

Sept. 17, 1940.

W. F. GLASER

2,215,098

ELEVATOR SYSTEM

Filed Sept. 17, 1938

6 Sheets-Sheet 1

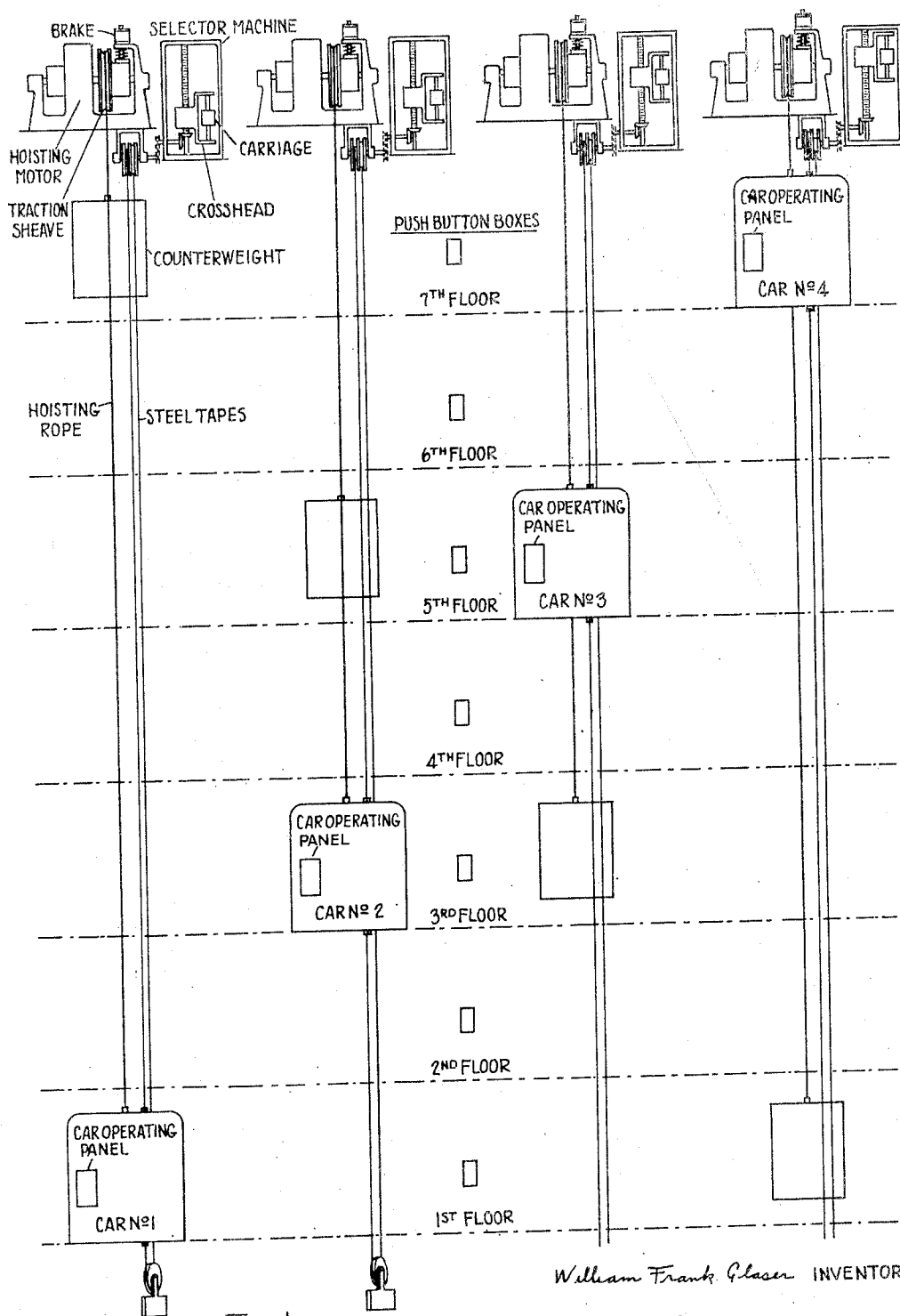


FIG. 1

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6 Sheets-Sheet 2

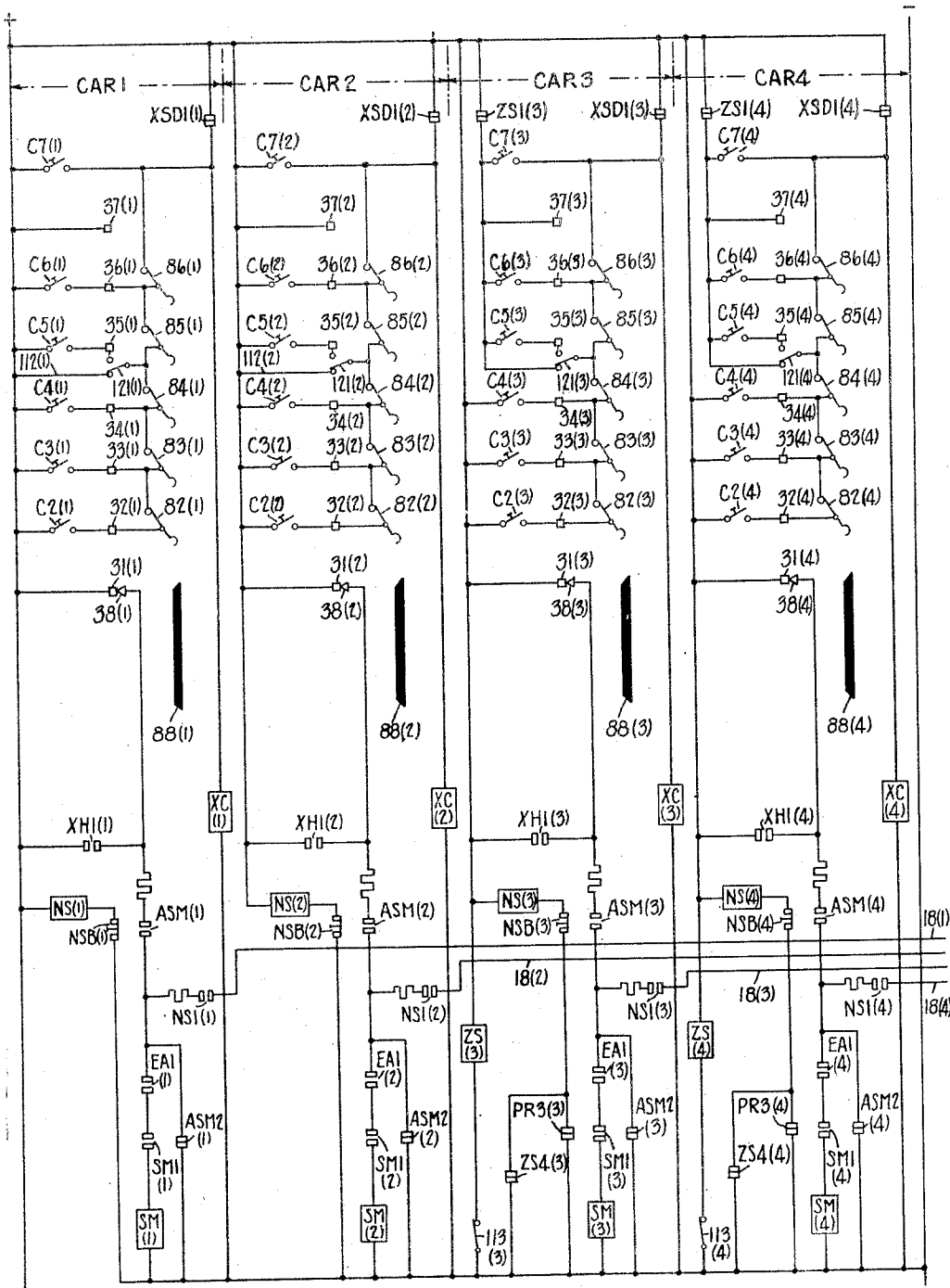


FIG. 2a

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ELEVATOR SYSTEM

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6 Sheets-Sheet 3

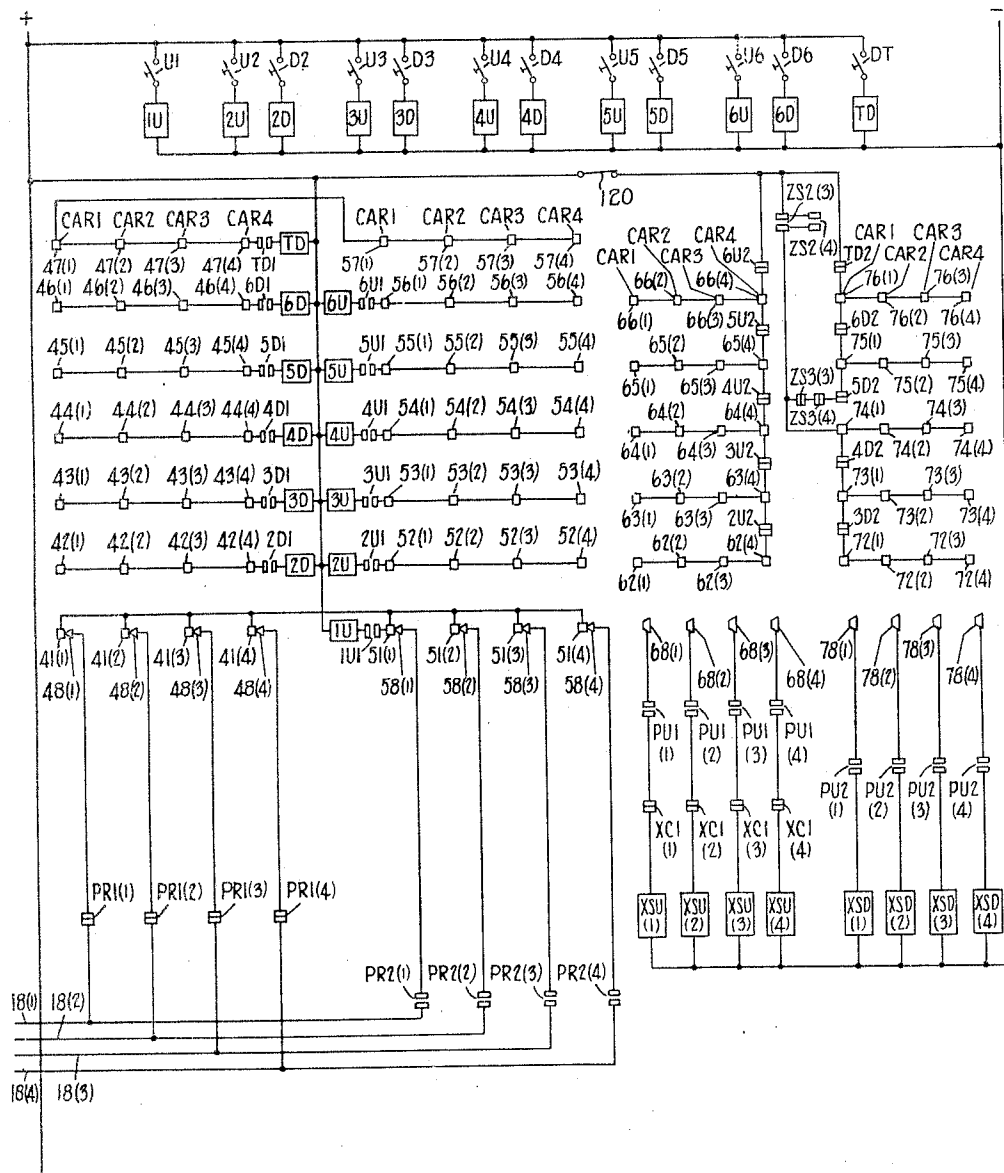


FIG. 2b

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ELEVATOR SYSTEM

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6 Sheets-Sheet 4

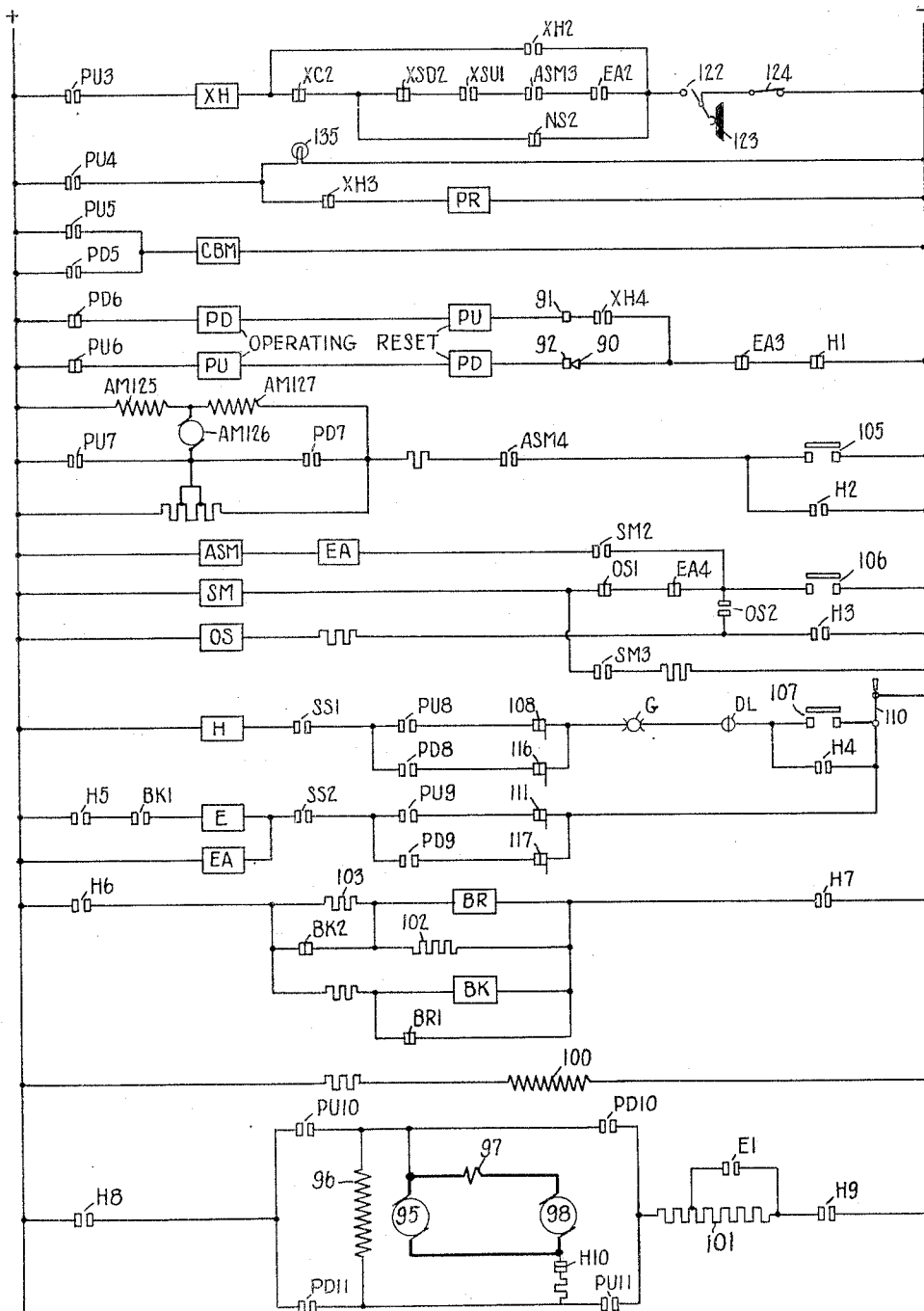


FIG. 3

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6 Sheets-Sheet 5.

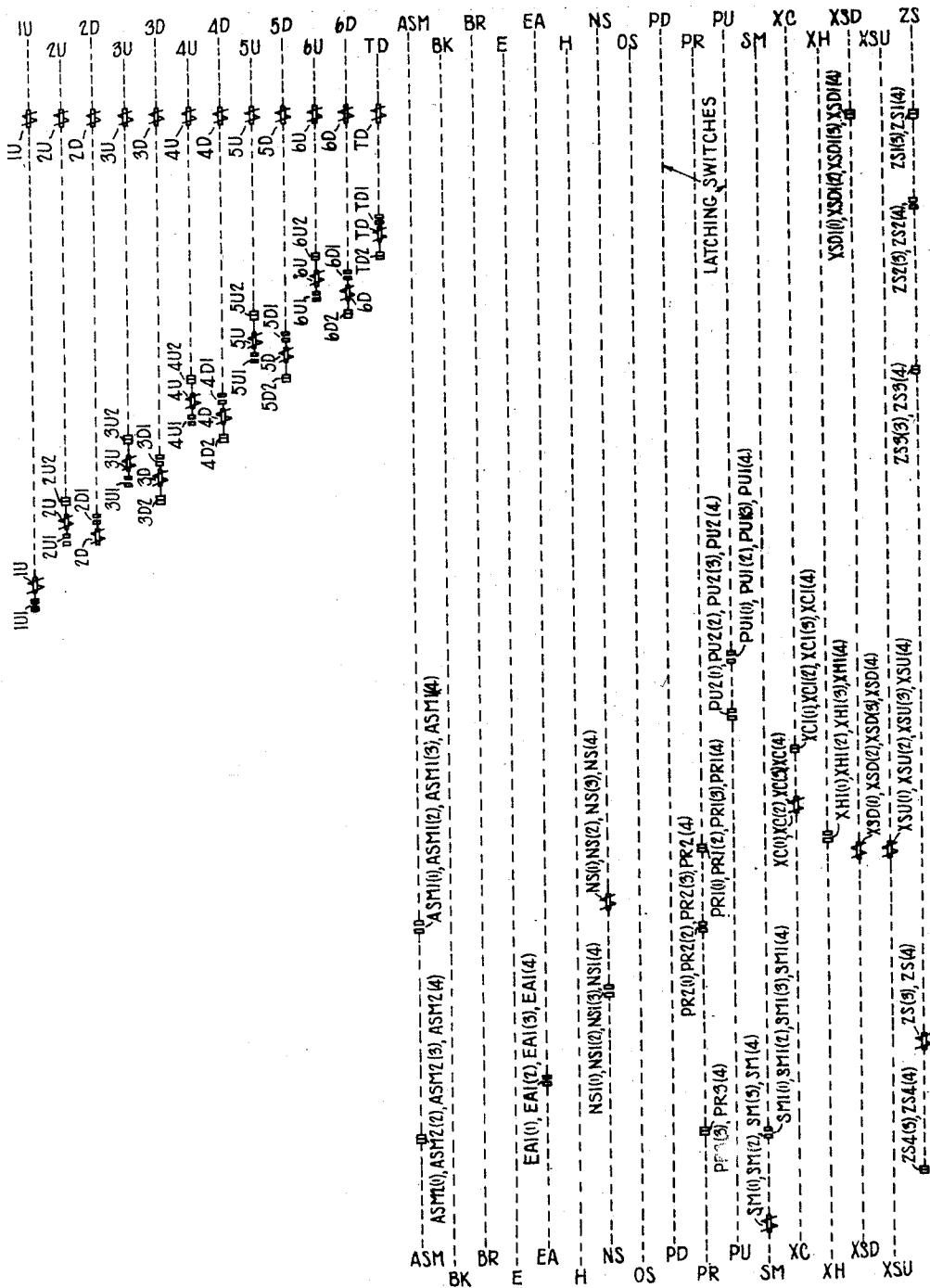


FIG. 2s

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ELEVATOR SYSTEM

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6 Sheets-Sheet 6

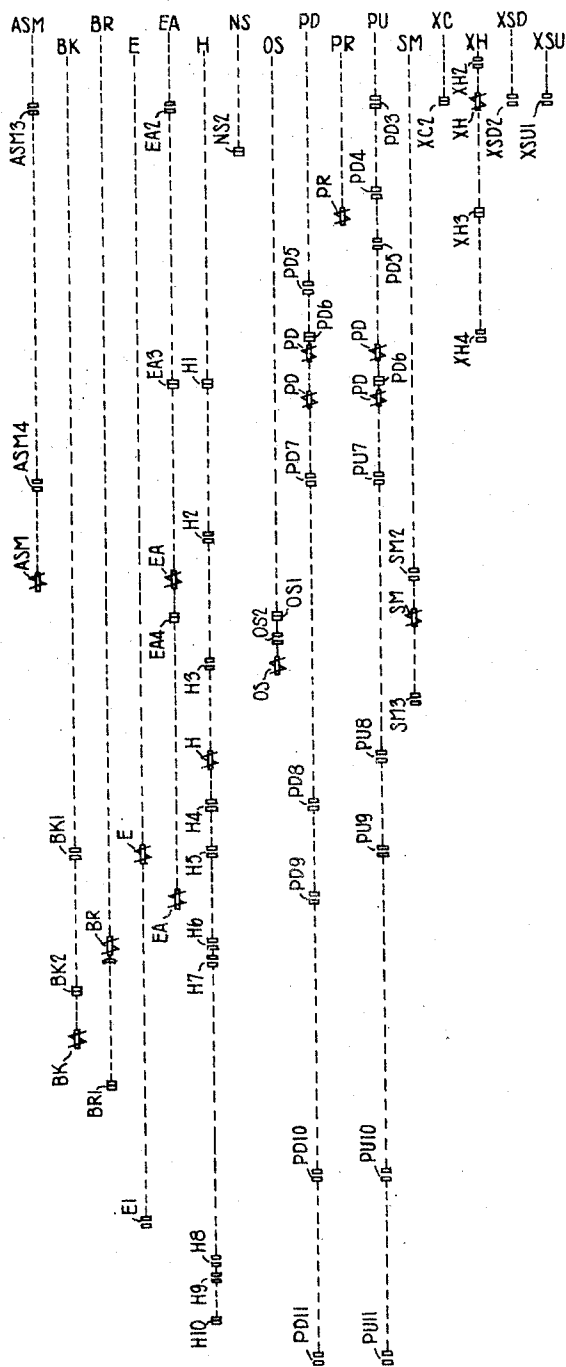


FIG. 3s

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UNITED STATES PATENT OFFICE

2,215,098

ELEVATOR SYSTEM

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corporation of New Jersey

Application September 17, 1938, Serial No. 230,461

21 Claims. (Cl. 187—29)

The invention relates to elevator systems.

The form of elevator control to which the invention especially relates is one in which the starting of the elevator car after each stop is under the control of an attendant in the car, while the stopping of the car is automatic, stops to discharge passengers being made in response to push buttons within the elevator car operated by the attendant as directed by the passengers, and stops to take on passengers being made in response to push buttons at the landings operated by the intending passengers themselves. With such control applied to a plurality of elevator cars, push buttons at the landings are common to the cars.

In many buildings to which such control is applicable, a peak demand arises at one or more periods during the day for elevator service to depopulate the building. The invention is especially directed to the control of the elevator cars during such a period and it is an object of the invention to cause operation of the elevators during such time in such way as to provide maximum traffic handling capacity with equal service to all portions of the building.

The invention involves causing the elevators to serve different zones of the building. Each zone comprises certain floors of the building and has certain cars assigned to it. Elevator systems to which the invention is applicable and in connection with which it will be described are very complex. As an aid to an understanding of the principles and features of the invention, operation of an embodiment of the invention chosen to illustrate these principles and features will be outlined.

