Dec. 2, 1952 G. B. CUNNINGHAM 2,619,953

SPACE HEATING AND VENTILATING APPARATUS

Filed Nov. 2, 1949

3 Sheets-Sheet 1

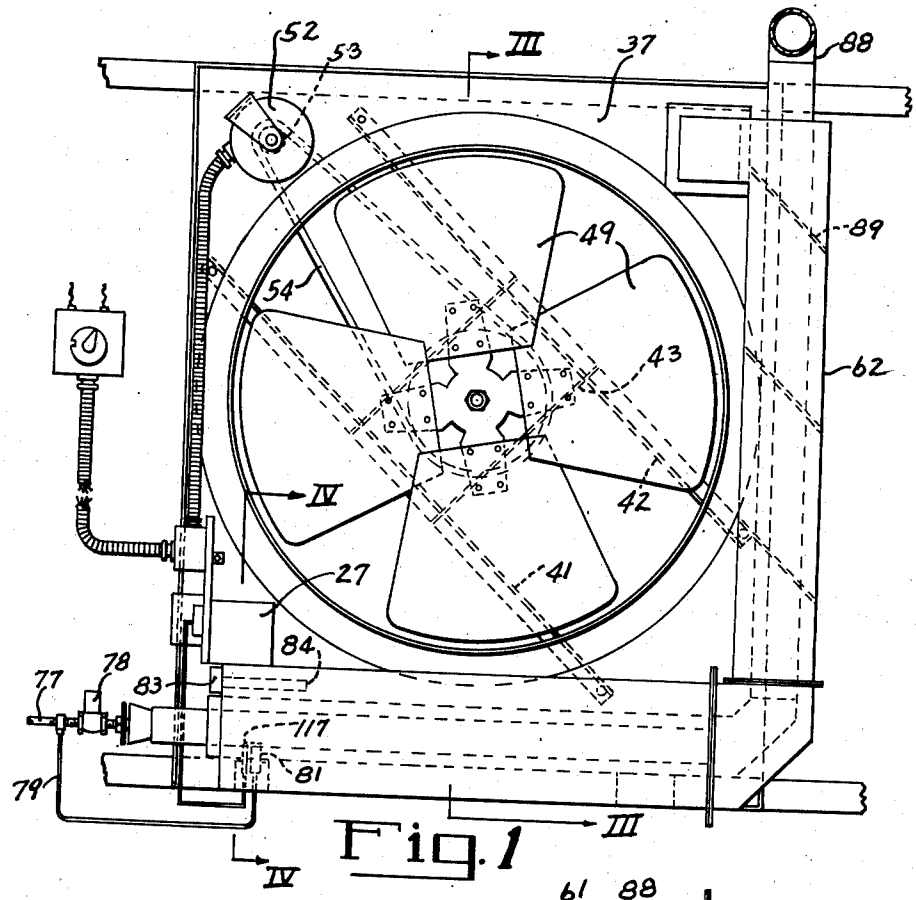



Fig. 1

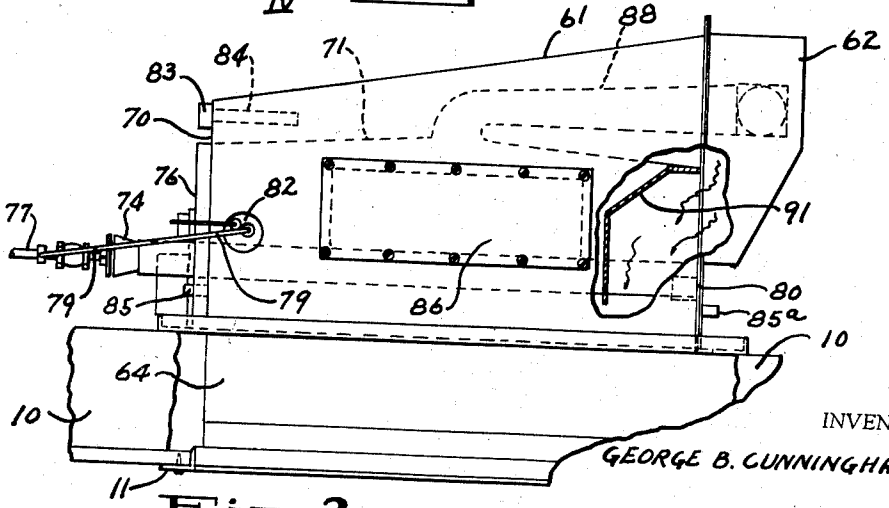



Fig. 2

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3 Sheets-Sheet 2

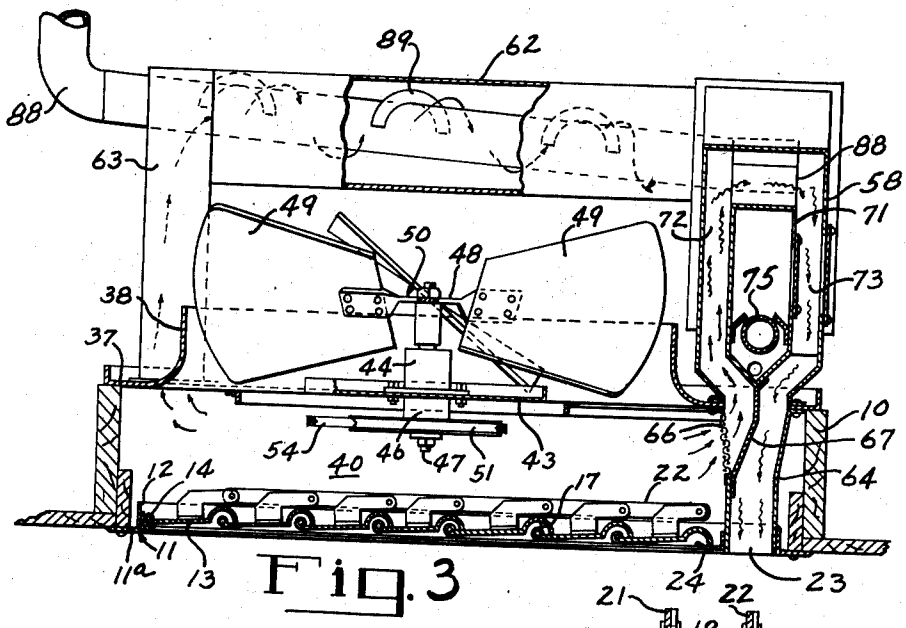



Fig. 3

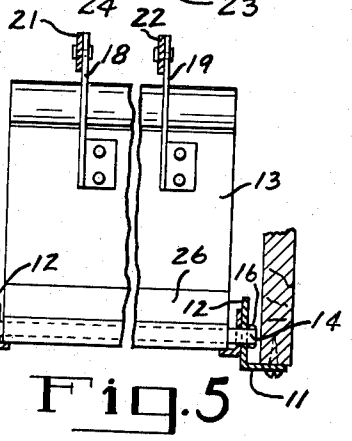



Fig. 5

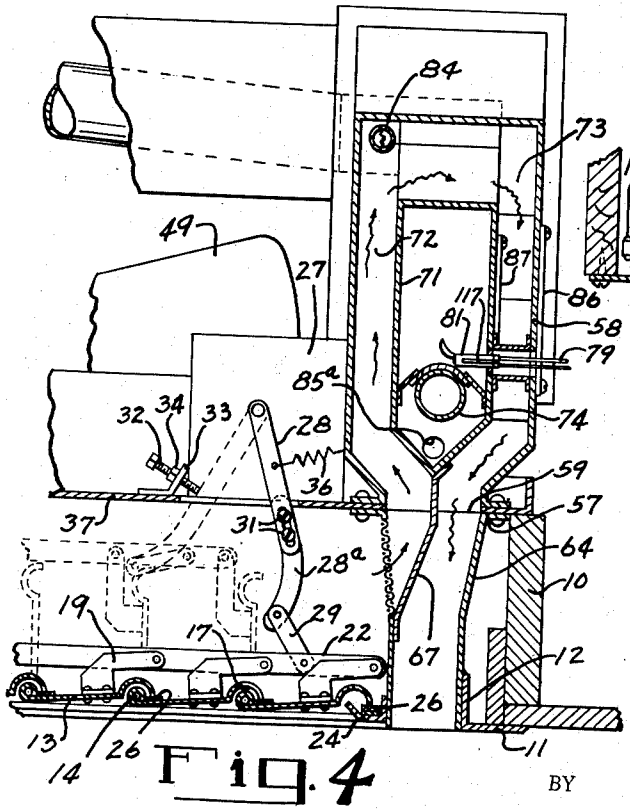



Fig. 4

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3 Sheets-Sheet 3

