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COMBUSTION CHAMBER AIR FLOW CONTROL

Filed May 10, 1966

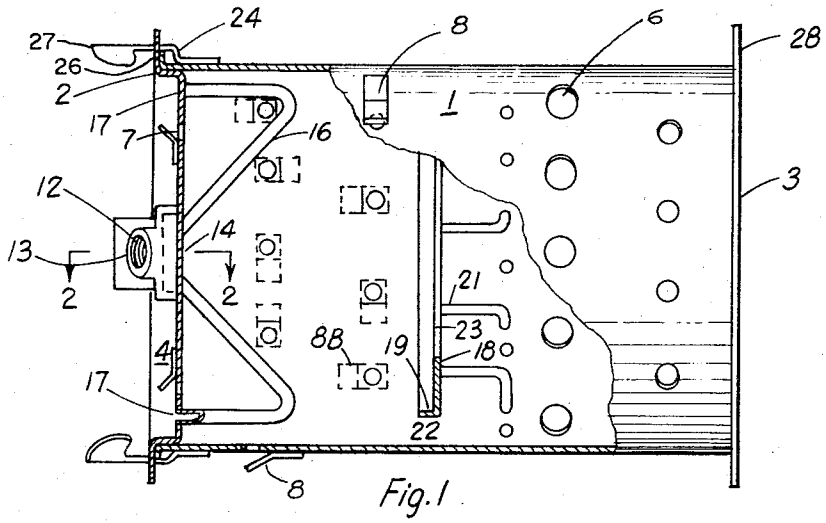


Fig. 1

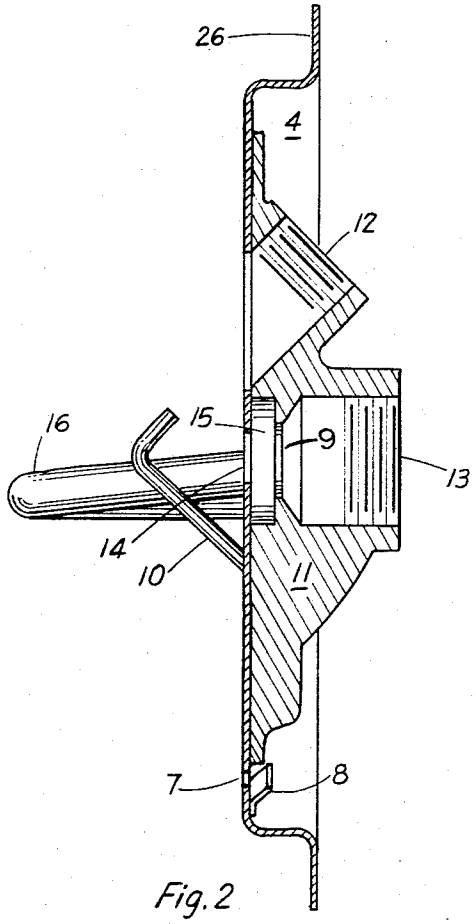


Fig. 2

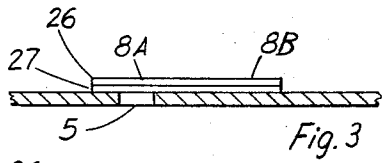


Fig. 3

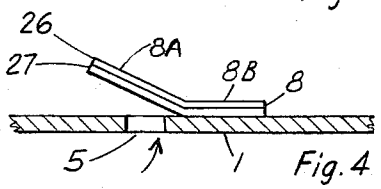


Fig. 4

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COMBUSTION CHAMBER AIR FLOW CONTROL

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ABSTRACT OF THE DISCLOSURE

A fuel burning combustor device where a combustion chamber is defined by a housing having air inlet apertures, where bimetallic strips are provided to cover the air inlet apertures at a low temperature in the combustion chamber and warp away from the inlet apertures in response to increased temperature in the combustion chamber to admit combustion air through the apertures.

Summary of the invention

In liquid fuel burning fluid heating devices, fuel is sprayed into the combustion chamber and vaporization is enhanced by the heat contained within the combustion chamber. Vaporization of the fuel facilitates further fuel-air mixing to promote more efficient combustion of the fuel. In previous combustion chambers inadequate pre-combustion fuel vaporization has resulted in carbon deposition with the formation of localized hot spots, incomplete combustion and smoking during ignition and subsequent warm up periods. In accordance with present invention it has been recognized that such problems are especially acute when heavier fuels, for example, kerosene, are used and the ambient temperature is extremely low, in the range for example of 23 below zero, so vaporization of the fuel sprayed into the combustion chamber is inhibited.

