

METHOD FOR CONTROLLING THE OPENING AND/OR CLOSING
OF A DOOR IN AN AUTOMATIC DOOR SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to a method for controlling the opening and/or closing of a door in an automatic door system.

2. Description of the Prior Art:

In general, automatic door systems are arranged such that a belt is wound round a drive pulley driven by an electric motor and a driven pulley, the belt being connected to a door, and when the motor is driven or rotated forwardly or reversely the belt is turned forwardly or reversely so as to move the door either in the opening direction or in the closing direction respectively.

Concerning such methods for controlling the opening and/or closing of a door in an automatic door system, a variety of methods have been developed.

For example, there is a method for controlling the opening and/or closing of a door in an automatic door system as described in Japanese Laid-Open Patent Application No. Sho63-66991, wherein the door is caused

to conduct an opening operation so as to move it to its opening-stop point after a power supply is turned on; a memory counter stores the pulses generated during the opening operation by a rotation detector adapted to generate pulses whose count is proportional to the number of revolutions of the motor; subsequently the door is caused to conduct a closing operation and the pulses generated by the rotation detector during the closing operation are counted by means of a counter; the motor is stopped when the count of the pulses generated during the closing operation corresponds to the count stored in the memory counter.

According to such a method of controlling the opening and/or closing of a door in an automatic door system, since the distance of movement of said door is measured by causing said door to conduct an opening operation when a power supply is turned on and is stored in a storage device, and during the subsequent closing operation or opening operation of the door the control of said operations is conducted on the basis of the stored distance of movement of the door, opening and/or closing operation of the door can be conducted without any overrun.

However, in the above method for controlling the opening and/or closing of a door in an automatic door system, since the distance of movement of said door is calculated from the number of revolutions of the motor,

if the belt is slipping, then there is the possibility that the distance of movement of said door calculated from the number of revolutions of the motor does not correspond to the actual distance of movement thereof, thus causing an overrun.

Furthermore, when the door is caused to conduct an opening or closing operation, said door is moved at a high speed to a predetermined position and then decelerated by applying a brake to the motor to decelerate the same so as to move said door at a low speed either to its opening-stop point or to its closing-stop point, and control of the opening and/or closing of said door is effected by using preset values of acceleration and deceleration. Therefore, if the initial acceleration and the deceleration upon braking of the door differ from their respective preset values, there is the possibility that the acceleration distance and the deceleration distance of said door may vary thus rendering it impossible to move the door smoothly. To state this briefly, in the case that the resistance to the sliding of the door increases excessively due to abnormal conditions of the reduction gear, the door-roller and the rails, etc., or in the case that the accelerating force or the braking force is reduced due to abnormal conditions of the motor drive circuit, the acceleration distance and the deceleration

distance will differ markedly from their respective preset values, thus endangering persons who pass through the doorway and rendering it difficult or impossible to control the opening and closing of the door.

SUMMARY OF THE INVENTION

The present invention has been devised in view of the above-mentioned situation in the prior art and has as its object the provision of a method for controlling the opening and/or closing of a door in an automatic door system which can solve the above-mentioned difficulties.

To achieve the above-mentioned object, according to the first aspect of the present invention, there is provided a method for controlling the opening and/or closing of a door in an automatic door system comprising the steps of causing said door to conduct an opening operation to its opening-stop point by the action of an initial opening signal transmitted after a power supply has been turned on and the arrival of said door at its closing-stop point has been confirmed, and measuring a first distance travelled by the door at that time; causing the door to conduct a closing operation to its closing-stop point when said door is stopped at the opening-stop point and the opening signal is not being input, and measuring a second distance travelled by the door at that time; and computing the difference between the first and second distances

when the door has returned to its closing-stop point, and outputting a signal indicating the occurrence of abnormal conditions if said difference between the first and second distances is more than a preset value, or causing the door to conduct its normal opening and/or closing operation if said difference between the first and second distances is less than the preset value.

By using this method, it can be readily checked whether or not the belt is slipping.