During the period of peak demand for elevators to depopulate the building, each car upon arriving at the lower terminal and discharging its passengers is started immediately by its car attendant, running to the highest floor in its zone for which a down hall call is registered. Upon picking up such a call, the car is slowed down and brought to a stop and automatically set for travel in the down direction. During its downward trip it stops in response to down calls until filled to capacity, whereupon the attendant by-passes further hall calls and the car runs express to the lower terminal. Preferably each car is responsive to car calls during this time, regardless of the direction of travel for which it is set. Also, certain cars, preferably those serving the upper zone, may be responsive to up hall calls when set for upward travel. However, since there is very little inter-floor traffic dur-

ing such period, each car usually runs express to the highest down hall call in its zone and after picking up this call travels downwardly, picking up down hall calls for floors below. Each car serves the floors in its own zone first and then, if there is space left in the car, assists the cars in the lower zones in taking on outgoing passengers until it is filled to capacity. Thus, not only is adequate service assured for all floors of the building, but the elevator system is utilized to its maximum passenger handling capacity so as to depopulate the building within a minimum of time.

Other features and advantages will become apparent from the following description and appended claims.

In the drawings:

Figure 1 is a simplified schematic representation of an elevator installation in accordance with the invention;

Figures 2a and 2b, taken together, constitute a simplified wiring diagram of the push button control circuits and the call pick up and call restoring circuits for a plurality of elevators in accordance with one embodiment of the invention;

Figure 3 is a simplified wiring diagram of the power and control circuits for one of these elevators; and

Figures 2s and 3s are key sheets for Figures 2a and 2b and Figure 3 respectively, showing the electromagnetic switches in spindle form with the contacts and coils on the spindles in horizontal alignment with the corresponding contacts and coils on the wiring diagram.

For a general understanding of the invention, reference may be had to Figure 1, wherein various parts of the system chosen to illustrate the principles of the invention are indicated by legend. Four elevators are illustrated, with the cars at different floors in the hatchway. The arrangement is the same for each elevator. Each car is raised and lowered by means of a hoisting motor, which motor drives a traction sheave over which pass hoisting ropes for the car and counterweight. An electromagnetic brake is provided and is applied to effect the final stopping operation and to hold the car when at rest.

Each elevator car is provided with a car operating panel on which are located a plurality of control switches for operation by the car attendant. These switches include a start control switch, a plurality of push buttons, one for each floor above the lower terminal, hereinafter termed car buttons, a safety switch and a non-

stop switch. These switches are shown in the wiring diagrams of Figures 2b and 3.

At each floor is a push button box within which are arranged push buttons, an up and a down push button at each intermediate floor and one push button at each terminal floor. These push buttons, which will hereinafter be termed hall buttons, are common to the cars.

