May 26, 1959 T. S. KINNEY 2,888,546

IMMERSION ELECTRIC HEATER

Filed Sept. 16, 1957

FIG. 1

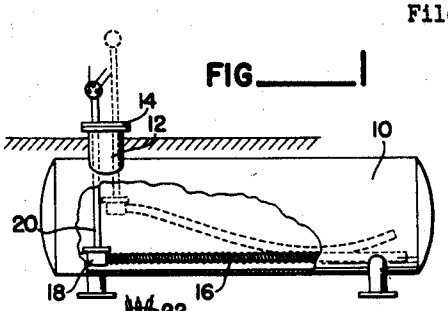


FIG. 7

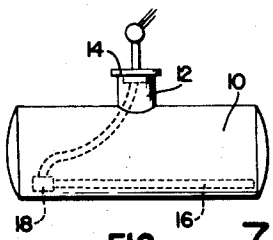


FIG. 2

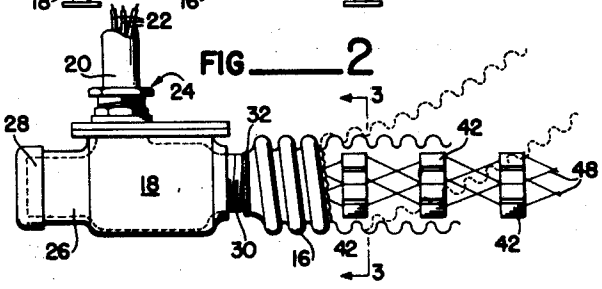


FIG. 4

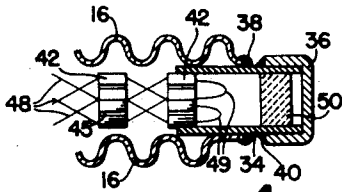


FIG. 3

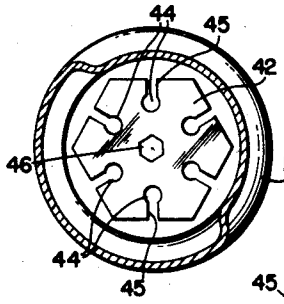
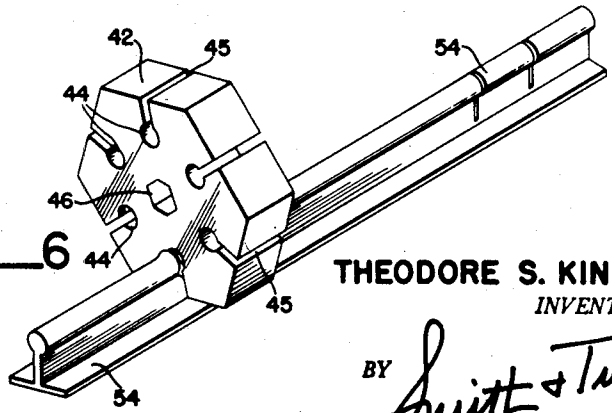


FIG. 5

FIG. 6



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IMMERSION ELECTRIC HEATER

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5 Claims. (Cl. 219—41)

This invention relates to an immersion electric heater and, more particularly, to the construction of an immersion heater for installation in pre-existing heating vessels.

A typical use of my new immersion heater is found in those fields where high viscosity materials, e.g. asphalt and heavy oils, are to be heated to suitable fluidity for pumping, spraying and the like. It often occurs that existing vessels are equipped for steam or hot-water heating and it becomes desirable to convert them for electric resistance heating.

Normal practice requires that such previously used vessels be thoroughly cleansed in order that workmen may safely flame-cut into the vessel wall for the installation from the outside of the heater element. Cleaning is obviously time-consuming and expensive and becomes needless when my new immersion electric heater is employed.

Usually the heater vessels to be converted are long, horizontal cylindrical vessels provided with a manhole or access port on the top-side. Quite often such vessels are buried and no access to the ends is readily available. The problem is to install, longitudinally of the vessel near its bottom wall, a heater element which is about as long as the vessel but is considerably longer than the diameter of the vessel or the distance from a side opening to the opposite side wall.

It is among the more important objects of this invention to provide an immersion electric heater which will overcome and solve the problems recounted; which is flexible for bending and subsequent straightening for insertion through a manhole in the side of a long vessel; which is fluid-tight although flexible; and which is not only easy to install and use but is relatively inexpensive to construct in a manner suitable to meet existing electric safety codes. In addition to these salient objects, others will become apparent during the course of this specification and are equally embraced within the scope of this invention.

