

ELEVATOR GROUP CONTROL SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to an elevator group control system, and in particular, it relates to an
5 elevator group control system suitable for improving elevator transportation capability and service quality in rush hours on congested floors, for example, such as during lunch time on cafeteria floor or the like.

In general office buildings, a ground floor is most
10 congested during morning and evening rush hours, and the ground floor as well as cafeteria floor are congested during lunch time. Normally, such traffic demand concentration in specific time zones even with a group control elevator system which fundamentally operates whole
15 elevators to serve whole floors is dealt with by enhancing transportation capability by splitting its plurality of elevators into two service groups one serving exclusively upper floors and the other serving exclusively lower floors thereby enabling split express operation during
20 congestion time zones. Further, in some buildings, rush hour congestions are avoided by time-shifting of office-coming, leaving, and lunch time.

Firstly, it is disclosed in JP-A No.59-177264 that division of elevators into plural service groups is
25 performed according to traffic demands thereby to ensure a uniform and improved service quality to each split service group.

Secondly, it is disclosed in JP-A No. 63-87486 that the traffic demand concentration time zone is divided into plural segments, that the service floors are divided into a priority floor zone and a non-priority floor zone, wherein
5 the priority floor zone are served by a larger number of elevators, and that the priority floor zone can be modified according to a split traffic demand concentration time segment.

Thirdly, it is disclosed in JP-A Nos.63-247279 and
10 63-247280 that a plurality of elevators are divided into two groups: one group for serving the whole floors and the other groups for serving specified floors exclusively, according to service time information, and that hall call buttons are also divided for exclusive use by each group to cope with
15 greater traffic demands.

Fourthly, it is disclosed in JP-A No.5-319704 that a traffic flow is divided into a high traffic demand flow and a normal traffic demand flow, and elevators assigned specifically are dedicated to serve the high traffic demand
20 flow exclusively thereby preventing unbalanced service distribution during elevator operation.

Traffic demands in the buildings are not fixed and invariable from the completion of the building but are constantly subject to a change with time. It often occurs
25 that the number of elevators which was supposed to be sufficient from the initial number of tenants becomes inadequate to cope with an increasing traffic demand for an

increasing number of tenants. In such an instance, a more efficient and strategic operation of the limited number of elevators is required in order to avoid any sustaining congestion during rush hours such as lunch time.

5 The above-mentioned first prior art of JP-A No.59-177264 discloses a method of dividing the service floors into plural service groups, however, it is not adequate to effectively handle a hall call occurring on a common service floor.

10 The above-mentioned second prior art of JP-A No.63-87486 discloses a process to change the numbers of elevators to serve priority service floors and non-priority service floors, which thereby does not need to divide hall call buttons according to respective service groups. However,
15 since it is directed to changing only the number of elevators to be assigned to a hall call occurring at each floor, it does not contribute to an increasing a total number of passengers to be transported.

 The third prior art methods disclosed in JP-A
20 Nos.63-247279 and 63-247280 determine a greater traffic demand according to time-related information alone, and thereby are inadequate to cope with a dynamic traffic demand within the building which changes hourly and yearly, thereby failing adequately to serve a common service floor
25 which is most congested.

 The fourth prior art of JP-A No.5-319704 discloses splitting of plural elevators into plural service groups,

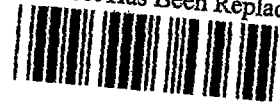
and a method of hall call for calling an elevator car from a particular service group to which it belongs and which the user wishes to ride to the common service floor which is served commonly by the plural elevators split into plural service groups, wherein hall call buttons provided on the common service floor are separated for each service group, which is the same as the method of conventional split express operation. However, this method has disadvantages that the user cannot determine which button to press for calling which elevator, and that although it is indicated how to choose a particular elevator car via twice pressing or continual pressing of the button, it is not easy for unaccustomed users to practice.

SUMMARY OF THE INVENTION

The elevator group control system of the invention is contemplated to solve these problems associated with the prior art.

An object of the present invention is to provide an elevator group control system which can substantially improve service quality which can be offered to the users at the common service floor which is served commonly by plural elevators belonging to plural service groups.

Another object of the invention is to provide an elevator group control system which can efficiently cope with a greater traffic demand occurring on a congested floor during rush hours such as lunch time or the like without impairing service quality affordable to other non-



congested service floors.

According to one aspect of the invention, an elevator group control system having a plurality of elevators which serve a plurality of floors, and a means for assigning one of the plurality of elevators to a hall call, is further characterized by comprising: a service zone set means which sets a different service zone for the above-mentioned plurality of elevators; a call means for calling an elevator in response to a hall call arising on the common service floor which is commonly served by the plurality of groups of elevators; and another call means for automatically calling a specific elevator assigned to serve a specific service zone to the common service floor independent of presence of a hall call therefrom.

An elevator group control system according to an embodiment of the invention is operated in such a manner that by detecting an inter service floor traffic demand, that is, respective traffic demands between respective service floors, obtained as a result of learning of these traffic demands over a predetermined period of time, planning of respective service groups and a common service floor is assessed in reference to a value of data in an inter service floor traffic demand look-up table, and thereby operating the plurality of elevators split into plural service groups according to the planning, wherein hall call buttons on the common service floor are not separated for respective service groups but are arranged to



facilitate respective hall calls for calling respective elevators from respective service groups.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

Fig. 1 is a schematic block diagram indicative of an elevator group control system of an embodiment of the invention;

Fig. 2 is a schematic block diagram indicative of a control processing software architecture according to the embodiment of Fig. 1;

Fig. 3 is a schematic block diagram indicative of a hardware architecture of the embodiment of Fig. 1;

Fig. 4 is a flow chart of a control program for processing a common service floor hall call for use in the embodiment of Fig. 1;

Fig. 5 is diagrams indicating various guidance statuses of hall annunciators at the common service floor during express operation according to the invention;

Fig. 6 indicates examples of service floors to be serviced separately and efficiently during split express operation according to the invention; and

Fig. 7 is a flow chart of a service floor modification program according to the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

With reference to the accompanying drawings of

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Figs. 1 to 7, preferred embodiments of the invention will be described more in detail.

Figure 1 depicts a schematic block diagram of an embodiment of the invention provided for serving a nine-story building with three elevators. In Fig. 1, an elevator control system 50 which is installed in an elevator machine room is comprised of a group control unit 501 and a plurality of elevator car control units 504 (A to C). In each elevator car 20 (A to C), a car call button 30 (A to C) is provided, and a signal from car call button 30 (A to C) is transmitted to elevator car control unit 504 (A to C).

Hall call buttons 601, ..., 608, 609 are provided at respective halls on respective service floors from the 1st to the 9th floors. Input from these hall call buttons is indicated in this drawing to be transferred directly to the group control unit 501, however, it is not limited thereto, and it may be entered via the elevator car control unit 504 (A to C) in the same way as input and output of hall lanterns 12(A to C), ..., 82(A to C), 92(A to C). Further, on a same floor there may be provided hall call buttons for exclusive use for a wheelchair, VIP and for underground parking lots. The above-mentioned hall lanterns have a function to flash a reservation lamp indicating which elevator car is assigned and informing its arrival. The group control unit 501 assigns a newly entered hall call to one of the plurality of elevators taking into account respective positions, running directions of respective

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elevators, current status of hall calls, degrees of congestion in respective elevators and the like which are transmitted from respective car control units 504 (A to C), and produces an assignment signal, i.e., reservation lamp
5 signal to the car control unit 504(A to C) which controls the assigned elevator car. Elevator car control unit 504 (A to C) controls operation of its associated elevator car and opening of the door thereof, and also controls turning on/off of hall lanterns 12(A to C), ...82 (A to C), 92(A to
10 C) in response to the reservation lamp signal from the group control unit 501. A guide annunciator including information display 11(A to C),...,81(A to C), 91(A to C), and a speaker 10(A to C),...,80(A to C), 90(A to C) provides information regarding destination floors of an
15 express car assigned by the group control unit 501, wait time therefor and a status of operation of the elevator to the users waiting on respective elevator halls. This information display 11 will be sufficed by an LED device capable of displaying, for example, 4 characters or so.
20 Numeral 40 depicts a call method select input unit for exclusive use by a maintenance staff or engineer for setting a particular operational specification, and which is connected to elevator control system 50 via signal line 41.

25 Figure 2 depicts a schematic block diagram of a control processing software and its structure in the group control unit 501 of the invention.

