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(54) RAIL VEHICLE AND RAIL VEHICLE VENTILATION DEVICE THEREFOR

(57) Disclosed is a rail vehicle ventilation device, comprising an air inlet drum. Two side faces of the air inlet drum are provided with a first air port (1) and a second air port (9), a top portion of the air inlet drum is provided with a top air port (10), and a bottom portion of the air inlet drum is provided with an air outlet (11), wherein the first air port is arranged opposite the second air port, and in a free state, the top air port, the first air port, the second air port and the air outlet communicate with one another. A first flow guide plate (3), a second flow guide plate (7), and a connecting rod (4) hinged between the first flow guide plate and the second flow guide plate are arranged in the air inlet drum, wherein a top portion of the first flow guide plate is hinged to a position, located above the first air port, on the air inlet drum; a top portion of the second flow guide plate is hinged to a position, located above the second air port, on the air inlet drum; the first flow guide plate and the second flow guide plate constitute a trapezoid connecting rod structure by means of the connecting rod, and an upper end of the connecting rod structure is a large-diameter end; and the second flow guide plate can swing to a state where the second air port is sealed. Further disclosed is a rail vehicle comprising the ventilation device. According to the ventilation device, the angle between a flow guide plate and a corresponding air port is automatically adjusted according to a change in vehicle speed, and a ventilation quantity can be ensured when a vehicle operates at a high speed.

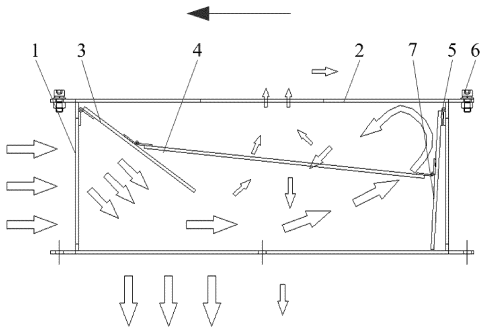

Fig. 2

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Description

[0001] The present application claims the priority to Chinese Patent Application No. 201811277387.X, titled "RAIL VEHICLE AND RAIL VEHICLE VENTILATION DEVICE THEREFOR", filed with the China National Intellectual Property Administration on October 30, 2018, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present application relates to the technical field of ventilation design for rail vehicles, and in particular to a rail vehicle ventilation device, and further relates to a rail vehicle.

BACKGROUND

[0003] At present, an air inlet device of a rail vehicle ventilator is generally mounted on a surface of a rail vehicle, such as a roof, a side wall or a side suspension beam. The air inlet surface at the ventilator is in negative pressure area.

[0004] When a rail vehicle is running, there is a negative pressure difference between an air inlet and an outlet of a ventilation branch. With the increasing of vehicle speed, the negative pressure value of the air inlet surface at the ventilator may continue to increase, resulting in a decrease of the ventilation volume. If the vehicle speed reaches a certain level, the negative pressure difference between the air inlet and outlet may be greater than or equal to the ventilator pressure value, and at this time, the ventilation volume is zero. Further, the unstable air volume in the ventilation branch may directly affect the working state of the components needing ventilation and cooling in rail vehicles.

[0005] Therefore, a technical issue to be addressed by those skilled in the art is to solve the problem that the ventilator cannot take in air when the vehicle is at a high speed.

SUMMARY

[0006] In view of this, an object of the present application is to provide a rail vehicle ventilation device, which can adjust the ventilation volume to adapt to the vehicle speed, and the ventilation volume can also be ensured when the vehicle is running at high speed. Another object of the present application is to provide a rail vehicle including the above rail vehicle ventilation device, and its ventilation device can adjust the ventilation volume to adapt to the vehicle speed, and the ventilation volume can also be ensured when the vehicle is running at high speed.

[0007] To achieve the above object, the present application provides the following technical solutions:

a rail vehicle ventilation device includes an air inlet duct, and a first airport and a second airport are respectively provided at two sides of the air inlet duct, the first airport is arranged opposite to the second airport, a top of the air inlet duct is provided with a top airport and a bottom is provided with an air outlet. In a free state, the top airport, the first airport, the second airport and the air outlet are in communication; a first guide plate, a second guide plate, and, a connecting rod hinged between the first guide plate and the second guide plate are arranged in the air inlet duct. A top of the first guide plate is hinged to the air inlet duct at a position above the first airport, and the top of the second guide plate is hinged to the air inlet duct at a position above the second airport. The first guide plate and the second guide plate are connected by the connecting rod to form a trapezoidal connecting rod structure, and the upper end is a large diameter end. The second guide plate can swing to a state of sealing the second airport.

[0008] Preferably, the first guide plate can swing to a state of sealing the first airport.

[0009] Preferably, the connecting rod structure is a symmetrical structure in the free state, and the first airport and the second airport have the same structure.

