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Wilson et al.

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[54] **SACRIFICIAL ANODE**

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Related U.S. Application Data

[63] Continuation of Ser. No. 214,207, Dec. 30, 1971, abandoned.

[52] **U.S. Cl.** ..... **204/197,** 204/286, 204/297 R

[51] **Int. Cl.** **C23f 13/00**

[58] **Field of Search** ..... 204/148, 197, 286, 297 R, 204/297 M

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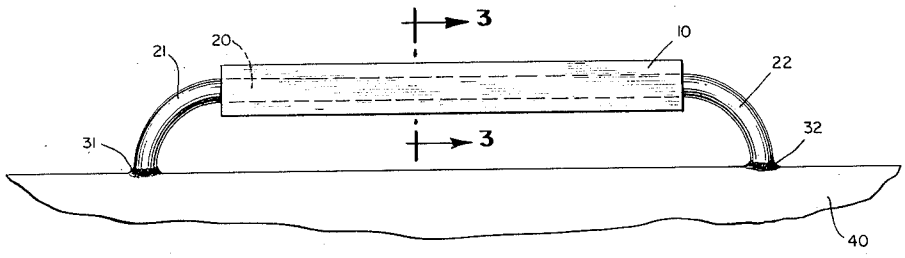
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[57] **ABSTRACT**

The opposite ends of the pipe core of a sacrificial anode are bent 90° through an arc having a relatively short radius, of the order of about four times the diameter of the pipe core.

