Dec. 8, 1959 S. J. HAYDEN 2,916,598

FUEL OIL PRE-HEATER

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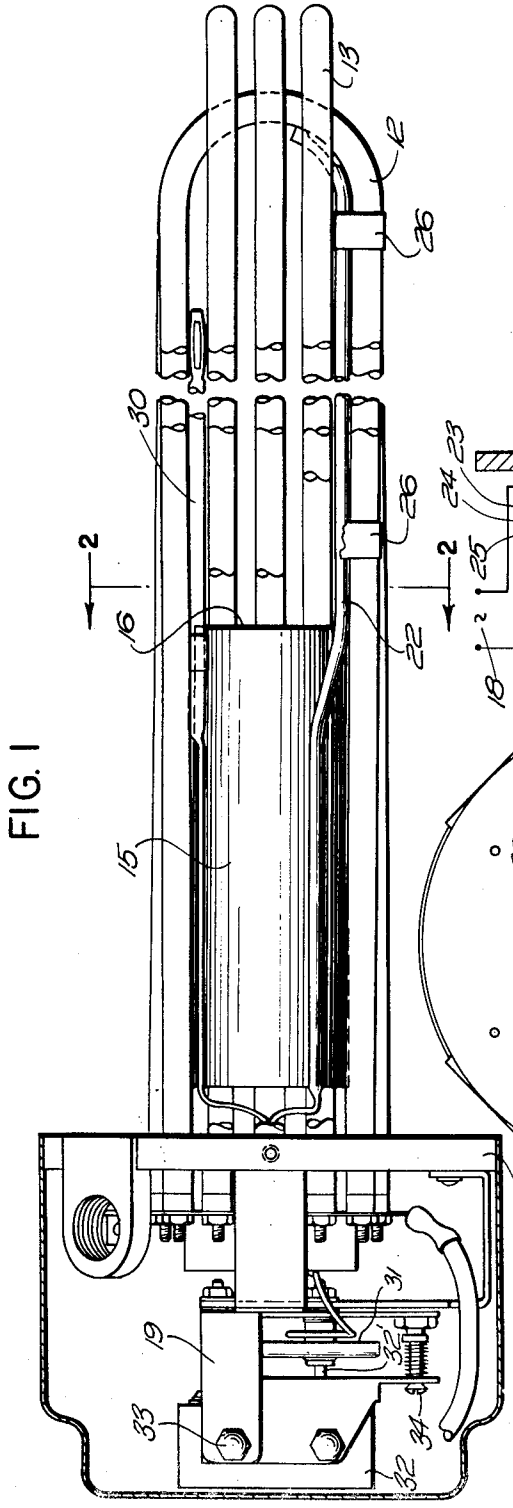


FIG. 1

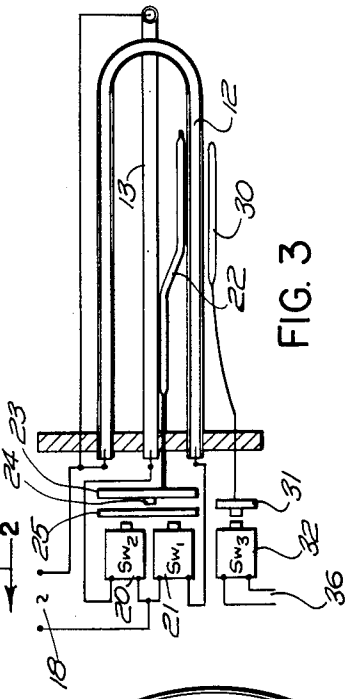


FIG. 3

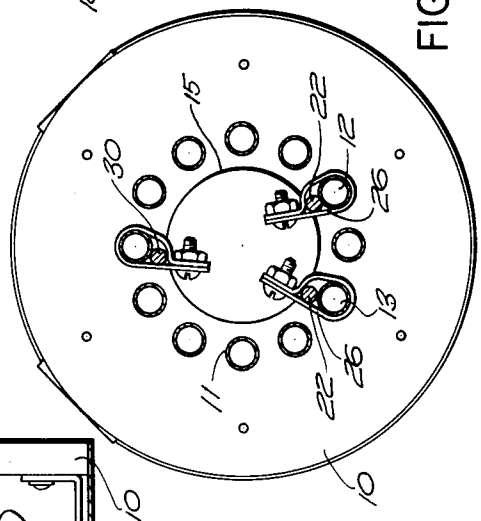


FIG. 2

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FUEL OIL PRE-HEATER

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6 Claims. (Cl. 219—39)