Reference may now be had to Figures 2a, 2b and 3, which illustrate diagrammatically the various control and power circuits. Figures 2a and 2b show the push button control circuits and the call pick up and call restoring circuits for four elevators, a seven floor installation being indicated. The circuits of Figures 2a and 2b are joined by wires 18(1), 18(2), 18(3) and 18(4), which extend from one figure to the other crosswise of the diagrams. Figure 3 shows the starting and stopping circuits and power circuits for one elevator, it being understood that such circuits are provided also for the other three elevators.

The control system illustrated has been considerably simplified. Such system has been shown because it facilitates disclosure of an application of the invention. It is to be understood that other control elements and safety elements may be added in making up the system and that such system is subject to many variations. For example, the invention may be applied to the control system disclosed in the patent to Waters and Glaser No. 2,074,575, dated March 23, 1937.

The electromagnetic switches employed in the system illustrated are designated as follows:

- ASM—Auxiliary stopping switch
- BK—Brake resistance relay
- BR—Brake
- E—Speed switch
- EA—Auxiliary speed relay
- H—Field and brake switch
- NS—Non-stop relay
- OS—Operating switch sequence relay
- PD—Down direction switch
- PR—Auxiliary direction relay
- PU—Up direction switch
- SM—Stopping magnet
- XC—Highest car call relay
- XH—Automatic return relay
- XSD—Highest down hall call relay
- XSU—Highest up hall call relay
- ZS—Zone switch

Throughout the description which follows, these letters will be applied to the coils of the above designated switches. Also, with reference numerals appended thereto, they will be applied to the contacts of these switches. Differentiation will be made between the different elevators by appending in Figures 2a and 2b to the characters employed to designate the various elements of the control system numbers indicative of the different elevators and arranged in brackets, as done above for cross wires 18.

The up hall buttons are designated U, while the down hall buttons are designated D. Numerals are appended to these letters indicating the floors for which the buttons are provided, the letter T being appended to the down hall button at the top floor instead of a number. The hall buttons are common to all of the elevators and act through floor relays designated first by the numeral corresponding to the floor for which the floor relay is provided and then by the letter U or D in accordance with whether the floor relay is for an up hall button or a down

hall button. The car buttons are designated C and, as in the case of the hall buttons, have numerals appended thereto as indicative of the floor for which the car buttons are provided. Each elevator has a car button for each floor above the lower terminal floor. Each elevator also has a non-stop button in the car, designated NSB. As in the case of the electromagnetic switches, differentiation is had between the car buttons and non-stop buttons for different elevators by appending to these characters numbers in brackets.

The circuits are shown in "straight" or "across the line" form, in which the coils and contacts of the various switches are separated in such manner as to render the circuits as simple and direct as possible. The relationship of these coils and contacts may be seen from Figures 2s and 3s, where the switches are arranged in alphabetical order and shown in spindle form. The positions of these coils and contacts in the wiring diagram may be found by referring to Figures 2s and 3s, where the coils and contacts are positioned on the spindles in horizontal alignment with the corresponding elements of the wiring diagram. The electromagnetic switches are illustrated in deenergized condition, direction switches PU and PD, which are of the latching type, being shown in reset condition.

Mechanism actuated in accordance with movement of the elevator car is utilized in the control circuits of each elevator. Such mechanism may be in the form of a floor controller or selector machine as indicated in Figure 1 and it will be assumed that the mechanism is of the construction shown in the aforementioned patent to Waters and Glaser No. 2,074,575. Details of this mechanism are not shown as such details are given in the Waters and Glaser patent, to which reference may be made.

Each selector machine is driven preferably by means of two steel tapes attached to the car. One tape extends from the top of the car to an overhead sheave. The other tape extends from the bottom of the car around a tension sheave and then up to a second overhead sheave. The tapes are wound on the overhead sheaves in a manner similar to the winding of a measuring tape, one being wound oppositely with respect to the other. The shaft upon which the overhead sheaves are mounted drives the selector machine through a chain and sprocket. One tape is unwound as the other is wound up in effecting the driving operation.

Each selector machine comprises a crosshead which is driven by a screw, which is in turn driven by the chain and sprocket, to move in accordance with movement of the car for which the machine is provided. The crosshead carries a carriage upon which is mounted mechanism for controlling circuits to cause the car to be slowed down and stopped at a floor. Mechanism is also mounted on the carriage for causing slow down to begin at a certain distance from the floor and for causing the car to be brought to a stop as it arrives at the floor. The carriage is advanced from a neutral position with respect to the crosshead in starting the car and is brought to a stop after a certain amount of movement. Thereafter the carriage moves with the crosshead. When circuits are set up to cause the car to be slowed down, the carriage is brought to a stop. The crosshead, which moves with the car, thereafter takes up

the advance of the carriage so that when the car comes to a stop, the carriage is again in neutral. This relative motion of the carriage and crosshead is utilized to control the slow down and stopping of the car.

The advance of the carriage is effected by means of a torque motor which will hereinafter be termed the advancer motor. The circuits of this motor appear in Figure 3 where the motor is designated AM. Energization of the advancer motor is controlled by contacts operated by the stopping magnet. The circuits of this magnet appear in Figures 2a and 3 where the magnet is designated SM. The magnet controls the extension and retraction of pawls carried by the carriage for cooperation with stopping lugs. A stopping lug is provided for each floor and is arranged on a floor bar, these floor bars being spaced in accordance with the distance between the floors for which the lugs are provided. The stopping magnet is energized in the starting operation to effect the retraction of the pawls and in doing so it engages contacts to effect the energization of the advancer motor. The advancer motor in advancing the carriage also effects the engagement of selector switches appearing in Figure 3 and designated SS1 and SS2. When a call is picked up the stopping magnet is deenergized to cause the deenergization of the advancer motor and to extend the pawls for cooperation with the stopping lug for the floor for which the call is registered. The pawl for the direction in which the car is travelling engages the stopping lug, bringing the carriage to a stop. The crosshead continues its upward movement and, due to the relative movement between the crosshead and the carriage, effects the opening of selector switches SS2 and SS1 in sequence to effect the slow down and stopping of the car.

The travelling brushes for each elevator illustrated in Figures 2a and 2b are carried by a panel on the carriage of the selector for that elevator. These brushes are arranged to cooperate with stationary contacts for the various floors arranged on the floor bars. When the car is stopped at a floor, the brushes are in engagement with their cooperating stationary contacts for that floor. Being on the advance panel, however, these brushes are advanced in starting the car, are latched in engagement with their contacts for a floor by the pawls when a call is picked up and are maintained in that condition as the advance is taken up as the car comes into the floor.

As in the case of the electromagnetic switches, differentiation between the corresponding elements of the selectors for the different elevators in Figures 2a and 2b is made by appending numbers in brackets to the characters employed for these elements. Also, legends "Car 1," "Car 2," "Car 3" and "Car 4" are applied to Figures 2a and 2b as a further aid in distinguishing between the mechanisms for the different elevators. Stationary contacts subject to the car buttons are designated 32, 33, 34, 35 and 36 for floors 2, 3, 4, 5 and 6 respectively, the stationary contacts 31 and 37 for the first and seventh floors being connected directly to the feed line. These contacts are engaged by brush 38. Instead of providing brushes and contacts for the call restoring circuits separate from those for the call pick up circuits, as is disclosed in the aforementioned Waters and Glaser patent, for convenience the same contacts and brushes are used for both cir-

cuits with a switching arrangement to insure the desired sequence of operation. It is to be understood, however, that the same arrangement as disclosed in the Waters and Glaser patent may be employed. The stationary contacts subject to the down hall buttons at the second, third, fourth, fifth, sixth and seventh floors and the stationary contact for the first floor in the call pick up and call restoring circuits are designated 41, 42, 43, 44, 45, 46 and 47 for the first, second, third, fourth, fifth, sixth and seventh floors respectively. These contacts are engaged by brush 48. The stationary contacts subject to the up hall buttons at the first, second, third, fourth, fifth and sixth floors and the stationary contact for the seventh floor in the call pick up and call restoring circuits are designated 51, 52, 53, 54, 55, 56 and 57 for the first, second, third, fourth, fifth, sixth and seventh floors respectively. These contacts are engaged by brush 58. Stationary contacts 62, 63, 64, 65 and 66 for the second, third, fourth, fifth and sixth floors respectively are arranged in the highest up hall call circuits to be engaged by brush 68. Also, stationary contacts 72, 73, 74, 75 and 76 are arranged in the highest down hall call circuits to be engaged by brush 78.

As shown in Figure 2a, each selector has a plurality of hook switches 82, 83, 84, 85 and 86, one for each of floors 2, 3, 4, 5 and 6, arranged on the floor bars for these floors to be engaged by a travelling cam 88 of insulating material also carried by the advancer panel. This cam is of a length to engage and open the hook switch for any particular floor slightly ahead of the engagement of the call pick up brushes with the stationary contacts for that floor when the car is travelling in the up direction and to engage and open the hook switch for the floor below such floor slightly ahead of the engagement of the call pick up brushes with the stationary contacts for such floor when the car is travelling in the down direction. Also, the brushes 68 and 78 in the highest hall call circuits are of a length to engage their stationary contacts slightly ahead of the engagement of the call pick up brushes with their contacts for the corresponding floors when the car is travelling in the up direction. The travelling crosshead of each elevator also carries an additional brush 90 (see Figure 3) on a panel separate from the advancer panel for engaging stationary contacts 91 and 92 for the terminal floors. This has to do with controlling the operation of direction switches PU and PD. An additional hook switch 122 (see Figure 3) is provided on the selector machine. This switch may be arranged to be operated by cam 88(1) so as to be open when the car is at the first floor and closed when it leaves the first floor. For convenience, however, a separate cam 123 (arranged on the advancer panel) is illustrated for operating this switch.

Any suitable form of power supply may be provided for the elevator motor. One of the preferred arrangements is to employ a direct current elevator motor and to cause current to be supplied to the motor at a variable voltage, as from a driven generator in accordance with Ward-Leonard principles. The generator of such arrangement has been illustrated. The driving motor for the motor generator set and control arrangement therefor have not been illustrated. It is to be understood that either a direct current or alternating current driving motor may be employed, depending upon the kind of power

supplied to the building and the character of the installation, and that any suitable control arrangement therefor may be utilized, such, for example, as one embodying the principles of the arrangement disclosed in the patent to Lindquist, Waters and Glaser No. 1,997,260, granted April 9, 1935.

When the generator is driven by an alternating current driving motor, an exciter which may be driven by the driving motor is employed to supply current to the separately excited field windings of the supply generator and the elevator motor and to the brake and the coils of the various electromagnetic switches of Figure 3. In such arrangement, the supply lines of Figure 3 would be connected to the exciter. Also, the call pick-up and call restoring circuits and highest call circuits for each elevator would be connected to the respective exciters. The hall button circuits through the operating coils of the floor relays, however, would be connected to the source of supply for the building so as to permit the operation of the floor relays at any time. In case of direct current power supply, the supply lines of Figures 2a, 2b and 3 would be connected to the power supply lines. For convenience, it will be assumed that direct current is supplied to the building.

The armature of the generator is designated 95, the separately excited field winding being designated 96 and its series field winding 97. The armature of the elevator motor is designated 98 and its separately excited field winding 100. A resistance 101 is provided for controlling the strength of the generator separately excited field and therefore the voltage applied to the elevator motor armature. 102 is a discharge resistance for the brake release coil BR, while resistance 103 serves as a cooling resistance for this coil.

The contacts operated by the car gate and engaged when the gate is closed are designated G. The door contacts operated by the various doors are arranged in series relation. These contacts are not closed until the doors are closed and locked. For convenience these door contacts are shown as a single pair of contacts designated DL. The car gate and hatchway doors for each elevator have not been shown but it is to be understood that they may be power operated, for example as disclosed in the aforementioned patent to Waters and Glaser, No. 2,074,575. The start control switch in the car has a plurality of contacts designated 105, 106 and 107. 110 is the safety switch in the car. 113, 120, 121 and 124 are service switches. It will be assumed that the service switches are in the positions illustrated.

The operation of the control system illustrated will now be described. It will be assumed that elevators Nos. 1 and 2 serve floors 5, 6 and 7 for outgoing traffic, whereas elevators Nos. 3 and 4 serve floors 2, 3 and 4 for outgoing traffic. The system is illustrated for the condition where all cars are standing at the first floor. To facilitate understanding of the system, the starting and stopping of car No. 1 will first be described. Assume now that the power is applied to the system. This completes a circuit for the coil of elevator No. 1 highest car call relay XC(1), this circuit being from line + through contacts XSD1(1) and by way of wire 112(1) through service switch 121(1) and hook switches 85(1) and 86(1), in parallel with contacts XSD1(1), to line -. It also completes the cir-

cuit for the coil of elevator No. 1 non-stop relay NS(1) through elevator No. 1 non-stop button NSB(1). Relay XC upon operation separates contacts XC1(1) and XC2. Contacts C1(1) are in the circuit for brush 68(1) in the highest up hall call circuits, disconnecting this brush from line -. Contacts XC2 are in the circuit for the coil of automatic return relay XH. Relay NS upon operation engages contacts NS1(1) and separates contacts NS2. Contacts NS1(1) control the circuits for the brushes 48(1) and 58(1) in elevator No. 1 call pick-up and call restoring circuits. The separation of contacts NS2 removes the by-pass for contacts XSD2, XSU1, ASM3 and EA2 in the circuit for the coil of automatic return relay XH. The application of power to the system also energizes elevator motor field winding 100.

