

CAGE STOP HEIGHT READJUSTING APPARATUS FOR ELEVATOR SYSTEM AND METHOD THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cage stop height readjusting apparatus for an elevator system and a method thereof, and in particular to an improved cage stop height readjusting apparatus for an elevator system and a method thereof which are capable of accurately stopping a cage at a predetermined floor at a zero level of a cage stop height.

2. Description of the Background Art

Generally, in the elevator system, a sensor connected with a shaft of a cage driving motor and generating pulses proportionally to the RPM of the motor, namely, the output pulses from a rotary encoder are accumulatively summed in accordance with a running direction of the cage, thus recognizing a synchronous position of the cage.

Therefore, when initially installing the elevator, the heights of each floor are measured and stored using the number of output pulses from the rotary encoder based on the position of a reference position (for example, the bottom of the lowest floor of a building). The cage is moved to the floor at which a cage call is generated based on the thusly measured value. At this time, when the cage is moving, the position in which the height of the bottom of the cage and the height of the floor are level is called the zero level.

When the cage arrives at the destination floor, the cage reaches the designation floor at a distance from the zero level due to the erroneous operation of a control apparatus or the characteristics of various sensors. In addition, after the cage arrives, when the load of the cage is varied due to the loading or unloading of the passenger, the elongation of a wire connected with the cage is varied, so that the cage stops at a distance from the zero level of the destination floor.

As a result, since there may occur a problem such as a passenger getting-on and getting-off problem due to the different height between the height of the floor and the height of the bottom of the cage. Therefore, it is required to urgently adjust the stop height of the cage based on the zero level. At this time, the cage is re-driven, thus accurately adjusting the cage stop height. The above-described operation is called a cage stop height readjusting operation.

Figure 1 illustrates a schematic block diagram illustrating the position control apparatus for a conventional elevator which includes a motor 4 for generating a driving force and transferring the force to a sheave 3 for running a cage 1, a speed detection rotary encoder 5 connected with a driving shaft of the motor 4 for outputting a speed signal V_r which is proportional to the RPM of the motor 4, a speed reference signal generator 6 for receiving position detection signals LU, LD and RL from the position detector (not shown) of the cage 1 and generating a speed reference signal V_p for a cage stop height readjusting operation, a subtractor 7 for performing a subtraction operation between a speed signal V_r from the speed detection rotary encoder 5 and a speed reference signal V_p from the reference signal generator 6 and outputting a deviation V_e , and a speed control apparatus 8 for controlling the RPM of the motor 4 based on the deviation V_{pe} from the subtractor 7. In the drawings, reference numeral 2 denotes a balance weight.

In addition, the reference speed generator 6 includes an input unit 6A for inputting position detection signals LU, LD and RL, a CPU 6D for computing the position detection signals LU, LD and RL inputted through a ROM 6B, RAM 6C, the input unit 6A and the bus and outputting a reference speed signal V_p , a timer 6E for generating a timing signal for an interrupt control, and an output unit 6F for outputting the reference speed signal V_p computed.

The operation of the elevator position control apparatus will be explained.

When the cage 1 arrives at the destination floor, the position detector installed in the cage 1 spacedly contacts with the position cam installed in each of the floors, the position detection signals LU, LD and RL are transmitted to the reference speed generator 6.

Figure 3 illustrates operational ranges of the position detection signals LU, LD and RL.

The operational range of the ARL is the cage stop height readjusting zone is composed of the zone A which indicates the cage stop height readjusting operation range in the up direction, the zone B which indicates the normal stop height range, and the zone C which indicates the operational range of the cage stop height readjusting operation in the down direction. Here, the zero point denotes the level of the cage height.

Therefore, the CPU 6D of the reference speed generator 6 receives the position detection signals LU, LD and RL through the input unit 6A and the bus BUS, executes the program stored in the ROM 6C, and transmits the reference speed signal V_p through the output unit 6F for the cage stop readjusting operation.

Figure 4 illustrates the patterns of the reference speed signal V_p and the speed signal V_T of the cage 1 for the cage stop height readjusting operation.

In the zone A, the reference speed signal V_p is increased by ΔV step-by-step as shown in Figure 4B for increasing the riding-on feeling of the cage, and at the speed V_{RL} , for a predetermined time, the above-described state is maintained. Thereafter, when the cage comes into the zone B of the normal stop height, the reference speed signal V_p becomes 0.

As a result, the speed control apparatus 8 receives the reference speed signal V_p through the subtractor 7, thus driving the motor 4. In the zone A, the cage 1 is moved in the up direction. As shown in Figure 4, when the reference speed signal V_p becomes 0, the speed signal V_r is gradually decreased and then becomes 0. Therefore, the cage arrives at the zero level.

The cage stop height readjusting operation will now be explained with reference to Figures 5 through 8.

When the power is supplied, the program read from the ROM 6C is executed, and the reference speed generator 6 is initialized, and the timer 6E is driven, and an interrupt signal is inputted.

When the interrupt signal is inputted from the timer 6E, the CPU 6D performs a processing routine for detecting the stop position of the cage as shown in Figure 5.

Namely, when the interrupt signal is inputted from the timer 6E, the CPU 6D judges whether the cage 1 is running in Step S1. As a result of the judgement, when the cage 1 is running, the flag FLAG is set to 0 and returns to the routine in Step S7. If the cage 1 is stopped, it is checked that whether the position detection signal RL, namely, the ARL, is a high level in the zone A in Step S2.

As a result of the checking, if the ARL is a high level, the CPU 6D checks the level of the position detection signal LU or the position detection signal LU in the

zone A, and thereafter it is judged that where the cage 1 is stopped among the zones A, B and C in Steps S3 and S4.

If the position detection signal LU is detected to be a low level in the zone A, since the cage 1 is stopped in the zone C, the CPU 6D outputs a down movement instruction DN to the speed control apparatus 8 through the output unit 6F, and if the position detection signal LU is a high level, and the position detection signal LD is a low level in the zone A, since the cage is stopped in the zone A, the CPU 6D output the up movement instruction UP to the speed control apparatus 8 through the output unit 6F. Thereafter, the flag FLAG is set to 1 and returns to the routine in Steps S5, S6 and S8.

In the zone A, the position detection signals LU and LD are all high levels, since the cage 1 is stopped in the normal zone in which the cage stop height readjusting operation is not needed, the flag FLAG is set to 0 and returns to the routine in Step S7. At this time, the flag FLAG denotes whether the reference speed signal V_p is computed for the cage stop height readjusting operation.

When the processing routine for detecting the stop position of the cage is finished, the CPU 6D checks the flag FLAG. If the flag FLAG is set to 1, the computation processing routine of the reference speed signal V_p as shown in Figure 6 is performed for the cage stop height readjusting operation.

Namely, if the flag FLAG is set to 1, the CPU 6D checks whether the position detection signals LU and LD are all high levels. As a result of the checking, if the position detection signals LU and LD are all high level, the reference speed signal V_p is set to 0.

As a result of the checking, if the position detection signals LU and LD are not all high level, the CPU 6D compares the reference speed signal V_p with a constant

speed V_{RL} . If the speed V_{RL} is higher than the reference speed signal V_p , the reference speed signal V_p is set to the V_{RL} , so that the cage 1 is accurately stopped in the normal zone B.

In addition, Figures 7 through 9 illustrate another examples of the patterns between the reference speed signal V_p and the speed signal V_T of the cage 1 for the cage stop height readjusting operation in the conventional art.

Figure 7 illustrates a pattern when the cage 1 is stopped in the normal zone B. At this time, since the cage 1 moves into the normal zone B before the reference speed signal V_p reaches the speed signal V_T of the cage 1, the reference speed signal V_p becomes 0.

Therefore, even when the cage stop height readjusting operation is finished, the distance L which is at a distance from the zero level is increased compared to the distance as shown in Figure 4.

In addition, Figure 8 illustrates a pattern for overcoming the problems which occur in the example of Figure 7. As shown therein, when the cage 1 is moving, the reference speed signal V_p is increased up to V_T , and then the same is slightly decreased down to a predetermined voltage V_{RL} . As a result, since the reference speed signal V_p of the cage 1 is quickly increased and is larger than the pattern shown in Figure 7, it is possible to shorten the distance L which is at a distance from the zero level.

Namely, if the flag FLAG is set to 1, the CPU 6D checks whether the position detection signals LU and LD are all high levels in Steps S15 and S16. As a result, if the position detection signals LU and LD are all high levels, the reference speed signal V_p is set to 0, and the flag STA is set to 0 and returns to the routine in Step S17 and S18 for the cage stop height readjusting operation.

If the position detection signals LU and LD are all low level, it is checked that whether the flag STA is set to 0. As a result, if the flag STA is set to 0, the CPU 6D sets the reference speed signal V_p to the V_M . In addition, the flag STA is set to 1 in Steps S20 and S21. At this time, the V_M becomes two or three times the V_{RL} .

If the flag STA is not set to 0, the CPU 6D compares the reference speed signal V_p with the speed V_{RL} in Step S22. If the speed V_{RL} is larger than the reference speed signal V_p , the reference speed signal V_p is set to the $V_p + \Delta V$ in Step S23, and if the speed V_{RL} is smaller than the reference speed signal V_p , the reference speed signal V_p is set to the V_{RL} in Step S24. Thereafter, the cage 1 is accurately stopped in the normal zone B.

Therefore, when the cage 1 is stopped in the normal zone B, since the cage 1 is re-driven using the reference speed signal V_p , it is possible to shorten the distance L which is at a distance from the zero level.

However, even when the cage stop height readjusting technique as shown in Figures 8 through 9 is used, in the conventional art, since the cage 1 stops at a distance L from the zero level, there is a big problem for accurately stopping the cage at the zero level.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a cage stop height readjusting apparatus for an elevator system and a method thereof which overcome the aforementioned problems encountered in the background art.

It is another object of the present invention to provide a cage stop height readjusting apparatus for an elevator system and a method thereof which are

capable of accurately stopping a cage at a predetermined floor at a zero level of a cage stop height.

To achieve the above objects, there is provided a cage stop height readjusting apparatus for an elevator system which includes a position detection rotary encoder for outputting a second pulse signal which corresponds to an actual running distance of a cage as a pulley is rotated by a wire connected with the cage, and a main controller for receiving first and second position detection signals from first and third position detectors and first and second pulse signals from the speed detection rotary encoder and position detection rotary encoder when the cage is stopped in a cage stop height readjusting zone, computing a cage stop height adjusting distance, and outputting a speed instruction signal for the cage stop height adjusting operation based on the thusly computed cage stop height adjusting distance.

To achieve the above objects, there is provided a cage stop height readjusting method for an elevator system which includes the steps of a first step for obtaining minimum values of first and second position detection signals from the position detectors when the cage is stopped at a stop level and obtaining maximum values of the first and second detection signals when the cage is stopped at a distance from the stop level, a second step for initializing a buffer storing a relative distance value when the cage comes into a door zone and storing the running direction, a third step for storing the value, which is obtained by accumulatively summing the number of pulses of the second pulse signal from the position detection rotary encoder, into a buffer as a relative distance value until the cage come into the door zone is stopped, a fourth step for reading a stored running direction of the cage when the cage is stopped in the cage stop height adjusting zone and obtaining the current position of the cage which is stopped, a fifth step for computing a cage stop height adjusting



distance between the zero level to the current position at which the cage is stopped, a sixth step for computing a speed pattern constant value for obtaining a speed pattern for re-running by the computed cage stop height adjusting distance after setting the re-running direction, and a seventh step for generating a shaped speed pattern based on the computed speed pattern constant value, generating the final speed instruction signal based on the generated speed pattern and re-running the cage.

