

(No Model.)

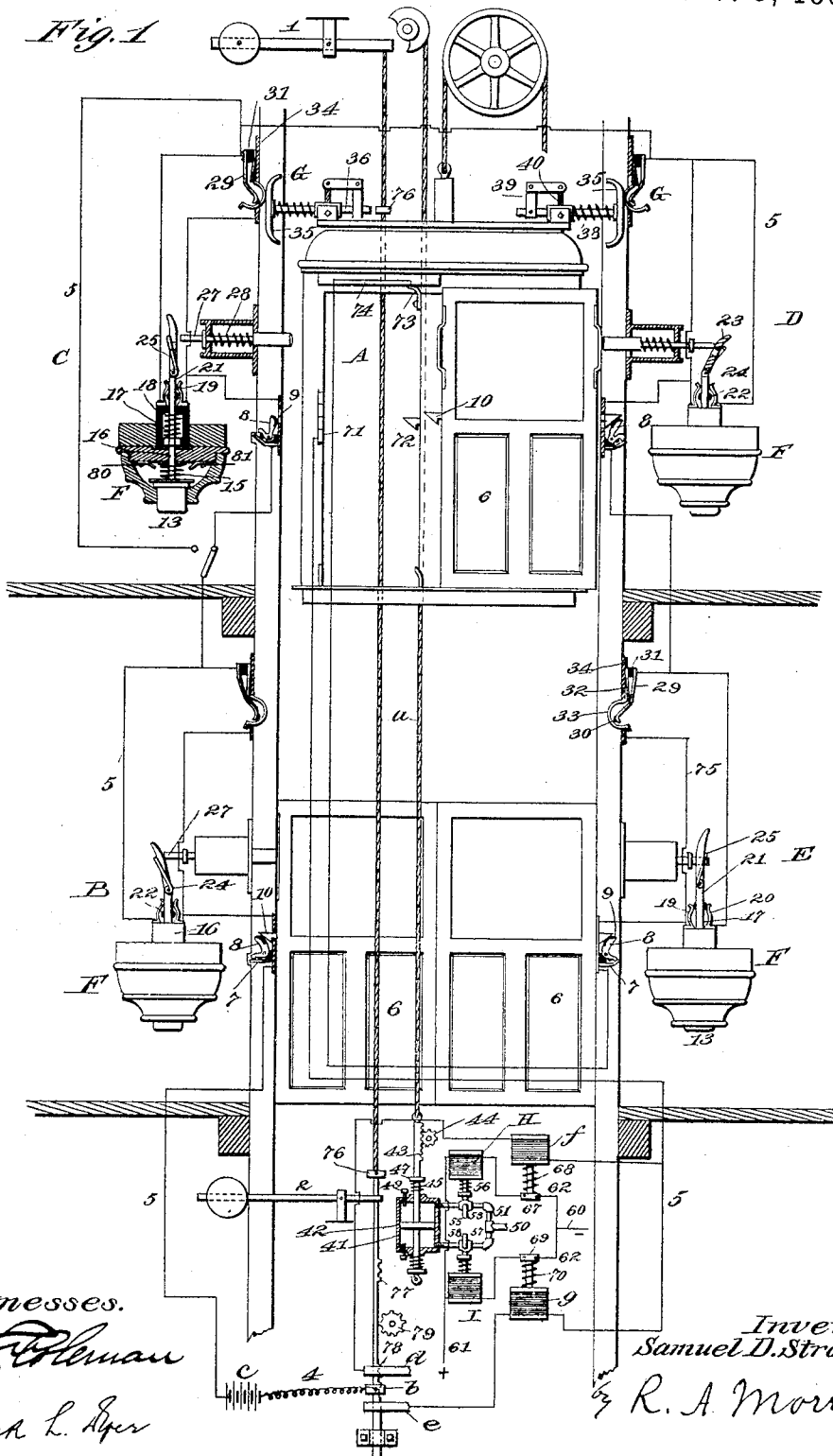
5 Sheets—Sheet 1.

S. D. STROHM.
ELECTRICALLY CONTROLLED ELEVATOR.

No. 570,827.

Patented Nov. 3, 1896.

Fig. 1



Witnesses.

J. S. W. Homan
Frank L. Ayer

Inventor
Samuel D. Strohm

R. A. Morrison
Atty.

(No Model.)

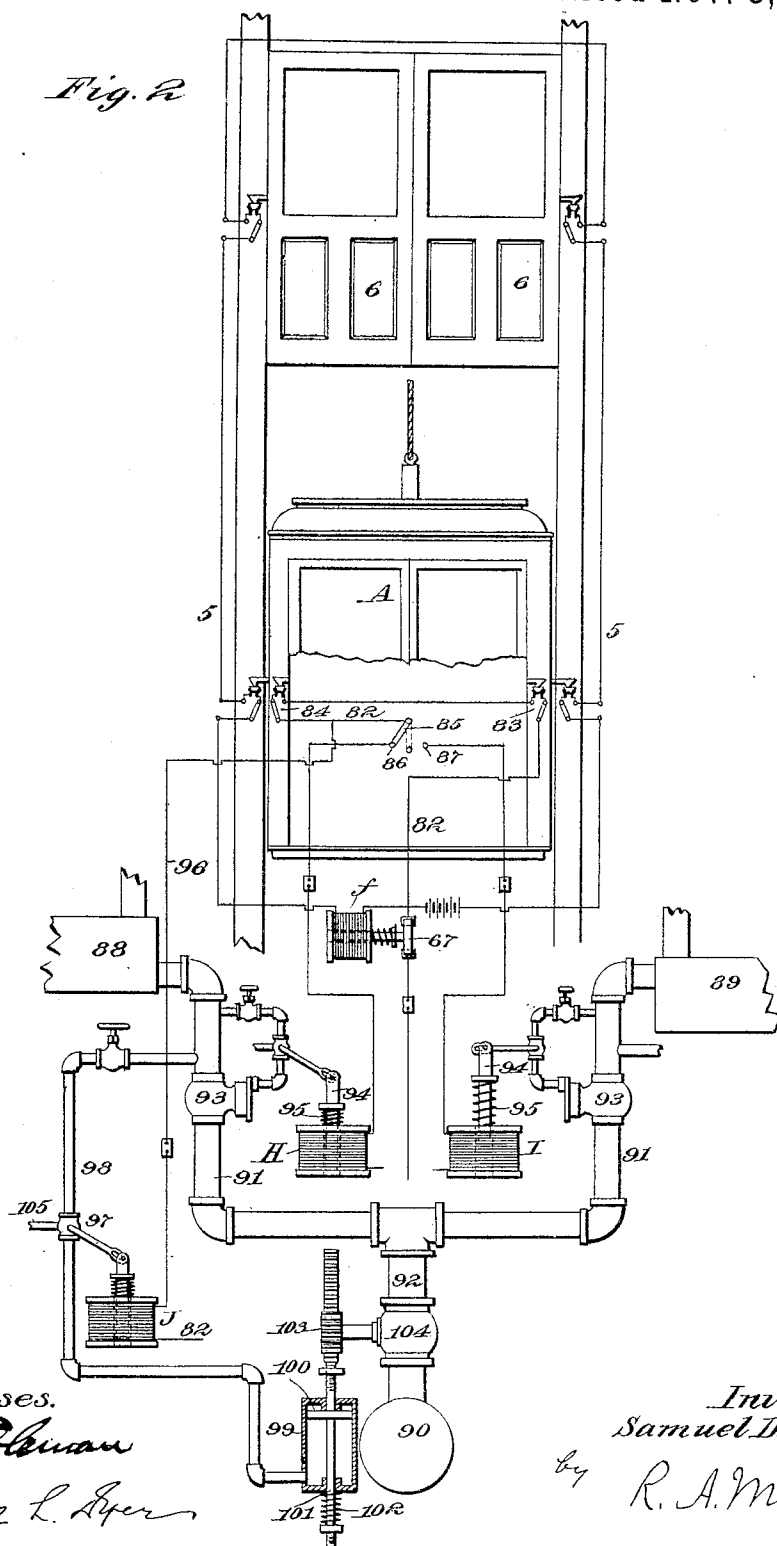
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S. D. STROHM.
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Fig. 2



Witnesses.