[0010] Preferably, the top airport, the first airport and the second airport are each provided with a protective net.

[0011] Preferably, at least two connecting rods are connected between the first guide plate and the second guide plate, and all the connecting rods are arranged in parallel.

[0012] Preferably, the top plate of the air inlet duct is detachably connected to the air inlet duct body, the top airport is provided on the top plate, and the top airport is provided in the middle of the top of the air inlet duct.

[0013] Preferably, the connecting rod is connected to the middle of the first guide plate and the second guide plate.

[0014] Preferably, the first guide plate and the air inlet duct, the second guide plate and the air inlet duct, the connecting rod and the first guide plate, and the connecting rod and the second guide plate are each connected by a hinge.

[0015] Preferably, the air inlet duct has a mirror symmetrical structure in a free state, and the symmetrical plane is located at the middle position of the first airport and the second airport; where, the first airport and the second airport are mirror symmetric with respect to the symmetry plane, and the first guide plate and the second guide plate are mirror symmetric with respect to the symmetry plane.

[0016] A rail vehicle includes the rail vehicle ventilation device described in any one of the above.

[0017] In the rail vehicle ventilation device provided by the present application, the trapezoidal connecting rod structure, consisting of the first guide plate, the second guide plate, and the connecting rod, is arranged to guide the wind. The connecting rod structure can adaptively adjust its own structure under the action of wind power, so as to automatically adjust the angle between the guide

plate and the corresponding airport according to the change of vehicle speed, thus achieving the purpose of basically stabilizing the ventilation volume of the air outlet, and ensuring the ventilation volume when the vehicle runs at high speed. The ventilation device is mounted at the air inlet of the ventilator in the negative pressure area of the locomotive surface, and automatically adjusts the inclination angle of the guide plate according to the running speed of the vehicle or locomotive and the air volume demand in the ventilator, which can effectively avoid that too much air volume will cause overflow of the ventilator, and avoid that the air volume is too small to meet the ventilation volume requirements of the ventilator.

[0018] According to the rail vehicle including the rail vehicle ventilation device provided by the present application, the ventilation device can adjust the ventilation volume according to the vehicle speed, and the ventilation volume can be ensured when the vehicle runs at high speed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] For more clearly illustrating embodiments of the present application or the technical solutions in the conventional technology, drawings referred to for describing the embodiments or the conventional technology will be briefly described hereinafter. Apparently, the drawings in the following description are only embodiments of the present application, and for the person skilled in the art, other drawings may be obtained based on the provided drawings without any creative efforts.

Figure 1 is a schematic diagram of a rail vehicle ventilation device provided by the present application when the vehicle is running at a low speed or in a stationary state, in which a solid arrows indicates a forward direction of the vehicle, and hollow arrows indicate a direction of wind;

Figure 2 is a schematic diagram of the rail vehicle ventilation device provided by the present application when the vehicle is running at a high speed, in which a solid arrow indicates the forward direction of the vehicle, and hollow arrows indicate the direction of wind;

Figure 3 is a top view of the rail vehicle ventilation device provided by the present application;

Figure 4 is a sectional view taken along the line A-A in Figure 3;

Figure 5 is a side view of the rail vehicle ventilation device provided by the present application;

Figure 6 is an internal top view of the rail vehicle ventilation device provided by the present application;

Figure 7 is a force analysis diagram of the first guide plate of the rail vehicle ventilation device provided by the present application, in which a solid arrow indicates the forward direction of the vehicle.

[0020] In Figures 1 to 7:

1 first airport	2 top plate
3 first guide plate	4 connecting rod
5 hinge	6 fastener
7 second guide plate	8 protective net
9 second airport	11 air outlet

DETAILED DESCRIPTION

[0021] The technical solutions according to the embodiments of the present application will be described clearly and completely as follows in conjunction with the drawings in the embodiments of the present application. It is apparent that the described embodiments are only a part of the embodiments according to the present application, rather than all of the embodiments. Based on the embodiments in the present application, all of other embodiments, made by the person skilled in the art without any creative efforts, fall into the scope of the present application.

[0022] A core of the present application is to provide a rail vehicle ventilation device, which can adjust the ventilation volume to adapt to the vehicle speed, and the ventilation volume can also be ensured when the vehicle is running at high speed. Another core of the present application is to provide a rail vehicle including the above rail vehicle ventilation device, and its ventilation device can adjust the ventilation volume to adapt to the vehicle speed, and the ventilation volume can also be ensured when the vehicle is running at high speed.