Additional advantages, objects and features of the invention will become more apparent from the description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Figure 1 is a view illustrating a running control apparatus for a conventional elevator system;

Figure 2 is a view illustrating a speed reference signal generation apparatus of Figure 1;

Figure 3 is a view illustrating operational ranges of a position detector of Figure 1;

Figure 4 is a view illustrating the patterns of a speed reference signal V_p for a cage stop height adjusting operation in the conventional art;

Figure 5 is a flow chart illustrating a method for detecting a cage stop position

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in the conventional art;

Figure 6 is a flow chart illustrating a reference speed signal V_p for a cage stop height adjusting operation in the conventional art;

Figure 7 is a view illustrating an interrelationship between a speed reference signal V_p and a cage speed pattern in the conventional art;

Figure 8 is a view illustrating another interrelationship between a speed reference signal V_p and a cage speed pattern in the conventional art;

Figure 9 is a flow chart illustrating a flow chart for a cage stop height adjusting operation for an elevator system of Figure 1;

Figure 10 is a view illustrating a cage stop height readjusting apparatus for an elevator system according to the present invention;

Figure 11 is a view illustrating a state that a position detector is shielded by a shielding plate of Figure 10;

Figure 12 is a detailed view illustrating a main controller of Figure 10;

Figures 13 and 14 are views illustrating an operational principle of a position detector of Figure 10;

Figure 15 is a view illustrating a speed and acceleration of a cage in a cage stop height readjusting zone according to the present invention;

Figure 16 is a view illustrating a digital value of a position detection signal from a position detector according to the present invention;

Figure 17 is a view illustrating a cage stop height readjusting zone according to the present invention;

Figure 18 is a view illustrating a speed and acceleration of a cage in a cage stop height readjusting zone according to the present invention;

Figure 19 is a flow chart illustrating a minimum value and maximum value

setting method of a position detection signal from a position detector according to the present invention; and

Figures 20 and 21 are flow charts illustrating a method for a cage stop height readjusting operation of an elevator system of Figure 10.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 10 illustrates an embodiment of the cage stop height readjusting apparatus for an elevator system according to the present invention.

As shown therein, position detectors 101 through 103 are installed in the upper portions of the cage 100. A shielding plate 104 is installed in each cage moving path of a corresponding floor to correspond with the position detectors 101 through 103. When the cage 100 stops at the zero level, as shown in Figure 13, the position detector 102 stops at the center of the shielding plate 104, and the position detectors 101 through 103 are shielded by a predetermined range thereof (for example, the half portion each thereof).

In addition, there are provided a pulley 108 which is rotated by the wire connected with the cage 100, a position detection rotary encoder 109 for outputting a pulse signal PUL2 corresponding to the actual running distance of the cage as the pulley 108 is rotated, a main controller 110 for receiving position detection signals MD, FML and MU from the position detectors 101 through 103 and pulse signals PUL1 and PUL2 from the position detection rotary encoders 107 and 109 and outputting a speed instruction signal V' , and an inverter 111 for phase-converting the speed instruction signal V' and driving the motor 106. In the drawings, reference numeral 105 denotes a sheave, and 106 denotes a motor.

As shown in Figure 12, the main controller 110 basically includes the CPU 10, ROM 11 and RAM 12 and further includes pulse shaping units 13 and 14 for shaping the pulse signals PUL1 and PUL2 from the speed and position detection rotary encoders 107 and 109, pulse counters 15 and 16 for accumulatively summing and subtracting the output signals from the pulse shaping units 13 and 14, speed and position detectors 17 and 18 for detecting the speed and position of the cage based on the output signals from the pulse counters 15 and 16, A/D converters 19 and 20 for digital-converting the position detection signals MU and MD, and a parallel input unit 21 for inputting the position detection signal FML.

The operation of the cage stop height readjusting operation of the elevator system according to the present invention will now be explained with reference to the accompanying drawings.

When the cage 100 arrives at a destination floor, the position detectors 101 through 103 installed in the upper portion of the cage 100 output position detection signals MD, FML and MU to the main controller 110 based on the shielding operation of the shielding plate 104.

In addition, the speed detection rotary encoder 107 connected with a driving shaft of the motor 106 and outputs a pulse signal PUL1 proportional to the RPM of the motor 106, and the position detection rotary encoder 109 outputs a pulse signal PUL2 corresponding to the actual running distance of the cage 100 based on the rotation of the pulley 108.

Figure 13 illustrates an operational principle of the position detector 102. The position detector 102 includes a read switch 102A and a permanent magnet 102B. At the usual time, the read switch 102A remains in an OFF state by the magnetic flux of the permanent magnet 102B as shown in Figure 13A. When the cage is

stopped at a predetermined floor, and the magnetic flux is shielded by the shielding plate 104, the read switch is operated. Therefore, the operational range of the position detector 102 is defined in the range of the length of the shielding plate 104 with respect to the zero level as shown in Figure 17.

In addition, Figure 14 illustrates an operation principle of the position detectors 101 and 103. The voltage which is induced between the primary coil L11 and the secondary coils L21 and L22 is outputted as the position detection signals MD and MU. When the cage stops in at the zero level, the induced voltage is shielded by the shielding plate 104. At this time, if the shielding operation is not performed by the shielding plate 104, assuming that the voltage values (digitalized) of the position detection signals MU and MD are 255, and the digital value is 0 when the shielding is fully performed, the operational range of the position detectors 101 and 103 is smaller than 200 as shown in Figure 18.

Therefore, the main controller 110 receives the pulse signals PUL1 and PUL2 from the speed and position detection rotary encoders 107 and 109, and the thusly received signals are shaped by the pulse shaping units 13 and 14. The number of pulses are accumulatively summed or subtracted by the pulse counters 15 and 16. The speed and position detectors 17 and 18 detects the running speed and position of the cage based on the counted values of the pulse counters 15 and 16 and outputs to the CPU 10 through the bus BUS.

In addition, the A/D converters 19 and 20 receive the position detection signals MU and MD induced by the secondary coils L21 and L22 of the position detectors 101 and 103 converts the same into digital values 0 through 255 and outputs to the CPU 10. The output values from the A/D converters 19 and 20 are shown in Figure 18. In addition, the parallel input unit 21 for processing the ON/OFF

signals converts the position detection signal FML from the position detector 102 into ON-OFF signals.

Therefore, the CPU 10 performs an arithmetic operation with respect to the data using the program read from the ROM 6C, and the speed instruction signal V is outputted to the inverter 111, and the inverter 111 phase-converts the speed instruction speed V and drives the motor 106.

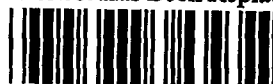
As shown in Figure 17, assuming that the length of the shielding plate 104 is 250mm, the cage 100 is stopped at a distance of ± 125 mm from the zero level, and the widths of the door zone and the position detectors 101 and 103 are 50mm, respectively, the position of the cage 100 is arranged from +125mm through +20mm or -125mm through -20mm as the cage stop height readjusting zone.

Therefore, when the cage 100 comes into the door zone, the main controller 110 accumulatively sums the number of pulse signals PUL2 from the rotary encoder 108 from the time when the output value MD from the position detector 101 or the output value MD from the position detector 103 becomes smaller than 128 to the time when the same becomes larger than 128 as shown in Figure 18.

Thereafter, when the cage is stopped in the cage stop height readjusting zone, the distance, namely, 125mm, from the zero level to the position at which the cage 100 is stopped is computed based on the number of stored pulses. Thereafter, the speed pattern by which the cage 100 re-runs by the computed distance is generated.

Next, the cage stop height readjusting operation will now be explained.

First, when repairing or maintaining the elevator system, a user positions the cage 100 at the level of a corresponding floor and sets the flag SREQ, which indicates the minimum value setting request, to 1, and then the minimum values



MU_LR and MD_LR of the position detection signals MU and MD from the position detectors 101 and 103 are obtained, and the flag SREQ is set to 0.

In addition, the cage 100 is moved to the positions 0 through ± 250 which are at a distance from the stop level, and the flag SREQ is set to 2 at the position. The maximum values MU_MR and MD_MR of the position detection signals MU and MD from the position detectors 101 and 103 are stored. At this time, the flag (SREQ)="1" indicates the minimum value setting request, and the flag (SREQ)="2" indicates the maximum value setting request.

Namely, as shown in Figure 19, the CPU 10 checks whether the minimum value setting request is generated by a user in Step S10s, and as a result of the checking, if there is the maximum value setting request, the digital values of the position detection signals MU and MD are received through the a/D converters 19 and 20. The digital values of the position detection signals MU and MD are stored into the RAM 12 as the minimum values of the position detection signals MU and MD in Step S101, and the flag SFLAG is set to "1", thus indicating the minimum value setting completion in Step S102.

In addition, if the flag SREQ is not set to 1, it is checked whether the minimum value setting operation is finished in Step S103, and when the minimum value setting is finished, it is checked that whether there is the maximum value setting request in Step S104. If there is the maximum value setting request, the digital values of the position detection signals MU and MD are received through the A/D converters 19 and 20. The digital values of the position detection signals MU and MD are stored into the RAM as the maximum values MU_MR and MD_MR of the position detection signals MU and MD in Step S105, and the flag SFLAG is set to 2, thus indicating the maximum value setting completion in Step S106. At this

time, the flag SFLAG is the flag which indicates the minimum value and maximum value setting completions of the position detectors 101 and 103.

Thereafter, when the cage 100 comes into the door zone, the position detectors 101 and 103 are shielded by the shielding plate. At this time, the CPU 10 checks whether the maximum value setting operation is finished in Step S107, and in a state that the maximum value setting is finished, if the maximum value MU_MR of the position detection signal MU is smaller than the digital value of the position detection signal MU which is currently detected by the position detector 103 in Step S108, and at the same time if the minimum value MD_LR of the position detection signal MD is larger than or identical to the digital value of the position detection signal MD which is currently detected by the position detector 101 in Step S109, the cage stop height readjusting interval (zone) A is set as shown in Figure 17, and the running direction of the cage 100 is in the up direction in Step S110.

In addition, if the maximum value MD_MR of the position detection signal MD is smaller than the digital value of the position detection signal MD which is currently detected by the position detector 101 in Step S111, and at the same time if the minimum value MU_LR of the position detection signal MU is larger than or identical to the digital value of the position detection signal which is currently detected by the position detector 103 in Step S112, the cage stop height readjusting interval (zone) B is defined as shown in figure 17, and the running direction of the cage 100 is in the down direction in Step S113. Thereafter, it is checked that whether the cage 100 is stopped in Step S114.

At this time, if the absolute value computation flag ABS is not set to 1 in Step S115, the absolute value computation flag ABS is set to 1, and the buffer DELT into which the relative distance value is stored is initialized, and the flag INT which

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indicates the initialization of the buffer DELT is initialized and the running direction are stored in Step S116. In addition, if the cage 100 is stopped in the cage stop height readjusting zone (interval), and the buffer DELT is initialized in Step S117, the flag START is set to 1 which indicates that the current position of the cage 100 is computed, and if a predetermined condition is generated for the next cage stop height readjusting operation, the absolute value computation flag ABS is initialized for the cage stop height readjusting operation in Step S118.

In a state that the maximum value setting is completed in Step S119, as shown in figure 21, when a request is generated for computing the relative distance value in Step S120, the value which is obtained by accumulatively computing the pulse signals PUL2 from the position detection rotary encoder 108 at the door zone entering position, namely, the position at which the cage 100 is stopped from the shielding position is stored into the buffer DELT in Step S121, and it is checked that whether there is a request for computing the current position CUR at which the cage 100 is positioned in Step S122.

