(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 678 434 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95108526.5**

(51) Int. Cl.[6]: **B61D 27/00**

(22) Date of filing: **31.10.88**

This application was filed on 02 - 06 - 1995 as a divisional application to the application mentioned under INID code 60.

(30) Priority: **02.11.87 JP 275761/87**
25.12.87 JP 327034/87
18.11.87 JP 175091/87 U

(43) Date of publication of application:
25.10.95 Bulletin 95/43

(60) Publication number of the earlier application in accordance with Art.76 EPC: **0 523 752**

(84) Designated Contracting States:
DE FR GB IT

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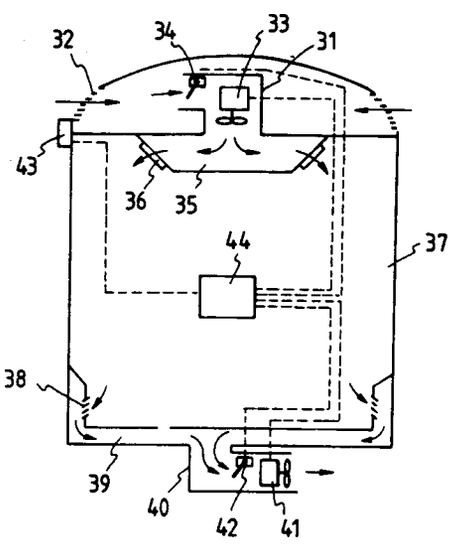
(54) Ventilating method and equipment for rolling stock.

(57) In the ventilating method for rolling stock a gradient of change in the pressure of air flowing in air flowpassages communicating between the inside of a vehicle and the outside of the vehicle is obtained and both flowpassages for drawing air from the outside of the vehicle into the inside of the vehicle (31), and for exhausting air from the inside of the vehicle to the outside of the vehicle (40), are closed when said gradient is equal to or higher than a predetermined value or said pressure is that in the outside of the vehicle.

FIG. 7



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BACKGROUND OF THE INVENTION

FIELD OF THE ART

The present invention relates to a ventilating method and a ventilating equipment for rolling stock, and more particularly to a ventilating method and an equipment for rolling stock suitable for rolling stock vehicles which run a tunnel at high speed.

DESCRIPTION OF THE PRIOR ART

When rolling stock pass through the tunnel at high speed, the pressure around the vehicles rapidly changes. Particularly, when the vehicles pass each other within the tunnel, the change in pressure around the vehicles becomes maximum. When the pressure around the vehicles changes in a manner as described, a change in pressure is transmitted to the interior of the vehicles. Such a change in pressure brings forth an uncomfortable feeling to passengers and the like. To clear such a problem, Japanese Utility Model Publication No. 28166/1978 and the like have been known. That is, a ventilating equipment disclosed in said patent comprises an air supply means for supplying outside air into the air-tight vehicle and an exhaust means for discharging the contaminated air from the interior of the vehicle to the exterior. A blower constituting the aforesaid air supply means and exhaust means has the performance in which the flow quantity is less changed with respect to the change in pressure outside vehicles. Further, Japanese Patent Publication No. 9022/1983 has been known to disclose an arrangement how a change in interior pressure of the rolling stock vehicles is regulated. A ventilating equipment disclosed in said patent comprises an air supply means for supplying the outside air into the air-tight vehicle and an exhaust means for discharging contaminated air from the interior of the air-tight vehicle, wherein the amount of air from the air supply means and exhaust means, respectively, is controlled by a temperature difference between the interior and exterior of the vehicle.

SUMMARY OF THE INVENTION

In Japanese Utility Model Publication No. 28166/1987 (corresponding to U.S. Patent No. 3,563,155), since each of blowers for the air supply means and exhaust means, respectively, is driven under the high output condition, noises or power consumption increases. In addition, the blower itself becomes large in size, causing a problem in that a large installation space is required.

On the other hand, in Japanese Patent Publication No. 9022/1983, no consideration is taken into a variation in pressure around the vehicles when the rolling stock run the tunnel.

It is an object of the present invention to provide a ventilating method and a ventilating equipment for rolling stock which can regulate a change in pressure within the vehicle resulting from a sudden change in pressure outside the vehicle and simplify the construction of the ventilating equipment itself.

According to one ventilating method of the present invention, a gradient of change in the pressure of air flowing in air flowpassages communicating between the inside of a vehicle and the outside of the vehicle is obtained and both flowpassages for drawing air from the outside of the vehicle into the inside of the vehicle, and for exhausting air from the inside of the vehicle to the outside of the vehicle, are closed when said gradient is equal to or higher than a predetermined value.

According to another ventilation method of the present invention, a gradient of change and an absolute value in the pressure of air flowing in air flowpassages communicating between the inside of a vehicle and the outside of the vehicle are obtained, both flowpassages for drawing air from the outside of the vehicle into the inside of the vehicle, and for exhausting air from the inside of the vehicle to the outside of the vehicle, are closed in each cases that said gradient is equal to or higher than a predetermined value and that said absolute value is equal to or higher than a predetermined value.

Preferably, said pressure is that in the outside of the vehicle.

According to the present invention, there is also provided a ventilating equipment for rolling stock comprising an air supply means for drawing air from the outside of a vehicle into the inside of a vehicle and an exhaust means for exhausting air from the inside of the vehicle to the outsied of the vehicle, said ventilating equipment further comprising damper means arranged on an air supply passage of said air supply means, damper means arranged on an air exhaust passage of said exhaust means, pressure detecting means for detecting the pressure of air flowing through said supply means and said exhaust means and a controller obtaining a change in pressure of the detected values by inputting detected values of said detecting means, and outputting a closing signal to each of said damper means when a gradient of

said change is equal to or higher than a predetermined value.

