Sept. 19, 1961 W. A. SPEAR 3,001,056

CEILING HEATER AND VENTILATOR

Filed Oct. 1, 1958 2 Sheets-Sheet 1

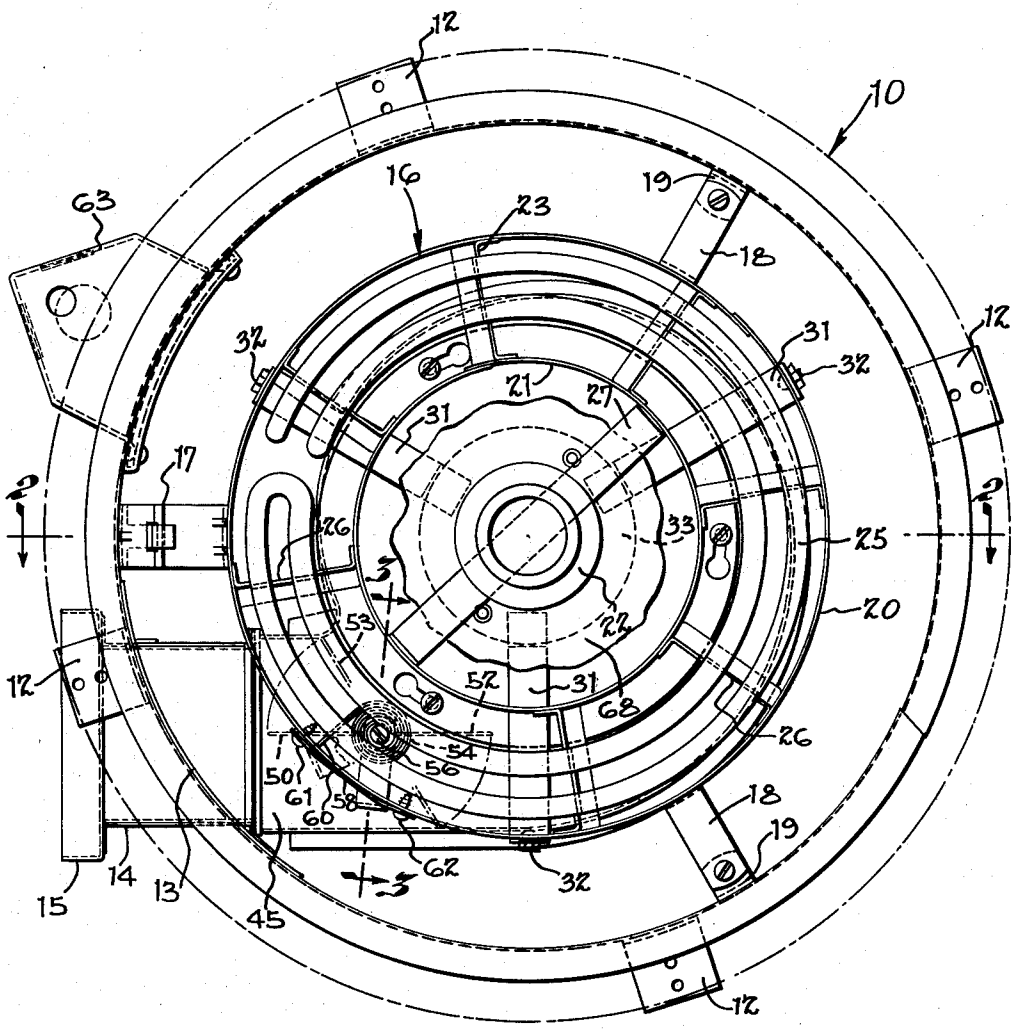


Fig. 1

INVENTOR.
Walter A. Spear.
BY
Wood, Herron & Evans.
ATTORNEYS.