As a result of the checking, if there is a request for obtaining the current position CUR of the cage 100 stopped, the flag START is initialized, and the flat INT is set to 1 in Step S123. If the cage 100 is moved in the up direction, the current position CUR is obtained based on the value of "the stored value of the buffer DELT + the zero level value - 125mm" in Steps S124 and S125. If the cage 100 is moved in the down direction, the current position CUR is obtained based on the stored value of "the buffer DELT + the zero level value + 125mm" in Step S126. Thereafter, the distance from the zero level to the position at which the cage is currently stopped, namely, the cage stop height readjusting distance Dist is computed, and the speed pattern is generated for rerunning the cage 100 by the computed distance

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Dist.

Namely, if the current position CUR of the cage 100 is larger than the zero level, the zero level is subtracted from the current position CUR, thus computing the cage stop height adjusting distance Dist, and the cage 100 is set to move in the down direction for performing the cage stop height readjusting operation by the cage stop height adjusting distance Dist in Steps 127 through 129. If the current position CUR of the cage 100 is smaller than the zero level, the current position CUR is subtracted from the zero level, thus computing the cage stop height adjusting distance Dist, and the running direction R_DIR of the cage 100 is set to be moved in the up direction for performing the cage stop height adjusting operation by the cage stop height adjusting distance Dist in Steps S130 and S131.

In addition, constant values T1, T2 and J1 are obtained for re-running the cage 100 based on the computed cage stop height adjusting distance Dist. At this time, the speed pattern shown in Figure 18 may be expressed in the following equation 1.

$$\text{Dist} = 2J(k_1T)^2(k_2T) \quad \text{..... Equation 1}$$

where the reference value of J is 0.25, and since T1 is fixed, the value may be divided based on the zone. At this time, the reference value for dividing the zone is the maximum distance (0.625) when t2 is 0 as shown in Figure 18. Therefore, the type of the speed pattern is divided into the types shown in Figure 15 and 18 based on the maximum distance.

If $\text{Dist} < 0.625$ in Step S132, since in the interval "a" shown in Figure 17, t2 is 0, and t1 is 0.5 as shown in Figure 15, the new value J, namely, J₁ is obtained

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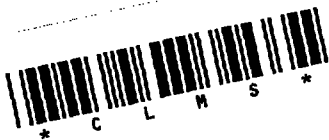
based on the cage stop height adjusting distance Dist in the $\text{Dist} - 2J(k_1T)^3$ in Step S133.

In addition, if $\text{Dist} \geq 0.625$ in Step S33, since the reference value of J is 0.25, and t_1 is fixed to 0.5 in the interval "b" as shown in Figure 17, k_2T , namely, t_2 , is obtained based on $\text{Dist} - 2J(k_1T)^3 + J(k_1T)^2(k_2T)^3$, and t_2 is instituted, thus obtaining a new value of J, namely, J_2 in Step S134.

As a result, the shaped speed pattern is generated in accordance with the constant values T_1 , T_2 and J_1 , and the CPU 10 outputs a speed instruction signal V^* to the inverter 111 based on the speed pattern, and the inverter 111 phase-converts the speed instruction signal V^* of the main controller 110, thus driving the motor 106, so that the cage 100 is accurately stopped at the zero level.

As described above, in the present invention, the distance between the zero level and the cage is obtained using the output signal from the position detection rotary encoder and the position detector, and then the constant value of the shaped speed pattern function is computed in accordance with the obtained distance, and the speed instruction signal V^* is generated based on the speed pattern by the computed constant values, thus enhancing the performance of the cage stop height readjusting operation.

Although the preferred embodiment of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as recited in the accompanying claims.



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What is claimed is:

1. A cage stop height readjusting apparatus for an elevator system wherein a position control apparatus for an elevator system includes first through third position detectors installed in an upper portion of a cage, a shielding plate installed in each running path of floors corresponding to the first through third position detectors, and a speed detection rotary encoder outputting a first pulse signal which is proportional to the RPM of a motor, comprising:

a position detection rotary encoder for outputting a second pulse signal which corresponds to an actual running distance of a cage as a pulley is rotated by a wire connected with the cage; and

a main controller for receiving first and second position detection signals from first and third position detectors and first and second pulse signals from the speed detection rotary encoder and position detection rotary encoder when the cage is stopped in a cage stop height readjusting zone, computing a cage stop height adjusting distance, and outputting a speed instruction signal for the cage stop height adjusting operation based on the thusly computed cage stop height adjusting distance.

2. A cage stop height readjusting method for an elevator system wherein a position control apparatus for an elevator system in which a cage is stopped at a zero level by re-running the cage when the cage is stopped in a cage stop height adjusting zone, comprising the steps of:

a first step for obtaining minimum values of first and second position detection signals from the position detectors when the cage is stopped at a stop level and

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obtaining maximum values of the first and second detection signals when the cage is stopped at a distance from the stop level;

a second step for initializing a buffer storing a relative distance value when the cage comes into a door zone and storing the running direction;

a third step for storing the value, which is obtained by accumulatively summing the number of pulses of the second pulse signal from the position detection rotary encoder, into a buffer as a relative distance value until the cage come into the door zone is stopped;

a fourth step for reading a stored running direction of the cage when the cage is stopped in the cage stop height adjusting zone and obtaining the current position of the cage which is stopped;

a fifth step for computing a cage stop height adjusting distance between the zero level to the current position at which the cage is stopped;

a sixth step for computing a speed pattern constant value for obtaining a speed pattern for re-running by the computed cage stop height adjusting distance after setting the re-running direction; and

a seventh step for generating a shaped speed pattern based on the computed speed pattern constant value, generating the final speed instruction signal based on the generated speed pattern and re-running the cage.

3. The apparatus of claim 2, wherein in said fourth step, the current position of the cage is "the stored value of the buffer + the zero level value - 125mm" when the cage is moved in the up direction, and the current position of the cage is "the stored value of the buffer + the zero level value + 125mm" when the cage is moved in the down direction.

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4. The apparatus of claim 2, wherein in said fifth step, the cage stop height adjusting distance is computed by subtracting the zero level from the current position when the current position of the cage is larger than the zero level, and the same is computed by subtracting the zero level from the current position when the current position of the cage is smaller than the cage.

5. The apparatus of claim 2, wherein in said seventh step, the type of the speed pattern is determined based on the reference distance.

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CAGE STOP HEIGHT READJUSTING APPARATUS FOR ELEVATOR SYSTEM
AND METHOD THEREOF

ABSTRACT OF THE DISCLOSURE

A cage stop height readjusting apparatus for an elevator system and a method thereof which are capable of accurately stopping a cage at a predetermined floor at a zero level of a cage stop height. The apparatus includes a position detection rotary encoder for outputting second pulse signal which corresponds to an actual running distance of a cage as a pulley is rotated by a wire connected with the cage, and a main controller for receiving first and second position detection signals from first and third position detectors and first and second pulse signals from the speed detection rotary encoder and position detection rotary encoder when the cage is stopped in a cage stop height readjusting zone, computing a cage stop height adjusting distance, and outputting a speed instruction signal for the cage stop height adjusting operation based on the thusly computed cage stop height adjusting distance.

(Fig.10)

