Feb. 20, 1962 W. G. SPIEGELHALTER 3,021,696

VENT AND EXHAUST ARRANGEMENT FOR AIR CONDITIONING UNIT

Filed Dec. 27, 1960

FIG. 1

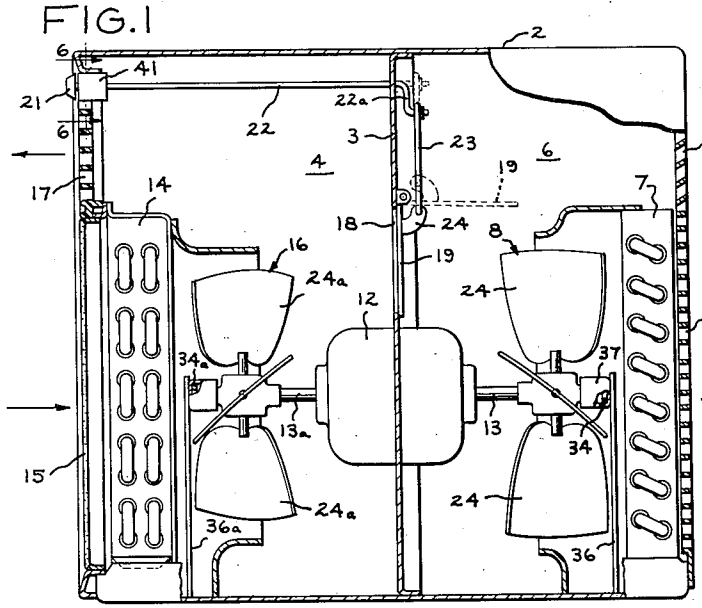


FIG. 6

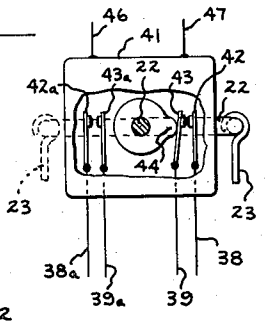


FIG. 2

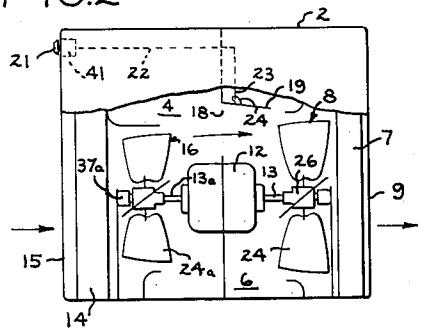


FIG. 3

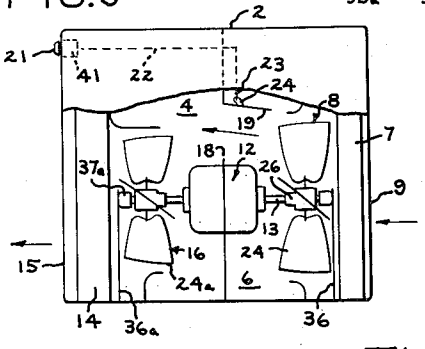


FIG. 4

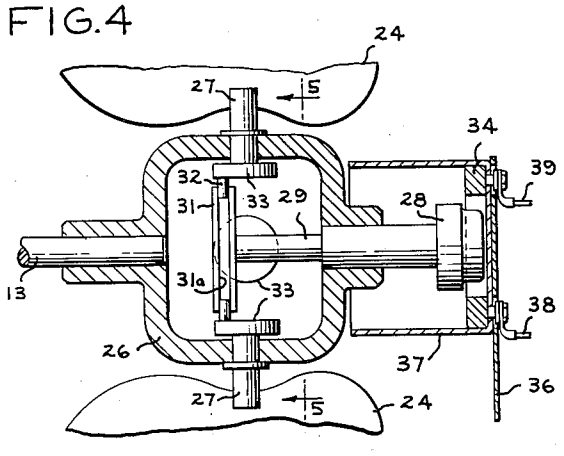
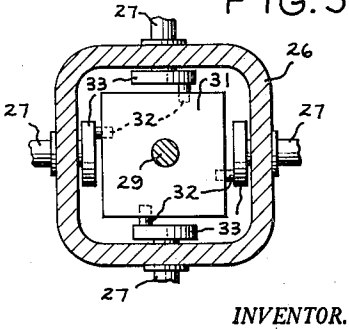


