



FIG. 1

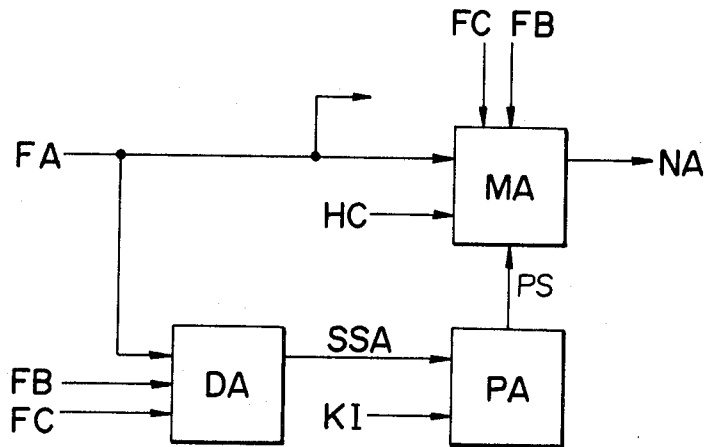


FIG. 3

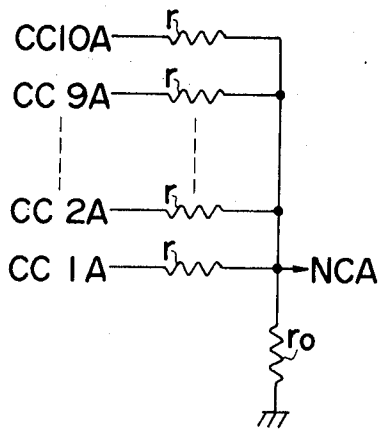
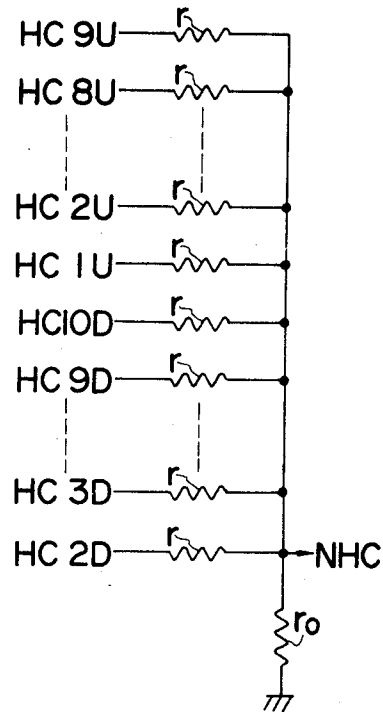


