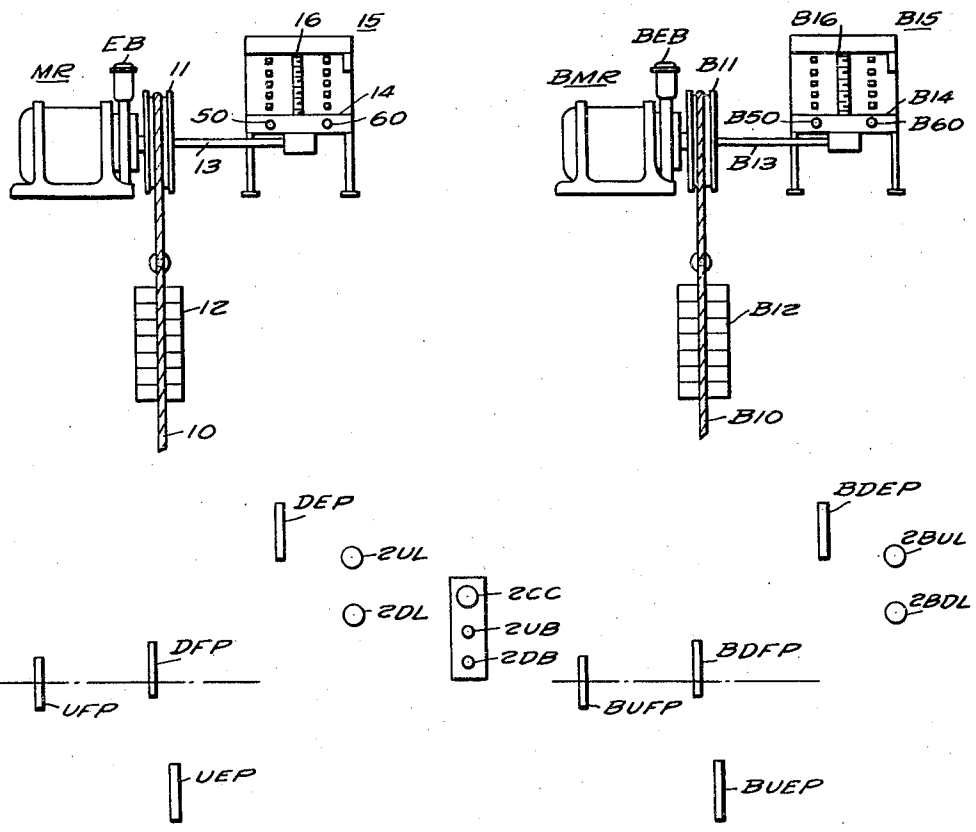
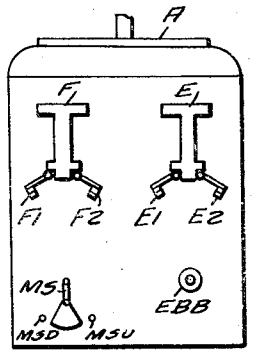
Aug. 19, 1941. W. F. EAMES 2,253,369

OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

Filed May 16, 1939 7 Sheets-Sheet 1





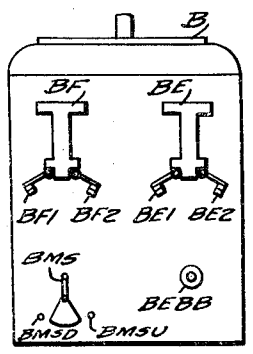


Fig. 1.

WITNESSES:

E. A. McElhaney.

Wm. C. Greene

INVENTOR

William F. Eames.

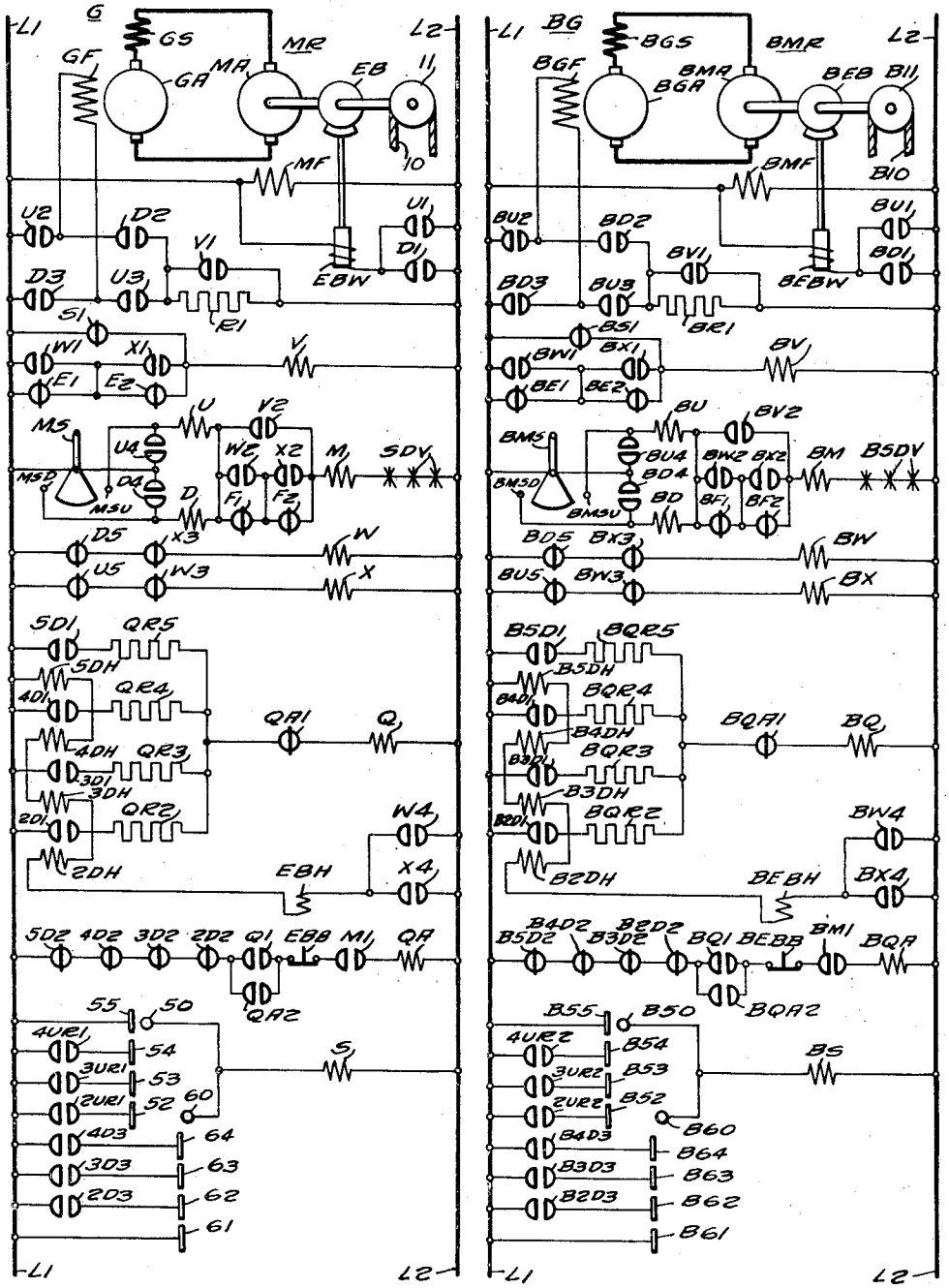
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Aug. 19, 1941. W. F. EAMES 2,253,369

OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

Filed May 16, 1939 7 Sheets-Sheet 2



WITNESSES:

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Fig. 2.

INVENTOR

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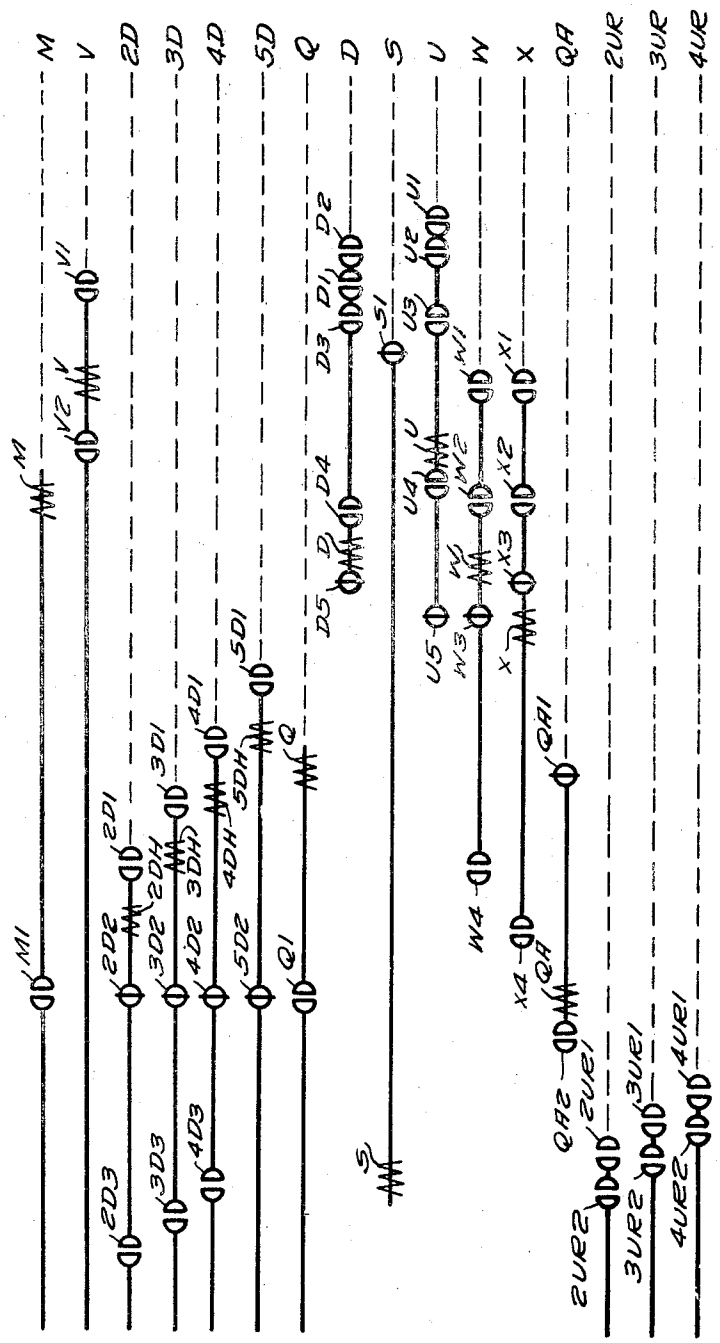
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Aug. 19, 1941. W. F. EAMES 2,253,369

OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

Filed May 16, 1939 7 Sheets-Sheet 3



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Fig. 2A.

