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H. W. MATTINGLY

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ELEVATOR CONTROL SYSTEM

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2 Sheets-Sheet 2

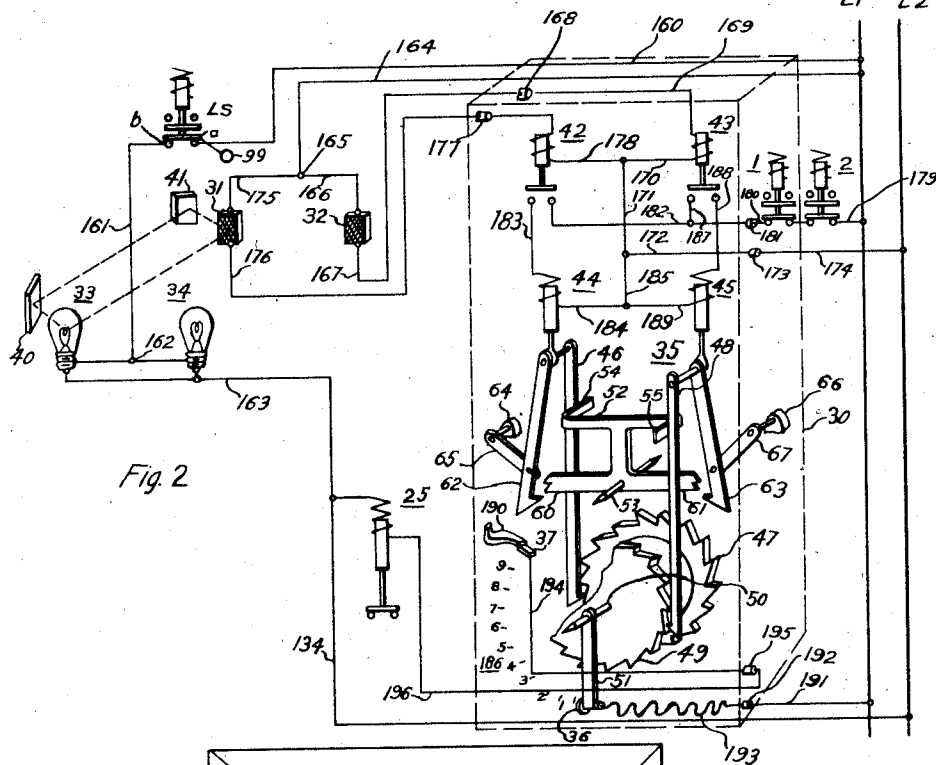


Fig. 2

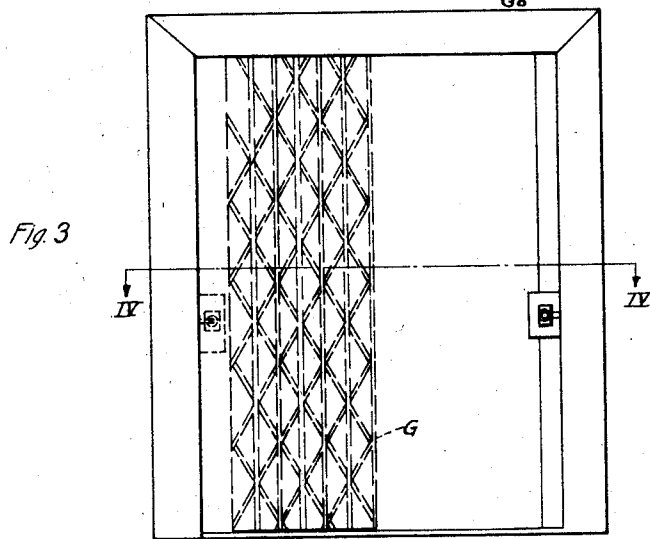


Fig. 3

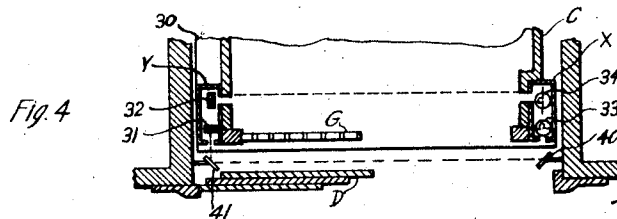


Fig. 4

INVENTOR
Harold W. Mattingly

BY

Wesley C. Shaw
ATTORNEY

UNITED STATES PATENT OFFICE

HAROLD W. MATTINGLY, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

ELEVATOR CONTROL SYSTEM

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My invention relates to control systems for elevators and more particularly to control systems embodying means for bypassing registered calls for service.

One object of my invention is to provide a control system in which light-sensitive devices and co-operating light sources may be employed to control the car in such manner that it will bypass registered calls for service when the passengers on the car are in excess of a predetermined number.

Another object of my invention is to provide an elevator-control system which will prevent a car, when the number of persons thereon exceeds a predetermined load limit, from receiving and answering any calls registered by passengers waiting at the floor landings.

A further object of my invention is to provide an elevator-control system, in which a car, when the number of persons thereon exceeds a predetermined limit, will answer the calls registered by the passengers in the car before answering the calls registered by the passengers waiting at the floor landings until such time as the load in the car is reduced below a predetermined number of persons.

It is also an object of my invention to provide for preventing a car operating under a push-button-control system from stopping at a floor landing to take on more passengers when the number of passengers on the car exceeds a predetermined limit.

Other objects of my invention will, in part, be obvious and will, in part, appear hereinafter.

For an illustration of one of the many forms my invention may take, reference may be had to the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of an elevator collector-control system embodying my invention.

Fig. 2 is a diagrammatic representation of the manner in which light-sensitive cells and cooperating light sources may be employed for controlling a counting device or relay which will cause the car to bypass registered calls when the number of passengers

on the elevator exceeds a predetermined limit.

Fig. 3 is a view, in front elevation, of the entrance to an elevator, illustrating the positions in which the light-sensitive cells and the cooperating light sources illustrated in Fig. 2 may be disposed, and

Fig. 4 is a view, in section, taken along the line IV—IV of Fig. 3.

While my invention may be utilized in connection with any elevator-control system provided with call registering devices whereby passengers may register calls for service, it is illustrated in the drawings as embodied in an elevator-control system of the push-button type, wherein passengers control the movements of the car without the necessity of having an attendant on the car, and wherein the car may be stopped at any number of floors during a single trip in answer to a number of calls for service registered by passengers at the landings. Control systems of this type are known in the art as collector-control systems, one form of which is illustrated and described in the copending application Serial No. 190,780, filed May 12, 1927, by F. E. Lewis, and assigned to the Westinghouse Electric & Mfg. Co.

As shown, a plurality of push-buttons 1D, 2D, 2U, 3D, 3U and 4U are disposed at the several floors served by the elevator to be operated by waiting passengers at the floor landings to call the car C to such landings.

Push buttons C1, C2, C3 and C4 are mounted in the car C to be operated by the passengers in the car for dispatching it to the floor landings at which they desire to leave the elevator.

