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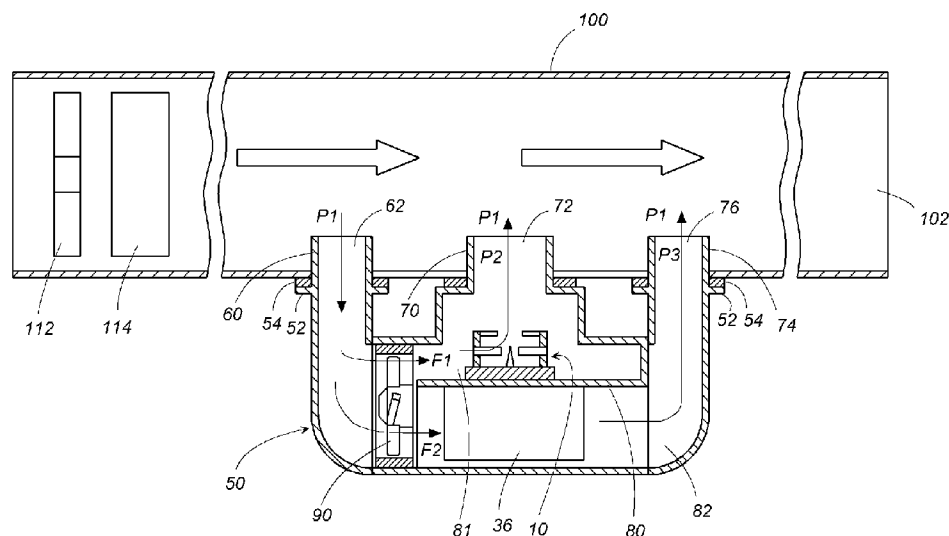
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[Continued on next page]

(54) Title: ELECTROSTATICALLY ATOMIZING KIT FOR USE IN A VEHICLE

[Fig. 1]



(57) Abstract: An electrostatically atomizing kit for use in a vehicle for constantly generating and spreading a mist of charged minute water particle into a passenger's room through a ventilation duct (100). The kit includes an atomising unit (10) for supplying the mist and a casing (50) thereof. The casing has an air intake (62), a first outlet (72), and a second outlet (76) for connection with the ventilation duct. An interior space of the casing is divided into a first passage (81) leading from the air intake to the first outlet, and a second passage (82) leading from the air intake to the second outlet. A blower (90) generates a first forced air flow through the first passage as well as a second forced air flow through the second passage. A mist generating side (10) of the unit is disposed within the first flow passage, while a heat radiator (36) of the unit is disposed within the second flow passage.

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Description

ELECTROSTATICALLY ATOMIZING KIT FOR USE IN A VEHICLE

Technical Field

[0001] The present invention relates to an electrostatically atomizing kit for use in a vehicle, and more particularly to a kit for providing a system of discharging a mist of charged minute water particles into a passenger's room of a vehicle as being carried on a conditioned air for deodorizing the passenger's room and/or deactivating allergens introduced in the room.

Background of the Invention

[0002] Japanese Patent Publication No. 2006-151046 A discloses an air conditioning device for a vehicle designed to supply a mist of charged minute water particles into a passenger's room as being carried on a conditioned air generated by an air conditioning system of the vehicle. The device includes an atomizing unit with an emitter electrode which is cooled to condense the water from within the surrounding air, and a high voltage source applying a high voltage to the emitter electrode for electrostatically atomizing the water into charged minute water particles. The atomizing unit is disposed within a ventilation duct of the vehicle so as to carry the mist on the conditioned air flowing into the passenger's room. In this device, the emitter electrode is exposed to the conditioned air flowing at a relatively high flow rate. Thus, the water supplied to the emitter electrode is likely to be blown off by the conditioned air, which eventually disables the device to atomize the water successfully. A straightforward solution to this problem is to dispose the atomizing unit outside of the ventilation duct in a separate chamber or casing, and to supply the mist into the ventilation duct with the use of an additional blower. With this scheme, the blower is required to develop a high pressure on the side of the atomizing unit than the pressure within the ventilation duct for constantly supplying the mist into the ventilation duct. However, because of that the air conditioning system is required to vary the flow rate of the conditioned air depending upon varying environments of the vehicle, it is practically difficult to keep an optimum pressure difference irrespective of the varying flow rate of the conditioned air.

