Nov. 22, 1932. R. D. MADISON 1,888,730

HEATING DEVICE

Filed Sept. 29, 1930 3 Sheets-Sheet 1

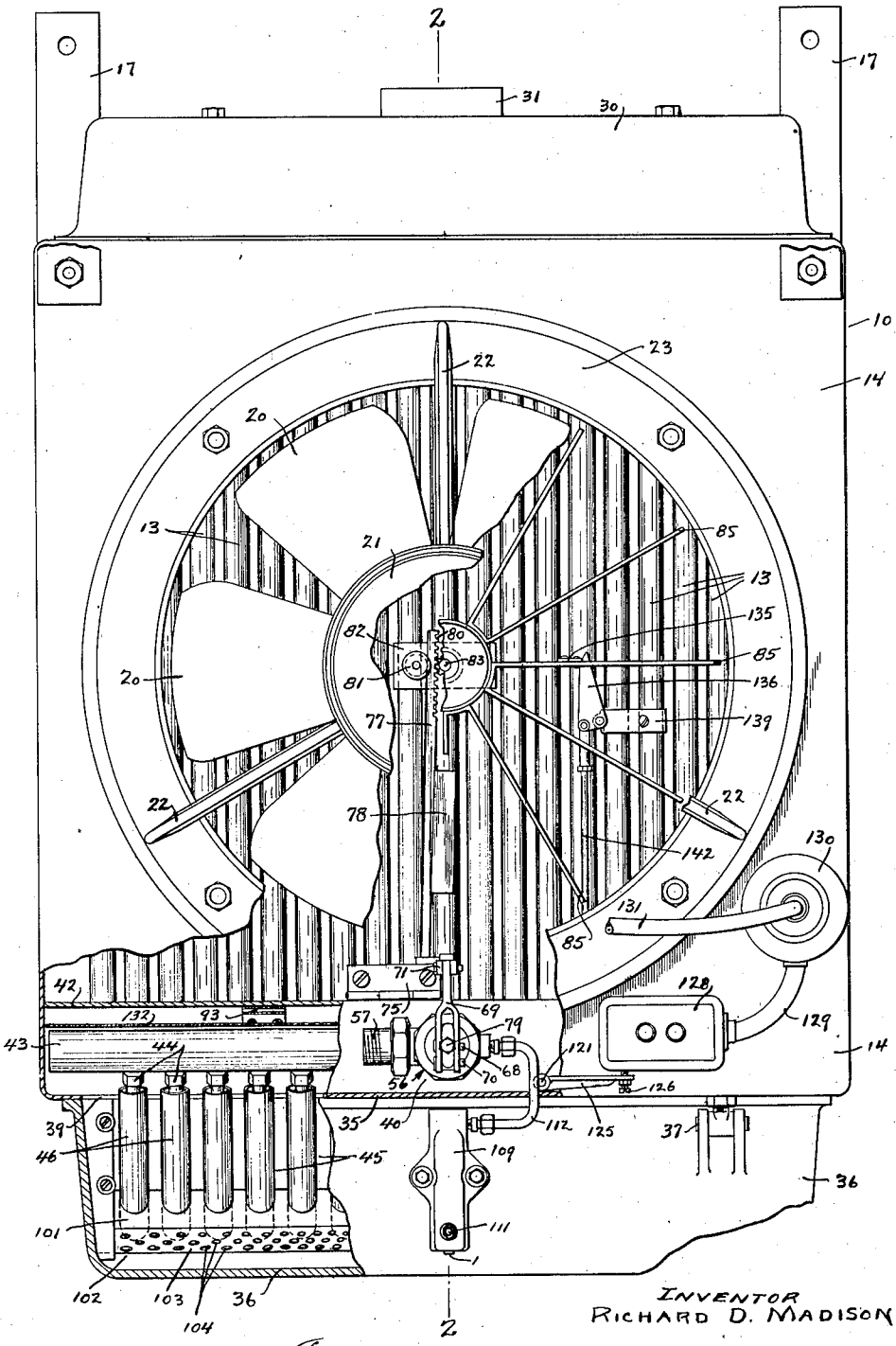


Fig. 1.