In order that the operation of the push buttons may cause the car C to move in the proper direction to respond thereto, the buttons are adapted to be connected, through the normally open contact members *b* of an "up"-direction relay SU or a "down"-direction relay SD, to an "up"-direction switch 1 or a "down"-direction switch 2 for operating a hoisting motor (not shown) in the up and down directions, respectively.

If it is desired to utilize my system with a car having more than one speed, a high-speed

relay 4 may be provided for causing the hoisting motor (not shown) to increase in speed when such relay is energized by connecting and disconnecting a resistor in the hoisting-motor circuit or by any other suitable speed-changing arrangement well known in the art.

An up-trip relay 10 and a down-trip relay 11 are provided for the purpose of causing the car to make a complete trip to the terminal in the direction in which it starts to answer a call.

A floor-call stopping relay 12 is connected in circuit with the floor push buttons and a car-call stopping relay 13 is connected in circuit with the car push buttons for stopping the car when it arrives at the floor landings for which calls have been registered by the floor buttons or by the car buttons, respectively.

The control system is also provided with a landing switch LS carried by the car (for convenience illustrated as included in the control circuit) for causing the car to land accurately level with the floor when it makes a stop at a landing. The landing switch LS is illustrated as being of the well known type that is mounted on the car and is operated by a roller which engages a notch in landing cams LC1, LC2, LC3 and LC4 disposed, respectively, at each landing in the hatchway. A retiring coil on the landing switch keeps its contact members closed and the roller away from the cams except when the car approaches a floor at which a stop is to be made.

Connected across the terminals of the armature MA of the hoisting motor, is a counter E. M. F. relay 14 that is provided with a dash-pot for the purpose of causing the car, when it comes to a stop at a landing, to pause a sufficient length of time to permit the passengers to open the elevator door. If it were not for this relay, the car, upon coming to a stop, would immediately restart to answer other registered calls.

Included in the system, is a floor selector FS for connecting the various circuits between the push buttons and the stopping relays 12 and 13, as well as the trip relays 10 and 11, in accordance with the position of the car relative to the floors which it serves. While any device which moves correspondingly to the movements of the car may be employed, I have illustrated one form of such device as a floor selector FS similar to those usually employed in elevator signal and control systems and may be located at any suitable point, for example, in the pent house or in the elevator shaft.

Mounted upon the selector FS, is a movable arm A that is operated by a screw S which is driven by some part of the operating mechanism of the car which the selector serves.

The floor selector FS is provided with a set of up contact segments and a set of down con-

tact segments disposed to be engaged by co-operating brushes 15, 16, 17 and 18 mounted on, and insulated from, the movable arm A.

Electromagnets 19 and 20 are mounted on the respective ends of the movable arm A and are controlled by the contact members *c* on the up-direction relay SU and the down-direction relay SD for the purpose of tilting the arm to the right or to the left so that its contact brushes will engage the up or the down contact segments in accordance with the up or down movement of the car.

The contact segments under each of the brushes 15 and 18 comprise a series of short segments that are respectively connected to the floor push buttons and contact strips that extend substantially the full length of the panel and are connected to the stopping relay 12. Similarly, the contact segments under each of the brushes 16 and 17 comprise a series of short segments that are respectively connected to the car push buttons and contact strips that are connected to the stopping relay 13.

Mounted upon the upper part of the selector FS, is a pair of normally closed contact members 21 for controlling the trip relay 10 and the up-direction relay SU. A wedge-shape member 22 of insulating material is disposed on the left-hand end of the movable arm A in position to enter between the contact members 21 to separate them as the car comes to the end of its upward run and thereby deenergize the trip relay 10 and the up-direction relay SU. Similar contact members 23 are mounted on the lower right-hand corner of the selector panel in position to be separated by a wedge-shape member 24 on the right-hand end of the arm A when the car reaches the end of its downward run for deenergizing the trip relay 11 and the down-direction relay SD.

When the car is fully loaded with passengers and there is no room to accommodate additional persons, it is futile to permit the car to stop in answer to additional calls, therefore, I provide means to bypass the calls registered by persons desiring to board the car by connecting the circuit from the floor buttons to the stopping relay 12 through a pair of normally closed contact members on a full-load relay 25 in such manner that the circuit will be opened when the car is fully loaded. When the circuit to the stopping relay 12 is open, no calls registered on the buttons at the floors for the car can be picked up by the car and, therefore, it will bypass, that is, fail to respond to, such calls until the overload relay is deenergized.

While the full-load relay 25 may be controlled by any suitable means that is responsive to a full load on the car, I have, in the present instance, provided a means for operating it when the number of passengers on the elevator exceeds a predetermined limit.

This means comprises a counting mechanism 30 contained within a housing 30 which will count the passengers as they enter and leave the car, when the number of passengers in the car exceeds a predetermined limit, will energize the full-load relay 25 to thereby cause the car to bypass outside registered calls until the number of passengers on the car drops below the predetermined limit.

10 The counting mechanism comprises a pair of suitable light-sensitive devices, such as photo-electric cells 31 and 32 and a pair of cooperating sources of light, such as electric lamps 33 and 34 that are provided for operating a counting relay 35, the contact members 36 and 37 of which are included in the circuit for the coil of the full-load relay 25 in such manner that the full-load relay will be energized when the contact members 36 and 37 are closed and will be deenergized when these contact members are open.

Each of the light-sensitive cells 31 and 32 may be of any suitable type, such as a selenium or any cell having the photo-electric property of changing its resistance to the passing of electric current or having similar characteristics under varied conditions of light.

As shown, the light-sensitive cell 32 is 30 mounted in the central portion of the left-hand side of the frame of the car gateway while its cooperating lamp 34, is mounted in the central portion of the right-hand side of the gateway of the car in such manner that 35 its rays of light will extend across the entrance to the car and control the light-sensitive cell 32.

The light-sensitive cell 31 is mounted beside the light-sensitive cell 32 to be controlled by the rays of light from its cooperating lamp 33 which is mounted beside the lamp 34 in the right-hand side of the car-door frame.

Referring to Figs. 3 and 4, I have illustrated a hatchway door D, closing the entrance to the elevator hatchway, in which operates car C. The car C is provided with a collapsible gate G, which may be of the usual type provided on elevators. Secured to the car at the right-hand side thereof, I have 60 illustrated a housing X, which encloses the lamps 33 and 34, the housing being provided with suitable openings through which beams of light may be projected from the lamps 33 and 34 to cross the hatchway-door opening and the car-gate opening. Similarly arranged upon the opposite side of the car is the housing Y, which encloses the light-sensitive cells 31 and 32, this housing, also being provided with suitable openings 60 through which the beams of light 33 and 34 may be directed upon the light-sensitive cells 31 and 32.

Referring particularly to Fig. 3, it will be observed that the lamps 33 and 34 and the 65 light-sensitive cells 31 and 32 are arranged in

such manner that the beams of light are projected across the entrance openings at about the level of the waist of the average passenger.

