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(56) Documents Cited:
GB 2032615 A **EP 0246948 A1**
DE 004300910 A1 **JP 2002005499 A**
JP 2000074473 A

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INT CL **F24F**
Other: **Online: WPI, EPODOC**

(54) Abstract Title: **An air flow control device having primary and secondary flow paths**

(57) The present invention provides an air flow control device that includes at least one inlet 2 and a primary flow path 3 associated with a primary outlet 4, and a secondary flow path 5 associated with a secondary outlet 6. The air flow device also includes at least one primary valve 7 associated with the primary flow path, said at least one primary valve being adapted to control the flow rate of air through said primary flow path. The secondary flow path may also be provided with a valve to control air flow through the second flow path. The device may be used in an air conditioning system to control the flow rate and flow pattern of air.

FIGURE 1

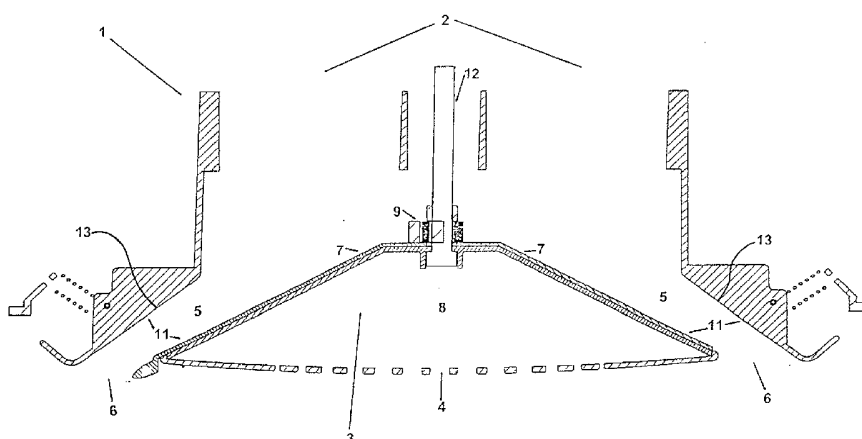


FIGURE 1

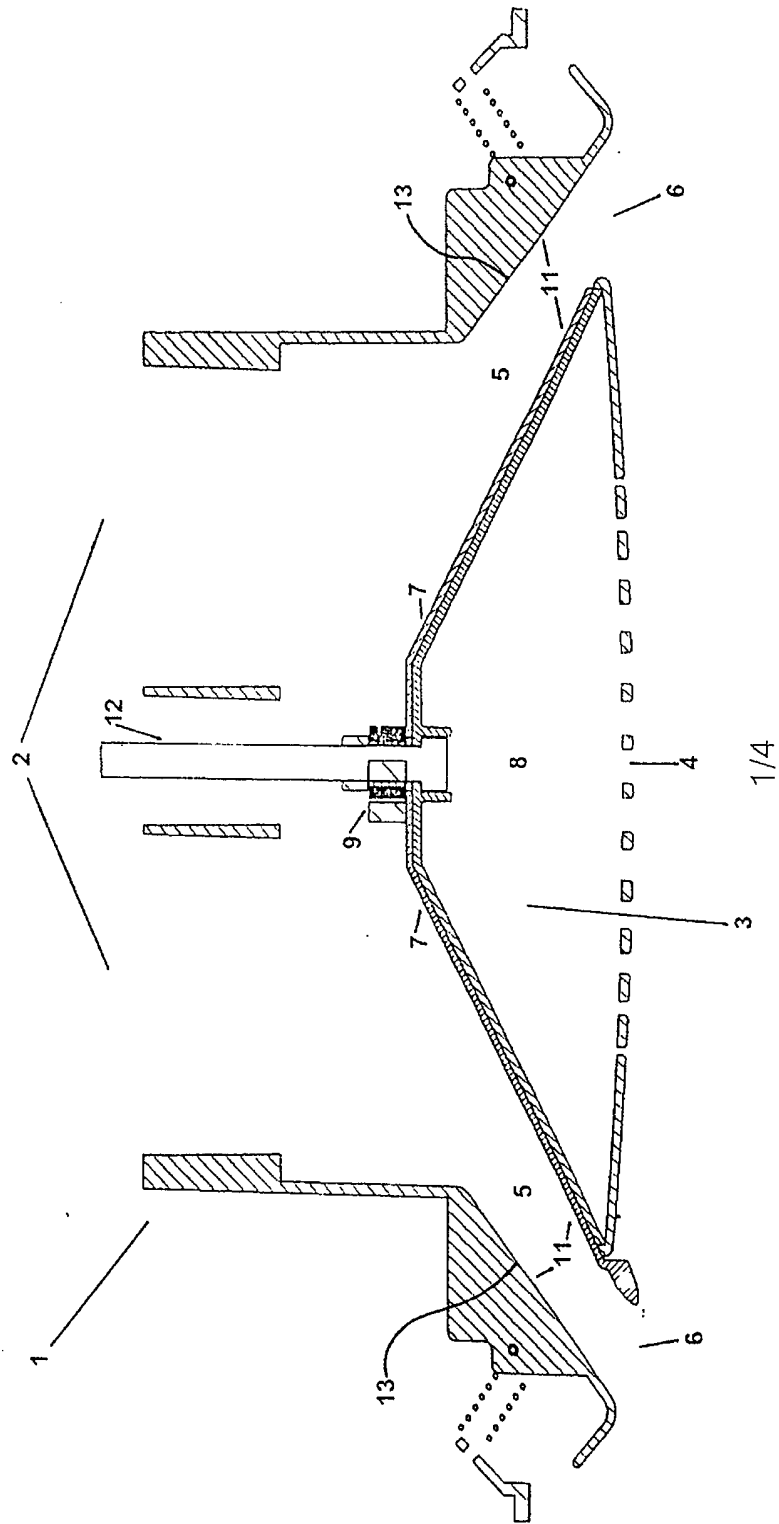


FIGURE 2b

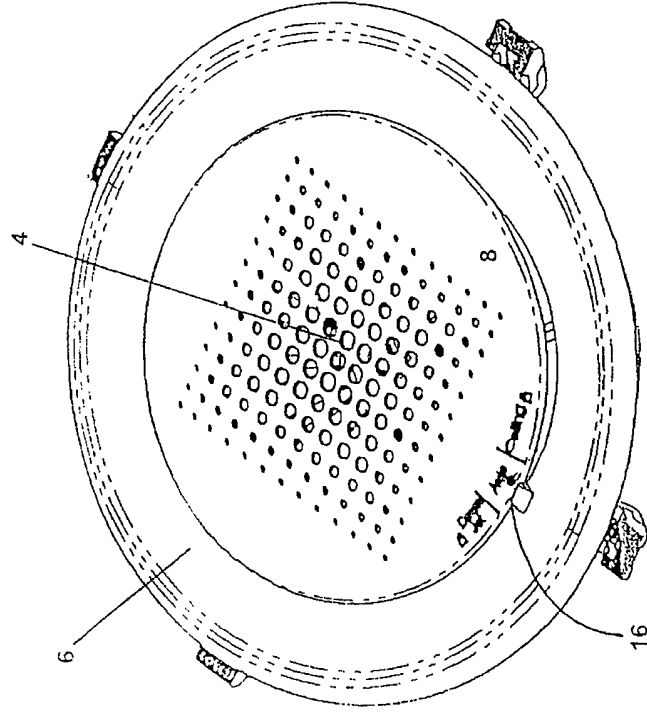


FIGURE 2a

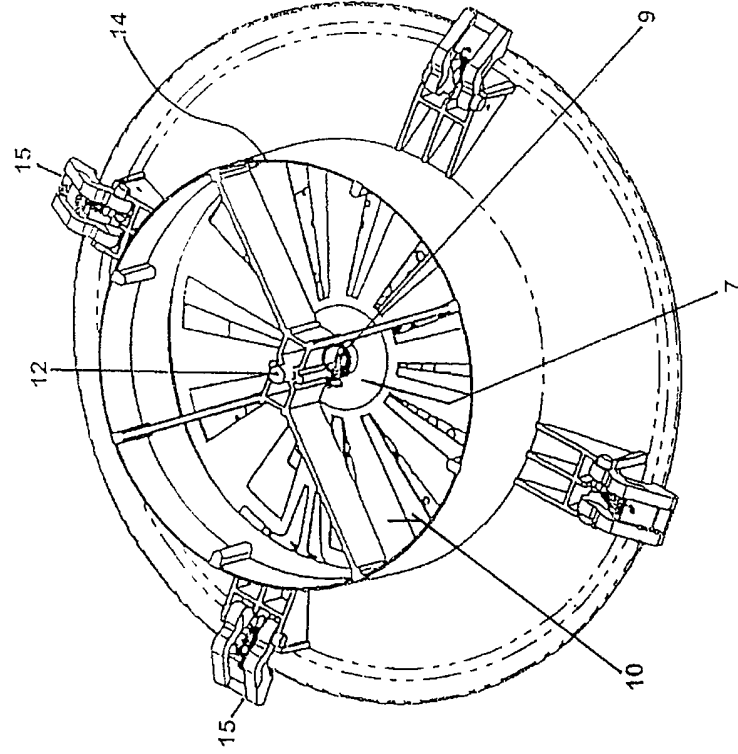


FIGURE 3a

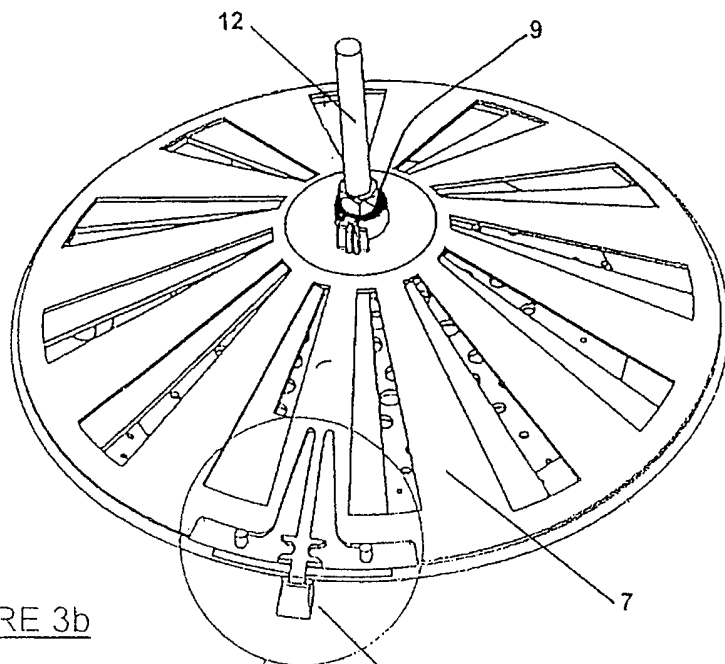


FIGURE 3b

