This invention relates to a fuel oil preheater which is adapted in one application to heat heavy fuel oil commonly referred to as bunker C or defined by viscosity as grades Nos. 5 and 6. These grades amongst others, require preheating in order to provide the necessary fluidity and atomization temperatures for burning. It is necessary that the fuel oil reach the burner with a viscosity which will permit a proper atomization.

One of the problems encountered with electric fuel oil heaters is maintaining small temperature variations from the desired temperature. Small variations are desired so that the oil oil will reach the point where it is to be burnt at the proper temperature for satisfactory combustion conditions consistently and evenly. For example, in grade No. 6 oil, a temperature rise from 170° to 193° F. reduces viscosity from 300 to 200 Saybolt. Thus, too low a temperature will result in too high a viscosity for proper atomization, while too high a temperature can cause troublesome vapors to form.

One of the objects of this invention is to provide an arrangement so that but little variation from the desired temperature will result. Consistent with this over-all objective a subordinate objective is the placing of a temperature sensing device which serves to control the input of power to the heating elements in such a location that its pickup of heat will correctly reflect the temperature of the fuel oil and of the heating element.

Also consistent with the above over-all objective a subordinate object is to control the flow of the oil so that there will be a distribution of heat thorough the oil to reflect a more uniform heating of the oil in the heater.

Another object of the invention is to reduce the mass of oil at the discharge section of the heater in order that the temperature thereof may be more evenly controlled. A further object of the invention is to provide in a single unit a temperature sensing device that will limit the surface temperature of the electrical heating rods while sensing oil temperature to prevent local breakdown of the oil and coke formation on the rods.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

FIG. 1 is a schematic view illustrating the oil casing and my heater therein;

FIG. 2 is a sectional view through the casing showing in top plan the heater element;

FIG. 3 is a sectional view through the casing showing the heater in side elevation with portions broken away to show the baffle;

FIG. 4 is a section on line 4-4 of FIG. 2; and

FIG. 5 is a section on line 5-5 of FIG. 3.

In proceeding with this invention, I have provided a tubular casing of a sufficient length for insertion of the heater element therein, and I have provided an inlet opening and an outlet opening for the passage of oil into and from this casing and along the heater element as is common in the art. Electrical energy will be conveyed to this heater element, and in order that the electrical energy may be turned off or turned on as required, there is a temperature sensing device disposed in the casing and located in a special way with reference to the heater element so that the heat picked up from the oil and the heater element will be reflected in the temperature sensing device which in turn will control the input of the electric current to the heater element. The particular location of this temperature sensing device to pick up the heat from the element and from the oil is of importance and thus in some places, I have attached the temperature sensing device directly to one of the rods of the heater element while in other places I have spaced the temperature sensing device from these rods so as to be in the oil to be heated but out of contact with the heater element. Also this heater element is disposed closely adjacent the discharge of the oil from the casing and at a location where the mass of the oil is minimized by use of a horizontal baffle so that the heat of the oil in this location may be more evenly controlled. Likewise the flow of oil is caused to be in a sinusuous path to aid in stripping it from the heater element through the use of projections or baffles as it flows through the casing.

With reference to the drawings, 10 designates a fire box which is utilized for providing a source of heat such as for a steam boiler or the like and in which the preheated oil is to be burned. The scheme of heating illustrates heavy fuel oil located in tank 11 for supplying to the preheater generally indicates at 12 by means of a conduit 13 leading to one end of the casing 14 of the preheater and being supplied to the fire box from the other end of the preheater by a conduit 15.

The preheater 12 is essentially a tubular shell 14 equipped with flanges 16 and 17 at either end with the inlet and closed by cover plate 18 while the discharge end receives a heating unit generally indicated at 20 having a flange 21 upon which its operating parts are mounted and which may be bolted to the flange 17 with a gasket between to provide a tight joint.

One set of U-shaped heater rods 22 are fixed to the flange or head 21 while another set of U-shaped heater rods 23 in planes substantially at right angles to the planes of the rods 22 and of slightly greater length are also carried by the head 21. These rods are arranged so that they provide substantially a complete circle as shown in FIGS. 4 and 5. Electrical current is supplied to these rods substantially as shown in Patent No. 2,916,598, dated December 6, 1959, and the control of this current is through a temperature sensing device designated generally 30, the placement of which is more or less critical for the desirable results attained in this invention.

One form of temperature sensing device consists of a capillary tube 31 which extends through the head 21 to control the electrical circuit carried by the head, which capillary 31 is connected to the bulb 32 which is of an elongated form and disposed in a sinusuous path here shown as having three branches 33, 34 and 35. The distal end portion branch 35 of this bulb is attached directly to one of the leading bank of heater rods such for instance as 22 by clips 36 so that it will lie along a portion of this heater rod 22 there being a direct contact one with the other. In this fashion the heat loss through the capillary is minimized, the point of highest sensed temperature being at the end away from the capillary.