Futhermore, to achieve the above-mentioned object, according to a second aspect of the present invention, there is provided a method for controlling the opening and/or closing of a door in an automatic door system wherein the opening operation comprises the steps of causing said door to open at a high speed over a predetermined distance by the action of an initial opening signal transmitted after a power supply has been turned on and the arrival of the door at its closing-stop point has been confirmed, and then applying a brake to a door drive motor to decelerate the same and thereby decelerate said door, and measuring the initial acceleration and the deceleration upon braking of said door; and thereafter causing the door to travel the remaining distance at a low speed to its opening-stop point; and the closing operation comprises the steps of causing the door to close at a high speed over a predetermined distance when said door is stopped at its opening-stop point and the

door opening signal is not being input, and then applying a brake to the door drive motor to decelerate the same and thereby decelerate the door, and measuring the initial acceleration and the deceleration upon braking of the door, and thereafter causing the door to travel the remaining distance at a low speed to its closing-stop point; and comparing the measured initial accelerations and the decelerations upon braking of said door with a preset acceleration and a preset deceleration respectively, once the door has stopped at its closing-stop point, and outputting a signal which indicates the occurrence of abnormal conditions if the difference between the measured and preset values of the initial acceleration and/or the deceleration upon braking lies outside an allowable range.

By this method, it can be readily detected whether the initial acceleration and the deceleration upon braking of the door are within their respective allowable ranges.

Accordingly the present invention having the above-mentioned aspects incorporated offers the undermentioned advantages and effects.

1. It is deduced from the difference between the measured distance of the opening movement and the measured distance of the closing movement of the door whether or not the belt is slipping, and in

the case that the belt is slipping, a signal indicating abnormal conditions is output, and hence whether or not the belt is slipping can be checked readily, and if the belt is slipping the door can be prevented from conducting its normal opening and/or closing operations.

2. Since the arrangement is made that the door is caused to conduct a high speed opening and/or closing operation over a predetermined distance, the time needed for said door to conduct opening and/or closing operations can be reduced and it can be quickly checked whether or not the belt is slipping.

3. Since a signal indicating abnormal conditions is transmitted in the case that the initial acceleration and the deceleration upon braking of the door lie outside their respective preset ranges, it can be found whether the initial acceleration and the deceleration on braking of the door differ from their respective preset values. As a result, it can be found whether the reduction gear, the rail or the motor driving circuit is in an abnormal condition, so that the door may be prevented from conducting its normal opening and/or closing operations in abnormal or improper working conditions.

The above-mentioned and other objects, aspects and advantages of the present invention will become apparent to those skilled in the art by making reference to the following description and the accompanying drawings, in which preferred embodiments incorporating the principles

of the present invention are shown by way of example only.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view showing an apparatus for controlling the opening and/or closing of a door in an automatic door system and controlling the opening and/or closing operations of said door according to the present invention;

Fig. 2 is an explanatory view showing in detail a control circuit for use with the apparatus;

Fig. 3 and 4 are diagrams, showing the operations of moving the door to its closing stop point after the power supply is turned on;

Fig. 5 is a flowchart showing the operations of the automatic door system;

Figs. 6 and 7 are diagrams, showing the opening and/or closing operations of the door used to determine whether or not abnormal conditions exist;

Fig. 8 is a flowchart showing the operations for determining whether or not abnormal conditions exist; and

Fig. 9 is a diagram showing one embodiment of the normal opening and/or closing operations of the automatic door system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described below by way of example only with reference to the accompanying drawings.

As shown in Fig. 1, a belt 3 is wound round a drive pulley 1 and a driven pulley 2. The drive pulley 1 is connected through a reduction gear 5 to an electric motor 6. The arrangement is made such that when the electric motor 6 is driven the door 4 is caused to conduct opening and/or closing movements between its closing-stop point and its opening-stop point.

The above-mentioned motor 6 has a rotating shaft to which is connected a pulse generator 7 adapted to output pulses whose count is proportional to the number of revolutions of the motor 6.

The pulses generated by the pulse generator 7 are input to a control circuit 8 which will then output a control signal to a motor drive circuit 9 so as to control the drive of the motor 6 as will be described later.

