United States Patent [19]

Savino

[11] **3,732,950**

[45] **May 15, 1973**

[54] ELEVATOR SYSTEMS

[75] Inventor: **Henry C. Savino,** Hackensack, N.J.

[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

[22] Filed: **Dec. 6, 1971**

[21] Appl. No.: **205,191**

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

[51] **Int. Cl.** **B66b 1/00**

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

[56] **References Cited**

UNITED STATES PATENTS

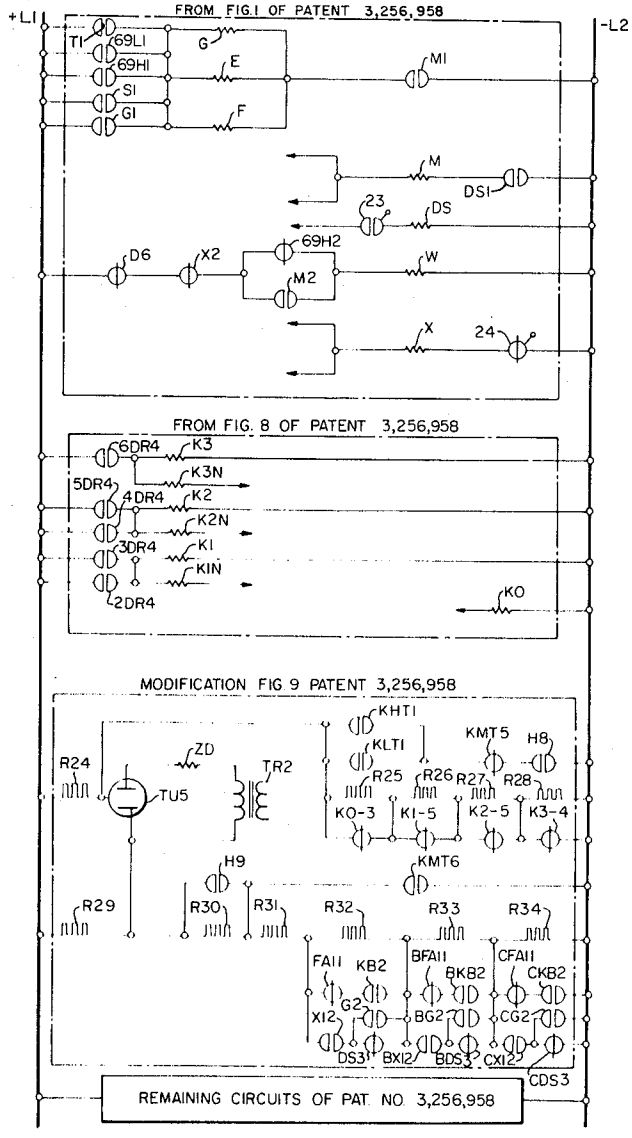
3,256,958	6/1966	Savino	187/29
3,587,786	6/1971	Savino	187/29
3,572,470	3/1971	Hirsch	187/29

Primary Examiner—Bernard A. Gilheany
Assistant Examiner—Thomas Langer
Attorney—A. T. Stratton et al.

[57] **ABSTRACT**

An elevator system having a bank of elevator cars which, under predetermined system conditions, become available for assignment and dispatching from the landings served thereby. The elevator cars are utilized more beneficially in certain types of structures, by modifying the basis for determining car availability, and the basis for determining the existence of a predetermined demand for service, upon the occurrence of predetermined traffic conditions and car positions.

