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(71) Applicant : OTIS ELEVATOR COMPANY
10 Farm Springs
Farmington, CT 06032 (US)

(72) Inventor : Kameli, Nader
658 West Main Street
New Britain, Connecticut 06053 (US)

(74) Representative : Jolly, Jean-Pierre et al
Cabinet Jolly 54, rue de Clichy
F-75009 Paris (FR)

(54) Elevator dynamic channeling dispatching for up-peak period.

(57) An elevator dispatching system is provided so that floors of a building are assigned to non-overlapping, equal traffic volume sectors that are dynamic in that both the number of floors in the sectors and the number of sectors is variable, depending upon traffic predictions for an up-peak period in the building. The floors within a sector are contiguous and the sectors within the building are contiguous. After the sectors are created an elevator car is assigned to each sector to be dispatched in association therewith. A floor service indicator means displays which elevator cars have been assigned to which sectors.

Where the sum of the populations of adjacent sectors falls below 100% of car capacity, said sectors are combined.

When the sum of the populations of adjacent sectors does not exceed a given limit, the adjacent sectors are combined and the elevator cars are dispatched according to the new sector assignments.

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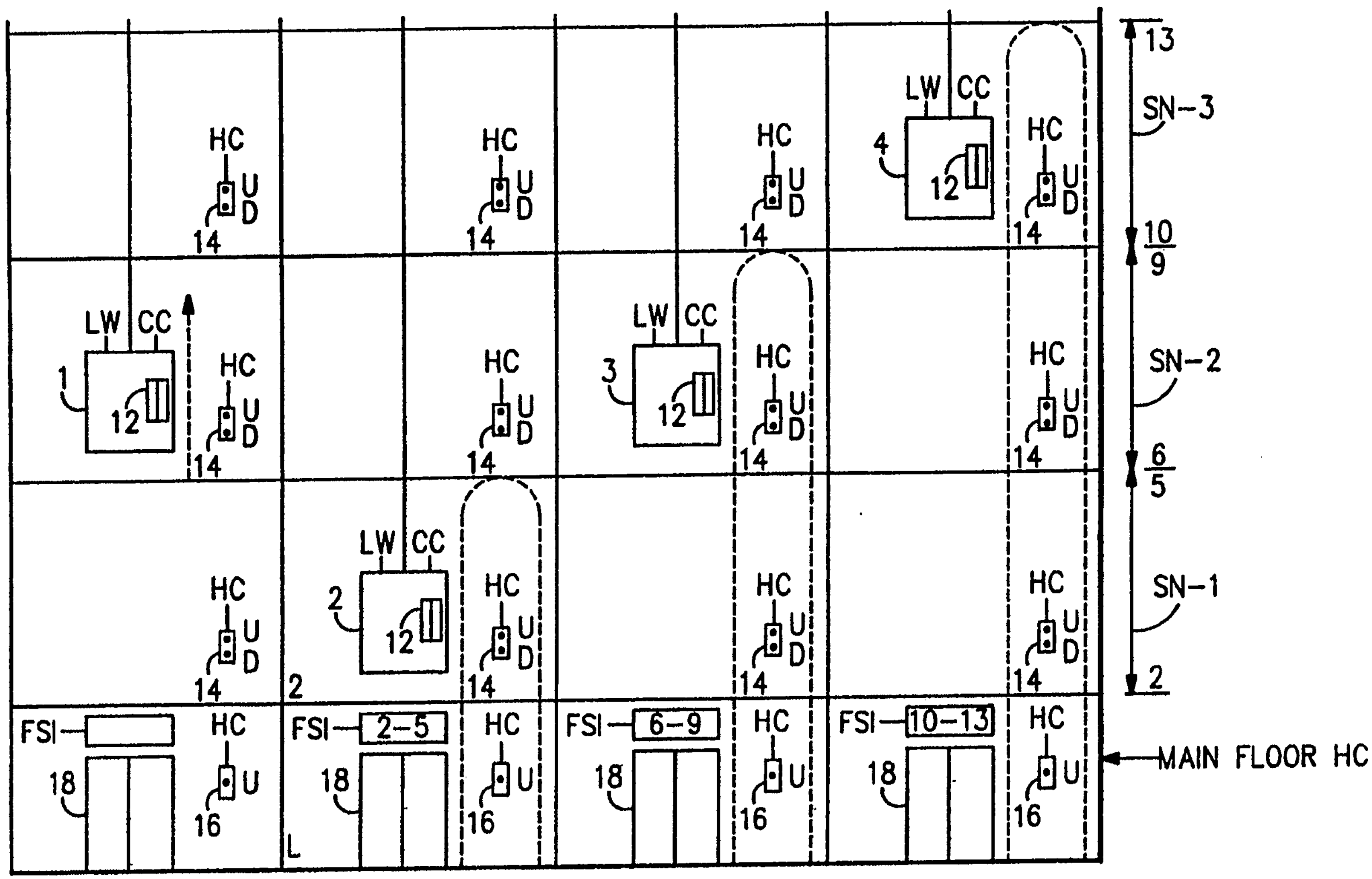

LW
CC
HC
U
D
1
2
3
4
12
14
16
18
L
FSI
2-5
6-9
10-13
13
SN-3
10
9
SN-2
6
5
SN-1
2
MAIN FLOOR HC

FIG.1

Technical Field

This invention relates to an elevator dispatching system which collects information on traffic flow and uses that information in assigning the floors of the building to sectors. The dispatching system then selects specific elevator cars to service designated sectors. In addition, such sectoring is optimized based on car capacity or the population density of the sector or channel.

Background Art

Elevator systems in the past have dispatched elevators in no particular fashion except that each elevator responds to hall calls (HC) from a passenger in the hall and car calls (CC) from a passenger in the car. Such elevator systems are inefficient because:

(i) cars are dispatched that are not full, (ii) the queue length, i.e. the number of people waiting to be served by the elevator, is unnecessarily long, (iii) the waiting time of passengers is unnecessarily long, and (iv) the number of stops by the car is more than it needs to be to achieve the same level of service.

The goal of an improved dispatching system is to reduce the time required for elevator service, or simply, the service time. The service time is composed of waiting time and travel time. The waiting time is the time period from when a passenger presses a button to make a hall call to the time when the elevator arrives to receive the passenger. The travel time is the time period from arrival of the elevator to receive the passenger to the arrival of the elevator at the destination floor and is dependent upon car speed and the number of car stops. Improved dispatching, while it cannot increase car speed, can both improve waiting time and reduce the number of car stops to reduce the time required for elevator service.

In order to maximize the efficiency of a dispatching system, the elevator should be dispatched when the number of people wishing to go to a floor is maximized - this would minimize the percentage of time that the car is not full on a run. An improved dispatching system will also take into account the extent that the traffic flow in a given building follows certain general patterns during certain periods of the day. Traffic from the lobby to the upper floors of an office building, called up-peak, is high in the early morning when people are coming to work. Traffic from the upper floors of the building to the lobby, called down-peak, is highest in the late afternoon, when people are leaving work. Interfloor traffic, traffic usually found between the hours of 10:00 a.m. and 12:00 p.m. or 1:00 and 4:00 p.m., when people have come to work and are working on a particular floor, but are not going to or from lunch, is less pronounced than up-peak or down-peak, and may be appropriately called off-peak.

