

May 6, 1958

R. A. BURG

2,833,376

DISPATCH MACHINE FAILURE CIRCUIT

6 Sheets-Sheet 1

Filed Feb. 4, 1957

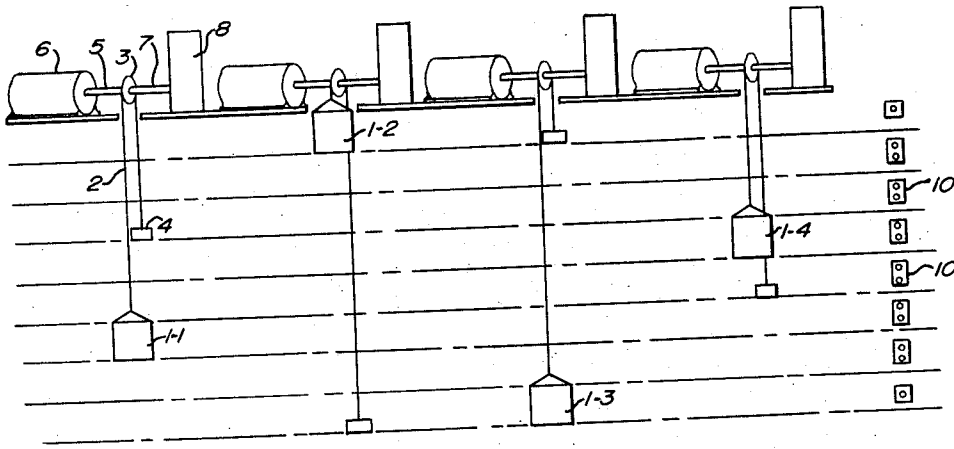


Fig. I

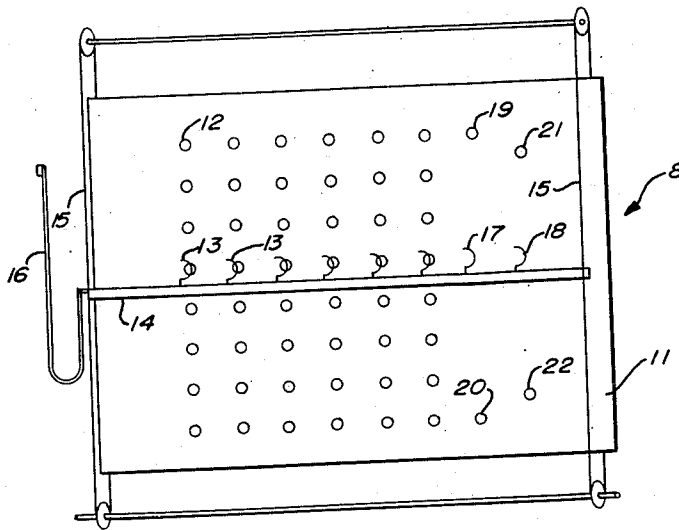


Fig. II

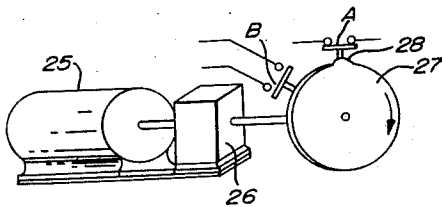


Fig. III

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6 Sheets-Sheet 2

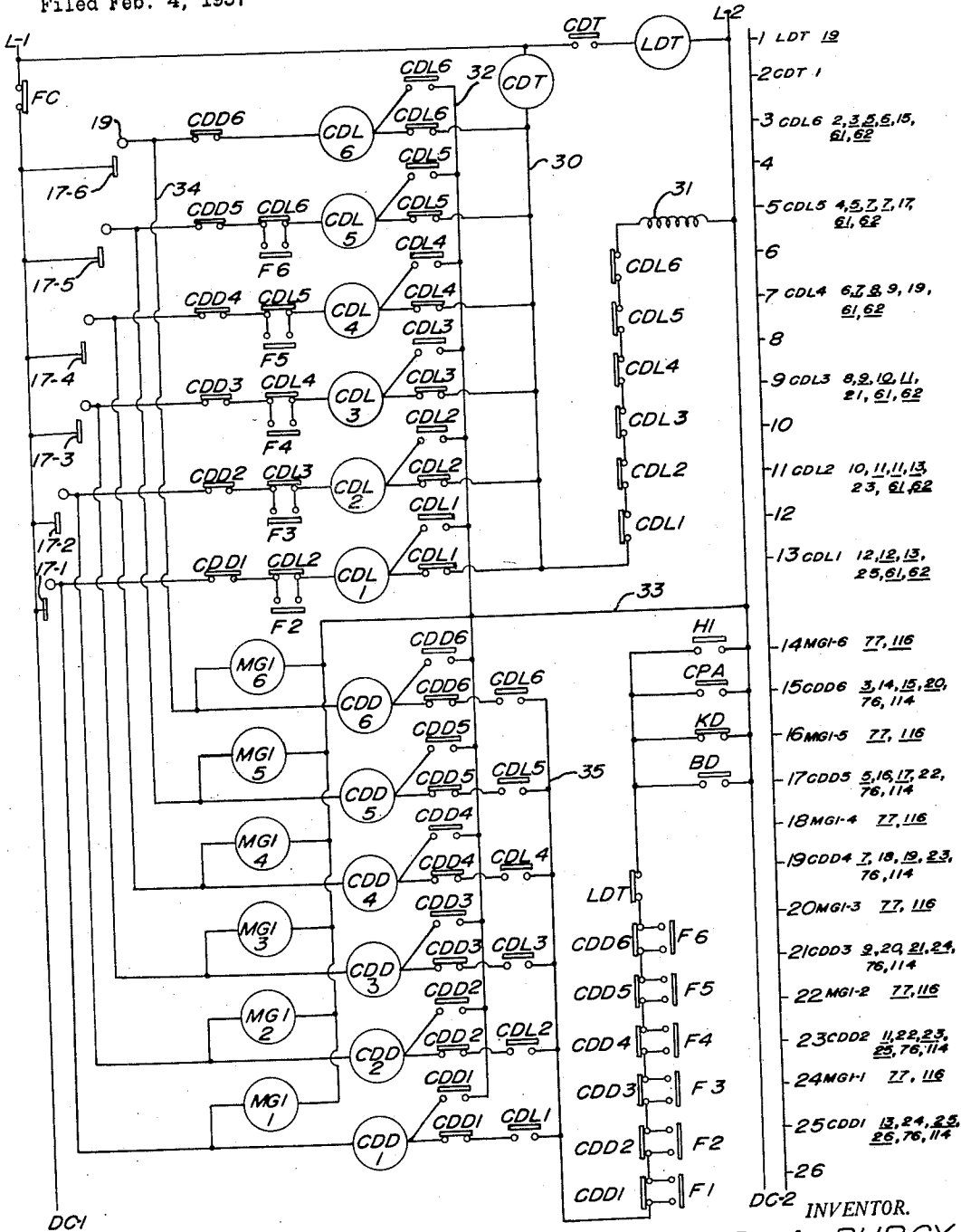


Fig. IV

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6 Sheets-Sheet 3

