

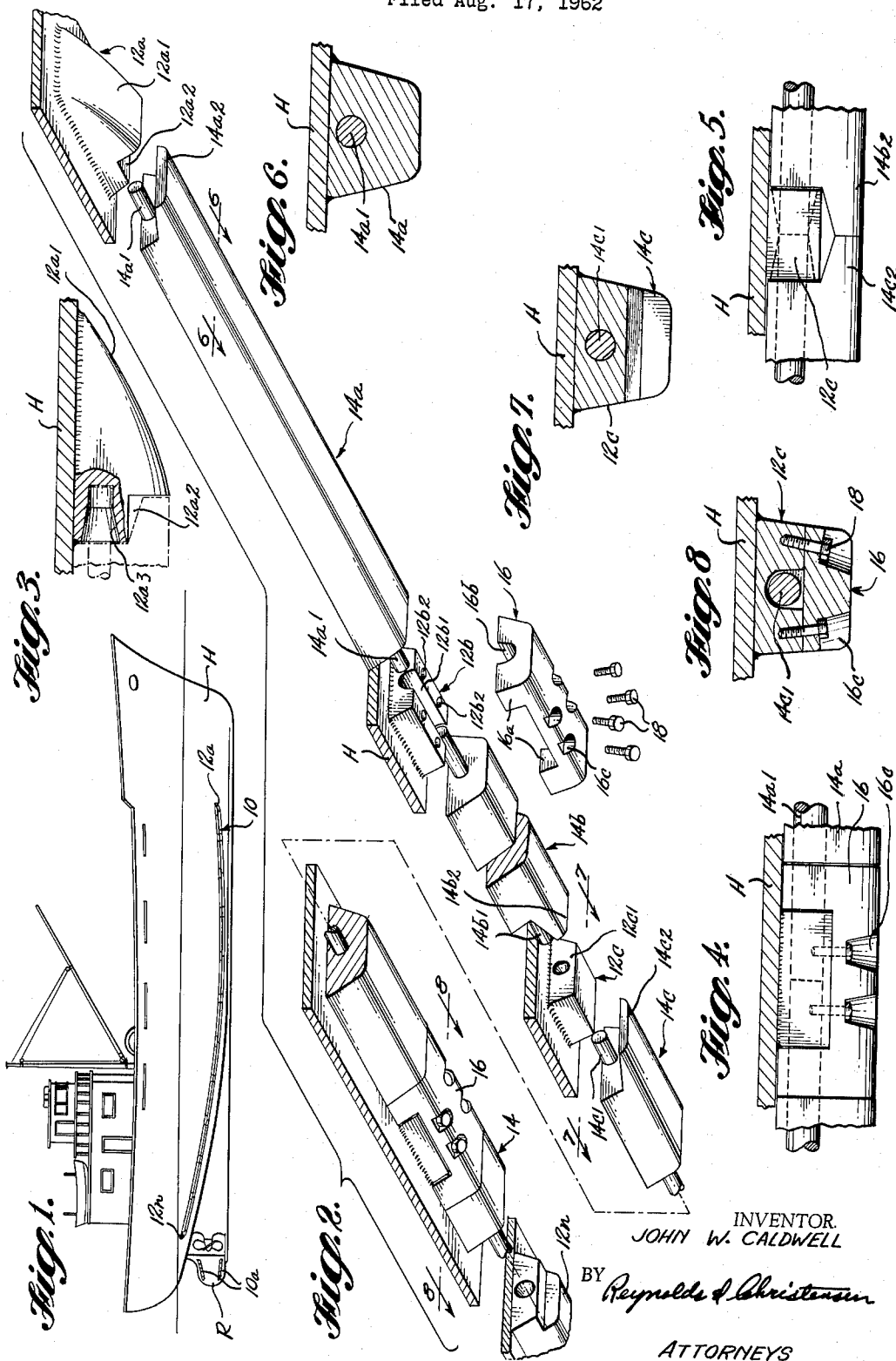
Feb. 1, 1966

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3,232,857

CATHODIC PROTECTION ANODE STRUCTURE

Filed Aug. 17, 1962



CATHODIC PROTECTION ANODE STRUCTURE
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Filed Aug. 17, 1962, Ser. No. 217,575