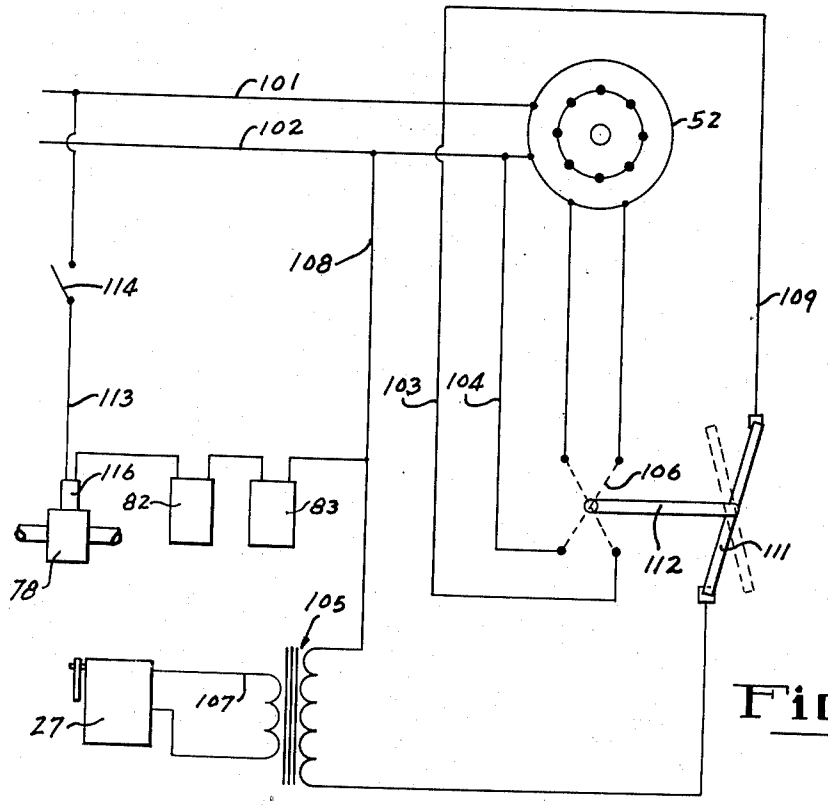



Fig. 6

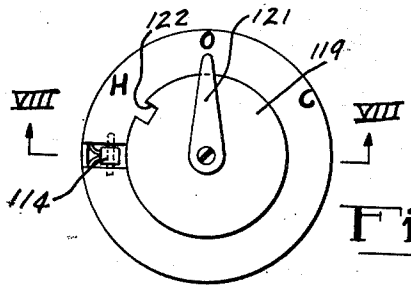



Fig. 7

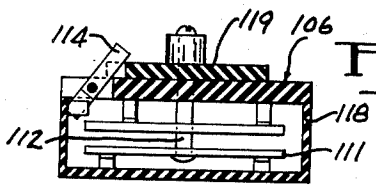



Fig. 8

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Patented Dec. 2, 1952

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# UNITED STATES PATENT OFFICE

2,619,953

## SPACE HEATING AND VENTILATING APPARATUS

George B. Cunningham, Birmingham, Ala., assignor to Cunningham Engineering Company, a partnership

Application November 2, 1949, Serial No. 125,021

8 Claims. (Cl. 126—110)

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This invention relates to apparatus for space heating and ventilating, particularly to apparatus adapted to be mounted in an opening in a room such as in the wall or ceiling thereof and has for an object the provision of apparatus of the character designated which shall include a fuel burning heating unit, together with controlled means for supplying fuel thereto.