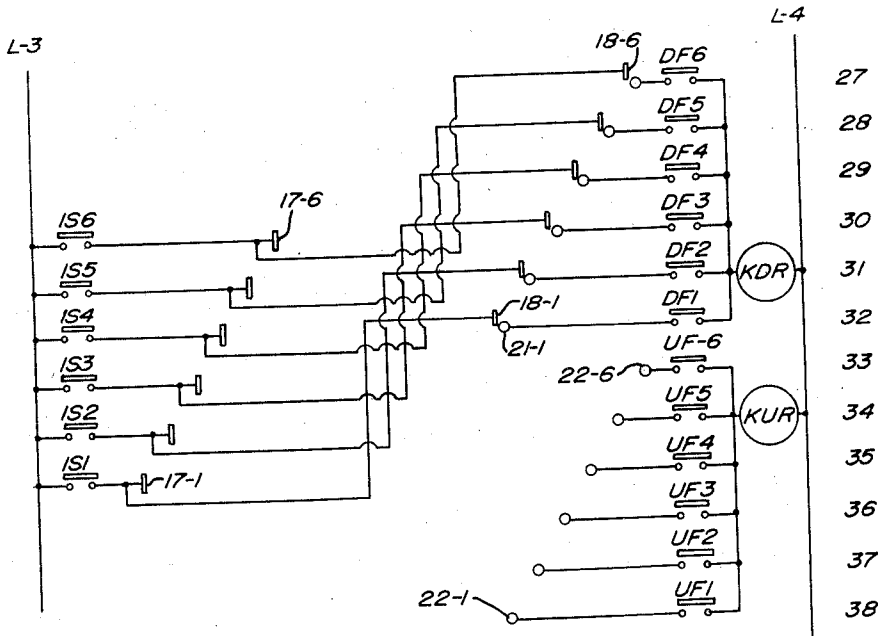


Fig. IVa

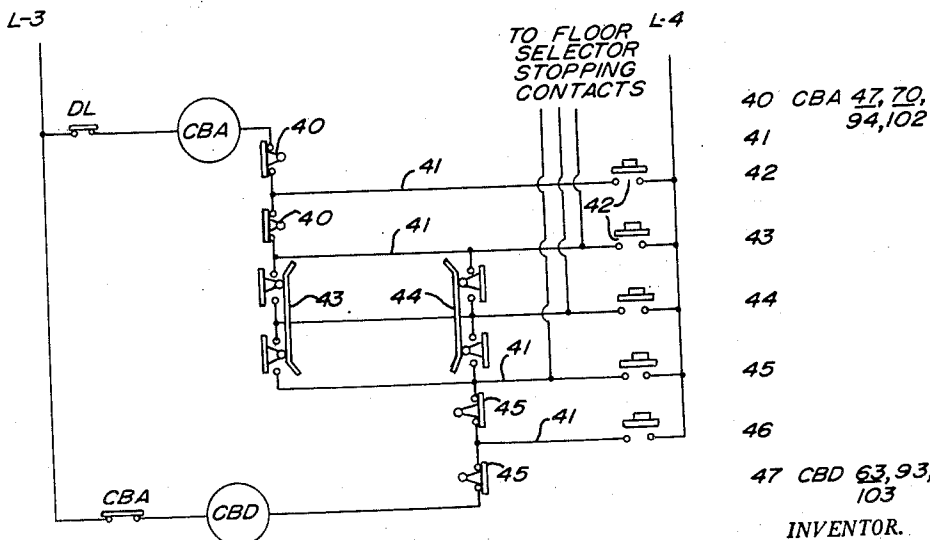


Fig. V

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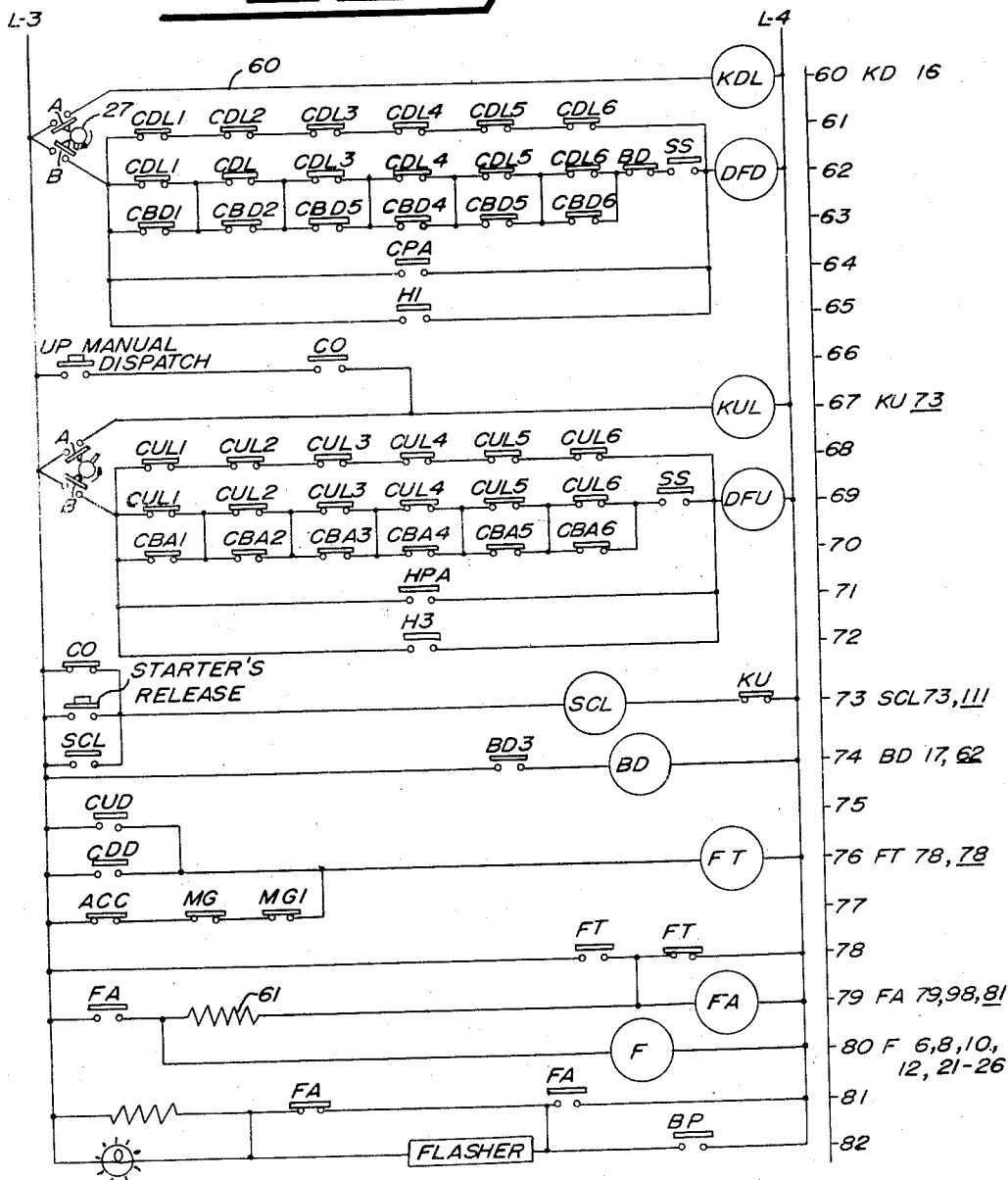
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DISPATCH MACHINE FAILURE CIRCUIT

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6 Sheets-Sheet 5

Fig. VII



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DISPATCH MACHINE FAILURE CIRCUIT

