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(54) **Title:** A VENTILATION CONTROL SYSTEM

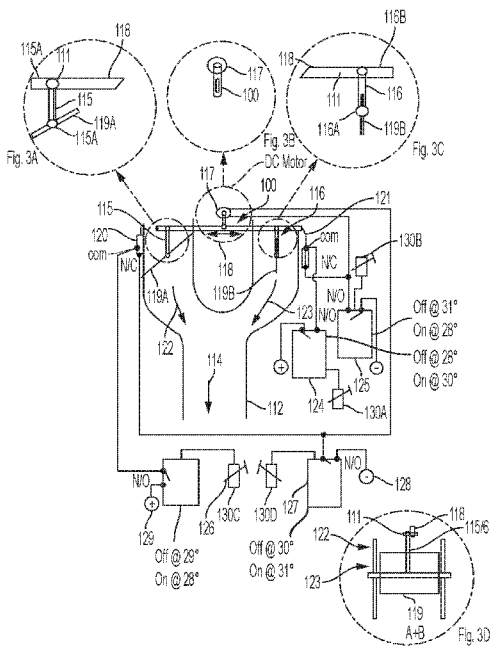

FIG. 3

(57) **Abstract:** A ventilation control system has a room space temperature sensor installed within a room space and a plenum space temperature sensor installed within a plenum space. A control mechanism is operative to move air between the spaces depending on temperatures measured by the sensors, including the relative difference of temperatures measured by the sensors between the spaces. The system may be used for room warming, either by assisting an existing heating system or operating in isolation wherein the system is configured to draw relatively warm air from a ceiling space to the room space. The control mechanism may be configured to control a vent control system to assist an existing heating system (such as a gas exchange heating system) by drawing relatively warm air from the ceiling space for the intake of the heating system.

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A ventilation control system

Field of the Invention

[1] This invention relates generally to air conditioning systems for heating and/or cooling and, more particularly, to a ventilation control system which can assist existing heating and/or cooling air-conditioning systems or operate in isolation to passively heat or cool room spaces thereby increasing energy efficiency of dwellings by between approximately 25% and approximately 35% or provide heating or cooling of dwellings that aren't fitted with heaters or coolers. These systems consume very little electricity (typically 100 Watts) as compared to a reverse cycle air conditioner using in excess of 2,000 Watts

Summary of the Disclosure

[2] There is provided herein a ventilation control system comprising room space temperature sensors installed within a room space and plenum space temperature sensors installed within a plenum space. A control mechanism is operative to move air between the spaces depending on temperatures measured by the sensors, including the relative difference of temperatures measured by the sensors between the spaces.

[3] The system may be used for room warming, either by assisting an existing heating system or operating in isolation wherein the system is configured to draw relatively warm air from a ceiling space to the room space. In embodiments, the control mechanism is configured to control a vent control system to assist an existing heating system (such as a gas exchange heating system) by drawing relatively warm air from the ceiling space for the intake of the heating system.

[4] In alternative embodiments, the system may be used for room cooling wherein the system is configured to draw relatively cooler air from an underfloor plenum space.

[5] It is estimated that the present system can passively derive energy efficiencies of up to 20 – 40% depending on relative temperatures between the

spaces of dwellings and the "climatic conditions", i.e., tropical, subtropical, temperate, and cooler zones.

[6] Other aspects of the invention are also disclosed.

Brief Description of the Drawings

[7] Notwithstanding any other forms which may fall within the scope of the present invention, preferred embodiments of the disclosure will now be described, by way of example only, with reference to the accompanying drawings in which:

[8] Figure 1 shows a ventilation control system for heating a room space in accordance with an embodiment;

[9] Figure 2 shows a ventilation control system for cooling a room space in accordance with an embodiment; and

[10] Figure 3 shows a vent control system for controlling air going to an air intake of an existing central heating system in accordance with an embodiment.

Description of Embodiments

[11] A ventilation control system 100 comprises one or more room space temperature sensors 101B and 101D installed within a room space 102 and plenum space temperature sensors 103A, 103B and 103C, installed within either plenum space 104A and 104B. The temperature sensors 103A and 103C have two separate thermocouple sensors that can either be separately connected to controllers 106A and 106C or alternatively connected in parallel to both controllers depending on the technical capabilities of the controllers employed.

