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TRAILING ANODE FOR CATHODIC PROTECTION SYSTEMS

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FIG. 3

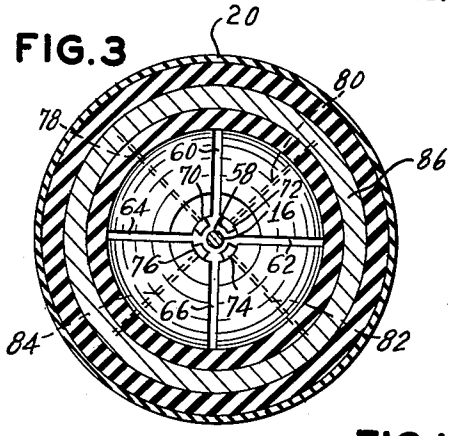
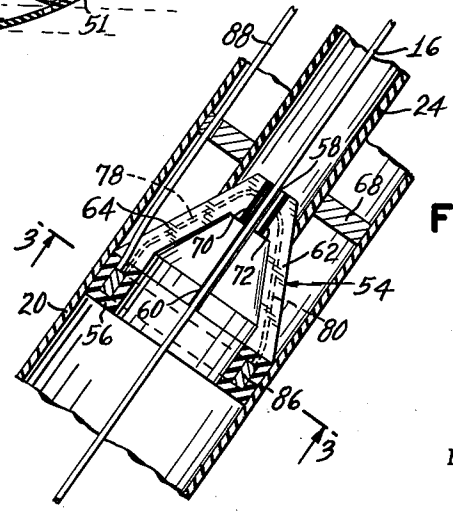


FIG. 1

FIG. 2



INVENTOR.
EDWARD P. ANDERSON
BY Karl Hubert
James E. Bryan
Alan C. Rose
ATTORNEYS

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TRAILING ANODE FOR CATHODIC PROTECTION SYSTEMS

Edward P. Anderson, Livingston, N.J., assignor, by mesne assignments, to Engelhard Industries, Inc., Newark, N.J., a corporation of Delaware

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This invention relates to anodes for cathodic protection systems and more particularly to anodes which may be trailed from ships.

It is well known that much of the rust and corrosion which attacks the metal hulls of ocean-going ships is the result of local electrolytic action. This action may be prevented by the use of cathodic protection systems in which direct current is supplied between the hull of the ship as a cathode and a corrosion resistant surface such as platinum located near the surface to be protected.

In the case of vessels in which maneuverability and frequent docking and embarking are important features, many anode installations have been made by affixing platinum surfaced anodes to the hull at spaced points below the water line. Such anode installations are relatively costly, however, as they require a number of openings in the hull and a corresponding number of stuffing box assemblies for sealing the electrical connections to each of the anodes.

Another type of impressed cathodic protection system which is well known, involves the use of trailing anodes. More specifically, some of the first anodes which were employed consisted of bodies of corrosion resistant materials such as graphite blocks which were immersed in the water. Such anodes were attached to insulated electrical cables and suspended from the deck of the ship. This type of trailing anode is subject to the disadvantage of becoming readily fouled on objects in the water. In order to carry a sufficiently high level of current and to support the graphite blocks the cables were of relatively heavy gage conductors. Consequently, they were easily broken as a result of fatigue. Furthermore, the heavy gage cable and the associated anode structures were relatively expensive to replace.

Accordingly, a principal object of the present invention is to provide an improved trailing anode arrangement for ships, particularly having a small gage wire and a high current carrying capacity. A further object of the invention is the provision of a readily replaceable trailing anode and a mounting arrangement in which the anode assembly is not readily damaged by fatigue.

As an illustrative embodiment of the invention, an anode assembly for cathodic protection systems includes a supply of a wire covered with precious metal on board the ship, the end portion of the wire extending into the water to be trailed therein when the boat moves. By means of a suitable outrigger-like device, the anode wire can be payed out into the water, preferably from the stern of the ship. Customarily, one bore through the hull is provided in the stern portion of the hull and a tubular guide structure is mounted to extend through the bore with its outer end below the water level. The continuing wire is payed out from a reel or the like, through the tubular guide and into the water until a desired length of wire emerges from the guide tube to form a trailing anode.

Therefore, in accordance with one important feature of this invention, the anode for cathodically protecting a shipe consists essentially of the immersed end portion of a continuous supply of a corrosion resistant conductor on board the ship, whereby a selected length of the conductor can be passed from said supply into the water. Good results have been obtained when using as conductor

a titanium wire covered with platinum. In the case of accidental shortening of the trailing wire anode by fouling on objects in the water or from fatigue, the trailing length of the wire can easily be restored from the supply on board.

