

March 12, 1963

J. R. DINNING
ELEVATOR CONTROLS

3,080,946

Filed Sept. 14, 1960

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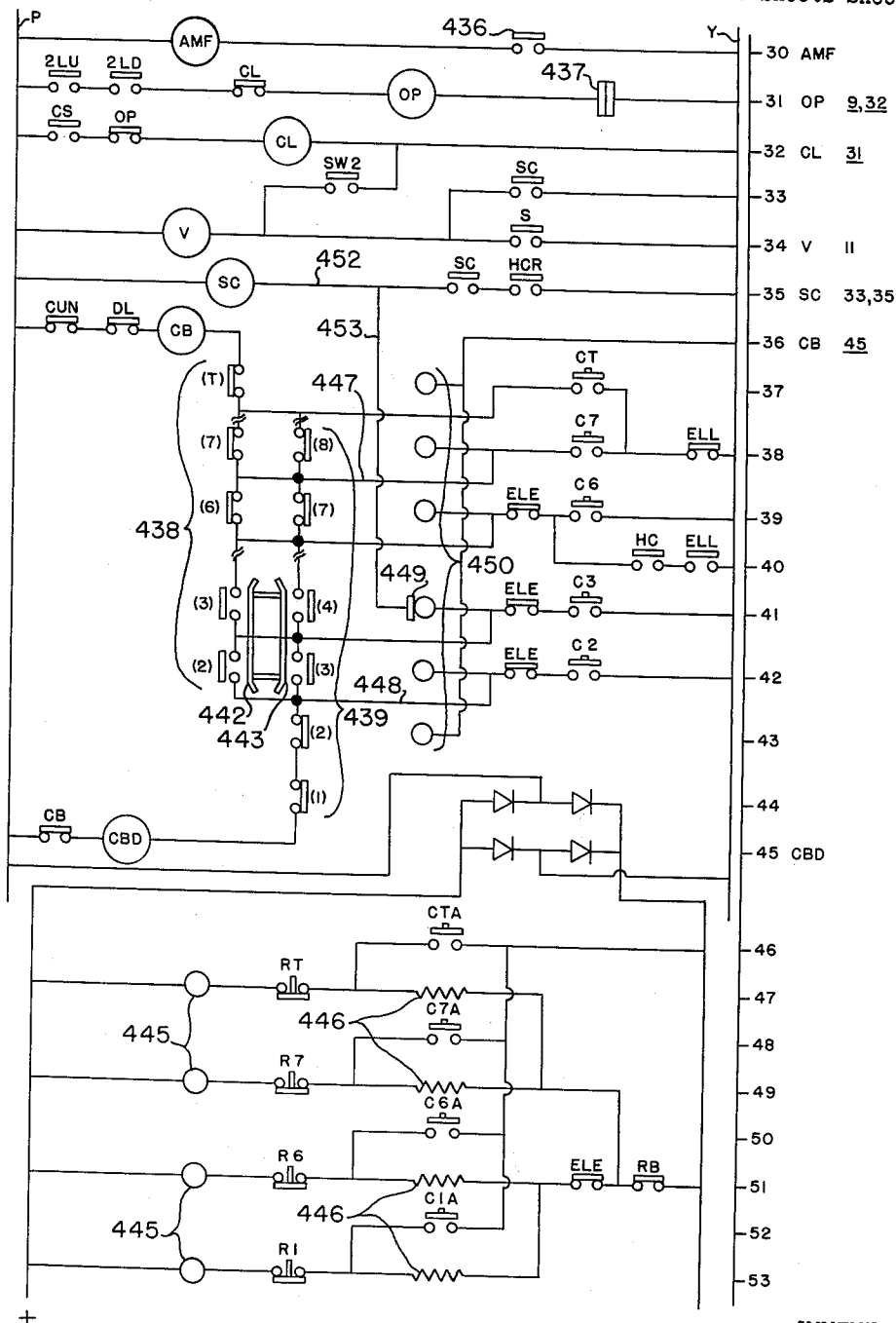


Fig. II

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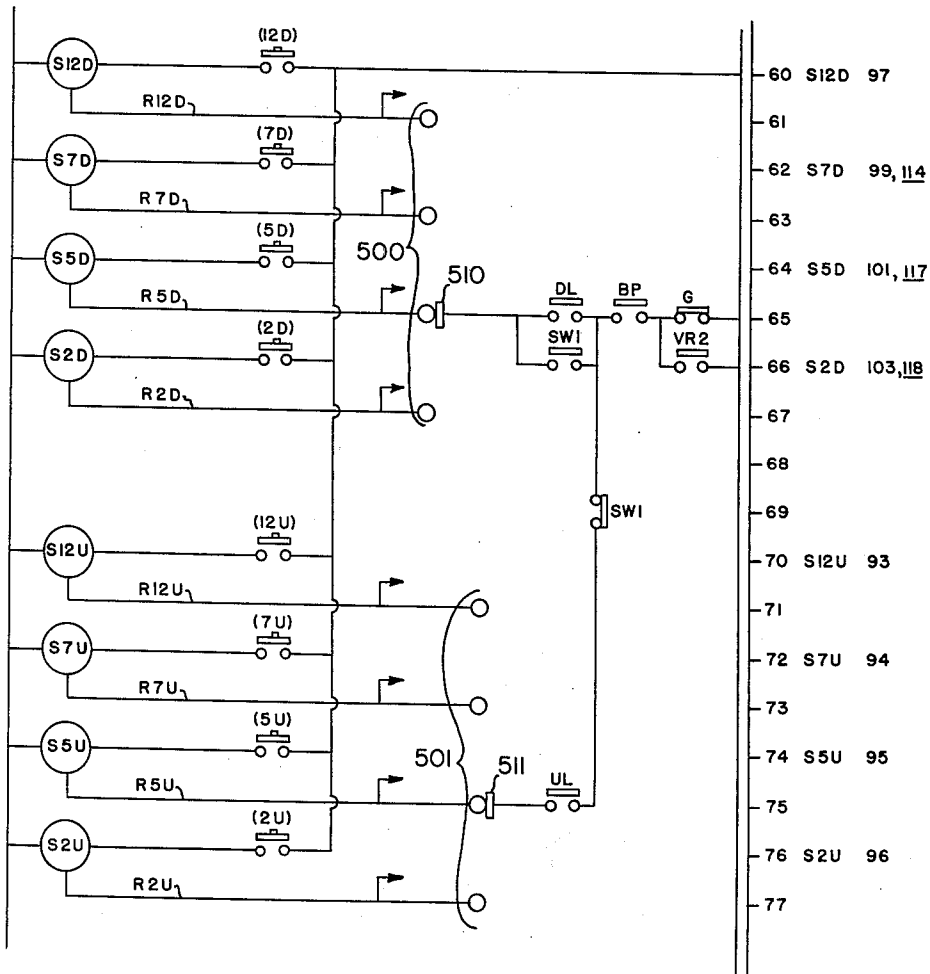