It will be observed that the light-sensitive cell 31 and its cooperating lamp 33 are arranged in such manner that the light from the lamp 33 will be directed to a mirror 40 from which it will be reflected to a mirror 41 and from thence to the light-sensitive cell 31. The mirrors 40 and 41 may be mounted in any suitable manner, but, in the present instance, they are shown as attached to the walls of the elevator shaft at the entrance to the elevator car. A pair of the reflectors or mirrors 40 and 41 may be provided at each landing so that the light from the lamp 33 will be reflected to the cell 31 when the car comes to a stop at that landing.

With the light sensitive cells 31 and 32 and their cooperating lamps 33 and 34 arranged as described so that the light from the lamps will shine upon the cells when the car is stopped and the doorway is clear but will be prevented from shining upon the cells when anyone crosses the entrance of the car. Thus, a person entering the car will first interrupt the light beam from lamp 33 to the cell 31 and then the light beam from lamp 34 to the cell 32. On the other hand, a person coming out of the elevator will first obscure the cell 32 and then cell 31. The successive obscuring of the cells together with the order in which they are obscured, is employed to operate the counting relay 35.

In order that the light-sensitive cells 31 and 32 may be used to operate the counting relay 35, they are connected in circuit with the coils of a pair of electro-magnets 42 and 43, which, in turn, control the circuits for actuating a pair of electro-magnets 44 and 45. The electro-magnet 44 is disposed to lift a pawl 46 that operates a ratchet wheel 47. The electromagnet 45 is disposed to lift a pawl 48 that operates a ratchet wheel 49. The two ratchet wheels 47 and 49 are fixedly mounted upon a shaft 50 and their teeth are oppositely disposed so that their direction of rotation will depend upon which of the ratchet pawls is pulled upwardly while in mesh with the ratchet wheels.

In order to prevent both of the pawls 46 and 48 from being in mesh with the ratchet wheels 47 and 49 at the same time, an escapement member 52 is mounted on a pin 53 between the ratchet pawls 46 and 48. The escapement member 52 is provided with an arm 54 that will engage the ratchet pawl 46 and push it out of touch with the escapement wheel 47, when the escapement member is moved to the left, and with an arm 55 that will engage the ratchet pawl 48 and move it out of touch with the ratchet wheel 49 when the escapement member is moved to the right.

As shown, the escapement member 52 is provided with a left arm 60 and a right arm 120

61 that are disposed to be engaged, respectively, by shifting pawls 62 and 63 that are connected to the armatures of the electro-magnets 44 and 45. The shifting pawl 62 is also connected to a stationary part 64 of the frame by means of a link 65. The link 65 is disposed at such an angle to the shifting pawl 62 that it will cause that pawl to move inwardly when it is raised by the armature of the electro-magnet 44 and thus engage the left-hand arm 60 of the escapement member 52 and tilt that member to the right. When the escapement member 52 is tilted to the right, its arm 55 will push the ratchet pawl 48 out of mesh with the ratchet wheel 49. Therefore, if the electromagnet 45 is energized at this time to pull up on the ratchet pawl 48, that pawl will not engage and move the ratchet wheel 49, but its shifting pawl 63 will engage the right-hand arm 61 of escapement member 52 and restore it to its normal central position to permit pawl 48 to be again positioned to engage ratchet 49.

Similarly, the escapement pawl 63 is connected to a stationary member 66 by a link 67 which causes the pawl to swing inwardly and engage the right-hand arm 61 of the escapement member 52 when the electro-magnet 45 is energized, unless the escapement member has been tilted out by its way by the prior action of the electro-magnet 44. Thus, if one actuating electro-magnet is energized immediately after the other is energized only the first one energized will be effective to move the ratchet wheels.

Firmly mounted upon the shaft 50 of the ratchet wheels, so that it will rotate with them, is an arm 51, upon the outer end of which is disposed the contact member 36. The contact member 36 is arranged to engage the contact member 37 on the frame of the counting device when the arm 51 is rotated a predetermined distance in a clockwise direction.

As shown, the circuit for energizing the lamps for throwing light rays upon the light-sensitive cells 31 and 32 passes through the contact members *b* on the landing switch LS. Therefore, the lamps 33 and 34 will be lighted only when the car is standing at a floor landing.

In order to keep the light-sensitive cells 31 and 32 from operating the counting relay 35 when the lights 33 and 34 are extinguished during the running of the car, the circuits for the electro-magnets 44 and 45 are connected, through the contact members *c* of the up and down direction switches 1 and 2, in such manner that they will be energized only while the car is in condition to stop and remain standing at a floor landing.

My invention will be best understood by an assumed operation of the elevator system illustrated in the drawings.

Assuming that the car is standing at the first floor landing, then, by reason of the fact

that the contact members 21 on the floor selector FS are closed, the up-direction relay SU will be energized so that the car is in condition to respond to any calls registered on the push buttons. This circuit extends from supply conductor L1 to conductor 70, through the contact members *a* of down direction relay SD, conductor 71, the coil of up-direction relay SU, conductors 72 and 73, contact members 21 and conductor 74, to supply conductor L2.

The opening of the contact members *a* on the relay SU prevents the energization of the down-direction relay SD while the relay SU is energized, even though the contact members 23 are thereafter closed, as by the car moving from the first floor.

The closing of the contact members *b* on the relay SU provides a path through which the up-direction switch 1 will be energized when the push buttons are pressed.

The closing of the contact members *c* on the relay SU completes a circuit for energizing the electro-magnet 20 on the right-hand side of the movable arm A on the floor selector FS, thereby causing the arm to be tilted to the left so that its brushes 15 and 16 will engage the up contact segments while the car makes an up trip. This circuit extends from supply conductor L1, through conductors 70 and 75, the contact members *c* of up-direction relay SU, conductor 76, the coil of electro-magnet 20 and conductor 77, to supply conductor L2.

Assuming now that a waiting passenger at the second floor, desiring to travel to the fourth floor, presses the floor push button 2U to call the car to the second floor. This operation will cause circuits to be set up for automatically moving the car to the second floor and stopping it at that landing when it arrives. The push button 2U is provided with a holding coil 80 that is energized whenever the button is operated.

The closing of the contact members *b* on the push button 2U completes a circuit for the holding coil 80 that extends from line conductor L1, through conductor 81, the contact members *b* of button 2U, the holding coil 80 and conductor 82, to supply conductor L2. Thus, the button, once operated, is maintained in operative condition until a "kick-out" or cancellation coil 83, connected by conductor 84 to a contact segment 85 on the floor selector and wound in opposition to the holding coil 80, is energized as hereinafter described.

The closing of the contact members *a* on the floor button 2U completes a circuit for moving the car to the second floor, which circuit extends from supply conductor L1, through conductor 86, door contact members 87, gate contact members 88, conductor 89, the coil of brake 90, conductors 91 and 92, the coil of up-direction switch 1, conductor 93, the contact members *b* of up-direction relay SU,

conductor 94, the contact members *a* of button 2U, conductors 95, 96 and 97, contact members *a* of the counter E. M. F. relay 14 and conductor 98, to supply conductor L2.

