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Yeasting

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[54] **ELEVATOR CONTROL**

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[21] Appl. No.: **300,704**

Related U.S. Application Data

[63] Continuation of Ser. No. 622,877, Feb. 7, 1967, abandoned, which is a continuation of Ser. No. 14,074, March 10, 1960, abandoned.

[52] **U.S. Cl.** **187/29**; 187/29

[51] **Int. Cl.** **B66b 1/20**

[58] **Field of Search** 187/29

[56] **References Cited**

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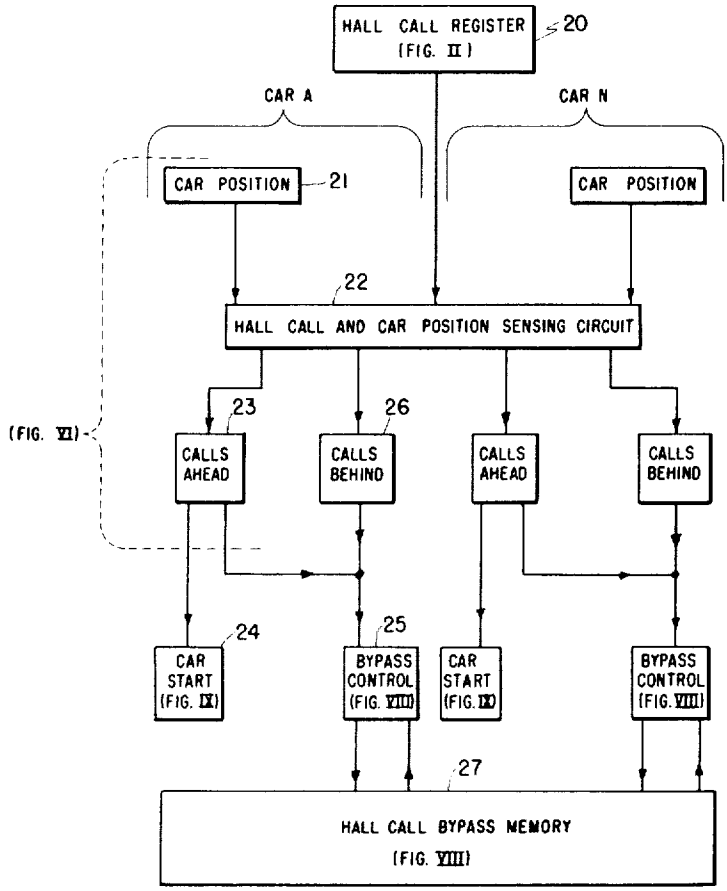
Primary Examiner—T. E. Lynch

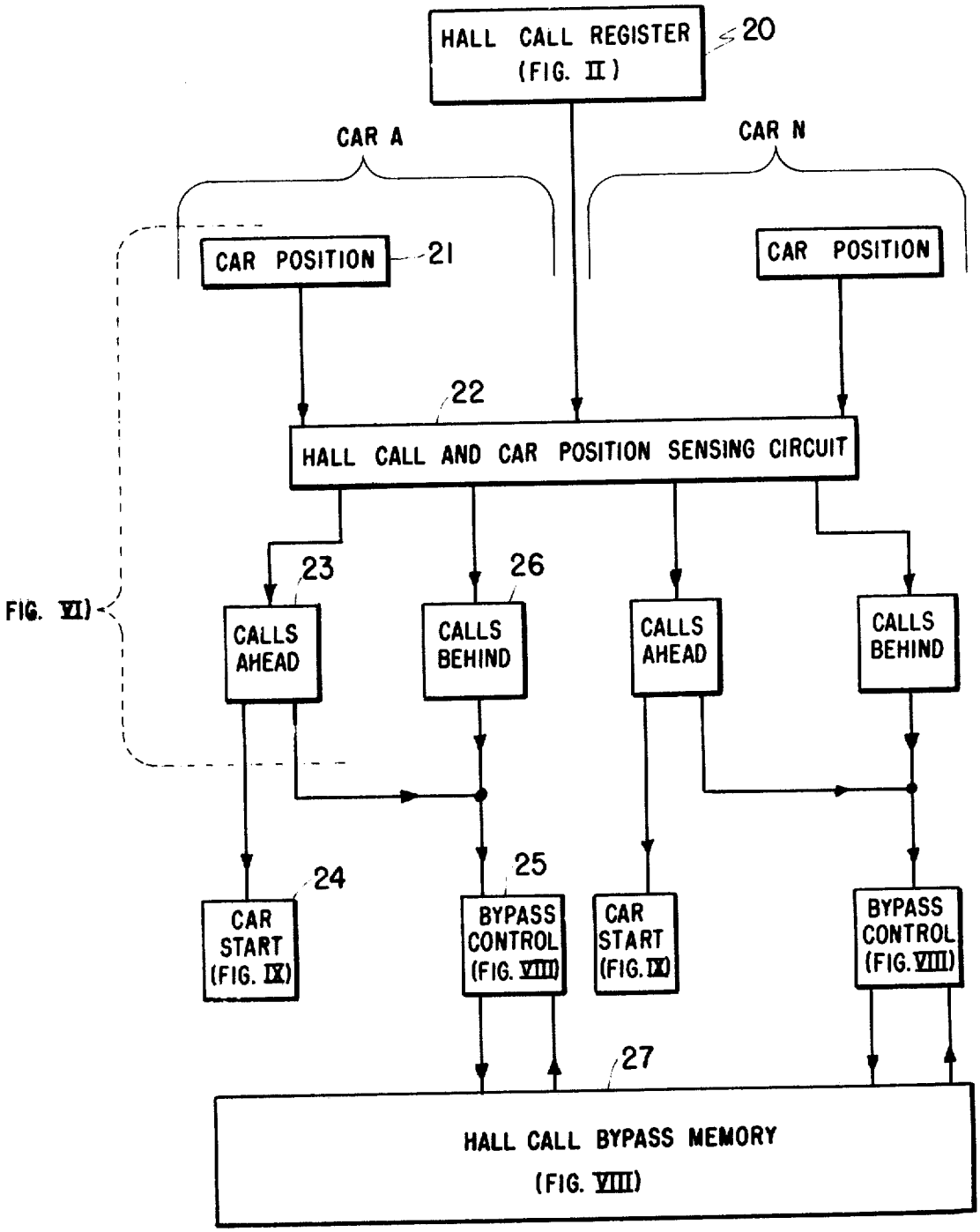
Attorney, Agent, or Firm—David H. Wilson

[57] **ABSTRACT**

A group supervisory control for a plural car elevator system in which the spacing between elevator cars is maintained by selectively bypassing hall calls for individual cars when the number of calls between a car and the next preceding car exceeds the number of calls between the car and the next following car. Calls can be bypassed once. When no calls are in registration cars set to ascend remain at the floor at which the last provided service and can be restarted to respond to a hall call for a floor extending to the next car above and the next car below. Cars set to descend run to a lower terminal floor even when no call requires such travel. Absence of a car at a lobby floor calls a car to that floor unless a car is set to travel downward. When two or more cars are at the lobby all but one car is sent upward from the lobby. Each car sent from the lobby is parked at a floor at which no other car is parked. The parking floors are spaced so that a car will be parked in proximity to the floor of any registered hall call and can be started to promptly serve that floor.

26 Claims, 10 Drawing Figures





Fig_I

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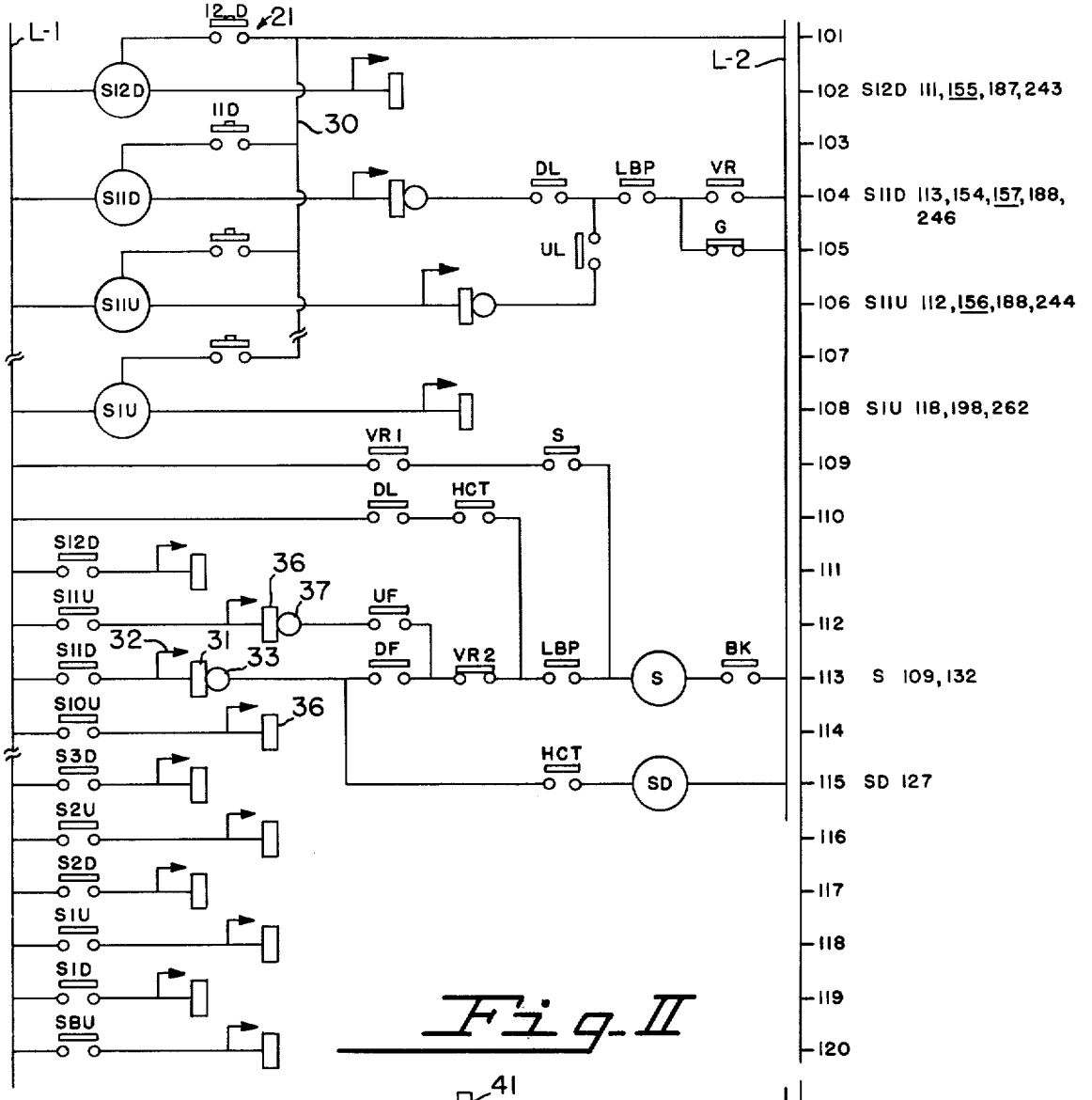


