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ELECTRIC HOT WATER SPACE HEATING UNIT HAVING
IMPROVED CIRCULATION PATH
Original Filed June 16, 1966

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FIG. 1

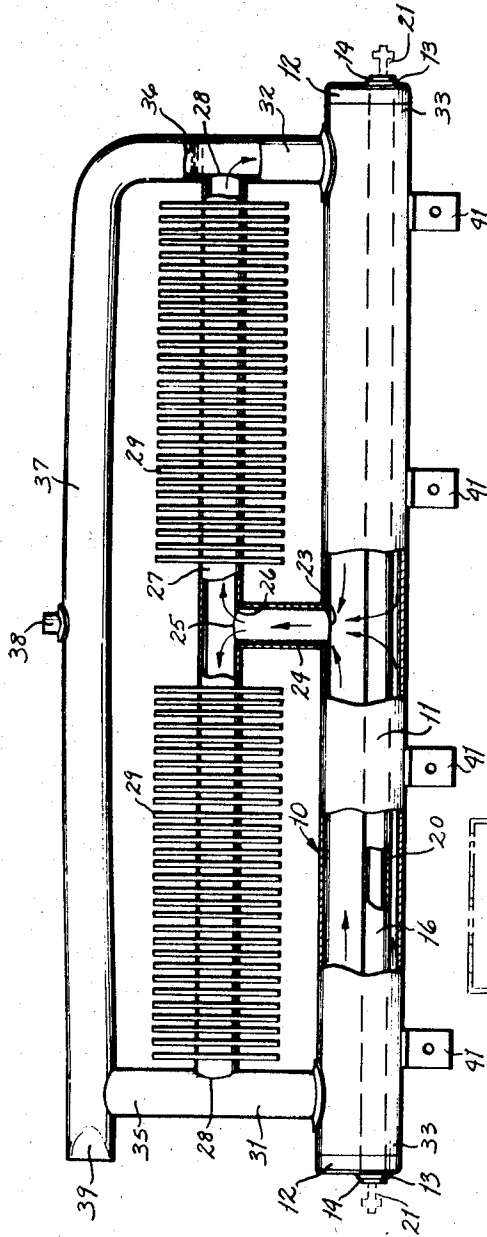


FIG. 3

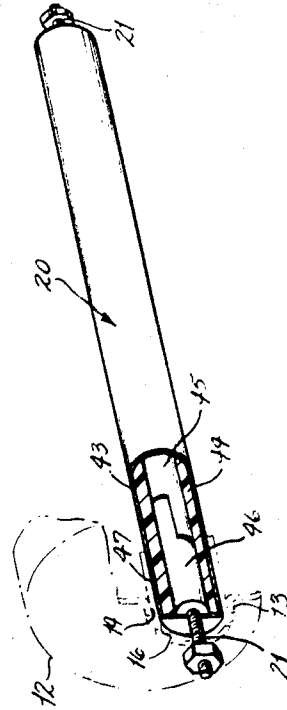
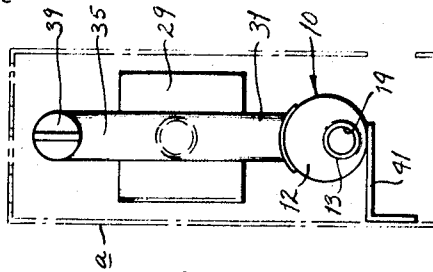


FIG. 2



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ELECTRIC HOT WATER SPACE HEATING UNIT HAVING IMPROVED CIRCULATION PATH

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Int. Cl. H05b 7/06

U.S. Cl. 219—341

4 Claims

ABSTRACT OF THE DISCLOSURE

An electric hot water heating unit for space heaters including an elongated horizontal liquid-heating chamber with end enclosures having openings which sealedly support an elongated heat-communicating tube in which a heater is enclosed or a cartridge heater is inserted. A riser tube whose lower end communicates with the wall of the heating chamber above the center of such heater element, leads upwardly to the center of a substantially-horizontal tubular liquid-flow passage which is finned to transfer heat to the atmosphere, cooling the heat-transfer liquid as it flows from the central riser outwardly in opposite directions to both ends of the horizontal-flow passage. At these ends, downwardly-extending tubular return passages, bridged by a superposed tubular expansion chamber, lead the cooler liquid into end portions of the water-heating chamber adjacent to its end closures, from which it flows inwardly as it heats, reaching its maximum temperature just prior to flowing up the riser tube.

This application is a continuation of S.N. 558,058, now abandoned, filed June 16, 1966.

The present invention relates to that type of self-contained elongated heater units in which hot water circulates from and returns to a heating chamber in which is enclosed an electrical resistance heater; and in particular to a new fluid circulation path therefor.

