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(54) Air conditioning apparatus

(57) Air conditioning apparatus 2 comprises a cooling unit 14, a heating unit 18 and a fan 16 for directing air through the heating and cooling units. The heating unit 18 is pivoted about an axis 54 so that it can rotate to a position in which it lies along the air flow path so as to reduce resistance to flow when it is not being used.

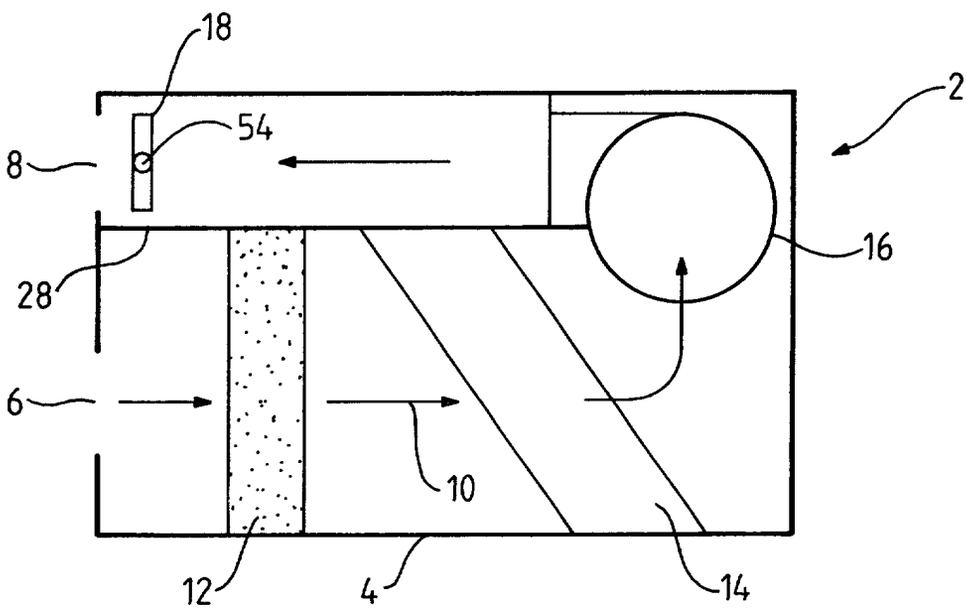

FIG. 1

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Description

[0001] The present invention relates to air conditioning apparatus and more particularly to air conditioning apparatus in which air may be heated or cooled depending on operational requirements.

[0002] Various air conditioning systems of the above type are known. In one such apparatus separate cooling and heating units are provided across which air is directed by means of a fan.

[0003] Typically the cooling unit is constituted by a cooling coil which is connected to a source of refrigerant. The heater, typically, may be an electric heater. The cooling unit or the heating unit may be operated as appropriate to give the desired air conditions.

[0004] In most operative conditions, the apparatus will be used to cool air, so the heating unit will be inoperative. However, air must still pass through the heating unit. The Applicants have recognised that this is a potential problem since there is a drop in air pressure as the air passes through the heating unit. This means that the air flow through the apparatus as a whole is unnecessarily impeded, leading to a lower cooling capacity. A larger fan unit, requiring increased energy supply, is required to maintain cooling capacity.

[0005] The present invention seeks to provide a solution to the above problem and from a first aspect provides air conditioning apparatus comprising a cooling unit, a heating unit and a fan for directing air through the heating and cooling units wherein the heating unit is movable between first and second positions, the heating unit presenting a lower resistance to air flow through the apparatus in its second position.

[0006] In accordance with the invention, therefore, the heating unit is moveable to a position in which it provides a lower resistance to a flow of air through the apparatus. Thus when the apparatus is to be used for cooling purposes, the heating unit can be moved to the second position so that the pressure drop across the heater is reduced or eliminated. This means that the cooling capacity of the cooling unit is improved, or a smaller fan unit can be used for a given cooling requirement, leading to energy savings.

[0007] In one embodiment of the invention, the heating unit may be withdrawn to a position outside an air flow passage, so as completely to eliminate its resistance to air flow. However, this arrangement may lead to additional space requirements. Accordingly, the heating unit is preferably moveable between respective positions within the air flow passage.

