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MECHANICALLY CONTROLLED AUTOMATIC ELEVATOR.

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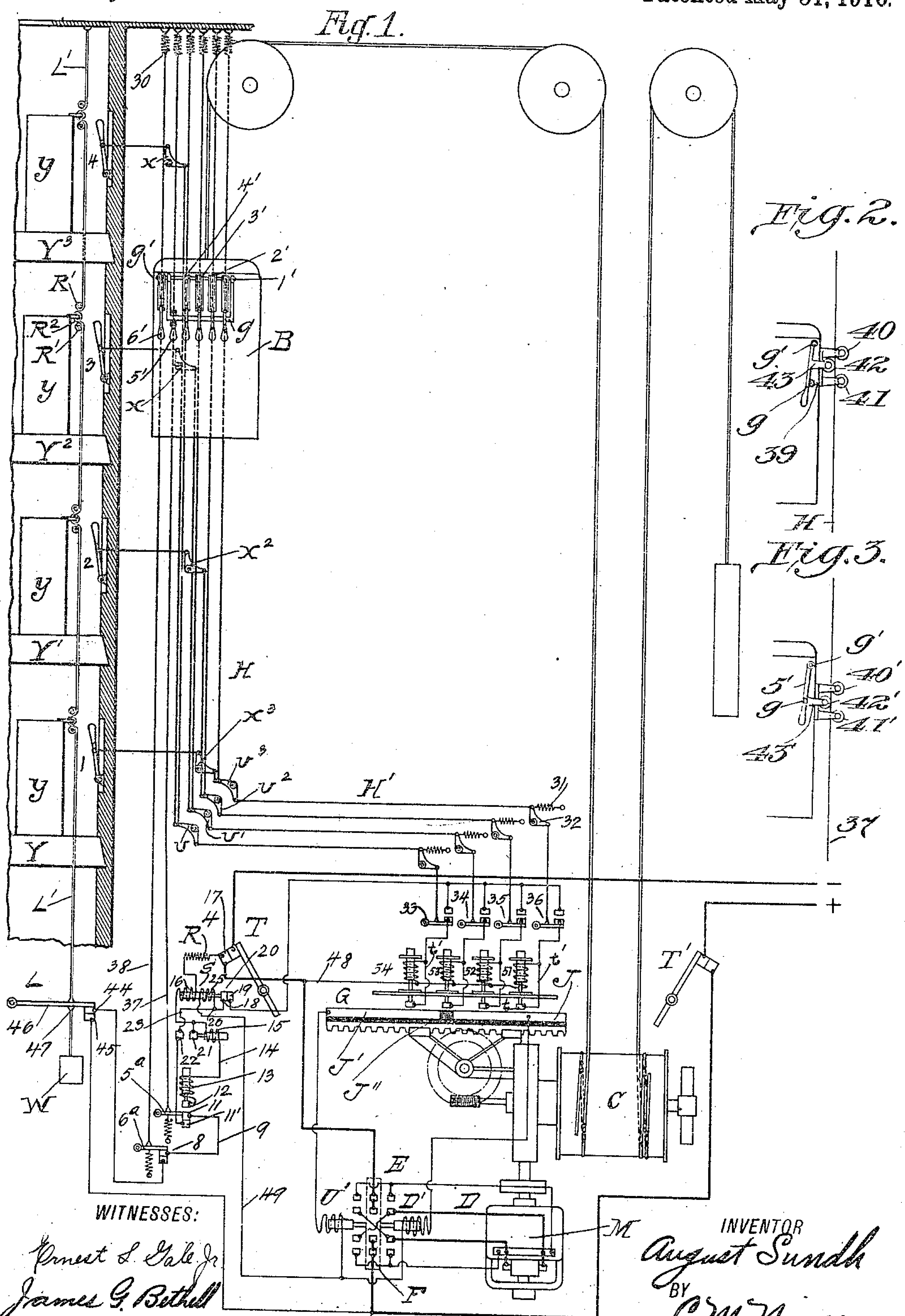
959,645. Patented May 31, 1910.