Disclosure of Invention

[0003] In view of the above problem, the present invention has been achieved to provide an electrostatically atomizing kit for use in a vehicle which is capable of constantly generating a mist of charged minute water particle and spreading the mist into a passenger's room as being carried on a conditioned air irrespective of varying flow rate

of the conditioned air. The kit in accordance with the present invention is adapted in use to the vehicle equipped with an air conditioning system having a ventilation duct blowing the conditioned air into the passenger's room through a blow port. The kit includes an atomizing unit configured to supply a mist of charged minute water particles to the ventilation duct, and a casing configured to accommodate therein the atomizing unit. The atomizing unit includes an emitter electrode, a cooler configured to cool the emitter electrode for condensing water thereon from within surrounding air, and a high voltage source configured to apply a high voltage to the emitter electrode so as to electrostatically atomize the water into the charged minute water particles. A heat radiator is also included in the atomizing unit to be connected to the cooler for dissipating heat generated at the cooler when cooling the emitter electrode. The casing is provided with an air intake, a first outlet, and a second outlet which are adapted to be connected to the ventilation duct upstream of the blow port. The casing has its interior space divided into a first passage leading from the air intake to the first outlet, and a second passage leading from the air intake to the second outlet. A blower is included in the casing to generate a first forced air flow through the first passage as well as a second forced air flow through the second passage. The emitter electrode is disposed within the first flow passage to supply the mist into the ventilation duct, while the heat radiator is disposed within the second flow passage. With this arrangement, the blower gives an additional pressure to the air taken from the ventilation duct so as to develop a substantially constant pressure difference between the air flowing in the first passage past the atomizing unit and the air flowing in the ventilation duct. Whereby, the mist generated in the first passage can be successfully supplied into the ventilation duct irrespective of the varying pressure or the flow rate of the conditioned air flowing through the ventilation duct. The blower also gives a constant air flow flowing from the ventilation duct through the second passage and back to the ventilation duct for effectively dissipating the heat of the cooler and therefore keeping stable atomizing effect.

[0004] Preferably, the second outlet has a cross-sectional area smaller than that of the first outlet so as to make a greater pressure difference at the connection between the second outlet and the ventilation duct than at the connection between the first outlet and the ventilation duct, thereby flowing the air flow faster through the second passage than through the first passage. Thus, the second passage sees a relatively fast air flow for enhancing a cooling effect of the heat radiator, while the first passage sees a relatively slow air flow to permit a stable supply of the water on the emitter electrode without being blown off by the air flow guided through the first passage.

[0005] The casing is provided with an air intake conduit, a first outlet conduit, and a second outlet conduit respectively configured to extend into the ventilation duct to define the air intake, the first outlet, and the second outlet. Thus, the kit of the present invention

can be easily assembled into the vehicle by coupling the individual ducts to the ventilation duct.

[0006] The present invention may be provided as an assembly including the ventilation duct so as to be easily mounted in the vehicle. In this instance, the air intake conduit, the first outlet conduit, and the second outlet conduit are arranged along a length of the ventilation duct with the intake port disposed upstream of the first and second outlet conduits. Alternatively, the air intake conduit, the first outlet conduit, and the second outlet conduit are arranged along a direction perpendicular to a length of the ventilation duct. In either version, the mist of the charged minute water particles can be successfully fed into the ventilation duct and is released into the passenger's room as being carried on the conditioned air.

[0007] These and still other advantageous features of the present invention will become more apparent from the following detailed description of a preferred embodiment when taken in conjunction with the attached drawings.

Brief Description of the Drawings

[0008] [fig.1]FIG. 1 is a sectional view illustrating an electrostatically atomizing kit for use in a vehicle shown as being assembled to a ventilation duct of the vehicle in accordance with a preferred embodiment of the present invention;

[fig.2]FIG. 2 is a sectional view of an atomizing unit employed in the above kit to generate a mist of charged minute water particles;

[fig.3]FIG. 3 is a schematic view illustrating a location of the above kit in a vehicle; and

[fig.4]FIG. 4 is a perspective view, partly in section, of the above atomizing kit assembled to a ventilation duct in a different fashion.

