Oct. 5, 1965 N. J. BURGER 3,210,526

ELECTRIC IMMERSION HEATER

Filed March 23, 1964 2 Sheets-Sheet 1

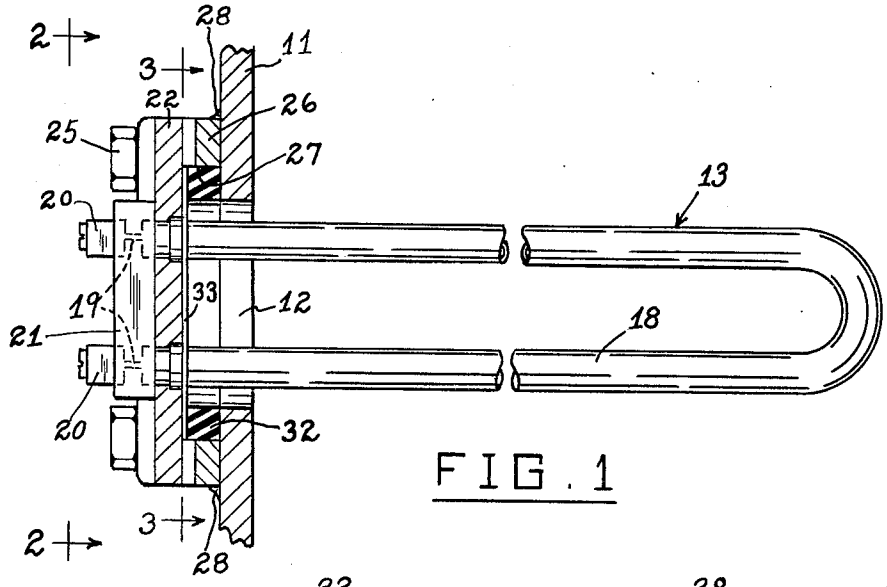


FIG. 1

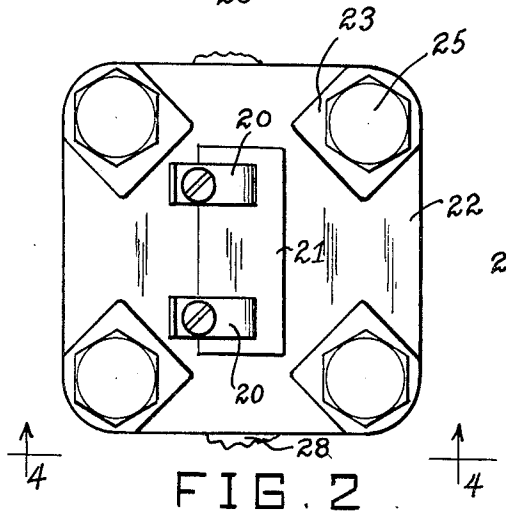


FIG. 2

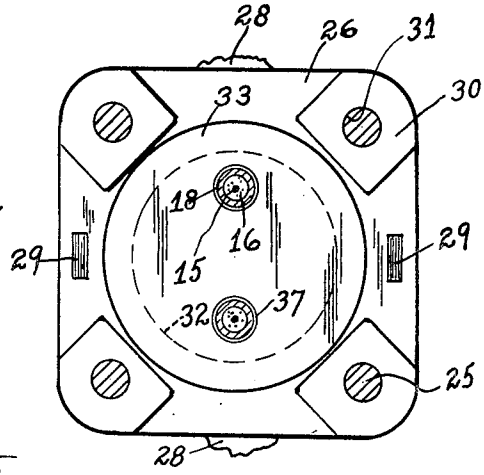


FIG. 3

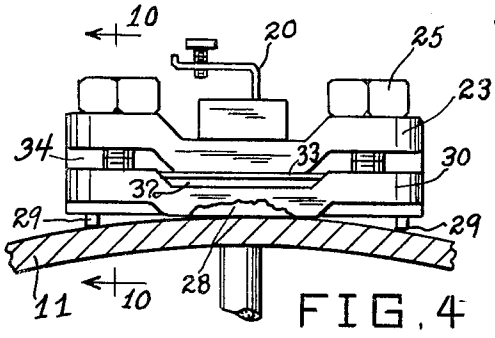


FIG. 4

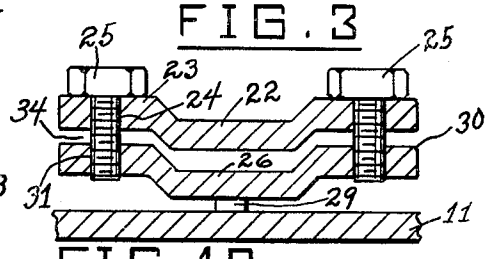


FIG. 10

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ELECTRIC IMMERSION HEATER

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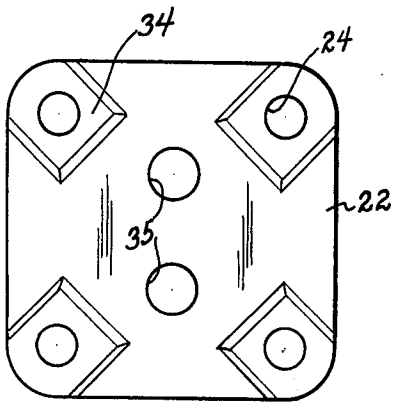


FIG. 5

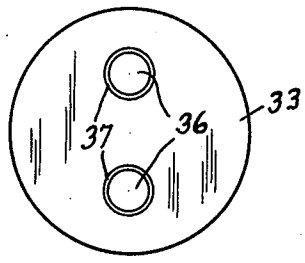


FIG. 6

