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(54) Title: IMPROVED AIR CONDITIONING SYSTEM

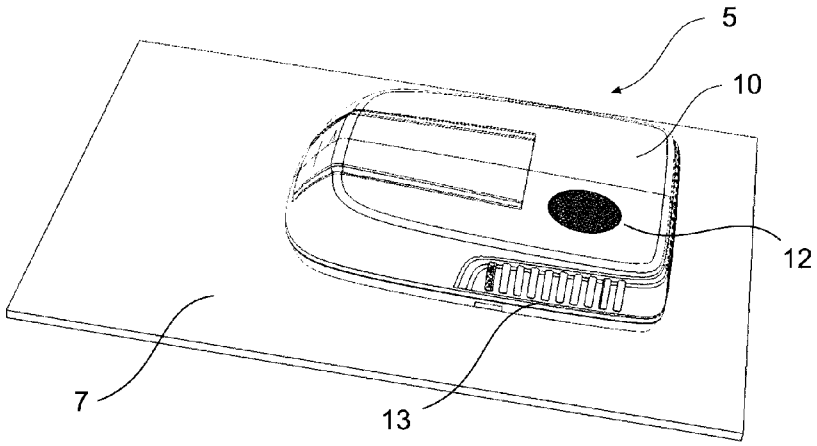


Figure 2

(57) Abstract: An air conditioning system for a vehicle having a roof, the air conditioning system having at least one air conditioning unit, with a first chamber and second chamber forming a conditioned air flow plenum having a configured S- shaped air flow path, and an outlet port configured to direct the air flow path in a substantially horizontal plane adjacent to the roof to disperse the air flow away from the air conditioning unit without the need for ducting.

WO 2015/131235 A1

IMPROVED AIR CONDITIONING SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to air conditioning systems and in particular to air conditioning systems that are located in a compact slim line housing that is suitable for use in a confined area.

BACKGROUND

Air conditioning systems are commonly used in order to make an environment more pleasing to occupants. This is particularly relevant when they're our options in a confined space, such as a caravan, mobile home or other recreational vehicle.

As used herein, the term "recreational vehicles" refers to motor homes, recreational vans, and other similar vehicles. Each of these has relatively confined spaces for the occupants to reside in and, as due to the nature of their use it is often that such vehicles are often used with a number of people, such as couples or families.

These recreational vehicles are built to suit a particular purpose so that there is a need to keep the weight of the vehicle to a minimum so that driving or towing them does not create too much of an impact on overall efficiency of the vehicle itself.

Conventional recreational vehicles have air conditioning systems that are built into the vehicle in some manner. For example, the air conditioning unit can be installed into the floor or roof and direct air around the interior cabin of the vehicles so that conditioned air is then provided to a particular area for the occupants.

Conventional air conditioning systems used in recreational vehicles are generally not as powerful as those that are used in domestic static dwellings due to the need to keep the weight and overall size of the air conditioning in

the recreational vehicle as low as possible. If an air conditioner unit has a simple conventional outlet, that is with a short path between the cooling chamber and the outlet, this results in a very small zone immediately adjacent to the outlet to which the conditioned air is supplied. For example, when an air conditioner is set to cool, the cooling zone around the outlet is relatively small and the efficiency of cooling, that is how large the cooling zone extends is proportional to the power of the air conditioner and so the effect reduces with respect to distance from the outlet.

Such a conventional system though may be appropriate in mild conditions when the variations of weather are minor, however it is during the hot summer months that such conventional air conditioning units fail to act to cool the interior cabin section of the recreational vehicle and so are inadequate.

Others had meet this shortcoming by making use of a ducting system in order to better deliver conditioned air to the occupants in a very targeted manner.

For example, as shown the figure 1, the air conditioning system 1 includes a number of ducts 2a and 2b that distribute the conditioned air around to various predefined outlets inside the interior of the vehicle. The length and size of the ducting can be varied to a certain degree to suit installation however the ducts must be of a minimum size to ensure that they are able to deliver a suitable volume of air to any one particular outlet so that the conditioned air can have some effect on the occupants.

The problem with such systems is that the ducts need to be quite large with respect to the area that they are being installed in taking into consideration that the walls of a recreational vehicle are relatively thin compared to a domestic wall. This then limits the size of the ducting that can be placed within the wall space or roof space of the recreational vehicle, and in many cases results in undersized ducting being used which reduces the air flow and air conditioner capacity.