An advance in efficient dispatching divides the building into sectors for elevator service so that certain floors are grouped in a specific sector and selected elevator cars are assigned to service that sector so that the number of car stops is minimized. A system of dividing the building into sectors may be found in U.S. Patent No. 4,804,069 by Bittar et al entitled "Contiguous Floor Channeling Elevator Dispatching." This patent discloses a system of "static channeling" in which the total number of floors in a building is divided into a constant number of sectors.

A system of dynamic channeling maybe found in U.S. Patent No. 4,846,311 by Thangavelu, entitled "Optimized "Up-Peak" Elevator Channeling System With Predicted Traffic-Volume Equalized Sector Assignments." In this patent the number of floors per sector is variable, hence the name "dynamic" channeling. The number of floors in each sector is varied based upon the location of the passengers in the building and their pattern of movement within the building and not upon the number of floors in a building. U.S. Patent No. 4,846,311 discloses an elevator dispatching system using dynamic channeling to decrease queue length and waiting time and increase elevator handling capacity. This system of "dynamic" channeling assigns floors to sectors such that the traffic volume per sector is equal. This is as opposed to static channeling in which a) the number of floors per sector is constant regardless of the number of people in the sectors, and b) the assignment of the floors to the sectors does not change. This system uses real and historic time predictions of traffic to determine the assignment of floors to sectors.

Static channeling is not the optimum dispatching strategy because it does not consider variations in traffic patterns.

Dynamic channelling as disclosed in these patents has been effective, but may be further improved. While the number of floors in a sector is not constant in the patent, the number of sectors in the building is a constant. Secondly, the reference does not constrain the number of floors in a sector with the result that there might be, for example, ten floors in a single sector allowing the potential for less than optimum dispatching. Thirdly, the above system of dynamic channeling allows one sector to overlap another. Passengers planning to go to the overlapped floor may see that they can get to there quicker by boarding the car with the overlapped floor as its first stop rather than its last. This will cause a reduction in the overall efficiency of the dispatching strategy.

It is noted that some of the general prediction techniques utilized in the present invention are discussed in general (but not in any elevator context or in any context analogous thereto) in Forecasting Methods & Applications by Spiros Maridakis and Steven C. Wheelwright (John Wiley & Sons, Inc., 1978).

Disclosure of the Invention

Objects of the present invention include efficiently dispatching elevator cars to decrease passenger waiting time, to decrease passenger queue lengths, and to decrease elevator service time during the up-peak period.

Still further objects of the present invention include ensuring that cars in an elevator system are filled to capacity, power consumption is reduced, and the life of the elevator system being lengthened.

Still further objects of the present invention include reducing service and waiting times, and increasing the frequency of sector assignment to cars.

According to the invention, an elevator dispatching system utilizes trafficestimates for each floor during the up-peak period such that floors of the building are assigned to sectors with the number of floors per sector and the number of sectors in the building varying according to the amount of traffic entering the lobby, and the destination floor, so that the sectors do not overlap and the number of floors per sector does not exceed a predetermined limit. In further accord with the invention, a traffic measuring means detects a situation where the number of people in two or more adjacent sectors is less than 100% of car capacity and these adjacent sectors are combined. In further accord with the invention, if the total number of people in adjacent sectors is less than an optimal average number of persons per sector, the adjacent sectors are combined reducing the number of sectors, thereby leaving more cars available, and increasing the frequency of assignment.

These and other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of a best mode embodiment thereof, as illustrated in the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a plan view of an elevator system in which the present invention may be applied;

Fig. 2 is a block diagram of a elevator control system using ring communication;

Fig. 3 is a logic flow diagram as may be used in the present invention.

Fig. 4 is a logic flow diagram as may be used in the present invention.

Figs. 5A, 5B and 5C are sector definition tables.

Fig. 6 is a logic flow diagram as may be used in the present invention.

Figs. 7A,7B, and 7C are tables of the sector assignments.

Best Mode for Carrying Out the Invention

An exemplary multi-car, multi-floor elevator application, with which the exemplary system of the present invention can be used, is illustrated in Fig. 1. Elevator cars 1-4 serve a building having a plurality of floors. The building has an exemplary 13 floors above a main floor, typically a ground floor or lobby (L). However, some buildings have their main floor at some intermediate or other portion of the building, and the invention can be adapted to them as well. Each car 1-4 contains a car operating panel (COP) 12 through which a passenger may make a car call to indicate a destination floor by pressing a button on the COP, producing a signal (CC), identifying the floor to which the passenger intends to travel. On each of the floors there is a hall fixture 14 through which a hall call (HC) is provided to indicate the intended direction of travel by a passenger on the floor. At the lobby (L), there is also a hall call fixture 16, through which a passenger calls the car to the lobby.

The depiction of the elevator system in Fig. 1 is intended to illustrate the selection of cars during an up-peak period, according to the invention, at which time the floors 2-13 above the main floor or lobby (L) are divided into an appropriate number of sectors depending upon the number of cars in operation and the traffic volume, with each sector containing a number of contiguous floors assigned in accordance with the criteria and operation used in the present invention.

The number of sectors into which the building is divided may change based on variations in the values of system traffic parameters and hence the building traffic. These traffic parameters may be car load weight (LW), or hall calls (HC). The number of sectors into which the building is divided will be greater than or equal to 1, not a constant. The number of sectors is assigned such that each sector carries a volume of traffic approximately equal to that of any other sector. At the lobby, there is a floor service indicator (FSI) for each car which shows the temporary, current selection of available floors exclusively reachable from the lobby by the car assigned to that sector, which assigment changes throughout the up-peak period. For distinguishing purposes each sector is given a sector number (SN) and each car is given a car number (CN).

The assignment of floors to sectors shown in Figure 1 represents only the sectors being used at a particular instant in time. The assignment of floors to the sectors shown, and consequently the division of the floors of the building into sectors, is dynamic, based on traffic variations. As empty cars arrive at the lobby, they are assigned to sectors in "round robin" fashion. Each car receives a sector assignment as it arrives at the lobby. If, for example, car 4 has just left the lobby and cannot be given a new sector assigment car, one will receive the assigment as soon as it gets to the lobby.

