Nov. 10, 1959 T. S. KINNEY 2,912,664

ELECTRIC HEATER ELEMENT

Filed Nov. 9, 1956

FIG. 2

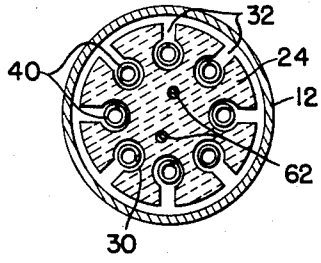


FIG. 1

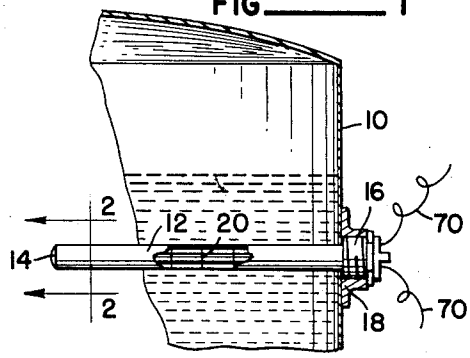


FIG. 5

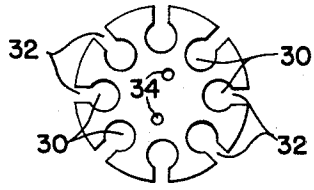


FIG. 6

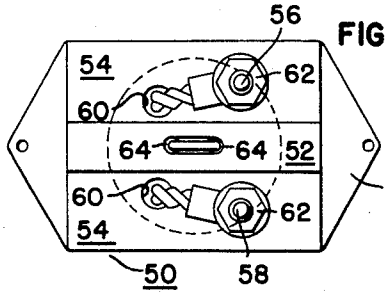
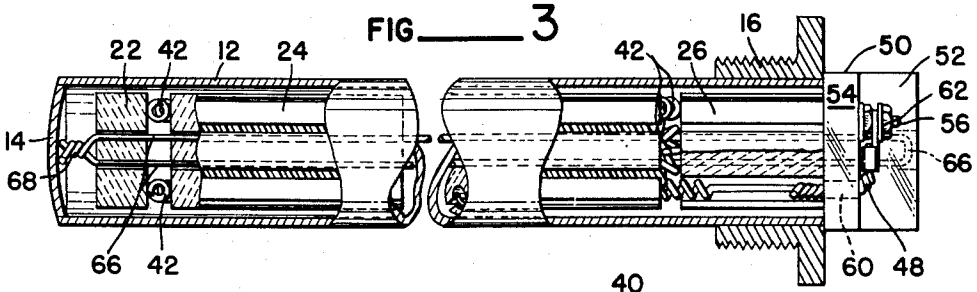


FIG. 3



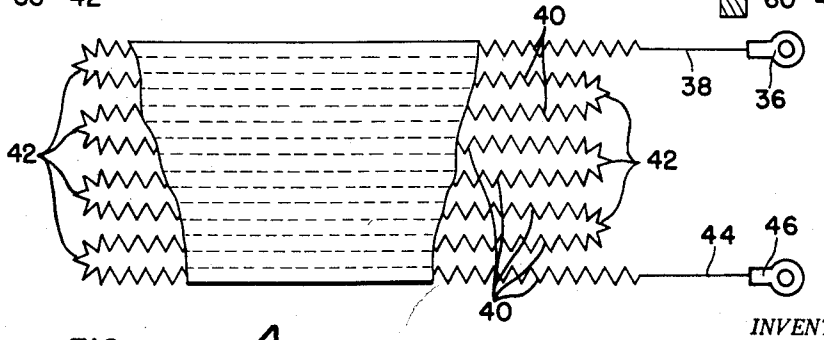


FIG. 4

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ELECTRIC HEATER ELEMENT

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1 Claim. (Cl. 338—229)

This invention relates to improvements in an electric heater element for liquid tanks, and more particularly, relates to a heater element of high wattage, compact design for installation in a tubular heater housing.

