July 10, 1934.

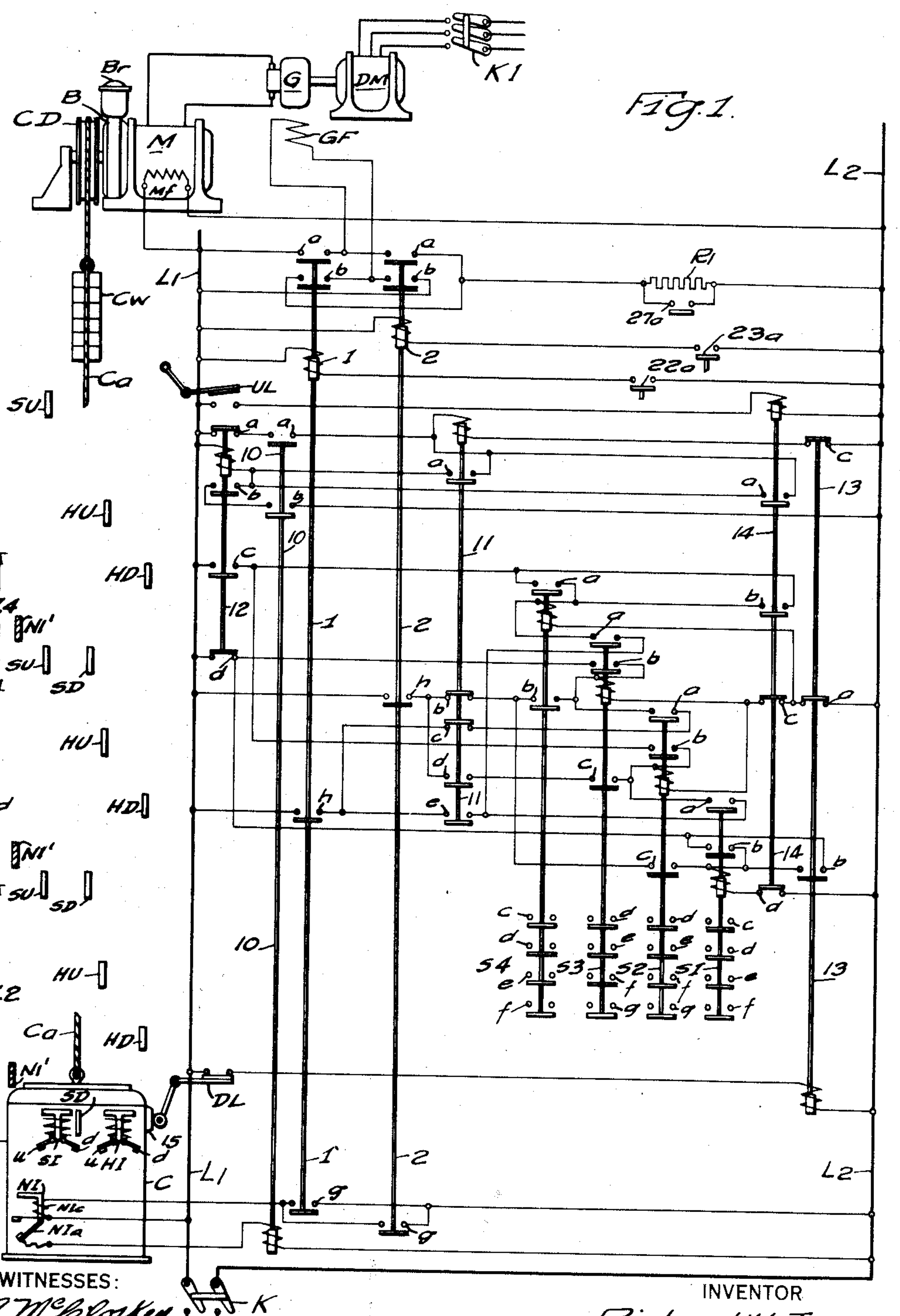
R. W. JONES

1,966,206

ELECTRIC ELEVATOR SYSTEM

Filed Aug. 25, 1932

3 Sheets-Sheet 1



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ELECTRIC ELEVATOR SYSTEM

Filed Aug. 25, 1932 3 Sheets-Sheet 2

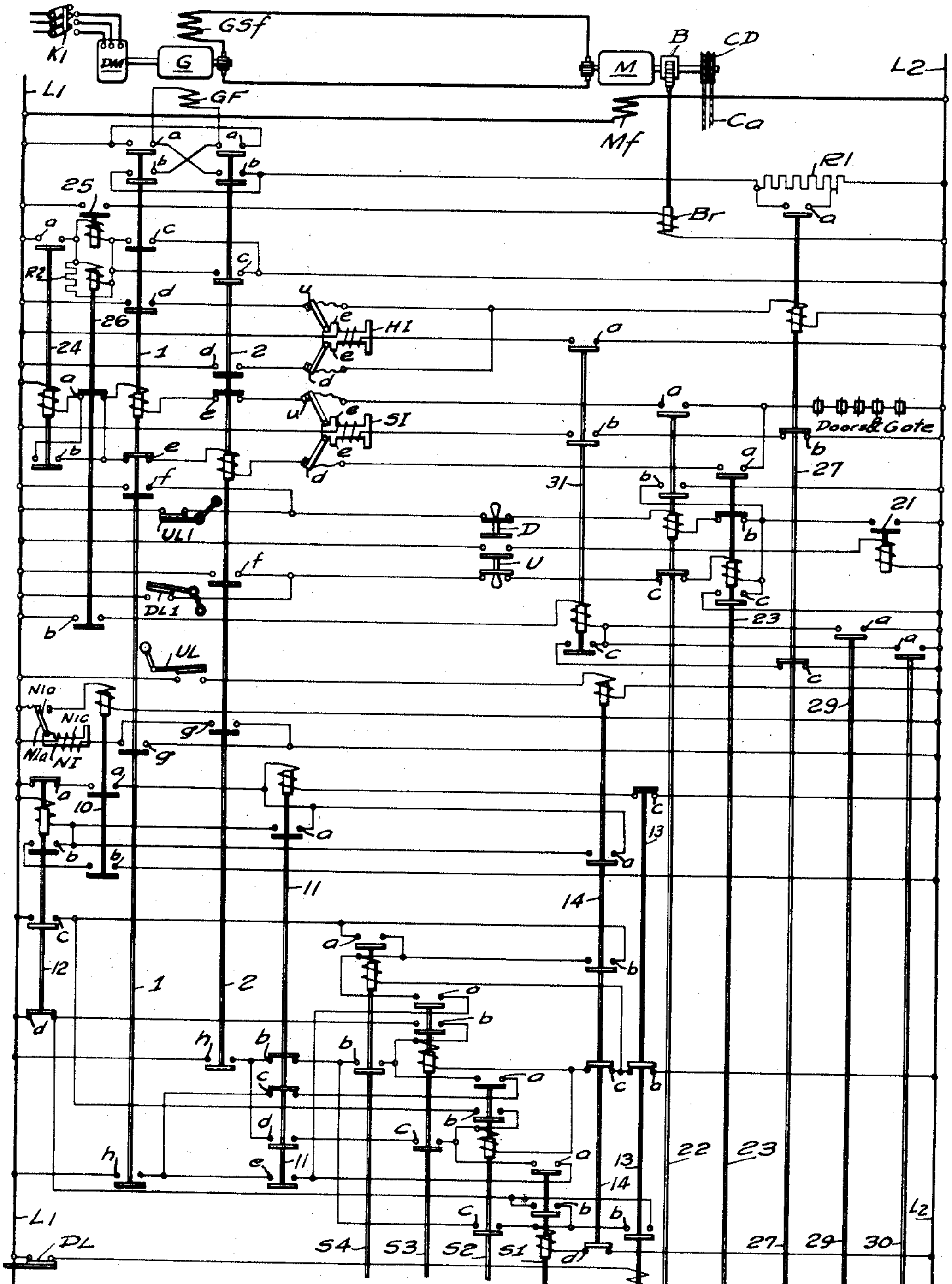

Fig. 2.

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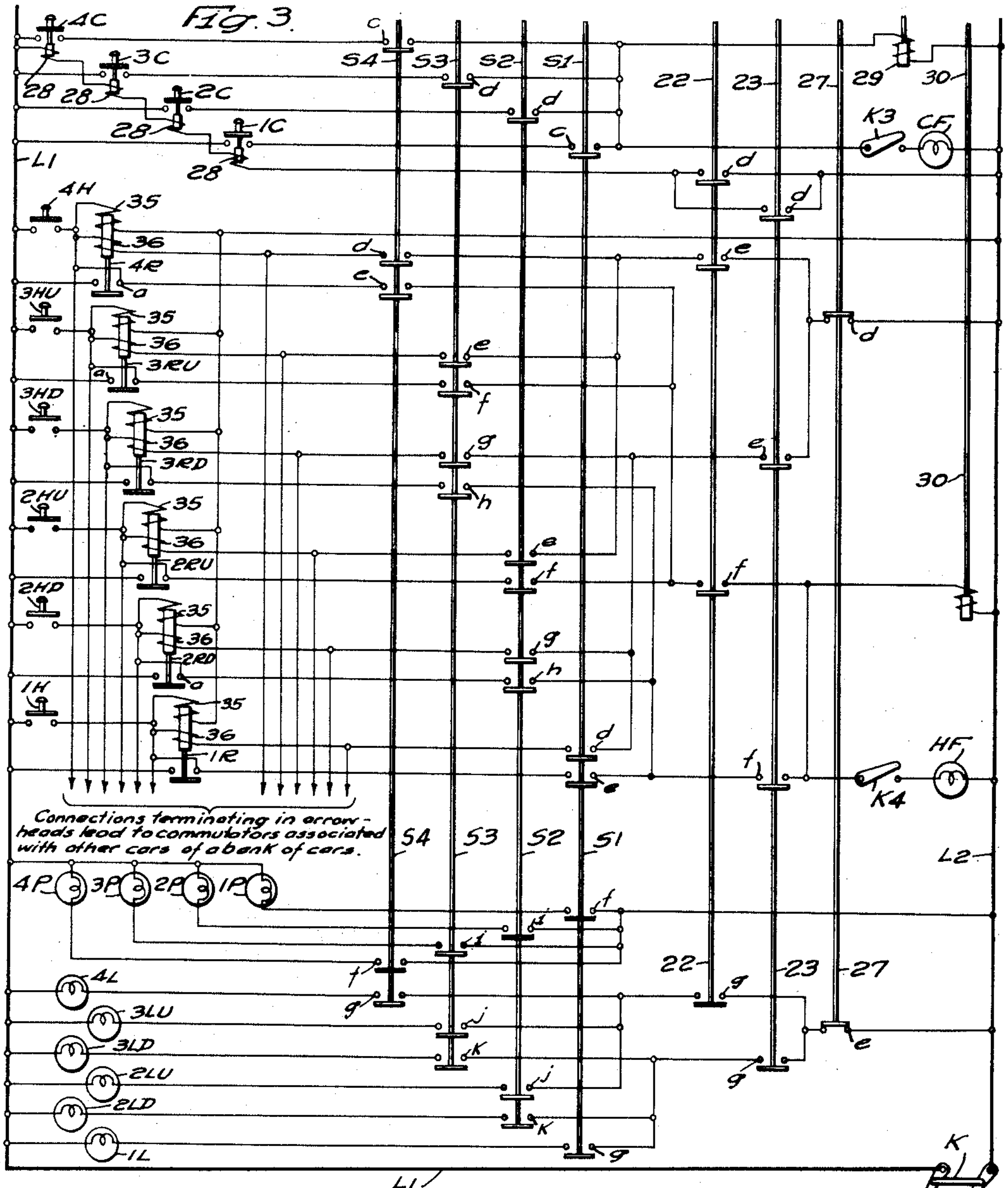
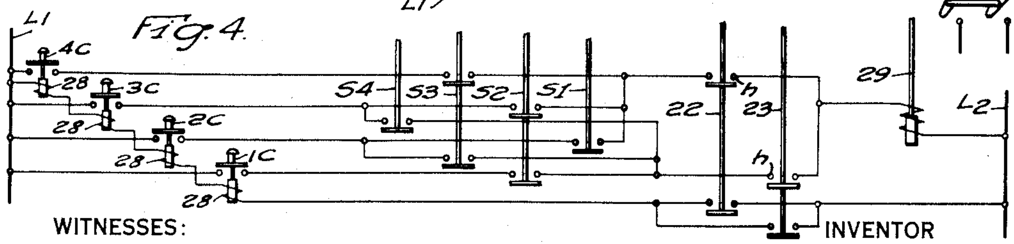
Filed Aug. 25, 1932 3 Sheets-Sheet 3