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In the drawing of Fig. 2, data transmission between group control unit 501 and car control unit 504(A to C) is constantly maintained through a group-to-car transmission program P01, whereby data on a car status including a car
5 call signal, car position, door open/close state, car loading and the like is transmitted from car control unit 504(A to C) to the group control unit 501, and alternatively data including a hall call assignment, dispersion command, hall lantern control signal and the
10 like is transmitted from the group control unit 501 to the car control unit 504. These transmitted data are stored in a transmission data table T01.

For a hall call register table T02, a flag is set for a type of call corresponding to the hall call button
15 depressed, direction and the floor of calling. When such a flag is set in the hall call register table T02, a hall call assignment program P02 is executed to calculate an assignment evaluation value for each elevator car based on its predicted arrival time and the like and to assign the
20 hall call to a most appropriate elevator having a minimum assignment evaluation value or a shortest waiting time, for example. Further, it is checked by reading data from a service floor table T03 whether or not the elevator car assigned to the hall call is immediately available to serve
25 the floor requesting the hall call. If it is not immediately serviceable, the elevator car having been assigned is excluded from the group of assignable

elevators, and the assignment process therefor is executed once again. If the floor can be served, associated data is set in a hall call assignment table T04. Then, its hall call assignment signal is translated in transmission data table T01, and transmitted to car control unit 504(A to C) by group-to-car transmission program P01, thereby causing the assigned elevator car to move to the hall call requesting floor.

A car status table T05 stores car call signals, car loading signals and the like, and on the basis of the data of car status table T05, a current traffic flow determination program P04 is run to analyze elevator car utility status and determine a current traffic flow whether it is morning or evening rush hours, prior or post lunch time, or normal operational time, the result of which is stored in a current traffic flow table T08. Further, daily utilization status of elevators is learned by means of a traffic demand learning program P03, and the result of learning is stored in an intra-building traffic flow data table T06. Further, traffic demand learning program P03 is run to learn respective traffic demands between respective service floors such as "the number of passengers who embarked on the 1st floor and disembarked at 5th floor", the result of which is stored in inter-floor traffic demand table T07.

SCT1 encircled by dots and lines depicts a split planning section for planning a split express operation on

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the basis of actual elevator operational status data.

Service group split planning program P05 is run to detect an inter-floor traffic demand having a greater traffic demand from inter-floor traffic demand table T07, produce plural plans for splitting service floors on the basis of the detected data of the greater traffic demand, and store them in service group split planning table T09. Service group split plans may be obtained by any expert system in which expertise and experiences of specialists are incorporated as programs or an appropriate split plan may be obtained also by repeating simulation using genetic algorithm.

The service group split plan having been stored in the service group planning table T09 is simulated by simulation program P06, and a result of its simulation is compared with a current service performance, and if the result of simulation is better than the current service performance, a permit signal is set in service group split permit table T10.

SCT2 encircled by dots and lines depicts a split plan execution section which modifies service floors of respective elevators on the basis of the split express plan produced by split planning section SCT1, and controls dispatching of elevators to the common service floor.

When the permit signal is set in service group split permit table T10, service floor modification program P07 is run to modify the service floor table T03 in

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accordance with a service floor pattern specified in service group split planning table T09. Further, common service floor hall call control program P08 is run to control hall call requests from the common service floor
5 upon splitting of service floors into plural groups, and by rewriting the hall call register table T02 through this program P08, execution of a hall call auto-register and elevator auto-call enabled.

A common service floor elevator call method
10 selected and entered via the call method select input unit 40 is stored in operation specification data table T11 through operation specification transmission program P09. The data stored in the operation specification data table T11 is read by common service floor hall call control
15 program P08 or service floor modification program P07, and is used for setting a control method for a common service floor hall call or setting of split service floors.

Figure 3 is a schematic block diagram depicting a hardware architecture of one embodiment of the invention.

20 In the drawing of Fig. 3, a micro processing unit (MPU) HD1 is coupled, via a bus line HC which includes an address bus, data bus and control bus, with a read only memory (ROM) HD2 which stores programs, a random access memory (RAM) HD5 which stores data, a dual port RAM (DP-
25 RAM) HD4 through which data is exchanged with a transmission microcomputer HD6, and an interface circuit of asynchronous communication interface adapter (ACIA) HD3

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through which signals are exchanged with external control devices. Transmission microcomputer HD6 reads or writes data for DP-RAM (HD4), and outputs and receives data to and from transmission device HD7. The transmission device HD7
5 outputs and receives the data to and from transmission microcomputer HD6 to transmission lines LAN1, LAN2, LAN3 or receives data therefrom. These devices of HD1 to HD7 are installed in group control unit 501.

A signal from each hall call button 601,...608, 609
10 provided on each floor is entered into communication peripheral HP1,...HP3, HP9 provided on each floor, and is transmitted via LAN1 to transmission device HD7. An entered hall call signal is processed by the program stored in ROM (HD2) for hall call assignment, and its hall call
15 assignment signal is stored in RAM(HD5).

Further, group control unit 501 which is connected with each car control unit 504A, 504B, 504C via transmission line LAN2 produces a hall call assignment signal, door close/open command signal, car position
20 signal, car call signal and the like thereto via LAN2.

Call method select input unit 501 is connected to group control unit 501, and a data corresponding to the call method selected by the call method select input unit 501 is transmitted to ACIA (HD3) via signal line 41, and
25 the data is stored in RAM(HD5).

Further, ACIA (HD3) produces display data and broadcasting code data to information display (4 character

LED indicator) 11, ...81, 91(A to C) and speaker 10,...80, 90(A to C) for traffic information guidance and broadcasting.

Figure 4 is a flow chart indicative of common service floor hall call control program P08 which is run when the express operation is executed.

In step S00, data of service group split permit table T10 is compared with data of current traffic flow table T08, and it is determined whether or not any flag corresponding to the current traffic flow is set in the service group split permit table. When the flag has been set, the step advances to S01. When the flag has not been set, the common service floor is not changed nor the express operation is performed.

In step S01, the common service floor hall call control method stored in operation specification data table T11 is read therefrom, and when its common service floor hall call control method is a method for automatically calling respective elevator cars from both service groups even without presence of a hall call request, the step advances to S02. In step S02, a hall call request to both groups is set in the common service hall call register table, thereby enabling to call respective elevator cars from different plural service groups to the common service floor. A section circled by dotted lines 5-1 in Fig. 4 corresponds to a step of calling one elevator car from respective service groups without need of registering the

hall call to the common service floor. A hall status of the common service floor under conditions of 5-1 above is indicated in Fig. 5-1 which will be described later.

Now, going back to Fig. 4, in step S03, when the
5 common service floor hall call control method is a type that calls cars from both groups upon its call registration, the step advances to S04. It is determined whether or not a hall call button of the common service floor is depressed in step S04, and in the case the button
10 of the common service floor is depressed, the process of step S02 is executed and one elevator car is called from each service group. In the case the button of the common service floor is not depressed, the hall call control process is completed. A section circled by dotted lines 5-2
15 in Fig. 4 corresponds to the process of calling one elevator car from each service group when a common service floor hall call is registered. Hall status of the common service floor in such circumstance is indicated in Fig. 5-2 which will be described later.

20 In step S05, it is checked whether or not the common service floor hall call control method selected is a type that automatically calls an express elevator even without presence of a hall call request. If it is determined to be the express elevator auto calling method,
25 the step advances to S06, at which an express elevator hall call to the common service floor is automatically set in the hall call register table, thereby enabling to call an

express elevator car to the common service floor without need of registering the hall call. Further, in step S07, it is decided whether or not an express floor car call should be automatically registered. Selection of whether or not

5 automatically register the express floor car call is enabled by the call method select/ input unit 40. In the case of auto registration of the express floor car call, the step advances to S08, in which the car call destined to the service floors of the express elevator is automatically

10 registered. A section circled by dotted lines 5-3 corresponds to the process of calling the express elevator car without need of registering the common service floor hall call. Hall status of the common service floor in this circumstance is indicated in Fig. 5-3 which will be

15 described later. By way of example, a whole floor serving elevator car is called by the normal hall call assignment control responsive to depressing of a hall call button.

In step S09, it is judged whether or not the common service floor hall call control method is a type that

20 automatically calls a whole floor service group elevator, and if it is the whole floor service group elevator auto call method, the step advances to S10. In step S10, a hall call request to dispatch to the common service floor from the whole floor service groups is set in the hall call

25 register table. Thereby, it becomes possible to call the whole floor serving elevator car to the common service floor without need of depressing the hall call button.

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section circled by dotted lines 5-4 corresponds to the process of calling the whole floor serving elevator to the common service floor without registering the common service floor hall call. Hall status of the common service floor in such a circumstance is indicated in Fig. 5-4 which will be described later. By way of example, an express elevator is called by the normal call assignment control responsive to entry by depressing of the hall call button.