The present invention provides an inexpensive, efficient, combustion chamber which significantly reduces the formation of carbon deposits, smoking, and incomplete combustion during ignition and warm up or operation regardless of the ambient temperature or the relative weight of the fuel used.

Furthermore, the advantageous combustion chamber in accordance with the present invention significantly decreases the time required for ignition and warm up periods and provides improved combustion air flow patterns in the combustion chamber.

Various other features of the present invention will become obvious to one skilled in the art upon reading the disclosure set forth hereinafter.

More particularly, the present invention provides an improved combustion chamber for a fluid heater comprising: an elongate combustion chamber housing having selectively spaced apertures therein for admission of combustion air to the housing, the housing having an inlet end including fuel feeding means and an outlet end for the emission of combustion products from the housing; and, means adjacent said housing to control air flow through selected air inlets in response to temperatures in said housing.

It is to be understood that various changes can be made in the arrangement, form, and construction of the combustion chamber disclosed herein without departing from the scope or spirit of the present invention.

Referring now to the drawing which discloses one advantageous embodiment of the present invention:

FIG. 1 is a plan view, partly in section, of a combustion chamber in accordance with the present invention.

FIG. 2 is a sectional view taken in a plane passing through line 2—2 of FIG. 1;

FIG. 3 is a sectional view of an air control device in accordance with the present invention in the "cold" position, and,

FIG. 4 is a sectional view of an air control device in accordance with the present invention in the "hot" position.

Referring now to FIG. 1, there is shown an example of a combustion chamber in accordance with the present invention including a housing 1 which has an outlet end 3, an inlet end 2, and a series of spaced air inlets 5, 6, and 7. A dished head 4 fits into the inlet end 2 of combustion chamber housing 1 in nesting relation. Head 4 includes combustion air inlet 7 and carries a casting 11, hereinafter described. Combustion chambers of the type shown in the figures are usually used to provide heat for selected types of equipment and can now be attached by means of flange 28 to an adjacent heat exchange device so combustion gases emitted through outlet 3 pass directly into such heat exchange device to perform useful work. Combustion air is furnished to combustion chamber 1 by means of an air moving device (not shown) and passes through air inlets 5, 6 in combustion chamber housing 1 and also through air inlets 7 of dished head 4.

Dished head 4 is demountable from housing 1 and is adapted to nest snugly in end 2 of combustion chamber 1. Dished head 4 also carries a casting 11 which has a middle opening 13 to receive a fuel nozzle (not shown) to atomize fuel and spray the atomized fuel into housing 1. As can be seen in FIGURES 1 and 2, casting 11 includes a central opening 9 and a central chamber 15 which are in cooperative, communicative, alignment with opening 14 of dished cover 4 to permit fuel to be sprayed into housing 1. Casting 11 also includes a cooperative threaded upper opening 12 to receive a flame igniter (not shown) for example, a spark plug, and hold the igniter in desired position relative the fuel spray. An electrode 10 can be carried by casting 11 in cooperative relation with such flame igniter to provide electrical ground means if needed. Cover 4 advantageously can have an aperture 17 and generally U-shaped tubes 16 have one end in each aperture 17, secured thereto as by welding. The other end of tubes 16 pass through cooperative apertures 17A in cover 4 and communicate with recess 15 of casting 11 (FIG. 2). Tubes 16 extend into combustion chamber 1 so combustion air supplied by the air supply means enters the tubes through openings 17, is heated as it passes through the tubes, and is advantageously discharged through apertures 17A into chamber 15 to heat the fuel nozzle tip and provide additional combustion air to the fuel sprayed through opening 9 of casting 11.

Cover 4 further includes peripheral flange 26 adapted to engage peripheral flange 24 around inlet 2 of housing 1 in sealing relation. Cover 4 is fastened to combustion chamber 1 by latches 27 fixed to housing 1 which interlock in cooperative slots (not shown) in flange 26 of cover 4.