Fig. II

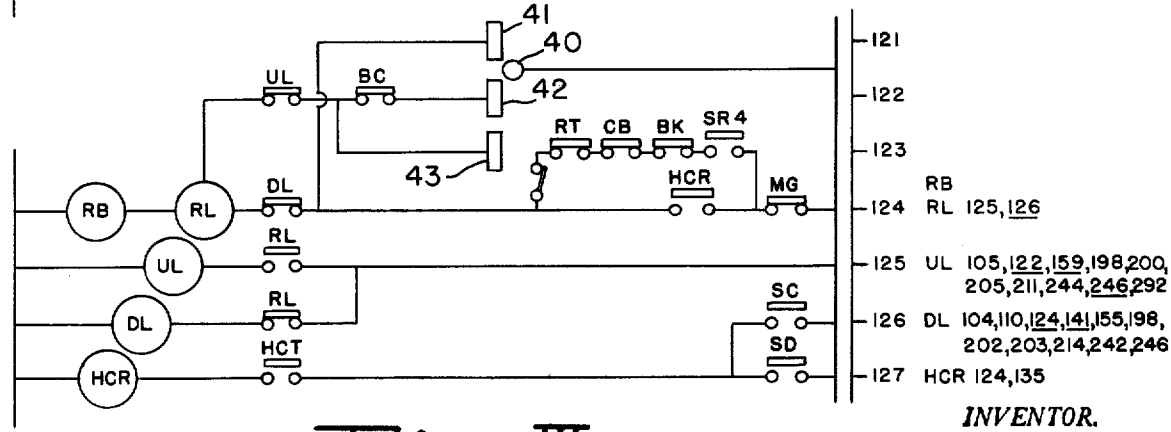


Fig. III

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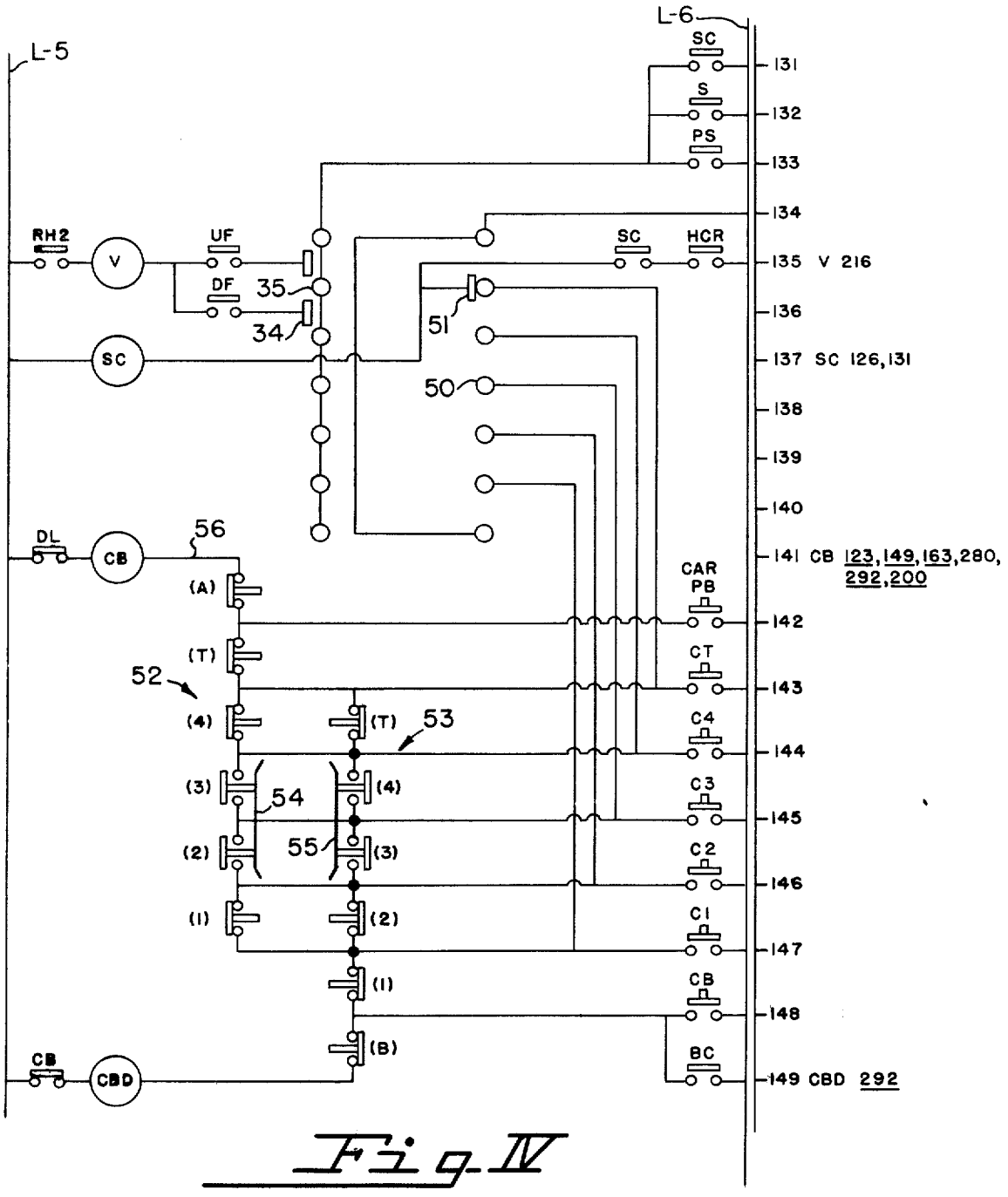


Fig. IV

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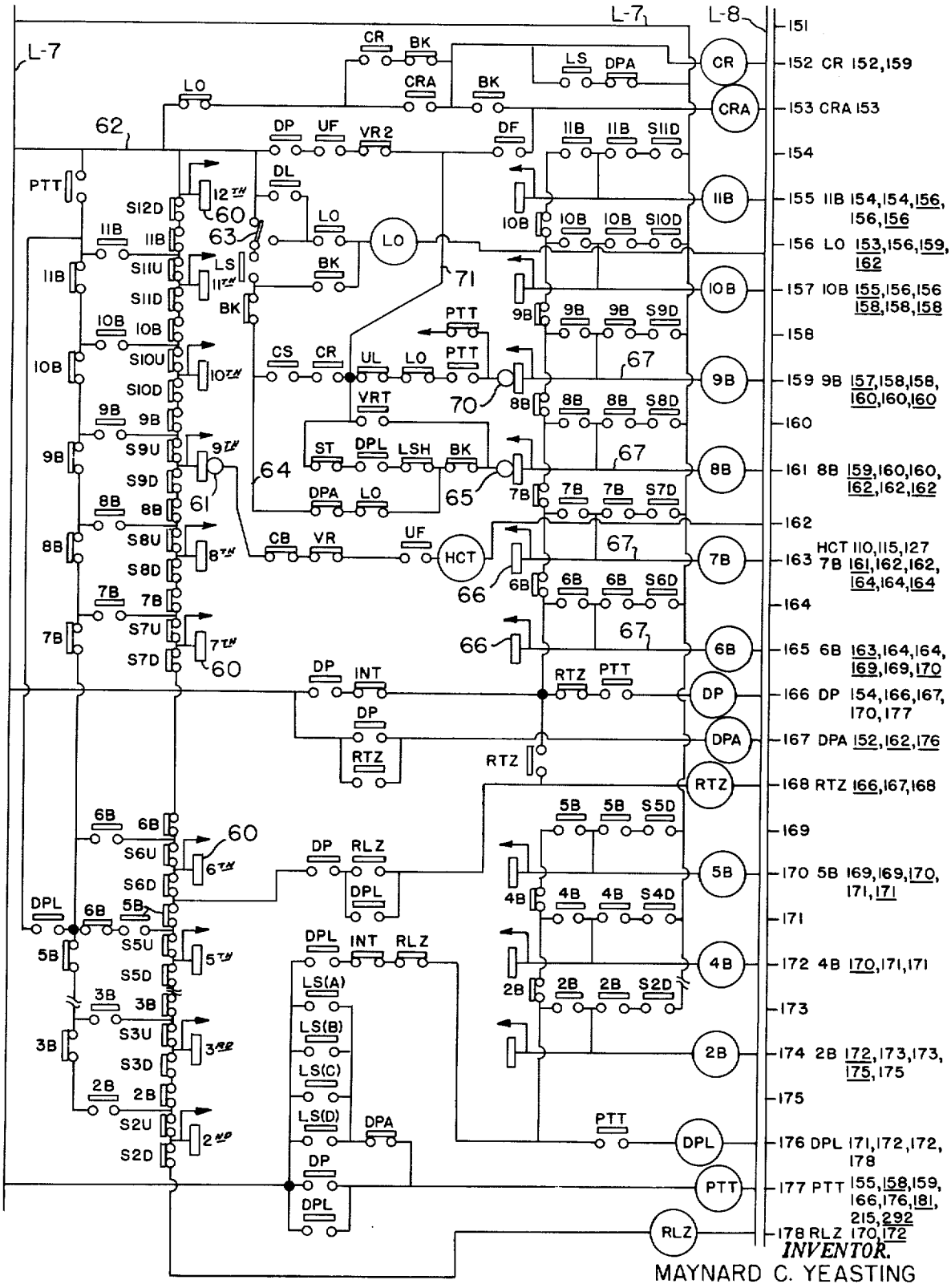


Fig V

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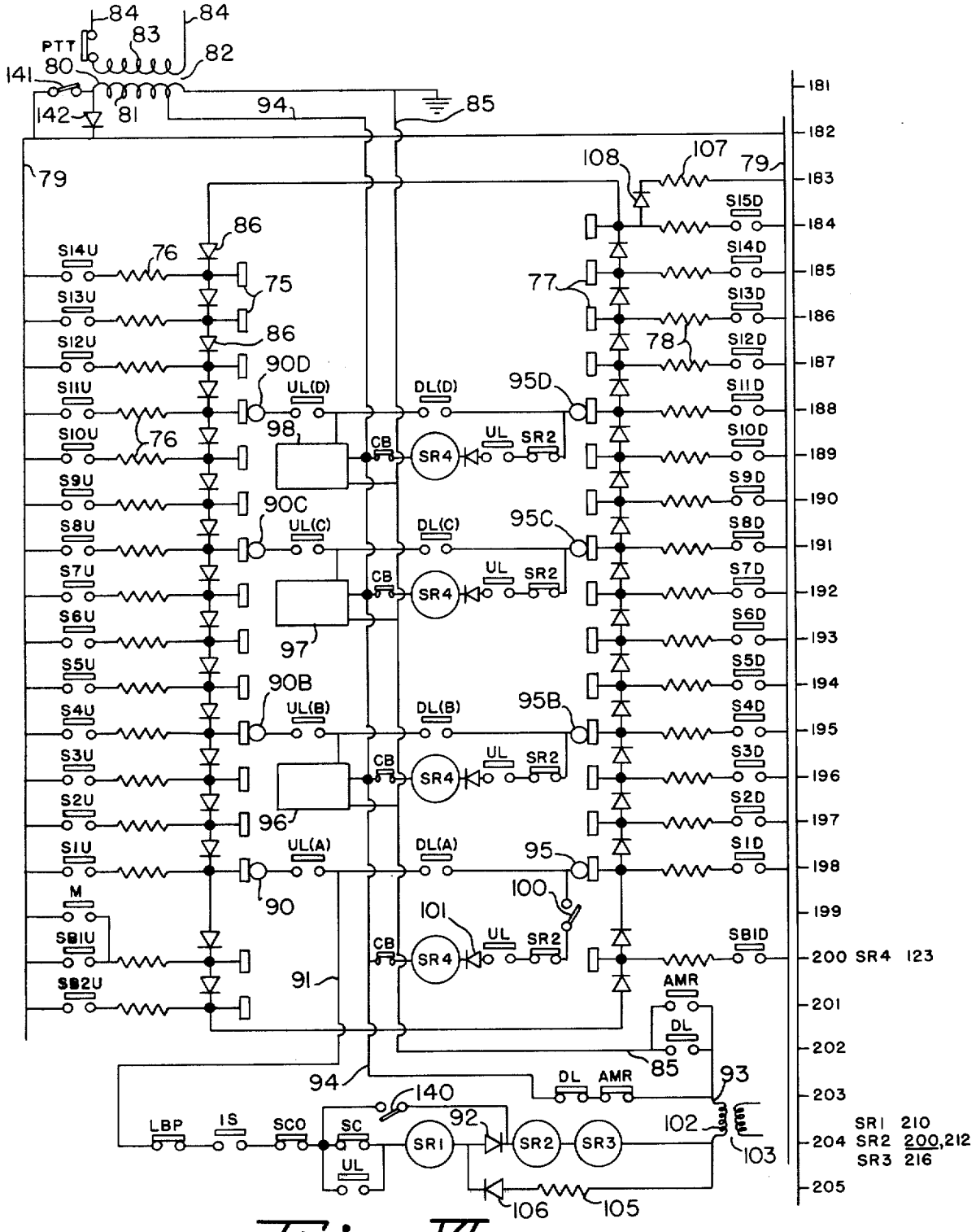


Fig. VI

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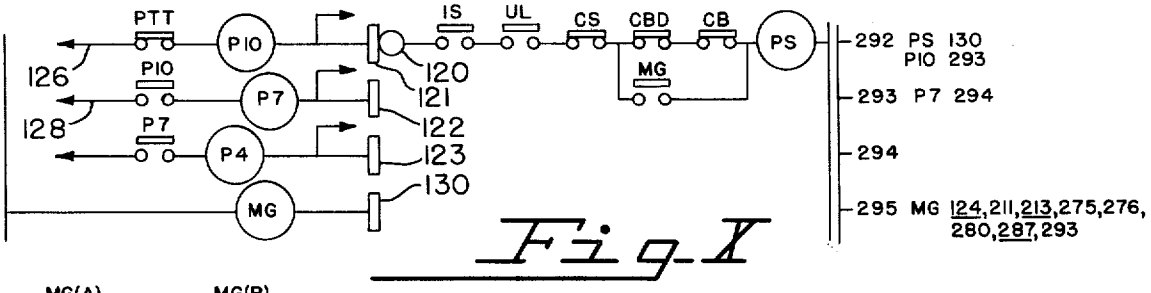


