, and pipe 16 to discharge pipe 2. The electrically operated valve V² operates to by pass pressure to the cylinder P′, by way of a pipe 17, valve V², pipes 15 and 14, and thence to the cylinder P′. It will thus far be seen, that the by pass valves V′ and V², control the car respectively to descend or ascend.

Referring now more particularly to Fig. 2, the elements will first be designated, they comprising a suitable source of current supply designated + and −, main line switch 18; an electromagnetic main line switch 19; reversing switches R, R′, controlling two sets of back contacts 20, 84 and 21, 83 respectively, the electric motor M having a series field winding M′; floor controller switches 22, 23, 24 and 25; floor relay magnets 26, each controlling a pair of normally open contacts 27; a noninterference magnet 28, having opposed windings, this magnet, controlling contacts 29; an additional relay magnet 30 controlling contacts 31; hall push buttons one at each floor landing, designated 32; car push buttons, one for each floor, designated 33, 33′ and 33², additional car push buttons 34, 35; an electromagnet 36, controlling a cam 36′ on the elevator car, this electrically operated cam controlling a door lock mechanism 37, for each hall door designated 38; door contacts 39; car door contact 40; safety car switch 41; limit switches 42; electromagnets G, G′ controlling the auxiliary valves, relay magnets, 43, 43′, controlling contacts 44, 44′, the latter contacts controlling circuits for the auxiliary valve operating magnets G and G′, respectively; two sets of contacts actuated by switches 45, 45′, mounted in the car, these switches controlling circuits for the relays 43, 43′; a series field resistance 46, controlled by an electromagnet 47, the electromagnet in turn being controlled by means of a cam operated switch 48, the cam 49 operating said switch, being rotatable with the valve shaft as seen in Figs. 1 and 3.

The floor controller according to the present invention comprises a number of switches constructed as shown in Figs. 10, 11 and 12. These switches are positioned in the elevator hatchway, there being one switch only, at the top and bottom floors, and two switches at each intermediate floor. These switches perform the same function as does the well known type, Carichoff floor controller, illustrated in Patent No. 783,174, granted February 21, 1905.

These switches are all of similar construction, each comprising a member 50, pivoted at 51, on an adjustable base or support 52. Fixed to this base or support is a casing containing a pair of fixed contact fingers 53. A contact blade 54 is controlled by the member 50, to make and break with the fixed contacts 53. The member 50 is provided with two oppositely extending arms such as 55, these arms being adapted to actuate the blade 54, through co-action with a roller 56′, fixed on the elevator car. The switches 23 and 25 control the car in ascending, it being noted that as the car ascends, the contacts 53 are positioned relatively with the blade, so as to be open circuited, the car in descending causing these contacts to be close circuited. The switches 22 and 24 control the car in descending, the contacts 53, associated with these switches, bearing such relation with the blade 54, as to be open circuited by the descending car, but close circuited by the ascending car. It will be pointed out here, that these switches are set at each floor, and relatively with their respective landings, so as to effect an exact landing at any desired floor, for a given car speed, and approximated load. However, as pointed out before, the car speed as well as load are subject to a wide

range of variations, which will tend to make the elevator car, either over run or under run a desired landing before a final stop; now in order to overcome this difficulty, there is provided in order automatically to bring the elevator exactly with the floor landing, aside from the electrically operated valves, V′, V², the relays 43, 43′ and switches 45, 45′; two sets of cams 61, 62, these cams being positioned in the elevator hatchway, the lowermost cams at each floor forming the set 51, and all being in the same vertical plane, and the upper cams at each floor forming the set 52, this set of cams being all in the same vertical plane, which is offset from that of the set 51. The two cams at each floor bear a certain relation to each other, as well as with the floor controlling switches at their respective floors, the reasons for this being pointed out more fully hereinafter. The cams forming the set 61, are adapted to actuate the switch 45′ mounted on the elevator car, the set 62, being adapted to actuate the switch 45. These switch devices are illustrated in detail in Figs. 8 and 9, the two switches being of similar construction, and being contained in a casing 57, the casing being fixed by an adjustable connection 58, to the top of the elevator car. A contact 86 is yieldingly connected to a suitable insulated base 59. A coacting contact 86′ is carried by a gravity actuated arm 60, the arm being pivoted at 61. The arm 60 carries a roller 85′, this roller being associated with the switch 45′ and adapted to coact with the cams forming the set 61. The roller 85 is associated with the switch 45, it being adapted to coact with the cams forming the set 62.