11 Claims. (Cl. 204—197)

This invention concerns improved sacrificial anodes used in cathodic protection of boat hulls and similar metallic structures subjected to electrolytic deterioration. A broad object of the invention is to provide an improved anode structure including means for attaching sacrificial anodic bodies to the hull without necessity for bolted connections or repeated weldings of and to the hull metal. The invention is herein illustratively described by reference to the presently preferred embodiment thereof; however it will be recognized that certain modifications and changes therein with respect to details may be made without departing from the essential features involved.

Current practice in the mounting of sacrificial anodes of low potential, such as those which comprise or include zinc, magnesium or aluminum, is to cast a steel core in the anode metal body and weld or bolt the core to the hull. Such anodes are usually mounted on the hull at a spacing of several diameters between anodes. In some instances arrays of these anodes have been mounted by bolting the same to studs which, in turn, were welded to the hull.

A further object hereof is to devise a compact, rugged and efficient anode structure which lends itself to smooth contouring so as to present minimum drag, and minimum likelihood of being scraped or torn loose. With the present structures, metallurgical integrity (i.e. by welding, casting or equivalent bonding method), and thereby better electrical conductivity, are achieved to a degree not practically attainable with bolt connections or other previous techniques which avoided the necessity for rewelding of anodes or anode cores to the hull when anodes were replaced. As a result, these improvements achieve a high degree of anode efficiency without danger of creating the highly stressed spots in hull plates characteristic of prior weld-attached anodes. A related object of this invention, therefore, is to devise an anode structure using a direct and permanent welded connection to the hull proper and metallurgical connections between the hull metal and anode metal through a mounting arrangement which permits anode blocks or bars to be replaced readily without disturbing or repeating hull welds. Furthermore, the present system assures a consistently low-resistance electric current path between the anode metal and the hull metal throughout the expendable life of the anode while attaining the other objectives set forth.

A specific object is to provide such an anode structure and mode of attachment in which support metal in the attaching brackets and anode cores are physically and electrically protected by sacrificial anode metal throughout anode life. A corollary object is to devise a cathodically protected anode mounting system providing maximum physical support and protection to the relatively soft anode metal bars.

In accordance with this invention, bars of sacrificial anode metal are mounted in serial relationship upon the boat hull or other surface by attaching elements which are more positive galvanically than the bar metal. These attaching elements comprise support rods projecting endwise from the bars and in metallurgical engagement therewith. The support rods in turn engage mounting brackets which are in permanent metallurgical engagement with the hull surface. The support rods and at least certain brackets are temporarily connected in metallurgical manner, as

by welding, such that when anode bars are expended severance of the support rods from the associated brackets is possible without disturbing the metallurgical engagement of the brackets with the hull.

The endmost brackets comprise protective nosings which are faired to the flow of water along the hull and thereby serve as deflectors which assist in the minimizing of damaging physical contact between underwater obstacles and anode bars. In turn, the brackets are cathodically protected by the bars themselves or by anode metal caps, and in the preferred forms the bars have flanges projecting endwise which protectively overlap the brackets. At least certain of the brackets have steps therein into which the flanges are protectively recessed. Moreover, sockets formed in the brackets receive the support rods, and in the case of intervening brackets, at least one or more of these comprise cradle-like recesses which permit engagement of the support rods therein by lateral movement of the support rods into the sockets after the support rods at the opposite ends of such bars have first been inserted endwise into socket holes in the adjacent brackets. Such arrangements provide physically integrated, compact structures and permit permanent welding of the brackets to the hull while allowing subsequent removal and insertion of anodes as anodes are expended.

These and other features, objects and advantages of the invention will become more fully evident from the following description thereof by reference to the accompanying drawings.