Another ventilating equipment for rolling stock of the present invention comprises an air supply means for drawing air from the outside of a vehicle into the inside of a vehicle and an exhaust means for exhausting air from the inside of the vehicle to the outside of the vehicle, damper means arranged on an air supply passage of said air supply means, damper means arranged on an air exhaust passage of said exhaust means, pressure detecting means for detecting the pressure of air flowing through said air supply means and said exhaust means, a controller outputting a closing signal to each of said damper means on the basis of the detected value from said pressure detecting means, wherein said controller outputs the closing signal to each of said damper means in the cases that a detected value from said pressure detecting means is equal to or higher than a predetermined value and that a gradient of change in pressure of said detected value is equal to or higher than a predetermined value.

Other objects of the present invention and the mode of embodiments thereof will be apparent from the ensuring description of the embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 schematically shows one embodiment of a ventilating equipment for rolling stock.

Figs. 2, 3 and 4 are respectively perspective views showing the operating state of an air flowpassage adjustable means of Fig. 1.

Fig. 5 is a front view showing another embodiment of a flexible plate.

Fig. 6 is a sectional view of a part taken on line VI-VI of Fig. 5.

Fig. 7 schematically shows another embodiment of a ventilating equipment for rolling stock according to the present invention.

Fig. 8 is a graph showing the relationship between air quantity Q and static pressure P in the blower shown in Fig. 7.

Fig. 9 is a graph showing an uncomfortable region A with respect to the gradient dP/dt in change of pressure outside vehicle and the amount of change in pressure Px.

Fig. 10 is a graph showing the change of the pressure outside vehicle Pout and the pressure inside vehicle Pin.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

One embodiment of the ventilating equipment for rolling stock according to the present invention will now be described with reference to Figs. 1, 2, 3 and 4. In these Figures, reference numeral 1 designates an air supply equipment provided on the roof of the vehicle to drawn air outside the vehicle into the interior of the vehicle. Reference numeral 2 designates an outside-air in take grille formed on the roof of the vehicle, the air outside the vehicle is taken by the air supply equipment from the outside-air in take grille 2. Reference numeral 3 designates a blower which is an essential part constituting the air supply equipment 1. Reference numeral 4 designates an air flowpassage adjustable means on the air-supply side inscalled upstream from the blower 3 in the air flowpassage into which air outside the vehicle is taken. The detail construction of the air flowpassage adjustable means 4 will be described later. Reference numeral 5 designates a duct for introducing the air outside the vehicle taken into the interior of the vehicle by the air supply equipment 1 into the vehicle. The duct 5 is provided with a number of diffusers 6 for distributing air. The duct is mainly installed lengthwise of a ceiling portion of a passanger compartment 7. Reference numeral 10 designates an exhaust air equipment for discharging contaminated air within the passanger compartment 7 outside the vehicle. Reference numeral 9 designates an exhaust air duct for dischanging the contaminated air within the passenger compartment 7 to the exhaust air equipment 10. Reference numeral 8 designates an exhaust air grille mounted on an open portion within the passenger compartment 7 of the exhaust duct 9. Reference numeral 11 designates a blower which is an essential part which constitutes the exhaust air equipment 10. Reference numeral 12 designates an air flowpassage adjustable means on the exhaust side installed downstream from the blower 11 on the air flowpassage for discharging the contaminated air within the vehicle outside the vehicle. This air flowpassage adjustable means will be described in detail later.

The aforementioned air flow passage adjustable means 4 and 12 will be described in their construction.

Reference numerals 20a and 20b designate flexible plates each having one end secured to the wall surface of an air flowpassage and the other being a free end which can freely swing. The flexible plates 20a and 20b are arranged at the right angle with respect to the air flowing direction. The shape of the flexible plates 20a and 20b coincides with the sectional shape of the air flowpassage and a swingable clearance is

provided in the outer periphery to form a shape which blocks the air flowpassage. The flexible plates 20a and 20b are arranged alternately so that respective fixed ends are positioned on the opposite ends. Between the flexible plates 20a and 20b is provided a air flow path so that when the flexible plate 20a or 20b is deflected to the greatest extent, the free end thereof contact with the other flexible plate 20b or 20a. A stopper 21a is provided upstream of the air flowpassage of the flexible plate 20a, and a stopper 21b is provided downstream of the air flowpassage of the flexible plate 20b. The stopper 21a supports the flexible plate 20a so that the flexible plate 20a will not deflect toward the upstream of the air flowpassage from the position at the right angle to the air flowing direction. The stopper 21b supports the flexible plate 20b so that the flexible plate 20b will not deflect toward the downstream of the air flowing passage from the position at the right angle to the air flowing direction. Incidentally, the flexible plate 20a has a rigidity by which the plate is not deflected when the normal air flow, as indicated by the dotted lines arrow in Figs. 2, 3 and 4, and has a rigidity by which when the air flow increases more than that of the normal state and the air flow indicated by the solid line arrow in Fig. 3 impinges upon the plate, the plate is deflected. On the other hand, the flexible plate 20b is lower in the rigidity than the flexible plate 20a, and has the rigidity to the extend that the flexible plate 20b is deflected a reverse flow of air as indicated by the solid line arrow in Fig. 4 occurs. Reference numeral 22a designates a guide plate provided upstream of the air flowpassage of the flexible plate 20a. The guide plate 22a has the size corresponding to the whole surface of the flexible plate 20a to prevent the air flow from directly applying the flexible plate 20a. The guide plate 22a has a curved shape for smoothly guiding the air flow. Reference numeral 22b designates a guide plate provided downstream of the air flowpassage of the flexible plate 20b. The guide plate 22b has the size corresponding to the whole surface of the flexible plate 20b to prevent the air flow from directly applying the flexible plate 20b in case of reverse air flow.

