April 26, 1949. W. H. BRUNS 2,468,289

ELEVATOR SYSTEM

Filed Sept. 11, 1946 9 Sheets-Sheet 1

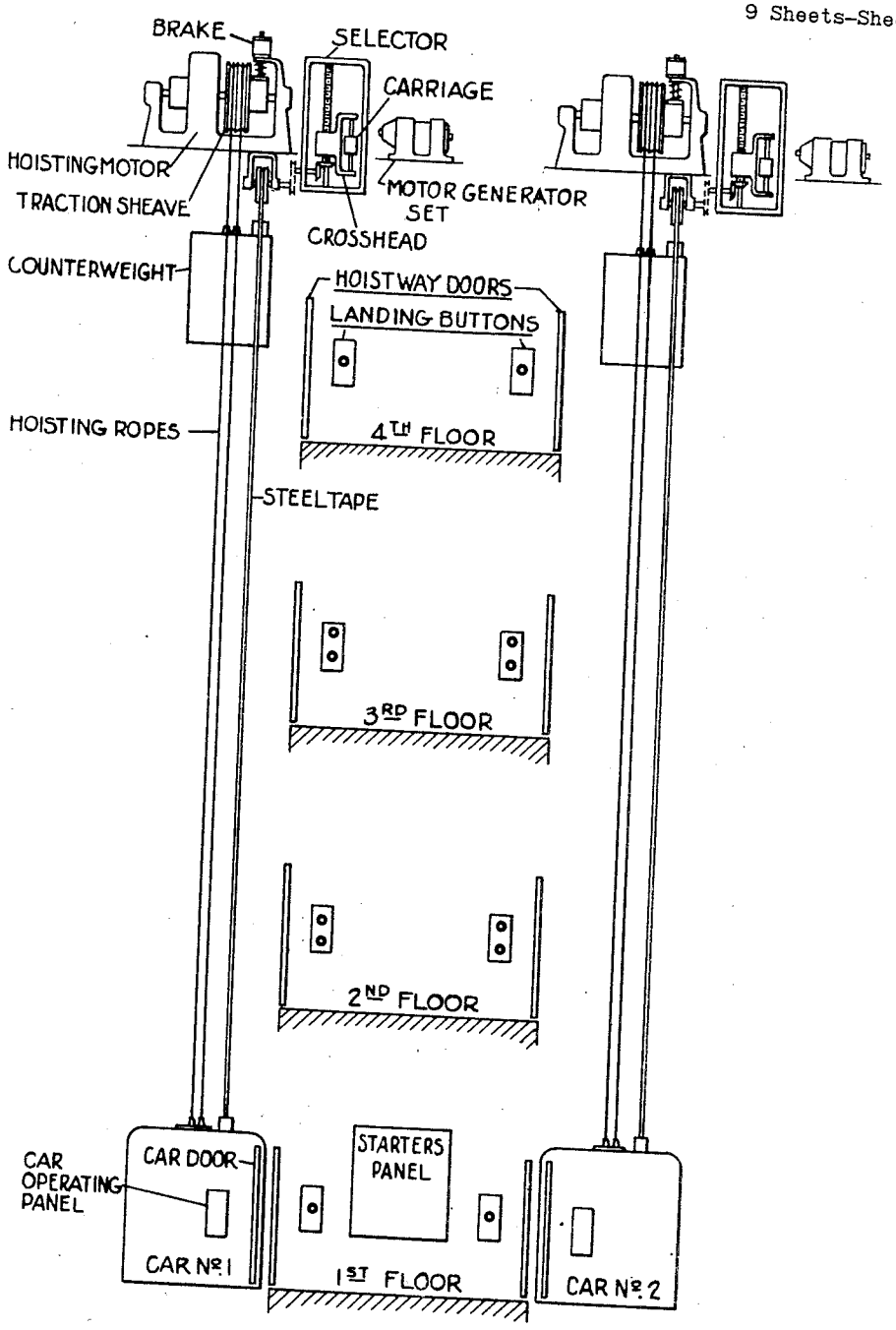


FIG. 1

William Henry Bruns INVENTOR

BY Walter C. Bradley ATTORNEY

April 26, 1949. W. H. BRUNS 2,468,289

ELEVATOR SYSTEM

Filed Sept. 11, 1946 9 Sheets-Sheet 2

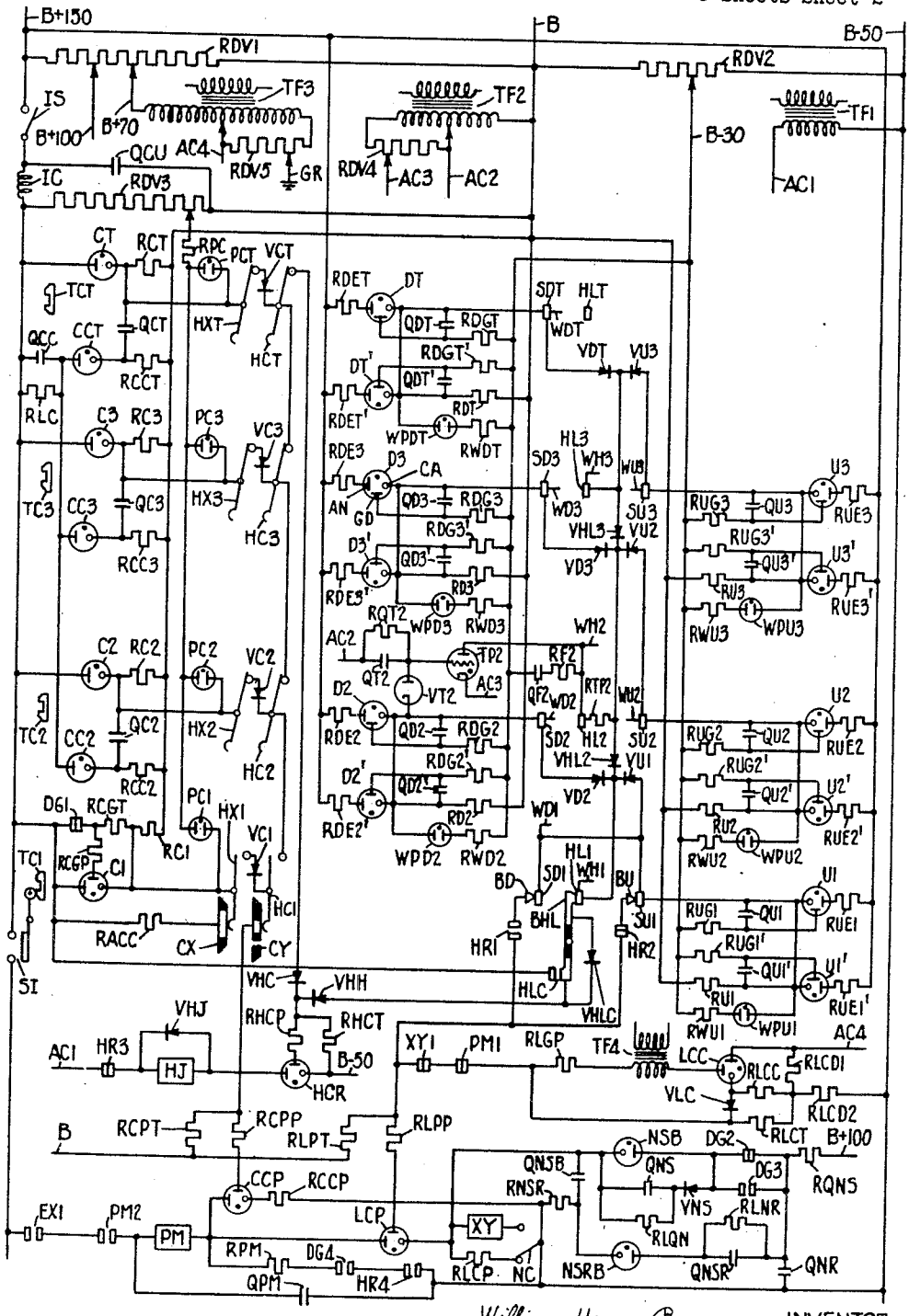


FIG. 2

William Henry Bruns INVENTOR

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April 26, 1949. W. H. BRUNS 2,468,289

ELEVATOR SYSTEM

Filed Sept. 11, 1946 9 Sheets-Sheet 3

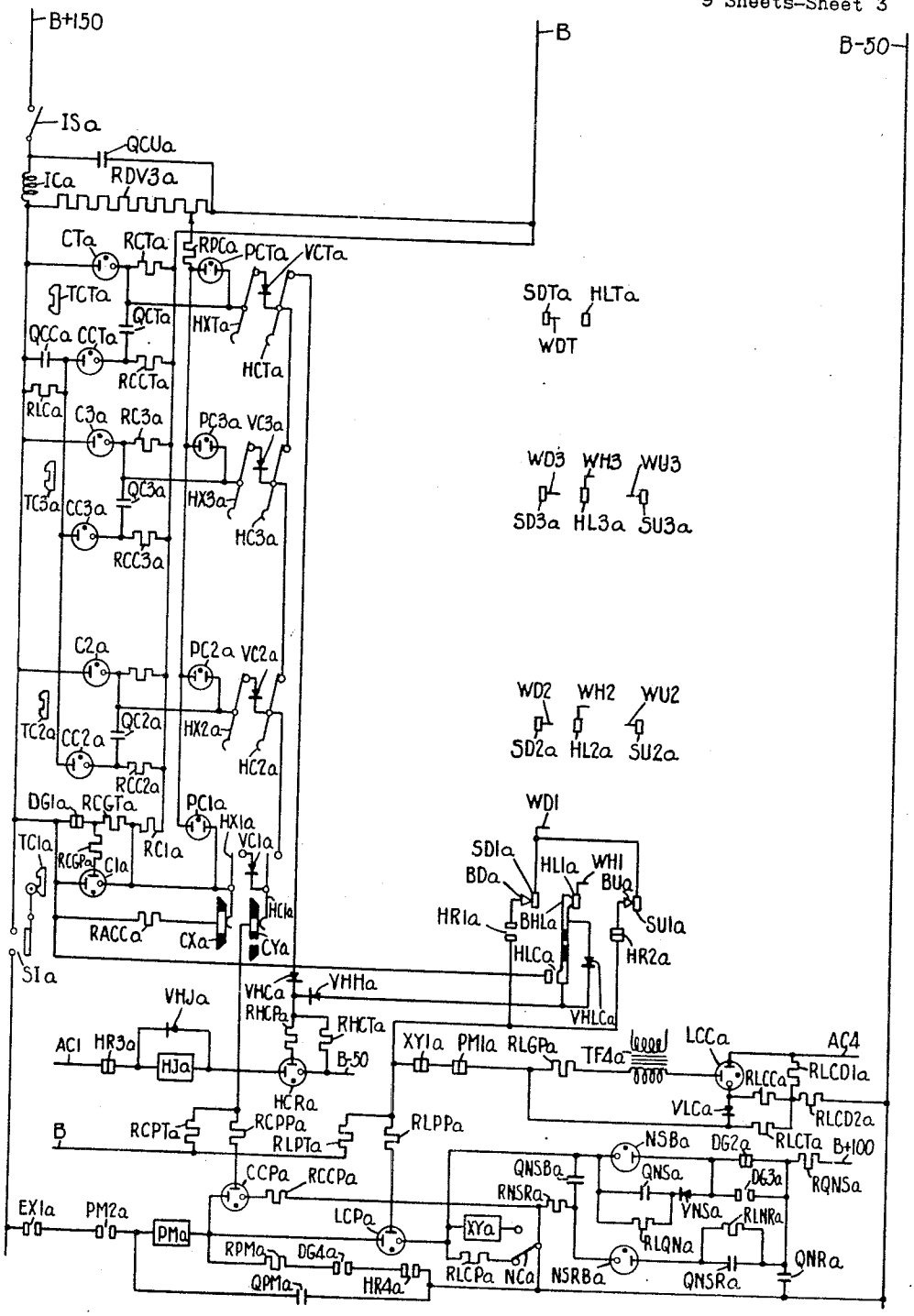


FIG. 2a

William Henry Bruns INVENTOR

BY Wm. H. Bradley ATTORNEY

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ELEVATOR SYSTEM

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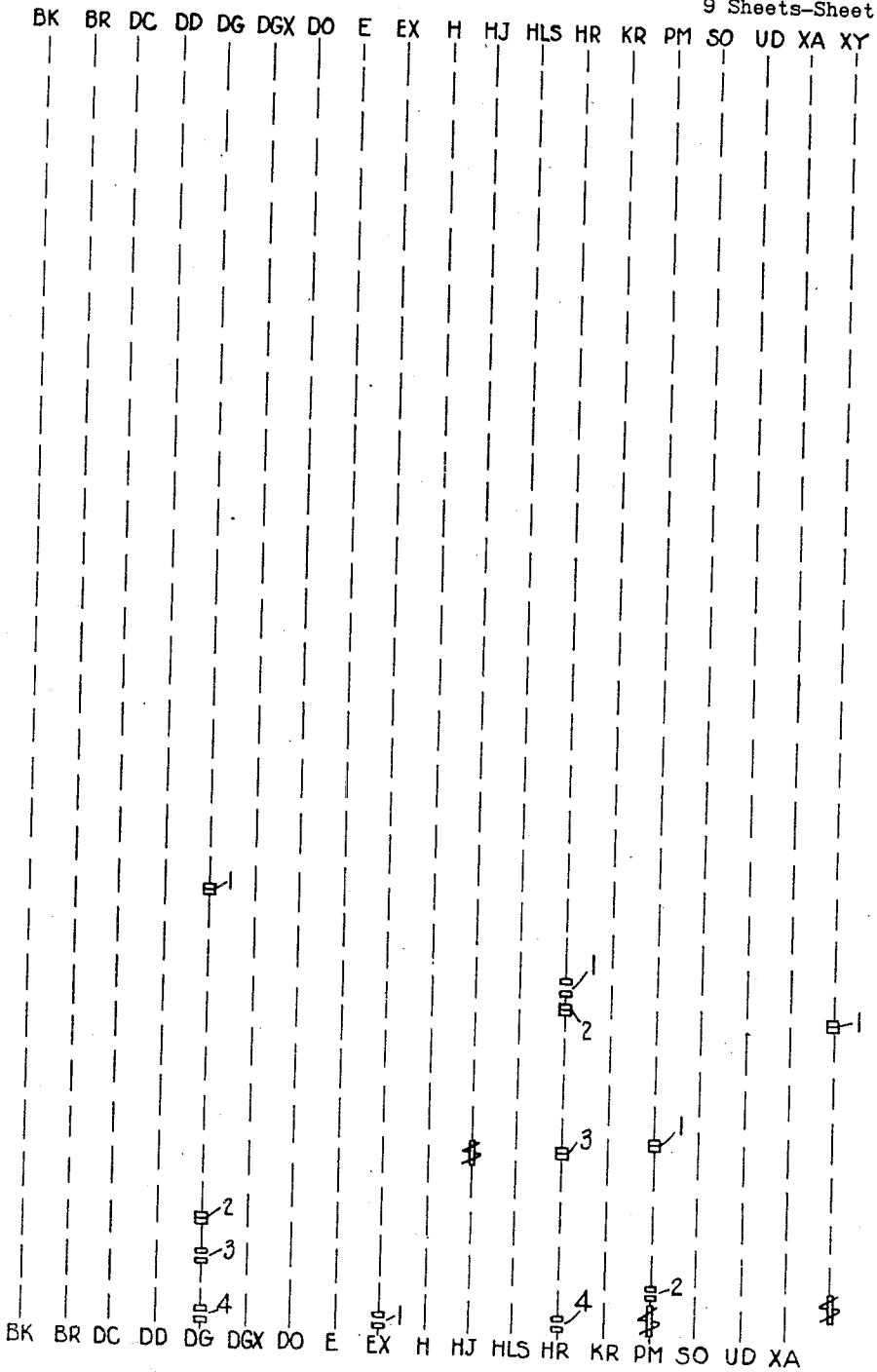


FIG. 2s

William Henry Bruns INVENTOR

BY Walter E. Bradley ATTORNEY

April 26, 1949. W. H. BRUNS 2,468,289

ELEVATOR SYSTEM

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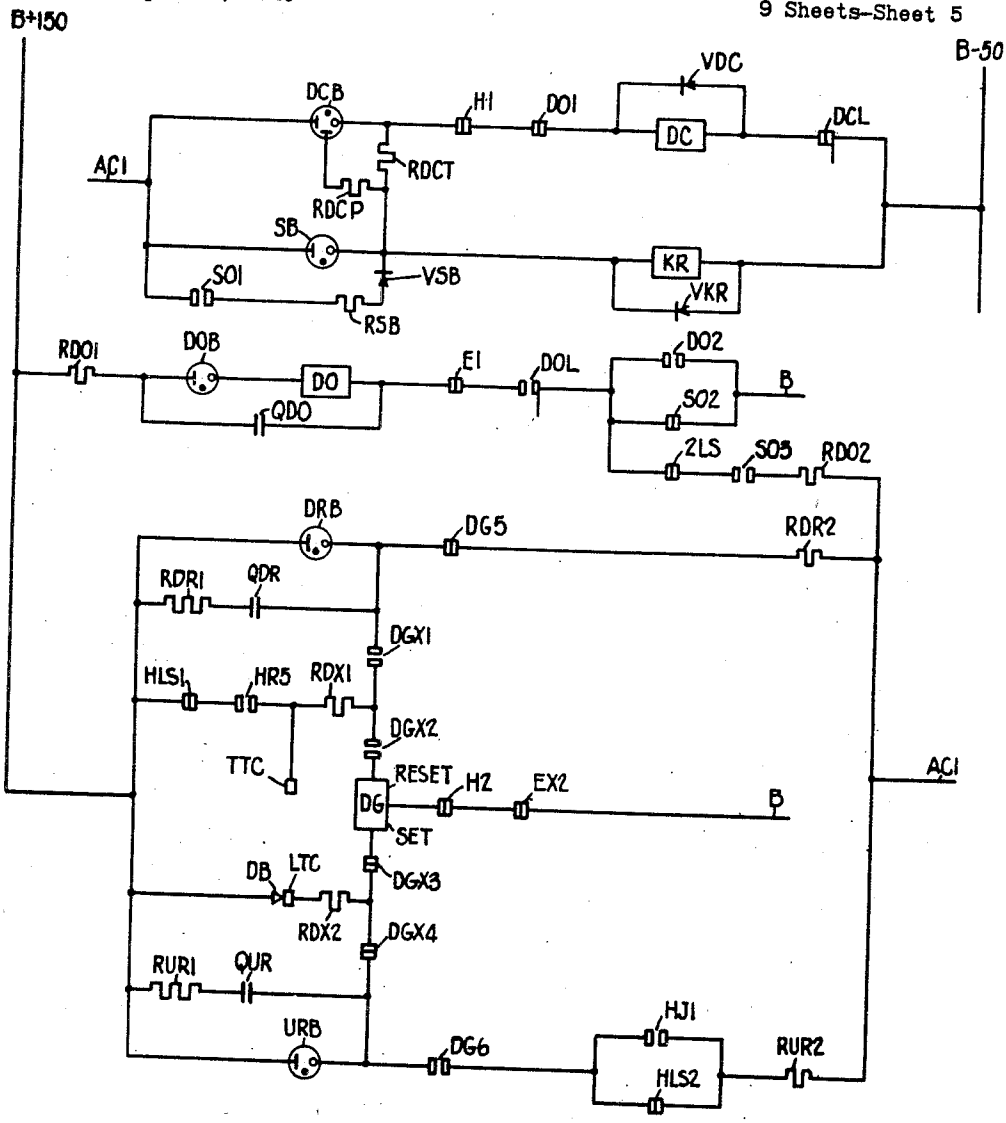