FIG. 4

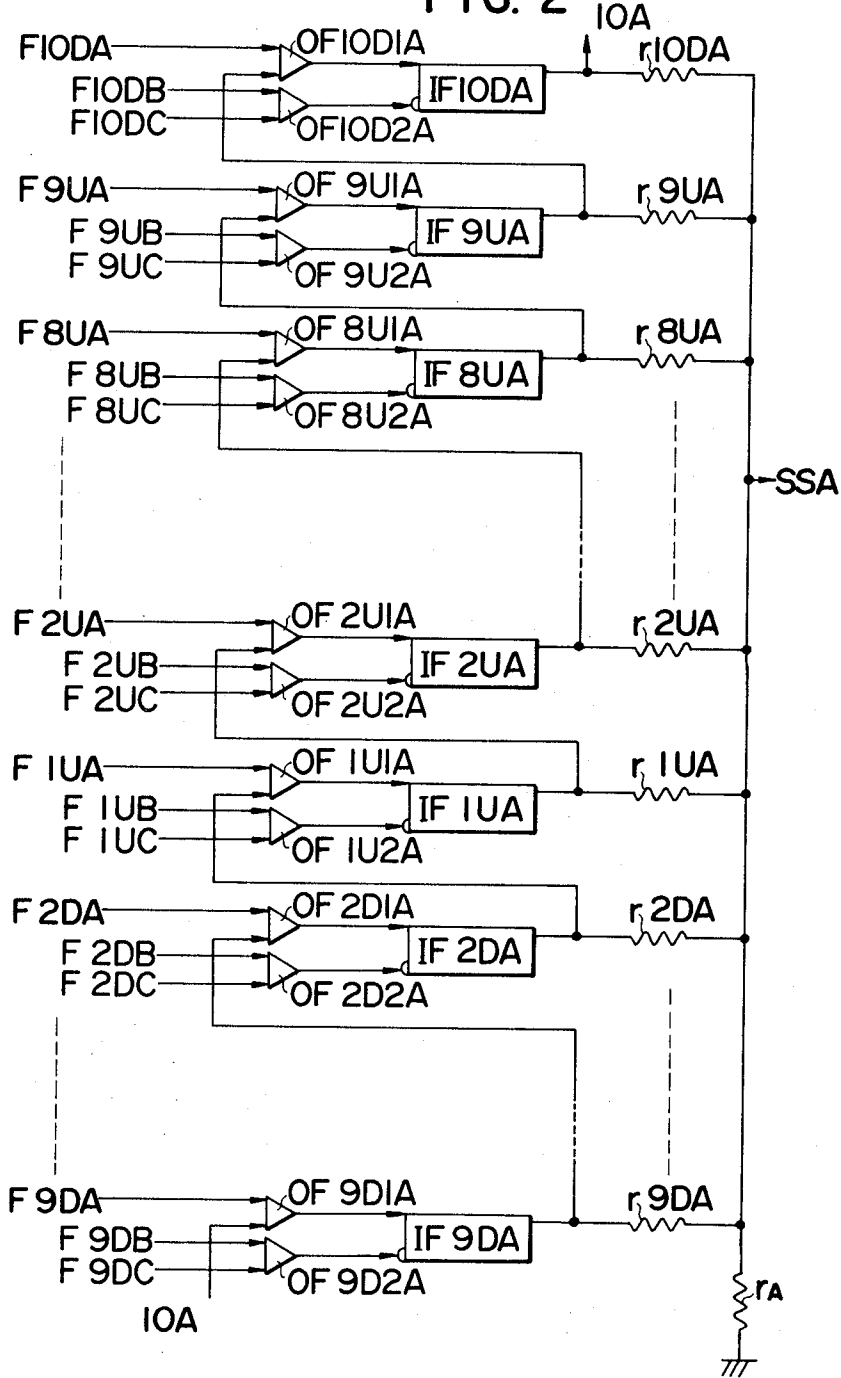


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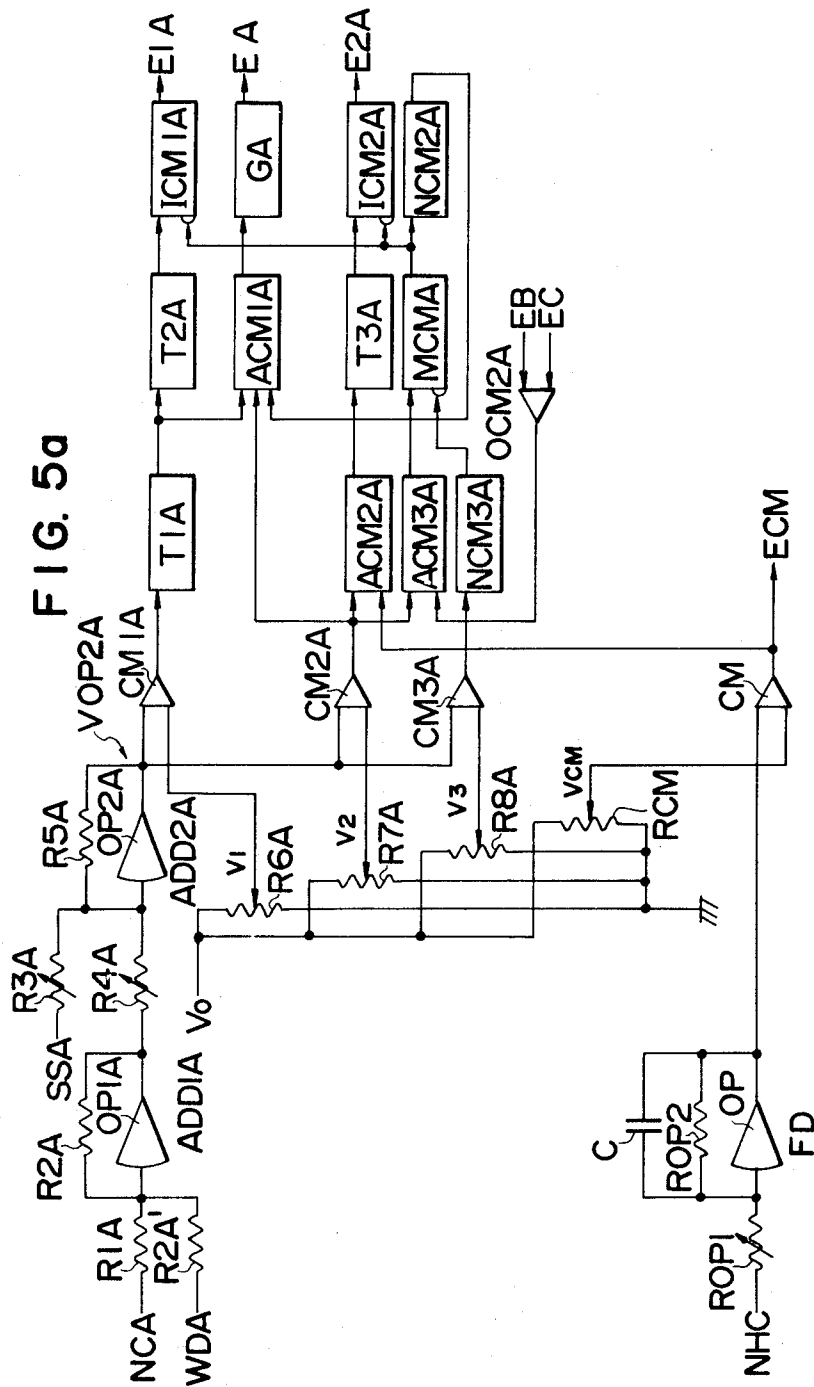
FIG. 2