[0023] In a specific embodiment of the rail vehicle ventilation device provided by the present application, referring to Figure 3, an air inlet duct is included. A first airport 1 and a second airport 9 are respectively provided at two sides of the air inlet duct, the first airport 1 is arranged opposite to the second airport 9, the top of the air inlet duct is provided with a top airport 10 and the bottom of the air inlet duct is provided with an air outlet 11. In a free state, the top airport 10, the first airport 1, the second airport 9 and the air outlet 11 are in communication. A first guide plate 3, a second guide plate 7, and, a connecting rod 4 hinged between the first guide plate 3 and the second guide plate 7 are arranged in the air inlet duct. The connecting rod 4 is rotatable relative to the first guide plate 3 and the connecting rod 4 is rotatable relative to the second guide plate 7. The top of the first guide plate 3 is hinged to the air inlet duct at a position above the first airport 1, and the top of the second guide plate 7 is hinged to the air inlet duct at a position above the second airport 9. The first guide plate 3 and the second guide plate 7 are connected by the connecting rod 4 so as to

form a trapezoidal connecting rod structure, and an upper end is a larger diameter end. The trapezoid refers to a shape in which the top spacing of two guide plates is greater than the bottom spacing of two guide plates and the spacing gradually decreases from top to bottom, that is, the connecting rod structure is a structure in which the spacing between two guide plates gradually decreases from top to bottom. The second guide plate 7 can swing to the state of sealing the second airport 9, that is, the wind cannot circulate at the second airport 9.

[0024] The air inlet direction and air volume can be changed by the movement of the guide plates, and the connecting rod 4 can support and limit the guide plates. The first guide plate 3 can swing relative to the air inlet duct, and the second guide plate 7 can swing relative to the air inlet duct. The first guide plate 3 and the second guide plate 7 are linked through the connecting rod 4. The connecting rod structure formed by the first guide plate 3, the second guide plate 7 and the connecting rod 4 is a movable structure relative to the air inlet duct. Since the connecting rod structure is a trapezoidal structure, guide channels can be formed between the first airport 1 and the first guide plate 3, and between the second airport 9 and the second guide plate 7, so as to guide the incoming wind to the air outlet 11.

[0025] In order to control the intake air volume of the flow guide device within a certain range, the flow guide device can automatically adjust the included angle α between the two flow guide plates and the air inlet duct according to the vehicle speed, so as to achieve the purpose of adjusting the intake air volume.

[0026] Referring to Figure 1, when the vehicle runs at a low speed or in a static state, the guide plate and the connecting rod 4 automatically return to the free state by their own gravity. The top airport 10, the first airport 1, the second airport 9 and the air outlet 11 are in communication, and the wind enters the interior of the air inlet duct from all air inlet surfaces of the ventilation device, including the top airport 10, the first airport 1 and the second airport 9. Since the guide plate sags under the action of gravity, it plays a certain shielding effect on the airport.

[0027] Referring to Figure 2, when the vehicle is running at high speed, the mounting direction of the whole ventilation device is that the front and rear air inlet surface is the same as the forward direction of the vehicle. The first airport 1 is arranged on the windward side, and the first guide plate 3 is pushed by the wind thrust to push the connecting rod 4, and force is exerted on the second guide plate 7 through the connecting rod 4. When the vehicle speed reaches a set critical value, the second guide plate 7 swings toward the second airport 9 to seal the second airport 9, and the second airport 9 is in a sealed state and cannot ventilate. After the position of the second guide plate 7 is secured, the first guide plate 3 can be restricted by the connecting rod 4, so that the connecting rod structure is dynamically balanced and stationary. After the structure of the connecting rod structure is stable, the intake air all comes from the intake air of the first airport 1, and the second airport 9 is sealed to prevent the wind from flowing. The guiding action of the first guide plate 3 can guide the wind toward the air outlet, so that the wind can flow out from the outlet. In addition, the top of the air inlet duct is a negative pressure area, which can divide and outflow part of the air inlet, so that the air flow out of the air outlet 11 can be kept within a set range, which ensures that wind can always enter the air inlet duct through the airport arranged on the side of the air inlet duct at high speed.

[0028] When the vehicle is running at high speed, the force on the first guide plate 3 is shown in Figure 7. The windward force Fn acts on the first guide plate 3 and is decomposed into a longitudinal force Fy and a transverse force Fx. The transverse force Fx is balanced after the second guide plate 7 and the connecting rod 4 react with the first guide plate 3, and the longitudinal force Fy is dynamically balanced with the reaction force of the second guide plate 7 and the connecting rod 4 plus gravity Fg of the guide plate and the connecting rod 4.

[0029] In the rail vehicle ventilation device provided by the embodiment, the trapezoidal connecting rod structure consisting of the first guide plate, the second guide plate and the connecting rod 4 is arranged to guide the wind. The connecting rod structure can adaptively adjust its own structure under the action of wind power, so as to automatically adjust the angle between the guide plate and the corresponding airport according to the change of vehicle speed, thus achieving the purpose of basically stabilizing the ventilation volume of the air outlet 11, and ensuring the ventilation volume when the vehicle runs at high speed. The ventilation device is mounted at the air inlet of the ventilator in the negative pressure area of the locomotive surface, and automatically adjusts the inclination angle of the guide plate according to the running speed of the vehicle or locomotive and the air volume demand in the ventilator, which can effectively avoid too much air volume causing overflow of the ventilator, and avoid the air volume too small not meeting the ventilation volume requirements of the ventilator.

