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(54) **RAIL TRAIN AND AIR CONDITIONER DUCT THEREOF**

(57) An air conditioner duct of a rail train and the rail train comprising the air conditioner duct. The air conditioner duct of the rail train comprises a passenger compartment air duct (1) and a driver cab main air duct (2). The passenger compartment air duct (1) comprises a cold air cavity (11), two warm air cavities (12), a first fresh air cavity (13), and a distribution valve for regulating and controlling the ratio of supplied cold and warm air. The driver cab main air duct (2) comprises a middle air cavity and two side air cavities (23); one side of the middle air cavity is provided with a second fresh air cavity (24) for communicating with the first fresh air cavity (13); the middle air cavity comprises an upper air cavity (21) and a lower air cavity (22); the upper air cavity (21) and the lower air cavity (22) are separated and isolated from each other by means of a gradient separator; a valve is provided on the gradient separator. The air conditioner duct can satisfy the requirements for multi-functionality; cold air and warm air are conveyed separately, thereby achieving good uniformity; air duct structures are integrated, thereby saving the space; moreover, when a driver cab requires emergency ventilation, the valve is switched on, air goes out via an air port communicated with the middle air cavity, and the passenger compartment air duct performs emergency air supply for the driver cab, so that the emergency handling capability is improved.

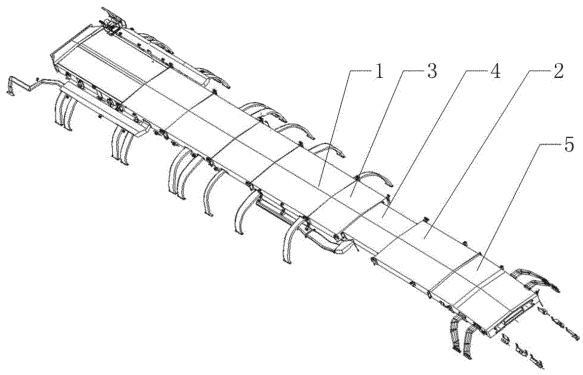

Figure 1

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Description

[0001] The application claims the priorities to Chinese patent application No. titled "RAIL TRAIN AND AIR CONDITIONER DUCT THEREOF" and Chinese patent application No. titled "RAIL TRAIN AND AIR CONDITIONER DUCT THEREOF", filed with the China National Intellectual Property Administration on December 27, 2017, which are incorporated herein by reference in their entireties.

FIELD

[0002] This application relates to the field of railway trains, and in particular to an air conditioning duct for a railway train. Moreover, the present application further relates to a railway train having the air conditioning duct.

BACKGROUND

[0003] A multiple-unit train is one type of railway trains, which includes at least two locomotives or powered cars and several non-powered cars. This type of train includes an air conditioning system for maintaining the comfort of passengers. An air conditioning duct delivers conditioned airflow to a required region in the car. A conventional air conditioning duct has a simple function, which generally only delivers air to a passenger compartment, and has a single structure, which results in poor temperature uniformity in the passenger compartment. Air delivery for a driver compartment requires an additional apparatus, thus, a requirement of multi-functionalization of the air conditioning duct cannot be met. Moreover, when emergency ventilation is required, a passenger compartment air duct cannot provide an emergency supply of air for the driver compartment, resulting in poor performance in emergency handling.

[0004] Therefore, an issue to be addressed presently is to provide an air conditioning duct, which meets the requirement of multi-functionalization and may provide an emergency supply of air for the driver compartment through a passenger compartment air duct of the air conditioning duct when the emergency ventilation is required, so as to improve the performance in emergency handling.

SUMMARY

[0005] An air conditioning duct for a railway train is provided according to the present application, which meets the requirement of multi-functionalization, delivers cold air and warm air separately, allows good temperature uniformity, has an integrated structure to save space, and may provide an emergency supply of air for a driver compartment through a passenger compartment air duct of the air conditioning duct when emergency ventilation is required, thereby improving the performance in emergency handling. A railway train including the air conditioning duct is further provided according to the present application.