2 Claims, 4 Drawing Figures



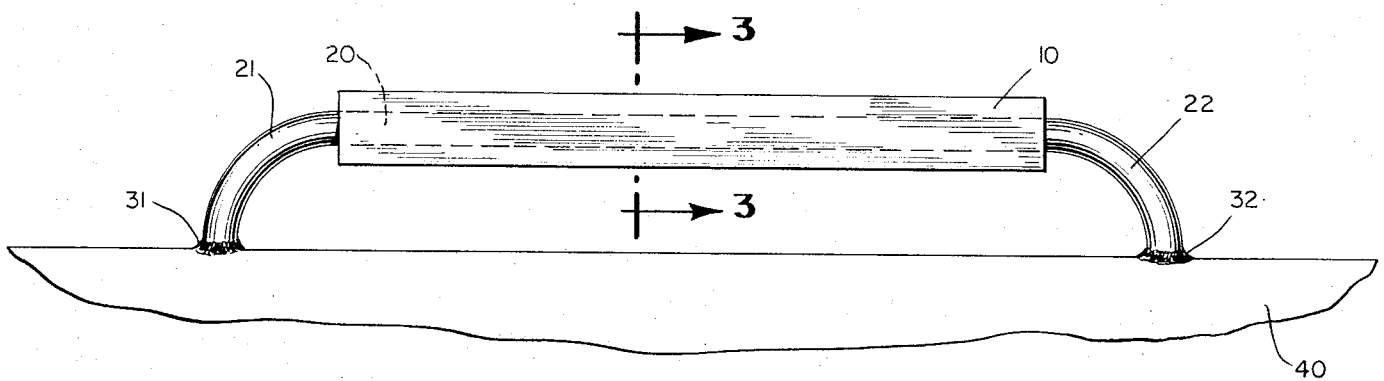


Fig. 2

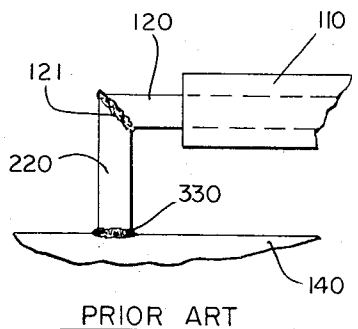


Fig. 4

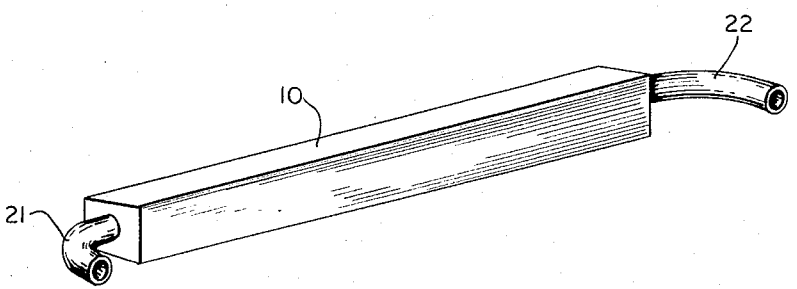


Fig. 1

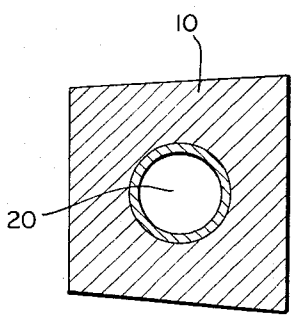


Fig. 3

SACRIFICIAL ANODE

This is a continuation of application Ser. No. 214,207 filed Dec. 30, 1971, now abandoned.

BACKGROUND OF THE INVENTION

In the electrolytic corrosion of metals, some parts of the surface act as anodes whereas other parts act as cathodes. The anode parts corrode. The cathode parts do not corrode. Protection against such type of corrosion may be provided by making the whole surface of the metal cathode to a separate anode. Sufficient voltage must, however, be available between the two electrodes. Sacrificial anodes of zinc, magnesium, or aluminum alloy may provide the potential. These metals are chemically reactive with the sea water which acts as the electrolyte, and the sacrificial body is gradually dissolved and destroyed. This type of protection is known as cathodic protection. It has been used to inhibit corrosion in a wide variety of submerged facilities and equipments, including underground and undersea pipe lines, and the submerged structures of drilling platforms, derricks, steel ship hulls, and others. The protection is provided by welding sacrificial anodes at spaced intervals along the undersea pipe, or at spaced apart locations on the submerged structures of the drilling platforms, derricks, and steel ship hulls. Such sacrificial anodes have heretofore consisted of zinc, magnesium, or aluminum alloy supported on a straight pipe core the opposite ends of which are beveled and welded by mitered joints to the ends of stanchions or support posts disposed at right angles thereto. The terminal ends of the support posts are then welded to the undersea pipeline, platformderrick structure, or steel ship hull.

In the prior art sacrificial anode structures decribed above, mechanical failures have frequently occurred at the mitered joints, making it necessary to repair or replace the structure before the sacrificial material has been fully consumed. These mechanical failures have resulted from the physical shock, stresses, and forces of the sea to which the sacrificial anode structures are subjected. In an effort to avoid or reduce the frequency of such mechanical failures, efforts have been made to achieve deep penetration welds, with X-ray examination of the welds a part of the inspection procedure.

SUMMARY OF THE INVENTION

A primary object of the present invention is to provide a sacrificial anode structure which is not subject to mechanical failure and which will last until the sacrificial material is consumed.

A more specific object is to provide a sacrificial anode structure which does not require a welded mitered joint.

The foregoing objects are achieved by providing a steel pipe core the projecting opposite ends of which are bent 90° through a relatively short arc. We have found that the opposite ends of a 4 inch schedule **80** steel pipe may be bent 90° through an arc of short length and small radius by placing the pipe core in a jig in a heavy press and bending the opposite ends of the pipe simultaneously. The terminal ends of the bent steel pipe core, which carries the sacrificial anode material on its straight center portion, are welded in the usual manner to the undersea pipeline or steel ship hull which is to be protected.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a sacrificial anode structure according to the present invention.

FIG. **2** illustrates the sacrificial anode of FIG. **1** welded to a pipeline, or ship hull, or other body to be protected against corrosion.

FIG. **3** is a view, in section, looking along the line **3—3** of FIG. **2.**

FIG. **4** is a fragmentary schematic illustration of the mitered joint of the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **1, 2** and **3,** a body **10** of sacrificial anode material, which may be zinc, magnesium or aluminum alloy, is supported on a one-piece steel pipe core **20.** Opposite end portions **21** and **22** of pipe core **20** are bent through an angle of 90° along an arc whose radius is relatively short.