J. F. Coleman
Frank L. Ayer

Inventor
Samuel D. Strohm

by *R. A. Morrison*
Att'y.

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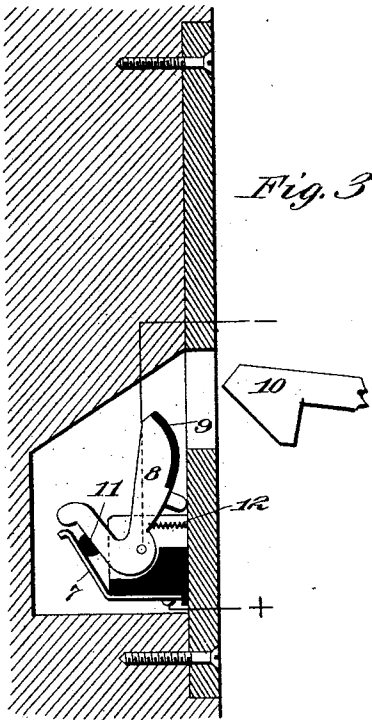


Fig. 3

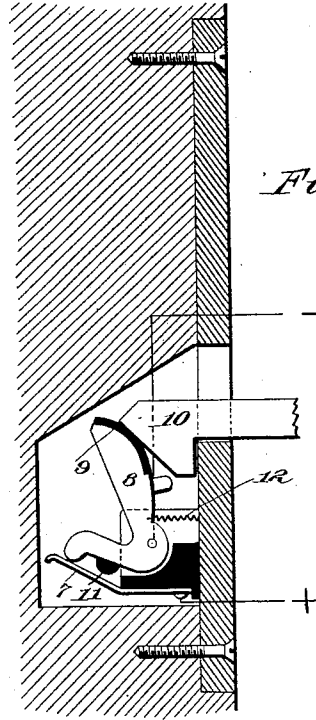


Fig. 4

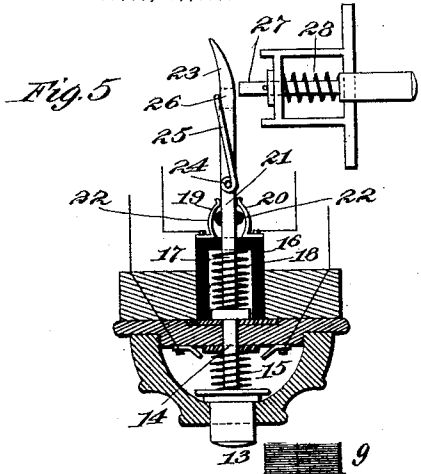


Fig. 5

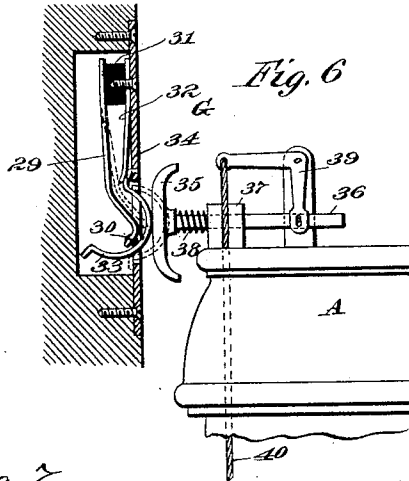


Fig. 6

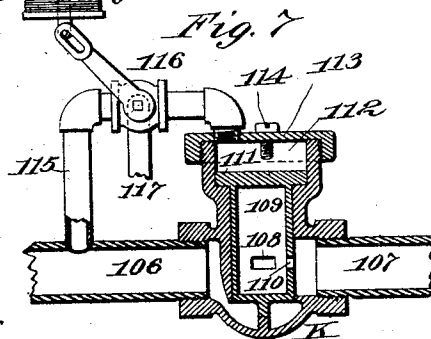


Fig. 7

Witnesses.

J. F. Coleman
Frank L. Ayer

Inventor
Samuel D. Strohm

R. A. Morrison
Atty

(No Model.)