[0006] In order to address the above technical issue, an air conditioning duct for a railway train is provided according to the present application. The air conditioning duct includes a passenger compartment air duct and a driver compartment main air duct. The passenger compartment air duct includes a cold air chamber, two warm air chambers, a first fresh air chamber and a distribution valve. The cold air chamber is used for delivering cold air. The two warm air chambers are located at two sides of the cold air chamber and used for delivering warm air. The first fresh air chamber is located at a side of the cold air chamber. The distribution valve is used for adjusting and controlling a ratio of delivered cold air to delivered warm air. The driver compartment main air duct includes an intermediate air chamber and two side air chambers. The intermediate air chamber is communicated with the cold air chamber. The two side air chambers are located at two sides of the intermediate air chamber and communicated with the two warm air chambers respectively. A second fresh air chamber is provided at a side of the intermediate air chamber for being communicated with the first fresh air chamber. The intermediate air chamber includes an upper air chamber communicated with a rear air port and a lower air chamber for being communicated with a front air port. The upper air chamber and the lower air chamber are isolated from and independent of each other by a slope partition plate. The slope partition plate is provided with a valve for controlling a communication state of the intermediate air chamber.

[0007] Preferably, a rear end of the second fresh air chamber is closed. A fresh air receiving port is provided at a lower portion of the second fresh air chamber.

[0008] Preferably, the air conditioning duct further includes assisting air ducts. A first assisting air duct includes an intermediate assisting air chamber and two side assisting air chambers. The two side assisting air chambers are located at two sides of the intermediate assisting air chamber. The intermediate assisting air chamber has a front end communicated with the cold air chamber and a rear end communicated with the intermediate air chamber. The side assisting air chamber has a front end communicated with the corresponding warm air chamber and a rear end communicated with the corresponding side air chamber. The first assisting air duct further includes a third fresh air chamber provided at a side of the intermediate assisting air duct. Two ends of the third fresh air chamber are respectively communicated with the first fresh air chamber and the second fresh air chamber.

[0009] Preferably, the first fresh air chamber is provided above one of the warm air chambers. The second fresh air chamber is provided at a side of the corresponding side air chamber. The third fresh air chamber is provided at a side of the corresponding side assisting air chamber.

[0010] Preferably, the assisting air ducts include the

first assisting air duct and a second assisting air duct communicated with each other. A width of the first assisting air duct is equal to a width of the main air duct and greater than a width of the second assisting air duct.

[0011] Preferably, a heater is provided in the second assisting air duct. An air delivery port is provided at a lower portion of the second assisting air duct.

[0012] Preferably, the air conditioning duct further includes a transition air duct which is communicated with the driver compartment main air duct and an air conditioning unit of a driver compartment. Air chambers in the transition air duct are correspondingly communicated with the intermediate air chamber and the two side air chambers of the driver compartment main air duct.

[0013] Preferably, each of a width of the driver compartment main air duct and a width of the transition air duct is equal to a width of the passenger compartment air duct.

[0014] Preferably, each of two sides of each air duct is provided with a connection tab. The connection tab is provided with a connection hole for bolted connection.

[0015] A railway train is provided according to the present application, including a car and an air conditioning duct. The air conditioning duct is provided at an upper portion of the car, and the air conditioning duct is the air conditioning duct according to any one of the above aspects.

[0016] The air conditioning duct for the railway train according to the present application includes the passenger compartment air duct and the driver compartment main air duct. The passenger compartment air duct includes the cold air chamber, the two warm air chambers, the first fresh air chamber and the distribution valve. The cold air chamber is used for delivering cold air. The two warm air chambers are located at two sides of the cold air chamber and used for delivering warm air. The first fresh air chamber is located at a side of the cold air chamber. The distribution valve is used for adjusting and controlling the ratio of delivered cold air to delivered warm air. The driver compartment main air duct includes an intermediate air chamber and two side air chambers. The intermediate air chamber is communicated with the cold air chamber, the two side air chambers are located at two sides of the intermediate air chamber and communicated with the two warm air chambers respectively. The second fresh air chamber is provided at a side of the intermediate air chamber for being communicated with the first fresh air chamber. The intermediate air chamber includes the upper air chamber communicated with the rear air port and the lower air chamber for being communicated with the front air port. The upper air chamber and the lower air chamber are isolated from and independent of each other by the slope partition plate. The slope partition plate is provided with the valve for controlling the communication state of the intermediate air chamber.