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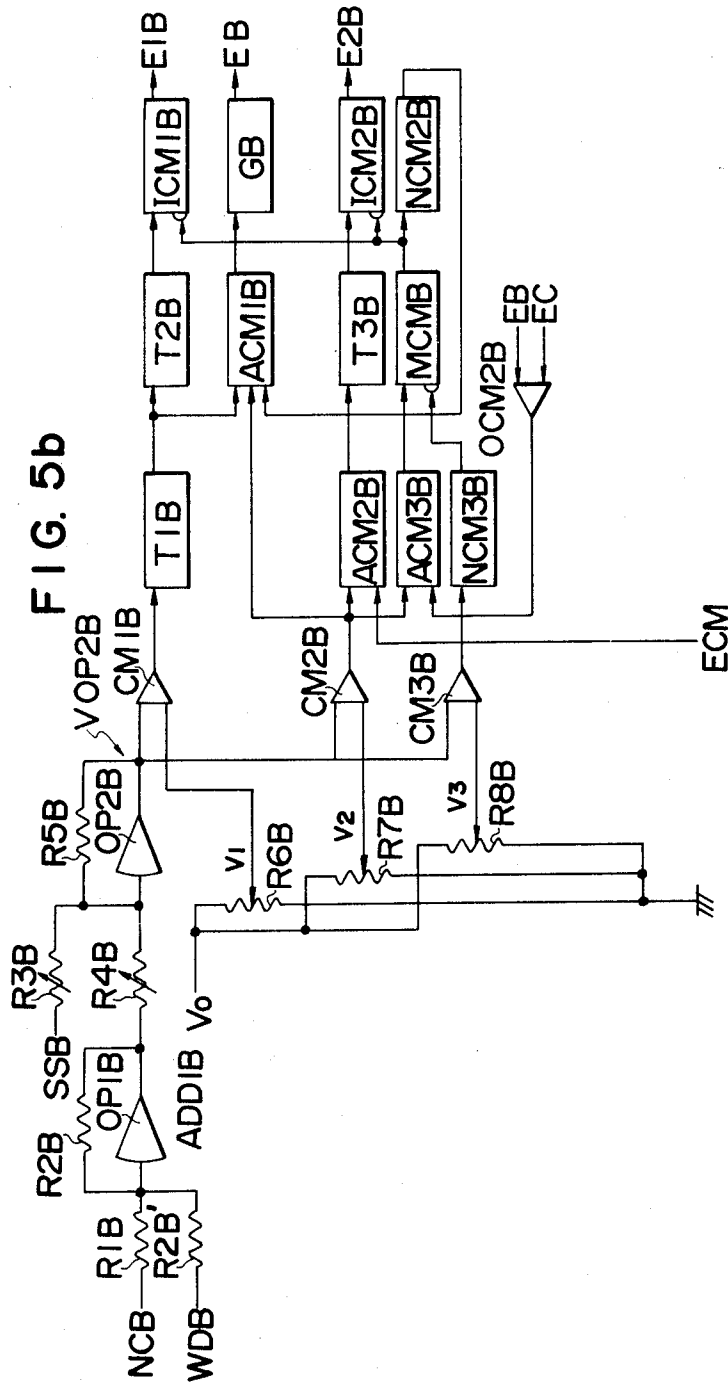