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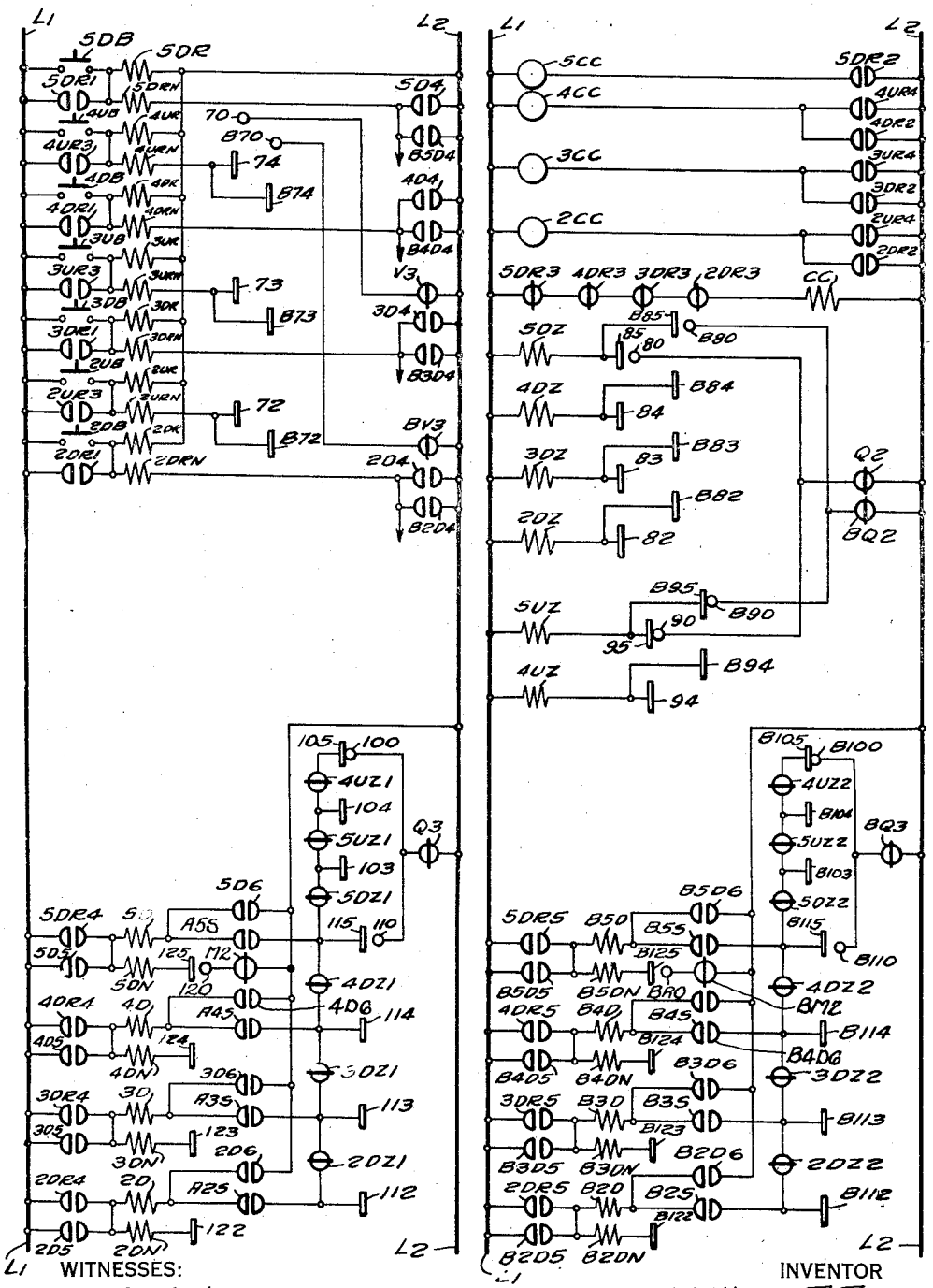
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Aug. 19, 1941. W. F. EAMES 2,253,369

OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

Filed May 16, 1939 7 Sheets-Sheet 4



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Fig. 3.

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Aug. 19, 1941. W. F. EAMES 2,253,369

OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

Filed May 16, 1939 7 Sheets-Sheet 5

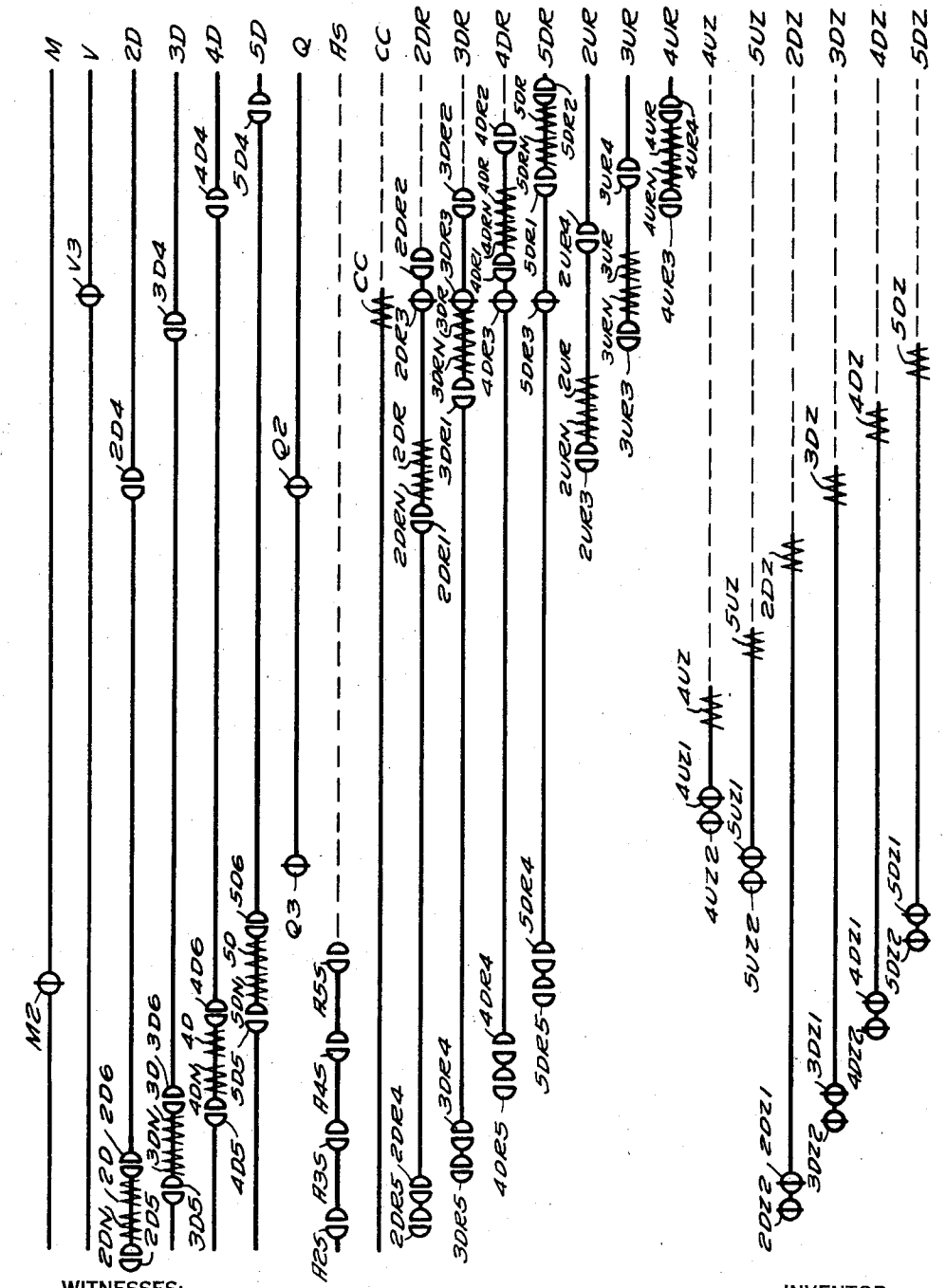


Fig. 3A.

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OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

Filed May 16, 1939 7 Sheets-Sheet 6

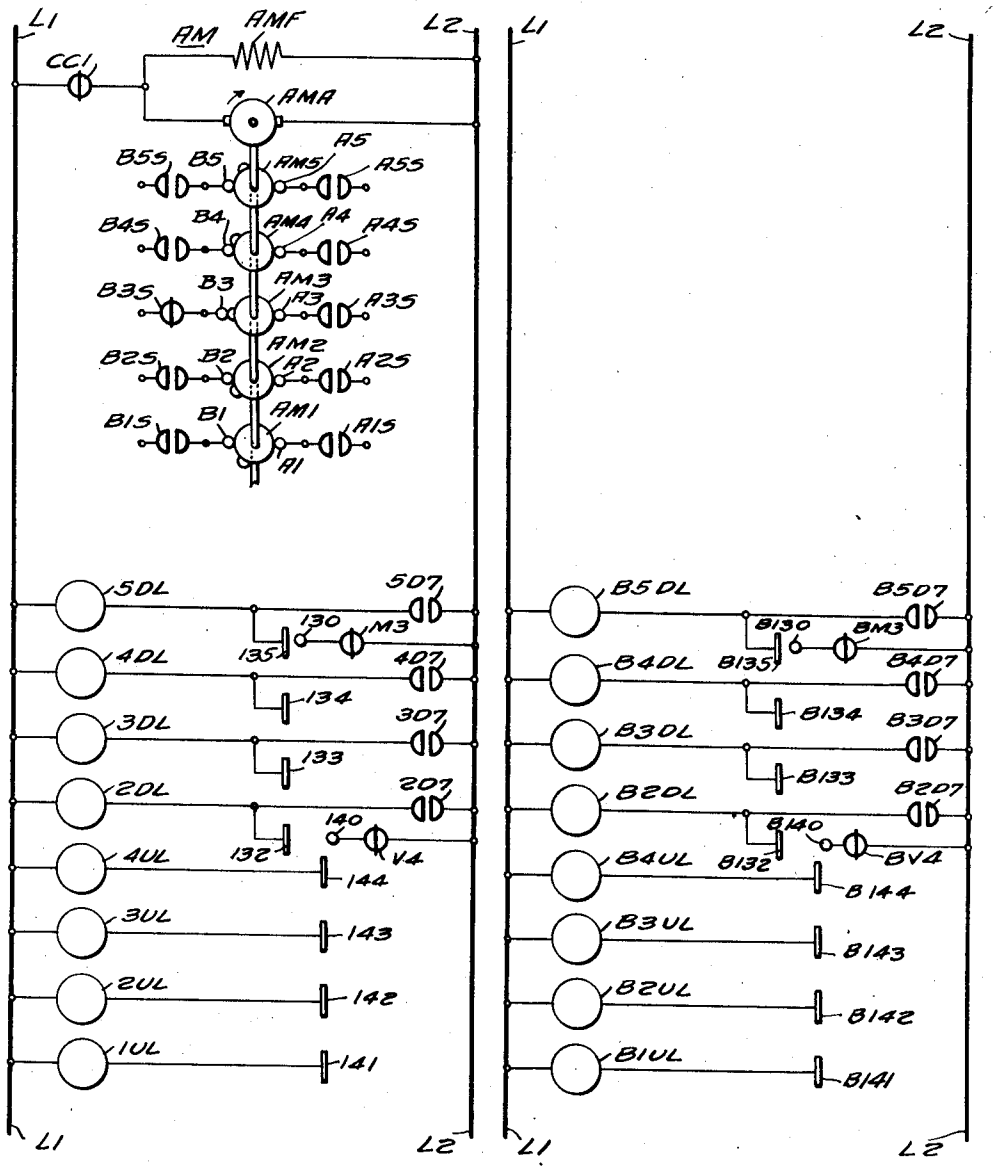


Fig. 4.