FIG. 5



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VENT AND EXHAUST ARRANGEMENT FOR AIR CONDITIONING UNIT

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2 Claims. (Cl. 62—429)

The present invention relates to an air conditioning unit of the type normally mounted in a window or an outside wall of an enclosure and more particularly to an improved air vent and exhaust arrangement for such a unit.

Air conditioning units of the self-contained type, which are normally mounted in an outer wall of a room for conditioning the air within the room, are sometimes provided with vent openings through which stale air from the room may be exhausted or through which fresh air from the outside may be brought into the room. Dampers, associated with the vent openings, are provided for diverting air through the vent opening from the air streams being circulated through the unit by the evaporator fan and the condenser fan. In many present day air conditioners both the evaporator fan and the condenser fan are operated off a shaft driven by the same motor and, consequently, it is impossible to reverse the direction of rotation of one fan without reversing the other. In order to obtain more efficient exhaust or ventilation, it is desirable in some cases, due to the location of the vent openings within the unit, to reverse the air stream being circulated by one fan while circulating the other air stream in its normal direction. It is desirable, therefore, to be able to independently control the direction of air flow circulation of either fan in order to obtain the most efficient ventilation and exhaust through the unit. This, of course, is sometimes possible with fans operating from separate motors, but is exceedingly difficult where the fans operate off of a shaft rotated by a single motor.

It is an object of the present invention to provide an improved exhaust and ventilation arrangement for a self-contained air conditioning unit having an evaporator fan and a condenser fan rotated by the same motor.

It is another object of the present invention to provide, in a self-contained air conditioning unit, an improved exhaust and ventilation arrangement in which the air streams circulated by either the evaporator fan or the condenser fan, operated by a single motor, may be reversed for efficient exhausting or ventilation of air through the unit.

A more specific object of the present invention is to provide an air conditioning unit having a control arrangement which automatically adjusts the condenser fan and the evaporator fan to circulate their respective air streams in the proper direction whenever the vent damper is opened by the operator of the unit to obtain ventilation or exhausting of air through the unit.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with the particularity in the claims annexed to and forming a part of this specification.

In carrying out the objects of the present invention there is provided a self-contained air conditioning unit adapted for mounting within an outer wall of a room. The unit includes a case divided by a barrier into indoor and outdoor compartments having openings leading respectively to the room and to the outdoors. Each of the compartments is provided with separate axial flow fans driven by a motor mounted in the unit and adapted to circulate separate air streams through the compartments from the indoors and outdoors respectively. The barrier is provided with a vent opening and a damper movable with respect to the opening for controlling air flow through the opening from one compartment to the other. At least one of the fans is provided with fan blades that are rotatable about their longitudinal axes from a first position wherein they blow air in one direction and to a second position for blowing air in the opposite direction. A heat responsive means is provided on this fan for rotating the fan blades from their first position to their second position. In order to enhance the flow of air through the vent opening during vent or exhaust operation, whichever the case may be, a heater is provided, within the case in close proximity to the heat responsive means on the fan which is automatically energized whenever the damper control is moved to the vent position, or, in some cases, to the exhaust position thereby causing the heat responsive means on the fan to move the fan blades from their first position to their second position and thereby reversing the direction of the air stream being circulated by the fan.