Sept. 19, 1961 W. A. SPEAR 3,001,056

CEILING HEATER AND VENTILATOR

Filed Oct. 1, 1958 2 Sheets-Sheet 2

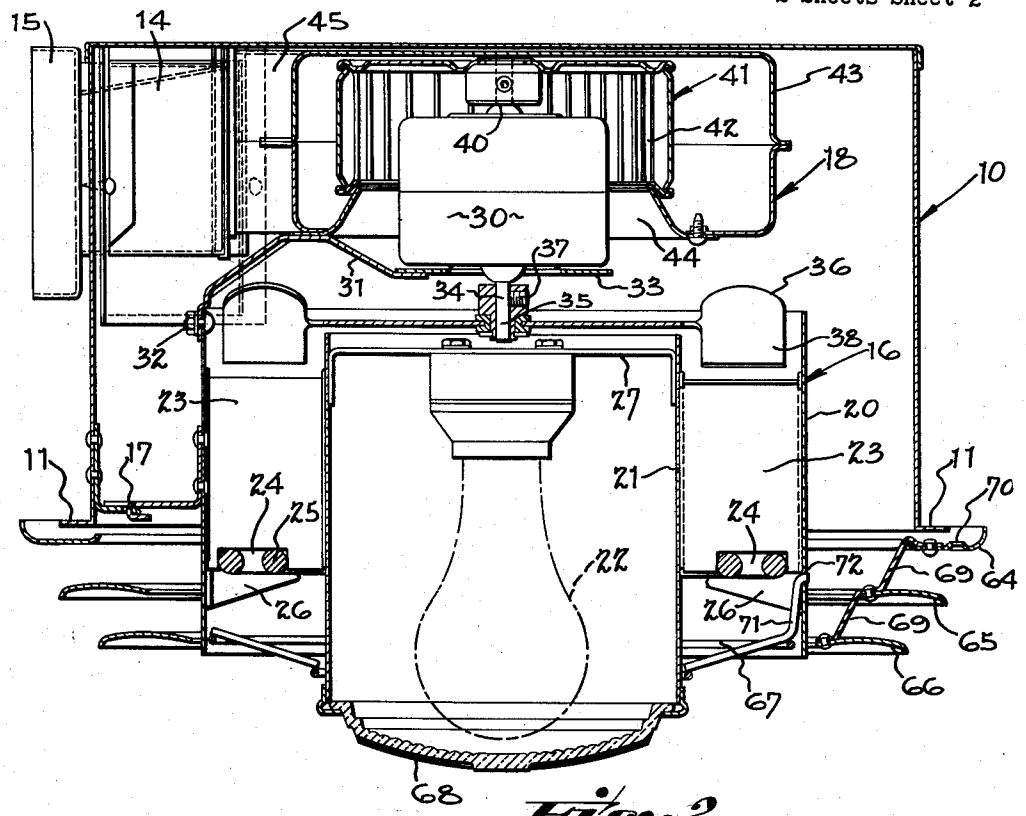


Fig. 2

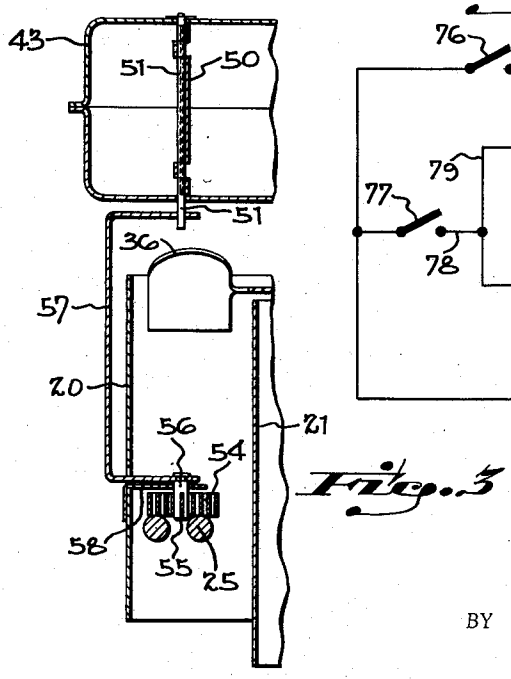


Fig. 3

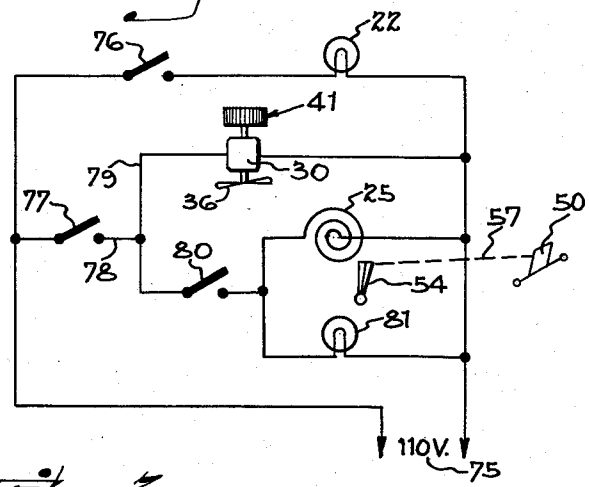


Fig. 4

INVENTOR.
Walter A. Spear.
BY Wood, Herron & Evans.
ATTORNEYS.

United States Patent Office 3,001,056
Patented Sept. 19, 1961

3,001,056

CEILING HEATER AND VENTILATOR

Walter A. Spear, Cincinnati, Ohio, assignor to Nutone, Inc., Cincinnati, Ohio, a corporation of New York

Filed Oct. 1, 1958, Ser. No. 764,680
5 Claims. (Cl. 219—39)

This invention relates to a combined room heater and ventilator, adapted, on the one hand, to drive air over a heating element into a room, and on the other hand to exhaust stale air from the room.

In devices of this type, it is important from the standpoint of the utility of the heating element to pass a convection current of air over the heating element during its operation. If it were not for the convection air being driven past the heating element, the principal heat transfer agent would be radiation, and such convection currents as might exist would merely carry the heat in an upward direction. Not only is it important from the standpoint of sound heat engineering design to provide the convection fan, but, additionally, Underwriter's Laboratories requires the utilization of a convection fan in combination with a heating element for approval of Underwriter's Laboratories to be obtained.

An appliance conforming to these requirements is the subject of U.S. Patent 2,689,906, owned by the assignee of the present invention. The device disclosed in the patent is a combination including a heating element, a single fan driven by a reversible motor, and an exhaust port. The combination is provided with means for driving the motor in one direction to operate the fan as a convection type fan that is, one which will circulate air over the heating element when the heating element is energized, and to drive the motor in the opposite direction when the heating element is de-energized so that the same fan can operate as an exhaust fan.

It has been an objective of the present invention to provide a heating-ventilating unit having a comparatively inexpensive, unidirectional motor. It has also been an objective of the invention to provide a convection fan for moving air in one direction over the heating element and to provide an exhaust fan for removal of air, both fans being driven by the single unidirectional motor. By replacing the single fan element of the prior patent with two fans, each specifically designed for optimum performance of its particular function, it is possible to avoid the disadvantage of requiring a compromise design of a single fan which performs neither of the functions of exhaust and circulation at optimum efficiency.

It has been still another objective of the invention to provide a unidirectional motor driving a convection fan for passing air over a heating element and simultaneously driving an exhaust fan with means for rendering the exhaust fan inoperative when the heating element is energized.

It has been yet another objective of the invention to provide, in a device of the type described above, a pivotally mounted exhaust port gate operably connected to a bimetallic element the bimetallic element being disposed adjacent the heating element so as to pivot the gate to a position closing the exhaust port when the heating element is energized, thereby rendering the exhaust fan inoperative.

Another objective of the invention has been to provide, in a device of the type described above, electric circuits controlling the operation of the motor and the heating element, the circuits being interlocked so that it is impossible to energize the heating element until the motor driving the convection fan is energized.