Fig. III

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5 Sheets-Sheet 4

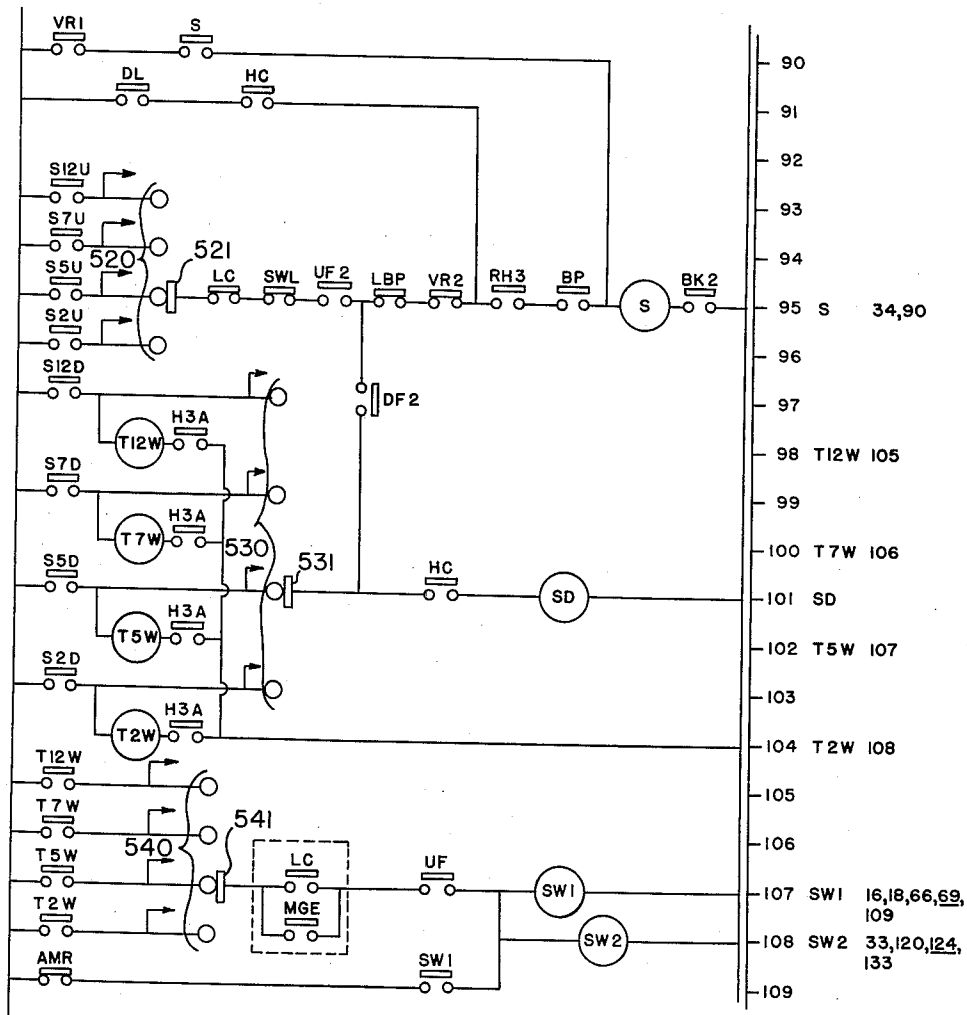


Fig. IV

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5 Sheets-Sheet 5

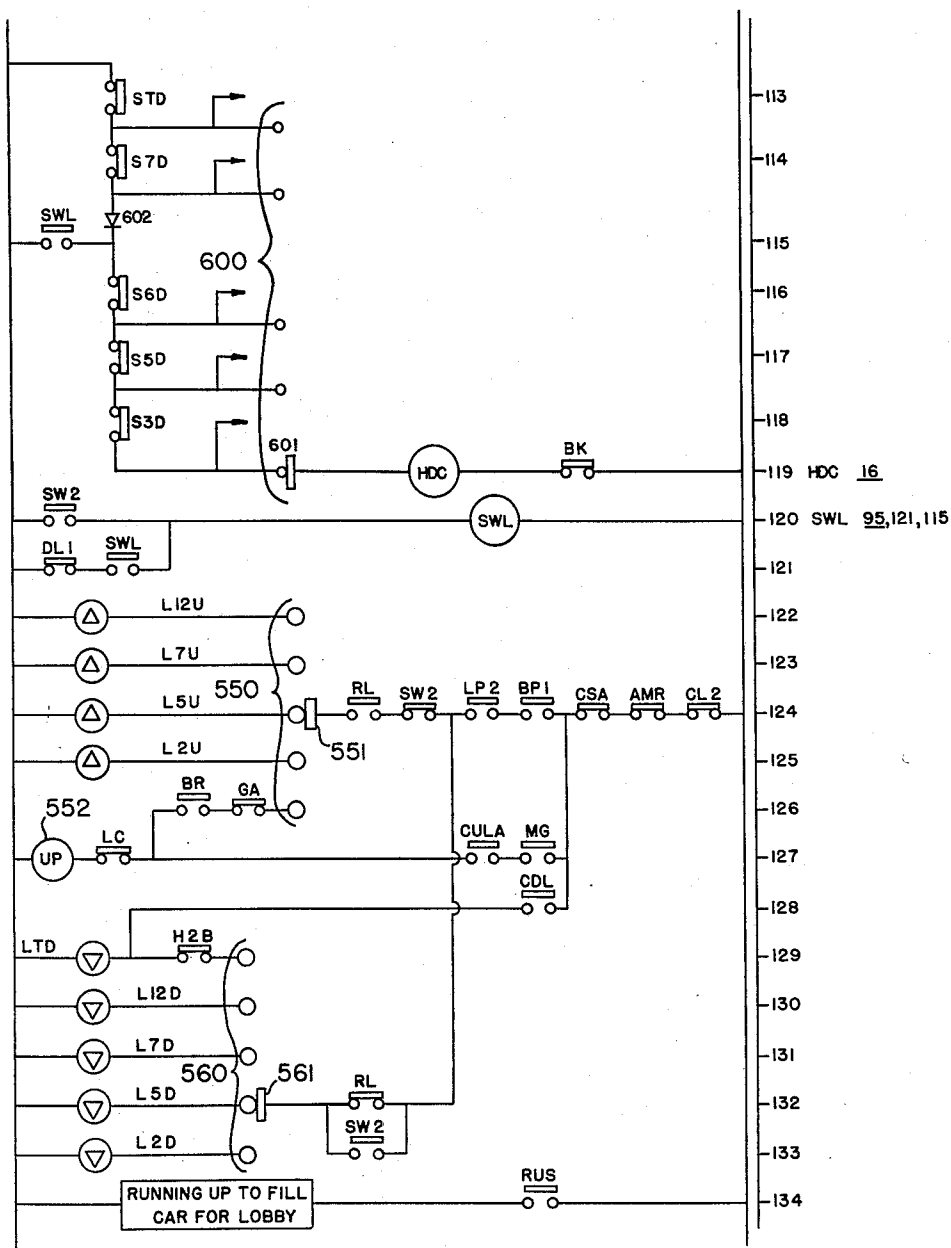


Fig. V

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3,080,946

ELEVATOR CONTROLS

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30 Claims. (Cl. 187—29)

This invention relates to control systems for elevators in general and in particular to control systems for elevator systems including a plurality of cars, operating together as a bank and controlled by passenger operated push buttons located at the various landings and in the cars.

Elevator systems serving buildings in which there are particularly heavy peak traffic conditions at various times of day have been provided with patterns or programs of operation to take care of the traffic demand during a particular time. Such traffic programs are well-known in the art and have been generally designated as "up peak" during the beginning of the morning working hours and at the end of the lunch period, "down peak" during the beginning of the lunch hour and at the end of the working day, a "balanced" program for passenger traffic during working hours at times other than the up and down peak traffic conditions, and a "night" or "off hours" program. The application of such programming to the operation of automatic elevator service has greatly improved the efficiency of passenger service for office buildings and tall structures having a large number of floors and a relatively large volume of passenger traffic.