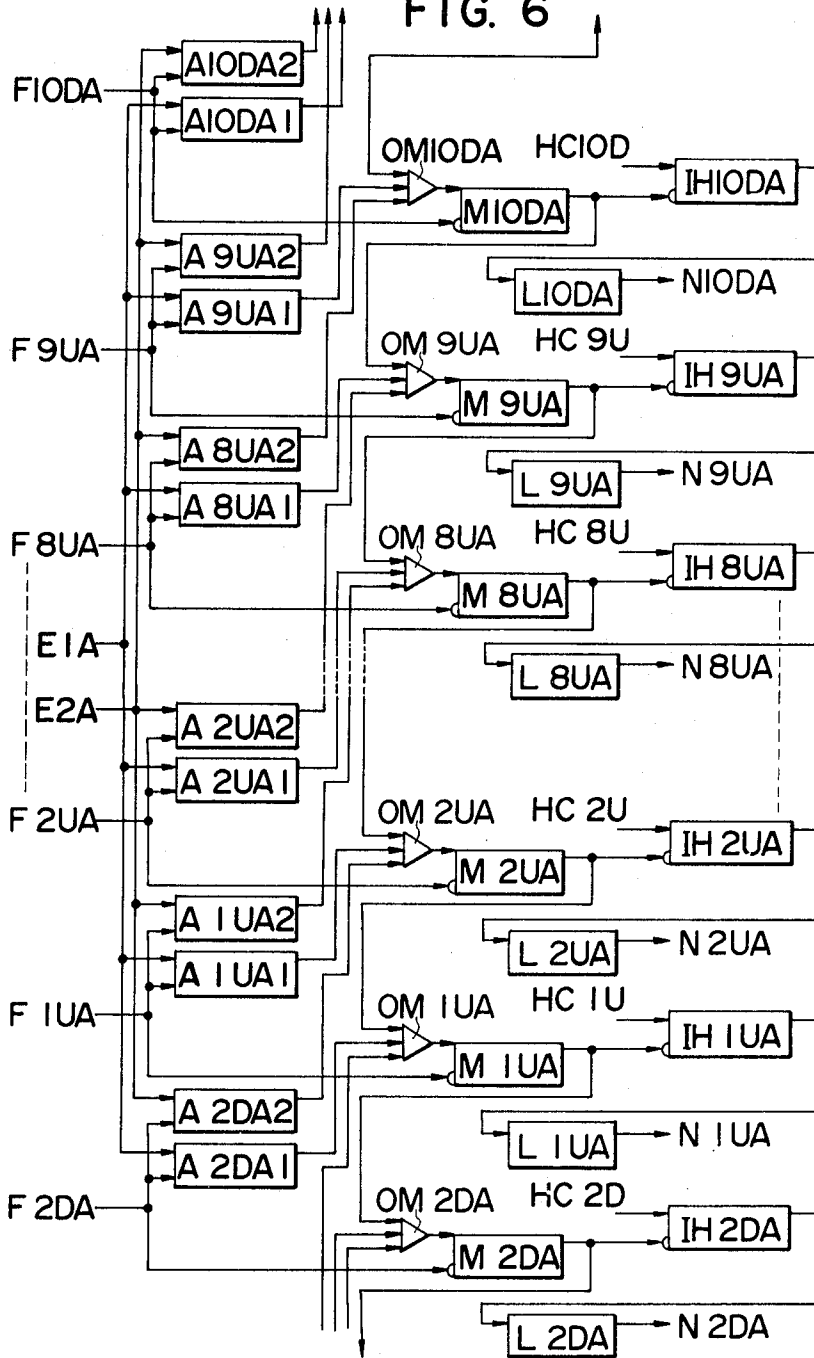
FIG. 5b

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FIG. 6



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## ELEVATOR CONTROL SYSTEM

The present invention relates to an improvement of an elevator control system and in particular an elevator control system used for a plurality of elevator cars.

When a plurality of elevator cars serve a plurality of floors, it is necessary to prevent the elevator cars from "bunching," namely, moving without suitable interval. In other words, the elevator cars must be operated, maintaining an appropriate, if not equal, space or time interval between them so that passenger waiting time for the arrival of an elevator car becomes almost equal for each floor.

In order to control the space between elevator cars, a conceivable method is to generate a position signal associated with the position of each elevator and when the interval between the positions associated with respective position signals of a preceding car and a succeeding car is reduced below a predetermined length, the response of the preceding car to hall calls from a floor or floors within a predetermined zone in forward direction from the position indicated by its own position signal is restricted, thereby advancing its apparent position.

According to such a control system, when a succeeding car approaches a preceding car too much, the preceding car neglects a hall call or hall calls from a forward floor or forward floors and moves on, while the floors neglected by the preceding car are served by the succeeding car, widening again the space between the preceding and succeeding cars. The above-mentioned position signal may indicate either floor number or distance, but for practical purposes, it should represent floor number. The position signal per se indicates the actual position of an elevator car and therefore is called a physical position signal. The floor number indicated by the position signal may be that of the floor where a car is stopped, in which case it agrees with the physical position, or that of the floor in advance of the physical position of the car when it is running. For example, when the car is running between the third and fourth floors at low, middle or high speed, the signal indication may be the fourth, fifth or sixth floor respectively. The same is true if the position signal is made to indicate distance.

In a typical elevator control operation, a hall call for up travel is served by a car moving up, while a hall call for down travel is served by a car moving down. That is to say, with the first floor as a terminal, an upgoing car starting from the first floor responds to up calls from the floors from first to top in order, and after reaching the top floor, it responds to down calls from the floors from top to first in order. Each of floors ahead of a moving car is called a forward floor and a call from a forward floor, a forward hall call, while each of floors behind a moving car is called a back floor and a call from a back floor, a back hall call. For example, if a car positioned at the fifth floor receives an up call from the sixth floor, it is a forward hall call, and if it receives a call from the third floor, it is a back hall call. The reverse is true in case of downward travel.

An elevator car is usually made to respond to forward hall calls from floors in advance of the position indicated by the position signal for that car. But in a special case where the car is made not to respond to forward hall calls associated with a specified zone, its posi-

tion is advanced in appearance. The nearest forward floor the hall call from which a car can actually respond to is hereinafter called an apparent position of that car. In other words, when response to forward hall calls is not limited, an apparent position agrees with the position indicated by a position signal, whereas it leads the position signal if a hall call or hall calls from some forward floor or floors is/are neglected.

In the above-mentioned device, it may be that, if a preceding car A is made to respond to a forward hall call (s) from a floor (s) between its apparent position and that of a car C which moves ahead of car A, a succeeding car B approaches car A too much when there are many hall calls to be served by car A and few hall calls for the service of car B. This problem becomes more apparent if it is required to inform waiting passengers at the time of a hall call as to which elevator car is actually to serve them, because once they are informed of a car serving them, the very car has no choice but to stop at the floor (s) where the passengers are waiting.

Further, where there are many cage calls for a preceding car and few cage calls for a succeeding car, the space between the preceding and succeeding cars does not widen even if response of the preceding car to hall calls is limited, because the preceding car has to serve the cage calls.

An object of the present invention is to achieve a more efficient control of car intervals by making a succeeding car lead a preceding car when the space between them is shortened too much.

It should be noted that it is less effective for the control of the car interval between two cars to detect the approach of the two cars when they stand side-by-side because there is the possibility of a small space remaining as between the preceding and succeeding cars. In that event, a control system in which the space between the preceding and succeeding cars is lengthened only when the two cars stand side-by-side on the same floor landing is not useful and, hence, it is desirable to lengthen the space between two cars by detecting the approach in a predetermined extent well before they stand side-by-side.