Fig. X

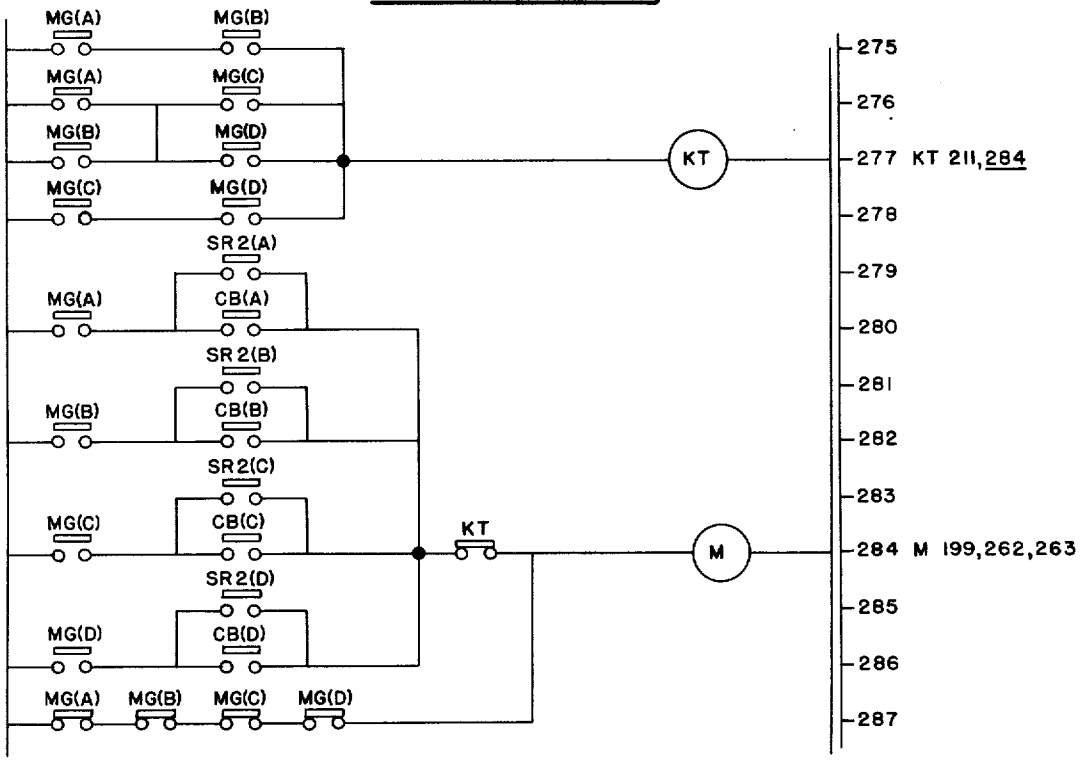


Fig. IX

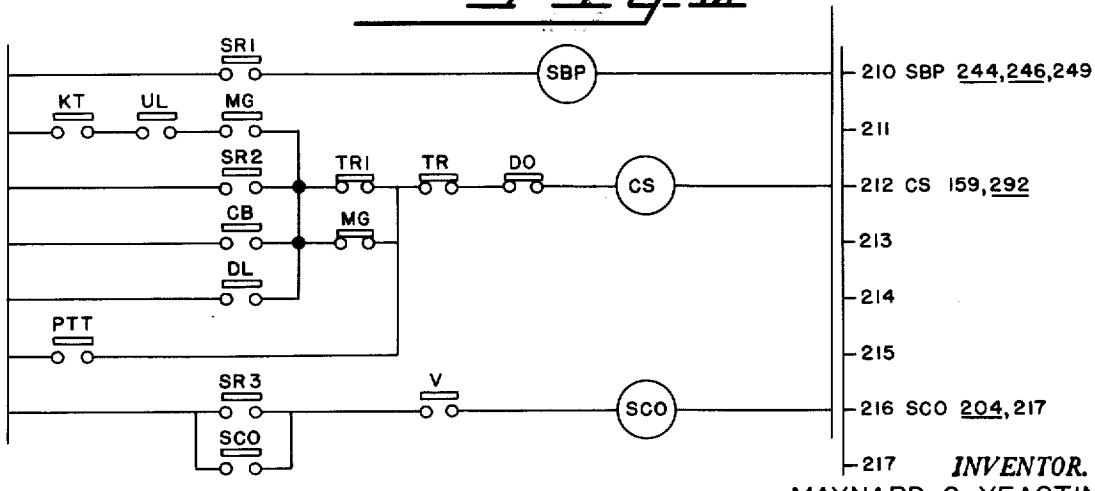


Fig. VII

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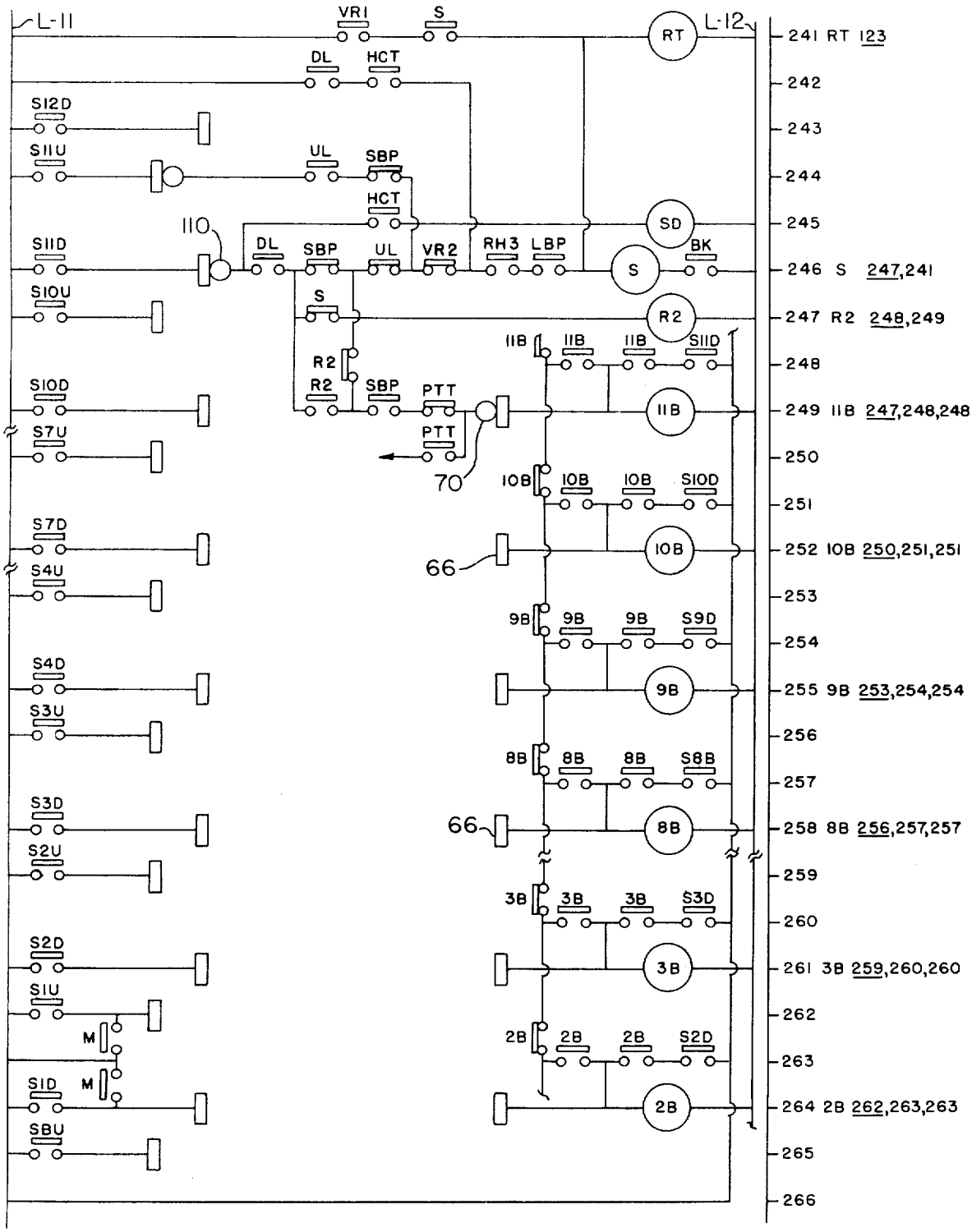


Fig. VIII

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ELEVATOR CONTROL

This application is a continuation of application Ser. No. 622,877 which was filed Feb. 7, 1967, entitled "Elevator Control Which Measures The Difference Between Calls Ahead And Behind A Car To Control Call Bypassing," now abandoned, and which was a continuation of application Ser. No. 14,074 which was filed Mar. 10, 1960, entitled "Elevator Control," now abandoned.

This invention relates to automatic passenger elevators and in particular to a supervisory control that is continuously responsive to registered hall calls and car positions for distributing the elevator service among the registered calls in a manner to minimize both the maximum and average waiting time of prospective passengers.

When a group of elevators serve a plurality of floors, and no supervisory control is exercised over the elevators, they invariably tend to collect into a bunch and follow each other closely with a large time interval occurring between the passage of the last car of the bunch and the arrival of the first car on the next round trip. This bunching occurs because, in normal operation, the first car to arrive or approach a hall call stops to answer that call. While it is answering the call the next following car, if following closely, passes the first car and answers the next call in the normal sequence of floors, Thus, the leading car is always delayed by answering hall calls and each of the cars therefore becomes the leading car as it overtakes the just previous leading car while it is answering a call. In order to correct this difficulty, many dispatching schemes have been proposed and used which, in effect, hold the cars at some particular point in their travel, usually the lobby floor, and permit the cars to leave at regular intervals of time. Traffic sensing mechanism is often included with such dispatching means to alter the interval of time according to the traffic demand on the system. In such a system the ideal dispatching interval is equal to the average round-trip time of a car divided by the number of cars in service. While dispatching systems are better than no supervisory control at all, they still leave much to be desired because of the complexity of equipment required to keep the dispatching time intervals properly adjusted to the traffic demands.

The principal object of this invention is to provide a supervisory control system for a group of elevators which continually monitors the demand for service in relation to the position of the various cars and coordinates the movements of the cars with respect to the signals to divide the traffic load as evenly as possible among the various cars of the system and to maintain the cars, as far as possible, in position to give prompt service to any traffic calls that may arise.

Another object of the invention is to provide means for causing cars about to be overtaken by following cars to by-pass sufficient hall calls to maintain an approximately uniform time spacing between the various cars of the system.

A still further object of the invention is to provide control means so that a hall call may not be successively by-passed by the various cars in attempting to maintain spacing.

A still further object of the invention is to provide means for preventing the elevator cars from accumulating at a particular floor, such as a lobby floor, and of locating the idle cars in positions from which they may promptly answer calls for service.

A further object of the invention is to provide simplified reliable circuits for the supervisory control system for a group of elevators.

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

According to the invention the supervisory control system comprises a sensing circuit that corresponds to the path of the elevator cars, which sensing circuit is energized at points corresponding to the various calls for service and which is effectively grounded or divided at points corresponding to the positions of cars that are in service and available for answering calls. Means individual to each car co-operate with the sensing circuit to indicate, for each car the existence of a call requiring service, the number of calls in the zone between the car and the next car ahead and the difference between that number and the number of calls in the zone between the car and the next following car. These calls may be real or simulated. The latter are used principally to simulate a number of calls behind the highest car or the last car to pass a certain position so that such car will not by-pass actual calls in attempting to maintain its spacing relative to the other cars.

In a system of elevator operating under a supervisory control according to the invention, each of the cars remains at the floor it reached in serving its last call requiring up travel until there is another call for service that may best be answered by that car. If such next call requires down travel the car answers the call and proceeds to the lobby answering any further down calls on the way. If this results in two cars stopping at the lobby floor, one of the cars is sent away after a brief time interval even though there is no call for service requiring movement of that car. Such a car travels upwardly until it reaches the highest unoccupied one of what may be called parking stations or parking floors that are distributed throughout the building in accordance with expected traffic demands. The idle cars, i.e., those that are not responding to or serving a call, are each responsive to calls that occur between it and the next adjacent higher or lower car in the system. Furthermore, to avoid the requirement that an intending passenger desiring to travel to the lobby be required to press a lobby button upon entering a car, the cars are arranged so that when they are conditioned for downward travel they automatically travel to the lobby floor.

The accompanying drawings illustrate an elevator system including the supervisory circuits and circuits individual to each car co-operating with the supervisory circuits for providing the improved type of operation.

In the drawings:

FIG. I is a block diagram setting forth the relationship of the salient functions of the elevator control of this invention.

FIG. II is a schematic diagram illustrating the circuits for registering hall calls and the circuit individual to each car for sensing and responding to the hall calls.

FIG. III is a circuit diagram of those portions of the circuit individual to each car for causing the car to reverse its directional relays and thus its direction of travel under certain conditions.

FIG. IV is a schematic wiring diagram of those portions of the circuit individual to each car for registering

car calls and for responding to car and hall calls in actually stopping the car at a floor.

FIG. V is a wiring diagram of those circuits effective during peak traffic conditions for regulating the order in which calls for service are answered.

FIG. VI is a schematic wiring diagram illustrating the sensing circuit that is responsive to hall calls and car positions for controlling the response of the elevator cars to calls for service.

FIG. VII is a wiring diagram of the circuits for each car that are auxiliary to the circuit shown in FIG. VI.

FIG. VIII is a diagram of stopping circuits for the individual elevators modified to prevent successive bypassing of calls.

FIG. IX is a circuit diagram of those circuits effective at the lobby for regulating the number of cars at the lobby and for calling another car to the lobby as the lobby car receives a call.

FIG. X is a circuit diagram including portions common to all of the cars and portions individual to each car for providing stopping signals for up-traveling cars under certain conditions.

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

Referring to FIG. I, the improved supervisory control for preventing "bunching" of the cars and maintaining substantially equal travel times between the cars comprises several cooperating circuits. In this system hall calls are registered, by operation of push-buttons at the landings, in a hall call register **20**. Signals corresponding to each of the hall calls together with signals indicating the position of each car, sensed by means **21** individual to the car, are transmitted from the register **20** and means **21** to a hall call and car position sensing circuit **22** (detailed in FIG. VI) that correlates the number of hall calls and their locations with the positions of the elevator cars available to serve the calls. The sensing circuit **22** issues signals to each car corresponding to the number of hall calls registered at floors located between the car and the next preceding car (calls ahead) and between the car and the next following car (calls behind). A signal corresponding to the number of hall calls from floors between the car and the next preceding car, i.e., the calls ahead, is transmitted through means **23** to a car start circuit **24** and to a bypass control **25**. The car is thus started whenever there is a call ahead of it. Simultaneously, a signal corresponding to the number of hall calls from floors between the car and the next following car, i.e., calls behind, is transmitted through means **26** to the bypass control **25**. The bypass control **25** responds to the excess of the number of calls ahead over the number of calls behind and causes the car to bypass hall calls until the excess is reduced to not more than one call.

In order to prevent successive bypassing of a hall call the bypass control **25** is arranged so that a signal is stored in a bypass memory **27** whenever a hall call is bypassed by a car in response to excess calls ahead. The bypass control for each car is also disabled by the memory **27** whenever the car approaches a previously bypassed car so that it stops in response to the call.

In the wiring diagrams the relays are given letter designations which under certain circumstances may also include a number. For example, those relays which are repeated for each floor of the building have designations which include the number of the corresponding floor. Certain relays which operate in sequence may also include numbers as part of the designation. Furthermore, since there can be no confusion between the symbols for contacts and the symbols for operating coils, the contacts operated by a given coil are given the same reference characters as the coil. The contacts operated by the coils are listed in a code along the right side of the Figures in line with the operating coils. An underscored line number indicates that the corresponding contacts are closed when the coil is de-energized.