For a better understanding of the invention reference may be had to the accompanying drawings in which:

FIG. 1 is a cross-sectional view of an air conditioner employing the present invention and showing a normal air flow pattern through the conditioner;

FIG. 2 is a small schematic view of the conditioner of FIG. 1, showing the air flow patterns through the conditioner when the vent is opened and the condenser fan blades are reversed;

FIG. 3 is a small schematic view of the air conditioner of FIG. 1, illustrating the air flow pattern when the vent is opened and the evaporator fan blades are reversed;

FIG. 4 is a detailed view of the fan hub and illustrating a heat responsive actuating means for rotating the fan blades about their longitudinal axis;

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 4; and

FIG. 6 is a cross-sectional view taken along line 6—6 of FIG. 1, illustrating the operation of the switch means during the movement of the damper control shaft to the exhaust position.

Referring now to FIG. 1 there is shown a self-contained air conditioning unit having a case 2 adapted for mounting in a window or other aperture of a room to be conditioned. The case is divided by a barrier 3 into two compartments, designated the inner compartment 4 and the outer compartment 6. The case is normally positioned within a window so that the inner compartment 4 is adjacent the room to be conditioned and the outer compartment 6 projects toward the outside. Mounted within the outer compartment 6 of the conditioner is a refrigeration condensing unit which includes a refrigeration compressor (not shown) and a condenser 7. A fan 8 is disposed in the lower part of the outer compartment 6 and pulls a stream of outdoor air through the inlet opening 9 over the condenser 7. The fan 8 normally blows the air stream toward the barrier 3 where it is diverted upwardly along the barrier and is then discharged to the outdoors through the outlet opening 11. The condenser fan 8 is driven by shaft 13 extending from a motor 12 mounted in the barrier 3.

In order to cool, or condition the air within the room, there is provided within the inner compartment 4, an evaporator 14 positioned across the end of the case and connected in refrigerant flow relationship with the condensing unit disposed in the outer compartment 6. Room air is drawn through the inlet grille 15 by a fan 16, which is also driven by the motor 12 by means of a portion 13*a* of the shaft extending into the inner compartment. The air stream drawn into the inner compartment 4 from the room passes through the evaporator 14 and

is blown rearwardly by the fan **16** toward the barrier **3** where it is diverted upwardly adjacent the barrier **3** and is then discharged back into the room through the outlet grille or opening **17**.

In conditioning a room, it is sometimes desirable to exhaust stale air from within the room into the outside or to bring in fresh outside air to be mixed with the recirculated room air. In order to provide these functions, there is provided in the barrier **3** an aperture or vent opening **18** which permits air to flow between the two compartments **4** and **6**. In the illustrated embodiment of the invention, the opening **18** is positioned in the barrier **3** directly above the fan motor **12**. A damper **19** is disposed in the outer compartment **6**, in order to open or close the aperture **18**. In the illustrated embodiment, the damper **19** is hingedly mounted on the barrier **3** and movable from a closed to an opened position across the opening **18** in the barrier. As shown in the dotted line position in FIG. 1, the damper moves outwardly into the outer compartment **6** in order to open the aperture **18**.

Means are provided for opening and closing the damper **19** with respect to the opening **18** in the barrier. More specifically, these means include a control knob **21** accessible from the front of the unit and preferably mounted with the other controls of the unit. The control knob **21** rotates a damper shaft **22** which extends from the knob **21** through the barrier **3** in the unit. The shaft **22** is provided with a crank **22***a* on its remote end and to this is pivotally connected one end of a damper link **23**. The other end of the damper link **23** is connected by means of a hinge or pivotable connection **24** to the damper **19**. Rotation of the knob **21** causes the crank **22***a* to lift the damper link **23** thereby swinging the damper **19** outwardly away from the vent opening **18** and into the condenser compartment **6**.