10 Claims, 4 Drawing Figures



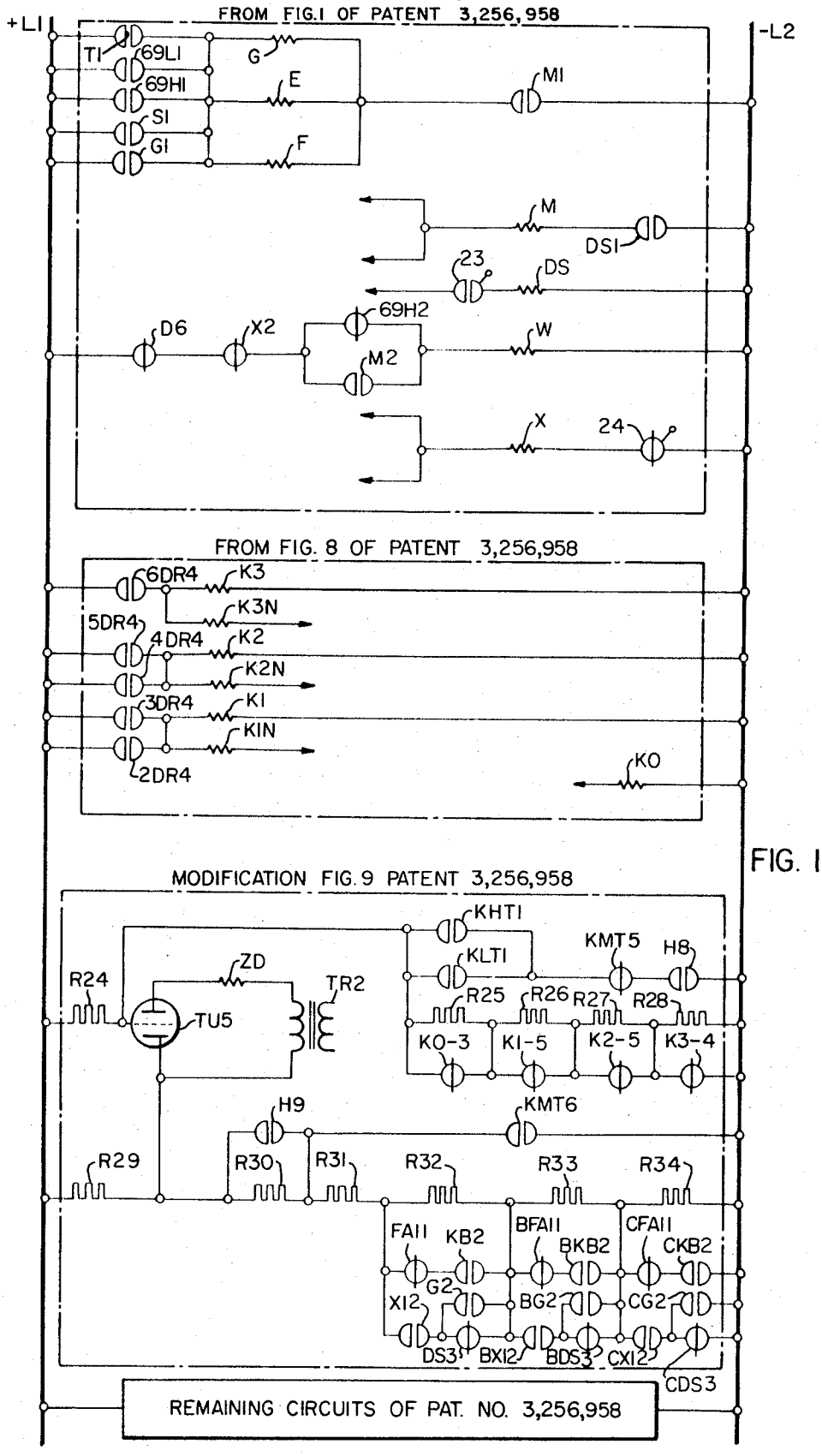

FROM FIG.1 OF PATENT 3,256,958
+L1
-L2
T1
69L1
69H1
S1
G1
G
E
F
M1
M
DS1
23
DS
69H2
D6
X2
M2
W
X
24
FROM FIG. 8 OF PATENT 3,256,958
6DR4
K3
K3N
5DR4
4DR4
K2
K2N
3DR4
K1
K1N
2DR4
KO
MODIFICATION FIG. 9 PATENT 3,256,958
KHT1
KLT1
KMT5
H8
R24
ZD
TR2
TU5
R25
R26
R27
R28
KO-3
K1-5
K2-5
K3-4
H9
KMT6
R29
R30
R31
R32
R33
R34
FA11
KB2
BFA11
BKB2
CFA11
CKB2
G2
XI2
BG2
CG2
DS3
BXI2
BDS3
CXI2
CDS3
REMAINING CIRCUITS OF PAT. NO. 3,256,958

FIG. 1

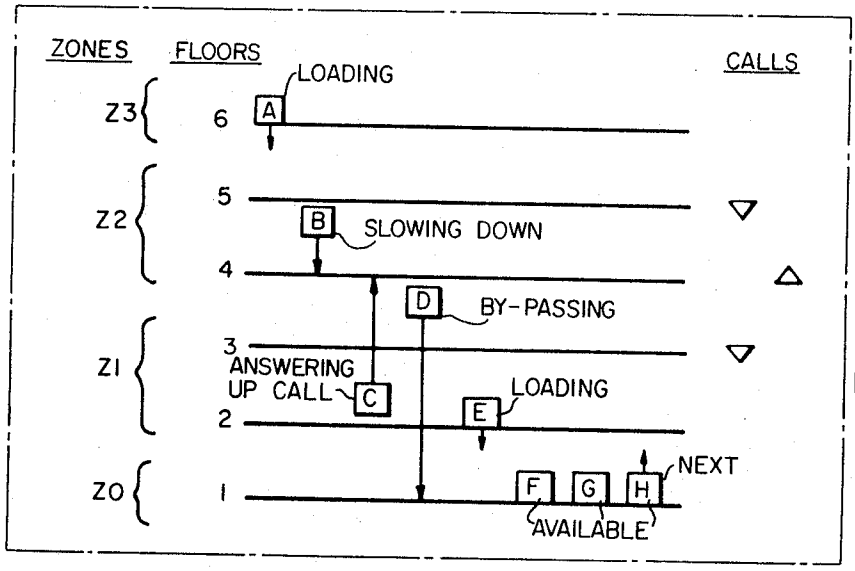

ZONES
FLOORS
CALLS
LOADING
Z3
6
A
5
Z2
B
SLOWING DOWN
4
D
BY-PASSING
3
Z1
ANSWERING
UP CALL
C
LOADING
2
E
NEXT
Z0
1
F
G
H
AVAILABLE