The function of the air flowpassage adjustable means 4 and 12 will be described hereinafter with reference to Figs. 2, 3 and 4.

Fig. 2 shows the normal ventilating state of the air flowpassage adjustable means. Both the flexible plates 20a and 20b stay still at the right angle to the air flow direction under the normal ventilating state. When two vehicles pass each other during the running of the vehicles in the tunnel, pressure outside the vehicles suddenly changes as indicated by C and D in Fig. 10. The state shown at C in Fig. 10 shows the state that the pressure outside the vehicles suddenly increases. The function of the air flowpassage adjustable means 4 under this state will be described with reference to Fig. 3. When the pressure outside the vehicles suddenly increases an described above as indicated by the solid line arrow, a pressure difference between upstream and downstream of the air flowpassage of the flexible plate 20a exceeds the rigidity of the flexible plate 20a due to the change in pressure, and therefore the flexible plate 20a deflects toward the flexible plate 20b. The area of the air flowpassage is narrowed by of the flexible plate 20a to regulate the function of the pressure outside vehicle into the vehicle. If the change in pressure outside vehicle is large, the flexible plate 20a is greatly deflected toward the flexible plate 20b to shut off air flowpassage. At that time, the change of the pressure outside vehicle will not be transmitted into the vehicle, and air outside vehicle will not be supplied into the vehicle. The air flowpassage is shut off by the flexible plate 20a, thus the ventilation of the vehicle is not dore. However, the time when the vehicles pass each other within the tunnel and the duration of the change of pressure outside vehicles is only a few seconds. Accordingly, even if the air outside vehicles is not supplied into the vehicle, there occurs no problem.

The function of the air flowpassage adjustable 4 when the pressure outside vehicles suddenly drops as indicated as D in Fig. 10 will be described with reference to Fig. 4. When the change in pressure on the negative pressure side is transmitted between the flexible plate 20a and the flexible plate 20b as indicated by the solid line arrow in Fig. 4, the air in the air flowpassage is reversed by the large change in pressure. The flexible plate 20b is deflected toward the flexible plate 20a as the result that the pressure on the side of the flexible plate 20a is lower. The area of the air flowpassage can be narrowed as the result that the flexible plate 20b deflects. Accordingly, the transmission of the pressure outside vehicle into the vehicle can be regulated. If the change in pressure outside vehicle is large, the flexible plate 20b shuts off the air flowpassage. At this time, a supply of air outside vehicle stops, which brings no problem because such duration of such a phenomenon is in a short period of time.

The operating condition when the pressure outside vehicle of the air flowpassage adjustable means increases, corresponds to that shown in Fig. 3. The operating condition, when the pressure outside vehicle of the air flowpassage adjustable means 12 decreases, corresponds to that shown in Fig. 4.

When the change in pressure outside vehicle suddenly occurs whereby said pressure change is directly transmitted to the flexible plate 20a or 20b, the flexible plate 20a or 20b suddenly deflects. At this time, the amount of deflection of the flexible plate 20a or 20b possibly exceeds a specified value. When the amount of deflection exceeds a specified value, self-excitation oscillations may occur on the flexible plate 20a or

20b. Guide plates 22a and 22b are provided to prevent the self-excitation oscillations of the flexible plates 20a and 20b. By the provision of the guide plates 22a and 22b, the change in pressure outside vehicle will not directly apply on the flexible plates 20a and 20b. Accordingly, the self-excitation oscillations can be prevented because the flexible plates 20a and 20b can not deflect more than a specified value.

According to the arrangement as described above, when the sudden change in pressure outside vehicle occurs, the flexible plates 20a and 20b of the air flowpassage adjustable means 4 or 12 are deflected to narrow the area of the air flowpassage. If the pressure change is large, the air flowpassage is shut off. The air flowpassage is narrowed or shut off in this manner whereby the transmission of the change in pressure outside vehicle into the vehicle or the passanger compartment 7 can be prevented. Thus, the uncomfortableness to the passengers resulting from the change in pressure outside vehicle can be prevented.

Next, the flexible plate 20b has lower rigidity than the flexible plate 20a. That is, the flexible plate 20b is not deflected in the normal operating state since it is supported by the stopper 21b. However, when a reverse flow occurs in the air flowpassage as shown by the solid line arrow in Fig. 4, it is necessary to quickly narrow the area of the air flowpassage. Thus, the flexible plate 20b is formed to have a low rigidity so that incase a reverse flow occurs in the air flowpassage, the area of the air flowpassage can be rapidly narrowed. The reverse flow of air in the air flowpassage of the air supply equipment 3 and exhaust air equipment 10 causes the pressure in the vehicle to change rapidly. It is therefore particularly effective that when the reverse flow occurs, the area of the air flowpassage is rapidly narrowed.

Next, the guide plates 22a and 22b can prevent a deflection in excess of a specified value of the flexible plates 20a and 20b. Accordingly, by installation of the guide plates 22a and 22b corresponding to the flexible plates 20a and 20b as previously mentioned, the self-excitation oscillations of the flexible plates 20a and 20b can be prevented.

Another embodiment of the flexible plates 20a and 20b will be described hereinafter with reference to Figs. 5 and 6. Reference numeral 20c designates a flexible plate in which flaps 23 are mounted on both ends. The flaps 23 are mounted on the flexible plate 20c by supports 24 such as rivets, screws or the like. The flaps are in contact with the inner wall Of the air flowpassage. Accordingly, by the deflection of the flexible plate 20c, the resistance due to the friction occurs between the flap 23 and the inner wall of the air flowpassage. The self-excitation oscillations of the flexible plate 20c can be prevented by the resistance. If the flaps 23 are provided on the flexible plate, said guide plates 22a and 22b need not be provided.