Best Mode for Carrying Out the Invention

[0009] Referring now to FIGS. 1 and 2, there is shown an electrostatically atomizing kit for use in a vehicle in accordance with the present invention. The kit is adapted to the vehicle equipped with an air conditioning system having a ventilation duct 100, a fan 112 drawing in an outside fresh air or a room air into the ventilation duct 100, and a heat exchanger 114 disposed downstream of the fan 112 to generate a conditioned air to be blown through the ventilation duct 100 into the passenger's room through a blow port 102 located in the passenger's room.

[0010] The kit includes an atomizing unit 10, a casing 50 accommodating therein the atomizing unit 10. The atomizing unit 10 is configured to take water from within the surrounding air by condensation, and electrostatically atomize it into charged minute water particles to generate a mist of the particles to be discharged out of the atomizing unit 10. The resulting mist is fed to the ventilation duct 100 and is released into a

passenger's room of the vehicle as being carried on the conditioned air flowing out through the blow port 102. For instance, the kit (K) is mounted behind a dashboard of the vehicle, as shown in FIG. 3, to supply the mist to the conditioned air immediately before flowing into the passenger's room. Thus obtained mist is known to contain radicals which remain over a long period of time when diffused in a large amount, and react effectively with offensive odors in the space for deodorize the passenger's room and/or deactivating allergens introduced in the room.

[0011] As shown in FIG. 2, the atomizing unit 10 includes a cylindrical barrel 12 carrying an emitter electrode 20 and an opposed electrode 24. The emitter electrode 20 projects through a bottom of the barrel 12, while the opposed electrode 24 is disposed in an opposite relation to the emitter electrode 20. The opposed electrode 24 is shaped from an electrically conductive substrate with a circular top opening 26 which has an inner periphery spaced by a predetermined distance from a discharge end 22 at the tip of the emitter electrode 20 to define a discharge port for discharging the mist. The atomizing unit 10 includes a cooler 30 and a high voltage source 40. The cooler 30 is coupled to cool the emitter electrode 20 in order to condense the water on the emitter electrode 20 from within the surrounding air for supplying the water thereto. The high voltage source 40 is configured to apply a high voltage across the emitter electrode 20 and the opposed electrode 24 so as to charge the water on the emitter electrode 20 and atomize it into the charged minute water particles to be discharged out through the top opening 26. The cooler 30 is realized by a Peltier module having a cooling plate 33 coupled to the emitter electrode 20 at its one end away from the discharge end 22, and having thermo-electric elements 35 which, upon being applied with a predetermined voltage, cools the emitter electrode 20 to a temperature below a dew point of the water. The thermo-electric elements 35 are arranged in parallel circuit with each other between conductor boards 32 to cool the emitter electrode 20 at a cooling rate determined by a variable voltage given from an external cooling electric power source through a cable 38. One of the conductor boards 32 defining a cooling side the module is coupled to the emitter electrode 20 through the cooling plate 33, while the other conductor board 32 defines a heat radiation side and is connected to a heat radiator 36 having a plurality of fins.

[0012] The Peltier module is fixed between the bottom of the barrel 12 and the heat radiator 36 with its cooling plate 31 in heat transfer contact with a root of the emitter electrode 20. The high voltage source 40 includes a high voltage generation circuit which applies a predetermined high voltage across the emitter electrode 20 and the grounded opposed electrode 24 to give a negative or positive voltage (for example, - 4.6 kV) to the emitter electrode 20. The atomizing unit 10 has a side opening 14 in a side wall of the barrel 12 for taking in the conditioned air as will be discussed later.