Fig. 1 shows an exemplary floor-car-sector assigment. Car 1 is allowed to be unassigned to a sector; car 2 (CN=2), is assigned to serve the first sector (SN=1). Car 3 (CN=3) serves the second sector (SN=2), and car 4 (CN=4) serves the third sector (SN=3). As Car 1 is not assigned to a sector it may serve none of the floors. The floor service indicator (FSI) for car 2 will display, for example, floors 2-5, the presumed floors assigned to the first sector for this example, to which floors that car will exclusively provide service from the lobby. Car 3 similarly provides service to a second sector, consisting of the floors assigned to that sector, for example floors 5-9, and the FSI for car 4 will show those floors. The FSI for car 4 indicates floors 10-13, the floors assigned to a third sector. Because of the round-robin assignment of cars to sectors, Car 1, though not functioned at the instant shown, will be assigned the next available sector in the order.

The FSI for car 1 is not illuminated, showing that it is not serving any particular sector at this particular instant of time during the up-peak channelling sequence reflected in Figure 1..

Each car will only respond to car calls that are made in the car from the lobby to floors that coincide with the floors in the sector assigned to that car. Car 4, for instance, will only respond to car calls made at the lobby to floors 10-13. It will take passengers from the lobby to those floors (provided car calls are made to those floors) and then return to the lobby empty, unless it is assigned to a hall call.

This system can collect data on demand throughout the day, by means of load weighers, for example, to arrive at a historical record of traffic demands for each day of the week and compare it to actual demand to adjust the overall dispatching sequences.

All such signals HC, CC, as well as other signals, like load weight (LW) are read by a door control subsystem 111 and are communicated by means of a ring communication system (Fig 2). There are three microprocessor systems associated with each car controller. Figure 2 shows an eight car group, each car having one operational controller subsystem (OCSS) 101, one door control subsystem (DCSS) 111 and one motion control subsystem (MCSS) 112. Such a system may be found in co-pending application serial number 07/029,495, (Otis Docket No. OT-522) entitled "Two Way Ring Communication System For Elevator Group control" by Auer and Jürgen (filed March 23, 1987).

There, elevator dispatching may be distributed to separate microprocessor systems, one per car. These microprocessor systems, known as operational control subsystems (OCSS) 101, are all connected together via two serial links (102, 103) in a two way ring communication system. Figure 2 shows an eight car group configuration. For clarity purposes MCSS (112) and DCSS (111) are only shown in relation to a specific OCSS; however, it is to be understood that there would be eight sets of these systems, one set to correspond with each elevator.

Hall buttons and lights, i.e., the elevator group related fixtures as opposed to car related fixtures, are connected with remote stations 104 and remote serial communication links 105 to the OCSS 101 via a switch-over module (SOM) 106. The car buttons, lights and switches are connected through remote stations 107 and serial links 108 to the OCSS 101. Car specific hall features, such as car direction and position indicators, are connected through remote stations 109 and a remote serial link 110 to the OCSS 101.

The car load measurement is periodically read by a door control subsystem (DCSS) 111, which is part of each car controller. This load is sent to motion control subsystem (MCSS) 112, which is also part of each car controller. DCSS 111 and MCSS 112 are microprocessor systems controlling door operation and car motion under the control of the OCSS.

The dispatching function is executed by the OCSS 101, under the control of an advanced dispatcher subsystem (ADSS) 113, which communicates with the OCSS 101 via an information control subsystem (ICSS) 114. The ICSS acts as a communication interface between the elements connected to the ring (OCSSs) and the ADSS. The car load measured may be converted into boarding and deboarding passenger counts by MCSS 112 and sent to OCSS 101. Each OCSS sends this data to the ADSS 113 via ICSS 114.

The ADSS, through signal processing, collects the passenger boarding and deboarding traffic data and car departure and arrival data at the lobby, so that, in accordance with its programming, it can predict traffic conditions at the lobby for predicting the start and end of peak periods, for example up-peak and down-peak. The ADSS 113 can also collect passenger boarding and deboarding counts at other floors and car arrival and departure counts for use in up-peak channeling and for varying bonuses and penalties based on predicted traffic. For further information on these techniques see U.S. Pat. No. 4,363,381, "Relative System Response Call Assigments", U.S. Pat. No. 4,323,142, "Dynamically Reevaluated Elevator Call Assigments", both to Bittar, and a magazine article entitled "Intelligent Elevator Dispatching System" of Nader Kameli and Kandasamy Thangavelu (AI Expert, Sept. 1989; pp. 32-37), the disclosure of which is also incorporated herein by reference.

The system can collect data on individual and group demands throughout the day to arrive at a historical record of traffic demands for each day of the week and compare it to actual demand to adjust the overall dispatching sequences to achieve a prescribed level of system and individual car performance. Following such an approach, car loading and lobby traffic may also be analyzed through signals (LW), from each car, that indicate car load for each car.

Fig. 3 represents the flow of logic of the methodology of the present invention. The creation of sectors begins at the top of the building. Step 301 works from the fact that the dispatching methodology used before implementation of the present methodology was static channeling used during the up-peak period. Step 301 provides that in a system which recently used static channeling, but now will use dynamic channeling, the current sector under construction (SS1) has as its initial defining number the number of static sectors(s) used in the prior channeling scheme. It is initially assumed by the present system that the number of dynamic sectors to be created may be as high as the number of static sectors which already exist. The first step, in effect, sets a counter. For example, if there were 5 static sectors, then the current sector under construction is the fifth sector. There will not be more dynamic sectors created than there were static sectors in the embodiment shown. The maximum limit on the number of dynamic sectors to be created need not be the number of static sectors used; the limit can be changed.

Step 302 sets the size of the present sector under construction as equal to all of the floors in the building from the floor above the lobby to the top floor in the building. The end of the sector under construction (ES1) is the top floor of the building and the start of the sector under construction (SS1) is the floor above the lobby. Step 303 calculates the number of people predicted to be in the sector under construction (NS1). This is done by using electrical signals to access a table of traffic data; the table, stored in a memory block associated with a signal processor, is arrived at by sensing the number of passengers boarding and deboarding over the past several minutes at the same time of day at some earlier time, for example, one or more days ago. The former sensings of boarding/deboarding are accumulated to form a real time prediction of the number of people predicted to be in the sector; the latter are accumulated for making an historic prediction of who will be in the sector. These two predictions, obtained on the basis of boarding/deboarding data, are combined to provide a still better measure of how many people may be in the sectors under construction. This measurement is the input into the present invention. The outputs will be: signals to the OCSS to assign cars to serve certain floors of the building, and signals to a floor service indicator to display information telling which cars are assigned to which floors.

Steps 304-7 work toward the same end: ensuring that the number of people in the sector is equal to a preset number, usually the number of people in the building divided by the number of sectors. The number of people in the building is estimated from information previously collected through load weighers or other means of collecting boarding/deboarding data. This information is also used to predict the destinations of passengers. Ideally, the number of people in each sector would be constant. The difference between BAP (beginning average persons per sector window) and EAP (end average persons per sector window) represents the variation from an average number of people in a sector (AP) which is acceptable. BAP represents the beginning of an acceptable window of variation from AP while EAP represents the end of the window. BAP may be, for example, 90% of AP, while EAP is 110% of AP. Step 304, then, determines if the number of people in the sector under construction, NS1, is less than EAP. If not, then we will want to subtract a floor from the sector, S1. This will reduce NS1. This is the purpose of Step 305. As SS1 is the nth floor at the bottom of the building, increasing it will make the start of the sector the nth plus 1 floor of the sector: the size of the sector will be correspondingly decreased by one.

