

June 26, 1956

A. B. MODINE

2,751,900

COMBUSTION TYPE HEATER

Filed May 22, 1951

2 Sheets-Sheet 1

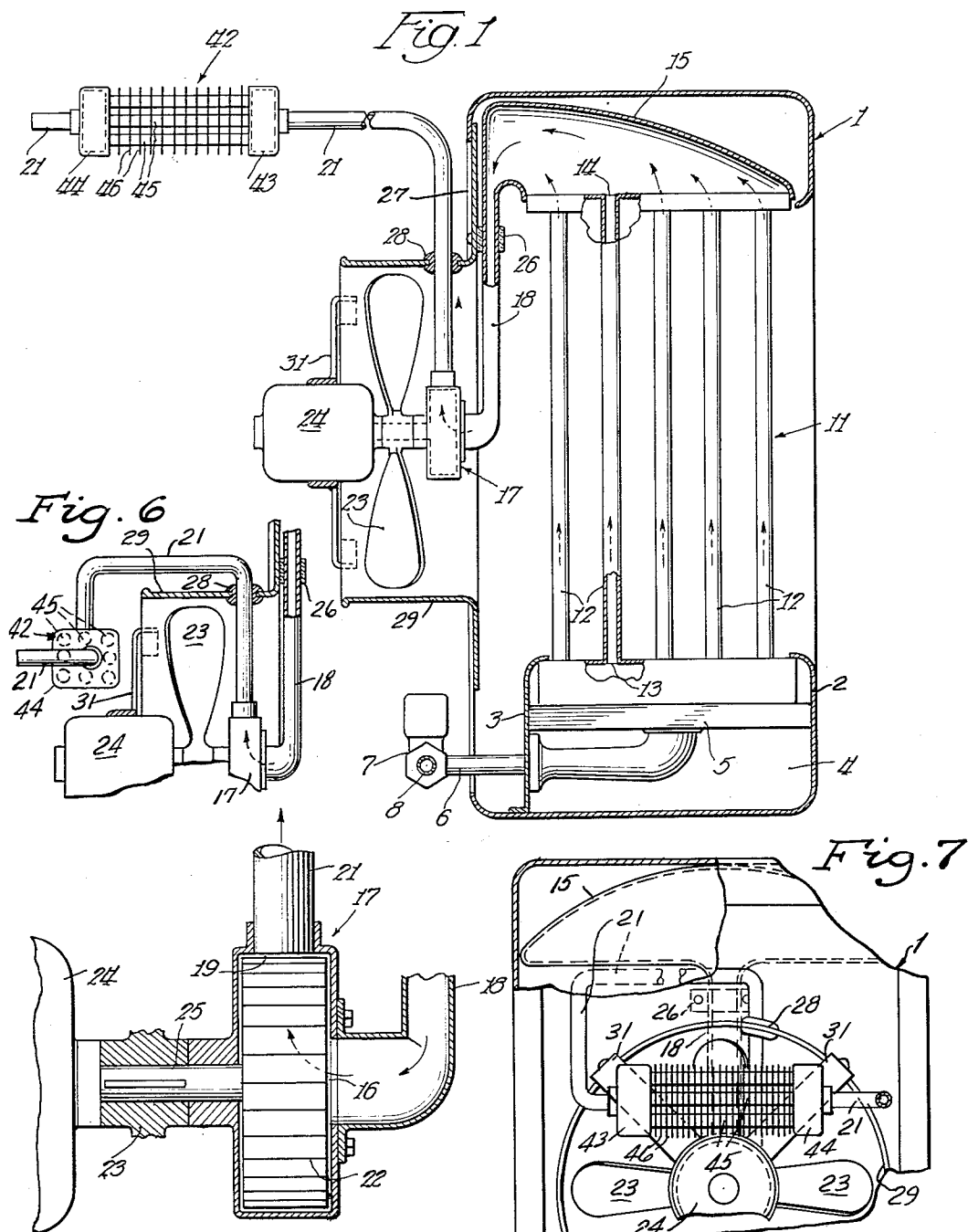


Fig. 3

Fig. 7

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Fig. 2

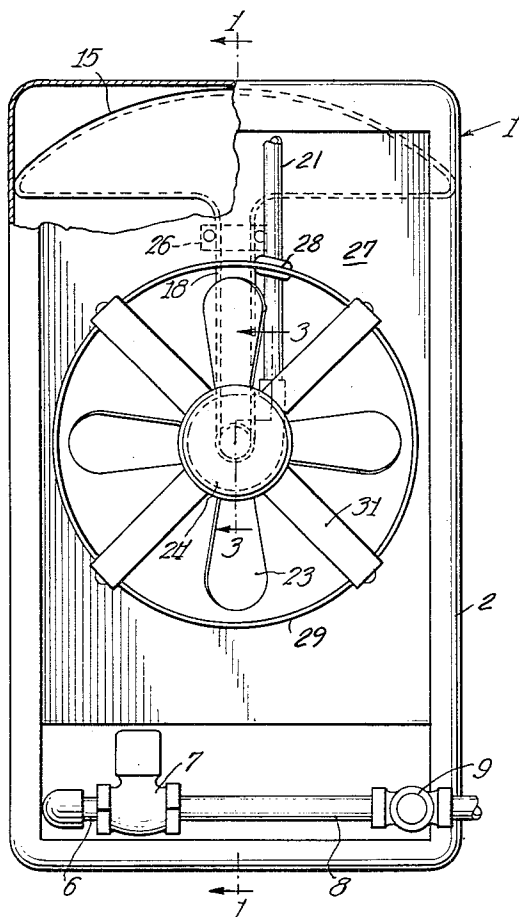


Fig. 4

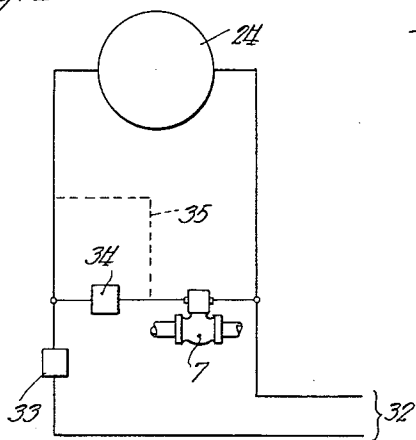
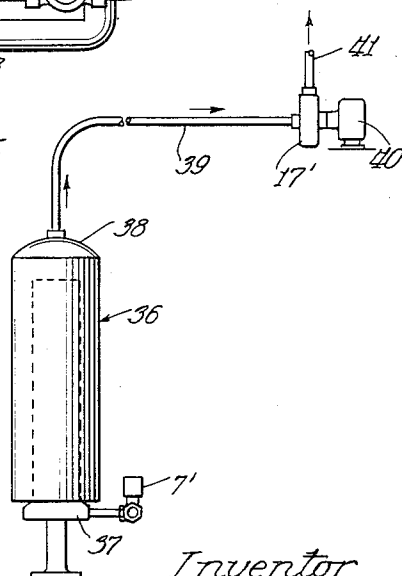


Fig. 5



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COMBUSTION TYPE HEATER

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3 Claims. (Cl. 126—110)

The invention relates generally to combustion heaters, and the like, and more particularly to a combustion heater construction adapted to be employed in connection with so-called unit heaters of the type utilizing a heat exchange structure and power fan or blower.

In the past, combustion heaters, as for example, gas fired heaters of the unit heater type to which the present invention is particularly applicable, have utilized a suitable gas burner in connection with a heat exchange structure for transferring the heat of combustion of the gas to the air which is to be added, the gases of combustion, subsequent to their passage through the heat exchange structure, being exhausted to the atmosphere through a suitable stack, normally taking the form of the usual stovepipe structure, which usually will vary from approximately four to eight inches in diameter, depending upon the capacity of the device. As the gases of combustion in such devices are discharged by thermo convection through the stack or flue pipe, the latter must be of sufficient size to insure complete exhaustion of the gases of combustion. Preferably, the flue pipe should also be as short and direct as possible, and in installing devices of this type, the flue pipe preferably extends vertically upward to the discharge point. Likewise, where it is necessary to have the flue pipe extend horizontally, it should slope upward toward the chimney or outside vent, and to obtain satisfactory draft and efficient results, the length of horizontal flue must of necessity be relatively short.

It will be apparent that in gas fired unit heaters adapted to be mounted in an elevated position above the floor of the enclosure to be heated, the requirement of a stack or flue pipe of relatively large diameter, and the limitations on the length and positioning thereof, are some of the primary factors considered in the locating of the unit heater in the enclosure. Thus, in some instances, the limitations in connection with the stack may even be the controlling factor in the installation whereby the heater must of necessity be positioned at a point in the enclosure which will provide satisfactory stack design, even though a more efficient installation from the standpoint of effectively heating the enclosure could be achieved by placing the heater at a different location.