INVENTOR
RICHARD D. MADISON

By J. W. McEllis

ATTORNEY

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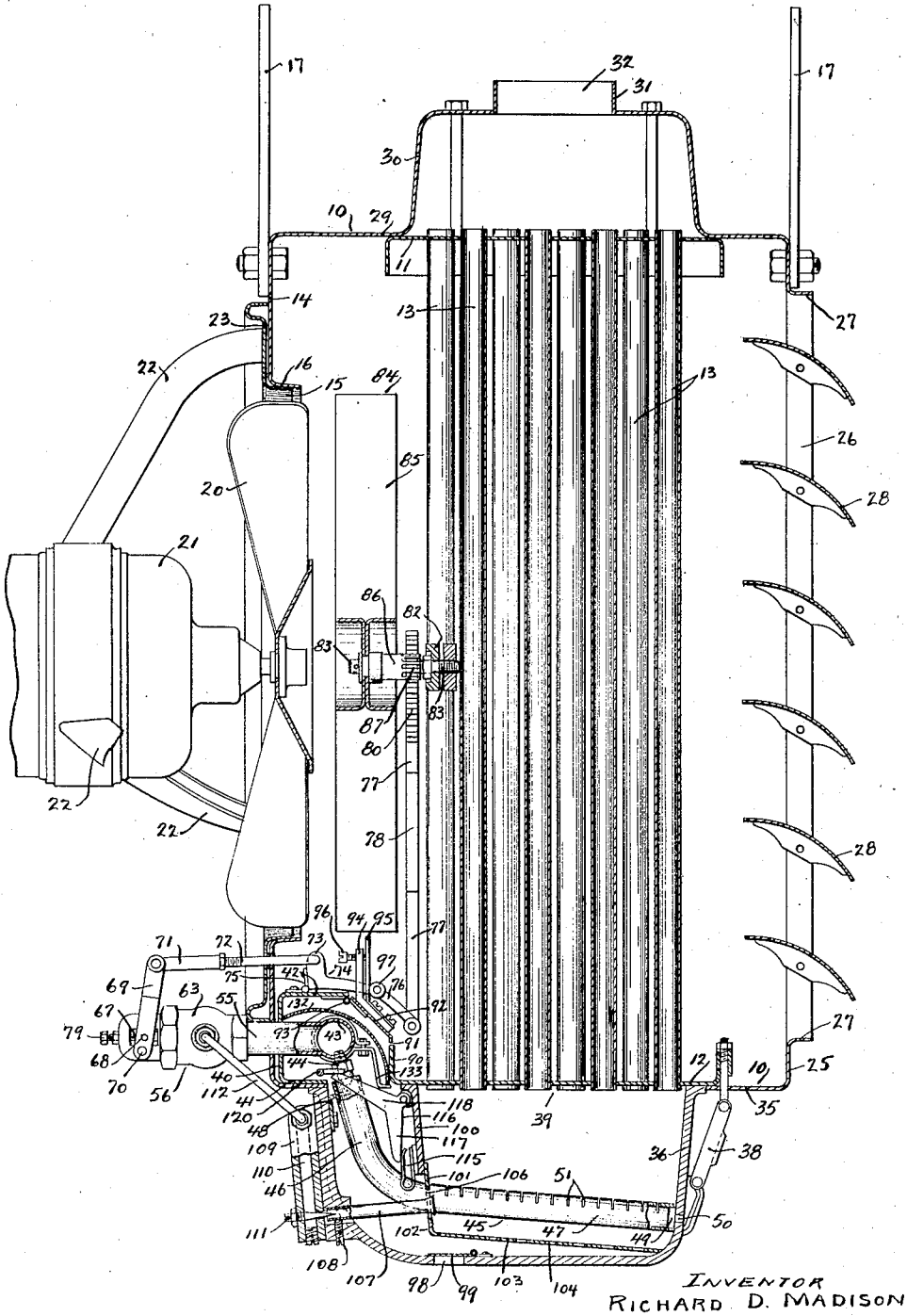


Fig. 2.

INVENTOR
RICHARD D. MADISON

BY J. W. McEllis

ATTORNEY

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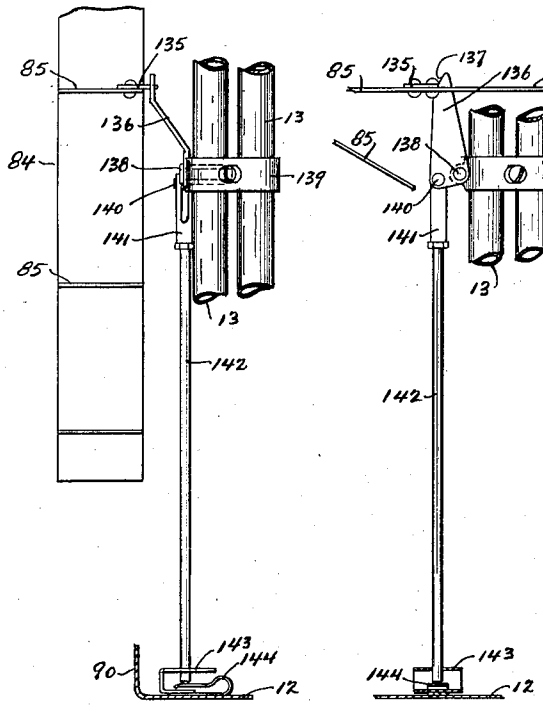


Fig. 4.