The contact force of the flaps 23 on the inner wall of the air flowpassage or the rigidity and width of the flaps themselves can be freely adjusted by the rigidity of the flexible plate 20c or the maximum value of the change in pressure outside vehicle.

Next, another embodiment of the ventilating equipment for rolling stock according to the present invention will be described with reference to Figs. 7, 8, 9 and 10. In these Figures, reference numeral 31 designates an air supply equipment for taking air outside vehicles into the vehicle. Reference numeral 32 designates an outside-air intake grille mounted on the opening of the roof. Reference numeral 33 designates a blower constituting said air supply equipment 31. The blower 33 has the performance in which the flow quantity is less changed with respect to the variation in pressure outside vehicles. The performance of the blower 33 can be controlled stepwise. The lowest performance among the performance of the blower 33 is the performance which can supply the flow quantity as required into the vehicle under the normal operating condition. Reference numeral 34 designates a damper provided upstream from the blower 33 of the air flowpassage taking air outside vehicles into the vehicle. This damper can change an area of the air flowpassage installed. In other words, the damper 34 can change the resistance R of the air flowpassage. Reference numeral 35 designates a duct, which has the function similar to that of the duct 5 in the previous embodiment. Reference numeral 36 designates a diffusers provided in the duct 35. Reference numeral 37 designates a passenger compartment. Reference numeral 40 designates an exhaust air equipment for exhausting contaminated air within the vehicle outside the vehicle. Reference numeral 39 designates an exhaust duct for feeding contaminated air within the passanger compartment 37 toward the exhaust device 40. The exhaust duct 39 has the function similar to the exhaust duct 9 in the previous embodiment. Reference numeral 38 designates a grille mounted on the open portion within the passenger compartment 37. Reference numeral 41 designates a blower constituting an exhaust device 40. The blower 41 has the function similar to that of the previous blower 33. Reference numeral 42 designates a damper installed upstream of the blower 41 of the air flowpassage for exhausting contaminated air within the vehicle outside the vehicle. This damper 42 can change an area of the air flowpassage. In other words, the damper 42 can change the resistance R of the air flowpassage.

The blowers 33 and 41 have the performance the solid lines P1-Q1, P2-Q2 and P3-Q3. The performance of the blowers 33 and 41 may be adjusted by varying the number of revolutions thereof. The dampers 34 and 42 have the resistance characteristics of the dotted lines R1, R2 and R3 in Fig. 8. The

dampers 34 and 42 are controlled to provide different of resistance characteristic.

Reference numeral 43 designates a pressure detector for detecting pressure outside vehicles. Reference numeral 44 designates a controller for controlling the blowers 33 and 41, the dampers 34 and 42 using, as the control inputs, the detected results which are sent from the pressure detector 43. The controller 44 calculates and judges the results of pressure detection obtained from the pressure detector 43, switches the performance of the blowers 33 and 41 and switches the resistance characteristics of the dampers 34 and 42.

When the vehicles run at a speed of 200 km/hr, for example, and pass each other in the tunnel, the pressure outside the vehicle changes as shown by the curve P_{out} in Fig. 10. That is, in the stage before the vehicles pass each other, the pressure outside the vehicles increases up to 198 mm Aq at the maximum. On the other hand, after the vehicles pass each other, the pressure outside the vehicles suddenly lowers down to -491 mm Aq.

In Fig. 10, the axis of abscissa represents time passage t (min), and the axis of ordinate represents pressure P (mm Aq).

Fig. 9 shows the uncomfortableness region A in which passengers within the vehicle feed the uncomfortableness with respect to the absolute value Px of the change in pressure outside the vehicles and the variation gradient dP/dt in change of the pressure outside the vehicles. In Fig. 9, the axis of abscissa represents the absolute value Px of the change in pressure outside the vehicles and the axis of ordinate represents the gradient dP/dt in change of the pressure outside the vehicles. The hatched portion in Fig. 9 is the uncomfortable region A. This uncomfortable region A is experimentally known. The cause wherein passengers in the vehicle running at high speeds feel uncomfortable is the absolute value Px of the change in pressure outside the vehicles and the gradient dP/dt in change of the pressure outside the vehicles.

In such an arrangement as described above, controls of the blowers 33, 41 and dampers 34, 42 by the controller 44 will be described hereinafter.

When the vehicles run into the tunnel at high speed and pass each other, the pressure outside the vehicles change as shown by P_{out} in Fig. 10. The pressure outside the vehicles at that time are continuously detected by the pressure detector 43 to output the detection results to the controller 44. The controller 44 calculates and obtains the gradient dP/dt in change of the pressure outside the vehicles and the absolute value Px of the change in pressure outside the vehicles on the basis of the detected results which are sent from the pressure detector 43. The performance of the blowers 33 and 41 and the resistance characteristics of the dampers 34 and 42 given in Table 1 below are selected from values of dP/dt and Px obtained by the controller 8.