Even with the utilization of such programs there was a tendency for the cars in such elevator systems to become bunched in one part of the system and fail to properly answer stop calls in other parts of the system. For example, during the "down peak" operation at the beginning of the lunch hour and in the evening at the termination of the office working hours when there is a rush on the part of the tenants to leave the building, the down stop calls at the lower floors may remain unanswered for an undesirable length of time because the cars become loaded at the upper floors and thus cannot stop to take on down passengers at the lower floors until the rush subsides. This problem has been partially solved by the use of zoning elevator controls along with the other programs discussed above. However, even with the application of such zoning to a bank of elevators there still remains a number of lower floors in each zone which have down stop calls which are unanswered for an undesirable length of time because the cars become loaded at the top or upper portion of the zones.

Accordingly, it is an object of this invention to provide an improved elevator control system.

It is a further object of this invention to provide control features which will provide service to any call within a reasonable length of time.

It is a still further object of this invention to provide service for any call within a reasonable length of time while providing the car stopping for such overtime registered call an opportunity to utilize its full capacity for a trip to the lobby and thus obtain the greatest efficiency for the elevator system.

This invention features an elevator system which comprises an elevator car serving a plurality of landings and a control system having means operative to provide direct service to an overtime call registered at one of said landings. In addition to the provision of direct service for overtime calls the control includes means responsive to the load in the car operative to cause said car to provide service to other registered calls, after answering said overtime call, until the car has received a predetermined percentage of full load. Further, the control may

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be made responsive to a high call reversing means that cooperates with said load responsive means to determine the landings serviced by said car after answering said overtime call. The high call reversing means, the load responsive means, and the overtime registered call answering means for an individual car may be limited to respond only within predetermined zones of the plurality of landings.

Other objects, features, and advantages of this invention will become apparent when the following description is taken in conjunction with the accompanying drawings, in which:

FIG. I is an across-the-line wiring diagram of the controls for an individual car in a bank of cars as employed by this invention, illustrating the directional circuits, zone indication circuits, and other miscellaneous circuits, simplified to best show the features of this invention;

FIG. II is an across-the-line diagram of additional circuits individual to the car including the circuits responsive to car calls and those for controlling the registration of car calls;

FIG. III is an across-the-line diagram of circuits for resetting the registration means for up and down hall calls at the landings as they are answered;

FIG. IV is an across-the-line diagram of circuits for picking up registered up and down hall calls and for initiating stopping of an elevator car to answer such calls; and

FIG. V is an across-the-line diagram of signal lanterns denoting the direction in which a car is traveling to passengers on the landing, and associated circuits.

To facilitate location and to provide a short description of each of the relay and switch functions Table A is below provided as a key or index to the relay coils appearing in the drawings. As an aid in determining the function of relay contacts whose coils are not shown in the accompanying drawings Table B is set forth to provide in alphabetical order the names of the relay coils having contacts only in the accompanying drawings.

The relay and switch tables follow:

TABLE A

Symbol	Name	Line Location
AMF	Above Main Floor Relay	30
BK	Brake Relay	6
CB	Car Signal Above Relay	36
CBD	Car Signal Below Relay	45
CL	Door Closing Relay	32
CS	Car Start Relay	9
DF	Down Generator Field Relay	7
DL	Down Signal Direction Relay	12
G	Gate Relay	8
LD	Down Leveling Relay	11
LU	Up Leveling Relay	10
LW	Load Weighing Relay	14
MGE	Express Zone Indication Relay	19
OP	Door Opening Relay	31
RB	Car Button Reset Relay	20
RL	Direction Throwover Switch	21, 22
RUS	Running Up Sign Relay	16
S	Landing Signal Stopping Relay	95
SC	Stopping Sequence Relay	35
SD	High Call Slowdown Relay	101
SWL	Overtime Wait Stop Limit Relay	120
SW1	Overtime Wait Stop Relay	107
SW2	Overtime Wait Stop Relay	108
S2D	2nd Landing Call Down	66
S5D	5th Landing Call Down	64
S7D	7th Landing Call Down	62
S12D	12th Landing Call Down	60
S2U	2nd Landing Call Up	76
S5U	5th Landing Call Up	74
S7U	7th Landing Call Up	72
S12U	12th Landing Call Up	70
T2W	2nd Floor Overtime Wait Timer	104
T5W	5th Floor Overtime Wait Timer	102
T7W	7th Floor Overtime Wait Timer	100
T12W	12th Floor Overtime Wait Timer	98
UF	Up Generator Field Relay	5
UL	Up Signal Direction Relay	13
V	Advance Motor Stopping Relay	34

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TABLE B

Symbol	Name
AM	Auxiliary Main Switch.
AMR	Advance Motor Auxiliary.
BK1, 2, 3	Brake Relays.
BF, BF1	Bypass Relays.
BR	Basement Run Relay.
BS, BS1	Basement Service Relay.
CDD	Down Dispatch Relay.
CDL	Down Load Relay.
CLB, CL2	Door Closing Relays.
CSA	Car Starting Relay.
CUD	Up Dispatch Relay.
CULA	Up Load Relay.
CUN	Up Next Car Relay.
DF2	Down Generator Field Relay.
ELE	Upper Zone Car Assignment.
ELL	Lower Zone Car Assignment.
EM	Emergency Relay.
GA	Auxiliary Gate Relay.
GS	Group Service Relay.
HC	Highest Call Relay.
HCR	High Call Reverse Relay.
HL2	Hatchway Actuated Leveling Contacts.
HLU	Hatchway Actuated Leveling Contacts.
H2B	Program Relay.
H3A	Program Relay.
H3B	Program Relay.
LA	Leveling Acceleration Relay.
LBP	Load By-Pass Relay.
LC	Local Car Relay.
LP2	Protective Relay.
LR	M-G Set Run Switch.
MG	Bottom Dispatching Floor Relay.
MGA	Car Position Relay.
MG1	Top Dispatching Floor Relay.
OPA	Door Closing Relay.
RH3	Rheostat Contact.
TO	Attendant Throwover.
TR	Start Time Relay.
TRLA	Standing Time Saver Relay.
UF2	Up Generator Field Relay.
VR1, VR2	Advance Motor Stopping Relays.
2LD, 2LU	Low Down and Up Speed Leveling Relays.

The above relays and switches and all other components illustrated are shown in across-the-line diagrams. Their contacts therefore are often located remote from the actuating coils. In order to illustrate the relationship and location of actuating coils and contacts a marginal key has been employed with each circuit diagram whereby the circuits are divided into horizontal bands which are identified by line numbers in the right-hand margin of the figure. Relay symbols are located in the margin to the right of the key numerals and in horizontal alignment with the relay actuating coil positions. Each contact actuated by a relay coil is designated to the right of the relay symbol by the numeral of its line location. Back contacts, those which are normally closed when the relay armature is dropped out and are opened when the actuating coil is energized, are underlined in the key to distinguish them from front contacts, those which are closed upon the coil being energized. Thus, for example, down generator field relay DF has its actuating coil located in line 7 of FIG. 1 and when energized closes its front contacts at lines 1 and 2 of FIG. 1, respectively designated in the margin as 1 and 2 and opens its back contacts at line 5 of FIG. 1 designated in the margin by 5.

Each contact is also labeled with the symbol of its actuating means and is illustrated in the condition it assumes while its armature is dropped out so that the front contacts of the down generator field relay are shown as open in lines 1 and 2 and are labeled DF while the similarly labeled back contact in line 5 is shown closed.