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6 Sheets-Sheet 6

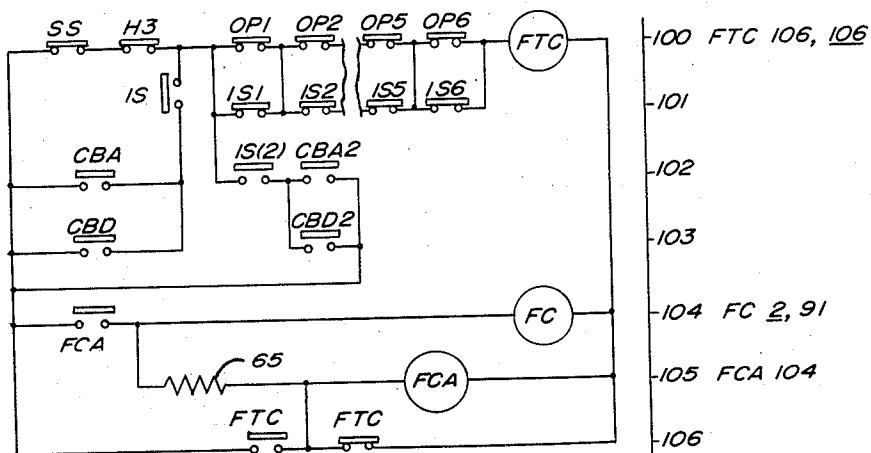


Fig. IX

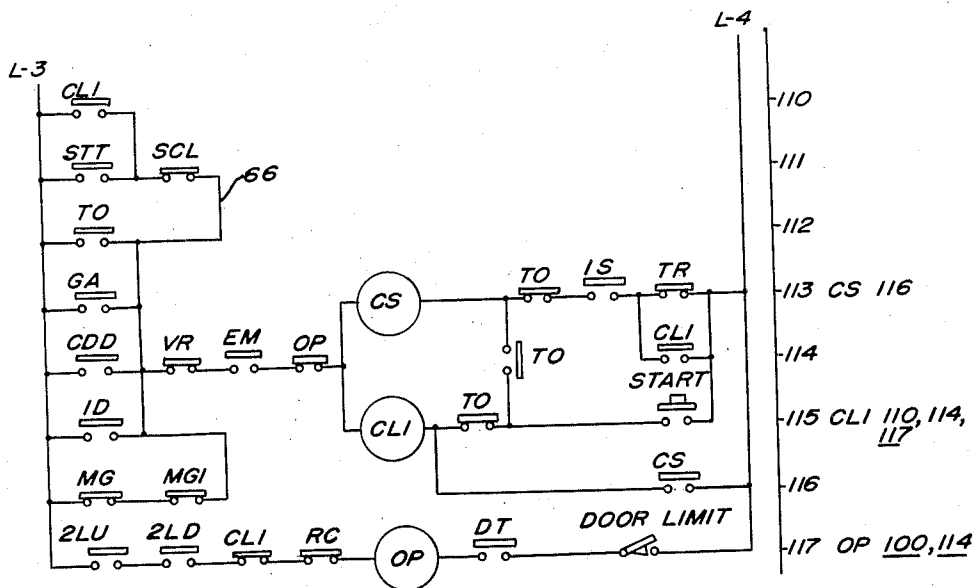


Fig. X

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DISPATCH MACHINE FAILURE CIRCUIT

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Application February 4, 1957, Serial No. 637,970

12 Claims. (Cl. 187-29)

This invention relates to supervisory control equipment for automatic passenger elevators and in particular to means for keeping the system in operation even though portions of the supervisory equipment may fail.

When a number of elevators are operated as a group the quickest possible service to waiting passengers is provided if the elevators are scheduled to follow each other at generally equal intervals of time rather than allowing them to become bunched and closely follow each other. In order to prevent bunching of the cars, which is a natural result unless supervisory control is exercised, it has been common practice to employ dispatching systems that operate either in response to generally uniform increments of time or to car and call positions to delay those cars that are operating ahead of schedule. Most dispatching machines are arranged to release the cars from the terminals at substantially uniform increments of time in which the time intervals are adjusted to be generally equal to the round trip time of a car divided by the number of cars in service. Thus, if there were four cars in operation and the average round trip time including stops to transfer passengers were two minutes, the cars would be dispatched at 30 second intervals. It is also customary in such systems to select the cars for dispatching substantially in the order of their arrival at the dispatching floor.

As long as elevator systems were operated by human attendants they could be maintained in proper operation by merely signaling each attendant when it was time for his car to leave the dispatching floor. If the signal did not come within a reasonable time after the attendant was reasonably sure he should have received a signal he could start the car and leave the terminal. Thus, a failure in dispatching system could not tie up the cars or make them inoperative.

With the advent of passenger operated elevator systems in locations subject to heavy traffic it become necessary to add automatic dispatching equipment to the previously known completely automatic or operatorless elevators. The addition of such a dispatching system allows the cars to operate efficiently on practically the same time schedules that were found satisfactory with attendants. It was found, however, that if a failure in the dispatching equipment or in any of the car selection equipment that selects the cars for dispatching occurred the usual result was that all of the cars would eventually arrive at a dispatching floor with none of them able to leave. Thus, the entire elevator system was rendered inoperative by a failure of any of the relays or relay contacts in the supervisory control system.

The principal object of this invention is to provide a supervisory control system that permits the elevator cars to operate without dispatching control in the event there is a failure in any of the car selecting or dispatching relays or contacts operated thereby.

Another object of the invention is to provide a supervisory control system that is responsive to a demand for

service and to a failure of the elevator system to respond to that demand.

Another object of the invention is to provide a supervisory control system that is responsive to the failure of an individual car to respond that is also responsive to a failure of the cars to respond to a demand for service.

More specific objects and advantages are apparent from the following description of a preferred form of the invention.

According to the invention an elevator system in which each car is provided with automatic starting circuits that start the car a predetermined time after each stop and reverse it at the terminal floor and in which dispatching equipment is used to keep the cars properly spaced in time by opening the starting circuits of cars standing at the dispatching floors until the dispatching time interval has elapsed is provided with call responsive means indicating the existence of calls for service, whether those calls originate from hall buttons or from car buttons, and a timer that is reset as any car opens its door arranged to operate as long as calls are registered and remove all cars from dispatcher control in the event its time interval expires without a reset. Since the timer is reset, after each door opening operation, the timer never times out as long as the cars are promptly answering hall or car calls in the normal manner. In the event that no car responds by opening its doors for a predetermined time while a call is registered, the supervisory timer times out and opens the circuit that supplies current to the dispatching and car selection equipment. The deenergization of this equipment permits the cars to operate individually and to respond to signals in the normal manner except that the cars are not held or detained at the dispatching floors. As soon as a car opens its door in response to a signal the timer is reset and the system again attempts to operate under normal dispatching conditions.

A preferred form of the invention is illustrated in the accompanying drawings.

In the drawings:

Fig. I is a schematic diagram of an elevator system comprising a plurality of cars arranged to serve a plurality of floors.

Fig. II is a diagrammatic representation of a floor selector control board suitable for use with any of the elevator cars shown in Fig. I.

Figure III is a diagrammatic representation of a dispatching machine showing the essential components and the timing arrangement for the contacts operated by the dispatching machine.

Fig. IV is a schematic wiring diagram showing the car selecting and dispatching relays including the floor relays for the upper terminal.

Fig. IVa is a diagram showing the circuits for resetting the dispatching relay.

Fig. V is a simplified schematic diagram showing the circuits for indicating the presence of car calls above and below the car.

Fig. VI is a similar diagram showing the circuits that are responsive to the presence of hall calls.

Fig. VII is a schematic diagram of the circuits for controlling the dispatching machine according to the presence of cars at the terminals and the existence of signals requesting service by the cars.

Fig. VIII is a schematic diagram illustrating the circuits for shutting down and starting the motor generator sets for each of the elevator cars according to the traffic demands.

Fig. IX is a schematic diagram of a supervisory control circuit that is responsive to the failure of all cars to respond to signals.

Fig. X is a simplified schematic diagram of the car

starting circuits indicating the conditions under which the cars may start automatically.

These specific figures and the accompanying description are intended merely to illustrate the invention and not to impose limitations on its scope.

The supervisory control system according to the invention may be applied to groups of elevators having any number of cars in the group. In the following description, Fig. I shows a four car system while the wiring diagrams in Figs. IV, IVa and VII indicate circuits for a six car system. The principles of the supervisory control, however, are applicable to systems having any number of cars arranged to operate as a group.

As shown in Fig. I, an elevator system comprises a plurality of cars 1-1, 1-2, 1-3, and 1-4, each of which is suspended by a cable 2 passing over a sheave 3 and attached to a counterweight 4. The sheave 3 is mounted on an armature shaft 5 of an elevator drive motor 6. The armature shaft 5 is also connected through an extension 7 to a floor selector machine 8 individual to that elevator. The elevators 1-1 to 1-4 inclusive, have similar driving and controlling equipment and will not be individually described except where the control for one differs from that of another car. Thus, any reference number followed with a dash and a number indicates an element which is specific to a particular one of the elevator car systems.