This invention relates to an electric fuel oil pre-heater, more particularly a pre-heater which is adapted to heat heavy fuel oil such as is defined by viscosity or grade numbers 5 and 6 which grades require pre-heating in order to provide the necessary fluidity and atomization temperatures for burning. Industrial type oil burners utilize a heavy fuel oil such as number 5 or 6, and it has become common practice to manufacture the burner with a suitable pre-heat compartment so that the heavy viscous oil may be readily handled and be in a better condition for atomization in the burner proper. Additionally, of course, the pre-heating of the viscous liquid makes it more readily handled in oil lines, pumps, etc., all of which are accessory items to the oil burner proper. Certain problems arise in the heating of a viscous oil such as has been defined above since it has been found that under normal heating conditions, these heavy oils tend to stratify within the pre-heat chamber and, of course, since oil is essentially an insulator it resists, under normal conditions, thermal transfer. Thus pockets of heavy oil may form in the pre-heat chamber which results in inconsistent viscosity of oil within the pre-heat chamber. Accordingly, a slow moving or static oil is present and such portions of oil are immediately susceptible to what is known as "coking." "Coking" is actually the formation of carbon deposits which tend to adhere within the pre-heating chamber to the heating elements themselves, ultimately baking on to the heater elements causing a failure thereof due to an excessive thermal build-up within the coated heater element. It is therefore the main object of the present invention to eliminate some of the aforementioned difficulties and provide a unit which is superior in performance to those previously available.

A more specific object of the invention is to provide a pre-heater unit which will eliminate stratification of the fuel oil within the pre-heating chamber.

A further object of the invention is to provide a pre-heater unit which will give a much finer degree of control and prevent overheating of the oil within the pre-heating chamber.

A still further object of the invention is to provide a thermostatically controlled pre-heater unit which embodies an integral lock-out device to prevent operation of the associated oil burner until the oil in the pre-heated chamber has reached a predetermined level.

Another object of the invention is to provide a thermostatic type control which will be arranged to provide an anticipation and averaging feature in a single sensing bulb to produce a degree of precision control not otherwise obtainable.

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:

Figure 1 is a top view of a heater unit made in accordance with the invention with portions of the unit broken away for clarity;

Figure 2 is a sectional view taken on lines 2—2 of Figure 1; and

Figure 3 is an electrical schematic of the operating controls for the heater.

In proceeding with this invention I take two sets of heater elements and arrange them so that each set may be individually controlled through its own switch. The switches are preferably mounted so as to be under the influence of a common thermostatic operating element and may be adjusted so that they each preferably operate at different temperature levels. A deflector means to prevent stratification of the oil within the heating elements is suitably positioned within said elements and the elements and the associated apparatus may be mounted on a flange plate for association with an oil burner.

Referring now more particularly to the drawings there is shown therein a mounting flange plate **10** which is bored with a plurality of holes **11** that are adapted to receive the electrical elements **12** and **13**. The electrical elements may be of any suitable manufacture and of any number, but in the present instance I have shown in Figure 1, six such elements of generally U-shape which terminate through the flange plate **10** in twelve holes **11**. The ends of the elements are suitably sealed to the flange plate **10** so as to be in fluid tight relationship therewith. With due respect to the electrical rating of the heating elements, they are suitably connected together in their respective banks **12** and **13** and since the holes **11** in the flange plate **10** are drilled in a circle, the elements basically enclose a cylindrical area within which is received a cylindrical tube **15** having a closed end **16**. Mounted on the face of the flange **10**, opposite the face from which extend the heating elements **12** and **13**, is the electrical-controlled mechanism for the apparatus.

For a better understanding of the control circuitry reference is made to Figure 3 which is a schematic view of the apparatus in which there are provided the two switches **20** and **21** that are preferably mounted in side by side relationship on a common bracket such as **19**, shown in Figure 1. These switches may be of any suitable manufacture, which are generally known in the trade as a microswitch, that is, a switch that will operate upon a very minute movement of an operating means with small operating force. In the present instance, the operating means associated with switches **20** and **21** consists of an expansion type thermal sensitive element having a sensing bulb **22** and a responsive diaphragm **23**. The responsive diaphragm **23** has a projection **24** extending therefrom and between this projection **24** and the switches **20** and **21** there is mounted a pivoting plate **25** which may be moved toward the operating pins of switches **20** and **21** by the expansion of the responsive diaphragm **23**. It will be realized at this juncture that, if both switches are positioned with respect to the plate **25** an equal distance, they will perhaps operate at the same time. However, either by suitable mounting of the switches **20** and **21** with respect to this plate **25** or by other abutments that may be inserted in the plate **25**, the operation of the switches **20** and **21** with respect to the amount of movement the plate **25** may be varied. With this thought in mind, the switches are positioned so that, upon a rise in temperature being experienced or sensed by the bulb **22**, first one switch will open and then the other, that is, they will change from their normally closed position to an open position. As will be readily apparent from examining Figure 3, the switch **20** is in series with the electrical heating element **13** as viewed from the source of current appearing at the terminals **18** while switch **21** is in series with the heating element **12**. Thus, when both switches are in their normally closed

position, which condition will be present when the temperature being sensed by the bulb 22 is below the normal operating range, both of these switches will energize the heating elements 12 and 13. When the temperature has risen to a suitable amount near the normal operating range, one switch will open thereby shutting off one-half of the effective heating capacity of the unit which will remain in that condition until the proper operating range has been secured whereby the second switch will open the last remaining heating element circuit.