FIG. 1
CONVENTIONAL ART

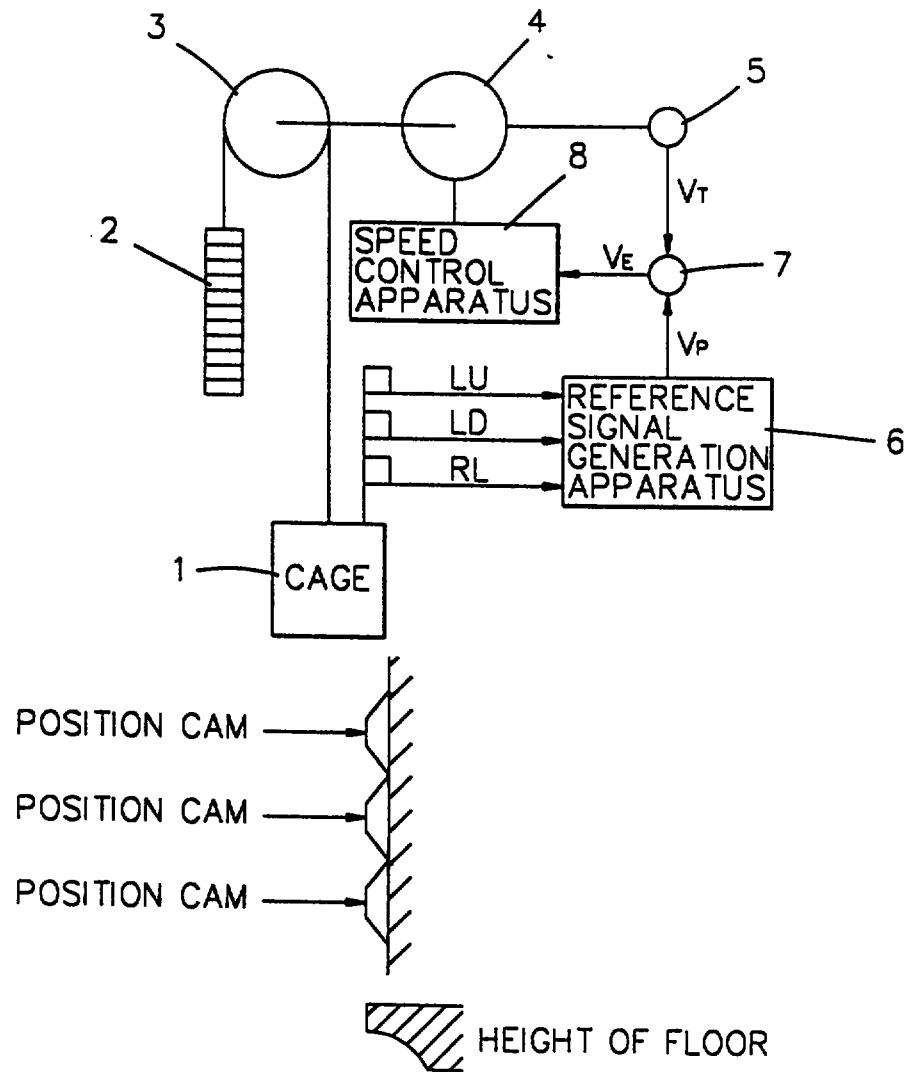


FIG. 2
CONVENTIONAL ART

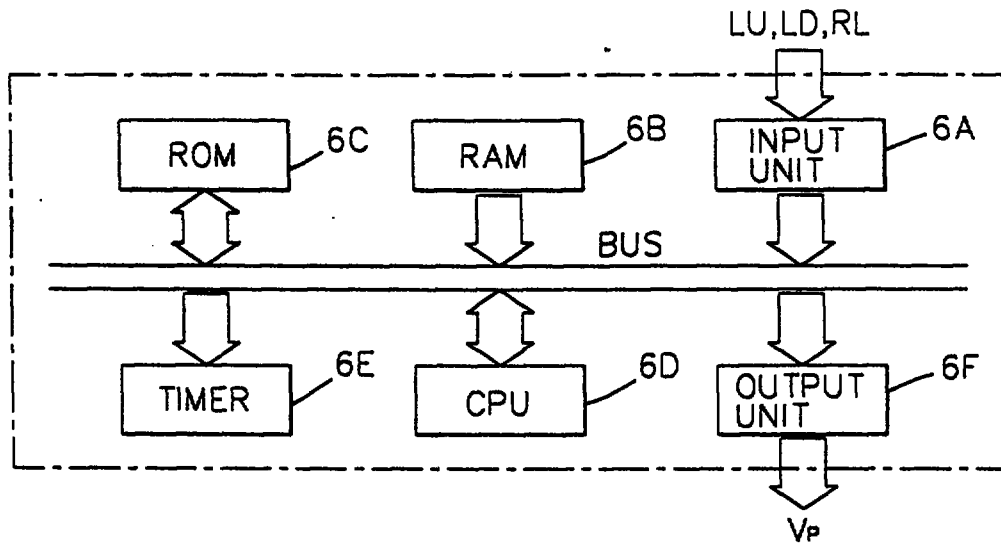


FIG. 3A
CONVENTIONAL ART

FIG. 3B
CONVENTIONAL ART

FIG. 3C
CONVENTIONAL ART

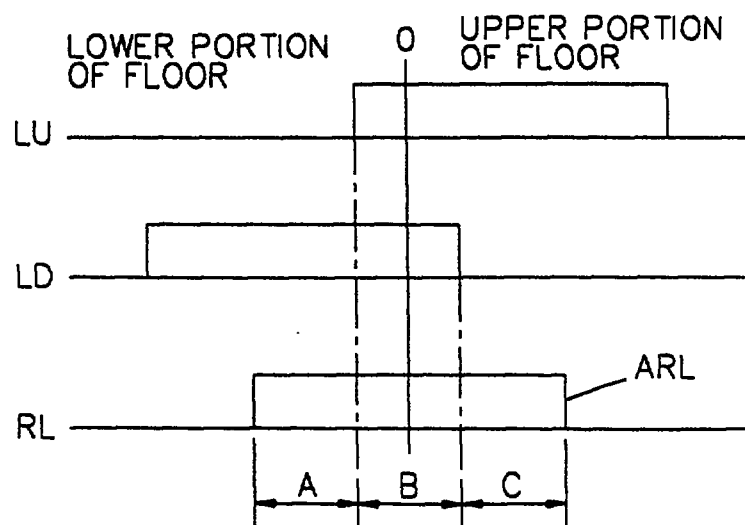


FIG. 4A ACCELERATION

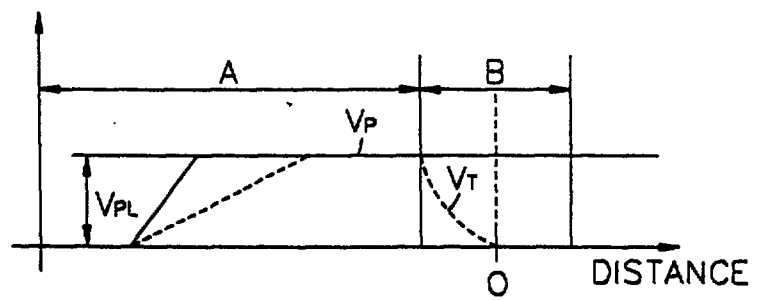


FIG. 4B

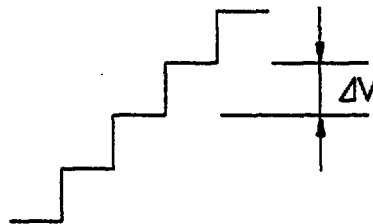


FIG. 5

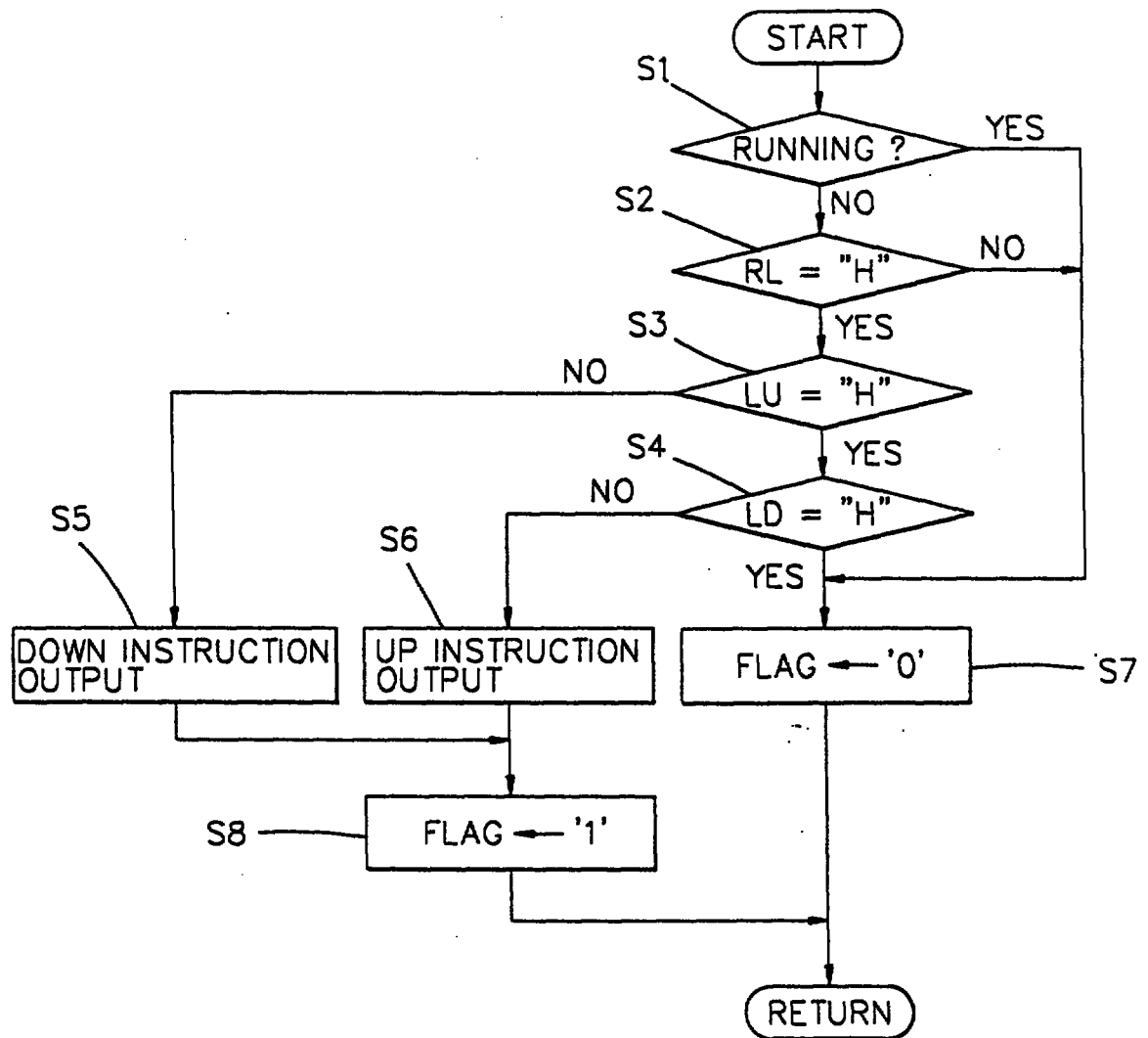