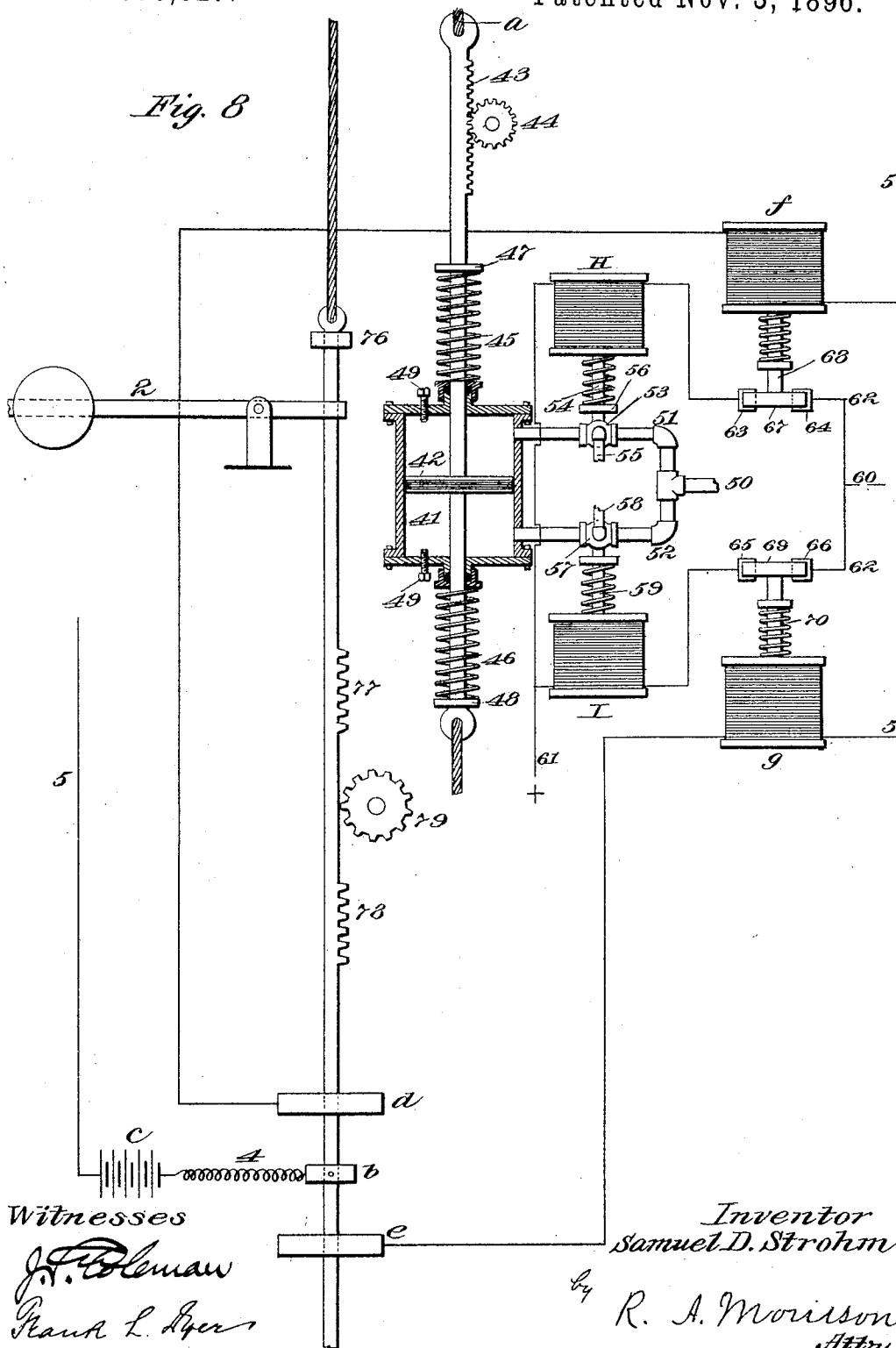
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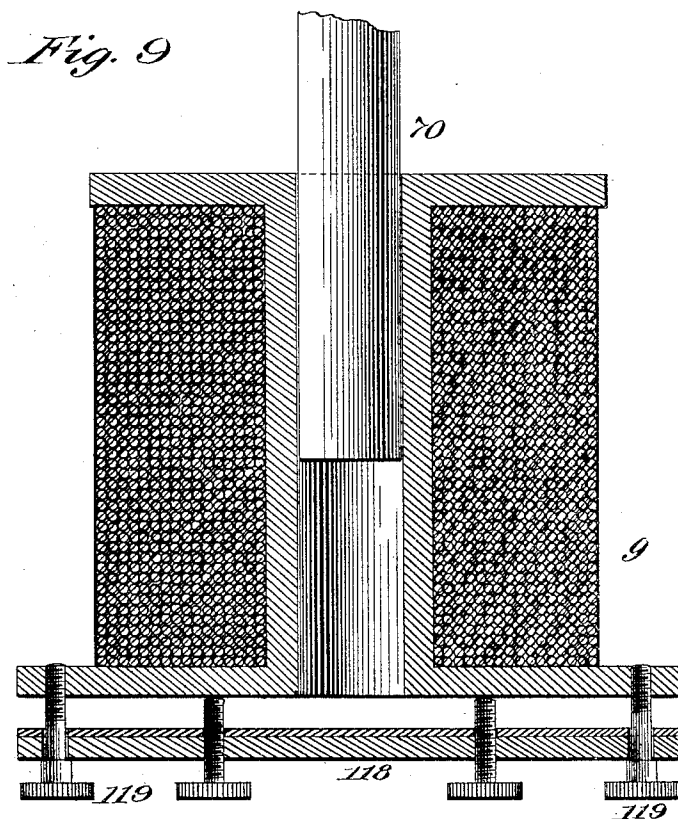
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Witnesses.

J. F. [Signature]
O. J. [Signature]

Inventor
Samuel D. Strohm

By R. A. Morrison

Atty.

UNITED STATES PATENT OFFICE.

SAMUEL D. STROHM, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE STROHM ELEVATOR SAFETY DEVICE COMPANY, OF SAME PLACE.

ELECTRICALLY-CONTROLLED ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 570,827, dated November 3, 1896.

Application filed April 4, 1896. Serial No. 586,211. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL D. STROHM, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Elevators, (Case A;) and I do hereby declare the following to be a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to various new and useful improvement in elevators, and more particularly to elevators which are controlled or operated by electrical means; and the object of the invention is to improve and simplify the construction and operation of such elevators.

My invention is capable of being applied to and carried out in connection with any elevator irrespective of type or motor mechanism.

By means of my invention an elevator equipped as I will describe will be rendered absolutely safe in operation, it being impossible to start the elevator when any one of the landing-doors is opened or is otherwise in an unsafe or insecure condition. Moreover, with my present invention, should the elevator-car be in operation and any one of the landing-doors be then opened or unfastened the elevator will be immediately brought to rest.

By means of my invention also the elevator can be automatically stopped at any one of the landings by a person thereat without the need of an operator in the car, so that the elevator will thereby practically be an automatic one.

Other features of novelty and utility will be presently described, and embodied in the claims.

In order that my invention may be better understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figures 1 and 8 are diagrammatic views of a hydraulic passenger-elevator equipped with my invention and illustrating the manner of controlling the elevator by a valve-rope pass-

ing through the car; Fig. 2, a similar view of the same, illustrating a method of controlling the motor mechanism by means of a switch carried on the car. Figs. 3 and 4 are details of a convenient form of circuit breaker or closer for the safety-circuit, operated by the latch or other fastening device of the landing-doors; Fig. 5, a sectional view of the elevator-controlling push-button shown in Fig. 1; Fig. 6, a detail view of the circuit-closer for breaking the safety-circuit by the elevator-shoe, as will be explained; Fig. 7, a sectional view, partly in elevation, of the preferred form of electrical valve employed; and Fig. 9, a sectional view of the preferred construction of solenoid.

In all of the above views corresponding letters and numerals of reference indicate the same parts.

A represents an elevator-car movable in an ordinary well or shaft and operated by a rope or cable in any suitable way.

B, C, D, and E indicate stations in the building at which the elevator is adapted to stop and from which it may be controlled.

In Fig. 1 the stations C and D are shown on one floor, and the stations B and E are shown on the floor below the same, but there may be separate stations or more than one station at each floor.

a is a controlling rope or rod vertically arranged in the elevator shaft or well, and which extends through the car, said rope or rod being counterbalanced by means of counterbalance-levers 1 and 2 and being guided at its lower end by a suitable sleeve 3, as shown. Carried near the lower end of said controlling rope or rod is a contact-plate *b*, insulated from the same and connected by a wire 4 to one side of the battery *c* or other source of supply.

d e are contact-plates with which the plate *b* is adapted to make contact, according to the position to which the controlling-rope is moved.

5 is a safety-circuit extending through circuit breakers or closers controlled by each of the landing-doors 6, and which, when in its operative condition, enables the hydraulic apparatus of the elevator to be controlled. In

the present instance this circuit is normally closed, in which case said mechanism may be operated.

Preferably the circuit closing or breaking device at the landings are actuated by the latches of the landing-doors, so that in order that said circuit may be put into its operative condition it is necessary that all of the landing-doors shall not only be closed but shall be actually secured. A convenient form of circuit-closing device is illustrated in Figs. 3 and 4, but it may be observed that the construction of the same is capable of many modifications which will suggest themselves to others skilled in the art, and I therefore do not wish to be limited to any particular form of device.

Having reference to the circuit-closer illustrated, 7 represents a suitable insulated spring, which is adapted to make contact with a shoe 8, pivotally mounted adjacent to said spring. Said shoe is provided with a face 9, of insulating material, with which the latch 10 of the landing-door 6 is adapted to come into contact, so as to make contact between the shoe 8 and the spring 7 and close the safety-circuit at that point. The shoe 8 is also provided with an insulating knob or button 11 thereon, which, when said shoe is forced to its retracted position by means of the spring 12, when the door is unfastened, comes into contact with the spring 7 and breaks the safety-circuit, as will be understood.

