

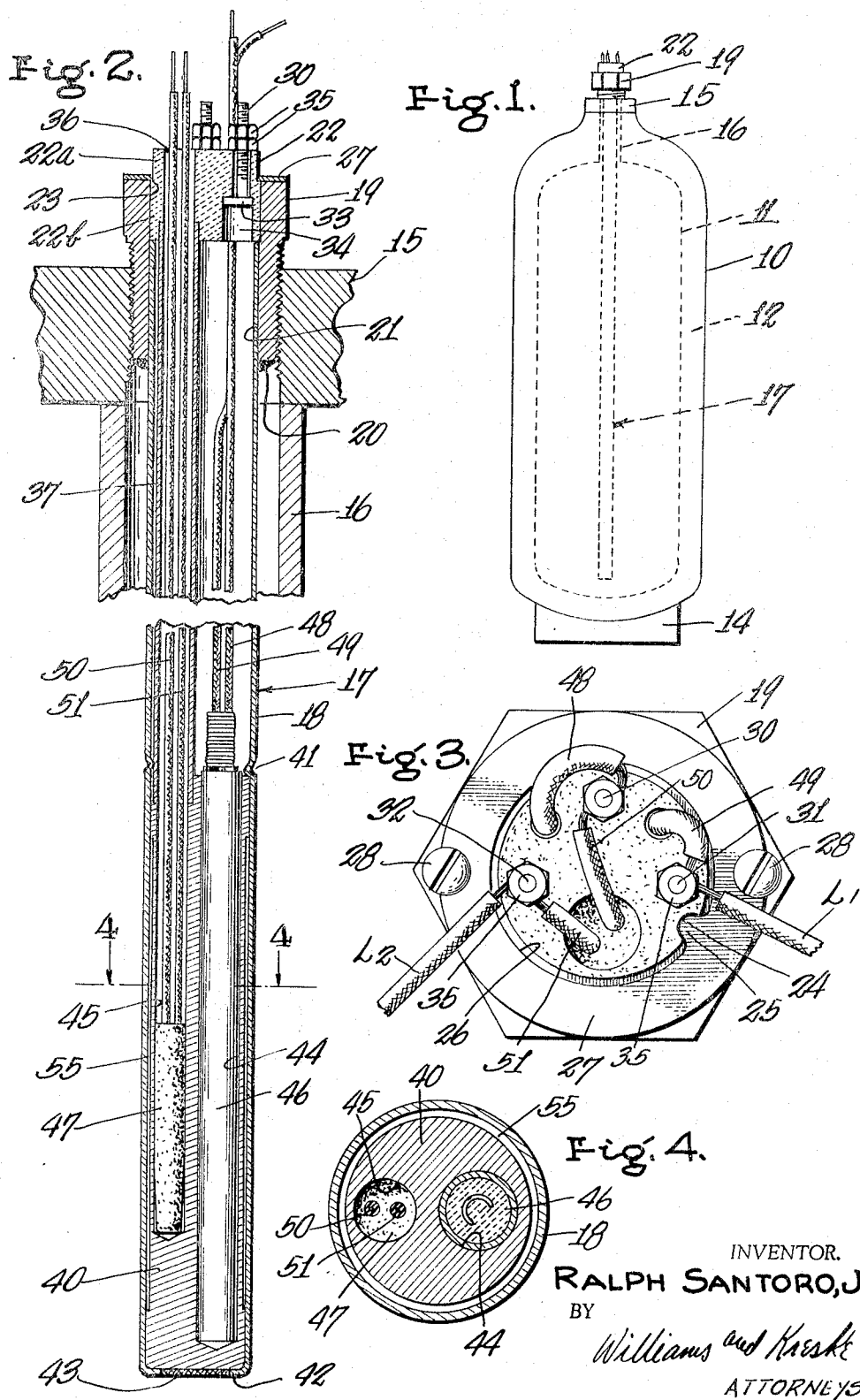
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ELECTRIC IMMERSION HEATER ASSEMBLY

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ELECTRIC IMMERSION HEATER ASSEMBLY
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My invention relates to an electric heater assembly and the principal object of my invention is to provide new and improved assemblies of this character.

My invention is particularly adapted for use in heating material which has very critical temperature limitations, and one such use is in the heating of liquid oxygen which is contained in the usual cylindrical steel containers. Liquid oxygen must be heated to gas form before it can be used for certain applications and it has a critical temperature characteristic in that if it is heated beyond a certain temperature it may explode. Through use of my invention, the amount of heat transferred to the liquid oxygen is precisely controlled, and the danger of explosion is therefore minimized.