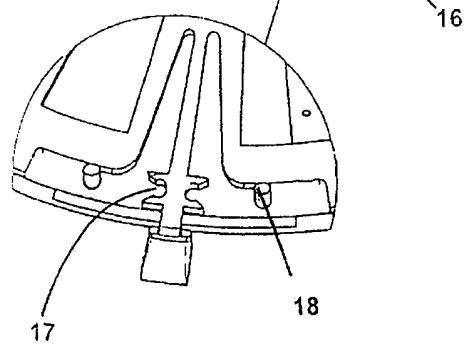


FIGURE 4a

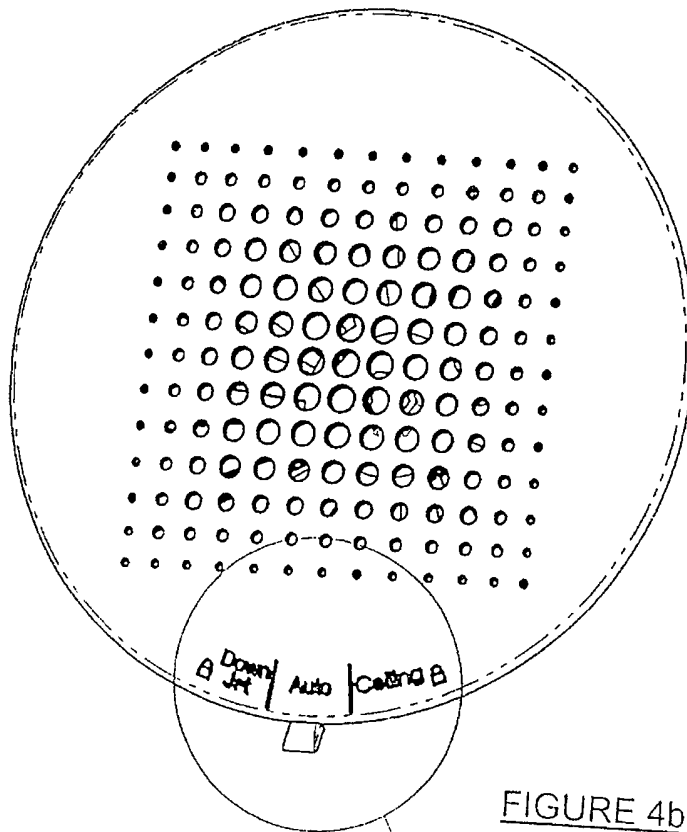
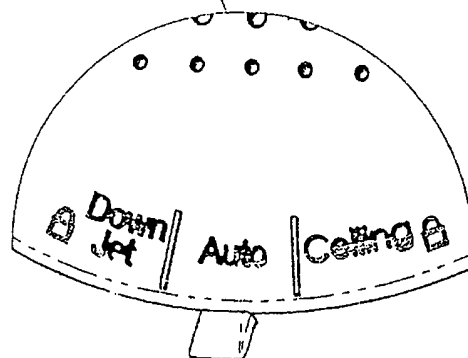


FIGURE 4b



AIR FLOW CONTROL DEVICE

TECHNICAL FIELD

This invention relates to an air flow control device. Preferably the present invention may be used to control the distribution of air delivered from an air circulation, or air conditioning system. However, those skilled in the art should appreciate that other applications for the airflow control device provided are also considered, and reference to its use with an air circulation or conditioning system only throughout this specification should be in no way seen as limiting.