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1,966,206

ELECTRIC ELEVATOR SYSTEM

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Application August 25, 1932, Serial No. 630,348

21 Claims. (Cl. 187—29)

The present invention relates to electric elevator systems, and more particularly, to commutating apparatus for use in such systems.

In elevator systems embodying automatic, or semi-automatic features, it is necessary that circuits of various types be commutated in accordance with the position of the car with respect to the several floor landings past which it operates. Representative circuits of this type include those which control the hall-lanterns and position-indicating mechanism, those which originate at the passenger-operated push-buttons and those which control the stopping of the car.

In the usual prior art arrangement, the mechanism for commutating the various circuits comprises a plurality of stationary contact elements arranged for cooperation with corresponding contact elements carried by a movable member. The stationary contact elements are ordinarily divided into independent groups, one group being associated with each of the several types of control operations, and each group including a contact element associated with each floor of the building at which the corresponding operation is to be effected. In accordance with certain arrangements, the movable member, which ordinarily comprises one or more contact elements corresponding to each group of stationary contact elements, is driven directly in accordance with the movements of the car, through suitable reducing mechanism. In accordance with a preferable arrangement, the movable elements are "notched" to succeeding circuit controlling positions when the car reaches corresponding points in the hatchway. An arrangement of the latter character is disclosed in the copending application of Frank E. Lewis (14,598) Serial No. 588,406, filed January 23, 1932 and assigned to the Westinghouse Electric and Manufacturing Company.

Commutating mechanisms of the above character are entirely satisfactory to the extent that they may be arranged to commutate any desired number of circuits, in accordance with the position of the car, but are disadvantageous to the extent that they require apparatus which is of a specialized character, and which involves a number of moving parts.

The present invention comprises an arrangement whereby electromagnetically-operated relays may be employed to commutate circuits in accordance with the position of the car in the hatchway. The application of relay mechanisms to this purpose is advantageous in that, since the commutating or selecting-relays may be of the same type which are also used elsewhere in the system, as the floor-button relays, etc., the number of different types of apparatus used in the complete elevator system is reduced. The reduction in the number of types of apparatus not only simplifies manufacturing operations, but also reduces the renewal parts requirements of the building owner. The arrangement is further advantageous in that, in the event, one or more of the relays becomes disabled, the disabled mechanism may be quickly removed from the control panel, and new mechanism substituted with minimum loss of operating time of the associated elevator.

In accordance with the present invention, a plurality of selecting-relays, one of which is associated with each floor of the building at which a control operation is to be effected, are arranged to be sequentially operated in one order as the car moves upwardly in the hatchway and to be sequentially operated in the reverse order as the car moves downwardly in the hatchway. In the illustrated embodiment of the present invention, each selecting-relay is utilized to commutate circuits associated with both directions of travel, and the operating mechanism for the relays is such that a particular relay is energized, while the car is in a zone extending predetermined distances both above and below the floor associated therewith.

As in the above-identified Lewis application, the sequential operation of the selecting-relays is effected primarily by means of an element, hereinafter referred to as a "notching" relay, which is arranged for operation at the junctions of adjacent zones. The operations initiated by the notching-relay are transmitted to the selecting-relays through a single pair of relays, each of which occupies one circuit-controlling position while the car is in alternate zones, and occupies a second circuit-controlling position while the car is in the intervening zones.

In accordance with this arrangement, alternate selecting-relays respond to movement of the above pair of relays to one position; intervening selecting-relays respond to movement thereof to a second position. The selecting-relays are caused to respond one at a time, however, by means of a circuit arrangement whereby the circuit for each selecting-relay may be controlled by the preceding relay in the series.

It is, accordingly, an object of the present invention to provide an elevator system in which control circuits associated with the system may be commutated in accordance with the position of the car in the hatchway by means of relay mechanisms.

It is a further object of the present invention to provide means for sequentially operating a plurality of relays in accordance with the position of the elevator car.

It is a further object of the present invention to provide means to sequentially operate a plurality of relays in one order when the car is moving upwardly and in the reverse order when the car is moving downwardly.

It is a further object of the present invention to provide a system of the above character in which the operating means for the series of relays is independent of the number of floors in the building.

It is a further object of the present invention to provide, in a system of the above character, resetting mechanism which is effective, at predetermined points in the hatchway, to ensure that only the selecting relay associated with that point is in the actuated position.

Other objects and advantages of the present invention will become obvious in the course of the following detailed description thereof.

In the drawings:

Figure 1 is a diagrammatic illustration of the control mechanism associated with the selecting-relays,

Figs. 2 and 3, taken together, constitute a diagrammatic illustration of a representative elevator system embodying the present invention; and,

Fig. 4 is a diagrammatic illustration of the application of the present invention to high-speed elevator systems.

In Fig. 1, a plurality of selecting relays *s*1, *s*2, *s*3 and *s*4 are arranged for operation by a notching-relay NI, an impulse-relay 10, a closing-relay 11, an opening-relay 12, a pair of directional switches 1 and 2, and a pair of resetting-relays 13 and 14. As shown in Fig. 1, the hatchway is divided into a plurality of adjacent zones, Z1 through Z4, and the arrangement is such that selecting-relay *s*1 is energized while the elevator car is in zone Z1; selecting-relay *s*2 is energized while the car is in zone Z2; selecting-relay *s*3 is energized while the car is in zone Z3; and selecting-relay *s*4 is energized while the car is in zone Z4. While only four floors and four selecting-relays are illustrated, it will be obvious from the following description that any desired number may be used in practice.

While I may use any of a plurality of well-known devices to initiate the transfer from one selecting-relay to another, in response to the arrival of the car at the junction of adjacent zones, I prefer to use a switching device of the type disclosed in a copending application of H. W. Williams et al., Serial No. 279,771, filed May 22, 1928 and assigned to the Westinghouse Electric and Manufacturing Company. In Fig. 1, this switching device is identified as notching-relay NI.

As described in the above-identified Williams et al. application, a portion of the magnetic circuit of notching-relay NI is carried upon the elevator car, in position to be brought into cooperative relation with a series of magnetizable members NI′ which are mounted at selected points in the hatchway. In the present invention the plates NI′ are so positioned that relay NI is brought into cooperative relation with a plate each time car C reaches a junction between two adjacent hatchway zones. The structure of relay NI is such that, although the coil NI*c* thereof is energized, the magnitude and direction of the magnetic field acting upon armature NI*a* is not such as to cause closure of the associated contact members. If, however, while coil NI*c* is energized, the relay structure is brought adjacent one of the series of magnetizable plates NI′, armature NI*a* is actuated to close the associated contact members.

According to one modification disclosed in the above-identified Williams et al. application, the magnetic circuit of the relay may be so designed that the armature may be maintained in the actuated position, during energization of the coil, even though the relay structure is subsequently moved out of cooperative relation with a magnetizable plate. In accordance with a second modification, the armature resumes the illustrated position, as soon as the relay is moved out of cooperative relation with a magnetizable plate, regardless of the condition of the coil. In the present system, only a momentary closure of the contact members of notching-relay NI is required at the junction of adjacent zones, and the relay is organized in accordance with the latter modification.

As will be more fully described hereinafter, each transfer operation consists in sequentially energizing one selecting-relay and then deenergizing the preceding selecting-relay. Each transfer operation is initiated by closure of the contact members of relay NI and is terminated by the opening thereof. The length of each of the magnetizable plates NI′, accordingly, is determined by the time required to establish the circuit for the succeeding selecting-relay. In practice, in a representative system arranged for operation at from 300 to 400 feet per minute, magnetizable plates of from 6 to 10 inches in length are satisfactory.

In the illustrated embodiment, the energization of selecting-relays associated with the intermediate floors is controlled exclusively by notching-relay NI, impulse-relay 10, closing-relay 11, opening-relay 12 and the directional switches 1 and 2. The selecting relays associated with terminal floors, however, are provided with additional energizing circuits controlled, respectively, by resetting-relays 13 and 14. Resetting-relay 13 is arranged to be closed when the elevator car is at or near the lower terminal floor, by means of a mechanically-operated limit-switch DL. Resetting-relay 14 is arranged to be closed when the elevator car is at or near the upper terminal floor by means of a mechanically-operated limit-switch UL. As illustrated, switches UL and DL are normally biased to the open position in any suitable manner (not shown) and may be moved to the closed position through the cooperation of an arm and roller associated therewith, respectively, and a cam 15 mounted upon car C.

The operation of the complete system shown in Fig. 1 may be described as follows:

Assuming that the car C is at the first floor, in which position limit switch DL is closed, closure of line switch K to condition the system for operation, causes completion of a circuit for the coil of resetting-relay 13. Upon completion of this circuit, resetting-relay 13 is actuated to open its contact members *a* and *c* and to close its contact members *b*. The opening of contact members *a* and *c* of relay 13 is without immediate effect, other than to ensure that selecting-relays *s*2, *s*3 and *s*4, and relays 11 and 12, are deenergized. Closure of contact members *b* of relay 13 completes a circuit for the coil of selecting-relay *s*1, which extends from line conductor L1, through normally closed contact members *d* of opening-relay 12, contact members *b* of resetting-relay 13, the coil of selecting-relay *s*1 and through normally closed contact members *d* of resetting-relay 14 to line conductor L2.

