United States Patent

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[54] **REFERENCE ELECTRODE FOR CATHODIC PROTECTION SYSTEMS**
3 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **204/196,** 204/147, 204/195, 204/290 F
[51] **Int. Cl.** **C23f 13/00**
[50] **Field of Search** ..... 204/1 T, 195 F, 147, 196, 290 F

[56] **References Cited**
UNITED STATES PATENTS

2,719,797	10/1955	Rosenblatt et al.	204/290 F
3,022,243	2/1962	Anderson	204/196
3,081,252	3/1963	Preiser et al.	204/196
3,129,161	4/1964	Anderson et al.	204/195 F
3,133,873	5/1964	Miller et al.	204/196
3,488,274	1/1970	Geld	204/196

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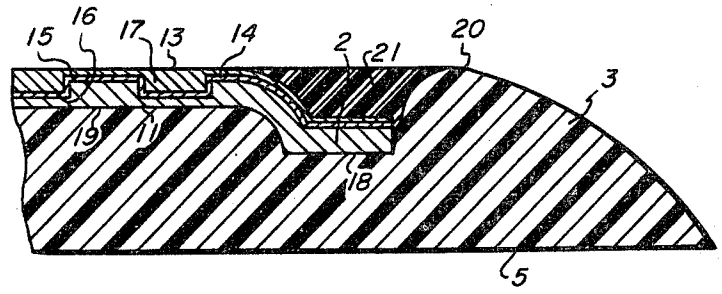
ABSTRACT: A reference electrode for cathodic protection systems on ships and boats comprising a metal base consisting of titanium, tantalum or niobium having a surface coated with silver, the silver-coated surface being a roughened surface in the form of ridges and depressions, e.g. an embossed surface, and the roughened surface being coated with silver chloride.