FIG. 6

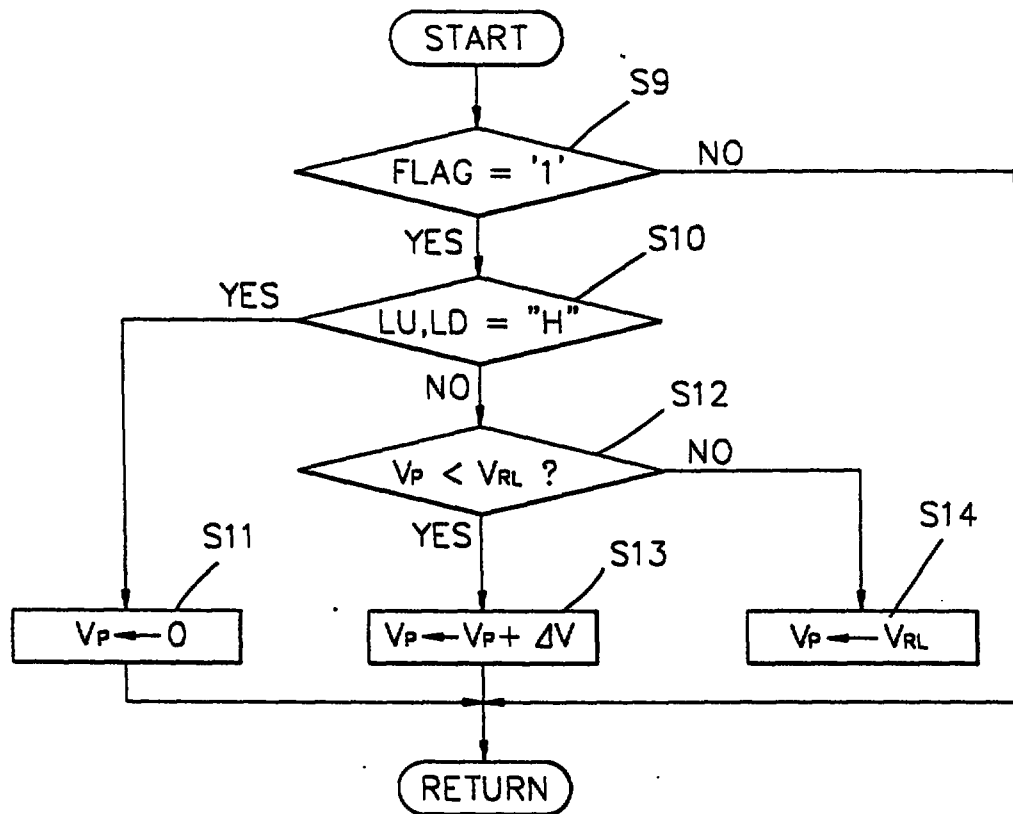


FIG. 7

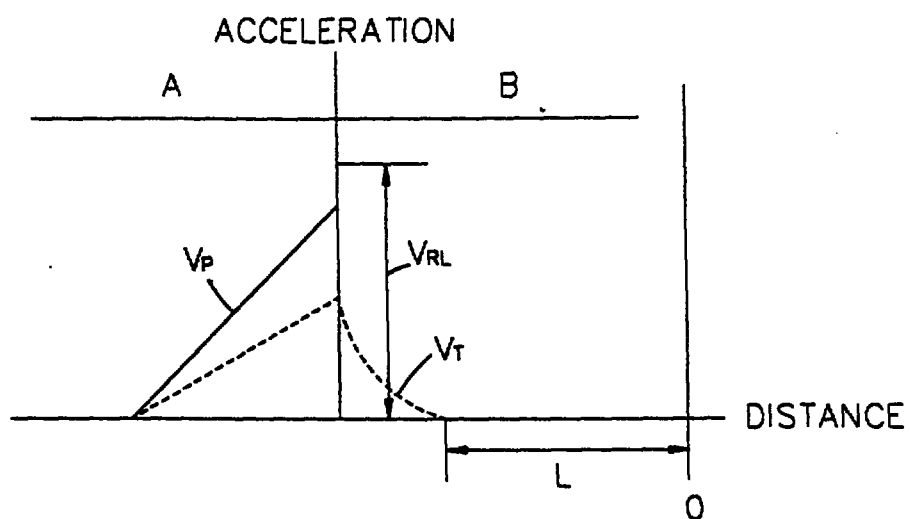


FIG. 8

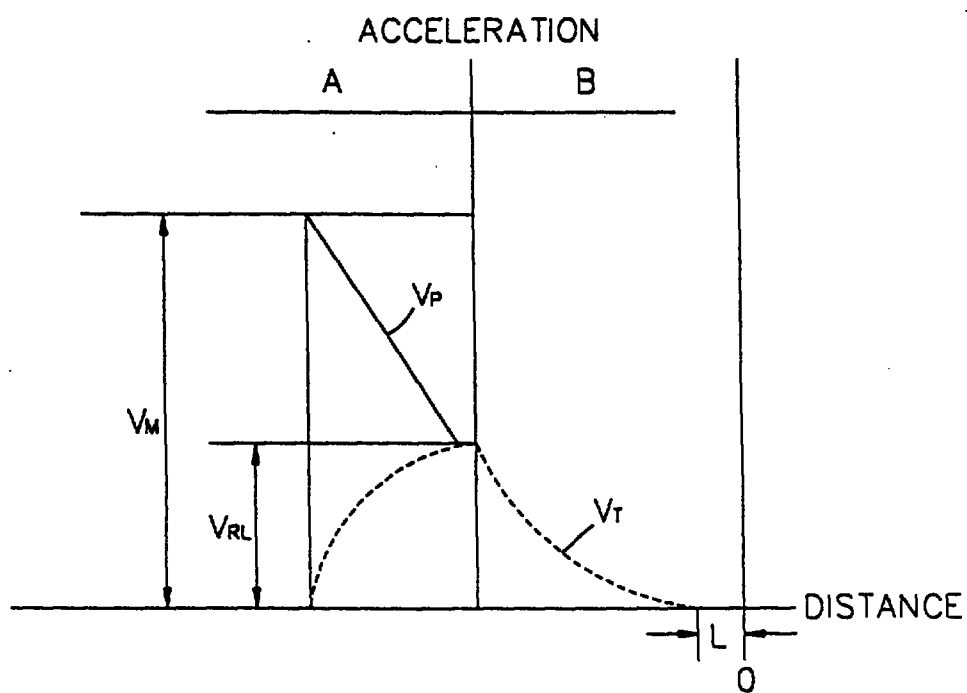


FIG. 9

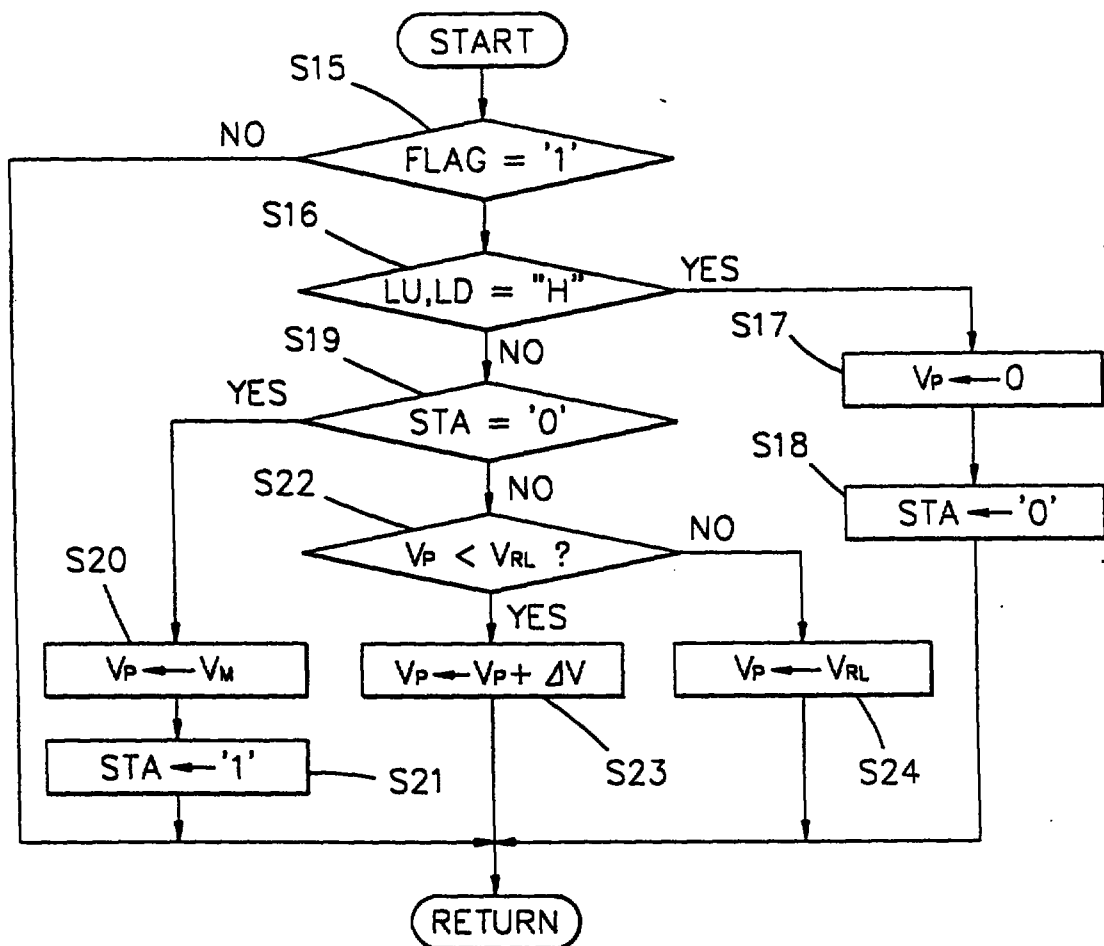


FIG. 10

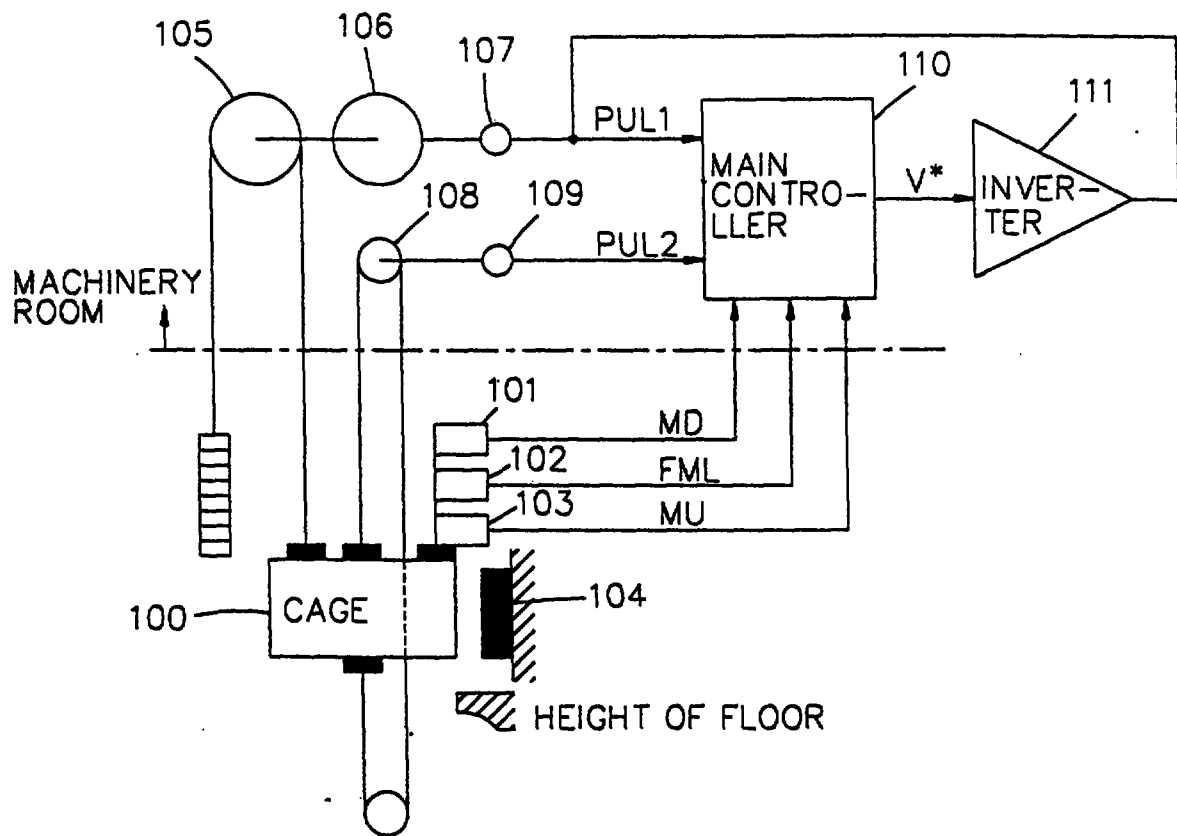


FIG. 11

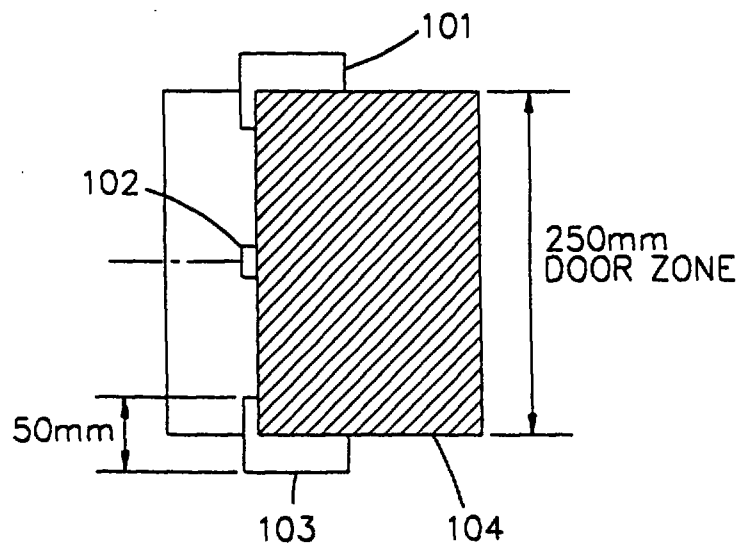


FIG. 12

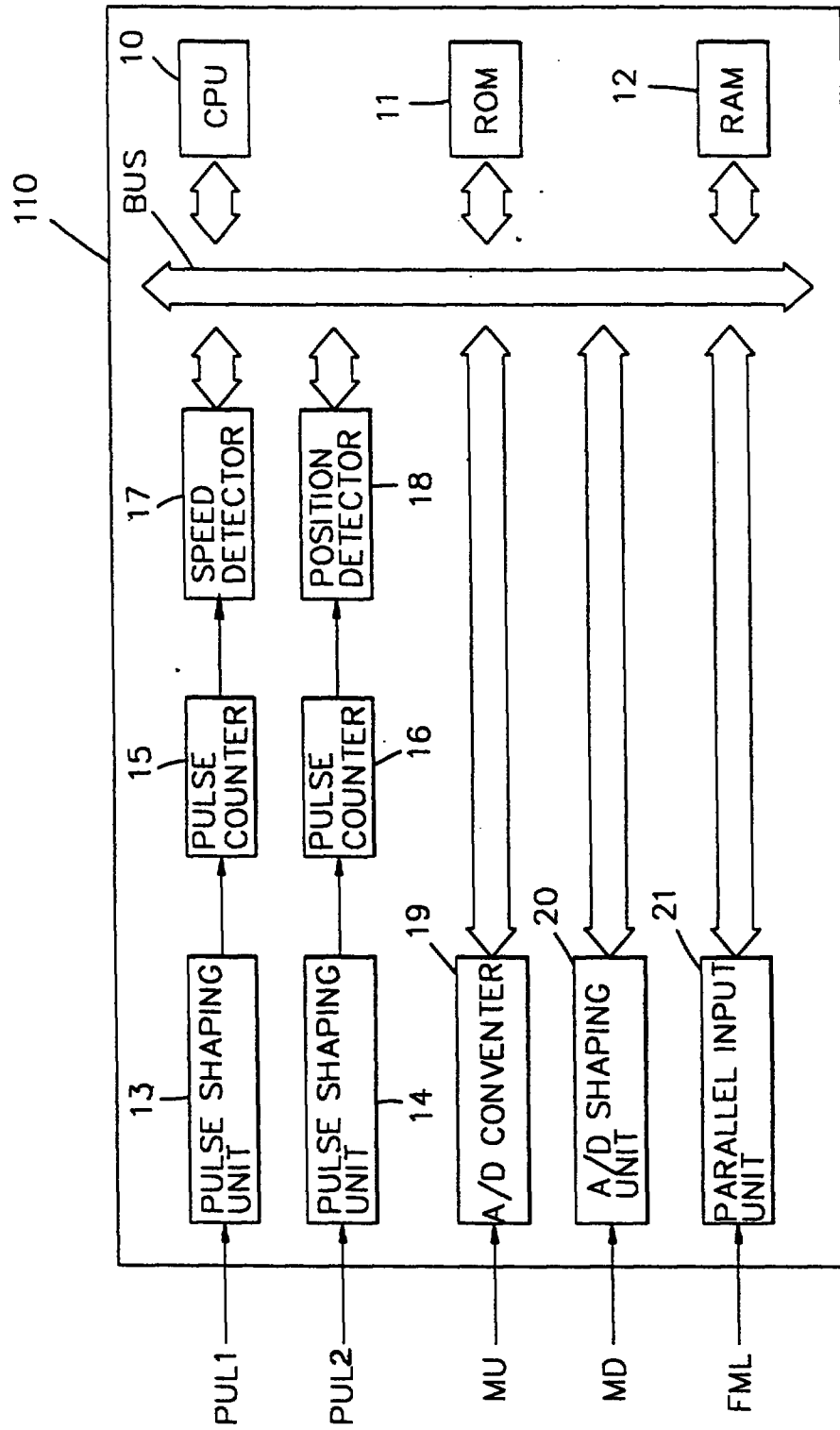


FIG. 13A