[0030] Based on the above embodiment, the first guide plate 3 can swing to the state where the first airport 1 is sealed, so that when the first airport 1 or the second airport 9 is located on the leeward side, the rail vehicle ventilation device can play the role in limiting the air volume during high-speed operation.

[0031] Based on the above embodiment, the connecting rod structure can be symmetrical in the free state, the two guide plates are the same, and the connecting position between the connecting rod 4 and the first guide plate 3 corresponds to the connecting position between the connecting rod 4 and the second guide plate 7. The first airport 1 and the second airport 9 have the same structure, which is convenient for machining and can make the first airport 1 and the second airport 9 have the same capacity of limiting air volume.

[0032] Based on any one of the above embodiments,

the top airport 10, the first airport 1 and the second airport 9 can all be provided with a protective net 8. Since the top airport 10, the first airport 1 and the second airport 9 may all be used as air inlets during the running of the vehicle, the mounting of the protective net 8 can reduce the entry of foreign matters into the air inlet duct and effectively play a protective role.

[0033] Based on any one of the above embodiments, at least two connecting rods 4 may be connected between the first guide plate 3 and the second guide plate 7, and all the connecting rods 4 may be arranged in parallel. Specifically, two or other numbers of connecting rods 4 may be provided. By arranging at least two connecting rods 4, the stability of the connecting rod structure can be ensured and the connecting rod structure can work reliably.

[0034] Based on any one of the above embodiments, the top plate 2 of the air inlet duct can be detachably connected to the air inlet duct body. The top airport 10 is arranged on the top plate 2. Specifically, the top plate 2 and the air inlet duct body may be connected by bolts or other fasteners 6. Since the top plate 2 is detachably connected to the air inlet duct body, the maintenance of the air inlet duct is convenient. Of course, the air inlet duct may also be integrally formed, or the top plate 2 is connected with the air inlet duct body by welding.

[0035] Based on any one of the above embodiments, the top airport 10 may be arranged in the middle of the top of the air inlet duct to further improve the symmetry of the ventilation device.

[0036] Based on any one of the above embodiments, the connecting rod 4 may be connected to the middle of the first guide plate 3 and the second guide plate 7, so as to improve the swinging flexibility of the first guide plate 3 and the second guide plate 7, and the relative positions of the first guide plate 3 and the connecting rod 4 and the second guide plate 7 and the connecting rod 4 can be conveniently determined, thereby facilitating installation.

[0037] Based on any one of the above embodiments, the first guide plate and the air inlet duct, the second guide plate and the air inlet duct, the connecting rod 4 and the first guide plate, and the connecting rod 4 and the second guide plate may be respectively connected by hinges 5. The hinge 5 is used for connection, and the angle of two connected parts can be adjusted at will, which is convenient for installation. Of course, hinge can also be realized by other manners, for example, the first guide plate is hinged with the air inlet duct through a hinge shaft.

[0038] Based on any one of the above embodiments, referring to Figure 4, the air inlet duct may have a mirror-symmetrical structure in the free state, and the symmetry plane is located in the middle of the first airport 1 and the second airport 9. The first airport 1 and the second airport 9 are mirror symmetric with respect to the symmetry plane, and the first guide plate and the second guide plate are mirror symmetric with respect to the symmetry plane. Correspondingly, the connecting rod forms mirror symmetry with respect to the symmetry plane itself, thus ensuring that the flow guiding effect of the ventilation device is not limited by the forward or backward movement of the vehicle at all. Whether the first airport 1 is on the windward side or the second airport 9 is on the windward side, the air inlet duct has the same flow guiding effect, and can ensure the air intake reliably.

[0039] Besides the above rail vehicle ventilation device, the present application further provides a rail vehicle including rail vehicle ventilation device, and the rail vehicle ventilation device can be any one of the rail vehicle ventilation devices provided by the above embodiments. The beneficial effects can be referred to the above embodiments accordingly. Please refer to the prior art for the structure of the other parts of the rail vehicle, which will not be repeated here.

[0040] The above embodiments are described in a progressive manner. Each of the embodiments is mainly focused on describing its differences from other embodiments, and references may be made among these embodiments with respect to the same or similar parts.

[0041] A rail vehicle and rail vehicle ventilation device therefor according to the present application is described in detail hereinbefore. The principle and the embodiments of the present application are illustrated herein by specific examples. The above description of examples is only intended to facilitate the understanding of the method and spirit of the present application. It should be noted that, for the person skilled in the art, many modifications and improvements may be made to the present application without departing from the principle of the present application, and these modifications and improvements are also deemed to fall into the protection scope of the present application defined by the claims.

