

April 22, 1952

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2,593,759

FORCED AIR FLOW AIR-HEATING FURNACE

Filed Feb. 19, 1948

2 SHEETS—SHEET 1

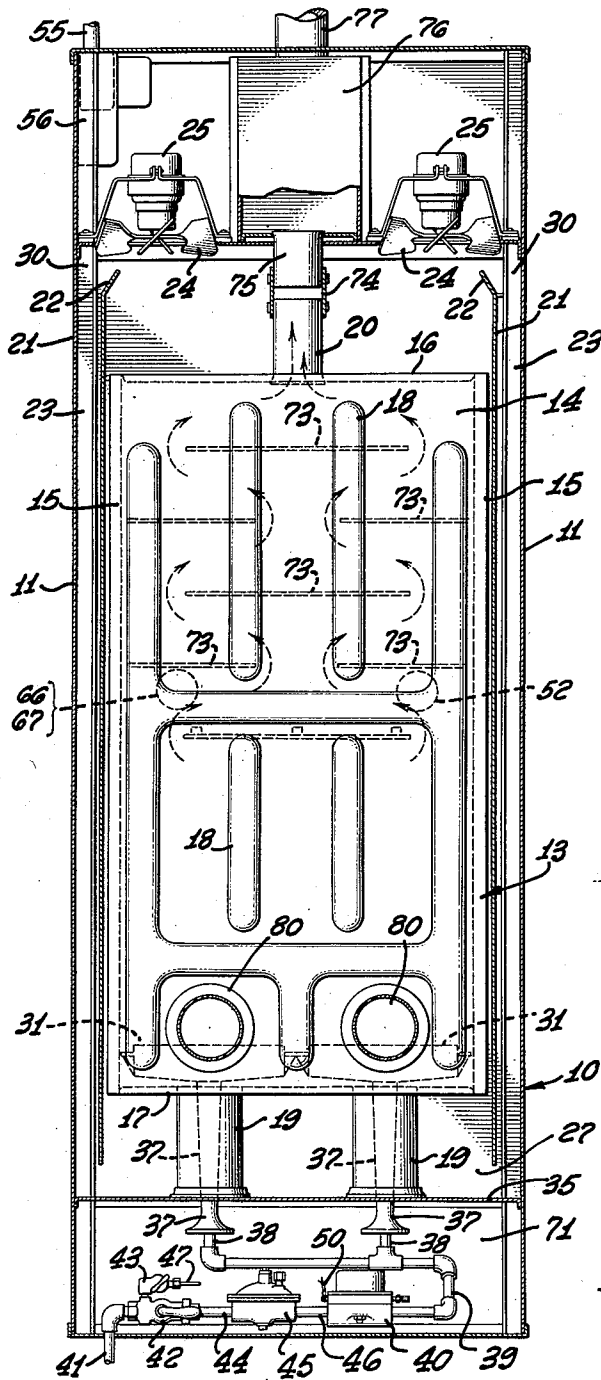


FIG. 2

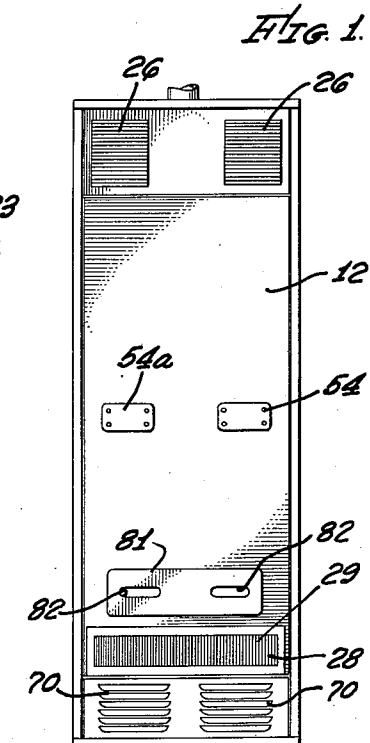


FIG. 1

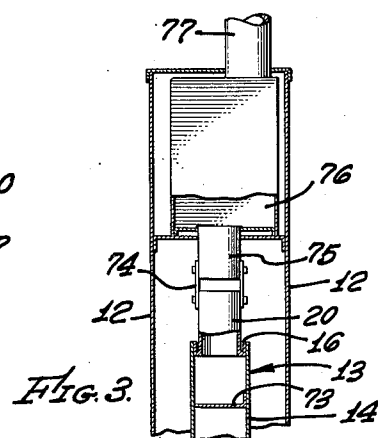


FIG. 3

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2 SHEETS—SHEET 2

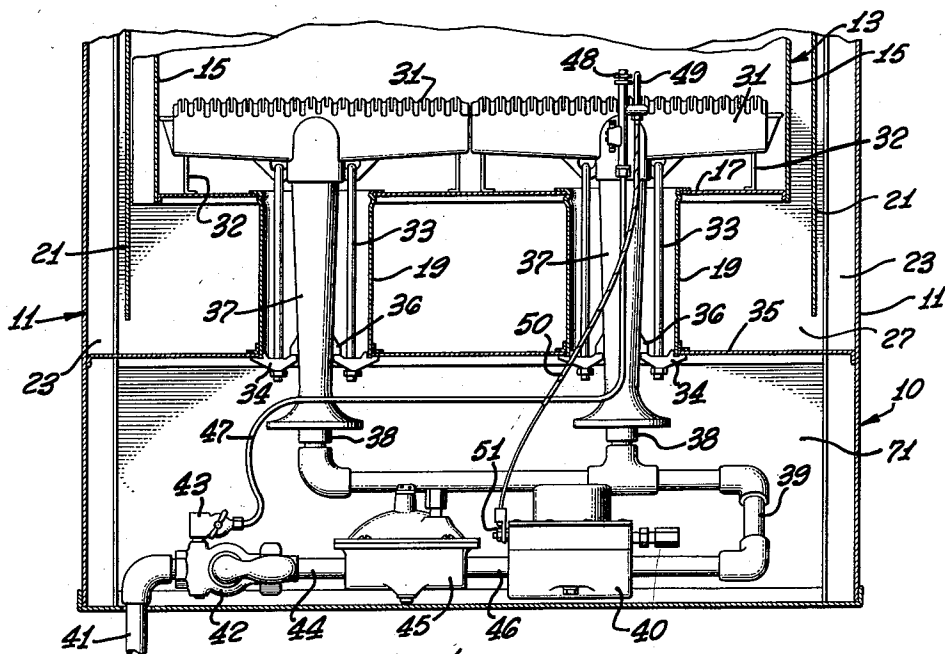


FIG. 4.

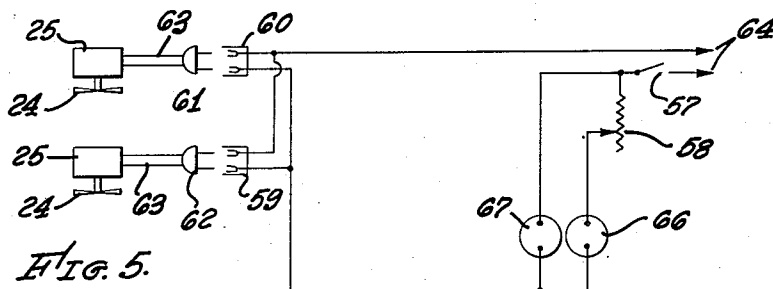


FIG. 5.

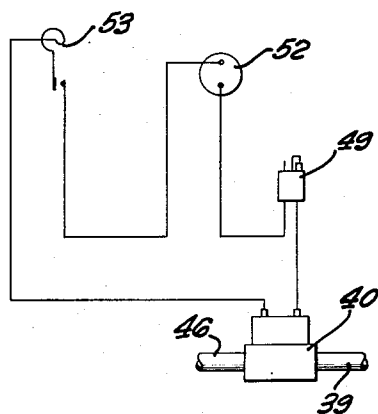


FIG. 6.

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FORCED AIR FLOW AIR-HEATING FURNACE

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2 Claims. (Cl. 126—110)

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This invention relates to heat exchange apparatus, and is particularly directed to fuel burning space heaters. This invention finds particular usefulness in connection with forced circulation air heaters which are adapted to be positioned within the space to be heated.

The principal object of this invention is to provide an improved form of self-contained space heater which is adapted to draw air from a room at a relatively high elevation and discharge warm air near the floor level, the air circulation being effected by means of power driven fans. This type of space heater has several outstanding advantages, and among these are the utilization of the heat contained in the air near the ceiling of the space being heated, which heat would otherwise be lost by conduction and radiation through the ceiling. The heated air is delivered near the floor level where it is most effective in producing a condition of comfort to the occupants of the space. Tests on actual installations have shown that the temperature differential between floor and ceiling when using this type of space heater is much lower than the differential obtained with appliances which utilize only the difference in weight between heated air and room temperature air as motive power for air circulation.

In accordance with my invention, the space heater is installed directly within the space to be heated, and it may be positioned within a room either adjacent or remote from a wall thereof, or it may be recessed partially or to its full depth within a partition. The warm air discharge may occur directly from a grille located in the housing of the device, or it may occur through a short duct leading to the exterior surface of the enclosing partition. These discharge ports may be located in the front, back or either side of the appliance so that heated air may be directed into two or three rooms adjacent to the partition in which the device is positioned.

