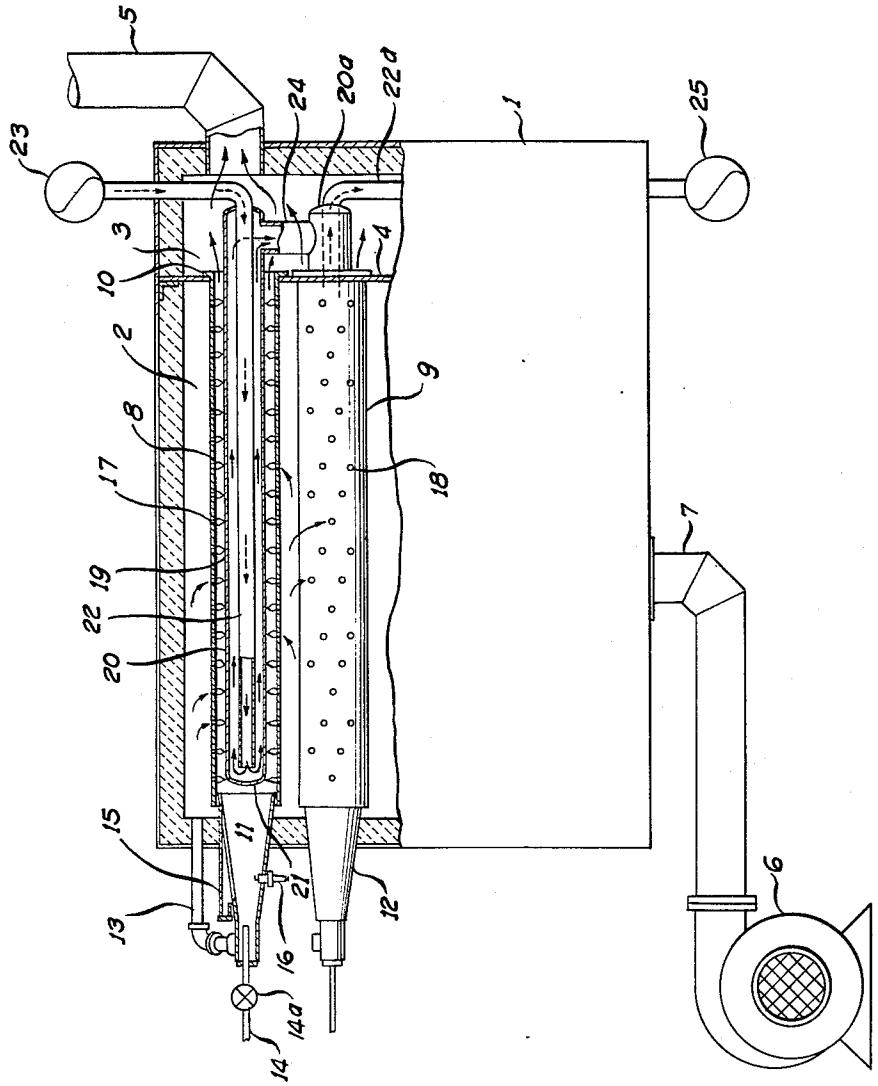
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COMBUSTION SYSTEMS FOR HEATING FLUIDS

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COMBUSTION SYSTEMS FOR HEATING FLUIDS

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This invention relates to new and useful improvements in combustion systems for heating fluids, and the present application is a continuation-in-part of application serially numbered 122,591 filed July 7, 1961 and now abandoned.

The invention relates to new and useful improvements in combustion systems for heating fluids such as liquids or gases and air and it is among the objects thereof to provide a fluid heater which consists of a combustion air tube surrounded by air under pressure, which tube has a perforated wall through which the surrounding air is forced into a stream of a pre-mix of fuel and air which is ignited to propagate a flame at each of the perforations by burning the inspirated pre-mix in the presence of the air that pierces it.

It is a further object of this invention to utilize a first fluid flow tube closed at one end that extends substantially the full length of the perforated burner tube and a second fluid flow tube disposed within said first tube to deliver the fluid to be heated to the first tube adjacent the closed end thereof to cause the liquid to flow through the annular chamber between the first and second tube to use. The fluid flowing in said annular chamber being heated by the series of burner flames propagated in the annular space between the first tube and the said combustion air tube.

It is a further object of this invention to provide a fuel and air pre-mix chamber at one end of the combustion tube connected to a source of fuel and air having means for igniting the combustible mixture which passes through the annular space between the combustion tube and the first fluid flow tube to a waste gas chamber or outlet.

These and other objects of the invention will become more apparent from a consideration of the accompanying drawing in which the single figure is a side elevational view partially cut away and partially in cross section, of a combustion system for heating fluids embodying the principles of this invention.

In the drawing, the numeral 1 designates a steel jacket or housing of substantially rectangular shape but any other such as cylindrical shape could be employed. The heating unit is divided into an air chamber 2 and a waste gas chamber 3 by a partition wall 4, said waste gas chamber having an exhaust stack 5. An air blower 6 supplies air under pressure to the air chamber 2 by ductwork 7 at any desired pressure. Disposed within the air chamber 2 are a plurality of combustion tubes 8 and 9. Any desired number of such tubes may be employed within the available space of air chamber 2. The tubes 8 and 9 are provided with flanges 10 by which they are attached to the partition wall 4 at one end and they may be suitably supported at their other end if desired or necessary because of their length. The tubes 8 and 9 are open to the waste gas chamber 3 for the escape of products of combustion as indicated by arrows. A pre-mix chamber 11 constituted by a conical shaped housing 12 has its large end disposed in the tubes 8 and 9 to have a sliding fit therewith to allow the combustion air tubes 8 and 9 to expand when heated. A pipe 13 communicates with the air chamber 2 to deliver air under pressure to the pre-mix chamber 11 and a fuel pipe 14 with a valve 14*a* extends into the chamber 11 to supply a gaseous fuel to the pre-mix chamber 11. A peep site 15 through which the combustion taking place within the combustion tube may be observed is mounted adjacent the pre-mix chamber 11, as shown, and a spark plug 16 or a pilot flame, not shown, is mounted on the conical housing of the combustion chamber, as shown.