Claims

1. A rail vehicle ventilation device, comprising,
an air inlet duct, wherein a first airport (1) and a second airport (9) are respectively provided at two sides of the air inlet duct, the first airport (1) is arranged opposite to the second airport (9), a top of the air inlet duct is provided with a top airport (10) and a bottom of the air inlet duct is provided with an air outlet (11); in a free state, the top airport (10), the first airport (1), the second airport (9) and the air outlet (11) are in communication; and a first guide plate (3), a second guide plate (7), and, a connecting rod (4) hinged between the first guide plate (3) and the second guide plate (7) are arranged in the air inlet duct; and a top of the first guide plate (3) is hinged to the air inlet duct at a position above the first airport (1), and a top of the second guide plate (7) is hinged to the air inlet duct at a position above the second airport (9), the first guide plate (3) and the second guide plate (7) are connected by the connecting rod

(4) to form a trapezoidal connecting rod structure, and an upper end of the trapezoidal connecting rod structure is a large diameter end, the second guide plate (7) is configured to swing to a state of sealing the second airport (9).

2. The rail vehicle ventilation device according to claim 1, wherein, the first guide plate (3) is configured to swing to a state of sealing the first airport (1).

3. The rail vehicle ventilation device according to claim 2, wherein, the connecting rod structure is a symmetrical structure in the free state, and the first airport (1) and the second airport (9) have the same structure.

4. The rail vehicle ventilation device according to claim 3, wherein, the top airport (10), the first airport (1) and the second airport (9) are each provided with a protective net (8).

5. The rail vehicle ventilation device according to claim 4, wherein, at least two connecting rods (4) are connected between the first guide plate (3) and the second guide plate (7), and all the connecting rods (4) are arranged in parallel.

6. The rail vehicle ventilation device according to claim 5, wherein, the top plate (2) of the air inlet duct is detachably connected to the air inlet duct body, the top airport (10) is provided on the top plate (2), and the top airport (10) is provided in the middle of the top of the air inlet duct.

7. The rail vehicle ventilation device according to claim 4, wherein, the connecting rod (4) is connected to the middle of the first guide plate (3) and the second guide plate (7).

8. The rail vehicle ventilation device according to claim 4, wherein, the first guide plate (3) and the air inlet duct, the second guide plate (7) and the air inlet duct, the connecting rod (4) and the first guide plate (3), and the connecting rod (4) and the second guide plate (7) are each connected by a hinge (5).

9. The rail vehicle ventilation device according to claim 1, wherein, the air inlet duct has a mirror symmetrical structure in the free state, and a symmetrical plane is located at the middle position of the first airport (1) and the second airport (9); the first airport (1) and the second airport (9) are mirror symmetric with respect to the symmetry plane, and the first guide plate (3) and the second guide plate (7) are mirror symmetric with respect to the symmetry plane.