A further object of my invention is to provide apparatus which shall include a reversible electric fan mounted in a suitable frame and adapted when operating in one direction to ventilate the space and in the other direction to heat it, together with a fuel burning heating unit and a system of shutters associated with the fan so mounted as to divert the current of air generated by the fan, when running in a reverse direction, over the heating unit and into the space to be heated.

A still further object of my invention is to provide space heating and ventilating apparatus which shall include a fuel burning heating unit together with means to supply fuel to the heating unit operable only when the fan is operating in a direction for heating.

Other objects of my invention are to provide apparatus of the character designated which shall be simple of design, economical of manufacture, reliable and safe in operation, and one which may be readily mounted in an opening in a room.

In my co-pending application Serial No. 87,330, filed April 13, 1949, I have shown, described and claimed heating and ventilating apparatus which includes an electric heating element, a reversible electric fan, and means to divert the current of air generated by the fan over and through the heating element when the fan is operating in the direction for heating. The principal improvement in my present invention over that therein described and claimed is that I provide means for utilizing a fuel burning heating element therein.

Apparatus embodying features of my invention is illustrated in the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a plan view of the apparatus as it is mounted in an opening in the ceiling of a room;

Fig. 2 is an end elevation of the apparatus with parts broken away and in section;

Fig. 3 is a sectional view taken along the line III—III of Fig. 1;

Fig. 4 is an enlarged sectional view taken along the line IV—IV of Fig. 1;

Fig. 5 is a detail sectional elevation of a shutter in open position;

Fig. 6 is a wiring diagram;

Fig. 7 is a front view of the control switches; and

Fig. 8 is a sectional view taken along the line VIII—VIII of Fig. 7.

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Referring now to the drawings for a better understanding of my invention I show an opening in a room defined by a rectangular wooden frame 10. For convenience of description, throughout this specification and the claims, the opening will be considered as being in the ceiling of a room opening upwardly above the ceiling and downwardly through the ceiling and the terms in the specification and claims indicating that some parts are above or below others are intended to refer to their location as shown in the drawings. It will be obvious that the apparatus may be mounted in an opening in the wall of a room and operate as well as if located in the ceiling. It will be noted that the rectangular frame 10 is of considerable depth which is of importance, as will be shown hereinafter, in the operation of the apparatus. Secured around the lower boundary of the frame 10 is a metal frame 11 made of structural angles with one flange 11a extending horizontally to join the frame 10 and the other flange 12 extending vertically.

Pivotally mounted in the upstanding flange 12 of the frame 11 are a plurality of shutters 13. The shutters 13 are mounted on rods 14 which extend transversely of the frame 10 and through the flanges 12, as shown in Fig. 5, the outer ends of the rods 14 being slightly upset as shown at 16 in order to prevent the rods from working out of the flanges. The opposite side of each of the shutters 13 is grooved as shown at 17 to span and cover the adjacent rod 14 and thereby form a tight closure. Secured to each of the shutters 13 near the ends thereof are L-shaped brackets 18 and 19. Secured to the brackets 18 is a shutter operating bar 21 and secured to the brackets 19 is a shutter operating bar 22. It will be seen that when the shutter operating bars are actuated to the left, as shown in Fig. 3, the shutters will be opened to the position shown in Fig. 5 and when moved to the right, the shutters will be closed. It will be seen also from Fig. 3 that the shutters 13 do not serve to close the entire space bounded by the rectangular frame 10, but that there is an opening 23 along one side of the frame not closed by the shutters. The inner side of the opening 23 is bounded by an angle member 24 having an upturned edge, as shown in Fig. 4 which is engaged by the curved outer edge of the last shutter 13 when the shutters are closed. Preferably, a strip of sound deadening material such as shown at 26 in Fig. 4, and Fig. 5, is placed adjacent the pivot of each of the shutters and along the angle 24 to be engaged by the lip of a closing shutter.

