

AUTOMATIC DOOR SYSTEM AND  
METHOD FOR CONTROLLING AUTOMATIC DOOR IN  
TURNING-ON TIME OF ITS POWER SUPPLY

BACKGROUND OF THE INVENTION

5 Field of the Invention:

The present invention relates to an automatic door system and a method for controlling an automatic door in a turning-on time of its power supply. .

Description of the Prior Art:

10 In an automatic door system, a door thereof conducts its opening/closing operation between a stop point thereof in its opening operation ( hereinafter referred to as the opening-stop point) and a stop point thereof in its closing operation ( hereinafter referred to as the closing-stop point), in  
15 which opening/closing operation the door moves at a high speed until it reaches a deceleration point, followed by a low-speed movement of the door, so that, if the deceleration point is not correctly  
20 established, the door collides against the opening-stop point and the closing-stop point.

In order to avoid such such collision, in a conventional automatic door system in which a distance between the opening-stop point and the  
25 closing-stop point, i.e., a door stroke is not recognized, the door conducts its opening/closing operation

1 at a low speed when a power-supply switch thereof  
is turned on, to determine the door stroke on the  
basis of which the deceleration points in both the  
opening operation and the closing operation of the  
5 door are established.

A problem to be resolved by the present  
invention is as follows:

In such conventional method for controlling  
the automatic door system in a turning-on time of  
10 its power-supply switch, after turning on the power-  
supply switch, the door does not conduct its normal  
opening/closing operation but repeats its low-speed  
operation until it is confirmed that the door has reached  
both the opening-stop point and the closing-stop point,  
15 i.e., until the door stroke is determined. Consequent-  
ly, when a plurality of human-body detection signals  
are inputted at short-time intervals before the opening-  
stop point and the closing-stop point are confirmed,  
the door repeats its low-speed opening/closing opera-  
20 tion to enable the door to move to the opening-stop  
point but prevent the door from moving to the closing-  
stop point, so that it is not possible to confirm  
both the opening-stop point and the closing-stop  
point. As a result, the door can not be returned  
25 to its normal opening/closing operation for a long

1 time. This is a problem inherent in the conventional  
method for controlling the automatic door system.

#### SUMMARY OF THE INVENTION

It is an object of the present invention  
5 to resolve the above problem by providing a method  
for controlling an automatic door system in a turning-  
on time of its power-supply switch, wherein the im-  
provement resides in that: after the power-supply  
switch is turned on, a door of said automatic  
10 door system conducts its low-speed opening/closing  
operation when a first human-body detection signal  
is inputted to said system; and then, in case that  
said door travels a door stroke more than a prede-  
termined minimum door stroke in said low-speed opening/  
15 closing operation, said door conducts its normal  
opening/closing operation after completion of its  
traveling said predetermined minimum door stroke.

Consequently, the method of the present  
invention enables the door of the automatic door  
20 system to return to its normal opening/closing opera-  
tion in a short time.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view illustrating  
an automatic door system for working the method  
25 of the present invention;

1           Fig. 2 is a block diagram illustrating  
a control apparatus employed in the automatic door  
system for working the method of the present invention;

5           Figs. 3, 4 and 5 are graphs showing the  
operations of the door; and

Fig. 6 is flowchart showing the operation  
of the automatic door system for working the method  
of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

10           Fig. 1 is a schematic view illustrating  
an automatic door system for working the method  
of the present invention, in which: a driving pulley  
1 is driven by a motor M. A belt 3 is running around  
the driving pulley 1 and a driven pulley 2, so that  
15 when the motor M rotates in its normal direction  
and reverse direction a door 4 conducts its opening/  
closing operation between an opening-stop point "A"  
and a closing-stop point B, and at this time, both  
a deceleration point C of the door 4 in its opening  
20 operation ( hereinafter referred to as the opening-  
deceleration point C) and a deceleration point D  
of the door 4 in its closing operation ( hereinafter  
referred to as the closing-deceleration point D)  
are established, and thereafter the door 4 conducts  
25 its high-speed opening/closing operation until the

1 door 4 reaches such deceleration points C and D,  
followed by the low-speed opening/closing operation  
of the door 4.