Having created a sector which has a population less than EAP, the higher end of a population within acceptable limits of AP, we will want to determine if the sector population has fallen below the limit set by the lower end of the window, namely BAP. Determining whether that condition is true or false is achieved by step 306. If it is true then one floor will be reduced from the sector, in step 307, but if it is not true then the next step in the creation of the sector will be step 308.

Having created a sector with the desired population, some number of people not above EAP nor below BAP, it is desired to modify the sector such that the number of floors in the sector does not exceed some predetermined number. Thus, step 308 determines if the number of floors in the sector, the difference between ES1 and SS1, exceeds MP, the maximum number of floors permitted in a sector. Step 309 subtracts a floor from the sector if there are too many floors in the sector. If there are not too many floors in the sector the method of the present invention proceeds to step 310 which determines if every floor in the building has been covered. If not, step 311 reduces by 1 the counter which keeps track of how many sectors have been created. Step 312 sets the size of the next sector as having in it all the floors in the building from the floor immediately below the bottom floor in the sector just created to the floor just above the lobby. If so, we must ask, in step 313, if the sector creation counter has been decremented to zero showing that the number of dynamic sectors created is the same as the number of static sectors which had been used. If no, in step 314 the system will reduce the number of sectors to be used to be the number of static sectors which had been used less the number of sectors left over and note the same in a table kept in the memory of ADSS; the table keeps track of how many sectors were created and what the definitions of these sectors are. If yes, in step 315 the sector creation has been completed. Therefore, in step 315: (a) signals are sent from the ADSS to the OCSS to dispatch the elevators according to the sector assigments just obtained; (b) the floor service indicator (Fig. 1) displays which cars are assigned to,which sectors. In step 316, the process is terminated.

The process is then run through again some interval later, during which time new boarding/deboarding information may necessitate restructuring the sectors; the value of S used in step 1 is that obtained in step 314 the first time the process was run through. The cycle will repeat itself as long as up-peak channeling is used.

Figure 4 shows a logic flow diagram for the present invention wherein sector assigments are based on car capacity. Inputs to the system are two: (A) a sector definition table, which includes (1) the sector numbers, (2) the starts of the sectors, (3) the ends of the sectors, and (4) the number of sectors created, and (B) traffic data. A table showing these inputs might be as seen in Fig. 5A. The goal is to combine sectors which are adjacent and have a population less than 100% of a single cars capacity. Combining of the sectors begins at the bottom of the building. This is to decrease the likelihood that sectors in the upper portion of the building will be combined; since the travel time to the upper sectors is longer than the ones below, it is desirable to have smaller sectors at the top of the building. Combined sectors will be larger sectors. Considering that sectors are numbered from the bottom of the building to the top of the building step 401 denotes that the combining of the sectors will begin at the bottom of the building; the current sector (S) is the zeroth sector. In step 402, the system determines whether the current sector being considered has a value equal to the number of sectors generated by a dynamic channeling method. If so, all of the sectors that may be combined have been combined and the method of the present invention has been completed. If the value of the current sector is not equal to the number of sectors generated by a dynamic channeling method, it is therefore less than that number, then, in step 404, the number of people in a sector is predicted based on the number of people predicted at each floor. These predictions may be based upon traffic measurements using load weighers, hall call button depressions and car call button depressions. The present invention does not make these measurements but only accesses a table of these measurements stored in a memory associated with a signal processor. Having determined the population density for each floor including the lobby, the number of people in each sector is calculated. Step 403 having been a step at which the methodology of the present invention terminated. The number of people in two adjacent sectors is NSO(s). This number represents the number of people between the point which is the start of the sector (SS(F)) and the end of the adjacent sector (ES(F+1)). Step 405 of the present invention determines whether the number of people in these two sectors is less than 100% of car capacity, and if it is not, the current sector need not be combined with its adjacent sector and the sector to be considered is incremented by one in step 406. If however, the number of people in these two sectors is less than 100% of car capacity (CCP) then step 407 is implemented. In step 407, the end of the current sector is-given the same ending point as the end of the adjacent sector. In step 408, the number of sectors (NOS) generated by a dynamic channeling method is decremented by 1. This is done to reflect the reduction of available sectors by one. This is reflected in the table in Fig. 5B. In step 409, the sector number defining the uppermost sector is removed and rejustified to reflect the current number of sectors. At this point one goal of the present invention has been obtained: adjacent sectors each having populations less than 100% of the car capacity have been combined. A rejustified sector definition table is found in Fig. 5C.

One could see that it is possible to eventually combine every sector in the building into one large sector. This is desirable in some situations, namely where dynamic channeling is being done but the traffic density is too small to have a number of sectors. Dynamic channeling produces optimal results when the traffic is large enough to support the methodology thereof. Combining many sectors into one results in greater frequency of sector-to-car assignment which results in better service to sporadic traffic as opposed to traffic that is concentrated in time. In step 403, the new car assigments are communicated to the OCSSs (Fig. 2) for each car so that the cars may carry out their assigments. Also in step 412, the FSIs are updated to reflect the new sector assigments. This process is repeated while dynamic channeling is used after some interval.

Fig. 6 shows the logic flow diagram for the present invention. The combination of sectors begins at the bottom of the building so that the chances of combining sectors at the top of the building are reduced. Since the travel time to the upper sectors is longer than the ones below, it is desirable to have smaller sectors on top. In a building with 15 floors above the lobby an exemplary embodiment of the invention could be used. The output from the previous channeling scheme would be the input to this procedure and have the form shown in Fig. 7A. Sector combination begins at the bottom of the building with the sector nearest the bottom-of the building, the zeroth sector, S=0 in step 601. In step 602, the average number of people in a sector is calculated. Also in step 602, the optimum number of people in a sector is calculated by multiplying 100% or greater by the average number of people in a sector. This is done by sensing the number of people in the building, that being a function of the number of boarding counts at the lobby and deboarding counts at the floors above the lobby (deboarding counts at the lobby and boarding counts at the floors above the lobby will be insignificant during up-peak when people are coming to work), divided by the number of sectors. In step 603, it is determined whether the current sector has a value equal to the number of sectors generated by a dynamic channeling method. Stated differently, step 603 determines whether every sector generated by dynamic channeling was considered for optimization. If so, the loop is exited in step 604, and the sector assigments are communicated to the OCSSs. At this point an elevator drive system may carry out the sector assigments, and the floor service indicator will obtain the assigments from OCSS memories and display those assignments to passengers. If, however, the current sector being considered is not one to have a value equal to the number of sectors generated by a dynamic channeling method, then the number of people in two adjacent sectors, the current sector, NSO(S) is calculated. This number is the sum of people going to floors starting from the start of the sector SS(F) to the end of the sector ES(F+1) as predicted by means for counting people boarding and deboarding, for example, car call buttons and hall call buttons. If this number is greater than the optimal average, then the current sector need not be combined with any other sector and the next sector is considered in step 607. If the number of people in a sector is not greater than the optimal average, then, in step 608, the end of the current sector becomes the end of the adjacent sector. At this point, two adjacent sectors have been combined. However, it is undesirable for the number of floors in a sector to exceed a certain maximum number of floors permitted in a sector (MP). Thus, in step 609, it is determined whether the number of floors in the newly generated sector is smaller than MP. If not, in step 610 the end point of the current sector is restored such that no combination is affected. If however, the number of floors in the newly generated sector is smaller than MP, then, in step 611, the number of sectors generated by a dynamic channeling method is decremented by 1. This is followed, in step 612, by removing the sector definition for the sector adjacent to the current sector and rejustifying the sector definition table. At this point the sector definition table of Fig. 7A would have the form shown in Fig. 7B. A rejustified table appears in Fig. 7C; NOS now equals two. The process continues until step 604 is arrived at. At this point, one car less is involved in the dispatching and this is reflected on the floor service indicators.

