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I. GELD ET AL
METHOD FOR ATTACHING IMPRESSED CURRENT ANODES
FOR CATHODIC PROTECTION
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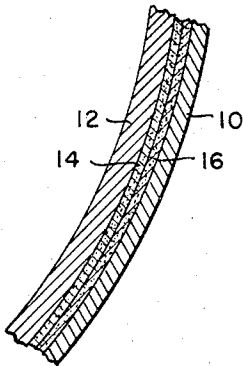


FIG. 1.

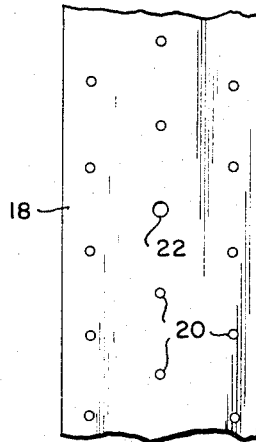


FIG. 2.

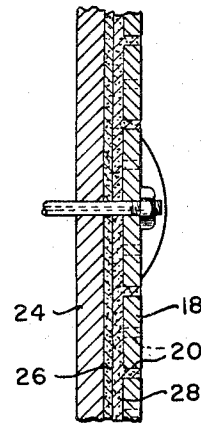


FIG. 3.

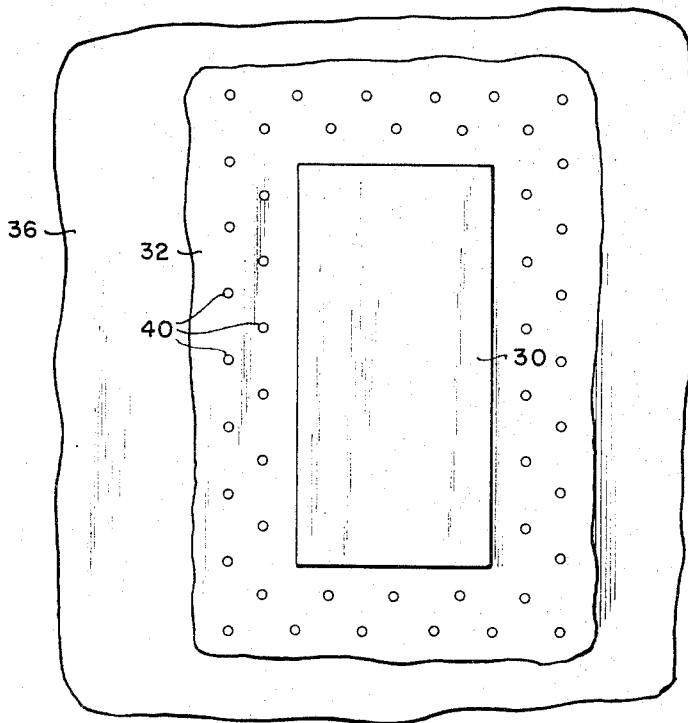


FIG. 4.

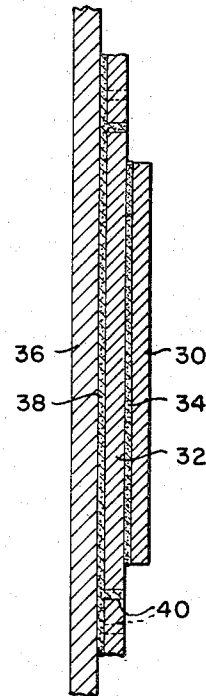


FIG. 5.

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METHOD FOR ATTACHING IMPRESSED CURRENT ANODES FOR CATHODIC PROTECTION

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ABSTRACT OF THE DISCLOSURE

Method of protecting a metal against electrolytic corrosion by bonding an anode to the metal with a curable electrically nonconducting adhesive in uncured state and then passing a direct current between the anode and the metal.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to securing or bonding together in face to face relationship a metal to be protected from electrolytic corrosion and an anode for providing such protection.

The invention is particularly useful in the securing of anodes to the metal hull of a ship and will be described in relation thereto. However, the invention is also applicable to other applications such as the protection of pipes or tanks from electrolytic action.

Conventionally the securement of anodes to the hull of a ship has been accomplished by such means as bolts, screws, hangers, straps and welding. These means are inherently disadvantageous for one or more of the reasons including the development of undesired resistance to the flow of water past the hull, the development of current leaks to inadequately insulated bolt threads and strap under sides, the weakening of hull structure by the drilling of holes or the use of welding and other factors including labor time required to effect the installation.

It is a general object of this invention to provide a simple, practical, strong, inexpensive and reliable means and method for attaching an anode to a metal to be protected against electrolytic action without alteration of the structural integrity and characteristics of the metal protected.

A further object is to provide an improved means and method particularly useful in mounting an anode to a metal under conditions requiring vertical or overhead attachment of the same.