In general it can be said that this invention comprises an elongated flexible seamless metal tube having fluid-tight end closures. A flexible electric heater element substantially coextensive in length with the tube as contained therein. One end closure of the tube constitutes a junction box from which may extend a conduit, which may be rigid or flexible, to contain electrical conductors for the supply of current to the heater element. The flexible tube is normally about as long as the tank in which it will be used. The conduit means is usually long enough to extend from near the bottom of a horizontally disposed vessel or tank to its upper side and outward therefrom a distance determined by appropriate electrical installation practices.

Turning now to the drawing showing my invention in its preferred embodiments,

Figure 1 is a broken away view showing a typical tank installation of my invention;

Figure 2 is an elevation view, partly in section, of an immersion electric heater element of my invention;

Figure 3 is an enlarged cross-sectional view on line 3—3 of Figure 2;

Figure 4 is an enlarged side view of an end portion of the heater tube;

Figure 5 is a perspective view of a preferred form of flexible electrical resistance heater used in my invention;

Figure 6 is a perspective view of an insulator and assembly strip; and

Figure 7 shows an alternate tank installation of any flexible immersion heater.

In the drawings like reference characters refer to like parts throughout the same.

Turning to Figure 1, tank 10 here shown buried has a neck or manhole portion 12 closed by a cover 14 which when removed permits access to the interior of the tank. As shown the tank 10 is cylindrical and is horizontally disposed beneath the ground surface. It will, of course, be understood that such a tank may be buried vertically or it may be disposed above the ground in a horizontal position. It often happens that pre-existing heating means such as steam pipes or the like are to be replaced with electrical immersion heaters. Such tanks having once been used may not be cut into as with a welding torch until after they have been thoroughly cleansed. It is possible, through the use of the manually flexible heater tube 16 connected at junction box 18 with a riser 20 to be inserted into a tank as in Figure 1 by introduction through the access opening in manhole 12. This is accomplished by flexing the tube, as suggested in the dotted line showing of Figure 1, wherein the major portion of the resistance heater tube 16 has been inserted and the riser 20 is being permitted to lower the junction box end of the tube to the bottom of the tank.

As may be seen in Figure 2 the riser 20 contains the conductor wires 22 by which current is carried to resistance heater wires of my flexible heater. The riser 20 is joined to the junction box 18 by a fluid type coupler 24. Junction box 18 may have a "heel" 26 closed by a cap 28 or in any other suitable fashion, the purpose of which will be described later. A nipple 30 extending opposite to the heel 26 is inserted into the seamless flexible metal tubing 16 and there secured by a welding bead 32. At the opposite end of tube 16 there may be a second pipe nipple 34 closed by a cover 36 and the nipple may be welded to the tube 16 at 38 and to cover 36 at 40. In this manner complete fluid tightness of the installed heater is insured.

The flexible resistance heater is shown in Figure 5 to which reference is now made. Such a heater preferably comprises a plurality of ceramic blocks 42 having keyhole-shaped openings 44 suitably arranged around the periphery of the block. A hexangular or other suitable multi-shaped opening 46 is preferably formed at the axis of the block 42.

The heater element as a whole is made up by threading heavy duty resistance wires 48 through the insulator blocks, an access being facilitated to the axis of the gullets of openings 44 by the open-mouth slots 45 in the outer periphery in the insulated blocks.

In Figure 5 I have shown a preferred pattern for the resistance wires whereby the assembly can be made without necessarily employing a backbone or spacer strip as has heretofore been conventional. The resistance heater of Figure 5 is produced by assembling in spaced apart relation on a hexagonal or other bar passing through the center of the insulators a series of such insulators in spaced apart relation. A wire 48 may be introduced into an opening 44 of one block 42 and then into the next block opening 44 that is 60 degrees to the right, or to the left as the case may be, of the adjacent block, thence into an opening aligned in a third block being

aligned with that of the first block, and so on. In this manner the resistance wires 48 of the several runs formed into a zig-zag pattern by being bent into form during assembly. At their outer ends the wires are looped to provide the necessary circuitry for the conduction of electrical energy. By withdrawing the assembly bar at the axis of the insulators one will find that the heater element has a considerable degree of flexibility. Normally the assembly bar is not withdrawn until the heater unit is in place in its flexible jacket tube 16.

In such an installation as is shown in Figure 4 an auxiliary insulator block 50 may be installed in the outward end of the tube so that the looped ends 49 of the wires may not come into contact with metal and thus create a short circuit.