Although this invention has been shown and described with respect to detailed embodiments thereof, it will be understood by those skilled in the art that various changes in form and detail thereof may be made without departing from the spirit and scope of the claimed invention.

Claims

1. An elevator system comprising:

   a plurality of cars for transporting passengers from one floor of a building to another;

   means for retrieving a table of historical-time traffic data, collected in the past several days, consisting of counts of the number of passengers who boarded cars at the lobby and deboarded cars at floors other than the lobby;

   means for retrieving a table of real-time traffic data, collected in the past several minutes, consisting of counts of the number of passengers who boarded cars at the lobby and deboarded cars at floors other than the lobby;

   predicting means, for predicting, based on said historical-time and real-time traffic data, the number of people who will be arriving at the lobby and the floors to which those people will go;

   a floor service indicator means, for indicating to passengers which floors a given car will service at a particular time;

   a signal processing means for determining when an up-peak condition occurs and, when such condition occurs, for further providing

   signals for dividing the number of floors in a building into a variable number of non-overlapping sectors, each sector having a volume of traffic approximately equal to that of any other sector as determined by said predicting means, each sector comprising at least one floor but no more than some predetermined maximum number of floors, each sector containing a variable number of floors, said floors in each sector being contiguous, said sectors within the building being contiguous;

   for assigning a sector to a car for transporting passengers to and from said sector; and

   for indicating on said floor service indicator means said assignment; and

   communications means for passing signals between and among said counting means, said predicting means, said floor service indicator means, and said signal processing means.

2. The system of claim 1 wherein adjacent sectors are combined when the sum of the populations of said sectors as given by said summing means is less than 100% of car capacity.

3. The system of claim 1 wherein adjacent sectors are combined when the sum of the populations of said sectors as given by said summing means is

greater than 100% of said average number of people per sector.

4. A method of dispatching elevator cars comprising the steps of:

retrieving a table of historical-time traffic data, which data consists of counts of the number of passengers who boarded cars at the lobby during an up-peak period and deboarded cars at floors other than the lobby, said counts having taken place several days prior to said retrieving of said historical-time traffic data;

retrieving a table of real-time traffic data, which data consists of counts of the number of people who boarded cars at the lobby and deboarded cars at floors other than the lobby during an up-peak period, said counts having taken place several minutes prior to said retrieving of said real-time traffic data;

predicting, based on data collected from said steps of retrieving said historical-time and real-time traffic data, the number of people who will be arriving at the lobby at some future time and the floors to which those people will be taken by any car; and

creating a variable number of non-overlapping, contiguous sectors of equal traffic volume, each sector containing a variable number of contiguous floors which number does not exceed a predetermined maximum.

5. The method of claim 4, further comprising the step of combining adjacent sectors when the sum of the populations of said sectors as given by said summing means is less than 100% of car capacity.

6. The method of claim 4, further comprising the step of combining adjacent sectors when the sum of the populations of said sectors as given by said summing means is greater than 100% of said average number of people per sector.