FIG. 2

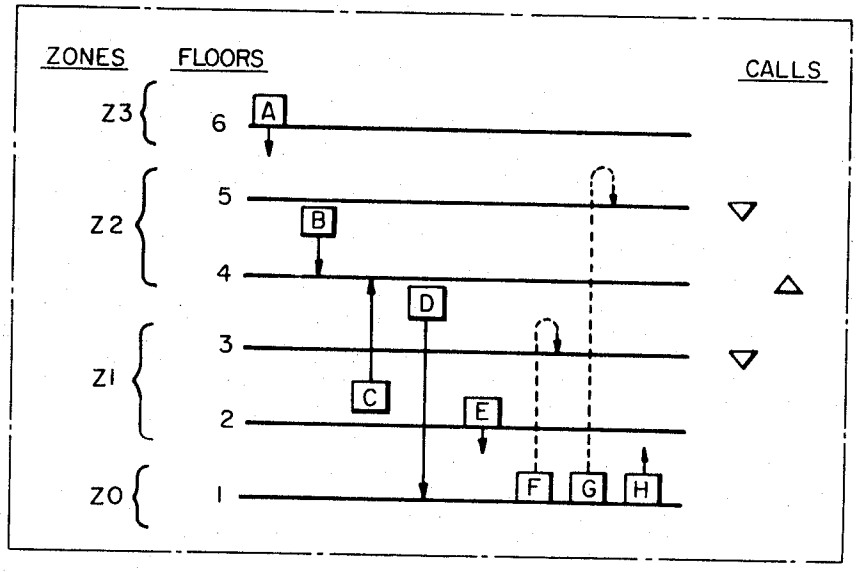

ZONES
FLOORS
CALLS
Z3
6
A
5
Z2
B
4
D
3
Z1
C
2
E
Z0
1
F
G
H

FIG. 3

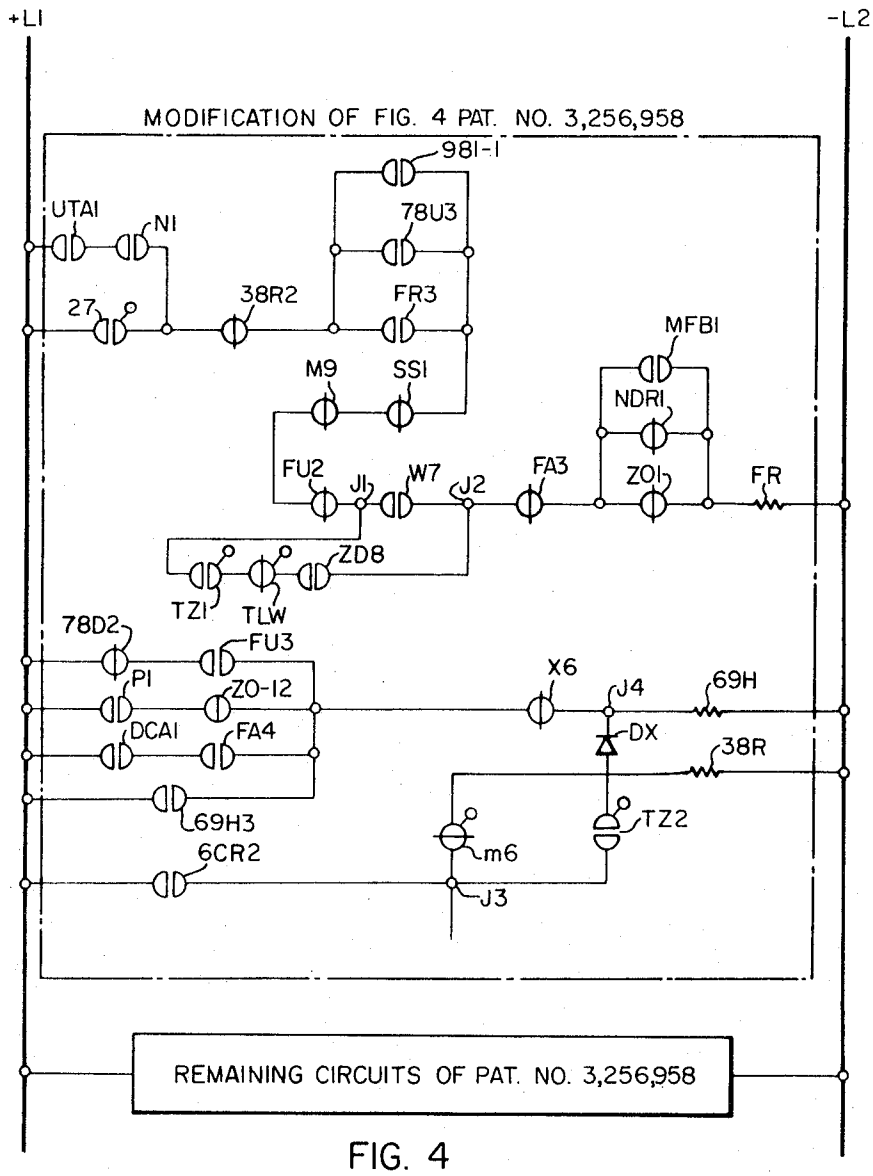

+L1
-L2
MODIFICATION OF FIG. 4 PAT. NO. 3,256,958
98I-1
UTAI
NI
78U3
27
38R2
FR3
MFBI
M9
SSI
NDRI
FU2
J1
W7
J2
FA3
ZOI
FR
ZD8
TZI
TLW
78D2
FU3
PI
ZO-12
X6
J4
69H
DCAI
FA4
DX
38R
69H3
TZ2
6CR2
m6
J3
REMAINING CIRCUITS OF PAT. NO. 3,256,958

FIG. 4

ELEVATOR SYSTEMS

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates in general to elevator systems having a bank of cars, with the preformance of the cars varying in accordance with demand for elevator service.

Description of the Prior Art

U.S. Pat. No. 3,256,958, which is assigned to the same assignee as the present application, and hereinafter referred to as the patent, discloses an elevator system in which the landings are divided into zones, with available cars being assigned to serve such zones according to the pattern of zones requiring service and the pattern of cars already serving the zones. This system provides a good distribution of cars for serving the landing calls, and it thus reduces the waiting time for service at any predetermined landing.

Once all zones having registered landing calls are provided for, additional cars which may become available stand idle, even though they could expedite service still further by assisting the cars which are already providing for the zones. U.S. Pat. Nos. 3,504,770, 3,504,771 and 3,587,786, all of which are assigned to the same assignee as the present application, disclose arrangements for utilizing additional available cars to further improve the service of the basic elevator system disclosed in the patent.

U.S. Pat. No. 3,504,770 discloses a system in which an additional elevator car may be assigned to a zone when a predetermined quota of calls per car already assigned to the zone have been exceeded.

U.S. Pat. No. 3,504,771 discloses an elevator system wherein an additional available car is dispatched to the highest down call registered when a car has been assigned to each zone requiring down service.

U.S. Pat. No. 3,587,786 discloses a system for improving down service when an additional available car is present after all zones have been provided for, by reestablishing a need for a car in a zone already provided for but which still has unanswered registered calls.

While the basic elevator system disclosed in the patent, and the modifications thereof disclosed in the additional U.S. patents, provide excellent service, it would be desirable to assign an additional available car to service down calls based more on prospective need. Further, when the upper terminal is a transfer floor, or has unusually heavy traffic, the system disclosed in the patent may experience a situation where the number of available cars within a given time is reduced, which thus reduces the effectiveness of the anti-bunching feature of the system.