To compensate for the use of ducts presently used in many installations, some manufacturers have increased the roof space in the recreational vehicle

however this results in either a slight lowering of the interior ceiling, which is not aesthetically pleasing or alternatively it can result in an increase in the outer roof height, which is the overall height of the recreational vehicle. Again, this is not desirable due to the need to keep the overall height of the recreational vehicle as low as possible to ensure that it is able to meet certain standards.

OBJECT OF THE INVENTION

It is an object of the present invention to provide an air conditioning system for use in a recreational vehicle that provides a greater distribution of air without the need for ducting.

It is an object of the present invention to overcome, or at least substantially ameliorate, the disadvantages and shortcomings of the prior art.

Other objects and advantages of the present invention will become apparent from the following description, taking in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed

SUMMARY OF THE INVENTION

According to one aspect, the present invention comprises an air conditioning system for a vehicle having a roof, the air conditioning system having at least one air conditioning unit, including

at least one centrifugal fan,

at least one return air entry port,

at least one outlet port,

at least one heat exchange coil operatively connected to a compression refrigeration system,

a first chamber formed by the at least one heat exchange coil substantially surrounding the at least one centrifugal fan, the at least one

centrifugal fan operable to draw in indoor air via the return air entry port and tangentially eject the indoor air in a substantially horizontal plane,

a second chamber forming a conditioned air flow plenum, said plenum having a conditioned air flow path to direct the indoor air flow through the at least one heat exchange coil, and out through an at least one outlet port, wherein said at least one outlet port is configured to direct the air flow path in a substantially horizontal plane adjacent to the roof.

In preference, the fan is located directly above the return air port.

In preference, the fan is a centrifugal fan.

In preference, the at least one outlet port is configured to direct the air flow path in a substantially horizontal plane adjacent to the roof by at least one louver.

In preference, the at least one louver is pivotable.

In preference, the at least one louver is pivotable between an open position and a closed position.

In preference, at least one directional vane is positioned in the first chamber adjacent to the at least one centrifugal fan.

In preference, the second chamber redirects the air flow path from the first chamber in a downward direction and towards the at least one return air entry port and then redirecting the airflow path by way of air flow guides outwards and away from the at least one return air entry port.

BRIEF DESCRIPTION OF THE DRAWINGS

By way of example, an embodiment of the invention is described more fully hereinafter with reference to the accompanying drawings, in which:

Figure 1 is an example of a prior art air conditioning system,

Figure 2 is a perspective view of an air conditioner constructed in accordance with the present invention,

Figure 3 is a horizontal cross sectional perspective view of figure of an air conditioner constructed in accordance with the present invention,

Figure 4 is side cross sectional view of the present invention,

Figure 5 is an exploded view of the lower plenum assembly,

Figure 6 is a plan view of the present invention showing the return air entry port and the air out let ports,

Figure 7 is a cross sectional view of Figure 6 along A-A;

Figure 8 is the cross section view of Figure 6 along B-B showing the path of the air entering into the return air entry port,

Figure 9 is a cross section view of the present invention showing the air paths through the interior of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to figure 2, the roof top air conditioner 5 of the present invention is located on a rooftop 7 of a vehicle (not shown), which may be a caravan, motor home, trailer or similar. As used herein, the term vehicle is intended to encompass all such motorised and non-motorised vehicles.

The air conditioner 5 has an outer cover 10 having and openings 12 and 13 to allow for the entry and exit of outside air into the heat exchange area of the air conditioner.

Figure 3 shows a view of the air conditioner 5 with a portion of the outer cover 10 removed showing the fan 15 that draws outside air into the heat exchange area and then forces it out through openings 13. The compressor 18 can be of any commercially acceptable type and is preferably mounted in a horizontal position as shown. Operatively connected to the compressor 18 is a condenser 20 that substantially surrounds the fan 15. Air drawn in from the outside is then forced through the condenser 20 and through the condenser to cool the refrigerant. This cooled refrigerant then passes through an expansion valve and into the evaporator 25 to absorb heat from indoor air that passes

over it. The refrigerant then returns back to the condenser 20 to once again be cooled then the condenser 20 and the evaporator 25 acts in unison as a heat pump.