While not shown in the drawing, each of the cars 1 is provided with a car control station having a series of push buttons corresponding to the various floors served by the car by means of which passengers in the car may select the floors at which they desire the car to stop. Likewise, a plurality of hall buttons 10, one for each of the terminal floors and two for each of the intermediate floors, are provided whereby intending passengers may register hall calls for causing the elevator to stop at the floors in response to the demand for service.

While not specified in the drawing, each of the elevator motors 6 preferably is a direct current motor driven by a variable voltage generator so as to provide variable speed operation as is required for high speed passenger elevator service. In a low speed system alternating current motors could be substituted for the direct current motors.

The floor selector machines 8 are commutator or switching devices that switch the various elevator control and indicating circuits according to the position of the car in the hatchway. The face of one of the selector machines 8 is schematically illustrated in Fig. II. Each selector machine includes a panel board 11 having rows of contacts 12 that cooperate with brushes 13, mounted on a carriage 14 that is supported on chains 15 for a movement up and down past the face of the panel board in accordance with the movement of the associated elevator car. The brushes 13 are connected into the circuits by way of a trailing cable 16 attached to the end of the carriage 14. As far as the supervisory control is concerned, only two brushes and cooperating contacts are of interest, these being the right hand brushes 17 and 18 that cooperate with contacts 19, 20, 21, and 22 forming part of the car selection and dispatching circuits.

A dispatching machine, as illustrated in Fig. III, comprises an adjustable speed motor 25 that, operating through a gear reducer 26, turns a cam 27 having a high spot 28 arranged to successively close switches B and A, B closing approximately a quarter of a revolution ahead of A. Each of the switches is closed momentarily as the high spot 28 of the cam passes the switch. Two of these machines are ordinarily employed, one for the upper terminal and the other for the lower terminal or dispatching floor.

In the circuits associated with the dispatching machine, the switch B operates in conjunction with other control relays to stop the motor 25 whenever there is no car available for dispatching or there is no call requiring

operation of the elevators. Switch A, which operates a short time later when the machine is running, initiates a dispatch signal which is stored by a latch relay until a car accepts and responds to the signal.

In the following description the circuits employed in the supervisory control are shown in "straight line" diagrams each of which has a code strip along the right hand side in which the respective lines of the drawings are numbered. At the right of the line numbers the symbols for any relay operating coils that may be found in such line are listed together with the line numbers wherein each of the contacts operated by such coil are shown. An underscored line number indicates that the contact corresponding thereto is closed when the operating coil is deenergized. Furthermore, since there is no possibility of confusion between the symbols of an operating coil and the contacts operated thereby, the contacts are given the same reference designation as the coil. Where more than one contact is operated by a coil the various contacts are identified in the description by the line numbers in which they occur. Coil operating contacts or relay contacts are indicated by short bars spanning the space between the contact terminals, push button contacts are indicated by the addition of a small upright section to the bar, while cam operated contacts such as the switches A and B of Fig. III are indicated in the diagrams by a bar with an added operator and a cam located in co-operative relation to the bar.

In the following description, a number of relays that are common to all the cars are mentioned as well as relays individual to each car. In some cases contacts are mentioned the operating coils are not included in the circuits. Those relays common to all cars and shown in the drawings, are:

BD—Car accumulation dispatch relay
 CDT—No car at terminal relay
 DFD—Top terminal dispatcher detent control
 DFU—Bottom terminal dispatcher detent control
 FC—Dispatcher failure relay
 FCA—Auxiliary dispatcher failure relay
 FTC—Dispatcher failure timer
 KD—Down dispatch latch relay
 KD_L—Latch coil of KD
 KD_R—Release coil of KD
 KU—Up dispatch latch relay
 KU_L—Latch coil of KU
 KU_R—Release coil of KU
 LDT—Late car loading interval timer
 SCL—Starter control relay for bottom terminal
 SS—No hall call relay

Relays that are individual to each car are:

CBA—Car call above
 CBD—Car call below
 CDD—Individual car down dispatch relay
 CDL—Individual car down loading relay (car selector)
 CL1 and CS—Car starting relays
 F—Individual car failure relay
 FA—Auxiliary relay for FT
 FT—Individual car failure timer
 MG1—Dispatching floor relay
 MGT—Timer for motor generator shutdown
 OP—Door opening relay
 RE—Starting relay for motor generator set

Control contacts, whose operating coils are not shown, that are common to all cars include:

BD3—Dispatcher speed control relay
 CPA—Accumulated car call relay
 H1—Up peak program relay
 H3—Down peak program relay
 HPA—Accumulated hall call relay

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and those contacts individual to each car include:

BP—By-pass relay
 DF—Down directional field control relay
 DL—Down directional control relay
 IS—In service relay
 G—Gate controlled relay
 UF—Up directional field control relay
 UL—Up directional control relay

Figs. IV and IVa

Typical circuits for selecting the cars for dispatching in order of arrival at a dispatching floor and giving dispatch signals to such cars are illustrated in Figs. IV and IVa which show the circuits for the upper terminal or upper dispatching floor only. The circuits for the lower dispatching floor are similar and therefore are not shown in the drawings.

The car selecting circuits for the upper terminal comprise for each car a car loading or car selection relay CDL, upper floor dispatching relay MG1, and a down dispatch relay CDD. The circuit may be easily explained by tracing the operation as a car arrives. Assuming first that there are no cars at the upper terminal and that a car is approaching the terminal. As it reaches the terminal its brush 17-6, assuming car number 6 to be the one just arriving, makes contact with selector machine contact 19 so as to complete a circuit in line 3 of Fig. IV from a first supply lead L-1 through normally closed common failure or dispatcher failure relay contacts FC, the brush 17-6, contact 19, down dispatch relay contacts CDD-6, coil CDL-6 of the sixth car loading relay, and thence through its normally closed contacts CDL-6 in line 3 and a lead 30 that is connected to a return lead L-2 through a series circuit of normally closed CDL contacts of all of the selection relays and an inductance coil 31. The lines L-1 and L-2 are supplied with direct current and this circuit is immediately completed under the assumed condition that no other cars are at the terminal. As soon as the CDL-6 coil operates it closes its contacts CDL-6 in line 2 to complete a sealing circuit through leads 32 and 33 connected to the return lead L-2. This seals in the CDL-6 relay so as to hold the selection. At the same time it opens its contacts CDL-6 in lines 3 and 6 thereby breaking the circuit from the coil CDL-6 to the lead 30 and from the lead 30 to the return lead L-2. This prevents the operation of any other CDL relay as long as one is operated.

The brush 17-6 and contact 19 complete a circuit through lead 34 to immediately energize a dispatching floor relay coil MG1-6 in line 14 and prepare a circuit to a down dispatching relay CDD-6 in line 15. This relay does not operate immediately but a circuit for operating it is completed through a circuit including its own normally closed contacts CDD-6 in line 15, contacts CDL-6 of the selection relay, lead 35, a series of normally closed dispatch relay contacts CDD arranged near the lower right hand side of the figure, and parallel connected dispatching contacts arranged in lines 14 to 17. The dispatching contacts include normally open contacts H1 of an up peak program relay, contacts CPA of a relay responsive to the number of car calls registered, contacts KD of the down dispatch latch relay KD, and contacts BD in line 17 of a relay responsive to a number of cars at the upper terminal. Any one of these four parallel paths complete the circuit for energizing the selected one of the down dispatch relays CDD. If the system is conditioned for up peak traffic it is desirable to dispatch the cars down from the upper terminal immediately upon their arrival thereat. Hence, H1 contacts are closed at this time. It is also desirable to dispatch a car immediately when there are a certain number of cars at the terminal as evidenced by the closure of the BD contacts or when there are an excessive number of car calls registered as evidenced by the closure of the

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CPA contacts. At the end of a dispatching time interval, the contacts KD close so as to complete the circuit from the lead 35 to the return lead L-2. As soon as the down dispatch relay CDD-6 operates it closes its contacts CDD-6 in line 14 to seal itself in and at the same time opens its contacts CDD-6 in line 15 as well as contacts CDD-6 in line 21 so as to prevent the energization of any other of the down dispatch relays. When the car leaves the dispatching floor in response to the dispatching signal the brush 17-6 leaves the contact 19 thereby deenergizing the dispatch floor relay MG1 as well as the down dispatch relay CDD.