The above factors which must be considered in devices of this type are due in a large part to the nature of operation thereof. Gravity actuated exhaust ducts, such as those commonly employed to vent the gases of combustion from open type of burners in an open combustion chamber, as distinguished from forced draft burners, depend upon the so-called chimney action resulting from the differences in weight between the column of air to be displaced and that of the combustion gases being exhausted. Consequently, a fairly high temperature of exhaust gases is required to overcome the friction head present in the exhaust conduit or chimney structure, and the longer and more involved this structure becomes, the diameter thereof must be accordingly increased for the

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purpose of reducing such friction head to within satisfactory operable limits.

The relatively high exhaust gas temperatures required, together with the necessity of large and bulky exhaust conduits, not only present a substantial fire hazard, but also result in a loss in efficiency of the heating device, it being commonly accepted that the thermal efficiency of a gas unit heater with common outdoor exhaust is only eighty percent as great as one in which the exhaust gases are distributed into the enclosure being heated, assuming that the noxious and corrosive effect of such gases could be ignored.

Another disadvantage of a gravity exhaust system is that when combustion is reduced or interrupted, the gravity exhaust duct permits a flow of interior room air out, or of exterior air in, during periods of non-operation. In a multiple installation of units, a combination of the two may take place, some exhausting room air, and others permitting an inflow of cold air. In the case of an intermittently operating hot water heater, it will be apparent that considerable heat may be dissipated from the water coils by such action during inoperative periods.

All of these disadvantages can be substantially completely eliminated by employing a positive exhaust system, enabling a reduction in the size of the exhaust duct, and a corresponding reduction in losses. Likewise, with such a system an economizer or salvage heat exchange structure may be employed to materially increase the efficiency of the heating system, as well as reduce the exhaust gas temperatures to a safe point, eliminating any fire hazard with respect thereto.

The present invention has among its objects the production of a combustion system which eliminates the above disadvantages, the same being so designed that a relatively large exhaust stack or flue pipe is eliminated, and the gases of combustion exhausted through a relatively small tube or duct of a size comparable to, or smaller than, the piping normally employed in hot water or steam installations, such duct being readily adapted to be constructed of relatively light, flexible tubing, or the like, which may be readily curved or bent, as may be required, and in which the positioning of the duct with respect to the horizontal or vertical is immaterial, as is the length of the duct within relatively wide limits. Consequently, the use of the present invention enables the production of a gas fired unit heater in which the location of the heater in the enclosure is substantially independent of the physical limitations present with respect to the installation of the usual exhaust duct or flue structure, as a result of which the unit heater may be suitably positioned in the enclosure for most efficient operation.

Another object of the invention is the production of such a heater structure in which gases of combustion are positively exhausted by a suitable blower structure, or the like, instead of by thermo convection, which structure is simple in construction, relatively inexpensive to manufacture, and very efficient for the purposes intended.

A further object of the invention is the production of a heater which may utilize the advantages of the present invention without the material change in present designs, and which may be readily incorporated in unit heaters employing a power blower or fan without requiring an additional source of power.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

To this end my invention consists in the novel construction, arrangement, and combination of parts herein shown and described, and more particularly pointed out in the claims.

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In the drawings, wherein like reference characters indicate like or corresponding parts:

Fig. 1 is a sectional view of a gas fired unit heater embodying the present invention taken approximately on the line 1—1 of Fig. 2;

Fig. 2 is a rear elevational view of the heater illustrated in Fig. 1, with a portion of the outer housing broken away;

Fig. 3 is a sectional view through the exhaust blower taken approximately on the line 3—3 of Fig. 2;

Fig. 4 is a diagrammatic view of a suitable wiring circuit which may be employed;

Fig. 5 is an elevational view of a gas fired heater, such as a hot water heater, illustrating the application of the present invention thereto;

Fig. 6 is a partial sectional view in elevation similar to Fig. 1 illustrating a modified arrangement of the secondary heat exchanger; and

Fig. 7 is a partial rear elevational view of the heater illustrated in Fig. 1 illustrating a modified arrangement corresponding to Fig. 6 of the secondary heat exchanger.

The present invention contemplates the use of a heat exchange structure of generally standard construction as presently employed in this field, utilizing a burner, such as a gas burner, positioned in a combustion chamber having a heat exchange structure associated therewith through which the gases of combustion may pass, with the air or other medium to be heated likewise passing through the heat exchange structure. The gases of combustion are collected in a suitable plenum chamber following their passage through the heat exchange structure, and are withdrawn from the plenum chamber by means of a power-operated blower, with the latter discharging such gases through a suitable exhaust duct which may be of relatively very small size. The exhaust blower may be operated from any suitable power source, and where a power actuated blower is utilized to force the air or other medium to be heated through the heat exchange structure, the power source for actuating such blower or fan may also be utilized to power the blower for exhausting the gases of combustion. It will be apparent that as the gases of combustion are mechanically exhausted, the positioning of the exhaust duct is not critical, and problems relating to proper draft, back drafts, and the like are completely eliminated.