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MECHANICALLY-CONTROLLED AUTOMATIC ELEVATOR.

959,645. Specification of Letters Patent. Patented May 31, 1910.

Application filed October 2, 1907. Serial No. 395,624.

To all whom it may concern:

Be it known that I, August Sundh, a citizen of the United States, residing in Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Mechanically-Controlled Automatic Electric Elevators, of which the following is a specification.

My invention relates to the control and operation of electric elevators, and one of its objects is to obviate the necessity of extending electrical connections to the car or cage and throughout the vicinity of the travel of the car, as in the elevator well and hallways.

In an electric elevator using high potential, great precautions are necessary for the protection of the connections to avoid danger to the operator and users, and in the ordinary systems of electrical control the switches and apparatus about the car and elevator well consume space for installation which it is not always convenient to provide. Again, the cost of the necessary electric wiring for connecting the various switches and apparatus in and about the car and landings is expensive and the labor involved in properly connecting such apparatus is considerable.

My invention consists, primarily, in providing mechanical connections between the car and floors or landings and the controlling apparatus proper of the motor, thus doing away with the necessity of extending electrical connections to the car and floor landings; and it also contemplates using mechanical connections operated by the well doors instead of electrical connections as heretofore, whereby the controlling circuits are broken whenever the well doors, or any one of them, are open.

My invention further consists in the various arrangement of parts substantially or more fully disclosed hereinafter.

One embodiment of my invention is set forth herein and the same is illustrated in its many details in the accompanying drawing in which—

Figure 1 is a diagrammatic view of apparatus made according to my invention. Figs. 2 and 3 are side views of details thereof.

Referring to the drawing, M represents a motor, shown as an electric motor, and B represents an elevator car connected to a drum C, operated by the motor through any suitable connections, such fo example as the usual worm and worm wheel.

Y, Y′, Y^2, Y^3, represent floors or landings, of which there may be any number, each being provided with a door *y*, opening, as usual, upon the elevator well.

In order to operate the motor and to control its direction of rotation for moving the elevator car upwardly or downwardly, starting and reversing electrical connections D are shown, but they may be of any suitable character, and, being no part of my invention, need not be further described. Connections are made between the motor and a reversing switch E, which also may be of any convenient character, but is preferably of that form described in the patent to Ihlder No. 710,914, granted October 7, 1902, for an improvement in electrical operation of elevators by a single push-button system. In this type of reversing switch an armature F, carrying contacts, is arranged to be swung to one side or the other of the center and close the proper circuits for the operation of the motor in one direction or the other, the armature F being actuated by suitable electro-magnets D′, U′. The arrangement is such in this instance that when the magnet D′ is energized it will attract the armature F and so connect the field and armature of the motor M to the supply mains that rotation will take place in a direction for moving the car B downwardly, while if the magnet U′ is energized the motor will rotate in such a direction as to move the car upwardly, and this rotation in one direction or the other will continue so long as one or the other of the magnets remains energized.

In order that the circuit may be broken at the proper time for the car to stop at the desired floor landing, the controlling circuits include a floor controller or controlling device G, included in the controlling circuits of the motor and of a preferred construction hereinafter described.

