United States Patent

Caroleo

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[54] ELECTRIC HEATERS

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[52] **U.S. Cl.**.....**219/335,** 219/538, 338/233, 338/274

[51] **Int. Cl.**.....**H05b 1/00**

[58] **Field of Search**.....219/335, 523, 538, 548, 336, 219/536, 544; 338/223–226, 232, 233, 253, 265, 273, 274; 29/592, 611, 613

[56] **References Cited**

UNITED STATES PATENTS

3,476,915	11/1969	Rapsis	219/336 X
2,858,403	10/1958	Butler, Jr.	338/229
1,459,307	6/1923	Laise et al.	219/536
2,754,407	7/1956	Smith	219/523

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[57] **ABSTRACT**

A heater for use in a highly corrosive environment such as, for example, for heating pickling solutions, plating baths and the like, comprising an imperious graphite sheath, an electric heating element within the lower end of the sheath, granular refractory material within the sheath, an epoxy cement topping the refractory material and encapsulating a grounding plate which is in electrical engagement with the interior wall of the sheath, the entire heater being resistive to corrosive action of the heated solution or the fumes therefrom, and including a member to permit air to enter or exit from the sheath.

10 Claims, 5 Drawing Figures

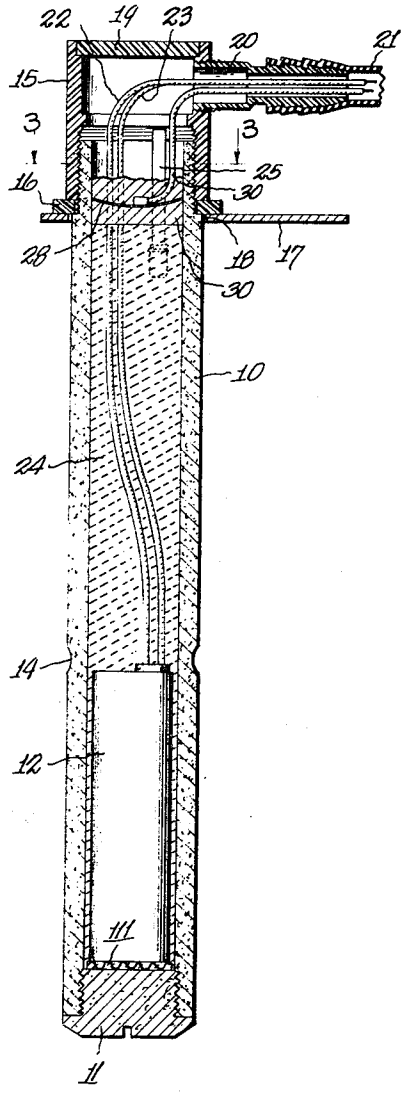


FIG. 1.