SUMMARY OF THE INVENTION

Briefly, the present invention is a new and improved elevator system which assigns an additional available car to service registered calls for down service, only when it appears that an additional car will be necessary to expedite the service. According to the system of the patent, a landing call for down service will not cause the assignment of an available car to the call, if a car set for down travel is in a zone above the zone in which the call is registered. In certain situations, however, it may take quite some time for this car to actually serve this call, and should this car become loaded before serving the call, the car will proceed directly to the lower terminal and bypass the call. Thus, additional time will be lost as an available car will not be assigned to the call until the car above the call becomes loaded. The present invention improves service where this is likely to happen, by changing or modifying the basis for determining the existence of a demand, which will cause the assignment of an available car to the demand. If the car above the zone of the registered call is moving in the downward direction, and has not initiated slowdown, the basis for determining the existence of a demand is not changed, as this car will in all probability be able to promptly serve the call, and it would be inefficient to send an additional available car to serve this call. If the car above the zone of the call is stopped, or has initiated slowdown to serve another landing, however, there is a good possibility that the car will be delayed in answering the call, and may even become loaded to capacity. In this situation, the basis for determining the existence of a demand is modified by not considering this stopped or slowing car as a car which can serve the call. Thus, an additional available car is dispatched to serve this call.

In another embodiment of the invention, the basis for determining car availability is changed or modified under certain conditions, to improve the elevator service. In the system of the patent, a car which arrives at the upper terminal in response to a down call at that floor is not made available to serve specific registered down landing calls. Once an unassigned car starts down it will answer any down call not specifically assigned to another car. If this frequently happens, such as when the upper terminal is a transfer floor, or otherwise has unusually heavy traffic, the number of available cars would be reduced over a given period of time, reducing the effectiveness of the system to provide equitable service to the bottom floors of the building. In this situation, the present invention makes a car available at the upper terminal, even though it is set to travel down, if the car load does not exceed a predetermined percentage of its full load, and a predetermined traffic condition exists for service toward the lower terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be better understood, and further advantages and uses thereof more readily apparent, when considered in view of the following detailed description of exemplary embodiments, taken with the accompanying drawing, in which:

FIG. 1 is a partially schematic and partially block diagram of an elevator system constructed according to a first embodiment of the invention;

FIGS. 2 and 3 are schematic views of an elevator installation illustrating the operation thereof without and with the teachings of the invention, respectively; and

FIG. 4 is a partially schematic and partially block diagram of an elevator system constructed according to another embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

The subject invention relates to modifications of the elevator system disclosed in the patent, and the invention will be described in detail as applied to the circuits illustrated in the patent.

For the purpose of disclosing working embodiments of the invention, the patent is hereby incorporated by reference into this application. For those portions of the circuits not specifically described herein, it can be

assumed that they function as illustrated and described in the patent except of course that the overall operation of the system will be modified by the disclosed embodiments of the invention.

The invention may be incorporated into an elevator system having any desired number of elevator cars, arranged either for attendant operation or for automatic operation to serve any desired number of floors. However, the invention may be described adequately with reference to an elevator system having three elevator cars arranged for fully automatic operation, as in the patent. Further the invention will be described as being applied to a building having six floors, with the floors being divided into three zones for the purpose of serving down corridor calls. Accordingly, landings **2** and **3** are grouped into a zone, landings **4** and **5** are grouped into a zone, and landing **6** is a zone. As in the case of the patent, the first landing or lower terminal is identified as a zone **Z0**, since it is considered a zone for certain purposes. It is to be understood that this grouping of landings into zones is arbitrary, and the zones may encompass any number of landings.

Electromagnetic switches and relays employed in the control circuits may each have numerous contacts of either the make or the break type. Each set of contacts of a relay or switch is designated by the reference character employed for the relay or switch, followed by a suitable numeral specific to the set of contacts. For example, the reference characters **M1** and **M9** designate, respectively, the first and ninth sets of contacts associated with the running relay M. The symbols designating the contacts on the schematic view indicate whether a particular set of contacts are of the make or break type. For instance, the contacts **M1** are make contacts which are normally open and do not close until the relay M is energized, while the contacts **M9** are break contacts which are normally closed and do not open until the relay M is energized.

The three cars utilized in the system are referred to as the A, B and C cars. Although some of the relays and switches utilized are common to all of the cars, others are individual to each car. For example, there is a holding relay G for each car. In keeping with the labeling system of the patent, the holding relay associated with the elevator car A is identified by the reference character G. The reference characters for the holding relays associated with the B and C cars are preceded by the respective car identifier, i.e., BG and CG; respectively. Therefore, throughout the patent and this application, relays and switches associated with an individual car will be preceded by the appropriate car identifier, except in the case of the A car.

In order to aid the understanding of the invention, the apparatus illustrated in FIG. **1** which is specific to car A, and certain apparatus common to all of the elevator cars, is set forth as follows:

Apparatus for Elevator Car A
DS - Door Relay
E - Inductor Slowdown Relay
F - Inductor Stopping Relay
FA - Downcall Assigned Relay
G - Holding Relay
KB - Down Zone Call Below Relay
M - Running Relay
S - Floor Call Stopping Relay
T - Car Call Stopping Relay
W - Up Preference Relay
X - Down Preference Relay
69H - High call Reversal Relay
69L - Low Call Reversal Relay
Apparatus Common to All Cars
H - Motor Generator Running Relay
KHT - High Up Zone Timing Relay
KLT - Low Up Zone Timing Relay
KMT - Down Zone Priority Relay
K0, K1, K2, K3 - Down Zone Demand Registering Relays
ZD - Down Zone Demand Relay
2 DR through **6** DR - Down Floor Call Registering Relays

The first embodiment of the invention, which is shown in FIG. **1**, will be described as being applied to the distribution of service to down landing or corridor calls. It may also be applied to up corridor calls, although providing equitable service to up calls is not as difficult as for down calls since most up calls in a building originate from the lower terminal floor while the down corridor calls appear randomly throughout the building.