Figure 5 depicts versatile status of elevator operation and its information guidance using annunciators on the common service floor according to one embodiment of the invention.

Fig. 5-1 is an example of both group auto call method according to the invention, wherein elevators ELA1 and ELA2 belong to service group A, while elevators ELB1 and ELB2 belong to service group B. Hall buttons HB1, HB2, HB3 of the common service floor are retained in a registered status even though the user does not depress the button, and always during the express operation, one elevator car is selectively called from each service group. Hall lanterns HL1, HL2 of elevators being called in respective service groups are flashed, and information indicators HY01, HY02 associated thereto display respective service floors of destination, thereby guiding the user easily to select a faster elevator going to one's destination.

Fig. 5-2 is an example of both group call method with call registration, wherein elevators ELA3, ELA4 belong

to service group A, while elevators ELB3, ELB4 belong to service group B. When either of hall buttons HB4, HB5 or HB6 on the common service floor is depressed, one elevator car is selectively called from each service group. After a
5 hall button is depressed, destinations of the elevators being called are indicated to the users by means of hall lanterns and information displays likewise in Fig. 5-1.

Fig. 5-3 depicts an example of an express elevator auto call method of the invention, wherein elevators EL1, EL2, EL3 are whole floor service elevators, and elevator
10 ELK1 is an express elevator. When a hall call button HB7, HB8, HB9 on the common service floor is depressed, a most appropriate elevator car selected from the whole floor service elevator group through the normal assignment
15 process is called. Further, express elevator ELK1 is automatically called to the common service floor without need of registration of its call during the express operation permit period. In this instance, hall lantern HL3 of express elevator ELK1 turns on, and information display
20 HY04 thereof displays express service destination floors, further the other information display HY03 of elevators other than the express elevator displays scroll information that express elevator ELK1 is now being called. Further, a speaker SP1 provided in the hall broadcasts that passengers
25 destined to the express service floors can take an express elevator without depressing the express elevator car call button, recommending to use express elevator ELK1 which is

automatically being called. Further, when a non-stop express service floor car call auto register method is selected by the call method select/input unit 40, a non-stop express service floor car call is automatically registered at the time when express elevator ELK1 arrives and the door thereof is opened, thereby the user of express elevator ELK1 needs not depress each time the non-stop express service floor car call button.

Fig. 5-4 is an example of a whole floor service group elevator auto call method of the invention, wherein elevators EL4, EL5, EL6 are whole floor service elevators, and elevator ELK2 is an express elevator. When hall call button HB10, HB11 or HB12 is registered, express elevator ELK2 is called, and information display HY06 displays service floors of the express elevator ELK2. Always, responsive to a hall call request for a whole floor service elevator, a most appropriate elevator car is selected and called from the whole floor service elevator group without depressing the hall call button through the call assignment process. In the drawing of Fig. 5-4, elevator EL6 is being called, and hall lantern HL4 thereof turns on to inform the user that it is now being called. Further, hall speaker SP2 announces that passengers not destined to the express service floors are advised to wait for a next whole floor service elevator without depressing the hall call button. Then, information display HY05 of the whole floor service elevators displays that passengers destined to the express

service floors are required to depress the hall call button. By such guidance easy for the users to understand, the users can select and call a most appropriate elevator which can take the passengers to their destination faster and most conveniently.

Usually, any floor to be set as the common service floor is a most congested floor. As a result of statistical analysis of operational conditions of elevators, it is revealed that hall call buttons of the congested floor are almost constantly being registered during the congestion time zones, thereby seldom it becomes dead services even if two elevator cars are called simultaneously to such congested floor. Further, according to this embodiment of the invention, since daily traffic demands are learned respectively for versatile traffic flow modes such as morning rush-hour traffic, lunch time traffic, normal hour traffic and the like, then, on the basis of such traffic demands having been learned, various express operation methods are simulated, and only when simulation of any of such express operation methods ensures that it improves service quality better than the currently adopted whole floor service operation, an approved express operation is executed, thereby resulting in no dead services, and thereby efficiently capable of handling the traffic demands of the congested common service floor.

Fig. 6 is a schematic diagram indicating several examples of elevator operations and their service floors

during various split express operations according to the invention.

Fig. 6-1 is a case in which the whole elevator cars are assigned to serve the whole floors. Conventional group control elevators are operated by this method.

Fig. 6-2 is an example of two part split express operation, wherein elevator cars No. 1 and No. 2 are assigned to serve the first floor and a higher zone of building of 5th, 6th and 7th floors, while elevator cars No. 3 and No. 4 are assigned to serve the first floor and a lower zone of building of 1 to 4th floors. A common service floor is assigned to the first floor. This two part split express operation is adopted in such occasions when a particular floor such as the lobby floor is congested in the morning rush hour or the like while the other floors are not so congested.

Fig. 6-3 is an example of non-stop operation destined to specified floors, in which No. 4 elevator car is assigned as a non-stop elevator which travels from the first floor directly to 6th and 7th floors and vice versa, while elevators Nos. 1 to 3 are assigned to serve the whole floors. This non-stop operation method is an effective express operation method suitable for serving particular floors accommodating restaurants, convention halls and the like having greater traffic demands thereto and therefrom. In this example, a common service floor is set to be the first floor, however, it is not limited thereto, and any

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floors accommodating restaurants and convention halls may be added as the common service floor. Further, the non-stop express elevator is not limited to No. 4 elevator car alone, and No. 3 elevator car may be assigned as the non-stop elevator alternatively, or both elevator cars Nos. 3 and 4 may be assigned depending on the traffic demands from the users.

Fig. 6-4 is an example of a directional non-stop operation of the invention, in which No. 4 elevator car is assigned as a non-stop elevator which serves the first, 6th and 7th floors in the up-going direction, but serves the whole floors in the down-going direction. In this directional non-stop operation also, the express elevator is not limited to No. 4 car alone, and it varies depending on the degree of congestion. This express operation method likewise the non-stop operation method of Fig. 6-3 is an effective method suitable for serving particular service floors having greater traffic demands.

Fig. 6-5 is an example of a skip operation of the invention, in which elevator cars Nos. 1 and 2 serve odd numbered floors, while elevator cars Nos. 3 and 4 serve even numbered floors. This skip operation method is effective when the number of elevators is limited and inadequate for increased traffic demands. Although the skip operation incurs some inconvenience on the user since the user cannot go direct to the floor of destination but must use a stairway, however, there is an advantage that the

transportation capacity can be improved substantially.

Fig. 6-6 is an example of a whole car split express operation method whereby the common service floor is served by the whole cars, but any other floor is served

5 exclusively by either one of them. This whole car split express operation method is an effective express operation method suitable for use when a traffic only at a particular floor is very congested but the other traffics at the other floors are sparse.

10 Further, the common service floor is depicted to be the first floor throughout all of the express operation methods in Fig. 6, however, it is not limited thereto, and any floor which is most congested may be assigned as the common service floor.

15 Figure 7 is a flow chart indicative of service floor modification program P07 of the invention.

In step S11, data of service group split permit table T10 is compared with data of current traffic flow table T08, and it is determined whether or not a flag is set
20 in the service group split permit table T10 corresponding to the current traffic flow. If this flag is not set, the step moves to S20 where service floor table T03 is changed to the whole floor service operation, thereby disabling the express operation.

25 If the flag corresponding to the current traffic flow is set therein, the step advances to S12 where service group split planning table T03 is read, and if a flag of

the two part split express operation is set, the step moves to S13 where service floor table T03 is rewritten to a service floor pattern for the two part split express operation.

5 In step S12, if a non-stop operation flag is set, the step moves to S14. In step S14, process counter i is reset to 0. Then, in step 15, the process counter adds "1". Then, in step S16, it is determined whether or not a non-stop operation execute flag is set for elevator car i, and
10 if the non-stop operation execute flag is set, the step advances to S17. If the non-stop operation execute flag is not set, the step moves to S18, in which service floor table T03 of elevator car No. i is rewritten to the whole floor service operation. In step S17, the service floor
15 table T03 only of car No. i is modified to the non-stop operation thereby prohibiting services to other floors other than the non-stop express service floors. In step S19, decision is made as to whether processing of steps S16, 17 and 18 is repeated as many times as the number of elevator
20 cars. Through such processing from steps S14 to S19, and by modifying the non-stop operation execute flag as required, it becomes possible to change the number of non-stop elevator cars or which car to assign as the non-stop operating elevator.