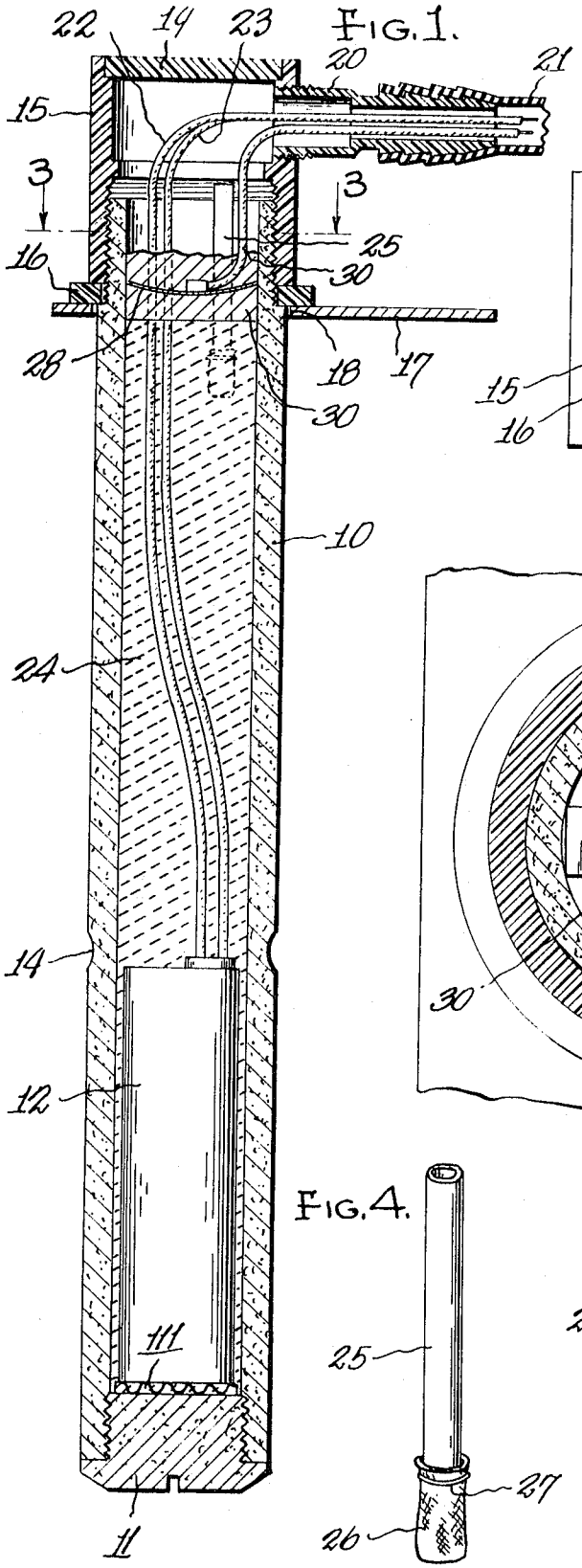


FIG. 2.

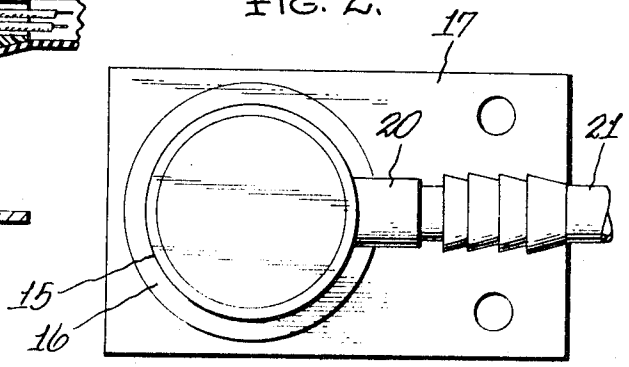


FIG. 3.

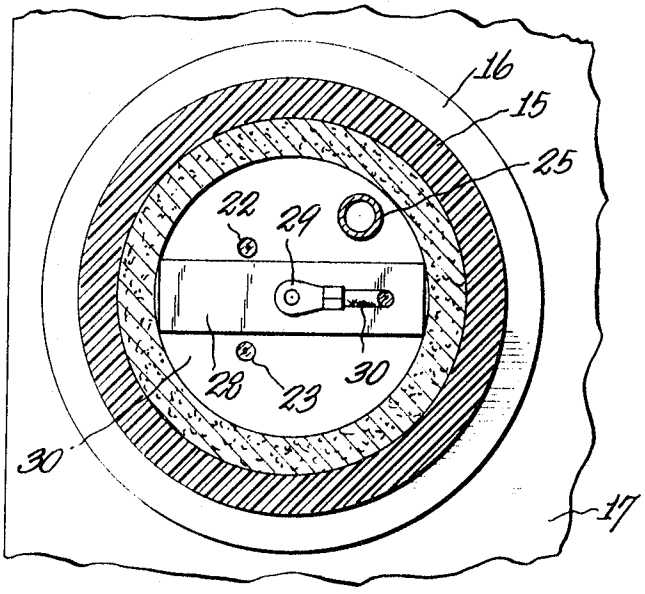
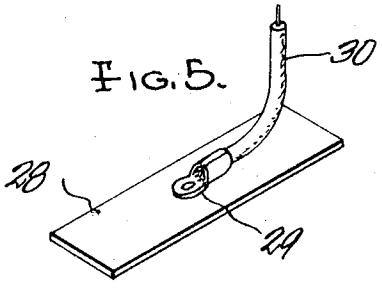


FIG. 4.

FIG. 5.



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ELECTRIC HEATERS

BACKGROUND AND SUMMARY

In the heating of highly corrosive solutions, such as hydrofluoric pickling solutions, copper fluoborate plating baths, and solutions containing hydrofluoric and concentrated phosphoric acids, great care is required in the design of the heater, not only to protect if from corrosive action from the solution itself but also from the fumes arising therefrom.