FIG. 3

William Henry Bruns INVENTOR

BY Hall & Bradley ATTORNEY

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ELEVATOR SYSTEM

Filed Sept. 11, 1946 9 Sheets-Sheet 6

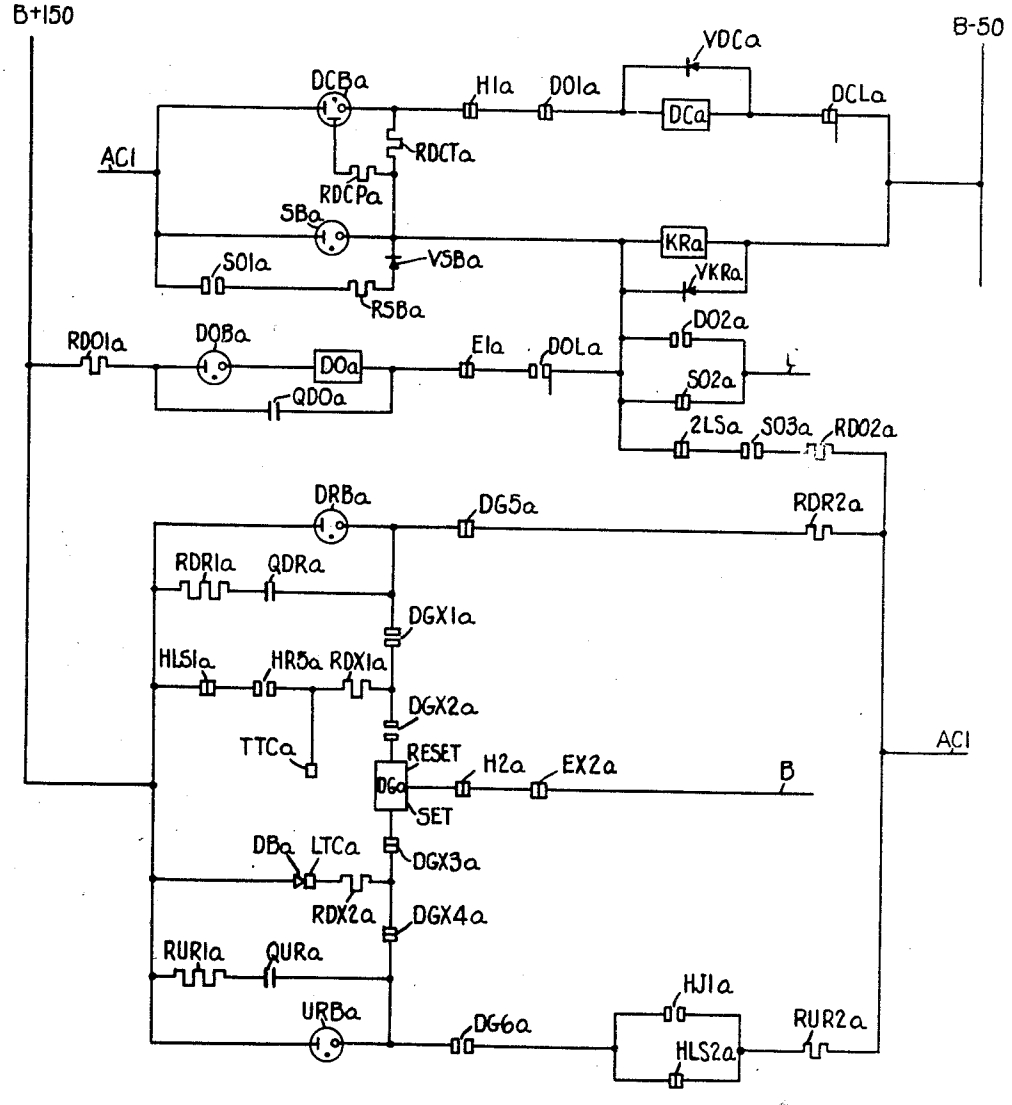


FIG. 3a

William Henry Bruns INVENTOR

BY Hartley & Bradley ATTORNEY

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ELEVATOR SYSTEM

Filed Sept. 11, 1946 9 Sheets-Sheet 7

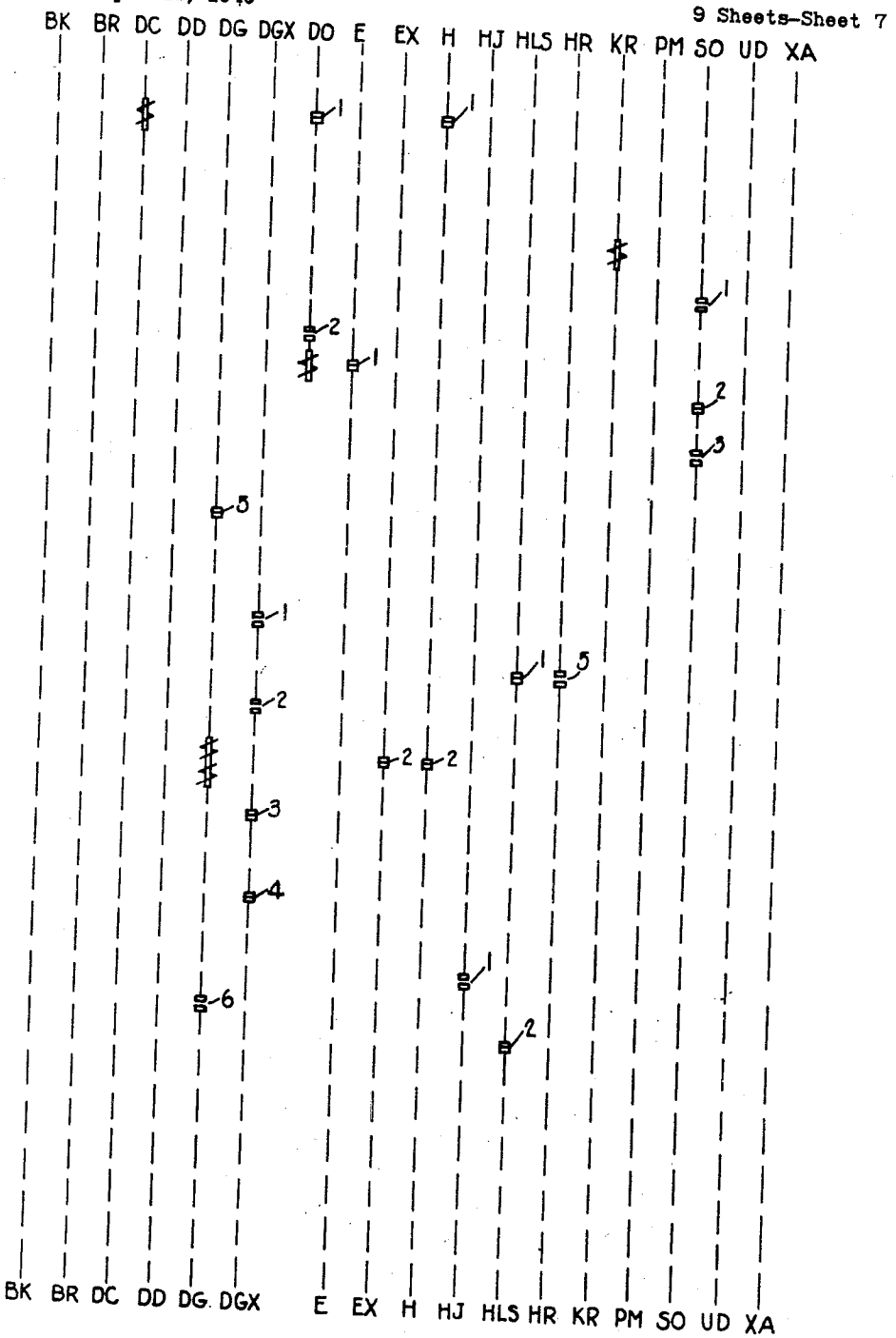


FIG. 3s

William Henry Bruns INVENTOR

BY Strauch & Bradley ATTORNEY

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Filed Sept. 11, 1946 9 Sheets-Sheet 8

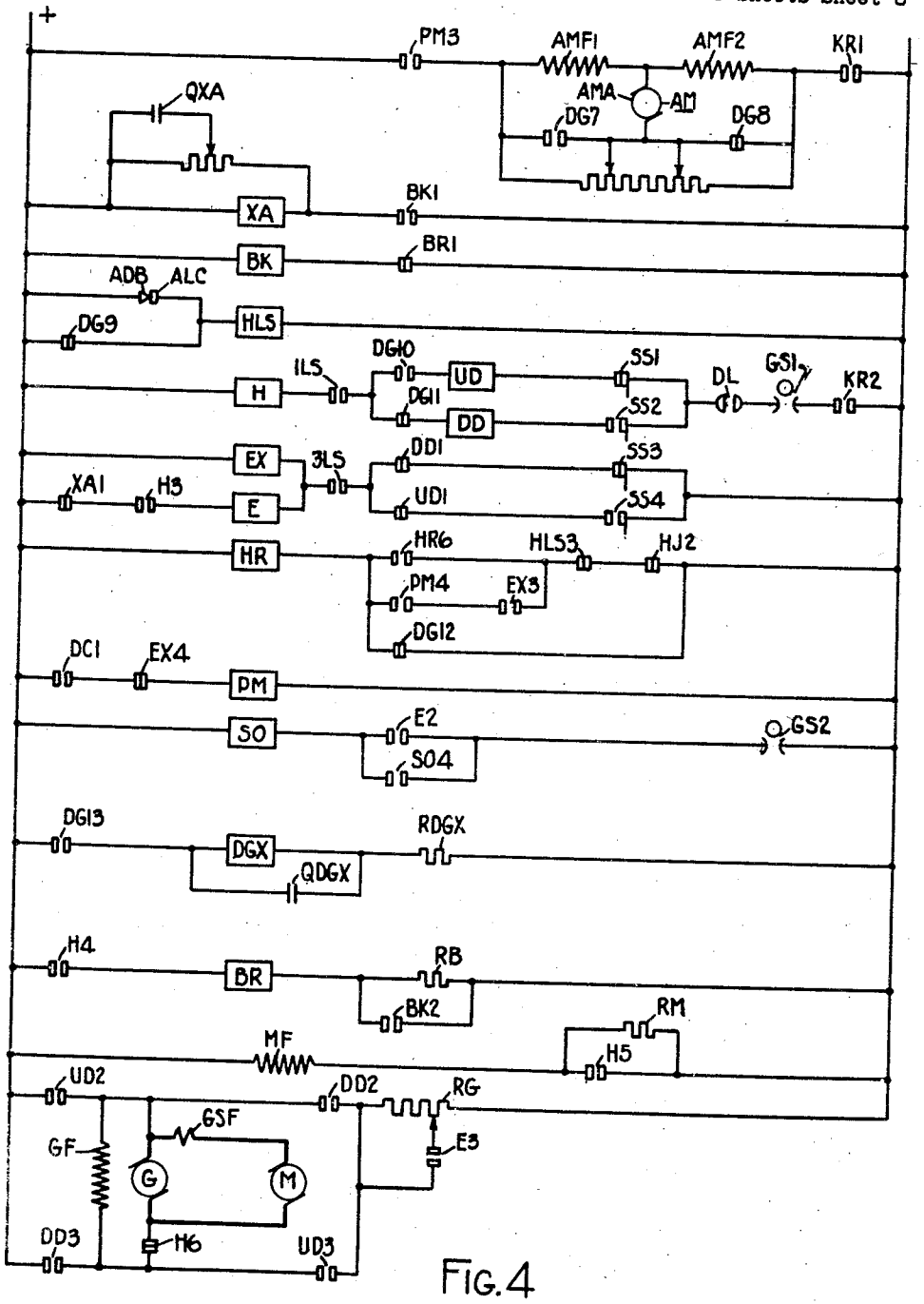


FIG. 4

William Henry Bruns INVENTOR

BY Matthew B. Bradley ATTORNEY

April 26, 1949. W. H. BRUNS 2,468,289

ELEVATOR SYSTEM

Filed Sept. 11, 1946 9 Sheets-Sheet 9

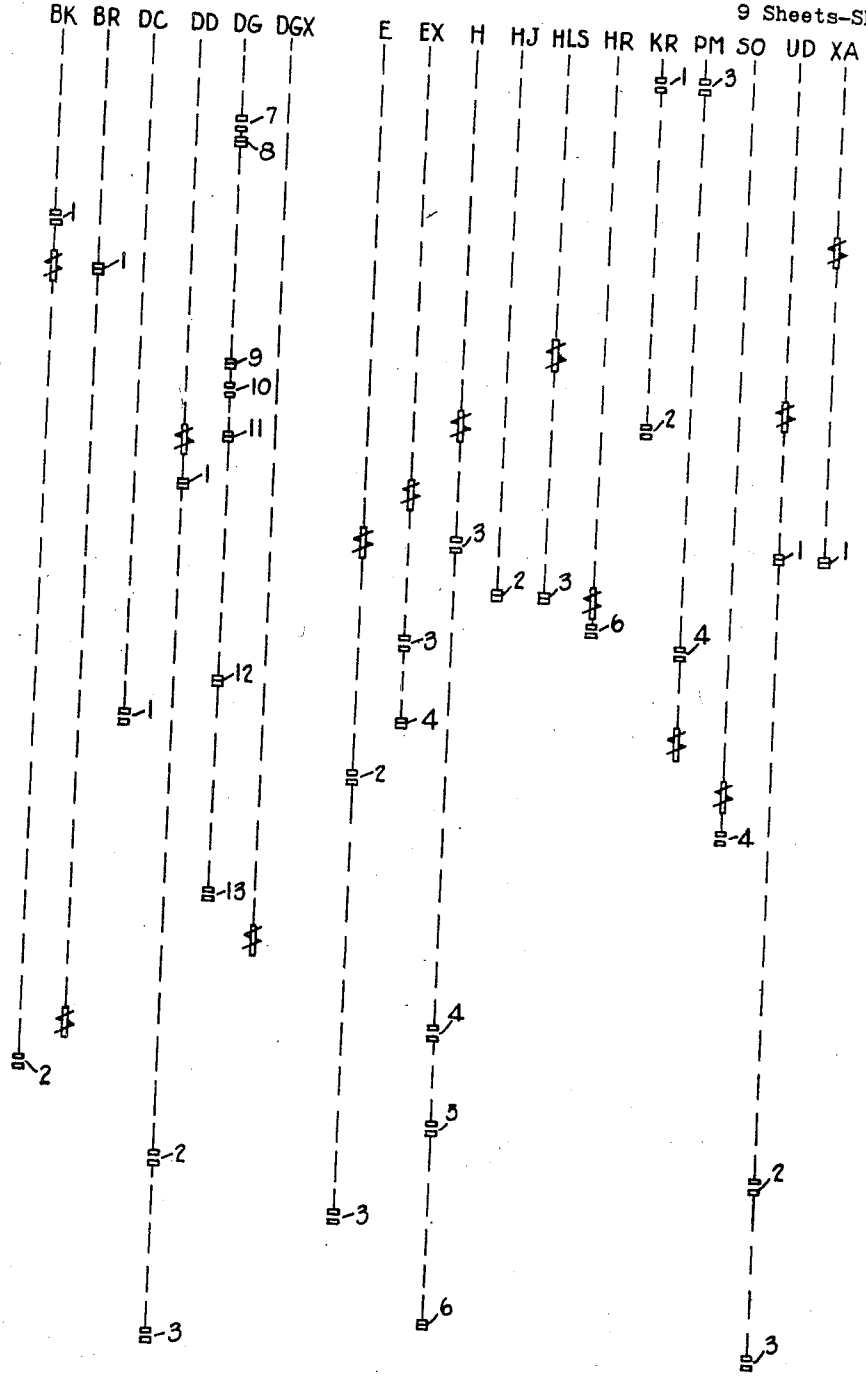


FIG. 4s

William Henry Bruns INVENTOR

BY Heath E. & Bradley ATTORNEY

Patented Apr. 26, 1949

2,468,289

UNITED STATES PATENT OFFICE

2,468,289

ELEVATOR SYSTEM

William Henry Bruns, Lincolndale, N. Y., assignor to Otis Elevator Company, New York, N. Y., a corporation of New Jersey

Application September 11, 1946, Serial No. 696,313

65 Claims. (Cl. 187—29)

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The invention relates to elevator systems.

The invention is especially directed to elevator control systems in which the starting of the elevator car after each stop is under control of an attendant in the car, while the stopping of the car is automatic, stops to discharge passengers being made in response to controls within the elevator car operated by the attendant as directed by the passengers, and stops to take on passengers being made in response to controls at the floors operated by the intending passengers themselves. At intermediate floors, two controls are provided, one an up control for operation by intending passengers desiring to be carried in the up direction and the other a down control for operation by intending passengers desiring to be carried in the down direction. With such control system applied to a plurality of elevator cars, the controls at the floors are common to the cars.

It is customary to utilize push buttons as these controls in the cars and at the floors. These push buttons when pressed close contacts to operate floor relays to register calls, enabling the push buttons to be released. Also it is customary to utilize manually operable switches with contacts for other control operations such as closing the doors and starting the car. There are certain advantages in exercising control of circuits electronically.

The object of the invention is to provide a control system for elevators, especially control systems of the above character, in which certain operations are effected or controlled electronically.

In carrying out the invention according to the preferred arrangement, electronic tubes are provided at the floors and arranged to be operated in response to touch by intending passengers. Electronic tubes, one for each floor, are also provided in the elevator car for operation in response to touch by the car attendant. These tubes, both in the car and at the floors, are cold cathode gas tubes with their circuits arranged so that they break down in response to manual touch and remain conductive, thereby registering the call and enabling the touch to be discontinued. When the call is answered the voltage between the anode and cathode of the tube is reduced to below sustaining value and the tube goes out, cancelling the call. Similar controls are provided in the cars for controlling other operations such as starting the car, opening and closing the doors, running non-stop past floors for which calls are registered from the floors

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and changing the direction of car travel at intermediate floors. Certain of these controls, such as the door close, start and reversal controls may be arranged so that the tube remains conductive only so long as the touch is continued or in the case of the start control only until the car has started.