25 This embodiment of the invention has been described by way of example of two cases with reference to the two part split express operation and the non-stop express

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operation, however, it is not limited thereto, therefore, the number of split groups may be 3 or more, and two or more elevator cars may be assigned as non-stop elevators within the scope of the invention. Further, respective
5 elevator cars are not fixed to particular service groups, and they may be switched flexibly between respective service groups depending on utilization conditions of elevators and traffic demands.

As described above, according to the embodiments of
10 the invention, it becomes possible for the user to call any elevator car to the common service floor without need of any additional operation by the user or incurring inconvenience to the user. The elevator car is selectively called from the plural service groups which are split into
15 different service groups in order effectively to serve unevenly dispersed and time-dependent traffic demands.

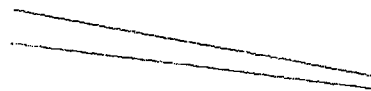
According to the invention, an elevator group control system has been provided which can substantially improve the service quality offered to the user on the
20 common service floor which is serviced by the plurality of elevator cars.

According to still another aspect of the invention, an elevator group control system has been provided which can effectively handle greater traffic demands arising at
25 congested floors without degrading service quality offered at the common service floor under a large traffic demand condition such as during rush hours including lunch time

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and the like.

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WHAT IS CLAIMED IS:

1. An elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to
5 a hall call arising on said plurality of floors, characterized by comprising:

a service zone set means for setting a different service zone to said plurality of elevators;

a first call means for calling an elevator in
10 response to a hall call arising on a common service floor which is served commonly by said plurality of elevators; and

a second call means for automatically calling an elevator assigned to serve the service zone specified to
15 said common service floor independent of presence of said hall call.

2. An elevator group control system having a plurality of elevators serving a plurality of floors and a means for
20 assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, characterized by comprising:

a service group split means for splitting said plurality of elevators into a plurality of service groups
25 and thereby setting a different specific service zone for said plurality of service groups; and

a means for automatically calling a specific

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elevator in dependence on a traffic demand to a common service floor which is served commonly by said plurality of elevators independent of presence of a hall call.

5 3. An elevator group control system according to claim 2, wherein said specific elevator being called to the common service floor is characterized by belonging to one of said service groups which is assigned to serve a specific service zone.

10

4. An elevator group control system according to claim 2, further comprising a select means for selectively switching-over said specific elevator between said plurality of service groups.

15

5. An elevator group control system having a plurality of elevators serving a plurality of floors and a means for assigning one of said plurality of elevators most appropriate in response to a hall call arising on said plurality of floors, characterized by comprising:

20 a service group split means for splitting said plurality of elevators into a plurality of groups and thereby setting a different service zone for said plurality of groups to serve;

25 a first hall call assignment means for calling an elevator from a first service group by assigning thereto a hall call arising on a common service floor which is served





commonly by said plurality of elevators of said split groups; and

a second hall call assignment means for automatically calling an elevator from a second service group independent of presence of a hall call on said common service floor.

6. An elevator group control system according to claim 5, wherein said second service group has a smaller number of floors assigned to serve than said first service group has.

7. An elevator group control system having a plurality of elevators that serve a plurality of service floors, and a means of assigning one of said plurality of elevators which is most appropriate in response to a hall call from said plurality of service floors, characterized by comprising:

a service group split means for splitting said plurality of elevators into a plurality of groups and thereby setting a different service zone therefor; and

a means for calling an elevator from each of said plurality of groups having been split in response to a hall call occurring on a common service floor which is commonly served by said plurality of elevators in said plurality of groups having been split.



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8. An elevator group control system having a plurality of elevators that serve a plurality of service floors, and a means for assigning one of said plurality of elevators that is most appropriate in response to a hall call from
5 said plurality of service floors, characterized by comprising:

a service group split means for splitting said plurality of elevators into a plurality of groups and thereby setting a different service zone therefor; and

10 a means for automatically calling an elevator from each of said plurality of groups having been split independent of presence of a hall call on said common service floor.

15 9. An elevator group control system having a plurality of elevators that serve a plurality of service floors, and a means for assigning one of said plurality of elevators which is most appropriate in response to a hall call from said plurality of service floors, characterized by
20 comprising:

a service group split means for splitting said plurality of elevators into a plurality of groups and thereby setting a different service zone therefor;

a means for sequentially and automatically
25 registering a hall call from a common service floor which is served commonly by said plurality of groups having been split; and





a means for calling an elevator from each of said plurality of groups in response to said hall call.

10. An elevator group control system according to
5 either one of claims 1 to 9, wherein said common service floor is a congested floor crowded with boarding passengers.

11. An elevator group control system according to
either one of claims 1 to 10, wherein said service group
10 split means comprises: a traffic demand detecting means;
and a split means for splitting the plurality of elevators into the plurality of service groups accordingly wherein a service floor to be assigned to each elevator is determined when said traffic demand detected coincides with a
15 predetermined condition.

12. An elevator group control system according to claim 11, further comprising a means for changing affiliation of each elevator with each group according to an operational
20 condition of each elevator.

13. An elevator group control system according to either one of claims 1 to 12, further comprising a means for differently setting a service floor at which an
25 elevator is allowed to stop, respectively for up-going and down-going operations of the elevator.



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14. An elevator group control system having a plurality of elevators that serve a plurality of floors, and an assignment means for assigning an elevator to a hall call from said plurality of floors, characterized by comprising:

5 a service group split means for splitting said plurality of elevators into a plurality of groups and setting a different service zone for said plurality of groups to serve; and

an auto register means for automatically
10 registering a car call arising at a common service floor that is served commonly by said plurality of groups of elevators, said car call requesting an elevator assigned to serve a limited number of service floors specified and destined thereto.

15

15. An elevator group control system having a plurality of elevators that serve a plurality of floors, and an assignment means for assigning an elevator to a hall call from said plurality of floors, characterized by comprising:

20 a service group split means for splitting said plurality of elevators into a plurality of groups including a first group and a second group, said first group of elevators servicing a greater number of floors and said second group of elevators serving a smaller number of
25 floors; and

a call means for calling an elevator from said first group in response to a hall call from a common

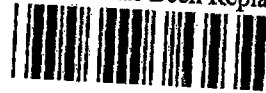


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service floor that is commonly serviced by said plurality of groups of elevators.



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ABSTRACT OF DISCLOSURE

In order efficiently to cope with a greater traffic demand occurring at a specific service floor at a specific time zone, a plurality of elevators are split into a plurality of service groups each for exclusively serving specified service floors assigned respectively thereto. During operation of such split service groups of elevator, a traffic demand at the common service floor which is serviced commonly by each service group is serviced automatically depending on the traffic condition or in response to a hall call by calling a most appropriate elevator car from each service group, wherein the hall call buttons on the common service floor need not be divided for each service group since it is automatically processed, thereby enabling to call a most appropriate elevator car for the user from any of the split service groups flexibly and efficiently without obliging the user to follow any specific operational instructions.