The motor and its controlling circuits and devices are controlled by mechanical means. At each floor landing Y, Y^1, Y^2, Y^3 are shown levers 1, 2, 3 and 4, and levers 1′, 2′, 3′ and 4′ are shown in the car, while mechanical connections extend from the levers at the floor landings and in the car to the motor controlling devices, these mechanical connections being shown in this instance as comprising flexible cords or wires H preferably composed of non-elastic and strong material such as piano wire, for example. Each of the car levers 1′, 2′, 3′, 4′, 5′ and 6′ is arranged to coöperate with a corresponding wire placed vertically in the elevator well adjacent the car B, and connected through the springs 30 to a fixed support at the upper part of the elevator well. The lower ends of the wires coöperating with the levers 1′, 2′, 3′ and 4′ are connected to the bell cranks v^3, v^2, v^1 and v', respectively, which in turn are connected through the wires H′ to other bell cranks 32 provided with springs 31. The latter are suitably connected to switches carrying contacts. Thus an arrangement is produced suitable for controlling electric circuits from a distance. The levers 1, 2, 3 and 4 located at the various floor landings are connected to corresponding bell cranks x^3, x^2, x^1 and x, which latter are connected to the bell cranks v^3, v^2, v^1 and v, respectively. Thus it is seen that each lever located at the different floor landings is interconnected with a corresponding lever located in the elevator car, and furthermore these interconnected levers are arranged to effect the operation of corresponding electric circuit-closing devices 33, 34, 35 and 36. The car levers 5′ and 6′ are connected to operate the switches 5^a and 6^a through the vertical wires 37 and 38, respectively. The switch 5^a is arranged in connection with the motor-controlling circuits and devices, and the handle or lever 5′ in the car may be termed the "safety lever" or "safety handle," since by operating it what will hereinafter be termed the "safety circuit" is controlled, while the lever 6′ in the car controls a switch 6^a, and this may be called the "stop lever," since its function is to break the controlling circuit in case of emergency and stop the motor, and therefore the elevator car.

Those points on the diagram indicated by the + and − signs represent the positive and negative mains leading from a suitable source of electric supply to the motor and to the controlling circuits.

What I have termed my "safety circuit" may be traced as follows: Starting from the point 7 on the positive main, connection is made through a switch L whose function will hereinafter be referred to, and from thence connection is made to the circuit-breaking switch contacts 8 controlled by the lever 6^a. From thence the circuit extends by a wire 9 through the normally open switch contacts 11, 12, through an electro-magnet 13, and by wire 14 through an electro-magnet 15, through one winding 16 of what I term my "safety magnet" S, and thence through a suitable balancing resistance R^4 to the negative main at point 17. The resistance R^4 is to prevent too much current passing through the safety circuit.

By any suitable mechanical connection as shown in Figs. 2 and 3, the levers 1′, 2′, 3′, 4′ and 5′ in the car are so arranged that the safety lever 5′ is always operated at the same time as any one of the other levers 1′, 2′, 3′, 4′ in the car, so that the safety circuit must first be closed before any of the other controlling circuits are closed. As shown, a swinging bar g in this instance is pivoted upon a rod g' and is rigidly connected to the safety lever 5′ (Fig. 3). This swinging bar g is held against the under side of the car levers 1′, 2′, 3′ and 4′ by means of a spring or springs 39 (Fig. 2) whose function is to hold the swinging bar g and adjacent levers 1′, 2′, 3′, 4′ in their normal outward position. The car levers with the exception of the safety lever 5′ are arranged as shown in Fig. 2 in which rollers 40 and 41 carried in suitable brackets fixed to the elevator car, are located directly behind corresponding vertical wires H. A third roller 42 is placed in front of the wire H and lies substantially in the plane of the stationary rollers 40 and 41, and is carried by a bracket 43 attached to the car lever, so that as a lever in Fig. 2 is moved to the right the roller 42 will deflect, crimp or bend into a loop a portion of the wire H in such manner as to shorten its length and thus effect an upward pull upon the bell crank to which this wire is connected.

Referring to Fig. 3 it is seen that the lever 5′, while having the same general arrangement as the other levers in the car, carries a roller 42′ on brackets 43′ which are further removed from the common pivot g' than corresponding brackets carried by the other levers. The roller 42′ carried by the safety lever 5′ will, for this reason, have a further movement for a given movement of its lever than will any one of the rollers carried by the levers 1′, 2′, 3′ and 4′ for a corresponding movement. Therefore, when any one of the car levers is operated, the safety lever 5′ is simultaneously operated, and the roller 42′ carried by said safety lever, having a greater relative movement than corresponding rollers carried by the other car levers, will operate to shorten its wire and so operate the safety switch 5^a before the car lever has had sufficient movement to operate the electrical device connected therewith.