5 The closing of the contact members *b* on the up-direction switch completes a circuit for energizing the high-speed relay 4 for speeding up the hoisting motor and for energizing the retiring magnet of landing switch LS to close its contact members *a* and withdraw its cam-engaging roller 99 from possible engagement with cams LC1, LC2, LC3 and LC4. This circuit extends from line conductor L1, through conductors 70 and 100 to a junction point 101, thence, in parallel, through the coils of the high-speed relay 4 and the landing switch LS, to a junction point 102, and then, through conductor 103, the contact members *b* of relay 14, conductors 104, 105 and 106, the contact members *b* of up-direction switch 1 and conductor 107, to supply conductor L2.

When the high-speed relay 4 is energized, it closes its contact members *a* and transfers the energizing circuit for itself and also the landing switch LS from the contact members *b* of counter E. M. F. relay 14 (which opens after the hoisting motor reaches a predetermined speed) to a circuit which extends, in series relation, through the contact members *a* on each of the stopping relays 12 and 13. This holding circuit now extends from supply conductor L1, through conductors 70 and 100, to a junction point 101, then, in parallel, through the coils of the high-speed relay 4 and the landing switch LS, a junction point 102, and from thence, through conductors 103 and 110, the contact members *a* of relay 4, conductor 111, the contact members *a* of relay 12, conductor 112, the contact members *a* of relay 13, conductors 113, 105 and 106, contact members *b* of up-direction switch 1 and conductor 107, to supply conductor L2.

When the landing switch LS is energized, the closing of its contact members *a* completes a holding circuit for the up-direction switch 1 that extends from supply conductor L1, through conductor 86, the door and gate contact members 87 and 88, conductor 89, brake coil 90, conductors 91 and 92, the coil of up-direction switch 1, the contact members *a* of up-direction switch 1, conductors 114 and 115, contact members *a* of landing switch LS and conductor 116, to supply conductor L2.

The closing of the contact members *c* on the up-direction switch 1 energizes the up trip relay 10 for causing the car, after each up stop at an intermediate floor, to continue upwardly until it reaches its upper terminal floor. This circuit extends from supply conductor L1, through conductors 120 and 121, contact members *c* of up-direction switch 1, conductors 122, 123 and 124, the coil of trip relay 10, conductors 125 and 73, contact mem-

bers 21 and conductor 74, to supply conductor L2.

The up-trip relay 10, upon being energized, closes its contact members *a* and sets up a self-holding circuit for itself that extends from supply conductor L1, through conductor 126, the contact members *a* of relay 10, the coil of relay 10, conductors 125 and 73, contact members 21 and conductor 74, to supply conductor L2. Therefore, the relay 10 will remain energized until the contact members 31 are separated by the wedge-shape member 22, as the car reaches the end of its up trip.

The closing of the contact members *a* on the up-trip relay 10 also prepares a circuit through conductors 124 and 128 for energizing the contact segment 127 on the floor selector for stopping the car C when it arrives at its uppermost terminal, as will be hereinafter described.

The closing of the contact members *b* on the up trip relay 10 partially completes a circuit for re-energizing the up-direction switch 1 after each stop at an intermediate floor for the purpose of causing the car to complete the trip to the upper terminal once it starts toward it. It may be noted that these contact members are connected in parallel with the contact members *a* of the push button 4U and perform approximately the same functions.

The closing of the contact members *d* on the up-direction switch 1 completes a circuit for the hoisting motor and starts the car upwardly.

After the car starts "up" from the first floor, the counter E. M. F. relay 14 across the armature MA becomes energized when the motor reaches a predetermined speed and opens its contact members *a* and *b*. Inasmuch as the up-direction switch has established a self-holding circuit for itself, the opening of the contact members *a* on the counter E. M. F. relay 14 will not affect the operation of the car in any way. Similarly, inasmuch as the holding circuit for the high-speed relay 4 and the landing switch LS has been transferred from the contact members *b* of the counter E. M. F. relay 14 to the contact members *a* of the stopping relays 12 and 13, the opening of the contact members *b* of counter E. M. F. relay 14 will not affect the energization of these relays and, therefore, the stopping of the car may be effected by deenergizing either one of the stopping relays 12 or 13.

As the car C moves up to and arrives at the second floor landing, the contact brush 15 on the movable arm A bridges the contact segment 85 and the contact strip 130, thereby completing a circuit for energizing the "kick-out" coil 83 for resetting the floor push button 2U and for energizing the stopping relay 12 to stop the car. This circuit extends from

supply conductor L1, through conductor 81, the contact members *b* of push button 2U, conductor 131, resetting coil 83, conductor 84, contact segment 85, contact brush 15, contact strip 130, conductor 132, the contact members of full-load relay 25, conductor 133, the coil of stopping relay 12 and conductor 134, to supply conductor L2.

The stopping relay 12, when energized, opens its contact members *a*, breaking the holding circuits for the high-speed relay 4 and the retarding coil for the landing switch LS. The high-speed relay 4, when de-energized, slows the car down to its low speed, but the car is not immediately brought to a stop since, at the time of the deenergization of the retarding coil on the landing switch LS, the roller 99 on the landing switch is in engagement with one of the faces of landing cam LC2 and will prevent the opening of the contact members *a* of the landing switch. Therefore, the car will continue to approach the second floor at slow speed.

As the car arrives level with the second floor, the roller 99 will drop into the notch in the landing cam LC2, thus opening the contact members *a* of the landing switch LS to thereby deenergize the up-direction switch and, consequently, causing the car to come to rest at a level with the second floor.

It will be observed that the energizing circuit for the coil of stopping relay 12 leads in series relation through the cancellation coil 83 of the button 2U. The resistance characteristics of the coil of relay 12 and the button cancellation coil 83 should be so selected that, when these coils are energized in series relation, the current which will flow in the circuit will be sufficient to operate the relay 12 and insufficient to cause the cancellation coil 83 to overcome the effect of holding coil 80. Therefore, in order to cancel the registered call, as by restoring the operated button to its normal position, it is necessary to provide a circuit for the cancellation coil which is independent of the stopping-relay coil. For this reason, we have provided an additional set of contact members *b* connected for operation by the relay 12 through a lost-motion connection represented by spring 136. Hence, energization of the relay 12 closes a shunt circuit around the coil of the relay for supplying full voltage to the cancellation coil 83, which shunt circuit extends from the junction point 137 on the conductor 133, through conductor 138, the contact members *b* of relay 12 and conductor 139, to supply conductor L2.

It will be observed that the cancellation of the registered calls should not occur until after the high-speed relay 4 has been de-energized. Hence, it is desirable to delay the cancellation of the call for a sufficient length of time to insure the de-energization of the speed relay. For this reason, I have

provided a dash pot 140 to retard the closing action of the contact members *b* of relay 12 for a short time after the opening of the contact members *a* of this relay. Hence, it is apparent that the cancellation of the registered call as soon as the car responds to the call is effected by initiating deceleration to make the stop at the corresponding floor.

Inasmuch as the circuit prepared by the closing of the contact members *b* on the up trip relay 10 for causing the elevator to move to the top floor still exists, the elevator would immediately start in the up direction after stopping at the second floor and before the waiting passenger could board it, if it were not for the fact that the counter relay E. M. F. 14 is provided with a dash pot that prevents its contact members from closing and re-completing the circuit for the up direction switch 1 for a predetermined length of time after the hoisting motor stops. The allotted time should only be sufficient to permit the waiting passenger at the second floor to open the elevator door and gate. After the elevator door and gate contact members 87 and 88 are opened, the car cannot start again until they are closed.