In combustion chambers of the type shown in the figure it is recognized as being desirable to control flow patterns of combustion gases within its chamber and various means, such as baffles, have been used to accomplish such flow control. In the example of FIG. 1, an annular baffle plate 18 is mounted intermediate inlet end 2 and outlet end 3 to extend diametrically across chamber 1 to control the flow pattern of unburned fuel and combustion products. Baffle 18 has its flanged outer edge 19 spaced from the chamber wall as indicated at 22 and is supported from housing 1 by a series of angular rods 21 riveted at one end to baffle 18 and the other end to combustion chamber housing 1. Baffle 18 is generally aligned with the longitudinal axis of housing 1 and opening 23 in the baffle is advantageously sized so a part of the fuel spray

passes through openings 22 and 23 and part impinges against baffle plate 18. Additional baffles can be provided as desired, particularly downstream of baffle 18 if further flow direction is desired.

The portion of housing 1 between plate 18 and cover 1 provides a turbulent pre-heating, or primary combustion zone, in which the air entering holes 7 in dished head 4 and holes 5 in the zone between baffle 18 and inlet 2 is thoroughly mixed with the fuel, and fuel is vaporized by the heat generated by combustion and contact with baffle 18 housing 1. Combustion air inlets 6 are provided in housing 1 downstream of baffle 18 to furnish additional combustion air and assure complete combustion of the fuel in the chamber.

In accordance with the present invention it has been recognized that during ignition and the early stages of combustion under conditions of very low ambient temperatures, cold air entering the primary combustion section between inlet 2 and baffle 18 of a combustion chamber cools the fuel and prevents the combustion chamber from getting hot enough to vaporize the cold fuel. This results in smoking, incomplete combustion, carbon deposition, and hot spots in the combustion chamber. On the other hand, after combustion has been established and the combustion chamber reaches a temperature high enough to vaporize fuel, it has been recognized by the present invention that admission of combustion air into the primary combustion section is desirable since the combustion chamber is then hot enough to heat the air and vaporize the fuel and the introduction of additional combustion air brings more of the combustion process into the primary section. Bringing more of the combustion process into the primary section heats the primary section to an even higher temperature to further vaporize the fuel and improve the efficiency and operation of the combustion chamber.

In accordance with the present invention, it has been recognized that it is desirable to provide means to distribute the flow of air in the combustion chamber and restrict the flow of cold combustion air into the combustion chamber housing during ignition and warm up periods when the combustion chamber is cold. Furthermore, the present invention provides means to change the air distribution to the chamber to increase the flow of combustion air to the combustion chamber as the combustion chamber becomes warmer.

As shown in the examples of FIGURES 1 and 2, temperature responsive bimetal strips 8 which can be, for example, of Chase #2300 Bimetal manufactured by the Wm. Chase Company are provided to extend over selected air inlets to control the admission of combustion air to combustion chamber 1. In the example of FIGURES 1 and 2, bimetal strips 8 are provided for air inlets 7 in cover 4 and selected air inlets in housnig 1, particularly inlets 6 in the section of combustion chamber 1 between inlet 2 and baffle 18. It will be realized that, within the scope of the present invention, such bimetal strips can be provided for any of the air inlets 5, 6, or 7. As shown in FIGURES 1, 3, and 4, each bimetal strip includes a section 8B fastened to combustion chamber housing 1 as by spot welding, riveting, or other suitable means. In the example of the figures each bimetal strip includes 2 dissimilar metal strips 26 and 27 bonded together along their common face. Portion 8A of each strip is free to warp in response to changes in the temperature of bimetal strips 8. The desired operating characteristics of the bimetal strips dictate the type of metal used and once the desired operating conditions are established, the composition of the bimetal strips can be determined. In the example of the figures bimetal strips 8, advantageously, cover selected combustion air inlets to restrict admission of cold air to the aforementioned primary section of housing 1 when combustion housing 1 and baffle 18 are cold. After combustion has been established, bimetal strips 8 are heated by conductive heat transfer from

housnig 1, or radiant or conventive heat transfer from the combustion process and the increasing temperature causes strips 8 to warp away from combustion air inlets. Air inlets 5 and 7 are thereby uncovered to permit combustion air to enter the combustion chamber in accordance with the temperature of the chamber.