Description of FIG. 1

For purposes of illustrating this invention it has been applied to elevator car controls wherein the lifting motor is of the D.C. type and is supplied from a generator. As schematically represented, a motor 401, drives the D.C. generator 402 through shaft 403. The generator 402 is coupled through its output leads 404 to a D.C. lifting motor 405. The armature shaft of the lifting motor is coupled directly to the sheave 407 over which the cables 408 supporting the elevator car 409 and its counterweight 410 are trained. A brake drum 412 is secured on shaft

405 and is provided with a spring applied and electromagnetically released shoe 413. Operation of the several control circuits in accordance with effective car position is actuated through a commutating device commonly identified as a floor selector 414 comprising vertical columns of contacts or segments commutated by brushes mounted on the crosshead 415 moving along those columns. In the particular arrangement chosen for illustration the floor selector 414 advances the crosshead with respect to the actual position of the car as represented on the selector 414. The floor selector contact array simulates a miniature elevator hatchway wherein the contacts are located at floor levels in aligned rows for the several circuit functions to be actuated when the car is effectively at a given level and the crosshead pushes the brushes at those levels. While the car is stopped the crosshead is at the same effective position on the array as the car is in the hatchway so that the stopping of the car at the fifth landing stops the crosshead on the floor selector to enable circuits for the controller for the fifth landing. When starting the car, the crosshead is driven at an essentially constant speed ahead of the car by an advance motor 416 whereby it moves in advance of the actual position of the car as represented on the floor selector contact array. Thus, when the crosshead encounters a contact indicating the presence of a call for which the elevator is to stop, the advance motor is deenergized to stop the crosshead and the car continues to move to the floor represented by the crosshead position. Slowdown controls operate as the car approaches that floor through a series of rheostat connections made through cam actuated contacts represented by contacts 417, 418 and 419. These contacts control the voltage applied to the shunt field of the generator 402 in accordance with the system disclosed in J. H. Borden Patent No. 2,685,348 which issued August 3, 1954, for "Elevator Control Systems," wherein the advance motor 416 and the lifting motor 405 jointly drive a differential 420 to control the cam shaft 422 and thus the contacts in the series field rheostat.

Direct current supplies the main leads R and B of FIG. 1. Operation of the car is controlled initially by a car starting relay CS at line 9 when the car is not at a dispatching terminal and lower dispatch terminal relay MG and upper dispatch terminal relay MG1 are deenergized to close their contacts at line 9, or the car is at one of the dispatching terminals and its dispatch relay CUD for up dispatching or CDD for down dispatching at lines 3 and 10, respectively, have been energized. In addition, the emergency circuits must be energized to close the contact EM, the doors of the car must not be opening so that door opening relay contacts OP are closed, and the start time relay TR must have timed out and closed its contact. Upon energization of relay CS it closes its contacts at line 6 which in conjunction with closed gate contacts G and the closed landing interlock switches 421 enables the generator field relays UF or DF and the brake relay BK to be energized and thereby release the brake holding the car at the floor and initiate the operation of the lifting motor 405.

Although not shown herein reference is made to the Walter A. Nikazy Patent No. 2,758,676 of August 14, 1956, entitled "Variable Standing Time Control," for circuits which are directed to the initiation of operation of the start time relay contacts TR in line 9 controlling operation of the car starting relay CS.

So long as the MG set is running contact LR at line 6 is closed. If the up signal direction relay UL is energized at line 13 through the closure of contact RL of direction throwover switch RL, up generator field relay UF at line 5 is energized through contacts UL at line 5 and brake relay at line 6 through the safety contacts in the motor generator run relay contacts LR at line 6 to lead R. Conversely, the motor can be set to lower the car by the operation of its down generator field relay DF at line 7 if contact DL at line 7 is closed by

virtue of the resetting of the direction throwover relay RL to energize down signal direction relay DL at line 12. If the brake relay is energized to close its contacts at lines 2 and 3, brake relay solenoid 423 is energized to lift the brake shoe 413 from the brake drum 412 on the motor armature shaft. At this time, assuming that the up signal direction has been set an up generator field relay UF is energized, contacts UF at lines 1 and 2 are closed to energize the generator series field with a polarity to cause the lifting motor 405 to drive the armature shaft in a lifting direction. Advance motor 416 is started at this time (by means not shown) to drive the crosshead 415 and differential 420 in the direction the car is set to travel. This imposes an accelerating voltage on the generator 402. The car therefore runs from the floor following the previously advanced crosshead 415 until the crosshead 415 picks up a stopping signal from one of the rows of contacts on the floor selector machine 414. Gate relay G appears at line 8 together with its gate limit contacts 425 which is closed when the gate is fully closed on the car. Up leveling and down leveling relays LU and LD are shown at lines 10 and 11. These relays are enabled upon the pick up of a stopping signal through the closure of contact V, at line 11 as will be described, and are pulled in when their circuits are completed by the closure of the contacts HLU and HLD in the leveling units. These leveling units are mounted on the car and are magnetically actuated by being carried with the car into the range of magnetic influence of vanes positioned adjacent the respective landings in the hatchway along which the car travels. Thus, as a car enters the leveling zone during an ascent contact HLU is first closed by the entry of its actuating unit into the range of magnetic influence of the stationary vane in the hatchway and when the car is level with the floor the HLU contact opens to deenergize the leveling relay LU. Similarly, if the car is descending the contacts HLD first enters the range of influence and the relay LD is energized. While the car is level with the floor, the vane is positioned between the units HLU and HLD and both contacts are open so that both relays LU and LD are deenergized.

By reference to lines 4 and 6 it will be appreciated that with the leveling unit operative, when the car sinks below a proper leveling condition at a landing, contact HLU is pulled in by the movement of its actuating unit into the range of magnetic influence of the vane to pull in relay LU and close its contacts at line 4. If the rheostat shaft 422 has returned to its neutral or stopped position, cam 426 permits contacts 427 and 428 to close and closed contact LU and line 4 completes an energizing circuit for the up generator field relay UF through the normally closed rheostat actuated contact 427 to energize relays BK and UF and cause the car to relevel. If the car is above the floor, the contact HLD is similarly closed to energize down leveling relay LD and close its contact at line 6, whereby the down generator field relay DF is energized and the lifting motor is caused to lower the car.

One column of floor selector contacts engaged by a brush 429 mounted on the crosshead 415 is shown at lines 18 through 21. The floor selector machine contact located in line 21 represents the contact located at the lower limit of travel of the car, the basement in a system serving a basement floor. The contact located in line 20 represents a location at the lower dispatching floor (for example a first floor) which can be considered to be the ground floor immediately above the basement. The contact located in line 19 is located on the floor selector panel at a position corresponding to the first landing in an express zone location, for example, the seventh floor if the first six floors are in a local zone. The contact located in line 18 in contact with the brush 429 represents a position corresponding to the top landing at the upper limit of travel and at the top of the upper

zone. Thus, when the crosshead is at the upper limit of travel as shown in line 18 brush 429 engages the top floor contact to energize the bottom coil of the direction throwover switch RL in line 22 to close contact RL in line 12. Energization of the bottom coil of the direction throwover switch RL in line 22 also closes contacts in line 732 and opens contacts in lines 13 and 124. Closure of contacts RL in line 12 energizes down signal direction relay DL. Similarly, when the crosshead is at the first floor level contacting the "first floor" contact in line 20 the top coil of the direction throwover switch RL in line 21 is energized providing the car is not assigned to basement service so that basement service contacts BS are closed and providing the car is in group service so that contacts GS in line 20 are closed. The energization of the top coil of the direction throwover switch RL in line 21 is operative to close RL contacts in lines 13 and 124 while opening RL contacts in lines 12 and 132. Thus, the closing of contacts RL in line 13 is operative to energize the up signal direction relay UL in line 13. Similarly, travel below the dispatching floor or to the basement floor such that the brush 429 contacts the basement contact at line 21 energizes the top coil of the direction throwover switch RL and the car will be set for up travel.

Reversal of an up traveling car can also be accomplished by energizing a high call reversal relay HCR to close contacts HCR in line 23. This energizes the bottom coil of the direction throwover switch RL to reset the direction throwover relay contacts as described above and the up signal direction relay UL.