These and other objectives of the invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a bottom plan view of the invention;

FIGURE 2 is a cross-sectional view taken along lines 2—2 of FIGURE 1;

FIGURE 3 is a cross-sectional view taken along lines 3—3 of FIGURE 1; and

FIGURE 4 is a circuit diagram of the invention.

The appliance is designed principally for installation in the ceiling of a bathroom but, of course, it can be useful in other types of rooms and in other locations in a room. The principal supporting element of the appliance is a housing **10** having an annular flange **11** which is mounted flush with a ceiling or the like by means of lugs **12** angularly spaced about the periphery of the flange **11** and fixed thereto as by welding, riveting, or the like. At the upper portion of the housing **10** an aperture **13** is provided through which a conduit **14** passes to form an exhaust port. The conduit **14** is terminated by a bell **15** to receive additional conduit by which the exhaust gases are passed to the exterior of the building.

A unit **16** containing the principal elements of the invention is removably mounted to the housing **10** by means of a hinge **17** and lugs **18** bolted to a bracket **19** fixed to the housing. The hinge **17** and bracket **19** support a sleeve **20**. Concentric with the sleeve **20** is a tubular receptacle **21** within which an electric lamp **22** mounted on a strap **27** is housed. The receptacle **21** is spaced from the sleeve **20** and supported therefrom by vanes **23** which are channel-shaped in cross-section as illustrated in FIGURE 1. The lower edge of each vane **23** is recessed as at **24** to receive a circular electric resistance heating element **25**. The heating element is supported by radial brackets **26**.

A motor **30** is supported above the sleeve **20** by supports **31** bolted at **32** to the sleeve **20**. The members **31** carry an apertured plate **33** on which the motor **30** rests. A shaft **34** extends through the motor and supports at the lower end **35** thereof a circulating or convection fan **36** secured to the shaft **34** by a set screw **37**. The operating surface of the fan **36** is concentrated at the extremity **38** thereof to cooperate with the vanes **23** and the annular passageway formed between the sleeve **20** and receptacle **21**.

At the upper end **40** of the shaft **34** is mounted a squirrel cage type fan having vanes **42** which rotates within a volute type housing **43**. The lower portion of the housing **43** has an aperture provided by a cowling **44** which forms an inlet passageway for the squirrel cage exhaust fan **41**. The housing **43** also has a tangential outlet **45** which, when the unit **16** is supported in its proper position is connected to the conduit **14**, which thereby forms a continuous extension of the outlet **45**.

Disposed in the exhaust port formed by the outlet **45** and the conduit **14** is a butterfly gate **50** fixed to a pivot pin **51**, the pivot pin being journaled at its ends in the housing **43**. The gate **50** has an open position indicated at **52** in which the passage of exhaust gases is substantially unimpeded and a closed position indicated at **53** in which the flow of exhaust gases is blocked. Referring particularly to FIGURE 3, the gate **50** is rotated between its open and closed positions by a spirally wound bimetallic element **54**, the inner end **55** of which is fixed by a pin **56** to a drive connector **57**. The upper end of the drive connector **57** is fixed to the pin **51** upon which the gate **50** is mounted (FIGURE 3). The bimetallic element is partially supported by a bracket **58** in which the pin **56** is journaled and is partly supported by the heating element **25** upon which the element **54** rests. The outer end **60** of the bimetallic element is secured to the tubular support member **20** by a metal screw **61** which also secures one end of the bracket **58** to the tubu-

lar support. The other end of the bracket is secured by a similar metal screw 62 to the support 20.

Electrical connections to the lamp, the motor and the heating element are made by suitable conductors (described in connection with FIGURE 4) which are passed into an outlet box 63 where a thermal protector and suitable terminal connectors are provided for making connections to the required wall switches.