Another important feature of the invention resides in the fact that electrical connection between the power supply and a point of the trailing anode is generally made below or near the water level. This is important to avoid excessive heat production in the anode wire. The connecting cable should, therefore, have a current carrying capacity considerably above that of the anode wire. As a result, no or little heat is generated in the connecting cable, while the trailing portion of the anode wire is cooled by the surrounding water. The wire may be of relatively small gage and quite inexpensive, so that loss of a length of wire by fouling is neither inconvenient nor costly.

Other features of the invention include suitable structures of an outrigger-like device, a clamping device for limiting the length of payed out anode wire extending into the water, arrangements for electrical connection to the anode wire, and a torsion tube to reduce fatigue failure of the trailing anode.

The anode of the invention combines the advantages of the formerly used trailing anodes with that of the fixed anodes mounted in openings through hulls used at the present time. Only one opening through the hull is required and by using a trailing conductor, suitably a wire, replacing the anode can be effected readily from the continuous supply on board the ship.

Other objects, features and advantages of the invention will be readily apprehended by a consideration of the following detailed description and the accompanying drawings, in which:

FIGURE 1 is a fragmentary schematic sectional view of an anode assembly according to the invention;

FIGURE 2 is a similar view of a modified clamping device, and

FIGURE 3 is a cross-sectional view along the line 3—3 of FIGURE 2, taken in the direction of the arrows.

In the drawing, reference numeral **10** designates the stern portion of the hull of a ship. The hull is connected to the negative terminal of a power supply **12** of which the positive terminal delivers the protecting current to the anode by means of a cable **14** as described below. A power supply and the circuitry associated therewith, suitable for the purpose of this invention, is described in my co-pending application Serial No. 766,147, filed October 8, 1958.

In accordance with this invention, the effective anode is formed by the end portion **16** of a conductor of which a continuous supply is on board the boat by means of a winch, or power operated reel, schematically indicated in the drawing by the reference numeral **18**. The conductor is preferably a wire and good results have been obtained when using a titanium wire coated with a precious metal, preferably platinum, as an anode.

The anode wire may be payed out into the water from the winch **18** by the action of gravity and the pull of the moving water. The wire **16** may be fed into the water by any suitable outrigger device mounted on the outside portion of the stern deck of the ship, so that no penetration through the hull **10** is required. However, and especially in the case when the installation of a cathodic protection system is planned when building the boat, an assembly such as that shown in the drawing may be used.

The mentioned assembly serves for paying out into the water a desired length of anode wire and clamping the wire for retaining it in that position to prevent the sliding of more wire into the water than the desired length. Additionally, electrical connection to the effective anode

wire end 16 is made at a point normally below water level to avoid overheating of the portion of the anode wire which is surrounded by air.

The stern face of the hull is provided with an opening through which is passed an assembly of a pair of coaxially arranged tubes of insulating, preferably plastic, material. The outer tube 20 is secured in the hull opening and supported by a bracket 22, while the inner tube 24 is slidably mounted within the outer tube. The outer end of the anode wire stored on the winch 18 passes through the inner tube 24 and this portion of the wire, designated by the reference numeral 26, is guided by the coaxial tubes into the water to form the effective anode 16. It will be noted that the guiding assembly connects a point inside the boat with a point outside thereof which is normally below water level.

It has been mentioned above that preferably only the immersed portion of the trailing anode wire should carry the protecting current. This is accomplished by a clamping device which electrically connects a normally immersed point of the wire to the comparatively heavy, insulated cable 14. The cable, which is suitably passed through and secured to the inner tube 24, connects the positive terminal of the power supply 12 with a wedge 28. A second wedge 30 is mounted inside the inner tube 24 facing the wedge 28 so that the wedges point in opposite directions. Both wedges cooperate to perform the clamping action mentioned above to stop the paying out of the anode wire 16. Additionally, the wedge 28, by its connection to the cable 14, ensures electrical contact with the anode wire 16, 26. Evidently, either the entire wedge or at least its surface must be made of conducting metal, and it is preferably provided with a precious metal surface in order to prevent corrosion thereof.

The wedge 28 is firmly secured to the inner tube 24 by any suitable means and therefore moves axially in the outer tube 20, together with the inner tube 24. On the other hand, the other wedge 30 is attached to the outer tube 20 by means of headed bolts 32 and 34 passing through slots 36 and 38 in the inner tube to permit axial movement of the inner tube relative to the wedge 30.