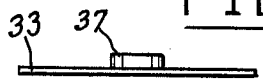


FIG. 7

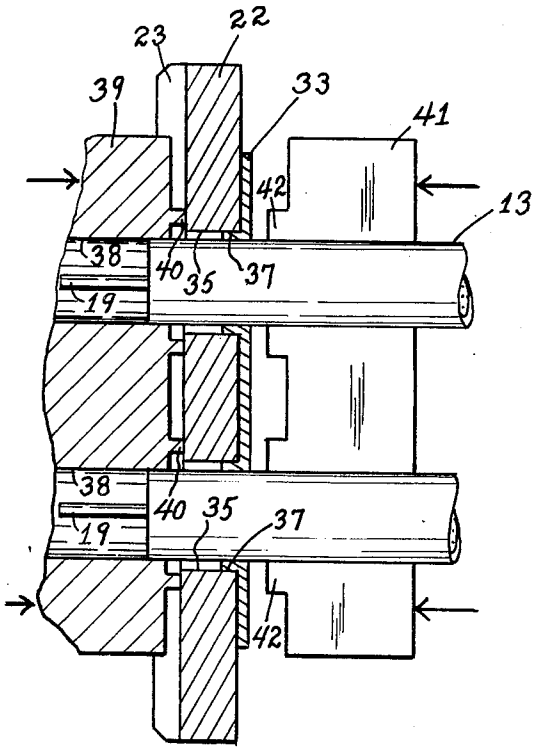


FIG. 8

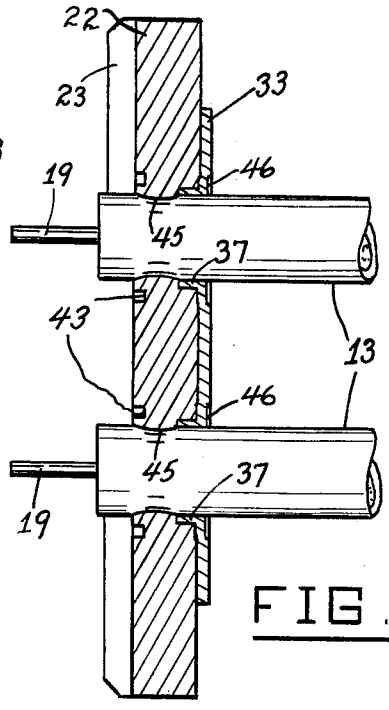


FIG. 9

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United States Patent Office 3,210,526 Patented Oct. 5, 1965

3,210,526

ELECTRIC IMMERSION HEATER

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Filed Mar. 23, 1964, Ser. No. 353,784
8 Claims. (Cl. 219—318)

This invention relates to electric immersion heaters, and more particularly to an electric immersion heater assembly adapted to be mounted in a water tank or similar receptacle.