The shutters 13 are moved toward an open position by means of a uni-directional motor 27 having an operating arm 28 connected by means of a link 29 to the shutter operating bar 22. For convenience of installation, the arm 28 may be

made adjustable as to length by means of providing a lower section 28a joined to the upper section by means of bolts 31 passing through slotted holes in the respective sections. The opening movement of the arm 28 is adjustably limited by means of a screw 32 passing through a bracket 33 mounted on a suitable stationary part of the apparatus. The screw 32 is held in adjusted position by means of a lock nut 34. The arm 28 and shutter operating bar 22 are moved toward a closing position of the shutters by means of a spring 36 connected to the arm 28 and to a suitable stationary part of the apparatus.

Mounted on top of the frame 10, over the shutters 13 is a plate 37 having an upwardly extending frusto-conical portion defining an opening and forming a fan casing. Extending across the casing and joined to the plate 37 are a pair of angle bars 41 and 42 and extending across and joined to the angle bars 41 and 42 is a plate 43 forming a fan support. Mounted on the plate 43 and secured thereto is an upper bearing 44 and on the underside of the plate is a lower bearing 46 for a fan shaft 47 which extends through both bearings. Mounted on the upper end of the shaft 47 is a spider 48 to which the blades 49 of a fan 50 are secured. Mounted on the lower end of the shaft 47, under the plate 37, is a pulley 51. The fan is driven by means of a reversible electric motor 52 mounted over the plate 37 near one corner of the frame 10 with its shaft extending downwardly through the plate 37 and with a pulley 53 on the lower end thereof which drives the fan 50 through the pulley 51 and a belt 54. It will be seen, with the fan mounted as shown in Figs. 1 and 3, when operating in one direction, with the shutters 13 open, there is a free passage of air upwardly through the shutters and out of the space with which the apparatus is associated to ventilate it. When operating in the other direction, with the shutters 13 closed, air is forced downwardly against the shutters, which form, with the plate 37 and frame 10, a plenum chamber 40.

As shown in Figs. 1, 3 and 4, the fan is mounted to one side of the frame 10, centrally over the opening controlled by the shutters 13. Along the other side of the frame 10 there is provided an opening 57 in the plate 37 over which is mounted a heating unit housing 58. As shown in Figs. 1 to 4, the housing 58 is generally rectangular in shape and narrows downwardly at the bottom, having an opening 59 therein which registers with the opening 57 in the plate 37. The housing 58 is secured to the plate 37 as shown in Fig. 4. The upper roof 61 of the housing 58 slopes upwardly as shown in Fig. 2 from one end to the other, and at its higher end is joined to a housing 62 which extends across the adjacent side of the frame 10 and is connected at its opposite end by means of a downwardly extending conduit 63 to the plenum chamber 40. Joined to the bottom of the heating unit housing 58, along the opening 57, is a hot air duct 64 which extends downwardly through the frame 10 and discharges out through the opening 23. Communicating with the plenum chamber 40 are screened openings 66 through the wall of the hot air duct. A partition 67 is joined at its lower end to the inner wall of the hot air duct 64 along the lower edge of the screened openings 66 and extends upwardly therefrom to divide the hot air duct into two passages.

Mounted within the heating unit housing 58



is a combustion chamber 71 which extends from end to end of the housing 58 but which is smaller in cross section whereby to form an air passage 72 which extends all around the combustion chamber, between it and the wall of the housing 58. The combustion chamber 71 and housing 58 have common end walls 70 and 80. The upper edge of the partition 67 is joined to the lower side of the combustion chamber 71 so that air from the plenum chamber 40 passes through the screened opening 66, thence upwardly through the air passage 72 over the top of the combustion chamber 71, and thence downwardly through passage 73 on the other side of the combustion chamber to join to the hot air duct 64. Mounted within the combustion chamber 71 is a gas burner 74 in the form of a pipe having burner openings 75 along the upper side thereof and which extends through the end wall 76 of the combustion chamber toward the other end thereof.