10. A rail vehicle, comprising the rail vehicle ventilation device according to any one of claims 1 to 9.

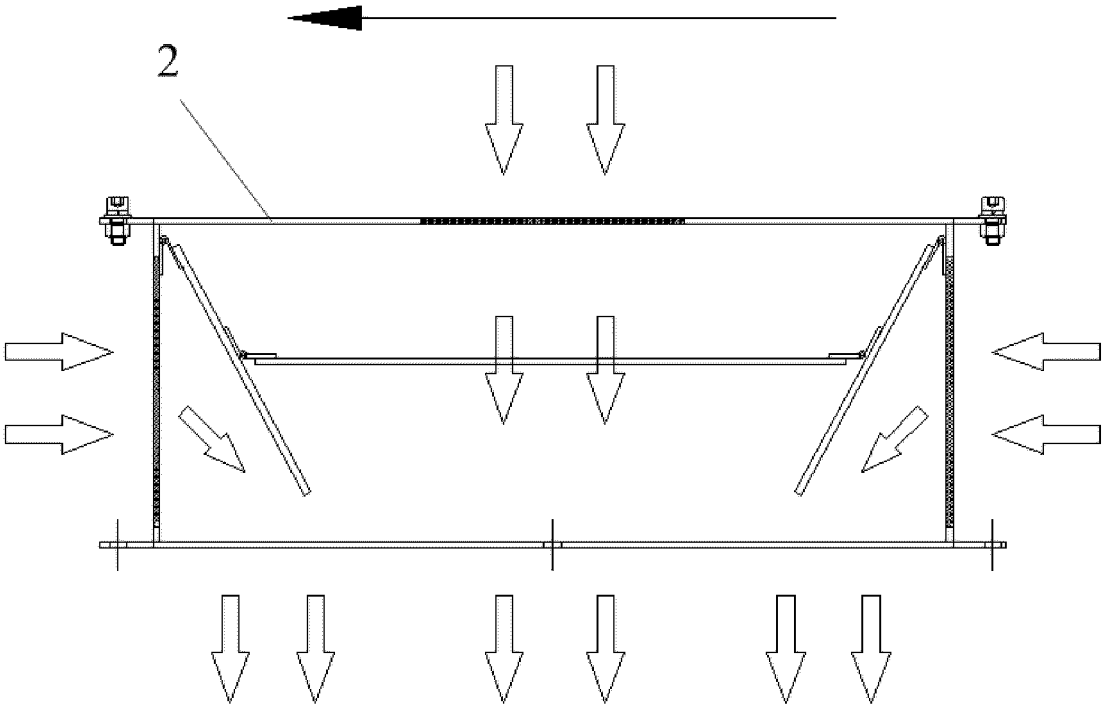

Fig. 1

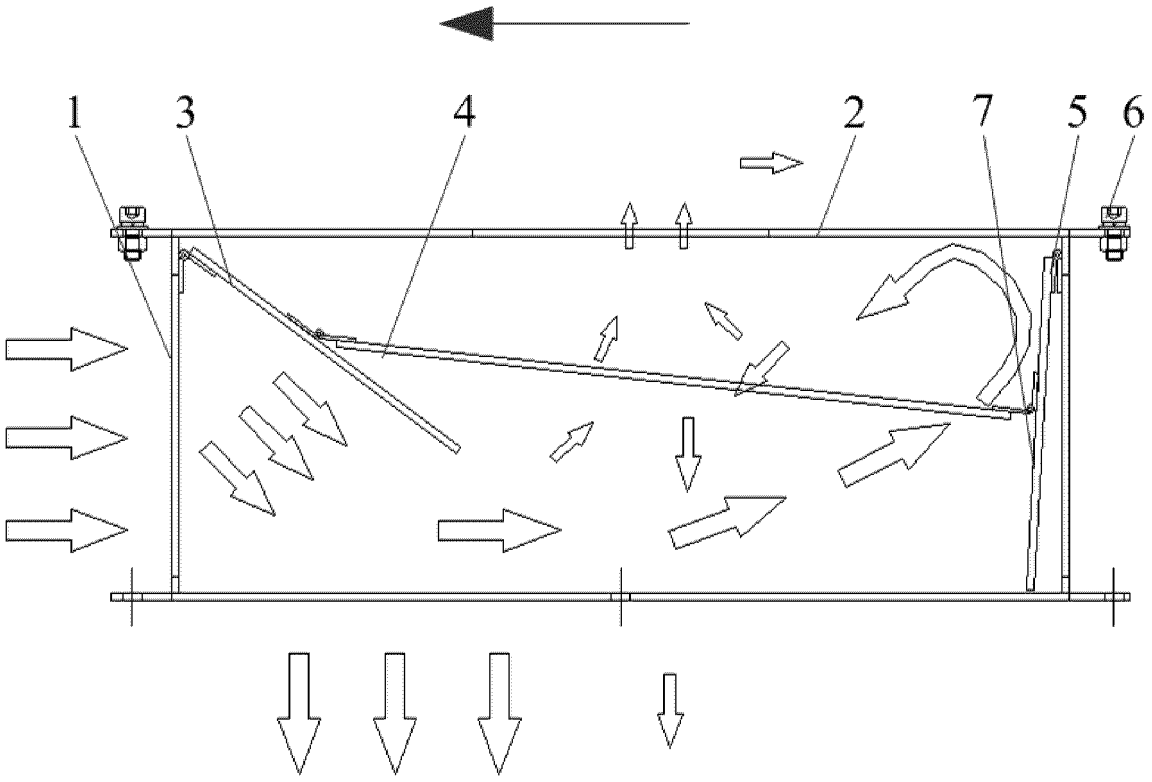

Fig. 2

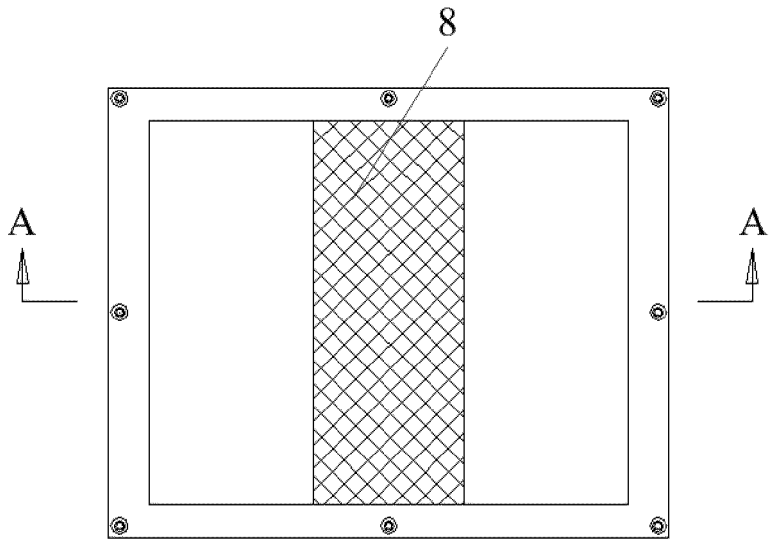

Fig. 3

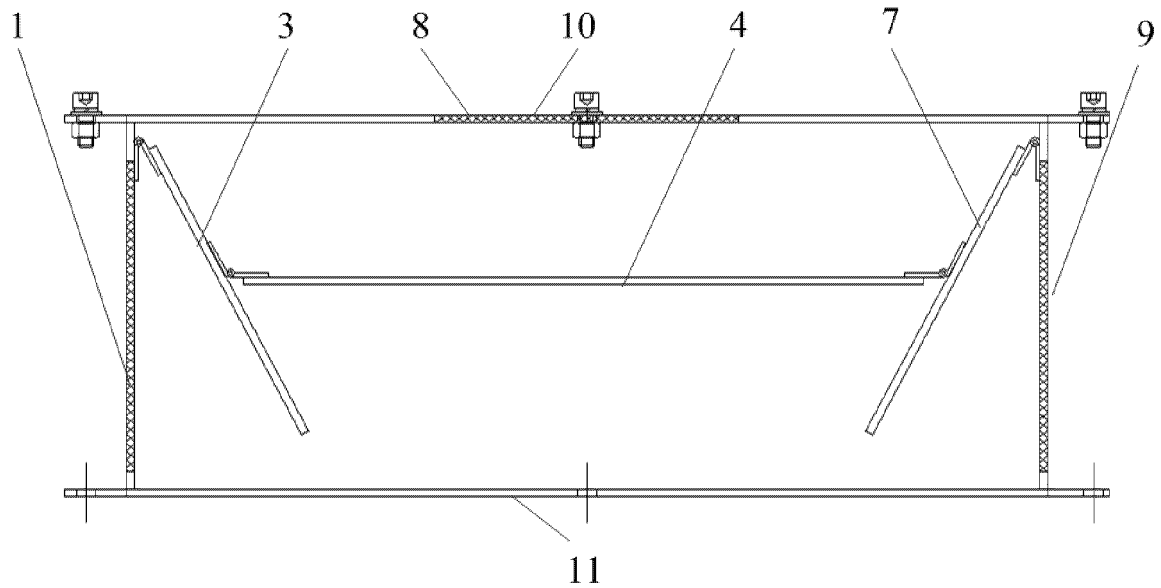

Fig. 4

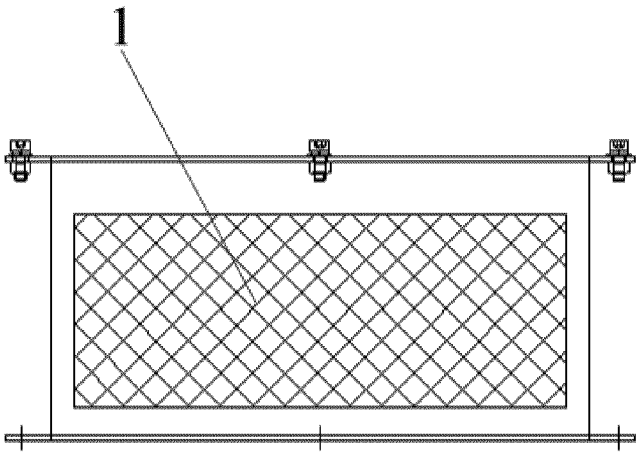

Fig. 5

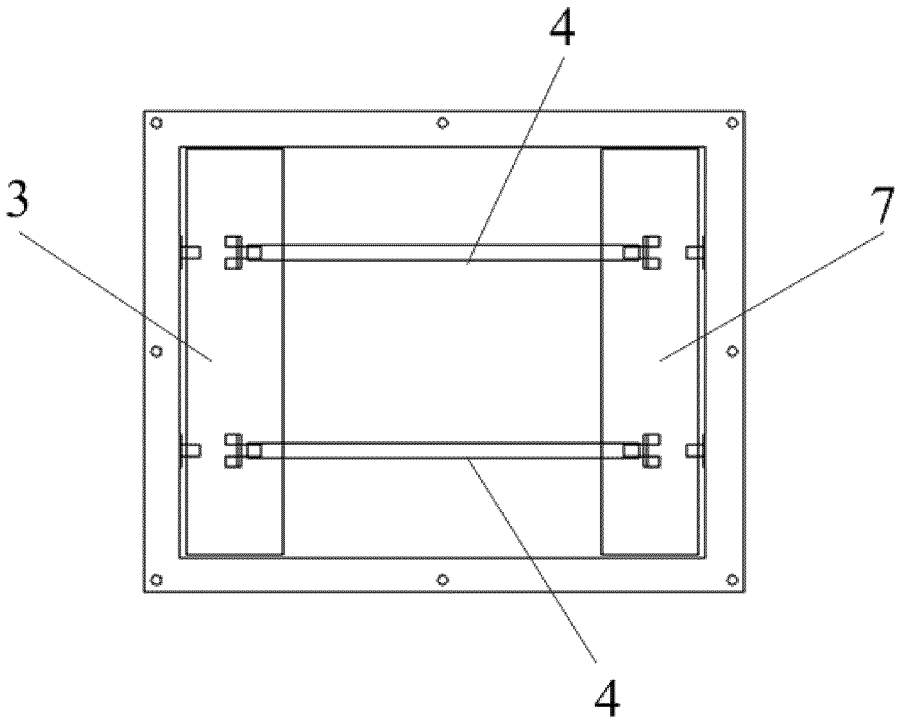

Fig. 6

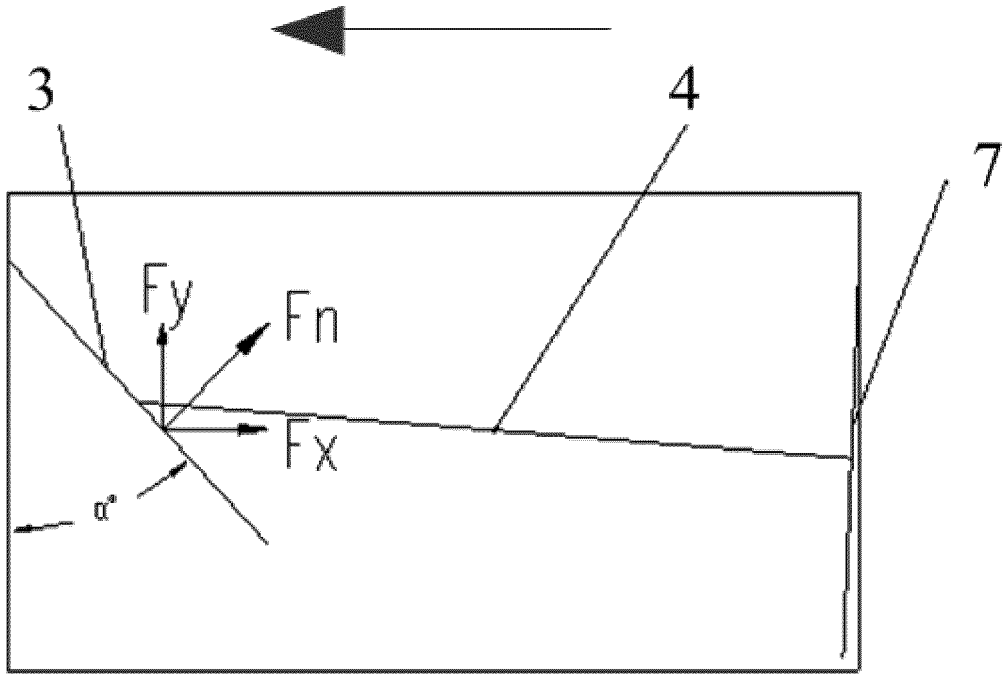

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/094837

A. CLASSIFICATION OF SUBJECT MATTER