When a prospective passenger presses the down corridor call button at a landing, the down floor call register relay for that floor is energized and it remains energized until an elevator car answers the call. Contacts of the appropriate down call registering relay close to energize the associated down zone demand registering relay **K1, K2,** or **K3.** The down zone demand registering relay **K1** is associated with the first down zone comprising the second and third floors, the relay **K2** is associated with the second down zone comprising the fourth and fifth floors, while relay **K3** is associated with the third down zone which comprises the sixth floor. Relays **K1, K2** and **K3** are energized by make contacts of the down floor call registering relays for the floors in the zone with which the respective relay is associated. Each of the down zone demand registering relays **K1, K2** and **K3** has a cancelling coil associated therewith wound on the same core, which is energized in opposition to the energization of the relay energizing coil when it is desired to reset and drop out the relay. Thus, reference herein to the registration of down zone demands for service refer to the conditions of the down zone demand registration relays **K1, K2** and **K3.** In other words, pick-up of one of these relays indicates the registration of a down zone demand for service as opposed to the registration of a down floor call for service, while dropout thereof signifies the absence or cancellation of such a down zone demand. In order for one of the relays **K1, K2** or **K3** to be picked up, a down floor call must be registered for a floor in the associated down zone, but when such a down floor call is registered, the associated down zone demand registering relay may be dropped out as a result of the operation of its associated cancelling coil; i.e., a down floor call must be registered in order to register a down zone demand for service, but the absence of the registration of a down zone demand for service does not necessarily indicate the absence of a registered down floor call for a floor in the associated zone. In addition, the energization of the down zone demand registering relay does not necessarily indicate the absence of a car in the zone conditioned to answer the registered down floor calls in the zone.

Pick up of the relay **K0** indicates the existence of a demand for elevator service for the first or lower termi-

nal floor. This relay is energized by means other than by the registration of a down corridor call and reference should be made to FIG. 8 of the patent for an illustration of the circuits for energizing this relay.

The patent describes in detail a system for assigning elevator cars to zones having their zone demand registering relays energized, to provide service for the down floor calls registered in such zones. According to the system of the patent, a zone demand relay ZD is energized when the number of down zones requiring service exceeds the number of cars serving down calls. Energization of this relay is controlled by a bridge circuit which has one arm having resistors R25, R26, R27 and R28 connected in series, with each resistor shunted respectively by the break contacts K0-3, K1-5, K2-5 and K3-4 of the appropriate zone demand registering relay. When none of the zone demand registering relays is energized, this arm of the bridge circuit is shorted. As the respective zone demand registering relays are picked up, the associated resistor is inserted into this arm of the bridge circuit. For example, when relay K2 is energized, the contacts K2-5 are opened to insert the resistor R27 into the bridge circuit. The resistors K25 through R28 are all equal in value, so that the total resistance in this arm of the bridge circuit is proportional to the number of zone demand registering relays which are energized.

The other arm of the bridge circuit includes resistors R31, R32, R33 and R34 connected in series. The resistor R32 is shunted by break contacts FA11 of the own call assigned relay for the A car, which contact is connected in series with the make contacts KB2 of the down zone call below relay associated with the A car. The resistors R33 and R34 are shunted by appropriate contacts of the down call assigned relay and down zone call below relays associated with the B and C cars, respectively. A down call assigned relay, for example relay FA associated with the A car, is energized while its associated car is being assigned to serve down calls. It will only remain energized momentarily if the car is above the down call it is to serve. If the car is below the assigned down call, the down call assigned relay will remain energized until the car reaches the assigned call and reverses its direction. A down call below relay, for example the KB relay associated with the A car, is energized at all times except when its associated car is traveling down, and a down zone demand registering relay for a zone below the car is energized.

Thus, resistors R32, R33 and R34 will be shunted except when a car is set for down travel and there is a down zone demand registered below the car; or, a car is traveling up to serve a down zone demand.

Resistors R31 through R34 are all equal in value to one another, and to the value of the resistors R25 through R28. With no down zone demands registered, all of the resistors in the upper arm of the bridge circuit are shunted so that the effective resistance of this arm is zero. Under these conditions, no cars will be serving down demands so that the resistors R32, R33 and R34 are also shunted. However, the resistor R31 is always a part of the effective resistance of the lower arm of the bridge circuit. Reference to the patent will show that the relay ZD will remain deenergized unless the effective resistance in the upper arm of the bridge circuit is equal to or greater than the effective resistance in the lower arm of the bridge circuit. Therefore, with no zone demands registered and no cars serving down corridors calls, relay ZD will be deenergized. When a call is registered in a zone, for instance the second down zone, so that the second down zone demand registering relay K2 is energized to open the break contacts K2-5, the resistor R27 will be introduced into the upper arm of the bridge circuit. Since the resistor R27 equals the resistor R31, the total effective resistance in the upper arm of the bridge circuit is equal to that in the lower arm of the bridge circuit thereby resulting in the energization of the zone demand relay ZD. The relay ZD is therefore a master zone demand relay which is energized when there are more demands than there are cars serving those demands.

Energization of the zone demand relay ZD results in the closing of the make contacts ZD2. Reference to the patent will show that this will result in the energization of a down call assigned relay, such as relay FA for the A car, through appropriate car and zone selection circuits. Energization of the relay FA results in the opening of the break contacts FA11 thereby inserting the resistor R32 into the lower arm of the bridge circuit. Since the total effective resistance in the lower arm of the bridge circuit is now twice that in the upper arm of the bridge circuit, the relay ZD will be deenergized to indicate that a car has been assigned to serve the down zone demand in the second down zone.

As hereinbefore mentioned, if the A car is below the second down zone when it is assigned, the contacts FA11 will remain open until the car reaches the second zone and reverses direction. On the other hand, if the car is above the second down zone when it is assigned thereto, the contacts KB2 will remain open to insert the resistor R32 into the lower arm of the bridge circuit. If the A car is idle in the second down zone when assigned, it will complete the circuit for the cancelling coil of the zone demand relay K2, and therefore close the contacts K2-5 to deenergize the down zone demand relay ZD. It can be seen that the relay ZD serves as a master down zone demand relay which is energized whenever there is a down zone requiring down elevator service which has not be provided for. It is also clear, that the zone is provided for when there is a car on its way to serve the demand. If a car is already in position, the down zone demand is provided for without assigning an available car. For example, if the A car is already traveling down in the third down zone when the down zone demand registering relay K2 of the second zone is energized, the contacts KB2 of the down zone call below relay KB will open to insert the resistor R32 into the lower arm of the bridge circuit, thereby preventing the energization of the relay ZD.