In the drawing accompanying this specification and forming a part of this application, there is shown, for purpose of illustration, an embodiment which my invention may assume, and in this drawing:

FIGURE 1 is a small scale side elevational view of a cylinder for containing liquid oxygen,

FIGURE 2 is an enlarged fragmentary longitudinal sectional view through the heater assembly of my invention, showing only a part of the oxygen cylinder,

FIGURE 3 is an enlarged end elevational view of the heater, showing wiring connections, and

FIGURE 4 is an enlarged transverse sectional view corresponding generally to the line 4—4 of FIGURE 2.

The usual liquid oxygen carrying cylinder is shown in FIGURE 1, and comprises an outer container 10 and an inner container 11, the latter being spaced from the former to provide a space 12 which may be either an insulating air space or may be filled with mineral wool. Flange 14 at the bottom maintains the cylinders in upright relation. An internally threaded sleeve 15 is fixed within the opening of the outer container 10, and the inner container 11 has a tubular portion 16 sealed to the sleeve 15. A suitable outlet for the gas resulting from the heating of the liquid oxygen is also provided, but is not shown since it may be of standard valve-controlled construction.

A heating element assembly 17 is carried by the sleeve 15 and a greater part of this assembly extends downwardly within the inner container, as seen in FIGURE 1, so as to be in direct contact with the liquid oxygen. The heating element assembly 17 is best shown in FIGURE 2, and comprises an elongated metal tube 18 which may be formed of any suitable metal, such as brass.

A screw plug 19, which may also be of brass, fits around the outer end of the tube 18 and has a liquid tight connection therewith, such as by a silver weld 20. The tube 18 stops short of extending completely through the receiving opening 21 in the screw plug 19 to form a shoulder against which a dielectric terminal block 22 seats. Preferably, the block is formed of ceramic material and is round to closely but slidably fit within the plug opening 21.

The terminal block 22 has an outer portion 22a of slightly reduced diameter to form a shoulder 23 with its inner portion 22b. The block portion 22a is formed with a longitudinally extending groove 24 (see FIGURE 3) which receives a tongue 25. The tongue 25 extends from the defining margin of an opening 26 in a thin metal washer over the block portion 22a, and self-tapping screws 28 (FIGURE 3) have their heads bearing against the outer surface of the washer 27 and their shanks passing through

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recesses in the outer peripheral margin of the washer and threaded into corresponding holes in the screw plug 19. Thus, the washer 27 holds the ceramic terminal block in place and the interfitting groove 24 and tongue 25 hold the block against rotation. If desired, the washer may serve as a name plate.

In the present case the terminal block 22 supports three electrical terminals in the form of screws 30, 31 and 32. Only the screw 30 is visible in its entirety in FIGURE 2 and since all screws are alike, a description of screw 30 will suffice. Each terminal screw is formed with an eccentric head 33 closely fitting within an eccentric opening 34 in the block 22 to prevent rotation of the screw. The shank of each screw passes through an opening in the block and a pair of nuts 35 are threaded on the shank exteriorly of the block, the inner nut holding the screw tightly on the block and the outer screw clamping a conductor wire between it and the inner screw.

The terminal block 22 is also provided with an opening 36 which has a slightly enlarged inner end to closely receive the outer end of a guide tube 37. The guide tube is formed of any suitable material and in the present embodiment is formed of brass. The inner surface of the tube is preferably the same diameter as the main part of the opening 36 so as not to form a shoulder.

The metal tube 18 is of a length to suit requirements and, as shown in FIGURE 1, is of a length to extend just short of the bottom of inner container 11. An elongated body 40 is disposed within the inner end of the tube 18 to form a heat sink which is in thermal transfer relation with the tube 18. The body may be formed of any suitable material and at present is formed as a brass slug, round in cross-section, and having an external diameter closely fitting within the lower end of the tube 18.

The brass slug may be inserted through the initially open lower end of the tube 18 a distance limited by engagement with an inwardly rolled shoulder 41 formed on the tube. With the slug in the position shown in FIGURE 2, the lower extremity of the tube 18 is rolled inwardly over the end of the slug, as shown at 42, and sealed to the slug, as by a silver weld 43.

The slug 40 is formed with a pair of longitudinally extending openings 44, 45. An electric heating element 46, of the cartridge type, is closely received within the opening 44 and may be of any suitable manufacture. In the presently disclosed embodiment, the heating element is a Chromalox Red Head cartridge unit manufactured by the Edwin L. Wiegand Company.