20 SELECTED DRAWING

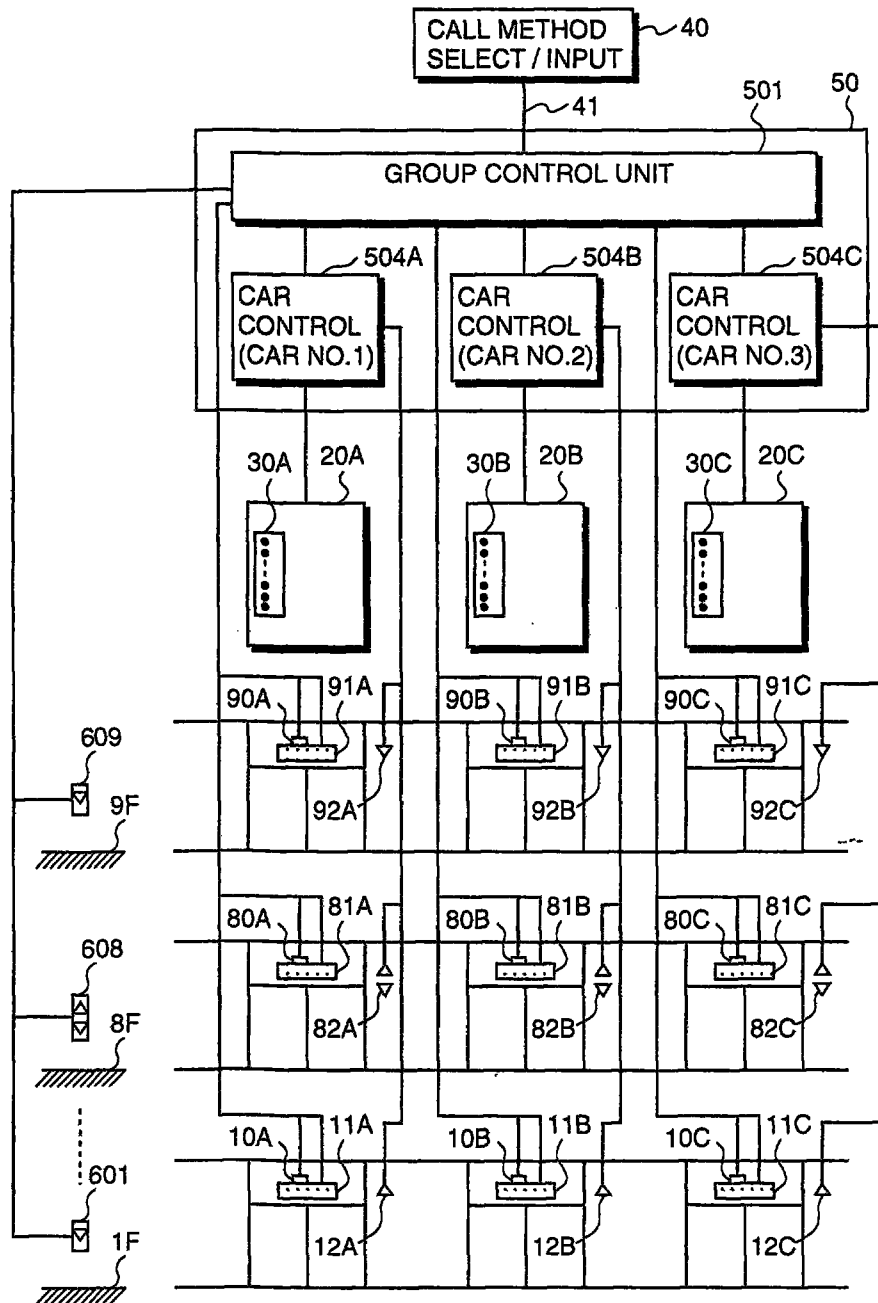
Fig. 5

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FIG. 1



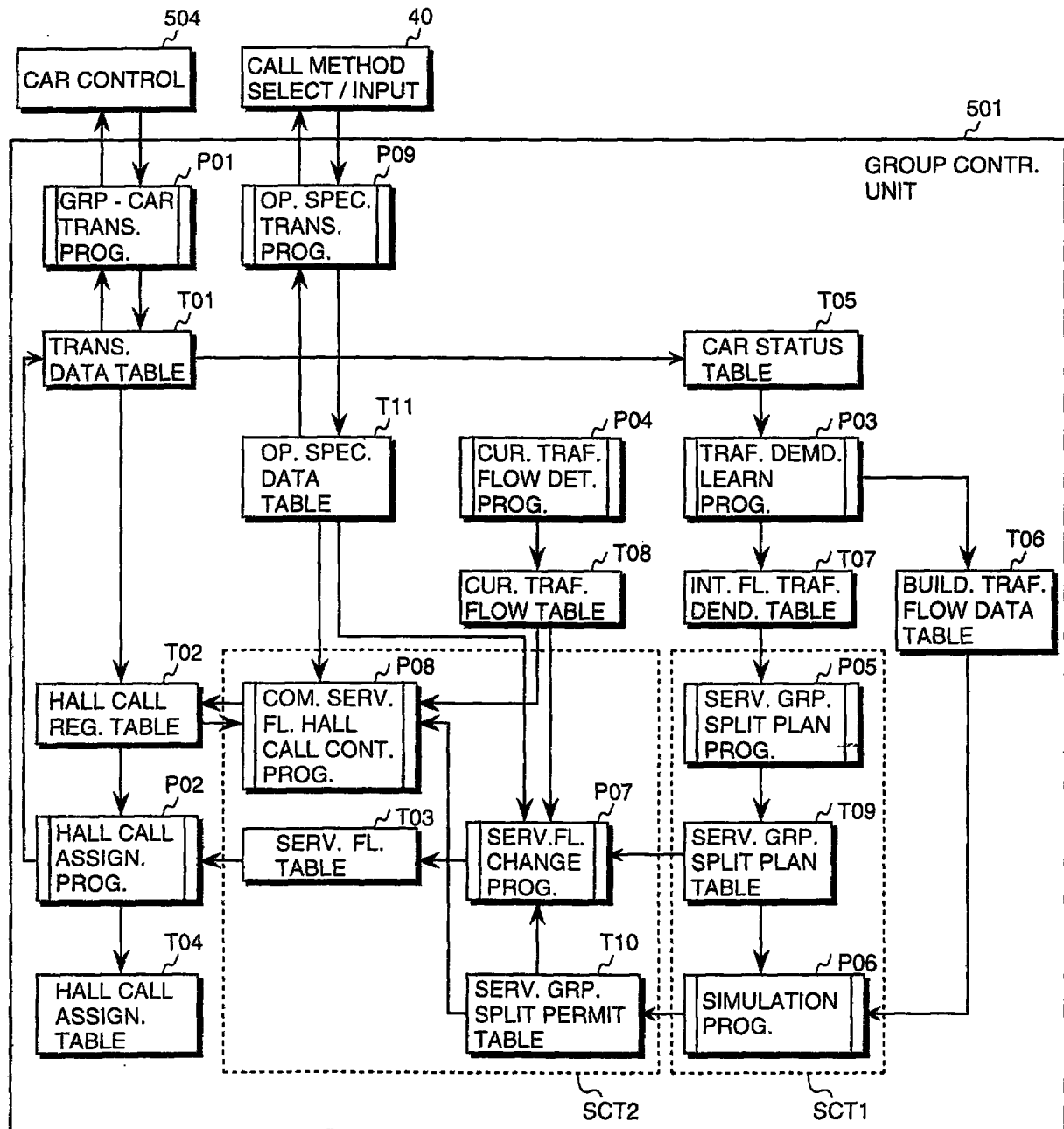


FIG.3

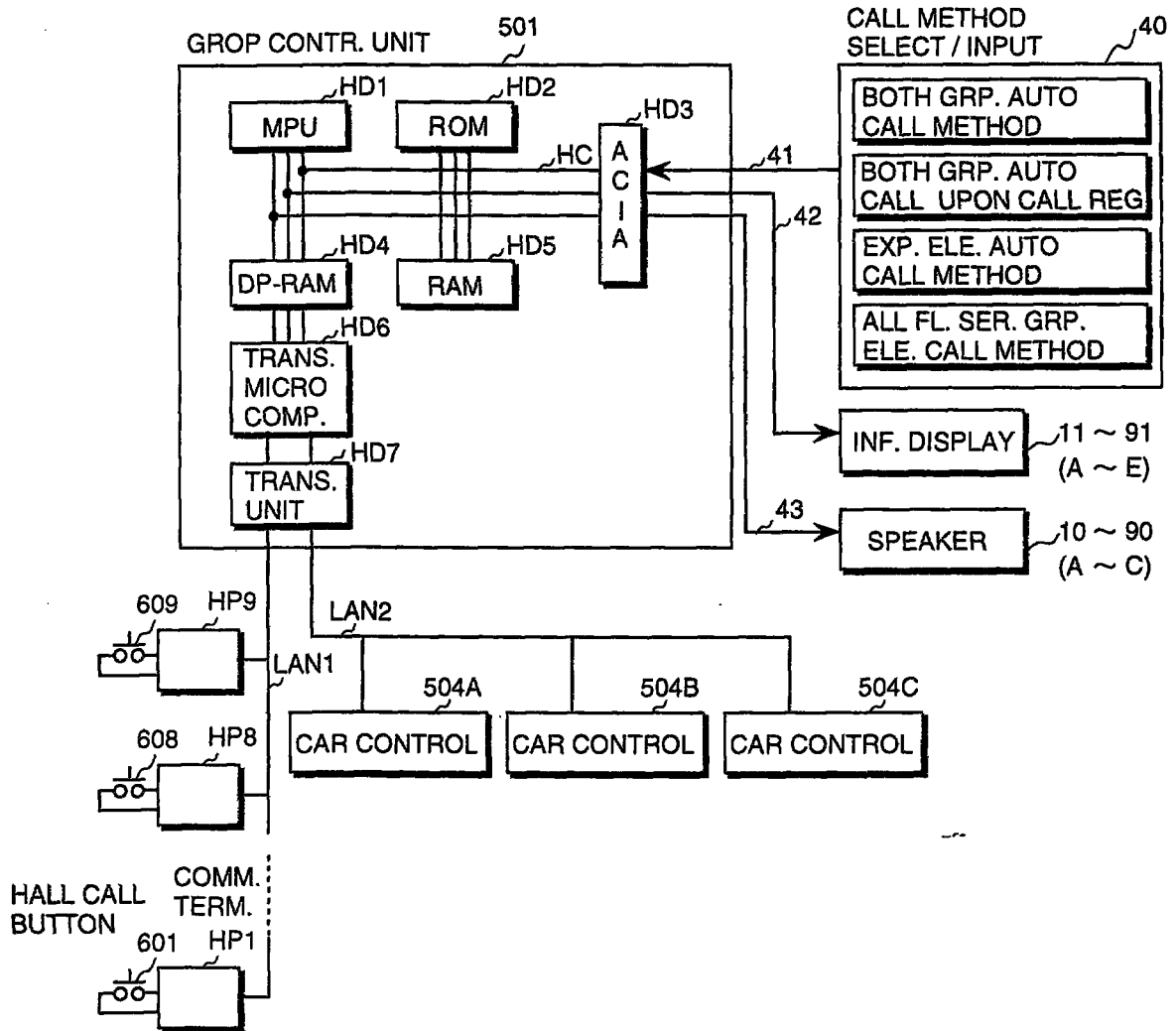


FIG.4

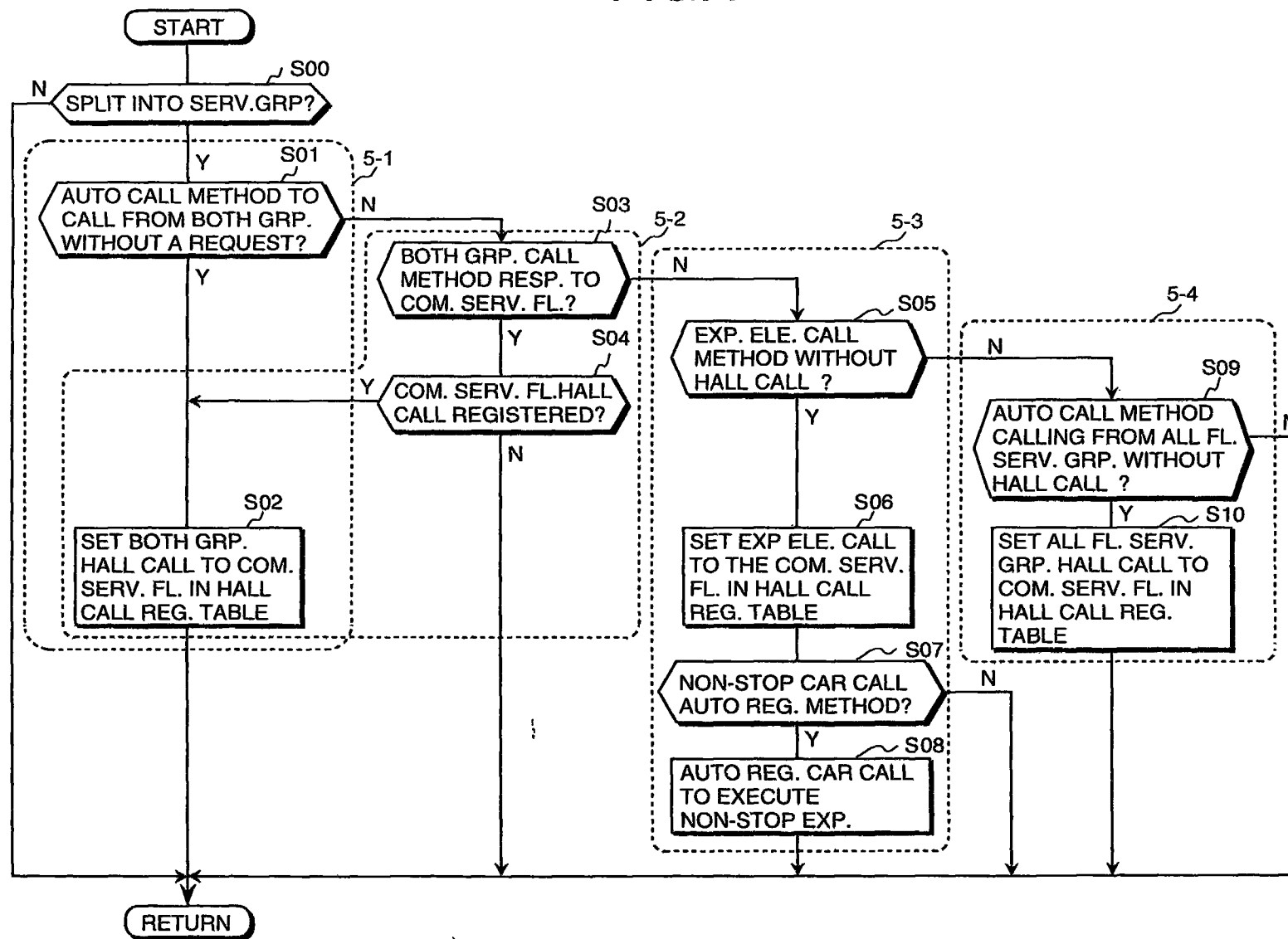


FIG.5

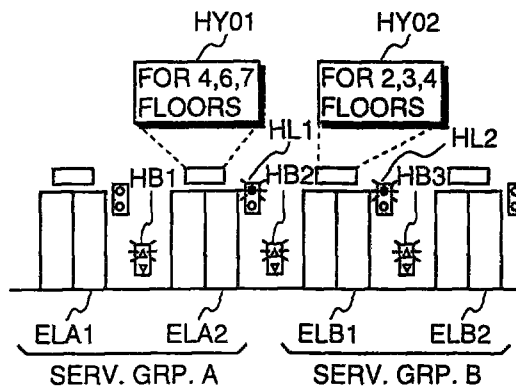