Thus far it will be pointed out, that the elements constituting the "automatic car leveling device" comprise, the electrically operated by pass valves V′, V², the relay magnets 43, 43′ which control circuits for the valve operating magnets G, G′ respectively, the relays being controlled by the switches 45, 45′ on the elevator car, and these switches in turn being controlled by the two sets of cams 61, 62 in the elevator hatchway. An auxiliary knife switch 18′, may be provided if desired (see Fig. 1) to connect or disconnect the automatic electrical car leveling apparatus from the source of current supply.

Having thus pointed out in detail the various elements constituting the present improved controlling system, I will now describe the operation of the various parts through a complete cycle of operation. We will assume that the elevator car is heavily loaded at the third floor as indicated in Fig. 1, it being desired to descend to the second floor. For this operation the car button 33′ is pressed. A circuit is thereby established as follows: from the + main, wire 63, door contact 40, switch 41, wire 64, wire 65, through one of the windings of non-interference magnet, wire 66, relay 30, wire 67 common to the car push buttons, push button 33′ to wires 68, 69, floor relay magnet 26′, wire 73, floor switch 24, which is now closed, wire 70, through down reversing switch winding R, wire 71, back contacts 21, wire 72, hatchway limit switches 42, and thence by wire 73′ to — line. A parallel circuit for the winding of the main line switch 19 may be traced from the junction 63′, hatchway door contacts 39, wire 75, to winding of main line switch 19, and thence by way of wire 76 and auxiliary contacts 76′, on the reversing switch R which is now closed, to the minus line. A parallel circuit for the winding of the cam magnet may be traced from the branch 64′, wire 77, cam magnet 36, wires 78 and 76, to — line by way of auxiliary contacts 76′. The cam magnet receiving current will now actuate the cam out of engagement with the door locking mechanism which will now operate to lock the door. The winding 19 now receiving current will close the main line switch and thereby connect the motor to the source of current supply, and since the reversing switch is closed, the motor M will now operate, to move the main valve, upwardly, thus connecting the plunger cylinder with the exhaust pipe 2, and permitting the elevator car to descend. The main valve is maintained in its operated position by the power exerted by the motor M, against the action of the weighted sheave 10. Upon the valve being operated to full open position, the cam 49 has at this time been rotated sufficiently to allow the switch 48 to close, thereby effecting an operation of the electromagnet 47, to insert a resistance 46 in series with the field winding M′, thus protecting against overheating the motor M. The non-interference magnet 28 operates in a usual manner to open its contacts 29, thus open-circuiting the wire 79, which is a common feed wire for the hall push buttons 32. The relay 30 closes its contacts 31 and establishes a holding circuit, which circuit is the one heretofore traced up to and through the relay 30, contacts 31, wire 80 to — line. As this latter holding circuit can normally be opened only at car door contacts 40, or the safety switch 41, the control of the car by operation of any of the floor landing switches is prevented until the car has stopped and car door opened to restore the magnets 28 and 30 and the door again closed. Furthermore since the hatchway door contacts are included in series with the winding of the main line switch 19, operation of the said switch and consequently the elevator car, is prevented, until all of the hatchway doors are closed. When the car push

button 33′ is released, the circuit for the windings of the reversing switch, non-interference magnet, etc., is then maintained by way of the branch wire 81, auxiliary contacts 81′, through the relay contacts 26″, and so on to the — line, by way of the floor controller switch 24. It will be mentioned here, that the push-button system of electrical circuits illustrated herein for controlling the valve operating electric motor M is well known.

The car now descending, will, upon reaching the 2nd floor landing, bring the roller 55′ carried thereon into engagement with the floor controller switch 24, thereby opening its associated contacts, which open the circuits for the windings of the reversing switch, etc. The reversing switch will now open, thereby cutting off the current supply to the electric motor M, and permitting the main valve to be centered by means of the valve centering device D. The main valve as is well known will be centered in a certain time period irrespective of the speed and load, of the car, and consequently with a heavily loaded descending car, the tendency will be for the elevator car to travel some slight distance below the second floor level, before the final stop corresponding to the center position of the main valve is effected.