Reference numeral 10 denotes a human-body detector unit such as, for example, a mat switch adapted to transmit a human-body detection signal M_g to the control circuit 8 as an input thereto.

The above-mentioned pulse generator 7 is, for example, a pulse encoder adapted to transmit a discrimination signal indicating the rotational direction of the motor 5 and pulses whose count is proportional to the number of revolutions of the motor 6 to the control circuit 8 as inputs thereto.

Futher, the arrangement can also be made such that

the motor drive circuit 9 may transmit pulses whose count is proportional to the number of revolutions of the motor 6 and a signal representative of opening and/or closing operations of the door to the control circuit 8 as inputs thereto.

The above-mentioned control circuit 8 comprises, as shown in Fig. 2, an acceleration detecting circuit 11, a speed detecting circuit 12, a counter 13 including a counter drive circuit and a counting function part, a clock 19, first, second, third and fourth setting units 14, 15, 16 and 17, and a logical operation control circuit 18, etc. The acceleration detecting circuit 11 is adapted to detect the acceleration of the door on the basis of a change in the pulse intervals, which is detected by comparing reference pulses from the clock 19 with the input pulses. In like manner, the speed detecting circuit 12 is adapted to determine that the door 4 has stopped by observing the increase in the pulse intervals and to output a signal indicating that the door has stopped. Further, the counter 13 is adapted to subtract from or add to the digital figure displayed on it when it is driven by the output transmitted by the counter drive circuit thereof which is activated by pulses generated by the pulse generator 7 when the door 4 conducts its opening operation and closing operation, respectively. The first, second, third and fourth setting units 14, 15, 16 and 17 store

fixed values, respectively, which will be described later, and the logical operation control circuit 18 is adapted to conduct control of logical operations which will be described later on the basis of each of the fixed values and to transmit a variety of signals to the motor drive circuit 9.

Next, one embodiment of the method for controlling the opening and/or closing of the door will be described.

1. After the power supply is turned on, the motor is driven so as to move the door 4 to its closing end position, namely the closing-stop point. In the case that the door 4 is closed when the power supply is switched on, even if the motor is driven, said door will not move.

2. When the door 4 is detected to be at the closing-stop point and an initial opening signal is input, the door 4 is caused to conduct an opening operation until it reaches its opening end position, namely the opening-stop point. The distance of movement, the initial acceleration and the deceleration upon braking of the door 4 during that opening operation are measured and are stored in the logical operation control circuit 18. When the door 4 is stopped at the opening-stop point and a door opening signal is not being input, the door 4 is caused to conduct its closing operation until it reaches its closing-stop point, and the distance of movement, the initial

acceleration and the deceleration upon braking of said door during that operation are measured and are stored in the logical operation control circuit 18.

3. The distance of movement of the door 4 during the above-mentioned opening operation is compared with that during the above-mentioned closing operation, and if they are equal or if the difference between them is within a predetermined allowable range, then it is determined that the belt 3 is free from slip, whilst if said difference lies outside the allowable range, then it is determined that the belt 3 is slipping, and an alarm indicating abnormal conditions is given, by actuating a buzzer for example, and operations for the case of abnormal conditions will be conducted.

To be more specific, if the belt 3 slips, then the relationship between the number of revolutions of the motor 6 and the distance of movement of the door 4 will deviate from a predetermined fixed ratio, and so an error will occur if the opening and/or closing operations of the door 4 are controlled by measuring the distance of movement of said door on the basis of pulses whose count is proportional to the number of revolutions of the motor 6. Therefore, as mentioned above, it is determined whether or not the belt 3 is slipping, and if the belt 3 is slipping then said belt and the drive pulley 1 are inspected to find the cause of the slip and, after repairs or maintenance so as to eliminate the

slip, the normal opening and/or closing operations which will be described later will be conducted.