BACKGROUND ART

Air circulation systems in buildings exchange stale air for fresh air. One type of air circulation system is an air conditioning system, which is also used for cooling or heating rooms throughout a building.

Typically in such systems, warm or cool conditioned air flows through a network of ducts distributed throughout a building, and then flows into a room via an outlet in a ceiling or wall. Outlet coverings such as diffusers are commonly used as control devices to control the flow rate or dispersal pattern of the air flow introduced in the room via these ducts. The direction and velocity of the air flow introduced influences the cooling or heating effect felt by the user in the room.

Diffusers can be designed for uniform dispersal of air across the entire volume of a room. The diffuser provided to control the air flow into the room can be static, with one shape provided that distributes the air in the same way irrespective of climatic conditions. In such instances the buildings occupants have limited control of the system apart from altering the temperature of the air provided to the diffuser via a central conditioning unit.

To achieve optimal cooling or heating with minimal energy wastage, air conditioning systems preferably need a diffuser which can change the way the air is spread throughout a room depending on the temperature change required.

Ideally, where cooling is preferred, an optimum cooling air distribution is achieved by altering the air flow out of a duct so that it flows laterally across the ceiling of a room. This lateral projection allows the air to spread evenly throughout the room as the air sinks via convection currents to the floor region.

When heating is preferred, an optimum air distribution is achieved by projecting heated air straight down to the floor of a room. As warmer air is less dense than the initial room air, the performance of the diffuser depends on its ability to direct air downwards quickly before the air spreads and rises.

Thus, the ability to change the flow pattern of the diffused air based on the temperature of the air provided is a preferable feature of ceiling diffusers.

Furthermore, the ability to adjust the flow rate for rapid or slow heating or cooling, depending on the preference of the user, is a desirable feature of such a diffuser. Allowing a user to alter the flow rate to quickly bring air to a desired temperature then reduce the flow rate for a maintenance level throughout the day is desired to provide maximum comfort levels to the user.

Some air flow control devices have been developed where the flow rate of air introduced can be altered, such as the Paltech Round Ceiling Diffuser made by PalTech Corporation (Aust) Pty Ltd. These systems alter the flow rate out of the duct by adjusting a valve or similar system which is opened or closed depending on the flow rate preferred by the user.

Flow rate changes can be achieved by using a valve in the diffuser of the air conditioning system. The "head" of the valve is formed by an internal stopper

attached to a threaded shaft. This threaded shaft and stopper combination restricts the diameter of an output channel into a room when closed, thus reducing the flow rate into the room. This threaded valve system can be a manual system, and as such is low in price. However in these systems only the flow rate is adjustable, while the flow pattern can not be altered.

Systems have also been developed which control the pattern of the air flow into a room. For this, systems involving manually operated mechanisms are generally used for lower cost installations. Some diffusers used have two different settings and the patterns are set once or twice a year, at the time of change between the months requiring heating or cooling. This approach is inflexible, as the system is unable to cater for unseasonable changes in heating or cooling requirements, causing discomfort for the user and wasted energy.

Attempts to provide a low cost diffuser which automatically alters the flow pattern based on temperature have been developed, such as that described in NZ Patent No. 247231.

This patent describes a diffuser with a bottom plate which is attached to bi-metallic coils which raise the plate section when heated, forcing air downwards. When the air flowing through the diffuser is cooler than the room, the plate is lowered, forcing the air laterally across the ceiling.

Although the cost of this type of diffuser is low, with little to no maintenance requirements and the flow pattern is adjustable, the flow rate is fixed at a central location and the user has no input into controlling the flow rate. This can result in uneven cooling or heating, as smaller rooms are brought to a stable temperature quickly, while larger rooms still require further cooling or heating.

An improved ceiling diffuser which addresses any or all of the above limitations would be an advantage. In particular, a ceiling diffuser which allowed for user control of

flow rate, and flow pattern, and preferably which allowed the user to choose between automatic or manual operation would be of advantage.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is acknowledged that the term 'comprise' may, under varying jurisdictions, be attributed with either an exclusive or an inclusive meaning. For the purpose of this specification, and unless otherwise noted, the term 'comprise' shall have an inclusive meaning - i.e. that it will be taken to mean an inclusion of not only the listed components it directly references, but also other non-specified components or elements. This rationale will also be used when the term 'comprised' or 'comprising' is used in relation to one or more steps in a method or process.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided an air flow control device that includes

at least one inlet, and

a primary flow path associated with a primary outlet, and

a secondary flow path associated with a secondary outlet, and

at least one primary valve associated with the primary flow path, said valve being adapted to control the flow rate of air through said primary flow path.

According to another aspect of the present invention there is provided an air flow control device substantially as described above wherein said air flow control device includes at least one secondary valve adapted to control of the flow rate of air through said secondary flow path.