The relays or relay contacts appearing in the drawings are as follows:

AMR	Motor
BC	Basement Call
BK	Brake
CB	Car Call Above
CBD	Car Call Below
CR	Ceiling Reset
CRA	Ceiling Reset Auxiliary
CS	Car Start
DF	Down Field
DL	Down Direction
DO	Door Opening
DP	Down Peak
DPA	Down Peak Auxiliary
DPL	Down Peak Low Zone
G	Gate
HCR	High Call Reverse
HCT	High Call Timer
INT	Intermittent Program
IS	In Service
KT	Car Count
LBP	Load By Pass
LO	Lock Out
LS	Load Switch
LSH	Load Switch - Half load
M	Lobby Call
HG	Lobby Floor
PS	Parking Stop
PTT	Peak Traffic Timer
P4	Fourth Floor Stopping
P7	Seventh Floor Stopping
P10	Tenth Floor Stopping
RB	Car Button Reset
RL	Reverse Latch
RLZ	Reset Low Zone Memory
RT	Reverse Timer
RTZ	Reset Top Zone Memory
R2	Memory Sequence
S	Stopping Relay - Hall Calls
SBP	Spacing By Pass
SC	Stopping Relay - Car Calls
SCO	Sensing Cut Out
SD	High Down Call Stop
SR1	Sensing Relay No. 1
SR2	Sensing Relay No. 2
SR3	Sensing Relay No. 3
SR4	Sensing Relay No. 4
ST	Maximum Stop Time
S-D	Down Hall Call
S-U	Up Hall Call
TR	Minimum Start Timer
TR1	Lobby Minimum Start Timer
UF	Up Field
UL	Up Direction
V, VR1, VR2, VRT	Stopping Sequence

FIGS. II and III

Circuits for registering hall calls and for initiating stops in response to hall calls are illustrated in FIG. II. These circuits include hall call relays S1U, S11U, S11D, S12D that are representative of the hall call storing relays, there being one for each terminal floor and two for each intermediate floor. These relays are of the mechanical or magnetic latch type and are arranged to be operated to an "energized" condition to close their normally open contacts whenever a corresponding hall button **21** is pressed and to be unlatched or reset when the call is answered. Thus, an intending passenger at the eleventh floor desiring down transportation presses

the down hall button 21 at the 11th floor. This action closes contacts marked 11D in line 103 so as to energize hall call relay S11D by current flow from a supply lead L-1 through the energizing coil of the relay S11D in line 104, through the now manually closed contacts 11D in line 103 and thence through a lead 30 connected to a return line L-2. As soon as a floor or hall call relay is energized it closes its corresponding contacts appearing along the left lower portion of FIG. II as well as opening or closing its contacts appearing in the supervisory circuits of FIGS. V, VI, and VIII.

The closure of the contacts S11D in line 113 prepares a circuit to selector machine segments 31, there being one for each elevator as indicated by the arrows 32, which co-operate with selector machine down stop brushes 33 so that when the selector machine brush 33 of a down traveling car contacts the energized segment 31 current may flow from the lead L-1 through the brush 33, down field contacts DF, normally closed stopping sequence relay contacts VR2, load by-pass contacts LBP, coil S of the stopping relay, and normally open but now closed brake relay contacts BK to return lead L2. The load by-pass contacts LBP open when the car becomes loaded. The stopping relay S, by closing its contacts in line 132 of FIG. IV, prepares a circuit to energize stopping relay V as soon as a down stopping brush 34 contacts the corresponding now energized selector machine segment 35 as the selector machine moves its brushes toward a position corresponding to the eleventh floor. Energization of the stopping relay V starts a relay sequence which includes operation of relays VR, VR1, and VR2. Relay VR1, by closing its contacts in line 109, completes a holding circuit for the now energized stopping relay S. Stopping relay VR, included in this chain of stopping sequence relays by closing its contacts in line 104, completes a circuit to the reset coil of the eleventh floor down hall call relay S11D by way of the contacts appearing in line 104 thus resetting the relay to its unenergized or de-energized condition. This is the indication that the call has been answered.

Simultaneously the stopping sequence relay VR2 by opening its contacts in line 113 prevents any feedback of power from the lead L-1 by way of the holding circuit contacts VR1 and S in line 109 to the brush 33 so as to continue the energization of the down stopping selector machine segments 31 for other elevators which would stop any other down traveling cars if they approached the eleventh floor while the first car was decelerating to its stop. Thus, unless two cars are running exactly abreast, only the first car to receive the signal will stop at the corresponding floor.

Similar operation for up hall calls is provided by the up hall call storing relays S-U and corresponding stopping circuits including selector machine segments 36 for the various floors which cooperate with selector machine brush 37.

If the car be traveling up and is approaching the highest hall call and has no higher car call to be answered, its high call timer relay HCT is energized so as to close its contact in lines 110, 115, and 127 and supposing the high call is a down call registered at the eleventh floor the car will, upon approaching the eleventh floor, have its high down call relay SD, line 115, energized which relay then completes a circuit in line 127 of FIG. III to energize a high call reverse relay HCR which in turn closes its contacts in line 124 to reset a reversing latch relay RL for the down direction. This direction relay thereupon closes its contacts in line 126 and opens its contacts in line 125 to de-energize the up direction relay UL and energize the down direction relay DL. Energization of the latter relay causes it to close its contacts in line 110 which in combination with the now closed high call timer relay contacts HCT completes a circuit to the stopping relay S so that the car then stops at the eleventh floor conditioned for down travel. FIG. III also shows the circuits for reversing the direction relays to the down direction whenever a selector machine brush 40 contacts a top floor selector machine segment 41 and also provides for reversing the direction relays for up travel whenever the brush 40 contacts a segment 42 corresponding to the lobby floor provided no basement call is registered or when the car reaches a basement floor and contacts the corresponding segment 43. The direction relays may also be reversesd from up to down under certain conditions sensed by the supervisory circuit which result in the closure of the series of contacts in line 123 to shunt contacts HCR in line 124. The circuits operating these contacts are discussed in connection with FIG. VI, VII, and VIII. Contacts SC, line 126, of the car call stopping circuits provide for reversal of the directional relays if the car is stopping for a car call and has no calls for service requiring further upward travel.

FIG. IV

The circuits for registering car calls, i.e., destination calls, and the circuits for providing car response to such calls are shown in FIG. IV. Car calls or destination calls are registered on push buttons appearing along the right side of FIG. IV at lines 142 to 148 inclusive. These push buttons are magnetically latched in contact closing position when they are manually pressed and they are held in contact closing position until the car reverses at which time the electromagnetic coils holding them closed are momentarily de-energized by energization of the car button reset relay RB shown in line 124 of FIG. III. These push buttons when energized or depressed complete circuits to selector machine segments 50, one for each floor, that co-operate with a selector machine brush 51 to energize a car stop relay SC at line 137 whenever the car approaches a position corresponding to a depressed car button. On a non-reversing stop in response to a car call the car stop relay SC remains energized until the car leaves that floor as it proceeds to the next floor. However, on a reversing stop in response to the highest car call, the car push buttons are released as the directional latch relay RL is energized thus de-energizing the selector machine segments 50. However, in this condition the car stop relay SC is held in for a brief interval, long enough to ensure reliable operation of the associated relays in the stopping sequence, by a holding circuit comprising car stop relay contacts SC and high call reverse relay contacts HCR, in line 135. In this combination referring also to lines 126 and 127 of FIG. III it may be noted that the sealing or holding circuit for the car stop relay SC is maintained closed until the high call timer relay HCT opens its contacts in line 127 to drop out the high call reverse relay HCR.

The actual stopping of the car in response to a car call is the same as the stopping in response to a hall call except that relay contacts SC in line 131 operate instead of hall call stopping relay contacts S in line 132.

FIG. IV also shows the circuits for indicating for each car whether there is an unanswered car call for a floor above or below the car. For this purpose a series of cam-operated switches **52** and **53** operated by cams **54** and **55** of the selector machine are provided to connect the car button circuits to call above relay CB and call below relay CBD. The normally closed cam operated switches **52** provide a circuit from any energized car button for a floor above the car upwardly to a lead **56** that is connected through an operatng coil of a car call above relay CB and normally closed down directional relay contacts DL to a supply lead L-**5**. In a similar manner the second series of normally closed cam operated switches **53** provide a series circuit from the energized car buttons to the bottom or lowermost of such switches thence to an operating coil of a car call below relay CBD and through normally closed contacts CB of the car call above relay CB which are connected to the supply lead L-**5**. The cams **54** and **55** are arranged to open the cam operated switches at points in the circuits above and below the position then occupied by the car. Thus, if the car is located at the third floor the cam **54** is arranged to open the second and third switches of the series **52** thereby breaking the circuit from car buttons for floors at or below car position to the car call above relay CB while the cam **55** is arranged to operate the third and fourth switches of the series **53** to break the circuit from car buttons for floors at or above the car position to the car call below relay CBD. Two cams and two series of switches are ordinarily supplied so that any variations of floor spacing may be accommodated.

Supervisory Control for Various Traffic Conditions

The supervisory control circuits must operate under a wide variety of traffic conditions. These vary from a condition of intermittent traffic which occurs during the night or on holidays when calls for service may be widely spaced in time to the other extreme of peak traffic conditions when it is difficult to promptly serve all of the demands for service. The peak traffic demands may occur in an office building during the start of a business day, during the lunch hour, and during the close of the business day. During the start of the day, most of the traffic is up traffic from a lobby floor, during the noon hour it varies from a heavy down traffic or peak down traffic through heavy two way traffic to up peak traffic as the tenants leave for the lunch hour and return.

During up peak traffic conditions, the traffic may be handled expeditiously if the cars are returned to the lobby floor as soon as empty and if each car departs on its upward trip as soon as it is fully loaded or a call is registered and a reasonable time interval elapses, without the entrance of a passenger. During periods of heavy down traffic the circuits are arranged to remember the position at which a car acquires a full load or another car subsequently answers the highest remaining call below such position and to limit the service of available or idle cars to those floors below such remembered floors. During light and intermediate traffic demand intervals, the cars, when not actively answering a hall call or serving a car call, assume positions from which they may quickly answer any demands for service.

FIG. V

The supervisory control circuits that are operative during peak traffic conditions are illustrated in FIG. V. This circuit comprises of a series of memory relays **2B** through **11B** that are representative of memory relays supplied for each of the intermediate floors of the building. The operating coils of these relays are shown along the right side of FIG. V. Each of these relays has normally closed contacts that are included in, and other contacts that co-operate with, a series of normally-closed, series-connected contacts of the hall call relays arranged in what is usually called a high call reverse circuit. In this circuit the relay contacts corresponding to each intermediate floor include, in order from the relay contacts of the floor above, the normally closed memory relay contacts for that floor, normally closed up hall call relay contacts for that floor, and normally closed down hall call relay contacts for that floor. The top floor end of this circuit is continuously energized from supply lead L-**7**. The junction points between the normally closed up and down hall call relay contacts for each floor are connected to selector machine segments **60** that co-operate with a brush **61** to energize the brush **61** whenever there are no hall calls registered requiring travel to floors above and none of the memory relays for the floors above are energized. Other normally closed contacts of the memory relays connected in series are shown at the left of the high call reverse circuit in FIG. V and normally open memory relay contacts connect selected points of the latter series to the high call reverse circuit to energize selected points of that circuit during periods of peak traffic when contacts PTT at line **154** of a peak traffic timer are closed.

Whenever one of the memory relays is energized it, by opening its contacts in series in the high call reverse circuit, divides that circuit into an upper and lower segment. During periods of peak traffic when a peak traffic timer relay PTT is energized to close its contacts in line **154** the lower segment of the divided high call reverse circuit is then energized through the normally closed contacts of each of the higher memory relays and the normally open contacts of the now energized memory relay. The highest energized memory relay thus provides what may be called a "ceiling" since the lower segment of the high call reverse circuit controls the operation of the cars as if there were no hall calls registered above the floor corresponding to the energized memory relay.

These memory relays in co-operation with load switch contacts of the various cars and the high call reverse circuit provide a program of operation to meet up peak and down peak traffic conditions. The up peak traffic conditions are met by maintaining a high call reverse program and causing the cars to return to the lobby floor immediately upon discharging the last passenger of the preceding trip. The cars may answer down hall calls during their return to the lobby.

The down peak traffic is met by a down peak program which is instituted as soon as a car acquires a full load during its down trip. Having acquired a full load it energizes the ceiling relay for the next lower floor so that the next empty up traveling car, i.e. a car having no car calls registered for a higher floor stops and reverses at the highest call at or below the floor corresponding to the energized memory relay. As each remaining highest call at or below the floor at which a memory relay is energized is answered, the memory relay for the next lower floor is energized. This shifts

the "ceiling" downwardly as the calls are answered. This program of operation further provides that in the event the highest call at or below an energized memory relay is answered by a down traveling car the memory relay for that particular floor is re-energized if upon the departure of the car it is fully loaded and waiting intending passengers re-register a down call before the car actually leaves the floor. This feature provides that any stranded passengers will be promptly served by the next up car. This possibility of re-energizing a memory relay is confined to cars that answer the call during down travel rather than an up traveling car reversing at the call because the up traveling reversing car is presumed to be empty and thus capable of receiving a full passenger load whereas the down traveling car may have been nearly fully loaded and thus able to accommodate only two or three additional passengers.

This program of operation also provides that if a memory relay in a low zone of floors is enrgized each car for a limited time while it is serving a call at which a memory relay is energized suspends or cancels the operation of the high call reverse circuit for the next lower floor to permit up traveling cars to proceed upwardly past such floors. This prevents a concentration of service at the lower floors of the building when there is a memory relay energized for a floor in such low zone.

The circuits as illustrated in FIG. V to provide these programs to meet peak traffic conditions are arranged so that when a car acquires a full load it closes its load switch contacts LS shown near the center of the diagram in one of lines **173, 174, 175,** or **176** to energize peak traffic timer relay PTT shown at line **177.** This relay thereupon closes its contacts PTT in lines **155** and **166** of FIG. V, line **215** of FIG. VII and opens its normally closed contacts at line **181** of FIG. VI. Simultaneously, with this action the fully loaded car also closes its load switch contacts at line **157** to complete a circuit which may be traced from the supply lead L-7 through a lead **62,** manually operated switch **63,** normally open but now closed load switch contacts LS, normally closed brake relay contacts BK, lead **64,** normally closed contacts DPA of a down peak auxiliary relay DPA, normally closed contacts LO of a lock-out relay, and a second set of normally closed brake relay contacts BK so as to energize a brush **65.** The brush **65** co-operates with a series of selector machine contacts **66,** each of which is connected through a lead **67** and operating coil of a memory relay, to the return lead L8. The memory relay thus energized, shown as relay **8B,** closes its contacts **8B** to connect its lead **67** to a series of normally closed memory relay contacts for the relays for floors below and thence through reset timer contacts RTZ and now closed peak traffic timer relay contacts PTT, line **166,** to energize a down peak relay DP. this relay thereupon closes its contacts in line **166** to complete, in series with normally closed intermittent traffic program relay contacts INT, a sealing circuit to both the down peak relay DP and to the now energized memory relay **8B.** Simultaneously, the closure of down peak relay contacts in line **167** energizes the down peak auxiliary relay DPA which thereupon opens its contacts DPA in line **162** to prevent any subsequently loaded car from energizing a memory relay.