Normally in an air conditioning apparatus of this type, in which both the indoor and outdoor fans are operated by a single motor **12** and thus operate at the same rotational speed, it is necessary to make the condenser fan **8** somewhat larger than the evaporator fan **16**. This is necessary, in order to reduce the size of the condenser and to assure proper condensation of refrigerant in the condenser. That is, because of the design parameters of the refrigeration components and the temperature conditions under which they operate, greater quantities of outdoor air must be blown over the condenser than are blown over the evaporator. Inasmuch as more air is usually circulated by the condenser fan, there is usually a much greater air pressure in the condenser compartment **6** than in the evaporator compartment **4**. This presents a difficult problem when attempting to exhaust room air being circulated through the indoor compartment **4** through the opening **18**. Under normal air flow conditions as illustrated by the arrows in FIG. 1, the difference in air pressure between the two compartments causes air to flow from the condenser compartment through the opening **18** into the evaporator compartment whenever the damper **19** is open. Further, inasmuch as both of the fans **8** and **16** are operating somewhat in opposition to each other, i.e., circulating their air streams toward the vent opening from opposite directions, this tends to reduce the overall efficiency of the unit for venting and exhaust purposes.

In order to overcome these problems, the present invention includes means for pivoting or rotating each of the fan blades of at least one of the fans around its respective longitudinal axis so that the fan circulates its air stream in a direction opposite from normal. In the illustrated air conditioner, where both of the respective air streams are drawn into the unit, blown against the barrier and then discharged out the upper portion of the unit, it is only necessary to provide means for rotating the blades of the condenser fan, thereby reversing the flow of air through the outer compartment, in order to accomplish more efficient air flow between the two compartments for exhaust purposes. If the normal air flow pattern through the condenser or outer compartment **6** were reversed, i.e., air entering the upper portion of the unit through opening **11** and discharging through the lower portion of the unit or opening **9**, then it would be necessary to reverse the condenser fan **8** blades in order to attain efficient ventilation through the opening **18**.

As may be seen in FIGS. 4 and 5, the fan is so constructed that the fan blades **24** are mounted in the hub **26** of the fan for rotation or pivoting about an axis passing through the longitudinal portion of the blades. As may be seen in FIG. 4, the base or shaft **27** of each blade extends through an opening in the hub and is rotatably secured therein. Mounted along the axis of the hub, as may best be seen in FIG. 4, is a heat responsive device or eutectic element **28**, having a piston or actuator **29**, adapted to move longitudinally or parallel to the axis of the hub **26**. The piston **29** moves longitudinally in the direction of the shaft **13** whenever heat is applied to the eutectic element **28**. Eutectic elements of this type are well known in the art and any of the types now available on the market may be used for this purpose, as long as they may be mounted for rotation within the hub of a fan and provide sufficient force to move the fan blades through an angle of approximately 90° or more. The heat responsive means or eutectic element **28** is adapted to rotate the blades of the fan through movement of its piston **29**. Mounted on the end of the piston **29** is a grooved disk **31** which moves axially along with the piston **29**. The grooved disk **31** engages pins **32** extending from the bottom flanges **33** of each shaft **27** into the grooves **31***a* of the disk. Movement of the piston **29** and the disk **31** back and forth longitudinally along the axis of the hub, causes the pins **32** to rotate the respective blades of the fan around their longitudinal axis.

In order to energize the eutectic element, or heat responsive means **28**, from one position to another, there is provided an electrical heater **34** arranged in close proximity to the eutectic element **28**. As may be seen in FIGS. 1 and 4, a heater **34** is supported by a bracket **36** extending upwardly from the bottom of the case. Disposed around the heater **34** is a cup **37** of thermal insulation material, which retains the heat dissipated by the heater within the area adjacent the heat responsive element **28**. Heater **34** is energized by a heater circuit, including the conductors **38** and **39**, which conduct electricity to the heater from a suitable source of power. In the illustrated embodiment of the invention, it is contemplated that the movement of the piston **29** will be from a first position, in which the blades are disposed for normal air flow, to a second position, in which the blades are pivoted approximately 90° or more, to completely reverse the air stream circulated by the fan. However, it should be mentioned that, by supplying heat to the eutectic elements in increments, any degree of control over the rotation of the fan blades is possible. Thus, it is a simple matter to control the amount of current supplied to the heater to vary over a wide range the rotation of the fan blades and, thus, control the direction and quantity of air circulated by the particular fan.