An actuating mechanism mounted inside the ship for producing the axial movement of the inner tube 24 with respect to the outer tube may consist of a screw spindle 40 rotatably mounted in a bearing support 42 and actuated by means of a crank 44. Upon rotation, the spindle 40 drives a sliding member 46 which entrains the inner tube 24. Thereby, an axial movement of the inner tube with respect to the outer tube 20 is obtained so that by actuating the crank 44 in one direction the wedges 28 and 30 are caused to clamp the anode wire. Alternatively, upon release of this clamping action by rotating the crank in the opposite direction the wire is allowed to run through the assembly under the gravity action of its own weight, so that any desired length of the wire 16 may be payed out from the winch 18 into the water.

In order to avoid short-circuiting through the winch 18 to the hull 10, the winch is mounted on an insulating base 48. As a result, the protecting current is supplied through the cable 14 of comparatively high current capacity through the wedge 28 to the trailing anode wire end 16 while the anode wire portion 26 will not carry any current. It is noted that the wedges are mounted at a point normally immersed in the water so that the clamping device and the trailing anode wire end 16 are prevented from being over-heated, while the cable 14, passing partly through air, is of sufficiently heavy gage to avoid substantial temperature increase under normal operating conditions.

The immersed, lower end 50 of the outer tube 20 is preferably provided with a flexible torsion tube 51 to prevent breaking of the trailing anode wire at the point where it emerges from the tube. Such a flexible end portion imparts a smooth curve to the wire 16 and no abrupt corner can be formed. It will be apparent that

the entire lower portion of the tubular guide assembly is located at a point below normal water level and will be filled with water under operating conditions, since the tubes are vented at the upper end. However, perforations 52 may also be provided in the lower portion of the outer tube 20 to improve the water circulation therein. The holes 52 are advantageously arranged as indicated in FIGURE 1 to permit the entry of cooling water but to avoid flow of water outwardly through the holes. In this manner excessive current flow toward the adjacent portion of the hull is avoided.

Another of the numerous possible embodiments of the clamping device is shown in FIGURES 2 and 3. A clamping member 54 of basically conical hollow shape has its cylindrical base 56 mounted in the outer tube 20, the cone pointing towards the boat and the wire supply. The anode wire 16 is passed through an axial bore 58 in the apex of the cone. By means of two axial saw cuts through the center line of the cone 54 forming an angle of 90° with respect to each other, four quadrants are obtained which are separated from each other by slots 60, 62, 64 and 66. These quadrants remain connected to each other at the cylindrical base 56. The body so obtained, and when made from resilient, insulating material such as polytetrafluoroethylene, constitutes an appropriate clamping device. Normally, the quadrants are biased to a neutral position in which the wire may freely pass through the central opening. When actuated by the wedge action of the inner tube 24, as it is moved axially in the left hand direction, the quadrants are urged inwardly to decrease the diameter of the bore 58 and clamp the wire. Suitably, one or more annular guides 68 may be mounted in the outer tube 20 for centering the inner tube 24.

In the embodiment so described, electrical connection to the power supply can be made through linings 70, 72, 74, 76 of conducting corrosion resistant metal applied to the wall of the bore 58 pertaining to each quadrant. One of the conductors 78, 80, 82, 84 passing through each quadrant connects the corresponding lining to a common annular bus 86. The cable 88, which may be conducted between the two concentric tubes leads to the power supply. The conductors 78, 80, 82 and 84, as well as the bus 86, are imbedded in the insulating body of the clamping member 54 and thereby protected against corrosion. In general, the apparatus of FIGURES 2 and 3 is similar to that of FIGURE 1 and may be provided with associated equipment as shown in FIGURE 1.

Evidently, numerous modifications of the described outrigger-like assembly can be made. The sliding gear including the spindle 40 and the sliding block 46 may be replaced by any other suitable device; for example, each of the tubes can be associated with a threaded end fitting so that the rotation of one of the fittings results in an axial movement of one of the tubes with respect to the other.

According to another modification, only one tube may be used which has a clamping device mounted in its lower portion; the clamping device may be controlled by any suitable means such as a lever system actuated by an axially-movable rod, a pull string or the like. It has been mentioned already that, in order to avoid drilling an opening through the hull, an appropriate outrigger-like device may be used for paying out the anode wire over the edge of the stern deck. As a combination of both methods, the assembly described herein and shown in the drawing may easily be adapted to be mounted entirely outside of the boat; in this case, the upper end of the tubular guide assembly emerges in proximity of, but outside the stern deck.