To provide an indication that the car is located in the express zone when the brush 429 makes contact with the express zone contact located at line 19 energization of the express zone relay MGE in line 19 will occur provided the program contacts H3B are closed. The program contacts H3B are energized only when a particular program is in effect such that an indication of the location of a car (whether express or local zone) is needed. If an indication of the car in the express zone is desired at times other than when the system is operating on the program indication by the H3B contacts such other program contacts may be placed in parallel with the H3B contacts in line 19 to enable the energization circuit of the express zone indication relay MGE. Contacts MGE and direction relay contacts DL in line 19 provide a seal-in circuit for the MGE relay. The express zone indication relay MGE is deenergized when the car reverses its travel and starts down thus having opened the down signal direction relay back contacts DL in line 19.

As will be noted energization of either the top or the bottom coil of the direction throwover switch RL will be operative to energize car button reset relay RB in line 20. Energization of the car button reset relay RB will, through the opening of its contacts RB in line 51 reset all of the car calls registered in the car upon reversal of direction by the car. Closure of contacts RB and contacts BK3 in line 25 operate as a seal-in circuit to insure that all of the car buttons have time to reset after the car button reset relay RB in line 20 has been energized. When the car starts movement again the brake relay contacts BK3 will open deenergizing relay RB.

Provision is made for attendant operation of the direction throwover switch RL by the pushbuttons 601 and 602 in lines 21 and 22. However, attendant throwover switch TO must first be operated to close contacts TO in lines 21 and 22 and to actuate TO contacts elsewhere to prepare the system for manual operation.

For more detailed information on the control circuits of an elevator system operative to provide the service in which this invention may be employed reference is made to application Serial No. 808,290, filed March 30, 1959, entitled "Elevator Controls" by Raymond A. Burgy.

Description of FIG. II

Additional control circuits for individual cars are shown in FIG. II. These circuits are supplied from a suitable alternating current supply through main leads P and Y. Above main floor relay AMF in line 30 is energized while the car is above the main dispatching floor by means of a cam operated contact 436 which is closed while the crosshead is above the main landing position on the floor selector and opens as the crosshead descends to the main floor. A door opening relay OP at line 31 is energized to initiate the opening operation of the car gate and hatchway door as the car is about six inches from the floor at which it is to stop as indicated by the energization of the second up leveling relay 2LU (not shown) and a second down leveling relay 2LD (not shown) contacts of which appear at line 31. Relay OP remains energized during the opening of the door through the normally closed contact of door closing relay CL at line 31 and is deenergized only as the door reaches its fully open position and opens the normally closed limit contacts 437 at line 31. Door closing relay CL at line 32 is actuated by operation of the car starting relay CS to close its contacts at 32 provided the door open relay OP has been deenergized by having been fully opened to cause the closing of back contacts OP at line 32. Advance motor stopping relay V at line 34 controls advance motor 416 to stop advancement of the crosshead 415 on the floor selector when a stopping signal has been picked up on either the landing or car call circuits. Pickup of a landing call is indicated by the operation of landing signal stopping relay S to close its contacts at line 34 and energize relay V. Pickup of a car call energizes relay V closing stopping sequence relay contact SC at line 33.

The remainder of FIG. II shows car call circuits including those for sensing a car call above or a car call below the current effective position of the car, those for sensing the arrival of the crosshead 415 at the position on the floor selector 414 corresponding to a floor for which a car call is registered and the means to control the registration of car calls. Relay CB at line 36 senses the presence of car calls above the current position of the car. Floor selector 414 is provided with two series of normally closed cam actuated contacts. One contact in each series is provided for each of the floors intermediate the floors at the limits of elevator travel. One of these series of normally closed contacts, designated 438 and appearing fragmentarily from lines 37 through 42, represents the landings above the car and includes a normally closed contact for the top landing. The individual landings of these groups are indicated by the parenthetical numbers adjacent the contacts. Contacts 438 are connected to car signal above relay CB. The second group of contacts 439, also represented fragmentarily for but a portion of the total travel of the cars, includes a contact for the lowermost landing in this instance a first landing identified by the parenthetical 1, and is connected to car signal below relay CBD at line 45. Cams 442 and 443 are carried by the crosshead 415 and actuate the contacts 438 and 439, respectively, to isolate the current car position by opening the series of contacts 438 and 439. Cam 442 isolates the circuits for landings at and below the car from relay CB. Cam 443 isolates the circuits for landings at and above the car from relay CBD. In FIG. II the cams are illustrated for crosshead position at the third floor. Thus, in the group 438 contacts for the second and third landings are opened, while in the group 439 contacts for the third and fourth landings are opened.

A car call button for each of the landings is provided in a main control panel 440, shown on the car in FIG. I, and an auxiliary control panel within the car. One pole of the main car buttons are shown from lines 37 through 42. Each of the car buttons is signified by the number of the landing for which it applies with the prefix C. Thus, the car button for the second landing shown at line 42 is C2. The car button for the top landing is

shown at line 37 as CT. These buttons are held in electromagnetically by holding coils 445 at lines 47 to 53, which, during normal operation, continuously carry current limited by the resistors 446 to a level sufficient to hold the contacts closed magnetically once the buttons are depressed but insufficient to pull the push buttons in magnetically. The car calls can be registered from the auxiliary circuits, however, by bypassing and shunting the resistances 446 through the auxiliary car button contacts CTA at 46 for the top landing, for example, whereby sufficient current is passed through the holding coils 445 to pull in the main buttons magnetically and hold them in the latch position. Reset buttons RT to R1 are also provided in series with the holding coils 445 whereby a car call can be reset by pressing the button to open the holding circuit as at RT for the top terminal, R7 for the seventh landing, R6 for the sixth landing and R1 for the basement landing as shown fragmentarily.

Operation of car signal above relay CB is caused by the car buttons for the landings above the effective position of the car crosshead and its cams 442 and 443. Thus, if a car call were registered at the seventh floor to close contact C7 at line 38 and the crosshead were positioned as shown at the effective third landing position, a circuit would be completed for a car set to ascend through the normally closed up next relay contact CUN and the normally closed down signal direction contact DL at line 36, coil CB, contacts 438 for the top through 7th landings, lead 447, car button C7, normally closed low zone contact ELL, to lead Y. In a similar fashion, a car call registered below the current position of the car causes car signal below relay CBD to be pulled in at line 45, provided no car signal above is registered to open normally closed contacts CB at line 45, through the contacts 439 to the car button. Consider, for example, the registration of a car call for the second landing by the closure of contacts C2 at line 42 while the crosshead is located at the position corresponding to the third landing as shown in FIG. II. Under these circumstances the circuit through contacts 439 would be complete from the first landing contact (1), through the second landing contact (2) thence to lead 448, upper zone car assignment relay contact ELE, the car button C2 and lead Y.

Stopping of a car in response to a car call is effected by the energization of stopping sequence relay SC at line 35. Brush 449 is mounted on the crosshead 415 of the floor selector machine 414 to successively pass over a series of contacts 450 each fed from lead Y through main car button contacts for the several landings served by the car. Brush 449 is shown on the contact 450 for the third landing. If the car button C3 for the third landing at 41 were closed relay SC would be energized through lead 452, lead 453, brush 449, contact 450 for the third landing, normally closed contact ELE of the upper zone relay, car button C3 and lead Y. The pull in of relay SC actuates advance motor stopping relay V at line 34 as indicated above to initiate the stopping of the floor selector crosshead 415 and the slowdown of the elevator car to level at the third landing.