Another object is to provide an improved means and method for attaching an impressed current anode to a metal in a manner minimizing the establishment or development of current leaks.

A still further object is to provide an improved means and method for economical attachment of an anode to a metal wherein a major portion of the work can be accomplished in the shop and wherein the time and labor required to effect the actual mounting of the anode on the metal at the site is minimized.

A further object is to provide a means and method for mounting an anode on a metal hull in a manner providing an improved and more durable shield for the metal of the hull adjacent the anode.

Other objects and advantages will appear from the following description of some examples of the invention and the novel features will be particularly pointed out in connection with the appended claims.

In the accompanying drawing:

FIG. 1 is a sectional view of a ship's hull and attached impressed current anode in vertical section;

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FIG. 2 is a plan view of a section of an impressed current anode in modified form and incorporating the invention;

FIG. 3 is a vertical sectional view of a section of the ship's hull with the anode of FIG. 2 mounted thereon;

FIG. 4 is a plan view of an anode of further modification and incorporating the invention; and

FIG. 5 is an elevational view in cross-section of a section of the ship's hull with the anode of FIG. 4 mounted thereon.

In accordance with this invention, an anode is attached to the hull of a ship (or other metal to be protected) by cementing one surface of the anode to an adjacent surface of the ship through two layers of curable adhesive material, one layer being applied and allowed to cure to hardened state to embed and cover projections in a roughened surface attachment area of the hull and thereafter the second coating being applied to effect a bond or securement of the anode to the hull.

In a second aspect of the invention, the anode is formed with holes such that adhesive material may be extruded into the holes and the adhesive heated in selected areas to effect local area cure in the adhesive to provide temporary holding of the anode in position while the remainder of the adhesive cures.

In a further aspect of the invention, the anode is fixed onto a sheet of shield material, of area extending beyond the perimeter of the anode, by suitable means which may include cement and/or fastenings and the sheet is formed with holes to accept adhesive extruded from the main layer of adhesive as the anode is pressed against the hull. Localized curing by heat is effected to initially tack the anode to the hull.

Referring to the drawing and initially to FIG. 1, there is shown an impressed current anode 10 fixed to a ship's hull 12 through layers or coatings 14 and 16 of electrically nonconductive curable adhesive such as epoxy type adhesive putty. In securing the anode 10 to the hull 12, the hull is sandblasted to provide a rough surface of projections to provide for better securement of the first coating 14 on the hull. The coating 14 is then applied and allowed to cure to hardened state to cover the projections in the hull surface and prevent the possibility of the projections piercing the second coating 16 and making electrical contact with the anode 12. The second layer or coating 16 is then applied either to the anode or to the coated section of the hull and the anode 10 is held in position against the hull to allow the second coat 16 to cure.

This method of attaching an anode to a hull has been found inexpensive, practical and reliable. No frames, brackets, belts, welds, or the like are required. No modification, weakening or variation on hull structure is required. Tests conducted have shown that the ohmic resistance between hull and anode is appreciably increased when two coatings are employed in the manner indicated as against one layer of the same thickness. It has also been found that thin anodes of large areas, i.e., anodes of $\frac{1}{16}$ " thick and several square feet in area are conveniently and securely attached by this method and provide improved ohmic resistance. Such anodes were difficult or impractical to attach by conventional means.

Referring to FIG. 2, a section of an anode of about $\frac{1}{8}$ " to $\frac{1}{2}$ " thick and several feet long is indicated at 18. Anode 18 may be prepared in a shop where work is more convenient or where it is desired to build up a stock of anodes. The anode 18 is formed with spaced holes 20 therealong through opposite faces and with a center hole 22 for penetration by a suitable stuffing box indicated at 19 in FIG. 3.

Referring to FIG. 3, the anode 18 is attached to a hull section 24 by the same method as described above in

relation to FIG. 1. That is, the hull section 24 is sandblasted. A first layer of adhesive 26 is applied to the sanded hull surface and allowed to cure. A second layer of adhesive 28 is applied to the cured layer 26 or to the anode 18. However, at this point an improvement in the method of attachment occurs. That is, the anode 18 is pressed against the coated hull section with sufficient force to cause a part of the coating 28 to extrude into the holes 20. The immediate effect is that resistance to lateral movement of the anode on the hull is developed by the extrusions and also additional resistance to removal of the anode from the hull is developed. This makes it easier to hold the anode in desired position on the hull. At this point, the worker then applies heat to local areas of the anode, as for example, by applying steam from a hose. The heat thus applied immediately begins polymerization at local areas of the second coating 28 and causes hardening in the heated areas. In this manner, the worker is able to tack the anode temporarily in place and leave it there for gradual curing of the remainder of the second coating. No special shoring or attachment tools or means are required. The installation is accomplished simply and reliably in a minimum amount of time. The hull structure is in no way affected as would be the case of welding, and no special hangers, bolts, or other means are required.