When the down dispatch CDD was energized it also opened its contacts CDD-6 in line 3 so as to deenergize the down selection relay CDL-6 so that it closes its contacts in line 6 and thus completes the circuit from the lead 30 to the return lead L-2. This prepares the circuit for the selection of the next car for dispatching. Assume that two cars had arrived at the dispatching terminal after the number 6 car had arrived and prior to its departure. These cars, assuming for the moment that they were cars 4 and 5, would have closed the circuits from the lead L-1 through their brushes 17-4 and 17-5 to the coils of the relays CDL-4 and CDL-5. However, until the selection relay CDL-6 was released these relays could not be operated because the circuit from the lead 30 to the return lead L-2 was broken at the contacts CDL-6 at line 6. However, as soon as the 6th car loading relay CDL-6 is released it completes the circuit from lead 30 to the inductance coil so that current can now flow through in parallel paths through the two operating coils of the relays CDL-4 and CDL-5. These relay coils are adjusted to have graduated operating times with the higher numbered relays responding more quickly than the lower numbered relays. If a different selection order is desired the operating times may be adjusted accordingly. Thus, CDL-5 tends to operate slightly quicker than CDL-4 and ordinarily operates enough in advance so that it closes its sealing contacts CDL-5 and opens its contacts CDL-5 in line 7 before CDL-4 can close its contacts in line 6. To make sure that only CDL-5, the higher numbered relay, is energized in this circumstance where the operating time difference between the relays is small, additional contacts are included in the circuit ahead of the operating coil CDL-4 to break the circuit to relay coil CDL-4 as soon as relay CDL-5 operates. Thus, only the higher number coil will be operated in the event two consecutive coils are prepared for operation when a previous car is given its dispatch signal by operation of its dispatch relay CDD.

As soon as the next dispatch interval expires, KD again closes its contacts in line 16 to energize the now selected dispatch relay CDD-5 since the contacts CDL-5 in line 17 are now closed. Energization of CDD-5 cause it to open its contacts in line 5 thereby breaking the circuit to CDL-5 permitting it to release and close its contacts CDL-5 in line 7 so as to permit the selection relay of the 4th car (assuming that no higher numbered car is at the terminal) to be energized as soon as current can build up through the lead 30 and inductance coil 31. Similar action occurs for the other cars. The circuit selects the first car to arrive in the event that there are no other cars present and selects the highest numbered car in the event that there are two or more cars present at the terminal when a selected car is dispatched and leaves the terminal.

In order to make sure that a car does not leave the terminal without providing time for a prospective passenger to note its arrival and enter it, particularly when the system is conditioned for up peak traffic, a relay CDT at line 2 is arranged to be energized through the series of normally closed contacts of the selection relays and the inductance coil 31 as long as there are no cars at the terminal selected to be dispatched. This relay com-

pletes a circuit to loading time timer LDT in line 1 which timer, as long as it is energized, opens its contacts LDT at line 19 which are in series with the normally closed contacts of the dispatching relays. Thus, when a car arrives at the terminal under an immediate dispatching program and there is no other car at the terminal at the time of arrival the then energized relay CDT is deenergized as the corresponding selection relay CDL is energized. Relay CDT, by opening its contacts in line 1, deenergizes the timing relay LDT which, after a time interval, closes its contacts LDT at line 19 so that the car can then be dispatched. This provides a minimum standing time that the car must wait at the terminal before it can leave under any circumstances. If another car had been at the terminal the other circuits would have taken care of the selection and timing.

Fig. IVa

This figure shows the circuit employed to reset the dispatching latch relay as the car leaves the terminal or dispatching floor. Each car that is in service has its in-service relay IS energized so as to complete the circuits indicated in the left hand portion of Fig. IVa in lines 30 to 35 inclusive. These contacts prepare a circuit from a first alternating current power lead L3 through the in-service contacts IS to the leads to the brushes 18 of the various selector machines. These brushes 18 as the car moves down from the upper terminal momentarily makes contact with selector machine terminal points 21 and thence through down directional relay contacts DF to a reset coil KD_R , shown in line 31. Contact between the brush 18 and the corresponding selector machine contact 21 occurs only momentarily as the car leaves the terminal and thus the relay is reset during this time but may be actuated again even though the car may have stopped at the next floor. Similar circuits as the car moves up from the lower dispatching floor are completed from the line 1 through the brushes 18 and selector machine contacts 22 leading to up directional relay contacts UF and thence to the up dispatching latch relay reset coil KU_R shown at line 34. Thus, this up dispatching relay is energized momentarily for resetting purposes as the car leaves the lower dispatching floor on its upward travel. The directional relay contacts include in these circuits are for the purpose of preventing a resetting of the dispatching relay as the car approaches the dispatching floor.

Dispatching signals for operating the KU and KD dispatching relay are received from timing mechanism illustrated in Fig. III and in the circuit diagram of Fig. VII.

Fig. V

Since it is desirable to provide dispatching signals only during such time as there is a call for service, means must be provided for indicating in the control circuit the presence of calls for service from either the car button stations in the cars or from the landing calls. The circuits for indicating the presence of car calls are indicated in Fig. V while the hall call circuits are illustrated in Fig. VI.

The car call circuits include a call above relay CBA shown in line 40 of Fig. V and a car call below relay CBD shown in line 47. The car call above relay CBA is energized from the line L3 through down directional contacts DL in line 40 and then through one or more of a series connected set of selector machine contacts 40 and leads 41 connected through car button contacts 42, of car buttons used for registering car calls, and thence to the return line L4. Cams 43 and 44 mounted on the carriage 14 of the selector machine are arranged to open the contacts 40 that are connected between the leads 41 for the floor at which the car is located and the floors immediately above and below the car. Thus, as long as there is a car call registered for the floor above the

position of the car a circuit is completed for the car call above relay CBA. However, this circuit is broken as soon as the car reaches its highest car call because at that time the series circuit of the contacts 40 is opened by cam 43 opening the last of the switches 40 then feeding current to the call above relay CBA.

Car calls below the car are indicated by operation of the car call below relay CBD which is energized from the lead L3 through normally closed CBA contacts in line 47 and thence through a series of normally closed contacts 45 which are operated by the cam 44. The junctions between the contacts 45 and the series circuits are connected through the leads 41 and the car buttons 42 to the return lead L4. The cam 44 is arranged to operate the contacts 45 for at least the floor immediately below the location of the car and thus interrupt the circuit to the car call below relay CBD in the event that the call at which the car is located is the lowest call. Any other calls below that position when the car is traveling down are indicated by energization of the car call below relay CBD.

In this circuit the normally closed DL contact in line 40 makes the car call above relay CBA responsive only when the car is conditioned for up travel while the normally closed CBA contacts in line 47 make the car call below contacts responsive at all times that there are no calls above the car.