FIGURE 1 is a side elevation of a vessel having the present cathodic protection means in one form installed thereon;

FIGURE 2 is an exploded isometric view of a representative assembly of anode bars and support brackets used in such an installation;

FIGURE 3 is a fragmentary side view of a nosing bracket installed;

FIGURE 4 is a fragmentary side view of one intermediate bracket, its protective anode metal cap, and portions of the adjacent core-mounted anode bars;

FIGURE 5 is a fragmentary side view of a second intermediate bracket with its associated anode bars shown fragmentarily with their cores engaged with the bracket;

FIGURE 6 is a transverse sectional view taken on line VI—VI in FIGURE 2;

FIGURE 7 is a transverse sectional view taken on line VII—VII in FIGURE 2; and

FIGURE 8 is a transverse sectional view taken on line VIII—VIII in FIGURE 2.

Referring to the drawings, there is illustrated in FIGURE 1 an anode structure 10 mounted in longitudinally-extending position adjacent the bilge line of the boat hull H, together with shorter and smaller anode structures 10a of generally similar nature mounted along the top and bottom edges of the rudder R. One or more anode structures 10 may be mounted on the hull H at each side of the keel. Preferably these structures are continuous throughout their length, although they may be of interrupted form. Such structures, as shown in FIGURE 2, for example, comprise a series of successively-spaced mounting brackets 12a, 12b, 12c . . . 12n usually of steel and permanently welded to the hull in positions of longitudinal alignment thereon, and intervening anode metal bars 14a, 14b, 14c . . . 14(n-1). The anode bars have supporting core rods therein to be described. The brackets and anode core rods are or should be of similar metal having a galvanic potential which is positive in relation to that of the anode metal (i.e. galvanically cathodic with respect to the anode metal).

The individual anode bars comprise elongated solid bars of anode material such as zinc, magnesium or aluminum, or alloys thereof. Each has a core rod, ends of

which project through and beyond the bar end faces. This core rod is in metallurgical contact with the bar metal and serves as a permanent support and electrical hull connector for the anode metal of the bar throughout the useful life of the anode. The core rod may be of steel or similar structural metal, preferably similar to that used in the boat hull or other surface being protected. Usually the core rod is embedded in the anode metal bar by casting the latter around the core rod.

The endmost brackets 12a and 12n comprise nosings which are faired in order to minimize drag. Thus the forward end of forward bracket 12a is rounded at 12a1. Its after end has a step 12a2 which extends across the width of the bracket. Between the step and the base of the bracket, lying in welded contact with hull H, the after end face of the bracket has a longitudinally directed hole 12a3. This hole serves as a socket for an anode body support rod or core 14a1. Preferably this socket hole has a flared entrance permitting tilting the support rod in relation to the hole axis when inserting and removing the support rod as will later be explained. The width of the brackets measured transversely of the elongated anode structure preferably corresponds to that of the anode bars.

Preferably there are, in a series structure comprising two or more anode bars, brackets positioned intermediate the endmost brackets. A first type of intermediate bracket 12b comprises a block of generally rectangular cross section having a cradling recess 12b1 extending longitudinally in its outside face. This cradling recess is of semicylindrical form and receives the projecting core rods of adjacent anode bars such as bars 14a and 14b. Bolt holes 12b2 in the outside face of the block 12b receive bolts 13 to hold an anode metal cover cap 16 in protective position overlying the block 12b and anode core rods. Leg portions 16a project toward the hull H at opposite ends of the cap 16 adjacent opposite sides of the core rods. These leg portions serve as spacers interposed between the mutually adjacent ends of the anode bars 14a and 14b and the respective end faces of the bracket 12b as a means to close the gap formed therebetween when the anode bars are installed by sliding their opposite core rods endwise into sockets of cooperating brackets. With the anode bar core rods thus socketed in bracket 12b metallurgical contact therebetween is completed by welding the core rod to the bracket along one or both edges of the recess 12b1. Grooves 16b in the protective anode metal cap 16 afford socket space complementary to that of the cradle recess 12b1 accommodating the core rods 14a1.