During this same time the first car, upon acquiring its full load, also closes its contacts LS, just below line **152,** which are in series with normally closed contacts of the down peak auxiliary relay DPA to briefly energize a ceiling reset relay CR shown at line **152.** Since this circuit is only completed momentarily during the relay sequence the ceiling reset relay CR is arranged to seal itself in through its own contacts and normally closed brake relay contacts appearing in line **152.** In the diagram it is assumed that the car is acquiring its full load at the ninth floor and is thereby establishing or energizing the eighth floor memory relay **8B.**

It is further assumed that since this is the first car to acquire a full load that it stopped at the ninth floor with a partial load and is able to accommodate only a few of the intending passengers waiting at that floor. As the loaded car prepares to leave the ninth floor it closes its car start relay contacts CS in line **159** so that current may flow from the lead **64** through the now closed car start contacts CS, ceiling reset relay contacts CR, normally closed up directional relay contacts UL, normally closed lock-out relay contacts LO, and peak traffic timer contacts PTT to energize a brush **70** which, in the position shown, co-operates with the selector machine segment **66** connected through its lead **67** to energize the ninth floor memory relay **9B.** If a stranded passenger re-registers a down call at the ninth floor before the loaded car starts and the brush **70** leaves the segment **66,** the ninth floor down hall call relay contacts S9D, line **158,** are closed to complete a holding circuit through the ninth floor memory relay contacts 9B, line **158,** to its lead **67** thus holding the ninth floor memory relay energized as the car leaves.

Since the memory relay **9B** is then the highest energized memory relay, it establishes the ninth floor as the top of the lower segment of the high call reverse circuit. This leaves the ninth floor memory relay energized through the ninth floor down hall call relay contacts and the eighth floor memory relay energized through the normally closed contacts of the lower memory relays and the down peak and intermittent program relay contacts appearing in line **166.**

As the car leaves the floor with a full load such that its load switch contacts LS are closed and its brake relay contacts BK are closed it energizes a lock-out relay LO appearing in line **156** which immediately seals itself into the supply lead **62** by way of down directional relay contacts DL in line **155** and its own contacts LO in line **156.** This relay also opens its contacts in lines **159** and **162** so that the loaded car is no longer able to energize any of the memory relays.

As the highest call at or below an energized memory relay is answered the memory relay for the next lower floor is energized provided the memory relay at the call being answered is the only or the lower one of the then energized memory relays. Thus, when a call registered by stranded passengers is answered, the memory relay for the floor below is not energized as a part of the answering operation. This energizing of a lower memory relay as calls are answered is equivalent to "sweeping" the ceiling down as the calls below the ceiling are cleared. The circuits accomplish this energization of a lower memory relay in slightly different manners depending upon whether the car is approaching the call from the upper or lower direction. To trace this operation assume first that the ninth floor memory relay **9B** was energized as the result of a call registered by stranded passengers and that the eight floor memory relay is also energized. As a higher car is traveling down its brush **65** is disconnected because both the normally

closed brake relay contacts in line **161** and the normally open stopping sequence time relay contacts VRT in line **160** are open. As the brush **70**, the higher of the two brushes, engages the seqment **66**, corresponding to the ninth floor memory relay, current flows from the ninth floor lead **67** in line **159** through the selector machine segment and brush **70** thence through peak traffic timer contacts PTT, lock-out relay contacts LO, the now closed up memory relay contacts UL, a lead **71**, now closed down field relay contacts DF in line **154** to energize the ceiling reset auxiliary relay CRA. Since the car is moving at this time its brake relay contacts BK in line **153** are closed so that the ceiling reset relay CRA by closing its contacts in line **153**, establishes a sealing circuit for itself as well as picking up or energizing the ceiling reset relay CR in line **152**. As the down traveling car stops for the ninth floor call by operation of the stopping circuits of FIG. II, it cancels the ninth floor down signal, thus de-energizing the ninth floor memory relay if there is a lower memory relay energized at that time. If there is a lower relay energized, nother further occurs in the memory relay system for this particular stop except that the ninth floor memory relay may again be re-energized if the car acquires a full load and stranded passengers re-register a call before the car leaves.

If the ninth floor memory relay **9B** had been the only relay in that zone that was energized, the cancellation of the ninth floor stopping signal would not de-energize the relay because it would still be energized through the sealing circuit connected to the holding circuit of the down peak relay DP. Therefore when the stopping sequence timer relay contacts VRT in line **160** close during the stopping sequence in answering the ninth floor call current flows from the ninth floor memory relay circuit lead **67** through the brush **70**, the contacts in line **159** and through the stopping sequence timer relay contacts VRT in line **160**, to the brush **65** to energize the eighth floor memory relay **8B**. As this relay is energized it opens its contacts in the sealing cirucit at line **160** to deenergize the ninth floor memory relay **9B**. The ninth floor relay remains energized by current feedback from the brush **65** to the brush **70** until the timer relay contacts VHT again open.

It may happen that the only energized memory relay in the zone is at the top of a group of floors at which no calls are registered. In that event, assuming that the car is approaching from a higher floor, its ceiling reset auxiliary relay CRA and ceiling reset relay CR are energized when the brush **70** contacts a segment **66** corresponding to the then energized memory relay. There being no call, the car proceeds downwardly and current is fed back from the holding circuit of the ceiling reset relays CR and CRA through the brush **70** to energize each of the memory relays in turn as the car proceeds down. This continues until the car reaches a floor at which a call is registered. Then as the call is answered and the car stopping sequence occurs, the next lower floor memory relay is energized and eventually, as part of the sequence, the memory relay at the floor at which the car is stopping is de-energized. Thus, the down traveling car sweeps the ceiling down past unoccupied floors.

It may be noted that the ceiling reset auxiliary relay CRA drops out whenever the car stops and that the ceiling reset relay CR drops out when the car starts. It may also be noted that these ceiling reset relays are effective only during the interval following the arrival of the car at a floor at which a memory relay is energized and until the car starts after the next succeeding step.

The response of the circuit if the car is traveling upward is slightly different. In this case it will be assumed that the eleventh floor memory relay is energized and that the highest call in registration is at the ninth floor, thus there being no demand for service above the ninth floor. Therefore, as the car is traveling up reaches the ninth floor segment **60** of the high call reverse circuit its brush **61** is energized for the first time since the ninth floor down hall call relay contacts S9D immediately below the connection to the ninth floor segment **60** are open. current now flows from the high call reverse circuit through the brush **61**, through no car calls above relay contact CB, normally closed stopping relay contacts VR and normally open but now closed up field relay contacts UF to energize a high call timer relay HCT in line **163**. Closure of the high call timer relay contacts HCT in line **115** of FIG. II energizes a high hall call relay SD so that both of these relays being energized a circuit is completed at line **127** to the high call reverse relay HCR. This relay thereupon closes its contacts in line **124** to reverse the directional relays RL, UL and DL. However, the car is still traveling up at this time so that its up field relay contacts are still closed. A circuit is now completed from the lead **62** in line **154** through down peak relay contacts DP, up field relay contacts UF, stopping sequence relay contacts VR2, lead **71**, normally closed up direction relay contacts UL, lock-out relay contacts LO, and peak traffic timer relay contacts PTT to energize the brush **70** and hence the memory relay **9B** for the ninth floor. As this relay opens its contacts **9B** in the sealing circuit just to the right of the segment **66** at line **157** it de-energizes the eleventh floor memory relay. The ninth floor memory relay **9B** also seals itself in through the sealing circuit so as to remain energized when the stopping sequence relay contacts VR2 in line **154** open as the car stops. It may be noted that the down field relay contacts DF, line **154**, are open at this time so that the ceiling reset auxiliary relay CRA cannot be energized. A normally closed leveling relay contact may be included in series between the lead **71** and the down field relay contacts DF to prevent energization of the ceiling reset relay CRA if the car overshoots the floor and relevels. A moment later during the stopping sequence, when contacts VRT in line **160** close, the circuit is completed from the brush **70** to the brush **65** so that current may flow from the ninth floor memory relay sealing circuit through the brushes to the eighth floor memory relay **8B** thus energizing that relay and de-energizing the ninth floor memory relay **9B**. A similar sequence occurs in the event the call being answered is at the same floor as the energized memory relay, the only difference being that the memory relay is already energized so that the first step of the sequence is already completed.

In the circuit as shown in FIG. V the high call reverse system is divided into an upper and a lower zone in addition to being divided into segments by the operation of the memory relays. This zoning is provided so that when a memory relay in the upper zone is the only one that is energized each up traveling cars not having a higher car call registered is stopped and reversed at the highest hall call at or below the energized memory relay. If the same condition held in the low zone it would

be possible to trap most of the cars during down peak operation to answer one or two calls in the low zone. To avoid this the circuits are arranged so that if there is a low zone memory relay energized and there is a partially loaded car answering calls in the low zone any up-traveling car leaving the lobby is permitted to travel to the highest actual call in the system.

As soon as one of the low zone memory relays is energized, it energizes the low zone down peak relay DPL which thereupon closes its contacts in line **172** to complete a holding circuit to the lower end of the memory relay holding circuits for the low zone. At the same time it closes its contacts DPL in line **171** so that, in cooperation with now closed contacts of the higher zone down peak relay DP, it prepares a circuit from the high call reverse circuit below the sixth floor down hall call contacts S6D at line **170** to energize the reset relay RTZ in line **168** in the event there are no call registered for floors at or below the energized high zone memory relay. Assuming there are no such calls registered the top zone reset relay RTZ is energized to close its contacts in line **167** to maintain itself energized in the event there is a higher memory relay energized at the same time that there is a down hall call at the corresponding floor. It also opens its contacts in line **166** to de-energize the down peak relay DP. This relay thereupon opens its contacts in line **170** to open the energizing circuit of the reset relay RTZ. As soon as the call at the energized memory relay is answered that relay and the reset relay are de-energized.

A similar action occurs in the low zone. As soon as all of the calls below the lowest of the energized memory relays are cleared the low zone reset relay RLZ is energized which relay, by opening its contacts in line **172**, interrupts the sealing cirucit to the low zone memory relays **2B** through **5B** as well as to the low zone down peak relay DPL in line **176.**

It was mentioned previously that as long as a memory relay was energized in the low zone cars traveling upwardly could pass the energized memory relay floors under certain conditions. Circuitwise, this be-passing is permitted as long as the brushes **65** and **70** for a particular car are connected by way of the circuit comprising peak traffic timer relay contacts PTT, the normally closed lock-out relay contacts LO, normally closed up direction memory relay contacts UL, normally closed standing time relay contacts ST, normally open low zone down peak relay contacts DPL, contacts LSH and brake relay contacts BK. The contacts LSH are load switch contacts that open when the car is approximately half loaded. As long as this circuit is complete, i.e., the car is not delayed at the stop, has less than a half load and is standing still, and a memory relay for the floor below that at which the car is standing is energized two adjacent memory relays are energized. Inspection of the high call reverse circuit along the left of the diagram indicates that under this condition the higher memory relay breaks the power circuit to the high call reverse circuit below its position so that the next lower memory relay connot establish a high call reverse ceiling at its floor and the absence of a down call at the higher memory relay floor prevents operation of the high hall call relay SD so an up traveling car cannot reverse at the floor corresponding to the higher energized memory relay. Thus, the up traveling cars are allowed to by-pass these floors without reversing as long as there is a car serving these floors.

This circuit further provides that memory relays can be simultaneously energized in the upper and lower zones so that up cars allowed to pass a low zone ceiling are available for clearing calls below an energized high zone memory relay thus expediting service to those floors. This supervisory control thus distributes the car service adequately to all floors during peak traffic conditions by providing, in general, that no floor will be served twice by empty cars while there are still calls to be answered at lower floors. Thus particularly during down peak traffic conditions the cars automatically concentrate on those calls which have been registered the greatest length of time and without requiring any cars to ordinarily travel to the lobby with less than a full load.

Supervisory Control for Moderate Traffic

During periods of moderate traffic it is desirable, and some building operators consider it imperative, that there be one car available at the lobby at practically all times. Thus, regardless of when an intending passenger walks into the lobby there is a car waiting to take him to his destination. It is furthermore desirable that those cars not at the lobby divide the calls between them with each of the cars answering the calls requiring the minimum travel or minimum time. To accomplish this, the supervisory control circuit, as illustrated in FIGS. VI, VII, VIII, IX, and X, is arranged so that, in the absence of calls, the cars distribute themselves, one at the lobby floor and the others at parking stations spaced at regular intervals up the height of the building with the highest car spaced down approximately one interval from the top floor. Thus, if there are four cars serving a 17 story building, for example, the cars would be distributed, one at the lobby floor and the others at the fifth, ninth, and thirteenth floors with all of the cars conditioned for upward travel. The circuits are arranged so that each car is responsive to up hall calls occuring between it and the next higher car or the top of the building and is additionally responsive, when there are no up calls within its zone, to down hall calls between it and the next lower car. If the cars at the intermediate floors park with their doors closed, to save door-closing time in answering a call at another floor, a call anywhere in the building could be answered within 6 to 10 seconds. The circuits further provide that any car conditioned for down travel travels to the lobby floor and then to the basement if there be a basement call. The circuits can further be arranged so that a car having answered a car call requiring travel to a basement floor either remains at such floor and becomes the next car to return to the lobby as the lobby car leaves or it may be arranged to return immediately to the lobby floor.

When operating under this supervisory control the arrival of a second car at the lobby causes the car already there to be started on its upward travel and it then travels to the highest unoccupied parking station. Furthermore, with a single car standing at the lobby the registration of an up hall call between that car and the next higher car or the registration of a car call in such lobby car provides a signal calling the lowest idle car to the lobby unless there be a car already in transit toward the lobby. An active up traveling car, i.e., one carrying passengers in the up direction, travels to the highest destination call while delivering the passengers at their respective floors and then stops and waits at whatever floor it finally reaches. It remains at that position until there is either an up hall call registered between it and

the next higher car or there is a down call registered between it and the next lower car. It is thus in the same condition as a parked car except that it may be at any floor.

Another feature of the invention is that if a call is registered ahead of a parked car and there is another car traveling toward the call but still beyond the parked car, the parked car does not respond to the call but rather leaves that for the running car which being in motion would probably reach the call as quickly and with one less stop. Should the running car have a car call requiring a stop before reaching the position of the parked car, the parked car will start toward the call as soon as the other car starts its slow down for its car call.