Fig. VI

This figure shows the circuits that are responsive to the registration of hall calls. Since in most multi-car dispatching systems it is not necessary to know the location of the hall call the usual high-hall call circuit is modified in order to indicate when there are no calls registered. This circuit energized from leads L3 and L4 consists of a series of normally closed contacts one for the floor relays arranged in numerical order of the floors. Thus, starting from lead L3 through branch lead 50 in line 50 the circuit leads through normally closed contacts TD of the top floor down relay TD, normally closed contacts 9U of the ninth floor up call relay, contacts 9D of the ninth floor down call relay, then the eighth floor up call relay contact 8U, and so on down through the first floor up call relay contacts 1U shown just above line 57. From this point the circuit continues through lead 51 and operating coil SS of a hall call relay SS shown in line 57. As long as there are no hall calls registered this circuit is complete and the hall call relay SS is energized. The registration of any hall call interrupts this circuit so as to deenergize the hall call relay SS and thus indicate that there is a call waiting to be answered. Since the hall calls are reset immediately upon the call being answered this circuit is immediately responsive to the existence of hall calls. The conventional circuits co-operating with the series of contacts for reversing the cars when they reach the highest call have been omitted. Under certain programs of operation certain cars are delegated to serve only certain floors of the building. Thus, the low zone cars ordinarily are operated on high call reverse so that they will reverse immediately upon reaching the highest hall call to which they are assigned or to their own highest car call. In order that a higher hall call shall not affect such low zone cars, program relay contacts H3 illustrated in lines 51, 52, and 53 are employed to by-pass the normally closed contacts of the high zone floor relays and thus continually complete a circuit to the lower portion of this series of contacts. Thus, an up traveling low zone car conditioned for high call reverse will get the same signal when it reaches the lowest of the leads energized through the program contacts H3 as it would get if there were no hall calls above that position.

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Fig. VII

The circuits for correlating the operation of the dispatching machine with the calls for service are illustrated in Fig. VII. In general, the dispatching machine, there being one provided for the upper dispatching terminal and one for the lower dispatching terminal, are stopped of detented after the expiration of three-quarters or eight-tenths of a timing interval in the event that either there are no cars available for dispatching or there are no calls requiring a car to be dispatched in order to answer demands for service. As long as there is a demand for dispatching, there being both a call registered and a car available at the dispatching terminal, the dispatching machine turns its cam 27 at a substantially uniform speed so as to periodically close its contacts B and A. For the upper dispatching terminal, the machine contacts A complete a circuit from the lead L3 of Fig. VII through a lead 60 in line 60, and a latching coil KDL of the down dispatch relay KD shown in line 60. When this relay is latched in by energizing this coil it closes its contacts KD in line 16 to complete the circuit so as to energize whichever one of the down dispatch relays CDD may have been prepared for energization by the car selection relays CDL.

In the event there are no hall calls registered or there are no car calls requiring travel of a particular car selected for dispatching and there are fewer than a given number of cars at the terminal it is usually desirable to withhold the dispatching signal until there is a demand for service. To provide this feature the dispatching machine is provided with contacts B, operated by the cam 27, in order to prepare a circuit to a down dispatch detent relay DFD whenever any of these conditions occur. The down dispatch detent relay DFD serves, when energized, to interrupt the driving circuit of the dispatcher motor 25. This detenting relay DFD may be energized through a first circuit including a series of normally closed car selection relay contacts CDL appearing in line 61. Thus, as long as there are no cars at the dispatching terminal available for dispatching at the time contacts B close, the detent relay DFD is energized and serves to stop the dispatching machine until a car arrives and is selected.

The dispatching machine may also be stopped in order to hold the car at the upper terminal in the event the selected car has no car calls registered. This condition is indicated by deenergization of the down car call relay CBD to close its normally closed CBD contacts appearing in line 63 in parallel with the down selection relay contacts CDL of the selected car appearing in line 62. This circuit also includes, in series, normally open contacts SS of the hall call relay SS and normally closed contacts BD of a relay responsive to the number of cars at the terminal floor. Thus, this circuit to the detenting relay may be completed as long as there are fewer than a certain number of cars at the terminal, there are no hall calls registered, and no car calls registered in the particular car selected for dispatching.

During the up peak traffic program the upper terminal dispatching machine is not necessary because the cars are dispatched down immediately upon arrival by means of the program contacts H1 appearing in line 14 of Fig. IV. Therefore, a by-pass circuit shown in line 65 is provided around the series circuit of contacts so as to continually energize the detent relay DFD. Thus, the dispatcher runs for three-quarters of a timing interval and then stops and waits until the program is changed thereby opening the H1 contacts in line 65. The dispatching machine may also be rendered inoperative in the event there are more than a given number of car calls registered as is indicated by closure of the contacts CPA appearing in line 64. This relay also closes its contacts CPA in line 15 to provide immediate dispatching of the

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cars. Thus, in either of these instances, i. e., during the up peak program or when more than a given number of car calls are registered, cars are immediately dispatched and the dispatching machine is not operated.

Similar circuits are employed for the lower dispatching terminal floor. These circuits are shown in lines 66 to 72 inclusive. Since the circuits operate in the same manner as those just described no further comment is necessary except to point out that the cars are immediately dispatched for up travel during the down peak program, that is when there are a large number of down calls, and in the event that during a time when the system is conditioned for other traffic programs an unexpected number of down hall calls accumulate as indicated by operation of the relay HPA closing its contacts in line 71 and in the corresponding dispatching circuits for the lower terminal.

In some installations it may be desirable that the dispatching of cars from the lower terminal be under the direct supervision of a supervisor or starter. A circuit shown in line 73 is therefore provided to allow a starter to delay the dispatching of the cars from the lower terminal. When this feature is in operation the starter releases each car by pressing a starter's release button in line 73 to complete a circuit to the starter dispatch control relay SCL which seals itself in through normally closed up dispatch relay contacts KU and its own contacts SCL shown just below the starter's release button. Other contacts of the SCL relay close the dispatching circuits. In this arrangement, the dispatching relay KU must be picked up and energized by the closure of the dispatcher A contacts of the lower dispatching machine so as to complete this circuit and any prior operation of the starter's release button is ineffective to close the circuit. Therefore, after the expiration of the dispatching interval the starter may dispatch the car by operation of the starter's button. This circuit is reset by the reset of the dispatching relay KU as soon as the car leaves. In the event that the starter wishes the cars to leave promptly upon expiration of the dispatching interval he may close a cutout switch CO shown in the diagram just above the starter's push button so as to complete the circuit around the starter's release button at all times. When so conditioned the relay SCL is energized as soon as the dispatching interval expires and it, by closing its contacts in the dispatching circuit, operates the corresponding up dispatch relay for the selected car.

It was mentioned that the cars are dispatched from the upper terminal as soon as more than a predetermined number of cars accumulate at that terminal. This is accomplished by a car counting relay BD appearing in line 74 in Fig. VII. This relay is energized through contacts BD3 of a sensitive relay whose coil carries a current proportional to the number of cars at the terminal. The dispatching relay BD, by closing its contacts in line 17 provides for immediate dispatch of any car that is selected for dispatching at the terminal and by opening its contacts in line 62 permits the dispatching machine to run through one cycle and until the detent relay DFD is again energized.

Occasionally a car that has received its dispatch signal or has stopped at an intermediate floor is prevented from starting by obstructions in the doorway or failure of some of the equipment. When this occurs at a terminal floor the dispatch relay contacts CUD or CDD in line 75 are closed to complete a circuit from the supply lead L3 through the now closed dispatch relay contact CUD or CDD, and through an operating coil or motor FT of a failure timer shown in line 76. This timer may also be operated at intermediate floors as long as an acceleration relay has its contacts ACC (line 77) closed and the dispatching floor relays MG and MG1 are both deenergized to close their contacts. If the interference persists for a long enough time for the timing motor FT to time out it closes its normally open contacts and opens

its normally closed contacts in line 78 to energize an auxiliary failure relay FA in line 79. This relay immediately seals itself in by closing its contacts FA in line 79 and also indicates this condition on the starter's control panel by closing a circuit in line 81 at the same time that it opens a by-pass circuit around a flasher element shown in line 82 so as to intermittently illuminate a by-pass indication light shown at the left in line 82. This light glows steadily as long as the associated car is by-passing signals as indicated by closure of its contacts BP in line 82 and flicker to indicate an interference failure.