Another object of my invention is to provide shield means between the combustion chamber and the enclosing housing in a manner so that a portion of the air set in motion by the fan or fans may pass between the shield and the housing in order to insure that the housing wall may remain cool.

Another object is to provide a device of this type employing a fan which operates at high speed when the temperature of the heated air exceeds a certain value and which operates at a low speed when the temperature is below that value. An advantage of this type of fan control lies in the fact that it is often necessary to provide a space heater of sufficient capacity to maintain comfortable conditions in a room even in the most severe weather, even though such severe conditions normally will not obtain for more than 5% of the time of the entire heating season, so that during the remaining 95% of the

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time the device is oversize. The two-speed fan control permits the combustion chamber of the device to act as a heat reservoir, and thus the fan may continue to deliver heated air to the room after the fuel burner has been cut off by the room thermostat.

Another object of my invention is to provide means for limiting the temperature of the housing in the event that the power for operating the fan should be cut off, so that any fire hazard may be avoided. Other objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is a front elevation of a preferred embodiment of my invention.

Figure 2 is a front elevation partly in section.

Figure 3 is a sectional side elevation of the upper portion of the device.

Figure 4 is a sectional view partly broken away showing details of construction of the lower portion of the device.

Figure 5 is a wiring diagram of the fan control circuit.

Figure 6 is a wiring diagram of the fuel burner control circuit.

Referring to the drawings, the casing or upright housing 10 is provided with parallel sides 11 and parallel front and back panels 12. Positioned within the housing 10 is a combustion chamber, generally designated 13. This combustion chamber may be of any preferred or desirable type, and as shown in the drawings comprises parallel front and back sheets 14 joined by sides 15 and ends 16 and 17. Ribs or raised portions 18 may be formed on the front and back plates 14 in any convenient or desirable pattern in order to provide additional stiffness for the sheets. A pair of down pipes 19 may extend from the lower end 17 of the combustion chamber 13, and a single venting pipe 20 may be provided in the upper end 16. The pipe 20 is positioned with lateral symmetry in the housing 11—in this example—centrally. A plurality of shields 21 are interposed between the combustion chamber 13 and the walls of the housing 10. These shields 21 may be of sheet material and serve to prevent overheating of the walls of the housing 10. The upper ends of the shields 21 may be deflected inwardly to provide baffles 22 increasing the inlet area to the passageways 23 defined between the shields 21 and the walls of the housing 10 in order to direct a portion of the air set in motion by the fans between the shield and the housing.

A plurality of fans 24 are provided in the upper end of the housing 10 above the position of the combustion chamber 13. These fans are disposed in lateral symmetry with respect to the pipe 20 and are driven by electrical motors 25. As shown in Figure 1 inlet ports 26 equipped with louvres may be provided in the upper portion of

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the front panel 12 in order that air may be drawn from the space to be heated at a location above the breathing level, that is, at an elevation somewhat in excess of six feet from the floor. The air entering through the inlet ports 26 is directed by the fans 24 downwardly within the housing 10 across the surfaces of the combustion chamber 13. The air is heated as it passes over the surfaces 14, 15 and 16 and passes outwardly from the space 27 within the lower portion of the housing 10 and outwardly through the discharge port 28. This port 28 may be of any convenient type, and as shown includes a grill having a plurality of air deflection fins 29.

While the major portion of the air entering the device through the inlets 26 is caused to pass in heat exchange relation with the surfaces of the combustion chamber 13, a minor portion of the air flow is directed by the fans 24 through the openings 30 adjacent the baffles 22 and into the passageways 23. The air in the passageways 23 accordingly is caused to move downwardly, and since this air is relatively cool it effectively prevents overheating of the walls of the housing 10. The air emerging from the passageways 23 into the lower space 27 mixes with the heated air and is discharged through the outlet 28.

Positioned within the lower end of the combustion chamber 13 is a pair of fuel burners 31. Each of these burners rests on legs 32 supported from the lower end 17 of the combustion chamber 13, and the burners are held against these legs by means of tension bolts 33 extending through crowfeet 34 at their lower ends. The crowfeet 34 engage the floor 35 which extends between the side walls 11 and front and back panels 12 in the form of a partition. This floor 35 is provided with openings to receive the lower ends of the down pipes 19. The crowfeet 34 also engage lugs 36 provided on the exterior of the Venturi pipes 37. These Venturi pipes 37 extend through the down pipes 19 and communicate with the burners 31, as will be readily understood. The usual spuds 38 extend into the open lower end of the Venturi pipes 37 and are provided with orifices (not shown) for directing a combustible fuel upwardly into the Venturi pipes 37. The spuds 38 are connected by suitable piping 39 with the electrically operated valve 40. Combustible fuel such as, for example, gas under pressure, is delivered from the supply pipe 41 to the manual shut-off valve 42 and the pilot cock 43.