The circuits of the patent which make up the assignment means thereof, assign the first car that becomes available to the highest zone requiring down elevator service. The next car to become available is assigned to begin serving down corridor calls at approximately the middle of the down zones which have their down zone demand registering relay picked up. Cars which subsequently become available are assigned either to the highest down zone requiring service, if there is no car assigned to such zone or above such zone, or to the midpoint of the unsatisfied demand.

According to the system disclosed in the patent, when all zones have been provided for, cars which subsequently become available will not be assigned since the relay ZD will not be energized. It is desirable, however, that available cars be assigned to assist down trav-

eling cars as long as they are not needed elsewhere. The need for this would be more evident in an installation wherein there are many floors per zone, or in buildings with a large bank of cars serving a small number of floors, with large floor area per floor.

FIG. 2 is a schematic view of an elevator installation which illustrates a traffic condition where cars are available but not assigned, according to the system of the patent. The landings are grouped into zones, illustrated by brackets embracing the selected floors and labeled Z0, Z1, Z2 and Z3 on the left side of the diagram. Registered up and down floor calls for selected floors are shown on the right side by appropriately oriented triangles. Locations of eight cars are indicated by blocks referenced A through H. Solid arrows extending from a block indicate the direction of travel. Absence of a solid arrow indicates the car is available.

More specifically, car A is loading at the sixth floor; car B is slowing down to stop at the fourth floor in response to either a car or corridor call; car C is traveling up to answer the up call at the fourth floor; car D is bypassing due to load; car E is loading at the second floor; cars F and G are available at the lower terminal or main floor; and, car H, which is "next," is unloading at the main floor. This traffic condition represents heavy down traffic, and yet no down service demand exists which would pick up relay ZD, as cars A and B are set for, or traveling in the down direction, and should be able to answer the down corridor calls at the fifth and third floors, respectively. However, car A is loading at the sixth floor, and car B is slowing down to stop at the fourth floor. Cars F and G are available but will not be assigned. Should cars A and B become fully loaded, they will bypass to the main floor, further delaying service to the fifth and third floors.

The present invention expedites service to these down calls when additional cars are available, without dispatching an additional car unnecessarily, by considering only a downwardly moving car which has not initiated slowdown as a car which can answer a down demand in a lower zone. In other words, a down traveling car that has stopped at a landing, or is preparing to stop at a landing, is not regarded as a car that can answer a down demand in a zone ahead of where it is stopped or stopping.

Using this principle, the elevator system shown in FIG. 2 would operate as shown in FIG. 3, which is a schematic view of the same traffic condition shown in FIG. 2, but applied to a system which operates according to the first embodiment of the invention. The dotted lines in FIG. 3 indicate travel of the cars after assignment.

More specifically, the system of FIG. 3 does not recognize cars A and B as being able to serve the down calls at the fifth and third landings, and available car F would be assigned to answer the down call at one of these floors, such as the third floor, and available car G would be assigned to answer the down call at the other floor. Thus, the available cars at the main floor are utilized to serve calls when there is a good possibility that down travelling cars located in zones above the zones of the calls will be delayed in serving them. When the down traveling car has not initiated slowdown, the basis for determining whether a down demand exists is unmodified, as it is likely the car will promptly serve the call.

Referring again to FIG. 1, FIG. 9 of the patent is modified to provide the desire functions by shunting each of the resistors R32, R33 and R34 by a circuit which includes contacts from a relay which indicates the car is conditioned for down travel, and contacts from relays which indicate that the car is stopped, or is preparing to stop.

Contacts from the holding relay G may be used to indicate that the car is preparing to stop at a landing, as the holding relay G is energized when a car call is registered for a floor which the car is approaching (contacts T1), when the car is approaching a floor at which it is to reverse its direction (contacts 69L1 or 69H1), or when the car is approaching a floor at which it is to answer a corridor call (contacts S1).

The contacts from the holding relay G which indicates the car is preparing to stop, may not be used to indicate a stopped car, however, as the door relay DS is deenergized by limit switch 23 when the doors start to open after the car stops at a landing. When the door relay DS drops out, contacts DS1 open to drop out the running relay M, and contacts M1 open to drop out the holding relay G. Since the door relay DS starts the sequence which drops out the holding relay G, break contacts on the door relay DS may be used to indicate a stopped car. Thus, as shown in FIG. 1, make contacts G2 from the holding relay may be connected in parallel with break contacts DS3 from the door relay DS, with respect to make contacts X12 from the down preference relay X. This circuit is connected across resistor R32, and the circuit is thus also in parallel with the shunting circuit which includes break contacts FA11 and make contacts KB2. The other resistors R33 and R34 for cars B and C, respectively, are shunted by contacts from the holding, door, and down preference relays associated with those cars. Therefore, even though contacts KB2 open in response to a call in a zone below the zone in which the associated car is traveling down, to prevent the down zone demand relay ZD from being picked up, if the car is preparing to stop, the resistor R32 will be shorted by the circuit which includes contacts X12 and G2, and if the car is stopped, resistor R32 will be shorted by the circuit which includes contacts X12 and DS3. Thus, the slowing or stopped car is not considered as a car which can satisfy the down demand, and the down zone demand relay ZD will be picked up by the call for down service, and initiate the sequence described in the patent for assigning an available car to serve the call. If the car is traveling downwardly towards the zone of the call for down service, and it is not preparing to stop, contacts G2, DS3 and KB2 will all be open, and the down zone demand relay will not pick up in response to the call. This downwardly traveling car will promptly serve the call, and it is unnecessary to assign an additional available car to serve this call.