An objective in designing all such electrical unit heaters is to achieve effective heat transfer to the atmosphere at the safe temperatures which hot-water heating makes possible, yet with such efficiency as to reduce the cost of heating. The specific purposes of the present invention are to provide such hot-water heaters with an improved liquid circulation path, so that the heated liquid will flow upward from the hottest portion of the heating chamber and return to cooler portions thereof. Additional purposes are, to utilize elongated electrical heaters having terminals at both ends, to provide for the removable installation of such heaters, and to provide for effective expansion-permitting means including a gas whose pressure bears on the expanding heated liquid of the heat-transfer liquid without escape of steam into the gas therein.

These and other purposes which will be evident from this specification, are achieved generally by providing the unit described in the abstract.

An expansion chamber spans the entire unit from one end of the finned liquid-flow passage to the other; so that gas in the expansion chamber resists expansion by exerting pressure on the cooler liquid in both portions of the circulating path. This avoids communication of steam into the expansion chamber from the hotter water of the central riser.

A preferred embodiment and an alternate embodiment of the present invention are shown in the drawings, in which:

FIG. 1 is an elevational view of a self-contained heater unit embodying the present invention, with a cartridge heater element installed therein shown in phantom lines. Electric connectors, thermostats and other conventional controls and auxiliaries are omitted.

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FIG. 2 is an end view showing the heater unit of FIG. 1 mounted in a convection cabinet frame shown in phantom lines.

FIG. 3 is a schematic perspective view, partly broken away, of a cartridge heater element such as utilized in the unit of FIG. 1.

A preferred form of the self-contained hot water heater unit of the present invention, as shown in FIG. 1, includes an elongated horizontal liquid heating chamber generally designated 10, preferably formed of a large diameter tube 11, with brazed-on end caps or closures 12 at each of its ends. Each of the closures 12 has a short neck 13 which defines a circular end opening 14, in horizontal alignment with each other, below center of the heating chamber 10, but above its lower inner surface. Sealed, as by brazing, within the end openings 14 and supported thereby is an elongated cylinder whose outer surface serves as means to communicate heat from within to the liquid within the heating chamber 10. In the example illustrated in FIG. 1, such means is a simple hollow copper cartridge-receiving tube 16, brazed at its ends within the end caps 12. Copper tubing was selected because of its consistency with the material of the end caps 12 and its heat-conductive properties.

Within such cartridge-receiving tube 16 and in surface contact with its inner surface, is removably inserted a cartridge resistance heater generally designated 20, described hereafter, whose electrical terminals 21 project outward from both ends of the tube 16.

Joining with and communicating into the upper portion of the large-diameter copper tube 11 of the heating chamber 10 at its center (that is midway along its length) and extending upwardly therefrom, is the lower end 23 of the copper riser tube 24. It extends upwardly therefrom to an upper end 25 which is joined by brazing to communicate through a central lower wall opening 26 into a substantially horizontal finned tubular water-flow passage 27. Between the riser tube 24 and both its left and right ends 28, the water-flow passage 27 has closely spaced convection fins 29 by which heat is transferred to the atmosphere. Outwardly of its finned length, the left and right ends 28 of the water-flow passage 27 are brazed to and communicate downwardly through a left tubular return passage 31 and a right tubular return passage 32, into the end portions 33 of the liquid heating chamber 10, inwardly adjacent to the end closures 12. Upward continuations of the left and right return passages 31, 32 extend upward above the tops of the fins 29, and are referred to as the tubular expansion riser portions 35, 36, respectively. The upper end of the right hand tubular expansion riser portion 36 shown at the right side continues in a bend to the left and then spans the entire width of the heater unit to provide a nearly horizontal slightly arched tubular spanning chamber portion 37, at whose upper center a pressure relief valve 38 is installed. The left end 39 of the tubular spanning chamber portion 37 is used for filling as hereinafter described, after which it is crimped and brazed. Immediately adjacent to its said end 39, the upper end of the left tubular expansion riser portion 35 opens into and is brazed to the lower surface of the spanning chamber portion 37.

The unit is charged (conveniently through the left end 39 prior to the crimping and brazing) with a conventional heat-transfer liquid, preferably water into which some anti-freeze is added, completely filling the heating chamber 10 about the tube 16 and extending upward to a level slightly above the upper margin of the finned water-flow passage 27. Air above this level is thus sealed within the tubular expansion riser portions 35, 36 and the tubular spanning chamber portion 37. The charged unit may

then be tested, and stored away for subsequent installation.

The manner of mounting for use will be apparent. Referring to FIG. 2, mounting angles 41 may be brazed onto the lower surface of the heating chamber 10; or any other simple mounting means may be used to hold the heater unit upright within a sheet metal convection casing *a* shown schematically in FIG. 2.

An advantage of the present construction is the utilization of replaceable cartridge heaters which extend straight through the heating chamber 10. The cartridge heater 20 of FIG. 3 illustrates a conventional type. It may have a cylindrical stainless steel sheath 43 covering an insulating coating 44 poured in and solidified around a core, consisting of an elongated slender rod-like electrical resistance heating element 45 and rod-like inner portions 46 of the terminal ends 21. These portions 46 are welded to the resistance element 45 spacedly inward of the ends of the sheath 43, leaving cooler sheath end portions 47 at and within the end openings 14 of the heater receiving tube 16.

