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ELECTROLYTIC COMPOSITE ANODE AND CONNECTOR

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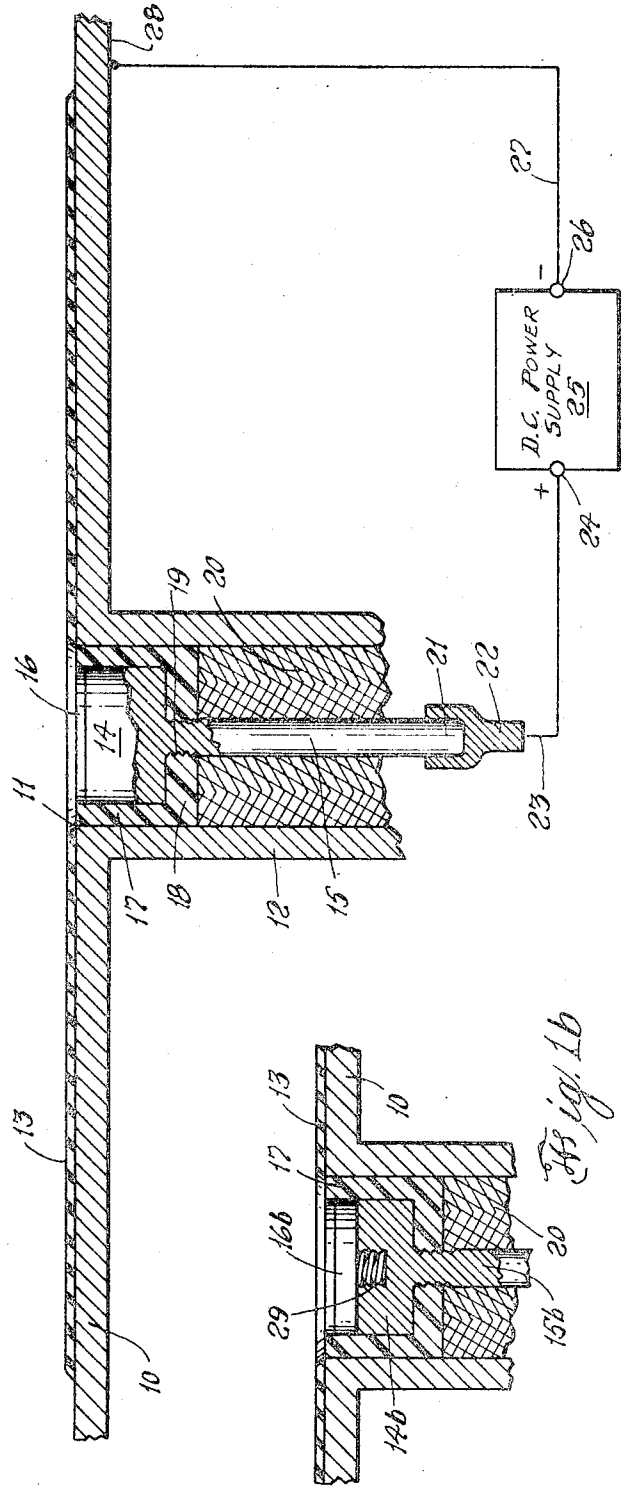

Fig. 1

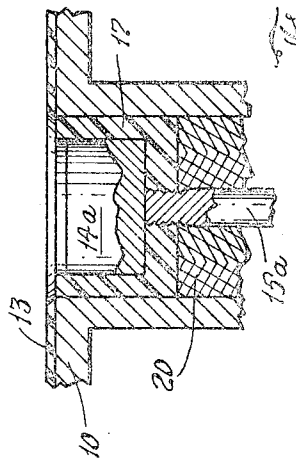

Fig. 1a

Fig. 1b

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ELECTROLYTIC COMPOSITE ANODE AND CONNECTOR

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ABSTRACT OF THE DISCLOSURE

An impressed current cathodic protection device which includes a structure having high anodic electrolytic resistance and low electronic pressure resistance. One face of the structure is coated with platinum which is the effective anode and the structure disposed in a dielectric housing except for the one face and a portion of the opposite face. The anode and the housing are positioned in an aperture in the hull of a ship below the waterline with the coated surface facing outwardly and flush with the hull surface. The housing abuts the aperture walls while a stem portion is threaded through the housing or welded so as to form a pressure contact with the anode structure. A non-electrically conducting stuffing gland provides a watertight seal between the stem and the aperture walls. Current passing between the stem-anode and the ship's hull provides cathodic protection for the metal hull.