Simultaneously to this operation, if the initial acceleration and the deceleration upon braking of the door 4 lie outside their respective preset ranges between their respective maximum and minimum accelerations, then it is determined that the initial acceleration and the deceleration upon braking of the door are abnormal, and an alarm for abnormal conditions is given, by actuating a buzzer for example, and operations for the case of abnormal conditions will be conducted.

To be more specific, the initial acceleration and the deceleration upon braking of the door are determined by the weight and the resistance to sliding of the door or by the electric current supplied to the motor 6, and the performance of said motor, etc. If the initial acceleration and the deceleration upon braking of the door lie outside their respective preset ranges, then at the time of normal opening and/or closing operations the door 4 cannot be moved smoothly. Therefore, as stated above, it is determined whether or not the initial acceleration and the deceleration upon braking of the door are abnormal, and should abnormal conditions exist, then the abnormality is eliminated and the door restored to its normal working condition, any necessary tests are made, and then the door again conducts the normal

opening and/or closing operations.

In the next section, each of the operations of the door is described in detail.

1. Operations for moving door 4 to its closing-stop point:

1-1 After the power supply has been switched on, if 10 seconds have passed without the logic operation control circuit 18 receiving human-body detection signal M_g as input, the content of the counter 13, namely the distance L of movement of the door 4 is compared with a preset distance L_g stored in the first setting unit 14.

At that time, since the door 4 has been kept stationary, the distance L of movement of the door 4 is zero, and hence L_g is more than L ($L_g > L$).

Therefore, a low speed closing signal S_1 is transmitted by the logical operation control circuit 18 to the motor driving circuit 9 so that the motor 6 is driven or rotated forwardly at a low speed to cause the door 4 to conduct a low speed closing operation and move said door to its closing-stop point, and the pulses generated by the pulse generator 7 during the low speed closing operation are counted by the counter 13 so as to measure the distance L over which the door 4 has been moved. This low speed closing operation is diagrammatically illustrated in Fig. 3. If a human-body detection signal M_g is input to the logical operation control circuit 18 when the door is in a low speed

closing operation, an opening operation which will be described later is conducted.

When the door 4 has reached its closing-stop point, the intervals between successive pulses input to the speed detecting circuit 12 become longer, hence showing that the door 4 has been moved to the closing-stop point.

Further, a limit switch may also be used to detect that the door 4 has been moved to its closing-stop point.

1-2 When the human-body detection signal M_g is input to the logical operation control circuit 18 less than 10 seconds after the power supply is switched on, and also when the human-body detection signal M_g is input during the aforementioned low speed closing operation, the preset distance L_g is compared with the distance L of movement of the door 4 during the closing operation thereof as described above, and if L_g is greater than L ($L_g > L$), then the logical operation control circuit 18 will transmit a low speed opening signal S_2 to the motor driving circuit 9 so as to cause the door 4 to conduct a low speed opening operation. However, if L_g is less than L ($L_g < L$), then the logical operation control circuit 18 will transmit a high speed opening signal S_3 to the motor driving circuit 9 so as to cause the door 4 to conduct an opening operation at a speed higher than the above-mentioned low speed for a distance $L_g - L_f$, and then conduct a low speed opening operation.

Reference character L_f is a preset value stored in the second setting unit 15.

During the above opening operation of the door, the pulses generated by the pulse generator 7 are counted by means of the counter 13 so as to measure the distance L over which the door 4 has been moved.

When the door 4 has been moved to an opening-stop point, this is detected by the speed detecting circuit 12, as mentioned above, thus stopping the motor 6 so as to stop said door at the opening-stop point. When the input of the human-body detection signal M_s to the control circuit 18 is discontinued, the operations given in Item 1-1 above are performed so as to cause the door 4 to conduct a closing operation to its closing-stop point.

When the door 4 is in this closing operation, the distance L of movement of said door during the aforementioned opening operation is compared with the preset distance L_s , with the result that, if L_s is more than L ($L_s > L$), then said door is caused to conduct a closing operation at a low speed. However, if L_s is less than L ($L_s < L$), then the door is caused to conduct a closing operation at a speed higher than the above-mentioned low speed over the distance $L_s - L_f$, and then conduct a low speed closing operation until it is stopped at its closing-stop point. The movement of the door 4 when L_s is less

than L ($L_s < L$) is diagrammatically illustrated in Fig. 4.