Registered car calls are reset at the end of each trip or whenever the car reverses direction of travel by the operation of the car button reset relay contacts RB at line 51 which is energized whenever one of the top or bottom coils of the direction throwover switch RL is operated to change the direction of travel of the car.

Description of FIG. III

FIG. III illustrates, in an across-the-line diagram, circuits for energizing landing call relays for up hall calls and down hall calls and means for resetting these relays as the calls are answered. In lines 60 to 66 there is represented fragmentarily down landing call registering circuits including down landing call relays S12D, S7D, S5D, and S2D in lines 60, 62, 64, and 66, respectively. Push buttons 12D, 7D, 5D, and 2D are associated with

each of the respective down landing call relays and when closed will energize their respective associated relays. It is to be noted that both the up and down landing call relays are of the magnetic latch variety. In the diagrams magnetic latch relays are depicted as having three leads extending from the circle in which the reference character is located. The two leads extending horizontally are the terminals of the energizing or pull in coil while the horizontal lead extending from the left and the vertical lead constitutes a reset or cancelling coil. Thus, as described above, closure of one of the push button contacts at the landings such as contact 12D will energize down landing call relay S12D, magnetically latching its contacts in the energized position even though the push button 12D is opened after the coil S12D has been energized. The down landing hall call magnetic latch relays are reset when their reset leads R12D, R7D, R5D, and R2D which are connected to contacts 500, mounted on the floor selector machine 414 at the proper representative floor rows, are contacted by brush 510. Brush 510 in line 65 operates to reset the down landing call relays if the car is traveling in a down direction and the down signal direction relay contacts DL are closed, if the descending car is not set to bypass thus its bypass relay contacts BP are closed and if the gate relay contacts G are closed, all in line 65. It may be noted that advance motor stopping relay contacts VR2 are in parallel with the gate relay contacts G thus allowing the resetting of the down landing call relays S12D through S2D if the VR2 contacts in line 66 are closed.

Similarly, up landing call relays S12U, S7U, S5U, and S2U are located in lines 70, 72, 74, and 76 and are actuated by push buttons 12U, 7U, 5U, and 2U located at the respective landings. Reset leads R12U, R7U, R5U, and R2U are connected to contacts 501 on the floor selector machine 414 at the floor positions analogous to the contacts 500 above. Brush 511 on the crosshead of the floor selector machine 414 contacts the contacts 501 and through the respective reset leads will reset the up hall calls registered by the various relays provided the car is set to travel upward thereby having its up direction signal relay contacts UL in line 75 closed, is not set to bypass therefore having bypass contacts BP closed and gate relay contacts G closed in line 65.

Description of FIG. IV

Illustrated in FIG. IV are the circuits which are operative to initiate a stopping sequence, a slowdown sequence and a sequence for answering overtime calls.

A column of contacts 520 located in lines 93 to 96 are located on the floor selector machine 414 and are energized through contacts S12U, S7U, S5U, and S2U of the up landing call relays illustrated in lines 70 to 76 of FIG. III. Brush 521 carried on the crosshead 415 of the floor selector machine is operative to contact one of the contacts 520 and to energize the landing signal stopping relay S in line 95 when one of the up landing call relay contacts are closed, provided the car has not been selected for zoning for a particular zone and its local car zone contacts LC are closed, the up generator field contacts UF2 of the lifting motor are energized, that the car is not fully loaded and its load bypass contacts LBP are closed, that a stopping sequence has not been yet initiated so that VR2 contacts are closed, provided a predetermined speed is being maintained and RH3 contacts on the cam operated rheostat are closed, and provided that the car is not bypassing and its bypass contacts BP are closed, and provided that the brakes are not set so that the BK2 contacts are closed. Energization of the landing signal stopping relay S at line 95 closes contacts as described earlier in line 34 to energize the stopping sequence relay SC and closes contacts S in line 90 to provide a seal-in circuit for the relay S when the advance motor stopping relay contacts VR1 are closed.

Similarly, down landing call contacts S12D, S7D, S5D,

and S2D in lines 97, 99, 101 and 103 energize respectively one of the column of contacts 530 on the floor selector machine when one of the respective down landing call relays of FIG. III has been energized. If the car is set to travel downward contacts DF2 in line 97 of the down generator field relay DF2 are closed and contacts UF2 in line 95 of the up generator field relay UF2 are open isolating the stopping relay S from the up call contacts 520 and connecting the relay S with the down call column of contacts 530. Therefore, contact of brush 531 with an energized one of the column of contacts 530 will energize the landing signal stopping relay S in line 95 provided that the same circumstances are met as set forth above for energization of relay S and that one of the contacts S12D to S2D has energized one of the contacts 530. If highest call relay contacts HC in line 101 are closed the high call slowdown relay SD in line 101 will be energized for a high call reverse operation more fully described in the last mentioned of the above-references copending applications.

The function of the overtime wait relays T12W to T2W in lines 98, 100, 102 and 104 and their respective contacts in lines 105 to 108 will be described hereinafter.

Description of FIG. V

FIG. V shows generally the landing lanterns that are energized when the car approaches or stops at a floor. Fragmentary circuits are shown in lines 122 to 125 for energizing up direction lanterns for the 12th, 7th, 5th, and 2nd floors, respectively. The lanterns for these floors are connected to a column of contacts 550 on the floor selector machine positioned at points representative of the floors. Contact 551 on the crosshead of the floor selector machine is disposed to brush contacts 550 and to energize the respective lanterns provided that the direction throwover contact RL is closed for up car operation, the protective relay contacts LP2 are closed, the car is not bypassing therefore contacts BP1 are closed, the car starting relay contacts CSA are closed, advance motor auxiliary relay contacts AMR are closed, and the door closing contacts CL2 are closed, all at line 124. If the preceding conditions are met the contact of brush 551 with an energized one of the contacts of 550 on the floor selector machine will energize the proper travel direction lantern shown in lines 122 to 125. Contact of brush 551 with the lowermost of the contacts 550 will energize a "This Car Up" sign 552 in the lobby, shown in line 127, provided that the local car contacts LC are closed, the car is not assigned to a basement run so that its basement run contacts BR2 are closed, and provided that its auxiliary gate relay contacts GA are closed. The "This Car Up" sign 552 in line 127 is also illuminated when the car is at the main floor or is at a dispatching terminal thereby having contacts MG closed, and when it is the next up load car selected from a plurality of cars available at a dispatching landing thereby having its up load contacts CULA closed.

Similarly, down direction lanterns for the top floor to the second floor are provided as indicated in lines 129 to 133 which are connected to respective representative contacts in a column of contacts 560 on the floor selector machine 414. A brush 561 of the floor selector machine will energize the proper respective lantern by touching its contact 560 when the direction throwover relay contact RL in line 132 is set for down travel. When a plurality of cars are at the top landing the landing lantern indicating that this car is the next to proceed down will be illuminated when the down load contacts CDL in line 128 are closed. The positioning of several cars at the upper landing would result only when the elevator bank is operating on a program selected by the program relay H2B. Therefore, its contacts H2B in line 129 of each of the car lantern circuits would be open so that the hall lantern for the next car down can be illuminated only through the CDL contacts in line 128.

There has thus been described a typical simplified elevator system to which this invention may be applied. A modification of the control circuits as described to provide the operation desired for the inventive concept disclosed herein will now be described.