According to the present invention, when the space between two cars is less than a predetermined extent, the two cars are caused to more closely approach one another on purpose so as to achieve a more efficient control of car intervals. In particular, the degree of the stepping-up of the speed of the succeeding car is changed in response to the extent of the space between the preceding and succeeding cars. The response of the succeeding car to a hall call or calls from a floor or floors in advance of an adjacent to the position thereof is limited when the succeeding car approaches the preceding car within the predetermined extent, so that the succeeding car more closely approaches the preceding car. As the succeeding car approaches the preceding car, the limiting of the response to hall calls is extended, whereby the succeeding car catches up with the preceding car and leads it at last.

The above and other objects, features and advantages will be made apparent by the detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram showing an embodiment of the present invention;

FIG. 2 is a detailed circuit diagram showing an example of a space detector means;

FIG. 3 is a circuit diagram showing an example of a means for detecting the number of cage calls;

FIG. 4 is a circuit diagram showing an example of a means for detecting the number of hall calls;

FIGS. 5a and 5b are detailed circuit diagrams showing an example of a space decision device; and

FIG. 6 is a circuit diagram showing an example of a service decision device for hall calls.

Referring to FIG. 1, explanation will be made below of a case in which three elevator cars A, B and C are serving ten floors from first to tenth floors. The control system of FIG. 1 is for car A, and similar systems are provided also for cars B and C. The space detector DA receives as inputs position signals FA, FB and FC of cars A, B and C respectively, whereby the distance between car A and a car ahead (in terms of the number of a floor or floors) is detected and the space detector DA produces a space signal SSA. When the space signal SSA becomes smaller than a by-pass condition signal KI, a by-pass control device PA imparts a by-pass instruction PS to the service control device MA, thereby temporarily limiting the response of car A to a hall call HC. This causes the operation of car A to be stepped up and as a result car A by-passes the preceding car.

The position signals FA, FB and FC of cars A, B and C are respectively applied to the service control device MA which makes a decision on whether or not car A should respond to the hall call HC. When responding to the hall call HC, it produces a response signal NA and informs the floor associated with a registered hall call signal that car A is to stop that floor. Incidentally, signal FA is applied to service control devices MB and MC (not shown). In this embodiment, the apparent position of each elevator car is not advanced and therefore it agrees with the position indicated by the position signal FA, FB or FC.

The position signals FA, FB and FC represent the very floors where elevator cars are stopped, or when they are running, the nearest forward floors where the elevator cars can offer their service. Therefore, the position of a car indicated by a position signal is different from the physical position of that car, depending on the running speed of that car at each time. For example, when a car is stopped at the fourth floor, the position signal indicates the fourth floor, whereas when it is running between the fourth and fifth floors at low, middle or high speed, the position indicated by the position signal FA is the fifth, sixth or seventh floor respectively.

It requires a certain decelerating distance for an elevator car to stop or reduce its speed, and this decelerating distance depends on the running speed of the elevator car. Accordingly, it is advantageous for improvement of the control efficiency and simplification of the control system if the physical position of an elevator car is advanced in accordance with the decelerating distance. On the other hand, if a physical position signal is used to advance the apparent position of an elevator car, it is necessary to provide a separate device for deciding whether or not the elevator car is in a position to serve a hall call or hall calls from a floor or floors ahead of the apparent position.

Referring now to FIG. 2 which shows a detailed circuit diagram of the space detector DA of FIG. 1, car A is set for up travel, and when it is at the first floor, the position signal F1UA is produced. Similarly, the position signals F2UA to F9UA are produced when car A set for up travel is at the second to ninth floors respectively.

On the other hand, when car A set for down travel is positioned at the second to tenth floors, the position signals F2DA to F10DA are produced respectively. Space detectors DB and DC (not shown in the drawing) for cars B and C respectively work on the same principle, producing position signals F1UB to F9UB, F2DB to F10DB for car B and F1UC to F9UC and F2DC to F10DC for car C. Each of the position signals F1UA to F9UA and F2DA to F10DA constitutes an input to each of corresponding OR elements OF1U1A to OF9U1A and OF2D1A to OF10D1A. A position signal for car B is paired off with a position signal for car C for the same direction of travel and for the same floor, and such a pair of the signals makes up two inputs to each of OR elements OF1U2A to OF9U2A and OF2D2A to OF10D2A. For example, a pair including the signals F2UB and F2UC is applied to the OR element OF2U2A.

Inhibit elements IF1UA to IF9UA and IF2DA to IF10DA are provided corresponding to the position signals F1UA to F9UA and F2DA to F10DA, and outputs of the OR elements OF1U1A to OF9U1A and OF2D1A to OF10D1A are applied to the input terminals of the above-mentioned inhibit elements respectively, while to their inhibit terminals are applied outputs of the OR elements OF1U2A to OF9U2A and OF2D2A to OF10D2A respectively. The outputs of all the inhibit elements are joined through resistors  $\gamma$ 1UA to  $\gamma$ 9UA and  $\gamma$ 2DA to  $\gamma$ 10DA and grounded through a common resistor  $\gamma$ A. The ends of the common terminal  $\gamma$ A produce space signal SSA respectively. The inhibit elements are arranged in the form of a ring in the order of IF1UA, IF2UA, . . . IF9UA, IF10DA, IF9DA, . . . IF2UA and IF1UA, the outputs of which are applied to OR elements OF1U1A to OF9U1A and OF2D1A to OF10D1A respectively of inhibit elements in the next stage.