A main object of the invention is to provide a novel and improved electric immersion heater assembly which is simple in construction, which is easy to install, and which is protected against corrosion.

A further object of the invention is to provide an improved electric immersion heater assembly which is inexpensive to manufacture, which is durable in construction, and which involves a minimum number of parts.

A still further object of the invention is to provide an improved electric immersion heater assembly which is liquid-tight but which employs only mechanical joints, requiring no brazed or welded connections, which can be manufactured more economically than assemblies using brazed or welded joints, which provides stronger and more reliable connections than assemblies using brazed or welded joints, and which presents connections involving the same metals to the liquid in the water tank or other receptacle in which the heater assembly is employed, thereby avoiding electrochemical action which occurs with joined dissimilar metals, and thereby avoiding corrosion at or near the joints.

A still further object of the invention is to provide an improved mounting assembly for mounting an electric immersion heater in a water tank or similar receptacle, said mounting assembly being of the type employing an anchor ring welded adjacent an opening in the tank, with a resilient deformable gasket mounted around the opening and placed under compression by the flange of the electric immersion heater, the assembly being arranged so that the main portion of the flange can be fabricated from relatively inexpensive material, such as steel, whereas the portion facing and exposed to the liquid in the tank can comprise a relatively thin plate made of the same metal as the tubing of the associated heater element, such as copper, whereby electrolytic and corrosive action adjacent the joints between the tubing and the heater flange can be minimized at relatively low cost.

A still further object of the invention is to provide an improved method of assembling an electric immersion heater unit of the type employing a flange of ferrous metal and a protective face plate of non-ferrous metal, in conjunction with a heater element having tubular legs of the same non-ferrous metal, said method requiring no brazing or welding, and providing a joint of high mechanical strength and rigidity, yet which is not brittle and which is much superior in corrosion resistance to a brazed or welded joint.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a longitudinal vertical cross-sectional view taken through an improved electric immersion heater assembly constructed in accordance with the present invention, shown mounted in operating position on the wall of a water tank.

FIGURE 2 is an end elevational view taken substantially on the line 2—2 of FIGURE 1.

FIGURE 3 is a transverse vertical cross-sectional view taken substantially on the line 3—3 of FIGURE 1.

FIGURE 4 is a horizontal cross-sectional view taken substantially on the line 4—4 of FIGURE 2.

FIGURE 5 is a plan view of the flange of the heater unit of FIGURE 1 prior to assembly.

FIGURE 6 is a plan view of a non-ferrous corrosion-preventing disc member employed with the flange of FIGURE 5.

FIGURE 7 is an elevational view of the disc member of FIGURE 6.

FIGURE 8 is a vertical cross-sectional view taken through the assembled heater unit employing the flange of FIGURE 5 and the disc member of FIGURE 6, prior to pressure-sealing the elements of the unit together.

FIGURE 9 is a vertical cross-sectional view similar to FIGURE 8, but showing the final configuration of the elements after the pressure-sealing step.

FIGURE 10 is a cross-sectional view taken on line 10—10 of FIGURE 4.

Referring to the drawings, **11** designates the wall of a water tank, said tank being provided with a generally circular aperture **12**, said aperture being adapted to receive a generally U-shaped electric immersion heater element **13**. The heater element **13** is of a well-known type comprising an outer sheath **18** of metal tubing, of copper or other suitable non-ferrous metal, containing a resistance winding **15** and a filling of densely packed refractory material **16**, packed to a rock-like consistency. The resistance winding **15** has the end terminal rods **19, 19** which are conductively joined to respective terminal lugs **20, 20** moulded in a terminal block **21** of insulating material. The free end portions of the tubular sheath **18** are suitably plugged with insulating material and are rigidly secured, in a manner presently to be described, to a transverse mounting flange **22** of steel, or other relatively inexpensive strong metal.