B61D 27/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61D, B60H, F24F, F04D, F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI, VEN: 车, 轨道, 通风, 风机, 通气, 进风, 风口, 板, 导流, 连杆, 旋转, 转动, 铰接, 摆动, 空气, 负压, 高速, vehicle, car, train, rail, ventilat+, fan, air, inlet, intake, plate, guide, rod, connect, rotat+, mov+, hinge, swing, vacuum, high, speed

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 109398393 A (CRRC ZHUZHOU LOCOMOTIVE CO., LTD.) 01 March 2019 (2019-03-01) see claims 1-10	1-10
A	CN 107415969 A (CRRC NANJING PUZHEN CO., LTD.) 01 December 2017 (2017-12-01) see description, paragraphs [0006]-[0021], and figures 1-3	1-10
A	CN 102390390 A (DALIAN LOCOMOTIVE & ROLLING STOCK CO., LTD., CNR GROUP) 28 March 2012 (2012-03-28) see entire document	1-10
A	CN 102765400 A (DALIAN LOCOMOTIVE & ROLLING STOCK CO., LTD., CNR GROUP) 07 November 2012 (2012-11-07) see entire document	1-10
A	CN 205439878 U (FAURECIA INTERIEUR INDUSTRIE) 10 August 2016 (2016-08-10) see entire document	1-10
A	US 3845700 A (PEUGEOT & RENAULT) 05 November 1974 (1974-11-05) see entire document	1-10

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 August 2019	**03 September 2019**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/094837

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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