It is often desirable to assemble insulators such as 42 on to a spacer strip wherein they are not only maintained in predetermined spacing but are also provided with a strap which facilitates their insertion into a heater tube, whether it be the type shown herein or a rigid piece of pipe. For this purpose I provide the inverted T-shaped strap 54 shown in Figure 6. Strap 54 has a bead edge on the leg thereof which fits into the keyhole shaped openings 44 of the insulator 42. By slitting the strap 54 it is possible that a portion may be bent laterally out of line and provide suitable lugs or stops on each side of the insulator block to keep it from moving after it has once been located where desired. This may be accomplished by using a simple slitting tool or by making a small saw cut.

A typical manually flexible metallic tube useful for my purposes is known in the trade as "Seamless Flexible Tubing" manufactured by the Allied Metal Hose Company. A suitable size tubing is that having a 2 inch inside diameter and approximately $3\frac{1}{16}$ inches outside diameter and a wall thickness of about .040 inch. The wall is formed into helical convolutions which permit the tube to be manually flexed to curvatures having radii of from 3 feet upward. Such curves are normally acceptable to permit the introduction of a heater tube and its contained resistance heater elements into a longitudinally disposed vessel having a length greater than the vessel's diameter from the side access opening to the opposite wall.

Such flexible metallic tubing may normally be curved by bending over a man's knee or by placing the same on the ground and while the operator stands on one portion of the tubing he lifts or raises an end to impart the necessary curvature. It is likewise capable of being manually straightened and this may be done within the tank by a single operator even though he may be working in an oxygen mask for protection from fumes that may be present.

It will be apparent from the foregoing that I have provided an immersion electrical heater which is flexible and capable of wide use in the field for which it has been designed, that it may be simply flexed and bent for insertion through a manhole into a vessel in which the length of the heater is considerably greater than the distance from the manhole to the opposite side of the tank, and which is easy to install and to use, but at the same time is relatively inexpensive and is capable of meeting the normally strict requirements of existing electric safety codes.

In the event that it is advisable and necessary to have access to the resistance circuitry of my immersion electric heater but without removing the flexible casing from the tank in which it is installed, it is possible for the junction box end of the heater 16 to be lifted sufficiently to give workmen access to the heel 26. This may be opened either by sawing or by unscrewing a fluid-tight cap if that has been used and the element within the tube 16 may be withdrawn therethrough and either repaired or replaced as circumstances require. Naturally it would be resealed again before the heater is returned to its normal operating position in the lower part of the tank in which it is installed.

Having thus described my invention, I claim:

1. An immersion-type electrical heater, comprising: an elongated manually flexible seamless bellows tube having fluid-tight end closures, said tube being characterized by having a thin wall formed with external and corresponding internal convolutions throughout its length; a flexible electrical resistance heater element longitudinally disposed in heat transfer relation in said tube; insulator blocks in spaced-apart relation within said tube supporting said resistance heater from the inner wall of the tube in non-parallel relation thereto; and fluid-tight electrical conductor means associated with said heater element at one of said end closures to integrate the heater element into an electrical supply circuit.

2. The structure according to claim 1 in which the convolutions are helical and extend from end to end of the tube.

3. The structure according to claim 1 in which the resistance heater comprises a series of spaced apart peripherally perforate ceramic blocks through the perforations of which extend electrical resistance wires, each wire between adjacent pairs of said ceramic blocks being disposed non-parallel to the axis of the resistance heater and extending unbent therebetween.

4. A fluid heater vessel, comprising: an elongated tank having an access opening in one side, the distance in said tank from the access opening to the opposite wall being substantially less than the length of said tank; an elongated manually flexible fluid-tight bellows tube disposed longitudinally of said tank and extending substantially the full length thereof, said tube being of greater length than the distance from the access opening to the opposite wall of said tank; a flexible electrical resistance heater element longitudinally disposed throughout the length of said tube and comprising a series of spaced apart peripherally perforate insulator blocks within said tube supporting electrical resistance wires from the inner wall of the tube, said electrical resistance wires being threaded through the block perforations non-parallel to the axis of the tube and being unbent between pairs of said blocks; and fluid tight electrical conductor means associated with said heater element at one end to integrate the heater element into an electrical supply circuit, said electrical conductor means passing out of said tank through said access opening.

5. The structure according to claim 4 in which the tank is horizontally disposed and the flexible tube lies adjacent and along the inner wall opposite said access opening.

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