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(54) IMMERSION TYPE HEATING ELEMENT FOR A WATER STORAGE TANK

(71) We, RHEEM INTERNATIONAL INC., a corporation organised under the laws of the State of Delaware, of 767 Fifth Avenue, New York, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electric heaters for water storage tanks, particularly an improved heating element head construction for an electric immersion heater as used in hot water tanks.

Typical electrically heated water tanks employ an electric immersion heater. Most lined water tanks constructed of ferrous metal also contain a sacrificial anode such as magnesium, aluminium or zinc. The anode is in electrical contact with the tank and serves to cathodically protect the tank from corrosion by electrolysis.

To prevent the sacrificial anode from being sacrificed at an excessively rapid rate, the prior art has recognised that an uncoated sheathed heating element cannot be directly grounded to the ferrous tank. For example, if the heating element sheath and ferrous tank are in perfect electrical contact, a substantial electropotential difference will exist between the copper sheath and the sacrificial anode. On the other hand, it has been established that the element sheath will corrode if the element is electrically isolated from the ferrous tank. Therefore, there must be an electrical connection between the sheath and the tank. The amount of current flow, however, has to be controlled to prevent excessive anode depletion.

It is an aim of this invention to provide an electric heating element for water tanks that has a conductive plastics element head connected to the metal heating element sheath which does not require a coating of a metal which is more electropositive to prevent excessive anode deterioration.

According to the present invention, there is provided an electric immersion water heater

comprising a heating resistor enclosed in and electrically insulated from a metallic sheath, and an element head, for attachment to a water heating tank with the sheathed resistor adapted to project into the interior of the tank, said element head being mechanically and electrically secured to the metallic sheath, in which the element head has an electrically conducting solid portion in contact with said sheath, said conducting portion having conductive carbon or metallic particles suspended in non-conducting material to allow current to flow from said sheath through the conducting portion containing the conductive particles to earth on said tank, said head also including an electrically insulating portion through which external leads are provided for connecting said heating element to a power source.

The element head is mechanically and electrically secured to the metallic sheath and eliminates the need for external electric circuits or plating of the metallic sheath with a metal which is more electropositive than the sheath metal while at the same time controlling anode deterioration. Preferably both portions of the head comprise a non-conducting solid such as a plastics resin.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Figure 1 is a schematic side view illustrating a conventional water tank and the placement therein of an anode and a water heating element;

Figure 2 is a detailed sectional side view of a conventional combination steel and plastics element head wherein the steel portion of the head is electrically connected to both the metallic sheath and metallic tank this coupling thereby requiring tin plating of the copper sheath to prevent excessive anode depletion;

Figure 3 is a detailed, sectional side view of a multipiece prior art element head and flange that requires an external electric circuit to control anode depletion;

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Figure 4 is a detailed partial sectional side view of the plastics element head of this invention as positioned in a water tank;

Figure 5 is a detailed, sectional side view of the element head illustrated in Figure 4 as detached from the water tank; and

Figure 6 is an end view of the heating element illustrated in Figure 5.

One solution employed by the prior art is to embed the heating element sheath in a steel head as illustrated in Figure 2. In this figure, a copper heating element sheath 7 is mechanically and electrically secured to a steel head 10 having a plastics centre portion 11 to retain wire leads 6. Steel head 10 is supplied with male threads 14 designed to engage the female threads in steel coupling 13 welded to the tank wall 4. To prevent excessive depletion of magnesium anode 2 due to the intimate electrical contact between sheath 7 and tank coupling 13 through steel head 10, copper sheath 7 and steel head 10 are plated with a metal 12, the thickness of the metal 12 being greatly exaggerated for purposes of illustration, of a metal which is more electropositive than copper such as tin. Because the distance in the electropotential series between tin and magnesium is less than the distance between magnesium and copper and because the tin coating has the tendency to polarize, the magnesium anode will not be depleted at an excessively rapid rate despite the fact that sheath 7 is mounted in direct electrical contact with the tank. While this solution to the anode depletion problem is satisfactory in most cases from a technical standpoint, it requires the expense of tin plating. Further, the tin plating may dissolve in certain waters thereby leading to rapid anode depletion.

Another prior art device used to control excessive anode depletion is illustrated in Figure 3. In this device, the heater head or flange comprises a copper faced steel plate 21, a non-conducting plate 22 and a steel face plate 23. Copper face plate 21 and steel face plate 23 are not in direct electrical contact and are separated by the non-conducting plate 22. This plate assembly or element flange is mounted on the wall 4 of a water tank by inserting sheath 7 through a wall opening 25 and connecting the plates to the tank flange 27 through bolts 20. An insulating gasket 26 separates the tank flange 27 from the plate 21. Electrical connection between the copper face plate 21 and steel plate 23 is provided by a 500-600 ohm resistor. This value of resistor allows sufficient current to pass from the sheath to ground (the tank) to prevent electrolytic corrosion of the sheath while at the same time preventing rapid anode deterioration. While this solution does not require the tin plating of the copper sheath, it does require

a more complex heating element head and the need for an external electrical circuit with a resistor.