- [0013] Referring back to FIG. 1, the casing 50 is formed with an air intake conduit 60, a first outlet conduit 70 and a second outlet conduit 74 respectively shaped for connection with spaced apart portions of the ventilation duct 100, and respectively defining an air intake 62, a first outlet 72, and a second outlet 76 at the individual connections to the ventilation duct 100. The casing 50 has its interior space divided by a partition 80 into a first passage 81 leading from the air intake 62 to the first outlet 72, and a second passage 82 leading from the air intake 62 to the second outlet 76. A blower 90 is disposed adjacent to the air intake 62 to introduce the air through the air intake 62 and generate a first forced air flow (F1) directed through the first passage 81 as well as a second forced air flow (F2) directed through the second passage 82. The atomizing unit 10 is disposed in the first passage 81 between the blower 90 and the first outlet 72 with the heat radiator 36 disposed in the second passage 82 between the blower 90 and the second outlet 76. The second forced air flow (F2) runs into the barrel 12 of the atomizing unit 10 through the side opening 14 and out of the barrel through the top opening 26 thereof so as to carry the mist generated from the emitter electrode 20.
- [0014] Assuming that the ventilation duct 100 flows the conditioned air with an associated main flow pressure P1, the blower 90 adds a flow pressure to the flow pressure (P1) of the air taken from the air intake 62 so as to give a first increased flow pressure P2 to the air immediately upstream of the first outlet 72 within the first passage 81, and also a second increased flow pressure P3 to the air immediately upstream of the second outlet 76 within the second passage 82. Since the flow pressures P2 and P3 are greater than the main flow pressure P1, the air carrying the mist of the charged minute particles released from the atomizing unit 10 is successfully introduced into the ventilation duct 100 due to a pressure difference (P2-P1), and the air passing around the heat radiator 35 is successfully introduced into the ventilation duct also due to the pressure difference (P3-P1). Basically, the increased flow pressure is determined by the capacity of the blower 90, the pressure differences at the respective outlets 72 and 76 are not influenced by the main flow pressure P1, i.e., the flow rate of the conditioned air flowing generated by the fan 112. Therefore, irrespective of variations in the flow rate of the conditioned air, the mist can be successfully supplied into the ventilation duct 100, and also the air passing the heat radiator 36 can be successfully discharged into the ventilation duct.
- [0015] It is noted in this connection that the second outlet 76 is dimensioned to have a cross-section area smaller than that of the first outlet 72 to give a relation of $P3 > P2$ for discharging the air out through the second outlet 76 faster than through the first outlet 72. This is effective to enhance the cooling effect of the heat radiator 36 for assuring stable water condensation on the emitter electrode 20, while enabling to flow the air around the emitter electrode 20 at a reduced flow rate for prevention of the blow off of the

water from the emitter electrode and therefore keeping stable generation of the mist.

[0016] The casing 50 is assembled to the ventilation duct 100 with each of the air intake conduit 60, the first outlet conduit 70, and the second outlet conduit 74 inserted into a corresponding hole in the wall of the ventilation duct. In order to hermetically seal the connections between the casing 50 and the ventilation duct 100, each of the air intake conduit 60, the first outlet conduit 70, and the second outlet conduit 74 is provided at its end with a flange 52 and a seal ring 54. The seal ring 54 is held between the flange 52 and the wall of the ventilation duct 100.

[0017] Although the above embodiment illustrates that the air intake conduit 60, the first outlet conduit 70, and the second outlet conduit 74 are arranged along a length of the ventilation duct 100 with the air intake conduit 60 upstream of the first and second outlet conduits, the present invention is not limited to this particular arrangement and may include a modification of FIG. 4 in which the air intake conduit 60, the first outlet conduit 70, and the second outlet conduit 74 are arranged in a direction perpendicular to the length of the ventilation duct 100. Like parts are designated by like reference numerals in this modification for easy reference.

[0018] The above described kit is particularly advantageous to be retrofitted to an existing ventilation duct 100, but can be also combined with a fresh ventilation duct to present a mist supplying device to be assembled into the vehicle.

[0019] Further, in the above illustrated embodiment, the atomizing unit 10 is configured to include the opposed electrode 24 in front of the emitter electrode 20. It should be noted that the opposed electrode 24 is only preferable for controlling a flow direction of the mist, but is not an essential element for generating the mist. For example, the high voltage may be alternatively applied to the emitter electrode 20 by best utilizing a portion of the casing or the ventilation duct as a ground.

