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BILGE KEEL ANODE  
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FIG. 1.

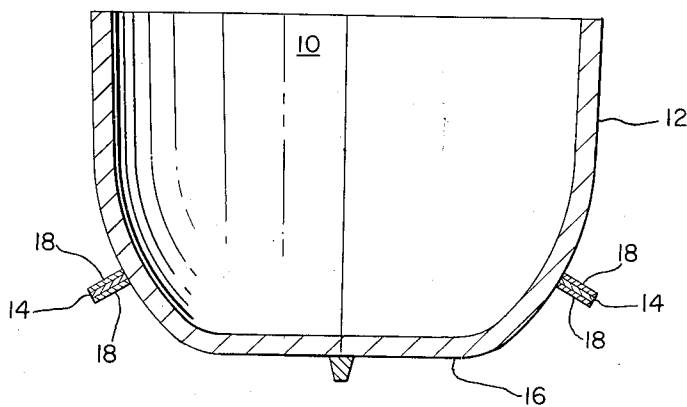
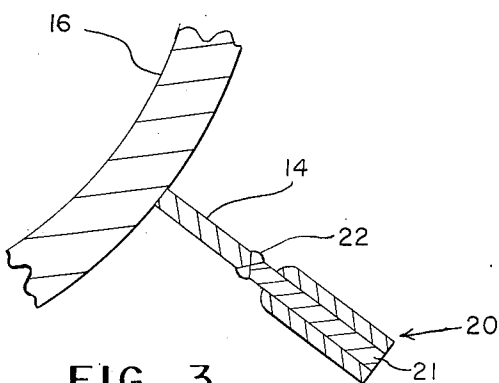


FIG. 3.

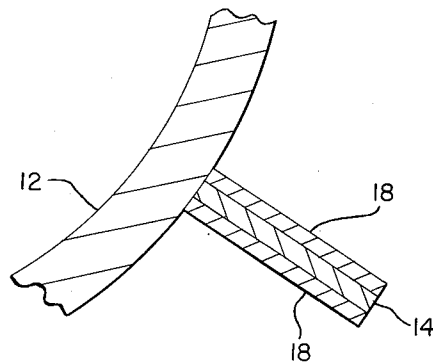


FIG. 2.

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## BILGE KEEL ANODE

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3 Claims. (Cl. 204—197)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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.

The present invention relates primarily to the cathodic protection of corrosible materials. More particularly, the invention concerns an improved method and means of providing a sacrificial anode for cathodically protecting the metallic structure of a sea going vessel from corrosion.

Generally, when two dissimilar metals are immersed in an electrolyte and are in electrical contact with each other, a primary or galvanic electric cell is established with the effect that an electric current flows from the metal having the higher order in the electromotive series to the other metal. The action of this current is to cause corrosion of the metals involved. To prevent this corrosive action, it is common practice to provide a sacrificial anode in electrical contact with the metals to be protected for producing an electric current which acts to neutralize the currents produced by the metals to be protected. The sacrificial anodes, which may comprise bars of magnesium, zinc, aluminum or other metals having a higher order in the electromotive series than the metals to be protected, are slowly dissipated in this process but are considered expendable since the desired action of corrosion protection is effectively accomplished.

Because of its simplicity and effectiveness, cathodic protection of sea going vessels has attained widespread usage. The usual procedure for protecting a vessel is to attach one or several sacrificial anode bars to that portion of the ship's body which will be immersed in the sea water electrolyte.

In the past, it has been customary to simply attach the anodes to the ship members by bolting the anodes in position. However, such bolting methods have not been too satisfactory inasmuch as a good electrical contact between the anode and its supporting member is never a certainty, and the bolting, if faulty, results in the anode giving a poor performance as a corrosive protective device. Moreover, this attachment of separate anodes to the hull or other portions of the vessel generally involves a number of fabrication problems which require large expenditures in time and labor. Another undesirable factor arising from bolting the anodes into position is the fact that the faying surfaces as well as the bolt holes of the anode must be carefully prepared with a waterproof material to prevent the anode material from dissipating and accumulating adjacent the faying and bolt joints. Such action causes a loosening and eventual disattachment of the anode from its support. Furthermore, as the sacrificial anodes are slowly dissipated in the electro-chemical action, the securing bolts which hold the anodes in position protrude above the body of the anode. Since the anodes are attached to the vessel's underbody and are immersed in sea water, these protruding bolts increase the water resistance of the vessel and therefore, reduce the speed of the vessel.

One object of the present invention is to overcome the

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foregoing difficulties by providing an improved method and means for applying and retaining the sacrificial anodes to the body of a cathodically protected vessel.

Another object of the present invention is the provision of a galvanic anode for a vessel structure that permits of simple and easy fabrication or renewal.

A further object of the invention is to provide a sacrificial anode which introduces negligible resistance to a vessel's underbody during the life of the anode.

Still another object of the present invention is the provision of a method and means for attaching a sacrificial anode to the body of a vessel which insures intimate electrical contact between the anode and its supporting structure at all times.

A still further object is to provide a method and means for applying an anode to the body of a vessel that eliminates the necessity of protecting the faying and joint surfaces of the anode.