The present invention provides an air flow control device which is preferably used with an air conditioning system. The air flow control device when used with an air conditioning system may provide optimal distribution of the air flowing from an air conditioning duct into a room. However, in an alternative embodiment, the air flow control device may be provided in conjunction with other systems, such as systems providing recycled or non-conditioned air.

Reference throughout this specification will be made to the present invention providing an air flow control device in conjunction with an air conditioning system. However, those skilled in the art should appreciate that the present invention can be used in a range of other applications, and reference to use with conditioned air only throughout the specification should in no way be seen as limiting.

Preferably, the air flow control device may control both the flow rate and flow pattern of air coming from the air conditioning system into a room. This allows optimal distribution of the air, thus reducing wasted energy and allowing maximum comfort levels for the user. However, in an alternative embodiment the air flow control device may not necessarily control both of these features. The air flow control device may only control one of the flow rate or flow pattern of the air coming from the air

conditioning system into a room.

Reference throughout this specification will be made to the present invention providing an air flow control device which controls both the flow rate and flow pattern of the air coming from the air conditioning system into a room. However, those skilled in the art should appreciate that the present invention may also be used to only alter one of the flow rate or the flow distribution pattern, and reference to the device being used to provide both features throughout the specification should in no way be seen as limiting.

Preferably, the inlet of the present invention may engage with the outlet of the air conditioning duct. Air may flow from the air conditioning duct outlet through the present invention by way of its inlet. However in alternative embodiments an inlet may not necessarily engage with a single air conditioning duct. Furthermore in other embodiments, the invention may have more than one inlet which allows for air to flow into the device if required.

Reference throughout this specification will be made to the present invention including a single inlet port engaged with the outlet of a duct. However, those skilled in the art should appreciate that the invention can be used with a range of other systems and reference to the above only throughout the specification should in no way be seen as limiting.

Preferably the air control device may include both at least one primary flow path and at least one secondary flow path. Having both a primary flow path and a secondary flow path in one air control device allows the air to flow in two directions from one inlet through a primary and a secondary outlet, thus distributing the air flowing into the room in multiple directions at once.

A flow path may be formed as a channel, configured to control a route that air takes through the air flow control device.

Preferably the primary and secondary outlets of the present invention allow the air flowing through the primary or secondary channels to be delivered into a room. Air may flow through either the primary or secondary channel, or both, into a room. It is these channels which may be restricted or altered to change the flow path so that the air flowing through the outlets exits in different directions.

A plurality of outlets may possibly be associated with each of the primary or secondary channels. In a preferred embodiment, a primary outlet may be formed with a diffusion grating, which is formed with many different sized holes, creating multiple outlets from the primary channel. This grating directs the air in a mostly downwards pattern, but other grating patterns may also be used, or in alternative embodiments there may be no grating associated with the primary outlet.

Preferably the air flow control device may include a primary valve associated with a primary channel. Preferably, the primary valve blocks or restricts the primary channel, forcing air into the secondary channel. In such embodiments, when the primary valve is opened, most of the air in the device goes through the primary channel, restricting the amount that goes in the secondary channel. When the primary valve is closed, air flow through the secondary channel will correspondingly increase.

Preferably a primary valve may be formed by the interleaving of two movable filtering components with complimentary apertures, such that the physical relationship between the two filters blocks or opens at least one channel between the two components. The interleaving of two filtering components allows one to be moved in relation to the other to block, open, or close the primary flow path through the primary channel and out to the primary outlet. This variable 'hit and miss' alignment pattern therefore provides the valve system required.

However, in an alternative embodiment the primary valve may be formed by a

butterfly valve, blade, or any other movable blocking element which performs the same function.

Reference made throughout this specification will in general be made to the primary valve being formed by two interleaved filtering components. However, those skilled in the art should recognise that the other components may be used to form a primary valve, and reference throughout this specification to the above only should in no way be seen as limiting.

Preferably a primary outlet associated with the primary channel may direct air flow in an alternative direction to the outlet associated with the secondary channel. This allows both the flow rate and the flow pattern to be altered, as closing or restricting the primary valve allows more air to flow through the secondary channel.

The primary valve in general effects the pattern of the air flowing through the air control device. However, one skilled in the art may recognise that the primary valve may be used to alter either the flow pattern or the flow rate, and reference throughout this specification to the primary valve altering the flow path only should in no way be seen as limiting.

Preferably the air flow control device may include a main body which forms a housing adapted to locate an interior primary flow path, a secondary flow path and associated valves, as well as defining the inlet.

Preferably, provided within the interior of the main body may be a central conduit. This central conduit may be adapted to define the primary flow path and locate a primary valve within its interior.

Preferably the secondary flow path may be defined by an exterior wall of the central conduit and a wall of the main body.

This means that the secondary flow path may be defined as the region where the air

flows past the outside of the central conduit, but the inside of the main body. The primary flow path can therefore be defined as the region where the air flows through the inside of the central conduit.