[0008] In one embodiment, the heating unit may be moved to lie flush with a wall of the air flow passage. However, such an arrangement may be difficult to realise, so in a preferred embodiment the heating unit is moveable to a position within the air flow passage in which it presents less resistance to the air flow.

[0009] The heating unit may be mounted for translational, for example linear, movement. Preferably, however, the heating unit is mounted for pivotal or rotary movement. In the preferred embodiment referred to above, therefore, the heating unit may have an axis of rotation extending, for example horizontally, through the air flow passage whereby in one position it may extend substantially across the air flow passage and in the other position it extends generally along the air flow passage, thereby providing less resistance to air flow.

[0010] The movement of the heater may be effected by any suitable actuator, preferably a linear actuator coupled to the heater unit by a suitably rotary coupling, for example a rack and pinion coupling. Preferably, the actuator is a thermoactuator. Typically such actuators comprise a PTC heater which, when energised, heats a wax motor. The wax then expands so as to impart a movement to an actuator member.

[0011] In the preferred embodiment the heating unit is an electric heating unit. The heating unit may typically comprise a heating element supported in a frame, and the frame is mounted for movement in the air flow passage.

[0012] The heating unit may be positioned upstream of the cooling unit, but preferably it is positioned downstream of the cooling unit.

[0013] The cooling unit and fan may be of a conventional design. For example, the cooling unit may comprise a cooling coil supplied with refrigerant through which the air flows. The fan may be of any suitable construction, for example an axial flow fan. Preferably, however, it is a centrifugal fan. The fan may be positioned in any convenient location, for example upstream of the cooling unit. Preferably, however, it is located between the cooling unit and the heating unit.

[0014] A preferred embodiment of the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows, schematically, a side view of an embodiment of the invention in a first operative state;

Figure 2 shows the apparatus of Figure 1 in a second operative state; and

Figure 3 shows the heating unit of Figures 1 and 2 in greater detail.

[0015] With reference to Figures 1 and 2, an air conditioning unit 2 comprises a housing 4, having an air inlet 6 and an air outlet 8. An airflow passage 10 extends through the housing 4 from the air inlet 6 to the air outlet 8. The airflow is represented schematically by arrows in the passage 10.

[0016] Arranged within the airflow passage 10 in a serial flow manner are an air filter 12, a cooling unit 14, a centrifugal fan 16 and a heating unit 18.

[0017] The cooling unit 14 is of a type conventional in the art, comprising a plurality of pipes connected to a source of refrigerant (not shown). As air drawn through

the cooling unit 14 by the fan 16 heat is transferred from the heat to the refrigerant in the cooling unit 14, thereby cooling the air.

[0018] The cooled air then passes through the centrifugal fan 16 which exhausts the air through the heater 18.

[0019] The heater 18 is an electric heater. As can be seen most clearly from Figure 3, the heater 18 is generally rectangular and comprises a plurality of heating elements 22 over which air is passed. The heater 18 is supported in a frame 20. Power is supplied to the elements 22 via electrical connectors 24 mounted on one side of the frame 20. Power is supplied to the connectors through wires 26.

[0020] The frame 20 is pivotally mounted to a section 28 of the wall of the airflow passage 10. The wall section 28 may be removably mounted in the apparatus for ease of assembly.

[0021] One end 30 of the frame is provided with an integrally formed L-shaped bracket 32 whose end is provided with an aperture 34. A further bracket 36 is upstanding from the passage wall section 28. The upper end of the bracket 36 mounts a journal 38 which extends through the opening 34 in the housing bracket 32 so as pivotally to support one end of the frame. The power supply wires 26 pass through the journal 38 and then through a grommet 40 mounted in the wall section 28 for connection to a control for the apparatus, not shown.

[0022] A second integrally formed L-shaped bracket 42 is provided at the other end 44 of the heater frame 20. The distal end 46 of the bracket 42 is provided with two-spaced apart openings which receive respective pins 48 of a rotary coupling 50 of an actuator 52. The axes of rotation of the coupling 50 and the journal 38 are coincident, to define an axis of rotation 54 for the heater unit 18.

[0023] The actuator 52 in this embodiment is a thermoactuator. It is of the type comprising a PTC heater which, when energised heats a wax motor. This substance expands, pushing out a rod 56 which is coupled to a rack and pinion rotary coupling 50. Actuators of this type are supplied by ELTEK SpA of Casale Monf., Italy under the product code 10.0331xx. In this way, linear motion of the rod 56 causes the pins 48 of the coupling 50 to rotate about axis 54, thereby rotating the heater unit 18.