Referring now to FIGS. 4 and 5, an anode 30 is attached to shield sheet 32 of material impervious to water and of hardness of Rockwell R110 or above, and of thickness of $\frac{1}{16}$ " or above. Any suitable means may be employed to fix the anode 30 to the sheet 32, such as fittings or adhesives. An epoxy adhesive as shown at 34 in FIG. 5 is satisfactory. The area of the shield sheet is larger than that of the anode 30 and selected to shield the area of a hull as indicated at 36 to a desired extent, normally about four feet from the perimeter of the anode. The hull 36 is sandblasted and an adhesive 38 applied to the hull or to the shield sheet 32. The sheet as indicated at 40 is formed with a plurality of spaced holes to receive a portion of the adhesive 38 as the anode is pressed to the hull. Localized heat is applied to the shield, as for example, by a steam hose, to temporarily tack the anode and shield to the hull while the remainder of the adhesive layer 38 is curing. Normally it is not necessary to provide holes in the sheet 32 under the anode 30. However should the weight of the anode be such as to require tacking in the anode area, such holes may be formed. Also, if the anode to be attached is of the impressed current type, the provision of an additional adhesive layer following the procedure explained with respect to FIG. 1 will be desirable.

The provision of a composite shield sheet and anode ready for attachment to a hull materially speeds installation and the ability to form the shield and anode in the shop and stock the same is a further advantage.

A further advantage of providing a composite shield and anode rather than utilizing the conventional means of installing the anode on the hull and painting the hull about the anode is explained below.

The disadvantage of paint on a hull is that penetration of the paint by water wets the underside of the paint and causes it to curl, thus destroying the electrical shield formed by the paint as well as the efficiency of the anode. It has also been found that a shield of relatively soft material such as rubber, although impervious to water, will also eventually curl at the edges when submerged in water for long periods and made subject to lateral forces of water on the peripheral edges of the sheet.

However, a shield sheet impervious to water and of hardness of Rockwell M110 and above, and of thickness of $\frac{1}{16}$ " and above, will considerably extend the anode shield life.

From the above, it is evident that applicants' means and method of attaching an anode to a metal to be protected satisfies the objectives and advantages described hereinbefore and provides new and useful results.

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.

We claim:

1. The method of securing together an anode and a metal which have adjacent mating surfaces for the purpose of protecting the metal against electrolytic corrosion comprising:

forming a plurality of holes through said anode and its mating face,
applying a curable electrically nonconducting adhesive in uncured state as a coating on one of said mating surfaces,
applying a curable electrically nonconducting adhesive in uncured state as a coating on the other of said mating surfaces,
positioning said anode against said metal to lightly compress said coatings and to cause a part of said coatings to extrude into said anode holes,
applying heat to said coated anode at selected spaced limited areas to cause rapid curing of the adhesive in such areas to temporarily hold said anode to said metal while the remainder of said adhesive is gradually cured, and
passing a direct current between said anode and said metal.

2. The method of forming a shielded anode and securing the same to a metal for protecting the metal against electrolytic corrosion comprising:

attaching to one face of the anode a sheet of shield material of area sufficiently greater than the area of the anode to provide the necessary shielded area about the anode,
forming holes through said shield sheet at spaced intervals thereon,
applying a coating of uncured electrically nonconducting adhesive to the free face of said shield sheet,
pressing said coated sheet against said metal to cause a portion of said coating to extrude into said holes,
applying heat to said coating at selected spaced areas through said holes to cause rapid cure of the adhesive in said selected areas to temporarily hold said anode and shield in place while the remainder of said adhesive gradually cures, and
passing a direct current between said anode and said metal.

3. The method of securing an anode to a metallic surface for protecting the metallic surface against electrolytic corrosion comprising:

roughening said surface to provide projections,
applying a first coating of an electrically nonconductive curable adhesive to said surface and allowing the same to cure and cover said projections,
applying a second coating of electrically nonconductive adhesive to said anode,
positioning said anode against said coated surface and allowing said second coating to cure to effect an adhesive bond of said anode to said metallic surface, and
passing a direct current between said anode and said metallic surface.

4. The method of securing an anode to a metallic surface according to claim 3, including roughening said cured first coating to improve the bonding of said second coating thereto.

5. The method of securing an anode to a metallic surface against electrolytic corrosion according to claim 3, including

forming a plurality of holes through said anode to allow said second coating to extrude into said holes as said anode is positioned against said coated surface, and

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applying heat at selected areas of said anode to effect
a quick cure of portions of said second coating to
temporarily hold said anode in position for gradual
curing of the remainder of said second coating.

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