When a call is registered, the tube upon which the call is registered directly controls the call pick-up and call cancelling circuits and the initiation of the stopping of the car. The invention will be described as applied to a system in which an up car answers a down call at an intermediate floor when no up call is registered for that floor and no call exists for a floor above and is then set for travel in the down direction. This operation is usually termed highest call return. The invention will also be described as applied to a system in which an up car may be stopped at a floor in response to a down call which has remained registered for more than a predetermined length of time, an operation referred to as timed call preference. Here again, the tubes upon which the calls are registered directly control the highest call return and timed call preference circuits.

The electronic tube itself is utilized to provide an illuminated indication that the desired operation is being performed. In the case of the controls for registering calls, this advises the passengers and also the attendant in case of car calls, that the calls have been registered. In certain installations, elevators are arranged on both sides of the corridors and it is considered desirable in such installations to provide controls on both sides of the corridor at each floor. The system which will be described provides for controls on both sides of the corridors and the circuits are arranged so that the registration of a call by touching a control on either side of the corridor also effects illumination of the tube of the corresponding control on the other side of the corridor. Thus visual indication that the call is registered is provided on both sides of the corridor.

It sometimes happens that a car call is registered for a floor when in fact no stop is desired there to discharge a passenger. The system also provides for cancelling this call by touch.

The electronic tubes of these various controls may be broken down either by touching the tube envelope or an operating member such as a button preferably immovable connected to the tube envelope. The latter arrangement is preferred as it has certain advantages and as passengers

and attendants have grown accustomed to manipulating buttons. This button may be of conducting material having a high or low resistance or may be of a material having a high dielectric constant. Also the tube and button may be shielded against unwanted operation.

Features and advantages of the invention will be gained from the above statements and from the following description and appended claims.

In the drawings:

Figure 1 is a simplified schematic representation of an installation of two elevators in accordance with the invention.

Figures 2, 3 and 4 taken together constitute a simplified schematic wiring diagram of the power and control circuits for one of the elevators of Figure 1, certain of the circuits being common to the elevators.

Figures 2*s*, 3*s* and 4*s* are key sheets for Figures, 2, 3 and 4, showing the electromagnetic switches in spindle form; and Figures 2*a* and 3*a* taken together are the control circuits for another of the elevators of Figure 1, corresponding to those of Figures 2 and 3 for one elevator.

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. Two elevators are illustrated and are indicated as serving four floors. Each elevator car is raised and lowered by means of a hoisting motor. This motor drives a traction sheave over which pass the hoisting ropes for the car and counterweight. An electromechanical 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 controls for operation by the car attendant. These include a plurality of call registering controls, one for each floor, hereinafter termed car buttons, a start control hereinafter termed start button, door controls hereinafter termed door close button and door open button, a non-stop control hereinafter termed non-stop button and reversal controls hereinafter termed up reversal button and down reversal button. These buttons are shown in the wiring diagrams and will be referred to later.

The call registering controls at the floors hereinafter termed landing buttons are illustrated as arranged in two risers as indicative of an installation in which elevators are arranged in groups on each side of the corridors. An up landing button and a down landing button are provided in each riser at each intermediate floor. One landing button is provided in each riser at each terminal floor.

Referring now to the wiring diagrams, the various control and power circuits are illustrated diagrammatically. Figures 2 and 3 show call registering, call pick-up, highest call, stop initiating and call cancelling circuits for four floors as applied to one elevator. Figure 4 shows additional control circuits and the power circuits for this elevator. When applied to a plurality of elevators, the landing call registering circuits and certain circuits associated therewith are common to the elevators, and circuits corresponding to those of Figures 2, 3 and 4 individual to the one elevator are provided for the other elevators, as will be seen from Figures 2*a* and 3*a*, circuits for a second elevator corresponding to those of Figure 4 not being shown but being the same. The same reference characters as employed in Figures 2 and 3, but with the letter "*a*" appended thereto, are applied to the corresponding parts in Figures 2*a* and 3*a*.

In the description which follows, unless otherwise indicated, reference will be to the circuits of Figures 2, 3 and 4. A simplified control system has been illustrated because it facilitates disclosure of an application of the invention. It is understood that other control and safety elements may be added in making up the system and that such system is subject to many variations.

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

BK, brake resistance switch
DC, door close switch
DD, down direction switch
DG, direction holding switch
DGX, auxiliary direction switch
DO, door open switch
E, speed switch
EX, auxiliary speed switch
H, field and brake switch
HJ, highest call switch
HLS, highest call light switch
HR, highest call reversal switch
KR, running switch
PM, pawl magnet
SO, operating sequence switch
UD, up direction switch
XA, speed switch timing relay
XY, landing call non-cancelling 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. The coil of the electromechanical brake is similarly designated as BR and contacts operated by the brake are designated as BR1. Letters are also employed to designate other switches and elements of the control system. In certain instances, such as the case of the landing buttons, these elements are provided for the floors. In such cases, differentiation as to floors is made by appending to the letters numerals corresponding to the floor numbers with the letter T used for the upper terminal instead of a numeral.

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 2*s*, 3*s* and 4*s*, where the switches are arranged in alphabetical order, and where the coils and contacts are positioned on spindles in horizontal alignment with the corresponding elements of the wiring diagram. The electromagnetic switches are illustrated in deenergized condition with direction holding switch DG, which is a latching switch, in unlatched condition.

Referring now especially to Figures 2 and 3, the up landing buttons are designated U while the down landing buttons are designated D. The landing buttons of one riser are marked with a prime to distinguish them from those of the other riser. The landing buttons in a plural elevator installation, whether arranged in a single or double riser, are common to all the elevators. The car buttons are designated C.

The start button is designated SB. The door close and door open buttons are designated DCB and DOB respectively. The non-stop button is designated NSB, The up reversal and down

reversal buttons are designated URB and DRB respectively.

A plurality of additional touch control electronic tubes, one for each floor above the lower terminal, are provided in the elevator car on the control panel for manually cancelling registered car calls for the corresponding floors when stops are not desired for passenger discharge. These controls which will hereafter be termed car call cancelling buttons are designated CC. A similar touch control electronic tube is provided for the non-stop button, this control being termed a non-stop release button and designated NSRB.

The electronic tubes of the touch buttons so far referred to are cold cathode gas tubes and preferably of the type having a wire anode extending to within a short distance of the glass envelope of the tube, such as the RCA 1C21 and Western Electric 313C. These tubes are arranged to be touched adjacent the anode or, where a fixed button is provided to be touched, the button is connected to the tube envelope adjacent the anode. Suitable arrangements are disclosed in the copending applications of William Henry Bruns, namely, application Serial No. 604,185, filed July 10, 1945, application Serial No. 769,035, filed August 16, 1947 and application Serial No. 31,293 filed June 5, 1948. The tubes of the type mentioned are three element tubes having an anode, a cathode and a control electrode, designated for landing button D3 for example an AN, CA and GD respectively. The control electrode is utilized for controlling the corresponding tube across the corridor. When a single riser of landing buttons is utilized the control electrodes are connected to the cathodes. This is done in case of the car buttons for floors above the first floor, car call cancelling buttons, start button, non-stop buttons, reversal buttons and door open button, and as a consequence the control electrodes are not indicated in the circuits. Also tubes having only two electrodes may be employed in such instances.

Other electronic tubes are employed in the system. These include tubes arranged in call pick-up and stop initiating circuits. Two of these tubes are provided, one for car calls designated CCP and one for landing calls designated LCP. Also a tube is provided in the circuits for automatically cancelling calls registered by the landing buttons when these calls are answered. This will hereinafter be termed landing call cancelling tube and designated LCC. Also a tube is provided in the highest call return circuits which will be termed highest call return tube and designated HCR. Tubes CCP, LCP, LCC and HCR are preferably cold cathode gas tubes of the RCA 0A4G type.

TP2 is a tube utilized in the time preference circuits for the second floor. This tube is a thyratron such as the RCA 2050.

One or more position indicators are provided for each car in each of which a plurality of car position indicator lamps, one for each floor, are utilized. These lamps are illustrated as glow discharge tubes and are designated generally as PC. The car position indicator may be located in the car or on the starter's panel (see Figure 1), or a car position indicator may be provided at each of these locations.

Waiting passenger indicator lamps are provided for indicating the calls registered by landing buttons. These lamps are illustrated as glow discharge tubes and are designated generally as WPU for up calls and WPD for down calls. The waiting passenger indicator is common to all the elevators and is usually located on the starter's panel, Figure 1, in control systems of this character.

A plurality of rectifiers are provided which are designated generally as V. A considerable number of these rectifiers are for blocking the flow of appreciable current in one direction in direct current circuits. Certain of these direct current blocking rectifiers, one for each floor, are in the circuits controlled by the car buttons and are designated VC. Certain other of these direct current blocking rectifiers, one for each intermediate floor, are in the highest landing call circuits and are designated VHL. Certain others of the direct current blocking rectifiers, one for each pair of down landing buttons and one for each pair of up landing buttons, are provided in the connections from these landing buttons to the highest landing call circuit. Those in the connections to down landing buttons are designated VD and those in the connections to up landing buttons are designated VU. Selenium rectifiers have been found satisfactory in these circuits. Other rectifiers employed in the circuits will be referred to later.

A plurality of resistors are provided which are designated generally as R. Certain of these resistors serve as load resistors in the anode-cathode circuits for the tubes of the car buttons and landing buttons. The load resistors for the tubes of the car buttons are designated RC. The load resistors for the tubes of the up landing buttons are designated RU while those for the tubes of the down landing buttons are designated RD. Resistors are also provided in the anode-cathode circuits for the tubes of the car call cancelling buttons. These resistors serve as protective resistors and are designated RCC. Protective resistors are also provided in the circuits for the control electrodes for the tubes of the landing buttons. These resistors for the tubes of the up landing buttons are designated RUG and for the tubes of the down landing buttons are designated RDG, with differentiation as to side of corridor the same as in the case of the landing buttons. Protective resistors are also provided in the circuits for the waiting passenger indicator lamps. These resistors for the up waiting passenger indicator lamps are designated RWU and those for the down waiting passenger indicator lamps are designated RWD. A protective resistor is provided for the car position indicator lamps. This resistor is common to these lamps and is designated RPC. Equalizing resistors are provided in the anode-cathode circuits for the tubes of the landing buttons to enable the tubes of the corresponding buttons across the corridor to be operated in parallel. These resistors for the tubes of the up landing buttons are designated RUE and those for the tubes of the down landing buttons are designated RDE, with differentiation as to side of corridor the same as in the case of the landing buttons. RUR2 is a protective resistor for the anode-cathode circuits for the tube of up reversal button URB while RDR2 is a protective resistor for the anode-cathode circuits for the tube of down reversal button DRB. RDO1 and RDO2 are protective resistors for the anode-cathode circuits for the tube of door open button DOB. RNSR is a protective resistor for the anode-cathode circuit for the tube of non-stop release button NSRB. RLCP is a protective resistor for the anode-cathode circuit for tube LCP, this resistor also serving as a protective resistor for the

anode-cathode circuit for the tubes of non-stop button NSB. RCCP is a protective resistor for the anode-cathode circuit for tube CCP. RDCP is a protective resistor in the circuit for the control electrode for the tube of door close button DCB while DRCT is a resisor in a circuit for connecting this electrode to the cathode of this tube. RCGP is a protective resistor in the circuit for the control electrodes for the tube of car button C1 for the first floor while RCGT is a resistor in a circuit for connecting this electrode to the cathode of this tube. RLPP, RCPP, RHCP and RLGP are protective resistors in the circuits for the control electrodes for tubes LCP, CCP, HCR and LCC respectively. RLPT, RCPT, RHCT and RLCT are resistors in circuits connecting the control electrodes and cathodes of tubes LCP, CCP, HCR and LCC respectively. RLCC is a load resistor in the anode-cathode circuit for tube LCC while resistors RLCD1 and RLCD2 taken together constitute a voltage divider for determining the voltage applied to the anode-cathode circuit of this tube. RSB is a resistor in a circuit having to do with enabling the attendant to discontinue the touch of the start button without interrupting the running of the car. RACC is a resistor in the circuit for automatically cancelling car calls when these calls are answered which enables load resistors of smaller capacity to be utilized for the car buttons. Other resistors employed in the circuits will be referred to later.

A plurality of condensers are provided which are designated generally as Q. Certain of these condensers designated QC are in the call cancelling circuits for the car buttons. Certain other of these condensers are in the circuits for the tubes of the landing buttons. Those for the up landing buttons are designated QU and those for the down landing buttons are designated QD, with differentiation as to side of corridor the same as in the case of the landing buttons. QCC is a condenser in a circuit common to the car call cancelling buttons and having to do with extinguishing the tube of the car call cancelling button when one is touched to manually cancel a car call. QNSR is a condenser which serves a similar purpose for the non-stop release buttons. QNS, QPM, QDO, QDR and QUR are voltage absorbing condensers to prevent unwanted firing of tubes due to voltage surges as when the anode-cathode circuits for the tubes are established. Condenser QCU and inductance IC serve to prevent unwanted firing of the tubes of the car buttons and car call cancelling buttons when switch IS is closed. RUR1 is a resistor for protecting the tube of buton URB from the collapse of condenser QUR when the tube breaks down. Resistor RDR1 serves the same purpose for the tube of button DRB, while coil DO serves the same purpose for the tube of button DOB and coil PM serves the same purpose for tubes CCP and LCP, assisted in the case of tube CCP by resistor RCCP and in the case of tube LCP by resistor RLCP. Other condensers employed in the circuits will be referred to later.

Mechanism actuated in accordance with movement of the elevator car is utilized in the electronic control circuits of each elevator. Such mechanism may be in the form of a floor selector as indicated in Figure 1. Each selector is driven preferably by means of a tape attached to the car and counterweight and having teeth thereon for engaging teeth on the selector driving wheel. It comprises a crosshead which is driven by a screw. This screw is driven through bevel gears by a chain and sprocket, in turn driven from the shaft upon which the driving wheel is mounted, thus moving the crosshead in accordance with movement of the car. The crosshead carries a carriage upon which is mounted mechanism for controlling the call pick-up, highest call, stop initiating and call cancelling circuits. Mechanism is also mounted on the carriage for causing, when a stop is initiated for a floor, 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 which moves with the car. When circuits are set up to initiate a stop the carriage is brought to a stop. This may occur either during the advance for installations of over a certain speed or during movement of the carriage with the crosshead. The crosshead 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 4 where the motor is designated AM. Energization of the advancer motor is controlled by contacts operated by the pawl magnet PM. The circuits for this magnet appear in Figures 2 and 4. This magnet has two coils, one an operating coil and the other a reset coil. When operated, the magnet is latched in operated condition as by a permanent magnet core and remains so until the reset coil is energized. The pawl 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 pawl 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 Figures 3 and 4 and designated 3LS, 2LS and 1LS. When a stop is initiated, the pawl magnet reset coil is energized to release the latch. This causes the deenergization of the advancer motor and the extension of the pawls for cooperation with the stopping lugs. The pawl for the direction in which the car is travelling engages the stopping lug for the floor for which the stop is initiated, bringing the carriage to a stop. The crosshead continues its movement and, due to the relative movement between the crosshead and the carriage, effects the opening of selector switches 3LS, 2LS and 1LS in sequence to effect the slow down and stopping of the car.

Travelling brushes are carried by a panel on the carriage to cooperate with stationary contacts for the various floors arranged on the floor bars. Also a cam is provided on this panel for engaging hook switches for the various floors mounted 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 and

the cam is engaged with the hook switch for that floor. Being on the advance panel, however, these brushes and cam are advanced in starting the car, are latched in engagement with their contacts and hook switch for a floor by a pawl when a stop is initiated and are maintained in that condition as the advance is taken up as the car comes into the floor. A switch is also carried by the carriage to be actuated by trough shaped cams, one for each floor, mounted on the floor bars. A brush and a cam are mounted on a panel carried by the crosshead so as not to be advanced by the advancer motor. This brush and cam are for engaging contacts and hook switches mounted on the floor bars. These brushes, cams, stationary contacts and hook switches are shown in the wiring diagram and occur for the most part in Figure 2.

Referring first to Figure 2, the switch operated by the trough shaped cams has to do with initiating stops and is designated SI. The trough shaped cams with which this switch cooperates are designated generally as TC. The cam carried by the crosshead which is not subject to the advancer motor and the hook switches engaged thereby are in the car position indicator circuits and automatic car call cancelling circuits. This cam is designated CX while the hook switches are designated generally as HX. This cam is formed with its leading edges of insulating material as indicated. This causes a hook switch, when engaged, to open its contacts before contact is made between the hook end of the switch and the conducting portion of the cam. The cam carried by the advancer panel and the hook switches with which it cooperates have to do with car call pick-up and the highest car call operations. This cam is designated CY while the hook switches are designated generally as HC. This cam also has its leading edges formed of insulating material so that the hook switches are open before contact is made with the current conducting portion of the cam. Also this cam is of a length to cause, when its conducting portion is engaging a hook switch, the lower insulating portion to open the hook switch next below. Two of the brushes carried by the advancer panel and the stationary contacts with which they cooperate have to do with landing call pick-up and automatic call cancelling operations. This brush for up landing calls is designated BU while the stationary contacts which it engages are designated generally as SU. The brush for down landing calls is designated BD while the stationary contacts which it engages are designated generally as SD. No stationary contact is provided for the top floor for engagement by brush BU. Another brush carried by the advancer panel and the stationary contacts with which it cooperates have to do with highest landing call circuits. This brush is designated BHL while the stationary contacts with which it cooperates are designated generally as HL. Brush BHL is mounted on a lever for effecting the separation of contacts HLC when the brush engages a stationary contact. The stationary contacts SU, SD and HL are connected to the corresponding stationary contacts of the selectors for the other elevators. This connection is effected by the wires designated generally as WU, WD and WH.

Referring now to Figure 4, another brush ADB carried by the advancer panel is arranged to engage a stationary contact ALC at the first floor. They have to do with the direction circuits as will be explained later. The brush carried by the

crosshead so as not to be subject to the advancer motor and the stationary contacts engaged thereby are shown in Figure 3 and have to do with automatically changing the direction of travel at the terminal floors. This brush is designated DB while the stationary contacts which it engages and which are provided at the first and top floors are designated LTC and TTC.