In order to energize the heater **34** in accordance with the desired direction of air flow through the air conditioning unit, there is provided a switch means which is actuated to energize the heater simultaneously with the movement of the damper **19** from the closed position to the open position. More specifically, as may be seen in FIG. 6, there is provided a switch means, generally designated by the numeral **41**, mounted adjacent the control knob **21**. The rotatable damper shaft **22** extends through the switch means **41** and opens or closes a circuit energizing the heater whenever the knob **21** is rotated to open the damper **19**. Thus, as may be seen in FIG. 6, when the damper shaft **22** is rotated counterclockwise, so that the damper link **23** lifts the damper **19** (as shown in the dotted line position of FIG. 1) away from the opening **18**, then the

switch means 41 energizes the heater 34. The switch means 41 includes a pair of contacts 42 and 43 which are energized by an actuator 44 attached to and rotatable with the damper shaft 22. The actuator 44 moves contacts 42 and 43 together thereby completing the circuit including the leads 38 and 39 leading to the heater 34. Power is supplied to the switch means 41 through lines 46 and 47 leading to a suitable source of power. Detent means (not shown) are provided for retaining the damper shaft 22 in its open or closed position.

In some cases, it may be desirable to have both the condenser fan and the evaporator fan of the unit supplied with pivotable fan blades adapted for control by heat responsive members so that the air streams circulated by either of these fans may be reversed in order to increase the efficiency of the unit for vent or exhaust purposes. As may be seen in FIG. 1, the evaporator fan 16 is also provided wtih pivotable fan blades 24*a*, and a second heater 34*a* is mounted in close proximity to the heat responsive means in the hub of the fan. More specifically, heater 34*a* is supported adjacent the hub of the fan 16 by a bracket 36*a* extending upwardly from the bottom of the case. The arrangement of the components of the air conditioner disclosed in FIG. 1 make it desirable to reverse the direction of the air streams flowing through the inner compartment whenever ventilation is desired. Thus, for ventilation purposes, fan 16 is reversed and cooperates with the condenser fan 8 in circulating air from the outer compartment 6 through the vent opening. Energization of the heater 34*a* to reverse the blades 24*a* may be accomplished in a manner similar to that previously described for the heater 34. As may be seen in FIG. 6, a pair of contacts 42*a* and 43*a* are provided opposite the contacts 42 and 43. Whenever the rotatable damper shaft 33 is rotated in the clockwise direction to open the damper 19, the actuator 44 is moved to close contacts 42*a* and 43*a*. Current is then supplied to the heater 34*a* adjacent the evaporator fan through a circuit including the conductors 38*a* and 39*a*.

Referring now to FIGS. 2 and 3, there are shown the air flow patterns which occur during venting and exhaust operation of the illustrated air conditioner. FIG. 2 represents the position of the damper 19 when the damper control knob 21 has been rotated so that the switch means 41 energizes the heater 34, located in close proximity to the condenser fan 18. In this position the condenser fan blades 24 are reversed and the condenser fan 8 circulates air outwardly through the outlet opening 9 and draws air inwardly through the opening 11. The evaporator fan 16 continues to operate in its normal position, drawing room air into the inner compartment 4 through the opening 15 and blowing this air rearwardly toward the barrier 3. A portion of the air, circulated by the evaporator fan 16, flows out the vent opening or aperture 18 into the condenser compartment 6 where it is exhausted with the air stream circulated by the fan 8 through the opening 9.

FIG. 3 illustrates the arrangement wherein ventilation may be provided to the enclosure. In this arrangement, the blades 24*a* of the evaporator fan 16 are pivoted so that the evaporator fan 16 blows air out the opening 15, which is, of course, opposite from the direction that air is normally passed through the inner compartment 4 by this fan. The blades 24 of the condenser fan 18 are arranged in their normal position, so that air is drawn into the compartment 6 through the opening 9 and directed rearwardly toward the barrier 3. A portion of this air then flows through the vent opening 18 into the evaporator compartment 4 where it is discharged along with the air being blown through the opening 15 by the evaporator fan 16. As mentioned previously, because of the difference in air pressures between the two compartments, it is not always essential that the evaporator fan have fan blades which are reversible. However, as is evident from the illustration of FIG. 3, such an arrangement is obviously advantageous and greatly increases the venting efficiency inasmuch as both fans propel air in the same direction rather than opposed to each other.