Referring to FIG. IV there is shown overtime wait relays T12W, T7W, T5W, T2W, in lines 98, 100, 102, and 104, respectively. Registration of a down hall call at one of the landings will apply an energizing current to one of the respective overtime wait relays just discussed, providing that the elevator system is operating on a down peak program as provided by the closure of the H3A contacts in series with the overtime wait relay coils. If a passenger at a landing registers a call and the call is not answered by a car before a predetermined interval the overtime wait relay, for example T5W, will time out closing its contacts T5W in line 107. The overtime wait contacts T12W through T2W are connected to a column of contacts 540 on the selector machine 414. The crosshead 415 of the selector machine carries a brush 541 disposed to contact successively the contacts in the column 540 as the crosshead 415 ascends. The brush 541 is connected through paralleled local car relay contacts LC and express zone indication contacts MGE, and serially connected with up generator field relay contacts UF at line 107 to energize overtime wait stop relay coils SW1 and SW2 located in lines 107 and 108.

After the overtime wait relay T5W has timed out, its contacts T5W in line 107 close. The next ascending car will be stopped at the fifth floor to service this overtime call when its brush 541 makes contact with the appropriate contact 540 in line 107. If both local and express cars are to be used to service any overtime wait call the LC and MGE contacts in lines 107 and 108 may be omitted. However, inclusion of the contacts as shown will provide that local cars will stop for overtime wait calls only in the local zone while the express cars will stop for overtime wait calls only in the express zone. It is to be noted that the H3A contacts for overtime wait control may be omitted if it is desired to place the overtime weight feature on all programs of the elevator operating system. If the H3A contacts are omitted, since they are herein utilized to designate a down peak program, then the LC and MGE contacts in lines 107 and 108 should also be omitted to provide the most efficient service. The overtime wait timer is omitted for the top floor of each zone. Thus, if the sixth floor were the top floor of the local zone it would not be provided with an overtime wait timer since the car is programmed to proceed there initially and reverse, to start down answering down hall calls.

Assuming that the fifth floor overtime wait call has been answered the SW1 and SW2 overtime wait stop relays in lines 107 and 108 are energized. The energization of relay SW1 closes contacts SW1 in line 109 to provide a seal-in circuit for the SW1 and SW2 relays through the advance motor auxiliary relay contacts AMR in line 109. SW1 contacts in line 16 close to enable the illumination of a running up sign relay RUS if the car is not filled at the fifth floor. SW1 contacts in line 18 close to enable the energization of the express zone indication relay MGE when a car goes into the express zone, SW1 contacts close in line 66 to complete a circuit around the down signal direction relay contacts DL so that the down landing call relay SSD at the fifth floor may be reset even though a car may not be set to go in the down direction, SW1 back contacts in line 69 open to prevent the resetting of any up hall calls that may be registered which would ordinarily be reset through the closed up signal direction relay contacts UL at line 75. SW2 contacts close at line 33 to energize the advance motor stopping relay V in line 34, SW2 contacts close in line 120 to energize the overtime wait stop limit relay SWL, SW2 back contacts open in line 124 to prevent

the illumination of the up lantern for the fifth floor since the car may reverse and return to the first floor if it receives a full load. Similarly, SW2 contacts in line 133 close to light the down lantern at the fifth floor indicating to the passengers on the landing that the car is going down.

When the passengers from the fifth landing have entered the car a load weighing switch in line 14 weighs the car to determine if a full load is present. If a full load is present load weighing relay LW is energized in line 14. The load weighing switch is not shown in detail since such apparatus is well known in the art. Energization of the load weighing switch in response to a predetermined load, for example, 80% of full load, opens back contacts LW in line 16. The opening of back contacts LW prevents energization of the running up sign relay RUS. When the doors to the car close contacts CLB in line 17 close thereby causing energization of the bottom coil of the direction throwover switch RL in line 22 through the DL back contacts in line 22, the running up sign relay RUS back contacts in line 17, the door closing contacts CLB in line 17 and the overtime wait contacts SW1 in line 16. As hereinbefore explained the energization of the bottom coil of the direction throwover switch RL operates to energize the down generator field relay and the down signal direction relays DF and DL and the car returns to the lobby to discharge the passengers.

If, when all of the passengers are in the car, and the load weighing switch in line 14 finds that a full load is not in the car the load weighing back contacts LW in line 16 will remain closed. Therefore, when the car starting contacts CS close as the car starts away from the floor the running up sign relay RUS in line 16 is energized. Energization of the running up sign relay RUS closes front contacts in line 15 to provide a seal-in circuit through the advance motor stopping relay contacts VR1, opens back contacts RUS in line 17 to prevent reversal of the car and taking less than the full load from the fifth floor to discharge them at the lobby, and closes front contacts in line 134 to illuminate a sign which may read "Running Up to Fill Car for Lobby" so the passengers may be informed that they correctly boarded the elevator and that the car will reverse and go to the lobby when it receives a full load.

Energization of the overtime wait stop limit relay SWL in line 120 causes it to close front contacts SWL in line 121 to provide a seal-in circuit through down signal direction relay contacts DL1. Back contacts SWL open in line 95 to prevent initiation of a stopping sequence for any up hall calls, as hereinbefore described, by the contact of brush 521 on one of the energized contacts of the column of contacts 520 in lines 93 to 97 indicating an up hall call. If the car still does not have a full load of passengers by the time it reaches the top of its zone it reverses and proceeds to the lobby to discharge the passengers it now has plus passengers it may pick up on the way down from ordinary registered down landing calls. If the car is assigned to a low zone the front contacts ELL are closed as in line 40. When a highest call relay HCT is energized it energizes highest call relay HC (not shown). The HC relay closes its contact at line 40 to energize stopping sequence relay SC for a low zone car having its contact ELL closed on the zone program. This limits travel of low zone cars to the low zone and reverses them at the top of that zone. Reversal of a car is effected by energization of high call reversal relay HCR (not shown) which operates direction throwover switch bottom coil RL in line 22 by the closure of HCR contacts in line 23 to set the car for travel downward and operate its down signal direction relay DL in the manner hereinbefore described. If a car is assigned to a high zone of two zones its ELE contacts in lines 39, 41 and 42 will be open preventing energization of the stopping sequence relay by any of the low zone car call button registrations in lines

39, 41 and 42. Reversal of the car in the top zone may be effected by the energization of the high call reversal relay HCR which would again operate the bottom coil of the direction throwover relay RL to set the car for travel downward, or the arrival of the car at the top floor of the upper zone would set the car for down travel as hereinbefore described.

In the event that an overtime wait call is answered without filling the car to the predetermined percentage necessary to actuate the load weighing feature, it is desirable that the car reverse its direction of travel and proceed back toward the lobby if there are no down landing calls registered at the landings between the car position and the top of its zone. Obviously, the system to be described will also be applicable if no zoning is utilized.

A circuit to detect down landing calls is illustrated at line 113 to 119 of FIG. V. Landing call down relay back contacts STD, S7D, S6D, S5D, and S3D at lines 113, 114, 116, 117 and 118, respectively, are connected in series to one lead, the positive lead if D.-C., of the power supply and are representative of similar back contacts for all landings. Each of the junctions between each of the serially connected back contacts is connected to a contact, of a lane of contacts 600 on the floor selector machine 414, corresponding to the floors which each of the landing call down relay back contacts represent.

A brush 601 is carried by the crosshead 415 of the floor selector machine 414 and is disposed to successively touch the contacts of the lane 600 as described hereinbefore. A high down call relay HDC is connected in series with a brake relay back contact BK between the brush 601 and the negative side of the power supply. The high down call relay HDC will be energized only when there are no down landing calls above the car within its zone. That is, assuming the car position to be at the second floor, as indicated by the position of brush 601 in line 119, a down landing call registered at any of the third three sixth floors of the local zone will cause its respective landing call down back contacts S3D to S6D to open disabling the energizing circuit for the high down call relay HDC in the local zone. The brake relay back contacts BK allow the circuit to sense down landing calls registered above only when the car is stopped at a landing. Further, the energizing circuit for the high down call relay HDC may be permitted to sense down landing calls above only when answering overtime wait calls by the use of normally open overtime wait stop limit relay contacts SWL in series with the energizing circuit as shown in line 115.