Other objects and many of the attendant advantages of this invention will be readily appreciated as soon as the same becomes better understood in connection with the following detailed description when considered in connection with the accompanying drawing wherein:

Figure 1 is a fragmentary, cross-sectional view of a sea-going vessel having the instant invention incorporated thereon;

Figure 2 is an enlarged cross-sectional view showing the detailed application of the instant invention to a bilge keel of Figure 1; and

Figure 3 is an enlarged cross-sectional view showing a method of incorporating the instant invention to a bilge keel of an existing vessel.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Figure 1 a fragmentary cross-sectional view of a conventional sea-going vessel 10 having a hull or shell 12, and a pair of bilge keels 14. These components, which are formed from suitable metals, usually steel, are necessarily immersed in or in contact with sea water. Since sea water is an electrolyte, electric galvanic action will exist between different parts of the wetted structure of the ship. Consequently, the surfaces of these components are subjected to corrosion and deterioration.

In order to protect the metal surfaces of the vessel, sacrificial metal anodes 18 are placed on and in electrical contact with the vessel body in such a manner that the anodes are immersed in sea water. Preferably, the sacrificial anodes are placed in electrical contact with the bilge keels 14 but it will be apparent that the exact placement of anodes 18 on vessel 10 may be varied in accordance with the particular cathodic current requirements which it is deemed necessary for optimum protection of the vessel. By placing the anodes on the bilge keels 14, however, it is found that a better cathodic current distribution may be obtained.

In accordance with the invention and as best shown in Figure 2, the cathodic sacrificial anode 18 is applied directly to the surface of its metallic supporting structure and firmly retained in position by an intermetallic adhesion or bond. The anodic material preferably is intermetallically adhered to its supporting structure by cladding, i. e. rolling the anodic material upon its metallic supporting structure although other intermetallic adhesion methods may be employed. Some examples of the latter may include casting or plating the anodic material upon its supporting structure. It will be apparent that by intermetallically applying the material to its supporting structure, the material will adhere to its supporting structure along its entire length and besides being securely retained thereon, will always be in good electrical contact there-

with. Additionally, the joint is always intimate and not significantly exposed to sea water at any time.

To form sacrificial anodes for a vessel, an integral part of the vessel, as for instance, the bilge keels 14, are formed in accordance with the structural design of the vessel and of the desired structural material. This material in a vessel is usually steel and more generally, a mild steel. A layer of suitable sacrificial anode material is then intermetallically adhered to the outer surface or surfaces of the formed part as by cladding. Suitable anodic materials may include substantially pure metals or metal alloys. One example of the latter is aluminum alloy comprising 1% zinc and 99% aluminum. Other suitable materials may comprise any metal having a higher order in the electromotive series than the metal to be protected and may include metals such as zinc and magnesium.

Preferably, the anode material is applied on bilge keels 14 to a thickness approximating a quarter of an inch. This dimension, however, is not to be considered as limiting inasmuch as the desired service life of the anode is determined by its total current capacity and, thus, its thickness and area. After application of the anode material to the bilge keels, the keels are then assembled upon the vessel in its usual manner.

It will be apparent from the above that due to intermetallic adhesion of the anodic material to the vessel structure, a positive electrical contact is assured at all times. Moreover, since the material is intermetallically bonded, fabrication, securing and fluid resistance problems which ordinarily appear whenever the material is secured to the core by separate fasteners are eliminated.

Figure 3 discloses a manner in which existing vessel structures may be modified or renewed with intermetallically adhered anodes and which, for purposes of illustration only, is shown in conjunction with a bilge keel 14. To this end, a section width having a contact area determined by anode current requirements is initially removed from the existing bilge keel. Removal may be by flame cutting methods or the like. A new keel section 20 having the same core scantling as the removed section and formed of anodic clad or adhered plate is then prepared and secured in the original position by suitable means such as butt welding 22. In order to secure section 20 in position, the core 21 of replacement section 20 is stripped of anodic material immediately adjacent the attaching end and the weld made between the core of section 20 and the original structural portion of bilge keel 14. Since the core of the replaced section is of the same scantling as the original portion, it will provide sufficient structural strength for the purpose intended. Therefore, it will be

appreciated that the dissipation of the anode will not structurally affect the vessel but while present, will aid in performing the function of a bilge keel.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be protected by Letters Patent of the United States is:

1. In the cathodic protection of a metallic vessel having a bilge keel, a sacrificial galvanic anode comprising an electrically conductive bilge keel in electrical contact with said vessel, and a sacrificial metal coating placed on said bilge keel, said metal coating having two major surfaces with one of such surfaces being metallicity bonded throughout its entire area to a corresponding area of said bilge keel and the other of said major surfaces being exposed.

2. In a ship's hull, a bilge keel comprising a first portion adjacent the hull and a second portion away from said hull, said portions having edges welded together, said second portion comprising a section having an anodic protective metal metallicity bonded thereto throughout substantially the entire area thereof.

3. In combination, a vessel's hull and a bilge keel for said hull, said bilge keel consisting of an elongated electrically conductive metal plate and a thin layer of anodic protective metal on each side of said metal plate, said metal plate being longitudinally secured along one edge to an outer wall of said hull by an electrically conductive connection, said anodic protective metal being a metal having a higher order in the electromotive series than said metal plate, and each of said layers of anodic protective metal being metallicity bonded to said metal plate throughout the entire area of such layers to thereby eliminate local galvanic action between the metal plate and the layers of protective metal, whereby said anodic protective metal serves the dual function of cathodically protecting the vessel's hull and acting as a functional member on said hull.

#### References Cited in the file of this patent

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