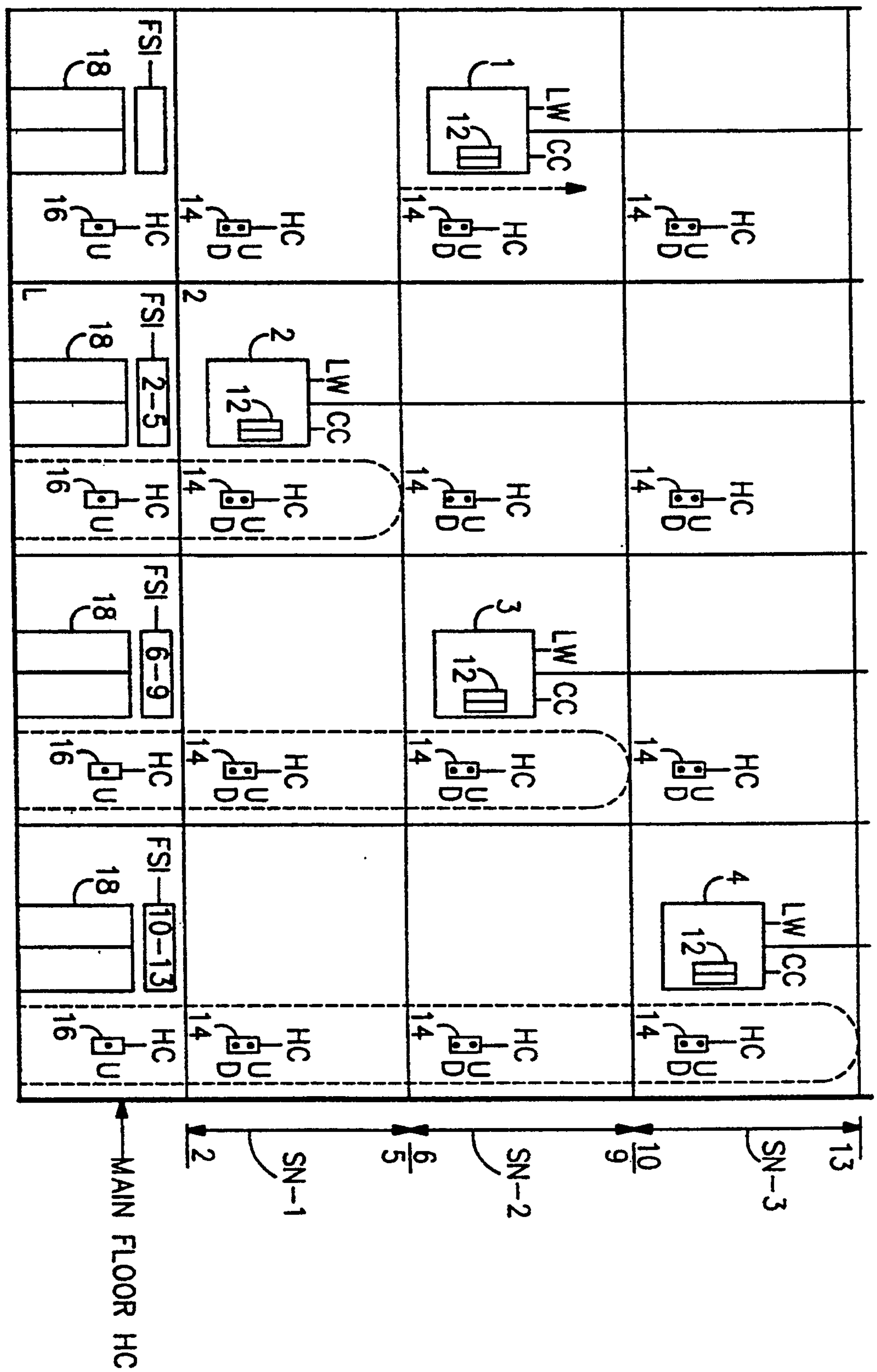

FIG.1

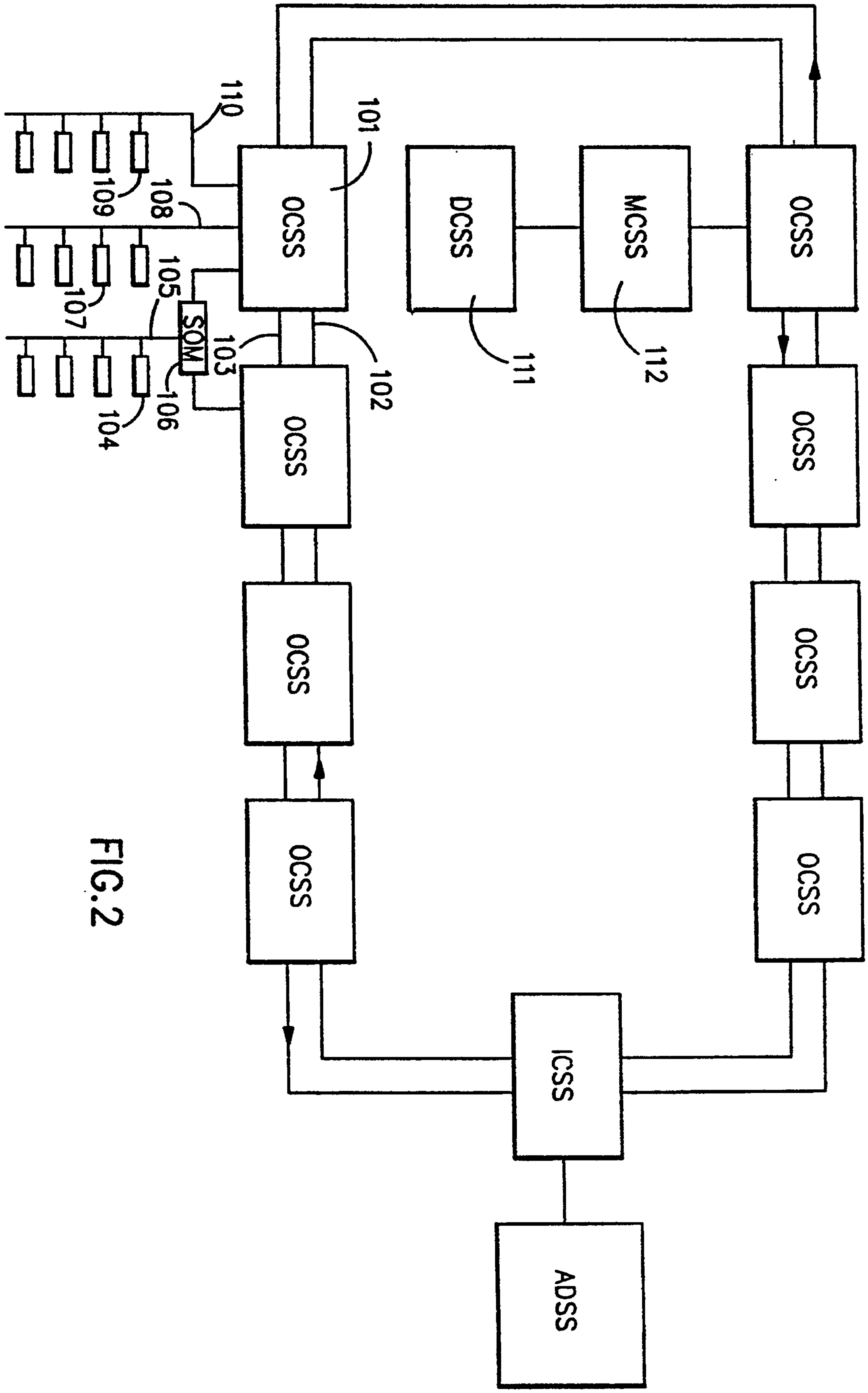
OCSS
OCSS
OCSS
OCSS
OCSS
OCSS
OCSS
OCSS
DCSS
MCSS
ICSS
ADSS
SOM
101
102
103
104
105
106
107
108
109
110
111
112