Assume that car B is at the eighth floor for up travel, car B at the second floor for up travel and car C at the fifth floor for down travel. (Car A is succeeding car B.) In this case, the position signals F8UB, F2UA and F5DC are produced. First, the position signal F2UA for car A energizes the OR element OF2U1A and thereby the inhibit element IF2UA produced an output. This signal is applied to the OR element OF3U1A (not shown in the drawing) which is attached to the inhibit element IF3UA (not shown in the drawing) in the next stage, thereby energizing this inhibit element. In like manner, the inhibit elements IF4UA, IF5UA, IF6UA and IF7UA (not shown in the drawing) are energized.

The output of the inhibit element IF7UA is applied both to the OR element OF8U1A and to the inhibit element IF8UA. However, since an input is applied to the inhibit terminal of the inhibit element IF8UA with the OR element OF8U2A energized by the position signal F8UB, the inhibit element IF8UA is not energized. As a result, inputs are supplied to the resistors  $\gamma$ 2UA to  $\gamma$ 7UA.

Assuming that an output voltage of each inhibit element is equivalent to a unit voltage, the voltage across the resistor

$$\gamma A: \frac{\gamma_0}{\gamma_0 + \frac{\gamma}{n}} = \frac{n\gamma_0}{n\gamma_0 + \gamma}$$

where  $\gamma$  is the resistance value of the resistors  $\gamma 1UA$  to  $\gamma 9UA$  and  $\gamma 2DA$  to  $\gamma 10DA$ ,  $n$  the number of inhibit elements producing outputs and  $\gamma_0$  the resistance value of the common resistance  $\gamma A$ . If  $\gamma_0 \ll \gamma$ ,

$$SSA = n\gamma_0/\gamma$$

From this, it is understood that a signal proportional to the number of inhibit elements energized is obtained. In the above-mentioned example,  $n=6$ . Therefore, the space of six floors between car A and the succeeding car B is detected.

A circuit for detecting the number NCA of cage calls from within car A is shown in FIG. 3, in which cage call signals CC1A to CC10A are applied through the resistor  $\gamma$  to produce an output signal NCA on the same principle as in the circuit of FIG. 1.

The circuit as shown in FIG. 4 performs a similar operation in which hall call signals HC2D to HC10D and HC1U to HC9U are applied through a common resistor  $\gamma_0$  whereby a signal NHC proportional to the number of hall calls is produced.

The detailed circuit diagram of an example of the space decision device attached to car A is shown in FIG. 5a, in which an adder ADD1 comprises an operational amplifier OP1A, feedback resistor R2A, input resistor R1A to which the signal NCA detected by the circuit of FIG. 3 is applied, and an input resistor R2A' to which a signal WDA corresponding to the weight of passengers inside the cage is applied. An adder ADD2 has an operational amplifier OP2A, feedback resistor R5A, input resistor R3A to which the space signal SSA detected by the circuit of FIG. 2 is applied, and an input resistor R4A to which the output of the adder ADD1A is applied. The output  $V_{OP2A}$  of the adder ADD2A is applied to the comparators CM1A to CM3A, to which reference voltages  $V_1$  to  $V_3$  set by variable resistors R6A to R8A are also applied. When a reference voltage exceeds the output voltage of the adder ADD2A in absolute value, the output of a comparator becomes "1." A signal corresponding to a hall call and a reference voltage  $V_{CM}$  depending on the variable resistor RCM are applied to the comparator CM, the output of which becomes "1" when the former is reduced below the latter. A smoothing device FD has an operational amplifier OP, Feedback resistor ROP2, feedback capacitor C and input resistor ROP1 to which the signal NHC corresponding to a hall call, obtained from the circuit of FIG. 4, is applied.

Timer elements T1A to T3A are energized a predetermined time after inputs are applied to them, and turned off immediately after the inputs are extinguished. The outputs of AND element ACM2A and ACM3A respectively become "1" when two inputs are applied to each of them. ICM1A and ICM2A show inhibit elements, NCM2A and NCM3A NOT elements, MCMA a memory element, OCM2A an OR element,

and GA a differentiating element which becomes "1" for a predetermined period of time when an input is applied to it.

FIG. 5b is a circuit diagram showing a space decision device attached to car B, and all the component elements therein are marked with B at their respective symbols. For convenience of explanation, the adder ADD1 is omitted and it is assumed that reference voltages  $V_1$ ,  $V_2$  and  $V_3$  are set at one, zero and two floors of car intervals respectively.

Assume that car A has approached a preceding car B. The space signal SSA obtained from the space detector DA of FIG. 2 is applied to the adder ADD2A. The output voltage  $V_{OP2A}$  of the adder ADD2A is applied to comparators CM1A to CM3A. Assuming that the space signal SSA indicates three floors, each of the sums of two inputs to the comparators CM1A to CM3A, namely,  $V_1 + V_{OP2A}$ ,  $V_2 + V_{OP2A}$  and  $V_3 + V_{OP2A}$  is negative. (The output of the adder ADD2A is assumed to be negative.) So, the output signal of any comparator is "0," whereby the output of the NOT element NCM3A is "1" which resets the memory element MCMA.