Also, associated with the control of circuity of the unit is what is known as a cold lock-out device which consists of a second thermal sensing element 30 which has a responsive diaphragm 31 that is mounted in close proximity to a normally open switch 32. The switch 32 may be mounted on the same bracket 19 as were switches 20 and 21 and is preferably pivoted to the bracket 19 as at 33 so that by means of adjusting screw 34 the position of the operating pin 32' of the switch 32 may be adjusted and thus change the range of operation of the switch. In a preferred embodiment the switch is adjusted to operate at a temperature below which it would be impossible for a burner to satisfactorily operate. Accordingly, as the oil in which the heater elements are immersed comes up to sufficient operating temperature, the diaphragm 31 will expand causing operation of the switch 32 and if the terminals 36 of the switch 32 are connected in series with the control means for the burner, the burner will now be activated and may start in the normal fashion.

The main operating control of sensing element 22, which has been previously referred to, is oriented in the apparatus in a particular manner to produce the desired result of the apparatus. Basically, the sensing element is tied to both sets of heating elements 12 and 13 by means of clips such as 26, 26' which clamp the sensing element to both sets of heater rods. Since the main sensing element is fastened in close heat transfer relationship with both sets of rods, the operation of the responsive diaphragm 23 will be such so as to prevent or anticipate temperature over ride and also anticipate temperature under ride. This comes about inasmuch as residual heat in a tubular type electric element is present for a sufficient length of time after the current to the element has been cut-off. Thus with the bulb fastened to the element, the residual heat may be curtailed and a shorter and more frequent operating cycle is obtained with consequent precision control of temperature. Furthermore, it will be noted that a certain section of the sensing element 22 is within space, that is, passes between the elements 12 and 13 in a free area, and thus, is also sensitive to the actual temperature of the liquid being heated. Without the anticipation and limitation of residual heat build up, a temperature control would be less effective for the atomization of fuel oil since the range of temperature variation would be wide and consequently continually change the viscosity.

In order to still further improve the effective thermal transfer of heat from the heating rods to the liquid, the baffle 15 is inserted within the heater element array. This baffle 15 consists of a cylinder having a closed end 16 and is installed within the general circular area inscribed by the heating rods 12 and 13. Cold oil entering the heater rod array is unable to stratify within the circular area inscribed by the heater rods for it strikes the end 16 of the baffle and is immediately deflected to the circumferential area of the heater rods. Thus, convection of the fuel oil within the heater rod array is enhanced by the use of the baffle 15.

It will be apparent from the above discussion that there is disclosed herein a combination of elements in a pre-heater for heavy fuel oils which provides a very fine degree of control for the heating of the fuel oil through the use of a two step thermostatic switch arrangement and combines in a bundle of heating elements, efficient means for preventing stratification of the fuel oil during the heating process and particularly from a cold start.

I claim:

1. An oil pre-heating apparatus comprising a chamber means for passing liquid therethrough a plurality of electric-heating elements in said chamber, said elements mounted on a common support and connected in at least two separate groups, switch means for each group, a thermostatic device having the sensing means thereof in thermal relation with each group of heating elements, said switch means operated by said thermostatic device to control the groups of elements and break the contacts of first one switch and then the other switch upon a temperature rise being sensed by said thermostatic device.

2. An apparatus as in claim 1 including a swingable plate, said thermostatic device moving said plate, said switches having actuator means mounted to be engaged by said plate and means whereby the position of said switch actuators may be varied with respect to said plate.

3. An oil pre-heating apparatus comprising a plurality of electric-heating elements, common means for supporting said elements, a thermostatic device having the sensing means thereof in thermal relation with said elements and the oil in which immersed, said device including a switch means in series with said elements and a source of electrical energy and baffle means adjacent said elements arranged to enhance the flow of oil in which said elements are immersed toward said elements.

4. An apparatus as in claim 3 wherein said elements are divided into a plurality of groups and said switch means comprises a separate switch for each group, said switches responsive to said sensing means and arranged to be sequentially opened upon a temperature rise being sensed by said sensing element.

5. An oil pre-heating apparatus comprising a plurality of U-shaped heating elements, the free ends of said elements arranged in a circle and secured to a mounting plate, a cylindrical baffle having a closed end received in the area enclosed by said elements, and switch means in series with said elements and a source of electrical energy.

6. An oil pre-heating apparatus as in claim 5 including a thermostatic device coupled to said switch means and having the sensing means thereof in thermal relation with said elements, said elements arranged in at least two separate groups, said switch means including a separate switch for each group with a common actuator adjusted so that upon a temperature rise being sensed by the sensing means first one switch will open and then the other.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,916,598 December 8, 1959

Sydney J. Hayden

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 10, after "chamber" insert a comma; line 11, after "therethrough" insert a comma.

Signed and sealed this 6th day of November 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

UNITED STATES PATENT OFFICE

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