As another feature the supervisory control circuit is arranged so that if more than a certain number of calls are resistered between a car and the next preceding car in the system a starting signal is transmitted to the next following car so that it may assist the car having the greater number of calls. This feature works in conjunction with another feature of the system in that if a car while proceeding toward unanswered hall calls has substantially more calls ahead of it than are ahead of the next following car which is also proceeding to answer calls, the leading car by-passes one or more calls leaving such calls to be answered by the following car. This has the effect of maintaining time spacing between the active cars and preventing them from operating as a bunched group. In connection with this feature of the supervisory control, means are provided so that the highest down traveling car will not by-pass calls in attempting to maintain spacing. Furthermore, since it is conceivably possible that a given down hall call might be successively by-passed by several cars in attempting to maintain proper spacing the memory relays discussed in connection with FIG. V of the down peak program circuits are used to remember by-passed down calls and to prevent a following car from by-passing such a call while attempting to maintain its spacing. Thus, a given down hall call may be by-passed once and only once.

To provide these various features of supervisory control the circuits must be responsive to the position of hall calls as well as to the position of each of the cars whether it be standing still or running. This information is provided by a sensing circuit as illustrated in FIG. VI. This circuit comprises selector machine segments **75** on each of the selector machines, these being connected in parallel for corresponding floors for up travel and another set of segments **77** similarly arranged but utilized during down travel. The segments **75** for the up direction are each individually connected to a supply lead **79** through resistors **76** serving as current limiting impedances and normally open up hall call relay contacts S-U for the various floors. Likewise, the down direction segments **77** are connected through resistors **78** and normally open contacts of the down hall call relay contacts S-D to the supply lead **79.** The lead **79** is connected to one terminal **80** of a secondary winding **81** of a transformer **82** that has its primary winding **83** energized from alternating current leads **84** as long as the peak traffic timer PTT, shown in FIG. V, is deenergized to close its contacts PTT in the lead to the primary winding **83.** The secondary winding serves as a current source for the sensing circuit. The other end of the secondary winding opposite the terminal **80** is connected to a return lead **85** which is preferably grounded and which serves as a return lead for the sensing circuit. Each of the selector machine segments **75** or **77** is connected to the adjacent segments by rectifiers **86** that are arranged to pass current from one segment **77** to the next segment above and from one segment **75** to the next segment below. Thus, the segments are connected in a series circuit arranged so that current may flow through the series circuit in a direction counter to the movement of cars moving up and down the hatchways. The rectifiers and segments may be considered as forming a sensing circuit that corresponds to the path of the elevator cars in moving up and down the hatchway of the building.

Each of the cars, furthermore, is provided with a sensing circuit which for car A comprises a brush **90** shown at line **198** that, while the car is conditioned for upward travel, is connected through normally open up direction relay contacts UL, lead **91,** normally closed load by-pass contacts LBP, normally open in service relay contacts IS that are closed as long as the car is available for use, normally closed spacing cutout relay contacts SCO, normally closed car stop relay contacts SC, a coil of a sensitive relay **SR1,** line **204,** and then through rectifier **92** and coils of sensitive relays **SR2** and **SR3** to a lead **93.** The load **93** is connected through normally closed motor relay contacts AMR and normally closed down direction relay contacts DL in line **203** to a lead **94** that is connected to a tap of the secondary winding **81** at a point near the grounded terminal of the secondary winding **81.** The sensitive relays **SR1, SR2,** and **SR3** are preferably of the instrument type such as a contact-making milliammeter having sufficiently low resistance so that the voltage drop from the lead **91** to the lead **93** is not appreciably greater than the voltage drop across a single rectifier. Therefore, as long as this circuit is completed the brush **90** affectively shorts the corresponding selector machine segments corresponding to the position of the elevator car to the return lead **94.** When the car is running such that the motor relay contacts AMR in line **201** are closed and the corresponding motor relay contacts in line **203** are open the lead **93** is connected to the grounded lead **85.** The difference in voltage between leads **85** and **94** prevents the sensing circuit of a standing car from receiving signals while there is a car running and in position to answer the signal.

The sensing circuit is thus energized from the lead **79** at points corresponding to registered calls, indicated by closure of the corresponding hall call relay contacts S-U or S-D and is grounded or returned at points corresponding to the car positions.

When a car is conditioned for down travel, its lead **91** is connected through down directional contacts DL to a down brush **95** that co-operates with the down signal segments **77.** Circuits similar to that shown in line **201** to **205** of FIG. VI relating to car A are provided for each of the other cars, those circuits for car B are indicated by a box **96** appearing at line **196,** those for car C are indicated by box **97** appearing at line **192,** while those for a fourth car, car D, are indicated by box **98** shown at line **189.**

In addition, each of the cars is provided with a fourth sensitive relay **SR4** the operating coil of which is connected between the down brush **95** and the return lead **94** by way of a manually operated switch **100,** normally closed contacts of the second sensitive relay **SR2,** normally open contacts UL of the up directional memory

relay, and a rectifier **101** oriented to pass current from the brush **95** to the return lead **94.**

To provide selection between cars in the event that two car sensing circuits, such as the circuit in lines **201** to **205,** are equally energized such as by contacting one of the segments **75** or **77** each of the return leads **93** may include in series therewith a secondary **102** of a transformer **103** that provides a small voltage which is different for each of the cars. These voltages injected by the transformers **103,** while small compared to the voltage drop across a rectifier due to the signal currents flowing through it, are nevertheless large enough to upset the balance between paralleled car sensing circuits and divert the signal currents to one car sensing circuit in preference to the other. Alternatively the sensing relays SR2 may have different response timing so that one will respond faster than another and thus select one of two equally positioned cars.

To trace the operation of this circuit it is first assumed that the entire system is momentarily idle and that the cars are distributed with car A at the lobby or first floor, car B at the fourth floor, car C at the eighth floor, and car D at the eleventh floor and that the building has fifteen floors. As long as the cars are idle they are conditioned for up travel such that their up direction relay contacts UL are closed. Further assume that an up call is registered at the tenth floor. During positive half cycles of the alternating current when transformer secondary terminal **80** of the transformer **82** is positive with respect to the grounded end lead **85** current flows from the lead **79** through the now closed tenth floor hall call relay contacts SLOU, the tenth floor resister **76** and thence through the rectifiers leading downwardly from the tenth floor segment to the eighth floor segment **75,** thence through the brush **90** (C) of car C and through its sensing circuit **97** which is similar to the circuit shown in lines **201** and **205.** Since the voltage drop through the sensitive relays of the car sensing circuit is small compared to the voltage drop across one of the rectifiers **86,** the current flow through the tenth floor resister **76** is directed entirely through the sensitive relay circuit for car C, it being the highest car below the call. The diversion of the current flow through there sensitive relays prevents any signal appearing for the cars below. The resulting energization of the second sensitive relay SR2 for car C causes that car to answer the call.

As a second example, assume that a down call is registered at the fifth floor. Current flow is then from the supply lead **79,** while such lead is positive in the alternating current cycle, through the rectifiers **86** from the fifth floor segment in line **194** upwardly to the eighth floor segment **77** in line **191,** the brush **95** (C) and the contacts SR2, UL, and rectifier to energize sensitive relay SR4 of car C. Again, since the voltage drop through the sensitive relay SR4 is less than the voltage drop through the rectifiers above the eighth floor only car C responds to the call. The energization of the sensitive relay SR4 by circuits shown in line **123** of FIG. III causes the car to reverse its directional relay circuits thereby opening its up directional relay contacts UL and closing its down directional contacts DL in line **191.** This shifts the car sensing circuit **97** to the down segments **77** and immediately results in the energization of the second sensitive relay SR2 of car C so that car now immediately proceeds downwardly.

Next let it be assumed that the cars are again positioned as shown and that down calls are registered almost simultaneously at the fifth, sixth, and seventh floors. Upon the registration of the first of these, car C, being the lowest car above those calls, immediately reverses so as to start down. However, there being three calls registered each of which transmits current through its corresponding resistor **78** the resulting current flow through the sensitive relays for car C after reversal is sufficient to energize not only SR1 and SR2 but also **SR3.** The sensitive relay **SR2,** which is adjusted to respond to the current flow through a single one of resistors **78** or **76,** is picked up by the first call to be registered. The sensitive relay **SR3** is adjusted to require the combined current flow through three of the resistors thus indicating a total of three calls ahead of the car. To expedite the service under this condition it is desirable to call a second car into operation thus dividing the three calls between the two cars. In the circuit the picking up of the SR3 sensitive relay closes its contacts in line **216** of FIG. VII to prepare a circuit to the sensing relay cutout SCO. As the car stops for the first down call that it reaches it closes its stopping sequence relay contacts V as soon as it picks up the call thus completing the circuit to the sensing cutout relay SCO. This relay thereupon picks up to close its contacts SCO in line **217** to by-pass the sensitive relay contacts SR3 and thus hold the sensing cutout relay SCO energized. This relay SCO also opens its contacts in series with the sensitive relays in the car sensing circuit **97** thereby effectively opening the ground connection from car C's selector machine brush **95** so that the signals represented by the closed hall call contacts S-D can flow upwardly past car C's position to car D shown at the 11th floor, line **188,** so that it responds by reversing and starting down. At this moment car C is stopping for the first or highest of the down hall calls while car D is starting down.

Depending upon the distances to be traveled, car D probably passes car C before it has picked up the passengers at the highest down call. After passing car C, car D has two calls ahead of it and none behind it. Therefore, it has a choice depending upon the circuit design and adjustment as to whether it will answer the next call or by-pass that call and answer the lowest of the original three calls leaving the intermediate cell for car C. When the remaining calls are at adjacent floors or closely spaced it makes little difference which calls each car answers because the cars, if they divide the calls evenly, will still arrive at the lobby at about the same time. However, if the calls are widely spaced, it is desirable that the leading car by-pass half of the calls and thereby acquire a substantial spacing lead over the following car so that it will not be delayed by later calls that might be registered at the higher floors while a higher down traveling car is answering its calls.

The circuits to allow this type of operation include, as an essential element, the first sensitive relay SR1 for each of the cars. The sensitive relay **SR1,** when energized, initiates a by-pass operation to, in effect, transfer the next call to the following car. In these circuits it may be noted that the sensitive relay SR1 receives, during positive half cycles of supply voltage when the lead **79** is positive with respect to the lead **85,** a current which is proportional to the number of calls ahead of the car. Then on the negative half cycles of the alternating current, as the lead **79** goes negative with re-

spect to the lead **85**, current flows from the lead **85** or lead **94** back through the first sensitive relay **SR1** by way of resistor **105** end rectifier **106** and the series of contacts in line **204** and thence back through the brush **90** and the series chain of rectifiers **86** and the resistors **76** or **78** for the calls behind the car. The sensitive relay **SR1** is preferably a milliammeter type movement adjusted to close its contacts when there is at least one more call ahead of the car then there is behind it. This relay may be used to indicate the difference between the number of calls ahead of the car and the number of calls behind the car.

It is desirable that the highest down traveling car should not by-pass any calls in attempting to maintain spacing. This is accomplished by providing at line **183** a resistor **107** and rectifier **108** connected to the top terminal segment **77**. The resistor **107** has a resistance value approximately one fifth of that of any of the resistors **76** or **78** and thus draws current when the lead **79** is negative equivalent to five calls at the top terminal i.e., above the highest car. This reverse current flow through the first sensitive relay **SR1** of the highest down traveling car prevents that relay from operating to initiate a spacing by-pass operation.

In the preceding example of several calls registered ahead of car C in which car D was started and probably passed car C, car D's sensitive relay **SR1** would move to contact closing position as soon as car D passed car C since car C's sensing circuit **97**, by practically grounding the selector machine segment at which car C is located, cuts off the effect of the resistor **107** on any lower segments **77**. When the first sensitive relay **SR1** of a car operates, it closes its contacts in line **210** (FIG. VII) to energize a spacing by-pass relay **SBP** which by opening its contacts **SBP** in lines **244** and **246** of the circuits shown in FIG. VIII causes the car to by-pass hall calls until it has balanced the number of calls ahead of it with the number of calls behind. At that time the sensitive relay is de-energized and the car responds normally to further down hall calls.

Since it is desirable to keep an available car at the lobby floor and since it is also desirable to keep the idle cars spaced at various positions up the hatchway, the circuits are arranged so that as soon as a car or hall call signal is registered which would take the car at the lobby away from the lobby the lowest idle car is called to the lobby provided there is no active down traveling car at that time. The signal for calling the low idle car to the lobby is provided by a lobby car call relay **M** (FIG. IX) which by closing its contacts in line **199** energizes the series loop circuit of rectifiers **86** at a point below the lobby floor. If there is an idle car at one of the basement floors such car is returned to the lobby. If there is no such car the signal from the now closed contacts M is transmitted up the series of rectifiers on the right side of the loop until it meets the lowest idle car. At this point it appears as a down signal to reverse such car and cause it to return to the lobby.

Referring now to FIG. VII the circuits controlled by the sensitive relays **SR1, SR2,** and **SR3** are shown at lines **210** to **218.** The first sensitive relay **SR1,** which is responsive to the difference between the number of calls ahead and the number of calls behind the car, is arranged, when the calls ahead exceed by a selected number the calls behind, to close its contacts in line **210** and thereby energize the spacing by-pass relay **SBP** which, in co-operation with the circuits shown in FIG. VIII, causes the car to by-pass hall signals. The cars are automatically started after each stop by a car start relay **CS** shown at line **212.** This relay may be energized whenever the second sensitive relay for that car is energized to close its contacts **SR2** in line **212** provided the doors are not opening so that the door open relay contacts **DO** are closed, the transfer time relay **TR** is timed out to indicate that sufficient time has elapsed since the stop was made to permit passengers to enter or leave, and provided the car is not at the main lobby floor or if at the lobby floor it has remained there a period of time measured by timing relay **TR1.** In lieu of a call ahead of the car the car will start automatically as long as its car call above relay **CB** is energized indicating that there is a car call registered for a floor above the position of the car. Likewise, the car starts automatically after each stop as long as it is conditioned for down travel such that its down memory relay contacts **DL** in line **214** are closed. Furthermore, during peak traffic conditions the operation of the peak traffic timer closes its contacts at line **215** for each car so the cars start automatically from any floor. The peak traffic timer contacts in line **215** are connected around the lobby floor timer relay contacts **TR1** so as to minimize the standing time at the lobby floor and keep the cars in active operation. Finally, a car standing at the lobby floor is started automatically as soon as another car arrives so as to energize car counting relay **KT**, FIG. IX, so that it closes its contacts KT in line **211.** This last starting circuit makes sure that there is never more than one car standing at the lobby floor for more than a few seconds.