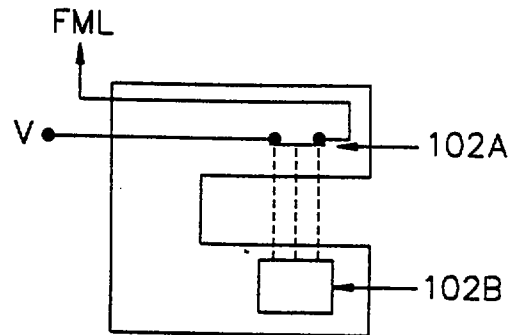


FIG. 13B

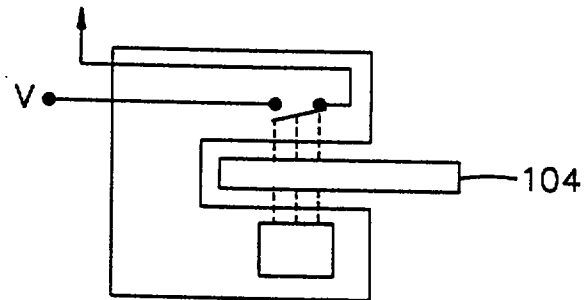


FIG. 14

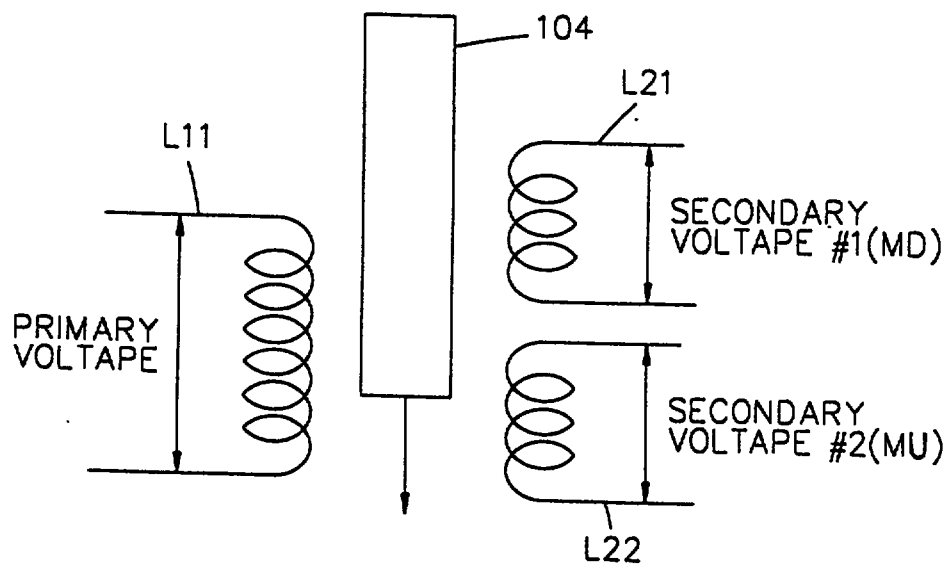


FIG. 15

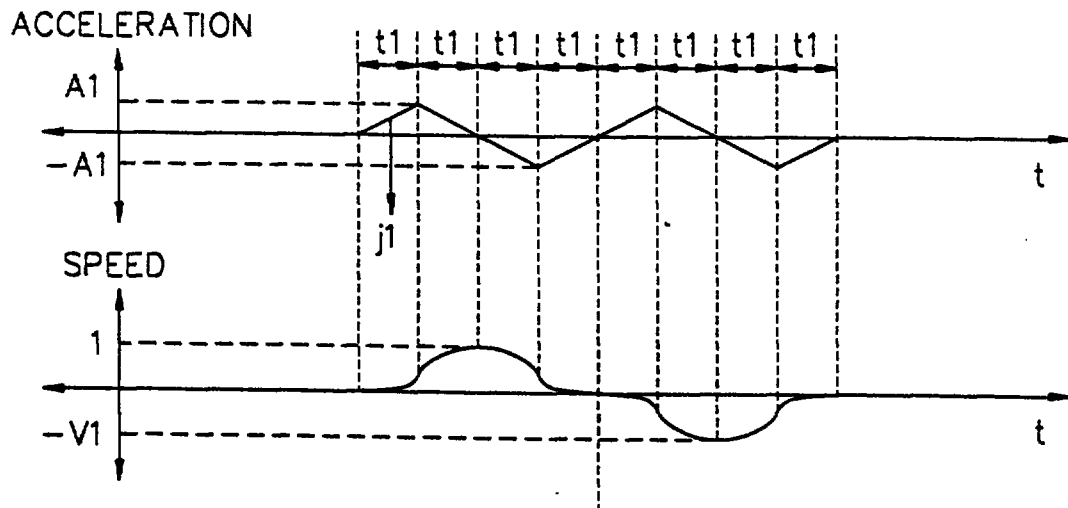


FIG. 16

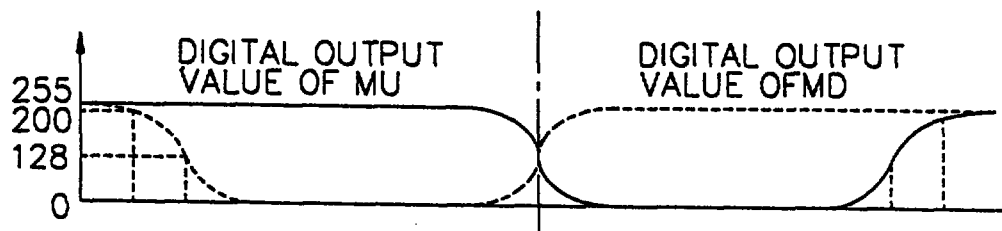


FIG. 17

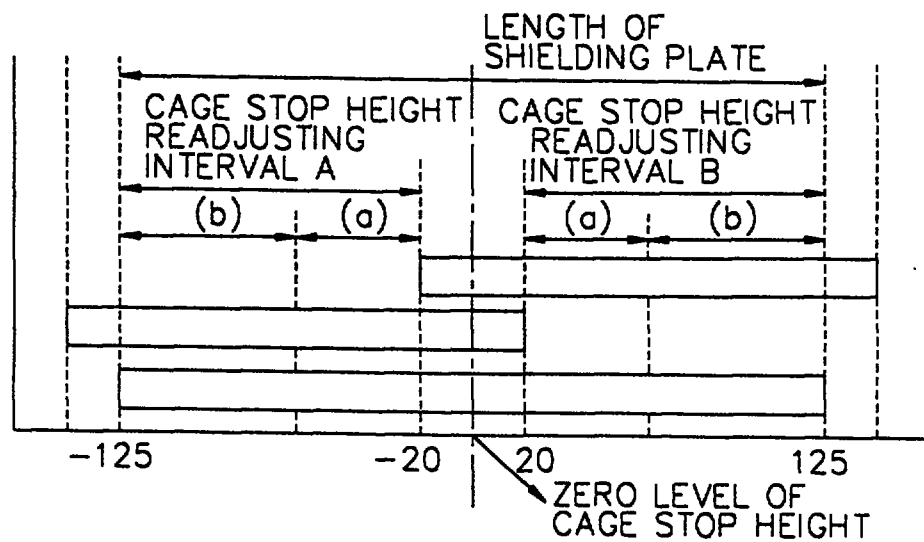


FIG. 18

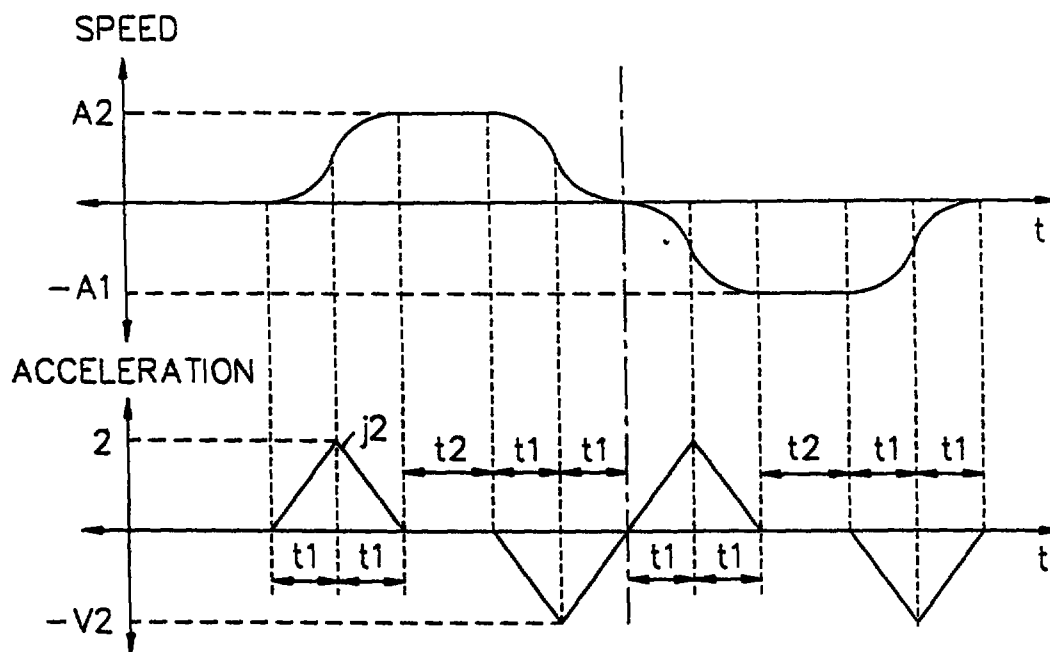


FIG. 19

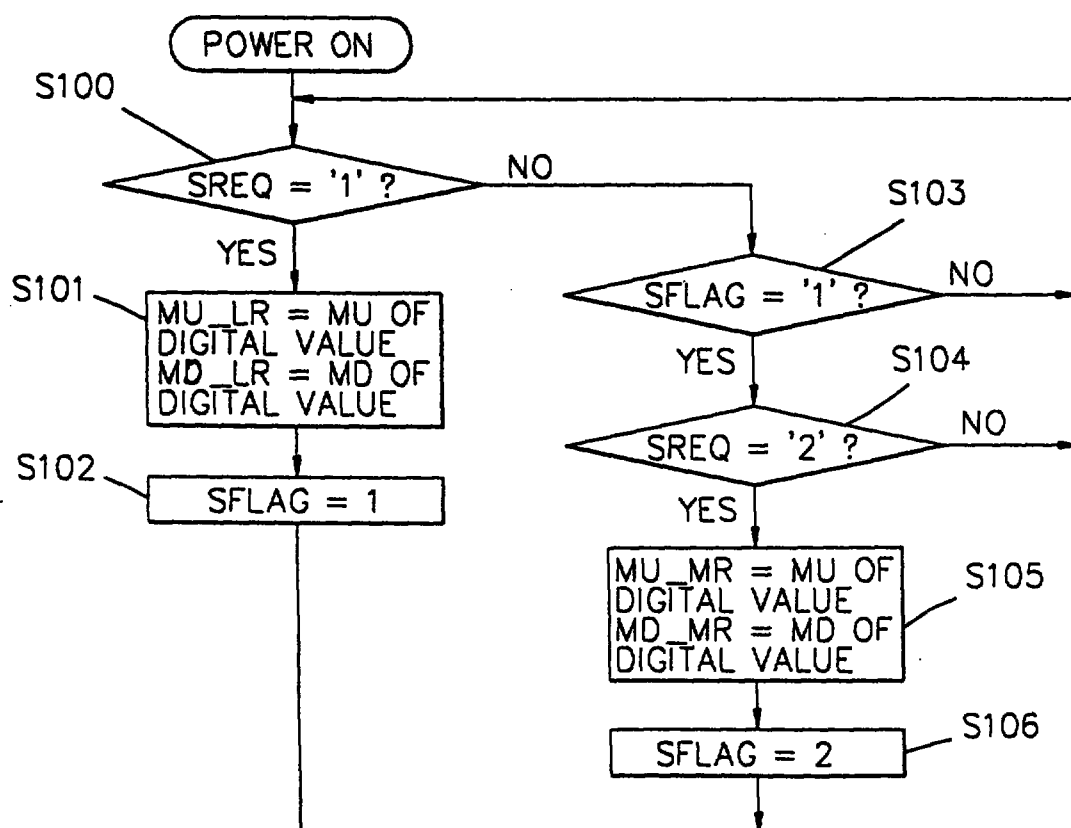


FIG. 20