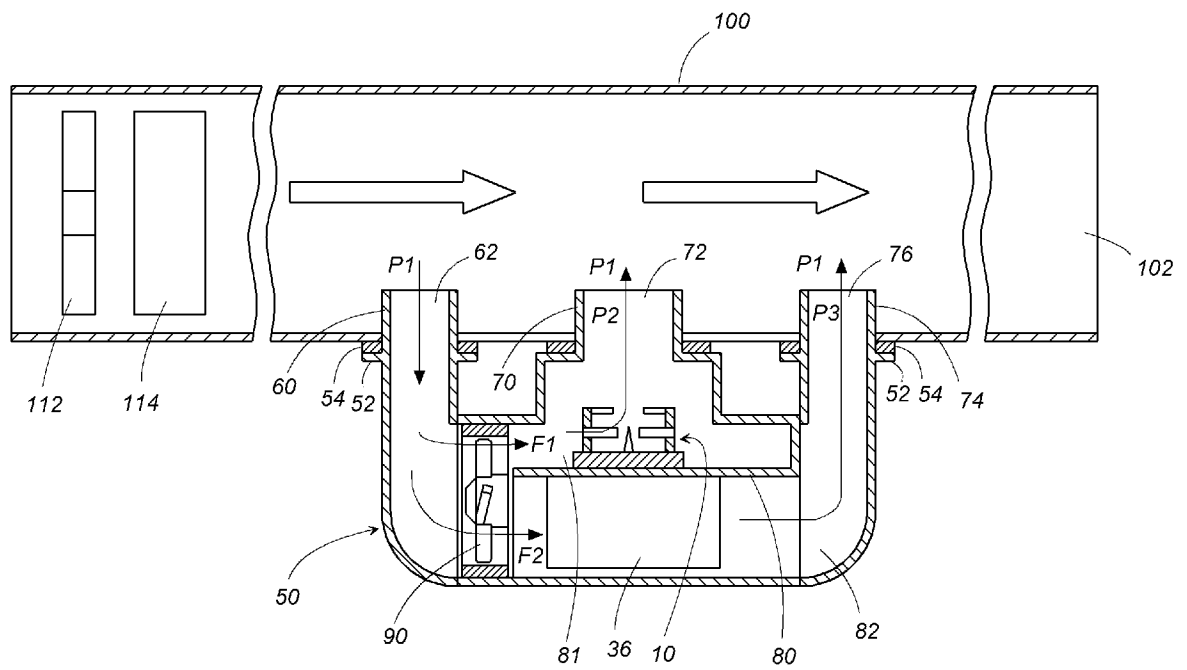
Claims

- [1] An electrostatically atomizing kit for use in a vehicle equipped with an air conditioning system having a ventilation duct blowing a conditioned air into a passenger's room through a blow port, said kit comprising:
an atomizing unit configured to supply a mist of charged minute water particles to the ventilation duct; and
a casing configured to accommodate therein said atomizing unit;
said atomizing unit comprising:
an emitter electrode;
a cooler configured to cool said emitter electrode for condensing water thereon from surrounding air;
a high voltage source configured to apply a high voltage to said emitter electrode so as to electrostatically atomize the water into a mist of charged minute water particles;
a heat radiator connected to said cooler for dissipating heat generated at said cooler when cooling said emitter electrode;
wherein
said casing is provided with an air intake, a first outlet and a second outlet which are adapted to be connected to said ventilation duct upstream of said blow port, said casing having its interior space divided into a first passage leading from said air intake to said first outlet, and a second passage leading from said air intake to said second outlet,
said casing includes a blower which generates a first forced air flow through said first passage as well as a second forced air flow through said second passage, said emitter electrode being disposed within said first flow passage to supply the mist into said ventilation duct,
said heat radiator being disposed within said second flow passage.
- [2] An electrostatically atomizing kit as set forth in claim 1, wherein
said second outlet has a cross-sectional area which is smaller than that of said first outlet.
- [3] An electrostatically atomizing kit as set forth in claim 1, wherein
said casing is provided with an air intake conduit, a first outlet conduit, and a second outlet conduit respectively configured to extend into said ventilation duct to define said air intake, said first outlet, and said second outlet.
- [4] A mist supplying device for a vehicle, said device comprising
the kit as defined in claim 3;
the ventilation duct configured to blow a conditioned air into a passenger's room