The second type of intermediate bracket 12c has generally rectangular proportions with flared socket holes 12c1 formed in opposite ends thereof to receive the adjacent anode bar core rods, such as 14b1 and 14c1, respectively. Engagement of the core rods in these sockets 12c is effected in the same manner as with the sockets in the endmost brackets 12a and 12n, namely by endwise insertion movement initially with the anode bar tilted to clear brackets of the 12b type, then by continuation of such movement with the bars extending parallel to the hull (i.e. with the cradle recess 12b1 slidably contacted by the associated core rods).

Each of the anode bars has a protective overhang or flange projecting endwise from its outer side at one end of the bar. These flanges on the bars serve electrolytic protective functions. Thus the flange 14a2 on anode bar 14b overlaps and protectively covers the core rod 14a1 and the stepped portion of bracket 12a. The flange seats in the recess afforded by step 12a2 and is thereby physically protected by the bracket. Flange 14b2 overlaps and protectively covers a portion of bracket 12 (FIGURE 5). The remainder of this bracket is similarly overlapped by flange 14c2 of anode bar 14c. One arrangement of successively abutting anode bars and cap(s) is such that a substantially continuous anode metal surface is presented to the slip stream of the vessel. The faired nosings at the ends and the low outline of this continuous line of elements

minimizes drag and likelihood of banging upon or being caught and damaged by underwater obstacles.

Depending upon the desired total length of the chain of elements in the anode structure there may be any desired number of brackets of the type represented by bracket 12b and a related number of the type represented by bracket 12c, such brackets alternating along the chain of elements.

In the installation of such an anode structure the nosing brackets and intermediate brackets are first welded in place to the vessel hull H. These are permanent welds and are not to be disturbed during the entire life of the hull or anode system used with the hull. However, the core rods of the anode bars are welded lightly to the respective brackets 12b. The welds between core rods and brackets 12b are easily cut or "washed" away with a torch when anode bars are to be replaced. The core ends which engage in the socket holes of brackets 12a, 12c and 12n are not welded to those brackets. The total arrangement provides metallurgical, hence electrical, continuity between the metal of the ship's hull H and the metal in the anode bars 14. It assures uniformity of electric resistance and thereby uniform current for cathodic protection of the ship's hull.

These and other aspects of the invention will be recognized by those skilled in the art on the basis of the foregoing disclosure of the presently preferred practices thereof.

I claim as my invention:

1. A cathodic protection structure for a metallic boat hull surface, comprising a plurality of sacrificial anode metal bodies each having a core element of metal metallurgically retained therein and galvanically cathodic with respect to said metal bodies, said elements having end portions projecting endwise from the bodies, opposite end brackets and an intermediate bracket of metal galvanically cathodic with respect to said bodies permanently welded to the hull surface to be protected and spaced in tandem serial relationship, said brackets having sockets therein receivingly engaged with said core element end portions and in metallic contact therewith, said end sockets having one end enclosed by said end brackets and one end open to receive a core end, thereby to support said bodies in serial relationship alongside the surface, the core element end portions received by the intermediate bracket being welded thereto by a temporary, severable weld.

2. The structure defined in claim 1, wherein the respective opposite end brackets have opposingly directed holes therein comprising the sockets thereof which receive the core element end portions of the endmost sacrificial metal bodies, and the intermediate bracket has an open sided cradling recess therein comprising the socket thereof.

3. The structure defined in claim 2, wherein the outwardly presented side of each end bracket has a step therein disposed between the outermost surface of the bracket and the socket, and the respectively adjacent metal body ends each have a flange projecting endwise therefrom received in the space formed by the step.

4. The structure defined in claim 3, wherein said intermediate bracket includes a removable cap of metal galvanically similar to the metal bodies, which cap covers said cradling recess thereby to protectively cover the core end portions socketed therein.

5. The structure defined in claim 3, including an additional intermediate bracket permanently welded to the hull surface and in tandem with the other brackets and having socket holes facing endwise and receiving core elements of the adjacent anode metal bodies, the latter having flanges of the same metal as the anode metal projecting endwise which overlie and thereby protect such additional bracket.