Fig. 5.

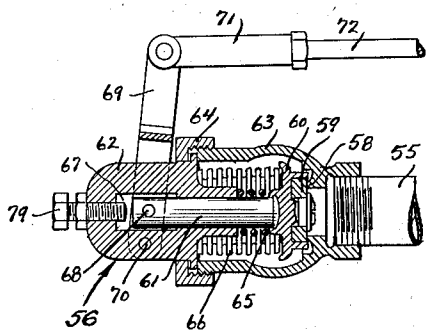


Fig. 3.

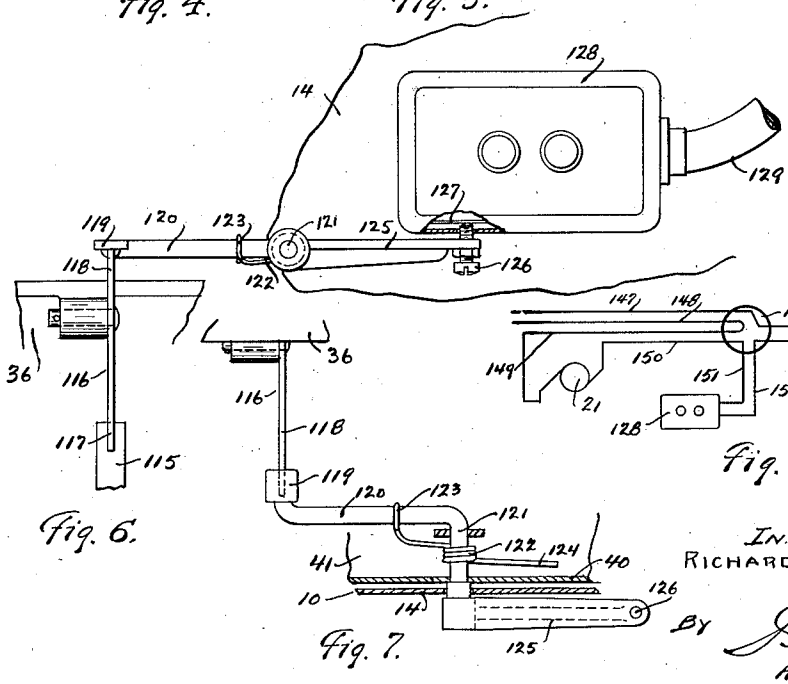


Fig. 6.

Fig. 7.

Fig. 8.

INVENTOR
RICHARD D. MADISON

BY J. W. McEllin

ATTORNEY

Patented Nov. 22, 1932 1,888,730

UNITED STATES PATENT OFFICE

RICHARD D. MADISON, OF BUFFALO, NEW YORK, ASSIGNOR TO BUFFALO FORGE COMPANY, OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK

HEATING DEVICE

Application filed September 29, 1930. Serial No. 485,028.

My invention relates in general to heating devices, and in particular, to that type of device which is used in factories, in which air is forced by means of a fan through the heating elements of the device.

The principal object of my invention has been to provide a device of this nature in which the regulating devices shall be actuated by the torque of the air stream coming from the fan wheel.

Another object has been to provide a device in which there shall be a better spread and diffusion of the air to the corners of the heating means, as well as an even distribution at the center.

Another object has been to provide a device having means for removing the residual rotation in the blast of air coming from the fan wheel.

Another object has been to provide a burner having automatic means for limiting the supply of air to the burner until the burner has reached its normal working temperature.

Moreover, in my device it has been an object to heat the device by means of gas and to control the supply of both gas and air.

Furthermore, the secondary air used in the gas burners is under the pressure exerted by the fan and is, therefore, controllable and permits the highest possible velocity in the tubes.

Furthermore, it has been an object to provide a heater having suitable automatic controls, whereby if the device fails to function properly, the gas and electricity will be shut off.

The above objects and advantages have been accomplished by the device shown in the accompanying drawings, of which:

Fig. 1 is a face view of my device with portions thereof broken away for clearness of illustration.

Fig. 2 is a vertical, sectional elevation taken on line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view of the gas valve used in my device.