All of the parts described are carefully insulated from the iron-work of the elevator structure, so that there can be no danger of grounds forming to short-circuit the battery.

A convenient arrangement of elevator-controlling push-button, which is also included in the safety-circuit, is shown in Fig. 5 and is lettered F in the other views.

13 is a suitable push-button mounted in a casing and connected with a rod 14, said push-button being normally forced to its outward position by a spring 15, surrounding said rod. The push-button is made, preferably, of insulated material, such as porcelain or fiber. At the back of said push-button is an insulated sleeve 16, in which works a plunger 17, with which the end of the rod 14 engages when the button 13 is pushed inwardly, said plunger being normally forced outward by a spring 18.

19 and 20 are two contact-springs carried on the end of the sleeve 16 and making contact normally with a rod 21, which may be a continuation of the plunger 17. Said rod also carries one or more insulated studs or buttons 22, which, when the plunger 17 is pushed inwardly, engage beneath the springs 19 and 20, so as to break the circuit at these points.

23 is a shoe pivoted on the end of the rod 21 at 24, and normally held in a position parallel with said rod by a spring 25, a stop (not shown) or other means being provided for

preventing said shoe from being forced to a position beyond that point. Said shoe 23 is provided with a curved forward end and with an opening 26 therein.

27 is a stud carried in a suitable framework and adapted to be forced to a retracted position by means of a spring 28. Said stud is normally held in the position shown at B and D, Fig. 1, so as to force the shoe 23 out of line parallel with the rod 21, as will be understood.

When one or more circuit-closing push-buttons such as I have explained are included in the safety-circuit, it is also desirable to include therein a circuit-breaking device, whereby the safety-circuit will be broken by a shoe carried on the elevator-car, for the purpose to be explained, and a convenient form of circuit-breaker for this purpose is shown in Fig. 6 at G.

29 is a contact-spring having an insulated button or knob 30 at its free end and secured at the top to an insulating-block 31, and is a second contact-spring secured to the under side of said block and with which the spring 29 normally makes contact, so as to close the safety-circuit.

33 is a U-shaped circuit-breaking spring carried by a plate 34, and normally extending through an opening in said plate, said spring being adapted to be forced inward to the position shown in Fig. 6, coming in contact with the insulating button or knob 30, so as to break the circuit between the springs 29 and 32. This is effected by means of a shoe 35, carried on a rod 36, which rod works in a bearing 37 at the top of the elevator, being held normally in its outward position by a heavy spring 38. When desired, said shoe may be drawn to a retracted position by means of a bell-crank lever 39, operated by a rope 40 from the elevator or by other means. In this condition the car will operate as an express-elevator and be thrown out of control of the various landing push-buttons, as will be explained.

41 is a cylinder mounted at any suitable point, in the present instance being at the bottom of the elevator shaft or well, and 42 is a piston working in said cylinder. The piston-rod of said cylinder extends through stuffing-boxes at the ends thereof, and said piston is formed with a rack 43 thereon, which engages with a pinion 44, to which the main actuating-valve is connected. The piston 42 is normally centered in the cylinder 41 by springs 45 and 46, said springs being seated upon adjusting-nuts 47 and 48, by which the tension thereof may be regulated, so that said piston will be normally properly centered. If desired, stop-screws 49 may be provided for limiting the throw of the piston 42, as will be understood.

50 is a main supply-pipe connected with any suitable source of fluid-pressure, such as with the pump which operates the elevator, and 51 and 52 are branch pipes connect-

ing said main pipe with the ends of the cylinder 41, above and below the piston 42.

53 is a three-way valve in the branch pipe 51, controlled by a core 54 of a solenoid H. 55 represents the overflow-pipe from said valve. Normally the valve 53 connects the interior of the cylinder 41 with said overflow-pipe and cuts off supply from the main pipe 50, said valve being held in this position by means of a spring. If desired, an insulating-block 56 may be interposed between the core 54 and the valve-stem, so as to prevent the possibility of any ground forming to the pipe in case of a leakage from the solenoid H to its core.

In the branch pipe 52 is a valve 57, having an overflow-pipe 58 and operated by a core 59 of the solenoid I in the same manner as I have explained. The solenoids H and I are included in a circuit 60 61, supplied, preferably, from the lighting-mains of the building, there being a separate branch or shunt circuit 62 for each solenoid. Each of said branch circuits is provided with two contact-plates 63 and 64 and 65 and 66, arranged in pairs therein, as shown. A switch-arm 67 is adapted to make contact between the contact-plates 63 and 64, being carried on a core 68 of the solenoid or relay-magnet *f*, and a switch-arm 69 is adapted to make contact with the contact-plates 65 and 66, said switch-arm being carried on a core 70 of a solenoid or relay-magnet *g*. These solenoids or relay-magnets *f* and *g*, when the safety-circuit through the landing-doors is closed, are adapted to be energized, attracting their cores and breaking the supply-circuits 62 to the solenoids H and I, but when said safety-circuit is broken said switch-arms are forced downward by springs upon the cores 68 and 70, so as to close the circuits 62 and allow the solenoids H and I to be energized.

The relay-magnet *f* is included in a circuit from the plate *d* to the safety-circuit 5, and the solenoid or relay-magnet *g* is included in a circuit from the plate *e* to said safety-circuit. Preferably said safety-circuit extends to the latch 71 of the elevator-car, as shown, being completed through the keeper 72 thereof, thence to a brush 73, carried on the car-door, which brush makes contact with a plate 74, from which plate the other side of said safety-circuit extends to the spring 7 of the circuit-closer at the station E, thence to the shoe 8, thence to the spring 19 on the push-button thereat, thence through the rod 21 to the spring 20, thence to the spring 29, thence to the spring 32, thence by the wire 75 down to the spring 19. From the spring 29 the circuit extends to the other stations of the building in the same way and returns to the other side of the battery or other source of supply *c*.

When the safety-circuit is completed, indicating that all the landing-doors (and, in this instance, the car-door also) are closed, and when circuit-closers of the construction shown are used, indicating that said doors

are actually secured, the elevator can be operated by elevating or lowering the controlling rope or rod *a*. It being supposed that said rod is elevated, the contact-plate *b* makes contact with the plate *d*, and the circuit from the battery *c* or other source is thereby completed through the solenoid or relay-magnet and through the safety-circuit 5, extending throughout the building. Said magnet being energized, elevates the switch-arm 67, breaking the circuit 62 of the solenoid H, causing said solenoid to be deenergized and opening the valve 53, so that water or other fluid under pressure flows into the cylinder 41, forcing the piston 43 downward, revolving the pinion 44, and opening the elevator-valve in the proper direction. This will cause the elevator to descend, when it may be stopped by grasping the elevator rope or rod *a* and bringing the contact-plate *b* out of contact with the plate *d*, so as to break the circuit through the solenoid or relay-magnet *f*, allowing the switch-arm 67 to close the circuit between the contact-plates 63 and 64, energizing the solenoid H, and throwing the upper part of the cylinder 41 into communication with the discharge-pipe 50, whereupon the springs 45 and 46 will center the piston 42 in said cylinder and close the elevator-valve.

It will be noted that if any one of the doors is open, or, in this case, if any one of the landing-doors is even unfastened, so as to break the safety-circuit, the elevator cannot be started, because the solenoids or relay-magnets *f* and *g* cannot be energized to break the circuits 62 to solenoids H and I.