FIG. 4 is a schematic diagram of an elevator system constructed according to another embodiment of the invention. Apparatus illustrated in FIG. 4 which was not shown in FIG. 1, is set forth below:

Apparatus for Elevator Car A
FR - Available car relay
FU - Up Car Assigned Relay
N - Next Car Relay
SS - Start Relay
ZO - Zone Position Relay
38R - Car Call Above Relay

78U - Up Call Above Relay
981 - Lower Terminal No-Start Relay
Apparatus Common to all Cars
MFB - Lower Terminal Surplus Car Relay
NDR - No Demand Return Relay
UTA - Dispatching Interval Expired Relay

Normally, the upper terminal of a building has the same traffic pattern as the floors intermediate the lower and upper terminal, and the system of the patent is very effective in preventing bunching of the cars, and thus it provides excellent service to all of the landings. When the upper terminal is a transfer floor, or has unusually heavy traffic for other reasons, the system of the patent is not as effective, since the cars which arrive at and leave the upper terminal may seldom be available for a specific assignment. In the system of the patent, if the car arrives at the upper terminal in response to a car call, and no demand for down service from the upper terminal has been registered, the up preference relay W will remain energized and the car is available to serve specific assigned down landing calls, as contacts W7 are closed to energize the available car relay FR. If the car arrives at the upper terminal in response to a down call at that floor, the high call reversal relay 69H will be energized via contacts DCA1, FA4 and X6, contacts 69H2 will be open, and the up preference relay W will drop when the car stops and contacts M2 of the running relay open. When the up preference relay W drops, its contacts W7 in the available car relay circuit open, and the car cannot be made available to serve specific down corridor calls.

The embodiment of the invention shown in FIG. 4, which is a modification of FIG. 4 in the patent, provides efficient, anti-bunching service when the upper terminal is a heavy traffic landing, by making cars at the upper terminal available under certain predetermined traffic conditions, notwithstanding that the car is conditioned to travel down with passengers.

In general, the basis for determining car availability is modified from that disclosed in the patent, when a down zone traffic demand condition exists, as sensed by the traffic sensing means of the patent. The traffic sensing means of the patent includes down zone demand registering relays K0, K1, K2 and K3, and the down zone demand relay ZD, which operate in a bridge circuit as hereinbefore described relative to the first embodiment of the invention. In the second embodiment of the invention, the energization of the down zone demand relay ZD is used as one of the traffic conditions which determines whether the availability basis is to be modified.

Another traffic condition which is considered when determining whether to modify the availability basis is loading of the car. If the car loading exceeds a predetermined percentage of full load, such as 50 percent, the basis for determining availability is not changed, even though the down zone demand relay ZD is energized.

More specifically, since the modification is only considered when the car is at the upper terminal, contacts Z0-1 of the zone position relay Z0 associated with the lower terminal will be closed, and contacts MFB1 and NDB1, connected in parallel with contacts Z01, associated with lower terminal surplus car relay MFB and the no demand return relay NDR, respectively, need not be considered.

Contacts 78U-3 will be closed at the upper terminal, as they are associated with the up call above relay 78U, which is energized when the car is not at the first floor and there are no up floor calls registered at or above the floor where the car is located. Therefore, contacts 981-1, associated with the lower terminal no start relay 981, which are connected in parallel with contacts 78U3, need not be considered.

Limit switch 27 closes when the car doors are within 4 inches of their fully-closed position, and the contacts UTA1 and N1 which are serially connected across switch 27, which are associated with the dispatching interval expired and next car relays, respectively, need not Be considered.

Contacts M6 open at the upper terminal to open the circuit which includes the the car call above relay 38R. Thus, contacts 38R2 are closed at the upper terminal. Contacts SS1, M9 and FU2 are also closed when the car is at the upper terminal.

The modification circuit, to be effective, need only shunt the make contacts W7 of the up preference relay, and thus may be connected from the junction J1 between contacts FU2 and contacts W7, to the junction J2 between contacts W7 and contacts FA3. The latter contacts are associated with the down call assigned relay FA, and are open once the car is assigned, to drop out the car availability relay FR.

The circuit added by the second embodiment of the invention includes a series circuit between junction J1 and J2, which includes a limit switch TZ1 which closes when the associated car is at the upper terminal. A switch TLW is provided in this series circuit which is responsive to car load, with switch TLW being closed when the load is below a predetermined percentage of full load, and open when the load exceeds this predetermined percentage. Make contacts ZD8 from the down zone demand relay ZD are also included in this circuit, which close when the traffic sensing means senses a down traffic condition in which there are more down zone demands for service than cars assigned to serve down calls.

The circuit of FIG. 4 of the patent is further modified, as shown in FIG. 4 of the present application to make it unnecessary for a car which arrived at the upper terminal in response to a car call, to wait for a specific assignment to serve corridor calls, or to wait for a command to return to the lower terminal and park. In other words, this further modification enables the car to serve car calls for passengers who entered the car at the upper terminal without registering a demand for down service via the corridor push button.

This function may be accomplished by a circuit which includes a limit switch TZ2, which closes when the car arrives at the upper terminal, after the car call for the upper terminal has been cancelled, and a unidirectional device DX. Switch TZ2 and device DX are serially connected from the junction J3 between the limit switch M6 and the contacts 2CR2 through 6CR2 of the car call relays, to the junction J4 between the contacts X6 and the high call reversal relay 69H. Unidirectional device DX, which may be a semiconductor diode, is poled to allow current to flow only from junction J3 to junction J4. Thus, when the car is at the upper terminal in response to a car call, the limit switch TZ2 will be closed and a car call registered in the car for any floor will pick up relay 69H. Relay 69H will open its contact 69H2, dropping the up preference

relay W and picking up the down preference relay X. The car will be available for assignment through the modification circuit which includes switch TZ1, the switch TLW and contacts ZD8, until the car leaves the upper terminal, at which time the limit switch TZ1 will open.