By operating the safety lever 5′, assuming that switch L is closed and the contacts 8 connected, the shortening of the flexible wire 37 will effect the lifting of the lever 5^a, thereby carrying the contact 11 out of electrical engagement with the contact 11′ and into electrical engagement with the contact 12. The safety circuit is now completed, as described, and electromagnets 13, 15 and the coil 16 of safety magnet S will receive current. The coil 16 of magnet S has not, however, sufficient power to separate contact 18 from the contact 19 of the normally closed switch 20, but magnet 15 will effect the connection of the normally separated contacts 21, 22, thereby completing a connection from one contact 22 to a branch or parallel conductor 23.

On the floor controller G are shown switch devices 33, 34, 35 and 36 corresponding to the car levers 4′, 3′, 2′ and 1′ and floor landing levers 4, 3, 2 and 1, and so arranged that when any one of the above levers is operated one of the normally open switches 33, 34, 35 or 36 is operated. In circuit with each one of the switches just mentioned are electro-responsive devices 51, 52, 53 and 54 forming controlling magnets or devices, the solenoids of which are connected to a suitable conductor 48 leading to the negative main at 17.

When the safety lever 5′ has been actuated by a partial movement of any one of the levers 1′, 2′, 3′ or 4′ to close the safety circuit, a further movement of one of the latter levers will sufficiently shorten the vertical wire H coöperating therewith to effect the closing of a corresponding switch device, such as 36, thereby completing a circuit in parallel with the safety circuit, including the normally closed switch 20, normally open switch 36, and a magnet 51. Each of the magnets 51, 52, 53, 54 comprises a movable core carrying a contact t, normally out of engagement with a movable conductor or bar J, but adapted to be moved into electrical connection with the latter in a direction substantially perpendicular thereto when the solenoid is excited with current. When a contact t carried by a core is moved into engagement with the movable bar J, a parallel circuit will be closed, starting from the point 26 and passing through the winding 25 of the safety magnet S, thence through conductor 49 and one or the other of the magnets D′ or U′ to the movable bar J or J′, and thence through a contact t, and by a connection t' to the magnet 51 and through conductor 48 and switch T to the negative line. This movable conducting bar J is connected with a moving part of the hoisting apparatus, as by means of a rack and pinion and worm and wheel with the shaft of the hoisting drum, and the travel of the movable bar is proportioned to move in harmony with the travel of the car.

Corresponding to the bar J is an additional bar J′, between which bars is a section of insulation J″ adapted to come into engagement with one of the contacts t and break a circuit to effect the stopping of the car when the latter approaches its destination, while the travel of the movable bars J and J′, as stated, is proportioned to the travel of the car. The distance between the contacts t must also be so arranged that the car is traveling between two floor landings during the time that the insulated portion J″ is moving between any two adjacent contacts t.

Assuming that the parts are in the relative position shown on the drawing, with the car at the third floor landing and at rest, and the insulated portion J″ is adjacent the magnet 53 corresponding to switch 34 and to the operating levers 3 and 3′, let it be supposed that an operator in the car desires to bring the car to the first floor landing Y. Let it be assumed also that the switches L and S are closed and all of the doors at the different floor landings are closed. Now when the operator first moves the car lever 1′, the lever 5′ will be actuated to close the safety circuit before described, and upon further movement of the lever 1′ the switch 36 will be actuated to bring into electrical engagement the contacts operated thereby, and a circuit in parallel to the safety circuit will be closed, starting from contacts 21 and 22 and including the contacts of switch 20, the contacts of switch 36, the magnet 51 corresponding to floor landing Y and through connection 48 and switch T to the negative main. The magnet 51 thereby energized will cause its contact t to impinge upon the movable bar J to close a circuit including the magnet D′, starting from the point 26 and including one winding 25 of the safety magnet S. The magnet D′ will operate the reversing switch E to cause the motor to rotate in such a direction as to move the elevator car downwardly. As the car travels the bar J will move to the right until the car has about reached the lowermost landing Y when the insulation J″ moves under the contact t, thus interrupting the circuit through the magnet 51 and the magnet D′. The reversing switch will therefore operate automatically to open position and the motor consequently be stopped.