BACKGROUND OF INVENTION

The present invention relates to cathodic protection of metallic ships' hulls in sea water and more particularly to an anode structure for an active cathodic protection system aboard a high speed ship and which may be readily removed and replaced without the necessity of drydocking the ship. Corrosion of ships' hulls exposed to sea water is due to galvanic action which involves the generation of an electric potential between two metals or between different sections of a metal surface having different oxidation-reduction potentials.

Present cathodic protection systems may be classified as being of two types, an active and a sacrificial system. These systems involve on the one hand galvanic or sacrificial anodes and on the other D.C. impressed currents. The impressed current or active type is becoming increasingly useful on hulls of active ships due to the smaller bulk and weight of the anode materials employed. In the active system, the ship's hull is serially connected through the sea water (electrolyte) to an anode insulated from the hull and a D.C. current passed therethrough. This passage of current results in a polarization effect which acts to block the adverse effects of the galvanic action on a ship's hull.

All of the present active systems which employ impressed current anodes are deficient in at least one respect. Anodes which are employed aboard active ships may protude from the hull and become damaged or broken off by mechanical inpact and/or high speed. In order to replace an anode, it is necessary either to remove and replace the anode with its electrical cable and connection or to replace the entire structure. In either case this generally necessitates the drydocking of the ship itself. It is clear under these circumstances that if minimizing damage to the anode and replacement thereof when required, carried out by a diver while the ship is in the water, the savings in both time, expense, and ships availability would be substantial.

Present anodes have a radius much larger than the connector and require at least a large, equal radius insulator between the anode and hull.

SUMMARY OF THE INVENTION

The general purpose of this invention is to provide a readily replaceable anode for an impressed current cathodic device which is mounted flush with the ship's hull so as to reduce damage and cavitation. Additionally the anode is provided with a platinum coating on its outer face and encased in a dielectric holder which also supports a stem connector in physical contact with the opposite face of the anode. Both the anode and the stem are made of a material which has a high anodic electrolytic resistance in sea water and a low electronic resistance on pressure contact with another conductor. The holder is disposed and supported entirely within opening in the ship's hull.

An object of this present invention is to provide a readily replaceable anode and/or holder for use on high speed ships and with an active cathodic protection system.

Another object of this invention is to provide a simple, reliable, inexpensive, practical and efficient cathodic protection system whose anode may be readily replaced by a diver who can be relatively unskilled in the electrical art without endangering the ship's electrical system.

Still another object is to provide an anode that is an integral part of the through-hull connection, is flush with the hull surface, requires no more labor to install than that for installing a stuffing gland, and requires no mechanical fastening directly to the hull.

Other objects and advantages will appear from the following description of an example of the invention, and the novel features will be particularly pointed out in the appended claims.

In the accompanying drawings:

FIG. 1 is a cross-sectional view of an embodiment made in accordance with the principles of this invention, and

FIGS. 1*a* and *b* are cross-sectional views of modified portions of the embodiment of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the illustrated embodiment of FIG. 1, the hull **10** of a high speed ship such as a hydrofoil is provided, below the waterline, with a circular opening **11** extending therethrough and joined by welding to a cylindrical flange **12** which can be considered an extension thereof. If the hull is of sufficient thickness this flange is not necessary for the purposes of this embodiment. Disposed about the opening **11** and affixed to the ship's hull is a dielectric shield **13** which may be of any thin dielectric material that is unaffected by sea water or electrolysis products such as neoprene. The shield extends well beyond the outer peripheral edge of the opening in order that the distribution of the current will cover as large an area as possible surrounding the opening into which an anode is placed.