The evaporator 25 is substantially surrounded by an evaporator cover 28 (top removed in figure 3), which can be made from any suitable material, such as polystyrene material for increased insulation effects. The enclosure or chamber formed by the evaporator cover 28 and the base 42 forms a plenum or chamber that acts to guide air being drawn in through the return air inlet port 32 by the centrifugal fan 34 that rotates about the centrifugal fan motor 36. So as to straighten out the airflow as it passes through the return air inlet port 32 a flow straightener 38 is located between the return air inlet port 32 and the centrifugal fan 34. A filter 50 provides filtration of the return air path.

The centrifugal fan 34 then ejects or forces the indoor air tangentially in a substantially horizontal manner so that it then is forced into and around the evaporator 25. As the evaporator 25 substantially surrounds the centrifugal fan 34 there is a significant increase in the cooling effect upon the indoor air that has been drawn in compared to conventional systems where the evaporator may only surround a small portion of the fan.

Once the indoor air has been cooled, or conditioned, by passing through the evaporator 25 it enters a further chamber formed by the cover 28 and the base portion 42, the conditioned air flow plenum, which directs the conditioned air along path 31 through an opening 33 that directs the air flow down and back towards the return air inlet port 32 where it is then further directed down and away from the air inlet port 32, ultimately ejecting the conditioned air through a louver 45 of the outlets 40 shaped to direct the outgoing air stream substantially horizontally, adjacent to the interior roof surface 46. The air path 31 is an “S”-shape which provides for a more compact arrangement of the openings 40 relative to the return air inlet port 32, however a more elongated “S”-shaped port may be employed although this would require a larger plenum cover 48 or alternatively a larger sized opening into which the air conditioning unit would reside.

By forcing the air path in this manner it was unexpectedly shown that the air flow so created traveled out a substantial distance away from the air outlets 40 so that it was able to cool areas well away from the air outlets 40 without requiring the need for any ducting to direct the air flow.

The plenum cover 48 has a number of air outlets 40 surrounding the return air inlet port 32. Each air outlet 40 has a louver, or air guide, 45 that is able to rotate about its horizontal axis so that it can move between an open and closed position. In figure 7, louver 45a is in a closed position such that no air can pass out through the opening 40a and louver 45b is in an open position. Figure 8 shows both louvers 45a and 45b in an open position. Each of the louvers 45 can be either manually or remotely adjusted.

The present invention also provides the unexpected benefit of better managing the flow of air back into the return air inlet port 32. One of the known problems with traditional vehicle air conditioning units is that conditioned air is often ejected relatively closely to the return air inlet port without having travelled far enough to cool the air space generally or the occupants. Whilst air conditioning systems that use ducts to take the conditioned air away from the return air inlet port partially address this problem, they introduce the complexity of having ducting work in the roof space of the vehicles cabin area as well as reducing the capacity of the air conditioner due to the decrease in air flow and thermal losses through the ducts.

The system of the present invention, which induces a substantial flat layer of airflow adjacent to and along the interior roof surface, allows the conditioned air to travel further away from the return air inlet port 32 and so the air being drawn into the return air inlet port 32 less likely to be recently conditioned air, which greatly enhances the effect of the conditioned air within the vehicles cabin by ensuring that the conditioned air is being used effectively to take heat out of the vehicle.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures can be made within the scope of the invention, which is not to be limited to the details described herein but it is to be accorded the full scope of the appended claims so as to embrace any and all equivalent devices and apparatus.

CLAIMS:

1. An air conditioning system for a vehicle having a roof, the air conditioning system having at least one air conditioning unit, including

at least one centrifugal fan,

at least one return air entry port,

at least one outlet port,

at least one heat exchange coil operatively connected to a compression refrigeration system,

a first chamber formed by the at least one heat exchange coil substantially surrounding the at least one centrifugal fan, the at least one centrifugal fan operable to draw in indoor air via the return air entry port and tangentially eject the indoor air in a substantially horizontal plane,

a second chamber forming a conditioned air flow plenum, said plenum having a conditioned air flow path to direct the indoor air flow through the least one heat exchange coil, and out through at least one outlet port, wherein said at least one outlet port is configured to direct the air flow path in a substantially horizontal plane adjacent to the roof.