The remaining circuit in FIG. VII is that including the third sensitive relay contacts **SR3** and the stopping sequence relay contacts V to energize the sensing circuit cut out relay **SCO** whenever a car has more than a predetermined number of calls ahead of it and is thus requesting aid of another car. When the sensing circuit cut out relay SCO is energized it opens its contacts in line **204** thus removing that car from the series circuit. The removal of the car allows the currents flowing through the rectifier **86** from the cells ahead to pass to the next car in line. That car then starts in response to the calls. Thus two cars may be called into service for calls ahead of the first car. Since the cut out relay SCO can be energized only while a car is slowing down for a stop, stopping relay V closed, there is very little chance of two cut out relays being simultaneously energized to start a third car until one of the cars is fully loaded to open its load by-pass contacts **LBP** in line **204.**

It was mentioned earlier that when cars are allowed to by-pass calls to maintain spacing in response to operation of the first sensitive relays **SR1** that it is desirable to remember such by-passed hall calls so that they cannot be successively by-passed. The circuits for accomplishing this feature are illustrated in FIG. VIII. These are a modification of the circuits shown in FIG. II and include the memory relays described in connection with the circuits shown in FIG. V. Since the probability of up traveling cars successively by-passing up hall calls to maintain spacing is very small, the circuit is arranged to be effective only on down hall calls.

When a down traveling car arrives at a down hall call, its brush **110** FIG. VIII) is energized from a supply lead **L11** by way of hall call relay contacts and selector machine segments and, assuming that the car is not loaded

and is not set to by-pass calls to maintain spacing, current flows through a series of contacts in line **246** which include now closed down directional relay contacts DL, normally closed spacing by-pass relay contacts SBP, normally closed up directional relay contacts UL, normally closed stopping relay contacts VR2, now closed rheostat contacts RH3 which are closed as long as the car is operating at more than a certain speed, load by-pass relay contacts LBP which open when the car acquires a full load, a coil of the stopping relay S, and normally open brake relay contacts BK. This circuit also energizes a reverse timer relay RT at line **241** which serves to delay the reversal of a stopping idle car in response to a hall call registered below the car and sensed by its fourth sensitive relay SR4. These relays seal themselves in through stopping contacts S of the stopping relay S in line **241** and contacts VR1 of a stopping sequence relay VR1 so as to remain energized until the car actually stops at the floor and its brake relay contacts BK in line **246** open to break the holding circuit. This holding circuit is required to hold the stopping relay S energized during the stopping time because sequence relay contacts VR2, line **246**, open as soon as the stopping sequence relays operate to prevent any feedback from the sealing circuit for the stopping relay S to the floor selector machine segments which would result in the stopping of another car should another car be closely following the one which is actually responding to the call.

If the car is traveling down and has more calls ahead of it than between it and the next following down traveling car, its first sensitive relay SR1 is energized so as to operate the spacing by-pass relay SBP in line **210** such that it opens its contacts in line **246** to prevent operation of the stopping relay S. At the same time it closes its spacing by-pass contacts SBP in line **249** to prepare a circuit through normally closed peak traffic timer relay contacts PTT in line **249**. As this down traveling car passes a down hall call, current flows from its brush **110** through normally closed stopping relay contacts S in line **247** to energize auxiliary memory relay R2 in line **247**. This relay immediately closes its contacts in line **249** and opens its contacts in line **248** so as to complete the circuit to selector brush **70** to energize the memory relay for the same floor. This relay as soon as energized seals itself in through now closed hall call relay contacts such as contacts S11D and memory relay contacts 11B, line **248**. Since spacing by-pass contacts SBP in line **246** are now open the stopping relay S is not energized and the car by-passes the call. If the car should by-pass more down calls before establishing a balance between the calls ahead of it and the calls behind it and ahead of the next following car it energizes the memory relays for those by-passed calls. Since the peak traffic timer PTT has not been energized at this time, the down peak relays are not energized so that the memory relays are held in only through the down hall call stopping relay contacts.

If a car on approaching a previously bypassed call with an energized memory relay has its spacing by-pass relay operated to attempt to by-pass the call, it nevertheless answers the call. The brush **70** which cooperates with the segments **66** is arranged to contact these segments **66** slightly earlier than the brush **110** contacts the down stopping signal segments. Therefore, before the auxiliary relay R2 has a chance to be energized current flows from the sealing circuit of the memory relay through the brush **70**, through the now closed spacing by-pass contacts SBP line **249**, the normally closed auxiliary relay contacts R2 in line **248** and the series of contacts in line **246** to energize the stopping relay S. Thus the stopping relay S is energized from the memory relay before the actual down hall call is picked up and by opening its contacts in line **247** prevents operation of the auxiliary relay R2.

The auxiliary relay R2 is required in this circuit to avoid energizing the stopping relay S at the same time that a memory relay is energized the first time a call is by-passed. This circuit thus provides that a down hall call may be by-passed once and only once by cars attempting to by-pass hall calls to maintain spacing.

The circuits shown in FIG. IX are those circuits that provide that only one car shall remain at the lobby floor and to provide for calling another car to the lobby when there is a single car at the lobby and it has received a single requiring it to leave the lobby. A lobby car count relay KT, line **277**, is arranged to be energized through a family of lobby floor relay contacts MG of the various cars arranged such that the energization of any two or more of the first floor relays MG will result in energization of the car count relay RT. This relay KT when energized closes its contact KT in line **211** to prepare circuits to the car start relay CS so that the first car to have its lobby floor timer TR1 time out receives a signal to start. When the car start relay CS is energized it opens its contacts CS in series with the coil of the lobby floor relay MG to immediately indicate the starting of that car and drop out the car count relay KT unless there are still two cars remaining at the lobby.

To provide the signal to call another car to the lobby as previously described a lobby call relay M shown in line **284** is arranged to be energized through a series circuit of normally closed contacts of each of the first floor relays MG of the various cars as shown in line **287** when there is no car at the lobby, and is arranged to also be energized whenever there is only one car standing at the lobby and it has a car call registered so as to close its car call above relay contacts CB or there is a hall call registered above the car which is sensed by the circuit shown in FIG. VI to energize the second sensitive relay SR2 for that car. when the relay H is energized it closes its contacts in line **199** of FIG. VI to provide a signal equivalent to a down call that is transmitted to the lowest of the parked cars provided there is no down traveling car at that time. If there is a down traveling car it sees this signal as a call at the lobby floor. Since the lobby call relay M is energized to call the next car as soon as the car at the lobby receives a signal and since, because the lobby car must clear and close its doors before starting, there is an appreciable interval of time before the lobby car actually leaves the lobby. The next car, unless intercepted by calls, therefore arrives at the lobby within a few seconds of the time that the first car leaves.

If a car started from the lobby floor by the arrival of another car has no car calls registered and there are no hall calls ahead of the car, the car travels upwardly until it reaches the highest of a series of parking stations or parking floors. It is stopped at the highest unoccupied one of these floors when its brush **120**, FIG. x, contacts the corresponding selector machine segment **121**, **122**, or **123** that are energized from selected points of the high call reverse circuit of FIG. V. As long

as there are no higher hall calls registered the selector machine segment **121** is energized by way of the high call reverse circuit through the tenth floor contact that is connected tp lead **126** at line **297** in FIG. X and thence through normally closed peak traffic timer contacts PTT at a coil of tenth floor parking station relay **P10.** When the brush **120** of this up traveling car contacts the segment **121** current then flows through its normally open in service relay contacts IS, normally open up memory relay contacts UL, normally closed car start contacts CS, now closed car call above contacts CB, and car call below contacts CBD to energize a parking stop relay PS, line **292.** The parking stop relay PS closes its contacts PS in line **133** to initiate the stopping of the car. The car then stops at this parking station and waits, still conditioned for upward travel, until it receives a signal from an up or down call above or a down call between it and the next lower car by way of the sensing circuit shown in FIG. VI.

When a first car stops at the tenth floor parking station and energizes the parking station relay **P10,** that relay closes its contacts in line **293** to prepare a circuit from the seventh floor contact at line **164** of FIG. V to a load **128** in line **293** to prepare a circuit to the seventh floor parking station relay **P7.** Therefore, as long as there is a car parked at the tenth floor the next up traveling car, having no car calls above and there being no higher hall calls registered, stops at the seventh floor. Similarly, as long as there is a car parked at the seventh floor to energize the seventh floor parking station relay P7 it closes its contacts in line **294** to similarly prepare a circuit from the fourth floor point of the high call reverse circuit of FIG. V so that the third up traveling car then stops at the fourth floor. If, before the third car started, the first car receives a start signal it proceeds to answer the signal thus leaving the seventh floor station filled and the tenth floor station vacant. This de-energizes parking relay **P10** thus deenergizing the seventh floor relay **P7** and it the fourth floor relay **P4.** Therefore the third car traveling up with no calls registered passes the fourth and seventh parking stations and stops at the tenth floor. If the second or third car were traveling up when the call ahead of the parked car was registered, the moving car receives the signal rather than the parked car. This selection, as previously explained, results from the voltage difference between the return leads **85** and **94** such that the signals are routed to the moving cars.

The lobby floor relay MG has its operating coil shown in line **295** of FIG. X connected between the supply lead and a selector machine segment **130** that may be included in the same lane with segments **121,** 122, and **123.** Therefore when the car arrives at the lobby floor and reverses at that floor thereby canceling any registered car calls both the car call above and car call below relays CB and CBD are de-energized so that the circuit leading from the segment **130** to the parking stop relay PS is completed to thus pick up the lobby floor relay MG. This relay then closes its contacts MG in line **293** to complete a holding circuit for this first floor relay MG until the car either receives a starting signal or is taken out of service which results in opening its in service contacts IS in line **272.**

These circuits according to the invention thus provide: (**1**) that a car that is about to be overtaken by an empty or partially loaded car will by-pass one or more hall calls, leaving such calls for the following car so as to maintain time spacing between the cars; (**2**) that in the event there are no hall calls registered and no car calls the cars distribute themselves with one at the lobby and with the others at various positions along the height of the building so as to be in position for quickly answering any cells that may arise.

In the event that the by-passing to prevent overtaking and leapfrogging of the cars is considered unnecessary in view of the distribution of the idle cars this feature may be eliminated by providing a shunt circuit including a switch **140** in line **203** for each car so as to short cut the first sensitive relay **SR1,** the rectifier **92** and the car stop relay contacts SC. At the same time the switches **140** for each car are closed a switch **141** at line **182** is opened to that a rectifier **142** is inserted into the circuit to take the place of the rectifiers **92.** If this is done the memory circuits shown in FIG. VIII to prevent the successive by-passing of calls may also be eliminated from this phase of the operation. They are still required as ceiling relays to remember the proper sequence in answering calls during heavy down peak traffic conditions.

The foregoing description is considered as exemplary only and various modifications may be made in the specific circuits and components without departing from the spirit and scope of the invention.

Having described the invention, I claim:

1. In an elevator control system, in combination, a plurality of cars arranged to serve a plurality of floors, means for registering calls for service, control means for each car for stopping the car at floors at which calls are registered, means for indicating the difference between the number of calls registered in the zones between the car and the next preceding and next following cars, auxiliary control means for each car adapted to de-energize the first control means for by-passing calls, and means operatively connected to said difference indicating means for actuating the auxiliary control means when the number of calls in the zone ahead of the car exceeds the number of calls in the zone behind the car.

2. In an elevator control system, in combination, a plurality of cars arranged to serve a plurality of floors, means for registering calls for service, stopping control means for each car for stopping the car at floors at which calls are registered, a by-pass control for each car, a sensing circuit corresponding to the path of the elevator cars, said sensing circuit comprising a series chain of unilateral conducting devices, means supplying alternating current to the junctions between the conducting devices corresponding to floors having registered calls, low impedance direct current measuring means individual to each car and connected to the series chain at a position corresponding to the car position and direction of travel, and means connected to the current measuring means for operating the by-pass means when the net direct current through the measuring means exceeds a predetermined value and polarity.

3. In an elevator control system, in combination, a plurality of cars arranged to serve a plurality of floors, means for registering calls for service, stopping control means for each car for stopping the car at floors at which calls are registered, a by-pass control for each car, a sensing circuit corresponding to the path of the elevator cars, said sensing circuit being connected to the call registering means to be energized according to the calls for service, means responsive to the positions

of the cars for dividing the sensing circuit into zones at points corresponding to car positions, measuring means for each car connected to the sensing circuit for indicating the excess of the number of calls in the zone ahead of the car over those in the zone behind the car, said measuring means being adapted to operate said by-pass means when said excess exceeds a predetermined number, and means simulating a number of down calls in a zone above a down traveling car.

4. In an elevator control system, in combination, a plurality of cars arranged to serve a plurality of floors, means for registering calls for service, stopping control means for each car for stopping the car in response to calls for service, a by-pass control for each car, a sensing circuit corresponding to the path of the elevator cars, said circuit being energized according to the calls for service and being divided into zones according to the positions of the cars, means individual to each car and connected to the sensing circuit for starting the car in response to a call in the zone ahead of the car, measuring means for each car connected to the sensing circuit for indicating the difference between the number of calls in the zones immediately ahead and behind the car and for operating the by-pass means when said difference exceeds a predetermined amount, and memory means for each of at least some of the floors served by the cars, said memory means being energized when a call is by-passed by a car in response to said difference in numbers of said calls and serving to stop the next available car.