However, this conduit may not form the inner wall of the secondary channel in alternative embodiments. For instance the secondary flow path may be entirely separate from the primary flow path, and reference throughout this specification to a conduit being nestled centrally in the main body of the air flow control device should in no way be seen as limiting.

Preferably the secondary channel may provide a static distribution pattern of air into the room. The secondary valve preferably only effects the flow rate of the air provided, not the flow pattern. In such embodiments this secondary channel allows air to flow on the outside of the primary channel with the primary valve primarily altering the distribution pattern of the air provided.

However, it should be recognised that the secondary flow path may, in alternative embodiments, include an element which allows a variable distribution pattern of the air flowing through the secondary outlet. This could be provided by a diffusion grill on the secondary outlet, or some kind of movable blocking element if required.

Reference throughout this specification will be made to the secondary flow path providing a static distribution pattern. However those skilled in the art should appreciate that the secondary flow path can be implemented in a range of ways, and reference to the secondary flow path providing a static distribution pattern only should in no way be seen as limiting.

Preferably the main body of the air flow control device may be formed by a funnel shaped element. However, the main body could also be formed in any other shape which allows air to flow through it in the way described in the specification as above. Any reference throughout the specification to the body being formed in the shape of a

funnel should in no way be seen as limiting.

Preferably the body of the conduit may be formed as a conical shape. This allows the conduit to easily be contained in the main body of the air flow control device. However, in alternative embodiments the conduit body may be any other shape which fits inside the main body provided for use in the present invention.

Reference throughout the specification will be made to the main body of the air flow control device being formed in a funnel shape and the interior conduit being formed by a conical shaped element. Those skilled in the art should appreciate that the invention can be used with a range of various other shapes and reference to these shapes only throughout the specification should in no way be seen as limiting.

Preferably the main body may include a secondary valve adapted to restrict the secondary flow path. This secondary valve primarily effects the rate of air flowing through the air flow control device.

Preferably a secondary valve may be formed by mounting the central conduit on a spindle which may be raised and lowered, thus moving one angled side wall of the secondary flow path in relation to its opposite wall and therefore reducing the span of the secondary channel.

However, in alternative embodiments the secondary valve may be formed in other ways. A butterfly valve may be used, or an electrical or magnetically driven valve may raise or lower the conduit, or alternatively the secondary flow path may be restricted by another way of moving the outer walls as opposed to the inner walls, or by any other valve which reduces the span of the secondary flow path.

Reference throughout the specification will be made to the secondary valve being a spindle which allows the internal conduit to be raised and lowered manually. Those skilled in the art should appreciate that the secondary valve could also be formed by

any kind of movement which restricts the secondary channel, and reference to the above only throughout the specification should in no way be seen as limiting.

Preferably the air flow control device may include a control means adapted to control the operation of a primary valve. This control means may control switching between the primary valve being fully open, fully closed, or partially open.

In some embodiments the control means may operate automatically. Automatic operation may be achieved by including a temperature sensitive element which controls the primary valve, so that the valve opens as warm air flows through the inlet and closes as cold air flows through the inlet. This allows air to travel primarily through the primary channel when the air is warmer than the room air and through the secondary channel when the air is colder than the room air, thus maximising energy efficiency.

For example, in some embodiments this automatic control means may be formed by bi-metallic strips attached to the primary valve mechanism. As the bi-metallic strips are heated, the thermal expansion of the metal forming the inside of each strip is less than that of the metal forming the outside. This causes the strips to rotate, in turn rotating the filtering components, thus opening the primary valve when warm air flows onto the bi-metallic strips. The opposite effect is seen when cooler air flows through, rotating the primary valve in the opposite direction, thus directing air through the secondary channel.

However, in other alternative embodiments the control means may be manually operated. For example in such embodiments the manual control means may be formed by a user control lever. This control lever may be directly linked to one of the filter elements, and may be used to adjust its position relative to the other filter element. The manual control means may also be locked on open, or on closed depending on user preference.

Preferably, the air flow control device may provide manual and automatic control of the primary valve depending on user preferences. Such a system may be implemented by including a control setting means which allows the user to choose between manual and automatic control.

This control setting means may preferably be provided in the form of a user control tab which can be moved by a user, locked in one position, or automatically moved by a temperature sensitive element so that the control means are automatic or manual.

The present invention may provide many potential advantages over the prior art.

The present invention can allow control of air flow rate and distribution pattern in one simple device. An air flow pattern can easily be adjusted to minimize energy wastage. To minimise energy wastage, air may be directed downwards when it is warmer than the air provided in the room, and laterally across the ceiling when the air provided is cooler than that already in the room. The air flow rate can also be adjusted to allow for faster heating or cooling, where this can be achieved by opening or closing the secondary valve. The air flow control device can provide the end user with a high level of control in one individual device.