Figs. 4 and 5 are, respectively, enlarged fragmentary front and side elevations of means for controlling the amount of air supplied to the burner until the burner has reached its normal working temperature.

Fig. 6 is an enlarged, fragmentary, front view, showing the automatic means for shutting off the fan motor in the event the pilot light is extinguished.

Fig. 7 is a fragmentary, plan view of the device shown in Fig. 6.

Fig. 8 is a diagrammatical view showing the electrical connection of my device.

My device comprises a casing 10, having an upper tube plate 11 and a lower tube plate 12. These tube plates carry a plurality of heater tubes 13 which extend vertically through the casing, the outside surfaces of the tubes only being exposed to the air being heated. Obviously, my device may be supported in any desirable manner, but I prefer to hang it from straps 17 secured to the casing 10. Arranged in the front wall 14 of the casing 10 is an inlet air opening 15 which is formed preferably by an inturned flange 16. The fan wheel 20 of my device is arranged in this inlet opening. This fan wheel is of any suitable type for picking up the air and forcing it into the casing of my device. The wheel is carried by an electric motor 21 which is suitably supported at the front of the machine by means of supporting arms 22 carried by an annular ring 23 arranged on the face of the casing and concentric with the inlet opening 15 thereof.

In the back wall 25 of the casing is formed an outlet opening 26. The wall around the opening is preferably bent outwardly in the form of flanges 27. Suitable louvers 28 are provided for controlling the amount of air coming from the outlet opening 26. These louvers may be pivotally carried by the flanges 27 and are actuated in any suitable way. The top wall 29 of the casing is formed with a collecting chamber 30 into which the gases are collected and from which they are conducted away by suitable piping attached to an upstanding collar 31 which surrounds the stack opening 32.

The bottom wall 35 of the casing is formed with an opening 39 over which is secured the combustion chamber 36 of my device. This chamber is mounted on suitable pivot pins 37

along its forward edge and is clamped up in position by means of a suitable clamp 38 at its rear side. By this arrangement the chamber may be conveniently lowered for inspection of the burner parts or repair thereof.

Carried inside the front wall 14 of the casing, and resting on top of the bottom wall 35 thereof is a channel member 40 having the forward edge of its lower leg 41 preferably in line with the opening 39 and with its upper leg 42 slightly overhanging the opening.

Suitably mounted within the channel member 40 is the gas manifold 43 of my device. This manifold is arranged slightly in front of the forward edge of the lower leg 41 of the channel member 40 and is provided with a plurality of downwardly extending nozzles 44 which supply gas to the burner tubes 45. Each burner tube 45 is provided with an upwardly extending bent portion 46 and with a forwardly extending portion 47. The tubes are mounted within the combustion chamber 36 by having their upper ends resting against a plate 48 and by having their lower ends secured to the rear wall of the combustion chamber. In each of such lower ends is mounted a plug 49 which has a reduced portion 50 for engagement with a suitable opening formed in the back wall. The upper ends of the bent portions 46 of the burner tubes are arranged in registration and spaced relation with the gas nozzles 44, whereby sufficient primary air will be drawn into the tubes to support combustion. The forwardly extending portion 47 of each of the tubes is provided with a plurality of openings which may be in the form of slots 51.

The manifold gas pipe 43 is provided with a forwardly extending feed pipe 55 at the outer end of which is arranged the gas valve 56 of my device. This valve has a suitable gas inlet 57 to which the main, supplying gas to my device, is attached. By referring particularly to Fig. 3 it will be seen that this valve comprises a valve seat 58 against which a valve disc 59 bears. This valve disc is carried by a valve head 60 which is mounted upon a valve stem 61. This stem is slidably mounted in a bearing member 62 which is preferably fastened to the body 63 of the valve by means of a coupling nut 64. The outward movement of the valve stem 61, and, therefore, the amount of opening of the valve disc is limited by an adjusting screw 79, which is carried by the bearing member 62. A helical spring 65 is mounted about the valve stem 61 and serves normally to keep the valve disc 59 upon its seat. An expansible element 66 is secured at one end to the valve head 60 and at the other end to the bearing member 62, whereby the valve stem is sealed against leakage of gas. The bearing member is provided with a lateral slot 67 for the passage of a pivot pin 68 which is carried at the outer end of the valve stem 61. This pivot pin engages with a yoke 69 which is pivotally carried by a pivot pin 70, passing through its lower end and supported by the bearing member 62. The upper end of this yoke is connected to a control yoke 71 which carries a control rod 72. This rod extends inwardly through the annular flange 23 and front 14 of the casing and is pivotally attached to the upper arm 73 of a control lever 74. This control lever is pivotally carried by the upper leg 42 of the channel member 40 and is attached thereto by means of a hinge member 75. The control lever 74 is provided with an inwardly extending arm 76 to which is pivotally attached the lower end of a control rack 77. This rack has formed in the face of its upper end a series of gear teeth 80, and the upper end of the rack is supported by means of a flanged roller 81 (see Fig. 1). This roller is carried by a suitable bracket 82 secured to two of the tubes 13. This bracket also carries an actuator shaft 83 which extends forwardly toward the fan and which is preferably concentrically arranged with the shaft. Mounted upon this actuator shaft is the actuator 84 of my device. This actuator comprises a plurality of paddles or vanes 85 having their faces arranged co-axially with the actuator shaft. The vanes are sufficiently broad so that the actuator will offer some resistance to the torque of the stream of air produced by the fan 20 and be actuated by such torque. The actuator is provided with a hub 86 which has a pinion portion 87, which portion engages with the teeth 80 of the actuating rack 77, so that as the actuator is rotated the actuating rack will be raised, thus operating the control lever 74, as hereinafter fully set forth. The control rack 77 may have a weight 78 which will return all the connected parts to normal when the fan is stopped.