[12] A control mechanism is operative to move air between the spaces depending on the relative difference of temperature measured by the sensors 101B 101D, 103A, 103B and 103C.

[13] The system 100 may comprise one or more fans (not shown) powered or controlled by fan control or power contacts 105. The control mechanism may be operative to power the fans to move air from the plenum spaces 104A and 104B to the room space 102.

[14] As shown in Figure 1, the control mechanism comprise a plurality of control modules 106. Each may have power input contacts 107 connected to a power source such as either a 240V or a 110V AC power source. Each control module 106 may further comprise temperature sensor inputs 108 operably coupled to a respective temperature sensor 101B and 101D or 103A, 103B and 103C. Furthermore, each control module 106A, 106B and 106C may comprise control outputs 109 which, in the embodiment shown, comprises relay contacts 109A, 109B and 109C.

[15] Each control module 106 may be configured with a set temperature at which the control output 109 operates depending on the temperature sensed by the temperature sensor inputs 108A, 108B and 108C.

[16] The embodiment shown in Figure 1 is for heating a room wherein the plenum space 104A is a ceiling space and the embodiment shown in Figure 2 is for cooling a room wherein the plenum space 104B is an underfloor plenum space/floor cavity.

[17] With reference to Figure 1, the control mechanism may be configured to move air from the ceiling space 104A depending on the temperatures measured by the sensors 101B, 103A and 103C

[18] For example, the control mechanism may comprise a third control module 106C set to 31° which is configured to move air from the ceiling space 104 to the room space 102 when the ceiling space temperature exceeds 31°. Furthermore, the control mechanism may comprise a second control module 106B set to 26° which is configured to move air from the ceiling space 104A to the room space 102 when the room space temperature is less than 26° when both conditions are met.

[19] In the embodiment shown in Figure 1, the control mechanism may be configured to move air from the ceiling space 104 when the difference between the and the rear space temperature exceeds a threshold for example, such as when the ceiling space temperature exceeds 31° and the room space temperature is less than 26°, these settings being dependent on climatic conditions of location.

[20] Specifically, the second control module 106B and the third control module 106C may be connected in series with the fan power or control contacts 105. In

other words, when the control outputs 109 of both control modules 106B and 106C close, the fan operates to move relatively warm air from the ceiling space 104A to the room space 102.

[21] The second control module 106B may be coupled to the room temperature sensor 101B and the third control module 106C coupled to the ceiling space temperature sensor 103A and 103C. As alluded to above, temperature sensor 103A and 103C comprises of two separate temperature sensors.

[22] The second control module 106B may be operative to close the contacts 109 when the temperature in the room space 102 is less than 26°. In other words, the second control module 106B is operative to open the contacts 109 when the temperature in the room space 102 exceeds 26°.

[23] Furthermore, the third control module 106C may be operative to close the contacts 109 when the temperature in the roof space 104A exceeds 31°. In other words, the third control module 106C is operative to close the contacts 109 when the temperature and the roof space 104A is greater than 31°.

[24] As such, for warming the room space 102, when the temperature in the roof space 104 is sufficiently greater than the room space 102, the control mechanism is operative to control the fan to draw relatively warm air from the ceiling space 104A from the ceiling space 104 to the room space 102.

[25] The control mechanism may further comprise a first control module 106A operatively coupled to the ceiling space temperature sensor 103A. The system may comprise a heater 110 operably controlled by the first control module 106A to turn on the heater 110 when the ceiling space temperature exceeds 26°C and the room temperature falls below, say, 18°C. As such, air warmer than 26° may rather be drawn from the ceiling space 104 instead. The air could be drawn from the ceiling plenum when above 26°C to preheat the air at the intake of a central heater as will be described in further detail below. When the temperature in the ceiling space falls below, say 26°C and the room temperature falls below, say, 18°C, air will be drawn in the usual way (i.e. re-circulated via room duct/s intake). It should be noted that

these aforementioned exemplary temperatures may be typical settings only and other temperature settings may be employed.