Assuming now that the second floor passenger has opened the door and gate, entered the car and reclosed the door and gate, then, as soon as the door and gate contact members 87 and 88 are closed, the car will start upwardly to complete its up trip by reason of the fact that the up trip relay 10 is in an energized condition, and the contact members *b* on the counter E. M. F. relay 14 are closed, thereby completing a circuit for energizing the up-direction switch 1 that extends from supply conductor L1, through conductor 86, door and gate contact members 87 and 88, conductor 89, brake coil 90, conductors 91 and 92, the coil of up-direction switch 1, conductor 93, the contact members *b* of up-direction relay SU, conductors 94 and 142, contact members *b* of up trip relay 10 and conductors 143, 96 and 97, the contact members *a* of counter relay E. M. F., 14 and conductor 98, to supply conductor L2.

Inasmuch as the up-direction switch is now energized, it closes its contact members *a*, *b*, *c* and *d* and completes the circuits as hereinbefore described in moving the car from the first floor to the second floor, thereby causing the car to travel upwardly.

As the car arrives at the fourth floor, it will be stopped by the contact brush 16 bridging the contact segment 127 and the contact strip 144 and thereby completing a circuit for energizing the stopping relay 13 to open its contact members *a*, which will, in turn, cause the high-speed relay 4, the landing switch LS and the up-direction switch 1 to be deenergized, as set forth in the description of stopping the car at the second floor. The circuit for energizing the stopping relay 13

extends from supply conductor L1, through conductor 126, the contact members *a* of up trip relay 10, conductors 124 and 128, the contact segment 127, brush 16 and contact strip 144 of the floor selector and conductor 145, the coil of relay 13 and conductor 134, to supply conductor L2.

As the car comes to rest at the fourth-floor landing, the wedge-shaped member 22 on the movable arm A enters between and opens the contact members 21, thereby deenergizing the trip relay 10 and also the up-direction relay SU.

Inasmuch as the contact members 23 associated with the down-trip relay 11 and the down-trip relay SD are closed, the closing of the contact members *a* on the relay SU, when it is deenergized, will complete a circuit for energizing the down-direction relay SD to place the car in condition to answer any calls registered on the push buttons. This circuit extends from line conductor L1, through conductors 70, the contact members *a* of relay SU, conductor 146, the coil of relay SD, conductor 147, the contact members 23 and conductor 148, to supply conductor L2.

The opening of the contact members *a* on the relay SD prevents energization of the up-direction relay SU while the relay SD is energized.

The closing of the contact members *b* on the relay SD provides a path through which the down-direction switch 2 will be energized when the push buttons are pressed.

The closing of the contact members *c* on the relay SD completes a circuit for energizing the electromagnet 19 on the left-hand side of the movable arm A of the floor selector, thereby causing the arm to be tilted to the right so that its brushes 17 and 18 will engage the down contact segments when the car descends. This circuit extends from supply conductor L1, through conductors 70 and 150, the contact members *c* of down relay SD, conductor 151, the coil of electromagnet 19 and conductor 77, to supply conductor L2. Thus, the car is prepared for a down trip.

In explaining the operation of the light-sensitive cells and the associated apparatus for counting the number of passengers on the car, reference will be made again to the landing of the car at the second floor to take on the second floor passenger. When the car stopped at the second floor, the deenergization of the up-direction switch 1 caused its contact members *e* to close, thereby partially preparing a circuit for supplying energy to the actuating electromagnets 44 and 45 of the passenger-counting relay 35 so that that circuit would be completed by the deenergization of the control electromagnets 42 and 43.

At the same time, the closing of the contact members *b* on the landing switch LS completed a circuit for lighting the counting

lamps 33 and 34, (see Fig. 2) which circuit extends from supply conductor L1, through conductor 160, the contact members *b* of landing switch LS, conductor 161 to a junction point 162, thence, in parallel, through the lamps 33 and 34 and from thence, through conductors 163 and 134, to the supply conductor L2. Thus, the lamps 33 and 34 are lighted as soon as the car stops at the second floor.

The cells 31 and 32 are connected to a supply of electrical energy by a circuit which extends from conductor L1, through conductor 164 to a junction point 165, one branch extending through conductor 166, cell 32, conductor 167, terminal 168 on housing 30, conductor 169, the coil of relay 43 and conductors 170, 171 and 172, terminal 173 on housing 30 and conductor 174, to supply conductor L2, and the other branch extending from the junction point 166, through conductor 175, the cell 31, conductor 176, terminal 177 the coil of relay 42, conductors 178, 171 and 172, terminal 173 and conductor 174, to supply conductor L2. Thus the relays 42 and 43 will remain energized so long as the lamps 33 and 34 throw light upon cells 31 and 32.

As the second floor passenger, in boarding the car, passes through the entrance to the car he first intercepts the light that is reflected from the lamp 33 by the mirrors 40 and 41 to the cell 31. Owing to the resistance characteristics of the light-sensitive cell 31, it will not permit current to pass through it when the light from the lamp 33 is prevented from reaching it. Therefore, the relay 42 will be deenergized and close its contact members.

The closing of the contact members of the relay 42 completes a circuit for energizing the electromagnet 44 which circuit extends from supply conductor L1 (see Fig. 2), through conductor 179, the contact members *e* of up and down-direction switches 1 and 2, conductor 180 terminal 181 conductor 182 and contact members of relay 42, conductor 183, the coil of electromagnet 44, and conductors 184, 185 and 172 terminal 173 and conductor 174, to supply conductor L2.

The energization of the electromagnet 44 causes its armature to raise the ratchet pawl 46 which is in engagement with the ratchet wheel 47 and thereby rotates the ratchet wheel 47 in a clockwise direction, which causes the arm 51 carrying the contact member 36 to also rotate in a clockwise direction to advance it to the numeral 1 on the scale 186.

It should be noted that the armature of the electromagnet 44, in raising the pawl 46, also raises the escapement pawl 62. As the pawl 62 rises, the link 65 causes it to move inwardly and engage the left-hand arm 60 on the escapement member 52 and tilt that member to the right. When the member 52 tilts to the

right, its right-hand arm 61 moves out of the way of the escapement pawl 63 and, at the same time, its arm 55 moves into engagement with the ratchet pawl 48 and swings that pawl away from the ratchet wheel 49. Therefore, as the passenger continues on into the car and passes between the light 34 and the cell 32, the ratchet wheel 49 will not be operated to move the counting arm 51.

Of course, inasmuch as the light between the lamp 34 and the cell 32 is intercepted as the passenger proceeds through the car entrance, no current will flow through the cell 32 because of its resistance characteristics when it is obscured. Therefore, the relay 43 will be deenergized, and the closing of its contact members will complete a circuit for energizing the electromagnet 45, which circuit extends from supply conductor L1, through conductor 179 the contact members *e* of the up and down-direction switches 1 and 2, conductor 180, terminal 181, conductors 182 and 187, the contact members of relay 43 conductor 188, the coil of electromagnet 45 and conductors 189, 185 and 172, terminal 173 and conductor 174, to supply conductor L2.