When car No. 1 last arrived at the first floor, brush 90 engaged stationary contact 92 and, upon the engagement of contacts H1 in the stopping operation, a circuit was established for the reset coil of down direction switch PD and for the operating coil of up direction switch PU. This caused the down direction switch to be reset, the condition in which it is shown in the drawings, and the operation of switch PU and latching of this switch in operated condition. The operation of switch PU caused the engagement of contacts PU1(1), PU2(1), PU3, PU4, PU5, PU7, PU8, PU9, PU10 and PU11 and the separation of contacts PU6. Contacts PU1(1) are in the circuit to brush 68(1), this circuit being broken by the separation of contacts XC1(1) as above described. Contacts PU2(1) connect brush 78(1) to line - through the coil of highest down hall call relay XSD(1). Contacts PU3 are in the circuit for the coil of automatic return relay XH, the establishment of this circuit being prevented by hook switch 122 being open. Contacts PU4 are in the circuit for lamp 135 in the elevator car and the coil of auxiliary direction relay PR. Thus, upon the application of power to the feed lines, the lamp in car No. 1 is illuminated and the auxiliary direction switch PR is operated. Contacts PU5 are in the circuit for car button magnet CBM so that this magnet is energized upon the connection of the feed lines with the source of current supply. Contacts PU6 disconnect the operating coil of up direction switch PU and the reset coil of down direction switch PD from the feed lines. Contacts PU7 connect field winding AM125 and armature AM126 of the advancer motor in parallel. Contacts PU8 control the circuit for the coil of brake and field switch H and contacts PU9 control of the circuit for the coil of speed switch E. Contacts PU10 and PU11 prepare the circuit for the generator separately excited field winding 96 for upward travel of the elevator car.

Auxiliary direction relay PR upon operation separates contacts PR1(1) and engages contacts PR2(1). The separation of contacts PR1(1) renders down hall call brush 48(1) ineffective for up car travel, while the engagement of contacts PR2(1) renders the up hall call brush 58(1) effective for up car travel.

To start the car, the start control switch for car No. 1 is thrown to full running position. This causes the bridging of contacts 105, 106 and 107, contacts 106 being bridged ahead of contacts 105 and 107. The bridging of contacts 106 completes circuits (not shown) causing the closing of the car gate and first floor hatchway door. It also completes a circuit for the operating coil of stop-

ping magnet SM through contacts OS1 and EA4. The stopping magnet upon operation engages contacts SM1(1), SM2 and SM3. Contacts SM1(1) are in the circuit for the neutralizing coil SM(1) of the stopping magnet. Contacts SM3 complete a holding circuit for the operating coil of the stopping magnet. Contacts SM2 complete a circuit for the coil of auxiliary stopping switch ASM and for one coil of auxiliary speed relay EA. Relay EA does not operate at this time. Switch ASM operates to separate contacts ASM2(1) and to engage contacts ASM1(1), ASM3 and ASM4. Contacts ASM2 are in a by-pass circuit for the neutralizing coil SM(1) of the stopping magnet. Contacts ASM3 are in the circuit for the coil of automatic return relay XH. Contacts ASM1(1) are in the circuit from brush 38(1) to coil SM(1). Contacts ASM4 prepare the circuit for the advancer motor AM, which is completed by the bridging of start control switch contacts 105, this circuit being through field winding AM127 and through field winding AM125 and armature AM126 in parallel. This results in the operation of the advancer motor to advance the carriage in the up direction. The advancer motor also effects the engagement of selector switches SS1 and SS2, preparing the circuits for the coils of field and brake switch H and speed switch E and completing the circuit for a second coil of auxiliary speed relay EA.

The energization of both coils of relay EA causes this relay to operate to engage contacts EA1(1) and EA2 and to separate contacts EA3 and EA4. Contacts EA1(1) are in the circuit for the neutralizing coil of relay SM(1) of the stopping magnet, the advance having progressed sufficiently by this time for the brushes to be off the stationary contacts for the floor at which the car is positioned. Contacts EA2 further prepare the circuit for the coil of automatic return relay XH. The separation of contacts EA3 prevents energization of the direction switches once the advancer mechanism has been energized to advance the carriage. Contacts EA4 prevent reoperation of the stopping magnet once a call has been picked up after the car has come to a stop at the floor for which the call is registered. This is especially useful in cases where the advancer mechanism advances the brushes into engagement with their stationary contacts for the floor beyond before starting of the car takes place, as, for example, in the system of the Waters and Glaser patent previously referred to.

The advance takes place fairly rapidly so that, upon the closure of the hatchway door and car gate, a circuit is established for the coil of field and brake switch H through contacts SS1, PU8, up limit switch 108, gate contacts G, door contacts DL, start control switch contacts 107 and safety switch 110.

Switch H upon operation engages contacts H2, H3, H4, H5, H6, H7, H8 and H9 and separates contacts H1 and H10. The separation of contacts H1 prevents operation of the direction switches during operation of the car. Contacts H2 by-pass start control switch contacts 105 in the advancer motor circuit. Contacts H3 complete the circuit for the coil of operating switch sequence relay OS. The operation of operating switch sequence relay OS causes the engagement of contacts OS2 and separates contacts OS1. The purpose of contacts OS1 will be explained later. The engagement of contacts OS2 completes a holding circuit for the coil of auxiliary

stopping relay ASM. Contacts H4 by-pass start control switch contacts 107, establishing a self-holding circuit for the coil of switch H. Thus with its contacts all by-passed, the start control switch may be returned to off position. Contacts H5 further prepare the circuit for the coil of speed switch E. Contacts H6 and H7 complete the circuit for brake release coil BR, while contacts H8 and H9 complete the circuit for the generator field winding 96. Contacts H10 disconnect the generator field winding from across the generator armature. The completion of the circuit for the generator separately excited field winding causes current to be supplied from the generator armature 95 to the hoisting motor armature 98 and, the brake being released as a result of the energization of its release coil BR, the elevator motor starts the car in the up direction.

The brake, upon being released, effects the separation of contacts BR1, which act to remove the short circuit for the coil of brake resistance relay BK. This relay operates to separate its contacts BK2 to insert cooling resistance 103 in circuit with brake release coil BR. It also engages contacts BK1, which completes the circuit for the coil of speed switch E through contacts H5, SS2, PU9, up limit switch 111 and safety switch 110. Switch E upon operation engages contacts E1 to short-circuit a portion of resistance 101 in the circuit of the generator field winding 96. This applies full voltage to the generator separately excited field winding, causing the generator voltage to build up to full value to bring the elevator car up to full speed.

It will be assumed for the present that no push buttons have been pressed. Service switches 121 and 113 are closed under the conditions where cars 3 and 4 serve only outgoing calls from floors in the lower zone, i. e., floors 2, 3 and 4. Switches 113(3) and 113(4) connect the coils of zone switches ZS(3) and ZS(4) for elevators Nos. 3 and 4 respectively to the feed lines. This causes contacts ZS2(3) and ZS2(4) to be in engagement and contacts ZS1(3), ZS1(4), ZS3(3) and ZS3(4) to be in separated condition. As brush 78(1) of elevator No. 1 moves upwardly and engages stationary contacts 72(1), 73(1) and 74(1) for the second, third and fourth floors, highest down hall call relay XSD is energized as each successive engagement occurs. The circuit completed by the engagement of the brush with contact 72(1), for example, is through service switch 120, contacts ZS2(3) and ZS2(4) in parallel and contacts 4D2 and 3D2 of the down fourth and third floor relays. Relay XSD upon operation separates contacts XSD1(1) and engages contacts XSD2. Contacts XSD2 are in the circuit for the coil of automatic return relay XH, this circuit being open, however, at contacts XC2. Contacts XSD1(1) are in the circuit for the coil of relay XC(1), this coil being maintained energized, however, from line + by wire 112(1), switch 121(1) and hook switches 85(1) and 86(1) for the fifth and sixth floors.

Upon the engagement of brush 78(1) with fifth floor stationary contact 75(1) to reestablish the circuit for the coil of relay XSD(1), in this case through contacts 7D2 and 6D2, cam 88(1) engages and opens fifth floor hook switch 85(1) which, together with the separation of contacts XSD1(1), breaks the circuit for the coil of highest car call relay XC(1). This relay, upon dropping out, reengages contacts XC1(1) and XC2. The engagement of contacts XC1(1) completes 75

a circuit for the coil of highest up hall call relay XSU(1) through contacts 6U2 and 5U2 of the sixth and fifth floor up floor relays, stationary contacts 55(1) and brush 68(1). Relay XSU(1) upon operation engages contacts XSU1 which, together with the engagement of contacts XC2 and XSD2, completes a circuit for the coil of automatic return relay XH.

Automatic return relay XH upon operation engages contacts XH1(1), XH2 and XH4 and separates contacts XH3. The engagement of contacts XH2 establishes a holding circuit for the coil of relay XH by-passing contacts XC2, XSD2, XSU1, ASM3 and EA2. Contacts XH4 prepare a circuit for the operating coil of down direction switch PD and the reset coil of up direction switch PU. Contacts XH3 break the circuit for the coil of auxiliary direction relay PR, causing this relay to drop out. Relay PR separates contacts PR2(1) and reengages contacts PR1(1), rendering brush 48(1) effective and brush 58(1) ineffective. The engagement of contacts XH1(1) completes a circuit through contacts EA1(1) and SM1(1) for the neutralizing coil SM(1) of the stopping magnet. This coil acts to oppose the operating coil of magnet SM, releasing the pawls and causing the separation of contacts SM1(1), SM2 and SM3. Contacts SM1(1) and SM3 break the energizing circuits for the coils of the stopping magnet, while contacts SM2 break the circuit for the coil of the auxiliary stopping switch ASM and one coil of auxiliary speed relay EA. The auxiliary stopping switch separates contacts ASM1(1), ASM3 and ASM4 and reengages contacts ASM2(1). Contacts ASM1(1) disconnect brush 38(1) from line —. Contacts ASM2 short-circuit neutralizing coil SM(1) of the stopping magnet. Contacts ASM3 are by-passed by contacts XH2 in the circuit for the coil of automatic return relay XH. Contacts ASM4 deenergize the advancer motor AM. Relay EA does not drop out on deenergization of its coil in series with the coil of switch ASM, being held in operated condition by its coil in parallel with the coil of speed switch E.

As the car continues its upward travel, the up pawl engages the fifth floor stopping collar, causing the opening of selector switches SS2 and SS1 in sequence. The opening of switch SS2 breaks the circuit for the coil of speed switch E, which drops out, separating contacts E1 to reinsert resistance 101 in the circuit of the generator field winding. This decreases the voltage of the generator, causing the car to slow down. The opening of switch SS2 also breaks the circuit for the other coil of relay EA, which drops out to separate contacts EA1(1) and EA2 and to reengage contacts EA3 and EA4. Contacts EA1(1) are in the circuit for the neutralizing coil of the stopping magnet already broken at contacts SM1(1). Contacts EA2 are by-passed by contacts XH2. Contacts EA3 further prepare the circuit for the operating coil of down direction switch PD and the reset coil of up direction switch PU. Contacts EA4 are in the initial energizing circuit of the operating coil of stopping magnet SM, this circuit being open at contacts SM1(1).

The opening of switch SS1, which occurs as the car arrives at the landing, breaks the circuit for the coil of field and brake switch H. Switch H, upon dropping out, separates contacts H2, H3, H4, H5, H6, H7, H8 and H9 and reengages contacts H1 and H10. Contacts H2 are in the circuit for the advancer motor AM, which was previously deenergized. Contacts H3, H4 and H5

are in the circuits for the operating coils of magnet SM and switches H and E, which circuits have already been broken. The separation of contacts H6 and H7 deenergizes brake release coil BR and the separation of contacts H8 and H9 disconnects the generator separately excited field winding 96 from the feed lines. Thus the external excitation of the generator is discontinued and the brake is applied to bring the car to a stop at the fifth floor landing. The engagement of contacts H10 reconnects the separately excited field winding across the generator armature substantially to destroy the residual flux of the generator field.

The separation of contacts H6 and H7 also breaks the circuit for the coil of brake resistance relay BK which drops out to separate contacts BK1 and reengage contacts BK2. Contacts BK1 are in the circuit for the coil of speed switch E, which circuit has already been broken. Contacts BK2 short-circuit cooling resistance 103 for the brake release coil in preparation for the next starting operation. The separation of contacts H3 also breaks the circuit for the coil of operating switch sequence relay OS, provided the start control switch has been returned to neutral position. However, if the start control switch is held in position where contacts 106 are bridged, switch OS remains energized upon the separation of contacts H3 so that contacts OS1 remain separated to prevent the reoperation of stopping switch SM. This prevents a restarting operation unless the start control switch is returned to neutral.