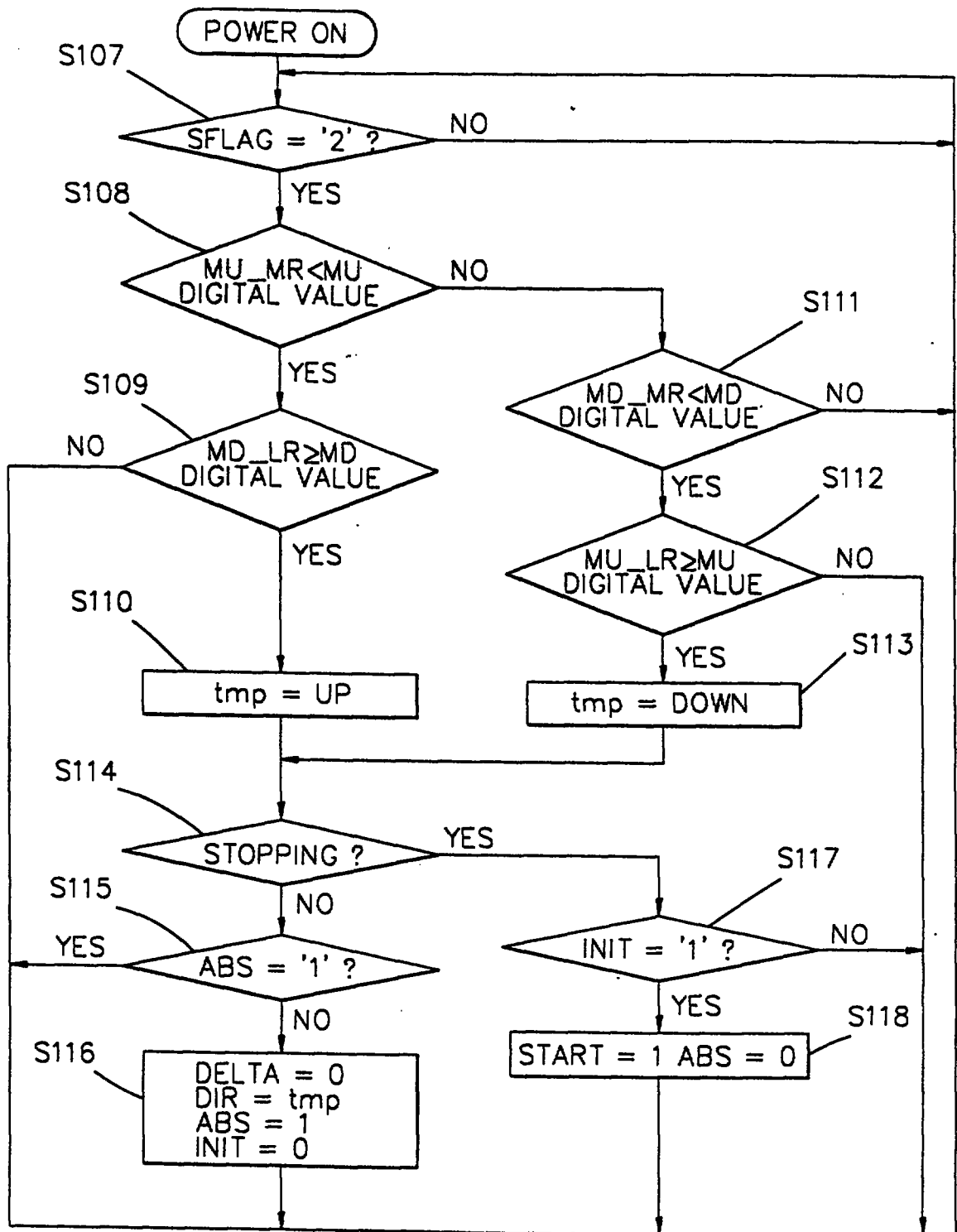
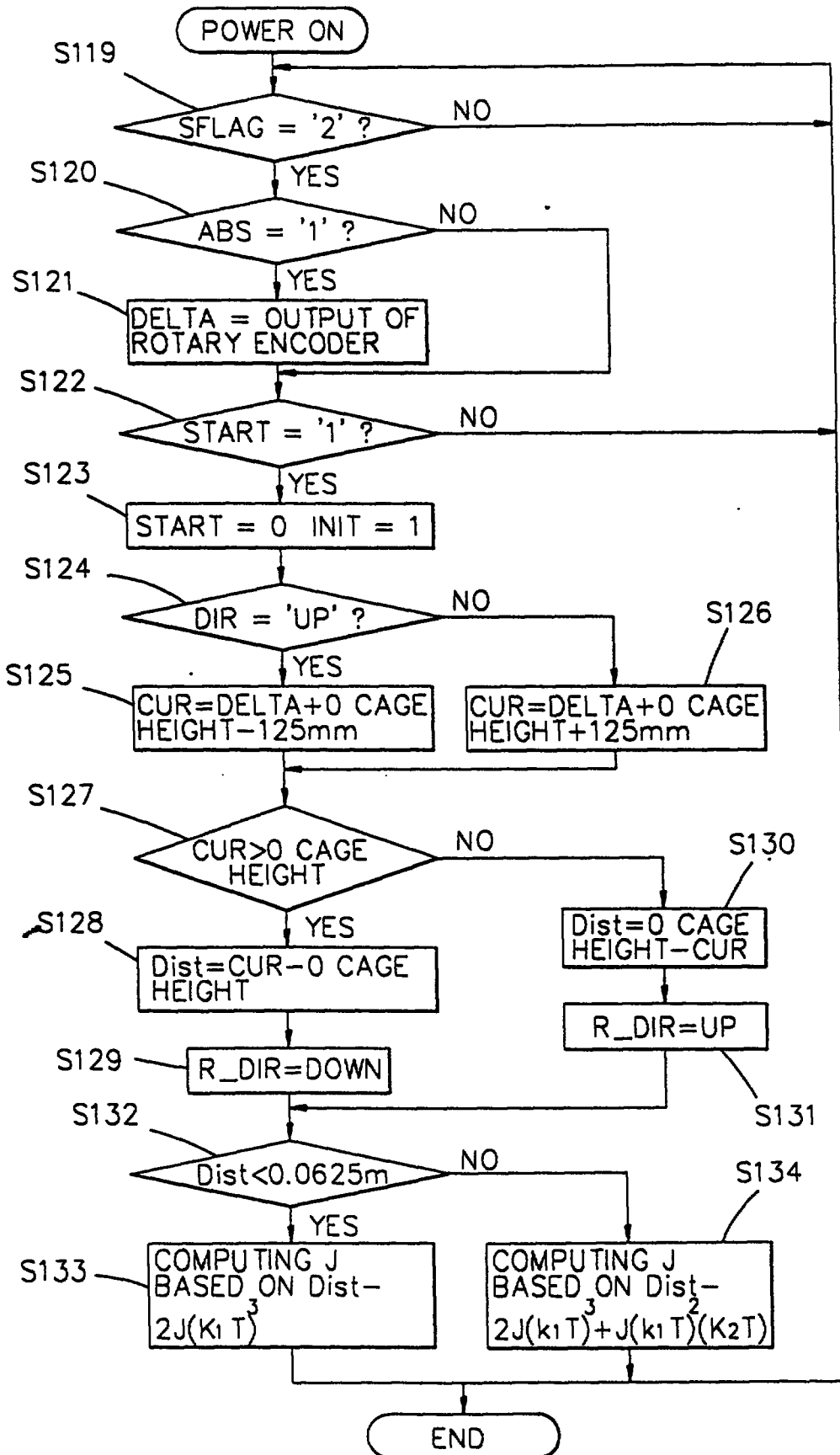
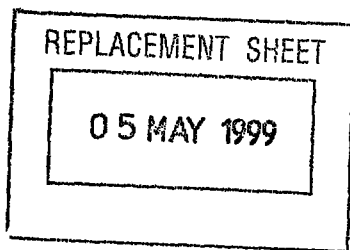


FIG. 21





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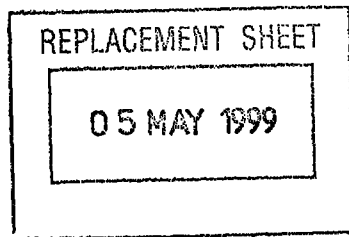
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Replacement Sheet – 4 May 1999

capable of accurately stopping a cage at a predetermined floor at a zero level of a cage stop height.