The source of power for the electronically controlled circuits, indicated principally at the top of Figure 2, is one capable of providing various values of direct current and alternating current voltages and combinations thereof. The feed lines of this source which provide direct current are designated generally as B with the differentiation made by appending numbers thereto indicative of the value and polarity of the voltage of the line with reference to the voltage of the line designated solely as B which is taken as zero. The voltage values indicated are for electronic tubes of the types mentioned for the particular circuits. The voltages provided by feed lines B+150 and B−50 are taken directly from the source. The voltages provided by feed lines designated B+100, B+70 and B−30 are obtained off voltage dividers RDV1 and RDV2 respectively connected across feed lines B+150, B and B−50. Another voltage divider RDB3 is connected across feed lines B and B+150 but subject to service switch IS. This is utilized to provide voltage for the lamps of the position indicator, the value of which depends on the type of lamps used. Certain of the alternating current voltages are illustrated as provided by transformers TF1, TF2 and TF3, which may have a primary common thereto instead of separate primaries. Connections are made from one side of the secondary of each transformer to certain ones of the direct current feed lines. The other side of the transformer TF1 is connected to a feed line designated AC1. A tap on the secondary of transformer TF2 is connected to a feed line designated AC2. A voltage divider RDV4 is connected from this tap to the other side of the secondary and a tap on this voltage divider is connected to a feed line designated AC3. A tap on the secondary of transformer TF3 is connected to a feed line designated AC4. A voltage divider RDV5 is connected from this tap to the other side of the secondary and a tap on this voltage divider is connected to ground GR. For the particular tubes mentioned, the root mean square values of the alternating current voltages are:

110 volts from AC1 to B−50
60 volts from AC2 to B
90 volts from AC3 to B
150 volts from GR to B+70
105 volts from AC4 to B+70

For convenience, feed lines AC1, AC2, AC3 and AC4 are not extended down the sheets as in the case of the direct current feed lines, but the connections are indicated by applying the reference characters for these feed lines to the circuits to which they are connected. In certain instances, connections to direct current feed lines are indicated in a similar manner. Also for convenience, a transformer TF4, the secondary of which is connected in circuit with the control electrode of tube LCC, is shown at that point. The root mean square value of the voltage of this secondary is 40 volts. The voltage values enumerated may vary, some considerably.

For the above voltage values and for the types of electronic tubes specified, the following ohmic values of resistors and capacities of condensers

in the electronic circuits have been found satisfactory.

Resistors	Ohms
RDO1, RDR1, RUR1	100
RDE, RUE	400
RF2	500
RDX1, RDX2, RQNS	1,000
RACC	1,250
RDO2	1,500
RSB	2,000
RPM	3,600
RC, RCC, RCCP, RD, RU	4,000
RLCP	5,000
RCPP, RDR2, RLGP, RLPP, RTP2, RUR2	10,000
RLNR, RLQN	20,000
RLCC	50,000
RLCD2	60,000
RCGP, RCPT, RDCT, RHCP, RHCT, RLPT	100,000
RLCD1	200,000
RDCP	300,000
RCGT, RNSR	400,000
RWD, RWU, RLCT	1 meg.
RDG, RLC, RUG	2 meg.
RQT	10 meg.

Condensers	Microfarads
QD, QU	.02
QNR	.03
QDO, QDR, QUR	.1
QF2	1
QT2	3.5
QC, QCC, QCU, QNS, QNSB, QNSR	4
QPM	8

Referring now also to Figure 4, 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. Such an arrangement is illustrated in Figure 4 and the motor generator set is shown in Figure 1. It is to be understood that either a direct current or alternating current driving motor may be employed to drive the generator, 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.

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 4. In such arrangement, the supply lines of Figure 4 would be connected to the exciter.

The armature of the generator is designated G, its separately excited field winding being designated GF and its series field winding GSF. The armature of the elevator motor is designated M and its separately excited field winding MF. A resistance RG is provided for controlling the strength of the generator separately excited field and therefore the voltage applied to the elevator motor armature. RM is a cooling resistance for the motor field winding MF while RB is a cooling resistance for the brake release coil BR.

The contacts operated by the car door and engaged when this door is closed are designated GS1 and GS2. The door contacts operated by the various hoistway doors are arranged in series relation. These contacts are not closed until the doors are closed and locked. For convenience the hoistway door contacts are shown as a single pair of contacts designated DL. The car door and hoistway doors are shown in Figure 1 and circuits are shown in Figure 3 for effecting their opening and closing by power. The door operating mechanism is not shown but may be of the type shown in Patent No. 1,922,708 to Clifford Norton, granted August 15, 1933. DOL and DCL are respectively the door open limit switch and the door close limit switch of the door operating mechanism.

SS1, SS2, SS3 and SS4 are terminal stopping switch contacts. The armature of the advancer motor is designated AMA. This motor has two field winding portions designated AMF1 and AMF2.

It will be assumed that the car is out of service and positioned at the first floor. When the car last arrived at the first floor, brush DB engaged stationary contact LTC completing a circuit from feed line B+150 through the brush and contact, resistance RDX2, contacts DGX3, set coil of direction holding switch DG, contacts H2 and contacts EX2, to line B. This caused the operation of switch DG which latched in operated condition. Thus when the car is placed back in service switch DG is in operated condition.

The car is returned to service by restarting the motor generator set and closing service switch IS. The closing of switch IS renders effective the car buttons and other controls individual to the car. The hall buttons, being common to all cars, remain effective when the car is out of service. The closing of service switch IS also causes sufficient voltage to be applied to the position indicator lamp PC1 for the first floor to cause this lamp to become illuminated. The circuit is from line B+150 through resistance RACC, contacting portion of cam CX, hook switch HX1, lamp PC1, resistance RPC, to voltage divider RDV3. The lighting of this lamp indicates that the car is at the first floor. Assuming that the voltage of supply lines + and — of Figure 4 is from an exciter driven by the motor generator set, the starting of the motor generator set causes the elevator motor field winding MF to be energized to a standing field value. Also, brake resistance switch BK is operated to cause, through the engagement of contacts BK1, relay XA to be operated. Switch BK also engages contacts BK2 to short circuit resistance RB in series with the brake release coil BR. As brush ADB is in engagement with stationary contact ALC, highest call light switch HLS also is operated. Further, as contacts DG13 are engaged, switch DGX is operated, this switch separating contacts DGX3 to disconnect the set coil of switch DG from the lines, inasmuch as this switch is latched in operated condition. The doors may be either parked open or parked closed. The circuits are illustrated for parked open condition although the same circuits may be utilized for parking the doors closed. In the event the doors were parked closed, it would be desirable to have in parallel with contacts SO3 a switch which is temporarily closed in starting the motor generator set. This, as will be seen from later description, would cause operation of door open switch DO to effect the opening of the doors and thus enable the attendant to enter the car.

To start the car, the attendant touches start button SB. It is to be noted that the anode-cathode circuit for the tube of this button is from A. C. feed line AC1 through the tube and the coil of running switch KR to feed line B—50. Thus 110 volts of alternating current are being applied to the tube which is insufficient to break it down.

However, when the attendant touches the start button, a circuit is established from ground GR to voltage divider RDV5, the secondary of transformer TF3 to line B+70, thence to voltage divider RDV1 and through voltage divider RDV2 to line B—50, thence through the secondary of transformer TF1 to line AC1 and thus to the anode of the tube, and thence from the tube envelope through the body of the attendant back to ground. This causes sufficient voltage to be applied across the envelope and anode of the tube to alter the field pattern of the tube sufficiently to cause the tube to break down. When the tube fires, it becomes illuminated, indicating that the control operation is being performed. As soon as the tube fires, the voltage across its anode-cathode drops to sustaining value with the result that sufficient voltage is applied to the coil of running switch KR to cause this switch to operate. Rectifier VKR acts to sustain the current in the coil of switch KR during the negative portion of alternating current cycle.

Upon the firing of the tube of button SB, sufficient voltage is applied across the control electrode and cathode of the tube of the door close button DCB to cause this tube to fire. When it fires, the tube becomes illuminated to indicate that its control operation is being performed. This in turn causes sufficient voltage to be applied to the coil of door close switch DC to cause this switch to operate. The circuit for the coil of switch DC is from line AC1 through the anode and cathode of the tube of button DCB, contacts H1, contacts DO1, coil DC and limit switch DCL to line B—50. The rectifier VDC acts to sustain the energization of the coil of switch DC during the negative portion of the alternating current cycle. Switch DC operates to initiate the closing of the first floor hoistway door and car door by contacts not shown. It also engages contacts DC1 to complete a circuit for the operating coil of pawl magnet PM through contacts EX4. The pawl magnet operates and becomes latched in operated condition. Upon operation it retracts the pawls to clear the stopping collars and in doing it engages contacts PM3 which completes a circuit from line +, through contacts DG7, armature AMA and field winding AMF2 of the advancer motor and contacts KR1, closed as the result of the operation of switch KR. Thus the advancer motor operates to advance the carriage in the up direction as the closing of the doors takes place.

During the advance of the carriage, selector switches 1LS and 3LS are closed and selector switch 2LS is opened. The closing of switch 3LS completes a circuit for the coil of auxiliary speed switch EX through contacts DD1 and contacts SS3. Switch EX separates contacts EX4 to disconnect the pawl magnet operating coil, inasmuch as the pawl magnet is latched in operated condition. Also the brushes, switch and cam carried by the advancer panel are advanced by movement of the carriage. This includes brush ADB which leaves contact ALC, breaking the circuit for the coil of switch HLS. This switch upon dropping out engages contacts HLS2 which completes a circuit from line B+150 through the tube of button URB, contacts DG6, contacts HLS2 and resistance RUR2 to line AC1. Thus 110 volts of alternating current superimposed on 200 volts of direct current are applied to this tube which causes the tube to break down, resistor RDX2 being disconnected at contacts DGX4 from across the tube at this time to insure the tube breaking down. The illumination of this tube serves to

indicate that the car is to travel in the up direction.

The doors may be closed without initiating the starting of the car by the attendant touching door close button DCB instead of start button SB. This causes the tube of button DCB to fire as a result of the connection through the attendant to ground, in the same manner as the start button tube is fired by touch as above described. The breakdown of the door close button tube causes the operation of the door close switch DC to initiate the closing of the doors. Regardless of whether closed by button SB or button DCB, as the doors reach closed position, door close limit switch DCL opens to break the circuit for the coil of door close switch DC with the result that the tube of button DCB is extinguished and the door close switch drops out.

The doors, at any point during their closing or after they have been closed either by door close button DCB or start button SB, may be reopened by the attendant touching door open button DOB. Where the doors have been closed by start button SB, the door open button is not effective if the starting operation has progressed beyond the point where switch E is operated and thus contacts E1 are separated. It is to be noted that a circuit exists from line B+150 through resistance RDO1, the tube of door open button DOB, coil of door open switch DO, contacts E1, door open limit switch DOL, and contacts SO2 to line B. This voltage, however, is not sufficient to break down the tube. When the attendant touches button DOB, a circuit is established from ground to voltage divider RVD5, the secondary of transformer TF3 to line B+70, thence through half of voltage divider RDV1 to line B+150 which is connected through resistor RDO1 and coil of switch DO to the anode of the tube, and thence from the tube envelope through the attendant's body back to ground. As a result, sufficient alternating current voltage is applied between the anode and the tube envelope to break down the tube. When the tube fires, it becomes illuminated to indicate that its control operation is being performed. The firing of the tube causes operation of the door open switch DO which engages contacts not shown to effect the opening of the doors. It also separates interlock contacts DO1 in the circuit for the coil of door close switch DC, and engages self-holding contacts DO2. As the doors reach open position, door open limit switch DOL opens to break the circuit for the coil of switch DO. As a result, the tube is extinguished and switch DO drops out.

It is to be noted that the anode-cathode circuit of the tube of button DOB is connected across lines B+150 and B so that this tube once fired is maintained conducting, enabling the attendant to remove his finger from the button. However, in the case of buttons SB and DCB, the anode-cathode circuit of each tube is connected across the secondary of transformer TF1 so that the tube is not maintained conducting when the touch is discontinued. Thus to maintain these buttons effective the attendant holds his finger in contact with the button. This arrangement is preferred for reasons of safety in connection with the operation of the doors.

It will be assumed that the attendant initiates the starting of the car and the closing of the doors by touching start button SB. As the doors reach closed positions car door contacts GS1 and GS2 engage and the first floor hoistway door contacts engage so that door contacts DL close. As

selector contacts 1LS, due to the advance of the carriage, are closed when contacts GS1 and DL close, a circuit is established from line + through the coil of field and brake switch H, selector contacts 1LS, contacts DG10, coil of up direction switch UD, contacts SS1, contacts DL, contacts GS1 and contacts KR2 to line —. Switch H upon operation engages contacts H5 to short circuit resistance RM in circuit with the elevator field winding MF, bringing this field up to full strength. Switch H also engages contacts H6 which completes a circuit for the release coil BR, of the electromechanical brake. It also separates contacts H6 to disconnect generator field winding GF from across the generator armature. At the same time switch UD engages contacts UD2 and UD3 to connect the generator field winding to lines + and —. The completion of the circuit for the generator field winding causes current to be supplied from the generator armature G to the motor armature M and, the brake being released as the result of the energization of its coil, the elevator motor starts the car in the up direction.

The brake, upon being released, effects the separation of contacts BR1 which breaks the circuit for the coil of brake resistance switch BK. This switch drops out to separate contacts BK2, inserting cooling resistance RB in circuit with the brake release coil. It also separates contacts BK1 to break the circuit for the coil of speed switch timing relay XA. Relay XA is delayed in dropping out by the discharge of condenser QXA. Upon dropping out it engages contacts XA1 which completes a circuit for the coil of speed switch E. This circuit is from line + through contacts XA1, contacts H3, coil E, switch 3LS, contacts DD1 and contacts SS3 to line —. Switch E upon operation separates contacts E1 to render door open button DOB ineffective. It also engages contacts E2 to complete a circuit through car door contacts GS2 for the coil of operating sequence switch SO. Switch SO upon operation engages contacts SO4 to establish a self-holding circuit. It also engages SO1 to establish a shunt circuit through resistance RSB and rectifier VSB for the tube of button SB, causing this tube to be extinguished. The discontinuance of the illumination advises the attendant that the may now remove his finger from the start button, switch KR being maintained operated by way of this shunt circuit. Switch E also engages contacts E3 to short circuit a portion of resistance RG in circuit with generator field winding GF. This increases the voltage applied to the generator field winding to a value to cause the generator voltage to build up to full value and thus to bring the elevator car up to full speed.

Assume that before the starting of the car from the first floor is initiated two passengers enter the car and announce the second and third floors as their destinations. The attendant thereupon touches car buttons C2 and C3. This causes their tubes to break down, the circuit in each case being from the tube envelope through the attendant's body to ground, thereby applying alternating current voltage obtained from transformer TF3 across the tube envelope and anode, the circuit being similar to that traced for the door open button DOB. As soon as the tubes break down, they become illuminated to indicate that the calls are registered and the attendant may then discontinue the touch, the tubes being maintained conductive by the voltage from across line B+150 to line B. Also, when the tubes become conductive a potential drop exists across the load resistors for these tubes, namely, resistors RC2 and RC3. This causes potential to be applied to the control electrode of highest call return tube HCR, the circuit in the case of the third floor car button for example being from a connection between the cathode of tube C3 and resistance RC3 through hook switch HX3, rectifier VC3, hook switch HC3, hook switch HCT, rectifier VHC and resistor RHCP to the control electrode. Thus voltage equal to the potential drop across resistor RC3 plus the potential difference between line B and line B—50 is applied across the control electrode and cathode of tube HCR, which causes this tube to break down between anode and cathode. The anode-cathode circuit of this tube is from line AC1 through contacts HR3, coil HJ, the anode and cathode of the tube to line B—50. When the tube fires sufficient voltage is applied to the coil of highest call switch HJ to cause this switch to operate, rectifier VHJ acting to sustain the current in the coil during the negative portion of the alternating current cycle. Relay HJ upon operation engages contacts HJ1 which causes the tube of button URB to break down immediately, the illumination of this tube thus also serving to indicate that a call exists above the car. Relay HJ also separates contacts HJ2, preventing the completion of a circuit for the coil of highest call reversal switch HR upon the engagement of contacts HLS3 incident to the starting of the car.

Upon the engagement of the conducting portion of cam CY with hook switch HC2, a circuit is completed from the connection of the cathode of the tube of button C2 and load resistor RC2 through hook switch HX2, rectifier VC2, hook switch HC2, cam CY and resistor RCPP to the control electrode of tube CCP. As explained in connection with tube HCR this applied voltage equal to the potential drop across resistor RC2 plus the potential difference between line B and line B—50 across the control electrode and cathode of tube CCP. This places the tube in condition to break down between anode and cathode upon the completion of its anode-cathode circuit. At this time the operating roller of switch SI is in engagement with the lower side of the trough of second floor cam TC2, causing this switch to be open. Shortly thereafter the roller rides into the trough of the cam causing the momentary closing of switch SI. This completes the anode-cathode circuit for tube CCP and, owing to the fact that the conducting portion of cam CY is of a length not to run off switch HC2 so that voltage is still applied across the control electrode and cathode of the tube, causes the tube to break down from anode to cathode. The circuit for this tube is from line B+150 through switch SI, contacts EX1, contacts PM2, pawl magnet reset coil PM, the anode and cathode of tube CCP and resistance RCPP to line B—50. When the tube thus breaks down, sufficient voltage is applied to the reset coil of the pawl magnet to cause the pawl magnet to be reset. The reset of the pawl magnet releases the pawls and separates contacts PM2 and PM3. The separation of contacts PM2 breaks the circuit for the reset coil of the pawl magnet and the anode-cathode circuit for tube CCP while the separation of contacts PM3 deenergizes the advancer motor AM.

As the car and therefore the crosshead move upwardly the up pawl engages the second floor stopping collar bringing the carriage to a stop. Also, at this time the roller of switch SI has moved out of the trough, opening the switch.

Continued movement of the crosshead causes the opening of selector switch 3LS, the closing of selector switch 2LS and the opening of selector switch 1LS in the order named as the car comes to the second floor. The opening of selector switch 3LS breaks the circuit for the coils of switches E and EX. Switch E drops out to separate contacts E3 which reinserts resistance RG in circuit with the generator field winding GF. This decreases the voltage of the generator causing the car to slow down. Switch E also engages contacts E1 in preparation for the automatic door operation.

The circuit for automatically initiating the opening of the doors is completed upon the engagement of contacts 2LS just before the car reaches the second floor. This circuit is from line B+150 through resistor RDO1, the tube of button DOB, coil DO, contacts E1, switch DOL, contacts 2LS, contacts SO3 and resistor RDO2 to line AC1. This causes 110 volts of alternating current superimposed upon 200 volts of direct current to be applied across the anode-cathode of this tube which causes the tube to break down. Thus the door opening switch DO is operated to cause the opening of the car door and second floor hoistway door in the manner previously described. The engagement of contacts DO2 transfers the circuit of coil DO and the tube from line AC1 to line B and thus maintains the door opening operation during the interval between the separation of contacts SO3 and the engagement of contacts SO2 as a result of the opening of car door contacts GS2 in the door opening operation.