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OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

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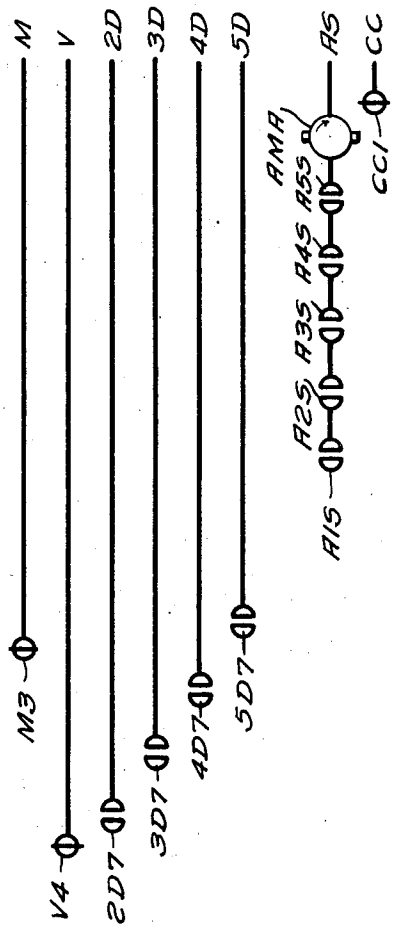


Fig. 4A.

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Patented Aug. 19, 1941 2,253,369

UNITED STATES PATENT OFFICE

2,253,369

OVER-QUOTA CONTROL SYSTEM FOR ELEVATORS

William F. Eames, Westfield, N. J., assignor to Westinghouse Electric Elevator Company, Jersey City, N. J., a corporation of Illinois

Application May 16, 1939, Serial No. 273,881

19 Claims. (Cl. 187—29)

My invention relates to systems of control for electric elevators, and more particularly to such systems in which a number of elevator cars operating together as a bank are controlled by passenger-operated push buttons located at the various floor landings. Although not limited thereto, my invention is particularly applicable to such elevator systems in which the elevator cars are driven at relatively high speeds by variable-voltage or other high-speed motive equipment and are automatically stopped at the floors by automatic landing equipment or equivalent apparatus. Such elevator systems provide the most efficient passenger service available and find their principal application in office buildings and other tall structures having a large number of floors and a relatively large volume of passenger traffic.

In such systems, in the absence of special control provisions which will be described, there is a tendency for the various elevator cars to distribute the building traffic unevenly, and, in the taller buildings, for the cars to become "bunched" and thus prevent reasonable uniformity of spacing between the cars.

These systems also tend to provide better service at certain floors than at others, particularly during the noon and evening rush periods, at which times a relatively large number of calls are registered at practically all floors of the building within a relatively short period of time. At such rush periods, each elevator car is filled to capacity by a relatively few stops, perhaps three or four. Considering a car leaving the upper terminal, such a car is usually required to make these few stops at the upper floors and so passes the lower floors without stopping. Because of the frequency with which calls are registered, the next car of the series is also filled to capacity by three or four stops at upper floors and so passes the lower floors without stopping. In the operation of these systems, therefore, the response to calls registered from lower floors of the building is delayed until most of the traffic from the upper floors has received attention.

In order to provide more uniform service throughout the building during heavy traffic peaks, the "quota" system, as disclosed in the United States patents of Richard W. Jones, No. 2,104,522, granted January 4, 1938 and of William F. Eames, No. 2,104,478, granted January 4, 1938, both assigned to Westinghouse Electric Elevator Company, has been devised. In accordance with the quota principle, each car is normally assigned a zone of floors extending in advance of itself up to some point of reference such as the next car travelling in the same direction, or, if no car is in advance of it travelling in the same direction, up to the last car travelling in the opposite direction. All corridor calls for service in the corresponding direction of travel, registered at floors included in a car's zone, are assigned to the car as soon as registered, until a predetermined number, or quota, of calls is received. Upon receipt of its quota of calls, the car loses its zone and cannot accept any further calls until it reaches a terminal. The zone of a car which has accepted its quota of calls is transferred to the next following car, so that the zone of the latter extends from its own position, past the car having its quota, up to the next preceding car travelling in the same direction, or to some other reference point.

It has been found in practice that the quota system distributes the acceptance of calls between upper and lower floors satisfactorily during heavy traffic conditions, and this system provides a more uniform time interval between the operation of a push button and the stopping of a car in response thereto, throughout the entire range of floors served by the system. Because of this more uniform time interval, the percentage of stops which result in the picking up of a single passenger is decreased; the average number of passengers picked up per stop is increased; the average number of stops per trip is decreased; and the average number of trips for the system as a whole per unit of time is increased as compared to corresponding values for systems otherwise similar but lacking the quota feature.

However, with a fixed number of stops per trip, there may be a considerable variation in the number of passengers per car transported during a trip. Accordingly, a car may arrive at the lower terminal carrying only a few passengers, whereas the car could have answered additional calls for floors between the car and the lower terminal, which had been registered before the car received its quota of assigned calls.

It is an object of the present invention to pro-

vide an elevator system of the type indicated above, in which the acceptance of calls beyond the quota limit will be subject to control by means of a manually operable element accessible to the operator.

Another object of my invention is to provide an elevator system of the type indicated above in which calls are assigned one-by-one to the individual cars, regardless of the number of calls registered at a given instant, and in which the operator of any car may accept calls additional to the normal limit or quota for his individual car.

Other objects of my invention will become evident from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a diagrammatic view showing the arrangement of two elevator cars A and B in a hatchway, and apparatus associated with the cars;

Figs. 2 to 4, inclusive, are diagrammatic views showing the circuit connections of various electrical elements used in the practice of the invention. These figures may be assembled vertically in numerical order with Fig. 2 at the top, to illustrate the circuit features of the invention; and

Figs. 2A to 4A are diagrammatic views showing the mechanical relationship of the coils and contacts of various relays shown in Figs. 2 to 4 inclusive. Figs. 2A to 4A may be arranged beside the corresponding Figures 2 to 4, inclusive, to facilitate the location of the various coils and contacts. The coils and contacts of Figs. 2A to 4A are at approximately the same levels, from top to bottom of the figures, as the corresponding elements of Figs. 2 to 4.

In order to reduce circuit complications to a minimum, the control circuits for two cars A and B only are shown herein. It will be understood, however, that similar circuits would be provided for each car of a bank, which might comprise, for example, six cars. Although no dispatcher for controlling the departure of the cars from the terminal is shown herein, it will be understood that a dispatcher of any suitable type may be used in the practice of the invention, and that the elevator system shown herein would commonly be used with a dispatcher. Suitable car call apparatus for individually stopping each car at any floor in either direction of car travel, for which a passenger within the car desires to register a call, is also preferably utilized in the practice of the invention. As such car call apparatus is well known in the art, and is not directly associated with the novel features of the present disclosure, it has not been illustrated.

In order to eliminate unnecessary multiplication of parts for the various floors, the invention has been illustrated as applied to a bank of cars operating between first and fifth floors. It will be obvious, however, that the system may be extended to include as many floors as desired.

Wherever possible, the apparatus which is individual to car B has been given the same reference character as the corresponding element of car A, with the exception that the prefix B is used to indicate that the apparatus is individual to car B. As the operation of car A will be described in detail, the prefix A has been omitted from the reference characters pertinent thereto, in order to reduce the number of symbols making up each reference character used in the description.

The control apparatus individual to car A, which is duplicated for the other cars such as car B, is listed below. The control apparatus common to cars A and B is listed in a separate schedule.

Control apparatus individual to car A

U—Up direction switch
D—Down direction switch
W—Up direction preference relay
X—Down direction preference relay
M—Running relay
V—Speed relay
Q—Quota relay
QA—Over-quota relay
S—Stopping relay
5D, 4D, 3D, 2D—Down call-storing relays
E—Slowdown inductor relay
F—Stopping inductor relay

Control apparatus common to both cars

5DR—Upper terminal call relay
4DR, 3DR, 2DR—Down call relays
4UR, 3UR, 2UR—Up call relays
5DZ, 4DZ, 3DZ—Down zoning relays
5UZ, 4UZ—Up zoning relays
CC—Motor starting relay

Apparatus shown in Figure 1 of the drawings

Referring particularly to Fig. 1 of the drawings, it will be observed that car A is arranged to be supported in a hatchway by means of a cable **10** which is passed over a sheave **11** to a suitable counterweight **12**. The sheave **11** is mounted for rotation with a shaft **13** which is driven by an elevator motor MR. A brake EB, of the usual spring-operated electromagnetically-released type, is provided for stopping further rotation of the sheave **11** when the motor M is deenergized.

A floor selector **15**, of any suitable type, is provided for commutating various circuits of the system in accordance with the position of car A. As illustrated, the shaft **13** is extended and is arranged to operate a brush carriage **14** of the floor selector **15** by mechanically rotating a lead screw **16**. The brush carriage **14** is provided with a number of moving brushes, each of which successively engages a row of stationary contacts, corresponding to the floors of the building, upon movement of the car. For simplicity, only two moving brushes **50** and **60** and the cooperating two rows of stationary contact segments are illustrated, but it will be understood that in practice a much large number of brushes and rows of contacts are provided.

For simplicity, the floor selector **15** has been illustrated as of the type in which the brush carriage **14** is initially rotated through a small angle to engage the row of stationary contact segments corresponding to the direction of car movement, before any linear movement of the brush carriage **14** along the axis of the lead screw **16** actually takes place. At the time of such initial rotation of the brush carriage **14**, the brush (**50**, for example) corresponding to the

direction opposite to that of the car movement is raised from its cooperating row of stationary contact segments, and the brush (60, for example) corresponding to the direction of car travel is moved into a position to successively engage its associated stationary contact segments. It will be seen, accordingly, that this form of floor selector provides automatic selection of the rows of stationary contact segments which will be engaged, depending upon the direction of car movement. Obviously, however, any of the more complicated forms of floor selectors known in the art may be used in the practice of the invention.

In order to effect accurate stopping of car A at floor level, a slowdown inductor relay E and a stopping inductor relay F are mounted upon the car in positions to cooperate with suitable inductor plates UEP, DEP, UFP and DFP, of iron or other magnetic material, mounted in the hatchway. The inductor relays E and F have normally incomplete magnetic circuits which are successively completed by the inductor plates UEP, UFP, or equivalent, as the car approaches floor level. For simplicity of illustration, the inductor relays E and F have been shown as of the type comprising a permanent magnetic core to which is attached suitable soft iron armatures for controlling the relay contacts. These inductor relays require no energizing coil, and a contact operation results each time an inductor relay passes one of the inductor plates UEP, etc., mounted in the hatchway. As shown, the inductor relays E and F each have a divided magnetic circuit constituting separate magnetic branches for upward and downward movement of the car, and are provided with separate contacts E1 and F1, respectively, for upward direction of car travel and E2 and F2, respectively, for downward direction of car travel.

At each floor, hall lanterns are provided over each hatchway door or at other suitable locations, to indicate which car will answer a call. As illustrated in Fig. 1 of the drawings, hall lanterns 2UL and 2DL are shown as individual to car A for the second floor. It will be understood that similar hall lanterns are provided for the other cars and for each floor between the terminals. At the terminal floors, only one lantern is required per car, in accordance with the usual practice.

In order to provide for registering calls at the floors, hall call buttons are provided at each floor intermediate the terminals, one button for each direction of travel. As illustrated, the second floor is provided with an up call button 2UB and a down call button 2DB. The other intermediate floors are similarly provided with hall call buttons, and a single button is provided at the terminal floors.