The flange **22** is generally rectangular in shape and is formed with outwardly offset, generally rectangular corner portions **23** provided with apertures **24** to receive anchor bolts **25**. Designated at **26** is an anchor ring of the same general shape as the flange **22** but formed with a circular aperture **27** which is somewhat larger than the tank aperture **12** and which is secured to the tank wall **11** concentrically with the aperture **12**, as by a pair of oppositely located welds **28, 28** at vertically aligned portions of the tank wall. The ring **26** is formed with depressed contact lugs **29, 29** located symmetrically on opposite sides thereof to engage the tank wall and to compensate for the curvature thereof, as shown in FIGURE 4. Ring **26** is further formed with outwardly offset generally rectangular corner portions **30** formed with tapped openings **31** to threadedly receive the anchoring bolts **25**.

An annular sealing ring **32** of resilient deformable material is received on the annular seat defined at the margin of aperture **12** inwardly adjacent the aperture **27** of ring **26**. A cover disc **33** of the same non-ferrous metal as the tubular sheath **18** is sealingly secured, in a manner presently to be described, to the inner face of flange **22**, the marginal portion of the disc **33** engaging on the sealing ring **32**, as shown in FIGURE 1.

When the bolts **25** are tightened, the disc **33** compresses the ring **32** into the seat defined within the aperture **27**, providing a liquid-tight seal between the flange **22** and the tank wall **11**. The spaced welds **28, 28** oppose the reaction of the compressed ring **32** and anchor the heating assembly to the tank wall without the necessity of welding continuously all around the anchoring ring **26**.

The sealing ring **32** has a normal thickness which is substantially greater than the thickness of anchor ring **26** so that sufficient pressure can be applied to the ring by tightening bolts **25** to insure sealing contact of the ring with all the annular seating surfaces adjacent thereto. The inside cavities **34** defined beneath the offset corner portions **23** of flange **22** are flared to receive the outward-

ly offset corner portions 30 of the anchor ring 26 so as to serve as guide means to insure accurate superposition of flange 22 on ring 26 and to properly align holes 24 with tapped openings 31 to facilitate the insertion of anchor bolts 25 and to prevent damage to their threads when they are tightened, as could occur without the provision of means to align flange 22 with ring 26.

As shown in FIGURE 5, flange 22 is originally provided with a pair of apertures 35, 35 spaced to receive the legs of the tubular sheath 18 and slightly larger in diameter than the outside diameters of the legs. The disc 33, which is made of the same metal as sheath 18, for example, copper, is formed with openings 36, 36 spaced by the same distance as openings 35, 35 and is integrally formed with collar elements 37, 37 around said openings 36, 36. In assembling the heater unit, the disc 33 is placed against the inner face of the flange 22 with the collar elements 37, 37 snugly received in the openings 35, 35, the free ends of the legs of the heating element 13 being inserted through the collar elements 37, 37 and being snugly received therein, as shown in FIGURE 8. The ends of the legs are slidably received in guide bores 38, 38 of an outer die segment 39, said die segment being provided with annular metal-deforming ribs 40, 40 spaced outwardly from and concentric with the ends of the guide bores 38, 38 and being engageable with annular outer areas of the outer surface of flange 22 spaced outwardly from apertures 35, 35, as shown. A pair of mating split die segments 41 are slidably secured around the legs inwardly adjacent the disc 33, said die segments having semi-circular mating abutment boss segments 42 located opposite the ribs 40. The die segment 39 and the joined mating die segments 41 are pressed together, whereby the metal of flange 22 around the openings 35 is deformed inwardly against the legs of heating element 13 and against the collar elements 37, 37, forming mechanically rigid liquid-tight joints between the legs and the flange and locking the disc 33 firmly to the inside face of the flange, providing the final configuration shown in FIGURE 9.