Among the more important objects of this invention are the provision of an electric heater element which has a maximum of heat generating ability in a minimum of mass, which is adaptable to and may be installed in existing tubular housing without requiring alteration of such housing and without the likelihood of damage to such housing, and which is simple to construct and easy of installation.

These and other objects of this invention will be apparent during the course of the following description. I set forth herein a preferred embodiment of my invention. Such changes and modifications as will occur to those skilled in this art and which are the fair equivalents of this invention are contemplated a part of this invention and to be covered by the subjoined claim.

In the drawings:

Figure 1 is a fragmentary elevation view of a fluid tank containing my heater element;

Figure 2 is an enlarged cross-section view taken on line 2—2 of Figure 1;

Figure 3 is an enlarged elevation view of my heater element with portions broken away and shown in section;

Figure 4 is a schematic diagram of the coiled-wire element of my heater;

Figure 5 is a face view of an insulator body of my heater; and

Figure 6 is a face view of a junction block used in my heater.

Referring to Figure 1, within tank **10** is installed the tubular heater housing **12** having its inner end closed by cap **14** and its outer end secured in the threaded and flanged bushing **16**. Tank **10** has a threaded fitting **18** attached thereto into which bushing **16** is threadedly engaged. Tank **10** is typified by any conventional hot-water heater tank. The tubular housing **12** is typical of many hundreds of thousands that have been installed over the years. Cap **14** is normally brazed into the end of tube **12**. Tube **12** is normally hard soldered into bushing **16**. It is imperative, when a low-wattage element as normally supplied with housing **14** is replaced by a high wattage element, that these brazed and soldered water-tight joints not be subjected to heat concentrations operable to destroy the bonds. It has been an object of this invention to provide a heater element which meets this requirement.

The heater element, designated as a whole in Figure 1 by the numeral **20**, is cylindrical and closely fits within housing **12** being inserted longitudinally through bushing **16**.

As may be seen in Figure 3, the element comprises the inner spacer body **22**, the intermediate radiator bodies **24**, and outer terminal body **26**. Bodies **22**, **24** and **26** are formed of high temperature ceramic materials and have identical cross-sections most clearly illustrated in Figure 5. Each body is cylindrical and has a plurality of

grooves **30** symmetrically arranged in a radial manner relative the longitudinal axis of the body. Each groove **30** has a restricted mouth **32** formed by the closing together of the outer portions of the material forming the walls of the grooves **30**. On opposite sides of the body axis is a pair of smaller passages **34**, **34**. It will be noted that there is an even number of grooves **30** in this preferred form of body. To aid in comprehension of this structure I prefer that such ceramic body be approximately one and eleven-thirty-seconds inches in diameter and that the width of grooves **30** be one-quarter inch with a mouth of approximately one-eighth inch. The length of bodies **22**, **24** and **26** varies from one-half inch for body **22**, to about two inches with bodies **24**, and body **26** is about one and one-half inches long. These dimensions are typical in a water heater in which the overall length of element **20** would be about sixteen inches. Naturally these dimensions would be varied for heaters of greater or lesser capacity yet without departing from the inventive principles involved here. For example, greater diameters and greater lengths may be employed and the heaters may be used in oil tanks and the like.

In Figure 4 I schematically show in plan the arrangement of the coiled wire resistance element which is threaded into blocks **24** and **26** shown in elevation in Figure 3. From connector lug **36** terminal lead **38** is straight for a distance slightly less than the length of body **26** and is then coiled in sinuous runs **40** as is conventional with electric resistance elements. Runs **40** are physically parallel to each other and, by means of bends **42** are shown here in series arrangement electrically. The other terminal lead **44** ends at lug **46**. It will be apparent that an electrically parallel arrangement is also operable in this apparatus. Deleterious effects on the element wires of juxtaposed elements are avoided by interposing, throughout the full length of the heater, a ceramic wall between each pair of element runs **40**. This ceramic wall is constituted by the ceramic material between any pair of grooves **30**.