Heaters having impervious graphite sheaths have been produced prior to this invention and have enjoyed a measure of success. However, insofar as I am aware, no heater of prior art has the desirable constructional features detailed in the following description, including features of safety and efficiency.

Accordingly, it is a principal object of my invention to provide a new and improved heater of the character described.

DESCRIPTION OF THE DRAWING

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

FIG. 1 is a longitudinal section of a heater, illustrating a preferred embodiment of my invention,

FIG. 2 is a top plan of the heater,

FIG. 3 is an enlarged sectional view corresponding to the line 3—3 of FIG. 1, and

FIGS. 4 and 5 are perspective views of details.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring particularly to FIG. 1, the heating element herein disclosed comprises a sheath **10** formed of a suitable impervious mineral material which is resistant to acids and the like. As presently preferred, the sheath is formed of a molded, impervious graphite such, for example, as that manufactured by Union Carbide Corporation under the mark Karbate. The lower end of the sheath (referring to the disposition of parts shown in FIG. 1) is internally threaded to receive a closure plug **11** which is also preferably formed of impervious graphite.

An electric heater **12**, of any suitable construction, is disposed lengthwise in the lower end of the sheath, and a groove **14** is formed in the outer wall of the sheath to indicate the upper limit of the heated length of the sheath. Preferably, an asbestos pad **111**, with no cotton fibers, is disposed between the plug **11** and the lower end of the heater **12**.

The upper end of the sheath **10** is externally threaded to receive an internally threaded coupling **15** which is also formed of acid-resistant material and presently is formed of molded polypropylene. A loose ring **16**, also formed of polypropylene, is disposed between the lower end of the coupling **15** and a metal plate **17** having an opening **18** to loosely pass the sheath **10**. The plate **17** may be secured to a suitable support so that the sheath may hang in a tank (not shown) which contains the solution to be heated. The upper end of the coupling **15** is closed by a polypropylene disc **19** which is sealed in position by a polypropylene cement.

The side wall of the coupling is formed with a threaded opening to receive a polypropylene conduit **20**, and the threaded joint is sealed with polypropylene cement. The end of a vinyl tube **21** is stretched over the outer end of the conduit **20** and is also preferably sealed thereto. The tube **21** is of a length to extend to a junction box (not shown) and protects the lead wires disposed therein from acid fumes.

As shown in FIG. 1, a pair of insulated lead wires **22, 23** extend through the vinyl tube **21**, the conduit **20**, the coupling **15**, the sheath **10**, and are sealed to terminals of the electric heater **12**. Granular refractory material **24**, such as magnesium oxide, fills the interior of the sheath and is disposed in the space between the exterior of the heater **12** and the inner wall of the sheath. The sheath is subjected to a vibrating action at the time the refractory material is introduced into the sheath to insure that all space is filled. However, the refractory material is preferably not highly compacted because the sheath is relatively fragile and because the refractory material is required to provide for a reasonable amount of expansion when the heater is energized.

At the time the sheath **10** is being filled with refractory material **24**, a stainless steel tube **25** is supported within the upper open end of the sheath so as to be disposed at least in part within the refractory material. The lower end of the sheath is covered by a jacket **26** (see FIG. 4) of woven polypropylene cloth which is wrapped around the tube lower end and held in place by a wire **27** which is wound therearound and has its ends twisted together. The jacket prevents the refractory material from flowing through the tube **25** in the event the heater is inverted during shipping or handling.

Before the coupling **15** is threaded onto the upper end of the sheath and sealed thereto, as by polypropylene cement, a flat spring plate **28**, of a length slightly greater than the inside diameter of the sheath, is positioned inwardly of the upper end of the latter. The plate **28** constitutes a grounding element and has a terminal clip **29** spot welded thereto, as best shown in FIG. 5. A lead **30** extends from the plate through the coupling **15**, the conduit **20** and tube **21** and it has its extremity suitably grounded. The plate is initially flat, but as it is forced into the sheath, it is slightly bowed, as seen in FIG. 1, and its corners dig into the wall of the sheath not only for good electrical contact but also to hold the plate in position.

Thereafter, a suitable cement **30** is poured into the upper open end of the sheath to seal the upper surface of the refractory material and to encapsulate the grounding plate **28** as well as to seal around the adjoining portions of the leads **22, 23** and **30**. The cement is preferably an epoxy which will air harden, such as Tecoset.