When the space signal SSA changes to two floors,  $V_3 + V_{OP2A} = 0$ , so that the output of the comparator CM3A changes to "1" (the outputs of the other comparators CM1A and CM2A being "0"), and the output of the NOT element NCM3A to "0," cancelling the reset signal for the memory element MCMA. When car A approaches car B so close that the space signal SSA indicates one floor,  $V_1 + V_{OP2A} = 0$  and  $V_2 + V_{OP2A} < 0$ , with the result that the output of the comparator CM1A becomes "1." This signal is applied to the inhibit elements T1A and T2A, thereby producing an output "1" of the hall call limiting signal E1A. As a result, the response of car A to a hall call or hall calls is limited. When car A further approaches and catches up with car B,  $V_1 + V_{OP2A} > 0$ ,  $V_2 + V_{OP2A} = 0$  and  $V_3 + V_{OP2A} > 0$ , with the result that all the outputs of comparators CM1A to CM3A become "0." Since the output of the memory element MCMA is "0," the NOT element NCM2A produces an output of "1." Three outputs of the AND element ACM1A are therefore "1," applying an input to the differentiating element GA thereby to maintain its output at "1" for a predetermined period, say, 100 ms. The comparator CM produces an output of "1" when the number of hall calls is below a predetermined level, and therefore the AND element ACM2A also produces an output of "1," thereby causing the timer element T3A to produce an output of "1" for a predetermined period of time, say, 200 ms. This signal makes "1" of the output of the inhibit element ICM2A, thereby producing a hall call limiting signal E2A.

As will be understood from above, when car A catches up with car B, both the hall call limiting signals E1A and E2A are set at "1" whereby the response of car A to a hall or hall calls is limited. On the other hand, the space signal SSB in FIG. 5b becomes "0" as in the case of car A, and thereby the outputs of the comparators CM1B, CM2B and CM3B become "1." The output of the comparator CM1B is applied as an input to the AND element ACM1B after a certain period of time set by the timer element T1B.

If the timer set by the timer element T1B is assumed to be 200 ms, the output of the NOT element NCM2B changes to "0" before the output of the timer T1B becomes "1." As a result, the output of the AND element ACM1B of car B is prevented from changing to "1," so that no signal EB is produced. It will be seen from the above description that when cars A and B come to run together side by side at the same floor, an inter-locking signal EA is applied as an input to the AND element ACM3B through the OR element OCM2B. Since the output of the comparator CM2B is "1" as already mentioned, the output of the AND element ACM3B changes to "1," thereby changing the output of the memory element MCMB to "1." This signal de-energizes the inhibit elements ICM1B and ICM2B and changes the output of the NOT element NCM2B to "0," with the result that no signal E1B, E2B or EB is generated.

Let us assume that while car B is serving hall calls, car A responds only to cage calls and as the result of the expeditious operation leads car B by three floors. When the space signal SSB of car B in FIG. 5b indicates three or more floors,  $V_3 + V_{OP2B} < 0$ , and thereby the output of the comparator CM3B becomes "0." The output of the NOT element NCM3B becomes "1," resetting the memory element MCMB. It follows that no outrunning instruction is issued until car B leads car A by three floors. Therefore, the case is avoided where cars A and B outrun each other.

When car A leads car B, the space signal SSA of car A indicates the space between car A and a car ahead, for example, car C. Under normal conditions, this space is considerably wide. Therefore, the outputs of the comparators CM1A to CM3A become "0," so that the hall call response limiting signals E1A, E2A and inter-locking signal EA are restored to "0." In other words, the expeditious operation of car A is stopped, but since, as will be described later, car A is prevented from serving a hall call or hall calls from the predetermined number of floors when cars A and B move without suitable interval at the same floor, the space between the two elevator cars widens to a sufficient degree.

No special consideration was given to cage calls in the above description, but if a signal DCA associated with the number of cage calls of car A is applied to the adder ADD1A, the output  $V_{OP2A}$  of the ADD2A becomes so high as to prevent hall call response limiting signals E1A and E2A for car A from being produced when there are many cage calls even though the distance between car A and car B is shortened. This is to prevent car A, which outran car B when there were many cage calls for car A, from being outrun again by car B while car A is serving its cage calls.

The number of hall calls NHC detected by the circuit of FIG. 4 is applied to the operational amplifier OP as shown in FIG. 5a. The comparator CM produces an output of "1" when the output  $V_{OP}$  of the operational amplifier OP is smaller than the reference voltage  $V_{CM}$ , that is,  $V_{CM} - V_{OP} \geq 0$ . For example, if the comparator CM is so set as to produce an output "0" when the number of hall calls NHC is 6 or more, the comparator CM operates as mentioned above thereby to cause car A to lead Car B when the number of hall calls is 5 or less. When the number of hall calls rises (to 6 or more

in the above-mentioned example), the output of the comparator CM is switched to "0," so that no hall response limiting signal E2A is produced. Thus the operation of limiting hall call response is regulated in accordance with the number of hall calls. It also provides an effective means for the detection of an approximate number of passengers in a cage if the output WDA of a weight detecting device (not shown in the drawing) which detects the weight of the passengers in the cage by a well-known method is supplied as an input to the adder ADD1A.