The lower tube plate 12 is provided with an upwardly extending flange 90 having its upper edge arranged below and somewhat forwardly of the forward edge of the upper leg 42 of the channel member 40, whereby an air opening 91 is formed. Closing this opening is an air shutter 92. This shutter is pivotally attached by means of hinge members 93 to the forward edge of the leg 42 of the channel member; whereby it may be raised or lowered to open or close the air opening 91. Carried at the central part of the shutter is an operating arm 94 which has a roller plate 95 arranged in front thereof and adjustable as to its relation thereto by means of an adjusting screw 96, carried by the arm. The forwardly extending arm 76 of the control lever 74 is provided with a roller 97 which is in engagement with the face of the roller plate 95. The pivotal connection of the control lever 74 is so arranged with respect to the pivotal connection 93 of the air shutter 92 that when the control rack 77 is elevated, the

roller 97 will cause the air shutter to be raised, thus increasing the opening 91, an amount depending upon the amount of actuation of the control rack. Since the gas valve is also connected to the control lever 74, it will also be operated a corresponding amount.

Arranged across the combustion chamber is a longitudinal wall 100 which is arranged below the forward portion of the lower tube plate 12, and in contact therewith. Secured to this wall is the upper wall 101 of an equalizer plate 102. The upwardly inclined portion 103 of this plate is provided with suitable openings 104, graduated in size, so that secondary air which is supplied to the burner tubes 45 will be distributed substantially equally over the entire length of the tubes. Provided in the upper wall 101 of this equalizer plate is an opening 106 to which the forward end of the pilot light 107 extends. This pilot light is supported by the front wall of the combustion chamber 36 and passes through an opening formed therein where it is held by means of a set screw 108. Carried by the front wall of the combustion chamber is a pilot light member 109 having a vertical gas passageway 110 formed therein which supplies gas to the pilot light 107. A needle valve 111 passes through the gas supply opening formed in the member opposite the pilot light and provides means for adjusting the amount of gas supplied to the pilot light. This member is connected to the casing 63 of the valve by means of the pipe 112 so that it will get full gas main pressure irrespective of the regulation of the valve. The pipe is bent substantially U-shaped as shown in Fig. 1 and its lower end is connected to the pilot light member 109 at such a position and in such a manner that the combustion chamber 39 may be swung on its pivot pins 37, as hereinbefore pointed out, without the necessity of disconnecting this pipe. A lighter opening 98 is formed in the bottom wall of the combustion chamber, whereby the pilot light 107 may be ignited. A door 99 is pivoted to the inside of the chamber for closing the lighter opening.