However, inasmuch as the arm 55 on the escapement member 52 has pushed the ratchet pawl 48 away from the teeth of the ratchet wheel 49, the up movement of the ratchet pawl 48 by the electromagnet 45 will not cause it to operate the ratchet wheel 49.

However, escapement pawl 63 will be drawn upwardly upon the energization of magnet 45 and, through the action of its link 67, will be moved inwardly into engagement with one of the teeth of the right-hand arm 61 on the escapement 52 and will thus restore the escapement member 52 to its central position, permitting pawl 48 to again be placed in position to actuate its ratchet 49 upon the next energization of the magnet 45, thus, it will be observed that the sequential of magnets 44 and 45 will cause the contact arm 51 to be stepped one point on the scale 186 toward contact members 37, thus registering the fact that one passenger moved into the car.

As the car leaves the second floor, the opening of the contact members *e* on the up and down-direction switches 1 and 2 prevents the electro-magnets 44 and 45 from being energized, and the opening of the contact members *b* on the landing LS extinguishes the counting lamps 33 and 34 while the car is running. The extinguishment of the lamps 33 and 34 may affect the cells 31 and 32 to deenergize the relays 42 and 43, but the deenergization of the relays 42 and 43 cannot cause the energization of the electro-magnets 44 and 45 by reason of the fact that the energizing circuit for these electro-magnets was opened by the opening of the contact members *e* on the up and down-direction switches 1 and 2 as the car started. Therefore, the

counting mechanism will not work while the car is running and will be in operation only when the car is standing at a floor.

As the car stops at the fourth floor, landing switch LS, which moves toward its open-circuit position to break its contact members *a* to thereby cause deenergization of up-direction switch 1, as the roller 99 passes over the face of cam LC4 and enters into the notch in the cam, which notch represents the exact floor level for the fourth floor. Landing switch LS is provided with an additional set of contact numbers *b*, which will be closed as soon as the landing switch is opened to thereby complete the energizing circuit for the lamps 33 and 34. The lamp will, therefore, project beams of light upon the light-sensitive cells 31 and 32, and, at this time, will cause energization of relays 42 and 43 to open the circuits for magnets 44 and 45. Since the landing switch LS opens first at the energized direction switch 1, the circuits for magnets 44 and 45 will be maintained open for a short period of time after the landing switch LS closes at contact members *b*. That is, the landing switch closes at contact members *b* and deenergization direction switch 1 simultaneously, but the lapse of time between the actual closing of contact members *b* on the landing switch LS and the closing of contact members *E* of the up-direction switch 1 will permit the relays 42 and 43 to be energized prior to the making of contact members *E* on operation switch 1. In this way, the stopping of the car at the floor causes the complete operation of the counting device to count passengers entering or leaving the car at that floor.

As the second floor passenger leaves the car at the fourth floor, he passes first between the light 34 and the light-sensitive cell 32. As the light provided by the lamp 34 is prevented from reaching the light-sensitive cell 32 by the passenger passing therebetween, no current for maintaining the relay 43 in its energized condition will pass through the light-sensitive cell 32. Therefore, the relay 43 will be deenergized to close its contact members and complete the circuit for energizing the electromagnet 45, previously traced.

The energization of the electromagnet 45 causes its armature to raise the ratchet pawl 48 and thereby rotate the ratchet wheel 49 in a counterclockwise direction and move the contact arm 51 one step back toward zero position. When the ratchet pawl 48 is pulled upwardly, the escapement pawl 63 is also pulled upwardly, and the link 67 causes it to move inwardly, as well as upwardly, to engage the right-hand arm 61 of the escapement member 52, thereby tilting the escapement member in a counterclockwise direction and causing its arm 54 to move against the ratchet pawl 46 and push it out of engagement with

the ratchet wheel 47 to prevent operation of the ratchet wheel 47 as the passenger leaves the car.

As the passenger continues on his way out of the car he intercepts the light from the counting lamp 33 to the light-sensitive cell 31, thereby obscuring the light-sensitive cell 31 and causing it to prevent the passage of sufficient current to the control relay 42 to keep that relay energized.

Upon deenergization, relay 42 closes its contact members, thereby completing a circuit for energizing the electromagnet 44, as hereinbefore described. The energization of the electromagnet 44 raises the ratchet pawl 46, but, inasmuch as the arm 54 on the escapement member 52 has pushed the ratchet pawl 46 out of the path of the teeth of the ratchet wheel 47, the energization of the electromagnet 44 will have no effect on the counting device 35.

However, the energization of magnet 44 causes escapement pawl 62 to engage the left-hand end of arm 60 of escapement member 52 to restore member 52 to its neutral or central position.

It will, therefore, be seen that the one passenger who boarded the car at the second floor and who was counted in by the counting device 34, is now counted out, that is, the contact arm 51, which had been moved one point toward contact member 37, is now back to the zero position, indicating that there are now no passengers upon the car.

It should be noted that the counting lights 33 and 34 should be placed such a distance apart or be so controlled by an arrangement of mirrors that the distance between the paths of light to the light-sensitive cells will be such that a person, in moving through the entrance to the car, that is, the counting zone, will intercept the one source of light and then the second source of light at such an interval that the counting apparatus will have time to move the ratchet pawl for the first magnet to be energized and thereby move the escapement member 52 to move the opposite ratchet pawl out of its effective position before the second relay is energized. By properly arranging the distance between the paths of light to the light-sensitive cells, the counting device will operate efficiently and accurately.

While the counting device 35 is illustrated as provided with a scale 186 having a limit of 10 persons, it is to be understood that the contact member 37 may be set to limit the load to any number desired. Furthermore, the contact member 37 should be mounted upon a resilient support, such as a spring 190, to permit it to move with the contact member 36 after it is engaged by that contact member. Thus, if more than a full load of persons crowd upon the car at any time, the counting device 35 may continue to operate after the contact members 36 and 37 are engaged with-

out straining or damaging any of its parts.

Assuming now that the normal capacity of the car is 10 persons, as the scale of the counting device 35 indicates; that the car is ready to move downwardly, and that 10 persons enter the car at the fourth floor, then, as the persons enter the car, they will first pass between the light 33 and the light-sensitive cell 31, and next between the light 34 and the light-sensitive cell 32, thereby operating the counting relay 35, as previously described, until the arm 51 forces the contact member 36 against the contact member 37, thereby completing a circuit for energizing the full-load relay 25, which circuit extends from supply conductor L1 (see Fig. 2), through conductor 191, terminal 192, conductor 193 the contact members 36 and 37, conductor 194, terminal 195, conductor 196 the coil of relay 25 and conductor 134, to supply conductor L2. The energization of the full-load relay 25 will cause the car to bypass all outside calls until the load in the car decreases below a predetermined limit.

Assuming further that the door and gate are closed and that the passengers press the car push button C2 to dispatch the car to the second floor, then the pressing of the button C2 closes its contact members *b* and completes a holding circuit for that button that extends from the supply conductor L1, through conductors 197 and 198, the contact members *b* of push button C2, a holding coil 199 and conductor 200, to supply conductor L2.