[26] The system 100 may further comprise a central heating system controlled by central heating contacts 111 operably coupled to the first control module 106A. The central heating system may also be controlled by control 110 when both conditions are met (i.e. temperatures are reached).

[27] The system 100 may comprise a vent control system 113 shown in Figure 3 to control air going to an air intake of the central heating system. The system is automated by configuring four temperature controllers (124, 125, 126 and 127 and their sensors 130A, 130B, 130C and 130D to be set with a small hysteresis of 2 or 3 degrees and (set for the rise and fall of the plenum temperature), so as to avoid double switching/crossing over of their relays in a particular manner to achieve logical activators, which, once set, can be left to achieve an automatic air intake selector, switching from conventional recirculated air to roof plenum heated air, increasing its efficiency and may be used in conjunction with the system shown in Figure 1 or independently.

[28] The vent control system 113 has a room space air intake 115 and a ceiling space air intake 116 going to an output 113 operably coupled to an intake 114 of the central heating system. Figure 3D depicts vanes rods through the walls of vent intakes 122 and 123, allowing their rotation.

[29] The system 113 may comprise an actuator 117 (such as a DC motor) which shunts a control rod 118 with slot 100 to allow sideways movement to open or close respective vanes with rods 111 being rotating and 115/116 is fixed to 115A and 116A so that air is drawn in from either intake 119A, 119B one at a time. Contact switches 120 may sense the travel limit of the control rod 118 to control the actuator 117 accordingly. Contact switches 120 and 121 will disconnect the DC power to 117 when 118 reaches either end of its travel opening one vane (119a) and closing the other vane (119b). All four temperature controllers may be in the roof plenum and may activate actuator 117 by reversing the polarity of the power to the motor,

according to the temperature (i.e. below 30°C will cause the actuator to move in one direction and vice-versa when the temperature goes above 30°C).

[30] When heating the room space 102, the control mechanism may control the vent control system 112 to draw relatively warmer air from the ceiling space 104A when the ceiling space temperature exceeds a threshold to assist the central heating system. when 100 reaches the end of travel, 120 becomes O/C and the motor stops and air is directed through chamber 123

[31] Conversely, the control mechanism may control the vent control system 112 to draw air from the room space 102, (as with existing central heating systems) when the ceiling space temperature is below a threshold, in chamber 122, controller 129 applies positive to 120 (N/C) and closes 125, applying negative directly to the motor

[32] The control mechanism may control the vent control system 112 depending on whether the difference between the ceiling space temperature and the room space temperature exceeds a threshold, causing positive through controller 124 and 121 (N/C), when 100 travels fully right 121 becomes O/C disconnecting positive to the motor, stopping it.

[33] As alluded to above, Figure 2 shows wherein the system 100 is for assisting cooling the room space 102. In this embodiment, the plenum space 104B is an underfloor plenum space and the control mechanism is configured for moving relatively cooler air from the underfloor plenum space when the room space temperature exceeds the underfloor plenum space temperature by a threshold, such as approximately 7°.

[34] As shown in Figure 2, the control mechanism may comprise a fourth control module 106D which is configured to move air from the underfloor plenum space 104B to the room space 102 when the room space temperature exceeds 25°.

[35] The control mechanism may comprise a fifth control module 106E which is configured to move air from the underfloor plenum space when the underfloor plenum space is less than 22°. Both conditions in 34 and 35 must be met to activate the fans.

[36] In embodiment shown, the control modules 106D and 106E are connected in series so that the control mechanism is configured to move air from the underfloor plenum space 104B when the room space temperature exceeds 25° and the underfloor plenum space is less than 22°C. in a similar manner as outlined above, the vent control system 107 may be used to direct relatively cooler air from the underfloor plenum space 104B to individual fans.

[37] These in-principle configurations are designed to achieve ease of use (by both installer and consumer) and maximum efficiency possible. Any other configuration will result in inoperative control and or a decrease of efficiency, due to the special arrangements creating both logical and conditional switching of any fans used. When all systems are employed, it may result in approximately 25 to 40% energy savings

[38] The foregoing description, for purposes of explanation, used specific nomenclature to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art that specific details are not required in order to practise the invention. Thus, the foregoing descriptions of specific embodiments of the invention are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed as obviously many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the following claims and their equivalents define the scope of the invention.