A pipe 44 leads from the shut-off valve 42 to the pressure regulator 45, and a pipe 46 connects the regulator 45 with the electrically operated valve 40. The regulator 45, valves 42 and 40, and associated parts are conveniently enclosed within the housing 10 below the floor 35. A conduit 47 leading from the cock 43 connects with the pilot burner 48 which is located adjacent the main burners 31. Means are provided adjacent the pilot burner 48 adapted to shut off the flow of fuel to the main burners 31 in the event that the pilot flames should be extinguished for any reason. Thus, a safety device is provided which prevents a flow of fuel such as gas to the burners 31 when there is no flame to ignite the gas. As shown in Figure 4 of the drawings, this means includes a thermocouple 49 adapted to be heated by the flames from the pilot burner 48. This thermocouple may be of any conventional design. It is connected by means of an electric conduit 50 to a terminal 51 on the electrically operated valve 40. The electrically operated valve 40 may be of any convenient or desirable type which is

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well known in the art. The thermocouple 49 is electrically connected in series as shown in the wiring diagram in Figure 6, so that upon failure of the pilot flame the electrical energy supplied by the thermocouple fails and the solenoid valve 40 acts to shut off the flow of fuel to the piping 39 and burners 31.

Also connected in series with the thermocouple 49 are the thermostatic high temperature limit control 52 and the room thermostat 53. When the temperature of the space to be heated reaches a predetermined value the thermostat 53 opens and thereby interrupts the electrical circuit through the solenoid valve 40 and causes it to shut off the supply of fuel. The thermostatic high temperature limit control 52 is mounted within the housing 10 at the position indicated by the phantom outline in Figure 2 and is positioned behind the removable cover plate 54, as shown in Figure 1. This device 52 is sensitive to radiant heat from the combustion chamber 13 and also is sensitive to the temperature of the circulating air, and acts to cut off the supply of fuel to the burners in case the temperature of the interior of the housing 10 should become excessive for any reason such as, for example, the failure of supply current to the fan motors 25 or the blocking of the air intake or air discharge ports. This device prevents excessive casing temperatures which might result in a fire hazard, and furthermore prevents damage to the fan motors 25 in case they should stop and the circulation of air through the device become reversed.

It may be noted that although the space heater is intended for operation by forced air discharge, air circulation does not depend entirely upon the fans 24. In case of electrical power failure the device retains partial efficiency as a gravity circulating heater, and as set forth above the temperature limiting control 52 is provided to prevent overheating of the housing walls when operating in this manner.

An electrical supply conduit 55 may extend through the top wall of the housing 10 as shown in Figure 2 and connect to a conventional form of outlet box 56. This box may include the master switch 57 which is manually actuated, and which is shown in diagrammatical form in the wiring diagram shown in Figure 5. The rheostat 58 and the receptacles 59 and 60 may be mounted in the outlet box 56 if desired. Suitable connection plugs 61 and 62 are provided for the fan motors 25, together with the necessary electrical leads 63. The outlet plugs 59 and 60 are connected in parallel, and current may be supplied to the lines 64 by any convenient source.

Thermostatic fan switches 66 and 67 are mounted within the housing 10 behind the movable cover plate 54a, as shown in Figure 1. The switch 66 is connected with the rheostat 58. The switches 66 and 67 are affected by the temperature of the air passing the surface 14 of the combustion chamber 13 and also by the radiant heat from the surface 14. The switch 66 may be adjusted to close contacts at a relatively low temperature. For example, as the temperature increases the switch may close contacts at about 120° F., and when the temperature is decreasing the switch may open contacts at about 95° F. The thermostatic fan switch 67 is connected in a manner to shunt the switch 66 and rheostat 58, and this switch may be adjusted so that its contacts are closed at a relatively high temperature. Thus, for example, the contacts may close at about 160° F. when the temperature is increas-

ing and are set to open at about 120° F. when the temperature is decreasing.