A car coming signal, preferably an incandescent lamp such as shown at 2CC, is provided at each floor, common to all of the cars of the bank. The car coming lantern 2CC is illuminated immediately upon operation of one of the push buttons 2UB or 2DB to denote that a call has been registered, and remains illuminated until the call is appropriated to one of the cars A or B, at which time the car coming signal 2CC is deenergized and the hall lantern 2DL or B2DL, for example, for the car to which the call is appropriated, becomes illuminated.

In order to start car A in either direction, a master switch MS is provided within the car in a position convenient to be controlled by the operator. The master switch MS includes an energizing segment which normally stands in a central position but is operable to either of two starting positions, the first in engagement with up contact member MSU for starting car A in the up direction, and the second in engagement with down contact member MSD for starting car A in the down direction.

An over-quota by-pass button EBB is also provided in car A in a position accessible to the operator. The over-quota by-pass button EBB is provided for enabling the operator to accept additional calls when he finds that the car has already accepted its quota of calls but is not filled. As will be hereinafter more fully explained, after a car has received its quota of calls, it will thereafter accept calls for floors in advance of the car in the down direction of car movement, one at a time, until the operator presses the over-quota by-pass button EBB, to thereby by-pass the car to the lower terminal without further stops in response to registered hall calls.

Apparatus shown in Fig. 2 of the drawings

Referring particularly to Fig. 2 of the drawings, it will be observed that on the left-hand side, control circuits are shown which are individual to car A. At the right-hand side, the circuits shown are individual to car B.

As shown, the motor MR is provided with an armature MA which is mechanically connected to the shaft 13 for driving the sheave 11. The brake EB is provided with a release winding EBW which is energized on energization of the motor MR, to thereby effect release of the brake and permit rotation of the motor. The motor MR includes the usual shunt type main field winding MF which is connected for energization between supply conductors L1 and L2. The armature MA of motor MR may be energized by means of a generator G which is provided with an armature GA connected in a local circuit with the armature MA.

In order to control the direction and magnitude of the voltage generated by the armature GA, the generator G is provided with a separately excited main field winding GF. A field resistor R1 is included in the circuit of field winding GF in order to provide speed control for the motor MR. The generator G is also provided with a suitable apparatus for correcting the speed regulation of motor MR, shown for simplicity as a series field winding GS.

The master switch MS, previously described as located in car A, is here shown connected to selectively control the energization of the operating windings of an up direction switch U and a down direction switch D. The direction switches U and D are provided with contact members, as illustrated, for reversing the connections of the generator field winding GF to the conductors L1 and L2, depending upon the direction in which it is desired to operate the elevator car. When either the up or the down direction switch U or D is energized, a running relay M is also energized to perform functions which will be set forth hereinafter. In order to apply the maximum voltage to the main field winding GF, a speed relay V is provided which operates to short-circuit the resistor R1 connected in series circuit relationship with the generator field winding GF. The usual safety devices SDV are included in the circuit of running relay M.

For the purpose of performing certain func-

tions which depend upon the direction of movement of the elevator car, an up direction preference relay W and a down relay X, are provided. The direction preference relays W and X are controlled by the direction switches U and D, and are so interlocked that upon the opening of one direction switch the other will close. When car A is standing at a floor, one or the other of the direction switches W and X will be closed, corresponding to the direction of car movement required to bring the car to the floor.

In order to initiate an automatic stopping operation of the car at any of the floors, a stopping relay S is provided. The stopping relay S is arranged to be operated upon approach of the car A to a floor for which a hall call is registered, as will be set forth hereinafter.

In addition to the apparatus shown for automatically stopping the car A in response to hall calls, suitable apparatus is also provided for stopping the car in response to car calls registered from within the car A. However, in order to simplify the description and drawings, the apparatus for registering car calls has been omitted. This apparatus may be of any suitable type known in the art, effective to permit the registration within the car of stop calls for all floors served by the car for both directions of car travel, and to initiate an automatic stopping operation of the car upon approach of the latter to a floor for which a car call is registered.

A quota relay Q is provided for preventing response of the car A to any hall calls, registered in the down direction, for floors in advance of the car, after the car has received its quota or total limit of calls. The quota relay Q is connected to be energized by means of a number of parallel circuits corresponding to the various floors at which down calls may be registered, and is designed to close when the total number of such circuits energized equals the number corresponding to the quota of the car. Each of the parallel energized circuits for the quota relay Q is provided with a quota resistor QR5, QR4, etc., which limits the value of current operated through the operating coil of the quota relay Q in response to a hall call for the corresponding floor. Ordinarily, the quota resistors QR5, QR4, etc., have the same resistance value, but in some installations, floors for which an excessive number of calls are registered may have their corresponding quota resistors of reduced resistance value, in order to weigh the corresponding floors in accordance with the average number of passengers which normally board the car during a stop at one of such unusually busy floors.

An over-quota relay QA is provided for preventing the energization of the quota relay Q when the car A has been assigned its total quota of calls, but the car is not yet fully loaded and it is possible for the car to accept further calls. The over-quota relay QA becomes energized on a downward trip of the car A, when the car has received its total number of calls, corresponding to its quota, and has answered all of these calls. In order to deenergize the over-quota relay QA, the over-quota by-pass button EBB is operated, whereupon further acceptance of calls by the car A is prevented until the latter reaches the lower terminal.

The stopping relay S for the car A is controlled by means of floor selector moving brushes 50 and 60, in cooperation with up and down rows of stationary contact segments. As shown, the stopping relay S is automatically operated at the upper and lower terminals whether or not any hall calls for the terminal floors are registered. At intermediate floors, the stopping relay S becomes energized if any of the up call relays 4UR, 3UR, etc., (to be more fully described in connection with Fig. 3) or any of the down call-storing relays 4D, 3D, etc., (which will also be described in connection with Fig. 3) are energized, and the car A is approaching the floor corresponding to the operated relay.

Apparatus shown in Fig. 3 of the drawings

A bank of down call relays 5DR, 4DR, 3DR and 2DR is provided for registering calls for floors in the downward direction of car travel, corresponding to associated call buttons 5DB, 4DB, etc., located at the various landings served by the car. Each of the down call relays 5DR, 4DR, etc., serves to register calls for the corresponding floor, common to all of the cars of the elevator bank.

Similarly, a bank of up call relays 4UR, 3UR and 2UR is provided for registering calls for the upward direction of car movement in response to operation of various up call buttons 4UB, 3UB, etc. located at the various landings.

The down call relays 5DR, etc., and the up call relays 4UR, etc., are of similar construction, each having an energizing coil designated by the same reference character as the relay itself, and a demagnetizing relay 5DRN, etc., and 4URN, etc., which act in opposing relationship upon the relay magnetic circuit. Upon energization of one of the energizing coils, such as 5DR, the front contacts of the corresponding relay all close and the relay back contacts all open. The front contacts remain closed and the back contacts remain open until the operating coil 5DR is deenergized, or until the demagnetizing winding 5DRN of the corresponding relay becomes energized, whereupon the relay contacts are restored to normal position.

The car coming lamps 5CC, 4CC, 3CC and 2CC, located at the various floor landings, which, as mentioned above in connection with Fig. 1, serve to indicate that a call has been registered, are shown in connection with their associated circuit controlling elements in the upper right part of Fig. 3. Each car coming lamp, such as 2CC, is controlled by contact of the up call relay 2UR for the corresponding floor, and independently by contacts of the corresponding down call relay, such as relay 2DR.

A motor starting relay CC is provided for initiating operation of an auxiliary motor AM, to be hereinafter more fully described in connection with Fig. 4, when all of the down call relays 5DR, 4DR, etc., are deenergized.

A plurality of down zoning relays 5DZ, 4DZ, 3DZ and 2DZ is provided for dividing the hatchway into zones of floors in dependence upon the positions of the cars A and B. Similarly, a plurality of up zoning relays 5UZ and 4UZ is provided for extending the down zones to include floors in the upward direction close to the upper terminal.

A plurality of down call-storing relays 5D, 4D, 3D and 2D, individual to car A, is provided for assigning calls exclusively to the latter car in response to operation of one of the down call relays 4DR, 3DR, etc., in the zone of car A. The call-storing relays 5D, 4D, etc., are each provided with an energizing coil bearing the same reference character as the relay as a whole, and a demagnetizing coil such as 5DN, which opposes

the operating coil in the relay magnetic circuit, similarly to the call relays 5DR, etc., described above. However, the down car selecting relays 5D, 4D, etc., are also provided with holding coils 5DH, 4DH, etc., (Fig. 2), which serve to maintain one set of contacts 5D1, 4D1, etc., closed after the remaining front contacts of the corresponding relay have been opened in response to deenergization of the relay operating coil, such as 5D (Fig. 3) or after energization of the relay demagnetizing coil 5DN. It will be understood that upon energization of an operating coil, such as 5D, all front contacts of the call storing relay 5D immediately close, and all back contacts of the relay 5D open. Upon deenergization of the operating coil 5D, or upon energization of the demagnetizing coil 5DN, all back contacts of the relay 5D close, and all front contacts open except the front contacts 5D1 (Fig. 2), which latter are held in closed position until the corresponding holding coil 5DH is deenergized.

Apparatus shown in Fig. 4 of the drawings

Referring to the upper part of Fig. 4, the circuits of the auxiliary motor AM are shown in connection with the contacts of the auxiliary motor starting relay CC. Upon deenergization of the auxiliary motor starting relay CC, the relay contacts CC1 close to effect energization of both the armature AMA and the shunt field winding AMF of the auxiliary motor AM. In response to such energization the auxiliary motor AM rotates continuously to effect successive engagement of a plurality of car selecting contacts A5S, A4S, etc., by means of suitable cams AM5, AM4, etc., in cooperative relationship with rollers A5, A4, etc. Each cam, such as cam AM5, is arranged to alternately operate contacts such as A5S for car A or B5S for car B, dependent upon the angular position of the auxiliary motor armature AMA. The arrangement of cams and contacts is such that for any car, such as car A, the corresponding contacts A5S, A4S, A3S, etc., can be closed only in small increments, preferably one at a time. The purpose of this arrangement is to distributively select the call storing relays of each car for operation, and momentarily prevent operation of those not selected, so that a large number of call storing relays for any one car cannot be simultaneously operated. As will be hereinafter more fully explained in connection with the operation of the system, the contacts A5S, B5S, etc., select the car to which a registered down call will be assigned.

The hall lanterns 5DL, 4DL, 3DL and 2DL for the downward direction of car travel are shown in connection with their associated circuit controlling elements in the lower left part of Fig. 4. It will be understood that a bank of down hall lanterns is provided individual to car A, and a similar bank (shown in the lower right part of Fig. 4) is provided individual to car B.

Corresponding banks of up call lanterns 4UL, 3UL, etc., for car A, and B4UL, B3UL, for car B are shown in connection with their associated circuit controlling elements in the lower part of Fig. 4 below the corresponding down floor lanterns. An up floor lantern or a down floor lantern is energized whenever a call has been assigned for the corresponding car and direction of car travel.

For the up direction of car travel, the up hall lanterns, such as 4UL, are energized only when the corresponding car is approaching the corresponding floor and has commenced to decelerate in order to stop at the corresponding floor. For the downward direction of car travel, however, the floor lanterns 5DL, etc., may be energized a considerable interval of time in advance of arrival of the car, as, for the downward direction of car travel, calls are assigned to the various cars shortly after registration of the corresponding call, if the corresponding floor is included in an active zone of one of the cars, as will be hereinafter more fully explained.