It will be seen that when the safety circuit is completed the winding 16 of the safety magnet S receives current, and when the circuit of one of the reversing switch magnets, as D′, is completed the other winding 25 of the safety magnet S also receives current. Now the arrangement is such that the winding 16 is of insufficient strength to cause the separation of the contacts 18, 19, but can hold them separated after the winding 25 is unexcited. The winding 25, however, is of sufficient strength to separate the contacts 18, 19 when separately excited or independently of the winding 16. It will be seen that by breaking the circuit of the switches 36, etc., at the contacts 18, 19, interference with the operation of the motor from a floor landing is effectually prevented;

since even though one of the switches 36, etc., should be operated it would have no effect.

When the circuit of a magnet D′ or U′ is automatically broken to stop the motor, the winding 25 of the safety magnet S would necessarily be deënergized; but the winding 16 remains energized, since the safety circuit remains energized after the motor has come to rest or the car has reached its destination, and this winding 16 is of sufficient strength to maintain contacts 18, 19 of switch 20 separated until the safety circuit is broken by some appropriate means, as by operating the stop lever 6′ or by operating the switch L in any desired manner. Since, therefore, switch 20 is maintained open after the car has reached its destination, after the motor has been operated from the car, the car is still under control of the operator and its movement cannot be interfered with from a floor landing until the safety circuit has been broken and again made, thereby restoring the parts to their normal positions in readiness to be operated from either car or floor landings.

With the parts in their normal conditions, contacts 11 and 11′ are normally in electrical engagement and connection is made between these contacts and the point 26. When a floor landing lever is operated the safety circuit is not completed, since the wire 37 is not actuated, but current passes from the point 7 on the positive main directly to contacts 8 and 11, 11′, from thence through switch 20, through one of the switches 33, etc., magnet 51, etc., to the negative main, and thereby operating one of the contacts *t* to close a circuit through one of the magnets D′, U′, at the same time energizing the winding 25 of safety magnet S. A holding or retaining circuit excluding the switches 36, etc., is thus established from point 7, through contacts 8, 11 and 11′, winding 25, conductor 49, magnet D′ or U′, bar J or J′, contact *t*, and a magnet 51, etc., to the negative main. The motor will then be operated to cause the car to travel in the desired direction and to be automatically stopped. Both the windings 16 and 25 do not receive current, but the winding 25 alone is sufficient to separate the contacts 18, 19 of the normally closed switch 20, thereby effectually preventing interference with the operation of the car during its travel; but since the safety circuit is not energized in this case, the winding 16 receives no current and therefore after the relay circuit is broken contacts 18 and 19 will resume their normally closed positions, and the motor and car may again be controlled from either the car or floor landings.

Limit switches T and T′ are shown adapted to break the circuit at the supply mains or at other suitable parts of the controlling circuits in case the automatic controller G should fail to operate, or in any case of emergency wherein the motor should continue to operate and cause the car to overrun its normal travel. In this case the movable contact bar J is adapted to strike one of the switches T, T′, should its movement be continued beyond normal, and break the circuit and stop the motor. A convenient arrangement for this operation is as shown, wherein the limit switches T, T′ are arranged respectively in the extended path of travel of the movable contact bars J, J′.