The operation of the fans 24 is thus automatically controlled by the radiant heat received from the combustion chamber and the temperature of the circulating air adjacent the combustion chamber. As the temperature increases from a low value the switch 66 closes first at about 120° F., thereby energizing the fans 24, but the rheostat 58 introduces a resistance into the circuit so that the fans operate under a reduced voltage and hence rotate at a relatively slow speed. As the temperature continues to increase until it reaches 160° F. the thermostatic switch 67 closes and hence shunts out the switch 66 and rheostat 58, applying full line voltage to the fan motors 25. The fans then operate at full speed. When the temperature of the space to be heated reaches a maximum the room thermostat 53 opens the circuit through the solenoid valve 40 and cuts off the supply of fuel to the burners 31. The appliance begins to cool and at approximately 120° F. the high temperature thermostat element breaks contact, removing the shunt across the rheostat 58 and hence reducing the fan speed to the lower setting. As the temperature continues to fall the low temperature thermostatic element 66 breaks contact and shuts off the fans completely.

An outstanding advantage of the multi-speed fan control is that greater heating efficiency is obtained. The size of the appliance is dictated by the required capacity for the severest weather, but a major portion of the time this full capacity is unnecessary. Accordingly, when the appliance is not operating continuously the two-speed fan control allows the combustion chamber to serve as a heat reservoir for delivery of heat to the heated space by continued rotation of the fans after the main fuel burners are shut off by the room thermostat. Tests have shown that when the device is controlled by a room thermostat with low temperature differential characteristics the appliance operates chiefly at low fan speed with the fans operating almost continuously although the burner is turned on and off intermittently.

Supplementary air for combustion is admitted through the louvres 70 at the lower portion of the front panel 12 and into the space 71 below the floor 35. The air passes into the open lower end of the Venturi pipes 37 in the conventional manner and also passes upwardly through the down pipes 19 into the interior of the combustion chamber 13. The products of combustion from the burners 31 pass upwardly through the interior of the combustion chamber 31 and through the baffles 73 which may be mounted within the interior of the combustion chamber 13. The products of combustion do not enter the space to be heated, but on the contrary pass upwardly through the venting pipe 20, connection tube 74 and outlet 75 into a draft hood 76 located in the central space between the fan motors 25. The products of combustion then pass out of the device through the vent 77.

It will be noted that the air flow is counter-current to the direction of travel of the combustion products resulting in a low vent temperature and high thermal efficiency.

The front wall 14 of the combustion chamber 13 is provided with a pair of laterally extending pipes 80 which extends through the front shield 21 and terminates adjacent the front panel 12 of the housing 10. A removable cover plate 81 is provided on the front panel 12 to per-

mit access to the pipes 80. When the pilot 49 is to be lighted initially, the cover plate 81 is removed, thereby allowing access to the burners 48 through the pipes 80. The cover plate 81 may be provided with transparent windows 82 if desired in order to facilitate inspection of the flames from the burners 31.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a space heater, the combination of an upright housing, a combustion chamber within the housing provided with heat exchange surfaces spaced from the housing walls thereby forming an air passage space for heated air, said housing extending above said chamber, a burner assembly positioned within the lower portion of the combustion chamber, vent means for the combustion chamber extending centrally into the upper portion of the housing, a pair of power driven fan assemblies positioned within the housing above the combustion chamber on opposite sides of the vent means, the housing having cold air inlet port means positioned adjacent said fan assemblies, the housing also having a heated air discharge port positioned near the lower end of the combustion chamber whereby the fan assemblies induce a flow of air from the inlet port means downwardly across the heat exchange surfaces and out through the discharge port.

2. In a space heater, the combination of an upright housing; a combustion chamber within and spaced from the housing walls thereby forming an air passage space for heated air, the upper portion of said housing extending above said chamber; a burner in the lower portion of said combustion chamber; vent means communicating with said combustion chamber, disposed with lateral symmetry, and passing vertically through the upper portion of said housing; fan means disposed symmetrically with respect to said vent means in the upper portion of said housing above said combustion chamber effective to force air to be heated past said combustion chamber; inlet port and outlet port means in said housing communicating with said fan means and with said air passage space, said inlet port means admitting relatively cold air to said housing, said outlet port means discharging heated air to the space to be heated.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,519,673	Doble	Dec. 16, 1924
1,673,072	Houghtby	June 12, 1928
1,993,262	Denison	Mar. 5, 1935
2,216,281	Ray	Oct. 1, 1940
2,243,609	Spackman	May 27, 1941
2,268,778	Scheuder	Jan. 6, 1942
2,294,694	Ray	Sept. 1, 1942
2,362,259	Findley	Nov. 7, 1944
2,368,850	Lange	Feb. 6, 1945
2,383,676	Paille	Aug. 28, 1945

FOREIGN PATENTS

Number	Country	Date
726,200	France	Feb. 29, 1932
726,474	France	Mar. 7, 1932