In order, therefore, that an elevator equipped with my improved apparatus may be operated, it is absolutely necessary that all of the landing-doors shall be placed in a safe and secure position before the controlling-valve can be actuated.

By providing an elevator with controlling push-buttons at the various landings an absolutely automatic elevator is produced. With such an elevator it is desirable that ordinary stops 76 should be placed upon the controlling rope or rod *a*, so that as the elevator reaches the top or bottom of its movement it will come into contact with one of said stops and move said rope or rod to reverse the circuits through the parts. Said controlling-rope is also preferably provided with two series of rack-teeth 77 78 above and below a pinion 79, which is also connected to the main controlling-valve. This latter arrangement is employed to obviate the danger of the electrically-controlled device failing to arrest the movement of the elevator at the top and bottom of its travel. If the elevator is moved too rapidly, it will be noted that an extreme movement of the controlling rope or rod *a* in either direction will engage the racks 77 or 78 with the pinion 79 and reverse the elevator A automatically. Devices of the kind being therefore used, the elevator will constantly travel up and down in the elevator well or

shaft without requiring attention. When it is desired to stop the elevator at any one of the floors, for instance, at the floor E, the push-button 13 is pushed in, carrying the shoe 23 with it and engaging the plunger 27 within the opening 26 in said shoe, so as to lock the shoe in this position and bring the insulated studs or buttons 22 into contact with the springs 19 and 20, so as to break the safety-circuit between said springs. The push-button 13, being released, is returned to its original position by the spring 15; but this movement does not affect the plunger 17, which is locked in its retracted position, as explained.

Although the safety-circuit has been broken between the springs 19 and 20, it will be observed that the shunt-circuit 75 still remains closed between the springs 29 and 32, so that the circuit to the solenoid or relay-magnet *f* or *g* is still closed.

When the car in its movement up or down approaches the landing at the station E, the shoe 35, carried on the car, will come into contact with the spring 33, forcing the same inward against the insulated button and breaking the shunt-circuit 75 between the springs 29 and 32. The safety-circuit therefore will be broken, deenergizing the solenoid or relay-magnet *f* or *g* and bringing the car to rest, as before explained. When the door at the landing E is then opened, the plunger 27 is forced back out of engagement with the shoe 23, allowing the said shoe to be returned to its original position by means of the spring 18 and closing the safety-circuit between the springs 19 and 20. At this moment the safety-circuit will be broken between the spring 7 and the shoe 8, controlled by the landing-door latch, so that the car does not start. When, however, said landing-door is shut, so as to complete the safety-circuit between the spring 7 and the shoe 8, the elevator will start in the direction it was originally moving, unless the operator desiring to direct the car in the opposite direction shall have moved the controlling rope or rod *a* accordingly.

If it is desired to operate the elevator as an express-elevator, the shoe 35 may be moved inward, so that it will not come into contact with the spring 33 in its movements, whereby the shunt-circuit 75 will always remain closed, irrespective of the breaking of the main safety-circuit between the springs 19 and 20. If desired, also, an ordinary annunciator may be included in a circuit 80 and 81, adapted to be closed by the push-button 13 in a well-known manner, so as to indicate the floor which is calling the elevator.

Instead of controlling the elevator-operating mechanism by electrical means actuated by a valve-rod with respect to which the car travels, as I have explained, it will be obvious that the general principles of my invention are capable of being carried out in a great many ways without departing from the essen-

tial spirit thereof, and which will suggest themselves to others skilled in the art.

As an illustration of the capabilities of my invention I have illustrated in Fig. 2 a modification wherein the same essential ideas are present, but in which the elevator is controlled by a switch carried upon the car and adapted to be moved to one side or the other, according to the direction in which the elevator is to be operated, or to be held in a central position when the elevator is to be stopped. Having reference, therefore, to this figure, the car A is operated in a well or shaft in the ordinary way, extending past the several landings, as explained. The safety-circuit 5 extends through circuit breakers or closers operated by the landing-doors and includes therein a single solenoid or relay-magnet *f*. In the present instance the safety-circuit is normally closed through circuit-breakers at the landings, and when in that condition said solenoid or relay-magnet *f* will be energized, indicating that all of the landing-doors are in a safe and secure condition.

The secondary circuit 82 of the solenoid or relay-magnet is adapted to be closed by a switch-arm 67, carried on the core of said solenoid or magnet, so that said secondary circuit will be closed at that point when all the doors are in a safe and secure condition. Said secondary circuit extends through a cable or in any other way to the car A, and first passes through circuit-breakers 83 and 84, controlled by the door or doors of the elevator, so that when said door or doors is or are closed the secondary circuit in the elevator will be closed. Said circuit extends to a switch-arm 85, which is adapted to make contact with the contact-plates 86 and 87 or be held in a central position between said plates, as shown in dotted lines. From said contact-plates separate circuits extend, in each of which is included a solenoid II or I.

88 represents a pressure-tank, in which water under pressure is confined, and 89 is a discharge-tank, into which water is discharged from the main hydraulic cylinder 90 when the elevator is descending. Said pressure or discharge tanks connect by means of a pipe 91 to a pipe 92, which communicates with the main cylinder 90, in front of the piston therein, in the ordinary way. Mounted within each of said pipes 91, on both sides of the pipe 92, are valves 93, which are preferably of special construction, as will be presently explained, but for the purpose of clearness I will assume these valves to be ordinary two-way valves, each of which is connected to the core 94 of the solenoid II or I, as the case may be. The cores of said solenoid are normally held in a retracted position by means of springs 95, so as to maintain said valves 93 normally closed, thereby cutting off communication between the tanks 88 and 89 and the main hydraulic cylinder 90.

It will be noted that the secondary circuit

of the solenoid or relay-magnet *f* may be closed by the switch-arm 85 when all of the landing-doors are in a safe and secure condition. In order to provide additional security and prevent the probability of the elevator mechanism being placed in an operative position when the door or doors of the elevator are not entirely closed, I employ a solenoid or magnet J, included in a shunt 96, extending from the circuit 82, between the circuit-breaker 84 and the switch-arm 85. The core of said solenoid J operates a small three-way valve 97, included in a pipe 98, extending from the pressure-tank 88 or from the pipe 91 above the valve 93 for said pressure-tank. Said pipe 98 connects with the lower end of a cylinder 99, in which is mounted a piston 100, the piston-rod 101 of which extends through stuffing-boxes at the top and bottom of said cylinder. Said piston 100 is normally held in a lowered position by means of a spring 102 on the lower end of said piston-rod 101. The upper portion of said piston-rod is formed with a rack thereon, which engages with a pinion 103, said pinion controlling a valve 104 in the pipe 92. The operation of the modification thus described will be immediately understood.

It being assumed that the safety-circuit 5 is closed, indicating that all of the landing-doors are in a safe and secure condition, so as to energize the solenoid or relay-magnet *f*, the secondary circuit 82 of said solenoid will be closed by means of the switch-arm 67, and it being further assumed that the door or doors of the elevator is or are closed said secondary circuit 82 will be closed at the circuit-breakers 83 84. The secondary circuit 82 being thereby closed through the solenoid J, as shown, said solenoid will be energized, opening the valve 97 and allowing water under pressure to enter the cylinder 99, beneath the piston 100 therein, elevating said piston and opening the valve 104. The switch-arm 85 may now be moved into contact with the contact-plates 86 and 87, being shown in the figure in contact with the former plate. The solenoid H will thereby be energized, attracting its core and opening the valve 93, so that water under pressure flows from the pressure-cylinder 88, through the pipes 91 and 92, into the main hydraulic cylinder 90, moving the piston therein and elevating the car or cage. When the switch-arm 85 is moved out of contact with said plate 86, the solenoid H will be deenergized, closing the valve 93 and stopping the car. When said switch-arm 85 is moved into contact with the other contact-plate, 87, the solenoid I will be energized, opening the valve 93 and allowing the water in the main cylinder 90 to discharge into the tank 89, so that the car or cage will descend.