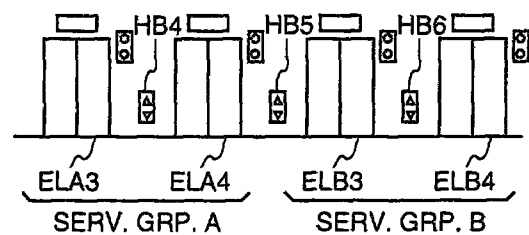
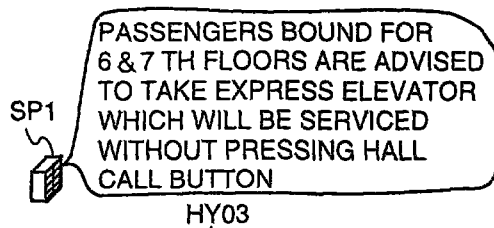
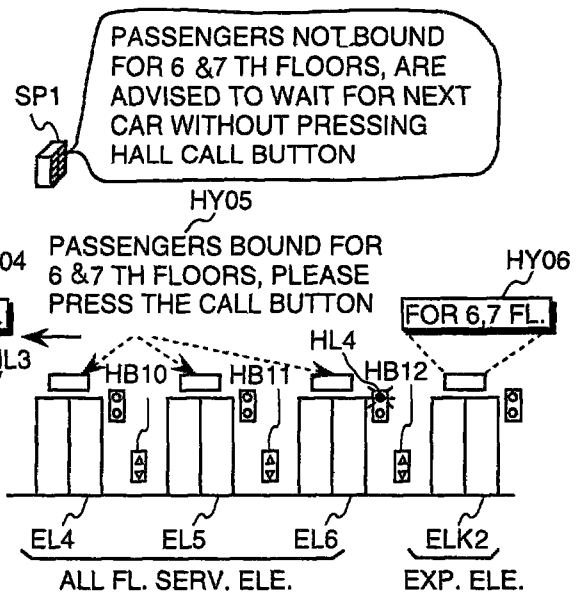
5-1 : EX. OF BOTH GRP. AUTO
CALL METHOD5-2 : EX. OF BOTH GRP. AUTO
CALL METHOD AT CALL REG.5-3 : EX. OF EXP. ELE. AUTO
CALL METHOD5-4 : EX. OF ALL FL. SERV. GRP.
ELE. AUTO CALL METHOD