2. The air conditioning system of claim 1, further characterized in that the fan is located directly above the return air port.

3. The air conditioning system of claim 2, further characterized in that the at least one outlet port is configured to direct the air flow path in a substantially horizontal plane adjacent to the roof by at least one louver.

4. The air conditioning system of claim 3, further characterized in that the at least one louver is pivotable.

5. The air conditioning system of claim 4, further characterized in that the at least one louver is pivotable between an open position and a closed position.

6. The air conditioning system of claim 5, further characterized in that the at least one directional vane is positioned in the first chamber adjacent to the at least one centrifugal fan.

7. The air conditioning system of any one of claims 1-6, further characterized in that second chamber redirects the air flow path from the first chamber in a downward direction and towards the at least one return air entry port and then redirecting the airflow path by way of air flow guides outwards and away from the at least one return air entry port.

8. The air conditioning system of claim 7, further characterized in that air flow path is “S”-shaped.

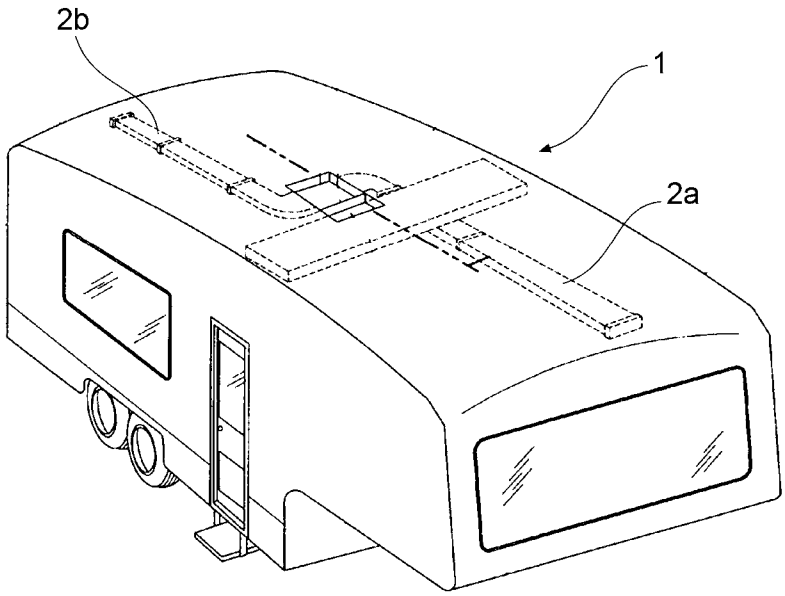


Figure 1

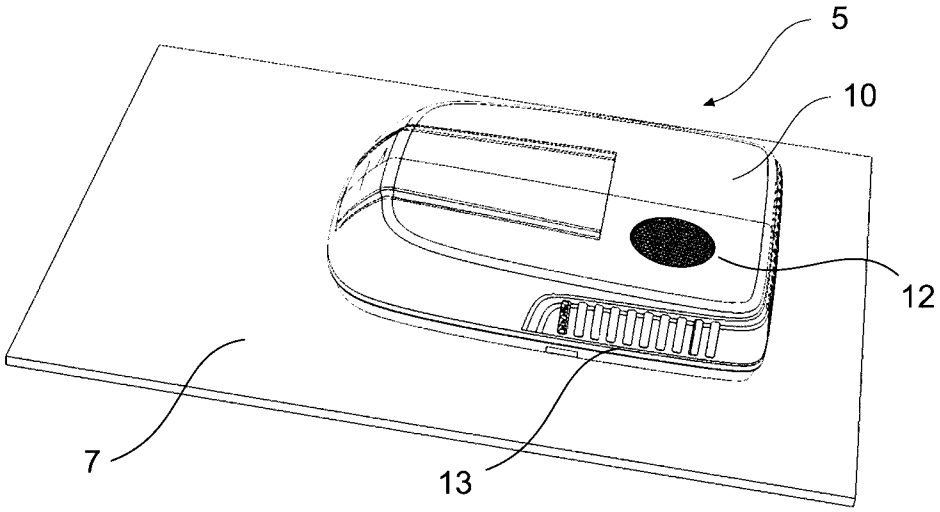


Figure 2

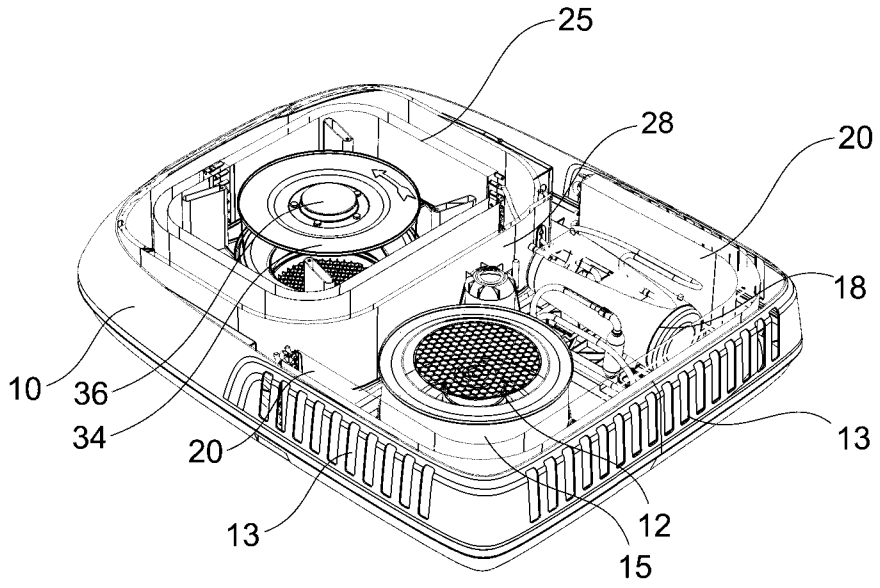


Figure 3

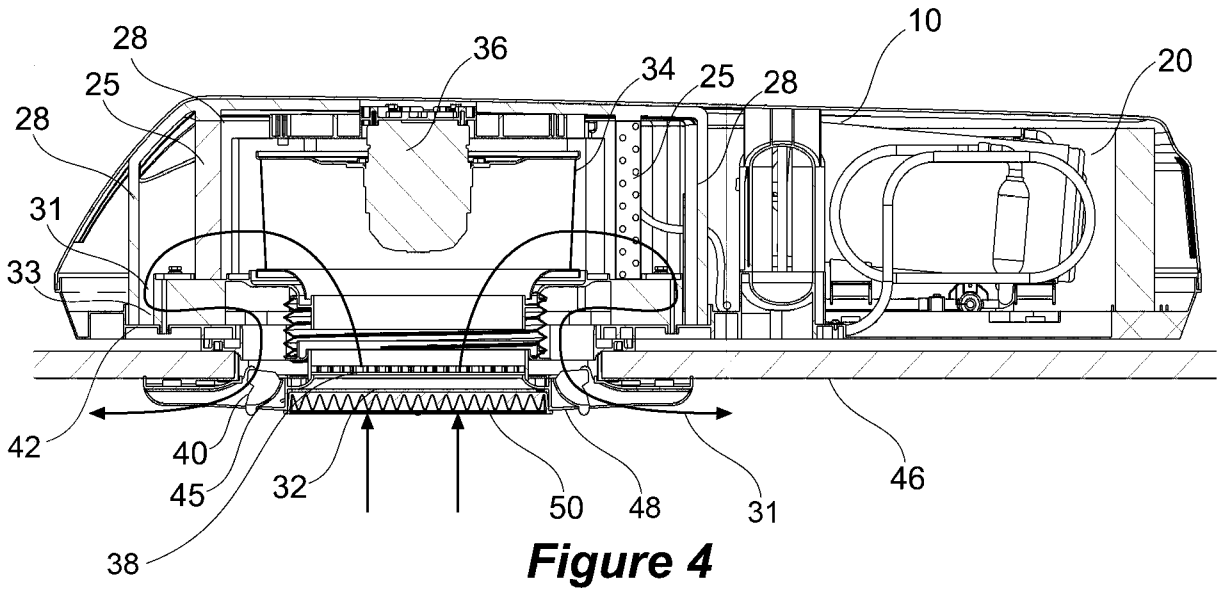


Figure 4

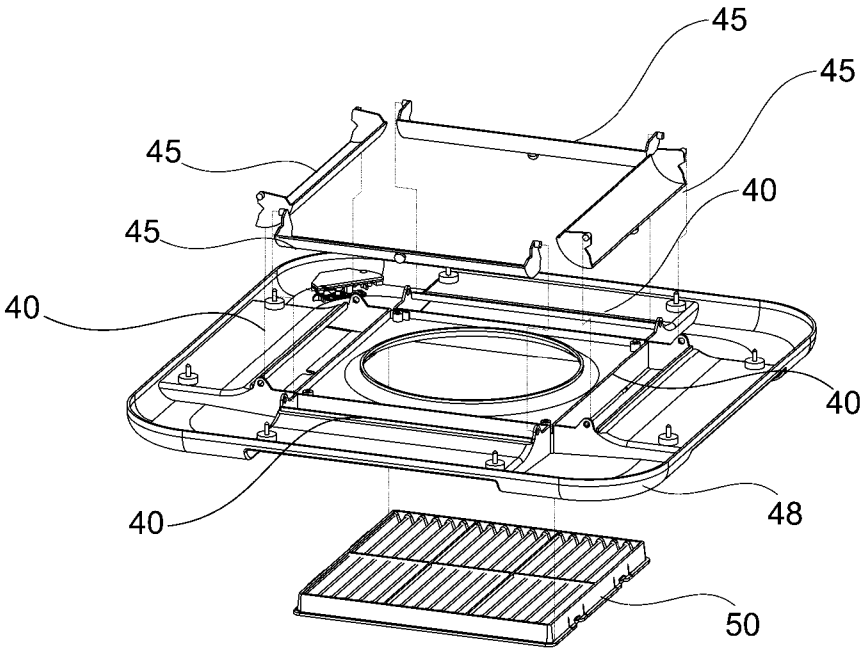


Figure 5