The present invention may also provide a manual and automatic primary valve control system.

When the control means is set to automatic control, the air flow control device automatically provides the correct distribution pattern for the air flowing through the device. The manual control setting allows the user to determine in which direction they would prefer the air to flow, therefore if the air flowing out of the air conditioning unit is warmer than they would prefer they can deflect this air by letting it flow across the ceiling. If the air is cooler then they can direct this air straight down to the floor. The manual control setting allows total control by the user of the direction and flow rate of the air.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 shows a cross section view of an air flow control device configured in accordance with a preferred embodiment;

Figure 2a, 2b shows a top and bottom view of the air flow control device of figure 1, and

Figure 3a, 3b shows a detailed view of the primary valve used in the embodiment shown with respect to Figures 1, 2a, and 2b.

Figure 4a, 4b shows in detail the control means used in the embodiment shown with respect to Figures 1, 2a, 2b, 3a and 3b.

BEST MODES FOR CARRYING OUT THE INVENTION

Figure 1 shows a side cross sectional view of an air flow control device (1) as configured in accordance with a preferred embodiment.

This view shows one inlet (2) adapted to engage with an outlet of an air conditioning duct, a primary flow path (3) forming a primary channel associated with a primary outlet (4), a secondary flow path (5) forming a secondary channel associated with a secondary outlet (6), and a primary valve (7) incorporated into the device (1).

The primary valve (7) is formed by an interleaved grill formed on the top of a conduit body (8) mounted in the centre of the main body of the air flow control device (1). The construction of the primary valve is shown in detail with respect to Figures 3a, 3b. An automatic control means (9) located in the centre of the interleaved grill forming the primary valve (7) allows automatic control of the valve.

It can be seen that the primary outlet (4) is formed in a conical shaped conduit body (8) which includes a grating on the bottom face. This grating directs the air flow through the primary outlet (4) in a mainly downward direction.

Also provided is a secondary valve system (11) which alters the flow rate out of the secondary outlet(s) (6). The secondary valve is formed by the internal conduit being mounted on a movable central spindle (12). As the conduit is raised on the spindle, the angled side walls (13) restrict the secondary channel, thus altering the flow rate out of the secondary outlet (6). Therefore, the secondary valve (11) is formed by the angled side walls (13) of the secondary channel (5) moving in relation to the main body.

Figure 2a shows a top view of an air flow control device (1) as described above. The inlet is formed by the top circular lip (14) which engages with an outlet of an air conditioning duct. The air flow control device may be attached to the air conditioning duct via spring clips (15) located on the side of the device.

Figure 2a shows a top view of the primary valve (7), mounting on the central spindle (12) a conduit body (8). The conduit body is mounted in the main body and formed by an interleaved filter or grill operating as the primary valve (7) which can be opened or closed to restrict or allow access to the primary channel. An automatic control mean (9) is mounted on top of the primary valve attached to the spindle.

Figure 2b shows the bottom view of the air flow control device substantially described above. The secondary outlet (6) is formed with one wall from the main body and one secondary wall being formed by the outer wall of the inserted conduit body (8). The secondary outlet directs air laterally outwards from the centre of the device.

The grating pattern on the bottom of the conduit body (8) forms the primary outlet. This grating pattern has larger holes in the centre to direct the air flow in a mainly downwards direction. A manual control means (16) is mounted on the side of the

device allowing the user to choose between automatic control or manual control.

When the manual control means (16) is placed in the Auto position, the automatic control means (9) seen in Figure 1, 2a will automatically rotate the primary valve (7) filtering components based on the temperature of air flowing onto the temperature sensor. When the air is warm the automatic control means will rotate so that the primary valve is substantially open position directing most of the air downwards through the primary outlet. When the air is cool, the automatic control means will rotate in the opposite direction, closing the interleaving primary valve components, directing most of the air through the secondary outlet and across the ceiling.

The automatic control means is shown in Figures 1, 2a and 3a as bi-metallic strips attached to the primary valve so that when a temperature change occurs these strips will rotate due to this change and the primary valve will open or close accordingly. This effect is achieved by attaching the bi-metallic strips to the primary valve in such a way that the filter elements (10) rotate closed when the air flow is cool, and rotate open when the air flow is warm.

Figure 3a and 3b show a top section view of the main conduit body. The mounting spindle is shown, with the bi-metallic strips attached to allow for automatic control of the primary valve.

When the manual control means (16) is placed in the ceiling position, this locks the filter elements, directing air through the secondary outlet and across the ceiling.

When the manual control means is placed in the down jet position, the filter elements primary valve is locked open and air is forced laterally across the ceiling.

Figure 3b shows an enlargement of the control means as referenced in Figure 2b. This shows how the primary valve position may be locked by moving the manual control means, including internal locking aperture (17) to a locked position, so that the

manual control means is locked when the internal aperture engages with a locking projection (18) in an open or closed position depending on the user. This manually controls the primary valve. When the user control setting means is placed in the middle, the valve is moved into an open or closed position by automatic control means (9).