It will be noted that if one of the elevator-doors is opened or unfastened, so as to break the secondary circuit 82 at the circuit-breaker 83 or 84, or at both of said circuit-breakers, the solenoid J will be deenergized, whereby

its core will be retracted, throwing the cylinder 99 into communication with the discharge-pipe 105, in which case the spring 102 will return the piston 100 to its lowermost position and close the valve 104. It will further be noted that if the safety-circuit 5 is broken by the opening or unfastening of any one or more of the landing-doors, whether the elevator-doors are closed or not, the secondary circuit to the solenoid J will be similarly broken, so that the same operation takes place.

It will of course be understood that with the modified form of device shown in Fig. 2 push-buttons may be provided on the landings for stopping the elevator thereat, as explained above, but for the purpose of clearness I have omitted said push-buttons and the accompanying elements from this view.

In order to obtain a very sensitive electrical valve and to be able to operate the same with a minimum amount of current, so that the electrical closing devices may be made as delicate as possible, I prefer to employ the special form of valve illustrated in detail in Fig. 7, to which particular attention is directed.

K is a valve-casing, of the general shape illustrated, to which the supply-pipes 106 107 and the discharge-pipe 108 are connected. The valve 109, which is preferably hollow, normally closes the passage-way between the pipes 106 and 107, and in this position the pipe 107 communicates by a passage 110 in the valve with the discharge-pipe 108.

By making the valve 109 hollow, as I have explained, and by admitting water within the same pressure is equalized therein, so that the valve may be constructed of a minimum amount of metal, and its coefficient of expansion can be therefore made to be practically the same as that of the valve-casing. This is a material and practical advantage, for the reason that with hydraulic elevators working on great pressure the temperature of the water is raised to a very high point, so that there is in consequence considerable expansion of the parts. I find that a solid valve cannot be made to operate satisfactorily, since it expands more than the casing, and I consider it therefore very important to make the valve hollow.

The valve 109 is formed with an integral piston 111 at its upper end, working within a cylinder 112, cast with the valve-casing. Said cylinder is provided with a screw-cap 113, in which is a limiting-screw 114 for regulating the play of the piston 111.

115 is a pipe of small bore connecting the pipe 106 with the top of the cylinder 112, so that normally water under pressure from the pipe 106 is forced upon the piston 111 and upon the bottom of the valve 109. Owing to the difference in area of these parts the valve will normally be kept in the position shown, so as to cut off the supply from the pipe 106 to the pipe 107.

116 is a small three-way valve in the pipe

115, which is normally open, so as to put the pipe 106 into communication with the cylinder 112, and which is adapted to be operated by a magnet or solenoid *f* or *g* to cut off such supply of water and to put such cylinder into communication with an overflow-pipe 117. By means of this device the solenoids or magnets *f* or *g* can be made very small and sensitive and be operated on very little current, since the valve 116, being of such small size, is very easily moved.

The operation of the particular form of valve described is as follows: The magnet or solenoid *f* or *g* being energized, so as to partially rotate the valve 116, the water supply from the pipe 106 is cut off from the cylinder 112 and said cylinder is put into communication with the discharge-pipe 117. The water-pressure on the bottom of the valve 109 will thereby elevate said valve, bringing the discharge-opening therein above the pipe 107, so that water under pressure flows immediately from the pipe 106 to the pipe 107 into a cylinder or elsewhere, such as the main hydraulic cylinder 90. When the magnet or solenoid *g* is energized, so as to return the valve 116 to its original position, cutting off the overflow-pipe 117 and allowing water to flow from the pipe 106 to the cylinder 112, the increase of area of the piston 111 will cause the valve 109 to be returned to its original position, cutting off the supply of water to the pipe 107 and putting said pipe 107 in communication with the discharge-pipe 108.

In practice I also prefer to make use of a solenoid of novel construction, which, in this art, I have found to be of great importance. It may be stated that while I desire at all times to be understood as including an electromagnet in the general expression "solenoid," yet, since the movement of the parts is considerable, a solenoid *per se* is superior to an electromagnet. My experiments have, however, led me to decide that an ordinary solenoid as now constructed is not very desirable for practical use, for the reason that the movement of the core toward its attracted position is uncertain, and the pull or strength of the solenoid decreases as the core enters the same, being strongest when the core is at its retracted position. I have therefore invented a specific form of solenoid wherein the core will be attracted very powerfully and in which the final movements of the core are considerably stronger and more rapid than its first movements, being, in fact, extremely sharp and quick. By this means a valve, switch, or other element may be operated to the best advantage.

In constructing my improved solenoid I prefer to wind an insulated coil preferably upon a brass or other non-magnetic spool and to attach to one of the ends of the solenoid a plate 118, of iron or steel, which becomes strongly magnetized by the coil and acts to attract the core near the end of its movement, so that said core is forcibly drawn against

said plate when the solenoid is energized. In order to prevent the core of the solenoid from sticking to said plate when the solenoid is deenergized, I secure upon the under side of said plate a plate of thin brass or other non-magnetic material, although it will be understood that such non-magnetic material may be carried on the end of the core.

To allow for the adjustment of the plate 118, whereby the movement of the core may be regulated, I mount the said plate on adjusting-screws 119, which may be screwed into the end of the solenoid-bobbin more or less for the accomplishment of this purpose.

Concerning my improved solenoid it will be noted that it consists, broadly, of a solenoid-coil for effecting the major movement of a core and a pole-piece for attracting the core toward the end of its movement. I preferably secure the pole-piece at the rear end of the coil and energize said pole-piece by means of the coil. It will be understood that the pole-piece may be located at the forward end of the coil and that the said pole-piece may be energized by a separate coil.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. In an elevator, the combination of a car or cage, means for operating the same, mechanism for controlling said operating means, a solenoid or magnet for operating said controlling means, a safety-circuit extending through the landings for operating said solenoid or magnet, a push-button at each landing for closing or breaking the safety-circuit, a shunt around each push-button, and a closer or breaker in said shunt operated by the elevator-car, substantially as set forth.

2. In an elevator, the combination of a car or cage, means for operating the same, mechanism for controlling said operating means, a solenoid or magnet for operating said controlling mechanism, a safety-circuit including said solenoid and extending adjacent to the elevator-shaft, a push-button at each landing for making or breaking said safety-circuit, a shunt around each push-button, a closer or breaker in said shunt, and a shoe carried on the elevator for operating said closer or breaker, substantially as set forth.

3. In an elevator, the combination of a car or cage, means for operating the same, mechanism for controlling said operating means, a solenoid or magnet for operating said controlling mechanism, a safety-circuit including said solenoid or magnet and extending adjacent to the elevator-shaft, a push-button at each landing for closing or breaking said safety-circuit, a shunt around each push-button, a closer or breaker in each shunt, a shoe carried on the elevator-car for operating said closers or breakers, and means for withdrawing said shoe and for holding the same in a retracted position, substantially as set forth.