Instead of extending the controlling circuits through contacts controlled by the well doors, as is customary, so that when a door is opened the controlling circuit is broken in order to avoid the use of wires carrying a heavy current or at a high voltage throughout the building, I provide an arrangement whereby the controlling circuit is always broken through the operation of mechanical means only upon the opening of a well door. The switch L is arranged for this purpose in a suitable position, in this instance shown as being at the bottom of the elevator well, and while different mechanical connections may readily be provided for operating the switch L by means of the doors, one suitable form is shown in Fig. 1. A strong, flexible wire, rope or cable L′ is suspended from the top of the well and is held taut by a weight W, or other means, and passes adjacent to the well doors. Sheaves R′ are provided at the floor landings, between which the rope or cable L′ is adapted to bend or deflect. Between each pair of sheaves R′ is arranged a sheave R^2, connected in any suitable manner with the door and engaging the wire L′, so that when a door is opened the wire is caused to extend still farther between the sheaves, thereby lifting the weight W, and thus providing means for actuating the switch L. In this instance the cable L′ is shown connected to the lever arm 46 of the switch L at the point 47. As the rope L′ is shortened by opening a landing door, the weight W and switch arm 46 are lifted, thus causing the contact 44 which is mounted upon the switch arm 46 to be moved out of electrical engagement with a stationary contact 45.

To summarize the operation briefly, it should be noted that normally all circuits are open. When a car lever is operated, the contacts 11, 11′ are first separated and the contacts 11, 12 connected. This will close a circuit from the positive main through contacts 45, 44, contacts 8, contacts 11, 12, magnet 13, magnet 15, winding 16, resistance R to the negative main. The magnet 13 will hold the contacts 11, 12 together independently of the car levers and the magnet 15 will connect the contacts 21, 22 and hold them together. Upon further movement of the car lever the switch 36 will be closed mechanically to cause current to flow from the positive main through contacts 45, 44, contacts 8, contacts 11, 12, magnet 13, magnet 15, contacts 21, 22, switch 20, switch 36, magnet 51, conductor 48 to the negative main. The contact *t* is then thrust downwardly onto the bar J and when this occurs current will flow from the positive main through contacts 45, 44, 8, 11, 12, magnets 13, 15, contacts 21, 22, winding 25, conductor 49, magnet D′, bar J, magnet 51, conductor 48 to the negative main. The contacts 18, 19 will then be separated and the core of the magnet S thrust farther into the winding 16. A holding circuit for the magnet 51 has been established and the switches 36, etc., excluded from having any effect, even though operated, by reason of the separation of the contacts 18, 19.

When the car reaches the selected floor the insulation J″ interrupts the circuit of the magnets D′ and 51 and of the winding 25, but the winding 16 and the magnets 13 and 15 still receive current. The contacts 18, 19 are held disconnected by the winding 16, therefore even after the car stops it cannot be started again until the contacts 8 are opened by actuating the stop lever 6′ in the car or a landing door is opened to separate the contacts 44, 45. In either event the magnets 13, 15 and winding 16 become deenergized and the contacts 18, 19 are therefore again connected, the contacts 21, 22 separated and the contacts 11, 11′ connected.

The mechanical controlling connections and controlling devices of the motor are so arranged that when any desired lever is operated, the controlling circuits are completed and the motor operated to bring the car to the desired floor landing corresponding to the lever operated, and there can be no interference with the operation of the motor after it is started. Furthermore, in operating any desired lever, whether the same is located in the car or at one of the floor landings, it is not necessary to retain the lever in its operative position until the motor has automatically operated to bring the car to the corresponding floor landing. It is merely necessary to hold such lever in its operative position until the magnet 51, etc., corresponding to the lever operated, has effected an electric l engagement between its contact *t* and the bar J or J′ of the floor controller. Since it requires only a short time for the magnet 51, etc., to become energized and operate its contact *t* after the circuit to its solenoid has once been closed, the operator can almost immediately release the lever after the same has been operated, and the springs 31, operating through the various bell cranks, will at once move said lever to its initial position and the switch 36, etc., corresponding to the lever operated will return to its open position by reason of its own weight or by spring tension, thereby separating its contacts. The circuit through the magnet 51, etc., is maintained through the floor controller contact J or J′ until the latter has moved to such position that this self-maintained circuit is automatically broken by the operation of the floor controller as before described.