Referring to the drawing, and particularly to Figs. 1 and 2, 1 indicates generally a unit heater or self-contained heater of the type adapted to be positioned in a space to be heated comprising an outer housing or casing 2 which is provided with a suitable wall or walls such as the partition wall 3, to form a combustion chamber or lower manifold 4, adjacent the bottom of the housing in which is positioned a gas burner head 5 operatively connected through a suitable conduit 6 and valve 7 to a gas supply line 8. In the embodiment of the invention illustrated, the valve 7 may be of the solenoid type and, if desired, a manual valve 9 may also be inserted in the gas supply line whereby the flow of gas may be manually shut off when desired. Positioned above the combustion chamber 4 is a heat exchange structure having a plenum chamber defining an air passage there-through, indicated generally by the numeral 11, illustrated in the present instance as comprising a series of hollow tubes 12, the lower ends 13 of which communicate with the combustion chamber 4, and the upper ends 14 of which communicate with a suitable plenum chamber or upper manifold 15 whereby the gases of combustion will pass from the combustion chamber 4 through the tubes 12 into the plenum chamber 15. The construction thus far described is generally similar to present types of heaters, and in such present types, the gas of combustion would normally be exhausted from the chamber 15 through a suitable stack, preferably extending vertically upward to a point of discharge, with such gases passing through the tubes 12, chamber 15, and stack by

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thermo convection. In the present construction, however, the plenum chamber 15 is operatively connected to the inlet port 16 of a suitable blower, indicated generally by the numeral 17, by means of a conduit 18 of a relatively small, internal cross sectional area. The outlet 19 of the blower 17 is operatively connected to the point of discharge to the atmosphere by a duct or tube 21, likewise of relatively small, internal cross sectional area.

The blower or pump 17 may be of standard construction, illustrated in the present instance as being of the centrifugal type having a rotary cage type impeller 22. The unit heater illustrated in Figs. 1 and 2 of the drawing is of the forced air type utilizing a suitable fan or space heating fluid impeller means 23, or the like, for moving the air to be heated through the heat exchange structure 11, the fan being actuated by suitable means, such as an electric motor 24. As clearly illustrated in Figs. 2 and 3, the blower 17 is so positioned relative to the motor 24 that the axis of the impeller 22 is axially aligned with and rigidly connected to the shaft 25 whereby the impeller and fan are both rotated by means of the single motor.

In the construction illustrated, the blower 17 may be supported by the conduit 18, a suitable bracket 26 providing a rigid connection between the conduit 18 and the rear wall 27 of the housing 2. Likewise, the conduit 21 may pass through a suitable bushing 28 carried by the annular portion 29 of the housing, the motor 24, in the present instance, being illustrated as supported by the portion 29 through a suitable bracket structure 31.

In use, the gases of combustion are withdrawn from the chamber 15 after passage through the heat exchange structure 11, through the duct 18, blower 17 and are discharged to the atmosphere through the conduit 21, and in this construction, the conduit or tube 21 may, for example, be of one inch internal diameter, or less, as compared with present stacks or flue pipes, which oftentimes are six to eight inches, or more, in diameter. It might be mentioned that a conduit of one inch internal diameter provides at least several times the cross sectional area actually required to provide adequate withdrawal of the gases of combustion from the heater, so that even with a conduit of such small size, a relatively large safety factor is incorporated in the structure.

Fig. 4 illustrates a typical wiring diagram suitable for use in conjunction with a heater embodying the present invention, wherein the motor 24 is operatively connected to a power line 32 through a switch 33, which may be either thermostatically actuated, or manually operated, to control the action of the fan 24. The solenoid valve 7 is connected in parallel with the motor 24 through a suitable switch 34, which may be of the limiting type thermally actuated by the temperature of the heat exchange structure, whereby the gas flowing through the solenoid 7 is reduced, or shut off, when the temperature of the heat exchange structure exceeds a predetermined amount, thus preventing overheating of the device. If a limit switch is not incorporated in the heater, the solenoid valve 7 may be connected directly in parallel with the motor 24 by a conductor 35, indicated in dotted lines in Fig. 4. It will be apparent that with a circuit of this type, gas will be admitted to the burner by the solenoid valve 7 only when the motor 24 is actuated, and thus only when the blower 17 is in operation, and if for any reason power is cut off whereby the motor 24, and thus the blower 17, is inoperative, the gas to the burner is likewise shut off, eliminating any danger of continued combustion with insufficient withdrawal of the gases of combustion.