6. In combination with a metallic surface to be protected against electrolysis, a chain of sacrificial anode metal bars in tandem serial relationship each having a

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support rod projecting endwise therefrom of a metal which is galvanically more cathodic than the bar metal and which is in metallurgical bonded relationship therewith, a supporting bracket permanently joined to the surface in metallurgical relationship therewith and severably joined in metallurgical relationship to the support rods of two such bars, and terminal faired nosing brackets supportingly connected to and in direct metallic contact with the endmost support rods and permanently joined to the surface in metallurgical relationship, said brackets being of a metal which is more galvanically cathodic than the bar metal, said terminal brackets having sockets having one end enclosed by the bracket and one end open to receive a support rod.

7. A cathodic protection expendable anode member mountable on support brackets, comprising an elongated anode metal bar, and a support element galvanically cathodic with respect to said bar, metallurgically joined to said bar, and projecting endwise from the ends thereof, said anode bar having an integral flange portion of the same metal as the anode metal projecting endwise from one end thereof in spaced relation to the adjacent support element.

8. A nosing bracket for a boat hull cathodic protection anode structure comprising at least one anode bar of sacrificial anode metal having a support rod projecting endwise therefrom of a metal which is more galvanically cathodic than the bar metal, said nosing bracket comprising a block of metal galvanically similar to the support rod and having a surface to be welded to a boat hull, said block being faired at one end for streamlining and having a step formation in its opposite end, including a first face transverse to and adjacent to said hull-contacting surface and a second transverse face offset endwise from the first face toward the faired end of the block, and a rod-receiving socket hole formed in one such face opening endwise of the block.

9. In a cathodic protection system for a metallic boat hull surface, a succession of sacrificial anode metal bodies of elongated form extending along the hull surface, each having a core element of metal metallurgically retained therein and galvanically cathodic with respect to said metal bodies, said elements having end portions projecting endwise from the bodies, and means permanently joined to the hull surface supporting said bodies removably but in electrically contiguous relationship therewith, including opposite end brackets and at least one intermediate bracket being permanently welded to the hull surface in longitudinally spaced serial relationship, said brackets having sockets therein receiving and in metallic contact with said core element end portions, thereby to support said bodies in spaced tandem relationship alongside the surface, said brackets being of a metal galvanically more cathodic than said bodies, the core element end portions received by the intermediate bracket being welded thereto by a temporary severable weld, and the outer ends of the terminal bodies in said succession having flanges of the same metal as the anode metal project-

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ing endwise which protectively overlies the respective end brackets to which they are joined, the latter each having a step therein in which one of said flanges is recessed.

10. In a cathodic protection system for a metallic boat hull surface, a succession of sacrificial anode metal bodies of elongated form extending along the hull surface, each having a core element of metal metallurgically retained therein and galvanically cathodic with respect to said metal bodies, said elements having end portions projecting endwise from the bodies, and means permanently joined to the hull surface supporting said bodies removably but in electrically contiguous relationship therewith, including opposite end brackets and at least one intermediate bracket being permanently welded to the hull surface in longitudinally spaced serial relationship, said brackets having sockets therein receiving and in metallic contact with said core element end portions, thereby to support said bodies in spaced tandem relationship alongside the surface, said brackets being of a metal galvanically more cathodic than said bodies, said end brackets having faired nosings protectively terminating the succession of anode metal bodies and projecting laterally outward from the hull surface substantially at least as far as the adjacent metal bodies joined thereto, the core element end portions received by the intermediate bracket being welded thereto by a temporary, severable weld.

11. In combination with a metallic surface to be protected electrolytically, a bar of sacrificial anode metal, spaced support brackets in tandem serial relationship permanently joined in metallurgical relationship to the surface, and a support rod permanently joined metallurgically to said bar and projecting therefrom into supported engagement with the respective brackets, a first one of said brackets comprising a faired protective nosing for the adjacent bar and into which said support rod is socketed, said support rod and a second one of the brackets being joined metallurgically in severable manner to permit replacement of the bar when expended, said brackets and said rod being of metal which is more galvanically cathodic than the bar metal, and cover means made of the same metal as the bar metal disposed in protective relationship with respect to the juncture of said last named rod and bracket.

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