Gas is supplied to the burner 74 from a conduit 77 and is controlled by a solenoid operated valve 78 in a manner to be described later. Secondary air for combustion may be supplied through openings 85 and 85a. A conduit 79 is joined to the conduit 77, ahead of the valve 78, and leads to a pilot light 81 located within the combustion chamber for igniting the fuel admitted to the burner 74, when required. Associated with the pilot light 81 is a pilot control device 82 which serves to cut off the supply of fuel to the burner 74 when the pilot light goes out, in a manner to be described later. Also associated with the fuel supply is an over-heat cut off switch 83 embodying a thermocouple 84 which extends into the heating unit housing 58 above the combustion chamber 71 and operates in a manner to be described later. Access may be had to the pilot light and to the combustion chamber through outer, removable observation doors 86 and 87 in the wall of the housing 58 and in the wall of the combustion chamber 71. The gases of combustion pass outwardly of the combustion chamber 71 through a flue 88 which extends from the combustion chamber midway its ends through the housing 58 and thence through the housing 62 to the atmosphere. Preferably, spiral baffles 89 are secured on the outer surface of the flue 88 to cause the air, when heating, to pass in a spiral path around the flue to the heater housing 58. Within the heater housing at the side of the combustion chamber 71 is a baffle member 91 which diverts the air coming through the housing 62 downwardly through the hot air duct 64.

Referring now to Figs. 6, 7 and 8 inclusive, the electrical controls for my improved heating and ventilating apparatus will be described. Electric current for operating the various devices is supplied from a line circuit 101, 102. Connected to the circuit 101, 102 is a circuit 103, 104 for the reversing motor 52 which drives the fan. Interposed in the circuit 103, 104 is a reversing switch 106. The shutter operating motor 27 is connected through a transformer 105 having a secondary motor circuit 107 to a circuit 108, 109, connected in turn to the line 101, 102. Interposed in the circuit 108, 109 is a switch 111 which is connected through a common operating shaft 112 to the reversing switch 106 so as to be operated in unison with the reversing switch. The circuit 108, 109 is arranged to energize the motor 27 and open the shutters 13 when the motor 52 is energized to operate the fan in a direction for ventilating or cooling the space with which it is associated. When the reversing switch 106 is turned to

the position for the motor 52 to run in the opposite direction, the shutters 13 are closed by means of the spring 36, as previously described. The fuel valve 78, the pilot light control 82, and the over heat control device 83 are all arranged in series in a circuit 108, 113 in which is interposed a switch 114. The fuel valve 78 is operated by means of a solenoid 116 which (when the circuit 108, 114 is closed, serves to open the valve. Included in the pilot valve control device 82 is a thermocouple 117 which operates, should the pilot light 81 go out, to interrupt the circuit 108, 113, whereupon the valve 78 is automatically closed by de-energization of the solenoid 116. Similarly, should the temperature in the housing 58 rise above a predetermined amount, the thermocouple 84 associated with the over heat cut off switch 83 will interrupt the circuit 108, 113 and cause the fuel valve 78 to be closed. The fuel supply control and safety devices just described are well known commercially available devices and form no part of my present invention. Accordingly, they are not described in detail.

One of the important features of my invention is the mounting of the switch 114 in the casing 118 of the reversing switch 106, as shown in Fig. 8. Included in the reversing switch 106 is a disc 119 carrying a pointer 121 indicating the position of the switch. Formed in the disc 119 is a notch 122 in position to receive the operating handle of the switch 114 and permit it to close only when the reversing switch 106 is turned to that position which causes the motor 52 to run in a direction for operating the apparatus for space heating. When the switch 106 is turned to any other position, the switch 114 cannot be closed and the heating unit cannot be put in operation.