The reengagement of contacts H1 completes a circuit through contacts PD6, XH4 and EA3 for the operating coil of the down direction switch PD and reset coil of the up direction switch PU. This causes the reset of the up direction switch to separate contacts PU1(1), PU2(1), PU3, PU4, PU5, PU7, PU8, PU9, PU10 and PU11 and the reengagement of contacts PU6. It also causes the operation and latching of the down direction switch to engage contacts PD5, PD7, PD8, PD9, PD10 and PD11 and to separate contacts PD6. The separation of contacts PU10 and PU11 and the engagement of contacts PD10 and PD11 prepares the circuit for the generator field winding for downward car travel. The separation of contacts PU1(1) and PU2(1) renders brushes 68(1) and 78(1) ineffective for downward travel. The separation of contacts PU3 deenergizes the coil of automatic return relay XH and prevents operation of this relay during downward car travel. The engagement of contacts PU6 prepares the circuit for automatic reoperation of the direction switches to restore the circuits for upward car travel when the car reaches the lower terminal floor. The separation of contacts PU5 and the engagement of contacts PD5 causes the deenergization and reenergization of the car button magnet CBM. The separation of contacts PU7 and engagement of contacts PD7 connect the advancer motor circuits for advancing the carriage in the down direction. The separation of contacts PU8 and the engagement of contacts PD8 transfer the circuit for the coil of switch H so as to be subject to lower terminal limit switch 116 while the separation of contacts PU9 and the engagement of contacts PD9 transfer the circuit for the coils of speed switch E and relay EA so as to be subject to lower terminal limit switch 117. These parallel circuits are provided to insure the deenergization of these switches at the terminal landings while permitting their reenergization

for operation in the opposite direction. The separation of contacts PU4 deenergizes the lamp 135 in the elevator car.

Thus, with the car set for downward travel at the fifth floor, upon operation of the start control switch to start the car, it is started in the down direction. It is believed that this operation will be understood from the description given of starting the car in the up direction.

If, during the upward trip of the car previously described, there were any up hall buttons or car buttons pressed for floors above the effective position of the car, the car would be caused to stop at the floors for which the push buttons are provided. Assume, for example, that two passengers entered the car at the first floor, one desiring to be carried to the third floor and the other to the sixth floor. Upon the passengers having announced their destinations, the car attendant presses car buttons C3(1) and C6(1) for the third and sixth floors, these buttons when released being held in operated condition by the car button magnet CBM. Upon the engagement of brush 38(1) with stationary contact 33(1), a circuit is completed for neutralizing coil SM(1) of the stopping magnet. This causes the car to be slowed down and brought to a stop at the third floor in the manner previously described. However, as the highest car call relay XC is maintained energized during this operation, automatic return relay XH is not operated so that the car remains set for upward travel. Thus, upon reoperation of the start control switch after the passenger transfer at the third floor has been effected, the door and gate close and the car starts in the up direction. Highest down hall call relay XSD(1) operates as before as brush 78(1) engages its contacts for floors 2, 3, 4 and 5. However, automatic return relay XH is not operated as brush 78(1) engages the fifth floor contact, owing to the fact that the highest car call relay XC(1) is maintained operated through the sixth floor car button C6(1) at the time contacts XSD(1) separate. Upon the engagement of brush 78(1) with sixth floor stationary contact 76(1) to effect separation of contacts XSD(1), the sixth floor hook switch 86(1) is opened by cam 88(1) so that relay XC(1) is deenergized, causing the operation of automatic return relay XH. This relay engages contacts XH1(1) to complete the circuit for neutralizing coil SM(1) and thus effect the reset of stopping magnet SM, this circuit also being completed by the engagement of brush 38(1) with stationary contact 36. The reset of the stopping magnet causes the car to be slowed down and brought to a stop at the sixth floor. Contacts XH4 being in engagement under the assumed conditions, the car is set for the opposite direction of car travel upon the reengagement of contacts H1. The separation of contacts PU5 and engagement of contacts PD5 incident to setting the car for downward travel causes the momentary deenergization of car button magnet CBM to release operated car buttons C3(1) and C6(1).

Similar operation is had in case an up hall button is pressed. Assume, for example, that the up hall button U2 at the second floor is pressed before brush 58(1) engages contact 52(1). When such engagement takes place, a circuit is completed from line + through restoring coil 2U and contacts 2U1 of the up second floor relay, second floor stationary contact 52(1), brush 58(1), contacts PR2(1) and by way of cross wire 18(1) through contacts NS1(1), EA1(1) and

SM1(1) and coil SM(1) to line -. This causes the resetting of the stopping switch SM, causing the car to be slowed down and brought to a stop at the second floor. The reengagement of contacts ASM2(1) upon the dropping out of switch ASM short-circuits coil SM(1), increasing the current supplied to the restoring coil 2U of the up second floor relay, causing this relay to be reset. As relay XC is maintained operated under the assumed conditions, the car remains set for upward travel. The car, upon being restarted in the up direction, continues at least to the fifth floor or farther in case the passenger taken on at the second floor desires to be carried to a floor above the fifth floor.

If the car is traveling in the up direction and the only button pressed is the up hall button U5 at the fifth floor, automatic return relay XH is not operated as the car arrives at the fifth floor. The fifth floor relay when in operated condition maintains contacts 5U2 separated in the highest up hall call circuit, thereby preventing the operation of highest up hall call relay XSU upon the engagement of brush 68(1) with contact 65(1) and the engagement of contacts XC1(1) as a result of the operation of relay XSD as the car approaches the fifth floor. As previously explained, the floor relay is not reset until after the reset of the stopping magnet SM as the up hall call at the fifth floor is picked up, due to the fact that the current supplied to the restoring coil of relay 5U is not sufficient to reset the relay until after the engagement of contacts ASM2(1). Therefore contacts ASM3 in the circuit for the coil of automatic return relay XH separate before contacts 5U2 reengage, thereby preventing the completion of the circuit for the coil of relay XH upon the operation of highest up hall call relay XSU to engage contacts XSU1 as a result of the reengagement of contacts 5U2. Thus the car is maintained set for upward travel so that the passenger taken on at the fifth floor may be taken to his destination before automatic reversal of the direction of car travel is effected.

If the car is travelling in the up direction and the only button pressed is the down hall button D6 at the sixth floor, automatic return relay XH is not operated as the car approaches the fifth floor owing to the fact that the separation of contacts 6D2 in the highest down call circuit prevents the operation of the highest down call relay XSD(1) upon engagement of brush 78(1) with the fifth floor stationary contact 75(1). As the car approaches the sixth floor, the engagement of brush 78(1) with sixth floor stationary contact 76(1) completes the circuit for the coil of relay XSD(1). This relay operates as previously described to cause the deenergization of highest car call relay XC(1) and thus the operation of highest up hall call relay XSU(1), thereby effecting the energization of the coil of automatic return relay XH to cause the car to be set for downward travel as it arrives at the sixth floor. The automatic return relay upon operation engages contacts XH1(1), causing the stopping magnet SM to be reset, thereby causing the car to be slowed down and brought to a stop at the sixth floor. It also separates contacts XH3 to deenergize auxiliary direction relay PR. Relay PR separates contacts PR2(1), rendering brush 58(1) ineffective. It also engages contacts PR1(1), rendering brush 48(1) effective. This completes a circuit through sixth floor stationary contact 46(1) for the restoring coil of the down sixth floor relay 6D, causing this relay to be reset.

If the down sixth floor relay and the up sixth floor relay are both operated, the separation of contacts 6U2 in the highest up hall call circuits prevents the operation of highest up hall call relay XSU(1) and thus prevents the operation of automatic return relay XH to set the car for downward travel upon its being brought to a stop at the sixth floor. Furthermore, as relay XH is not operated, contacts XH3 remain separated, preventing the reset of the down floor relay for the sixth floor by the engagement of brush 48(1) with contact 46(1).

Once the car set for upward travel has set up circuits to cause the direction of car travel to be changed to down upon the car being brought to a stop at a floor, that is, once the circuit for the coil of its automatic return relay XH has been completed, the registration of a call for a floor above that floor or of an up hall call for that floor after the establishment of this circuit is ineffective to prevent operation of the direction controlling switches to set the car for downward travel as it comes to a stop. This is due to the fact that contacts XC2, XSD2 and XSU are all by-passed by the holding contacts XH2 of the automatic return relay. Any such call registered by a hall button remains operated under such conditions so that this call is ultimately responded to. This will be understood from later description.

It is believed that it will be seen from the above description that car No. 1, once started in the up direction, continues to travel in the up direction at least until a certain floor (the fifth floor in the arrangement illustrated) is reached, stopping at that floor if no call is registered for any floor above and continuing past that floor without stopping if neither a car call nor an up hall call is registered for that floor and a call is registered for a floor above. In the latter event, the car continues to travel in the up direction until it reaches the floor for which the highest call, either car call or down hall call or both, is registered, before reversal becomes effective. In case the highest call is an up hall call, the car remains set for upward travel in order that the intending passenger may be taken in the indicated direction. During its travel in the up direction, stops are made in response to calls registered by car buttons for floors intervening the lower terminal and its ultimate destination, and also in response to up hall calls for such intervening floors. The stops are made in the order of succession of floors, regardless of the order in which the calls are registered. Stops are not made at intervening floors in response to down hall buttons because the automatic return relay XH is not operated under such conditions.

During downward travel of the car, stops are made in response to all car calls and down hall calls that are registered. Up hall calls, however, are answered only by an up travelling car. It is believed that the stops in response to car buttons will be understood from the previous description inasmuch as when a car button is pressed it is maintained operated by the car button magnet CBM so that, upon the engagement of brush 38(1) with the contact rendered alive by this button, the call is picked up and the car is caused to slow down and come to a stop at the floor. Similarly, each down hall button that is pressed operates a down floor relay that remains operated until the contact rendered "alive" thereby is engaged by brush 48(1) to pick up the call. This causes the stopping magnet to drop out, the floor

relay to be reset and the car to be slowed down and brought to a stop at the floor at which the button is located. The stops are made in the order of succession of floors regardless of the order in which the calls are registered. When the car becomes filled to capacity the non-stop button NSB(1) is pressed, deenergizing the non-stop relay NS(1). This relay drops out to separate its contacts NS1(1), rendering brush 48(1) ineffective to pick up further down calls during the remainder of its trip to the lower terminal. Car buttons, however, are responded to unaffected by the non-stop button, so that stops may be made to discharge passengers.

The operation of elevator No. 2 is the same as that of elevator No. 1, previously described. If both cars are set for travel in the up direction, both will travel at least to the fifth floor before reversing. Each car will continue beyond the fifth floor if a car button is pressed in that car for a floor above, an up hall call is registered for the fifth floor or a hall call is registered for a floor above. With both cars set for upward travel, each up hall call is answered by the car whose brush 58 is the first to engage its stationary contact for the floor for which the call is registered. The highest down call for a floor above the fifth floor is answered by the first car whose brush 78 engages its stationary contact for that floor. If only one hall call remains to be responded to for a floor above the fifth floor, upon its being picked up by one of the cars, the other car, if it is in effect below the fifth floor, is caused to travel at least to the fifth floor and to stop thereat and become set for downward travel if no car button in that car is pressed for a floor above. If such other car is in effect above the fifth floor at the time the hall call is picked up, the car is automatically caused to slow down and stop at the floor the stationary contact for which is next to be engaged by brush 78 for that car after the reset of the floor relay, or if in engagement with a contact at that time at the floor for which the contact is provided. For example, assume that both cars are set for travel in the up direction and that the only call registered is a hall call at the seventh floor. Upon the engagement of brush 58 for one of the cars, say car No. 1, with its contact 57(1) for the top floor, the stopping magnet for that car is deenergized, which causes the reset of the seventh floor relay in the manner previously described, the circuit being through brush 58(1). Assume that the next stationary contact engaged by brush 78(2) for car No. 2 after the reset of the seventh floor relay is the sixth floor contact 76(2). As this engagement takes place, relay XSD(2) is operated, causing the operation of relay XH for car No. 2 and the car to be slowed down and brought to a stop at the sixth floor and set for travel in the down direction. If the hall call registered had been an up call at the sixth floor and this call had been picked up by car No. 1, car No. 2 would be caused to slow down and stop at the fifth floor in response to the engagement of brush 78(2) with contact 75(2). This is due to the fact that the reset of the up sixth floor relay to reengage contacts 6U2 permits the operation of highest up hall call relay XSU(2) in response to the reengagement of contacts XC1(2) as a result of the operation of relay XSD(2). Thus relay XH for car No. 2 is operated, causing the car to be slowed down and brought to a stop at the fifth floor, and set for travel in the down direction. If more than one hall call remains to be

responded to for a floor above the fifth floor and the farthest one of these calls is picked up by one of the cars, the other car is caused to continue to travel in the up direction to answer this call at an intervening floor.