Within the opening 45, a temperature responsive device 47 is closely but slidably received, the device presently used being a heat fuse assembly having a ceramic outer shell. The fuse thus provides a non-cycling device which must be replaced once it opens.

A pair of insulated conductor wires 48, 49 extend from the heating element 46, through the tube 18, and through openings in the terminal block 22, the wire 48 being connected to the terminal screw 30 and the wire 49 being connected to the terminal screw 31 which also has a line wire L1 connected thereto. A pair of insulated conductor wires 50, 51 extend from the fuse assembly 47, the wire 50 being connected to the terminal screw 30 and the wire 51 being connected to the terminal screw 32 which also has a line wire L2 connected thereto.

In the event the fuse assembly 47 opens, it may be removed by disconnecting the wires 50, 51 from the terminal screws 30, 32, and by pulling on the wires 50, 51 to draw the fuse through the guide tube 37 and through the opening 36 in the ceramic block 22. A new fuse may be inserted to position by a reversal of the just-described removal operations. To facilitate replacement the inner

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end of the ceramic outer shell of the fuse 47 may be slightly tapered, as shown in FIGURE 2.

As seen in FIGURE 2, both the heating element 46 and the fuse assembly 47 are in heat transfer relation with the slug 40. To insure that heat transferred from the heating element 46 to the tube or shell 18 is not materially in excess of that transferred to the fuse assembly 47, an insulating air space is provided at a desired location between the slug 40 and the tube 18. In the present embodiment, the round slug 40 is formed with a peripheral undercut 55 which extends substantially the length of the active heating portion of the heating element 46 so that there is a better transference of heat to the fuse assembly 47. The use of the brass slug 40 with an undercut 55 in the heated section makes it possible for a quicker response to heat being transferred to the fuse assembly 47. The space formed by the undercut acts as an air insulator which prevents the outside surface of the tube 18 from getting hotter than desired.

By varying the depth of type of undercut, and/or by use of fuse assemblies having different temperature settings, a wide variety of temperatures on the exterior surface of the tube or shell 18 may be controlled with a close degree of tolerance. As seen in FIGURE 2, the heater assembly is an integral unit and a user need only insert the tube 18 into the container 11 and screw the plug 19 into the sleeve 15 to properly assemble the heater with the liquid oxygen container.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described; hence it will be appreciated that the herein disclosed embodiment is illustrative only, and that my invention is not limited thereto.

I claim:

1. A heater assembly, comprising an elongated metal tube adapted to be inserted into a container to heat the contents thereof, an elongated metal slug within said tube, said slug having side-by-side longitudinally extending recesses, an electric heating element within one of said recesses and a temperature responsive device within the other recess, said element and device having terminals for the purpose of placing them in electric circuit with a source of electrical energy, said slug being coextensive with at least the active heating portion of the heating element and the active thermal responsive portion of said temperature responsive device, said slug having an outer surface in closely fitting engagement with the inner surface of said tube, and means on at least one of the inner surface of the tube and the outer surface of said slug for providing limited heat transfer engagement between the

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slug and tube in that area of the slug which is transversely aligned with transversely aligned active portions of said heating element and temperature responsive device to insure that heat transferred from said heating element through said slug to said tube is not materially in excess of the heat transferred from said heating element through said slug to said temperature device.

2. The construction of claim 1 wherein the means for providing limited heat transfer engagement comprises an undercut in the outer surface of said slug to form an elongated air space between the undercut surface and the inner surface of said tube.

3. A heater assembly, comprising an elongated outer tube adapted to be inserted into a container to heat the contents thereof, said tube having a closed inner end and an open outer end, an elongated metal slug within said tube and extending inwardly of said tube from the closed end thereof, said slug having side-by-side longitudinally extending recesses, an elongated electric heating element within one of said recesses and an elongated temperature responsive device closely but slidably fitting within the other recess, said element and device having terminals for the purpose of placing them in electric circuit with a source of electrical energy, an inner tube extending from said slug to the outer end of said outer tube and having an inner diameter substantially equal to and forming a continuation of the slug recess into which said temperature responsive device fits, the terminals for said responsive device extending through the inner tube for connection in said circuit, said responsive device being movable through said outer open end of said outer tube to and from predetermined position within said slug recess by respectively pushing and pulling on said responsive device terminals to move said device longitudinally of its slug recess and said inner tube.

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