4. In an elevator, the combination of an elevator car or cage, means for operating the

same, controlling mechanism for said operating means, a solenoid or magnet for operating said controlling mechanism, a safety-circuit including said solenoid or magnet and
 5 extending adjacent to the elevator-shaft, a push-button at each landing for closing or breaking said safety-circuit, means controlled by the landing-doors for locking said push-buttons in their retracted positions, to main-
 10 tain the safety-circuit closed or broken through the same, a shunt around each push-button, a closer or breaker in each shunt, and means carried by the car for operating said circuit closers or breakers, substantially as
 15 set forth.

5. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a solenoid or magnet for operating said controlling mechanism, a safety-circuit includ-
 20 ing said solenoid or magnet and extending adjacent to the elevator-shaft, a push-button at each landing for breaking or closing the safety-circuit, a latch controlled by each land-
 25 ing-door for maintaining the push-button thereat in its retracted position to maintain the safety-circuit closed or broken, a shunt around each push-button, a closer or breaker in said shunt, and means carried by the car
 30 for operating said closer or breaker, substantially as set forth.

6. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a solenoid or magnet for operating said controlling mechanism, a safety-circuit includ-
 35 ing said solenoid or magnet, and extending adjacent to the elevator-shaft, a push-button at each landing for closing or breaking the safety-circuit, a shoe pivoted to the moving
 40 elements of said push-button, a spring-pressed plunger for engaging said shoe when the latter is moved to make or break the safety-circuit at each landing, said plunger being re-
 45 tracted from such engagement when the landing-door is opened, a shunt around each push-button, a closer or breaker in each shunt, and means carried by the car for operating
 50 said closer or breaker, substantially as set forth.

7. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a solenoid or magnet for operating said oper-
 55 ating mechanism, a safety-circuit including said solenoid or magnet and extending adjacent to the elevator-shaft, and a push-button mechanism, at each landing, comprising a casing, a spring-pressed push-button, a sepa-
 60 rate plunger engaged by said push-button for making or breaking the safety-circuit, a shoe pivoted to said plunger, a second plunger with which said shoe engages, normally held in
 65 position to be engaged by said shoe by the closing of the landing-door, and adapted to be disengaged from said shoe when the land-
 ing-door is opened, substantially as set forth.

8. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, 70
 a solenoid or magnet for operating said controlling mechanism, a safety-circuit includ-
 ing said solenoid or magnet and extending adjacent to the elevator-shaft, and a push-
 button mechanism at each landing compris- 75
 ing a casing, a push-button mounted in said casing, an annunciator-circuit operated by said push-button, a separate plunger also op-
 erated by said push-button and adapted to break the safety-circuit, a shoe carried by 80
 said plunger, a second plunger with which said shoe is engaged, normally held in a posi-
 tion to be engaged by said shoe by the closing of the landing-door, but adapted to be
 withdrawn from said shoe when the landing- 85
 door is opened, and a shunt around said push-button, substantially as set forth.

9. In an elevator, the combination of a car or cage, means for operating the same, controlling means for said operating mechanism, 90
 a solenoid or magnet for operating the said controlling mechanism, a safety-circuit in-
 cluding said solenoid or magnet, and push-
 button mechanism at each landing compris-
 ing a casing, a push-button mounted in said 95
 casing, a separate plunger operated by said push-button, insulated buttons on said plunger, a pair of contact-springs with which the
 plunger normally engages, a shoe carried on
 said plunger, a second plunger with which 100
 said shoe engages but adapted to be with-
 drawn from the shoe on the opening of the
 landing-doors, and a shunt around said push-
 button, substantially as set forth.

10. In an elevator, the combination of a car 105
 or cage, means for operating the same, controlling mechanism for said operating means, a solenoid or magnet for operating said controlling mechanism, a safety-circuit includ-
 ing said solenoid or magnet and passing 110
 through circuit closers or breakers controlled by the latches of the landing-doors, and mechanism for each landing for controlling said
 solenoid or magnet, substantially as set forth.

11. In an elevator, the combination with a 115
 car or cage, means for operating the same, controlling mechanism for said operating means, a cylinder, a piston in said cylinder, connections between said piston and the con-
 trolling mechanism, a pipe or pipes for nor- 120
 mally supplying liquid under pressure to both ends of said cylinder, a valve at each of said pipes, a solenoid or magnet for controlling
 each valve, and means under the control of 125
 the operator on the car for energizing either of said solenoids or magnets, substantially as
 set forth.

12. In an elevator, the combination of a car or cage, a cylinder, a piston in said cylinder, connections between said piston and the con- 130
 trolling mechanism, means for normally centering said piston for maintaining the controlling mechanism in an inactive condition, pipes leading to both ends of the cylinder, a

valve in each pipe, a solenoid or magnet for controlling each valve, and means under the control of the operator for energizing either end of said solenoids or magnets, substantially as set forth.

13. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a cylinder, a piston in said cylinder, connections between said piston and the controlling means, pipes leading to both ends of said cylinder, and normally supplying a liquid under pressure thereto, a valve in each pipe adapted to shut off the supply of liquid to either end of the cylinder and put the same in communication with a discharge-pipe, a solenoid or magnet for operating each valve, and means under the control of the operator on the car for energizing either one of the solenoids or magnets, substantially as set forth.

14. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a cylinder, a piston in said cylinder, connections between said piston and the controlling mechanism, pipes connecting with both ends of said cylinder, a valve in each pipe, a solenoid or magnet for operating each valve, a switch in the circuit to each solenoid, a relay-magnet or solenoid for operating each switch, and a safety-circuit including said relay-magnets or solenoids, said safety-circuit extending through circuit closers or breakers controlled by the landing-doors, substantially as set forth.

15. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a cylinder, a piston in said cylinder, connections between said piston and the controlling mechanism, pipes connecting with both ends of said cylinder, a valve in each pipe, a solenoid or magnet for operating each valve, a switch in the circuit to each solenoid, a relay-magnet or solenoid for operating each switch, and a safety-circuit including said relay-magnets or solenoids, said safety-circuit extending through circuit closers or breakers controlled by the latches of the landing-doors, substantially as set forth.

16. In an automatic elevator, the combination of means for causing an elevator to travel continuously up or down in an elevator shaft or well, and mechanism at each landing controlling the operating mechanism of the elevator, whereby the elevator may be stopped at any landing, substantially as set forth.

17. In an elevator, the combination of means for causing the elevator to continuously travel up and down in an elevator shaft or well, a push-button at each landing controlling the operating mechanism for the elevator, and a circuit breaker or closer at each landing controlled by a shoe carried on the elevator car or cage and adapted to coact with the said push-button, whereby when said push-button is operated the movement of the car in

actuating said circuit closer or breaker will bring the car to rest, substantially as set forth.

18. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a cylinder, a piston in said cylinder, connections between said piston and the controlling mechanism, pipes leading into said cylinder at both ends thereof, a valve in each pipe, a solenoid or magnet for operating each valve, a stationary contact-plate in circuit with each solenoid or magnet, a contact-plate movable between said stationary plates and controlled by the operator on the car, and a safety-circuit including said contact-plates extending through circuit closers or breakers controlled by the landing-doors, substantially as set forth.