The closing of the contact members *a* on the push button C2 completes a circuit for energizing the down-direction switch 2 for the moving of the car from the fourth floor down to the second floor, which circuit extends from supply conductor L1, through conductor 86, the door and gate contact members 87 and 88, conductor 89, brake coil 90, conductors 91 and 201, the coil of down-direction switch 2, conductor 202, the contact members *b* of down-direction relay SD, conductors 203, 94, 204, and 205, the contact members *a* of push button C2, conductors 206, 207, 96 and 97, the contact members *a* of C. E. M. F. relay 14 and conductor 98, to supply conductor L2.

When the down-direction switch 2 is energized, the closing of its contact members *b* completes a circuit for energizing the landing switch LS and the high-speed relay 4 that extends from supply conductor L1, through conductors 70 and 100 to a junction point 101, then, in parallel relation, through the coil of the landing switch LS and the coil of the high-speed relay 4, to junction point 102 and from thence, by way of conductor 103, the contact members *b* of C. E. M. F. relay 14, conductor 104 and 105, the contact members *b* of down-direction switch 2 and conductors 208 and 116, to supply conductor L2.

As soon as the contact members *a* on the landing switch LS are closed, a self-holding circuit for the down-direction switch 2 is established from supply conductor L1, through conductor 86, as previously described, to the coil of the down-direction switch 2, the contact members *a* of down-direction switch 2, conductors 209 and 115, the contact members *a* of landing switch LS and conductor 116, to supply conductor L2.

The now energized high-speed relay 4 completes a self-holding circuit for itself through its contact members *a*, as hereinbefore described.

The closing of the contact members *c* on the down-direction switch 2 completes a circuit for energizing the down-trip relay 11 to cause the car, after each down stop at an intermediate floor, to continue in a down direction. This circuit extends from supply conductor L1, through conductors 120 and 210 contact *c* on down-direction switch 2, conductors 211 and 212, the coil of down-trip relay 11, conductor 213, the contact members 23 on floor selector FS and conductor 148, to supply conductor L2.

The closing of the contact members *d* on the down-direction switch 2 completes a circuit for the hoisting motor and the car starts down.

As the hoisting motor speeds up, the coil on E. M. F. relay 14 becomes energized, and the circuit for energizing the landing switch LS and the high-speed relay 4 is transferred from the contact members *b* of the relay 14 to the contact members *a* of the stopping relay 12 and the stopping relay 13. The circuit for energizing the landing switch LS and the high-speed relay 4 now extends from supply conductor L1, through conductors 70 and 100, to the junction point 101, thence, in parallel, through the coils of the landing switch LS and the high-speed relay 4, to a junction point 102 and thence, by way of conductors 103 and 110, contact members *a* of relay 4, conductor 11, the contact members *a* of relays 12 and 13, conductors 113 and 105, the contact members *b* of down-direction switch 2 and conductors 208 and 116, to supply conductor L2.

Assuming now that, while the car is fully loaded and starting down to the second floor, a waiting passenger at the third-floor landing presses the button 3D to bring the car down to the third floor in order that he may go down to the first floor, then the actuation of the button 3D closes its contact members *b* and completes a self-holding circuit for itself that extends from supply conductor L1, through conductor 214, contact members *b* of button 3D, the coil 215 of button 3D and conductor 82, to supply conductor L2.

The closing of the contact members *a* of the button 3D connects the conductors 94 and 96 to provide a circuit for moving the car,

but, inasmuch as the car is on its way down to the second floor, this circuit will have no additional effect upon it at present.

The closing of the contact members *b* on the button 3D not only completes a holding circuit for the button, as described, but it supplies current, through conductor 216, to the contact segment 217 on the down side of the floor selector FS for the purpose of stopping the car when it reaches the third floor while travelling downwardly.

As the car approaches the third floor, the brush 18 on the floor selector bridges the contact segment 217 and the contact strip 218 and would, if the car were not fully loaded, thereby complete a circuit for energizing the stopping relay 12 to stop the car, which circuit would extend from contact strip 218, through contact members on full-load relay 25, and thence through the coil of floor call stopping relay 12 as previously described for this coil.

However, it will be recalled that the car is fully loaded and that the counting relay has closed its contact members 36 and 37, thus energizing the full-load relay 25 and causing it to open its contact members.

Inasmuch as the contact members of the full-load relay 25 are open, the circuit for the stopping relay 12 is open, thereby preventing energization of the relay 12 as the car arrives at the third floor and the brush 18 bridges the contact segment 217 and the contact strip 218.

Since the stopping relay 12 is not energized, no circuit is completed for canceling the third floor call and, therefore, the car in moving from the fourth floor to the second floor, with a full load of passengers, will pass the third floor without stopping but will leave the call registered to be served by the car on its next trip.

As the car continues toward the second floor on its down trip, the brush 17 on the movable arm A bridges the contact segment 219 and the contact strip 220 to complete a circuit for energizing the stopping relay 13 to stop the car at the second floor and for energizing the resetting coil 221 to cancel the car call for the second floor, which circuit extends from supply conductor L1, through conductors 197 and 198, the contact members *b* of button C2, conductor 222, the resetting coil 221, conductor 223, contact segment 219, brush 17, contact strip 220, conductor 145, the coil of relay 13 and conductor 134, to supply conductor L2.

The energization of the stopping relay 13 causes its contact members *a* to open the circuit to the coils of the landing switch LS and the high-speed relay 4. Therefore, as soon as the roller 99 on the landing switch permits its contact members *a* to open, the down-direction switch 2 will be deenergized and the car will stop.

As was described with reference to the operation of stopping relay 12, the circuit for energizing the stopping relay 13 also extends in series relation with the cancellation coil 221 of the second floor car button C2. The current flowing in this circuit, is, therefore, not sufficient to cause cancellation of the call until the contact members *b* of the stopping relay 13 are closed at a predetermined time after the opening of the contact members *a* of that relay, and, when so closed, the contact members *b* of relay 13 will shunt the coil of relay 13 and supply full voltage to cancellation coil 221. In this manner, the car call, when answered, will be automatically cancelled.

As the passengers leave the car they successively step through the counting zone, and each time one steps through the zone, the counting device moves the arm 51 to bring the contact member 36 another point toward zero.

As soon as a sufficient number of passengers have left the car so that the contact member 36 is moved away from the contact member 37, the full-load relay 25 will be deenergized and its contact members will close, thereby restoring the circuit for the stopping relay 12 and placing the car in condition to again answer the floor-button calls.

Therefore, it will be seen that I have provided a control system in which the car, when fully loaded, will bypass such outside calls as may be in existence, but which will not cancel such outside calls and will answer them as soon as conditions permit, thus avoiding the stopping of the car to take on additional passengers after it is loaded to such an extent that additional passengers cannot get on it if it does stop.

While I have illustrated and described only one specific embodiment of my invention, I realize that it is susceptible of wide application and I do not desire to be limited to the precise system illustrated and described.