A bi-metal element 115 is arranged on the forward side of the longitudinal wall 100 of the combustion chamber, and near the lower edge thereof at a point where it would be affected by the heat from the pilot light 107. Pivotally carried by the longitudinal wall is a bell-crank lever 116, the lower end 117 of which bears normally against the bi-metal element 115, while its upper end 118 extends upwardly and bears against a plate 119 formed at the outer end of a crank lever 120. This crank lever has a shaft portion 121 mounted in suitable bearings and passing through the front wall 14 of the casing 10 and the vertical member of the channel member 40. A spring 122 is mounted about the shaft portion 121 of the crank lever and the end 123 of this spring is wrapped about the outer end 120 of the crank lever, whereas its inner end 124 bears against the lower leg 41 of the channel member 40 whereby the pad 119 is forced downwardly in contact with the upper end 118 of the bellcrank lever 116. Carried at the forward end of the shaft portion 121 of the crank lever is a switch arm 125. The switch arm is provided at its outer end with an adjusting screw 126 which engages with a movable element 127 provided in the motor switch 128. This motor switch is secured to the face of the forward wall 14 of the casing and is connected by means of a conduit 129 with a terminal box 130, also carried on the face of the wall 14. Suitable wiring 131 connects the motor 21 with the terminal box. The switch 128 is a standard article of manufacture and is not, therefore, shown or described in detail. The screw 126 is passed through an aperture formed in the bottom wall of the switch, whereby the movements of the screw will effect the movement of the switch element 127 to open or close this switch depending upon the position of the crank lever.

A fire screen 132 is arranged over the gas pipe 43 and extends from the vertical wall of the channel member 40 rearwardly and downwardly to the upstanding flange 90 formed on the bottom tube plate 12, whereby a screened wall is provided between the opening extending from the combustion chamber to the opening 91 controlled by the air shutter. This screen is preferably curve-shaped as shown in Fig. 2 and its rearward edge is supported by a number of brackets 133 carried by the pipe 43.

I have found that when the burner is first lighted if the correct amount of secondary air is admitted for the normal operation of the device, the mixture will be too lean and there will be a tendency for the flame to be blown away from the burner ports. It is important, therefore, that the amount of secondary air admitted to the combustion chamber be limited until time as the burner has reached its normal working temperature. This is accomplished by the detent means shown enlarged in Figs. 4 and 5. Carried by one of the vanes 85 of the actuator 84 is a detent plate 135 which is engaged during the course of rotation of the actuator by a detent lever 136 which has a notch 137 formed in its upper edge for engagement with the detent plate 135. This detent lever 136 is pivoted at one side to a pivot pin 138 which is carried by a bracket 139, supported by the tubes 13 of the heater. Arranged at one side of the pivot pin 138 is another pivot pin 140 which is located substantially beneath the notch 137 of the detent lever, whereby movement of the pivot pin 140 in a vertical plane will cause the notch 137 to be engaged with or disengaged from the detent plate 135. The

pivot pin 140 connects the upper bifurcated end 141 of a detent rod 142 to the detent lever. The lower end of the detent rod 142 is slidably supported in a bearing bracket 143 which is secured, together with a bi-metal element 144, to the lower tube plate 12 by suitable means. The bi-metal element 144 is arranged in such a position that it is affected by the temperature within the combustion chamber.

Referring now to Fig. 8 where I show in a diagrammatic manner the circuits of my device, 145 indicates a room thermostat which is preferably employed with my device, although this is not at all essential to its operation. Below the room thermostat is a room switch 146. The line current is conducted to the terminal box 130 by means of leads 147 and 148. The lead 148 is connected to one side of the motor 21 by means of a lead 149, whereas the other side of the motor is conducted back to the terminal box by means of a lead 150. Extending from the lead 150 in the terminal box is a lead 151 which extends to one side of the motor switch 128. A lead 152 extending from the other side of the motor switch is conducted back to the terminal box and is there connected with a lead 153 which is connected to the room switch 146. The room switch 146 and room thermostat 145 are connected by means of a lead 154, and the other side of the room thermostat is connected to the lead 147 in the terminal box by means of lead 155. It will be seen, therefore, that the motor is connected in series with the motor switch 128; the room switch 146; and the room thermostat 145.

When my device is put into use, current is conducted to the motor 121 which causes the rotation of the fan wheel 20. If the room switch and thermostat are used, then the motor switch 128 is normally in its "on" position, and the motor is then started by closing the room switch.