Here is where my improved master car leveling device is brought into action, automatically to bring the elevator car exactly to the floor landing, it being particularly noted that the elements accomplishing this result operate independently of the car speed or load. So soon as the car floor tends to travel below the second floor landing, the switch 45′ is closed through the engagement of its roller 85′ with the cam 61. The closing of the switch 45′ closes a circuit for the relay magnet 43′, whose contacts 44′ in turn establish a circuit for the electromagnet G′, the latter now actuating the valve V^2, to by-pass pressure into the plunger cylinder P′ by way of pipes 17, valve V^2, and thence by way of pipes 15 and 14 to the cylinder P′. The pressure now admitted to the cylinder P′ will cause the car to ascend at an approximated slow speed, and directly as the car floor comes flush with the floor landing, the roller 62 rides off the cam 61, thus allowing the switch 45′ to open. The electromagnet G′ is in this manner deënergized, permitting the valve V^2 to return to its normal position. In this way the pressure supply is cut off from the cylinder P′ thus causing the elevator car to stop the very instant the car floor is exactly level with the floor landing.

It is a well known fact, that in a hydraulic elevator system there is always more or less leakage around the valves, or plunger, or in fact both. This leakage is objectionable since it permits the elevator car gradually to crawl or settle below the floor landing. Now it will be seen that with the present invention, so soon as the car starts to settle, it will be automatically returned exactly level with the floor landing, through the action of the automatic car leveling device as described above.

In operating the elevator car in an ascending direction by means of either the car or hall push buttons, the main parts operate in a similar manner as for the descending car operation, with the exception of the electric motor M, which for an ascending direction of car travel, is controlled by the reversing switch R′, to operate in a reverse direction to that heretofore described, thus effecting a movement of the main valve in a reverse direction, which in this instance would be downwardly, thereby connecting the plunger cylinder P′ with the pressure supply. Pressure now being admitted to the plunger cylinder, causes the car to ascend to the desired floor, whereat the opening of the floor controlling switch by the roller 55′ causes the car to be brought to a stop. Take now for example the case of the car ascending from the 1st to the 2nd floor, with a light load. The tendency in this instance is for the elevator car to coast past the second floor landing. In this instance the upper cam 62, at the second floor coacts with the roller 85, thereby closing the switch 45, the cam 62 being positioned so as to actuate this switch directly as the car floor rides above the floor landing. The switch 45 closes a circuit for the relay 43, whose contacts 44 establish a circuit for the electromagnet G, the latter actuating the valve V′ to bypass pressure from the cylinder P, by way of pipes 14, 15, valve V′, and thence by way of pipe 16 to the exhaust pipe 2. Water pressure now being relieved from the cylinder, causes the car to descend, at an approximated slow speed, until the car floor is exactly level with the landing, at which instant the roller 85′ rides off the cam 62 thus allowing the switch 45 to open. Opening the switch 45 causes the deënergization of the magnet G, which permits the valve V′ to close and thus cut off the escape of fluid pressure. In this manner the ascending elevator car is brought automatically at an exact level with the floor landing, in case the car tends to travel or coast past the desired landing. It will here be pointed out that the common return wire 82 for the electromagnets G, G′ is contained in series with the auxiliary back contacts 83, 84 on the reversing switches R′ and R respectively, hence, so long as either one of these switches is closed or operated, it is impossible to effect an operation of either of said electromagnets.

Aside from the automatic control system for the valve magnets G, G′ there may be

provided for controlling these elements a manual control comprising two push buttons in the elevator car, the buttons for this purpose being designated 34 and 35. These buttons control the operation of the valve magnets G, G′ in the same manner as do the switches 45, 45′ on the car. The button 34 controls the operation of the magnet G, it being connected in parallel with the switch 45, and the button 35 controls the operation of the up magnet G′, it being connected in parallel with the switch 45′. These two buttons, primarily are used to effect what is commonly termed an inching operation.

In case the motor M or its associated electrical controlling apparatus should get out of order, the motor and its connected sprocket wheel, etc., may be disconnected from the valve shaft 5, by actuating the clutch mechanism 7. The main valve then may for the ordinary operation be controlled by a car lever operative through the medium of the hand rope A.

Now it will be evident that with the use of the present master car leveling device, together with the particular arrangement of the apparatus controlling the same, permits of the most fine adjustment of parts, to bring the car to a stop exactly at the desired floor level. Furthermore it is an inherent feature in the present master car leveling device to overcome the objectionable crawl or settling of the car due to leakage, etc., it being seen that the device becomes operative in the event of the car overrunning or underrunning the desired landing, either in its ascent or descent, or in the event of settling, after once being brought exactly level with the floor landing.