Operation of the system

It will be assumed initially that cars A and B are standing at the upper terminal and that the quota for each car is two calls. The operation of the above-described apparatus under these conditions may be set forth as follows.

The speed relay V (Fig. 2) for car A is closed as its coil is energized through a circuit traversing the back contacts S1 of stopping relay S, which latter relay is at this time deenergized. As the speed relay V is energized, its contacts V1 (Fig. 2) complete a short-circuit around the speed register R1; its contacts V2 (Fig. 2) in the circuit of running relay M are closed; its back contacts V3 (Fig. 3) are open; and its back contacts V4 (Fig. 4) are open to prevent energization of the common circuit of the up hall lanterns 4UL, 3UL, etc.

The speed relay BV for cam B (Fig. 2) is similarly energized and its various contacts corresponding to those of speed relay V are in corresponding positions.

An energizing circuit is completed for the up direction preference relay W (Fig. 2) which may be traced as follows:

L1; D5; X3; W; L2

In response to completion of the latter circuit, the up direction preference relay W is energized, and its front contacts W1 and W2 (Fig. 2) are closed to prepare associated circuits for subsequent energization; its back contacts W3 (Fig. 2) in the circuit of down direction preference relay X are open; and its front contacts W4 (Fig. 2) are closed to complete a common circuit for the holding coil EBH of the over-quota bypass button EBB and the various holding coils 2DH, etc., of the car selecting relays 2D, etc. The up direction preference relay W, rather than the down direction preference relay X is closed at this time as the car A was travelling in the up direction in arriving at the upper terminal, and the down direction switch D has not yet been energized to effect its deenergization.

A similar circuit is completed for the up direction preference relay BW (Fig. 2) for car B, and the latter relay is closed to effect similar control of circuits which may be readily identified in the various figures.

Referring to Fig. 3, a circuit is completed for the motor starting relay CC, which circuit may be traced as follows:

L1; 5DR3; 4DR3; 3DR3; 2DR3; CC; L2

In response to completion of this circuit, the motor starting relay CC is closed to interrupt the common circuit of the auxiliary motor armature AMA and auxiliary motor field winding AMF (Fig. 4) by means of its back contacts CC1.

As car A was travelling in the up direction to arrive at the upper terminal, the up direction brush 90 (Fig. 3) of the floor selector 15 is in engagement with the stationary contact segment 95 for the fifth floor, thereby completing a circuit for the up zoning relay 5UZ, which circuit

will be obvious from the figure. The up zoning relay 5UZ is accordingly energized to open its back contacts 5UZ1 (Fig. 3), which are without effect at this time.

Registration of down call

Assuming that a prospective passenger at the 4th floor desires to register a call for the downward direction, he presses the call button 4DB at the 4th floor landing, thereby completing an energizing circuit for the relay 4DR (Fig. 3), which may be traced as follows:

L1; 4DB; 4DR; L2

The down call relay 4DR, accordingly, is energized to complete a holding circuit for itself by means of its front contacts 4DR1 (Fig. 3); to complete a circuit for the car coming signal lamp 4CC for the 4th floor (Fig. 3) by means of its contacts 4DR2; to interrupt the energizing circuit of the motor starting relay CC (Fig. 3) by means of its contacts 4DR3; and to close its contacts 4DR4 and 4DR5 (Fig. 3) which are at this time without effect except in the preparation of circuits.

In response to the deenergization of the operating coil of the motor starting relay CC by the opening of contacts 4DR3 (Fig. 3) as described above, the motor starting relay CC completes a circuit for the auxiliary motor armature AMA and field winding AMF by means of its back contacts CC1 (Fig. 4).

Call stored pending acceptance of zone

As the auxiliary motor AM is now energized, its armature AMA (Fig. 4) commences to rotate in the clockwise direction, thereby successively effecting engagement of the various pairs of contacts B2S, B1S, etc., in sequence. A circuit for each of the call storing relays 4D and B4D has been partially completed by the contacts 4DR4 and 4DR5 (Fig. 3) of the call relay 4DR, which latter is at this time energized. However, the engagement of contacts A4S (Fig. 4), controlled by the auxiliary motor AM, is ineffective to complete a circuit for the call storing relay 4D, as the circuit of the latter relay is open at the contacts 5UZ1 and also at the floor selector, inasmuch as the down brush 110 has not yet engaged the down floor segment 115 for the 5th floor. Similarly, engagement of the motor controlled contacts B4S (Fig. 4) is ineffective to cause energization of the call storing relay B4D. The auxiliary motor AM accordingly continues to rotate, thereby sequentially causing engagement of its associated contacts, and the call registered by the call relay 4DR remains unaccepted by either car A or car B.

Starting of car downward from terminal

It will be assumed that in response to operation of a suitable dispatcher (not shown) the operator of car A has been given a start signal by suitable dispatcher signalling apparatus (not shown), and that in response to such start signal, the operator of car A starts his car in the downward direction. In starting car A downward, the operator rotates the master switch MS in the clockwise direction, thereby causing the rotating segment of the latter switch to engage the contact MSD. A common energizing circuit for the down direction switch D and the running relay M (Fig. 2) is accordingly completed, which circuit may be traced as follows, referring to Fig. 2:

L1; MS; MSD; D; F1; F2; M; SDV; L2

In response to completion of the latter circuit, the down direction switch D and the running relay M close. The down direction switch D, in closing, completes an energizing circuit for the brake release winding EBW by means of its contacts D1 (Fig. 2); completes an energizing circuit for the generator field winding GF (Fig. 2) by means of its contacts D2 and D3; completes a holding circuit for itself by means of its contacts D4 (Fig. 2); and interrupts the circuit of the up direction preference relay W (Fig. 2) by means of its back contacts D5.

The running relay M, in closing, prepares the circuit of the over-quota relay QA (Fig. 2), for subsequent energization, by means of its contacts M1; and opens its contacts M2 (lower left part of Fig. 3) and M3 (Fig. 4), which latter contacts are at this time ineffective.

As mentioned above, the circuit of the up direction preference relay W was opened upon energization of the down direction switch D, by means of the back contacts D5 (Fig. 2) of the latter switch. The up direction preference relay W, accordingly, drops out, to open its front contacts W1 and W2 (Fig. 2), which are at this time without effect; to complete a circuit for the down direction preference relay X (Fig. 2), by means of its back contacts W3, as will be obvious from the latter figure; and to open the common circuit of the holding coils EBH, etc., (Fig. 2) by means of its contacts W4.

As the down direction preference relay X is now energized, it closes its contacts X1 and X2 (Fig. 2), which are at this time without effect; opens its contacts X3 (Fig. 2), which are also without effect at this time; and again completes the common energizing circuit of the holding coils EBH, etc. (Fig. 2) by means of its contacts X4.

As the generator G now develops voltage, and the brake EB is released, the motor MA commences to accelerate as the generator voltage builds up, and car A is driven downward from the upper terminal floor.

Starting car accepts zone and stored calls

As car A starts to move downward from the 5th floor, the brush carriage of the floor selector 15 undergoes its initial rotation to effect disengagement of the selector moving brushes for the up direction from their associated contact segments for the up direction, and to effect engagement of the floor selector brushes for the down direction with the corresponding stationary segments for the down direction of car travel. In this operation the selector brush 110 (Fig. 3) engages the stationary contact segment 115 for the downward direction, thereby interrupting one of the breaks in the circuit of the call storing relay 4D, mentioned above under the heading Call stored pending acceptance of zone. It will be recalled that the auxiliary motor AM (Fig. 4) is rotating and thereby successively effecting engagement of the various pairs of contacts associated with the auxiliary motor. At the first reclosure of the auxiliary motor contacts A4S, therefore, a circuit is completed for the call storing relay 4D (Fig. 3) which may be traced as follows, referring to the latter figure:

L1; 4DR4; 4D; A4S; 4DZ1; 115; 110; Q3; L2

The call storing relay 4D for the 4th floor and

the downward direction of car travel, accordingly, closes to appropriate the call registered on the call relay 4DR, to car A. The call storing relay 4D, in closing, places one call on the quota relay Q by completing one of the parallel branch circuits of the latter relay by means of its contacts 4D1 (Fig. 2); opens its back contacts 4D2 (Fig. 2) which are at this time without effect; closes its contacts 4D3 (Fig. 2), also without effect at this time; completes a circuit for the demagnetizing coil 4DRN of the call relay 4DR by means of its contacts 4D4 (Fig. 3); completes a holding circuit for itself by means of its contacts 4D5 and 4D6 (Fig. 3); and completes a circuit for the down hall lantern 4DL (Fig. 4) by means of its contacts 4D7.

Upon completion of the circuit for the demagnetizing winding 4DRN (Fig. 3), by contacts 4D4, as mentioned above, the down call relay 4DR opens. The down call relay 4DR, in opening, interrupts the circuit of the car coming signal lamp 4CC for the 4th floor (Fig. 3) by means of its contacts 4DR2, and completes a circuit for the motor starting relay CC (Fig. 3) by means of its back contacts 4DR3. The down call relay 4DR in opening, also effects disengagement of its various pairs of front contacts 4DR1, 4DR4 and 4DR5 (Fig. 3), all of which are at this time ineffective to cause relay operation.

As the motor starting relay CC is now energized, its contacts CC1 (Fig. 4) are open, thereby effecting disconnection of the armature AMA and field winding AMF of the auxiliary motor AM. The latter motor, accordingly, is brought to rest. It will be noted that as the car coming signal 4CC for the 4th floor is now deenergized, and the down hall lantern 4DL for car A for the 4th floor is energized, the assignment of the down call at the 4th floor to car A is communicated to the prospective passenger at the 4th floor landing, and the passenger, accordingly, moves to a position in front of the hatchway door for car A.

Call in assigned zone immediately accepted

As car A is now moving downwardly, its associated floor selector brush carriage is in an angular position corresponding to downward movement, and car A has the zone extending from the upper terminal downward. A call registered at this time will not be stored for subsequent selection of a car, but will be assigned promptly to car A which now has the downward zone.

Assuming, for example, that a prospective passenger at the 3rd floor desires to register a call for downward service, he presses the down call button 3DB (Fig. 3) for the 3rd floor, thereby completing a circuit for the down call relay 3DR, which will be obvious from Fig. 3. In response to completion of the latter circuit, the down call relay 3DR closes to complete a holding circuit for itself by means of its contacts 3DR1 (Fig. 3); to momentarily complete a circuit for the car coming lamp 3CC for the 3rd floor by means of its contacts 3DR2 (Fig. 3); to interrupt the circuit of the motor starting relay CC by means of its contacts 3DR3 (Fig. 3); and to close its contacts 3DR4 and 3DR5 (Fig. 3), which are at this time ineffective except in the preparation of circuits.