FIG.2

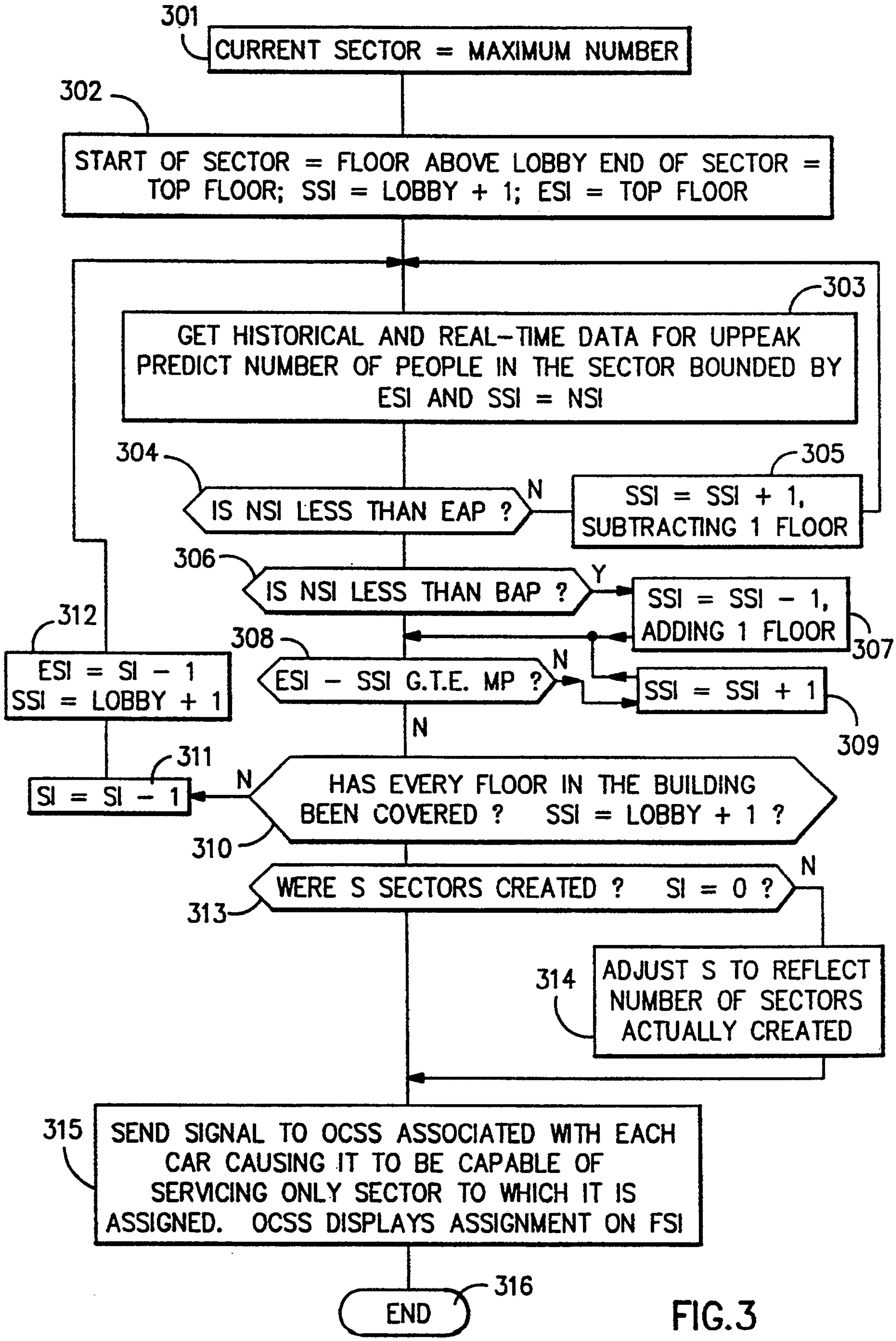
301
CURRENT SECTOR = MAXIMUM NUMBER
302
START OF SECTOR = FLOOR ABOVE LOBBY END OF SECTOR = TOP FLOOR; SSI = LOBBY + 1; ESI = TOP FLOOR
303
GET HISTORICAL AND REAL-TIME DATA FOR UPPEAK PREDICT NUMBER OF PEOPLE IN THE SECTOR BOUNDED BY ESI AND SSI = NSI
304
IS NSI LESS THAN EAP ?
N
305
SSI = SSI + 1, SUBTRACTING 1 FLOOR
306
IS NSI LESS THAN BAP ?
Y
SSI = SSI − 1, ADDING 1 FLOOR
307
308
ESI − SSI G.T.E. MP ?
N
SSI = SSI + 1
309
312
ESI = SI − 1
SSI = LOBBY + 1
N
311
SI = SI − 1
N
HAS EVERY FLOOR IN THE BUILDING BEEN COVERED ? SSI = LOBBY + 1 ?
310
WERE S SECTORS CREATED ? SI = 0 ?
N
313
314
ADJUST S TO REFLECT NUMBER OF SECTORS ACTUALLY CREATED
315
SEND SIGNAL TO OCSS ASSOCIATED WITH EACH CAR CAUSING IT TO BE CAPABLE OF SERVICING ONLY SECTOR TO WHICH IT IS ASSIGNED. OCSS DISPLAYS ASSIGNMENT ON FSI
END
316

FIG.3

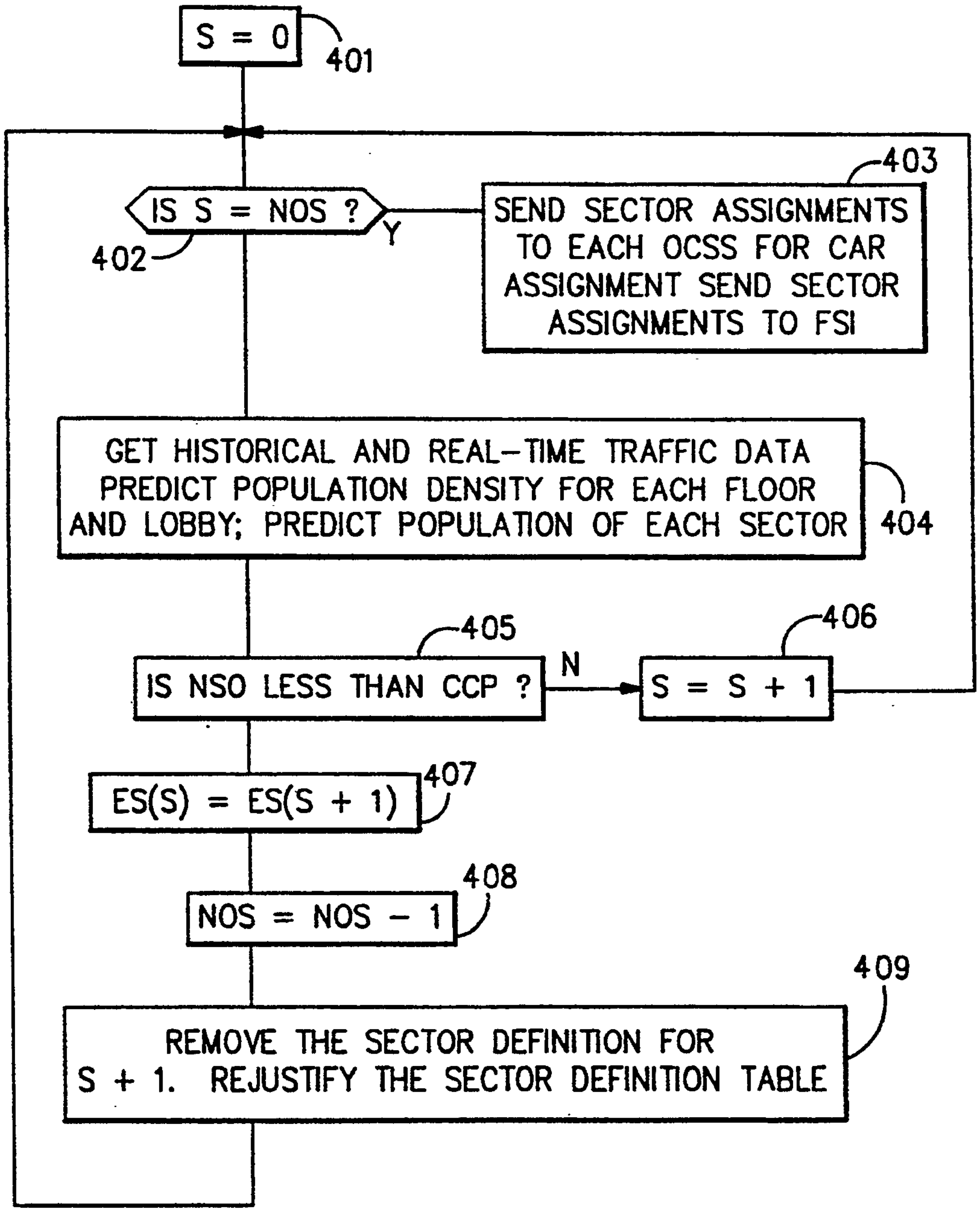
S = 0
401
IS S = NOS ?
Y
402
403
SEND SECTOR ASSIGNMENTS TO EACH OCSS FOR CAR ASSIGNMENT SEND SECTOR ASSIGNMENTS TO FSI
GET HISTORICAL AND REAL-TIME TRAFFIC DATA PREDICT POPULATION DENSITY FOR EACH FLOOR AND LOBBY; PREDICT POPULATION OF EACH SECTOR
404
405
IS NSO LESS THAN CCP ?
N
406
S = S + 1
ES(S) = ES(S + 1)
407
408
NOS = NOS − 1
409
REMOVE THE SECTOR DEFINITION FOR S + 1. REJUSTIFY THE SECTOR DEFINITION TABLE