The heater thus formed is suitable for heating highly corrosive substances, such as acid, since the impervious graphite sheath will resist deleterious attacks by acid, and the remaining parts resist corrosive action of the acid fumes. The support plate **17** may be coated with rubber or the like, so it too will resist corrosive attack. During operation, the heating element **12** may expand since the relatively loosely packed refractory material will permit this. Also, the sheath **10** may "breathe", that is, air may enter or exit during off and on cycles, through the stainless steel tube **25**. The grounding plate **28** provides safety in the event a crack appears in the sheath and solution enters to short circuit the heating element, and thus guards against the danger of having the solution and the tank become a conductor for electrical currents from the shorted heating element.

I claim:

1. A heater for heating highly corrosive solutions contained within a tank, comprising a sheath formed of an impervious mineral material which resists the corrosive action of said solutions, said sheath having an end adapted to be disposed within the solution to be heated, an electric heating element within said sheath, a coupling member formed of material which will resist the corrosive action of said solution or the fumes therefrom, said coupling member being joined to the opposite end of said sheath in sealed manner, conductor leads extending from said heating element through said sheath and coupling member and adapted to be connected to a source of electrical energy, means sealing said opposite sheath end, and a tube extending through said sealing means and having one open end within said sheath and the opposite open end within said coupling member to permit air to flow between the interior of said coupling member and the interior of said sheath.

2. The construction of claim **1** wherein said sheath is formed of impervious graphite.

3. The construction of claim **1** wherein said sheath contains granular refractory material below said sealing means and said one tube end is covered with pervious means which prevents refractory material from entering said tube.

4. The construction of claim **3** wherein said sheath is filled with granular refractory material to a point short of said op-

posite sheath end to leave a space thereat, and wherein epoxy cement is disposed within said space to seal said sheath opposite end, and wherein said tube extends through said cement.

5. A heater for heating highly corrosive solutions contained within a tank, comprising a sheath formed of impervious material which resists the corrosive action of said solutions, said sheath having one end adapted to be disposed within the solution to be heated, an electric heating element within said sheath, conductor leads extending from said heating element and outwardly of said sheath for connection to a source of electrical energy, and a grounding element comprising a metallic member spanning the opening in said sheath with ends thereof in electrical engagement with opposed portions of the inner wall of said sheath, and a conductor lead electrically connected to said metallic member and extending outwardly of said sheath for connection to a ground.

6. The construction of claim 5 wherein said sheath is formed of impervious graphite.

7. The construction of claim 6 wherein said grounding element is a plate of spring metal which is bowed upon insertion within said sheath so that marginal portions thereof are spring-pressed against the wall surface of said sheath.

8. A heater for heating highly corrosive solutions contained within a tank, comprising a sheath formed of impervious graphite, said sheath having one end adapted to be disposed within the solution to be heated, an electric heating element within said sheath and extending from said one sheath end to a point short of the other sheath end, conductor leads extending from said heating element and outwardly of said sheath for connection to a source of electrical energy, granular refractory material filling the space within said sheath and surrounding said heating element, said refractory material stopping short

of said sheath other end to leave a space, a grounding element comprising a plate of spring metal which is bowed upon insertion within said space so that marginal portions thereof are spring-pressed against the wall surface of said sheath surrounding said space, a conductor lead electrically engaged with said plate and extending outwardly of said sheath for connection to a ground, an epoxy cement seal transversely filling said space and overlying said refractory material and encapsulating said plate and sealing around the leads for said heating element and said grounding plate, and a tube extending through said cement in sealed manner and having one end opening on the side of said cement which faces said refractory material and the opposite end opening on the other side of said cement.

9. The construction of claim 8 wherein said sheath is formed with a groove in its outer surface to indicate the extent of the heated length of said sheath.

10. A heater for heating highly corrosive solutions contained within a tank, comprising a sheath formed of an impervious mineral material which resists the corrosive action of said solutions, said sheath having an end adapted to be disposed within the solution to be heated, an electric heating element within said sheath, a coupling member formed of material which will resist the corrosive action of said solution or the fumes therefrom, said coupling member being joined to the opposite end of said sheath in sealed manner, conductor leads extending from said heating element through said sheath and coupling member and adapted to be connected to a source of electrical energy, and a hardened cement within said opposite sheath end to close the same except for an opening through the cement to permit air to flow between the interior of said coupling member and the interior of said sheath.

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