As the motor starting relay CC is again deenergized, it completes a circuit for the armature AMA and field winding AMF of the auxiliary motor AM (Fig. 4), causing the latter motor to start its rotation. However, as the motor AM commences to rotate, the contacts A4S are opened and the motor driven contacts A3S (Fig. 3) are closed, thereby completing a circuit for the down call storing relay 3D. Assuming that car A is still nearer the fifth floor than the fourth floor, this circuit extends:

L1, 3DR4, 3D, A3S, 3DZ1, 4DZ1, 115, 110, Q3, L2

Operation of quota relay

As the call storing relay 3D for the 3rd floor is energized, it closes to complete a second energizing branch of the circuit of the quota relay Q (Fig. 2) by means of its contacts 3D1. The call storing relay 3D, in closing, also opens its back contacts 3D2 and 3D3 (Fig. 2), which are at this time without effect; completes a circuit for the demagnetizing winding 3DRN of the call relay 3DR (Fig. 3) by means of its contacts 3D4; completes a holding circuit for itself by means of its contacts 3D5 and 3D6 (Fig. 3); and completes an energizing circuit for the down hall lantern 3DL for the third floor by means of its contacts 3D7 (Fig. 4).

As the operation of the relay 3D completed a branch of the energizing circuit of quota relay Q (Fig. 2), and as another branch had been completed by the relay 4D previously, the total current circulated through the relay Q corresponds to two calls, or its quota, and the relay Q closes.

The quota relay Q, in closing, effects engagement of its front contacts Q1 (Fig. 2) and separation of its back contacts Q2 (Fig. 3), both of which operations are at this time without effect; and also effects separation of its contacts Q3, (Fig. 3) to thereby prevent the assignment of further calls to car A.

As mentioned above, the closure of contacts 3D4 of the call-storing relay 3D (Fig. 3) completes a circuit for the demagnetizing winding 3DRN to thereby effect deenergization of the down call relay 3DR for the third floor. The down call relay 3DR accordingly drops out to interrupt the circuit of the car coming lamp 3CC and to complete a circuit for the motor starting relay CC, as will be obvious from the corresponding operation for the down call relay 4DR, described above under the heading Starting car accepts zone and stored calls. The motor starting relay CC is, accordingly, energized to again interrupt the circuit of the auxiliary motor AM.

Automatic stopping of car

As car A continues its movement downward from the 5th floor, the down brush 60 of the corresponding floor selector engages the stationary contact segment 64 (Fig. 2) thereby completing a circuit for the stopping relay S, which will be obvious from Fig. 2. The stopping relay S, accordingly, opens its back contacts S1 (Fig. 2), thereby removing a short-circuit around the inductor contacts E1 and rendering the latter contacts effective to control the circuit of the speed relay V. As car A continues its downward movement, the permanent magnet type inductor relay E, mounted on car A, passes the inductor plate (not shown) corresponding to the slowdown point for the 4th floor, and the inductor contacts E1 open to interrupt the circuit of the speed relay V.

The speed relay V, accordingly, opens to reinsert the resistor R1 in series with the generator field winding GF, by means of its contacts V1

(Fig. 2); to render the inductor contacts F1 effective to subsequently control the down direction switch D, by the opening of its contacts V2 (Fig. 2); and also closes its back contacts V3 (Fig. 3) and V4 (Fig. 4), which back contacts are at this time ineffective.

As car A continues its downward movement toward the 4th floor, the permanent magnet type inductor relay F passes the stopping inductor plate (not shown) for the down direction of car travel at the fourth floor, and the common energizing circuit of the down direction switch D and running relay M is interrupted at the inductor contacts F1 (Fig. 2).

The down direction switch D, accordingly, becomes deenergized, opening its contacts D1 (Fig. 2) and thereby effecting deenergization of the brake release winding EBW; and opening its contacts D2 and D3 (Fig. 2) to thereby disconnect the generator field winding GF. The down direction switch D, in dropping out, also opens its contacts D4 (Fig. 2) without effect at this time, and closes its contacts D5 (Fig. 2) in the circuit of the up direction preference relay W.

The running relay M, in dropping out, completes a circuit for the demagnetizing winding 4DN of the down call storing relay 4D by means of its back contacts M2 (Fig. 3); and completes an additional circuit for the down hall lantern for the 4th floor 4DL, by means of its contacts M3 (Fig. 4). The running relay M also opens its contacts M1 (Fig. 2), which are without effect at this time.

As mentioned above, the relay M in dropping out, completes a circuit for the demagnetizing winding 4DN of the call storing relay 4D, by means of its contacts M2. This circuit may be traced as follows, referring to Fig. 3; L1; 4D5; 4DN; 124; M2; L2.

In response to completion of this circuit, the call storing relay 4D drops out. The contacts 4D1 (Fig. 2) of the call storing relay 4D do not reopen at this time, however, as these contacts are held closed by the holding coil 4DH (Fig. 2) associated therewith. The call registered on the quota relay Q by the car selecting relay 4D, accordingly, remains recorded even though the relay 4D drops out. The call storing relay 4D, in dropping out, interrupts the circuit of the stopping relay S by means of its contacts 4D3, (Fig. 2); and opens one of the two parallel branch circuits for the hall lantern 4DL which exist at this time, by means of its contacts 4D7 (Fig. 4). The call storing relay 4D, at this time, also closes its contacts 4D2 (Fig. 2), and opens its contacts 4D4, 4D5, and 4D6 (Fig. 3), all of which are at this time without effect.

As the stopping relay S is now deenergized, it closes its back contacts S1 (Fig. 2) to thereby reestablish the circuit of the speed relay V, and the latter relay, accordingly, recloses. The operations performed by the speed relay V in closing are described above under the heading Operation of the system. As the generator G is now deenergized, and the brake release winding EBW is also deenergized, permitting application of the brake by means of its spring (not shown), car A is brought to rest at the 4th floor.

Answering a call at intermediate floor

After entry of the prospective passenger at the 4th floor into car A, the operator restarts car A downwardly in order to answer the call assigned thereto for the third floor, of which call the operator has been notified by suitable signal apparatus (not shown).

In starting car A downward, the operator again rotates the master switch MS in the clockwise direction, completing a common circuit for the down direction switch D and running relay M (Fig. 2) as described above under the heading Starting of car downward from terminal. The car A accordingly starts downward from the 4th floor. As car A approaches the third floor, the down floor selector brush 60 (Fig. 2) engages the stationary contact segment 63, thereby completing a circuit for the stopping relay S, and the latter relay closes to initiate an automatic stopping operation as described above under the heading Automatic stopping of car. Accordingly, the inductor relays E and F cause the deenergization of the speed relay V, the down direction switch D, and running relay M, respectively, as described above. The down direction switch D, in dropping out, again interrupts the circuit of the brake release winding EBW and also the circuit of the generator field winding GF to cause car A to stop at the third floor.

The running relay M, in dropping out, completes a circuit for the demagnetizing winding 3DN of the call storing relay 3D, to thereby effect deenergization of the latter relay. The call storing relay 3D, in dropping out, opens the circuit of the stopping relay S, which in turn completes a circuit for the speed relay V, all as described above under the heading Automatic stopping of car. Similarly to the call storing relay 4D, the call storing relay 3D, in dropping out, does not efface the call held on the relay Q by the contacts 3D1 (Fig. 2).

Preparation for assigning additional calls to car having quota

Car A is now at rest at the third floor, and no further recorded stops are assigned to it, as the car has answered the two calls at the 4th floor and the third floor which constitute the car's quota. The quota relay Q (Fig. 2) is held in through the two parallel branch circuits completed by the contacts 4D1 and 3D1 of the call storing relays 4D and 3D, respectively. Assuming that the number of passengers boarding car A at the third floor is insufficient to load the car, there is still available space for additional passengers, even though the quota of two calls of the car has already been answered. Under this condition, the operator of car A refrains from operating the over-quota by-pass button EBB (Fig. 2), and upon initial movement of car A in the downward direction, the latter car will become eligible to accept further calls beyond its quota.

In order to start car A downward from the third floor, the operator again rotates the master switch MS in the clockwise direction, thereby establishing the common energizing circuit for the down direction switch D and running relay M, described above. The down direction switch D and running relay M, accordingly, close to perform the various operations specified above under the heading Starting of car downward from terminal. However, as contacts Q1 (Fig. 2) of the quota relay Q are now closed, the closure of the running relay M effects an additional operation in completing the circuit of the over-quota relay QA, which circuit may be traced as follows, referring to Fig. 2:

L1; 5D2; 4D2; 3D2; 2D2; Q1; EBB; M1; QA; L2

In response to completion of the latter circuit, the over-quota relay QA closes to interrupt the circuit of the quota relay Q by means of its contacts QA1 (Fig. 2); and to complete a holding circuit for itself by means of its contacts QA2 (Fig. 2). The quota relay Q, therefore, drops out, opening its contacts Q1 (Fig. 2); closing its contacts Q2 (Fig. 3) to thereby complete a circuit for the down zoning relay 3DZ; and closing its contacts Q3 (Fig. 3) to prepare the circuits of the call storing relays 5D, 4D, etc., to accept further calls. The energizing circuit for the down zoning relay 3DZ, mentioned above, may be traced as follows, referring to Fig. 3:

L1; 3DZ; 83; 80; Q2; L2

In response to completion of the latter circuit, the down zoning relay 3DZ opens its contacts 3DZ1 and 3DZ2 (Fig. 3), which are at this time without effect.

Call out of assigned zone stored

As car A has now passed below the 4th floor, a prospective passenger at the latter floor is no longer able to register a call which will be assigned to car A. Assuming a prospective passenger at the 4th floor operates the call button 4DB, a circuit is completed for the call relay 4DR, as traced above under the heading Registration of down call. The call relay 4DR, accordingly, closes to perform the various operations specified under the above-mentioned heading, namely, to complete a circuit for the car coming signal 4CC for the 4th floor, and to interrupt the circuit of the motor starting relay CC. The motor starting relay CC, therefore, drops out to again energize the auxiliary motor AM, and the latter motor commences to rotate. However, as the circuits of the down call storing relay 4D for car A and the down call storing relay B4D for car B, are both open at the two break points indicated above under the heading Call stored pending acceptance of zone, the auxiliary motor AM continues to rotate indefinitely, and the call for the 4th floor remains stored.

Assuming that car B, which has heretofore been standing at the upper terminal, has now received a start down signal from the dispatcher (not shown), the operator of the latter car operates the master switch BMS in the clockwise direction, thereby completing a common energizing circuit for the down direction switch BD and the running relay BM, which will be obvious from the above description. The down direction switch BD, therefore, closes to start car B in the downward direction, and to interrupt the circuit of the up direction preference relay BW (Fig. 2), which latter relay, in turn, completes a circuit for the down direction preference relay BX (Fig. 2), as will be readily understood from the corresponding description for car A under the heading Starting of car downward from terminal.

The starting of car B downwardly effects engagement of the selector brush B110 with the stationary segment B115 (lower part of Fig. 3), thereby preparing the circuit of the car selecting relay B4D for subsequent acceptance of the call registered at the 4th floor. It will be recalled that the auxiliary motor AM is now rotating in response to closure of the down call relay 4DR for the 4th floor and the failure of either of the cars A or B to accept the registered call. As the auxiliary motor AM continues to rotate, the contacts B4S associated therewith are closed, thereby completing a circuit for the call storing relay B4D, similar to the circuit traced above under the heading Starting car accepts zone and stored call. In response to completion of this circuit, the call storing relay B4D closes to assign a call to the quota relay BQ (Fig. 2) of car B; to effect the deenergization of the call relay 4DR (Fig. 3); and to complete a circuit for the down hall lantern B4DL (Fig. 4) for car B at the 4th floor. Upon deenergization of the call relay 4DR (Fig. 3), the latter relay opens to interrupt the circuit of the car coming signal lamp 4CC (Fig. 3) for the 4th floor, and to again complete the circuit of the motor starting relay CC (Fig. 3), which latter relay interrupts the energizing circuits of the auxiliary motor AM (Fig. 4).