Alternately (not illustrated) a heater constructed similarly to the cartridge heater 20 but copper sheathed, may itself be brazed into the end openings 14 of the necks 13 of the end closures 12; so that the heat-transfer liquid within the heating chamber 10 will circulate and direct heat-receiving contact with its copper sheath, which thus itself serves as the heat-communicating means within the heating chamber 10.

Operative tests show that the end portions 33 of the heating chamber 10 are cooler than its center portion. This appears to be due in part to the fact that the end closures 12 lose heat to the surrounding atmosphere and in part to the fact that the cartridge end sheath portions 47 are not heated. The central location of the riser tube 24 provides the unit heater with a novel liquid circulation path, upwardly through the riser tube 24 and thence outward in opposite directions, to the left and right ends of the water-flow passage 27. As the heat-transfer liquid passes through the water-flow passage 27, heat is absorbed by the fins 29 which are constantly cooled by the flow of convection air through the casing *a*. When the heat-transfer liquid reaches the left and right tubular return passages 31, 32, its temperature is lowered; it returns downwardly through the return passages 31, 32 to the end portions 33 of the heating chamber 10, thence flowing inwardly around the outer surface of the cartridge heater 20 to be again heated and flow upwardly again through the riser tube 24.

As the heat-transfer liquid is heated, it expands somewhat, driving back the air within the sealed expansion riser portions 35, 36 and the spanning chamber portion 37, and increasing its pressure. This serves to raise the boiling point of the heat-transfer liquid, increasing its heating capacity. Ordinarily a heat-limiting thermostatic control (not shown) will be used to de-energize the current flow through the terminals 21 just short of such elevated boiling temperature. Nevertheless there may be some formation of steam bubbles at the hottest point of the heating chamber 10; and these will flow upward in the riser tube 24. To have such steam bubbles burst to the liquid surface within an expansion tube, then condense and flow back, would tend to result in noises. This result is avoided, however, since the expansion riser portions 35, 36 communicate with the circulation flow path only at the return passages 31, 32, that is, where the circulating water is the coolest. Another advantage of these connections is that the spanning chamber portion 37 exerts a balanced pressure on the cooler water in both the left and right circuit portions of the circulation path. Additionally such spanning chamber 37 lends rigidity to the entire unit.

It will be understood that the device illustrated is to be used with conventional electrical circuitry and suitable thermostat and pressure controls.

The length of the present unit water heater may be varied to suit needs, dependent upon the length of resistance heaters available; normally the length will be relatively greater than illustrated. Regardless of length, the unique central riser and the double path of the flow circuit has added efficiency to the functioning as well as simplicity to the construction and servicing of self-contained electrical resistance water heaters.

Modifications will occur to those familiar with the art; hence the present invention is not to be construed narrowly, but rather as co-extensive with the claims hereof.

I claim:

1. A unit heater having an improved circulation path for a liquid, comprising
 - a horizontal tubular heating chamber, elongated heat-communicating surface means within the heating chamber,
 - a water-flow passage tube at a higher level and including means at both sides of its midpoint to transfer heat to the atmosphere,
 - the water-flow passage tube having end portions upwardly adjacent to end portions of the heating chamber,
 - return flow tubes communicating from the end portions of the water-flow passage tube to those of the heating chamber,
 - a fill of liquid within said chamber and tubes, and means to permit expansion of the liquid therein,
 - the unit heater being characterized in having riser tube means communicating between the heating chamber tube and the water-flow passage tube substantially midway between their end portions, and in having
 - means to so position the elongated heat-communicating surface means, relative to the end portions of the heating chamber, that the heat transfer liquid is heated more near the riser tube means than near the end portions of the heating chamber,
 - whereby, when heated by the heat-communicating surface means, the liquid circulates in a path inwardly from the ends of the heating chamber upwardly through said riser tube means and thence in opposite directions through the portions of the water-flow passage tube outwardly thereof to and through the return flow tubes, to the end portions of the heating chamber.
2. A unit heater as defined in claim 1, in which the elongated heat-transfer surface means is the outer metal sheath of an electrical resistance heater having an unheated end portion, and in which the means to position same comprises an end closure of the heating chamber, in which end closure said unheated end portion is sealedly supported.
3. A unit heater as defined in claim 1, in which the elongated heat-transfer surface means is a cylindrical heater-receiving tube formed of heat-conductive metal and having an open end, together with an elongated cylindrical electric resistance cartridge heater removably fitted in heat-conductive relationship therein, and in which the means to position said heat-transfer surface means is an end closure of the heating chamber, in which end closure said heater-receiving tube is sealedly supported.
4. A unit heater as defined in claim 1, in which the means to permit expansion of the liquid comprises tubular expansion risers extending upwardly from both end portions of the water-flow passage tube, and
 - a sealed tubular spanning chamber portion joining said expansion risers and enclosing a gas,
 - whereby on the expansion of the liquid when heated, pressure is exerted by said gas balancedly on the circulating liquid as it reaches both the return flow

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tubes and after such transfer of heat to the atmosphere.

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