Upon completion of this circuit, selecting relay *s*1 is actuated to close its auxiliary contact members *a* and *b* and to close its main contact members *c*, *d*, *e*, etc. As will be described in connection with Figs. 2 and 3, the main contact members are associated with the various control circuits of the system.

Closure of contact members *a* of selecting-relay *s*1 prepares a circuit for the coil of selecting-relay *s*2. Closure of contact members *b* of selecting-relay *s*1 completes a holding circuit for the coil of relay *s*1 which is independent of relay 13. Accordingly, as long as car C remains in zone Z1, selecting-relay *s*1 remains energized.

If it is desired to move car C upwardly, starting contact members 22*a* may be closed to thereby complete a circuit for the coil of up-direction switch 1. Upon completion of this circuit, switch 1 is actuated to close its contact members *a*, *b*, *h* and *g*. Closure of contact members *a* and *b* completes a circuit for field winding G*f* of generator G. In the illustrated embodiment, as will be more fully described in connection with Figs. 2 and 3, generator G is arranged to supply power to motor M in accordance with the Ward-Leonard or variable voltage system of control. Accordingly, upon application of voltage to the armature thereof, motor M is caused to move car C upwardly.

Closure of contact members *h* of reversing switch 1 is without immediate effect. Closure of contact members *g* of reversing switch 1 completes a circuit for the coil of notching-relay NI. Completion of this circuit has no effect, other than to prepare relay NI for operation.

As car C leaves the first floor, cam 15 is moved out of engagement with the roller-arm associated with switch DL, which thereupon moves to the open position, interrupting the circuit for the coil of resetting-relay 13. The consequent closure of contact members *a* and *c*, respectively, of relay 13 prepares the circuits for selecting-relays *s*2, *s*3 and *s*4 and relays 11 and 12; opening of contact members *b* of relay 13 is without effect.

When car C reaches the lower limit of zone Z2, notching-relay NI is brought adjacent one of the magnetizable plates NI′ and the contact members thereof are actuated to the closed position. Closure of the contact members of relay NI completes a circuit for the coil of impulse-relay 10.

Upon completion of this circuit, relay 10 is actuated to close its contact members *a* and *b*. Closure of contact members *a* of impulse-relay 10 completes a circuit for the coil of closing-relay 11 which extends from line conductor L1 through normally closed contact members *a* of opening-relay 12, contact members *a* of impulse-relay 10, through the coil of closing-relay 11, to line conductor L2 and normally closes contact members *c* of relay 13. Closure of contact members *b* of impulse-relay 10 is without immediate effect.

Upon completion of the circuit for the coil thereof, closing-relay 11 is actuated to close its contact members *a*, *d* and *e* and to open its contact members *b* and *c*. Closure of contact members *a* of operating relay 11 completes a self-holding circuit for the coil thereof which is independent of the contact members of relays 10 and 12, but includes the coil of relay 12. Completion of this circuit, however, does not cause operation of relay 12, since the coil thereof is short-circuited through contact members *a* of relay 10.

The opening of contact members *b* and *c* and closure of contact members *d* of closing-relay 11 is without immediate effect. Closure of contact members *e* of relay 11, however, completes a circuit for the coil of selecting-relay *s*2, which extends from line conductor L1 through contact members *h* of up-direction switch 1, contact members *e* of relay 11, the now closed contact members *a* of selecting-relay *s*1, the coil of selecting-relay *s*2 and through normally closed contact members *c* and *a* of resetting-relays 14 and 13, respectively, to line conductor L2.

Upon the completion of this circuit, selecting-relay *s*2 is actuated to close its auxiliary contact members *a*, *b* and *c* and to close its main contact members *d*, *e*, etc. Closure of contact members *a* of selecting-relay *s*2 is without effect. Closure of contact members *b* of selecting-relay *s*2 prepares a holding circuit for the coil thereof. Closure of contact members *c* of selecting-relay *s*2 is without effect during upward travel of the car.

When car C reaches the upper limit of zone Z1, notching-relay NI is moved out of range of the magnetizable plate NI′, and the contact members thereof resume the illustrated open position. The opening of the contact members of notching-relay NI interrupts the circuit for the coil of impulse-relay 10, which thereupon resumes the illustrated position, opening contact members *a* and *b*.

The opening of contact members *b* of impulse-relay 10 is without effect. The opening of contact members *a* of impulse-relay 10 removes the short-circuit from the coil of opening-relay 12. In response to the interruption of the short-circuit, holding relay 12 is actuated to open its contact members *a* and *d* and to close contact members *b* and *c*. The opening of contact members *a* is without effect, the coils of relays 11 and 12 now being connected, in series through contact members *a* of relay 11, across line conductors L1 and L2. Closure of contact members *b* of holding relay 12 is without immediate effect. Closure of contact members *c* of relay 12 completes a holding circuit for the coil of selecting-relay *s*2, which extends from line conductor L1, through contact members *c* of relay 12, contact members *b* of selecting-relay *s*2, and through the coil thereof to line conductor L2, as previously traced. The opening of contact members *d* of relay 12 interrupts the circuit for the coil of selecting-relay *s*1, which thereupon resumes the illustrated position, opening all contact members associated therewith.

The transfer from relay *s*1 to *s*2 involves, first, completing an energizing circuit for relay *s*2 through contact members *a* of relay *s*1, second, completing a holding circuit for relay *s*2, and third, interrupting the circuit for relay *s*1. The second and third steps are controlled by contact members *c* and *d*, respectively, of relay 12. Dependent upon the construction of relay 12, there may be a very short interval, during the closing movement thereof, during which both contact members *c* and *d* are open. Under these circumstances, the circuit for relay *s*1 would be interrupted (contact members *d*) before completion of the holding circuit for relay *s*2 (contact members *c*). The inherent inductive delay in the opening of a relay, following interruption of the circuit for the coil thereof, is such, however, that the opening of contact members *a* of relay *s*1 does not occur until after the expiration of the above noted interval.

As will be obvious, however, if desired, relay 12 may be so constructed that, following energization of the coil thereof, contact members *c* close before contact members *d* open; following deenergization of the coil thereof, contact members *d* close before contact members *c* open.

Assuming that it is desired to stop at the second floor, switch 1 may be opened, in a manner to be described in connection with Figs. 2 and 3, thereby deenergizing field winding G*f* of generator G and bringing elevator car C to rest. The opening of contact members *g* of switch 1 interrupts the circuit for the coil of notching-relay NI. Since the contact members of notching-relay NI are now open, however, this operation is without effect.

The opening of contact members *h* of reversing switch 1 is without effect, since the circuit for selecting-relay *s*2 is now independent of these contact members, being controlled only by opening-relay 12. Accordingly, until the latter relay is deenergized, which occurs at the upper limit of zone Z2, selecting-relay *s*2 is maintained closed.

Assuming elevator car C has again been started, in the manner previously described, the sequential energization of selecting-relay *s*3 and deenergization of selecting-relay *s*2, which occurs at the junction of zones Z2 and Z3, is effected in the following manner:

When car C reaches the lower limit of zone Z3, notching-relay NI is brought adjacent to another of the magnetizable plates NI′ and the contact members thereof are again closed to energize impulse-relay 10.

Upon being again energized, impulse-relay 10 is actuated to close contact members *a* and *b*. Closure of contact members *a* of impulse-relay 10 is without effect, but closure of contact members *b* thereof short-circuits the coil of closing-relay 11, contact members *b* of relay 12 being included in the short-circuit. Upon completion of the short-circuit, relay 11 resumes the illustrated position, opening its contact members *a*, *d* and *e* and closing its contact members *b* and *c*.

The opening of contact members *a*, *d* and *e* and closure of contact members *b* of relay 11 is without effect. Closure of contact members *c* of relay 11, however, completes a circuit for the coil of selecting-relay *s*3 which extends from line conductor L1 through contact members *h* of switch 1, contact members *c* of relay 11, contact members *a* of selecting-relay *s*2, the coil of selecting-relay *s*3 and through contact members *c* and *a* of resetting relays 14 and 13, respectively, to line conductor L2.

Upon completion of this circuit, selecting-relay *s*3 is actuated to close its auxiliary contact members *a*, *b* and *c* and to close its main contact members *d*, *e*, etc.

Closure of contact members *a* and *c* is without effect, but closure of contact members *b* of selecting-relay *s*3 prepares a holding circuit for the coil thereof.

When elevator car C reaches the upper limit of zone Z2, notching relay NI is moved out of range of the magnetizable plate NI′ and the contact members thereof resume the illustrated position, thereby deenergizing impulse-relay 10.

The consequent opening of contact members *a* of impulse-relay 10 is without effect, but the opening of contact members *b* thereof interrupts the circuit for the coil of relay 12, which thereupon resumes the illustrated position, opening contact members *b* and *c* and closing contact members *a* and *d*.

Closure of contact members *a* and opening of contact members *b* of relay 12 is without effect. Closure of contact members *d* of relay 12, however, completes a holding circuit for the coil of selecting-relay *s*3, which extends from line conductor L1 through contact members *d* of relay 12, contact members *b* of selecting-relay *s*3 and through the coil thereof to line conductor L2, as previously traced. The opening of contact members *c* of relay 12 interrupts the circuit for the coil of selecting-relay *s*2, the consequent opening of the contact members of which is without effect.

Accordingly, between the time that car C leaves zone Z2 and enters zone Z4, only selecting-relay *s*3 is energized. When car C enters zone Z4, bringing notching-relay NI adjacent another of the magnetizable plates NI′, impulse-relay 10 is again actuated to close contact members *a* and *b*. As described in connection with the entrance of car C into zone Z2, closure of contact members *b* of impulse relay 10 is without effect, but closure of contact members *a* thereof completes a circuit for the coil of relay 11, which is thereupon actuated to close its contact members *a*, *d* and *e* and to open its contact members *b* and *c*.

Closure of contact members *a* of relay 11 completes a holding circuit for the coil thereof, as previously described. The opening of contact members *b* and *c* and closure of contact members *d* of relay 11 is without effect. Closure of contact members *e* of relay 11, however, completes a circuit for the coil of selecting-relay *s*4 which extends from line conductor L1 through contact members *h* of reversing switch 1, contact members *e* of relay 11, contact members *a* of selecting-relay *s*3, the coil of selecting relay *s*4 and through contact members *a* of resetting-relay 13 to line conductor L2.

Upon completion of this circuit, selecting-relay *s*4 is actuated to close its auxiliary contact members *a* and *b* and to close its main contact members *c*, *d*, etc. Closure of contact members *b* of selecting-relay *s*4 is without effect, but closure of contact members *a* thereof prepares a self-holding circuit.

When car C reaches the upper limit of zone Z3, notching relay NI is moved out of range of the magnetizable plate NI′, thereby causing deenergization of impulse-relay 10. As previously described, the consequent opening of contact members *b* of relay 10 is without effect, but the opening contact members *a* removes the short-circuit from the coil of relay 12, thereby causing closure thereof.