[0024] The actuator 52 and coupling 50 are supported on an angle bracket 58 which is mounted to the wall section 28. Wires 60 for the actuator extend through a grommet 62 in the wall section 28 for connection to the apparatus control.

[0025] The top 64 of the frame 20 is provided with a yet further integrally formed mounting bracket 66. A thermal cut out 68, such as a bimetallic disc type cut out, is mounted on this bracket 66 so as to interrupt the power supply to the heating elements 22 in the event of the unit overheating.

[0026] Returning now to Figures 1 and 2, in the operative condition shown in Figure 1, the heater 18 is arranged in a first position in which it is arranged generally vertically so as to extend across the airflow passage 10. This corresponds to the operative condition of the heater 18 as shown in Figure 3. In this operative condition, the heater will be energised and air directed through the heater will be heated to an appropriate temperature and exhausted through the air outlet port 8. In this operative condition, the cooling unit 14 will normally be inoperative.

[0027] However, in a cooling mode of operation of the apparatus 2, (as shown in Figure 2) the electric heater is de-energised and coolant circulated through the cooling unit 14. In this operative condition, the actuator 52 is energised to rotate the heater 18 about its axis 54 by 90° to a second position in which it lies along the airflow passage 10, generally parallel to the air flow.

[0028] In this operative condition, therefore, the heating unit 18 presents a much reduced frontal area to the airflow, thereby reducing the resistance to airflow. Accordingly, there is a smaller pressure drop across the heater than would otherwise be the case. This means that in the cooling mode, the cooling capacity of the cooling unit 14 is increased or the fan 16 can be made smaller thereby reducing energy consumption.

[0029] It will be appreciated that various modifications can be made to the above described embodiment without departing from the scope of the invention. For example, the heater 18 may be mounted in a different position in the airflow passage 10, and need not have a rotational axis extending across the centre of the passage - the axis could be displaced to or towards a side of the passage. Also, a different type of actuator could be used. A different type of heater could also be used.

Claims

1. Air conditioning apparatus comprising a cooling unit, a heating unit and a fan for flowing air through the heating and cooling units wherein the heating unit is movable between first and second positions, the heating unit presenting a lower resistance to air flow through the apparatus in its second position.

2. Apparatus as claimed in claim 1 wherein the heating unit is removable to a position outside an air flow passage of the apparatus.

3. Apparatus as claimed in claim 1 wherein the heating unit is moveable between first and second positions within an air flow passage.

4. Apparatus as claimed in claim 3 wherein the heating unit is movable to lie flush with a wall of the air flow passage.

5. Apparatus as claimed in claim 3 wherein the heating unit is moveable to a position within the air flow pas-

sage in which it presents less resistance to the air flow.

6. Apparatus as claimed in any preceding claim wherein the heating unit is mounted for translational movement.

7. Apparatus as claimed in any of claims 1 to 5 wherein the heating unit is mounted for pivotal or rotary movement.

8. Apparatus as claimed in claims 7 wherein the heating unit has an axis of rotation extending through the air flow passage.

9. Apparatus as claimed in claim 8 wherein in one position the heating unit extends substantially across the air flow passage and in the other position it extends generally along the air flow passage thereby providing less resistance to air flow.

10. Apparatus as claimed in claim 8 or 9 wherein the axis extends horizontally through the airflow passage.

11. Apparatus as claimed in any preceding claim comprising a linear actuator and a rotary coupling for movement of the heater unit.

12. Apparatus as claimed in claim 11 wherein the actuator is a thermoactuator.

13. Apparatus as claimed in any preceding claim wherein the heating unit is an electric heating unit.

14. Apparatus as claimed in claim 13 wherein the heating unit comprises a heating element supported in a frame, said frame being mounted for movement.

15. Apparatus as claimed in any preceding claim wherein the heating unit is positioned downstream of the cooling unit.

16. Apparatus as claimed in any preceding claim wherein the cooling unit comprises a cooling coil supplied with refrigerant.