The opening of switch 1LS, which occurs as the car arrives at the second floor, breaks the circuit for the coils of switches H and UD. Switch UD separates the contacts UD2 and UD3 to break the circuit for the generator field winding GF, while switch H separates contacts H4 to break the circuit for release coil BR of the electromechanical brake. Thus the excitation of the generator is discontinued and the brake is applied to bring the car to a stop at the second floor. At the same time switch H engages contacts H6 to reconnect field winding GF across the generator armature and separates contacts H5 to reinsert resistance RM in circuit with elevator motor field winding MF. Contacts H1 of switch H prevent the initiation of the reclosing of the doors and the restarting of the car, as by maintaining touch on button SB, until the car has been brought to a stop.

As the car arrives at the second floor, the conducting portion of cam CX engages hook switch HX2 which establishes a shunting circuit through resistor RACC for the tube of button C2. This raises the cathode potential of this tube, causing the tube to be extinguished and thus automatically cancelling the second floor car call. Also, the engagement of this conducting portion of cam CX with this hook switch completes a circuit for the second floor car position indicator lamp PC2 causing this lamp to become illuminated to indicate that the car is positioned at the second floor.

After the passenger has been discharged at the second floor, the doors are reclosed and the car started as before by the attendant touching start button SB. The advance of the carriage is for up car travel and the car is started in the up direction inasmuch as switch DG remains latched in operated condition.

Upon the engagement of the top insulated portion of cam CY with hook switch HC3, the hook switch opens to break the previously traced circuit to the control electrode of tube HCR. However, at this time brush BHL is below contact HL3 so that contacts HLC are in engagement. This maintains the voltage across the control electrode and cathode of tube HCR, the circuit to the control electrode being from line B+150 through contacts HLC, rectifier VHH and resistance RHCP. Thus tube HCR is maintained conductive and switch HJ is maintained operated.

Upon the engagement of the conducting portion of cam CY with hook switch HC3, voltage is applied across the control electrode and cathode of tube CCP as previously described. At the same time brush BHL engages stationary contact HL3 causing the opening of contacts HLC to discontinue the application of voltage across the control electrode and cathode of tube HCR. Inasmuch as alternating current is being supplied to this tube, the tube goes out and this switch HJ drops out. Upon dropping out, switch HJ engages contacts HJ2 which completes a circuit through contacts PM4, contacts EX3 and contacts HLS3 for the coil of highest call reversal switch HR. Switch HR engages contacts HR6 to establish a self-holding circuit and also engages contacts HR4 in a circuit through contacts DG4 and resistor RPM for the reset coil of the pawl magnet. Upon the closing of switch SI, as its roller runs into the trough of cam TC3, a circuit is completed for the pawl magnet reset coil through resistance RPM, contacts DG4 and contacts HR4. Tube CCP may also break down from anode to cathode depending upon the value of resistance RPM. The energization of the reset coil of the pawl magnet causes the car to be slowed down and brought to a stop at the third floor and the third floor hoistway door and car door to be automatically opened in the manner above described. The third floor car call is automatically cancelled and the third floor position indicator lamp PC3 is illuminated as the car comes to the floor, also as above described.

Contacts EX2 reengage at the initiation of the slow down and contacts H2 reengage as the car is brought to a stop at the third floor, whereupon a circuit is completed for the reset coil of direction holding switch DG, this circuit being from line B+150 through contacts HLS1, contacts HR5, resistance RDX1, contacts DGX2, reset coil of switch DG, contacts H2 and contacts EX2 to line B. This causes switch DG to be reset. Upon being reset switch DG engages contacts DG1 to place sufficient potential on the control electrode of the tube of button C1 to cause this tube to break down, thus automatically registering a car call for the first floor. It also separates contacts DG10 and engages DG11 to set the car for down car travel. It also separates contacts DG6 to extinguish the tube of button URB and engages contacts DG5 to establish a circuit for the tube of button DRB from line B+150 through the tube, contacts DG5 and resistor RDR2 to line AC1, causing this tube to break down, ressitor RDX1 being disconnected from across the tube by separation of contacts DGX1. Thus a visual indication is provided that the car is set for down direction of travel. It also engages contacts DG9 to reestablish the circuit for the coil of highest call light switch HLS, causing this switch to operate. It also engages contacts DG12 to by-pass contacts HLS3 and HJ2 to maintain switch HR operated. It also separates contacts DG13 to break the circuit

for the coil of auxiliary direction switch DGX which drops out. The resultant separation of contacts HLS1 and contacts DGX2 breaks the circuit for the reset coil of switch DG, switch DG remaining in reset condition.

After the passenger has been discharged at the third floor, the doors are reclosed and the car started as before by the attendant touching start button SB. However, owing to the fact that the switch DG is now reset and the car is set for downward travel, the carriage is advanced in the direction for down car travel and the car is started in the down direction. The downward advance of the carriage is due to the fact that contacts DG7 are separated and contacts DG8 are engaged wherefore the circuit for the advancer motor is through field winding AMF1 instead of through field winding AMF2. The starting of the car in the down direction is due to the fact that contacts DG10 are separated and contacts DG11 are engaged so that, upon the closure of the third floor hoistway door and car door to cause the engagement of door contacts DL and car door contacts GS1, a circuit is completed for the coil of down direction switch DD along with the coil of switch H. Thus switch DD engages contacts DD2 and DD3 so that the polarity of generator field excitation is such that the car is started in the down direction. Upon the engagement of the conducting portion of cam CY with hook switch HC1 as the car approaches the first floor, voltage is applied across the control electrode and cathode of tube CCP so that upon the closing of switch S1 as its roller runs into the trough of cam TC1, the reset coil of the pawl magnet PM is energized to effect the reset of the pawl magnet. As a result, the down pawl engages the first floor stopping collar, bringing the carriage to a stop and opening the selector switches to cause the slowing down and stopping of the car at the first floor and the automatic opening of the doors as previously described. Also terminal stopping switch contacts SS4 and SS2 open to assure the slowing down and stopping of the car at the first floor. The first floor car call is reset and the first floor car position indicator lamp PC1 is illuminated as the car arrives at the first floor due to the engagement of the conducting portion of cam CX with hook switch HX1.

As the car is brought to a stop, contacts H2 reengage which completes a circuit through brush DB and contact LTC for the set coil of switch DG, this circuit having been previously traced. Switch DG, upon operating, engages contacts DG13 which completes a circuit for the coil of switch DGX, condenser QDGX and resistance RDGX acting to delay the operation of this switch sufficiently to insure that switch DG is operated and latched in operated condition before contacts DGX3 separate. The operation of switch DG sets the car for travel in the up direction and extinguishes the tube of button DRB. Also switch HLS is maintained operated after the separation of contacts DG9 owing to the fact that brush ADB is in engagement wtih contact ALC with the car at the first floor.

Assume now that before button SB is touched to start the car from the first floor, an intending passenger at the second floor wishing to be carried in the up direction touches one of the up landing buttons, for example button U2. The touching of this button causes the tube of this button to fire in the same manner that the tubes of the car buttons were caused to fire as previously described, the circuit being from the envelope of the tube back to the ground through the body of the intending passenger. It is to be noted that before this tube fires the potential of its control electrode with respect to its cathode and that of the control electrode wtih respect to the cathode of the tube of the corresponding across the corridor button U2' is 30 volts negative. This, however, is not sufficient to cause the tubes to break down. However, when either tube does break down due to touch, that of button U2 in the example being discussed, the potential of the cathode of this tube rises an amount equal to the potential drop across load resistor RU2, which correspondingly raises the cathode potential of the tube of button U2'. This increases the difference in potential between the cathode and control electrode of the tube of button U2' to an amount equal to 30 volts plus the potential drop across resistance RU2 which is sufficient to fire this tube, equalizing resistors RUE2 and RUE2' enabling these two tubes to be conductive in parallel. Thus upon the touching of one button to register a call, both tubes fire, providing a visual indication on both sides of the corridor that the call has been registered.

As regards operations performed by these tubes in addition to the call registration indications, inasmuch as their cathodes are connected directly in parallel, the tubes act as one. The potential drop across load resistor RU2 plus 30 volts obtained from voltage divider RDV2 is applied to tube WPU2 which serves as up second floor waiting passenger indicator, causing this tube to break down and thus become illuminated to indicate that an up call has been registered at the second floor. Also a potential above line B equal to the voltage drop across load resistor RU2 is placed on selector contacts SU2. Also this results in a voltage equal to the potential drop across resistor RU2 plus the potential difference between line B and line B—50 being applied across the control electrode and cathode of tube HCR. This circuit is from the connection between load resistor RU2 and the cathodes of the tubes of buttons U2 and U2' to contact SU2, rectifier VU2, rectifier VHL2, contact HL1, brush BHL, rectifier VHLC, rectifier VHH and resistor RHCP to the control electrode of tube HCR. The firing of tube HCR causes the operation of switch HJ. Switch HJ engages contacts HJ1 causing the tube of button URB to fire to indicate that a call exists above the car. It also separates contacts HJ2 to prevent the energization of the coil of switch HR. Potential is also placed on selector stationary contacts SU2*a*, etc., for all other elevators but as to whether tube HCR for any other elevator is fired due to the registration of this call depends on whether the car is set for up travel and the position of brush BHL for that elevator.

Assume further that before button SB is touched to start the car, an intending passenger at the third floor wishing to be carried in the down direction touches one of the down landing buttons, for example D3. This causes the tubes of both down landing buttons D3 and D3' to fire as described in connection with the firing of the tubes of up landing buttons U2 and U2'. This applies a voltage equal to the potential drop across load resistor DR3 plus 30 volts obtained from voltage divider RDV2 to tube WPD3. This causes this tube to break down and thus provides visual indication that a down call has been registered at the third floor. Also potential is

placed on selector contact SD3, SD3a, etc., for each elevator and an additional circuit is provided for applying potential to the control electrode of tube HCR, HCRa, etc. for each elevator, this circuit for tube HCR being from the left hand side of load resistor RD3 to contact SD3 through rectifier VD3 and thence by way of rectifier VHL2 to the control electrode of tube HCR as previously traced.

Assume that the starting of the car is initiated. Potential is maintained on the control electrode of tube HCR and thus the tube is maintained conductive during movement of brush BHL between HL contacts by contacts HLC as previously described. Upon engagement of brush BU with contact SU2, voltage equal to the potential drop across resistor RU2 plus the potential difference between line B and line B—50 is applied across the control electrode and cathode of tube LCP. Upon the closing of switch SI the anode-cathode circuit of this tube is completed causing the tube to break down from anode to cathode and reset the pawl magnet. The circuit is similar to that previously traced for tube CCP. This causes the car to be slowed down and stopped at the second floor, as previously described.

As the pawl magnet is reset at the initiation of the stop, contacts PM1 engage to connect the control electrode of tube LCC to the cathodes of tubes of buttons U2 and U2'. The circuit is from these cathodes to stationary contact SU2, brush BU, contacts HR2, contacts XY1, contacts PM1, resistor RLGP and the secondary of transformer TF4 to the control electrode. The anode and cathode of tube LCC are connected across resistor RLCD1 which with resistor RLCD2 forms a voltage divider connected across lines B—50 and AC4. Thus 105 volts alternating current superimposed on 120 volts direct current are applied to the voltage divider and, as resistor RLCD1 is about three times the ohmic value of resistor RLCD2, about three-quarters of this voltage is applied across the anode-cathode of tube LCC. With contacts PM1 separated, the control electrode of this tube is connected to the cathode through the secondary of transformer TF4, the voltage of this secondary being in phase with that of the secondary of transformer TF3. This places the control electrode 40 volts above the cathode potential. Thus with contacts PM1 separated the voltage values are such that tube LCC does not break down. However upon the closing of contacts PM1, the cathode potential of the tubes of buttons U2 and U2' is placed on the control electrode of tube LCC. The control electrode potential is thus raised to a point which, with the alternating current voltage from transformer TF4 superimposed thereon, is sufficient to cause tube LCC to fire. This raises the cathode potential of tube LCC to a value tube drop below the anode potential. Due to blocking rectifier VLC permitting the flow of current from the cathode of tube LCC to the cathodes of the tubes of buttons U2 and U2', the potential of the cathodes of these latter tubes is raised with respect to their anodes, causing these tubes to be extinguished. Condensers QU2 and QU2' enable the potential of the control electrodes of the tubes of buttons U2 and U2' to be raised along with the cathodes to assist in extinguishing the tubes. Thus the up call at the second floor is automatically cancelled immediately the stop is initiated, preventing any other car answering the call. The cancelling of the call drops the potential of the cathodes of tubes U2 and U2' to that of line B. As a result, tube LCC is extinguished during the negative portion of the alternating current cycle and does not refire, obviating the stopping of another car due to the connection of the cathode of tube LCC through brush BU to selector contacts SU2 of the various elevators. Upon cancelling of the up second floor call, the application of voltage to the waiting passenger indicator lamp WPU2 is discontinued so that this lamp is extinguished when the call is answered.

For convenience it will be assumed that no passenger enters the car at the second floor and therefore that no car call is registered. Brush BHL as it moves upwardly touches the stationary contacts for the successive floors to ascertain whether or not potential is applied to these contacts. Thus, upon the engagement of brush BHL with contact HL2 for the second floor, potential was found on this contact due to the fact that an up call was registered at the second floor and a down call is registered at the third floor so that potential was maintained on the control electrode of tube HCR upon the separation of contacts HLC as the engagement of the brush with the stationary contact took place. When the up second floor call was cancelled, the potential was maintained due to the third floor down call. However, upon the engagement of brush BHL with stationary contact HL3 incident to the car proceeding from the second floor to the third floor (assuming button SB has been touched to initiate restarting of the car), no potential is found on this contact inasmuch as no up call is registered for the third floor and no landing call is registered for the fourth floor, rectifier VHL3 blocking the flow of current from the connection from load resistor RD3 through rectifier VD3. Thus upon the separation of contacts HLC, potential is removed from the control electrode of tube HCR which remains extinguished after the negative portion of the alternating current cycle, permitting switch HJ to drop out. Switch HJ engages contacts HJ2 which completes a circuit for the coil of switch HR as previously traced. Switch HR operates to become self-holding and separates contacts HR2 and engages contacts HR1, rendering up brush BU ineffective and down brush BD effective. Upon closing of switch SI a circuit is established for the reset coil of pawl magnet PM through contacts HR4. Also tube LCP may be caused to break down from anode to cathode inasmuch as the engagement of contacts HR1 places potential from resistor RD3 by way of contact SD3 and brush BD on the control electrode of this tube. The reset of the pawl magnet causes the car to be slowed down and stopped at the third floor in the manner previously described. Also the engagement of contacts PM1 causes the down third floor call to be automatically cancelled, the circuit to the control electrode of tube LCC being by way of contact SD3, brush BD and contacts HR1. The cancelling of this call prevents its being answered by another car. Owing to contacts HR5 being engaged, a circuit is completed for the reset coil of switch DG as the car comes to a stop to set the car for downward travel, as previously described.

Again for convenience it will be assumed that no passenger enters the car at the third floor and therefore that no car call is registered. Instead, it will be assumed that the car is again at the first floor and that instead of a down call

being registered at the third floor and an up call at the second floor, an up call is registered at the third floor and a down call at the second floor. Upon the engagement of brush BHL with contact HL2 incident to the car proceeding from the first floor to the second floor potential is found on this contact owing to the upcall registered at the third floor. Thus switch HJ is maintained operated. Therefore contacts HR1 are separated so that the engagement of brush BD with contact SD2 does not place potential on the control electrode of tube LCP. The car therefore passes the second floor without stopping in response to the down second floor call. Upon the engagement of brush BHL with contact HL3 potential is found on this contact, again due to the fact that an up call is registered at the third floor, it being noted that the connection from resistor RU3 to this contact is by way of contact SU3 and rectifier VU3. Thus switch HJ is maintained operated. However, upon the engagement of brush BU with stationary contact SU3, potential is placed upon the control electrode of tube LCP so that upon the closure of switch SI, a circuit is established for the reset coil of pawl magnet PM causing the car to be slowed down and stopped at the third floor. The engagement of contacts PM1 causes the up third floor call to be reset. When this takes place, the potential placed on the control electrode of tube HCR from resistor RU3 by way of rectifier VU3 is removed. Thus switch HJ is dropped out. It is to be noted that as distinguished from answering the highest call when this call is a down call as in the previous example where switch HJ was dropped out before the pawl magnet was reset, the answering of the highest call when this call is an up call causes the pawl magnet to be reset first and then switch HJ to be dropped out. As a result, the engagement of contacts HJ2 can not complete a circuit for the coil of switch HR as contacts PM4 are separated. Thus contacts HR5 are not engaged so that switch DG is not reset and the car is maintained set for up travel as it is brought to a stop at the third floor.

Again for convenience it will be assumed that no passenger enters the car and no car call is registered. Upon the disengagement of brush BHL from contact HL3 incident to restarting of the car, contacts HLC close to cause reoperation of switch HJ. Thus upon engagement of contacts EX3 as the advance of the carriage continues a circuit is not completed for the coil of switch HR. Upon the engagement of brush BHL with stationary contact HLT potential is again removed from the control electrode of tube HCR, causing switch HJ to drop out. This completes a circuit for the coil of switch HR which engages contacts HR4 so that upon the closure of switch SI the circuit is established for the reset coil of pawl magnet PM. Thus the car is caused to slow down and stop at the fourth floor, contacts SS3 and SS1 opening to insure the slowing down and stopping operation. Owing to the engagement of contacts HR5 and the engagement of brush DB with stationary contact TTC, a circuit is completed for the reset coil of switch DG as the car comes to a stop, causing the direction of car travel to be set for down. Thus, upon the attendant touching start button SB, the car is started in the down direction from the top terminal. It is to be noted that contacts DG12 are engaged while the car is set for downward travel so that switch HR is maintained operated. Thus contacts HR1 are engaged and contacts HR2 are separated for downward car travel and thus brush BD is effective and brush BU is ineffective for downward car travel. Brush BU being ineffective, up calls are not answered on downward travel. Also contacts HR3 are separated, preventing the operation of switch HJ while the car is set for downward travel. Upon the engagement of brush BD with stationary contact SD2, potential is placed on the control electrode of tube LCP owing to the fact that an unanswered down call exists for the second floor. Thus upon the closing of switch SI a circuit is completed to effect the reset of the pawl magnet, causing the car to be slowed down and brought to a stop at the second floor, the down second floor call being automatically cancelled upon the engagement of contacts PM1 in a manner previously described.