From the foregoing description, the operation of my improved apparatus will be readily understood. When it is desired to use the apparatus for space cooling or ventilating, the pointer 121 is turned to the position C shown in Fig. 7, in which position the reversing switch 106 energizes the motor 52 to operate the fan 50 in a direction to draw air upwardly through the frame 10. In that position of the reversing switch 106, the switch 111 is closed which causes the motor 27 to be energized through the circuit 107, 108, 109 and effects opening of the shutters 13. It will be seen that when thus operating, there is a free passage for the air to pass upwardly through the open shutters and out of the space with which the apparatus is associated. Whenever it is desired to use the apparatus for heating, the pointer 121 of the reversing switch 106 is turned to the position H as shown in Fig. 7 which brings the notch 122 opposite the operating handle of the switch 114. The switch 114 can then be closed to bring about the admission of fuel to the combustion chamber. Also, in this position, the circuit 108, 109 to the shutter operating motor 27 is open, thereby causing the shutters 13 to be closed by the spring 36, as already described. The fan 50 is now operating in a direction to force air downwardly into the plenum chamber 40 from which it passes through the screened opening 66 into the passage 72, around the combustion chamber, within the housing 58, and downwardly through the passage 73 and out through the opening 23 to the space to be heated. Air also passes from the plenum chamber 40 upwardly through the conduit 63 and housing 62, around the outlet flue 88 from whence it enters the housing 58 and passes downwardly under the baffle 91 to the outlet 23.

While I have described the fuel to be employed as gas it will be obvious that oil may be utilized by substituting appropriate burning devices in the combustion chamber.



From the foregoing it will be apparent that I have devised a combined heating and ventilating apparatus which is simple of design and operation and which includes a fuel burning heating unit.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In a combined heating and ventilating apparatus adapted for mounting in an opening in a room, a frame adapted to be disposed around the opening, a cover over the frame having an opening therein with a fan casing extending outwardly therefrom and a second opening in said cover extending along one side of the frame adjacent the first mentioned opening, a fuel burning heating unit mounted over and communicating with the second opening and having a duct for discharging the products of combustion, a reversible fan mounted in the casing substantially coaxial therewith and constructed and arranged to induce a current of air selectively in either direction through the casing, a plurality of shutters pivotally mounted in the side of the frame opposite the fan in position when open to afford free passage for the air current therethrough, and to interrupt said passage when closed and form, with the frame and cover, a plenum chamber, and means providing air passages leading from the plenum chamber through the heating unit and out through the opposite side of the frame from said cover.

2. In a combined space heating and ventilating apparatus, a relatively deep frame, a cover for the frame having an opening therein, a frusto conical fan casing mounted on the cover and communicating with said opening in the cover, a reversible electric fan mounted in the casing in position to induce a current of air in one direction therethrough when ventilating and in the opposite direction when heating, there being a second opening in said cover extending along one side of the frame adjacent the first mentioned opening, a fuel burning heating unit embodying an enclosed housing mounted over and communicating with said second opening, a hot air duct communicating with the heating unit housing and disposed to discharge hot air at the opposite side of the frame from said cover, an enclosed combustion chamber within the heating unit housing and spaced therefrom to define air passages between the housing and the combustion chamber, means to supply fuel to the combustion chamber, a plurality of shutters pivotally mounted in the frame opposite the fan in position when open for ventilating purposes to afford free passage of the air therethrough and to interrupt said passage and form a plenum chamber when closed for heating, and means providing air passages from the plenum chamber into the heating unit housing.

3. In a combined heating and ventilating apparatus, a relatively deep frame, a cover for the frame having an opening therein, a fan casing mounted on the cover and communicating with said opening in the cover, a reversible electric

fan mounted in the casing in position to induce a current of air in one direction therethrough when ventilating and in the opposite direction when heating, there being a second opening in said cover extending along one side of the frame adjacent the first mentioned opening, a fuel burning heating unit embodying an enclosed housing mounted over and communicating with said second opening, an enclosed combustion chamber within the heating unit housing and spaced therefrom to define air passages between the housing and the combustion chamber, means to supply fuel to the combustion chamber, a hot air duct joined to the housing and disposed to discharge hot air at the opposite side of the frame from said cover, a partition in the hot air duct extending longitudinally of the housing and joined along one edge of the combustion chamber and at its opposite edge to the inner side of the duct, there being an opening in the inner side of said duct inwardly of said partition and communicating with said housing for the entrance of air thereinto, and a plurality of shutters pivotally mounted in the frame opposite the fan in position when open for ventilating purposes to afford free passage of the air therethrough and to interrupt said passage and form a plenum chamber when closed for heating, said plenum chamber communicating with the housing through the opening in the inner side of the hot air duct.