The lower portion of the assembly is attractively enclosed by a concentric vertically spaced louver or grille members 64, 65 and 66, a wire guard 67, and a lens 68 which is removably bolted to the receptacle 21. The grille members are integrally joined by angularly spaced strap 69, and fixed to the assembly by bolting the uppermost member 64 through holes 70 to the lugs 11. The guard 67 is removably mounted below the heating element 25 by resilient stringers 71 which pass through holes 72 in the sleeve 20.

The circuit diagram of FIGURE 4 illustrates the manner in which the electrical units of the combination are energized and the manner in which the circuits are interlocked to permit energization of the heating element 25 only when the motor 30 is energized. The circuit is connected to a 110 volt power supply indicated at 75. The lamp 22 is connected to the power source through a switch 76 and the motor is connected to the power source by a switch 77. A conductor 78 connects the switch to the fan motor 30 at 79 and connects the switch 77 to a heater switch 80. Thus, a parallel circuit of heater and motor is provided, the parallel circuit being connected in series with the switch 77, whereby the switch 77 controls the operation of both legs of the parallel circuit. In parallel with the heater element is a pilot light 81 to be associated with the wall switches and which will be energized with the heater upon the closing of the switch 80 (assuming that the motor switch 77 has previously been closed) to serve as an indicator that the heating element is energized, a situation which might not otherwise be easily determined.

FIGURE 4 also contains a diagrammatic illustration of the positioning of the bimetal 54 adjacent the heating element 25 and the connection 57 to the gate 50.

The operation of the invention can best be understood by reference to FIGURE 4. When it is desired to operate the exhaust fan, the switch 77 is closed and the exhaust fan motor 30 is directly energized by the power source 75. Under these conditions, including the fact that the heating element is cold, the gate 50 will remain in the open position indicated at 52 in FIGURE 1, permitting the exhaust fan to remove air from the room. The exhaust fan and its cooperating housing 43 are designed for considerably greater efficiency than the convection fan 36. As a consequence, the exhaust fan, which is operating in opposition to the convection fan, drives many times the volume of air than does the convection fan so that the flow of air is up and out through the exhaust port.

If heating rather than ventilating should be desired, the switch 80 is closed along with the switch 77. Initially, because of the greater efficiency of the exhaust fan, the operation will be one of exhausting the air but within a short time the heating element 25 will be heated enough to expand the bimetal 54. The expansion of the bimetal 54 which is fixed at its outer end will cause the rotation of the inner end thereof through approximately 45 degrees to swing the gate 50 to the closed position illustrated at 53 in FIGURE 1. Closing the exhaust port will effectively render the exhaust fan inoperative so that the convection fan 36 will be fully effective. The convection fan 36 will draw air through the grill work 64—66 and force it downwardly through the annular passageway between the members 20 and 21. The downwardly moving air will pass over the heating element 25, picking up heat therefrom and conveying it into the room below.

The combination of the high volume squirrel cage exhaust fan 41 and the low volume convection fan 36, with the exhaust fan being placed above the convection fan as illustrated in FIGURE 2 of the drawings, such that air moved by either fan passes through the common annular passageway which exists between the circular lamp receptacle 21 and the sleeve 20, overcomes an objection to the combination disclosed in the assignee's U.S. Patent No. 2,689,906. In the patented combination, in order to meet underwriters requirements, it is necessary that the convection fan be energized at the same time the heating element is energized. Thus, in the short time while the heating element is heating up, the convection fan drives a column of chilling air down into the room below. By contrast, when the heater in the combination disclosed herein started, the butterfly gate 50 is open and when the squirrel cage blower starts, it "robs" the convection fan 36 of its air so that even though the convection fan is rotating with the blower, the air moves up through the passageway between the lamp housing 21 and sleeve 20 and out through the butterfly gate 50 into the exhaust duct. Now, as the heater coil starts heating up, the butterfly gate begins closing, so that the squirrel cage exhaust fan 41 becomes decreasingly effective and when the heating element reaches its peak temperature, the squirrel cage exhaust fan is completely ineffective, serving merely as a flywheel, and the convection fan takes over to drive a column of air over the heating element 25 down into the room. In substance, therefore, the squirrel cage exhaust fan "starves" the convection fan when the heater is just turned on and during the period that the element heats up, the squirrel cage exhaust fan becomes less and less effective while the convection fan becomes more and more effective. This eliminates the chilling column of air of the patented combination.