As for elevators Nos. 3 and 4, due to the fact that relays ZS for these cars are operated under the assumed conditions, their cars do not serve floors above the fourth floor. Taking car No. 3, for example, owing to the fact that contacts ZS1(3) are separated, car buttons for floors above the fourth floor and service switch 121(3) are rendered ineffective. Thus highest car call relay XC(3) is not energized through the hook switches for the second, third and fourth floors unless the car button for one of these floors is operated. Highest down hall call relay XSD(3) is not subject to down floor relays for floors above the fourth floor owing to the fact that contacts ZS3(3) are separated. The car cannot respond to up hall calls owing to the fact that contacts ZS4(3) and PR3(3) are separated, deenergizing coil NS(3) of elevator No. 3 non-stop relay. Thus contacts NS1(3) are separated, rendering brush 58(3) ineffective when the car is set for upward travel, this brush being ineffective when the car is set for downward travel due to the fact that contacts PR2(3) are separated. Also, contacts NS2 for elevator No. 3 are engaged, by-passing contacts XSD2, XSU1, ASM3 and EA2 for elevator No. 3, so that the circuit for the coil of the automatic return relay for elevator No. 3 is completed upon engagement of contacts XC2 for elevator No. 3.

If the starting of car No. 3 in the up direction is initiated under conditions where no car calls for that car for the second, third or fourth floors and no down hall calls for the second, third or fourth floors are registered upon the engagement of brush 78(3) with contacts 72(3) highest down hall call relay XSD(3) for car No. 3 is operated, causing the deenergization of highest car call relay XC(3). This completes a circuit for automatic return relay XH for car No. 3, causing the car to be slowed down and brought to a stop at the second floor and set for travel in the down direction. However, if a down hall call had been registered for say the third floor, relay XSD(3) is not operated upon the engagement of contacts 78(3) with contacts 72(3), the completion of this circuit being delayed until the brush engages contacts 73(3), whereupon relay XC(3) is deenergized as before, causing the operation of automatic return relay for elevator No. 3 to cause the car to be slowed down and brought to a stop at the third floor, and set for travel in the down direction. If a down hall button had been registered for the fourth floor as well as the third floor, the energization of relay XSD(3) is delayed until the engagement of brush 78(3) with contacts 74(3) and the car passes the third floor without stopping. The car is slowed down and brought to a stop at the fourth floor in response to the engagement of brush 78(3) with contacts 74(3) and set for travel in the down direction. If the only down hall call registered is a down call at the second floor, relay XSD(3) is energized upon engagement of brush 78(3) with contacts 72(3). In each case the down floor relay is reset in response to the deenergization of auxiliary direction relay PR(3) for elevator No. 3 as a result of the operation of automatic return relay XH for elevator No. 3. Upon being deenergized, relay PR(3) engages contacts PR1(3) in the circuit for brush 48(3) and engages contacts PR3(3) to ef-

fect the energization of relay NS(3) which engages contacts NS1(3), completing the reset circuit.

If a second, third or fourth floor car button in elevator No. 3 had been pressed it would maintain relay XC(3) operated until the corresponding hook switch is engaged and opened by cam 88(3), thus preventing the car being set for the opposite direction of car travel at a lower floor. In other words, if the fourth floor car button, for example, had been pressed, relay XC(3) is not deenergized until the engagement of hook switch 84(3) by cam 88(3). However, if the second and third floor car buttons also were pressed, the car stops at the second and third floors as well as the fourth floor in response to the car buttons for these floors, the calls being picked up by the engagement of brush 38(3) with the contacts 32(3) and 33(3) respectively.

It will be seen from the above description that car No. 3, when started in the up direction, continues to travel in the up direction until it reaches the highest floor in its zone for which a down hall call is registered or a car call for that car is registered. During its travel in the up direction, stops are made in response to car buttons pressed for floors intervening the lower terminal and its ultimate destination. Stops are made in the order of succession of floors regardless of the order in which the calls are registered. No stops are made in response to up hall calls, these calls being answered by car No. 1 or car No. 2. If, upon the starting of car No. 3 in the up direction being initiated, no car calls or down hall calls are registered before the engagement of brush 78(3) with contact 72(3) and the opening of hook switch 82(3), the car is automatically caused to slow down and stop at the second floor and becomes set for travel in the down direction upon the stop being made.

During downward travel of the car, stops are made in response to all car calls and all down hall calls that are registered. As in the case of elevators Nos. 1 and 2, when a car button in car No. 3 is operated it is maintained energized by the car button magnet so that upon the engagement of brush 38(3) with the contact rendered "alive" by this button, the call is picked up and the car is caused to slow down and come to a stop at the floor. Also, when brush 48(3) engages a contact rendered "alive" by an operated down floor relay, the call is picked up and the car is caused to slow down and come to a stop at the floor for which the contact is provided. The stops are made in the order of succession of floors regardless of the order in which the calls are registered.

The operation of elevator No. 4 is the same as that of elevator No. 3, previously described. If both of these cars are set for travel in the up direction, a down hall button is pressed for a floor in the lower zone and no car or down hall buttons for floors in the lower zone above that floor are pressed, this call is answered by the car whose brush 78 is the first to engage a stationary contact for the floor for which the call is registered. The other car, if no car buttons in that car or down hall buttons for intervening floors are pressed, is automatically caused to slow down and stop at the floor the stationary contact for which is first to be engaged by brush 78 for that car after the reset of the floor relay. However, if a down hall call, for example, is registered for an intervening floor, this other car is caused to con-

tinue its travel in the up direction and come to a stop at the floor for which the call is registered.

Both cars Nos. 3 and 4 answer down hall calls for floors below when set for downward travel, the car which answers each call being the one whose brush 48 first engages the stationary contact for the floor for which the call is registered. Inasmuch as the circuit arrangements enable cars Nos. 1 and 2 to answer down calls at all floors when these cars are set for downward travel, these cars may assist cars Nos. 3 and 4 in answering down calls in the lower zone. However, when cars Nos. 1 and 2 become filled, the attendants may prevent their picking up further down calls in their downward travel by pressing the non-stop buttons NSB in the respective cars. The pressing of this button in car No. 1, for example, causes the deenergization of the non-stop relay NS(1) which, upon dropping out, separates its contacts NS1(1) to render brush 48(1) ineffective. So long as the non-stop button in car No. 1 is held depressed, this car is unable to pick up any down hall calls in its downward travel. The down floor relays are not reset so that these calls are picked up by the next car set for travel in the down direction whose "alive" brush 48 engages the stationary contacts for the floors for which the calls are registered. Cars Nos. 3 and 4 may be similarly non-stopped by their attendants pressing the non-stop buttons NSB in the respective cars.

Elevator systems operating in the manner above described are especially suitable for such buildings as office buildings, where there is a large amount of outgoing traffic concentrated at a certain time in the evening. In such buildings, the quitting time is the same for most employees, which creates a sudden maximum demand for elevators to depopulate the building. Inasmuch as there is very little or no inter-floor traffic at such time, each elevator car runs express from the lower terminal to the highest down call in its zone, where it is brought to a stop and set for travel in the down direction. The car then proceeds to pick up down calls on its downward trip until filled to its maximum capacity. The car is then expressed (by pushing the non-stop button) to the lower terminal, where the passengers are discharged, whereupon it is immediately started on its upward trip for more passengers. Inasmuch as the elevators are assigned to definite zones, equal service to each portion of the building is assured. Furthermore, owing to the fact that the cars serving the upper zone may, if not loaded to capacity, make stops in response to down hall calls in the lower zone to assist the lower zone cars in depopulating that portion of the building, the entire handling capacity of the elevator system is utilized. Thus the building is depopulated in a minimum of time while assuring equalized service to all floors.

At certain times it may be desirable to cause another elevator car to assist cars 1 and 2 in serving the upper zone or to take the place of one of these cars when it is temporarily out of service. This may be done in the case of elevator No. 3, for example, by opening service switch 113(3), deenergizing elevator No. 3 zone switch ZS. This switch upon dropping out re-engages contacts ZS1(3), ZS3(3) and ZS4(3) and separates contacts ZS2(3). The engagement of contacts ZS1(3) renders service switch 121(3) effective to cause the car to travel at least to the fifth floor before becoming set for travel in the down direction. The engagement of these con-

tacts also renders the car buttons for the fifth, sixth and seventh floors in car No. 3 effective to control that car. The engagement of contacts ZS4(3) causes the non-stop relay NS(3) for elevator No. 3 to be energized when the car is set for upward travel, thus enabling this car to stop and pick up up calls when set for travel in the up direction. The car responds to the highest down call the same as described for elevators Nos. 1 and 2. The control circuits for car No. 4 may be similarly changed over to cause this car to serve the upper zone by opening service switch 113(4).

The elevators may also be changed over to operation whereby each car set for up travel is automatically set for travel in the down direction upon being brought to a stop at a floor when, at the time that circuits are set up to cause the car to slow down and be brought to a stop at that floor, no push buttons are pressed which require or indicate further travel in the up direction from that floor. This may be done by opening service switches 113(3) and 113(4) for elevators Nos. 3 and 4 and by throwing over service switch 121 for each elevator from the lower position shown to its upper position to render control of the highest car call relay XC for each car subject to the fifth floor car button in that car as well as the other car buttons. Under such conditions, as both contacts ZS2(3) and ZS2(4) are separated and both contacts ZS3(3) and ZS3(4) are engaged, the highest down hall call relay XSD for each car is not energized until brush 78 for that car engages a stationary contact under conditions where no down hall calls are registered for floors above the one at which the stationary contact is provided. If no car call is registered in that car for a floor above that floor, the operation of relay XSD causes the deenergization of the highest car call relay XC for that car. If no up hall call is registered for that floor or for a floor above, this causes the operation of the highest up hall call relay XSU for that car and consequent operation of the automatic return relay XH for that car, causing the car to be slowed down and brought to a stop at the floor and set for downward travel. If a car call is registered for a floor above, the highest car call relay XC is not deenergized so that a stop is not made in response to the down call. Relay XC is maintained operated until the hook switch for the floor for which the highest car call is registered is opened and if at that time no further hall calls have been registered which require or indicate further travel in the up direction, relay XH is energized to cause the car to be slowed down and brought to a stop at the floor and the setting of the car for travel in the down direction. If an up hall call is registered, this causes the car to be brought to a stop at the floor for which the call is registered and to be maintained set for upward travel so as to be restarted away from that floor in the up direction. Upon becoming set for downward travel, each car stops in response to calls registered by its car buttons for floors below and also in response to down hall calls for floors below.

This operation is particularly suitable for the morning peak in buildings such as office buildings, where there is a large amount of incoming traffic concentrated at a certain time in the morning. Inasmuch as working hours in such a building begin at the same time for the majority of employees, this creates a maximum demand

for elevators to carry employees from the ground floor to their various destinations. There is very little or no inter-floor traffic at such time so that the cars make few stops in response to hall buttons. Assuming no hall calls, each car automatically becomes set for travel in the down direction at the floor at which the last stop is made to discharge a passenger, runs express to the ground floor, takes on more passengers and the cycle is repeated. Thus each car provides a maximum of transportation capacity with minimum car travel to meet the demands placed upon the system.

These operations are also suitable for noon peaks. At the noon hour, when there is a severe demand for service to depopulate the building, the same operation as for the evening peak may be provided. That is, switches 113(3) and 113(4) are closed and all of switches 121 are placed in their lower positions automatically assigning the cars to their zones to provide "zone return" operation, causing elevators Nos. 3 and 4 to serve the lower zone and elevators Nos. 1 and 2 to run to the upper zone before becoming set for downward travel. Just before one o'clock, when there is a severe demand for service to take the employees back into the building, the same operation as for morning peak may be provided. That is, switches 113(3) and 113(4) are both opened and all of switches 121 are thrown to their upper positions to provide "highest call return" operation, causing each car to become set for travel in the down direction upon making a stop at a floor in its upward travel under conditions where no calls are registered which require or indicate further travel in the up direction.

During periods intermediate the morning and noon peaks and the noon and evening peaks, the elevators may be caused to always run to the upper terminal before reversing. This may be effected by opening service switch 124 for each elevator, preventing the operation of relay XH and thus preventing the automatic setting of the car for downward travel until the engagement of brush 90 with contact 91 as the car arrives at the upper terminal and contacts H1 reengage. Also, service switch 120 in the circuit common to the highest hall call circuits is opened to prevent the energization of the coils of any of the XSU or XSD switches during such intermediate periods. Service switches 113 for elevators Nos. 3 and 4 are both opened to de-energize zone switches ZS for these elevators, thus rendering the car buttons in cars Nos. 3 and 4 for the fifth, sixth and seventh floors effective to control cars Nos. 3 and 4, as in the case of elevators Nos. 1 and 2. With the service switches in these positions, each elevator, when travelling in the up direction, stops in response to its car buttons which are pressed and also in response to unanswered up hall calls which are picked up. No stops are made during its upward travel in response to down hall calls. When set for travel in the down direction, each car stops in response to its car buttons which are pressed and also in response to unanswered down hall calls which are picked up. No stops are made during downward travel in response to up hall calls.