FIG.6

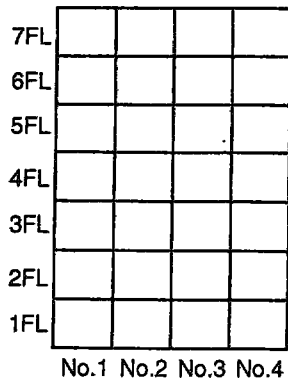
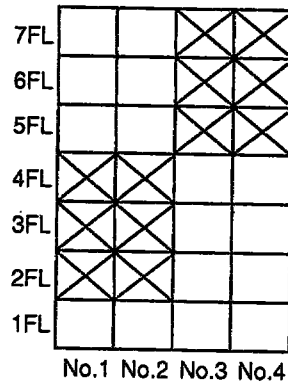
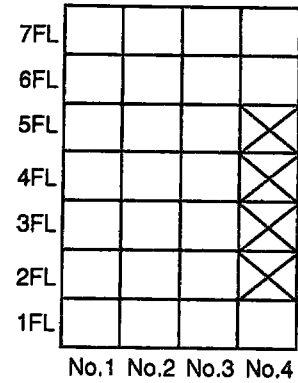
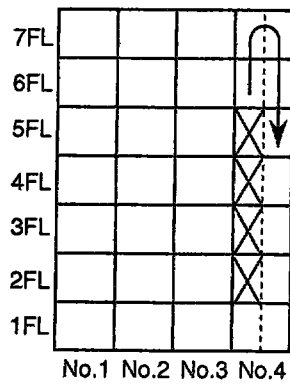
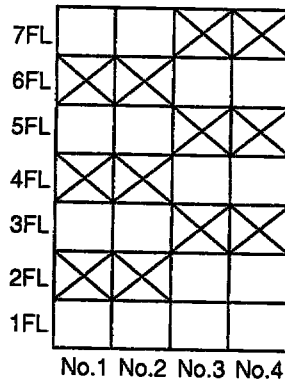
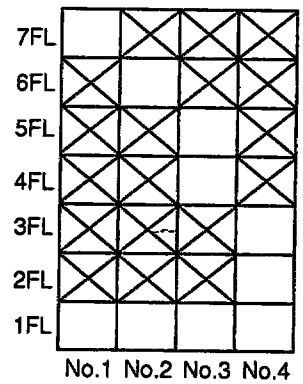
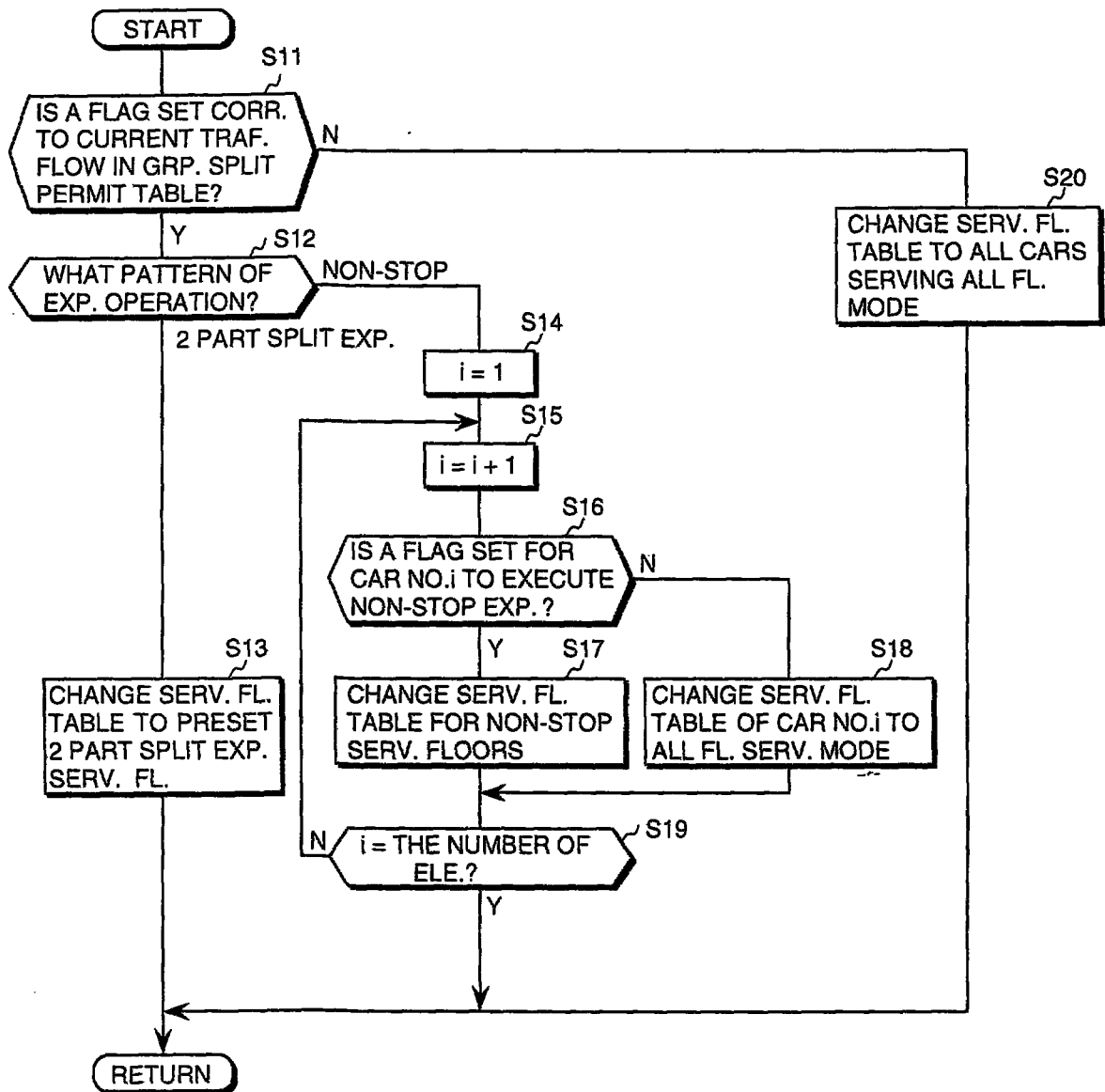
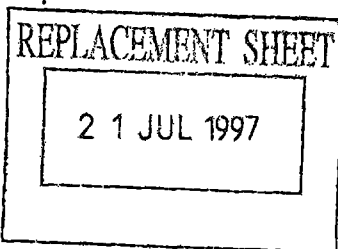
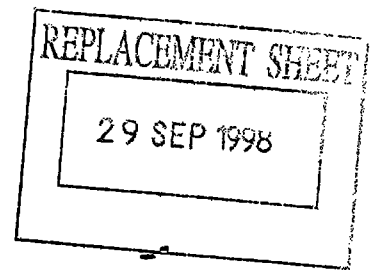
6-1 : ALL CARS SERVING
ALL FLOORS6-2 : 2 PART SPLIT
EXPRESS
OPERATION6-3 : NON-STOP
OPERATION6-4 : DIRECTIONAL
NON-STOP
OPERATION6-5 : SKIP
OPERATION6-6 : ALL CARS
RUNNING SPLIT
EXP. OPERATION

FIG.7



ABSTRACTELEVATOR GROUP CONTROL SYSTEM

In order efficiently to cope with a greater traffic demand occurring at a specific service floor at a specific time zone, a plurality of elevators are split into a plurality of service groups each for exclusively serving specified service floors assigned respectively thereto. During operation of such split service groups of elevator, a traffic demand at the common service floor which is serviced commonly by each service group is serviced automatically depending on the traffic condition or in response to a hall call by calling a most appropriate elevator car from each service group, wherein the hall call buttons on the common service floor need not be divided for each service group since it is automatically processed, thereby enabling to call a most appropriate elevator car for the user from any of the split service groups flexibly and efficiently without obliging the user to follow any specific operational instructions.



CLAIMS

1. An elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, comprising:

a means for dividing said plurality of elevators into a plurality of groups including a first and a second group, each group having at least one elevator;

a service zone set means for setting a plurality of different service zones, said plurality of different service zones having at least one or more common service floor(s) served in common;

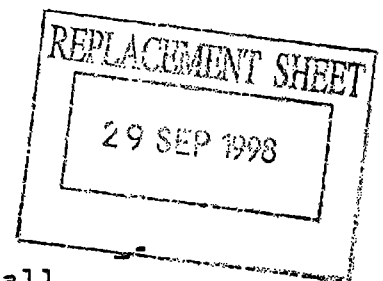
a means for assigning said plurality of different service zones to said plurality of groups, respectively;

a plurality of hall call buttons provided on said common service floor(s) which are used in common for any elevators in said plurality of groups;

a first call means for calling an elevator from said first and/or said second group in response to a hall call arising on said common service floors; and

a second call means for automatically calling an elevator in said second group to said common service





floor(s) without occurrence of said hall call.