The motor M is controlled by a control  
5 apparatus 5 which comprises: a main control circuit 7  
for issuing to a speed-control circuit 6 of the motor  
M a normal-direction rotation signal  $R_1$ , a reverse-  
direction rotation signal  $R_2$ , a high-speed signal  
VH and a low-speed signal VL; and a detector 8 for  
10 issuing clock pulses  $P_1$  proportional to a traveling  
stroke of the door 4 for counting use, an opening  
signal R and a closing signal L both of which are  
employed for identifying the opening/closing operation  
of the door 4. Such detector 8 is constructed of  
15 a detecting unit and a direction-identification circuit  
such as those disclosed in Japanese Patent Application  
Laid-open Specification No. 58-210270.

Hereinbelow, the operation of the door  
4 will be described with reference to the block diagram  
20 of the control apparatus shown in Fig. 2.

Step (1):

A timer 12 of a command circuit 11 is actuated  
when a power-supply switch 10 is turned on. After  
that, in case that a human-body detector 13 does  
25 not issue a human-body detection signal  $R_3$  to the

1 command circuit 11 after collapse of a certain period  
of time, for example, a period of 10 seconds pro-  
grammed in the timer 12, the command circuit 11 issues  
to the speed-control circuit 6 a reverse-direction  
5 rotation signal and a low-speed signal at a time  
when the power-supply switch 10 is turned on ( herein-  
after referred to as the turning-on reverse-direction  
rotation signal  $R_4$  and the turning-on low-speed signal  
 $R_5$ , respectively), to cause the motor M to rotate  
10 at a low speed in its reverse direction, so that  
the door 4 conducts its low-speed closing operation.

Step (2):

In case that the human-body detection signal  
 $R_3$  is inputted to the command circuit 11 before col-  
15 lapse of the period of time programmed in the timer  
12, the command circuit 11 issues a normal rotation  
signal at a time when the power-supply switch 10  
is turned on ( hereinafter referred to as the turning-  
on normal-direction rotation signal  $R_6$ ) and the turning-  
20 on low-speed signal  $R_5$  to the speed-control circuit  
6 to cause the motor M to rotate at a low speed in  
its normal direction, so that the door 4 conducts its  
low-speed opening operation.

Step (3):

25 In Fig. 1, at a time when a closing-origin

1 detection switch 14 is in its turning-on condition,  
i.e., at a time when the door 4 stays at the closing-  
stop point B, as described later, on the basis of  
the minimum door stroke, both the opening-deceleration  
5 point C and the closing-deceleration point D are  
calculated, and then on the basis of the thus obtained  
deceleration points C and D, the door 4 conducts  
its normal opening/closing operation when the human-  
body detection signal  $R_3$  is inputted to the command  
10 circuit 11. A graph of such operation of the door  
4 is shown in Fig. 3.

Step (4):

- As described in the Step (2), before collapse  
of the period of time programmed in the timer 12,  
15 the motor M rotates at a low speed in its normal  
direction while the command circuit 11 issues a signal  
to a stroke-confirming register 15 to have the same  
15 establish a minimum door stroke therein, which  
minimum door stroke is subjected to a gradual subtrac-  
20 tion by means of the clock pulses  $P_1$  issued from  
the detector 8 at a time when the door 4 conducts  
its low-speed opening operation. In such low-speed  
opening operation of the door 4, a pulse-interval  
checking circuit 16 provided in the output side of  
25 the detector 8 detects that the pulse interval of

1 the clock pulses  $P_1$  is increased, i.e., that the door  
4 reaches the opening-stop point "A" at which the  
door 4 stops, to obtain a detection signal  $R_7$  which  
is issued to the command circuit 11 to cause the  
5 same 11 to issue a check signal to an overflow-confirm-  
ing flag register 17, so that it is judged whether or  
not the contents of the stroke-confirming register  
15 are below zero, i.e., whether or not the door  
4 travels a distance more than the minimum door stroke  
10 in its opening operation. In case that the door 4  
travels a distance more than the minimum door stroke  
in its opening operation, the command circuit 11,  
to which the flag register 17 issues a confirmation  
signal, has a stroke register 18 establish the minimum  
15 door stroke therein, a signal of which minimum door  
stroke is inputted to both an opening-deceleration-  
point calculating circuit  $19_1$  and a closing-deceleration-  
point calculating circuit  $19_2$  to calculate both the  
opening-deceleration point and the closing-deceleration  
20 point signals of which are inputted to an opening-  
deceleration-point setting unit  $20_1$  and a closing-  
deceleration-point setting unit  $20_2$ , respectively,  
while the door 4 conducts, according to the instructions  
issued from the command circuit 11, its high-speed  
25 closing operation until the door 4 reaches the closing-

1 deceleration point, followed by its normal closing  
operation which continues until the door 4 reaches  
the closing-stop point B.