Closure of contact members *b* and opening of contact members *a* of relay 12 is without immediate effect. Closure of contact members *c* of relay 12 completes a self-holding circuit for the coil of selecting-relay *s*4 which extends from line conductor L1 through contact members *c* of relay 12, contact members *a* of selecting-relay *s*4 and through the coil thereof to line conductor L2, as previously traced. The opening of contact members *d* of relay 12 interrupts the circuit for the coil of selecting-relay *s*3, thereby causing the opening of all contact members associated therewith.

Accordingly, as long as the elevator car is in zone Z4, relay *s*4 is the only energized selecting-relay.

When car C reaches the fourth floor, motor M may be stopped, as in the previous example, by deenergizing up-direction switch 1. As previously described, the opening of contact members *a* and *b* of switch 1 deenergizes field winding G*f* of generator G to thereby stop the car; the opening of contact members *h* is without effect; the opening of contact members *g* has no effect other than to deenergize the coil N1c of notching-relay NI.

When car C reaches a position at or near the upper terminal floor, limit switch UL is moved to the closed position by cam 15. Closure of limit switch UL completes a circuit for the coil of resetting-relay 14, contact members *c* and *d* of which are accordingly opened, and contact members *a* and *b* of which are accordingly closed. The opening of contact members *c* and *d* of resetting-relay 14 has no effect other than to ensure that all selecting relays, except selecting relay *s*4, are deenergized. Closure of contact members *b* of resetting-relay 14 is without effect, since the now-closed contact members *a* of selecting-relay *s*4 are connected in parallel therewith. Closure of contact members *a* of resetting-relay 14 is without effect, since the now closed contact members *a* of relay 11 are connected in parallel therewith.

Accordingly, as long as the elevator car remains at the fourth floor, selecting relay *s*4, closing-relay 11, opening-relay 12 and resetting-relay 14 remain in the actuated positions. To disable the selecting mechanism, as, for example, in the event that car C is to be taken out of service, line-switch K may be opened, thereby restoring all relays to the illustrated positions.

Assuming that switch K has been opened, thereby disabling the system, and that it is desired to again utilize the selecting mechanism, switch K may be reclosed to thereby reenergize resetting-relay 14. As above described, opening of contact members *c* and *d* of resetting-relay 14 ensures the deenergization of all selecting relays other than relay *s*4. Closure of contact members *a* of resetting-relay 14 completes a circuit for the coils of closing-relay 11 and opening-relay 12, which extends from line conductor L1 through the coil of opening-relay 12, contact members *a* of resetting-relay 14 and through the coil of closing-relay 11 to line conductor L2.

Closure of reclosing-relay 11 is without effect, other than to complete a holding circuit for the coils of relays 11 and 12, but closure of opening-relay 12 completes a circuit for the coil of selecting-relay *s*4 which extends from line conductor L1 through contact members *c* of opening-relay 12, contact members *b* of resetting-relay 14, and through the coil of selecting-relay *s*4 to line conductor L2, as previously traced. It is seen, therefore, that reclosure of resetting-relay 14 functions to restore the system to the same dondition effected by the entrance of the car into zone Z4.

It will be recalled that the operation of resetting-relay 13, in response to car C being positioned at the first floor caused the closure of selecting-relay *s*1, and opened an interlock in the circuit for closing-relay 11 and opening-relay 12. Since the illustrated system comprises an even number of floors, it is necessary that relays 11 and 12 occupy the open position while the car is in one terminal zone, and occupy the closed position while the car is in the other terminal zone. Accordingly, resetting-relay 13 is arranged to ensure the deenergization of relays 11 and 12 when the car is in the lower terminal zone, and resetting-relay 14 is arranged to ensure that relays 11 and 12 are energized while the car is in the upper terminal zone. It will be obvious that, if Fig. 1 were arranged for an odd number of floors, relays 11 and 12 would both be deenergized while the car occupied a position in either terminal zone. In this case, resetting-relays 13 and 14 would perform equivalent functions.

Assuming that selecting relay *s*4, closing-relay 11, opening-relay 12 and resetting-relay 14 are closed, either as a result of the entrance of car C into zone Z4, or as a result of the sequence following a reclosure of switch K, the selecting-relays may be sequentially operated in the reverse order, by closing down-direction switch 2 to cause the car to move downwardly. Closure of contact members *a* and *b* of down-reversing switch 2 excites field winding G*f* of generator G with the proper polarity to cause motor M to move car C downwardly. Closure of contact members *h* of switch 2 is without immediate effect. Closure of contact members *g* of switch 2 has no immediate effect, other than to energize the coil of notching-relay NI.

When car C reaches the upper limit of zone Z3, impulse relay 10 is again closed. As previously described, closure of contact members *a* of relay 10 is without immediate effect, but closure of contact members *b* thereof short-circuits the coil of closing-relay 11, causing this relay to resume the illustrated position.

The opening of contact members *a*, *d* and *e* and closure of contact members *c* of relay 11 is without immediate effect, but closure of contact members *b* of relay 11 completes a circuit for the coil of selecting-relay *s*3, which extends from line conductor L1 through contact members *h* of switch 2, contact members *b* of relay 11, contact members *b* of selecting-relay *s*4, the coil of selecting-relay *s*3 and through the now closed contact members *c* and *a* of resetting-relays 14 and 13, respectively, to line conductor L2. Upon completion of this circuit, selecting-relay *s*3 is again actuated to close its auxiliary contact members *a*, *b* and *c* and to close main contact members *d*, *e*, etc. The closure of the several auxiliary contact members is, however, without immediate effect.

When car C reaches the lower limit of zone Z4, impulse-relay 10 resumes the illustrated position, the opening of contact members *a* thereof being without effect. The opening of contact members *b* of relay 10 deenergizes opening-relay 12, which thereupon resumes the illustrated position.

The closure of contact members *a*, and the opening of contact members *b* of relay 12 is without effect. The opening of contact members *c* thereof deenergizes selecting-relay *s*4, the several contact members of which are consequently opened. The opening of contact members of selecting-relay *s*4 is without effect. The opening of contact members *b* of selecting-relay *s*4 interrupts the previously traced energizing circuit for the coil of relay *s*3 but a holding circuit therefor now extends through contact members *d* of opening relay 12 and contact members *b* of selecting-relay *s*3.

Similarly, when car C enters zone Z2, closing relay 11 is again actuated to cause closure of selecting relay *s*2 through contact members *d* of relay 11, when car C reaches the lower limit of zone Z3, opening-relay 12 is again energized to deenergize selecting-relay *s*3.

It will be observed that car C may be reversed at any point in the hatchway without disturbing the relationship between the position of car C and the selecting-relays, since the only effect of the reversal is to deenergize one reversing switch and energize the other. The opening of contact members g of the reversing switch which was closed prior to reversal has no effect other than to deenergize the coil of notching-relay NI. Similarly, the opening of contact members h of the reversing switch which was closed prior to reversal is without effect, since, although these contact members are effective to control initial energizing circuits for the selecting-relays associated with intermediate floors, the maintaining circuits for such selecting-relays are independent thereof.

When car C passes the junction between zones Z2 and Z1 the deenergization of closing-relay 11 causes closure of selecting-relay $s1$; the deenergization of opening-relay 12 causes deenergization of selecting-relay $s2$. As car C approaches the first floor, down-reversing switch 2 may be opened to stop car C and to deenergize the coil of notching-relay NI. As the car nears the first floor also, resetting-relay 13 is again closed in response to closure of lower limit-switch DL. As long as car C remains at the first floor, accordingly, unless line switch K is opened, selecting-relay $s1$ and resetting-relay 13 remain in the actuated positions.

It will be recalled that the entrance of car C into zones Z2 and Z4 resulted in the energization of relays 11 and 12, regardless of the direction of movement of car C; and that the entrance of car C into zones Z3 and Z1 resulted in the deenergization of relays 11 and 12, regardless of the direction of movement of car C. It will also be recalled that all selecting-relays associated with even numbered floors, as $s2$ and $s4$, are energized in response to energization of relay 11; and that all selecting-relays associated with odd numbered floors, as $s1$ and $s3$, are energized in response to deenergization of relay 11. Since the circuit for any particular selecting-relay is controlled by the preceding relay of the series, however, an operation of relay 11 results in the energization of only such particular relay. Similarly, since only one selecting-relay is controlled by opening-relay 12, at a time, an operation of relay 12 results in the deenergization of only that one relay. Accordingly, a single pair of relays, as 11 and 12, is effective to control the sequential energization and deenergization of any desired number of selecting relays. In view, also, of the operation of reversing switches 1 and 2, (contact members h), the succeeding selecting-relay is determined, in each case, by the direction of movement of the car at the time the junction between two adjacent hatchway zones is reached.

It will be obvious that the several zones may all be of the same length or of different lengths, and that selecting-relays may be associated with all or only a part of the floors, depending upon the particular installation, without modifying the relationship between the several elements of the system.

A representative system embodying the novel selecting mechanism of the present invention, in which, as in Fig. 1, one selecting-relay is associated with each of four floors of a building, and in which the transfer points between successive zones are located approximately midway between adjacent floors, is shown in Figs. 2 and 3, taken together.

The system shown in Figs. 2 and 3, taken together, is of the type in which the initial starting operation, in either direction, is manually controlled; in which subsequent restarting operations are controlled by suitable time element mechanism; and in which stopping operations are controlled by means of passenger operated push buttons located at the several floors and in the elevator car.

The motive means illustrated in Fig. 2 is of the variable or Ward-Leonard type and comprises a generator G continuously driven by any suitable means, as an alternating-current motor DM, and arranged to supply power to a hoisting motor M. Generator G is provided with a separately excited field winding Gf, which may be selectively excited to control the direction and speed of operation of motor M, and a series field winding GSf, which is wound to raise or lower the voltage of generator G, depending upon the value and character of the load current, by an amount sufficient to render the speed of motor M substantially independent of the load. Motor M is provided with a separately excited field winding Mf which is illustrated as being connected directly to line conductors L1 and L2. The shaft of motor M carries a brake drum B and a cable drum CD, over which the cables Ca, which support car C and counterweight Cw (Fig. 1), are passed.

An up-button U, a down-button D, a starting-relay 21, an up-direction relay 22, a down-direction relay 23, an up-direction switch 1, a down-direction switch 2, a line-switch 24, a brake-relay 25, a restarting-relay 26 and a high-speed-relay 27, are arranged to control the reversing, brake and high-speeds circuits to cause the car to start and travel at high speed.

A slowdown-switch HI and a stopping-switch SI are arranged to control, respectively, the high-speed and the reversing and brake circuits to bring the car to rest at the several floor landings. While I may use any of a plurality of well-known switching devices to effect the deceleration of the car, I prefer to use magnetically operable switches of the type disclosed and claimed in the above-identified Williams et al. application.

Accordingly, slowdown-switch HI and stopping-switch SI, which are similar to notching relay NI, except that each is provided with independently operable up and down armatures disposed, upon actuation, to open normally closed up and down contact members u and d, respectively, are mounted upon car C.