The invention in its fundamentals may have a wide range of applications, to either electrically or mechanically controlled elevators, employing any well known motive means, such as, steam, electricity or hydraulic pressure.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In an elevator, the combination of the car, a hydraulic hoisting motor therefor, mechanism to control the motor to raise and lower the car, means independent of the car to actuate the said mechanism, and means controlled automatically by the car, to control the said actuating means to cause the latter to actuate the said mechanism to control the hoisting motor to raise and lower the car.

2. In an elevator, the combination of the car, a hydraulic hoisting motor therefor, mechanism to control the motor to raise and lower the car, electro-responsive means to actuate the said mechanism, and mechanism controlled automatically by the car, to control the electro-responsive means to cause the latter to actuate the said mechanism to control the hoisting motor to raise or lower the car.

3. In an elevator, the combination of the car, a hydraulic hoisting motor therefor, a main valve and an auxiliary valve to control the motor, means to operate the main valve, means to open the auxiliary valve to cause the motor to move the car to a level with the desired landing, comprising an electro-magnet, an electric circuit therefor, including a switch, means to close the switch automatically by the movement of the car to the desired landing.

4. In an elevator, the combination of a car, a hydraulic hoisting motor therefor, a main valve and an auxiliary valve to control the motor, means to operate the main valve, means to open the auxiliary valve, to cause the motor to move the car to a level with the desired landing, independently of the main valve, comprising an electro-magnet, an electric circuit therefor, including a switch, a cam in the hatchway to engage the switch and close it upon the movement of the car to the landing to cause the electro-magnet to open the auxiliary valve, and upon the car floor becoming level with the landing to release the switch to open the circuit to deënergize the magnet to allow the auxiliary valve to close.

5. In an elevator, the combination of the car, a hydraulic motor therefor, a main valve to control the motor, means to operate the valve, two auxiliary valves also to control the motor, one auxiliary valve to control the car in its ascent and the other auxiliary valve to control the car in its descent to cause the motor to raise or lower the car floor to a level with the floor landing, means to open the auxiliary valves, comprising electro-magnets and electric circuits therefor, including switches in the circuits, and cams to close the switches by the movement of the car to a desired floor landing to open the auxiliary valves, whereby the car floor is brought to a level with the landing floor.

6. In an elevator, the combination of a car, a hydraulic hoisting motor therefor, a main valve and an auxiliary valve for controlling the motor, means to operate the main valve, means to open the auxiliary valve, to move the car to a level with the floor landing independently of the main valve, comprising an electro-magnet, an electric circuit for the magnet, a switch on the car in the circuit, a cam in the hatchway to engage and close the switch upon the movement of the car to the desired floor landing, and to release the switch and allow it to open to allow the auxiliary valve to close, upon the car floor being level with the landing floor.

7. In a hydraulic elevator, the combina-

tion of a car, a hydraulic hoisting motor therefor, a main controlling valve for the motor, a push button electrically operable apparatus including an electric circuit therefor, to control the main valve to operate the car, an auxiliary valve further to control the motor, independently of the main valve, to bring the car to a level with the desired floor landing, means electrically operable to open the auxiliary valve, and an electric circuit therefor, the said circuit being interrelated with the push-button apparatus and so controlled thereby as to prevent it being closed if and when the first named circuit is closed.

8. In a hydraulic elevator, the combination of a car, a hydraulic hoisting motor therefor, a main controlling valve for the motor, a push button controller apparatus, operable to open the main valve, and means to close the main valve, an auxiliary valve for further controlling the motor, independently of the main valve, to bring the car to a level with the floor of a desired landing, electrically operable means including a switch to control the auxiliary valve to open it, and means automatically operable upon the movement of the car to close the said switch to control the auxiliary valve, to open the same to cause the motor to operate the car to have its floor become level with the landing floor.

9. In a hydraulic elevator, the combination of a car, a hydraulic motor to operate the car, a main valve to control the motor, an electric motor to open the main valve, a push button apparatus for controlling the electric motor, an electric circuit to the electric motor, a switch in the circuit, means to engage the switch and open it upon the movement of the car to a desired floor, to allow the main valve to be closed, an auxiliary valve for further controlling the motor to bring the car floor to a level with the floor of the landing floor, another electric means, including an electric circuit and a switch therein, and means to close the last mentioned switch by the movement of the car to the desired landing, to open the auxiliary valve.