[0017] By providing the driver compartment main air duct, the passenger compartment air duct is communicated with the driver compartment, thus, air may be supplied to the driver compartment, and a requirement of multi-functionalization of the air conditioning duct is met. The air conditioning duct has muffling and heating functions, and cool air and warm air are delivered separately, thus, the temperature uniformity is good. The air conditioning duct has an integrated structure, which saves space. Through the distribution valve, airflow delivered out by an air conditioning unit is distributed at different ratios to the cold air chamber and the warm air chambers according to the seasons. When the emergency ventilation is required for the driver compartment, the valve for controlling the communication state of the intermediate air chamber is opened and then air goes out via the front air port and the rear air port communicated with the intermediate air chamber, thus, the passage compartment air duct provides an emergency supply of air for the driver compartment, thereby improving the performance in emergency handling.

[0018] The railway train including the above air conditioning duct is further provided according to the present application. Since the air conditioning duct has the technical effects described above, the above railway train should also have the same technical effects, which will not be described in detail herein.

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 describe the embodiments or the conventional technology will be briefly described hereinafter. Apparently, the drawings in the following description are only examples of the present application, and for the person skilled in the art, other drawings may be obtained based on the drawings without any creative efforts.

Figure 1 is a schematic view showing the structure of an embodiment of an air conditioning duct according to the present application; and

Figure 2 is an exploded schematic view of the embodiment of the air conditioning duct according to the present application.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] Technical solutions in the embodiments of the present application are described clearly and completely hereinafter in conjunction with the drawings in embodiments of the present application. The embodiments described are only part of embodiments of the present application and not all embodiments of the present application. All other embodiments, obtained by the person skilled in the art based on the embodiments in the present application without any creative efforts, are within the scope of the present application.

[0021] An air conditioning duct for a railway train is pro-

vided according to the present application, which meets the requirement of multi-functionalization, delivers cold air and warm air separately, allows good temperature uniformity, has an integrated structure to save space, and may provide an emergency supply of air for a driver compartment through a passenger compartment air duct of the air conditioning duct when emergency ventilation is required for the driver compartment, thereby improving the performance in emergency handling. A railway train including the air conditioning duct is further provided according to the present application.

[0022] In order to make the person skilled in the art have a better understanding of a solution of the present application, the present application is described hereinafter in further detail in conjunction with the drawings and embodiments.

[0023] Reference is made to Figure 1 and Figure 2. Figure 1 is a schematic view showing the structure of an embodiment of the air conditioning duct according to the present application, and Figure 2 is an exploded schematic view of the embodiment of the air conditioning duct according to the present application.

[0024] The air conditioning duct for the railway train according to the embodiment of the present application includes a passenger compartment air duct 1. The passenger compartment air duct 1 includes a cold air chamber 11, two warm air chambers 12 and a first fresh air chamber 13. The cold air chamber 11 is used for delivering cold air. The two warm air chambers 12 are located at two sides of the cold air chamber 11 and used for delivering warm air. The first fresh air chamber 13 is located at a side of the cold air chamber 11, that is, one of the two warm air chambers 12 is located at the same side with the first fresh air chamber 13. The air conditioning duct further includes a driver compartment main air duct 2. The driver compartment main air duct 2 includes an intermediate air chamber and two side air chambers 23. The intermediate air chamber is communicated with the cold air chamber 11. The two side air chambers 23 are located at two sides of the intermediate air chamber and respectively communicated with the two warm air chambers 12. A second fresh air chamber 24 for being communicated with the first fresh air chamber 13 is provided at a side of the intermediate air chamber, that is, one of the two side air chambers 23 is located at the same side with the second fresh air chamber 13. The air conditioning duct further includes a distribution valve for regulating and controlling a ratio of delivered warm air to delivered cold air. The distribution valve includes a servo motor and a valve structure. The passenger compartment air duct 1 is in a structure of multiple separated sections. The distribution valve is arranged in a section, away from the driver compartment main air duct 2, of the passenger compartment air duct 1.