As shown in Fig. 1, a series of magnetizable plates HU is mounted in the hatchway to cooperate with switch HI and cause opening of contact members u; a series of magnetizable plates HD is mounted in the hatchway to cooperate with switch HI and cause opening of contact members d. Since switch HI controls the high speed circuits, the positioning of plates HU and HD is such that the associated contact members are opened when the car arrives at the slowdown distance in advance of any particular floor. In a representative system, arranged for operation at from 300 to 400 feet per minute, a slowdown distance of from 4 to 5 feet is suitable.

Similarly, a series of magnetizable plates SU is mounted in the hatchway to cooperate with switch SI and cause the opening of contact members u thereof; a series of plates SD is mounted in the hatchway to cooperate with switch SI and cause the opening of contact members d thereof. As will be more fully described hereinafter, the operation of switch SI effects the deceleration of the car from a low landing speed to rest. In a system arranged for operation at from 300 to 400 feet per minute, the positioning of the plates of the SU and SD series is such as to cause operation of switch SI when the car is from 1 to 2 inches in advance of a particular floor landing.

As described hereinbefore, according to one modification of the switching device disclosed in the Williams et al. application, the magnetic circuit thereof is such that the armature may be maintained in the actuated position, during energization of the coil, although the magnetizable plate is subsequently moved out of range thereof. Switches HI and SI are organized in accordance with this modification, the holding feature being provided, in the illustrated diagrammatic form of the switches, by means of small lugs *e*. The switches are so designed that the magnetic attraction between the lugs *e* and the associated armatures is ineffective to cause actuation of the latter, but is effective to maintain the armatures in the actuated position during energization of the coil.

The windings of switches HI and SI are controlled by car buttons 1C through 4C, up-hall buttons 2HU, 3HU and 4H, and down-hall buttons 1H, 2HD and 3HD, through the intermediary of selecting-relays *s*1 through *s*4, a car-stopping-relay 29, a hall-stopping-relay 30 and a transfer-relay 31.

The car buttons, one of which is associated with each floor of the building, are of the type which, after being manually closed, are maintained in the actuated position magnetically, by means of holding-coils 28. Holding-coils 28 are arranged to be momentarily deenergized upon each reversal of the direction of travel of car C, to thereby cancel all car-calls registered during movement of the car in the preceding direction.

Closure of the up-hall buttons 2HU, 3HU and 4H, which are associated, respectively, with the second, third and fourth floors, is arranged to cause actuation, respectively, of floor-relays 2RU, 3RU and 4R; closure of the down-hall buttons 1HD, 2HD and 3HD, which are associated, respectively, with the first, second and third floors, is arranged to cause actuation, respectively of floor-relays 1R, 2RD and 3RD. The floor relays are each provided with a closing-coil 35, responsive to momentary closure of the associated button to actuate the associated relay and to maintain it in that position; and an opening-coil 36, arranged for energization at an appropriate stage of the decelerating operation, and wound to generate a magnetomotive force in opposition to that of closing-coil 35, to thereby restore the associated relay to the deenergized condition.

In addition to commutating the stopping circuits, selecting-relays *s*1 through *s*4 are arranged to control a position indicator comprising lamps 1P through 4P, associated, respectively, with the several floors of the building; a series of up-hall-lanterns 2LU, 3LU and 4L, associated, respectively, with the second, third and fourth floors; and a series of down-hall-lanterns 1L, 2LD and 3LD, associated, respectively, with the first, second and third floors.

As will be obvious, in Fig. 2, the connections for notching-relay NI, limit switches UL and DL, resetting-relays 13 and 14, impulse-relay 10, closing-relay 11, opening-relay 12 and selecting-relays *s*1 through *s*4 are as shown and described in connection with Fig. 1.

The system shown in Figs. 2 and 3 may be prepared for operation by closing line switches K and K1. Closure of line switch K energizes the field winding M*f* of motor M, thereby preparing this machine for operation upon the application of voltage to the armature thereof; and causes closure of resetting-relay 13. Closure of contact members *b* of resetting-relay 13 completes a circuit for selecting-relay *s*1 and the opening of contact members *a* of relay 13 ensures that all selecting-relays other than *s*1 are deenergized. Closure of switch K1 causes motor DM to bring generator G to running speed.

Closure of contact members *a* and *b* of selecting relay *s*1 performs the functions described in connection with Fig. 1. Closure of contact members *c* of selecting-relay *s*1 is without effect, since car-button 1C has not been operated. Closure of contact members *d* and *e* of relay *s*1 is without effect since hall-button 1H has not been operated. Closure of contact members *g* of selecting-relay *s*1 is without effect since the circuit for hall-lantern 1L is interrupted elsewhere. Closure of contact members *f* of selecting-relay *s*1, however, causes the illumination of position indicating lamp 1P, to thereby indicate that the car is located in zone Z1.

To cause car C to start upwardly, and to continue in motion at high speed until a floor is approached for which either a car or a hall call has been registered, up-button U may be momentarily actuated to complete a circuit for starting-relay 21, and to prevent completion of a circuit for down-direction-relay 23. Upon being energized, starting-relay 21 is actuated to complete a circuit for the coil of up-direction-relay 22, which extends from line conductor L1, through the now closed contact members of an auxiliary limit switch UL1, the now closed contact members of down-button D, the coil of up-direction-relay 22, normally closed contact members *b* of down-direction-relay 23 and through contact members of starting-relay 21 to line conductor L2. Auxiliary limit switches UL1 and DL1 are of the usual mechanically operable type, and are arranged to be closed except when the elevator is at or near the corresponding terminal floor.

Upon completion of the above circuit, up-direction-relay 22 is actuated to close contact members *a*, *b*, *d*, *e*, *f*, and *g* and to open contact members *c*. The opening of contact members *c* of relay 22 prevents energization of down-direction relay 23. Closure of contact members *b* of relay 22 completes a self-holding circuit for the coil thereof which is independent of the contact members of starting relay 21. Upon completion of this circuit, button U may be released to the illustrated position. As will be obvious, upon completion of this circuit also, relay 22 remains in the actuated position until the upper terminal is reached, unless down-button D is actuated to reverse the car at an intermediate point in the hatchway.

Closure of contact members *d* of relay 22 energizes the holding coils 28 associated with all of the car buttons 1C through 4C, thereby conditioning these buttons for manual operation. Closure of contact members *e* of relay 22 prepares circuits for the opening-coils 36 associated with floor-relays 2RU, 3RU and 4R. Closure of contact members *f* of relay 22 renders hall-stopping-relay 30 subject to control by floor-relays 2RU, 3RU and 4R. Closure of contact members *g* of relay 22 prepares the circuits for up-hall-lanterns 2LU, 3LU and 4L. Closure of contact members *a* of relay 22 completes a circuit for the coil of line-switch 24 and up-direction-switch 1, which extends from line conductor L1, through the coil of switch 24, normally closed contact members *a* of restarting-relay 26, the coil of switch 1, normally closed contact members *e* of switch 2, normally closed contact members *u* of stopping-switch SI, contact members *a* of relay 22, and, assuming all hatchway doors and the car gate are closed, through the door and gate interlocks to line conductor L2. Upon completion of this circuit, line-switch 24 is actuated to close its contact members *a* and *b* and up-switch 1 is actuated to close its contact members *a, b, c, d, f, g* and *h* and to open its contact members *e*.

Closure of contact members *a* of line-switch 24 prepares a circuit for brake-relay 25 and restarting-relay 26. Closure of contact members *b* of line-switch 24 completes a holding circuit for line-switch 24 and up-switch 1 which is independent of the contact members *a* of restarting-relay 26.

Closure of contact members *a* and *b* of up-switch 1 connects field winding G*f* of generator G across line conductors L1 and L2 in series with a resistor R1. Upon completion of this circuit, the voltage of generator G rises to a value corresponding to the low or landing speed of elevator car C. Closure of contact members *c* of up-switch 1 completes the circuit for brake-relay 25 and restarting relay 26, which extends from line conductor L1 through contact members *a* of line-switch 24 in parallel through the coils of relays 25 and 26 and through contact members *c* of switch 1 to line conductor L2. The opening of contact members *a* of relay 26 is without effect during acceleration. Closure of contact members *b* of relay 26 prepares a circuit for the coil of transfer-relay 31. The actuation of relay 25 energizes release-coil B*r* of the electro-magnetic brake B. Upon release of the brake, and upon application of voltage to the armature of motor M, elevator car C is caused to start upwardly at slow speed.

The opening of contact members *e* of switch 1 prevents completion of a circuit for down-direction switch 2. Closure of contact members *f* of switch 1 is without effect since switch UL1 is connected in parallel therewith. Closure of contact members *g* and *h* of switch 1 performs the functions described in connection with Fig. 1.

Closure of contact members *d* of switch 1 completes a circuit for the coil of high-speed-relay 27, which extends from line conductor L1 through contact members *d* of switch 1, contact members *u* of slowdown-switch HI and through the coil of relay 27 to line conductor L2. Upon completion of this circuit, relay 27 is actuated to close its contact members *a* and to open its contact members *d* through *e*. Closure of contact members *a* of relay 27 excludes resistor R1 from the circuit of field winding G*f*, thereby causing elevator car C to accelerate to high-speed. The opening of contact members *b* through *e* of relay 27 is without effect during the accelerating operation.

As elevator car C moves upwardly from the lower terminal floor, auxiliary-limit-switch DL1 is released to the closed position. This operation is without effect, however, since the circuit for down-direction-relay 23 is interrupted at contact members *c* of up-direction-relay 22. Similarly, as described in connection with Fig. 1, as car C moves away from the lower terminal floor, limit-switch DL is released to the open position, this operation being without effect other than to deenergize resetting-relay 13.

Assuming that, either before or after car C is started, car-button 4C and hall-button 3HU are closed, the following circuits are prepared. Closure of hall-button 3HU completes a circuit for closing-coil 35 of floor-relay 3RU. Upon completion of this circuit, relay 3RU is actuated to close its contact members *a*, to thereby complete a holding circuit for coil 35 and to prepare a circuit for the coil of hall-stopping-relay 30. In view of the holding circuit, it will be obvious that only a momentary closure of button 3HU is required and that relay 3RU will remain in the actuated position until opening-coil 35 is energized. Upon being closed, car button 4C is retained in that position under the influence of coil 28, and prepares a circuit for the coil of car-stopping-relay 29.

When car C, moving upwardly, reaches the junction point between the zones Z1 and Z2, notching-relay NI, impulse relay 10, closing-relay 11 and opening-relay 12 function as described in connection with Fig. 1 to effect the energization of selecting-relay *s*2 and the deenergization of selecting-relay *s*1. Upon being deenergized, contact members *a* through *g* of selecting-relay *s*1 are opened. As described in connection with Fig. 1, the opening of contact members *a* and *b* is without effect. The opening of contact members *c, d, e* and *g* is also without effect since car-button 1C and hall-button 1H have not been operated, and since the circuit for first floor hall-lantern 1L is interrupted elsewhere. The opening of contact members *f* of selecting-relay *s*1, however, extinguishes first floor position indicating lamp 1P, thereby indicating that car C has moved out of zone Z1.