By the present invention there has been provided a convenient and very easily controlled arrangement for venting and exhausting air from the outdoors and indoors respectively through an air conditioning unit. Moreover this arrangement is easily adaptable to, and efficiently controlled by the damper control apparatus usually found on air conditioning units of this type for opening and closing the vent opening.

While in accordance with the patent statutes there has been described what at present is considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and it is, therefore, the aim of the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A self-contained air conditioning unit for conditioning air within a room comprising a case adapted for mounting within an aperture in a wall of said room, a barrier dividing said case into inner and outdoor compartments having openings leading respectively to said room and to the outdoors, an evaporator fan and a condenser fan mounted respectively in said inner and outer compartments for circulating separate streams of air from said room and from the outdoors through said compartments along opposite sides of said barrier, a motor mounted in said barrier for driving both of said fans, said condenser fan including a hub and a plurality of blades pivotably mounted on shafts extending through said hub for rotation about an axis passing through the longitudinal portion of said blades, heat responsive means mounted on said condenser fan hub, said heat responsive means having an actuator engaging the shafts of said fan blades for rotating said blades from a first position wherein air is blown in one direction to a second position wherein air is blown in the opposite direction during rotation of said fan, a vent opening in said barrier above said motor through which air may be circulated from one compartment to the other, a damper for opening and closing said vent opening in said barrier, damper control means adapted to move said damper to the open or closed position with respect to said vent opening in said barrier, a heater mounted within said case in close proximity to said heat responsive means on said condenser fan for actuating said heat responsive means to move said fan blades from said first position to said second position, and switch means operated by said damper control means for energizing an electrical circuit including said heater when said damper is moved by said damper control means to the open position so that the air stream circulated by said condenser fan is reversed thereby aiding the flow of air through said vent opening from said inner compartment to said outer compartment.

2. A self-contained air conditioning unit for conditioning air within a room comprising a case adapted for mounting within an aperture of an outer wall of said room, a barrier dividing said case into inner and outdoor compartments having openings leading respectively to said room and to the outdoors, an evaporator fan mounted in the lower portion of said inner compartment and a condenser fan mounted in the lower portion of said outer compartment, said fans adapted to circulate separate streams of air from said room and from the outdoors through said compartment along opposite sides of said barrier, each of said fans including a hub and a plurality of blades pivotally mounted on shafts extending through said hub for rotation about an axis passing through the longitudinal portion of said blades, each of said fans having heat responsive means mounted on said fan hub, said heat responsive means including an actuator engaging said shafts of said fan blades for pivoting said fan blades from a first position wherein air is blown in one direction to a

second position wherein air is blown in the opposite direction during rotation of said fan, a motor mounted in said barrier for driving both of said fans, a vent opening in said barrier above said motor through which air may be circulated from one compartment to the other, a damper for opening and closing said vent opening in said barrier, manually operated damper control means accessible from the room side of said unit and adapted to move said damper to the open or closed position with respect to said vent opening in said barrier, a condenser fan heater mounted within said case in close proximity to said heat responsive means on said condenser fan and an evaporator fan heater mounted within said case in close proximity to said heat responsive means on said evaporator fan, said heaters adapted to energize said heat responsive means on said fans to move said fan blades from said first position

to said second position, and switch means for operation by said damper control means selectively energizing electrical circuits including either said condenser fan heater or said evaporator fan heater when said damper is moved by said damper control means to the open position so that the air streams circulated by said respective fans are circulated in a direction calculated to aid the flow of air through said vent opening according to the wishes of the operator.

References Cited in the file of this patent

UNITED STATES PATENTS

2,118,654	Meijer	May 24, 1938
2,858,678	Rose	Nov. 4, 1958