It sometimes happens that a car call is registered and it is desired to cancel this call. The attendant may do this by touching the corresponding car call cancelling button. Assume, for example, that a car call is registered for the third floor and that it is desired to cancel this call. With the tube of button C3 conducting, the potential of its cathode above line B is 150 volts minus the tube drop. This potential is applied to one side of condenser QC3. Since tube CC3 is not conducting, the potential of the other side of the condenser is that of line B. In other words, the potential drop across load resistor RC3 is applied to condenser QC3 causing this condenser to be charged. To cancel the third floor car call, the attendant touches car call cancelling button CC3 which breaks down in the same manner as the tube of button C3 broke down in response to touch. Immediately the tube of button CC3 becomes conductive, the potential of its cathode rises above line B an amount equal to 150 volts minus the tube drop. Inasmuch as the charge on condenser QC3 can not be dissipated instantaneously, this raises the potential of the cathode of the tube of button C3, thereby decreasing the voltage across this tube to below sustaining value. This extinguishes the tube, cancelling the call. The tube of button CC3 automatically extinguishes as the charging current of condenser QCC, which is common to the tubes of the car call cancelling buttons, decreases to a certain value. Resistor RLC connected across condenser QCC serves as a leak for this condenser to prevent its being in a charged state when a car call cancelling button is touched. This resistor also serves as a discharge resistance for this condenser to decrease the condenser discharge time after the tube of the car call cancelling button is extinguished. This minimizes the time, after the cancellation of a car call by touching a car call cancelling button, before the other car call cancelling buttons becomes effective. This is of advantage in the event that it is desired to cancel more than one car call.

If it is desired, as for example when the car becomes fully loaded, to run the car non-stop insofar as landing calls are concerned, this may be done by the attendant touching the non-stop button NSB. This establishes a circuit from the tube envelope of this button through the attendant's body back to ground to cause this tube to fire in a manner similar to that in which the car call tubes are fired, the sustaining circuit for this tube being from line B+100 through resistor RQNS, contacts DG2 or DG3, the tube resistor RLCP and switch NC to line B—50. When this tube fires the cathode potential rises to a value

above line B—50 equal to the voltage drop across resistor RLCP. This correspondingly raises the potential of the cathode of tube LCP. Assume that the car is set for downward travel at the top floor and that a down call is registered for the third floor. With the non-stop button operated, upon the engagement of brush BD with contact SD3 potential is applied to the control electrode of tube LCP but, owing to the raising of the cathode's potential, the voltage applied across the control electrode and cathode of this tube is less than when the tube of button NSB is not conducting by an amount equal to the potential drop across resistor RLCP. Also the voltage applied to the anode-cathode of tube LCP upon the closing of switch SI is correspondingly less than when the tube of button NSB is not conducting. As a result, tube LCP does not fire and a stop is not made in response to the down call at the third floor.

The tube of the non-stop button is automatically extinguished by contacts DG2 or contacts DG3 upon a change in the setting of the direction of car travel. For example, if the car has been travelling in the down direction, as it arrives at the first floor contacts DG2 separate to break the circuit for this tube. Rectifier VNS prevents the tube being sustained by the discharge of condenser QNS, this discharge being absorbed in resistor RLQN to bring the condenser voltage to a value which will not cause the tube to flash on again when contacts DG3 engage, resistor RQNS preventing the immediate recharging of the condenser upon engagement of contacts DG3. Thus the tube does not break down again upon the engagement of contacts DG3 even though this occurs quickly after the separation of contacts DG2. Thus the non-stop button is automatically released. The non-stop button may be manually released by the attendant touching non-stop release button NSRB, the firing circuit being from the tube envelope through the attendant's body back to ground and the anode-cathode circuit being from line B+100 through condenser QNSR, the tube and resistor RNSR to line B—50. The action is similar to that previously described in connection with the manual cancellation of car calls. When the tube of button NSB is conducting, condenser QNSB is in a charged state, its potential on the cathode side of the tube of button NSB being potential drop across resistor RLCP above line B—50, while the potential on the cathode side of the tube of button NSRB is the potential of line B—50. Upon the tube of button NSRB being rendered conductive, its cathode potential rises above that of line B—50 in the amount of the potential drop across resistor RNSR. This raises the cathode potential of the tube of button NSB, thereby reducing the voltage across the tube of button NSB to below sustaining value, whereupon the tube is extinguished. The tube of button NSRB is automatically extinguished as the charging current of condenser QNSR falls to a certain value, whereupon the tube goes out. Resistor RLNR serves as a leakage resistance for the condenser QNSR, preventing this condenser being in a charged state at the time button NSRB is touched. Condenser QNR prevents the unwanted firing of the tube of button NSRB during non-stop operation.

When a stop is made in response to a car button under conditions where the non-stop button is operated, should a landing call for the direction of car travel be in registration for the floor at which the stop is being made, it is automatically

cancelled upon the engagement of contacts PM1 as previously described. However, should it be desired to arrange the system so that the landing call is not cancelled under such conditions, this may be done, for example, by substituting for resistor RLCP the coil of non call cancelling switch XY. In the circuits illustrated, this may be done by throwing switch NC from the position shown into its other operated position. Thus when the non-stop button is operated, switch XY is operated, separating its contacts XY1 in the circuit to the control electrode of tube LCC, thereby preventing the automatic cancellation of landing calls when stops are made in response to car calls. Breaking contacts on switch XY could be utilized in a feed circuit common to signal lanterns at the floors which indicate when a stop is being made and the direction of car travel, signal lantern circuits not being shown.

It sometimes happens as, for example, when the car is operating non-stop that a landing call remains unanswered for an extended period of time. This is particularly true of down calls for the lower floors during the evening peak when the building is being depopulated and when all cars are likely to be running non-stop on their downward trips as they reach these floors. The system may be arranged to respond to such calls and such arrangement is illustrated for a down call at the second floor. A circuit exists from line B through resistor RD2, a rectifier tube VT2 and condenser QT2 to line AC2. Thus with no down call registered for the second floor condenser QT2 is in a charged state, placing a negative potential on the grid of tube TP2 with respect to the cathode, preventing this tube from becoming conductive. Assume that a landing call is in registration for a floor above the second floor, causing switch HJ to be operated. Assume now that a down call is registered for the second floor. Switch HJ prevents the stopping in response to this down call of the car upon its upward trip. If the non-stop button is operated before down brush BD engages contact SD2 on a downward trip, this call is not answered on the downward trip. Due to traffic conditions, this condition may continue to exist with a result that the down call at the second floor remains unanswered. However, when the down call for the second floor is registered, the potential of the cathodes of the tubes of buttons D2 and D2' rises above line B an amount equal to the potential drop across resistor RD2. Thus the potential of the cathode of rectifier tube VT2 is correspondingly raised so that this tube is no longer capable of sustaining condenser QT2 in its former charged state. The condenser thereupon discharges into its discharge resistor RQT2, gradually rendering the grid of tube TP2 less negative with respect to its cathode until after a certain time interval the tube becomes conductive. The circuit for this tube is from the cathodes of the landing button tubes for any floor above the second floor which are fired or from the cathodes of landing button tubes U2 and U2', if they are fired, through the rectifiers as previously traced, through resistance RTP2 contact HL2 and the anode and cathode of tube TP2 to line AC3. Thus a positive potential equal to the potential drop across resistor RD3 above line B with 90 volts alternating current superimposed thereon is applied to the anode-cathode of tube TP2 so that when the voltage of condenser QT2 decreases sufficiently the tube becomes conductive. Owing to resistor RTP2, this reduces the potential on contact HL2

so that, assuming no car call for a floor above, upon the engagement of brush BHL with this contact when the car is set for upward travel, the potential applied to the control electrode of tube HCR is insufficient to sustain this tube, condenser QF2 and resistor RF2 acting as a filter to maintain the lowered potential on the control electrode of tube HCR during that portion of the alternating current cycle when tube TP2 is not conducting. As a result, switch HJ drops out causing the car to be slowed down and brought to a stop at the second floor, the down second floor call to be automatically cancelled and the car to be set for travel in the down direction. As soon as the call is cancelled, condenser QT2 recharges, restoring the negative potential on the grid of tube TP2 and thus preventing the refiring of the tube upon subsequent positive portions of the alternating current cycles. Thus response is had to a down call which has remained unanswered for a predetermined period of time.

The direction of car travel may be manually changed at any one of the intermediate floors at which the car is stopped by touching the proper one of buttons URB and DRB. Assume, for example, that a stop is made at the third floor with the car remaining set for upward travel. To change the direction of car travel to down, the attendant touches button DRB. This completes a circuit from the envelope of the tube through the attendant's body back to the ground causing the tube to fire. Upon firing, a circuit is completed for the reset coil of switch DG which is from line B+150 through the tube, contacts DGX1, and contacts DGX2, the reset coil, contacts H2 and contacts EX2 to line B. This causes switch DG to be reset to set the car for downward travel as previously explained. The reengagement of contacts DG5 as switch DG is reset establishes another circuit for the tube of button DRB from line D+150 to line AC1 causing this tube to be illuminated and thus provide visual indication that the car is set for downward travel. It is believed that the operations resulting from the touching of button URB to manually set the car for upward travel when the car is stopped at an intermediate floor will be understood without detailed description, as they are similar to those just described in connection with the touching of tube DRB.

It is thus seen that the starting of the car is effected in response to manual control on the part of the car attendant. Stops to discharge passengers are made at the floors desired by these passengers, these stops being made in response to car calls registered for these floors by the attendant as advised by the passengers and in either direction of car travel. Also stops to take on passengers are made in response to landing calls registered by the intending passengers themselves, at the floors for which these calls are registered. At each intermediate floor an up call and/or a down call may be registered. Stops in response to up calls are made during up car travel and stops in response to down calls are made during down car travel. However, the car may stop at a floor during upward travel in response to a down call, provided it has reached its highest call, i. e., no up call is registered for that floor and no car call or landing call is registered for a floor above. The stops for each direction of travel are made in the order of succession of floors for which the calls are registered, regardless of the order in which the calls are registered. The car also may be caused to stop on its up trip in response to a down call when this call is not the highest call provided it has been registered for a predetermined length of time. The calls are automatically cancelled when they are answered. In addition car calls may be manually cancelled if desired. The doors are automatically opened when a stop is made and automatically reclosed incident to the restarting operation. Also the doors may be opened or closed in response to manual control on the part of the attendant. When a stop is made on an up trip at an intermediate floor in response to a down call, the direction of car travel is automatically changed to down as the car comes to a stop. The direction of travel is also automatically changed at the terminal floors. Also, the direction of car travel may be changed in response to manual control at any intermediate floor at which a stop is made. The car, by a manual control exercised by the attendant, may be caused to run non-stop as regards landing calls. Visual indication is made at the landing buttons and car buttons that the calls are registered. Visual indication is also made of the operated condition of other manual controls. In association with the indications made of the operation of the manual direction controls, indication is made of the direction of car travel including indication of calls above. Indication is made on a waiting passenger indicator of the floors for which landing calls are made and of the direction of these calls. Also indication is made as to the position of the car in the hoistway. When applied to a plural elevator system, any one of the cars serving the particular floor may respond to a landing call for that floor. If, for example, two or more up cars are in position with respect to a floor for which an up call is registered to enable them to answer the call, the call will be answered by that car whose switch SI is first to close after the engagement of brush BU for that car with its SU contact for that floor. The resultant automatic cancellation of the call prevents the other cars stopping in response to this call. Similarly, with two or more down cars in position with respect to a floor for which a down call is registered to enable them to answer the call, the call will be answered by that car whose switch SI is first to close after the engagement of brush BD for that car with its SD contact for that floor. Where the same down call is the highest call for two or more up cars, that call will be answered by that car whose switch SI is first to close after the engagement of its brush BHL with its HL contact for that floor. If in that case a succeeding car has no intervening call, it is brought to a stop at the floor, the contact HL for which is or is next engaged by brush BHL for that car. Similarly when a down timed call is answered by an up car, the car of those set for upward travel which answers this call is that one whose switch SI is first to close after the engagement of its brush BHL with its HL contact for the floor for which the call is registered. Where the cars of plural elevator systems are arranged on opposite sides of a corridor with the landing buttons also on each side of the corridor, visual indication is made on both sides of the corridor of the registration of a call by a landing button on either side. All of these operations are electronically effected or controlled.

The landing calls are each registered by touch on the part of the intending passenger which causes the firing of an electronic tube. The tube remains conductive to maintain the call regis-

tered until answered, enabling the touch to be discontinued. Also the illumination of the tube is an indication that the call is registered. The potential drop across a load resistor in circuit with the tube is applied to another electronic tube to cause this other tube to break down, this other tube serving as a waiting passenger indicator. Also, this potential drop is utilized to cause the break down of another tube to initiate stopping of the car in response to the call. Also, this potential drop is utilized when the call is responded to, to cause breakdown of still another tube which acts to reduce the voltage across the call registering tube to below sustaining value, extinguishing the tube and thus automatically cancelling this call. Where there are across the corridor buttons, this load resistor potential drop raises the cathode potential of the tube of the across the corridor buttons sufficiently to enable a potential on a control electrode of this tube to fire this tube. Thus the touching of either button fires both tubes, providing visual indication of the registration of the call on both sides of the corridor.

The car calls also are each registered by touch, but on the part of the car attendant as directed by the passengers, causing the firing of an electronic tube. As in the case of landing calls, the tube remains conductive to maintain the call registered until answered, its illumination is utilized to indicate that the call is registered and the potential drop across a load resistor in circuit with the tube is utilized to cause breakdown of another tube to initiate the stopping of the car in response to the call. When the call is responded to, the voltage across the call registering tube is reduced to below sustaining value, extinguishing the tube and thus automatically cancelling the call. The car calls may be manually canceled by the attendant touching corresponding car call cancelling buttons. The touching of one of these cancelling buttons causes its tube to fire which reduces the potential across the call registering tube to below sustaining value.

When the car is set for upward travel an electronic tube is rendered conductive by calls registered for floors above the car. This is done by applying to circuits controlling this tube potential from the call registering tube load resistors at points related to the floors. Tests are made of these circuits at these points and when a point is reached where no potential exists, the tube is extinguished. This is utilized to cause a stop to be made in response to a down call on an up trip, when this call is the highest call and also when higher landing calls exist if the call has been unanswered for a certain period of time and aso to cause a stop to be made when no calls exist for floors above the car. This is also utilized to cause the direction of travel of the car to be set for down as the car is brought to a stop under any of these conditions and also when the car is brought to a stop in answer to a car call when this is its highest call.

The starting of the car after each stop is effected by touch on the part of the car attendant which causes the firing of an electronic tube. This tube remains conductive so long as the touch is continued or until a certain point in the starting operation is reached. The illumination of the tube indicates that the operation is being performed. When this certain point in the starting operation is reached the tube is automatically extinguished, the discontinuance of the illumination advising the attendant that the touch may be discontinued. This operation by the attendant to initiate starting of the car is also utilized to effect the closing of the doors and the circuits are illustrated as causing the firing of the tube of a door close button to effect this operation. The door close button tube may be fired by touch on the part of the attendant to cause the closing of the door without starting the car. The opening of the doors is effected by the attendant touching a door open button which causes the firing of a tube. This tube remains conductive until the doors reach open position, enabling the touch to be discontinued. This tube is fired automatically as a stop is being made to effect the opening of the doors. The illumination of these door operating buttons serves as an indication that these operations are being performed. The direction of car travel is manually changed at an intermediate floor by the attendant touching the proper reversal button. The illumination of the tube of the touched button indicates that the operation is being performed. Also these tubes are fired automatically to provide indication of the direction of car travel and, when the car is standing at the first floor, the tube of the up button is fired automatically when a call is registered for a floor above to indicate that such call exists.

Non-stopping of the car to prevent answering landing calls is effected by the attendant touching a non-stop button which causes the firing of a tube. The firing of this tube raises the potential of the cathode of the landing call stop initiating tube to a point where it will not fire, thus preventing response to landing calls. Also the illumination of the tube indicates that the non-stop condition is set and advises the attendant that he may discontinue the touch. Non-stop is automatically discontinued upon a change in the direction for which the car is set and may be manually discontinued by the attendant touching a non-stop release button. This causes the tube of this button to fire which decreases the voltage applied to the non-stop button tube to cause it to be extinguished.

Unwanted operations in the highest landing call circuits and landing call pick-up circuits are obviated by rectifiers VHL, VU and VD for the various floors. With the VHL rectifiers, the flow of appreciable current upward as viewed in the diagram in the circuit in which they are connected is blocked. For example with a down call registered at the second floor, potential is placed on selector contact HL1. However, due to the blocking action of rectifier VHL2, no effective potential due to this down second floor call is placed on contact HL2 or contact HL3. Thus, if there is no potential on these contacts due to some other landing call, for example an up call for the second floor or a landing call for a floor above in the case of contact HL2, no effective potential due to a landing call is applied to the control electrode of tube HCR upon the engagement of the contact by brush BHL. The VU and VD rectifiers block the flow of appreciable current to the stationary selector contacts SU and SD from selector contacts HL. Thus no effective potential can be placed on selector contacts SU and SD due to landing calls other than those registered on tubes directly connected to these contacts. Thus false stops are obviated and more than one landing call may be registered at a time. The blocking rectifiers VC are principally for preventing, due to the registration of a car call, the application of appreciable potential to the cathodes

of the tubes for the other car buttons, thus enabling any number of car calls to be in registration at a time.

The registration of calls electronically eliminates electromagnetic floor relays with their various contacts and the contact type push buttons. Potential for the call pick-up and highest call circuits is taken off load resistors with rectifiers blocking unwanted circuits. Only two feed wires, line B+150 and line B, and one wire for each floor and a wire from contacts DGf are carried in the travelling cable for the entire circuits for the car buttons, car call cancelling buttons and car position indicator lamps; voltage divider RDV3, condenser QCC, resistor RLC and the QC condensers and RCC resistors being carried by the car. The wires feeding the waiting passenger indicator lamps run from the particular floor down the hoistway to the starter's station. The call registering tubes themselves, by providing tell-tale indication that the calls are registered, obviate separate hoistway and travelling cable wiring and lamps for this purpose. Separate lamps may be used if desired, in which event they may be connected to be subject to the voltage drop across the load resistors with load resistors RC carried by the car and load resistors RU and RD positioned at the landing buttons, thereby obviating separate hoistway and car cable wiring to feed these lamps. Also where across corridor buttons are provided, the connections are effected by feeds B+150 and B—30 in the hoistway on each side of the corridor and a hoistway wire leading from the cathode of each tube to the selectors with the equalizing resistors RUE and RDE, protective resistors RUG and RDG and condensers QU and QD located in the button fixtures. The cam CY and hook switches HC serve for both the car call pick-up and highest car call operations, not only minimizing the wiring but also the apparatus for these operations.