In the operation of the elevator system shown in FIG. 4, when the elevator car arrives at the upper terminal and stops, limit switches TZ1 and TZ2 will close, contacts M9 of the running relay M will close, and limit switch TLW will be closed if the car load does not exceed a predetermined percentage of full load. If there is no down zone demand, indicated by deenergization of relay ZD, the availability circuit will not be modified, as make contacts ZD8 in the modifying circuit will be open, and car availability will be determined as disclosed in the patent. If there are more down zones requiring down service then the number of cars serving down calls, relay ZD will be energized, energizing the availability relay FR as follows:

L1, 27, 38R2, 78U3, SS1, M9, FU2, TZ1, TLW, ZD8, FA3, ZO-1, FR, L2

Relay FR enables the down call assigned relay FA for the associated car, and if the car is assigned to the down call, break contacts FA3 will open to drop out the availability relay FR. The down call assigned relay FA will also open its contacts FA11, shown in FIG. 1, to indicate a car has been assigned to the down demand.

In summary, there has been disclosed new and improved elevator systems which may be used to improve the operation of the basic elevator system disclosed in U.S. Pat. No. 3,256,958 in certain types of installations. For example, if the elevator installation has fewer down zones than cars, or a large number of floors per down zone, it may be desirable to change the basis for determining the existence of a demand, according to the teachings of the first embodiment of the invention. This embodiment of the invention, unlike the system of the patent, does not consider a car set for down travel, which is above the down zone in which the demand exists as being able to satisfy the demand, if the car is stopped, or preparing to stop. If the car in a zone above is stopped, or stopping, the modified system will search for an available car and dispatch it to serve the call. If the car in the zone above is traveling downwardly and is not in the process of stopping, the modification circuit is ineffective, and the car is considered as being able to answer the down demand.

If the elevator installation has unusually heavy traffic to and from an upper terminal floor, the system of the patent may be improved by utilizing the system of the second embodiment of the invention, which, in certain traffic conditions, modifies the basis for determining if a car is available to serve a registered demand for down service. Instead of automatically considering a car which arrives at the upper terminal in response to a down corridor call as not being available the car is considered to be available for assignment to serve specific down landings calls if a down zone demand exists and the car loading is below a predetermined value, notwithstanding the car being conditioned for down service with passengers. This provides equal distribution of service throughout the building. This embodiment of the invention may be incorporated into an elevator system in which the first embodiment of the invention has been also incorporated, or the embodiments may be applied individually to elevator systems, as required by specific installations.

I claim as my invention:

1. An elevator system, comprising:
- a structure having a plurality of landings, with said landings being divided into zones,
- a plurality of cars mounted for movement relative to said structure to serve said landings,
- and control means controlling the movement of the cars between the landings, said control means including call registering means, availability means, zone demand means, master zone demand means, and assignment means,
- said call registering means being operable for registering a call for service from a plurality of said landings.
- said availability means being associated with each of a plurality of said cars and operable to condition the associated car to be available for assignment to serve registered calls,
- said zone demand means being associated with a plurality of zones and operable in response to the registration of calls at a landing to establish a demand for service to the associated zone,
- said master zone demand means being operable from a first condition to a second condition responsive to the presence of zone demands in excess of the number of cars serving registered calls,
- said master zone demand means including means for sensing whether a car approaching a registered call ahead of its direction of travel, which call requests service in the direction of travel of the car, is in the process of serving another landing, said master zone demand means counting a car as serving a registered call only when the car is moving and not in the process of serving a landing,
- said assignment means being responsive to the operation of said master zone demand means to its second condition, to assign an available car to serve the registered calls.

2. The elevator system of claim 1 wherein the assignment means includes means for selecting the zone to which a car is assigned from a plurality of zones requiring service, according to the pattern of such zones and the pattern of cars already serving those zones.

3. The elevator system of claim 1 wherein the call registering means includes means operative to register calls for service in a first direction from a plurality of the landings, and the master zone demand means indicates when all zones having registered first direction landing calls are provided for.

4. The elevator system of claim 3 wherein a first direction landing call is only considered provided for by a car displaced in the second direction from the zone having a registered first direction call, when the car is moving toward the zone of the call and is not in the process of stopping at the landing outside the zone of the call.

5. An elevator system, comprising:
- a structure having a plurality of landings, including lower and upper terminal landings, and a plurality of intermediate landings,
- a plurality of cars mounted for movement relative to said structure to serve said landings,
- and control means controlling the movement of the cars between the landings, said control means in-

cluding landing call registering means, car call registering means, and availability means,

said landing call registering means being operable for registering a call for service from a plurality of said landings,

said car call registering means being operable for registering a call for each of the landings desired for the load within the associated car,

said availability means being associated with each of a plurality of cars and operable under predetermined conditions, including the requirement that the car be conditioned for up travel, to condition the associated car to be available for assignment to serve calls registered on the landing call registering means,

and traffic sensing means responsive to a predetermined traffic demand for rendering said availability means operable to condition a car located at the upper terminal floor to be available to serve calls registered on said landing call registering means, notwithstanding the car being conditioned for down travel with passengers.

6. The elevator system of claim **5** including load sensing means responsive to load within each of the cars, said load sensing means overriding the traffic sensing means when a car exceeds a predetermined loading, to prevent the traffic sensing means from conditioning a car to be available for serving registered landing calls.

7. The elevator system of claim **5** wherein the predetermined traffic condition sensed by the traffic sensing means is demand for service towards the first terminal floor.

8. The elevator system of claim **5** wherein the plurality of landings are divided into a plurality of zones, and the traffic sensing means includes zone demand means and master zone demand means, said zone demand means being associated with a plurality of said zones and operable in response to a registration of a call at a landing on the landing call registration means to establish a demand for service to the associated zone, said master zone demand means being operable from a first condition to a second condition responsive to the presence of zone demands by said zone demand means in excess of the number of cars serving registered landing calls, the availability means being responsive to the second condition of said master zone demand means to condition a car located at the upper terminal to be available to serve calls registered by the landing call registration means.

9. The elevator system of claim **8** including assignment means, said assignment means being responsive to the second condition of the master zone demand means, to assign an available car to serve registered landing calls.

10. The elevator system of claim **8** including load sensing means responsive to load within each of the cars, said load sensing means overriding the traffic sensing means when a car exceeds a predetermined loading to prevent the traffic sensing means from conditioning a car to be available for serving registered landing calls.

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