While I have described my invention in connection with a typical elevator apparatus in which direct current of constant potential is used, my invention is equally adapted to alternating or intermittent current, in which case a motor adapted to use with such current would be employed, the system of operation remaining substantially the same.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of my invention, and I desire therefore not to be limited to the precise construction disclosed.

What I claim is:—

1. In an apparatus for controlling elevators, the combination with a motor and a car, of a stationary controlling device for the motor, levers in the car, and a mechanical connection between each lever and the controlling device.

2. In an apparatus for controlling elevators, the combination with a car and a motor, of motor controlling circuits, stationary switches in the circuits, switch operating devices in the car, and separate mechanical connections between said devices and the switches.

3. In an apparatus for controlling elevators, the combination with a car and a motor, of switches in the motor circuits located outside the path of travel of the car, switch operating devices in the car, and separate mechanical connections between said devices and the switches.

4. In an apparatus for controlling elevators, the combination with a car and a motor, of a motor controlling circuit, switches in said circuit located outside the path of travel of the car, manually operable devices within the car, and mechanical connections between each of said devices and one of said switches.

5. In an apparatus for controlling elevators, the combination with a car and a motor, of electrical circuits for the motor located outside of the path of travel of the car, a plurality of independently operable circuit controlling devices within the car, and mechanical connections between said devices and the circuits.

6. In an apparatus for controlling elevators, the combination with a car and a motor, of motor controlling circuits, switches in said

circuits, levers in the car, levers at the floor landings interconnected with the levers in the car, and mechanically connected with the switches.

7. In an apparatus for controlling elevators, the combination with a car and a motor, of a floor controller comprising a plurality of switches, operating levers in the car and at the floor landings, and mechanical connections between the levers and the switches.

8. In an elevator system, the combination with a car and a motor, of an automatic stationary floor controller, and mechanical means for governing the operation of the controller from the car.

9. In an elevator system, the combination with a car and motor, of a floor controller, mechanical means for governing the operation of the controller from the several floor landings and means for governing the operation of the controller from the car.

10. In an apparatus for controlling elevators, the combination with a car and operating means therefor, of a plurality of flexible members extending parallel with the path of travel of the car, manually operable devices within the car adapted to flex the respective members, and means controlled by said members for automatically bringing the car to rest at predetermined positions corresponding to the devices operated.

11. In an elevator system, the combination with a car and operating means therefor, of a plurality of flexible members extending parallel with the path of travel of the car, manually operable devices within the car adapted to flex the respective members, switches, operating connections between the switches and flexible members, and means for automatically bringing the car to rest at predetermined positions corresponding to the switches operated.

12. In an automatic elevator system, the combination with a car, a motor, and a floor controller, of devices located at the floor landings for governing the operation of the floor controller, devices in the car for also governing the controller, a stationary device for automatically rendering the devices at the floor landings ineffective when any of the devices in the car are operative and mechanical connections between said devices in the car and said stationary device for operating the latter.

13. In an automatic elevator system, the combination with a car and a motor, of a plurality of normally open switches corresponding to the several floor landings, devices for operating said switches at the floor landings and in the car, connections between the switches and said devices, means operative upon the closure of one of said switches to control the motor circuits and bring the car to a floor landing corresponding to said switch, a circuit including said switches, and mechanically operated means for automatically opening said circuit upon the operation of one of the switch operating devices in the car.

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

AUGUST SUNDH.

Witnesses:

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