[39] The term “approximately” or similar as used herein should be construed as being within 10% of the value stated unless otherwise indicated.

Claims

1. A ventilation control system comprising:

a room space temperature sensors installed within a room space;

a plenum space temperature sensors installed within plenum spaces; and

a control mechanism operative to move air between the spaces depending on temperatures measured by the sensors.

2. The control system as claimed in claim 1, wherein the control mechanism is operative to move air between the spaces depending on the relative difference of temperatures measured by the sensors.

3. The control system as claimed in claim 1, further comprising at least one fan and wherein the control mechanism is operative to power the fan/s to move air between the spaces.

4. The control system as claimed in claim 3, wherein the control mechanism is operative to power the at least one fan to move air from the plenum space to the room space.

5. The control system as claimed in claim 1, wherein the plenum space is a ceiling space and wherein the control mechanism is configured to move air from the ceiling space when the ceiling space temperature exceeds the room space temperature by a threshold.

6. The control system as claimed in claim 5, wherein the threshold is approximately 5°.

7. The control system as claimed in claim 6, wherein the control mechanism is configured to move air from the ceiling space when the ceiling space temperature exceeds 31°.

8. The control system as claimed in claim 6, wherein the control mechanism is configured to move air from the ceiling space when the room space temperature is less than 26°.

9. The control system as claimed in claim 6, wherein the control mechanism is configured to move air from the ceiling space when the ceiling space temperature exceeds 31° and the room space temperature is less than 26°.

10. The control system as claimed in claim 1, wherein the plenum space is a ceiling space and wherein the control system is configured to turn the heater on or off depending on the temperature of the ceiling space .

11. The control system as claimed in claim 1, wherein the plenum space is a ceiling space and further comprising a heating system heating the room space, the heating system having an air intake, and wherein the system further comprises a vent control system operably coupled to the air intake to either take air from the room, space or the ceiling space and wherein the control mechanism is further operative to control the vent control system depending on the temperature of the ceiling space, to maximise efficiency of an existing central heater.

12. The control system as claimed in claim 11, wherein the control mechanism is configured to control the intake to draw air from the ceiling space when the ceiling space temperature exceeds a threshold.

13. The control system as claimed in claim 11, wherein the control mechanism is configured to control the intake to draw air from the room space when the ceiling space temperature does not exceed the room space temperature by a threshold.

14. The control system as claimed in claim 1, wherein the plenum space is an underfloor plenum space and wherein the control mechanism is configured to move air from the underfloor plenum space when the room space temperature exceeds the underfloor plenum space temperature by a threshold.

15. The control system as claimed in claim 14, wherein the threshold is approximately 7°.

16. The control system as claimed in claim 15, wherein the control mechanism is configured to move air from the underfloor plenum space when the room space temperature exceeds approximately 25°.

17. The control system as claimed in claim 15, wherein the control mechanism is configured to move air from the underfloor plenum space when the underfloor plenum space is less than approximately 22°.

18. The control system as claimed in claim 15, wherein the control mechanism is configured to move air from the underfloor plenum space when the room space temperature exceeds 25° and the underfloor plenum space is less than 22°.

19. The control system as claimed in claim 1, wherein the plenum space is an underfloor plenum space and the system further comprises a cooling system cooling the room space, the cooling system having an air intake, and the system further comprises a vent control system operably coupled to the air intake to either take air from the room space or the underfloor plenum space and wherein the control mechanism is further operative to control the vent control system depending on the temperature of the underfloor plenum space.