As shown in Figure 3 leads **38** and **44** are passed into the arms of lugs **36** and **46** respectively and are then reversed and the free ends are twisted about the standing part as at **48**.

The terminal block **50** formed of similar ceramic material is essentially T-shaped in cross-section and comprises leg **52** and cross arms **54**, **54**. It supports a pair of bolts **56**, **58** outstanding one on each side of leg **52** from the underside of an arm **54**. Each arm **54** is also posted to form a passage **60** through which the terminal leads **38** or **44** are passed.

In the assembly of Figure 3, a run **40** of the coiled-wire resistance element passes through aligned grooves **30** of a series of bodies **24**. At each end of an adjacent pair of runs a bend **42** straddles the wall material separating adjacent grooves. This may be seen in Figure 3. The resistance is sinuously arranged in the grooves **30** in the arrangement depicted in Figure 4. Leads **38**, **44** outstanding from the outer end of the series of bodies **24** are passed into and through mating grooves **30** in body **26**, thence through one of the passages **60** whereupon the lug **36** or **46** is attached and same secured to a bolt **56** or **58** by a nut **62**.

By arranging that all the holes **34** of bodies **22**, **24** and **26** are aligned with a similarly spaced pair of holes **64**, **64** through block **50**, a wire bent U-shaped to provide strands **66**, **66** may be inserted from the outer end inward. The inner ends of wires **66**, **66** pass through the spacer body **22** and twist **68** secures them together and retains the bodies and element in assembled relation.

This electric heater element may be installed in the tubular housing **12** by longitudinal insertion. The terminal block **50** bears on and abuts the outer face of

bushing 16. Supply conductor wires 70, 70 are then connected to bolts 56 and 58 and the heater will operate.

By means of the construction described and shown, when the heater is activated and the coils 40 are radiant the heat generated passes outward of grooves 30 through throats 32 and directly to the inner surface of tube 12 to heat the same. By this means I insure that the maximum amount of heat from the element to the heat transfer surface be by direct radiation and not only by conduction through the ceramic bodies. This arrangement eliminates any possibility of a serious accumulation of heat within the ceramic bodies, especially along their axis, which would tend to destroy them. Since no element runs are located within the symmetric arrangement here there is likewise avoided any possible damage to the element from over-heating.

The use of spacer body 22 separates the brazed in place cap 14 from the heat sufficiently to avoid heat-destruction of the brazing. Likewise terminal body 26 spaces the radiant heater element away from the soldered junction between tube 12 and bushing 16 to avoid its injury or destruction.

It will be seen from the foregoing that this apparatus effectively accomplishes the stated and other apparent objectives with simplicity and certainty.

Having thus described my invention, I claim:

An electric heater element for installation in a tubular metallic heater housing, comprising: an inner spacer body, an intermediate radiator body, and an outer terminal body; each of said bodies being formed of ceramic material and having a longitudinally extending pair of medially-located, spaced-apart holes from end to end, said bodies being disposed in coaxial alignment with said holes aligned; said intermediate radiator body being cylindrical and having a plurality of grooves radially disposed longitudinally along its outer surface, each said groove being inwardly enlarged relative the mouth of the groove for the reception of a coiled resistance element larger in cross-section than said groove mouth; a coiled wire resistance element sinuously laced into said grooves in continuous manner from a first terminal end to a second terminal end, said terminal ends both being located at the outer end of said radiator body, and said terminal body having a pair of passages each to receive a terminal end for external connection to a power source and a U-shaped, straight strand, wire loop inserted into said aligned holes from the outer end inward and having the inner strand ends joined together to secure said bodies against endwise movement relative each other and providing an extension protruding longitudinally from said spacer body to abut the inner face of the tubular housing and separate the inner spacer body therefrom.

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