[0025] A front air port and a rear air port are provided below the intermediate air chamber. The intermediate air chamber includes an upper air chamber 21 for being communicated with the rear air port and a lower air chamber 22 for being communicated with the front air port. The upper air chamber 21 and the lower air chamber 22 are isolated from and independent of each other by a slope partition plate. The slope partition plate is provided with a valve for controlling a communication state of the intermediate air chamber. When the valve for controlling the communication state of the intermediate air chamber is closed, the intermediate air chamber and the passenger compartment air duct 1 are independent of each other, and when the valve for controlling the communication state of the intermediate air chamber is opened, the intermediate air chamber and the passenger compartment air duct 1 are communicated with each other, thereby providing an emergency supply of air for the driver compartment via the front air port and the rear air port.

[0026] By providing the driver compartment main air duct 2, the passenger compartment air duct 1 is communicated with the driver compartment, thus, air may be supplied to the driver compartment, and the requirement of the multi-functionalization of the air conditioning duct is met. The air conditioning duct has muffling and heating functions, and cool air and warm air are delivered separately, thus, the temperature uniformity is good. The air conditioning duct has an integrated structure, which saves space. Through the distribution valve, airflow delivered out by an air conditioning unit is distributed at different ratios to the cold air chamber and the warm air chambers according to the seasons. When the emergency ventilation is required for the driver compartment, the valve for controlling the communication state of the intermediate air chamber is opened and then air goes out via the front air port and the rear air port communicated with the intermediate air chamber, thus, the passage compartment air duct 1 provides an emergency supply of air for the driver compartment, thereby improving the performance in emergency handling.

[0027] Specifically, a rear end of the second fresh air chamber 24 is closed, and a fresh air receiving port is provided at a lower portion of the second fresh air chamber 24. That is, the second fresh air chamber 24 changes a manner of delivery of fresh air, and the delivery of fresh air is changed from horizontal delivery to vertical delivery. The fresh air is sent to an air conditioner of the driver compartment via the fresh air receiving port located at the lower portion of the second fresh air chamber 24.

[0028] The air conditioning duct according to the embodiment of the present application further includes assisting air ducts. A first assisting air duct 3 includes an intermediate assisting air chamber 31 and two side assisting air chambers 32. The two side assisting air chambers 32 are located at two sides of the intermediate assisting air chamber 31. The intermediate assisting air chamber 31 has a front end communicated with the cold air chamber 11 and a rear end communicated with the intermediate air chamber. The side assisting air chamber 32 has a front end communicated with the corresponding warm air chamber 12 and a rear end communicated with the corresponding side air chamber 23. The first assisting

air duct 3 further includes a third fresh air chamber 33. The third fresh air chamber 33 is provided at a side of the intermediate assisting air duct. Two ends of the third fresh air chamber 33 are communicated with the first fresh air chamber 13 and the second fresh air chamber 24, respectively. That is, the first fresh air chamber 13, the third fresh air chamber 33 and the second fresh air chamber 24 are connected in a listed sequence. The first fresh air chamber 13 and the second fresh air chamber 24 are communicated with each other through the third fresh air chamber 33 for achieving transitional connection and adjusting the size of an air chamber, so as to meet the installation requirement of the driver compartment main air duct 2.

[0029] Specifically, the construction of the fresh air chambers is adjusted. The first fresh air chamber 13 is provided above one warm air chamber 12, the second fresh air chamber 24 is provided at a side of the corresponding side air chamber 23, and the third fresh air chamber 33 is provided at a side of the corresponding side assisting air chamber 32.

[0030] The assisting air ducts include the first assisting air duct 3 and a second assisting air duct 4 communicated in a listed sequence. The width of the first assisting air duct 3 is equal to the width of the main air duct and greater than the width of the second assisting air duct 4. The processing is simplified by providing two assisting air ducts. Correspondingly, an intermediate assisting air chamber 41, a side assisting air chamber 42 and a third fresh air chamber 43 are provided in the second assisting air duct 4. Each of the intermediate assisting air chamber 41, a side assisting air chamber 42 and a third fresh air chamber 43 corresponds to the respective chambers in the first assisting air duct 3. A heater may be further provided in the second assisting air duct 4. An air delivery port is provided at a lower portion of the second assisting air duct 4 for achieving the function of air delivery and heating and the function of air delivery from a lower side. It is also possible to provide the heater and the air delivery port in different air ducts respectively, and each of the cases is within the protection scope of the present application.