While the invention has been described as applied to a plural elevator installation, it is also applicable to single elevator installations. Also, while the control systems illustrated for two elevators are the same, it is to be understood that the control of one or more of a plurality of elevators may be different from that of the others with attendant variations in circuits and apparatus. In installations in which there is only a single riser of landing buttons, the equalizing resistors RUE and RDE, grid protective resistors RUG and RDG and condensers QU and QD may be omitted. Also, with across the corridor buttons, the visual indication on both sides of the corridor of the registration of a call at either side of the corridor may be effected in other ways. Also, while a highest call return system has been illustrated, the invention is applicable to other types of operation such as where the cars always run to the terminals. To make a car always run to the upper terminal, its top floor car button may be fired at the lower terminal by making contacts on switch DG. In such event, the circuits and apparatus for providing highest call return operation could be omitted or a throwover switch provided for changing from one type of operation to the other.

The touch button tubes and their associated circuits are subject to considerable variation. For example, the tubes may be caused to fire by touching buttons connected to control electrodes of the tubes. On the other hand push buttons of the type operating contacts may be arranged to fire the tubes, or a certain amount of movement of the touch button may be allowed to simulate the movable type push buttons with contacts. The load resistors may be connected at other points in the anode-cathode circuits. The calls may be automatically cancelled in other ways. Also the car call cancelling buttons and associated circuits may be dispensed with, especially with efficient attendants. The landing button tubes and/or car button tubes may be arranged to operate floor relays, the coils of which are connected in place of or to supplement the load resistors. In such event, the potential drop across the relay coil may be utilized for further control or signal operations. The non-stop button may be arranged so that touch must be continued to maintain the tube conductive. In such event, this button may be arranged also to initiate starting of the car and closing of the doors, for example in a manner similar to the way in which start button SB causes the firing of the door close button tube. Other non-stop arrangements may be utilized. Where the cathode potential of tube LCP is not altered for non-stop operation, a single tube may be utilized in place of tubes CCP and LCP. The selector circuits are subject to variations and other forms of selector apparatus may be employed.

Certain parts of the control system may be electronic while the other parts may be subject to contact type switch control. For example, only the call registering buttons may be electronic with the start, door, reversal and non-stop controls of the contact type switches. The landing buttons may be electronic and the car buttons of the contact type. Also, either the highest car call circuits or highest landing call circuits or both may be made subject to floor relay contacts instead of to the potential drop off load resistors. The reset of the pawl magnet for a stop at the first floor may be effected without automatically registering a first floor car call. Also, where a first floor car call is automatically registered, this may be done by connecting the point of joinder of resistors RCGT and RCGP to the cathode of tube DRB through a condenser, thereby eliminating contacts DGf and the wire therefrom in the travelling cable. The car position indicator circuits and apparatus may be varied or omitted. Also the waiting passenger indicator circuits and apparatus may be varied or omitted. The circuit for stopping an up car in response to a down call registered for a certain period of time may be provided for other floors. Also these circuits may be varied or omitted. Certain features of the invention are applicable to other forms of elevator control.

It is seen therefore that many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, and it is 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 elevator system comprising; an elevator car; a floor served by said car; an electronic tube individual to said floor; a circuit for said tube for causing operation thereof; and means responsive to the operation of said tube for slowing down said car at said floor.

2. An elevator system comprising; an elevator car; a plurality of floors served by said car; an electronic tube for each of said floors; a circuit for each tube for causing operation thereof to

register a call for the floor for which the tube is provided; means controlled by said tubes for causing slowing down of the car at the floors for which calls are registered; and means for stopping the car at each floor at which the car has slowed down.

3. A control system for an elevator car comprising; an electronic tube for a floor served by the car for registering a call for that floor; a load for said tube; and means controlled by the potential drop across said load for initiating stopping of the car at said floor.

4. A control system for an elevator car comprising; a cold cathode electronic tube for each of a plurality of floors served by the car; a manually controlled circuit for each tube to cause the tube to be broken down to register a call for the floor for which the tube is provided; a resistor for each tube connected in circuit therewith; and means controlled by the potential drop across said resistors for causing the car to be stopped at floors for which calls are registered.

5. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a source of current for said tubes; means for each tube for causing the tube to be broken down in response to a person's touch to register a call for the floor for which the tube is provided; a load resistor for each tube connected in circuit therewith to said source; and means controlled by the potential drop across said load resistors for causing the car to be stopped at floors for which calls are registered.

6. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube at each of said floors; a source of current for the anode-cathode circuits of the tubes; a source of periodic current; a circuit for each tube connected to said periodic source for enabling the tube to be broken down in response to a person's touch to register a call for the floor for which the tube is provided; a load resistor for each tube connected in the anode-cathode circuit thereof; and means controlled by the potential drop across said load resistors for causing the car to be stopped at floors for which calls are registered.

7. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a circuit for each tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; means controlled by each tube upon which a call is registered for causing the car to be stopped at the floor for which such call is registered to answer that call; and means operable incident to the answering of a call for extinguishing the tube upon which the call is registered.

8. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a circuit for each tube to enable the tube to be broken down in response to a person's touch to register a call for the floor for which the tube is provided; a load for each tube connected in circuit therewith on the cathode side; and means controlled by the cathode potential of each tube upon which a call is registered for causing the car to be stopped at the floor for which such call is registered and for raising the cathode potential of such tube to a point to extinguish the tube to automatically cancel the call incident to the stopping of the car at that floor.

9. A control system for an elevator car serving a plurality of floors comprising; a pair of cold cathode electronic tubes at each of said floors, one for up car travel and the other for down car travel; a source of direct current for the anode-cathode circuits of the tubes; a source of periodic current; a circuit for each tube connected to said periodic source for enabling the tube to be broken down in response to a person's touch to register a call for the direction and for the floor for which the tube is provided; a load resistor for each tube connected in the anode-cathode circuit thereof; means successively controlled by the potential drop across said load resistors for causing the car in its upward travel to be stopped at floors for which up calls are registered and for causing the car in its downward travel to be stopped at floors for which down calls are registered, with the stops in the natural order of floors regardless of the order in which the calls are registered; and means operable incident to the stopping of the car in response to a call to raise the cathode potential of the tube upon which the call is registered to automatically cancel the call.

10. A control system for an elevator car serving a plurality of floors comprising; a call registering cold cathode tube for each of said floors; a load for each tube in the anode-cathode circuit thereof; means successively controlled by the cathode potential of said call registering tubes for stopping the car at the floors for which calls are registered; a call cancelling cold cathode electronic tube having a control electrode; means rendered effective by said stopping means in stopping the car at a floor for applying to said electrode said cathode potential of the call registering tube in response to which the stop is being made to cause breakdown of said call cancelling tube; and a circuit controlled by said call cancelling tube for automatically cancelling said call.

11. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a circuit for each tube to enable the tube to be broken down in response to a person's touch to register a call for the floor for which the tube is provided; a load for each tube connected in circuit therewith on the cathode side; stopping mechanism; a stopping electronic tube controlled by the cathode potential of each call registering tube upon which a call is registered for causing operation of said mechanism to stop the car at the floor for which such call is registered to answer such call; and a call cancelling electronic tube rendered subject by said stopping tube to control by the cathode potential of the call registering tube upon which the call being answered is registered for raising the cathode potential of such call registering tube to a point to extinguish the tube to automatically cancel the call.

12. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors for up direction of car travel; a cold cathode electronic tube for each of said floors for down direction of car travel; a circuit for each tube to enable the tube to be broken down in response to a person's touch to register a call for the floor and for the direction for which the tube is provided; a load for each tube connected in circuit therewith on the cathode side; stopping mechanism; a call pick-up cold cathode electronic tube controlled by the cathode potential of each call registering tube for up car travel upon which a call is registered for causing operation of said mechanism to stop

the car in its upward travel at the floor for which such up call is registered to answer such call, and controlled by the cathode potential of each call registering tube for down car travel upon which a call is registered for causing operation of said mechanism to stop the car in its downward travel at the floor for which such down call is registered to answer such call; and a call cancelling cold cathode electronic tube rendered subject by said call pick-up tube to control by the cathode potential of the call registering tube upon which the call being answered is registered for raising the cathode potential of such call registering tube to a point to extinguish the tube to automatically cancel the call.

13. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a circuit for each tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; a load for each tube connected in circuit therewith on the cathode side; means controlled by car movement and by the cathode potential of each tube upon which a call is registered for causing the car to be stopped at the floor for which such call is registered in answer to that call; and means controlled by car movement for shunting the tube upon which the call being answered is registered to extinguish the tube and thus cancel the call as the call is answered.

14. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a circuit for each tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; means controlled by car movement and by each tube upon which a call is registered for causing the car to be stopped at the floor for which such call is registered to answer that call; means controlled by car movement for extinguishing the tube upon which the call being answered is registered incident to the answering of the call; and manual means for extinguishing a tube upon which a call is registered.

15. A control system for an elevator car serving a plurality of floors comprising; a plurality of cold cathode electronic tubes, one for each of said floors; a circuit for each tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; and manual means for each floor for causing the extinguishing of the tube for that floor to cancel the call registered thereon.

16. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering cold cathode electronic tubes, one for each of said floors; a plurality of call cancelling cold cathode tubes, one for each of said floors; a circuit for each call registering tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; a circuit for each call cancelling tube to enable the tube to be broken down in response to manual touch; and means for each floor interconnecting said call cancelling tube and call registering tube for that floor for causing, upon the touching of the call cancelling tube for that floor when a call is registered on the call registering tube for that floor, the extinguishing of such call registering tube to cancel the call.

17. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering cold cathode electronic tubes in the car, one for each of said floors; a plurality of call cancelling cold cathode tubes in the car, one for each of said floors; a source of current for said tubes; a source of periodic current; a resistor for each tube connected in circuit therewith on the cathode side; a circuit for each call registering tube connected to said periodic source to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; a circuit for each call cancelling tube connected to said periodic source to enable the tube to be broken down in response to manual touch; a plurality of condensers, one for each floor; a circuit for each condenser for connecting the condenser between the cathodes of the call registering tube and call cancelling tube for the floor for which the condenser is provided to cause the condenser to be in a charged state when a call is registered for that floor and thus cause, upon the breaking down of the call cancelling tube for that floor, the raising of the cathode potential of the call registering tube for that floor to extinguish the tube and cancel the call; and a condenser in a circuit common to said call cancelling tubes for causing any such tube which is broken down to be extinguished when the condenser charging current falls to a certain value.

18. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a circuit for each tube for enabling the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; a load for each tube connected in the anode-cathode circuit thereof on the cathode side; a call pick-up cold cathode electronic tube; means for rendering said call pick-up tube successively subject to control by said call registering tubes; and stopping mechanism controlled by said call pick-up tube for stopping the car at the floors for which calls are registered.

19. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors; a source of direct current for the anode-cathode circuits of the tubes; a source of periodic current; a circuit for each tube connected to said periodic source for enabling the tube to be broken down in response to a person's touch to register a call for the floor for which the tube is provided; a load for each tube connected in the anode-cathode circuit thereof on the cathode side; a call pick-up cold cathode electronic tube; means for rendering said call pick-up tube successively subject to the cathode potential of the tubes upon which calls are registered in the order of succession of floors; and stopping mechanism controlled by said call pick-up tube for stopping the car at the floors for which calls are registered.

20. A control system for an elevator car serving a plurality of floors comprising; a pair of cold cathode electronic tubes at each of said floors, one for up car travel and the other for down car travel; a source of direct current for the anode-cathode circuits of the tubes; a source of periodic current; a circuit for each tube connected to said periodic source for enabling the tube to be broken down in response to a person's touch to register a call for the direction and for the floor for which the tube is provided; a load resistor for each tube connected in the anode-cathode circuit thereof on the cathode side; a call pick-up cold cathode electronic tube; means

operable when the car is set for upward travel for rendering said call pick-up tube successively subject to the cathode potential of the tubes upon which up calls are registered to set up stops at the floors for which up calls are registered in the order of succession of such floors and operable when the car is set for downward travel for rendering said call pick-up tube successively subject to the cathode potential of the tubes upon which down calls are registered to set up stops at the floors for which down calls are registered in the order of succession of such floors; and means controlled by said call pick-up tube when subject to the cathode potential of a call registering tube upon which a call is registered to cause stopping of the car, when travelling in the direction for which such call is registered, at the floor for which such call is registered.

21. A control system for an elevator car serving a plurality of floors comprising; means for each of said floors for registering a call for that floor; a plurality of stationary contacts, one for each of said call registering means; means for each contact connecting that contact to be subject to a certain potential when a call is registered on the call registering means for which the contact is provided; unidirectional current conducting means connecting each contact with the contact for the floor next beyond in a given direction to enable placing on that contact said potential from a contact for a floor beyond in said direction but to prevent placing potential from that contact on the contacts for floors beyond in said direction; and contacting means actuated in accordance with car movement for engaging said contacts for controlling the stopping of the car.

22. A control system for an elevator car serving a plurality of floors comprising; means for each of said floors for registering a call for that floor; a plurality of stationary contacts, one for each of said call registering means; means for each contact connecting that contact to be subject to a certain potential when a call is registered on the call registering means for which the contact is provided; means including a rectifier connecting each contact with the contact for the floor next beyond in a given direction to enable placing on that contact said potential from a contact for a floor beyond in said direction but to prevent placing potential from that contact on the contacts for floors beyond in said direction; and contacting means actuated in accordance with car movement for engaging said contacts for controlling the stopping of the car.

23. A control system for an elevator car serving a plurality of floors comprising; means for each of said floors for registering a down call for that floor; a plurality of stationary contacts, one for each of said floors; means for each contact for connecting that contact to be subject to a certain potential when a down call for the floor next above the one for which the contact is provided is registered; means connecting each contact with the contact for the floor next above to enable placing on that contact said potential from a contact for a floor above but to prevent placing potential from that contact on the contacts for the floors above; contacting means actuated in accordance with car movement for engaging said contacts; and means operable, upon the engagement of said contacting means with a contact which does not have said potential thereon, to cause stopping of the car in its upward travel at the floor for which such contact is provided.

24. A control system for an elevator car serving a plurality of floors comprising; means for each of said floors for registering an up call for that floor; a plurality of stationary contacts, one for each of said floors; means for each contact for connecting that contact to be subject to a certain potential when an up call for the floor for which the contact is provided is registered; means connecting each contact with the contact for the floor next above to enable placing on that contact said potential from a contact for a floor above but to prevent placing potential from that contact on the contacts for the floors above; contacting means actuated in accordance with car movement for engaging said contacts; and means operable, upon the engagement of said contacting means with a contact which does not have said potential thereon, to cause stopping of the car in its upward travel at the floor for which such contact is provided.

25. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors for up direction of car travel; a cold cathode electronic tube for each of said floors for down direction of car travel; a circuit for each tube to enable the tube to be broken down in response to a person's touch to register a call for the floor and for the direction for which the tube is provided; a load for each call registering tube connected in circuit therewith on the cathode side; a plurality of stationary contacts, one for each of said floors; means for connecting each contact to be subject to the cathode potential of the up tube for the floor for which the contact is provided and of the down tube for the floor above the one for which the contact is provided; means connecting each contact with the contact for the floor next above to enable placing on a contact the cathode potential of a tube connected to a contact for a floor above but to prevent appreciable current flow from each contact to the contact for the floor next above; contacting means actuated in accordance with car movement for engaging said contacts; a highest call cold cathode electronic tube having a control circuit connected to be controlled by said contacting means and contacts; stopping mechanism; and means controlled by said highest call tube operable, upon the engagement of said contacting means with a contact which does not have thereon the cathode potential of a call registering tube upon which a call is registered, to cause operation of said mechanism to stop the car in its upward travel at the floor for which such contact is provided.

26. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering cold cathode electronic tubes, one for each of said floors; a resistor for each tube in circuit therewith on the cathode side; a plurality of switches, one for each of said tubes, said switches being connected in series relationship in the order of succession of floors and being connected also respectively to the cathodes of the tubes for which they are provided; a cam actuated in accordance with car movement for opening said switches, said cam having an intermediate portion of conducting material adapted upon engaging a switch to be connected to the cathode of the tube for which the switch is provided, the end portions of said cam being of insulating material; means controlled by the opening of said switches by said cam for determining when the car in its upward

travel has reached the highest floor for which a call is registered; and means controlled by the engagement of said intermediate portion with said switches for causing the stopping of the car at floors for which calls are registered.

27. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering cold cathode electronic tubes, one for each of said floors; a resistor for each tube in circuit therewith on the cathode side; a plurality of switches, one for each of said tubes, said switches being connected in series relationship in the order of succession of floors; means connecting each switch between the cathode of the tube for which it is provided and the resistor for that tube to enable placing cathode potential of that tube on the switch but to prevent placing on the cathode of that tube the cathode potential of any other tube; a cam actuated in accordance with car movement for opening said switches, said cam having an intermediate portion of conducting material adapted upon engaging a switch to be connected to the cathode of the tube for which the switch is provided, the end portions of said cam being of insulating material; a highest call cold cathode electronic tube having a control electrode connected to the switch for the highest of said floors; and a call pick-up cold cathode electronic tube having a control electrode connected to said intermediate portion of the cam.

28. A control system for an elevator car serving a plurality of floors comprising; an electronic tube within the car; a manually controlled circuit for said tube for causing breakdown thereof; means controlled by said tube to cause starting of the car; a call registering electronic tube for each of said floors; a manually controlled circuit for each tube for causing breakdown thereof to register a call for the floor for which the tube is provided; and means controlled by said call resigtering tubes for causing stopping of the car at the floors for which calls are registered.

29. A control system for an elevator car serving a plurality of floors comprising; a pair of electronic tubes at each of said floors, one for up car travel and the other for down car travel; a manually controlled circuit for each tube for causing the tube to be rendered conductive to register a call for the direction and for the floor for which the tube is provided; means for causing the car in its upward travel to be stopped at floors for which up calls are registered and for causing the car in its downward travel to be stopped at floors for which down calls are registered; a start control electronic tube within the car; a manually controlled circuit for said start control tube for causing the tube to be rendered conductive; and means controlled by said start control tube for causing starting of the car after each of said stops.