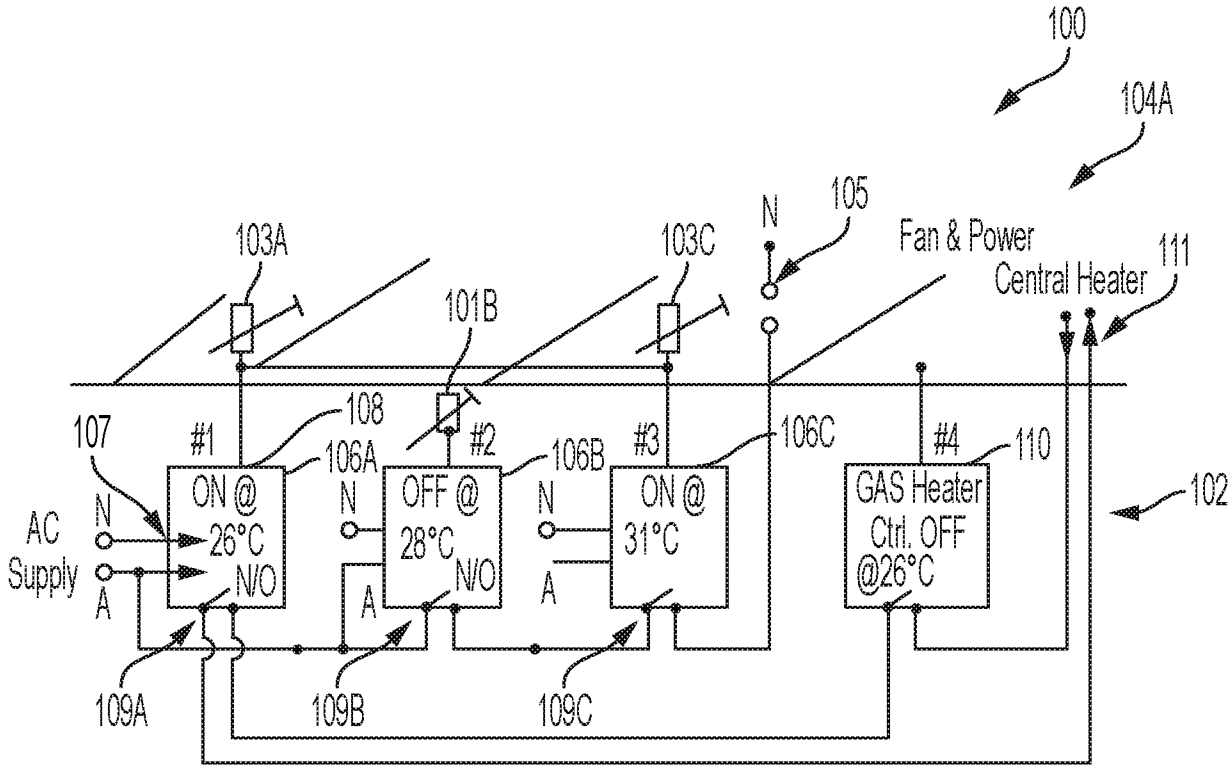
100
104A
105
N
Fan & Power
Central Heater
111
103A
103C
101B
107
#1
108
106A
#2
106B
#3
106C
#4
110
102
AC
Supply
N
A
ON @
26°C
N/O
OFF @
28°C
ON @
31°C
GAS Heater
Ctrl. OFF
@26°C
109A
109B
109C