The closing of the auxiliary failure relay contacts FA in line 79 also completes a circuit to the failure relay in line 80 which has contacts arranged in the car selection and dispatching circuits so as to remove that car from dispatching. After the interference has been cleared and the car has either moved from an intermediate floor so as to open its acceleration contacts ACC momentarily, or has left the dispatching floor so as to release its dispatching relays CUD or CDD the failure timer FT in line 76 resets and opens its normally open contacts in line 78 and closes its normally closed contacts FT thus throwing a short across the operating coil of the auxiliary failure relay FA. A resistor 61 connected in the circuit between the normally closed failure timer contacts FT and the auxiliary relay contacts FA prevents the closure of the normally closed FT contacts in line 78 from drawing excessive current from the supply leads L3 and L-. De-energization of the auxiliary failure relay breaks the circuit to the failure relay F in line 80 so that the car is again permitted to enter its regular dispatching sequence.

Fig. VIII

During the night and on Sundays and holidays long periods of time may pass without any calls for service. To conserve power it is desirable to shut down the motor generator sets of the individual elevators during such intervals. The circuits shown in Figure VIII provide such automatic shut down and starting. This circuit includes a motor generator control relay RE that is energized whenever operation of the motor generator set is required and a timer MGT for gauging the demand for service. The timer MGT which operates only when the car is at the main floor is set to time out after several minutes and is reset whenever the car responds to a call. The operating circuit for the timer extends from a lead L-5 through a manual-automatic throwover contacts TO in line 93, through the motor of the timer MGT, contacts TR2 of a timer included in the standing time control system, contacts of a dispatching floor relay MG, and motor generator run relay contacts LR to a return lead L-6. The timer MGT therefore operates as long as the car remains at the dispatching floor after the ordinary loading time interval.

When the timer MGT times out it opens its contacts MGT in line 97 to open the energizing circuit for the motor generator relay RE. The energizing circuit for this relay includes, in series, contacts OL of overload relays, the coil of the motor generator relay RE, contacts RP of a phase rotation relay RP, contacts of a pair of stop buttons, the normally closed contacts MGT of the timer and the contacts LR of the motor generator run relay LR. The phase rotation relay RP is included to prevent any possibility of starting of the motor generator set in reverse rotation.

The motor generator relay RE may be energized by operation of either of the start buttons shown in lines 95 and 96 or, if on automatic operation such that throwover contacts TO are closed, by closure of the up dispatch relay contacts CUD in line 92 or the car call contacts CBA or CBD in lines 93 and 94.

The relay RE may also be energized if the other cars fail to respond to signals. This is accomplished by the closing of contacts FC in line 91 to complete the circuit for the motor generator relay RE.

This circuit thus shuts down the motor generator set whenever there is an overload on the AC driving motor or no demand for service and restarts the motor generator set whenever the services of that car are required.

While the failure timer FT, shown in Fig. VII at line 76, in cooperation with the failure relay F, shown in line 80, takes care of many of the interference failures of the system it cannot respond to certain types of failure in the car selection or dispatching circuits. It will be noted that the failure timers FT there being one for each car do not operate until a dispatch signal has been given to the particular car and the car has failed to move or if the car is at an intermediate floor if it stands for more than a certain length of time. If a failure occurs in the car selection circuits it is possible for all of the cars to accumulate at one of the dispatching floors without any car being able to depart from the floor. Furthermore, the dispatching machine, after it has detented in response to no car being at a terminal, may fail to start when a car does arrive. This also may tie up the whole system because the dispatcher being detented, will not close the dispatching relays to permit departure of the cars. Under these conditions it is desirable that auxiliary failure timing equipment common to all the cars be employed. This structure is shown in Fig. IX.

Fig. IX

According to one aspect of the invention, a common failure time FTC, shown at line 100 in Fig. IX, is arranged to operate or run as long as there are calls for service as indicated by the closure of the hall call relay contacts SS in line 100, the system is not on down peak operation as indicated by the closure of the normally closed program contacts H3 and no car in service in the system is opening its doors as indicated by the opening of the OP contacts in line 100. Under this condition, the circuit is completed to the operating motor of the common failure timer FCT so that it will time that interval. An in service relay IS for each car, when the car is removed from service closes its IS contacts in line 101 which are arranged in parallel with the door opening contacts of the car so that an out of service car does not affect the failure timer. This timer is also energized by the car call above and car call below relays CBA and CBD as long as the car is in service, that is, with its IS relay closed. These contacts and relays are repeated for each of the cars as indicated by the CBA(2) and CBD(2) contacts shown to the right of the other CBA and CBD contacts in lines 102 and 103. The timing interval of the common failure timer FTC is ordinarily long enough so that it will not operate under the normal time interval that expires between operation of the doors of the cars while they are answering calls. A one minute interval is usually satisfactory.

If this timer times out it closes its normally open contacts FTC in line 106 and opens its normally closed contacts FTC so as to energize an auxiliary common failure relay FCA in line 105. This relay immediately closes its contacts in line 104 to energize a common failure relay FC and at the same time completes a holding circuit through a resistor 65 to the auxiliary common failure relay FCA. In the event that the common failure timer FTC times out, which can occur if no car opens its doors within one minute after the registration of a hall call or car call, the relay FC is energized to open its normally closed contacts in line 2 of Fig. IV. Opening these contacts deenergizes all of the car selection and dispatching equipment and the cars operate from the terminal or dispatching floors in the same manner as they operate at intermediate floors. Once a car responds the dispatching equipment is again energized. Since most failures result from faulty contacts an operation of the relay carrying the contact usually clears the fault and the system usually operates normally for the next and succeeding cars.

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Fig. X

This figure illustrates the car starting circuits including the door opening relay circuit so as to indicate the conditions under which a car can start from a floor. These circuits include, starting from the top of Fig. X, normally open door close contacts CL1 in line 110 which serve as a sealing circuit for the door close relay CL1 in line 115. In parallel with the CL1 contacts are normally open dispatcher contacts STT which are part of the up dispatching relay system. Starter release relay contacts SCL are arranged in line 111 in series with the combination of the contacts CL1 and STT to complete a circuit to lead 66 which then leads through normally closed contacts VR of the stopping relay chain, normally open contacts EM of an emergency relay which contacts open as long as any of the safety circuits are not complete, and thence through normally closed contacts OP of the door opening relay to the operating coils of the car starting relay CS and door closing relay CL1. The door closing relay coil is energized through normally open car starting relay contacts CS in line 116. The car starting relay CS is connected to the return lead L4 through normally closed throwover contacts TO in line 113, normally open IS contacts of the in service relay thence through normally closed contacts TR of an individual stop timing relay TR thence to the return lead L4. The timing relay contacts TR insure that the car will not start within a minimum time interval after arriving at a floor. Once the circuit is completed and both relays have become energized the circuit is sealed through the car starting relay CS by way of contacts CL1 in line 114 that by-pass the timing relay contacts TR which open as soon as the car starts.

When the system is thrown over to manual operation or attendant operation TO contacts next to line L3 in line 112 serve to by-pass the other starting control contacts so as to connect the starting relays CS and CL1 through the contacts VR, EM, and OP directly to the line L3. The throwover switch when operated also breaks the circuit to the automatic starting contacts of the timing relay TR and substitute contacts of a car start button shown in line 115. This start button by energizing the car start relay CS also serves to energize the door closing relay CL1.

When the system is operated without attendants the throwover contacts are in the condition illustrated in the drawings. Next in order in the automatic start control circuit are the gate contacts GA in line 113 which complete a circuit for the car starting relay to take care of the situation of emergency stops between floors when otherwise it would be impossible to start the car. Next in order are the down dispatch relay contacts CDD shown in line 114 and the instant dispatch contacts ID shown in line 115 which may be closed by other circuits to start the car without waiting for its normal dispatching signal. Next below these are a series combination of the dispatch floor relay contacts MG and MG1 in line 116 which are closed as long as the car is not at a dispatching floor. Thus, these last named contacts during automatic operation serve to complete the starting circuit when the car is at intermediate floors. Since the coils of the dispatch floor relays MG and MG1 are energized through the common failure relay contacts FC at line 2 of Fig. IV it is apparent that when the common failure timer times out and opens its contacts FC it deenergizes the dispatch floor relays MG and MG1 so as to complete the car starting circuit for any of the cars so that they may operate from the dispatch floors in the same manner that they operate from other floors. Under this condition there is no dispatching equipment in operation.