19. In an elevator, the combination of a car or cage, means for operating the same, controlling mechanism for said operating means, a cylinder, a piston in said cylinder, connections between said piston and the controlling mechanism, pipes leading into said cylinder at both ends thereof, a valve in each pipe, a solenoid or magnet for operating each valve, a stationary contact-plate in circuit with each solenoid or magnet, a contact-plate movable between said stationary plates and controlled by the operator on the car, and a safety-circuit including said contact-plates extending through circuit closers or breakers controlled by the latches of the landing-doors, substantially as set forth.

20. In an elevator, the combination of a car or cage, a hydraulic cylinder, pipes connecting the ends of said cylinder with the pressure supply, a three-way valve in each of said pipes normally conveying the pressure to both ends of the cylinder, a solenoid or magnet for operating each valve for cutting off the pressure to either end of the cylinder and connecting the same with the discharge, and a switch controlled from the car or cage for energizing said solenoid or magnet, substantially as set forth.

21. In an elevator, the combination of a car or cage, a hydraulic cylinder, pressure and discharge pipes connected with said cylinder, a valve on each of said pipes, a solenoid or magnet for operating each of said valves, a switch carried on the car for energizing either of said solenoids or magnets, a switch in the circuit of said solenoids or magnets, a relay-magnet or solenoid for operating said switch, and a safety-circuit including said solenoid or magnet and extending through closers or breakers controlled by the landing-doors, substantially as set forth.

22. In an elevator, the combination of a car or cage, a hydraulic cylinder, pressure and discharge pipes connected with said cylinder, a valve on each of said pipes, a solenoid or magnet for operating each of said valves, a switch carried on the car for energizing either of said solenoids or magnets, a switch in the

circuit of said solenoids or magnets, a relay-magnet or solenoid for operating said switch, and a safety-circuit including said solenoid or magnet and extending through closers or breakers controlled by the latches of the landing-doors, substantially as set forth.

23. In an elevator, the combination of a car or cage, hydraulic mechanism for operating the elevator, a valve in the main supply-pipe, a cylinder, a piston in said cylinder, connections between said piston and said valve, a pipe supplying water under pressure to said cylinder on one side of said piston, a valve in the latter pipe, a solenoid or magnet for operating the latter valve, and a safety-circuit extending through said solenoid or magnet and including closers or breakers controlled by the landing-doors, substantially as set forth.

24. In an elevator, the combination of a car or cage, hydraulic mechanism for operating the elevator, a valve in the main supply-pipe, a cylinder, a piston in said cylinder, connections between said piston and said valve, a pipe supplying water under pressure to said cylinder on one side of said piston, a valve in the latter pipe, a solenoid or magnet for operating the latter valve, and a safety-circuit extending through said solenoid or magnet and including closers or breakers controlled by the latches of the landing-doors, substantially as set forth.

25. In an elevator, the combination of a car or cage, hydraulic mechanism for operating the elevator, a main supply-pipe, a valve in said pipe, a pinion on said valve, a cylinder, a piston in said cylinder, a rack connected to said piston and engaging said pinion, a spring for normally keeping said piston at one end of said cylinder, a pipe leading into said cylinder at the same end, a valve in said pipe, a solenoid or magnet for operating said valve, a circuit for said solenoid or magnet, a switch in said circuit, a relay-magnet or solenoid for operating said switch, and a safety-circuit including said relay-magnet or solenoid extending through the closers or breakers formed by the landing-doors, substantially as set forth.

26. In an elevator, the combination of a car or cage, hydraulic mechanism for operating the elevator, a main supply-pipe, a valve in said pipe, a pinion on said valve, a cylinder, a piston in said cylinder, a rack connected to said piston and engaging said pinion, a spring for normally keeping said piston at one end of said cylinder, a pipe leading into said cylinder at the same end, a valve in said pipe, a solenoid or magnet for operating said valve, a circuit for said solenoid or magnet, a switch in said circuit, a relay-magnet or solenoid for operating said switch, and a safety-circuit including said relay-magnet or solenoid extending through the closers or breakers formed by the latches of the landing-doors, substantially as set forth.

27. An improved circuit closer or breaker

operated by a latch comprising a pivoted shoe, an insulating button or knob carried on said shoe, and a contact-spring engaged by said button or knob when the shoe is moved to one position and engaged by the shoe itself when in another position, substantially as set forth.

28. An improved circuit closer or breaker operated by a latch comprising a shoe, an insulated face on said shoe with which the latch engages, an insulating knob or button on said shoe, and a spring engaged by said knob or button when the shoe is in one position, and by the shoe itself when in another position, substantially as set forth.

29. An improved push-button for the purpose mentioned, comprising a casing, a push-button 13 in said casing, a spring 15 for said push-button, a sleeve 16 secured to said casing, a plunger 17 mounted within said sleeve, a spring 18 for said plunger, a rod 21 carried by said plunger, insulating buttons or knobs on said rod, contact-springs 19 and 20 normally engaging said rod, and a shoe 23 pivoted to said rod, substantially as set forth.

30. An improved valve, comprising a valve-casing, pipes 106, 107, entering the same at opposite sides, a discharge-pipe connecting with the same between the pipes 106, 107, a valve centrally located in said valve-casing and having a piston on one of its ends, a cylinder for receiving said piston and formed integral with the valve-casing, a pipe 115 connecting the pipes 106, 107 with said cylinder, and an auxiliary valve in said pipe, substantially as set forth.

31. An improved electric valve, comprising a valve-casing, a cylinder connected to said casing, a valve in said casing, a piston mounted in said cylinder and connected with said valve, a stop-screw for adjusting the supply of said valve, a branch pipe for normally supplying pressure to said cylinder, a valve in said branch pipe, and a solenoid or magnet for operating the latter valve, substantially as set forth.

32. In an improved electric valve, the combination of a valve-casing K, pipes 106, 107 leading to and from said casing, a valve 109 in said casing, the exit-pipe 108 normally connected to the pipe 107, the cylinder 112 integral with the valve-casing, the piston 111 in said cylinder integral with the said valve, the branch pipe 115 connecting the pipe 106 with the cylinder 112, the valve 116 in said branch pipe, the discharge-pipe 117, and a solenoid or magnet connected to said valve 116, substantially as set forth.

33. In an improved electric valve, the combination of the valve-casing K, pipes 106 and 107 leading to and from said casing, the valve 109 in said casing, the exit-pipe 108 normally connected to the pipe 107, the cylinder 112 integral with the valve-casing, the piston 111 in said cylinder integral with the said valve, the stop-screw 114, the branch pipe 115 connecting the pipe 108 with the cylinder 112 and the valve 116 in said branch pipe, the dis-

charge-pipe 117, and the solenoid or magnet connected to said valve 116, substantially as set forth.

34. An improved solenoid, comprising a
5 coil, a core movable in said coil, and a magnetized disk or plate parallel with the rear end of the coil and magnetized by the same, said disk or plate attracting the core during its final movements, substantially as set forth.

10 35. An improved solenoid, comprising a coil, a core movable in said coil, a disk or plate at the rear of the coil and adjustably secured thereto and magnetized by the coil, said disk or plate attracting the core during its
15 final movements, substantially as set forth.

36. An improved solenoid, comprising a coil, a core movable in said coil, a disk or plate at the rear of the coil and adjustably secured thereto and magnetized by the coil, said disk or plate attracting the core during its
20 final movements, and a non-magnetic plate interposed between said magnetized disk and the core, substantially as set forth.

This specification signed and witnessed this 12th day of March, 1896.

SAMUEL D. STROHM.

Witnesses:

FRANK L. DYER,
L. DELLA MCGIRR.