The above-mentioned movement of the door 4 to its closing-stop point is illustrated in the form of a flowchart in Fig. 5. The door 4 can be moved to the closing-stop point regardless of its position when the power supply is turned on, and should the door 4 have been moved in its opening direction more than the preset distance L_s , the door 4 can conduct a high speed closing operation over the distance $L_s - L_f$, so that the door 4 can be moved to the closing-stop point in a short time and stopped there.

Furthermore, the expression "detection of abnormal condition" includes the case where the door 4 is locked or the path of the door is obstructed by an obstacle which renders it unable to conduct opening and/or closing operations. In such a case, an alarm is given by actuating a buzzer and the opening/closing operation of the door is interrupted.

2. The detection of abnormal conditions during opening and/or closing operations.

2-1 Upon confirming that the door 4 has reached the closing-stop point after the power supply has been turned on as described above, when the logical operation control circuit 18 receives an initial door opening signal, the control circuit 18 will transmit a high speed opening signal S_3 to the motor driving circuit 9

so as to cause the door 4 to conduct a high speed opening operation. The distance L of movement of the door 4 in this operation is measured by counting (by means of the counter 13) the pulses generated by the pulse generator 7. When the door 4 has been moved over the distance $L_g - L_f$, the logical operation control circuit 18 will transmit a braking signal S_4 to the motor drive circuit 9 to apply a braking force to the motor 6 so as to decelerate the same and thereby decelerate said door. When the speed detecting circuit 12 detects that the speed of the door 4 is zero, the logical operation control circuit 18 will output a low speed opening signal S_2 to the motor driving circuit 9 so as to cause said door to conduct a low speed opening operation until it reaches the opening-stop point.

The distance of the opening movement L most of the door 4 from the closing-stop point to the opening stop point during an opening operation is measured by counting by means of the counter 13 the pulses generated by the pulse generator 7, and the distance of the movement is stored by the logical operation control circuit 18. In addition, the initial acceleration A_{mo} and the deceleration on braking B_{mo} are measured by means of the acceleration detecting circuit 11 and the measured values are stored by the logical operation control circuit 18.

When the speed detecting circuit 12 detects that the

door 4 has been stopped at the opening-stop point, if a door opening signal is not being input to the logical operation control circuit 18 at that time, then the control circuit 18 will transmit a high speed closing signal S_5 to the motor drive circuit 9 so as to cause said door to conduct a high speed closing operation. The distance L of movement of the door 4 during that operation is measured by counting (by means of the counter 13) the pulses generated by the pulse generator. When the door 4 has been moved over the distance $L_s - L_f$, the logical operation control circuit 18 will transmit a braking signal S_4 to the motor drive circuit 9 so as to apply a braking force to the motor 6 to thereby decelerate said door. When it is detected by the speed detecting circuit 12 that the speed of the door 4 has been reduced to zero, the logical operation control circuit 18 will transmit a low speed closing signal S_1 to the motor driving circuit 9 so as to cause said door to conduct a low speed closing operation until it reaches the closing-stop point and is stopped there.

The above-mentioned opening and closing operations are diagrammatically illustrated in Fig. 6.

The distance of the closing movement L_{mcst} of the door 4 from the opening-stop point to the closing-stop point during the closing operation, the initial acceleration A_{mc} and the deceleration upon braking B_{mc} are measured

and stored in the logical operation control circuit 18.

When it is detected by the speed detecting circuit 12 that the door has been stopped at the closing-stop point as described above, the logical operation control 18 will determine whether or not abnormal conditions exist.