I claim as my invention:

1. In an elevator-control system, a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls for stopping the car at the corresponding floor and means responsive to a predetermined number of persons on the car for causing the car to bypass the calls registered on the passenger operated means at the floors.

2. In an elevator-control system, a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls for causing the said car to move to the corresponding floor and means responsive to a predetermined number of passengers on the car for causing the car to bypass the calls registered on the passenger operated means at the floors.

3. In an elevator-control system, a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls for causing said car to move to the corresponding floor, passenger-operated means disposed on the car for dispatching the car to the floors, means responsive to a predetermined number of persons on the car for causing the car to bypass the calls registered on the passenger-operated means at the floors in responding to the dispatching means and for causing said car, when the load thereon decreases, to respond to the registered calls that were bypassed.

4. In an elevator-control system a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls for causing said car to move to and to stop at the corresponding floor, means responsive to the passenger-operated means at the floors for stopping the car at the floors at which calls have been registered, means disposed on the car for dispatching the car to the floors, means responsive to the dispatching means for stopping the car at the floors to which it has been dispatched, and means for rendering the stopping means associated with the passenger-operated means at the floors ineffective while the number of persons on the car exceeds a predetermined limit.

5. In an elevator-control system, a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, a counting means associated with said car for determining the number of passengers on the car at any time and means operably responsive to the operation of the counting means for causing said car to by-pass calls registered on said passenger-operated means while the number of passengers on the car exceeds a predetermined limit.

6. In an elevator-control system, the combination with a car operable in a hatchway past a plurality of floors, and passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, of a plurality of light-sensitive devices and cooperating light-giving means operably responsive to the passage of persons into and out of the car for determining the number of passengers in the car, and means operably responsive to the operation of the light-sensitive devices for causing said car to by-pass calls registered on said passenger-operated means.

7. In an elevator-control system, the combination with a car operable in a hatchway past a plurality of floors and passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, of a pair of light-sensi-

tive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means in one order by successively persons passing into the car and in a reverse order by persons passing out of the car, a counting device operably responsive to the obscuring of the light-sensitive devices for determining the number of persons in the car, and means operably responsive to the counting device for causing the car to by-pass calls registered on said passenger-operated means while the number of passengers on the car exceeds a predetermined limit.

8. In an elevator-control system, the combination with a car operable in a hatchway past a plurality of floors and passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, of a pair of light-sensitive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by persons passing into the car and in a reverse order by persons passing out of the car, a counting device operably responsive to the obscuring of the light-sensitive devices for determining the number of persons in the car, means operably responsive to the counting device for causing the car to by-pass calls registered on said passenger-operated means while the number of passengers on the car exceeds a predetermined limit, and means operably responsive to the operation of the car for connecting said light-giving means and said counting device to a source of electrical power when the car makes a stop at a landing.

9. In an elevator-control system, the combination with a car operable in a hatchway past a plurality of floors and passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, of a pair of light-sensitive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by persons passing into the car and in a reverse order by persons passing out of the car, a plurality of electro-magnets disposed to be deenergized by the obscuring of the light-sensitive cells, and means operably responsive to the deenergization of said electromagnets for causing said car to by-pass calls registered on said passenger-operated means while the number of passengers on the car exceeds a predetermined limit.

10. In an elevator-control system, the combination with a car operable in a hatchway past a plurality of floors and passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, of a pair of light-sensi-

tive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by persons passing into the car and in a reverse order by persons passing out of the car, a plurality of control electromagnets disposed to be deenergized when the light-sensitive cells are obscured, a plurality of actuating electromagnets disposed to be energized by the deenergization of the control electromagnets, and means operably responsive to energization of said actuating electromagnets for causing said car to by-pass calls registered on said passenger-operated means while the number of passengers on the car exceeds a predetermined limit.

11. In an elevator-control system, the combination with a car operable in a hatchway past a plurality of floors and passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, of a pair of light-sensitive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by persons passing into the car and in a reverse order by persons passing out of the car, a plurality of control electromagnets disposed to be deenergized when the light-sensitive cells are obscured, a plurality of actuating electromagnets disposed to be energized by the deenergization of the control electromagnets, a plurality of ratchet pawls disposed to be actuated by said actuating electromagnets, a plurality of ratchet wheels disposed to be operated by said pawls, and means operably responsive to the operation of the ratchet wheels for causing said car to by-pass calls registered on said passenger-operated means while the number of passengers on the car exceeds a predetermined limit.

12. A counting mechanism for an enclosure comprising a pair of light-sensitive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by individuals passing into the enclosure and in a reverse order by individuals passing out of the enclosure, and means operably responsive to the obscuring of the light-sensitive devices for determining the number of individuals that enter and remain in the enclosure.

13. A counting mechanism for an enclosure comprising a pair of light-sensitive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by individuals passing into the enclosure and in a reverse order by individuals passing out of the enclosure, a plurality of electromag-

nets controlled by said light-sensitive devices a pair of ratchet pawls disposed to be operated by said electromagnets, a pair of ratchet wheels disposed to be operated by said pawls, and means operably responsive to the operation of said ratchet wheels for determining the number of individuals that enter and remain in the enclosure. 70

In testimony whereof, I have hereunto subscribed my name this 4th day of September, 1929.

HAROLD W. MATTINGLY.

14. A counting mechanism for an enclosure comprising a pair of light-sensitive devices and means for illuminating said light-sensitive devices, said light-sensitive devices being disposed to be obscured from said light-giving means successively in one order by individuals passing into the enclosure and in a reverse order by individuals passing out of the enclosure, a plurality of electromagnets controlled by said light-sensitive devices a pair of ratchet pawls disposed to be operated by said electromagnets, a pair of ratchet wheels disposed to be operated by said pawls, an escapement member operably responsive to the engagement of either pawl with one of the ratchet wheels for preventing the immediate engagement of the other pawl with the other ratchet wheel and means operably responsive to the operation of said ratchet wheels for determining the number of individuals that enter and remain in the enclosure. 75

15. In an elevator-control system, a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, a light-sensitive device and a light-giving means for illuminating said light-sensitive device, a second light-sensitive device and a second light-giving means disposed on said car, reflecting means disposed at each floor for reflecting light from the second light-giving means to the second light-sensitive device, said light-sensitive devices being arranged to be obscured from the light of said light-giving devices successively in one order by persons passing into the car and in a reverse order by persons passing out of the car, a counting device operably responsive to the obscuring of the light-sensitive devices for determining the number of persons in the car and means operably responsive to the counting device for causing the car to bypass calls registered on said passenger-operated means while the number of persons on the car exceeds a predetermined limit. 80

16. In an elevator-control system, a car operable in a hatchway past a plurality of floors, passenger-operated means disposed at each floor for registering calls to cause said car to stop at the corresponding floor, and a mechanism for causing the car to bypass calls registered on said passenger-operated means while the number of persons on the car exceeds a predetermined limit, said mechanism including a light-sensitive device disposed on the car, a light-giving means disposed on the car and reflecting means disposed at each landing for reflecting light from said light-giving means across the entrance to the car to said light-sensitive device. 85

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