[0031] Based on the air conditioning duct according to the embodiment described above, the air conditioning duct further includes a transition air duct 5. The transition air duct 5 is communicated with the driver compartment main air duct 2 and an air conditioning unit of the driver compartment. The transition air duct 5 has air chambers correspondingly communicated with the air chambers of the driver compartment main air duct 2. The air chambers in the transition air duct 5 are an upper transition air chamber 51, a lower transition air chamber 52 and two side transition air chambers 53. Each of the upper transition air chamber 51, the lower transition air chamber 52 and the two side transition air chambers 53 corresponds to the respective air chambers of the driver compartment main air duct 2.

[0032] Each of the width of the driver compartment main air duct 2 and the width of the transition air duct 5 is equal to the width of the passenger compartment air duct 1. Each of two sides of each air duct is provided with a connection tab. The connection tab is provided with a connection hole for bolted connection. According to the situations, the size and connection of each of the air ducts may be adjusted, and each of the cases is within the protection scope of the present application.

[0033] In addition to the air conditioning duct described above, a railway train including the air conditioning duct described above is further provided according to the embodiment of the present application. For the structures of other components of the railway train, reference may be made to the conventional technology, which will not be described herein.

[0034] The railway train and the air conditioning duct thereof according to the present application are 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 help the understanding of the concept of the present application. It should be noted that, for the person skilled in the art, a few of improvements and modifications 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 scope of protection of the present application defined by the claims.

Claims

1. An air conditioning duct for a railway train, comprising:

   a passenger compartment air duct (1); and
   a driver compartment main air duct (2),
   wherein the passenger compartment air duct (1) comprises a cold air chamber (11), two warm air chambers (12), a first fresh air chamber (13) and a distribution valve, and the cold air chamber (11) is provided for delivering cold air, the two warm air chambers (12) are located at two sides of the cold air chamber (11) for delivering warm air, the first fresh air chamber (13) is located at a side of the cold air chamber (11), the distribution valve is provided for adjusting and controlling a ratio of delivered cold air to delivered warm air,
   wherein the driver compartment main air duct (2) comprises an intermediate air chamber and two side air chambers (23), and the intermediate air chamber is communicated with the cold air chamber (11), the two side air chambers (23) are located at two sides of the intermediate air chamber and communicated with the two warm air chambers (12) respectively, a second fresh air chamber (24) is provided at a side of the in-

termediate air chamber for being communicated with the first fresh air chamber (13),
wherein the intermediate air chamber comprises an upper air chamber (21) communicated with a rear air port and a lower air chamber (22) for being communicated with a front air port, the upper air chamber (21) and the lower air chamber (22) are isolated from and independent of each other by a slope partition plate, and the slope partition plate is provided with a valve for controlling a communication state of the intermediate air chamber.

2. The air conditioning duct according to claim 1, wherein a rear end of the second fresh air chamber (24) is closed, and the second fresh air chamber (24) is provided at a lower portion of a fresh air receiving port.

3. The air conditioning duct according to claim 2, further comprising assisting air ducts, wherein a first assisting air duct (3) comprises an intermediate assisting air chamber (31) and two side assisting air chambers (32), the two side assisting air chambers (32) are located at two sides of the intermediate assisting air chamber (31), the intermediate assisting air chamber (31) has a front end communicated with the cold air chamber (11) and a rear end communicated with the intermediate air chamber, the side assisting air chamber (32) has a front end communicated with the corresponding warm air chamber (12) and a rear end communicated with the corresponding side air chamber (23), the first assisting air duct (3) further comprises a third fresh air chamber (33) provided at a side of the intermediate assisting air duct, and two ends of the third fresh air chamber (33) are respectively communicated with the first fresh air chamber (13) and the second fresh air chamber (24).

4. The air conditioning duct according to claim 3, wherein the first fresh air chamber (13) is provided above one of the warm air chambers (12), the second fresh air chamber (24) is provided at a side of the corresponding side air chamber (23), and the third fresh air chamber (33) is provided at a side of the corresponding side assisting air chamber (32).

5. The air conditioning duct according to claim 4, wherein the assisting air ducts comprise the first assisting air duct (3) and a second assisting air duct (4) communicated in a listed sequence, a width of the first assisting air duct (3) is equal to a width of the main air duct and greater than a width of the second assisting air duct (4).