First, a comparison is made to find whether the measured initial accelerations A_{mo} , A_{mc} and the decelerations upon braking B_{mo} , B_{mc} are within the range between the maximum acceleration A_{max} and the maximum deceleration B_{max} preset by the third setting unit 16 and the minimum acceleration A_{min} and the minimum deceleration B_{min} preset by the fourth setting unit 17, respectively, with the result that, if the acceleration A_{mo} , A_{mc} or the deceleration upon braking B_{mo} , B_{mc} lie outside the preset range, then it is determined that abnormal conditions exist. Furthermore, the difference in distance between the opening movement L_{most} and the closing movement L_{mcst} is computed, and, if this difference is more than a preset value L_{ref} , then it is determined that abnormal conditions exist.

When it is determined that abnormal conditions exist, a buzzer is actuated to give an alarm, and should the human-body detection signal M_g be input the door 4 is caused to conduct low speed opening and closing operations.

2-2 The operations described in Item 2-1 above are conducted in the case that no human-body

detection-signal M_g input to the logical operation control circuit 18 while the door 4 is conducting a closing operation. The operations that are conducted in the case that a human-body detection signal M_g is input while the door 4 is conducting a closing operation are described below.

As stated in the Item 2-1 above, the door 4 is caused to conduct a high speed closing operation from its opening-stop point. When the human-body detection signal M_g is input to the logical operation control circuit 18 while the door 4 is conducting a low speed closing operation, the control circuit 18 will transmit a braking signal S_4 to the motor driving circuit 9 to thereby stop the motor 6. When the door 4 has been stopped, the distance L of movement of said door during the closing operation is input into the control circuit 18. Next, the distance L of movement of the door 4 is compared with the preset distance L_g , and, if L is more than L_g ($L > L_g$), then the door 4 is caused to conduct a high speed opening operation over the distance $L_g - L_f$ and thereafter conduct a low speed opening operation until it reaches the opening-stop point, as shown by the one-dot chain line in Fig. 7. However, in the case that L is less than L_g ($L < L_g$), the door 4 is caused to conduct a low speed opening operations until it reaches the opening-stop point, as shown by the two-dot chain line

in Fig. 7. When the door 4 has been stopped at the opening-stop point, said door is caused to conduct a high speed closing operation over the distance $L_s - L_f$ as mentioned above, and thereafter conduct a low speed closing operation until it reaches the closing-stop point.

The above operations are illustrated in the form of a flowchart in Fig. 8.

After a human-body detection signal is input to the logical operation control circuit 18, the door 4 is caused to conduct a high speed opening operation for a distance of $L_s - L_f$ before it is caused to stop and thereafter conduct a low speed opening operation. Therefore, said door is moved quickly to its opening-stop point.

In the case that there is a risk of the door 4 striking the opening-stop point if said door is caused to conduct a high speed opening operation over a distance $L_s - L_f$, then said door is caused to conduct a low speed opening operation, so that said door can be prevented from striking against the opening-stop point.

Whether or not abnormal conditions exist is determined as described above, and, if no abnormal conditions exist, then the door is caused to conduct normal opening and/or closing operations.

For example, braking points for opening and closing operations, are set on the basis of the distance of the closing movement L .

most which is measured at the time of the closing operation in the above-mentioned opening and closing operation for detecting abnormal conditions. The distance of movement of the door 4 is measured by counting by means of the counter 13 the pulses generated by the pulse generator 7 whose count is proportional to the number of revolutions of the motor 6. When the distance of movement of the door 4 corresponds to the door braking point, then a braking force is applied to the motor 6 so as to decelerate and stop same and thereby stop said door. After that, the door 4 is caused to conduct either an opening operation or a closing operation to move it to its opening-stop point or its closing-stop point respectively.

An embodiment of the normal opening and/or closing operation will now be described below with reference to Fig. 9.

As shown in Fig. 9, a braking point for the opening operation, a brake application terminating point for the opening operation, and a stopping point for the opening operation are set using the opening-stop point as the reference; the stopping point for the opening operation in this case is set at a position somewhat away from the opening-stop point as a preliminary opening-stop point. A braking point for the closing operation, a brake application terminating point for the closing operation, and a pushing point for the closing operation are set

using the closing-stop point as the reference.