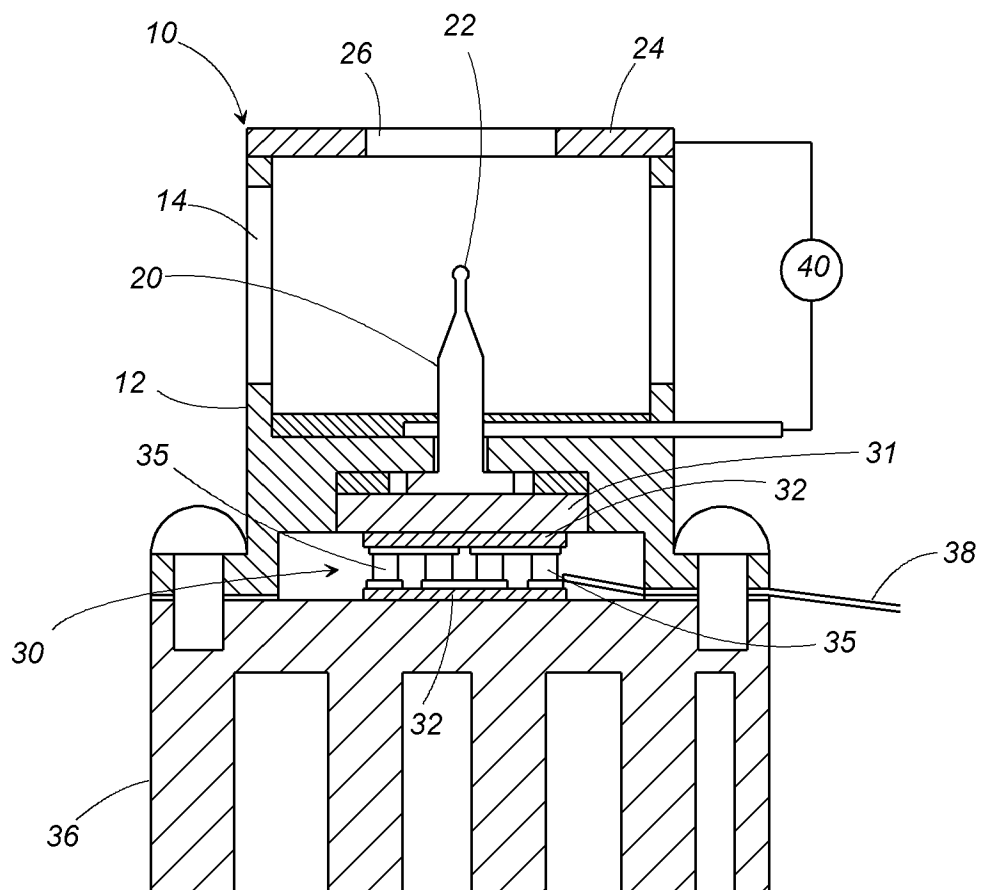
through a blow port of said vehicle.

- [5] A mist supplying device as set forth in claim 4, wherein said air intake conduit, said first outlet conduit, and said second outlet conduit are arranged along a length of said ventilation duct with said air intake conduit disposed upstream of said first and second outlet conduits.
- [6] A mist supplying system as set forth in claim 4, wherein said air intake conduit, said first outlet conduit, and said second outlet conduit are arranged along a direction perpendicular to a length of said ventilation duct.

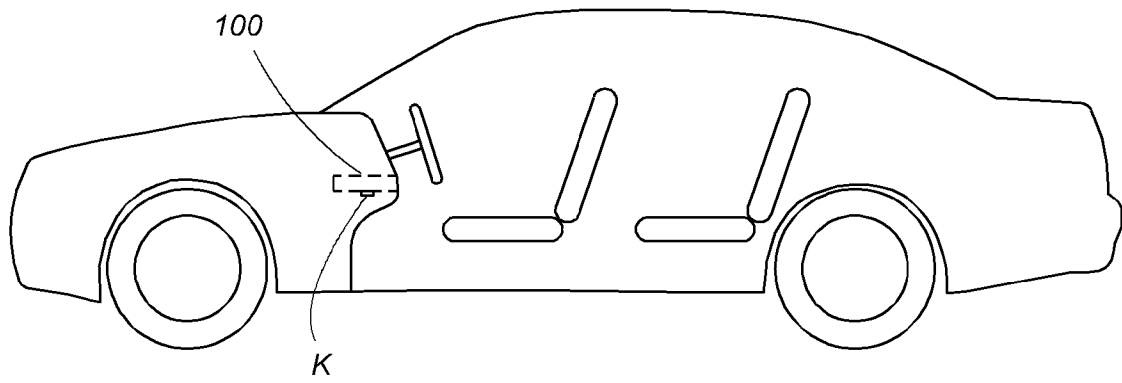
[Fig. 1]



[Fig. 2]



[Fig. 3]



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. B60H3/00

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)
B60H F24F B05B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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