4. Apparatus as defined in claim 3 in which there is provided a flue for the gases of combustion leading from the combustion chamber outwardly of the housing and an air conduit surrounding the flue and communicating at one end with the plenum chamber and at the other end with the housing.

5. In a combined heating and ventilating apparatus, a relatively deep frame, a cover for the frame having an opening therein, a fan casing mounted on the cover and extending outwardly from said opening in the cover, a reversible electric fan mounted in the casing in position to induce a current of air in one direction therethrough, when ventilating and in the opposite direction when heating, there being a second opening in said cover extending along one side of the frame adjacent the first mentioned opening, a fuel burning heating unit embodying an enclosed housing mounted over and communicating with said second opening, an enclosed combustion chamber within the heating unit and spaced therefrom, a hot air duct joined to the housing and discharging hot air at the opposite side of the frame from said cover, a partition in said hot air duct extending longitudinally of the housing and joined at one edge to the combustion chamber and at its opposite edge to the inner side of the duct, there being an opening in the inner side of said duct inwardly of said partition and communicating with said housing for the entrance of air thereinto, means in the side of the frame opposite the fan interrupting the flow of air through the frame and forming a plenum chamber when heating, said plenum chamber communicating with the housing through the opening in the side of the hot air duct, a reversible electric motor and an electric circuit connected to the fan for operating said fan in one direction when ventilating, a reversing switch interposed in said circuit to operate the fan in a reverse direction when heating, means to supply fuel to said combustion chamber when heating, a separate electric circuit controlling the supply of fuel, a switch in said latter circuit, and means operatively associated with the reversing switch to obstruct the closing of the switch in said latter circuit except when the reversing switch is in position for the fan to run in a direction for heating.

6. In a combined heating and ventilating apparatus, a relatively deep frame, a cover for the frame having an opening therein, a fan casing mounted on the cover and extending outwardly from said opening in the cover, a reversible electric fan mounted in the casing in position to induce a current of air in one direction therethrough when ventilating and in the opposite direction when heating, there being a second opening in said cover extending along one side of the frame adjacent the first mentioned opening, a fuel burning heating unit embodying an enclosed housing mounted over and communicating with said second opening, a plurality of shutters pivotally mounted in the side of the frame opposite the fan in position when open for ventilating purposes to afford free passage of an air current therethrough and to interrupt said passage and form a plenum chamber when closed for heating, means affording passage for the air current from the plenum chamber through the heating unit housing and disposed to discharge the same at the opposite side of the frame from said cover when the shutters are closed, a reversible electric motor and an electric circuit therefor connected to said fan to operate it in one direction for ventilating, a reversing switch interposed in said circuit to operate said fan in a reverse direction for heating, means to open said shutters when operating as a ventilating unit, means to supply fuel to said combustion chamber, an electric circuit controlling the supply of fuel, a switch in said latter circuit, and means operatively associated with the reversing switch to obstruct the closing of the switch in said latter circuit except when the reversing switch is in position for the fan to run in a reverse direction.

7. The apparatus defined in claim 6 in which the means to operate the shutters comprises an electric motor and an electric circuit therefor, and a switch interposed in said latter circuit operatively connected to and operable in unison with the reversing switch.

8. The apparatus defined in claim 7 in which the electric motor is unidirectional in operation and operates to open the shutters when its associated switch is closed and the fan is running in a direction for ventilating, and in which the shutters are closed by spring and linkage means.

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