6. The air conditioning duct according to claim 5, wherein a heater is provided in the second assisting air duct (4), and the second assisting air duct (4) is provided at a lower portion of an air delivery port.

7. The air conditioning duct according to any one of claims 1 to 6, further comprising a transition air duct (5) which is communicated with the driver compartment main air duct (2) and an air conditioning unit of a driver compartment, wherein air chambers in the transition air duct (5) are correspondingly communicated with the intermediate air chamber and the two side air chambers (23) of the driver compartment main air duct (2).

8. The air conditioning duct according to claim 7, wherein each of a width of the driver compartment main air duct and a width of the transition air duct is equal to a width of the passenger compartment air duct (1).

9. The air conditioning duct according to claim 8, wherein each of two sides of each air duct is provided with a connection tab, and the connection tab is provided with a connection hole for bolted connection.

10. A railway train, comprising:

a car; and
an air conditioning duct provided at an upper portion of the car,
wherein the air conditioning duct is the air conditioning duct according to any one of claims 1 to 9.

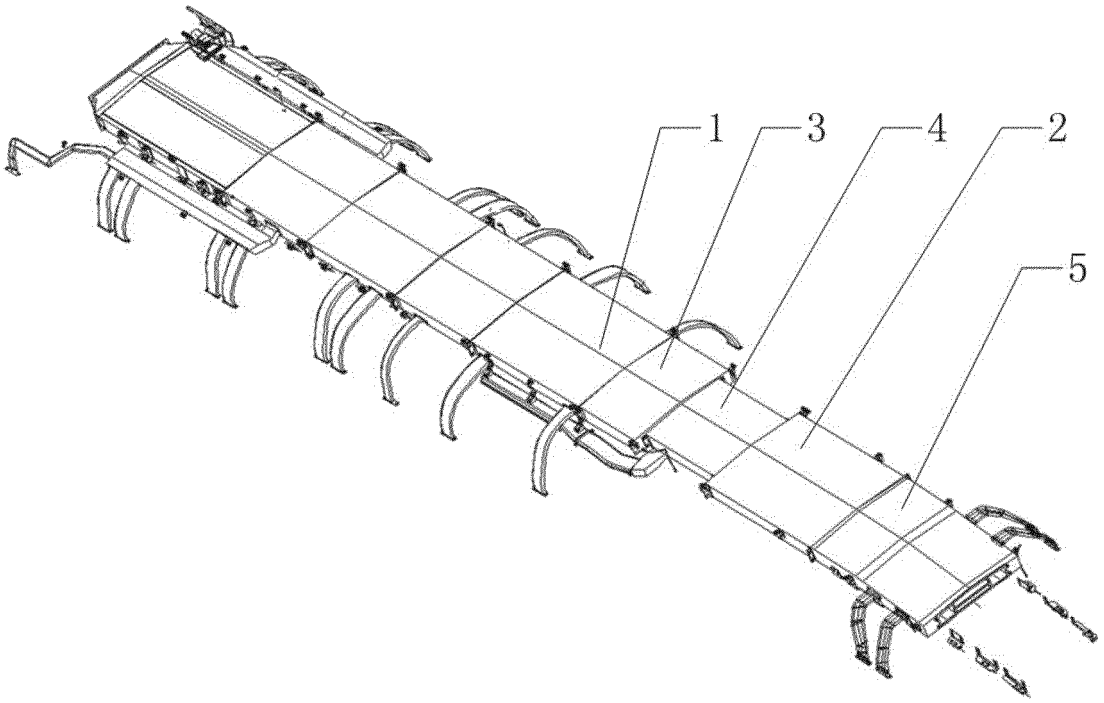

Figure 1

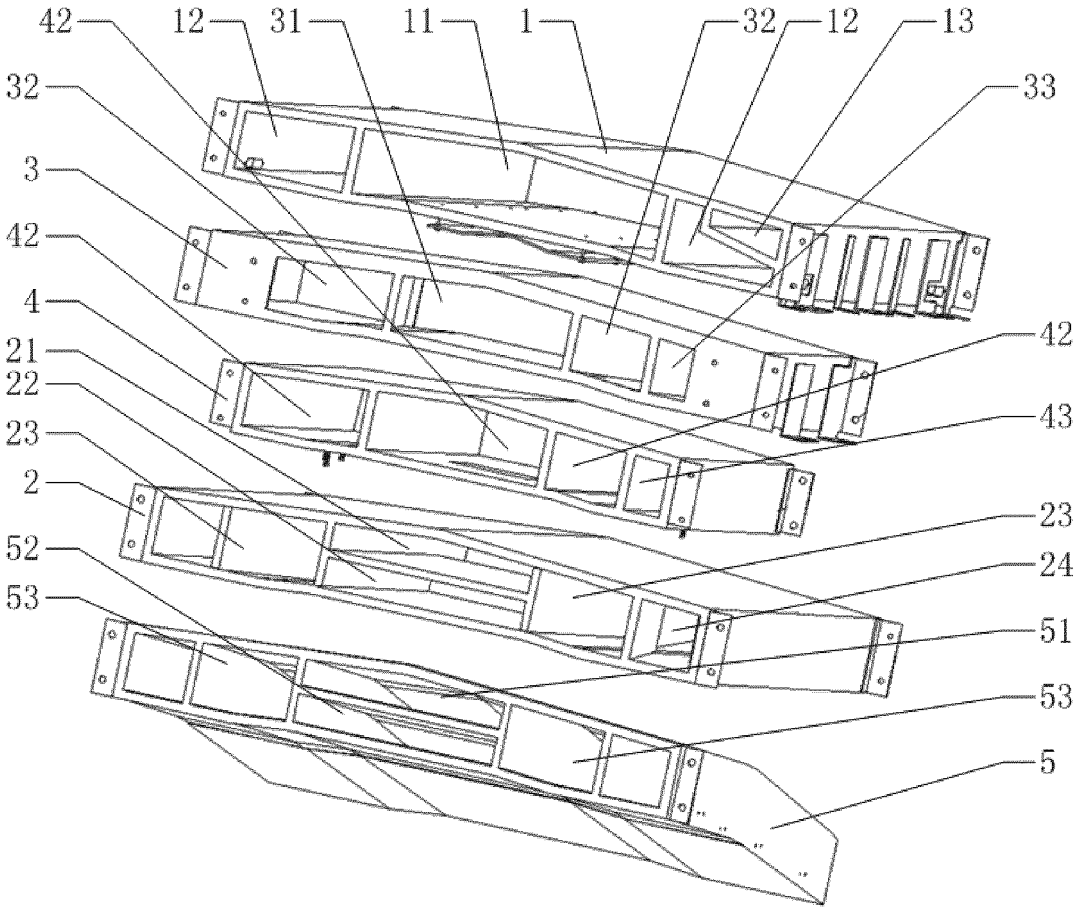

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/119270

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, F24F

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)