A current of air will now be produced by the fan and forced through the casing of the device and out through the outlet opening 26, when the louvers 28 are open. There will be a natural tendency for the stream of air to rotate in the same direction as the rotation of the fan wheel and this tendency will produce a torque upon the actuator 84 causing it to rotate. Since, however, the detent plate 135 is so located that only a limited movement of the actuator is permitted, the actuator will be stopped when the detent plate reaches the notch 137 of the detent lever 136. During such limited movement of the actuator the pinion carried by its hub will cause a limited vertical movement of the control rack 77 and will, therefore, raise the outer end 76 of the control 74 a distance corresponding to the limited movement. The pivotal points of the roller 97 and hinge 75 of the control lever are, however, so located that some movement of the arm 76 will be permitted before the roller acts upon the roller plate 95, whereby the gas valve will be opened a limited amount and permit gas to enter the burner tubes 45 where combustion will occur, primary air being drawn into the tubes in the well known manner. When the temperature of the combustion chamber 36 reaches its normal working range, the bi-metal element 144 will raise the detent rod 142 and serve to rotate the detent lever 136 about its pivot 138, thereby moving the notch 137 thereof out of engagement with the detent plate 135. The torque produced by the stream of air will now be unrestricted in its action upon the actuator and will cause the actuator to be rotated its maximum amount. As the actuator is brought to its limit of movement, the control rack 77 will raise the end 76 of the control lever to its maximum and the roller 97 thereof will serve through its engagement with the roller plate 75 to open the air shutter 92, thus increasing the size of the opening 91 and admitting a maximum amount of secondary air to the combustion chamber. Such movement will also open the gas valve to its maximum adjusted position. If for any reason the heater is shut off and the motor stopped, and it is desired to promptly start it again, the actuator will again be moved to its maximum position since the bi-metal element 144 will hold the detent lever 136 out of contact with the detent plate 135 so long as the temperature of the combustion chamber does not fall below the normal working range.

The pilot light is, of course, used when the device is normally in operation, but, of course, has its greatest usefulness when the device is under thermostatic control. It is, therefore, of utmost importance that the motor, and therefore, the actuator, be prevented from being brought into operation in the event the pilot light has been extinguished. So long as the pilot light is burning, the bi-metal element 115 will permit the motor switch 128 to remain in its "on" position. When, however, the pilot light is extinguished, this bi-metal element will cool off and it will allow the bellcrank lever 116 to move downwardly as the crank arm 120 is rotated in a counter-clockwise direction as viewed in Fig. 6, by means of the spring 122. When the crank lever is so rotated, the switch arm 125 is moved upwardly and, through the medium of the screw 26 serves to force the motor switch 128 to its "off" position, thus cutting off the flow of current through the motor, since this switch is in series with the other controlling devices. When the combustion chamber 36 is lowered for inspection or repairs, the bellcrank lever 116 is carried downwardly around the pivot points of the chamber and, therefore, the spring 122 serves to rotate the crank lever 120, as just above

described, and thereby interrupts the motor circuit through the switch 128. This prevents the premature starting of the motor and dangerous flow of gas. Moreover, should the device be started with the louvers 28 closed, there would be no stream of air and therefore the actuator would not be operated.

These and other modifications of the details herein shown and described may be made without departing from the spirit of my invention or the scope of the appended claims, and I do not, therefore, wish to be limited to the exact embodiment herein shown and described, the form shown being merely a preferred embodiment thereof.

Having thus described my invention, what I claim is:

1. A heater comprising heating means, a source of heat for the heating means, a rotary fan for forcing air over said heating means and for creating a whirling stream of air on its pressure side, and means located on the pressure side of the fan and adjacent thereto for controlling the source of heat by means of the whirling action of the stream of air.

2. A heater comprising suitable air heating surfaces, a source of heat for raising the temperature of said surfaces, a rotary fan for forcing a stream of air over such surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque produced by the whirling stream of air, and means connected with the actuator for controlling the source of heat.

3. A heater comprising suitable air heating surfaces, a source of heat for raising the temperature of said surfaces, a rotary fan for forcing a stream of air over such surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque produced by the whirling stream of air, means connected with the actuator for controlling the source of heat, and means for limiting the movement of the actuator until the source of heat has reached its maximum working temperature.

4. A heater comprising a casing, heating surfaces carried by and extending through the casing, a combustion chamber arranged below the heating surfaces, a gas burner arranged in the combustion chamber, a rotary fan carried by the casing for causing a stream of air to be forced over the heated surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque produced by the whirling stream of air, and means connecting the gas burner with the actuator, whereby gas and air will be supplied to the burner when the fan is operated.

5. A heater comprising a casing, heating surfaces carried by and extending through the casing, a combustion chamber arranged below the heating surfaces, a gas burner arranged in the combustion chamber, a rotary fan carried by the casing for causing a stream of air to be forced over the heated surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque produced by the stream, means connecting the gas burner with the actuator, whereby gas and air will be supplied to the burner when the fan is operated, and means for limiting the movement of the actuator until the combustion chamber has reached its normal working temperature.