Table 1 Gradient in Change of Outside Pressure dP/dt (mmAq/sec)

Outside pressure Px (mm Aq)	0	10	20	30	40	50
0	P_3-Q_3 R_1	P_3-Q_3 R_2	P_3-Q_3 R_2	P_3-Q_3 R_3	Shut off	Shut off
100	P_3-Q_3 R_1	P_3-Q_3 R_2	P_3-Q_3 R_2	P_3-Q_3 R_3	Shut off	Shut off
200	P_2-Q_2 R_1	P_2-Q_2 R_2	P_2-Q_2 R_2	P_2-Q_2 R_3	Shut off	Shut off
300	P_1-Q_1 R_1	P_1-Q_1 R_2	P_1-Q_1 R_2	P_1-Q_1 R_3	Shut off	Shut off
400	Shut off	Shut off	Shut off	Shut off	Shut off	Shut off
500						

The controller 44 outputs, as the control outputs, the results calculated and judged as mentioned above to the blowers 33, 41 and dampers 34, 42. The blowers 33, 41 and dampers 34, 42 are operated by the control output from the controller 44. For example, where the pressure outside the vehicles is changed as shown in Fig. a change in the maximum pressure P_{max} occurs in a short period of time. Accordingly, the absolute value Px of the change in pressure and the gradient dP/dt in change of the pressure increase in value. If the absolute value Px of the change in pressure is less than the maximum pressure, for example, 400 mm Aq, of the blowers 33 and 41, the operation is made with the performance of blowers 33 and 41 in the range of minimum P3-Q3 to maximum P1-Q1. On the other hand, if the gradient in change of pressure dP/dt is less than the limit at which passengers feel uncomfortable, for example, 40 mm Aq/sec., the dampers 34 and 42 are controlled in the range from R_1 at which the resistance is minimum to R_3 at which the resistance is maximum. In this manner, the blowers 33 and 41 are controlled by the controller 44 to enhance the pressure characteristic of the blowers 33 and 41 as the absolute value Px of the change in pressure outside the vehicles increases, whereby the change in flow quantity resulting from the change in pressure outside the vehicles can be reduced. Also, the operation is made so that the resistance of the dampers 34 and 42 increases as the dampers 34 and 42 of the controller 44 are controlled and the gradient dP/dt in change of the pressure outside the vehicles increases. The dampers 34 and 42 are closed as the

gradient dP/dt in change of pressure outside the vehicles increases, the propagation of the pressure outside the vehicles into the vehicle can be regulated. In this manner, the change in flow quantity of the blowers 33 and resulting from the change in pressure outside the vehicles can be regulated and the transmission of the pressure outside the vehicles into the vehicle can be regulated, and therefore, the variation is pressure within the vehicle can be regulated at minimum.

If the gradient dP/dt in change of the pressure outside the vehicles exceeds the value at which passengers feel uncomfortable, for example, 40 mm Aq/sec., the dampers 34 and 42 are completely closed. Also, if the absolute value Px of the change in pressure outside the vehicles exceeds the maximum pressure of the blowers 33 and 41, for example, 400 mm Aq, the dampers 34 and 42 are completely closed. Where the change in pressure outside the vehicles is extremely large, the vehicle is completely closed. The state wherein the pressure outside the vehicles is changed largely as described above is for a snort period of time, causing no problem in securing the exhaust an quantity.

In the present embodiment, if the absolute value Px of the change in pressure outside the vehicles and the variation gradient dP/dt in change of the pressure outside the vehicles are within the uncomfortable region A, ventilation is continuously carried out. At this time, the performance of the blowers 33 and 41 are controlled to minimize the influence of the change in pressure outside the vehicles to the interior of the vehicle. Further, the resistance of the dampers 34 and 42 are controlled. Accordingly, in the present embodiment, it is possible to minimize the influence of the change in pressure outside the vehicles to the passengers while continuously carrying out the ventilation. Furthermore, in the present embodiment, where the absolute value Px of change in pressure outside the vehicles and the gradient dP/dt in change of the pressure outside the vehicles fall to the uncomfortable region A, the vehicle is closed, and therefore, it is possible to minimize the influence of the change in pressure outside the vehicles to the passengers can be eliminated.

As described above, in the present invention, it is possible to regulate the change in pressure within the vehicle resulting from the variation in pressure outside the vehicles. Accordingly, the uncomfortable condition will not occur to the passengers.

Claims

1. A ventilating method for rolling stock,
characterized in that said method comprises the steps of:
obtaining a gradient of change in the pressure of air flowing in air flowpassages communicating between the inside of a vehicle and the outside of the vehicle, and
closing both flowpassages for drawing air from the outside of the vehicle into the inside of the vehicle, and for exhausting air from the inside of the vehicle to the outside of the vehicle, when said gradient is equal to or higher than a predetermined value.

2. A ventilating method according to claim 1, characterized in that said pressure is that in the outside of the vehicle.

3. A ventilating method for rolling stock,
characterized in that said method comprises the steps of:
obtaining a gradient of change and an absolute value in the pressure of air flowing in air flowpassages communicating between the inside of a vehicle and the outside of the vehicle, and
closing both flowpassages for drawing air from the outside of the vehicle into the inside of the vehicle, and for exhausting air from the inside of the vehicle to the outside of the vehicle, in each of cases that said gradient is equal to or higher than a predetermined value and that said absolute value is equal to or higher than a predetermined value.

4. A ventilating method according to claim 3, characterized in that said pressure is that in the outside of the vehicle.

5. A ventilating equipment for rolling stock comprising an air supply means (31) for drawing air from the outside of a vehicle into the inside of a vehicle and an exhaust means (40) for exhausting air from the inside of the vehicle to the outside of the vehicle,
characterized in that said ventilating equipment further comprises:
damper means (34) arranged on an air supply passage of said air supply means (31);
damper means (42) arranged on an air exhaust passage of said exhaust means (40);

pressure detecting means (43) for detecting the pressure of air flowing through said air supply means (31) and said exhaust means (40); and

a controller (44) obtaining a change in pressure of the detected values by inputting detected values of said detecting means (43), and outputting a closing signal to each of said damper means (34, 42) when a gradient of said change is equal to or higher than a predetermined value.

6. A ventilating equipment according to claim 5, characterized in that said pressure detecting means (43) detects the pressure in the outside of the vehicle.