As shown in FIGURE 9, metal is displaced from the front face of flange 22, forming annular die grooves 43, 43 around the ends of the heater element legs. Also, metal of the flange is displaced inwardly so as to deform the walls of the heater sheath inwardly, as shown at 45, 45. Furthermore, some inward displacement of the metal of the disc 33 around the apertures 36, 36 occurs, forming shallow counterbores 46, 46 in the thin metal disc.

As a result of the above-described method of assembly, the disc 33 is firmly locked to the inside face of flange 22 with close metal-to-metal liquid-tight joints at the collars 37, 37. The exposed surfaces inside the tank are therefore of the same metal, without any foreign material included in the joints. Therefore, no electrochemical reactions can take place at the joints or at any other surface portion of the heating unit in contact with the liquid in the tank. This keeps corrosion to a minimum.

Heretofore, the steel flanges have been provided with a plating or spray coating of copper for the purpose of preventing corrosion. However, it has been found that the thin films of copper are quickly dissolved under high temperature operating conditions, allowing serious corrosion to occur within a relatively short period of time after installation of the heater units. By employing the sheet metal protective disc 33, as herein described, which is actually clamped to the sealing ring or gasket 32, such corrosion is prevented, since the disc 33 acts as a sealing plate rather than as a mere film or coating.

It will be further noted that the collar elements 37 are of substantial length, being of the order of between one third and one half the thickness of the flange 22, whereby the seal between the disc 33 and the flange 22 is of substantial depth, and is of much greater depth than the usual brazed or welded joint. This provides not only an improved seal but also a stronger mechanical joint than is obtainable by brazing or welding.

While a specific embodiment of an electric immersion heater assembly for a water tank has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. An electric immersion heater comprising an elongated electric heating element including a tubular sheath of non-ferrous metal, a plate-like flange having an opening therethrough, said heating element having one end mounted in said opening, said heating element extending in cantilever fashion from one side of said flange, and a non-ferrous sheet metal cover element positioned in covering relation to at least a substantial portion of said one side of said flange, said cover element having a portion positioned between the flange and the sheath, the metal of the flange being deformed inwardly against the sheath and said portion of the cover element continuously around the sheath to form a liquid-tight and mechanically rigid joint therebetween.

2. The immersion heater recited in claim 1, and wherein said cover element portion comprises a collar element integrally formed on the cover element.

3. In combination, a fluid receptacle having a wall provided with an aperture, an electric immersion heater mounted in said aperture, said heater comprising an elongated electric heating element including a tubular sheath of non-ferrous metal, a plate-like flange having an opening therethrough, said heating element having one end mounted in said opening, said heating element extending in cantilever fashion from one side of said flange into said receptacle, a non-ferrous sheet metal cover element positioned in covering relation to at least a substantial portion of said one side of said flange, said cover element having a portion positioned between the flange and the sheath, the metal of the flange being deformed inwardly against the sheath and said portion of the cover element continuously around the sheath to form a liquid-tight and mechanically rigid joint therebetween, means securing the flange to the receptacle, and deformable sealing means surrounding the aperture and disposed sealingly between the margin of the aperture and said cover element.

4. The structural combination recited in claim 3, wherein the means securing the flange to the receptacle comprises an anchor ring secured to said wall around said aperture and being larger than said aperture to expose the circumferential margin of said aperture, and means fastening the flange to the anchor ring, and wherein said deformable sealing means is mounted on said exposed circumferential margin.

5. The structural combination recited in claim 3, wherein the means securing the flange to the receptacle comprises an anchor ring secured to said wall around said aperture, a plurality of spaced outwardly offset portions on said anchor ring, said flange having outwardly offset portions defining guide cavities receiving said first-named outwardly offset portions, and fastening means connecting said flange to said anchor ring.

6. The structural combination recited in claim 5, wherein the fastening means comprises bolts engaged through the outwardly offset portions of the flange and threadedly engaged in the outwardly offset portions of the anchor ring.

7 .The structural combination of claim 4, wherein the anchor ring is provided with a plurality of spaced outwardly offset portions and the flange is provided with outwardly offset portions defining guide cavities receiving said first-named outwardly offset portions.

8. The structural combination of claim 7, and wherein

the fastening means comprises bolts connecting said outwardly offset portions.

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