In a typical case, the body **10** of sacrificial anode material may be 96 inches long and have a generally square cross-sectional configuration with the lengths of the sides being of the order of ten inches. Actually, two of the opposite sides of the sacrificial body are usually not parallel but are inclined slightly toward each other. Typical dimensions may be 9.6 inches each for the non-parallel inclined sides, 9.1 inches for the short-dimension side, and 10.6 inches for the long-dimension side. The anode structure may weigh of the order of 725 pounds. The steel pipe core **20** may be 4-inch schedule 80 steel pipe having an outside diameter of 4.5 inches an inside diameter of 3.826 inches, and a wall thickness of 0.337 inches. Pipe **20** may have a total length of the order of 154 inches, and the opposite ends **21** and **22** may each have a straight length of about 29 inches beyond the 96-inch anode body **10.** These 29-inch ends **21** and **22** are bent 90° on a radius of 16.0 inches, as measured to the center axis of the pipe core **20,** with the terminal end of the bent pipe extending tangentially for three-fourth inch. When so bent, the over-all length of the structure is 132.5 inches. Bending of the 4-inch steel pipe is accomplished by placing the pipe in a jig and employing a powerful press to simultaneously bend the opposite ends of the pipe.

It will be understood that the foregoing dimensions and values are only illustrative and that cores for anodes may be formed out of steel pipe in sizes other than 4 inches and that the radii may be other than four times the pipe size. Also, the anodes could weigh more or less than 725 pounds.

As illustrated in FIG. **2,** the terminal ends of the pipe core **20** of the sacrificial anode structure are welded as at **31** and **32** to the undersea pipe line, or the submerged structure of the derrick, or steel ship hull, indicated in FIG. **2** by the reference numeral **40.**

The sacrificial anode structure shown in FIG. **3** represents an important improvement over that heretofore available. It is very much stronger and much less susceptible to fracture and damage by the sea forces to which it is subjected. A fragmentary illustration of the prior art sacrificial anode is given in FIG. **4** of the drawing. It will be seen from FIG. **4** that the pipe core **120,** which carries the body of zinc, magnesium, or aluminum alloy **110,** is straight and is connected by a welded mitered joint **121** to pipe support **220,** which is welded at **330** to the pipeline **140** to be protected. The prior art

sacrificial anode structure illustrated in FIG. **4** is prone to fracture and failure at the mitered joint **121** and, in many cases, replacement of the sacrificial anode structure is necessary before the anode material **110** has been consumed. This is, of course, a very unsatisfactory situation. It makes it impossible to estimate in advance as to the expected life of the sacrificial anode, and makes frequent inspection necessary. This, of course, adds to the cost.

In contrast to the prior art structure illustrated schematically in FIG. **4**, the new structure illustrated in FIGS. **1, 2** and **3** will now have to be replaced until the sacrificial anode material **10** has been entirely consumed. The time when this should occur can be estimated in advance. Costly inspections prior to that time are avoided. When the sacrificial material is consumed, the protective structure is removed from the structure **40** being protected and a new sacrificial anode structure is welded thereto.

What is claimed is:

1. A sacrificial anode structure comprising:

a. a one-piece pipe core of 4-inch Schedule 80 steel pipe having an elongated straight central section and 90° arcuate sections at each opposite end of said straight section, the radius of curvature of said arcuate sections being about four times the diameter of the pipe core;

b. and a body of sacrificial anode material surrounding and supported by the elongated straight central section of said pipe, said central section of said pipe emerging from opposite ends of the body of anode material.

2. A sacrificial anode structure according to claim **1**, in which the total length of the pipe core is about 154 inches, the portion of the pipe core surrounded by anode material is about 96 inches, each arcuate section is bent on a radius of about 16 inches, and the resultant bent structure has an overall length of 132.5 inches.

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