WPI, EPODOC, CNKI, CNPAT, 中车长春轨道客车, 曹艳华, 空调, 客车, 司机室, 风道, 阀, air conditioner, air channel, passenger cabin, driver's cabin, valve

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 102046405 A (MITSUBISHI ELECTRIC CORPORATION) 04 May 2011 (2011-05-04) description, paragraphs [0002] and [0025]-[0040], and figures 1-2	1-10
A	EP 3202634 A1 (HITACHI LTD.) 09 August 2017 (2017-08-09) entire document	1-10
A	CN 206406921 U (BOMBARDIER SIFANG (QINGDAO) TRANSPORTATION LTD.) 15 August 2017 (2017-08-15) entire document	1-10
A	CN 203318424 U (JIANGSU NEW UNITED AIR CONDITIONER SYSTEM CO., LTD. ET AL.) 04 December 2013 (2013-12-04) entire document	1-10
A	KR 101551140 B1 (DAWONSYS CO., LTD.) 07 September 2015 (2015-09-07) entire document	1-10

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 August 2018	**19 September 2018**

Name and mailing address of the ISA/CN	Authorized officer
State Intellectual Property Office of the P. R. China **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China**	
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/119270

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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		JP WO2009144808 A1	29 September 2011
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		EP 3202634 A4	13 June 2018
		JP WO2016051580 A1	22 June 2017
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CN 203318424 U	04 December 2013	None	
KR 101551140 B1	07 September 2015	None	

Form PCT/ISA/210 (patent family annex) (January 2015)