Namely, although the command circuit 11  
5 issues the reverse-direction rotation signal  $R_2$  to  
the speed-control circuit 6 and also to a second  
AND gate  $21_2$ , since a second comparator  $24_2$  does  
not issue any signal to the second AND gate  $21_2$ ,  
the second AND gate  $21_2$  does not issue any signal.  
10 At this time, since a first OR gate  $22_1$  does not  
also issue any signal, an invertor 23 issues a signal  
to a third AND gate  $21_3$  to which is also inputted  
a signal issued from a second OR gate  $22_2$  to cause  
the third AND gate  $21_3$  to issue the high-speed signal  
15 VH to the speed-control circuit 6, so that the motor  
M rotate at a high speed in its reverse direction  
to have the door 4 conduct its high-speed closing  
operation.

As a result, the clock pulses  $P_1$  issued  
20 from the detector 8 are inputted to a counter circuit  
25 which is employed to detect a live position of the  
door 4, and are employed in the gradual subtraction  
of the minimum door stroke established in the stroke  
register 18 to produce a resultant signal which is  
25 inputted to the second comparator  $24_2$  in which the

1 thus produced resultant signal is compared with the  
signal of the closing-deceleration point established  
in the closing-deceleration-point setting unit  $20_2$ .  
When such resultant signal coincides with the signal  
5 of the closing-deceleration point in the second compa-  
rator  $24_2$ , a signal is issued to the second AND gate  
 $21_2$  from the second comparator  $24_2$ , and in turn the  
the second AND gate  $21_2$  issues a signal to the first  
OR gate  $22_1$  which issues the low-speed signal VL  
10 to the speed-control circuit 6 accordingly, to cause  
the motor M to rotate at a low speed in its reverse  
direction, so that the door 4 conducts its low-speed  
closing operation until it reaches the closing-stop  
point B.

15 A graph of the above operation is shown in  
Fig. 4. After the above operation, the door 4 returns  
to its normal opening/closing operation.

Step (5):

On the other hand, in the step (4), in  
20 case that the door 4 does not travel a distance more  
than the minimum door stroke, for example, in case  
that the power-supply switch 10 is turned on at a  
time when the door 4 is open, such condition is detected  
by the flag register 17 which issues a signal to  
25 the command circuit 11 to make the same 11 identify

1 a stop point of the door 4 in its opening operation  
as the opening-stop point "A" and accordingly make  
the same 11 reset the counter circuit 18 to zero.  
At the same time, the contents of the stroke-confirming  
5 register 15 are also set to zero according to the  
instructions issued from the command circuit 11.

Step (6):

When the human-body detection signal  $R_3$   
disappears, the command circuit 11 issues the turning-  
10 on reverse-direction rotation signal  $R_4$  and the turning-  
on low-speed signal  $R_5$  to the speed-control circuit  
6 to cause the door 4 to conduct its low-speed closing  
operation.

At this time, the clock pulses  $P_1$  issued  
15 from the detector 8 are counted up in the stroke-  
confirming register 15 to determine the closing stroke  
of the door 4, while the command circuit 11 receives  
the detection signal  $R_7$  issued from the pulse-interval  
checking circuit 16 to recognize that the door 4  
20 stops at the closing-stop point B, so that the motor  
is stopped while, according to an instructions issued  
from the command circuit 11, the contents of the  
stroke-confirming register 15, i.e., a live stroke  
of the door 4 is compared in a third comparator  $24_3$   
25 with the minimum door stroke established in the stroke

1 register 18. As a result, in case that the contents  
of the stroke-confirming register 15 are larger than  
the minimum door stroke, the minimum door stroke  
is replaced with such contents of the stroke-confirming  
5 register 15 in the stroke register 18 so that the  
opening-deceleration point and the closing-deceleration  
point are recalculated in the opening-deceleration-  
point calculating circuit  $19_1$  and the closing-deceler-  
ation-point calculating circuit  $19_2$ , respectively,  
10 to establish a new opening-deceleration point and  
a new closing-deceleration point in the opening-  
deceleration-point setting unit  $20_1$  and the closing-  
deceleration-point setting unit  $20_2$ , respectively.

Step (7):

15 After that, when the human-body detection  
signal  $R_3$  is inputted to the command circuit 11,  
the door 4 conducts its high-speed opening operation  
until the door 4 reaches the thus established new  
opening-deceleration point, and then conducts the  
20 low-speed opening operation until the door 4 reaches  
the opening-stop point "A" at which the door 4 stops.  
After collapse of a predetermined time, the door  
4 conducts its normal closing operation as described  
in the above, and stays at the closing-stop point  
25 B until the following human-body detection signal

1      $R_3$  is inputted to the command circuit 11. When the  
following human-body detection signal  $R_3$  is inputted  
to the command circuit 11, the door 4 conducts its  
normal opening/closing operation.