Figures 4 and 5 illustrate the improvement of the present invention, comprising a rigid plastics head 30 having intimately connected thereto a conventional tubular, untinned copper heating element sheath 7. Tubular sheath 7 houses a conventional high resistance heating wire (not illustrated) maintained in a spaced relation from the sheath 7 by a suitable insulating material such as magnesium oxide. Head 30 is provided with suitable male threads 33 adapted to engage the female threads in a tank coupling 13 affixed to a wall 4 of the heating tank.

As illustrated in Figure 5, sheath 7 is firmly embedded in the plastics head 30. Electrical leads 6 extend from the high resistance heating wire (not shown) in sheath 7 through an electrically insulating plastics centre piece 35 concentrically positioned within a plastics matrix 31 of head 30. Leads 6 may be connected to a suitable external power source.

The portion of head 30 comprising the plastics matrix 31 is made, for example, from a phenolic plastics material having uniformly distributed within the matrix electrically conducted carbon or metallic particles 32. The electrically insulating centre piece 35 is comprised of an insulator for the leads 6 and preferably is made from the same plastics material as matrix 31. Of course the conductive particles 32 are excluded from centre piece 35.

The amount of particles 32 per unit volume of matrix 31 will generally determine the resistance of the matrix 31 of the head 30. High amounts of conductive particles 32 generally result in lower resistance and lower amounts result in higher resistance. Alternatively, particles 32 can comprise conductive units of particles dispersed in a polymerized resin, each discrete unit comprising an aggregate of conductive particles bonded together by the resin matrix 31. Conductive resins comprising conductive carbon or metallic particles suspended in a resin matrix are well known to those trained in the art and need not be described in detail herein.

In general, any type of solid resin of either an inorganic or organic nature, natural or synthetic, which is an electrically non-conducting material may be used in the practice of the present invention.

Presently, the matrix 31-particle 32 combination has a resistance value sufficient to allow a small amount of current to flow from the sheath 7 to the tank so as to eliminate the need for tinning the copper sheath 7 or using an external resistance. Typically, the matrix 31-particle 32 combination has a resistance of about 500-600 ohms

although a resistance range of 200 to 1,000 ohms has been found satisfactory.

The resin for matrix 31 used must have sufficient stability to stand exposure to water temperatures of the order of 100—180°F. as encountered in ordinary water heaters.

A preferred resin would be a phenolic compound with fillers added to improve resistance to temperature, cracking, chemicals, etc.

The conductive particles suspended in the non-conducting matrix consist of either carbon particles or metal particles or a mixture of both. Accordingly, any metal powder may be used as the conductive material of the present invention, for example, copper, iron, zinc, aluminium, magnesium, tin, antimony, silver and chromium. In addition, conductive oxides of metals may be used.

With respect to carbon, certain forms offer lower resistance values, such as crystalline carbon (graphite), whereas the amorphous forms of carbon (carbon black) afford higher values of resistance. Lamp black, having a specific resistance less than carbon black and greater than graphite may be used to obtain resistances of an intermediate value.

WHAT WE CLAIM IS:—

1. An electric immersion water heater comprising a heating resistor enclosed in and electrically insulated from a metallic sheath, and an element head, for attachment to a water heating tank with the sheathed resistor adapted to project into the interior of the tank, said element head being mechanic-

ally and electrically secured to the metallic sheath, in which the element head has an electrically conducting solid portion in contact with said sheath, said conducting portion having conductive carbon or metallic particles suspended in non-conducting material to allow current to flow from said sheath through the conducting portion containing the conductive particles to earth on said tank, said head also including an electrically insulating portion through which external leads are provided for connecting said heating resistor to a power source.

2. An electric immersion heater according to Claim 1 wherein the carbon or metallic conductor is present in an amount sufficient to provide a resistance of 200—1,000 ohms between the sheath and earth.

3. An electric immersion heater according to Claim 1 or Claim 2 wherein the non-conducting material is a plastics resin.

4. An electric immersion heater according to any of the preceding claims wherein the electrically insulating portion comprises a plastics resin coaxially positioned with the conducting portion.

5. An electric immersion water heater for a water heater tank substantially as herein described with reference to Figures 1, 4, 5 and 6 of the accompanying drawings.

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