Scheduling mechanism may be employed for the elevators if desired on terminal to terminal operation. This mechanism may cause the giving of starting signals to start the cars away from the terminals at timed intervals, thereby effecting

operation of the cars so as to give efficient service to all floors of the building. Scheduling mechanism such as shown in the patent to David C. Larson No. 1,966,071, granted July 10, 1934, may be employed if desired. Scheduling mechanism may be used also when the cars are under "highest call return" operation to automatically give the starting signal to the cars only at the lower terminal. When the direction of travel of the car has been changed upon a stop being made in the upward travel of the car, the attendant is notified by the extinguishing of lamp 135 in the car. Scheduling mechanism may also be used when the cars are under "zone return" operation, the starting signal being given to each elevator as it arrives at the lower terminal so that it will immediately start in the up direction after discharge of its passengers.

The above system may also be employed for night service. Any one or more of the cars may be picked out for use during this period. It is preferred to operate "highest call return" for night service, with a signal to advise the attendant in the car when a call is registered.

Although not described, it is to be understood that hall lanterns are provided for the various cars at the landings. These lanterns may be controlled as disclosed in the aforementioned patent to Waters and Glaser with those at the first floor also controlled by the dispatching and scheduling mechanism so that the hall lantern for a car is lighted only in the event that it is about to leave the floor, thereby advising the intending passenger at that floor which car to take. For "zone return" operation, electric signs may be employed to direct any intending passengers at the ground floor to the cars serving the upper zone.

Although the invention has been described as applied to an installation in which each zone is served by two cars, it is to be understood that it is applicable to installations in which the zones are served by other numbers of cars. The control circuits for each zone are the same for each car serving that zone. It is also to be understood that the number of floors in each zone may be varied, the circuits being arranged in accordance with the number of floors. The floor constituting the lower terminal in an upper zone (the fifth floor in the circuits shown) is determined by the hook switch connected to the feed line by switch 121 and the stationary contact to which contacts ZS2 and ZS3 are connected, the car buttons controlled by contacts ZS1 being governed accordingly. Thus, for example, the upper zone lower terminal in the circuits shown may be changed from the fifth to the sixth floor by connecting switches 121 to hook switches 86 instead of hook switches 85, by connecting the circuit controlled by contacts ZS2 and ZS3 to contacts 75 and 6D2 instead of to contacts 74 and 5D2 and by connecting the fifth floor car buttons C5(3) and C5(4) directly to feed line + instead of subject to ZS contacts.

If desired, the circuits may be arranged to cause each car when travelling in the up direction on "zone return" operation always to travel at least to some intermediate floor in its zone regardless of whether any call is registered to which that car is responsive for a floor above the lowest floor in that zone. This may be done, for example, in the circuits illustrated, assuming that it is desired to have cars Nos. 1 and 2 always travel at least to the sixth floor instead of the fifth floor and that it is desired to have cars Nos.

3 and 4 travel at least to the third floor instead of the second floor, by connecting the sixth floor hook switch 86 of each of the four elevators instead of hook switch 85 directly to feed line + through switches 121 and by providing a similar circuit connecting the third floor hook switch 83 of each elevator directly to feed line + through a similar service switch. Also, the sixth and third floor car buttons are disconnected from their respective hook switches. The fifth floor car buttons, however, are connected to their corresponding hook switches. With this arrangement, cars Nos. 1 and 2, when set for travel in the up direction, travel at least to the sixth floor and cars Nos. 3 and 4, when set for travel in the up direction, travel at least to the third floor regardless of the calls registered. However, cars Nos. 3 and 4 do not answer calls above the fourth floor as the circuits controlled by the contacts of zone switches ZS are not changed.

It is to be further understood that, although the invention has been described as applied to two zones, any number of zones may be provided, depending upon the requirements of the particular installation. This may be done by carrying forward the principles already set forth. To provide for example a zone intermediate the upper and lower zones previously described, assuming for convenience a larger number of floors, say fifteen, and two more elevators, with elevators Nos. 1 and 2 being assigned to floors 11 to 15, elevators Nos. 3 and 4 being assigned to floors 6 to 10 and elevators Nos. 5 and 6 being assigned to floors 2 to 5; the hook switches for the eleventh floor for elevators Nos. 1, 2, 3 and 4 would be connected to line + through service switches as is done for hook switches 85 in Figure 2, and the hook switches for the sixth floor for elevators Nos. 3, 4, 5 and 6 would be connected to line + through service switches as is done for hook switches 85 in Figure 2; zone switches for elevators Nos. 3, 4, 5 and 6 would control the car buttons for those cars for floors 11 to 15 in the same manner as those for floors 5 to 7 are controlled for cars Nos. 3 and 4 in Figure 2 and would control the rendering of the circuits for the coils of relays XSD subject to down hall calls for floors above the tenth floor in the same manner as the rendering of the circuits for these coils subject to down hall calls for floors above the fourth floor is controlled by the zone switches in Figure 2; and additional zone switches for elevators Nos. 5 and 6 would control the car buttons for those cars for floors 6 to 10 in the same manner as those for floors 5 to 7 are controlled by the zone switches of cars Nos. 3 and 4 in Figure 2 and would control the rendering of the circuits for the coils of the relays XSD subject to down hall calls for the sixth to the tenth floors in the same manner as this is effected for elevators Nos. 3 and 4 for floors above the fourth floor in Figure 2. This arrangement would permit either or both of elevators Nos. 3 and 4 to be changed over to cause the cars to assist or replace the cars serving the uppermost zone and would permit either or both of elevators Nos. 5 and 6 to be changed over to cause the cars to assist or replace the cars serving the intermediate zone. The zone switches for each of elevators Nos. 3 and 4 would control the non-stop switch of that elevator in the same way as in Figure 2 while the two zone switches for each of elevators Nos. 5 and 6 would have their back contacts in series relation in the by-pass for contacts PR3 in the circuit for the coil of the non-stop

switch. With such arrangement, and with the hook switches for the eleventh floor for elevators Nos. 5 and 6 connected to line + through service switches, the circuits of either or both of elevators Nos. 5 and 6 could also be thrown over to cause them to assist or replace elevators Nos. 1 and 2 in serving the uppermost zone.

By providing elevators Nos. 3 and 4 with additional zone switches like elevators Nos. 5 and 6, the circuits for elevators Nos. 3 and 4 could also be thrown over to cause either or both of these cars to assist or replace elevators Nos. 5 and 6 in serving the lowermost zone. With such arrangement, the zone switches for each of elevators Nos. 3 and 4 could be advantageously controlled by dial switches. Cars can be shifted from one zone to another as conditions warrant, and by shifting all cars in a zone to the zone above, these zones may be combined.

It is contemplated that many of the features of the invention disclosed may be used in connection with apparatus and circuits different from those specifically described and also in connection with other forms of elevator control. The system of control admits of many variations and many apparently widely different embodiments of the invention can be made without departure from the spirit or scope of the invention. It is therefore intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of up controls, one for each of said floors; means for each of said cars serving the upper zone for causing that car during its upward travel to stop in response to all up controls that are operated at the floors for which such controls are provided; and means for preventing each of said cars serving the lower zone from stopping in response to operated up controls at any time during its upward travel, regardless of the positions of the other cars.

2. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of up controls, one for each of said floors; a plurality of down controls, one for each of said floors; means for each of said cars serving the upper zone for causing that car during its upward travel to stop in response to up controls that are operated at the floors for which such controls are provided and also in response to an operated down control for a floor in the upper zone at that floor under conditions where no control for a floor in that zone above such floor is operated; and means for each of said cars serving the lower zone for causing that car in its upward travel to stop in response to an operated down control for a floor in the lower zone at that floor under conditions where no control for a floor in that zone above such floor is operated but for preventing that car from responding to any operated up control.

3. An electric elevator system comprising; a plurality of floors forming an upper zone; a

plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of up controls, one for each of said floors; a plurality of down controls, one for each of said floors; means for each of said cars for causing that car, during its upward travel, to travel to the highest floor in the zone served thereby for which a down control is operated, stop thereat in response to such control and be set for travel in the down direction; means for causing only said cars which serve the upper zone to stop in response to up controls, during said upward travel thereof; and a start control for each car manually operable from within the car to cause starting of the car.

4. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of up controls, one for each of said floors; a plurality of down controls, one for each of said floors; means for each of said cars for causing that car, during its upward travel, to travel to the highest floor in the zone served thereby for which a down control is operated, stop thereat in response to such control and be set for travel in the down direction; means for causing only said cars which serve the upper zone to stop, during said upward travel thereof, at intervening floors in response to up controls for such floors; means for causing each of said cars, during downward travel thereof, to stop in response to down controls for floors below the car at the corresponding floors; and a start control for each car manually operable from within the car to cause starting of the car.

5. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of up hall buttons, one at each of said floors; a plurality of down hall buttons, one at each of said floors; means for each of said cars for causing that car, during its upward travel, to travel to the highest floor in the zone served thereby for which a down hall call is registered, stop thereat in response to such call and be set for travel in the down direction; means for each of said cars which serves the upper zone for causing that car, during said upward travel thereof, to stop at intervening floors in response to up hall calls for such floors; means for each of said cars which serves the lower zone for preventing that car, during said upward travel thereof, from stopping at intervening floors in response to up hall calls for such floors; means for causing each of said cars, during downward travel thereof, to stop in response to down hall calls for floors below the car at the corresponding floors; mechanism for each car for causing the order of stops of that car to be in the natural order of floors; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

6. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of

which serves the lower zone; a plurality of up hall buttons, one at each of said floors; a plurality of down hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving the upper zone; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving the lower zone; means for each of said cars for causing that car, during its upward travel, to travel to the highest floor in the zone served thereby for which a car call for that car or down hall call is registered, stop thereat in response to such call and be set for travel in the down direction; means for each of said cars which serves the upper zone for causing that car, during said upward travel thereof, to stop at intervening floors only in response to car calls for that car and up hall calls for such floors; means for each of said cars which serves the lower zone for causing that car, during said upward travel thereof, to stop at intervening floors only in response to car calls for that car for such floors; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

7. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of hall buttons, one at each of said floors; means for each of said cars serving the upper zone for causing that car to stop at floors in the upper zone in response to calls registered by hall buttons at such floors; means for each of said cars serving the lower zone for causing that car to stop at floors in the lower zone in response to calls registered by down hall buttons at such floors; means for preventing each of said cars serving the lower zone from responding to calls registered by hall buttons at floors in the upper zone; means for changing the floors forming the zones; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

8. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of down hall buttons, one at each of said floors; means for each of said cars serving the upper zone for causing that car during its downward travel to stop first at floors in the upper zone and thereafter at floors in the lower zone in response to calls registered by down hall buttons at such floors; means for each of said cars serving the lower zone for causing that car, during its downward travel, to stop at floors in the lower zone in response to calls registered by down hall buttons at such floors; and means for preventing each of said cars serving the lower zone from responding to calls registered by down hall buttons at floors in the upper zone.

9. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving the upper zone; a plu-

rality of car buttons, one for each of said floors
 of said lower zone, in each of said cars serving
 the lower zone; means for each of said cars for
 causing that car, during its upward travel, to
 5 travel to the highest floor in the zone served
 thereby for which a car button for that car or
 hall button is operated, stop thereat in response
 to such button and be set for travel in the down
 10 direction; means for preventing each of said
 cars serving the lower zone from continuing its
 travel in the up direction to a floor in the upper
 zone in response to a hall button for such floor;
 and a start control for each car manually oper-
 15 able from within the car to cause the starting
 of the car after each stop.

10. An electric elevator system comprising; a
 plurality of floors forming an upper zone; a plu-
 rality of additional floors forming a lower zone;
 a plurality of elevator cars, at least one of which
 20 serves the upper zone and at least one other of
 which serves the lower zone; a plurality of up
 hall buttons, one at each of said floors; a plu-
 rality of down hall buttons, one at each of said
 floors; a plurality of car buttons, one for each
 25 of said floors, in each of said cars serving the
 upper zone; a plurality of car buttons, one for
 each of said floors of said lower zone, in each
 of said cars serving the lower zone; means for
 each of said cars for causing that car, during its
 30 upward travel, to travel to the highest floor in
 the zone served thereby for which a car call for
 that car or down hall call is registered, stop
 thereat in response to such call and be set for
 35 travel in the down direction; means for each of
 said cars which serves the upper zone for causing
 that car, during said upward travel thereof, to
 stop at intervening floors only in response to
 car calls for that car and up hall calls for such
 floors; means for each of said cars which serves
 40 the lower zone for causing that car, during said
 upward travel thereof, to stop at intervening
 floors only in response to car calls for that car
 for such floors; means for preventing each of
 said cars serving the lower zone from travelling
 45 to a floor in the upper zone to respond to a hall
 call for such floor; and a start control for each
 car manually operable from within the car to
 cause starting of the car after each stop.