Figures 4a and 4b show detailing on the user control setting means, as seen in Figure 2b. When the manual control means is placed in the ceiling position, this locks the filter elements, directing air through the secondary outlet and across the ceiling.

When the control means is placed in the down jet position, the filter elements primary valve is locked open and air is forced laterally across the ceiling.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the appended claims.

WHAT I/WE CLAIM IS:

1. An air flow control device which includes

at least one inlet, and

a primary flow path associated with a primary outlet, and

a secondary flow path associated with a secondary outlet, and

at least one primary valve associated with the primary flow path, said at least one primary valve being adapted to control the flow rate of air through said primary flow path.
2. An air flow control device as claimed in claim 1 which includes at least one secondary valve adapted to control the flow rate of air passing through said secondary flow path.
3. An air flow control device as claimed in claims 1 or 2 wherein the inlet is engaged with an air conditioning system.
4. An air flow control device as claimed any one of claims 1 to 3 wherein the air flow control device controls both the flow rate and flow pattern of air delivered from the primary and secondary outlets.
5. An air flow control device as claimed in any one of claims 1 to 4 wherein a flow path is formed as a channel configured to define a route that air takes through the air flow control device.
6. An air flow control device as claimed in any one of claims 1 to 5 wherein the primary outlet is formed as a diffusion grating.
7. An air flow control device as claimed in claim 6 wherein the diffusion grating

includes a plurality of apertures of varying diameter.

8. An air flow control device as claimed in any one of claims 5 to 7 wherein the secondary channel allows air to flow on the outside of the primary channel.
9. An air flow control device as claimed in any one of claims 1 to 8 wherein the primary valve is formed by at least two overlaid movable filters.
10. An air flow control device as claimed in claim 9 wherein the physical relationship between said at least two filters blocks or opens at least one channel.
11. An air flow control device as claimed in any one of the previous claims which includes a main body which forms a housing configured to locate a primary flow path.
12. An air flow control device as claimed in claim 11 wherein provided within the interior of the main body is a central conduit which defines the primary flow path.
13. An air flow control device as claimed in claim 11 or 12 wherein the secondary flow path is defined by an exterior wall of the central conduit and a wall of the main body, and the primary flow path is defined as the region where the air flows through the inside of the central conduit.
14. An air flow control device as claimed in any one of claims 11 to 13 wherein the secondary valve is formed by mounting the central conduit on a spindle which is raised and lowered.
15. An air flow control device as claimed in any one of the previous claims which includes a control means adapted to control the operation of the primary valve.

16. An air flow control device as claimed in claim 15 wherein the control means operates automatically.
17. An air flow control device as claimed in claim 16 wherein the control means includes a temperature sensitive element.
18. An air flow control device as claimed in claim 16 or 17 wherein control means includes bi-metallic strips attached to the primary valve mechanism.
19. An air flow control device as claimed in claim 15 wherein the control means is formed from a manually operated control lever.
20. An air flow control device as claimed in claim 19 wherein the said control lever includes a locking mechanism configured to lock the control lever in a selected position.
21. An air flow control device as herein described with reference to and as illustrated by the accompanying figures and/or examples.

Application No: GB0606409.1

Examiner: Rebecca Villis

Claims searched: 1

Date of search: 14 August 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 3-6, 8, 11-13 and 16 at least	GB 2032615 A (GEBRUDER TROX) (see page 1 line 3-51, 116-119, page 2 lines 6-25 and fig.1 noting inlet 14, primary path 12, 6, secondary path 11, 4, 7 and valve 17)
X	1, 3-6, 8, 11-13, 15 and 19 at least	JP 2000074473 A (SHIN NIPPON AIR) (see paras. [0001], [0005], [0006], [0015]-[0022] and figs. 1, 2, 3, 6 and 7 noting inlet 8, primary path F2, 7, secondary path F1, 8 and valve 6)
X	1-3, 5, 6, 8, 11 and 15 at least	EP 0246948 A1 (VALEO) (see abstract and fig. 1 noting inlet 10, primary path 12, 14, secondary path 18, 24 and valve 40)
X	1-3, 5, 6, 8, 11, 12 and 15 at least	JP 2002005499 A (SANKEN) (see abstract and fig. 5 noting primary path 2, secondary path 3 and valve 5)
X	1, 3, 5, 6, 8, 11, 12 and 15 at least	DE 4300910 A1 (DAIMLER BENZ) (see abstract and fig. 1 noting primary path 11, secondary path 12 and valve 20)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X:

F4V

Worldwide search of patent documents classified in the following areas of the IPC

F24F

The following online and other databases have been used in the preparation of this search report

Online: WPI, EPODOC