7. A ventilating equipment for rolling stock comprising an air supply means (31) for drawing air from the outside of a vehicle into the inside of a vehicle and an exhaust means (40) for exhausting air from the inside of the vehicle to the outside of the vehicle,

characterized in that said ventilating equipment further comprises:

damper means (34) arranged on an air supply passage of said air supply means (31);

damper means (42) arranged on an air exhaust passage of said exhaust means (40);

pressure detecting means (43) for detecting the pressure of air flowing through said air supply means (31) and said exhaust means (40); and

a controller (44) outputting a closing signal to each of said damper means (34, 42) on the basis of the detected value from said pressure detecting means (43),

wherein said controller (44) outputs the closing signal to each of said damber means (34, 42) in the cases that a detected value from said pressure detecting means (43) is equal to or higher than a predetermined value and that a gradient of change in pressure of said detected value is equal to or higher than a predetermined value.

8. A ventilating equipment according to claim 7, characterized in that said pressure detecting means (43) detects the pressure in the outside of the vehicle.

FIG. 1

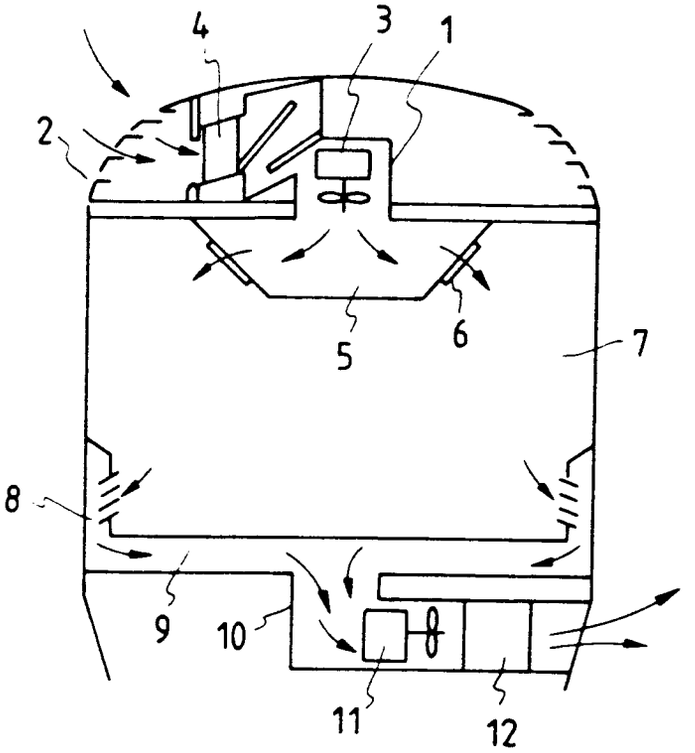


FIG. 5

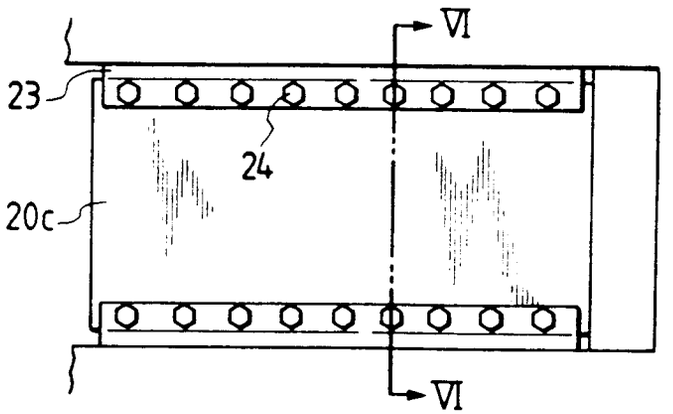


FIG. 6

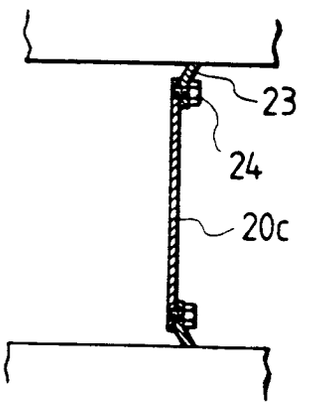


FIG. 2

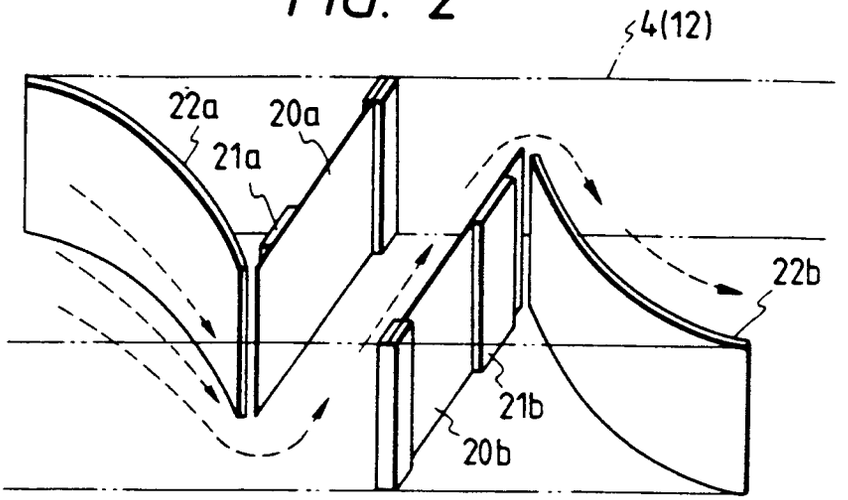


FIG. 3

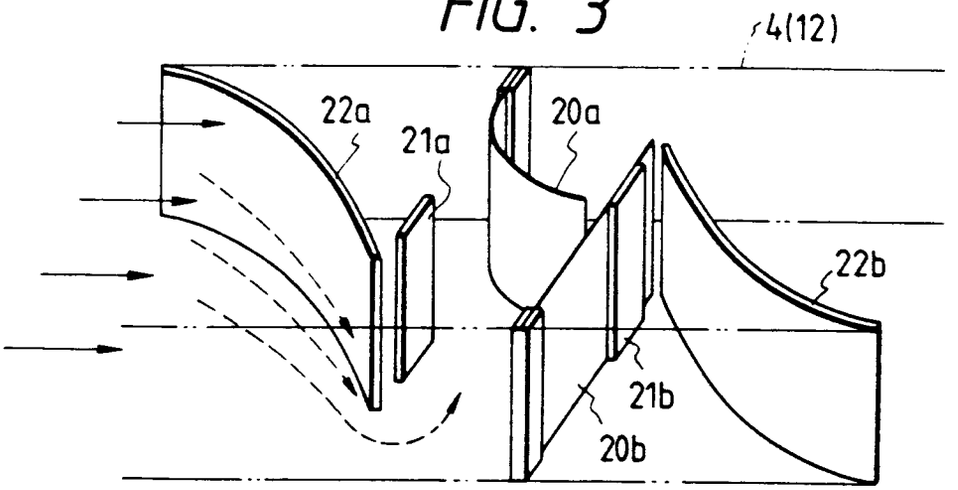


FIG. 4

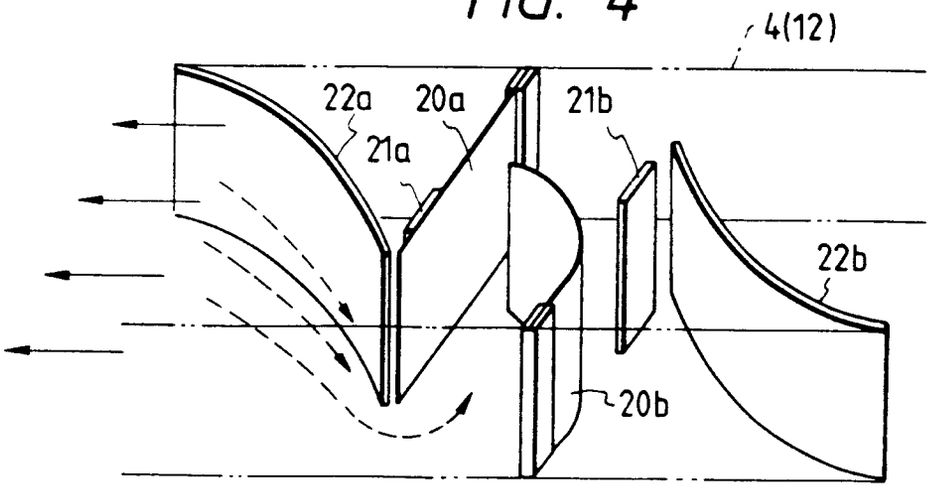


FIG. 7

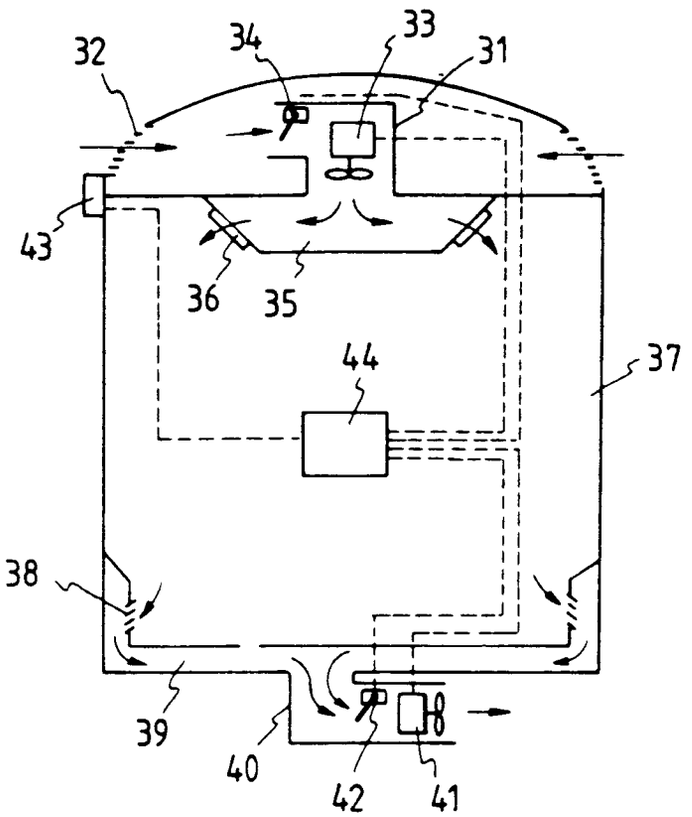

32
34
33
31
43
36
35
44
37
38
39
40
42
41

FIG. 8

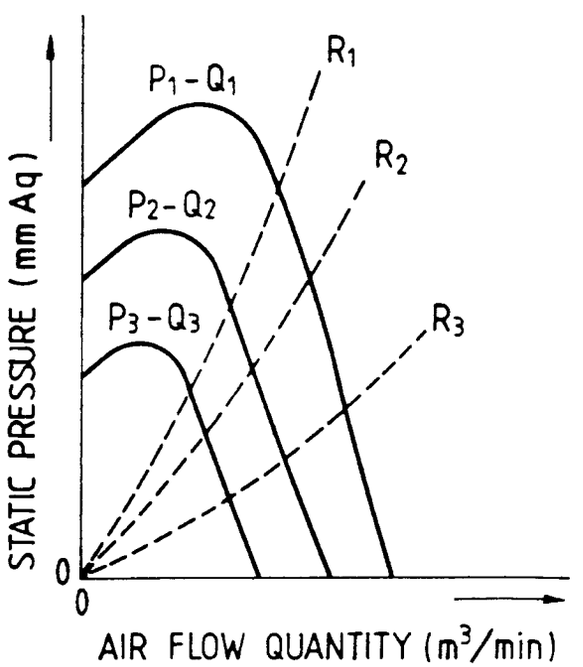

R1
P1 - Q1
R2
P2 - Q2
P3 - Q3
R3
STATIC PRESSURE (mm Aq)
0
0
AIR FLOW QUANTITY (m3/min)

