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PRESSURIZED HEATER FOR PRODUCING HOT PROCESS WATER IN LARGE QUANTITIES FROM SCALE-FORMING WATER

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5 Claims. (Cl. 60—39.56)

This invention relates to a direct contact pressure combustion heat exchanger particularly adapted for use in heating large quantities of scale-forming water, sea water, or similar liquid, to temperatures well above 212° F.

As discussed in copending application Serial Number 280,083, filed April 2, 1952, many industrial processes require large volumes of heated water and frequently the temperature must be well over 212° F. As an example, water over 250° F. is needed in the Frasch process of sulphur mining. If the water has scale-forming or corrosive properties, the scale or precipitate will tend to deposit on heat transfer surfaces in the conventional indirect heater which will reduce efficiency and will give other undesirable effects. If acid is introduced for the purpose of inhibiting scale formation, the water may become quite corrosive so that such is not practicable.

One of the main objects of the present invention is to provide an improved direct contact pressure combustion heater unit especially adapted for heating of large quantities of sea, saline, or similar type water or liquid.

A further object of the invention is to provide heat exchange apparatus in which sea or similar water can be heated efficiently and without undesirable effects to a temperature above that causing deposition of scale in the conventional indirect heat exchanger.

The pressure employed in the direct contact pressure combustion heater is chosen so as to be sufficiently high to maintain a partial pressure of steam equivalent to the temperature of the water to be furnished at the outlet of the heater for process purposes. When water is heated at atmospheric pressure in a direct contact heater, it cannot be heated to more than about 190° F., because each volume of gas leaving carries with it sufficient water vapor to limit the maximum water temperature to approximately 190° F. by evaporation. When the term "water" is used herein, it includes other liquids where appropriate.

In one aspect of the invention, the heat exchanger can comprise a pressure tight casing having a combustion chamber, heat transfer zone or zones, and a liquid reservoir at the bottom thereof from which the heated water can be drawn.

The combustion chamber is arranged so that part of the water may be transformed into vapor therein or closely adjacent thereto, the vapor passing upwardly with the flue gases through a first heat transfer zone wherein part of the down-coming water may be transformed into vapor. The gases and water vapor carried therewith then pass upwardly through a second heat transfer zone where the water vapor gives up its latent heat to the incoming water. If desired, water also can be introduced in the form of spray into the combustion chamber, the water rapidly reducing the flame temperature and being transformed into vapor which passes upwardly with the gases. It can be seen that heat transfer to the raw water may take place in two steps or zones. Preferably, the burner is arranged so that radiant heat from its flame may be absorbed by water in the water reservoir.

In a further form of the invention, combustion can be

arranged to take place below the water level of the water reservoir, such combustion being known as "submerged combustion." In this instance, heat is transferred by direct contact of the flue gases bubbling through the water being heated. The formed water vapor as it passes upwardly thereafter through the heat transfer zones or packed tower portion of the pressure vessel will release heat to the down-coming liquid. In another aspect of submerged combustion, the combustion zone can be in a combustion vessel separate from a packed tower vessel, the gases and water vapor being fed to the second pressure or packed tower vessel having two zones wherein heat transfer takes place as in the upper packed tower portion of the previously described arrangement. In such an instance, the main precipitation of scale-forming substances will take place in the combustion vessel.

These and other objects, advantages, and features of the invention will become apparent from the following description and drawings which are merely exemplary.

In the drawing:

Fig. 1, is a sectional elevation view of one form of the invention.

Fig. 2, is a sectional elevation of another form of the invention.

The direct contact pressure combustion heater of the present invention is particularly useful in process water heating systems such as disclosed in copending applications Serial Number 280,083, filed April 2, 1952, by Clifford M. Cockrell and Serial Number 284,673, filed April 26, 1952, by Vas Hubert Brogdon.

As previously mentioned, the pressure can be chosen so as to be sufficiently high to maintain a partial pressure of steam equivalent to the temperature of the process water desired.

Merely by way of example, if the heated water for process purposes is to be furnished at 300° F., then the pressure should be approximately 100 pounds per square inch absolute (p. s. i. a.). Temperatures above and below 300° F. are contemplated, such as 250° to 350°, but the invention is not limited thereto. Shell **10** can be suitably constructed of metal of sufficient thickness to withstand the pressure at which it is to be operated. The raw or natural water to be heated can be fed to water distributing means **11** in any suitable manner, the water distributing means serving to distribute the water over the entire cross sectional area of the heater. Drift eliminator **24** may be used to prevent water being carried out of the upper part of the heater.

The water to be heated passes downwardly through heat transfer zone **12**, preferably, if not necessarily, having packing therein which may be composed of conventional rings, slats, coke, or other suitable material. Next, the water to be heated passes into the lower heat transfer zone **13**, which preferably has high temperature resistant packing with open gas passages therein. These zones need not be separate but may instead be a continuous section of packing.

Combustion chamber **14** has a downwardly directed burner means **15** having a lining with radiating surfaces **15*a***, to which burner air and fuel under pressure are fed. The burner and the lining are arranged so that the most intense part of the heat of the flame and of the resulting combustion gases and of the radiant energy therefrom are directed toward the surface of the water **17** where absorption of intense heat takes place.

In the lower part of the packing, gas temperature, which may be in the range of 2300° to 3000° F., will be reduced quickly and at the same time, some of the water will be converted into water vapor, thereby converting sensible heat in the gas to latent heat in the vapor. Preferably, but not necessarily, a water spray nozzle **18** may spray water into combustion chamber **14**.