5             Namely, in a condition in which the door  
4 stays at the closing-stop point B after completion  
of the above low-speed closing operation thereof,  
when the human-body detection signal  $R_3$  is inputted  
to the command circuit 11, the command circuit 11  
10     issues the normal-direction rotation signal  $R_1$  to  
both the speed-control circuit 6 and the first AND  
gate  $21_1$  while the first comparator  $24_1$  does not  
issue any signal to the first AND gate  $21_1$ , so that,  
in the same manner as that described in the above,  
15     the third AND gate  $21_3$  issues the high-speed signal  
VH to the speed-control circuit 6 to cause the motor  
M to rotate at a high speed in its normal direction,  
whereby the door 4 conducts its high-speed opening  
operation. When the door 4 reaches the opening-deceler-  
20     ation point, the opening-deceleration point coincides  
with the door position detected by the counter circuit  
25     to cause the first comparator  $24_1$  to issue a signal  
to the first AND gate  $21_1$ , so that, in the same manner  
as that described in the above, the first OR gate  
25      $22_1$  issues the low-speed signal VL to the speed-

1 control circuit 6, whereby the motor M rotates at  
a low speed in its normal direction to cause the  
door 4 to conduct its low-speed opening operation.

A graph of the above operation is shown  
5 in Fig. 5.

Step (8):

In the low-speed closing operation of the  
door 4 described in the Step (6), when the human-  
body detection signal  $R_3$  is inputted to the command  
10 circuit 11 before the command circuit 11 receives  
the detection signal  $R_7$  issued from the pulse-interval  
checking circuit 16, the contents of the stroke-  
confirming register 15 are compared in the third  
comparator  $24_3$  with the contents of the stroke register  
15 18. As a result, when the contents of the stroke-  
confirming register 15 are larger than those of the  
stroke register 18, the contents of the stroke register  
18 are replaced with those of the stroke-confirming  
register 15 as described above, while the opening-  
20 deceleration point and the closing-deceleration point  
are recalculated to produce a new opening-deceleration  
point and a new closing-deceleration point which  
are established in the opening-deceleration-point  
setting unit  $20_1$  and the closing-deceleration-point  
25 setting unit  $20_2$ , respectively, on the basis of which

1 new deceleration points, the door 4 conducts its  
normal opening/closing operation as described above.

A flowchart of the above operation is shown  
in Fig. 6.

5 The effect of the present invention resides  
in the following:

In case that the door 4 travels a distance  
more than the minimum door stroke in its opening  
operation or closing operation at a time when the  
10 power-supply switch 10 is turned on, the door 4 can  
conduct its following normal opening/closing operation  
to make it unnecessary to confirm both the opening-  
stop point and the closing-stop point in contrast  
with the conventional method. In addition, even when  
15 a plurality of the human-body detection signals  $R_3$   
are inputted to the command circuit 11 at short-  
time intervals after the power-supply switch 10 is  
turned on, it is possible that the door 4 conducts  
its normal opening/closing operation after a first  
20 human-body detection signal  $R_3$  is inputted to the  
command circuit 11. Consequently, the method of the  
present invention enables the door 4 to conduct its  
normal opening/closing operation within a short time  
after the power-supply switch 10 is turned on. This  
25 is the effect of the method of the present invention.



1     CLAIMS:-

1.           A method for controlling an automatic door system in a turning-on time of its power-supply switch, wherein the improvement resides in that: after said power-supply switch is turned on, a door of said automatic door system conducts its low-speed opening/closing operation when a first human-body detection signal is inputted to said automatic door system; and then, in case that said door travels a door stroke more than a predetermined minimum door stroke in said low-speed opening/closing operation, said door (4) conducts its normal opening/closing operation after completion of its traveling said predetermined minimum door stroke.
2.           An automatic door system comprising means for controlling the system in a turning-on time of its power-supply switch, including means to cause a door of said automatic door system to conduct its low-speed opening/closing operation when a first human-body detection signal is inputted to said automatic door system after said power-supply switch is turned on, and then, in case that said door travels a door stroke more than a predetermined minimum door stroke in said low-speed opening/closing operation, to cause said door to conduct its normal opening/closing operation after completion of its traveling said predetermined minimum door stroke.