To achieve the above objects, there is provided a cage stop height readjusting apparatus for an elevator system which includes a position detection rotary encoder for outputting a second pulse signal which corresponds to an actual running distance of a cage as a pulley is rotated by a wire connected with the cage, and a main controller for receiving first and second position detection signals from first and third position detectors and first and second pulse signals from the speed detection rotary encoder and position detection rotary encoder when the cage is stopped in a cage stop height readjusting zone, computing a cage stop height adjusting distance, and outputting a speed instruction signal for the cage stop height adjusting operation based on the thusly computed cage stop height adjusting distance.

To achieve the above objects, there is provided a cage stop height readjusting method for an elevator system which includes the steps of a first step for obtaining minimum values of first and second position detection signals from the position detectors when the cage is stopped at a stop level and obtaining maximum values of the first and second detection signals when the cage is stopped at a distance from the stop level, a second step for initializing a buffer storing a relative distance value when the cage comes into a door zone and storing the running direction, a third step for storing the value, which is obtained by accumulatively summing the number of pulses of ~~the second~~ pulse signal from ^a~~the~~ position detection rotary encoder, into a buffer as a relative distance value until the cage come into the door zone is stopped, a fourth step for reading a stored running direction of the cage when the cage is stopped in the cage stop height adjusting zone and obtaining the current position of the cage which is stopped, a fifth step for computing a cage stop height adjusting



distance between the zero level to the current position at which the cage is stopped, a sixth step for computing a speed pattern constant value for obtaining a speed pattern for ~~re-running~~ ^{running} by the computed cage stop height adjusting distance after setting the ~~re-running~~ ^{running} direction, and a seventh step for generating a shaped speed pattern based on the computed speed pattern constant value, generating the final speed instruction signal based on the generated speed pattern and ~~re-running~~ ^{running} the cage.

Additional advantages, objects and features of the invention will become more apparent from the description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

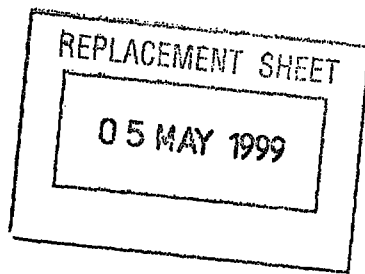
Figure 1 is a view illustrating a running control apparatus for a conventional elevator system;

Figure 2 is a view illustrating a speed reference signal generation apparatus of Figure 1;

Figure 3 is a view illustrating operational ranges of a position detector of Figure 1;

Figure 4 is a view illustrating the patterns of a speed reference signal V_p for a cage stop height adjusting operation in the conventional art;

Figure 5 is a flow chart illustrating a method for detecting a cage stop position



signals converts the position detection signal FML from the position detector 102 into ON-OFF signals.

Therefore, the CPU 10 performs an arithmetic operation with respect to the data using the program read from the ROM 6C, and the speed instruction signal V' is outputted to the inverter 111, and the inverter 111 phase-converts the speed instruction speed V' and drives the motor 106.

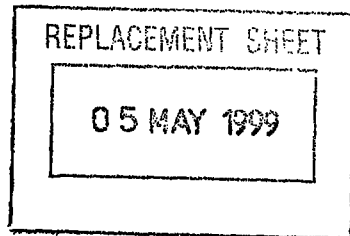
As shown in Figure 17, assuming that the length of the shielding plate 104 is 250mm, the cage 100 is stopped at a distance of ± 125 mm from the zero level, and the widths of the door zone and the position detectors 101 and 103 are 50mm, respectively, the position of the cage 100 is arranged from +125mm through +20mm or -125mm through -20mm as the cage stop height readjusting zone.

Therefore, when the cage 100 comes into the door zone, the main controller 110 accumulatively sums the number of pulse signals PUL2 from the rotary encoder 108 from the time when the output value MD from the position detector 101 or the output value MD from the position detector 103 becomes smaller than 128 to the time when the same becomes larger than 128 as shown in Figure 18.

Thereafter, when the cage is stopped in the cage stop height readjusting zone, the distance, namely, 125mm, from the zero level to the position at which the cage 100 is stopped is computed based on the number of stored pulses. Thereafter, the speed pattern by which the cage 100 ^{runs} ~~re-runs~~ by the computed distance is generated.

Next, the cage stop height readjusting operation will now be explained.

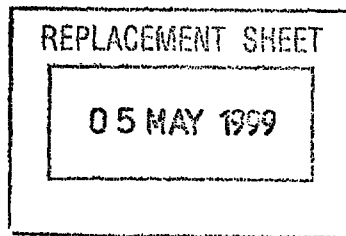
First, when repairing or maintaining the elevator system, a user positions the cage 100 at the level of a corresponding floor and sets the flag SREQ, which indicates the minimum value setting request, to 1, and then the minimum values



indicates the initialization of the buffer DELT is initialized and the running direction are stored in Step S116. In addition, if the cage 100 is stopped in the cage stop height readjusting zone (interval), and the buffer DELT is initialized in Step S117, the flag START is set to 1 which indicates that the current position of the cage 100 is computed, and if a predetermined condition is generated for the next cage stop height readjusting operation, the absolute value computation flag ABS is initialized for the cage stop height readjusting operation in Step S118.

In a state that the maximum value setting is completed in Step S119, as shown in figure 21, when a request is generated for computing the relative distance value in Step S120, the value which is obtained by accumulatively computing the pulse signals PUL2 from the position detection rotary encoder 108 at the door zone entering position, namely, the position at which the cage 100 is stopped from the shielding position is stored into the buffer DELT in Step S121, and it is checked that whether there is a request for computing the current position CUR at which the cage 100 is positioned in Step S122.

As a result of the checking, if there is a request for obtaining the current position CUR of the cage 100 stopped, the flag START is initialized, and the flat INT is set to 1 in Step S123. If the cage 100 is moved in the up direction, the current position CUR is obtained based on the value of "the stored value of the buffer DELT + the zero level value - 125mm" in Steps S124 and S125. If the cage 100 is moved in the down direction, the current position CUR is obtained based on the stored value of "the buffer DELT + the zero level value + 125mm" in Step S126. Thereafter, the distance from the zero level to the position at which the cage is currently stopped, namely, the cage stop height readjusting distance Dist is computed, and the speed pattern is generated for ~~for running~~ ^{running} the cage 100 by the computed distance



Dist.

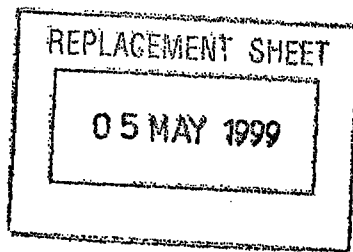
Namely, if the current position CUR of the cage 100 is larger than the zero level, the zero level is subtracted from the current position CUR, thus computing the cage stop height adjusting distance Dist, and the cage 100 is set to move in the down direction for performing the cage stop height readjusting operation by the cage stop height adjusting distance Dist in Steps 127 through 129. If the current position CUR of the cage 100 is smaller than the zero level, the current position CUR is subtracted from the zero level, thus computing the cage stop height adjusting distance Dist, and the running direction R_DIR of the cage 100 is set to be moved in the up direction for performing the cage stop height adjusting operation by the cage stop height adjusting distance Dist in Steps S130 and S131.

In addition, constant values T1, T2 and J1 are obtained for ~~re-running~~ ^{running} the cage 100 based on the computed cage stop height adjusting distance Dist. At this time, the speed pattern shown in Figure 18 may be expressed in the following equation 1.

$$\text{Dist} = 2J(k_1T)^2(k_2T) \quad \text{..... Equation 1}$$

where the reference value of J is 0.25, and since T1 is fixed, the value may be divided based on the zone. At this time, the reference value for dividing the zone is the maximum distance (0.625) when t2 is 0 as shown in Figure 18. Therefore, the type of the speed pattern is divided into the types shown in Figure 15 and 18 based on the maximum distance.

If $\text{Dist}) < 0.625$ in Step S132, since in the interval "a" shown in Figure 17, t2 is 0, and t1 is 0.5 as shown in Figure 15, the new value J, namely, J₁ is obtained



What is claimed is:

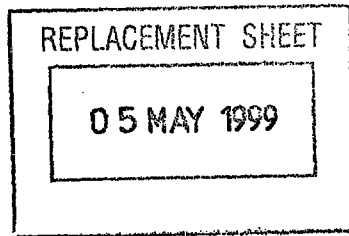
1. A cage stop height readjusting apparatus for an elevator system wherein a position control apparatus for an elevator system includes first through third position detectors installed in an upper portion of a cage, a shielding plate installed in each running path of floors corresponding to the first through third position detectors, and a speed detection rotary encoder outputting a first pulse signal which is proportional to the RPM of a motor, comprising:

a position detection rotary encoder for outputting a second pulse signal which corresponds to an actual running distance of a cage as a pulley is rotated by a wire connected with the cage; and

a main controller for receiving first and second position detection signals from first and third position detectors and first and second pulse signals from the speed detection rotary encoder and position detection rotary encoder when the cage is stopped in a cage stop height readjusting zone, computing a cage stop height adjusting distance, and outputting a speed instruction signal for the cage stop height adjusting operation based on the thusly computed cage stop height adjusting distance.

2. A cage stop height readjusting method for an elevator system wherein a position control apparatus for an elevator system in which a cage is stopped at a zero level by ~~re-running~~ ^{leveling} the cage when the cage is stopped in a cage stop height adjusting zone, comprising the steps of:

a first step for obtaining minimum values of first and second position detection signals from ~~the~~ position detectors when the cage is stopped at a stop level and



obtaining maximum values of the first and second detection signals when the cage is stopped at a distance from the stop level;

a second step for initializing a buffer storing a relative distance value when the cage comes into a door zone and storing the running direction;

a third step for storing the value, which is obtained by accumulatively summing the number of pulses of the ~~second pulse~~^a signal from ~~the~~^a position detection rotary encoder, into a buffer as a relative distance value until the cage come into the door zone is stopped;

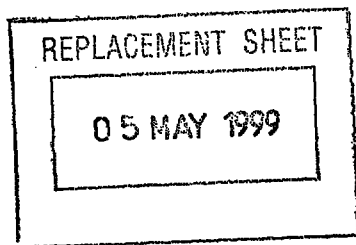
a fourth step for reading a stored running direction of the cage when the cage is stopped in the cage stop height adjusting zone and obtaining the current position of the cage which is stopped;

a fifth step for computing a cage stop height adjusting distance between the zero level to the current position at which the cage is stopped;

a sixth step for computing a speed pattern constant value for obtaining a speed pattern for ~~re-running~~^{running} by the computed cage stop height adjusting distance after setting the ~~re-running~~^{running} direction; and

a seventh step for generating a shaped speed pattern based on the computed speed pattern constant value, generating the final speed instruction signal based on the generated speed pattern and ~~re-running~~^{running} the cage.

3. The ~~apparatus~~^{method} of claim 2, wherein in said fourth step, the current position of the cage is "the stored value of the buffer + the zero level value - 125mm" when the cage is moved in the up direction, and the current position of the cage is "the stored value of the buffer + the zero level value + 125mm" when the cage is moved in the down direction.



4. The ~~apparatus~~^{method} of claim 2, wherein in said fifth step, the cage stop height adjusting distance is computed by subtracting the zero level from the current position when the current position of the cage is larger than the zero level, and the same is computed by subtracting the zero level from the current position when the current position of the cage is smaller than the cage.
5. The ~~apparatus~~^{method} of claim 2, wherein in said seventh step, the type of the speed pattern is determined based on the reference distance.