As heretofore mentioned, in heater structures not incorporating the fan, or the like, and thus having no power source equivalent to the motor 24, the blower 17 may be actuated by any suitable power source, as for example, its own electric motor. An example of this construction is

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illustrated in Fig. 5, wherein the invention is disclosed in conjunction with a hot water heater of standard type, indicated generally by the numeral 36, having a gas burner 37 supplied with gas through a suitable solenoid valve 7' corresponding to the valve 7. In this construction, the usual flue pipe or stack is eliminated, and the gases of combustion accumulating at the top 38 of the heater is discharged through a tube or conduit 39 connected to the inlet of a blower 17' corresponding to the blower 17, with the blower 17' discharging the gases through a conduit or tube 41 corresponding to the tube 21. In this construction, the blower 17' is actuated by suitable power source, such as the electric motor 40, and the valve 7' and motor 40 could be connected in a manner similar to that illustrated in Fig. 4, in which case the switch 33 would be responsive to the temperature of the water, or other medium being heated by the device.

It will be apparent that in installing a unit heater, or gas heater of the type illustrated in Fig. 5, the installation problems relating to flue pipes or stacks is substantially completely eliminated, as the tubes 21, 39, and 41 may be conveniently positioned without regard to draft requirements, etc., present in the installation of the usual stacks or flue pipes, so that the heater may be installed in practically all cases at the most efficient or convenient location available, and as the tubes 21, 39, and 41 are comparable to or smaller in size than the usual water or steam pipes, they may be readily and inconspicuously run in places which could not accommodate the usual stack or flue pipe.

Regardless of the type of heater, whether for hot water or air, a suitable economizer unit may be employed therewith. For example, a secondary heat exchanger 42 may be inserted in series in the exhaust duct 21, as shown, or in the duct 41, such secondary exchanger in the embodiment illustrated comprising an inlet plenum chamber 43, and an outlet plenum chamber 44 connected by a plurality of tubes 45, the latter carrying a plurality of heat transfer fins 46 thereon. This heat exchanger is preferably made from suitable material which will efficiently withstand the corrosive action of the gases passing therethrough. As illustrated in Fig. 1, the secondary unit may be so positioned that at least a portion of the air entering the main heat exchanger may be preheated. Thus additional heat transfer and resulting efficiency increase is achieved, as well as a material reduction in the temperature of the exhaust gases, and elimination of fire hazards with respect to the exhaust conduit. Likewise, the exchanger 42 may be designed to preheat substantially all air passing through the main heat exchanger, as illustrated in Fig. 6 and Fig. 7 and if desired, could be suitably formed as a part of the latter.

Figs. 6 and 7 illustrate a modified arrangement of the secondary heat exchanger 42 from that illustrated in Fig. 1 and like reference characters indicate the same or similar parts. With this arrangement the secondary heat exchanger 42 may preheat substantially all air passing through the main heat exchanger 11. The air preheated by the secondary heat exchanger 42 is drawn thereacross by the fan 23 and forced through the main heat exchanger 11.

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It will be apparent from the above description that I have provided a very simple and efficient heater structure which eliminates one of the major problems attendant to the efficient use of combustion heaters of this type, particularly the so-called unit heaters, which construction is very simple, and does not materially add to the cost of construction, particularly wherein a suitable source of power is available, as for example, in present types of unit heaters. It will also be noted that the present invention facilitates the efficient and convenient placing of the heater as desired, as well as in some cases enabling the use of a heater of this type in a location which could not be served by a heater requiring the usual flue pipe or stack.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence, I do not wish to be understood as limiting myself to the exact form, construction, arrangement, and combination of parts herein shown and described, or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. In a self-contained heater of the type adapted to be positioned in a space to be heated, the combination of a housing having a plenum chamber defining an air passage therethrough, upper and lower manifolds within said housing interconnected by heat exchange means extending across said air passage, burner means associated with said lower manifold and serving to supply hot products of combustion to said heat exchange means, forced draft means including a pump associated with said upper manifold adapted to withdraw said products of combustion therefrom, and space heating fluid impeller means supported adjacent to said housing and serving to direct the fluid to be heated past and in contact with said heat exchange means, said pump being disposed in the line of flow of fluid through said air passage and interposed between said heat exchange means and said space heating fluid impeller means.

2. A self-contained heater as claimed in claim 1, wherein a sleeve means is supported adjacent to said housing and is provided with means for positioning within it said forced draft means and said heating fluid impeller means.

3. A self-contained heater as claimed in claim 2, wherein said forced draft means and said heating fluid impeller means have a common drive shaft.

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