FIG. 1

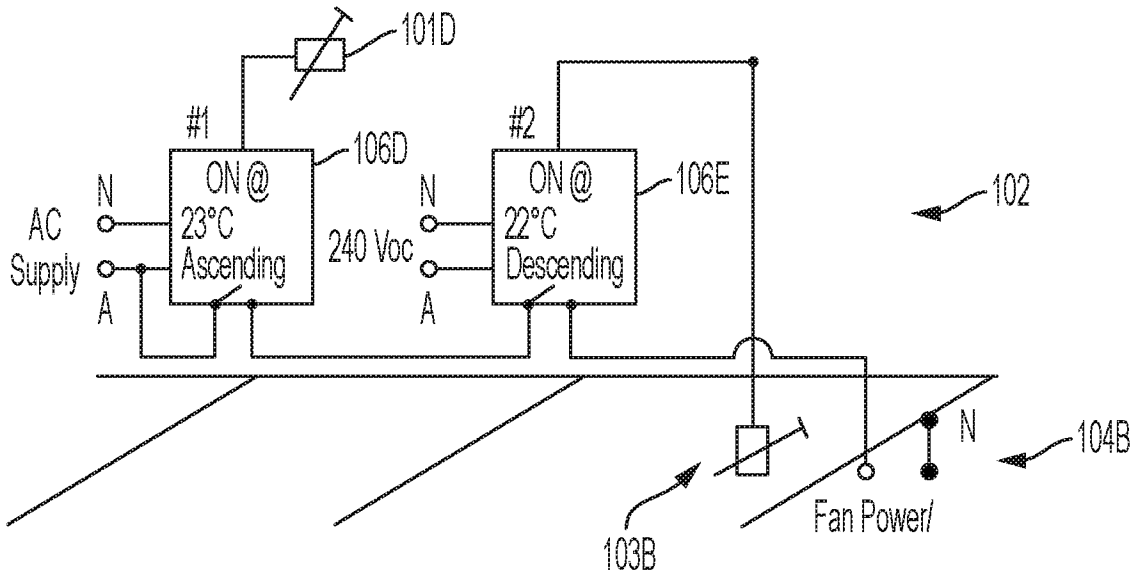
101D
#1
106D
ON @
23°C
Ascending
N
AC
Supply
A
240 Voc
#2
106E
ON @
22°C
Descending
N
A
102
N
104B
103B
Fan Power/

FIG. 2

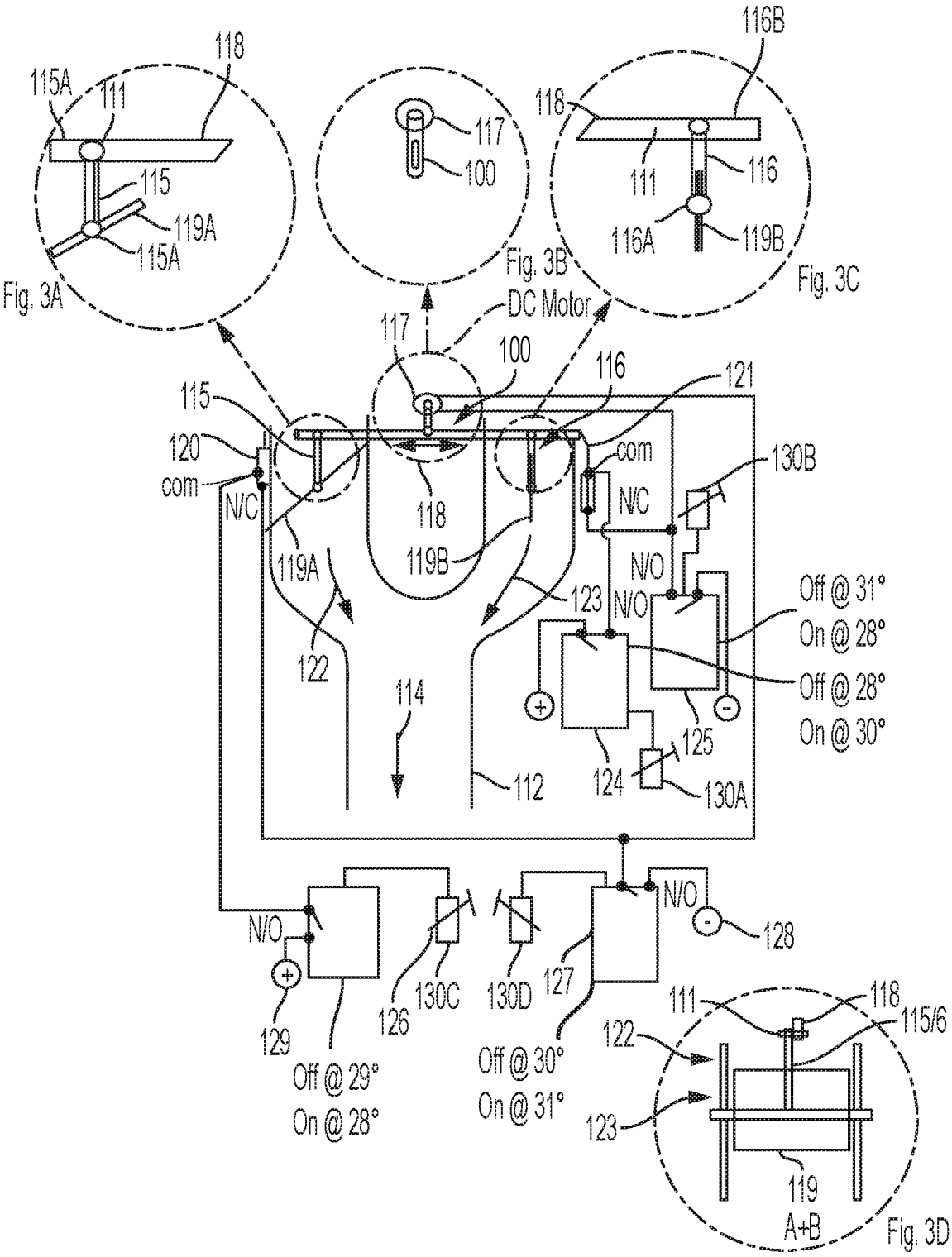
118
115A
111
115
119A
115A
Fig. 3A
117
100
Fig. 3B
116B
118
111
116
116A
119B
Fig. 3C
DC Motor
117
100
116
121
115
120
com
N/C
118
119A
119B
com
N/C
130B
N/O
123
N/O
Off @ 31°
On @ 28°
Off @ 28°
On @ 30°
122
114
112
124
125
130A
N/O
N/O
128
129
126
130C
130D
127
Off @ 29°
On @ 28°
Off @ 30°
On @ 31°
111
118
115/6
122
123
119
A+B
Fig. 3D