When human-body detection signal M_g input to the logical operation control circuit 18, the motor 6 is driven or rotated forwardly at a high speed so as to cause the door 4 to conduct a high speed opening operation. When the door 4 is moved to the braking point for opening operation, the braking means is rendered operative to decelerate the motor 6 and hence reduce the moving speed of said door. When the door 4 has been moved to the brake application termination point for the opening operation, the motor 6 is driven or rotated forwardly at a low speed so as to cause said door to conduct a low speed opening operation. When the door 4 has been moved to the preliminary opening-stop point, the motor 6 is stopped so as to stop said door at a position somewhat away from the opening-stop point to thereby prevent said door from striking against the door-stop on the door opening side.

A predetermined fixed time after input of the human-body detection signal M_g to the logical operation control circuit 18 has ceased, the motor 6 is rotated reversely at a high speed so as to cause the door 4 to conduct a high speed closing operation. When the door 4 has been moved to the braking point for the closing operation, a braking force is applied to the motor 6 so as to decelerate same, and hence decelerate said door. When the door 4 has reached the brake

application terminating point, the motor 6 is driven or rotated reversely at a low speed so as to cause said door to conduct a low speed closing operation. When the door 4 has been moved to the pushing point for closing operation, the output torque developed by the motor 6 is reduced to a very low value, and the rotational speed of the motor 6 is reduced to a yet lower value so as to cause the door 4 to conduct the closing operation at a yet lower speed to bring the door into contact with the door-stop at the closing-stop point and enable the door 4 to be pushed continuously against the door stop by a very weak force.

This enables airtight sealing material inserted between the door 4 and the door stop to be compressed so as to provide a satisfactory airtight condition.

It should be understood that the foregoing description is merely illustrative of preferred embodiments of the present invention, and that the scope of the present invention is not to be limited thereto, but is to be determined by the scope of the appended claims.



Claims

1. A method for controlling the opening and/or closing of a door in an automatic door system comprising the steps of:

causing said door to conduct an opening operation to its opening-stop point by the action of an initial opening signal transmitted after a power supply has been turned on and the arrival of said door at its closing-stop has been confirmed, and measuring a first distance travelled by the door during said opening operation;

causing said door to conduct a closing operation to its closing-stop point when the door is stopped at the opening-stop point and no opening signal is being input, and measuring a second distance travelled by the door during said closing operation; and

computing the difference between said first and second measured distances once the door has stopped at the closing-stop point, and outputting a signal indicating the occurrence of abnormal conditions if the difference between said first and second distances is more than a preset value, or causing the door to conduct its normal opening and/or closing operations if said difference is less than the preset value.



2. A method for controlling the opening and/or closing of a door in an automatic system as claimed in Claim 1, wherein after confirmation of the arrival of said door at the closing-stop point, said door is caused to conduct opening and/or closing operations at a high speed over an initial preset distance of the overall distance travelled by said door during said opening and/or closing operations and thereafter conduct the operation at a low speed.

3. A method for controlling the opening and/or closing of a door in an automatic door system as claimed in claim 1, wherein said opening operation comprises the steps of causing the door to open at a high speed over a predetermined distance by the action of an initial opening signal transmitted after a power supply has been turned on and the arrival of the door at its closing stop point has been confirmed, and then applying a brake to a door drive motor to decelerate the same and thereby decelerate said door, and measuring the initial acceleration and the deceleration upon braking of said door, and thereafter causing the door to travel the remaining distance at a low speed to its opening-stop point; and

said closing operation comprises the steps of causing the door to close at a high speed over a predetermined distance when said door is stopped at its opening-stop point and the door opening signal is not being input, and then applying a brake to the door drive



motor to decelerate the same and thereby decelerate the door, and measuring the initial acceleration and the deceleration upon braking of the door at that time, and thereafter causing the door to travel the remaining distance at a low speed to this closing-stop point; and

the measured initial accelerations and the decelerations upon braking of the door are compared with a preset acceleration and a preset deceleration respectively once the door has stopped at its closing-stop point, and a signal indicating the occurrence of abnormal conditions is output if the difference between the measured and preset values of the initial acceleration and/or the deceleration upon braking lies outside an allowable range.