The anode structure **14** is of a generally cylindrical form and of an electrically conductive material which has a high anodic electrolytic resistance in water, a high resistance to chemical deterioration, and a low resistance on pressure contact with an electronic conductor, examples of which are tantalum and titanium. The anode may include integral therewith a depending stem **15** of the same material as the anode portion **14**. The anode is disposed in the hull opening **11** with the stem **15** extending inwardly of the hull while the outward face of the anode is coated or cladded with a layer of platinum **16**. The upper or outer clad surface is position flush with the hull. The anode, except for the clad surface and a portion of the stem are confined within a surrounding electrically

insulating means or as illustrated a housing **17** whose inner surfaces abut and conform to the anode and whose outer surface tightly abuts the inner walls of the hull opening **11**. The housing **17** serves to confine and position the anode as well as to electrically insulate the anode from the hull and to prevent entry of water past the anode into the ship. The lower wall **18** of the housing is provided with an aperture **19** whose inner wall is threaded to mate with threads provided on the outer surface of the upper portion of stem **15**. This structural arrangement limits any relative movement between the housing **17** and the anode-stem combination when the anode is seated in the housing and the stem threaded to the housing.

Disposed inwardly of the housing between the stem **15** and the hull wall or penetration flange is a stuffing gland **20** which may be of any standard construction presently available on the market. The gland is represented as shown since many types are available and suitable for the purposes of maintaining the watertight integrity of the hull and to limit movement of the stem-anode combination. The lower or inner portion **21** of the stem extends well within the ship and there mates with a detachable electrical connector **22** which is connected by cable **23** to the positive terminal **24** of a D.C. power supply **25**. The negative terminal **26** of the supply is connected via cable **27** to the ship's hull as at **28**. Clearly, with this physical arrangement, replacement of the anode is a relatively simple matter and can be accomplished from the outside of the ship.

Since the watertightness of the hull would be lost if both the anode and the stem were simultaneously removed, separate components are illustrated in FIGS. 1*a* and *b*. In FIG. 1*a* the stem **15***a* is threaded into the housing **17** so as to tightly abut the anode and thereby form a low resistance electronic contact therewith. When the anode **14***a* is removed (without the housing **17**) the outside water will not pass the remaining stem and gland **20**. Moreover, the power supply **25** will not be shorted to the incoming sea water contacting the stem since the tantalum or titanium provides a high anodic electrolytic resistance. As an additional alternative and illustrated in FIG. 1*b*, a platinum-clad tantalum cap **16***b* may be substituted for the coated portion of the anode and affixed to the anode as by threading into a mating thread **29** within the anode **14***b* which is integral with the stem **15***b*. Locking structures can be incorporated in accordance with standard practice.

With 10 volts applied potential (normally encountered in ship service), the current output from a platinum clad anode of approximately 2 square inches is about 2.5 amperes, which will provide adequate protection for a hydrofoil. Two to four such anodes will suffice for a typical PC class ship or any boat with a relatively small underwater surface area. Electrochemical deterioration of the platinum at these current densities is negligible. Further the anode structure described requires no more labor to install than that necessary to install a stuffing gland and yet does not necessitate any mechanical fastening directly to the ship's hull. The flush mounting helps reduce damage by impact and does not interfere with the high speed hydrodynamics. Cavitation damage to the platinum is not a problem on a hydrofoil since vigorous gas evolution at the anode provides a gas "cushion" which prevents possible damage.

It will be understood that various changes in the details, materials, and arrangements of parts (and steps), which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. An impressed current cathodic protection system for a high velocity metal hulled ship having a direct current supply source carried by said ship and having the negative terminal of said source connected to said metal hull, which comprises:

an opening through said hull below the waterline,

a dielectric sheath affixed to said hull in the area proximate and spaced from said opening,

an anode of a material having a high anodic electrolytic resistance in sea water and low electronic resistance on pressure contact with another conductor,

said anode having one surface thereof clad with platinum and disposed in said opening with said clad surface facing outwardly of and flush with said hull, and

electrically insulating means disposed about said anode and between said anode and the walls of said opening, and having a threaded passageway on the portion thereof opposite said clad surface,

A stem of the same material as said anode being threaded into said passageway and in abutting relation with the rear surface of said anode,

whereby when the positive terminal of said source is connected to said stem said system will provide active cathodic protection for said hull.

2. The anode structure according to claim **1** wherein said anode comprises a pair of separable parts:

a main anode part, and

a platinum coated cap portion detachably affixed to said main anode part.

3. The anode structure according to claim **2** wherein said cap portion is threaded into said main anode part.

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