Upon being energized, selecting-relay *s*2 is actuated to close contact members *a* through *k*. Closure of contact members *a* through *c* of selecting-relay *s*2 performs the functions described in connection with Fig. 1. Closure of contact members *d* through *h* of selecting-relay *s*2 is without effect, since car-button 2C and hall-buttons 2HU and 2HD have not been operated. Closure of contact members *j* and *k* of selecting-relay *s*2 is without effect since the circuits for second floor hall-lanterns 2LU and 2LD are interrupted elsewhere. Closure of contact members *i* of selecting-relay *s*2, however, causes illumination of second floor position indicating lamp 2P, to thereby indicate that car C is in zone Z2.

When car C reaches the junction between zones Z2 and Z3, notching-relay NI, impulse-relay 10, closing-relay 11, and opening-relay 12 function as described in connection with Fig. 1 to energize selecting-relay *s*3 and deenergize selecting-relay *s*2. The opening of selecting-relay *s*2 has no effect other than to extinguish position indicating lamp 2P to thereby indicate that car C has moved out of zone Z2.

Upon being energized, selecting-relay *s*3 is actuated to close its contact members *a* through *k*. Closure of contact members *a* through *c* of selecting-relay *s*3 performs the functions described in connection with Fig. 1. Closure of contact members *d* of relay *s*3 is without effect, since car-button 3C has not been operated. Closure of contact members *g* and *h* of selecting-relay *s*3 is without effect, since the circuits controlled thereby are interrupted, respectively, at contact members *e* and *f* of down-direction-relay 23. Closure of contact members *j* and *k* of selecting-relay *s*3 is without effect since the circuits for third floor hall-lanterns 3LU and 3LD are interrupted elsewhere. Closure of contact members *i* of selecting-relay *s*3 causes illumination of position indicating lamp 3P to thereby indicate that car C is in zone Z3. Closure of contact members e of selecting-relay $s3$ prepares a circuit for opening-coil 36 of floor-relay 3RU.

Closure of contact members f of selecting-relay $s3$ completes a circuit for the coil of hall stopping-relay 30, which extends from line conductor L1 through contact members a of relay 3RU, contact members f of selecting-relay $s3$, contact members of up-direction-relay 22 and through the coil of relay 30 to line conductor L2.

Upon completion of this circuit, relay 30 is actuated to close its contact members a. Closure of contact members a of relay 30 completes a circuit for the coil of transfer-relay 31, which extends from line conductor L1, contact members b of restarting-relay 26, the coil of relay 31, and through contact members a of relay 30 to line conductor L2.

Upon completion of this circuit, transfer-relay 31 is actuated to close its contact members a, b and c. Closure of contact members c of relay 31 prepares a holding circuit for the coil thereof. Closure of contact members b thereof prepares a circuit for stopping-switch SI. Closure of contact members a of relay 31 completes a circuit for the coil of slowdown-switch HI, which extends from line conductor L1, through the coil of switch HI and through contact members a of relay 31 to line conductor L2.

As car C continues toward the third floor, in zone Z3, slowdown-switch HI is brought opposite the magnetizable plate HU associated with the third floor, and the magnetic circuit thereof is modified in the previously described manner, thereby causing contact members u of switch HI to open. The opening of contact members u of switch HI interrupts the circuit for high-speed relay 27, contact members a of which are accordingly opened, and contact members b through e of which are again closed.

The opening of contact members a of relay 27 re-includes resistor R1 in the circuit of generator field-winding Gf, thereby initiating the deceleration of car C to the low-landing speed. Closure of contact members b of relay 27 completes a circuit for the coil of stopping-switch SI, thereby preparing that switch for operation. Closure of contact members c of relay 27 completes the previously prepared holding circuit for the coil of transfer-relay 31. Closure of contact members d of relay 27 completes a circuit for opening-coil 36 of floor-relay 3RU, which extends from line conductor L1 through contact members a of relay 3RU, coil 36 of relay 3RU, contact members e of selecting relay $s3$, contact members e of up-direction relay 22 and through contact members d of high-speed relay 27 to line conductor L2.

Upon completion of this circuit coil 36 generates a magneto-motive force in opposition to that of coil 35, thereby restoring relay 3RU to the illustrated position and cancelling the third-floor call. The cancelling of the third-floor call, however, has no effect other than to deenergize hall-stopping-relay 30, since the circuit for transfer-relay 31 is now independent of relay 30.

Since contact members d of relay 27 remain closed until the car has again been accelerated to high-speed, it will be observed that additional operations of button 3HU, between the time deceleration is initiated and until the car starts away from the third floor, have the effect of simultaneously energizing both coils 35 and 36 of relay 3RU, and are, therefore, ineffective to register a third floor up call.

Closure of contact members e of high-speed relay 27 completes a circuit for the third floor up-hall-lantern 3LU, which extends from line conductor L1, through lantern 3LU, contact members j of selecting-relay $s3$, contact members g of relay 22 and through contact members e of relay 27 to line conductor L2. Upon completion of this circuit, the third-floor up-hall-lantern is illuminated to indicate to the waiting passenger that car C is approaching the third floor in the upward direction, and is being decelerated in response to the third-floor call.

As car C continues toward the third floor, stopping-switch SI is brought adjacent the magnetizable plate SU, associated with the third floor, and contact members u of switch SI are actuated to the open position, to thereby interrupt the circuit for line-switch 24 and up-switch 1.

Upon interruption of the above circuit, contact members a and b of switch 24 are opened, contact members a, b, c, d, f, g and h of switch 1 are opened, and contact members e of switch 1 are closed. As described in connection with Fig. 1, the opening of contact members h of switch 1 is without effect, and the opening of contact members g thereof has no effect other than to deenergize the coil of notching-relay NI. The opening of contact members f of switch 1 has no effect, since limit-switch UL1 is connected in parallel therewith. Closure of contact members e of switch 1 is without effect since the circuit for down-switch 2 is interrupted elsewhere. The opening of contact members d of switch 1 is without effect since the circuit for relay 27 has been previously interrupted. The opening of contact members c of switch 1 and contact members a of switch 24 interrupts the circuit for brake-relay 25 and restarting-relay 26. The opening of contact members a and b of switch 1 interrupts the circuit for field winding Gf, thereby reducing the voltage of generator G to substantially zero.

In response to the interruption of the reversing and brake circuits, car C is brought to rest substantially level with the third floor landing.

Upon interruption of the circuit for the coil of relay 26, the energy stored in the coil thereof starts to discharge through a local circuit including a resistor R2. At the expiration of an interval determined by the ratio of resistance to inductance of this circuit, contact members a of relay 26 resume the closed position and contact members b thereof resume the open position. The opening of contact members b of relay 26 interrupts the circuit for the coil of transfer-relay 31, contact members a through c of which are consequently opened. The opening of contact members c of transfer-relay 31 is without effect, but the opening of contact members a and b thereof deenergizes the windings of switches HI and SI.

It will be observed that, although relay 22 remains energized while the car is at the third floor landing, the circuit for line-switch 24 and up-switch 1 is subject to the reclosure of contact members a of restarting-relay 26, since contact members b of relay 24 are opened in the course of the slow-down operation. The timing of contact members a of relay 26 is so adjusted as to prevent restarting of the car for a period of perhaps 4 or 5 seconds, or sufficiently long to permit the opening of the car gate and the hatchway door. As will be observed, the circuit for line-switch 24 and up-switch 1 cannot be completed while the car gate or any hatchway door is open.

Since up-relay 22 remains energized while the car is at the third floor, third-floor up-hall-lantern 3LU remains illuminated until contact members *e* of relay 27 are opened, which does not occur until the car leaves the third floor.

Assuming that all of the hatchway doors and the car gate are again closed, and that contact members *a* of restarting-relay 26 are closed, the circuit for line-switch 24 and up-switch 1 is again completed, as previously traced. In response to completion of this circuit, up-switch 1 and line-switch 24, brake-relay 25, restarting-relay 26 and high-speed-relay 27 are again actuated to cause the car to accelerate to and travel at high speed, the sequence of operation being as previously described.

The closure of contact members *a* and opening of contact members *b* and *c* of high-speed-relay 27, during the accelerating operation, perform the functions described in connection with the first accelerating operation. The opening of contact members *d* of relay 27 prevents completion of a circuit for opening-coil 36 of floor-relay 3RU, thereby permitting the registration of third-floor up calls. The opening of contact members *e* of relay 27 extinguishes third-floor up-hall-lantern 3LU.

When car C reaches the junction between zones Z3 and Z4, notching-relay NI, impulse-relay 10, closing-relay 11 and opening-relay 12 function as described in connection with Fig. 1 to effect the energization of selecting-relay *s*4 and the deenergization of selecting-relay *s*3. The opening of selecting relay *s*3 has no effect other than to extinguish, at contact members *i*, the third-floor position indicating lamp 3P.

Closure of contact members *a* and *b* of selecting-relay *s*4 performs the functions described in connection with Fig. 1. Closure of contact members *d*, *e* and *g* of selecting-relay *s*4 is without effect, since hall-button 4H has not been operated, and since the circuit for the fourth-floor hall-lantern 4L is interrupted elsewhere. Closure of contact members *f* of selecting-relay *s*4 causes illumination of the fourth-floor position indicating lamp 4P, to thereby indicate that car C is in the fourth-floor zone Z4. Closure of contact members *c* of selecting-relay *s*4 completes a circuit for the coil of car-stopping-relay 29.

Upon completion of this circuit car-stopping-relay 29 is actuated to close its contact members *a*, to thereby cause completion of a circuit for the coil of transfer-relay 31.

Upon completion of the latter circuit, transfer-relay 31 is actuated to close contact members *a*, *b* and *c*. As previously described, closure of contact members *c* of relay 31 prepares a holding circuit for the coil thereof, closure of contact members *b* prepares a circuit for the coil of stopping-switch SI and closure of contact members *a* completes a circuit for the coil of slowdown-switch HI.

As previously described, as car C continues toward the fourth floor, contact members *u* of switch HI are opened to deenergize relay 27. The deenergization of relay 27 initiates the deceleration of the car (contact members *a*), completes a circuit for the coil of stopping-switch SI (contact members *b*), completes a holding circuit for transfer-relay 31 (contact members *c*), and causes illumination of fourth-floor hall-lantern 4L (contact members *e*). In this example, closure of contact members *d* of relay 27 is without effect, since the fourth-floor hall button 4H has not been operated. It should be noted, however, that closure of button 4H, while car C is slowing down to make a stop at the fourth floor, would be ineffective to register a fourth-floor call, since such closure would energize both coils 35 and 36 of relay 4R.

As the car continues toward the fourth floor, switch SI is brought opposite a cooperating plate SU and contact members *u* thereof are opened to cause interruption of the circuits for line-switch 24, up-switch 1, brake-relay 25, restarting-relay 26, transfer-relay 31 and the coils of switches HI and SI. As in the previous example, deenergization of switches 1 and 24, and relay 25 brings the car to rest. The deenergization of relays 26 and 31 and of the coils of switches HI and SI prepares the system for the next starting operation.