10. In an elevator, the combination of the car, a hydraulic hoisting motor therefor, a main valve and an auxiliary valve mechanism to control the motor, means to control the operation of the main valve, electro-responsive means to actuate the auxiliary valve mechanism, a switch, means automatically to close the switch by movement of the car to a desired landing, and an electrical circuit for the said electro-responsive means, controlled by the main valve controlling means and the said switch.

11. In a hydraulic elevator, a car, a hydraulic hoisting motor therefor, a main valve to control the motor, an electric motor to open the main valve, a switch controlling a circuit for the electric motor, auxiliary controlling mechanism further to control the hydraulic motor to bring the car floor to a level with the floor of a desired landing, electric means to actuate the auxiliary mechanism, and means controlled by movement of the car to control a circuit for the said electric means, said circuit being also controlled by the above-named switch.

12. In an elevator, the combination of the car, a hydraulic hoisting motor, a main valve, means controllable from the car to control the main valve, auxiliary valve mechanism to control the hydraulic motor to move the car to a level with a desired landing, electro-responsive means to actuate the auxiliary valve mechanism, a switch controlled by movement of the car, and a circuit for the electro-responsive means, controlled by the first named controlling means and the said switch.

13. In an elevator, the combination of the car, a hydraulic hoisting motor therefor, a valve mechanism to control the motor to raise and lower the car, electro-responsive means to actuate the valve mechanism, switches to control electrical circuits for the electro-responsive means, and means to close one of the switches automatically by movement of the car to a desired landing, and to open said switch when the car platform is level with the said landing, and means to close the other of said switches automatically by movement of the car platform in overrunning the said landing, said switch closing a circuit to the electro-responsive means to effect operation of the valve mechanism to control the hydraulic motor to reverse the movement of the car and return its platform to a level with the said desired landing.

14. In a hydraulic elevator, a car, a hydraulic hoisting motor therefor, a main valve to control the motor, an electric motor to open the valve, a circuit to the electric motor, a switch in the circuit, front and back contacts on the switch, the front contacts forming a part of the said circuit, an auxiliary valve further to control the hydraulic motor to bring the car floor to a level with the floor of the desired landing, electric means operable to open the auxiliary valve, an electric circuit for the said electric means, including the said back contacts, and means to close and open the said circuit by the movement of the car to a desired landing.

15. In an elevator, the combination of the car, a hydraulic hoisting motor therefor, a main valve, manually operable means to control the operation of the main valve, an auxiliary valve mechanism to control the motor to raise and lower the car independently of the main valve, and means controlled man-

ually, to actuate the auxiliary valve mechanism to control the motor to raise and lower the car.

16. In an elevator, the combination of the car, a hydraulic hoisting motor, a main valve, means controllable from the car to control the main valve, auxiliary valve mechanism to control the motor, electro-responsive means to actuate the auxiliary valve mechanism to control the motor to raise and lower the car independently of the main valve, and manually operable circuit controller in the car, and a circuit for the electro-responsive means controlled by the first named controlling means and the said manually operable circuit controller.

17. In an elevator, the combination with the car, motive means for the car, push button controlled apparatus to control the motive means and means under the control of the said push button controlled apparatus to level the car with the landing, independently of the said apparatus.

18. In an elevator, the combination with the car, motive means for the car, push button controlled apparatus to control the motive means independently of its speed, and means under the control of the said push button controlled apparatus automatically to raise or lower the car and level the same with the landing.

19. In a hydraulic elevator, the combination of the car, a hydraulic motor, a main valve, a motor for actuating the valve, an automatic push button system of electrical circuits and a floor controller apparatus comprising a switch at each floor operable by the car to control the motor, an electrically controlled by-pass valve, and means comprising a coacting cam and switch dependent on the car overrunning or underrunning the desired landing, automatically to control the by-passing means to effect an exact car landing.

20. In an elevator, the combination with the car, push-button controlled apparatus to control the car, and means under the control of the push button controlled apparatus automatically to level the car with the landing, independently of the first named apparatus.

21. In an elevator, the combination with the car, push-button apparatus to control the car, and auxiliary means controlled by the said push button apparatus automatically to raise or lower the car.

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

FLOYD C. FURLOW.

Witnesses:

JESSE H. VAN ALSTYNE,

T. M. BALDWIN.