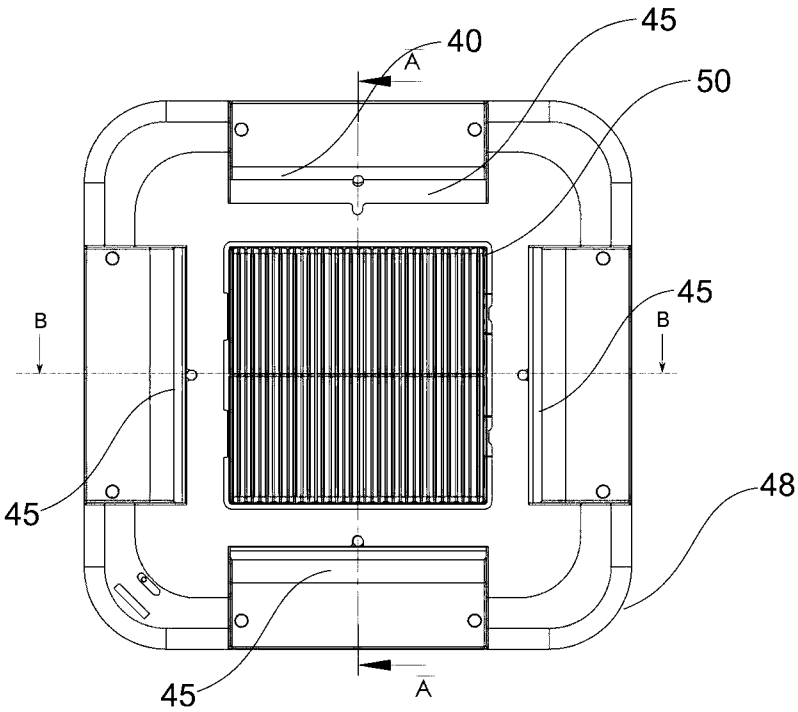


Figure 6

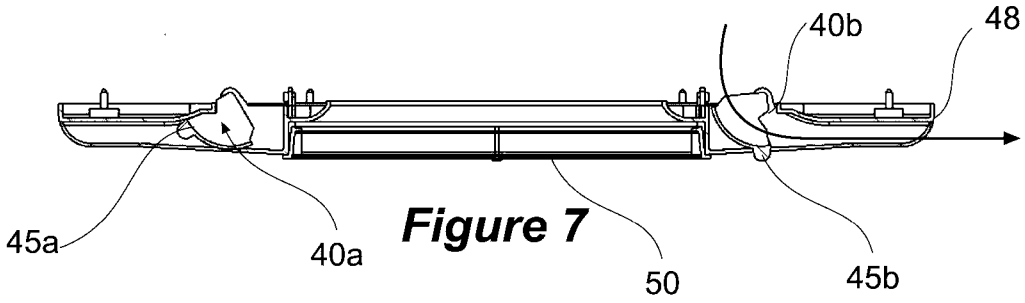


Figure 7

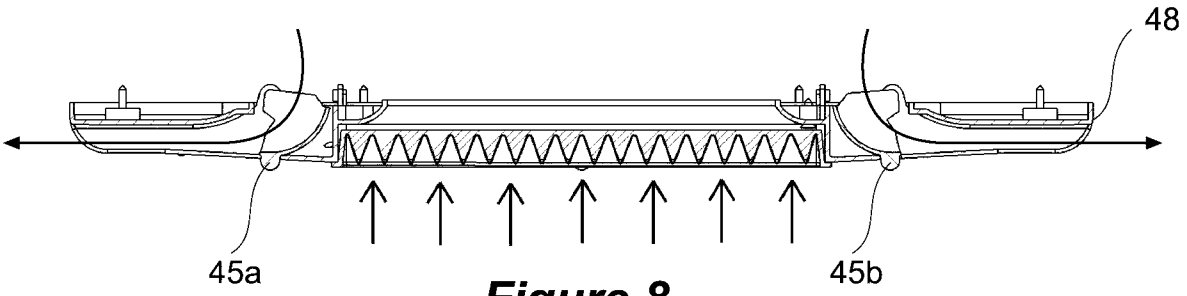


Figure 8

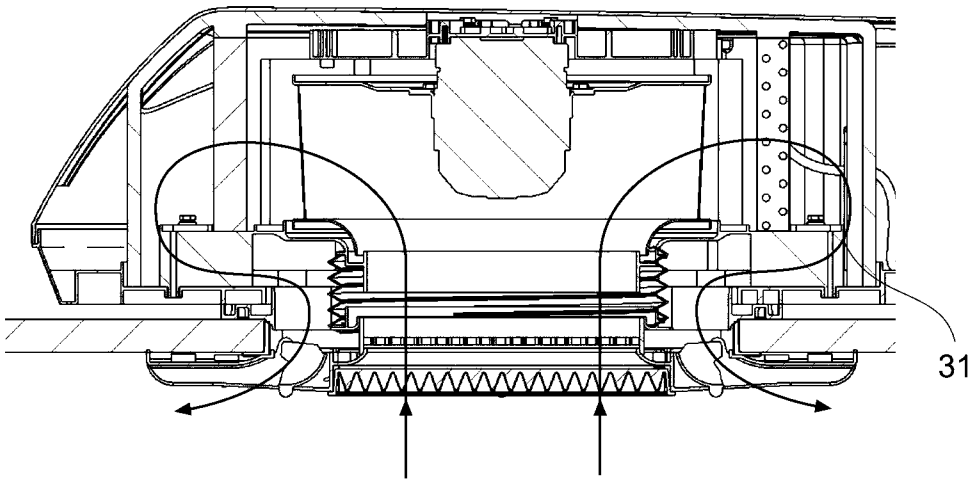


Figure 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2015/000126

A. CLASSIFICATION OF SUBJECT MATTER

B60H 1/00 (2006.01)

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)

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, WPIAP, EPODOC, GooglePatents, Espacenet, JPO searched using keywords: Air Conditioning, Air Conditioner, HVAC, Mobile Home, Caravan, Vehicle, Car, Truck, Train, Rail, Bus, Roof, Ceiling, Air Flow, Horizontal, Adjacent etc.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

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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
11 May 2015	11 May 2015
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Steven Howell AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262837996

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2015/000126**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4217764 A (ARMBRUSTER) 19 August 1980 Whole Document	1-8
A	US 5184474 A (FERDOWS) 09 February 1993 Whole Document	1-8
A	US 6357249 B1 (ROBINSON et al.) 19 March 2002 Whole Document	1-8

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2015/000126**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 4217764 A	19 August 1980		
US 5184474 A	09 February 1993	EP 0542577 A2	19 May 1993
US 6357249 B1	19 March 2002		

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.