30. A control system for an elevator car serving a plurality of floors comprising; a pair of cold cathode electronic tubes at each of said floors, one for up car travel and the other for down car travel; a source of periodic current; a circuit for each tube connected to said periodic source for enabling the tube to be broken down in response to an intending passenger's touch to register a call for the direction and for the floor for which the tube is provided; a load resistor for each tube connected in the anode-cathode circuit thereof; means successively controlled by the potential drop across said load resistors for causing the car in its upward travel to be stopped at floors for which up calls are registered and for causing the car in its downward travel to be stopped at floors for which down calls are registered, with the stops in the natural order of floors regardless of the order in which the calls are registered; means operable incident to the stopping of the car in response to a call to raise the cathode potential of the tube upon which the call is registered to automatically cancel the call; a start control cold cathode electronic tube within the car; a circuit for said start control tube connected to said periodic source to enable the tube to be broken down in response to the touch of the car attendant; and means responsive to the breakdown of said start control tube to cause starting of the car after each of said stops.

31. A control system for an elevator car serving a plurality of floors comprising; an electronic tube within the car; a manually controlled circuit for said tube for causing breakdown thereof; and means controlled by said tube to cause starting of the car.

32. A control system for an elevator car serving a plurality of floors comprising; an electronic tube within the car; a source of periodic current for said tube; a circuit for said tube for enabling the tube to be broken down by manual touch and maintained conductive until after the starting of the car, provided the touch is continued; means operable upon breakdown of said tube to cause starting of the car; and means operable upon the starting of the car to maintain said starting means operative independent of said tube, whereupon the touch may be discontinued.

33. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube within the car; a source of periodic current connected across the anode-cathode of said tube; a second source of periodic current; a firing circuit for said tube connected to said second source to break down the tube by the touch of the car attendant and maintain it so so long as the touch is continued, the illumination of said tube being utilized to indicate that said tube is conductive; starting means for the car; an electroresponsive device in circuit with said tube and operable upon breakdown of said tube to cause operation of said starting means to start the car; and means responsive to the starting of the car and operable, after the car has started, to extinguish said tube without interrupting the running of the car, whereby the illumination of said tube is discontinued to advise the attendant that the touch may be discontinued.

34. A control system for a plurality of elevator cars serving a plurality of floors comprising; a call registering cold cathode electronic tube for each of said floors common to said cars; means controlled by said tubes upon which calls are registered for causing any car to slow down and stop at the floors for which calls are registered; and means for preventing the slowing down and stopping of more than one car at a floor in response to a call for that floor.

35. A control system for a plurality of elevator cars serving a plurality of floors comprising; a cold cathode electronic tube for each of said floors common to said cars; a circuit for each tube to enable the tube to be broken down in response to manual touch to register a call on the tube; a resistor for each tube connected in circuit therewith; means for each car controlled by the potential drop across said resistor for any tube upon which a call is registered for causing that car during its travel in a given direction to slow

down and stop at the floor for which such call is registered in response to the call; and means for preventing the response of more than one car to each call.

36. A control system for a plurality of elevator cars serving a plurality of floors comprising; an up call registering cold cathode electronic tube for each of said floors common to said cars; a down call registering cold cathode electronic tube for each of said floors common to said cars; a source of current for said tubes; a source of periodic current; a circuit for each tube connected to said periodic source to enable the tube to be broken down in response to manual touch to register a call on the tube; a load resistor for each tube connected in circuit therewith on the cathode side; means controlled by the cathode potential of each up call registering tube upon which a call is registered for causing any car during its travel in the up direction to stop at the floor for which such call is registered in response to such call, and by the cathode potential of each down call registering tube upon which a call is registered for causing any car during its travel in the down direction to stop at the floor for which such call is registered in response to such call; and a cold cathode electronic tube controlled by said stopping means and by the call registering tube upon which the call being answered is registered for raising the cathode potential of such call registering tube to extinguish the tube, thereby cancelling the call and preventing the response of more than one car to the call.

37. An elevator system in which a plurality of elevator cars serve a plurality of floors comprising; two cold cathode electronic tubes for each of said floors adapted upon being broken down to register a call for that floor; a circuit for each tube to enable the tube to be broken down in response to a manual operation; and means for each floor interconnecting said tubes for that floor for causing, upon the breaking down of either tube for that floor, the automatic breaking down of the other tube for that floor.

38. An elevator system in which a plurality of elevator cars serve a plurality of floors comprising; a plurality of call registering cold cathode electronic tubes, one for each of said floors; a plurality of additional call registering cold cathode electronic tubes, one for each of said floors; a circuit for each call registering tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided, the light from each tube being utilized when the tube is broken down to indicate that the call is registered; and means interconnecting said tubes for each floor for causing, upon the breaking down of either, the other to break down to indicate at such other tube that a call is registered.

39. An elevator system in which a plurality of elevator cars serve a plurality of floors from two sides of a corridor comprising; a plurality of call registering cold cathode electronic tubes, one for each of said floors, on one of said sides of said corridor, each tube having a control electrode; a plurality of additional call registering cold cathode tubes, one for each of said floors, on the other of said sides of said corridor, each tube having a control electrode; means for applying a negative potential to the control electrode of each tube with respect to the cathode insufficient to cause the tube to break down; means for each call registering tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided, the light from each tube being utilized when the tube is broken down to indicate that the call is registered; and a circuit for each floor interconnecting said tubes for that floor for causing, upon the breaking down of either, the raising of the cathode potential of the other tube to break it down, thereby causing indication that a call is registered to be made on both sides of the corridor.

40. An elevator system in which a plurality of elevator cars serve a plurality of floors from two sides of a corridor comprising; a plurality of call registering cold cathode electronic tubes, one for each of said floors, on one of said sides of said corridor, each tube having a control electrode; a plurality of additional call registering cold cathode tubes, one for each of said floors, on the other of said sides of said corridor, each tube having a control electrode; means for applying a negative potential to the control electrode of each tube with respect to the cathode insufficient to cause the tube to break down; means for each call registering tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided, the light from each tube being utilized when the tube is broken down to indicate that the call is registered; a circuit for each floor interconnecting said tubes for that floor for causing, upon the breaking down of either, the raising of the cathode potential of the other tube to break it down, thereby causing indication that a call is registered to be made on both sides of the corridor; means for stopping said cars at the floors in response to said calls; and means operable incident to the stopping of a car at a floor in response to a call to cause the extinguishing of both tubes for that floor.

41. A control system for an elevator car serving a plurality of floors comprising; an electronic tube within the car for controlling starting of the car; a door close electronic tube; a circuit for said start controlling tube to break down the tube by the touch of the car attendant; and means controlled by said start controlling tube for causing, upon breakdown thereof, the breakdown of said door close tube.

42. A control system for an elevator car serving a plurality of floors comprising; a car start cold cathode electronic tube within the car; a door close cold cathode electronic tube within the car, said door close tube having a control electrode; a source of current for each tube; a source of periodic current; a firing circuit for said start tube connected to said periodic source to break down the tube by the touch of the car attendant; a resistor connected between the cathodes of said tubes; and means connecting said control electrode to said resistor for causing, upon breakdown of said start tube, cathode potential of said start tube to be applied to said control electrode to cause breakdown of said door close tube.

43. A control system for an elevator car serving a plurality of floors comprising; closure means for controlling access to and from the car; a door close electronic tube within the car operable upon being rendered conductive to cause closing of said closure means; and means enabling the tube to be rendered conductive in response to manual touch.

44. A control system for an elevator car serving a plurality of floors comprising; a source of periodic current; a door close cold cathode elec-

tronic tube within the car connected to said source; a second source of periodic current; a firing circuit for said tube connected to said second source to enable the tube to be broken down in response to touch by the car attendant and maintained so long as the touch is continued and said tube is connected to the first mentioned source; car starting means; and means operable, incident to the operation of said car starting means to start the car, to disconnect said tube from the first mentioned source.

45. A control system for an elevator car serving a plurality of floors comprising; closure means for controlling access to and from the car; a door open electronic tube within the car operable upon being rendered conductive to cause the opening of said closure means; and means to enable the tube to be rendered conductive in response to manual touch.

46. A control system for an elevator car serving a plurality of floors comprising; closure means for controlling access to and from the car; a door open cold cathode electronic tube within the car; a firing circuit for said tube for breaking down the tube in response to touch by the car attendant; car stopping means; means operable incident to the operation of said car stopping means to stop the car at a floor to break down the tube automatically; and means operable upon the tube breaking down to cause the opening of said closure means.

47. A control system for an elevator car serving a plurality of floors comprising; closure means for controlling access to and from the car; a door open cold cathode electronic tube within the car; a source of direct current for said tube of a voltage value insufficient to break down the tube but sufficient to sustain it once broken down; a source of periodic current; a firing circuit for said tube connected to said periodic source to enable the tube to be broken down in response to touch by the car attendant; car stopping means; a second source of current for said tube of a voltage value sufficient to break down the tube; means operable incident to the operation of said car stopping means to stop the car at a floor to connect said tube to said second source; and electroresponsive means in circuit with said tube operable upon the tube breaking down to cause the opening of said closure means.

48. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering means, one for each of said floors; means controlled by said call registering means to cause stopping of the car at the floors for which such calls are registered; and an electronic tube adapted to be manually broken down to prevent operation of said stopping means in response to said calls.

49. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering means, one for each of said floors; a call pick-up cold cathode electronic tube controlled by said call registering means and operable upon firing to cause stopping of the car at the floors for which such calls are registered; and a non-stop cold cathode electronic tube adapted to be manually broken down and operable upon being broken down to prevent the firing of said call pick-up tube, thereby causing non-stop operation of the car with respect to said calls.

50. A control system for an elevator car serving a plurality of floors comprising; a plurality of cold cathode electronic tubes, one for each of said floors, adapted to be manually broken down to register calls for the floors for which they are provided; a resistor for each tube connected in circuit therewith on the cathode side; a call pick-up cold cathode electronic tube controlled by the cathode potential of said call registering tubes upon which calls are registered for causing upon firing the stopping of the car at the floors for which such calls are registered; a resistor in circuit with said call pick-up tube on the cathode side; and a non-stop cold cathode electronic tube adapted to be manually broken down and having its cathode connected to the cathode of said call pick-up tube to raise the cathode potential thereof, upon the breaking down of said non-stop tube, to a point to prevent the firing thereof, thereby causing non-stop operation of the car with respect to said calls.

51. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering means, one for each of said floors; means controlled by said call registering means to cause stopping of the car at the floors for which such calls are registered; a non-stop electronic tube adapted to be broken down in response to manual touch to prevent operation of said stopping means in response to said call registering means; and manually controlled means for extinguishing the non-stop tube to discontinue the non-stop operation.

52. A control system for an elevator car serving a plurality of floors comprising; a plurality of call registering means, one for each of said floors; a call pick-up cold cathode electronic tube controlled by said call registering means and operable upon firing to cause stopping of the car at the floors for which such calls are registered; a non-stop cold cathode electronic tube adapted to be broken down in response to manual touch; means rendered effective by the breaking down of said non-stop tube to prevent the firing of said call pick-up tube, thereby causing non-stop operation of the car; a non-stop release cold cathode electronic tube adapted to be broken down in response to manual touch; and means rendered effective by the breaking down of the non-stop release tube to extinguish the non-stop tube to discontinue the non-stop operation.

53. A control system for an elevator car serving a plurality of floors comprising; a plurality of cold cathode electronic tubes, one for each of said floors, adapted to be manually broken down to register calls for the floors for which they are provided; a resistor for each tube connected in circuit therewith on the cathode side; a call pick-up cold cathode electronic tube controlled by the cathode potential of said call registering tubes upon which calls are registered and operable upon firing to cause stopping of the car at the floors for which such calls are registered; a resistor in circuit with said call pick-up tube on the cathode side; a non-stop cold cathode electronic tube adapted to be manually broken down and having its cathode connected to the cathode of said call pick-up tube to raise the cathode potential thereof, upon the breaking down of said non-stop tube, to a point to prevent the firing thereof, thereby causing non-stop operation of the car; a non-stop release cold cathode electronic tube adapted to be manually broken down; and means connecting the cathodes of the non-stop tube and non-stop release tube for causing, when the non-stop release tube is broken down, the raising of the cathode potential of the non-stop tube to extin-

guish the tube and discontinue the non-stop operation.

54. A control system for an elevator car serving a plurality of floors comprising; an electronic tube within the car; means enabling the tube, when the car in its travel in a certain direction is stopped at a floor, to be rendered conductive in response to manual touch; and means operable upon the tube becoming conductive to set the car for travel in the opposite direction.

55. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering a call for that floor; means operable when the car is travelling in a certain direction for stopping the car at the floors for which such calls are registered; an electronic tube within the car; means enabling the tube to be rendered conductive in response to manual touch; direction means operable upon the tube becoming conductive to set the car for travel in the opposite direction; and means operable incident to the operation of said car stopping means to stop the car at the farthest floor in said certain direction for which such call is registered to cause operation of said direction means to set the car for travel in the opposite direction.

56. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering a call for that floor; means operable when the car is travelling in a certain direction for stopping the car at the floors for which such calls are registered; an electronic tube within the car; means enabling the tube to be rendered conductive in response to touch by the car attendant; direction means operable upon the tube becoming conductive to set the car for travel in the opposite direction; means operable incident to the operation of said car stopping means to stop the car at the farthest floor in said certain direction for which such call is registered to cause operation of said direction means to set the car for travel in the opposite direction; and means operable upon operation of said direction means to set the car for travel in said opposite direction to cause said tube, if conductive, to be maintained so and, if not, to become conductive automatically, the light of said tube being utilized to indicate that the car is set for travel in said opposite direction.

57. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering a call for that floor; an electronic tube within the car; and means responsive, with the car at a terminal floor, to a registered call to cause said tube to be rendered conductive automatically, the tube upon becoming conductive indicating that such call is registered.

58. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering a call for that floor; means for stopping the car at said floors; a cold cathode electronic tube within the car; a source of current for said tube; a source of periodic current; a firing circuit for said tube connected to said periodic source and effective when the car in its downward travel is stopped at a floor above the lower terminal to enable the tube when connected to the first mentioned source to be broken down in response to touch by the car attendant; means responsive to said breakdown of the tube in response to touch to set the car for travel in the up direction, the illumination of said tube indicating that the car is set for upward travel; another source of current of a higher voltage value than the first mentioned source; and means responsive with the car at said lower terminal to the registration of a call to connect said tube to said higher voltage source to cause the tube to break down automatically, the illumination of said tube indicating that a call is registered for a floor above.

59. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering a call for that floor; a plurality of stationary contacts, one for each of said floors; means for each contact for placing a certain potential thereon; means controlled by said call registering means for a given floor and operable, upon the expiration of a certain time interval after such call is registered, to cause less than said certain potential to be applied to said contact for said given floor; means actuated in accordance with car movement for engaging said contacts; and means responsive, when the car is set for travel in a given direction, to the engagement of said actuated means with said contact for said given floor when such contact has less than said certain potential thereon for causing stopping of the car at that floor.

60. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering a call for that floor; a plurality of stationary contacts, one for each of said floors; means for each contact for placing a certain potential thereon; a brush actuated in accordance with car movement for engaging said contacts; stopping mechanism; means operable, when the car is set for travel in a given direction, upon the engagement of said brush with any one of said contacts which has less than said certain potential thereon for causing operation of said mechanism to stop the car at the floor for which such contact is provided and to set the car for travel in the opposite direction; an electronic tube for a given one of said floors; means controlled by said call registering means for said given floor for causing said tube to become conductive upon the expiration of a certain time interval after such call is registered; and means controlled by said tube when conductive to cause less than said certain potential to be applied to said contact for said given floor.

61. A control system for an elevator car serving a plurality of floors comprising; means for each floor for registering an up call for that floor; means for each floor for registering a down call for that floor; a plurality of stationary contacts, one for each of said floors; means for each up call registering means for placing when a call is registered thereon a certain potential on the contact for the floor for which the call registering means is provided and on the contact for each floor below; means for each down call registering means for placing when a call is registered thereon said certain potential on the contact for the floor next below the one for which such call registering means is provided and on the contact for each floor below; a brush actuated in accordance with car movement for engaging said contacts; a timed call electronic tube; means controlled by said down call registering means for a given one of said floors for causing said tube to become conductive upon the expiration of a certain time interval after such call is registered, provided an up call is registered for such floor, or a call is registered for a floor above; means controlled by said tube when conductive to cause less than said certain potential to be applied to the contact for the floor for which the

tube is provided; stopping mechanism; and means operable when the car is set for upward travel upon the engagement of said brush with any one of said contacts which has less than said certain potential thereon for causing operation of said mechanism to stop the car at the floor for which such contact is provided and to set the car for downward travel.

62. A control system for an elevator car serving a plurality of floors comprising; a cold cathode electronic tube for each floor for registering a down call for that floor; a resistor for each tube in circuit therewith; stopping mechanism; means controlled by said call registering tubes for causing operation of said mechanism to stop the car in its downward travel in response to down calls at the floors for which such down calls are registered; a source of periodic current; a rectifier; a condenser for one of said floors connected through said resistor for the down call registering tube for that floor and said rectifier to said source to cause the application of voltage to said condenser to maintain thereon a certain charge when no call is registered on such down call registering tube; means effective when a call is registered on said down call registering tube for the floor for which said condenser is provided to reduce the charging voltage for said condenser by an amount equal to the potential drop across said resistor for such tube; means effective upon said reduction of said charging voltage to discharge said condenser to a certain less charge in a certain time interval; a timed call tube controlled by said condenser adapted to become conductive at said less charge on said condenser; and means operable when said timed call tube is conductive to cause operation of said stopping mechanism to stop the car in its upward travel at the floor for which said timed call tube is provided.

63. An elevator system in which the elevator car serves a plurality of floors comprising; a plurality of electronic tubes, one for each of said floors; a manually controlled circuit for each tube for causing operation thereof to register a call for the floor for which the tube is provided; a load for each tube; and means for each tube subject to the potential drop across the load for the tube for indicating that the call is registered.

64. An elevator system in which the elevator car serves a plurality of floors comprising; a plurality of cold cathode electronic tubes, one for each of said floors; a circuit for each tube to enable the tube to be broken down in response to manual touch to register a call for the floor for which the tube is provided; a resistor for each floor in circuit with the tube for that floor; and a second electronic tube for each floor, connected to be subject to the potential drop across the resistor for that floor so as to be broken down when the call registering tube for that floor has been broken down to register a call, for indicating that the call is registered.

65. An elevator system in which the elevator car serves a plurality of floors comprising; a plurality of electronic tubes, one for each of said floors; a circuit for each tube for causing breakdown thereof to register a call; means controlled by said tubes for causing stopping of the cars at floors for which calls are registered; a plurality of additional electronic tubes, one for each of said floors; a contact for each of said floors; contacting means operable in accordance with car movement for engaging said contacts as the car arrives at the floors for which the contacts are provided; and means for causing upon the engaging of a contact by said contacting means the breakdown of said additional tube for the floor for which the contact is provided to indicate the position of the car in the hoistway and, if a call is registered on the call registering tube for that floor, the extinguishing of such call registering tube to cancel the call.

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