FIG.4

SECTOR NUMBER	START	END
2	10	13
1	6	9
0	2	5

TOTAL NUMBER OF SECTORS, NOS = 3

FIG.5A

SECTOR NUMBER	START	END
2	10	13
1	6	9
0	2	9

TOTAL NUMBER OF SECTORS, NOS = 3

FIG.5B

SECTOR NUMBER	START	END
1	10	13
0	2	9

TOTAL NUMBER OF SECTORS, NOS = 2

FIG.5C

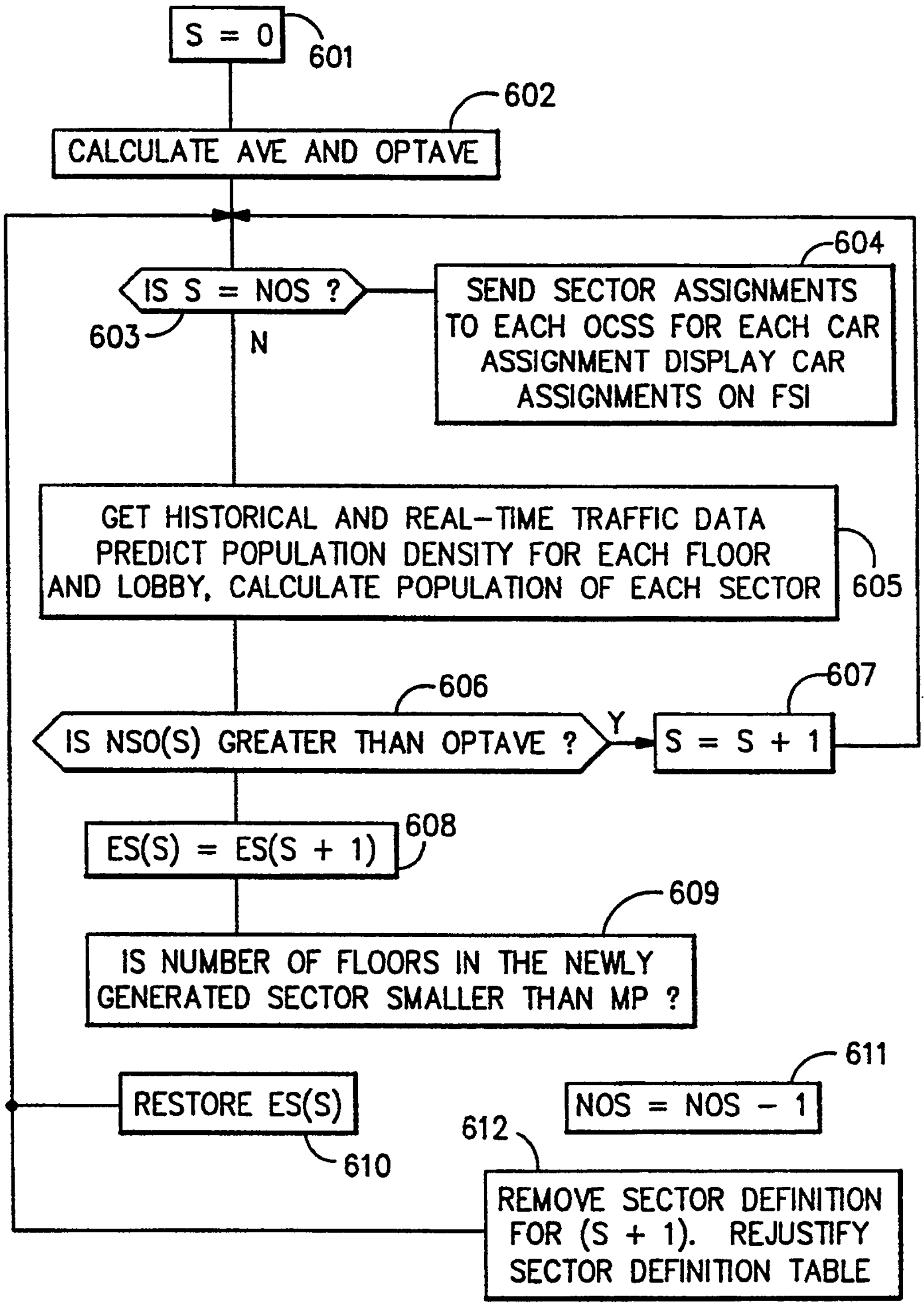
S = 0
601
CALCULATE AVE AND OPTAVE
602
IS S = NOS ?
603
N
SEND SECTOR ASSIGNMENTS TO EACH OCSS FOR EACH CAR ASSIGNMENT DISPLAY CAR ASSIGNMENTS ON FSI
604
GET HISTORICAL AND REAL-TIME TRAFFIC DATA PREDICT POPULATION DENSITY FOR EACH FLOOR AND LOBBY, CALCULATE POPULATION OF EACH SECTOR
605
IS NSO(S) GREATER THAN OPTAVE ?
606
Y
S = S + 1
607
ES(S) = ES(S + 1)
608
IS NUMBER OF FLOORS IN THE NEWLY GENERATED SECTOR SMALLER THAN MP ?
609
RESTORE ES(S)
610
NOS = NOS - 1
611
612
REMOVE SECTOR DEFINITION FOR (S + 1). REJUSTIFY SECTOR DEFINITION TABLE

FIG.6

SECTOR NUMBER	START	END
2	10	13
1	6	9
0	2	5

TOTAL NUMBER OF SECTORS, NOS = 3

FIG.7A

SECTOR NUMBER	START	END
2	10	13
1	6	9
0	2	9

TOTAL NUMBER OF SECTORS, NOS = 3

FIG.7B

SECTOR NUMBER	START	END
1	10	13
0	2	9

TOTAL NUMBER OF SECTORS, NOS = 2

FIG.7C