As car C approaches the fourth floor, auxiliary limit-switch UL1 is moved to the open position. This operation is without immediate effect, however, since it occurs prior to the opening of contact members of switch 1. Upon the opening of contact members *f* of switch 1, however, the circuit for up-direction-relay 22 is interrupted, contact members *a*, *b*, *d*, *e*, *f* and *g* of which are consequently opened, and contact members *c* of which are consequently closed. The opening of contact members *a* and *b* and closure of contact members *c* of relay 22 are without effect. The opening of contact members *d* of relay 22 deenergizes holding coils 28, thereby causing any operated car-buttons to return to the illustrated positions. The consequent opening of button 4C deenergizes car-stopping relay 29.

The opening of contact members *e* and *f* of relay 22 is without effect. The opening of contact members *g* of relay 22 extinguishes floor-lantern 4L.

As car C approaches the upper terminal, also, as described in connection with Fig. 1, limit switch UL is moved to the closed position, to thereby complete a circuit for the coil of resetting-relay 14. Upon completion of this circuit contact members *a* and *b* of resetting relay 14 are closed and contact members *c* and *d* thereof are opened. As also described in connection with Fig. 1, closure of contact members *a* and *b* of relay 14 is without effect, since contact members *a* of relays 11 and *s*4, respectively, are connected in parallel therewith. Similarly, the opening of contact members *c* and *d* of resetting-relay 14 has no effect other than to insure that all selecting-relays except *s*4 are deenergized. Accordingly, at the expiration of the stopping operation and as long as car C remains at the fourth floor, all relays except closing-relay 11, opening-relay 12, resetting-relay 14 and selecting-relay *s*4 are deenergized.

Assuming that it is desired to operate car C in the downward direction, button D may be momentarily closed to complete a circuit for starting-relay 21, closure of which completes a circuit for down-direction-relay 23, which circuit extends from line conductor L1 through the now closed contact members of auxiliary limit switch DL1, back contact members of button U, contact members *c* of relay 22, the coil of relay 23 and through contact members of relay 21 to line conductor L2.

Upon completion of this circuit down direction relay 23 is actuated to close its contact members *a*, *c*, *d*, *e*, *f* and *g*, and to open its contact members *b*. The opening of contact members *b* of relay 23 prevents completion of a circuit for up-direction-relay 22. Closure of contact members *c* of relay 23 completes a self-holding circuit for the coil thereof which is independent of starting-relay 21 and which, as described in connection with the corresponding circuit for relay 22, remains completed until the lower terminal is reached, unless button U is operated to reverse the car at an intermediate point.

Closure of contact members *a* of relay 23 completes a circuit for the coils of line-switch 24 and down-switch 2, which extends from line conductor L1 through the coil of line-switch 24, contact members *a* of restarting-relay 26, contact members *e* of switch 1, the coil of switch 2, contact members *d* of stopping-switch SI, contact members *a* of relay 23 and through the door-and-gate interlocks to line conductor L2.

Since contact members *a* through *h* of switch 2 perform functions which correspond to functions performed by contact members *a* through *h* of switch 1, with the exception that field winding G*f* of generator G is connected across line conductors L1 and L2 in the reverse direction, it is believed that the acceleration of the car to full speed in the downward direction, in response to closure of switches 24 and 2 need not be described in detail.

Closure of contact members *d* of relay 23 completes a circuit for holding-coils 28, thereby preparing car-buttons 1C through 4C for operation, as described in connection with operation in the up-direction.

Closure of contact members *e* of relay 23 prepares circuits for the opening-coils 36 associated with down-floor-relays 3RD, 2RD and 1R. It will be observed that, during upward travel of the car, only up-calls can be cancelled since the cancellation circuits associated with down-floor-relays are interrupted at contact members *e* of relay 23; during downward travel of the car only down-calls can be cancelled, since the cancellation circuits for up-floor-relays are interrupted at contact members *e* of up-direction relay 22.

Closure of contact members *f* of relay 23 renders hall-stopping-relay 30 subject to control by the down-floor-relays 3RD, 2RD and 1R. It will be observed that, during upward travel of the car, relay 30 responds only to up-calls, since the circuits prepared at the down-floor-relays are interrupted at contact members *f* of relay 23; that during downward travel of the car, relay 30 responds only to down-calls, since the circuits prepared at the up-floor-relays are interrupted at contact members *f* of relay 22.

Although the hall-buttons are effective to cause the stopping of the car only when travelling in a certain direction, it will be observed that car-buttons 1C through 4C are effective to cause the stopping of the car when travelling in either direction, the circuit for car-stopping-relay 29 being independent of the direction-relays 22 and 23.

Closure of contact members *g* of relay 23 prepares the circuits for the down-hall-lanterns 3LD, 2LD and 1L. Since relays 22 and 23 control respectively, the circuits for the up-hall-lanterns and the down-hall-lanterns, it will be observed that only up-lanterns are illuminated during upward travel of the car, and that only down-lanterns are illuminated during downward travel of the car.

As described in connection with Fig. 1, as car C moves downwardly in the hatch, selecting-relays *s*4, *s*3, *s*2 and *s*1 are sequentially operated, as the car reaches the junction points between the associated zones. It is believed to be obvious that if no calls are registered during the downward movement of the car, the sequential operation of the selecting-relays will have no effect other than to cause the sequential illumination of the position-indicating lamps 4P, 3P, 2P and 1P.

Since the stopping operation initiated by registration of a down-call at either the intermediate or terminal floors is in all respects analogous to a stopping operation during upward travel, it is believed that a detailed description of a stopping operation in response to a down call is unnecessary.

As described in connection with Fig. 1, the elevator car may be reversed at intermediate points in the hatchway without disturbing the relationship between the operated selecting-relays and the position of the car. The system shown in Figs. 2 and 3 may be reversed at intermediate points by momentarily closing the starting button corresponding to the reverse direction.

Assuming, for example, that the car has been brought to rest, during upward travel, in the manner previously described, and that it is desired to reverse the car without proceeding to the upper terminal, down-button D may be momentarily operated to interrupt the circuit for up-direction-relay 22, and to complete a circuit for starting-relay 21. Since both auxiliary limit switches are closed while the car is at intermediate points in the hatchway, closure of relay 21 completes a circuit for down-direction-relay 23, the circuit for relay 22 being interrupted at the contact members of button D. The consequent closure of relay 23 prepares the down-direction circuits in the manner previously described. Since the holding coils 28 associated with the car buttons are momentarily deenergized during the transfer from relay 22 to relay 23, all car-buttons are restored to the illustrated positions.

When the car reaches the lower terminal floor and is stopped thereat, either as a result of the operation of car-button 1C or hall-button 1H, or through the operation of the usual limit switch mechanism (not shown), all switching mechanism except resetting-relay 13 and selecting-relay *s*1 assume the illustrated deenergized positions, the circuits for resetting-relay 13 and selecting-relay *s*1 being completed in the manner described in connection with Fig. 1.

In certain systems it is desirable that either visual or audible signalling means be arranged for operation as the car approaches a floor at which a call is registered, to inform the operator that a stop should be made. In the illustrated system, two lamps CF and HF are arranged for connection, through throw-over switches K3 and K4 respectively, in parallel with car-stopping-relay 29 and hall-stopping-relay 30. As will be obvious, if switches K3 and K4 are closed, lamp CF will be illuminated each time the car enters a zone which includes a floor at which a car-call has been registered, and lamp HF will be illuminated each time the car enters a zone which includes a floor at which a hall-call has been registered.

In describing the operation of the system shown in Figs. 2 and 3, reference has been made to the use of only a single car in the elevator system. The arrangement shown in Figs. 2 and 3, is, however, well adapted for use in systems involving a bank of cars.

In present day systems for controlling a plurality of elevator cars, it is customary to so arrange the floor selecting circuits that a single series of up and down push-buttons, located at the several floors, are effective to cause the stopping of all of the cars of the bank. It is usual in the art to so arrange the call cancellation circuits that the call is cancelled at the time the first car to approach the associated floor initiates a slow-down operation in response to the call. Systems arranged in this way are identified in the art as "selective" systems for the reason that the stopping of more than one car in response to the same call is prevented.

A typical system of the above character is shown and described in reissue application, Serial No. 529,535, filed April 11, 1931 by Edgar M. Bouton, and assigned to the Westinghouse Electric and Manufacturing Company. As shown in the Bouton application, the car-stopping and call-cancellation circuits which originate at the several floor relays extend, in parallel, to the individual floor selecting mechanisms associated with the individual cars which form the bank. Returning to Fig. 3 of the present application, it is to be noted that branch circuits, which terminate in arrow heads, are shown as connected in parallel to the circuits which lead from the floor-relay contact members to those contact members of selecting-relays $s1$ through $s4$ which control hall-stopping-relay 30. Similarly, branch circuits, also terminating in arrow heads, are shown as connected in parallel with those contact members of the selecting-relays which control the cancellation circuits of the several floor-relays. As indicated in the legend at the bottom of Fig. 3, the connections, which terminate in arrow heads, lead through the floor-selecting relays associated with other cars of a bank of cars.

In accordance with the arrangement shown in the above-identified Bouton application, in adapting the system shown in Figs. 2 and 3 of the present application for use in connection with a bank of cars, all of the apparatus, with the exception of the hall-push-buttons and floor-relays, is duplicated for each car of the bank. It is seen, therefore, that the circuits shown in Fig. 3 as terminating in arrow heads, if completed, would extend through the selecting-relays associated with additional cars to complete the stopping and cancellation circuits for those cars in the manner described in connection with the corresponding circuits which are completely illustrated in Fig. 3. Under these circumstances, it is believed unnecessary to further illustrate or describe these circuits.

Assuming that the illustrated system is arranged to control a bank of cars, it will be observed that the circuit arrangement inherently provides the above-described selective feature. It will be recalled that stopping-relay 30 is energized at the time the car enters the zone associated with the floor at which the call is registered, and that the call is cancelled as soon as high-speed-relay 27 is deenergized. If a second car should enter the zone which includes the floor at which the call is registered, after the stopping-relay associated with the first car is energized, but before the high-speed-relay associated with that car is deenergized, the stopping-relay for the succeeding car would also be energized. Upon deenergization of the high-speed-relay associated with the first car, however, the call is cancelled, and the cancelling operation results in the deenergization of the stopping-relays 30 associated with both cars. Accordingly, although two cars may approach each other so closely that the stopping-relays associated with both are energized in response to the same call, the leading car cancels the call as soon as slow-down is initiated, thereby deenergizes the stopping-relay associated with the following car, and prevents such following car from being stopped.

In Figs. 2 and 3, the arrangement is such that the slow-down distance for the elevator car is equal to, or less than, half the distance between adjacent floor landings. Under these circumstances, it will be observed that all control operations associated with a particular floor, as the stopping, cancellation of calls, illumination of hall-lanterns and of the position-indicating lamps, occur while the elevator car is in a single zone. In systems arranged for operation at speeds in excess of from 350 to 400 feet per minute, the required slow-down distance is, of course, correspondingly greater. For example, in a system arranged for operation at 600 feet per minute a slow-down distance of from 10 to 11 feet is suitable; in a system arranged for operation at 1200 feet per minute a slow-down distance of from 35 to 40 feet is suitable. A series of selecting-relays, arranged for sequential operation in accordance with the present invention may be arranged to commutate various circuits associated with high-speed systems in the manner illustrated in Fig. 4.