In a simplified version of the present invention, the apparatus would include an insulating pipe lined with conductive material at least at its lower end. The negative terminal of the cathodic protection power supply is connected to the hull of the ship, and the positive

terminal is connected to the conductive lining and could also be connected to the winch. Clamping of the wire in position is provided by means of a ratchet **90** associated with the winch assembly as shown in FIGURE 1. The insulating torsion tube secured to the end of the insulating pipe serves the functions as described above. It is noted in passing that the arrangement of FIGURE 3 could be employed in this manner if the inner movable tube **24** should be temporarily immobilized. Under these circumstances frictional engagement of the wire with the metal linings **70**, **72**, **74** and **76** would provide the electrical contact for power supply to the wire.

As mentioned above, the trailing wire anode **16** is preferably coated with platinum, or platinum alloyed with other platinum group metals. Such a coating of platinum or an alloy thereof will be designated a "platinim group metallic coating." The base for the wire **16**, on which the platinum group metallic coating is applied, is preferably made of titanium, and may also be formed of tantalum. As indicated by the showing in FIGURE 1 at the end of the anode, the anode may be formed of a stranded wire. In this case, each strand may be made up of several titanium or tantalum wires, each of which is plated with platinum or a platinum alloy. The use of a stranded wire greatly increases the strength and flexibility of the wire, and greatly improves the resistance of the trailing wire to failure which could otherwise result from vibration and turbulence.

It will be obvious that many more modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. In a cathodic protection system for ships, the hull of the ship, power supply means having its negative terminal connected to the hull, a tubular assembly connecting a point on board the ship with a point in the water adjacent the ship, a corrosion resistant metal wire, a winch mounted on the ship for storing a continuous supply of said corrosion resistant wire, the wire passing from said winch through said tubular assembly and protruding therefrom into the water to form electrical contact therewith, the lower end portion of the tubular assembly comprising a flexible portion to avoid breaking the wire at this location, said lower end portion of the tubular assembly including clamping means for retaining the wire in a fixed position with respect to the tubular assembly, said clamping means including at least one electrical contact surface connected to a conductor having a current carrying capacity above that of the corrosion resistant wire, and means for connecting said conductor to the positive terminal of said power supply means.

2. In an assembly for cathodic protection systems, a tube, an actuating member slidably arranged in the tube, a corrosion resistant metal wire, a reel associated with said tube for storing said corrosion resistant wire, the wire adapted to be passed from said reel through the tube and to protrude therefrom, the tube having a flexible end portion forming a torsion tube adapted to prevent breakage of the wire, a plurality of cooperating clamping members

mounted in the tube, means for moving said actuating member with respect to said tube for closing said clamping members and holding said wire, at least one of said clamping members having a conductive surface for making electrical contact with the wire, and an electrical conductor extending from one end of the tube to the conducting surface, the power carrying capacity of said conductor considerably exceeding that of the wire.

3. In a cathodic protection system for ships, the hull of the ship, power supply means having its negative terminal connected to the hull, an insulating tube mounted in the stern portion of the ship for connecting a point on board the ship with a point in the water adjacent the ship, a corrosion resistant metal wire, a winch mounted on the ship for storing a continuous supply of said corrosion resistant wire, the wire passing from said winch through the tube and protruding therefrom into the water to make electrical contact therewith, the tube having a flexible end portion to prevent breakage of the wire at this location, a clamping device mounted inside the tube, the clamping device including a plurality of resilient elements in a radial arrangement to form a passage for said corrosion resistant metal wire, means for actuating said resilient elements toward each other to decrease the width of said passage for clamping the wire, electrical contact means mounted in said passage, and means for connecting said contact means to the positive terminal of said power supply means.

4. In a cathodic protection system for ships, the hull of the ship, power supply means having its negative terminal connected to the hull, an insulating tube mounted in the stern portion of the ship for connecting a point on board the ship with a point in the water adjacent the ship, a corrosion resistant metal wire, a winch mounted on the ship for storing a continuous supply of said corrosion resistant wire, the wire passing from said winch through the tube and protruding therefrom into the water to make electrical contact therewith, a clamping device mounted inside the tube, the clamping device including a hollow conical body having axial incisions through a portion thereof to form a plurality of interconnected resilient sections, an axial passage for said corrosion resistant metal wire through said conical body, means for actuating said resilient sections toward each other for decreasing the width of said passage to thereby clamp the wire, said actuating means including an inner tube axially movably guided in said outer tube, the end of the inner tube facing the apex of the conical body, electrical contact means mounted in said passage, and means imbedded in said conical body for connecting said contact means to the positive terminal of said power supply means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,477,099	Baum	Dec. 11, 1923
2,719,797	Rosenblatt	Oct. 4, 1955
2,863,819	Preiser	Dec. 9, 1958
2,916,429	Vossnack et al.	Dec. 8, 1959

FOREIGN PATENTS

13,971	Great Britain	Sept. 5, 1890