Selection of car accepting call dependent on car position

In the operating sequence so far described, car B is leaving the 5th floor or upper terminal in the downward direction, and car A is leaving the 3rd floor in the downward direction. The zone below the third floor is, accordingly, assigned to car A, and the zone below the 5th floor down to the third floor, is assigned to car B, if a call is registered at the second floor by operation of the down button 2DB, this call will be assigned to car A, even though the latter car has accepted its quota of calls, as will be apparent from the following. Upon operation of the down call button 2DB, a circuit is completed for the down call relay 2DR (Fig. 3), as will be obvious from the latter figure, and the call relay 2DR closes to complete a circuit for the car coming lamp 2CC (Fig. 3) for the second floor, and to interrupt the circuit of the motor starting relay CC (Fig. 3), as will be apparent from the above description with reference to call relay 4DR.

The motor starting relay CC drops out, in response to operation of the call relay 2DR, and again completes the energizing circuits for the auxiliary motor AM (Fig. 4). The latter motor, accordingly, commences to rotate, thereby successively effecting engagement of the contacts B3S, B2S, B1S, A5S, A4S, A3S and A2S. In this sequence, the closure of the contacts B2S is ineffective to complete a circuit for the call storing relay B2D, as the circuit of the latter relay is open at the contacts 3DZ2 of the down zoning relay 3DZ. Closure of the contacts A2S, however, is effective to complete a circuit for the down call storing relay 2D, which circuit may be traced as follows, referring to Fig. 3: L1; 2DR4; 2D; A2S; 2DZ1; 113; 110; Q3; L2.

Upon completion of the latter circuit, the call storing relay 2D closes, causing deenergization of the call relay 2DR (Fig. 3) by completing a circuit for the demagnetizing winding 2DRN; completing a holding circuit for itself through its contact 2D5 and 2D6; and deenergizing relay QA by opening its contacts 2D2. When relay QA drops to its deenergized position contact QA1 closes and the current through contacts 4D1, 3D1, and 2D1 reenergize relay Q to prevent further call registration on car A in the event that it is at a position where other calls may be registered at floors lower.

When the call registered at the next floor is answered, the contacts M2 close, thus energizing coil 2DN to deenergize relay 2D which now closes its back contacts 2D2. Again a circuit is established to relay QA. The previously described action then repeats, registering one more call

on car A (assuming again it is a position where other down calls can exist below it). This action will continue, assigning one call at a time to car A until the circuit to QA coil is manually opened by the operation of push button EBB by the car operator. This he will do when he has accepted a predetermined number of overquota calls or when his car has a capacity load of passengers.

In the sequence of operation so far described, car B has left the upper terminal and is moving downward slightly below the 5th floor. Car A has left the third floor on a downward trip but has not yet approached the second floor. A down call at the 4th floor is assigned to car B, and a down call at the second floor is assigned to car A.

As car B approaches the 4th floor in its downward movement, the down floor selector brush B60 (Fig. 2) engages the stationary floor selector segment B64, thereby completing a circuit for the stopping relay BS, similar to the circuit traced for the stopping relay S under the heading Automatic stopping of car.

As car B passes the slowdown point in advance of the 4th floor, the inductor contacts BE1 (Fig. 2) effect the deenergization of the speed relay BV, and upon further movement of car B to the stopping point in advance of the 4th floor, the inductor contacts BF1 effect the deenergization of the down direction switch BD and the running relay BM (Fig. 2). Car B accordingly decelerates and stops at the 4th floor.

Operation of zoning relay

As car B approaches the fourth floor, during its stopping operation, the moving selector brush B80 engages the stationary selector segment B84 for the fourth floor (Fig. 3), thereby completing a circuit for the down zoning relay 4DZ, which circuit may be traced as follows, referring to Fig. 3: L1; 4DZ; B84; B35; Q2; L2.

The down zoning relay 4DZ accordingly becomes energized to open its back contacts 4DZ2 (Fig. 3), to thereby prevent the assignment of a call at the 5th floor to car B; and to open its contacts 4DZ1 (Fig. 3), at this time without effect.

As car B stops at the 4th floor, the stopping relay BS and the car selecting relay B4D are deenergized in the manner described above under the heading Automatic stopping of car.

Assuming that a further down call is registered at the third floor by operation of the third floor down button 3DB, a circuit for the down call relay 3DR (Fig. 3) is completed, as will be obvious from the above description. The call relay 3DR accordingly closes to complete a circuit for the car coming signal lamp 3CC (Fig. 3); and to again interrupt the circuit of the motor starting relay CC (Fig. 3). Deenergization of the latter relay causes the auxiliary motor AM (Fig. 4) to start and to complete a circuit for the call storing relay B3D (Fig. 3, as will be understood from similar operations described above under the heading Call in assigned zone accepted immediately.

As the circuit of call storing relay B3D has been completed, this relay closes. The call storing relay B3D, in closing, opens the circuit of the car coming signal lamp 3CC (Fig. 3); completes a circuit for the down hall lantern B3DL (Fig. 4); completes a circuit for the motor starting relay CC (Fig. 3), to thereby effect deenergization of the auxiliary motor AM (Fig. 4); and registers a second call on the quota relay BQ of car B (Fig. 2), thereby effecting operation of the latter quota relay.

In order to answer the call existing at the third floor and assigned to car B, the operator of the latter car starts the car downward and an automatic stop is effected at the third floor, in a manner which will be apparent from the above description. As car B moves from the fourth floor to the third floor, the down zoning relay 4DZ becomes deenergized, and the down zoning relay 3DZ (Fig. 3) for the third floor becomes energized in a manner which will be apparent from inspection of Fig. 3. Upon stopping of car B at the third floor, the corresponding call storing relay B3D (Fig. 3) drops out, completing a circuit for the over-quota relay BQA (Fig. 2) as described above under the heading Preparation for assigning additional calls to car having quota. The energization of the over-quota relay BQA causes the deenergization of the quota relay BQ.

Operation of over-quota by-pass relay

Assuming that car B is completely filled by passengers boarding the car at the third floor, the operator of car B may prevent the stopping of the car in response to any further hall calls by pressing the over-quota by-pass button BEBB (Fig. 2). Upon operation of the over-quota by-pass button BEBB, the energizing circuit of the over-quota relay BQA (Fig. 2) is interrupted, and the latter relay drops out to again complete the circuit of the quota relay BQ, by means of its contacts BQA1 (Fig. 2).

The quota relay BQ accordingly closes to effect engagement of its front contacts BQ1 (Fig. 2) in the circuit of the over-quota relay BQA; to open its contacts BQ2 (Fig. 4), to thereby remove car B from the zoning system; and to open its contacts BQ3 (Fig. 3), to thereby prevent the assignment of any further down calls to car B, before arrival of the latter at the lower terminal.

It will be assumed that car A stops at the second floor in response to the down call registered for that floor and assigned to car A, picks up the prospective passenger at the second floor, and is restarted downward to the lower terminal where it is stopped by the associated stopping relay S, and inductor relays E and F, as described above under the heading Automatic stopping of car.

Registration of up call

The registration of an up call is effected in a somewhat different manner from the registration of a down call. Assuming that the up call button 4UB for the fourth floor is pressed, a circuit is completed for the up call relay 4UR (Fig. 3), as will be obvious from the figure. The up call relay 4UR, therefore, closes to prepare an energizing circuit of the stopping relay S for subsequent completion, by means of its contacts 4UR1 (Fig. 2); to prepare a similar circuit for the stopping relay BS of car B by means of its contacts 4UR2 (Fig. 2); to complete a holding circuit for itself by means of its contacts 4UR3 (Fig. 3); and to complete a circuit for the car coming signal lamp 4CC for the 4th floor by means of its contacts 4UR4 (Fig. 3).

It will be observed that the up call relay 4UR prepares both the stopping relay S for car A and the stopping relay BS for car B for subsequent energization, so that whichever car is the first to approach the 4th floor in the up direction will be automatically stopped in response to the up call. The up call is, therefore, stored indefinite-

ly on the up call relay 4UR, without assignment to either car. Also the up call relay 4UR effects energization of the car coming signal lamp 4CC, and the latter lamp remains energized until one or the other of the cars A and B approaches the 4th floor in the up direction and accepts the registered up call. When the call is accepted by an upwardly moving car and the accepting car commences to decelerate, a circuit for the corresponding up hall lantern 4UL or B4UL is completed by floor selector contacts, as will be obvious from Fig. 4.

I do not intend that the present invention shall be restricted to the specific structural details, arrangement of parts, or circuit connections herein set forth, as various modifications thereof may be effected without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. In an elevator system having a plurality of cars operable past a plurality of floors; an individual group of call storing elements for each of said cars for recording desired stops of the corresponding car at any of said floors; automatic means for distributively selecting, in timed sequence independent of movements of said cars, said elements of each of said groups and for temporarily preventing operation of all of said elements except the elements momentarily selected; and totalizing means for each of said cars, each of said totalizing means being responsive to a predetermined totalized effect of the stops assigned to the associated car for preventing the assignment of additional stops thereto.

2. In an elevator system having a plurality of cars operable past a plurality of floors; a group of relay elements individual to each of said cars, each of said groups comprising a plurality of elements corresponding to a plurality of said floors; automatic means for distributively selecting, in timed sequence independent of movements of said cars, said elements of each of said groups and for temporarily preventing operation of all of said elements except the elements momentarily selected; totalizing means for each of said cars, each of said totalizing means being responsive to a predetermined totalized effect of the operated relay elements of the corresponding group to prevent operation of additional elements of said corresponding group; and control means for selecting and operating said relay elements, said control means including a manually controllable element for each of said groups, each of said manually controllable elements being effective, after operation of the corresponding totalizing means, to selectively permit or prevent the operation of an additional relay element of the associated group.

3. In an elevator system having a plurality of cars operable past a plurality of floors; a group of relay elements individual to each of said cars, each of said groups comprising a plurality of elements corresponding to a plurality of said floors, automatic means for distributively selecting, in timed sequence independent of movements of said cars, said elements of each of said groups and for temporarily preventing operation of all of said elements except the elements momentarily selected; means effective when any selected car is prepared for movement, for rendering operable at least a part of the individual group of relay elements corresponding to said selected car and for preventing operation of said relay elements of other cars for corresponding floors; totalizing means for each of said cars, each of said totalizing means being responsive to a predetermined totalized effect of the operated relay elements of the corresponding group to prevent operation of additional elements of said corresponding group; and control means for selecting and operating said relay elements, said control means including a manually controllable element for each of said groups, each of said manually controllable elements being effective, after operation of the corresponding totalizing means, to selectively permit or prevent the operation of an additional relay element of the associated group.

4. In an elevator system having a plurality of cars operable past a plurality of floors; a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; automatic means for distributively selecting, in timed sequence independent of movements of said cars, said relays of each of said groups and for temporarily preventing operation of all of said relays except the relays momentarily selected; and control means for selecting and operating said relays, said control means including a manually-controllable element for each of said groups, each of said manually controllable elements being effective in one condition to permit operation of any relay of the corresponding group selected by said automatic means, and in another condition, to prevent operation of all of said relays of the associated group.