17. Apparatus as claimed in any preceding claim wherein the fan is a centrifugal fan.

18. Apparatus as claimed in any preceding claim wherein the fan is located between the cooling unit and the heating unit.

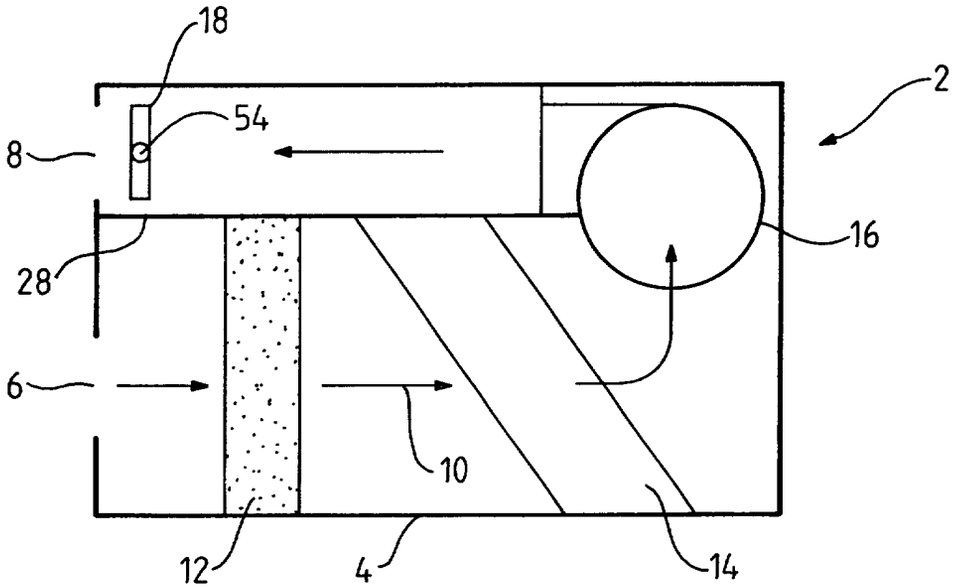

FIG. 1

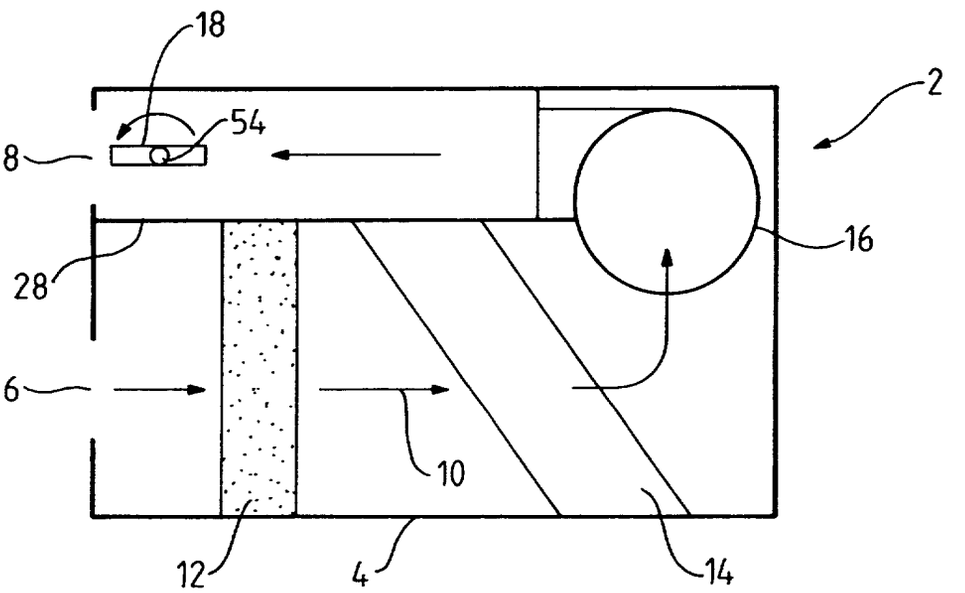

FIG. 2

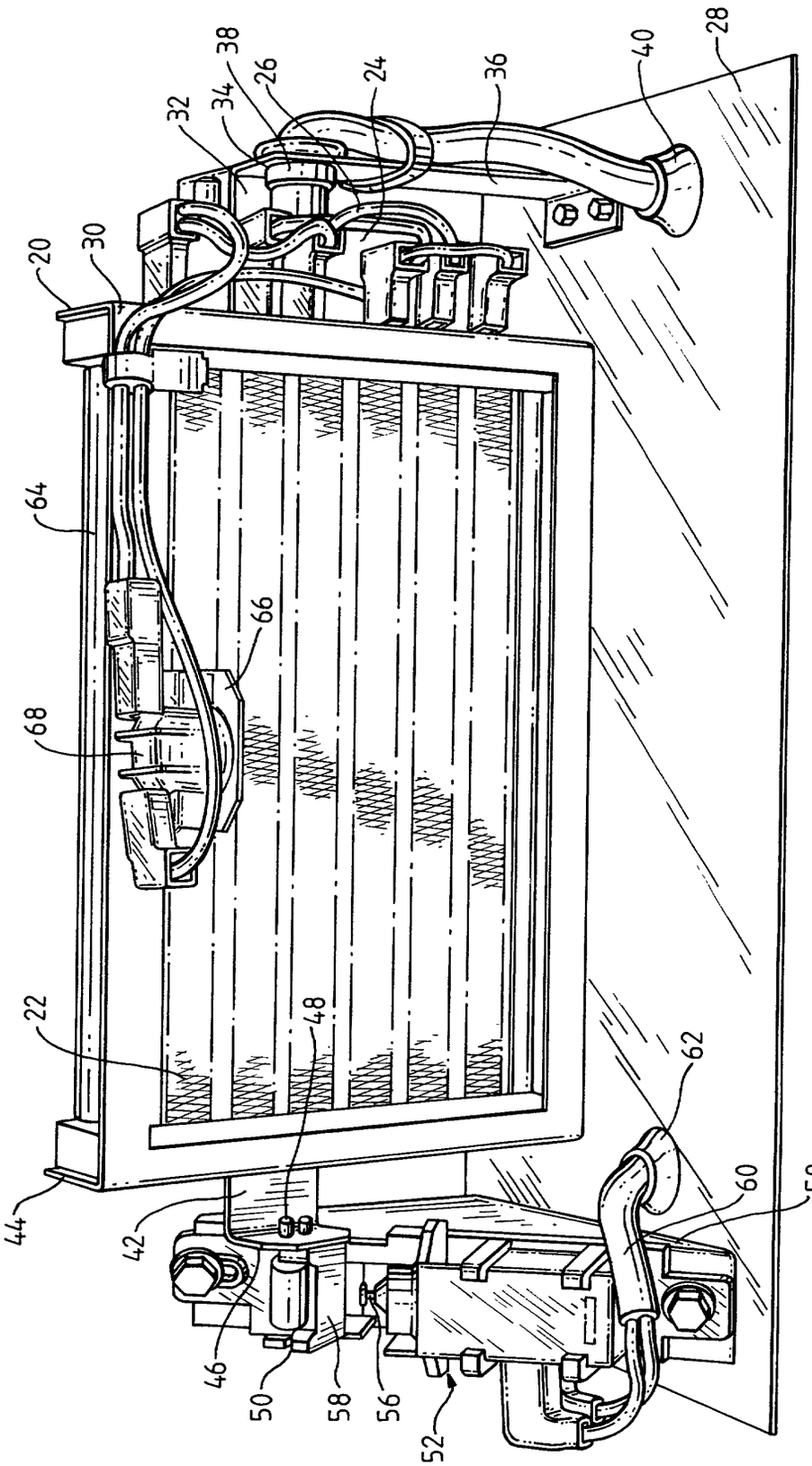
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FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 02 25 1748

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 087 (M-291), 20 April 1984 (1984-04-20) & JP 59 004839 A (TOKYO SHIBAURA DENKI KK), 11 January 1984 (1984-01-11) * abstract *	1,3-5, 7-10, 13-16,18	F24F1/00
A	DE 16 04 240 A (LAING NIKOLAUS) 3 September 1970 (1970-09-03) * page 2, paragraph 1; figure 4 *	1	
A	GB 2 296 087 A (INDUSTCOOL ENG LTD) 19 June 1996 (1996-06-19) * abstract * * page 2, line 11,12; figures 2A,2E *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	24 July 2002	Lienhard, D

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 25 1748

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-07-2002

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82