6. A heater comprising a casing, heating surfaces carried by and extending through the casing, a combustion chamber arranged below the heating surfaces, a gas burner arranged in the combustion chamber, a rotary fan carried by the casing for causing a stream of air to be forced over the heated surfaces and for creating a whirling stream of air on its pressure side, a motor for rotating the fan, a pilot light for the gas burner, means for supplying gas to the pilot light, and means controlled by the temperature of the pilot light for governing the operation of the motor, whereby when the pilot light is extinguished the fan will be prevented from rotating, and means located on the pressure side of the fan and adjacent thereto for controlling the supply of gas and air to the burner.

7. A heater comprising a casing, heating surfaces carried by and extending through the casing, a combustion chamber arranged below the heating surfaces, a gas burner arranged in the combustion chamber, a gas valve for controlling the supply of gas to the burner, an air shutter controlling the supply of air to the burner, a rotary fan for producing a stream of air through the casing and over the heating surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque of the stream, and means connected with the gas valve and air shutter and operated by the rotation of the actuator.

8. A heater comprising a casing, heating surfaces carried by and extending through the casing, a rotary fan for causing a stream of air to be forced over the heating surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque of the whirling stream of air, a combustion chamber arranged below the casing, a gas burner for the combustion chamber comprising a plurality of burner tubes located within the combustion chamber, a gas manifold arranged adjacent the inlet ends of the burner tubes, a gas nozzle carried by the manifold

for each of the tubes, a gas valve for supplying gas to the manifold, an air shutter for supplying air to the tubes, and means connecting the gas valve and air shutter to the actuator, whereby the amount of gas and air supplied to the burner is controlled by the rotation of the actuator.

9. A heater comprising a casing, heating surfaces carried by and extending through the casing, a rotary fan for causing a stream of air to be forced over the heating surfaces and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque of the whirling stream of air, a combustion chamber arranged below the casing, a gas burner for the combustion chamber comprising a plurality of burner tubes located within the combustion chamber, a gas manifold arranged adjacent the inlet ends of the burner tubes, openings formed in the upper faces of the tubes, a partition formed in the combustion chamber and located between the portion of the tubes having the openings and their inlet ends, an equalizer plate carried by the partition and extending across the bottom of the tubes, a gas nozzle carried by the manifold for each of the tubes, a gas valve for supplying gas to the manifold, an air shutter for supplying air to the tubes, and means connecting the gas valve and air shutter to the actuator, whereby the amount of gas and air supplied to the burner is controlled by the rotation of the actuator.

10. A heater comprising a casing, tubes carried by the casing and extending centrally therethrough, a rotary fan carried by the casing for forcing a stream of air through the casing and around the tubes and for creating a whirling stream of air on its pressure side, an actuator located on the pressure side of the fan and adjacent thereto and rotatable by the torque produced by such whirling stream of air, a combustion chamber arranged below the tubes, a gas burner located in the combustion chamber, a gas valve for supplying gas to the burner, and a control lever carried by the casing and connected to the gas valve and air shutter, a control rack connected to the control lever and operated by a gear pinion carried by the actuator.

11. A heater comprising a casing, heating surfaces carried by and extending through the casing, a combustion chamber arranged below the heating surfaces, a gas burner arranged in the combustion chamber, a rotary fan carried by the casing for causing a stream of air to be forced over the heated surfaces, an actuator located on the pressure side of the fan and rotatable by the torque produced by the whirling stream of air, means connecting the gas burner with the actuator, and for creating a whirling stream of air on its pressure side, an electric motor for rotating the fan, a switch for the motor, a pilot light for the gas burner, means for supplying gas to the pilot light, and means controlled by the temperature of the pilot light for governing the operation of the motor comprising a bi-metal element located in such a position as to be affected by the temperature of the pilot light, and lever means connecting the bi-metal element with the electric switch, whereby the switch will be moved to its open position when the pilot light is extinguished.

12. A heater comprising a casing, heating surfaces carried by and extending through the casing, a combustion chamber arranged below the casing, a gas burner for the combustion chamber, a rotary fan for forcing air through the casing and for creating a whirling stream of air on its pressure side, an actuator located adjacent the pressure side of the fan and rotatable by the torque produced by the whirling stream of air, a gas valve for supplying gas to the burner, an air shutter for controlling the supply of air to the burner, means connecting the gas valve and the air shutter to the actuator, and means for limiting the movement of the actuator during the initial operation of the burner, comprising a bi-metal element carried by the casing and controlled by the temperature within the combustion chamber, a detent rod actuated by the bi-metal element, a detent lever connected to the upper end of the detent rod, and a detent carried by the actuator and engageable with the detent lever, whereby the actuator will be permitted to rotate only a limited amount until the temperature of the combustion chamber is raised to its normal working range.

RICHARD D. MADISON.