5. In an elevator system having a plurality of cars operable past a plurality of floors; a group of relay elements individual to each of said cars, each of said groups comprising a plurality of elements corresponding to a plurality of said floors; automatic means for distributively selecting, in timed sequence independent of movements of said cars, said elements of each of said groups and for temporarily preventing operation of all of said elements except the elements momentarily selected; individual holding means for each of said elements, each of said holding means being effective upon operation of the corresponding element to maintain said corresponding element in operated condition irrespective of the condition of said automatic means; and control means for selecting and operating said relay elements, said control means including a manually controllable element for each of said groups, each of said manually controllable elements being effective in one condition to permit operation of any relay element of the corresponding group selected by said automatic means, and in another condition to prevent operation of any additional relay elements of the associated group.

6. In an elevator system having a plurality of cars operable past a plurality of floors; a group of relay elements individual to each of said cars, each of said groups comprising a plurality of elements corresponding to a plurality of said floors; automatic means for distributively selecting, in timed sequence independent of movements of said cars, said elements of each of said groups and for temporarily preventing operation of all of said elements except the elements momentarily selected; individual holding means for each of said elements, each of said holding means being effective upon operation of the corresponding element to maintain said corresponding element in operated condition irrespective of the condition of said automatic means; control means

for selecting and operating said relay elements, said control means including a manually controllable element for each of said groups, each of said manually controllable elements being effective in one condition to permit operation of any relay element of the corresponding group selected by said automatic means, and in another condition to prevent operation of any additional relay elements of the associated group, and position responsive means for each of said cars, effective upon approach of the corresponding car to any selected floor, for rendering said holding means for any operated relay element for said selected floor ineffective.

7. In an elevator system having a plurality of cars operable past a plurality of floors; a group of relay elements individual to each of said cars, each of said groups comprising a plurality of elements corresponding to a plurality of said floors; automatic means for distributively selecting, in timed sequence independent of movements of said cars, said elements of each of said groups and for temporarily preventing operation of all of said elements except the elements momentarily selected; individual holding means for each of said elements, each of said holding means being effective upon operation of the corresponding element to maintain said corresponding element in operated condition, irrespective of the condition of said automatic means; totalizing means for each of said cars, each of said totalizing means being responsive to a predetermined totalized effect of the operated relay elements of the corresponding group to prevent operation of additional elements of said corresponding group; and control means for selecting and operating said relay elements, said control means including a manually controllable element for each of said groups, each of said manually controllable elements being effective, after operation of the corresponding totalizing means, to selectively permit or prevent the operation of an additional relay element of the associated group.

8. In an elevator system having a plurality of cars operable in a hatchway past a plurality of floors, a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; a switch means for each individual floor, each of said switch means being effective in a predetermined condition to render all of said relays for the corresponding individual floor operable; automatic means for selecting increments of said relays of each of said groups for operation in sequence, and for temporarily preventing operation of all of said relays except the increments selected; and control means for selecting and operating said relays, said control means including a manual element for each of said groups, each of said manual elements being effective in one condition to permit operation of any relay of the corresponding group prepared by the associated switch means and selected by said automatic means, and in another condition to prevent operation of all of said relays of the associated group.

9. In an elevator system having a plurality of cars operable in a hatchway past a plurality of floors, a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; a switch means for each individual floor, each of said switch means being effective in a predetermined condition to render all of said relays for the corresponding individual floor operable; automatic means for selecting individual relays of each of said groups for operation in sequence, and for temporarily preventing operation of all of said relays except the individual relays selected; and control means for selecting and operating said relays, said control means including a manual element for each of said groups, each of said manual elements being effective in one condition to permit operation of any relay of the corresponding group prepared by the associated switch means and selected by said automatic means, and in another condition to prevent operation of all of said relays of the associated group.

10. In an elevator system having a plurality of cars operable in a hatchway past a plurality of floors, a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; a switch means for each individual floor, each of said switch means being effective in a predetermined condition to render all of said relays for the corresponding individual floor operable; automatic means for selecting increments of said relays of each of said groups for operation in sequence, and for temporarily preventing operation of all of said relays except the increments selected; call assignment mechanism for choosing an individual one of said relays corresponding to a car prepared to approach the associated floor and for preventing the operation of any relays for said associated floor except said individual one of said relays; and control means for selecting and operating said relays, said control means including a manual element for each of said groups, each of said manual elements being effective in one condition to permit operation of any relay of the corresponding group prepared by the associated switch means, selected by said automatic means and chosen by said call assignment mechanism, each of said manual elements being effective in another condition to prevent operation of all of said relays of the associated group.

11. In an elevator system having a plurality of cars operable in a hatchway past a plurality of floors, a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; a switch means for each individual floor, each of said switch means being effective in a predetermined condition to render all of said relays for the corresponding individual floor operable, automatic means for selecting individual relays of each of said groups for operation in sequence, and for temporarily preventing operation of all of said relays except the individual relays selected; call assignment mechanism for choosing an individual one of said relays corresponding to a car prepared to approach the associated floor, and for preventing operation of any of said relays for said associated floor except said individual one so chosen; and control means for selecting and operating said relays, said control means including a manual element for each of said groups, each of said manual elements being effective in one condition to permit operation of any relay of the corresponding group prepared by the associated switch means, selected by said automatic means and chosen by said call assignment mechanism, each of said manual elements being effective in another condition to prevent operation of all of said relays of the associated group.

12. In an elevator system having a plurality

of cars operable in a hatchway past a plurality of floors, a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; a switch means for each individual floor, each of said switch means being effective in a predetermined condition to render all of said relays for the corresponding individual floor operable; automatic means for selecting increments of said relays of each of said groups for operation in sequence and for temporarily preventing operation of all of said relays except the increments selected; zoning means for dividing said hatchway into zones of floors and for assigning said zones individually to said cars; and control means for selecting and operating said relays, said control means including a manual element for each of said groups, each of said manual elements being effective in one condition to permit operation of any relay of the corresponding group, prepared by the associated switch means, selected by said automatic means and corresponding to a floor included in a zone assigned to the corresponding car, each of said manual elements being effective in another condition to prevent operation of all of said relays of the associated group.

13. In an elevator system having a plurality of cars operable in a hatchway past a plurality of floors, a group of relays individual to each of said cars, each of said groups comprising a plurality of relays corresponding to a plurality of said floors; a switch means for each individual floor, each of said switch means being effective in a predetermined condition to render all of said relays for the corresponding individual floor operable; automatic means for selecting individual relays of each of said groups for operation in sequence, and for temporarily preventing operation of all of said relays except the individual relays selected; zoning mechanism for dividing said hatchway into zones of floors and for assigning said zones individually to said cars; and control means for selecting and operating said relays, said control means including a manual element for each of said groups, each of said manual elements being effective in one condition to permit operation of any relay of the corresponding group, prepared by the associated switch means, selected by said automatic means and corresponding to a floor included in a zone assigned to the corresponding car, each of said manual elements being effective in another condition to prevent operation of all of said relays of the associated group.

14. In an elevator system having a plurality of cars operable past a plurality of floors; call storing means for each car for recording desired stops of the corresponding car at any of said floors; quota means for controlling said call storing means to limit the number of stops assigned to an individual car; manually operable switch means, and electromagnetic means responsive thereto after said quota means has operated to limit the number of stops assigned to any selected car, to thereafter selectively permit the assignment of at least one additional stop to said selected car.

15. In an elevator system having a plurality of cars operable past a plurality of floors; call storing means for each car for recording desired stops of the corresponding car at any of said floors; quota means for controlling said call storing means to limit the number of stops assigned to an individual car; over-quota means, means responsive to operation of said quota means for presetting said over-quota means after said quota means has operated to limit the number of stops assigned to any selected car, to thereafter selectively permit the assignment of additional stops, one by one, to said selected car, and manually operable switch means for operating the over-quota means after it has been preset to assign additional stops, one by one, to said selected car.

16. In an elevator system having a plurality of cars operable past a plurality of floors; call-storing means for each car for recording desired stops of the corresponding car at any of said floors; totalizing means for each of said cars, each of said totalizing means being responsive to a predetermined totalized effect of the stops assigned to the associated car for preventing the assignment of additional stops thereto; an over-quota device associated with each totalizing means, each over-quota device requiring a presetting as a prerequisite for operation, means responsive to operation of a totalizing means for presetting the over-quota device associated therewith for operation, and a manually operable device associated with each over-quota device by which its operation may be completed after it is preset to permit the assignment of at least one additional stop to the car with which the preset over-quota device is associated.

17. In an elevator system having a plurality of cars operable past a plurality of floors; an individual group of call storing elements for each of said cars for recording desired stops of the corresponding car at any of said floors; means effective when any selected car is prepared for movement, for rendering operable at least a part of the individual group of call storing elements corresponding to said selected car and for preventing operation of said call storing elements of other cars for corresponding floors, said part corresponding to a zone of floors assigned to said selected car; totalizing means for said selected car, said totalizing means being responsive to a predetermined totalized effect of the operated call storing elements of said part for causing operation of said zoning means to transfer said zone of floors to a different car; an over-quota device associated with said totalizing means, said over-quota device requiring a presetting as a prerequisite for operation, means responsive to operation of said totalizing means for presetting the over-quota device, and a manually operable device associated with said over-quota device by which its operation may be completed after it is preset for restoring said zone of floors to said selected car until an additional stop is assigned thereto.

18. In an elevator system having a plurality of cars operable past a plurality of floors; an individual switch means for each floor, common to all of said cars, for registering calls for service; call storing means for each car for recording desired stops of the corresponding car at any of said floors; motive apparatus individual to each of said cars; zoning means, effective when any selected car is prepared for movement, for rendering the call storing means for that car effective to record calls in response to operation of the switch means corresponding to at least a part of said plurality of floors and for preventing operation of the call storing means for other cars in response to operation of said plurality of said switch means; stopping means

for each car for controlling its motive apparatus to cause it to stop at the floors for which stops are recorded on its call storing means, a quota means for each car for controlling its call storing means to limit the number of stops assigned to that car, an over-quota means for each car for controlling the call storing means of that car, said over-quota device requiring a presetting as a prerequisite for operation, means responsive to operation of the quota means of a car for presetting its over-quota means, and manually operable means associated with each over-quota means by which operation thereof may be completed after it is preset to render the call storing means of its car effective to accept at least one additional stop after operation of its quota means.

19. In an elevator system having a plurality of cars operable past a plurality of floors; an individual switch means for each floor, common to all of said cars, for registering calls for service; call storing means for each car for recording desired stops of the corresponding car at any of said floors; motive apparatus individual to each of said cars; zoning means, effective when any selected car is prepared for movement, for rendering the call storing means for that car effective to record calls in response to operation of the switch means corresponding to at least a part of said plurality of floors and for preventing operation of the call storing means for other cars in response to operation of said plurality of said switch means; stopping means for each car for controlling its motive apparatus to cause it to stop at the floors for which stops are recorded on its call storing means, a quota means for each car for controlling its call storing means to limit the number of stops assigned to that car, an over-quota means for each car for controlling the call storing means of that car, said over-quota device requiring presetting as a prerequisite for operation, means responsive to operation of the quota means of a car for presetting its over-quota means, manually operable means associated with each over-quota means by which operation thereof may be completed after it is preset to render the call storing means of its car effective to accept at least one additional stop after operation of its quota means, and means responsive to that car answering that additional stop for conditioning its call storing means to accept another additional stop.

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