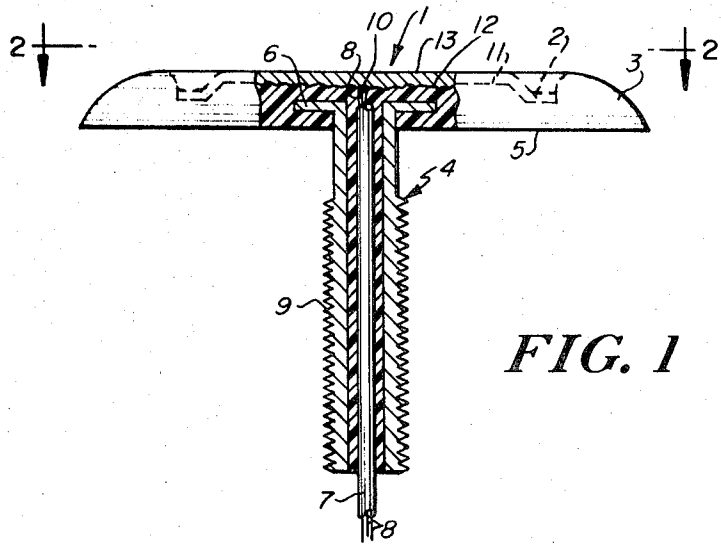


FIG. 1

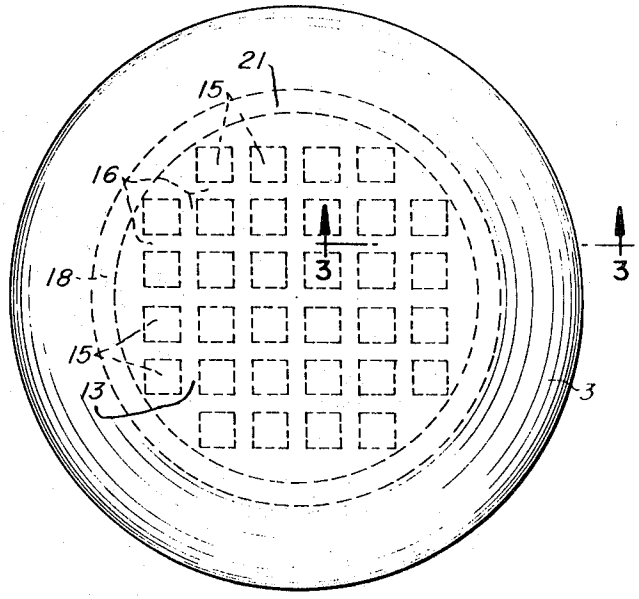


FIG. 2

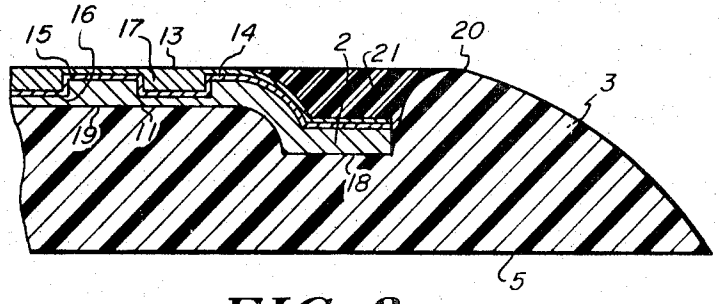


FIG. 3

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REFERENCE ELECTRODE FOR CATHODIC PROTECTION SYSTEMS

BACKGROUND OF THE INVENTION

Cathodic protection consists basically of applying an electrical current to an anode, immersed in an electrolyte, and to the surface to be protected as the cathode, whereby the surface potential is maintained cathodic with respect to the electrolyte, thus preventing corrosion of the surface. In the case of painted metallic surfaces such as ship hulls, however, when the impressed current density exceeds a certain amount the paint film will become damaged, whereas an insufficient current results in inadequate protection against corrosion. Therefore, an optimum exists and cathodic protection systems have been suggested, in which the fluctuating potential on the metallic surface is continuously registered and the power output to the anodes controlled accordingly, either by manually or automatically adjusting the output. In order to register the potential on the metallic surface to be protected, reference electrodes immersed in the electrolyte are used, in conjunction with the cathodic protection system, and which perform in cooperation with the metallic surface as a voltaic cell to produce a current which functions to indicate the condition of the metallic surface and whose response is utilized in a system to automatically monitor and adjust the output of the cathodic protection system. The reference electrodes usually employed for such purpose are the silver-silver chloride type electrodes. Some such electrodes are of the silver button-type coated with silver chloride. In any case, such electrodes are subject to deterioration either by lack of desirable physical strength of the silver button or a too rapid loss of the silver chloride, as by abrasion, to maintain the reference electrode potential stability for long periods.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a reference electrode preferably constructed to be positionable approximately flat to the surface to be protected, e.g., a ship's hull, with insulation means therebetween and of sufficient strength to withstand prolonged usage while at the same time having a composition and construction such as will provide a copious supply of the chloride ion and which will maintain a stabilized electrical potential for extended periods.

The electrode can be in the form of a disc, washer, or a rivet having a rivet head as the functioning electrode, and composed of a metal base consisting of titanium, tantalum or niobium having its outer surface roughened, e.g., embossed, or otherwise provided with such a roughened surface which is characterized by ridges and depressions, e.g., a surface having intersecting grooves, with the roughened surface being coated with a silver layer and then with a silver chloride layer which fills the depressions and covers the ridges, the depressions functioning as a reservoir of silver chloride should the silver chloride covering the ridges become substantially depleted as by abrasion from the ridges or deterioration over extended periods. The use of the particular base metal composition is less expensive than the use of a solid silver base and is of critical significance because when exposed to the electrolyte, e.g., by abrasion, the metal has the ability to readily form upon itself a film of insulating oxide which will prevent the development of stray currents which would otherwise unbalance the original stabilized current output of the electrode.

DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a partly elevational and partly cross-sectional side view of an electrode assembly according to the invention,

FIG. 2 illustrates a top view of the electrode assembly along lines 2—2 of FIG. 1 with the base metal being so modified that the roughened surface thereof is in the form of an embossed surface,

FIG. 3 illustrates an enlarged fragmentary view along lines 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Regarding FIG. 1, the electrode assembly comprises a reference electrode generally designated as 1 in the form of a circular disc having a circumferential marginal portion 2 thereof extending downwardly and forming a flange which is embedded in an insulating platelike resin base 3 with the major portion of the electrode surface exposable to an electrolyte. A tubular stem 4 is mounted on the insulating plate and extends outwardly of the undersurface 5. The tubular stem comprises a flanged end portion 6 embedded in the resin plate. An insulated electrical conductor means 7 containing electrically conducting wires 8 passes through the stem 4, which is threaded on its outer surface as at 9 for subsequent mounting through a ship's hull by a mounting nut (not shown). The end of the insulated conductor means passing through the stem and adjacent the undersurface of the electrode has its conductor wires 8 electrically connected to the bottom surface of the electrode, for example by welding or soldering as at 10.

The electrode disc illustrated by FIG. 1 comprises a metal base 11 of titanium, tantalum or niobium having its outer surface 12 in a roughened condition characterized by ridges and depressions, e.g., a surface having intersecting grooves or otherwise being embossed as more particularly shown by FIGS. 2 and 3.

FIGS. 2 and 3 illustrate the invention showing the metal base 11 of titanium, tantalum or niobium having a roughened surface, e.g., an embossed surface as illustrated, is coated, as by electroplating, to provide an intermediate layer of silver 14 with the silver-coated layer being then coated with an outer layer 13 of silver chloride, as by dipping in molten silver chloride or by sprinkling silver chloride powder on the surface and heating sufficiently to melt the silver chloride into adherence with the roughened surface. The roughened or embossed surface of the base metal is characterized by ridges 15 and depressions 16 with the layer of silver 14 conforming with the roughened surface leaving the depressions 16 as reservoirs 17 of excess silver chloride should the coatings 13 and 14 become abraded from the elevated portions or ridges of the base metal and to still leave a sufficient amount of silver chloride on the electrode to maintain a copious supply of the chloride ion and with the metal composition of the base, as above described, being capable, when exposed to the electrolyte, of readily forming an insulating oxide film which will prevent the development of stray currents to unbalance the original stabilized current output of the electrode.

The platelike resin insulating base 3 is provided with an annular groove 18 inwardly adjacent to the marginal portions of the insulator plate to receive the downwardly extending flange 2 of the electrode 1 and the top central portion 19 of the insulator base is slightly recessed to receive the electrode in conformity with the shape and thickness of the disc 1 in such manner that the surface of the electrode does not extend above the ridge 20 on the marginal portion of the insulator base. Having the electrode positioned on the insulator base 3 with the flange 2 in recess 18, the space of the groove 18 above the flange 2 is filled with an insulating resin, e.g., an epoxy resin 21 so that the top surface of the electrode and the marginal portions of the platelike base are substantially in a common plane.

What is claimed is:

1. In a cathodic protection system, a reference electrode comprising a metal base consisting of titanium, tantalum or niobium, the metal base having a roughened surface characterized by ridges and depressions, a layer of silver on the roughened surface, and a layer of silver chloride coating the silver layer, said silver chloride layer filling the silver-coated depressions and covering the silver-coated ridges.

2. In a cathodic protection system according to claim 1, wherein the silver-coated surface is a roughened surface characterized by intersecting grooves.

3. In a cathodic protection system according to claim 1, wherein the silver-coated surface is an embossed surface.

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