5. In an elevator control systems, in combination, a plurality of cars arranged to serve a plurality of floors, means for registering calls for service, stopping control means for stopping the car as it approaches a floor having a registered call for service, a by-pass control for each car, a sensing circuit corresponding to the path of the elevator cars, said circuit being energized according to the calls for service and being divided into zones according to the positions of the cars, means individual to each car and connected to the sensing circuit for starting the car in response to a call in the zone ahead of the car, measuring means for each car connected to the sensing circuit and the by-pass control adapted to operate the control when the number of calls ahead of the car exceeds by a predetermined number the calls behind the car, memory means for at least some of the floors, said memory means being energized when a call at the corresponding floor is by-passed, stopping means responsive to the memory means for stopping cars at previously by-passed calls, and means responsive to a predetermined number of calls ahead of a car for simulating a call for service in the zone behind the car.

6. In an elevator control system, in combination, a plurality of cars arranged to serve a plurality of floors, means for registering calls for service, stopping control means for stopping the car as it approaches a floor having a registered call for service, a by-pass control for each car, a sensing circuit corresponding to the path of the elevator cars, said circuit comprising a series chain of unilaterally conductive elements having junctions corresponding to floors served by the cars, alternating current means including a series impedance connected to the junctions corresponding to floors having registered calls, low impedance direct current measuring means individual to each car and connected to the sensing circuit at a point corresponding to the position of the car, a first element in said direct current measuring means responsive to current in one direction arranged to initiate starting of the elevator car, and a second element in the direct current measuring means responsive to the net direct current through the measuring means adapted to operate the by-pass control.

7. In an elevator control system, in combination, a plurality of elevator cars arranged to serve a plurality of floors, means for moving the cars from floor to floor, means for registering calls for service, means for each car for stopping the car at floors at which calls are registered, a sensing circuit comprising unilateral conducting devices corresponding to the path of the elevator cars, a current supply having a first and a return lead, means including current limiting impedances for connecting the first lead to the sensing circuit at points corresponding to registered calls, current responsive means for each car connecting the return lead to the sensing circuit at points corresponding to the car positions, car starting means connected to the current responsive means for starting each car in response to current flow, and means for increasing the voltage in the return leads of moving cars whereby current is diverted to the responsive means of moving cars.

8. In an elevator control system, in combination, a plurality of elevator cars arranged to serve a plurality of floors, means for moving the cars from floor to floor, means for registering calls for service, means for each car for stopping the car at floors at which the calls are registered, a sensing circuit comprising unilateral conducting devices corresponding to the path of travel of the elevator cars, current supply means having a first and return lead, means including current limiting impedance connecting the first lead to the sensing circuit at points corresponding to the registered calls, current responsive means for each car connecting the return lead to the sensing circuits at points corresponding to the position of the car, car sensing means connected to the current responsive means, said current responsive means for each car including a portion responsive to current flow indicating more than a predetermined number of calls between said respective car and a next adjacent car along the path of travel of the elevator cars, and means cooperating with said portion for each car arranged to momentarily interrupt the circuit through the current responsive means whereby the current flows through the current responsive means of the next car to start such car.

9. In an elevator control system, in combination, a plurality of elevator cars arranged to serve a plurality of floors, means for moving the cars from floor to floor, means for registering calls for service, means for each car for stopping the car at floors at which the calls are registered, a sensing circuit comprising unilateral conducting devices and corresponding to the path of the elevator cars, a current supply means having a first lead and a return lead, means including current limiting impedances for connecting the first lead to the sensing circuit at points corresponding to registered calls, current responsive means for each car connecting the return lead to the sensing circuit at points corresponding to the position of the car, relay means responsive to the presence of at least two cars at a lobby floor, said relay means preparing circuits for starting all but one of said cars at the lobby, and means for stopping each of said started cars at a predetermined different one of the intermediate floors until a signal is registered requiring travel by such car.

10. An elevator control system according to claim 9 in which cars started from the lobby by the arrival of other cars travel to and stop at different floors in anticipation of hall calls from the various floors.

11. In an elevator system, in combination, a plurality of elevator cars arranged to serve a plurality of floors including a lobby floor, means for moving the cars from floor to floor, means for distributing idle elevator cars among the plurality of floors with one car at the lobby floor and with each car conditioned for travel away from the lobby floor, means for registering calls for service from the various floors, a signal distribution circuit for transmitting calls for service to the cars, said signal distribution circuit normally transmitting each of such calls for service to the nearest car adapted to serve the call, and means responsive to a further car approaching such call adapted to interrupt the transmission of the call for service to such nearest car.

12. An elevator system according to claim 11, in which said interrupting means is ineffective in the presence of a plurality of calls ahead of such nearest car.

13. In an elevator system, in combination, at least three elevator cars arranged to serve a plurality of floor including a lobby floor, a terminal floor and a plurality of floors intermediate said lobby and terminal floors; means for moving each car from floor to floor; a control for each car setting its travel direction; means for automatically starting each car having its control set for travel toward the lobby floor; lobby means for automatically starting a car standing at the lobby floor in response to the arrival of another car at the lobby floor; means for stopping a car started by said automatically starting lobby means at a floor at which no other car is stopped; means for each of said floors for registering hall calls for service by said cars at said floor; hall call transmitting means responsive to a call registered by said call registering means for a floor for transmitting said call to that car of said plurality of cars located at the floor most proximate said floor of said call; and means for starting only said most proximate car toward the floor of said call in response to said call transmission by said transmitter means.

14. A combination according to claim 13 wherein said call registering means includes means for registering calls for service upward from the floor for those floors from which up service is provided, and means for registering call for service downward from the floor for those floors from which down service is provided; and wherein said hall call transmitting means includes means to transmit said call for a floor only to said car located at a floor on the side of said floor of said call opposite the direction of said call.

15. A combination according to claim 13 wherein said car stopping means includes means for predetermining a plurality of parking floors each spaced from other parking floors by at least one floor which is not a parking floor.

16. An elevator system comprising at least three elevator cars serving a plurality of floors distributed along a path of travel for said cars and including at least one main floor, means for each of a plurality of floors for registering a hall call for service at said floor; means for assigning each car to serve hall calls for floors in a zone of floors between the floor at which said car is located and the floor at which the next adjacent car along said path of travel is located; means for each car for registering car calls for service to each of a plurality of landings; means for conditioning a car as an active car in response to a car call or a hall call assigned to said car; means conditioning each car as an idle car in response to an absence of a car call for said car or a hall call in said zone of floors for said car defined by said assigning means; means to maintain an idle car at a floor other than a main floor at which it last provided service; means to start an idle car in response to the registration of a hall call by said registering means for a floor in the zone of floors assigned said car by said assigning means; and means for assigning an active car at a floor adjacent a zone of floors to which an idle car is assigned to serve a hall call registered for a floor in said zone in preference to said idle car.

17. An elevator system comprising at least three elevator cars serving a plurality of floors distributed along the paths of travel of said cars, means for each of a plurality of said floors for registering a hall call for service at said floor; means for assigning each car to serve hall calls for floors in a zone of floors between the floor at which the said car is located and the floor at which the next adjacent car along said path of travel is located; means conditioning each car as an idle car in response to an absence of a call for a floor in a zone of floors for said car defined by said assigning means; means to maintain each of a plurality of said cars conditioned as an idle car by said conditioning means at a floor other than a main floor at which said car last provided service; means to start a first idle car in response to the registration of a call by said registering means for a floor in the zone of floors assigned said car by said assigning means; and means to start a second idle car in response to a predetermined call registration for floors in the zone of floors assigned said first idle car by said assigning means.

18. An elevator system comprising at least three elevator cars serving a plurality of floors including a main floor, means for each of a plurality of said floors for registering a call for service at said floor; means for assigning registered calls to individual cars; means for moving each of said cars to said floors in response to calls for service for said floor assigned by said assigning means to said cars; means for maintaining a first car at a floor of said plurality of floors other than said main floor when all calls imposed on said system are assigned by said assigning means to other than said first car; means for maintaining a second car at a floor of said plurality of floors other than said main floor when all calls imposed on said system are assigned by said assigning means to other than said second car; means for each car for sensing passenger activity in said car; detecting means having a first condition when any of said cars is at said main floor, said detecting means having a second condition when all of the cars are spaced from said main floor, said detecting means having said second condition when only one of said cars is at said main floor and passenger activity is sensed by said sensing means in said one car; and actuating means responsive to said second condition of said detecting means for causing one of said first and second cars to run to said main floor.

19. An elevator system according to claim 18 including means for each car for registering car calls for service to each of a plurality of landings for passengers within said car; said sensing means being responsive to registration of a car call on said car call registering means for said car.

20. A control system for a plurality of elevator cars which operate to serve a building containing a plurality of landings which in said system are arranged in a plurality of zones, each including a predetermined number of said landings, comprising: call registering means located in each said car and at each said landing for registering calls for service to and from said landings; starting and stopping means individual to each car, each causing its respective car to start and to stop operating automatically in response to the registration of calls by said call registering means; car detection means individual to each zone actuated in response to the presence of a car in its respective zone for detecting that presence; assignment means operated in response to the presence of a car in a zone for assigning said car to said zone while said car is detected in that zone by said detecting means for that zone; and control means responsive to the occupation of any one of the zones by an assigned car and arranged to prevent the starting and stopping means of a car outside said occupied zone from starting its respective car in response to the registration of a landing call for a first predetermined direction of travel by said call registering means located at the landings in said occupied zone and in an empty zone adjacent in said first predetermined direction to said occupied zone.

21. A control system for a plurality of elevator cars which operate to serve a plurality of landings, including a main landing, which in said system are arranged in a plurality of zones, each zone including a predetermined number of landings, comprising: call registering means located at each landing for registering landing calls for service; starting and stopping means individual to each car, each starting and stopping the operation of its respective car automatically in response to the registration of landing calls by said call registering means; assignment means for each zone assigning to one zone a predetermined number of cars only while present in said one zone; first control means arranged to limit a car assigned to any zone to start in operation in response to the registration of landing calls for a first predetermined direction of travel registered only by said call registering means located at the predetermined number of landings in the zone in which said assigned car is located when the zone next adjacent said zone in said predetermined direction also has a car assigned to it; and second control means responsive to the absence of a car in the zone including said main landing for enabling a car assigned to another zone to start in operation, notwithstanding said first control means otherwise would prevent the starting of said car.

22. A control system for a plurality of elevator cars operating to serve a plurality of landings which in said system are arranged in a plurality of zones, each zone including a predetermined number of said landings comprising: call registering means located at each said landing for registering calls for service; starting and stopping means individual to each car, each starting and stopping the operation of its respective car automatically in response to the registration of calls by said call registering means; assignment means for each zone, each operating to assign to one zone a predetermined number of cars only while present in said one zone; and control means responsive to the occupation of any one of the zones by an assigned car and arranged to enable the starting and stopping means of a car in said occupied zone to start its respective car in response to the registration of calls for a first predetermined direction of travel by said call registering means located in said occupied zone and in contiguous empty zones one of which is adjacent said one zone in said predetermined direction, as well as to prevent the starting and stopping means of any car outside said occupied zone from starting its respective car in response to the registration of a landing call for said first predetermined direction of travel by said call registering means located in said occupied zone in said predetermined direction.

23. A control system for a plurality of elevator cars operating to serve a plurality of landings which in said system are arranged in at least three zones, each zone including a predetermined number of said landings, comprising: call registering means located at each landing for registering calls for service; starting and stopping means individual to each car, each causing its respective car to start and to stop operating automatically in response to the registration of calls by said call registering means; assignment means for each zone, each operating to assign to one zone a predetermined number of cars only after being located in said one zone, said assignment means terminating the assignment of each said assigned car when it leaves the zone to which it has been assigned; and control means causing a car, the assignment of which has been terminated, to continue operating regardless of the existence of registered calls until it is located in and assigned to a zone which thereafter is occupied by no more than the predetermined number of assigned cars for that zone; said control means operating in the absence of registered calls to cause said cars to distribute themselves into the various zones for assignment thereto in which circumstances the starting and stopping means of each assigned car causes its respective car to stop operating at a landing in the zone to which it is assigned.

24. A control system for a plurality of elevator cars which operate in two directions of travel to serve a building containing a plurality of landings comprising: up landing call registering means located at each said landing except the uppermost of said landings for registering calls for service upward from said landings; means for segregating said up landing call registering means into at least three groups, each group being for a plurality of contiguous, predetermined landings; car call registering means in each car for registering calls for service to said landings; down landing call registering means located at each said landings except the lowermost of said landings for registering calls for service downward from said landings; starting and stopping means individual to each car, each causing its respective car to start and to stop operating automatically in response to the registration of calls by said call registering means; means for detecting the presence of a car at a landing having an up landing call registering means in a group; assignment means operating under predetermined circumstances while a car is detected at a landing having an up landing call registering means in a group to assign said car to respond to said up landing calls in said group; and control means responsive to the occupation by a car assigned to a group of a landing having an up landing call registering means in said group and arranged to limit the starting and stopping of said assigned car in response to the registration of up landing calls to starting and stopping in response to up landing calls registered only by call registering means

in said one group provided a car is assigned to the group next above said one group, so that in such circumstances, and in the absence of up landing calls in said one group and in the absence of car calls in said one car and down landing calls, the starting and stopping means for said one car stops operating said car at a landing having a call registering means in said one group.

25. The control system for an elevator installation in a building containing both a plurality of landings and a plurality of elevator cars which operate to serve the landings comprising: up landing call registering means located at each landing except the uppermost of said landings for registering calls for service; means for segregating said up landing call registering means into at least three groups, each group being for a plurality of contiguous, predetermined landings; starting and stopping means individual to each car, each causing its respective car to start and to stop operating automatically in response to the registration of calls by said call registering means; assignment means for each group, each operating to assign to one group a predetermined number of cars only after being located at a landing having an up landing call registering means in said group; and control means responsive to the occupation by an assigned car of a landing having an up landing call registering means in a group and arranged to prevent the starting and stopping means of a car at landings below those landings having up landing calls in said one group from starting its respective car in response to the registration of an up landing call by said up landing call registering means for landings having up landing call registering means in said group and for landings having up landing call registering means in a group which is empty and adjacent above said one group.

26. A control system according to claim **25** including second control means responsive to the occupation by a car assigned to a group of a landing having an up landing call registering means in said group for cooperating with said first control means for causing a car so assigned to start in response to the registering means of said one group and a contiguous empty group above said one group.

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