A rectifier 602 connected in series with the landing call down relay back contacts at line 115 may be utilized to isolate the upper zone sensing circuit from the lower zone. The same result may be accomplished by opening the circuit at the point where the rectifier 602 has been inserted. The rectifier 602 is utilized only with a direct-current power supply and prevents energization of the high down call relay HDC through the overtime wait stop limit contacts SWL at line 115 even though there are down landing calls registered above the car position in the upper zone.

The energization of the high down call relay HDC is operative to open its back contacts HDC at line 16. This prevents energization of the running up sign relay RUS so that its back contacts RUS in line 17 stay closed. Therefore, when the door closing relay CLB (not shown) is energized to initiate door closing the contacts CLB close in line 17 to complete a circuit to the RL bottom coil. The energization of the RL bottom coil, as explained hereinbefore, is effective to cause the car to reverse and travel downward.

Thus there has been disclosed and described herein a specific embodiment of an elevator system showing a car serving a plurality of landings. There was disclosed means for registering down hall calls at each of said landings and means for timing the length of registration of said down hall calls. Further, means for dispatching

the elevator car up or to answer the down hall calls was shown. The particular inventive concept herein involved was set forth in control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent the car from stopping at any landing other than the overtime wait landing on its way up. This control means was shown in combination with means responsive to the load in the car. The control means, in response to the load responsive means, was further operative to cause the elevator car to answer down hall calls at other landings until a predetermined percentage of load in the car was obtained. That is, the car proceeded upward to answer other down hall calls, and then reversed the direction of the travel of the car when a full load was obtained. The control means was also operative to reverse the direction of travel of the car when the car reached a predetermined floor, for example, the top landing or as in zoning of a bank of elevators. Means were provided with the car, responsive to a continuation of upward travel of the car, to indicate to the passengers that the car was running upward to attempt to fill the car for the lobby before its travel was reversed. In addition, control means were shown which were operative to reverse the travel of the car, after answering an overtime wait call, if no down landing calls were registered at any landing above the car in its zone. If the system is not on a zoning operation then the car will reverse under such circumstances if no down landing calls are registered above the position of the car.

More generally there was shown an elevator system which comprised an elevator car serving a plurality of landings, means operative to register ordinary landing calls and overtime wait landing calls, control means operative to dispatch the elevator car in a first direction to serve an overtime wait landing call, means responsive to the load in said car, said control means in response to the load responsive means being further operative to cause the car to proceed in said first direction and to answer other landing calls until the car receives a predetermined percentage of full load. Thus, the system shown and described may be applied to systems other than the high call reversal of a car answering overtime wait down hall calls after the car has been filled or has reached a predetermined floor. For example, in a building having a plurality of floors below the main floor or lobby, as in a basement construction, it is conceivable that a program of low call reverse operation would be desirable between the basement calls and the ground or lobby floor. Again, means would be provided within the car responsive to a continuation of travel of the car in the first direction indicating to the passengers that a predetermined load condition or the arrival at a predetermined landing is necessary to reverse the car travel to go back to the lobby or other floor.

In conclusion, it is to be noted that while the illustrated example constitutes a practical embodiment of my invention, I do not limit myself to the exact details shown since modification of the invention may be made without departing from the spirit and scope of the concept disclosed and described.

Having described the invention, I claim:

1. In an elevator system, in combination; an elevator car serving a plurality of landings; means operative to register overtime wait landing calls; control means operative to dispatch said car to service an overtime wait landing call; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to answer other landing calls until said car receives a predetermined percentage of full load.

2. In an elevator system, in combination; an elevator car serving a plurality of landings; means operative to register ordinary landing calls and overtime wait landing calls; control means operative to dispatch said car to service an overtime wait landing call; means responsive to the

determined load condition or the arrival at said predetermined landing is necessary to reverse car travel.

23. In an elevator system, in combination; a car serving a plurality of landings; means for registering down hall calls at each of said landings; means for timing the length of registration of said down hall calls; means for dispatching said car upward to answer said down hall calls; control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent said car from stopping at any landing other than said overtime wait landing; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to answer down hall calls at other landings until a predetermined percentage of load in said car is attained.

24. In an elevator system, in combination; a car serving a plurality of landings; means for registering down hall calls at each of said landings; means for timing the length of registration of said down hall calls; means for dispatching said car upward to answer said down hall calls; control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent said car from stopping at any landing other than said overtime wait landing; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to proceed upward to answer down hall calls at other landings until a predetermined percentage of load in said car is attained.

25. In an elevator system, in combination; a car serving a plurality of landings; means for registering down hall calls at each of said landings; means for timing the length of registration of said down hall calls; means for dispatching said car upward to answer said down hall calls; control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent said car from stopping at any landing other than said overtime wait landing; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to proceed upward to answer down hall calls at other landings until a predetermined percentage of load in said car is attained, and then to reverse the direction of travel of said car.

26. In an elevator system, in combination; a car serving a plurality of landings; means for registering down hall calls at each of said landings; means for timing the length of registration of said down hall calls; means for dispatching said car upward to answer said down hall calls; control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent said car from stopping at any landing other than said overtime wait landing; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to proceed upward to answer down hall calls at other landings until a predetermined percentage of load in said car is attained, and then to reverse the direction of travel of said car; and means within said car, responsive to a continuation of upward travel of said car, indicating to passengers that said car is running upward to attempt to fill the car before reversal.

27. In an elevator system, in combination; a car serving a plurality of landings; means for registering down

hall calls at each of said landings; means for timing the length of registration of said down hall calls; means for dispatching said car upward to answer said down hall calls; control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent said car from stopping at any landing other than said overtime wait landing; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to proceed upward to answer down hall calls at other landings until a predetermined percentage of load in said car is attained, and then to reverse the direction of travel of said car; said control means also being operable to reverse the direction of said car in response to the arrival of said car at a predetermined landing.

28. In an elevator system, in combination; a car serving a plurality of landings; means for registering down hall calls at each of said landings; means for timing the length of registration of said down hall calls; means for dispatching said car upward to answer said down hall calls; control means operable in response to the expiration of a predetermined time interval of registration of an overtime wait hall call to prevent said car from stopping at any landing other than said overtime wait landing; means responsive to the load in said car; said control means, in response to said load responsive means, being further operative to cause said car to proceed upward to answer down hall calls at other landings until a predetermined percentage of load in said car is attained, and then to reverse the direction of travel of said car; said control means also being operable to reverse the direction of said car in response to the arrival of said car at a predetermined landing; and means within said car, responsive to a continuation of upward travel of said car, indicating to passengers that said car is running upward to attempt to fill the car before reversal.

29. In an elevator system, in combination; an elevator car serving a plurality of landings; means operative to register overtime wait landing calls; control means operative to dispatch said car in a first direction to service an overtime wait landing call; means responsive to the load in said car; means for sensing other landing calls registered in said first direction past the car position; said control means, in response to said load responsive means, being operative to cause said car to answer other landing calls in said first direction until said car receives a predetermined percentage of full load; said control means, in response to said other landing call sensing means, being operative to reverse the travel of said car if no other landing calls are registered in said first direction.

30. In an elevator system, in combination; an elevator car serving a plurality of landings; means operative to register overtime wait landing calls; control means operative to dispatch said car in a first direction to service an overtime wait landing call; means for sensing other landing calls registered in said first direction past the car position; said control means, in response to said other landing call sensing means, being operative to reverse the travel of said car if no other landing calls are registered in said first direction.

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