The branch portions 33 and 34 however are surrounded by sleeves 37, 38, respectively so as to be definitely spaced away from the heater rods by a predetermined amount, clips 39 being used to hold the branch 33 in position at the sleeves 37. These sleeves 37, however, extend beyond the longitudinal extent thus providing a passage between the bulb and the heater rods along the major portion of the branches 33 and 35 for the circulation of oil around the bulb, and are of different wall thickness. In this manner the bulb is suspended in the oil so as to pick up heat therefrom. All portions of the bulb will of course sense the oil temperature but in the case of the closely coupled
branch 35 the heater rod will have the greatest effect on the bulb since its temperature is necessarily above the fluid oil temperature during the heating cycle. This will be shown 32 of the bulb is disposed closely to the outlet opening 24 from the casing 14 and the capillary 31 connects to this portion 32 of the bulb to the control apparatus carried on the head 21. The entire sensing element is located in the top portion of the casing so it is exposed to the hottest heated oil. Branch 35, in contact with the heating elements, should preferably be located slightly below the other two branches to give the maximum sensing during shut-down conditions when no oil is being pumped. By this over-all arrangement as above described, the temperature sensing device may have sufficient sensitivity to respond quickly and cause power shut-off, as the temperature sensing device will have sufficient exposure to hot oil to prevent the heater current from coming on again quickly as a result of power demand from the heater rod cooling yet under flow conditions the rod temperature will contribute less to the total control.

Cooperating with this arrangement of the temperature sensing device, I provide a horizontal baffle 40 comprising a tubular air tight cylindrical member with closure ends 41 and 42 which will extend from the head inwardly a distance into the space surrounded by the heater rods substantially equal to the length of the temperature control element. The horizontal baffle 40 is important in a static condition. When fluid flow is stopped, a quick response of the temperature sensing device is needed to prevent overheating of the static fluid. The cylindrical baffle aids greatly in accomplishing quick response because of the reduced volume of the liquid about this baffle, which will be close to the exit or discharge 24 from the casing and by providing a section which by reason of this reduced volume will be heated at a faster rate than the total volume under shut-down conditions and consequently may be more accurately controlled.

I also provide an arrangement to inhibit laminar flow of the oil. As the oil is heated by the rods, because of the combined effect of high viscosity sensitivity and low heat conductivity, it has a tendency to move along the rods in close proximity therewith, the hot portion in effect tunneling through the mass of the colder oil and disturbing it little. By providing vertical baffle plates 45 and 46 extending from the casing inwardly a major portion of the diameter across the casing, as may be seen in FIG. 5, and providing each baffle with openings through which the rods pass, the oil entering at the inlet end 25 of the casing will have to follow a sinuous path along the heater rods. In this fashion, the hot oil is caused to mix with the cold oil creating a more uniform distribution of heat throughout the oil in the casing and preventing the formation of hot vapor bubbles. Effectively a greater turbulence of flow is thus created and the relatively low heat conductivity of the oil partially compensated for.

The temperature sensing device shown in the drawing is of the sealed vapor pressure type known as a diastat. Other types of instrumentation, such as distributed resistance elements, will work equally well in the arrangement which has been described.

While the novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that many changes may be made in the details of construction shown and described without departing from the spirit of the invention. I, therefore, do not wish to be limited to the exact details shown and described as they are set forth only by way of illustration.

I claim:

1. A fuel oil preheater comprising a hollow casing having generally a horizontal axis and an oil inlet and an oil outlet located at opposite ends of the casing through which the oil to be heated passes, axially extending heater elements suspended in said casing between the inlet and outlet for contacting the oil to be heated, a horizontally extending baffle within said casing, said baffle having side and end walls creating an area free of oil, said baffle forming with the casing walls a generally annular oil flow passage and located adjacent the oil outlet, the portion of said heater elements adjacent the oil outlet being located in the annular oil flow passage, the inner end of said baffle distant from the oil outlet being also spaced from the oil inlet, and elongated temperature sensing means in said casing substantially coextensive with said baffle and disposed substantially about said baffle, said sensing means being the primary control for activating or deactivating said heater elements.

2. A fuel oil preheater comprising a hollow casing having generally a horizontal axis and an oil inlet and an oil outlet located at opposite ends of said casing through which the oil to be heated passes, axially extending heater elements suspended in said casing between the inlet and outlet for contacting the oil to be heated and a horizontally extending baffle within said casing, said baffle having side and end walls creating a space free of oil, said baffle forming with the casing walls a generally annular oil flow passage and located adjacent the oil outlet, the end of said baffle distant from the oil outlet being also spaced from the oil inlet, at least two spaced baffles projecting from said elements between the inlet and the last said end of the baffle to direct the flow of oil away from the element and toward the wall of the casing, said baffles extending at generally right angles to the axis of said casing and from diametrically opposite sides thereof over a major portion of the diameter of the casing to cause a sinuous flow of oil through such baffled portion of the casing.

3. In a fuel oil preheater as in claim 2 wherein temperature sensing means are disposed substantially in the area about said baffle, said sensing means controlling the heat output of said heater elements and having portions thereof spaced from the heating elements in the boundary layer of warm and cool oil and other portions thermally coupled to said heater elements.

References Cited by the Examiner

UNITED STATES PATENTS

1,139,001 5/1915 Varrel 219—299 X
1,468,722 9/1923 Macy 219—307
2,421,562 6/1947 Hynes 219—298 X
2,694,768 11/1954 Stiebel 219—306
2,714,139 7/1955 Yula 158—360 X
2,783,354 2/1957 Loebel et al. 219—306 X
2,916,598 12/1959 Hayden 219—306 X

FOREIGN PATENTS


ANTHONY BARTIS, Primary Examiner.