As a car stops at a floor in response to a call it opens its doors by operation of a door opening relay OP shown in line 117. The operating coil of this relay is energized by a circuit leading from the supply lead L3 through a series circuit comprising normally open contacts 2LU

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and 2LD of leveling control relays, normally closed contacts CL1 of the door closing relay, normally closed contacts RC of a hall door control cam relay which serves to control the mechanism that couples the hatchway doors to the car doors during an opening operation and thence through the operating coil OP, door timer contacts DT which open if the door does not reach fully open condition in a certain length of time and thence through a door limit control which opens when the door reaches its open position. This circuit is thus completed when a car approaches a floor at leveling speed and until the door is fully open or the time has expired during which time the door should have become fully open. The operation of this relay OP as the door is opening interrupts the circuit to the common failure timing motor or timer FTC in line 100 and thus causes this timer to reset and start a new timing interval.

These circuits are particularly suitable for use in completely automatic systems in that the delay of an individual car from starting due to interference with its door closing operation after it has received a dispatch signal or is at an intermediate floor merely takes that particular car out of the dispatching sequence so that it does not interfere with the normal movement of other cars. Furthermore, any failure that occurs in the contacts or the relays of the car selection and dispatching equipment whether it be in the selection or in the dispatching circuits is compensated after a comparatively short time interval. The common failure timer FTC is continually watching for failures as long as a call for service exists. Thus, this timer cannot operate as long as the system has no demand for service.

The usual failure that occurs in the car selection and dispatching equipment is a failure of a contact to complete its circuit because of a particle of dirt getting between and separating the actual contact surfaces. This ordinarily is an intermittent type of failure in that another operation of the relay usually dislodges the piece of dirt and allows the circuit to be completed the next time the relay operates. This system automatically clears such faults or failures in that once the common failure timer times out it permits all of the cars to operate individually without reference to the dispatching equipment and also deenergizes any of the car selecting relays as well as the dispatching relays so that they all assume their deenergized condition. Upon the opening of a set of car doors the timer is deenergized and the dispatching system again energized. The car selection relays therefore pick up according to which cars are present at the terminal and select a car for dispatching in the ordinary manner. If the fault has corrected itself the system continues to operate in its normal manner. If the fault persists, as it may if the failure were due to a failure of the dispatching machine to start after a detenting operation, the cars are again released from the dispatching floors when the common failure timer times out.

Thus, the addition of only the single failure timer with its auxiliary relays permits the entire system to be cut free of the supervisory control and allowed to operate as individual cars from the terminals as well as from intermediate floors until the fault is corrected. The relays attempt to operate periodically to clear the fault and should it be cleared the system continues to operate in the normal manner.

Various details of the circuits may be changed to vary the manner of car selection and dispatching or to obtain different indicia of failure to operate without departing from the spirit and scope of the invention.

Having described the invention, I claim:

1. In an elevator control circuit for an elevator system comprising a plurality of cars in which cars are selected for departure and released at substantially equal intervals of time and in which selecting and releasing circuits for the cars are subject to failure, in combination, a timer, an energizing circuit for said timer that is completed

as long as there is a call for service registered and no car is opening its doors, contacts that are operated by the timer at the expiration of its time interval, and means controlled by said contacts arranged to deenergize the car selection and releasing circuits.

2. In a control circuit for an elevator system comprising a plurality of cars in which the movement of cars is controlled by the registration of calls and by car selection and dispatch circuits that are subject to failure, in combination, a circuit that is in a first condition as long as there is a call for service registered and no car is opening its doors, a timer that is energized through said circuit when in the first condition and reset upon a change in condition, contacts on the timer that operate at the expiration of a predetermined period of continuous energization of the timer, and means controlled by the timer contacts for deenergizing the car selection and dispatch circuits.

3. In a control circuit for an elevator system comprising a plurality of cars in which movement of the cars from selected floors is controlled by car selection and dispatching means, in combination, a circuit that is completed when there is a call for service and no car is in process of opening its doors, a timer that is energized by the completion of said circuit, contacts on the timer that are operated at the expiration of a predetermined period of continuous energization of the timer, car selection means for interrupting the starting circuits of cars standing at the selected floors, and means operated by closure of said contacts for completing the car starting circuits.

4. In a control circuit for an elevator system comprising a plurality of cars in which movement of the cars from selected floors and operation of motor generator sets for driving the elevators is controlled by calls for service, car selection and dispatch means, and timing means for stopping motor generator sets in the absence of calls, in combination, a circuit that is completed as long as there is a call registered and no car is opening its doors, a timer operated by said circuit, circuits for starting each car after each stop, said timer contacts being connected to permit operation of said car starting circuits, and other timer contacts connected to complete the motor generator starting circuit of at least one car of said system.

5. A circuit according to claim 4 in which a second timer is energized through the contacts of said timer and arranged to energize the motor generator starting circuit of at least one other car of said system.

6. In a control circuit for an elevator system comprising a plurality of elevator cars operating under a group supervisory system including means for selecting cars for dispatching, means for dispatching said cars, and means for registering calls for service, in combination, a circuit that is completed as long as there is a call for service and no car is in process of opening its doors, a timer energized through said circuit, and timer contacts that operate after a predetermined time interval arranged to deenergize the car selection and dispatching means.

7. In a control circuit for an elevator system according to claim 6 in which each car has a motor generator for providing its driving force and means for shutting down the motor generator if the car is idle more than a predetermined interval of time, and contacts on said timer arranged to complete a circuit to restart the motor generator of a selected elevator car when said timer operates its contacts.

8. In a control circuit for an elevator system comprising a plurality of elevator cars operating under a group supervisory control including means for selecting cars for dispatching and for giving dispatching signals at generally uniform increments of time, means for registering car calls in each car, hall call registering means common to all the cars, a set of contacts for each car that are opened while the car is opening its doors, at least one set of car call contacts for each car that are closed when there is a registered car call, at least one set of hall call contacts that are closed when there is a hall call, a timer, circuit means including a parallel combination of the call contacts arranged in series with the car door opening responsive contacts of the cars for energizing the timer, and means responsive to uninterrupted operation of the timer for a predetermined time interval for deenergizing the selecting and dispatching means.

9. A control circuit according to claim 8 in which the timer closes the starting circuit of the motor generator of at least one elevator car.

10. A control circuit according to claim 9 including a second timer arranged to close the starting circuit of a second motor generator after an additional time interval.

11. In an elevator control circuit in which elevator cars are automatically selected and dispatched, in combination, a car selecting circuit arranged to select cars substantially according to the order of arrival at a dispatching floor, dispatching circuit means adapted to energize a dispatching relay for the selected car, a car starting circuit for each car arranged to start the car after each stop, at least one dispatching floor relay having contacts arranged to interrupt the car starting circuit when the car is at the dispatching floor, said dispatching relay having contacts connected in parallel with the dispatching floor relay, means responsive to the registration of calls for service, a timer, circuit means including the call responsive means and means responsive to movements of car doors for energizing the timer while there is a call for service and all car doors are at rest, and contacts operated by the timer arranged to break the circuit that energizes the car selection and dispatching floor relays of the elevator cars.

12. In an elevator control circuit in which elevator cars are automatically selected and dispatched at generally equal intervals of time, in combination, a car starting circuit that automatically starts the car after each stop, a dispatching selection floor relay for each car for each dispatching floor, a car selecting circuit energized through the floor relays arranged to select cars for dispatching substantially according to the order of arrival at a dispatching floor, contact means on the floor relays for interrupting the car starting circuits as long as the car is at a dispatching floor for holding the car at the dispatching floor, dispatching circuit means including a timer and dispatch relay for each car for energizing the starting circuit for the selected car, means responsive to the registration of calls for service, a supervisory timer that is energized through said call responsive means, means for resetting the supervisory timer as a car opens its doors, and means operated by the supervisory timer at the expiration of its timing interval for deenergizing the selector floor relays and the car selecting and dispatching circuits.

No references cited.