Fig. 4 illustrates the car-stopping circuits for a system arranged for operation at such a speed that deceleration must be initiated before the car enters the selecting-zone which includes the floor at which the call is registered.

In Fig. 4, the relation between the hatchway zones and the several selecting relays is as described in connection with Figs. 1, 2 and 3. Similarly, up-direction-relay 22, down-direction-relay 23, and car-stopping-relay 29 perform the functions described in connection with Figs. 2 and 3. In Fig. 4, however, car-button 1C is associated with selecting-relay $s2$; car-button 2C is associated with selecting relays $s1$ and $s3$; car-button 3C is associated with selecting-relays $s2$ and $s4$; and car-button 4C is associated with selecting-relay $s3$.

In accordance with this arrangement, during downward movement of the car, and assuming car-button 1C has been operated, car-stopping-relay 29 is energized when selecting-relay $s2$ is energized, which occurs when car C is approximately 1½ floors in advance of the first floor. Assuming car-button 2C has been operated, during upward movement of the car, relay 29 is actuated while the car is standing at the first floor; during downward movement, relay 29 is actuated when selecting-relay $s3$ is energized, which occurs when the car is approximately 1½ floors in advance of the second floor. Assuming car-button 3C has been operated, during upward movement of the car, relay 29 is actuated when the car is approximately 1½ floors below the third floor; during downward movement, relay 29 is actuated while the car is standing at the fourth floor. Assuming car-button 4C has been operated, relay 29 is actuated when the car is approximately 1½ floors below the fourth floor. The feature whereby car-stopping relay 29 may be actuated, in response to intermedate floor calls, through either of two selecting relays, depending upon the direction of travel, is provided by additional contact members h on direction-relays 22 and 23.

Since, as described in connection with Figs. 2 and 3, relay 29 functions only to prepare switches HI and SI for operation, the point of actual slow-down being determined by the position of the magnetizable plates HU, it follows that the arrangement shown in Fig. 4 is suitable for use in any system in which the slow-down distance is more than half the distance between adjacent floors and less than 1½ times the distance between adjacent floors.

It will be understood that the types of control circuits described in the present application, which include those associated with the hall-lanterns, position-indicating mechanism, car-stopping and call-cancellation apparatus, are illustrative only, and that the novel selecting mechanism of the present invention may be utilized to commutate any desired control circuit in accordance with the position of the car in the hatchway. It will also be understood that while, in the present application, the transfer point between adjacent zones has been described as being located approximately midway between adjacent floors, that such transfer-points may be located at any desired points in the hatchway, either at equal or unequal intervals. Similarly, although a single set of selecting-relays is described as being arranged to control a plurality of different types of control operations, it will be understood that a separate series of selecting-relays may be associated with each class of control operation. It will also be understood that the novel selecting mechanism of the present invention may be used in elevator systems of a different type than the disclosed system, and that the structure of the floor-selecting mechanism may be modified in various ways.

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

I claim as my invention:

1. In an electric elevator system for operating an elevator car in a hatchway, a plurality of circuit controlling devices for controlling circuits in said system, a switch comprising a pair of cooperating contact members common to all of said devices, means responsive to car position for causing an operation of said switch when said car reaches each of a plurality of predetermined points in said hatchway, and means responsive to the operation of said switch at predetermined points for sequentially operating said devices.

2. In an electric elevator system for operating an elevator car in a hatchway, a plurality of circuit controlling devices for controlling circuits in said systems, a switch comprising a pair of cooperating contact members common to all of said devices, means responsive to car position to cause an operation of said switch when said car reaches each of a plurality of predetermined points in said hatchway, and means including circuit connections and responsive to said repeated operations of said switch for sequentially operating said devices.

3. In an electric elevator system for operating an elevator car in a hatchway in upward and downward directions, a plurality of circuit controlling devices for controlling circuits in said system, a switch comprising a pair of cooperating contact members common to all of said devices, means responsive to movement of the car for repeatedly operating said switch, means including circuit connections and responsive to said repeated operation of said switch for sequentially operating said devices, means responsive to upward travel of the car for causing the sequential operation to occur in one order and means responsive to downward travel of the car for causing the sequential operation to occur in another order.

4. In an electric elevator system, an elevator car operable in a hatchway past a plurality of landings, a circuit controlling device individual to each of said floor landings for controlling a circuit in said system, each of said devices being disposed to assume normal and operated conditions, a switch common to all of said devices, means responsive to operation of the car through a plurality of zones for effecting repeated operations of said switch, and means responsive to operation of said switch for maintaining in an operated condition the device associated with a floor while the car is in a predetermined zone corresponding to that floor.

5. In an electric elevator system, an elevator car operable in a hatchway past a plurality of landings, a circuit controlling device associated with each of said landings, each of said devices being disposed to assume a normal and an operated condition, a switch common to all of said devices, zone defining means including means to effect one operation of said switch when said car enters a predetermined zone associated with any of said floors and to effect a second operation of said switch when said car leaves said predetermined zone, and means comprising circuit connections to cause the device associated with any of said floors to assume said operated condition in response to said first operation of said switch and to asume said normal condition in response to said second operation of said switch.

6. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, control means for said devices including means defining a plurality of adjacent zones in said hatchway, each of said zones being individual to one of said devices, and means responsive to car position to cause the device associated with any of said zones to assume said operated condition upon the entrance of said car into that zone, and to cause that device to assume said normal condition upon the exit of said car from that zone.

7. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, control means for said devices including means defining a plurality of adjacent zones in said hatchway, each of said zones being individual to one of said devices, and means responsive to car position to cause the device associated with any of said zones to assume said operated condition upon the entrance of said car into that zone, and additional means responsive to car position to cause that device to assume said normal condition upon the exit of said car from that zone.

8. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, control means for said devices including means defining a plurality of adjacent zones in said hatchway, each of said zones being individual to one of said devices, and position-responsive means including a first element to cause the device associated with

any of said zones to assume the operated condition upon the entrance of said car into that zone, a second element to cause that device to assume said normal condition upon the exit of said car from that zone and an element responsive to car position for controlling both of said first and second elements.

9. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, control means for said devices comprising a control element common to all of said devices, means defining a plurality of adjacent zones in said hatchway, each of said zones being individual to one of said devices, said zone defining means being effective to cause operation of said common control element upon the arrival of said car at the junction between any two zones, and means responsive to operation of said element upon the entrance of said car into any of said zones to cause the associated device to assume said operated condition, and responsive to the operation of said element upon the exit of said car from that zone to cause that device to assume said normal condition.

10. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, control means for said devices comprising a control element common to all of said devices, means defining a plurality of adjacent zones in said hatchway, each of said zones being individual to one of said devices, said zone defining means being effective to cause operation of said common control element upon the arrival of said car at the junction between any two zones, and means responsive to operation of said element upon the entrance of said car into any of said zones to cause the associated device to assume said operated condition, and additional means responsive to operation of said element upon the exit of said car from that zone to cause that device to assume said normal condition.

11. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume an operated and a normal condition, control means for said devices including an element operable in accordance with car-position, and means rendered effective upon each operation of said element to cause one of said devices to assume said operated condition and to cause another of said devices to assume said normal condition.

12. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume an operated and a normal condition, control means for said devices including an element operable in accordance with car position, said element being common to all of said devices, and means responsive to each operation of said element to cause one of said devices to assume said operated condition and to cause another of said devices to assume said normal condition.

13. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, means for sequentially controlling said devices including an element operable in accordance with car position, and means responsive to each operation of said element to cause one of said devices to assume said operated condition and to cause another of said devices to assume said normal condition.

14. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, means for sequentially controlling said devices including an element repeatedly operable in accordance with car position, said element being common to all of said devices, and means responsive to each operation of said element to cause one of said devices to assume said normal condition and to cause another of said devices to assume said operated condition.

15. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume an operated and a normal condition, control means for said devices including an element operable in accordance with car-position, means rendered effective upon each operation of said element to cause one of said devices to assume said normal condition and to cause one of the remainder of said devices to assume said operated condition, and means including direction-controlled means for selecting said last-mentioned one of said devices.

16. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume an operated and a normal condition, control means for said devices including an element operable in accordance with car-position, means rendered effective upon each operation of said element to cause one of said devices to assume said normal condition and to cause one of the remainder of said devices to assume said operated condition, and means including means controlled by said first-mentioned one of said devices for selecting said last-mentioned one of said devices.

17. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, control means for said devices comprising means dividing said hatchway into predetermined adjacent zones, each of said zones being individual to one of said devices, and means rendered effective when said car reaches the junction between any two adjacent zones to cause the device associated with the preceding zone to assume said normal condition and to cause the device associated with the succeeding zone to assume said operated condition.

18. In an electric elevator system, an elevator car operable in a hatchway, a plurality of circuit controlling devices associated with said system, each of said devices being disposed to assume a normal and an operated condition, and control means for said devices comprising an element common to all of said devices, means defining a plurality of adjacent zones in said hatchway, each of said zones being individual to one of said devices, said zone defining means being effective to cause operation of said common element upon the arrival of said car at the

junction between any two adjacent zones, and means responsive to operation of said common element to cause the device associated with the preceding zone to assume said normal condition and to cause the device associated with the succeeding zone to assume said operated condition.

19. In an electric elevator system, an elevator car operable in a hatchway, signalling means associated with said system, and control means for said signalling means including a plurality of circuit controlling devices, a switch comprising a pair of cooperating contact members common to all of said devices, means for repeatedly operating said switch in accordance with car position, and means including circuit connections to render said devices sequentially responsive, one at a time, to said repeated operations of said switch.

20. In an electric elevator system, an elevator car operable in a hatchway past a plurality of landings, signalling means individual to each of said landings and circuits therefore, and means to commutate said circuits comprising a circuit controlling device individual to each of said circuits, a switch comprising a pair of cooperating contact members common to all of said devices, means responsive to car position to cause an operation of said switch at each of a plurality of points located, respectively, at predetermined distances in advance of said landings, and means including circuit connections responsive to an operation of said switch at any of said points to cause operation of the circuit controlling device associated with the corresponding landing.

21. In an elevator control system, an elevator car operable in a hatchway past a plurality of landings, control means for said car including stopping mechanism, circuits for said stopping mechanism and means to commutate said circuits in accordance with the position of said car with respect to said landings, said commutating means including a plurality of circuit controlling devices, associated respectively, with said landings, a switch comprising a pair of cooperating contact members common to all of said devices, means responsive to car position to cause an operation of said switch at each of a plurality of points located, respectively, at predetermined distances in advance of said landings, and means including circuit connections responsive to an operation of said switch at any of said points to cause operation of the device associated with the corresponding landing.

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