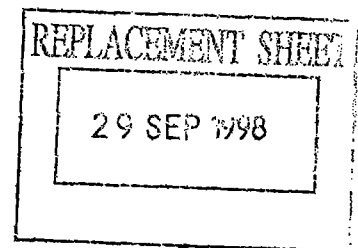
2. An elevator group control system according to claim 1, further comprising a means for interchanging group members to be called between said first group and said second group such that the elevator in said second group to be called by said second call means is interchanged to belong to said first group.

3. An elevator group control system according to claim 2, wherein said means for interchanging group members comprises a means for transferring a member of elevators belonging to said first group to said second group.

4. An elevator group control system according to claim 2, wherein said means for interchanging group members to be called comprises a means for changing a service zone assigned to a member of elevators belonging to said first group to another service zone assigned to said second group.

5. An elevator group control system according to any one of claims 2 to 4, further comprising:





a detection means for detecting an operational condition of each elevator of said plurality of elevators; and

a means for operating said interchanging means in response to an output from said detection means when said output indicates a predetermined state.

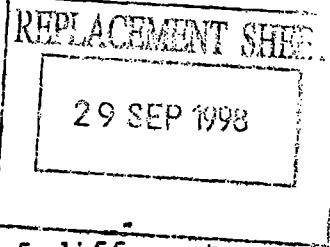
6. An elevator group control system according to claim 1, further comprising a means for allocating any one of said plurality of different service zones which has a smaller number of floors to serve to said second group.

7. An elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, comprising:

a means for dividing said plurality of elevators into a plurality of groups including a first and a second group, each group having at least one elevator car;

a means for setting a plurality of different service zones having one or more floors as a common service floor;





a means for assigning said plurality of different service zones to said plurality of groups, respectively;

a plurality of hall call buttons provided on said common service floor(s) which are used commonly for any elevators in said plurality of groups;

a first call means for calling each elevator in said first and second groups in response to said hall call from said common service floor; and

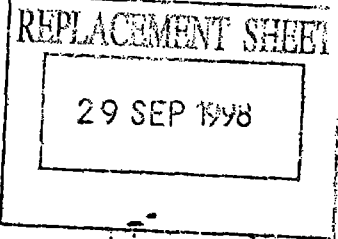
a second call means for automatically calling an elevator in said second group irrespective of the presence or absence of said hall call from said common service floor.

8. An elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, comprising:

a plurality of common hall call buttons provided on each boarding floor used for addressing to all of said plurality of elevators belonging to said elevator group control system,

a first mode operating means for operating said all





of said plurality of elevators in a first operation mode which designates the all elevators to service all floors in response to said common hall call;

a means for dividing said plurality of elevators into a plurality of groups including a first and a second group, each group having at least one elevator;

a means for setting a plurality of different service zones having a common service floor of one or more floors;

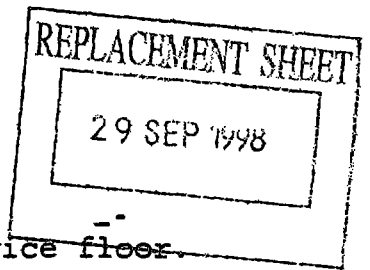
a means for assigning said plurality of different service zones to said plurality of groups, respectively; and

a second mode operating means for calling an elevator in said first and/or said second groups in response to said common hall call requested from said common service floor; and

a means for automatically calling an elevator in said second group irrespective of the presence or absence of said hall call from said common service floor.

9. An elevator group control system according to any one of claims 1 to 8, further comprising a means for automatically registering a specific floor of destination





for each elevator called to the common service floor.

10. An elevator group control system according to either one of claims 1 to 9, further comprising a means for changing service floors at which each elevator car is allowed to stop depending on whether the same is going up or going down.

11. An elevator group control system according to any one of the preceding claims, wherein said means for dividing the plurality of elevators into groups comprises dividing the plurality of elevators into said first and said second groups in dependence on determination that the traffic demand having been detected becomes a predetermined condition.

12. An elevator group control system according to any one of the preceding claims wherein said common service floor(s) is any floor which is congested with many users waiting for elevators.

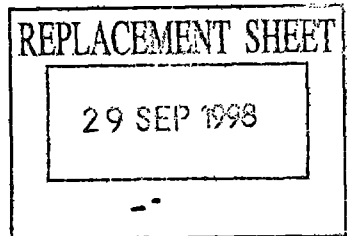


REPLACEMENT SHEET
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33

13. An elevator group control system substantially as herein described with reference to the attached figures.





- 5 -

congested service floors.

According to a first aspect of the invention, there is provided an elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, comprising:

a means for dividing said plurality of elevators into a plurality of groups including a first and a second group, each group having at least one elevator;

a service zone set means for setting a plurality of different service zones, said plurality of different service zones having at least one or more common service floor(s) served in common;

a means for assigning said plurality of different service zones to said plurality of groups, respectively;

a plurality of hall call buttons provided on said common service floor(s) which are used in common for any elevators in said plurality of groups;

a first call means for calling an elevator from said first and/or said second group in response to a hall call arising on said common service floors; and

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- 5a -

a second call means for automatically calling an elevator in said second group to said common service floor(s) without occurrence of said hall call.

According to a second aspect of the invention there is provided an elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, comprising:

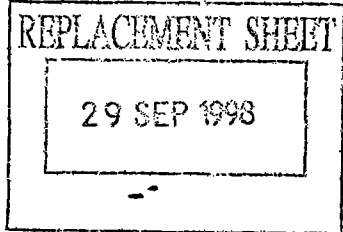
" a means for dividing said plurality of elevators into a plurality of groups including a first and a second group, each group having at least one elevator car;

a means for setting a plurality of different service zones having one or more floors as a common service floor;

a means for assigning said plurality of different service zones to said plurality of groups, respectively;

a plurality of hall call buttons provided on said common service floor(s) which are used commonly for any elevators in said plurality of groups;

a first call means for calling each elevator in said first and second groups in response to said hall call



- 5b-

from said common service floor; and

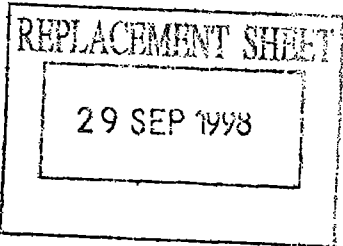
a second call means for automatically calling an elevator in said second group irrespective of the presence or absence of said hall call from said common service floor.

According to a third aspect of the invention there is provided an elevator group control system having a plurality of elevators serving a plurality of floors, and a means for assigning one of said plurality of elevators in response to a hall call arising on said plurality of floors, comprising:

a plurality of common hall call buttons provided on each boarding floor used for addressing to all of said plurality of elevators belonging to said elevator group control system,

a first mode operating means for operating said all of said plurality of elevators in a first operation mode which designates the all elevators to service all floors in response to said common hall call;

a means for dividing said plurality of elevators into a plurality of groups including a first and a second group, each group having at least one elevator;



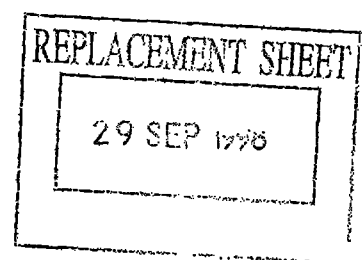
- 5c -

a means for setting a plurality of different service zones having a common service floor of one or more floors;

a means for assigning said plurality of different service zones to said first and said second groups, respectively; and

a second mode operating means for calling an elevator in said first and/or said second groups in response to said common hall call requested from said common service floor.

An elevator group control system according to an embodiment of the invention is operated in such a manner that by detecting an inter service floor traffic demand, that is, respective traffic demands between respective service floors, obtained as a result of learning of these traffic demands over a predetermined period of time, planning of respective service groups and a common service floor is assessed in reference to a value of data in an inter service floor traffic demand look-up table, and thereby operating the plurality of elevators split into plural service groups according to the planning, wherein hall call buttons on the common service floor are not separated for respective service groups but are arranged to



facilitate respective hall calls for calling respective elevators from respective service groups.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

Fig. 1 is a schematic block diagram indicative of an elevator group control system of an embodiment of the invention;

Fig. 2 is a schematic block diagram indicative of a control processing software architecture according to the embodiment of Fig. 1;

Fig. 3 is a schematic block diagram indicative of a hardware architecture of the embodiment of Fig. 1;

Fig. 4 is a flow chart of a control program for processing a common service floor hall call for use in the embodiment of Fig. 1;

Fig. 5 is diagrams indicating various guidance statuses of hall annunciators at the common service floor during express operation according to the invention;

Fig. 6 indicates examples of service floors to be serviced separately and efficiently during split express operation according to the invention; and

Fig. 7 is a flow chart of a service floor modification program according to the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

With reference to the accompanying drawings of