It should be understood that whereas the illustrated form of the invention is preferred because of the simplicity and efficiency of the operating elements, there are many variations which can be made in the invention without departing from the spirit and scope thereof. For example, the gate 50 could be operated by a solenoid connected in series with the pilot light 81, the solenoid driving a rack engaged by a pinion mounted on the pin 51. Thus, direct operation of the gate would be afforded without relying on the heating of the bimetal 54 for the operation of the gate. Alternatively, the heat of the element 25 might be utilized through the agency of a thermocouple, the electrical energy of the thermocouple being utilized to operate the gate 50 as through a relay or other amplification means.

In a general manner, while there has been disclosed in the above description, what is deemed to be the most practical and efficient embodiment of the invention, it should be well understood that the invention is not limited to such embodiment as changes may be made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

I claim:

1. An appliance comprising a motor, an exhaust fan and a circulating fan driven by said motor in opposition to each other, said exhaust fan being of greater air propelling efficiency than said circulating fan and tending to starve said circulating fan, a heating element in the path of flow from said circulating fan, and means automatically rendering said exhaust fan ineffective to starve said circulating fan when said heating element is energized.

2. An appliance comprising a motor, an exhaust fan and a circulating fan driven by said motor in opposition to each other, said exhaust fan being of greater air propelling efficiency than said circulating fan and tending to starve said circulating fan, a heating element in the path of flow from said circulating fan, and bimetal means

mounted adjacent said heating element for automatically rendering said exhaust fan ineffective to starve said circulating fan when said heating element is energized.

3. An appliance comprising a frame, a motor mounted by said frame, an exhaust fan and a circulating fan driven by said motor in opposition to each other, said exhaust fan being of greater air propelling efficiency than said circulating fan and tending to starve said circulating fan, an exhaust port formed in said frame, said exhaust fan tending to drive air through said exhaust port, a gate movable to open and closed positions such that when said gate is in open position said exhaust fan starves said circulating fan and propels air through said port and such that when said gate is closed said exhaust fan is rendered ineffective to starve said circulating fan, a heating element in the path of air flow from said circulating fan, and means automatically closing said gate when said heating element is energized.

4. An appliance comprising a motor, an exhaust fan and a circulating fan driven by said motor in opposition to each other, said exhaust fan being of greater air propelling efficiency than said circulating fan and tending to starve said circulating fan, a heating element in the path of flow from said circulating fan, circuit means including a switch for connecting said motor to a voltage source, circuit means including a switch for connecting said heating element to a voltage source, means interlocking said respective circuit means so that said heating element can be energized only when said motor is energized, and means automatically rendering said exhaust fan ineffective to starve said circulating fan when said heating element is energized.

5. An appliance comprising a frame, an exhaust port in said frame, an exhaust fan mounted to propel air through said port, a gate pivotally mounted in said port and movable between open and closed positions therein, a motor having a shaft passing therethrough, means connecting said exhaust fan to one end of said shaft, a circulating fan connected to the other end of said shaft, said exhaust fan being of greater air propelling efficiency than said circulating fan and starving said circulating fan when said gate is in open position, a heating element disposed in the flow path of said circulating fan, a spirally wound bimetal strip mounted adjacent and in heat conducting relationship to said heating element, and means connecting said bimetal element to said gate whereby said gate is moved to closed position when said heating element is energized.

References Cited in the file of this patent

UNITED STATES PATENTS

1,041,322	Mies	Oct. 15, 1912
1,749,039	Lincecum	Mar. 4, 1930
2,351,096	Blue	June 13, 1944
2,689,906	Corbett	Sept. 21, 1954
2,870,319	Ford	Jan. 20, 1959
2,875,316	Ford et al.	Feb. 24, 1959