11. An electric elevator system comprising; a
 50 plurality of floors forming an upper zone; a plu-
 rality of additional floors forming a lower zone;
 a plurality of elevator cars, at least one of which
 serves the upper zone and at least one other of
 which serves the lower zone; a plurality of up
 55 hall buttons, one at each of said floors; a plu-
 rality of down hall buttons, one at each of said
 floors; a plurality of car buttons, one for each
 of said floors, in each of said cars serving the
 upper zone; a plurality of car buttons, one for
 60 each of said floors of said lower zone, in each
 of said cars serving the lower zone; means for
 each of said cars for causing that car, during
 its upward travel, to travel to the highest floor
 in the zone served thereby for which a car call
 65 for that car or down hall call is registered; stop
 thereat in response to such call and be set for
 travel in the down direction; means for each of
 said cars which serves the upper zone for causing
 that car, during said upward travel thereof, to
 70 stop at intervening floors only in response to car
 calls for that car and up hall calls for such
 floors; means for each of said cars which serves
 the lower zone for causing that car, during said
 upward travel thereof, to stop at intervening
 75 floors only in response to car calls for that car

for such floors; means for causing each of said
 cars, during downward travel thereof, to stop
 in response to car calls within that car and
 down hall calls at the corresponding floors;
 mechanism for each car actuated in accordance
 5 with sequence of floors for causing the order of
 stops of that car to be in the natural order of
 floors; and a start control for each car manually
 operable from within the car to cause starting of
 the car after each stop.

12. An electric elevator system comprising; a
 plurality of floors forming an upper zone; a plu-
 rality of additional floors forming a lower zone; a
 plurality of elevator cars, at least one of which
 10 serves the upper zone and at least one other of
 which serves the lower zone; a plurality of up hall
 buttons, one at each of said floors; a plurality of
 down hall buttons, one at each of said floors; a
 plurality of car buttons, one for each of said
 floors, in each of said cars serving the upper zone;
 20 a plurality of car buttons, one for each of said
 floors of said lower zone, in each of said cars
 serving the lower zone; means for each of said
 cars for causing that car, during its upward
 travel, to travel to the highest floor in the zone
 served thereby for which a car button in that car
 or down hall button is operated, stop thereat in
 response to such button and be set for travel in
 the down direction; means for each of said cars
 which serves the upper zone for causing that car,
 30 during said upward travel thereof, to stop at
 intervening floors only in response to operated car
 buttons within that car and up hall buttons for
 such floors; means for each of said cars which
 serves the lower zone for causing that car, during
 35 said upward travel thereof, to stop at intervening
 floors only in response to operated car buttons in
 that car for such floors; means for causing each of
 said cars, during downward travel thereof, to stop
 in response to car buttons within that car and
 40 down hall buttons that are operated, at the cor-
 responding floors, the upper zone cars, after re-
 sponding to down hall buttons in the upper zone,
 thereby assisting the lower zone cars in respond-
 ing to down hall buttons in the lower zone; mech-
 45 anism for each car actuated in accordance with
 the sequence of floors for each direction of travel
 for causing the order of stops of that car for each
 direction of travel to be in the natural order of
 floors, regardless of the order in which the but-
 50 tons in response to which the stops are made are
 operated; and a start control for each car manu-
 ally operable from within the car to cause start-
 ing of the car after each stop.

13. An electric elevator system in which a plu-
 55 rality of elevator cars are provided, each stopping
 at floors in response to calls registered by push
 buttons and restarted after each stop in response
 to the manual operation of a start control within
 the car, characterized in that the floors are
 60 grouped into at least two zones, with at least one
 of the cars serving the upper zone and at least one
 other of the cars serving the lower zone and that
 means are provided for preventing the lower zone
 cars from serving floors in the upper zone and in
 65 addition means are provided for changing the
 floors forming either zone.

14. An electric elevator system in which a plu-
 rality of elevator cars are provided, each stopping
 at floors in response to calls registered by push
 70 buttons and restarted after each stop in response
 to the manual operation of a start control within
 the car, characterized in that the floors are
 grouped into at least two zones, with at least one
 of the cars serving the upper zone and at least one
 75

other of the cars serving the lower zone and that there are provided means for preventing the lower zone cars from serving floors in the upper zone and means for rendering said preventing means for at least one of said lower zone cars ineffective to permit such car to serve said upper zone.

15. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of hall buttons, one at each of said floors; means for each of said cars for causing that car, during its upward travel, to travel at least to a certain one of the floors in the zone served thereby and, if a call is registered by one of said hall buttons for a floor in that zone above such floor, to travel above said certain floor to such floor above in response to such call; means for preventing each lower zone car from travelling into the upper zone to respond to a hall call for any floor in said upper zone; and a start control for each car manually operable from within the car to cause starting of the car.

16. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of down hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving the upper zone; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving the lower zone; means for each of said cars for causing that car, during its upward travel, to travel at least to a certain one of the floors in the zone served thereby, automatically stop thereat and be set for travel in the down direction, provided no car button in that car or down hall button for a floor above is operated and, if such button is operated, responsive to such button to cause the car to run past such certain floor without stopping except in response to the car button within that car for such certain floor; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

17. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves the upper zone and at least one other of which serves the lower zone; a plurality of hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving the upper zone; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving the lower zone; means for each of said cars for causing that car, during its upward travel, to travel at least to a certain one of the floors in the zone served thereby, automatically stop thereat and be set for travel in the down direction, provided no car button in that car or hall button for a floor above in that zone is operated and, if such button is operated, responsive to such button to cause the car to run past such certain floor without stopping except in response to the car button within that car for such certain floor; means for preventing each lower zone car from travelling into the upper zone in response to any push button for any floor in said upper zone; and a start control for each

car manually operable from within the car to cause starting of the car after each stop.

18. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves both of said zones and at least one other of which serves only the lower zone; a plurality of up hall buttons, one at each of said floors; a plurality of down hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving both zones; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving only the lower zone; means for each of said cars which serves both zones for causing that car, during its upward travel, to travel at least to a certain one of the floors in said upper zone, automatically stop thereat and be set for travel in the down direction, provided no car button in that car or hall button for a floor above in that zone is operated and, if such button is operated, to run past said certain floor without stopping except in response to the car button within that car or the up hall button for said certain floor; means for each of said cars which serves only the lower zone for causing that car, during its upward travel, to travel at least to a certain one of the floors in said lower zone, automatically stop thereat and be set for travel in the down direction, provided no car button in that car or down hall button for a floor above in that zone is operated, and if such button is operated, to run past such certain floor without stopping except in response to a car button within that car for such certain floor; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

19. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves both of said zones and at least one other of which serves only the lower zone; a plurality of up hall buttons, one at each of said floors; a plurality of down hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving both zones; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving only the lower zone; means for each of said cars which serves both zones for causing that car, during its upward travel, to travel to a certain one of the floors in said upper zone, automatically stop thereat and be set for travel in the down direction, provided no car button in that car or hall button for a floor above in that zone is operated and, if such button is operated, to travel to the highest floor in said upper zone above such certain floor for which a car button in that car or down hall button is operated, stop thereat in response to such button and be set for travel in the down direction; means for preventing each of said cars which serves both zones from stopping, during said upward travel thereof, at said certain floor in said upper zone under conditions where a car button in that car, an up hall button or a down hall button for a floor above in said upper zone is operated, except in response to the car button within that car or the up hall button for said certain floor; means for each of said cars which serves only the lower zone for causing that car, during its upward travel, to travel to a certain one of the floors in said lower zone, automatically stop thereat and be set for travel in

the down direction, provided no car button in that car or down hall button for a floor above in that zone is operated, and if such button is operated, to travel to the highest floor in said lower zone above said certain floor for which a car button in that car or down hall button is operated, stop thereat in response to such button and be set for travel in the down direction; means for preventing each of said cars which serves only the lower zone from stopping, during said upward travel thereof, at said certain floor in said lower zone under conditions where a car button in that car or a down hall button for a floor above in said lower zone is operated, except in response to a car button within that car for such certain floor; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

20. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves both of said zones and at least one other of which serves only the lower zone; a plurality of up hall buttons, one at each of said floors; a plurality of down hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving both zones; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving only the lower zone; means for each of said cars which serves both zones for causing that car, during its upward travel, to travel to a certain one of the floors in said upper zone, automatically stop thereat and become set for travel in the down direction, provided no car button in that car or hall button for a floor above in that zone is operated and, if such button is operated, to travel to the highest floor in said upper zone above such certain floor for which a car button in that car or down hall button is operated, stop thereat in response to such button and become set for travel in the down direction; means for each of said cars which serves both zones for causing that car, during said upward travel thereof, to stop at intervening floors only in response to operated car buttons within that car and up hall buttons for such floors; means for preventing each of said cars which serves both zones from stopping, during said upward travel thereof, at said certain floor in said upper zone under conditions where a car button in that car, an up hall button or a down hall button for a floor above in said upper zone is operated, except in response to the car button within that car or the up hall button for said certain floor; means for each of said cars which serves only the lower zone for causing that car, during its upward travel, to travel to a certain one of the floors in said lower zone, automatically stop thereat and be set for travel in the down direction, provided no car button in that car or down hall button for a floor above in that zone is operated, and if such button is operated, to travel to the highest floor in said lower zone above said certain floor for which a car button in that car or down hall button is operated, stop thereat in response to such button and become set for travel in the down direction; means for each of said cars which serves only the lower zone for causing that car, during said upward travel thereof, to stop at intervening floors only in response to operated car buttons in that car for such floors; means for preventing each of said cars which serves only the lower zone from stopping, during said upward travel thereof, at

said certain floor in said lower zone under conditions where a car button in that car or a down hall button for a floor above in said lower zone is operated, except in response to a car button within that car for such certain floor; means for causing each of said cars, during downward travel thereof, to stop in response to car buttons within that car and down hall buttons that are operated, at the corresponding floors; mechanism for each car actuated in accordance with the sequence of floors for each direction of travel for causing the order of stops of that car for each direction of travel to be in the natural order of floors, regardless of the order in which the buttons in response to which the stops are made are operated; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

21. An electric elevator system comprising; a plurality of floors forming an upper zone; a plurality of additional floors forming a lower zone; a plurality of elevator cars, at least one of which serves both of said zones and at least one other of which serves only the lower zone; a plurality of up hall buttons, one at each of said floors; a plurality of down hall buttons, one at each of said floors; a plurality of car buttons, one for each of said floors, in each of said cars serving both zones; a plurality of car buttons, one for each of said floors of said lower zone, in each of said cars serving only the lower zone; means for causing each of said cars which serves both zones, during upward travel thereof, to travel at least to a certain one of said floors in said upper zone and if a car button in that car, an up hall button or a down hall button for a floor above in said upper zone is operated to travel to the highest floor in said upper zone above such certain floor for which such button is operated in response to such button; means for causing each of said cars which serves both zones, during upward travel thereof, to stop automatically at such certain floor, provided no car button in that car, up hall button or down hall button for a floor in said upper zone above such certain floor is operated, to stop in response to the car buttons within that car and up hall buttons that are operated at the corresponding floors and to stop in response to a down hall button in said upper zone at a floor above such certain floor at that floor, under conditions where no car button in that car or down hall button for a floor above that floor in said upper zone is operated and no up hall button at that floor or at a floor above such floor in said upper zone is operated; means for preventing each of said cars which serves both zones, during upward travel thereof, from stopping at said certain floor in said upper zone under conditions where a car button in that car, an up hall button or a down hall button for a floor above in said upper zone is operated, except in response to the car button within that car or the up hall button for such certain floor; means for causing each of said cars which serves both zones, during said upward travel thereof, upon being brought to a stop at a floor in said upper zone above such certain floor in response to a down hall button or to a car button under conditions where no car button in that car or hall button for a floor above in said upper zone is operated, to become set for travel in the down direction; means for causing each of said cars which serves only the lower zone, during upward travel thereof, to travel at least to a certain one of said floors in said lower zone and if a car

button in that car or a down hall button for a floor above in said lower zone is operated to travel to the highest floor in said lower zone above such certain floor for which such button is operated in response to such button; means for causing each of said cars which serves only the lower zone, during upward travel thereof, to stop automatically at such certain floor in said lower zone, provided no car button in that car or down hall button for a floor in said lower zone above such certain floor is operated, to stop in response only to car buttons in that car that are operated at the corresponding floors and to an operated down hall button in said lower zone for a floor above such certain floor at such floor above, under conditions where no car button in that car for nor down hall button at a floor above that floor in said lower zone is operated; means for preventing each of said cars which serves only the lower zone, during upward travel thereof, from stopping at said certain floor in said lower zone under conditions where a car button in that car or down hall button for a floor above in said lower zone is operated, except in response to a car button within that car for such certain floor; means for causing each of said cars which serves only the lower zone, during said upward travel thereof, upon being brought to a stop at a floor in such zone above such certain floor in response to a car

button or down hall button under conditions where no car button in that car or down hall button for a floor above in said lower zone is operated, to become set for travel in the down direction; means for causing each of said cars which serves only the lower zone, during downward travel thereof, to stop in response to the car buttons within that car and down hall buttons for floors within the lower zone that are operated, at the corresponding floors; means for causing each of said cars which serves both zones, during downward travel thereof, to stop in response to the car buttons within that car and down hall buttons that are operated at the corresponding floors, such cars thereby assisting the lower zone cars in responding to down hall buttons in the lower zone after responding to down hall buttons in the upper zone; mechanism for each car actuated in accordance with the sequence of floors for each direction of travel for causing the order of stops of that car for each direction of travel to be in the natural order of floors, regardless of the order in which the buttons in response to which the stops are made are operated; and a start control for each car manually operable from within the car to cause starting of the car after each stop.

WILLIAM FRANK GLASER.