An example of the hall call response control device is shown in the circuit diagram of FIG. 6, in which A1UA1 to A9UA1, A1UA2 to A9UA2, A2DA1 to A1ODA1 and A2DA2 to A1ODA2 show AND elements whose outputs become "1" when two kinds of input are applied simultaneously to them respectively, OM1UA to OM9UA and OM2DA to OM1ODA show OR elements each of which produces an output of "1" when at least one of three inputs is applied to it. M1UA to M9UA and M2DA to M1ODA show memory elements each of which produces an output of "1" or "0" respectively when a set or reset input is applied to it IH1UA to IH9UA and IH2DA to IH1ODA show inhibit elements each of which produces an output of "1" when only a hall call signal HC is applied to it. L1UA to L9UA and L2DA to L1ODA show selection gates.

Although FIG. 6 shows the hall call response control device for car A, other cars are provided with same devices.

Now, let us assume that the hall call limiting signal E1A as shown in FIG. 5a becomes "1" when car A is moving up at the eight floor. (Let F8UA be "1.") First, the output of the AND element A8UA1 becomes "1" and the memory element M9UA produces an output "1" through the OR element OM9UA. The output of the memory element M9UA causes an inhibit input to be supplied to the inhibit element IH9UA, so that car A neglects a hall call HC9U from the ninth floor. As a result, car A responds only to an up call HC8U from the eighth floor and a down call HC1OD from the tenth floor. As already described, an upgoing elevator car, although not shown in the drawing, is so controlled as to respond to no other calls than an up call or up calls from a floor (s) higher than the position indicated by the position signal and a hall call from the highest floor. (or HC1OD in the present embodiment). In other words, since gates other than the selection gates L8UA to L1ODA are opened, only hall call response signals N8UA and N1ODA are produced, so that car A does not respond to a hall call from the ninth floor.

When the hall call response limiting signal E2A is "1," the AND element A8UA2 is energized, thereby setting the memory element M1ODA through the OR element OM1ODA. The output of the memory element M1ODA causes the memory element M9UA to be set through the OR element OM9UA. The memory element M8UA continues to produce an output "0" since it is reset by the position signal F8UA. Thus the inhibit element IH9UA and IH1ODA are put into the state of "0" and neglect the hall calls HC9U and HC1OD.

It will be seen from above that in this embodiment, when the space between a preceding car and a succeeding car becomes one floor, the succeeding car neglects a hall call and its motion is stepped up. Further, when it

catches up with the preceding car, it neglects two hall calls with its motion stepped up. The number of floors to be neglected may be other than one or two floors as desired. The reason why the succeeding car A is made to neglect few floors when there are many hall calls is that expeditious operation of car A will shorten too much the distance between car A and car C which is travelling ahead of car B.

Also, when the succeeding car A excessively approaches the preceding car B, the succeeding car A may be made to neglect hall calls until car A leads car B by a required distance.

According to the present invention, a succeeding car by-passes a preceding car under predetermined conditions and thereby the proper regulation of car intervals can be performed when the preceding car is stagnating.

What we claimed is:

1. In operating a plurality of elevator cars serving a plurality of floors, an elevator control system comprising means for expediting the motion of said succeeding car when the distance between said preceding car and said succeeding car is less than a predetermined distance, thereby rendering said succeeding car lead said preceding car, said means for expediting including means for generating a position signal associated with the position of each elevator car and means for limiting the response of said succeeding car to at least one hall call when the interval between position signals respectively indicating the positions of said preceding and succeeding cars is shortened, thereby stepping up the motion of said succeeding car, and means for generating a position signal indicating the position in advance of the physical position of a running elevator car.

2. In operating a plurality of elevator cars serving a plurality of floors, an elevator control system comprising:

- means for generating a position signal associated with the position of each of the elevator cars;
- means for generating a space signal associated with the space between a preceding car and a succeeding car including means for comparing the position signals respectively associated with the positions of said preceding and succeeding cars;
- means for comparing said space signal with a predetermined standard; and
- means for preventing the succeeding car from

responding to at least one hall call within a special zone comprising at least one forward floor in response to the reduction of the space signal below the predetermined standard.

3. An elevator control system according to claim 2, wherein said means for preventing the succeeding car from responding to at least one hall call within a special zone includes means for generating an apparent position signal indicating an apparent position in advance of said zone and in advance of the physical position of said succeeding car.

4. An elevator control system according to claim 3, wherein said means for preventing the succeeding car from responding to at least one hall call within a special zone includes a service decision means responsive to said apparent position signal for actuating said succeeding car to respond to hall calls of the floors in advance of said apparent position.

5. An elevator control system to claim 2, further comprising:  
means for detecting the number of hall calls and for producing an output signal representative of the number of hall calls; and  
means responsive to said output signal of hall calls for varying the number of floors contained within said special zone.

6. In operating a plurality of elevators cars serving a plurality of floors, an elevator control system comprising:

- means for generating a position signal associated with the position of each of the elevator cars;
- means for generating a space signal associated with the space between a preceding car and a succeeding car including means for comparing the position signals respectively associated with the positions of said preceding and succeeding cars;
- means for comparing said space signal with each of a plurality of predetermined standards; and
- means for preventing the succeeding car from responding to at least one hall call within a special zone comprising at least one forward floor in response to the reduction of said space signal below at least one of said predetermined standards, the number of floors contained within said special zone being predetermined in accordance with said predetermined standards.

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