The movement of baffles 8 in response to changing temperatures is clearly illustrated in FIGURES 3 and 4. In FIG. 3, baffle 8 is illustrated in the "cold" position where the portion 8A of baffle 8 covers air inlet 5 in combustion chamber housing 1 during the period when the burner is not in operation or during the initial start up of the burner before the combustion chamber wall 1 has been heated. In FIG. 4, bimetal strip 8 is shown in the "hot" position. In this position combustion has been initiated and the temperature of the combustion chamber has been increased so heat has been transferred to bimetal strip 8 and portion 8A of the strip has warped away from air inlet 5 to allow combustion air to enter as shown by the arrow. It will be understood that the aforementioned "hot" and "cold" positions are relative and are determined by the composition and configuration of bimetal strips 8.

It will be noted that within the scope of the present invention, bimetal strips 8 can be disposed on combustion chamber housing 1 to advantageously direct the incoming combustion air in a desired fashion to correspondingly affect air flow patterns in the combustion chamber. Such bimetal strips can, advantageously, be disposed on the inner or outer surface of the combustion chamber. In the present example, as shown in the figures, strips 8 are fastened to the outside of housing 1. It has been recognized, in accordance with the present invention, that strips 8 can be fastened to the inner surface of housing 1 and can be used to direct the flow of incoming combustion in a selected pattern.

The invention claimed is:

1. In a fluid heater, an improved combustion chamber comprising: an elongate combustion chamber housing having selectively spaced apertures therein for admission of combustion air to said housing, said housing including an inlet end having fuel feeding means and an outlet end for emission of combustion products from said housing; and, combustion air control means to control air flow through selected apertures including temperature responsive bimetal strips adjacent selected apertures near said inlet end of said housing, which strips move in a first direction in response to low temperatures and in a second direction in response to high temperatures and are disposed so a first portion of said strip extends over said air inlet apertures to cover said apertures at low temperature in said housing and moves away from said apertures in response to increasing temperatures in said housing.

2. The apparatus of claim 1 wherein said bimetal strips includes a second portion fastened to the outer side of said housing adjacent said selected air inlets so said first portion is disposed over said air inlets.

3. The combustion chamber of claim 2 wherein said second portion of said bimetal strips connected to said housing is in heat transfer relation with said housing.

4. The combustion chamber of claim 1 including: baffle means disposed intermediate said inlet end and said outlet end in substantially perpendicular relation to the longitudinal axis of said housing, to intercept and deflect a portion of the fuel emitted from said fuel heating means to maintain said portion of fuel in the segment of said housing between said inlet end and said baffle means, where said temperature responsive bimetal strips bend in one direction in response to low temperature and in a second direction in response to high temperatures said strips having a first end fastened to said combustion chamber housing adjacent selected air inlets in the portion of said housing between said baffle means and said inlet end, said strips being disposed so a second portion of said strips extend from said fastened end over said adjacent air inlets to cover said inlets in response to selected low

temperatures in said housing and move progressively away from said air inlets in response to increasing temperatures in said housing.

5. The apparatus of claim 4 wherein said bimetal strips are cooperatively disposed within said housing to selectively direct combustion air entering said housing.

6. In a fluid heater an improved combustion chamber comprising: an elongated combustion chamber housing having selectively spaced apertures therein for admission of combustion air to said housing, said housing including an inlet end having a combustion air inlet means and fuel feeding means and an outlet end for the emission of combustion products from said housing; annular baffle means disposed intermediate said inlet end and said outlet end in substantially aligned, perpendicular, relation to the longitudinal axis of said housing, said annular baffle plate being positioned to provide a peripheral space intermediate its outer edge and said combustion chamber housing for passage of flame and fuel therethrough, said baffle plate serving to intercept and deflect a portion of the fuel emitted from said fuel inlet means to maintain said portion of fuel in the segment of said housing between said inlet and said annular baffle plate, said annular plate having a central aperture to permit a portion of said fuel to pass therethrough; and temperature responsive bimetal strips which bend in one direction in response to low temperature and a second direction in response to high temperature, said strips having a first end fastened to the outer surface of said housing adjacent selected air inlets in the portion of said housing between said annular baffle plate and said inlet end, said strips being disposed so a second portion of said strips extend from said fastened end over said adjacent air inlets to cover said inlets in response to selected low temperature in said housing and move progressively away from said air inlets in response to increasing temperature in said housing, said strips being cooperatively disposed on said housing to selectively direct incoming air.

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