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2022/051055

A. CLASSIFICATION OF SUBJECT MATTER

G05D 23/19 (2006.01) ***G05D 23/30 (2006.01)*** ***F24F 11/00 (2018.01)*** ***F24F 11/30 (2018.01)*** ***F24F 11/46 (2018.01)*** ***F24F 11/79 (2018.01)*** ***F24F 11/871 (2018.01)*** ***F24F 110/10 (2018.01)*** ***F24F 7/10 (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)

Google Patents, Google, Espacenet and PATENW search using keywords: VENTILATION, CONTROL, SYSTEM, INDOOR, OUTDOOR, PLENUM, ROOM, AIR, MOVE, TEMPERATURE, DIFFERENCE, PLURALITY, SENSOR, HEATING, COOLING, FAN, PASSIVE, INDIRECT, and like terms. Relevant results viewed.

IPC and CPC symbols: F24F2110/10, F24F2011/0002, F24F11/00, F24F11/0001, F24F11/30, F24F11/46, F24F11/70, F24F11/72, F24F11/79, F24F11/80, F24F11/81, F24F11/87, F24F11/871, F24F7/00, F24F7/02, F24F7/06, F24F7/007, F24F7/10, F24F5/0096, G05D 23/00, G05D23/19, G05D23/193, G05D 23/1934, Y02B30/00, Y02B30/70. Relevant results viewed.

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

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
24 November 2022	24 November 2022
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	Raihan Rumman AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61 2 6283 2443

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2022/051055**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2805117 B1 (WINDOWMASTER AS [DK]) 15 June 2016 Abstract, title, paragraphs 0001, 0011, 0012, 0041-0045, 0055, 0075, claim 1, Fig. 2, etc.	1-19
X	WO 2013/016824 A1 (POULIN ET AL.) 07 February 2013 Page 13 lines 1-5, page 6 lines 24-31, page 8 lines 10-15, pages 17-20, claims 11, 12, 15, 16, 21.	1-19
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A	US 20050144963 A1 (PETERSON ET AL.) 07 July 2005 Whole document	1-19
A	WO 2019157602 A1 (VENNE JEAN SIMON [CA]) 22 August 2019 Whole document	1-19

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2022/051055**

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	
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		CA 3090718 A1	22 Aug 2019
		US 2021003308 A1	07 Jan 2021

End of Annex

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