FIG. 9

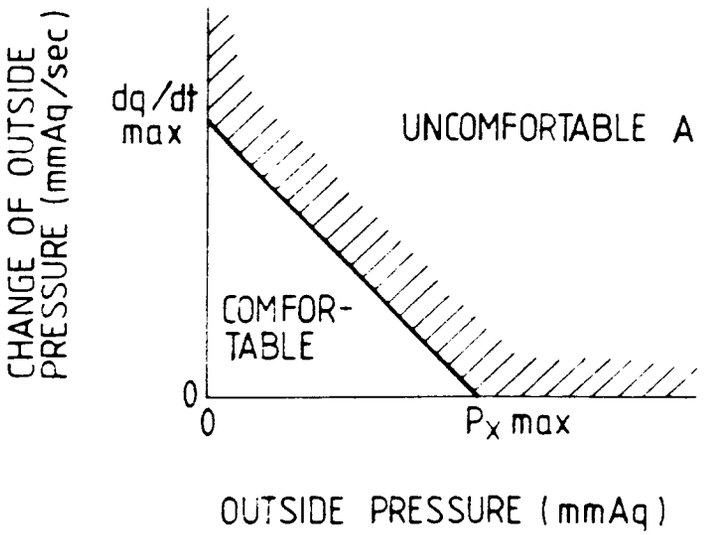
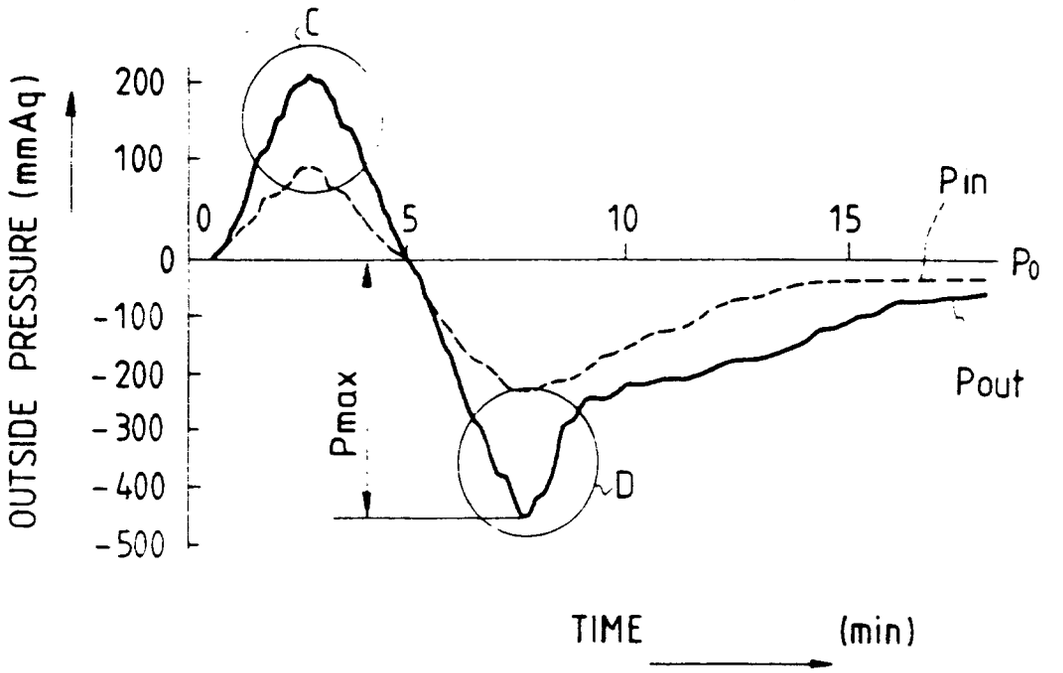

CHANGE OF OUTSIDE PRESSURE (mmAq/sec)
dq/dt max
UNCOMFORTABLE A
COMFOR-TABLE
0
0
Px max
OUTSIDE PRESSURE (mmAq)

FIG. 10


OUTSIDE PRESSURE (mmAq)
200
100
0
-100
-200
-300
-400
-500
C
0
5
10
15
Pin
Po
Pout
Pmax
D
TIME
(min)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 10 8526

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.4)
Y	EP-A-0 143 931 (MESSERSCHMITT-BÖLKOW-BLOHM G.M.B.H.) * page 3, last line - page 4, line 4 *	1,2,5,6	B61D27/00
P,Y	EP-A-0 253 979 (R. HERMA) * column 1, line 31 - line 40 *	1,2,5,6	
A	EP-A-0 234 297 (BROWN, BOVERI & CIE AG) * page 4, line 13 - line 20 *	3,4,7,8	
A	DE-A-19 17 999 (DAIMLER-BENZ AG) * claim 1 *	3,7	
E	EP-A-0 579 536 (GEC ALSTHOM TRANSPORT SA) * abstract; figures *		

TECHNICAL FIELDS SEARCHED (Int.Cl.4)
B61D B60H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 August 1995	Marangoni, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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