The combustion tubes 8 and 9 are provided with perforations 17 and 18, respectively, to propagate the flames 19, as will be hereinafter described.

Disposed within the combustion tubes 8 and 9 are fluid flow tubes 20, as shown in tube 8. The tube 20 has an end closure 21. It is spaced from the air combustion tube 8 a distance to allow for the propagation of the flame 19 at the burner holes or perforations 17 and if desired, the pressure in the air chamber 2 may be such that the flame 19 plays fire on the tube 20 carrying the liquid to be heated to allow for rapid heating of the liquid.

Disposed within the fluid flow tube 20 is a second fluid flow tube 22, which is open at the end adjacent the closure 21 of tube 20 and is connected to a cold fluid header 23 from which the fluid, whether air or liquid, flows through the tube 22 into the annular space between the tube 22 and tube 20 and thence to an outlet 24. Outlet 24 is connected to a fluid flow tube 20*a* like the tube 20 in which is disposed a smaller tube 22*a* like the tube 22. As shown by the arrows, the heated fluid from tube 20 flows into the tube 20*a* and passes through the annular flow passage between the tube 20*a* and tube 22*a* to the open end of the latter and it is then conducted through the tube 22*a* as shown by arrows. In this manner, the fluid may pass through several burners and heater assemblies to increase its temperature before it is delivered to the heated fluid header 25.

It is evident that the outlets 24 of the upper heating unit could be connected to a manifold so that a supply of fluid would be heated by a single pass through one or more of the combustion tubes and fluid flow assemblies or any number of the fluid heating units could be connected in series to increase the temperature of the fluid as it flows from one assembly to another and finally to a point of use.

It is also apparent that instead of a liquid such as water, pickling fluids, etc., air or gases can be heated in the same manner.

By regulating the air blower 6, any desired air pressure may be maintained in the air chamber 2 and this pressure is communicated through the pipe 13 to the pre-mix chamber 11. At ignition, a lean mix is ignited by the spark plug or pilot burner 16 and after ignition, more fuel is added by regulating the valve 14*a* of the fuel line 14 so that ignition takes place in the combustion air tube where the combustion air pierces the pre-mix as it passes through the annular space between tubes 8 and 20 to the waste gas chamber 3.

The pressure in air chamber 2 is of a degree to cause the air to pass through the perforations 17 and pierce the pre-mix thereby inspirating the pre-mix into the cone of air to create a combustible mixture. These pre-mixed cones become ignited beginning from the pre-mix chamber throughout the length of the combustion tube to propagate the flames 19, as shown. By regulating the air pressure, the flame can be lengthened or shortened within limits and even made to play direct on the metal wall of the tube 20 to heat the liquid delivered by the fluid flow tube 22 to the space between tube 20 and 22 and thence through the outlet connection 24. Obviously the air in chamber 2 becomes preheated by combustion within the combustion air tube 8 so that the air forced through the perforations is at substantially combustion temperatures when it reaches the burner flames. In this manner, combustion is maintained throughout the entire length of the tube because as the pre-mix within the combustion air tube 8 becomes contaminated with the prod-

ucts of combustion, it also increases in temperature which, together with the preheated air from the perforations 17, consumes any residual combustible fuel or atmosphere as it flows to the waste gas chamber 3.

Instead of the combustion tubes and the fluid flow tubes being disposed horizontally, as shown in the drawing, they can be disposed vertically and they can of course be arranged in any numbers in cylindrical housings or rectangular shaped ones.

Although one embodiment of the invention has been herein illustrated and described, it will be evident to those skilled in the art that various modifications may be made in the details of construction without departing from the principles herein set forth.

We claim:

1. In a combustion system for heating fluids a pressure chamber for maintaining combustion air under pressure, an assembly comprising a combustion air tube disposed in said chamber having perforations in the wall thereof to direct jets of air from said pressure chamber to the interior of said tube, means delivering to said tube at one end a supply of premixed fuel and air that burns when inspirated into the jets of air entering the tube, the other end of said tube having a waste outlet, a first fluid flow tube closed at one end disposed inside of said combustion air tube to provide an annular flow passage, for

the flow of the premixed fuel and air and products of combustion therethrough and to said waste gas outlet, a second fluid flow tube open at one end extending into said first fluid flow tube terminating with its open end adjacent the closed end of said first tube to provide an annular fluid flow passage between said first fluid flow tube and second fluid flow tube for the flow of fluid to be heated, and ignition means for firing the premixed fuel and air at the perforations of the combustion air tube.

2. A combustion system for heating fluids as set forth in claim 1 together with one or more additional combustion air and fluid flow tube assemblies disposed in said air chamber and wherein the fluid flow tubes are inter-connected to pass heated fluid from one fluid flow tube assembly to another fluid flow tube assembly to be further heated and delivered to a point of use.

References Cited by the Examiner

UNITED STATES PATENTS

764,010	7/04	Rowe	126—90
931,565	8/09	Caygill	126—117
2,393,792	1/46	McCollum	126—110
2,462,395	2/49	Heiman	126—110 X

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