

Dec. 24, 1957

R. H. McCALL

2,817,634

DEVICE FOR PREVENTING CORROSION

Filed Sept. 22, 1953

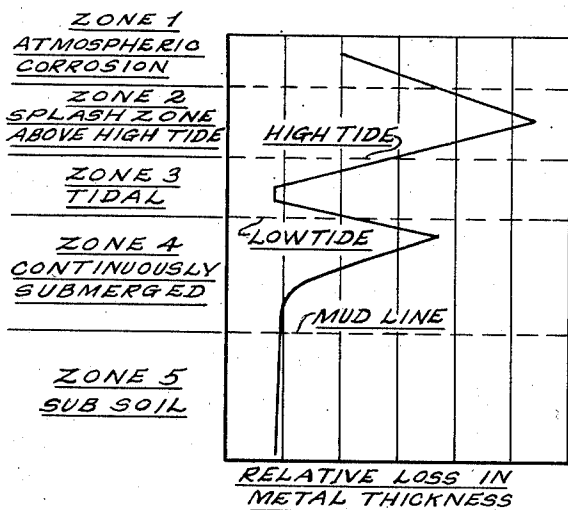


Fig. 1.

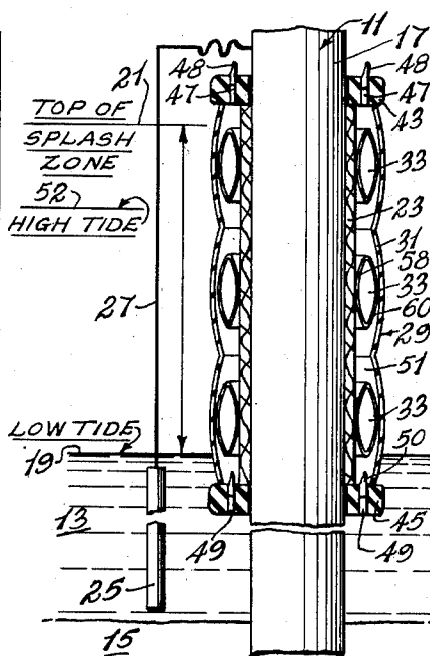


Fig. 2.

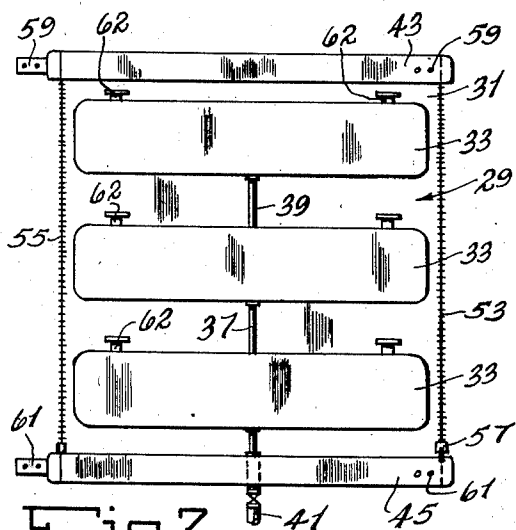


Fig. 3.

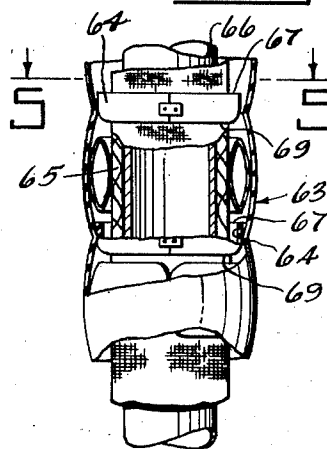


Fig. 4.

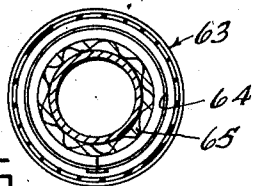


Fig. 5.

1

2,817,634

DEVICE FOR PREVENTING CORROSION

Richard H. McCall, Houston, Tex., assignor to The Texas Company, New York, N. Y., a corporation of Delaware

Application September 22, 1953, Serial No. 381,626

4 Claims. (Cl. 204—197)

This invention relates to a novel method of and device for protecting against corrosion a metal member having at least a part that is normally wet only intermittently by electrolyte from a body of electrolyte. More particularly the invention concerns protecting against corrosion such structural members as steel piling and oil well pipes which are located in the water of seas, lakes, marshes, and rivers.

In the drawings illustrating the present invention:

Figure 1 is a graph showing the relative amounts of corrosion occurring on various parts of an unprotected steel member exposed to the sea, based on "Corrosion," vol. 5, page 292;

Figure 2 is a vertical sectional view, parts being in side elevation, showing one form of device in accordance with the invention in position for protecting a structural member;

Figure 3 is a plan view showing a part of the device of Figure 2 opened up and in condition for application to a structural member;

Figure 4 is a vertical sectional view, parts being in side elevation, showing a modified form of device in accordance with the invention; and

Figure 5 is a cross-sectional view taken along the line 5—5 in Figure 4.

When metal structural members are employed in or near a body of water, for example, when offshore oil well drilling platforms are supported by vertical steel piles driven into the mud at the bottom of the sea, serious corrosion occurs not only of the part of the piling which is continuously submerged but also of the part above the low tide mark which is only intermittently wet by changes in the tidal level and by the splashing of waves.

Figure 1 shows that the maximum corrosion rate is in the splash zone (zone 2) above high tide, but that substantial corrosion also occurs in the tidal zone (zone 3) between the low and high tide marks. Cathodic protection reduces corrosion of parts of such a steel member while submerged (zone 4 continuously; and zone 3 only periodically), but serious corrosion still has occurred above the low tide mark.

It has been proposed to protect cathodically such metal members as steel piling and oil well flow pipes by maintaining in contact with at least the part of the structural member between the low tide mark and the top of the splash zone a layer of bibulous material which absorbs water at high tide and retains this water in wetting contact with the metal member after the tide has receded. Meanwhile a protective electrical current is impressed upon the metal member to counteract its normally anodic state and make it cathodic, thus reducing corrosion. The electrical current can be impressed in any desired way known to the art, but the use of a sacrificial metal anode is preferred.

While the method described above can be used successfully, when the structural member is subjected to blows, stresses, and scraping by the action of such equipment as barges and pile drivers the protective coating

2

of bibulous material may be seriously damaged and protection accordingly reduced.

In the following description the term "sea water" will be used for simplicity to describe one type of corrosive electrolyte to which metal members are exposed, but it is to be understood that the principles of the invention apply also when metal members are subject to corrosion by other electrolytes.

I have provided a novel method for cathodically protecting against corrosion a metal member having at least a part that is normally wet only intermittently by sea water, and which is subjected to physical contact with such equipment as barges and pile drivers, by maintaining a layer of bibulous material in contact with the exposed part, exposing the bibulous layer to the sea water whereby sea water is absorbed therein and retained during periods when the part is normally out of contact with the sea water, impressing a protective electrical current on the member, and maintaining an inflatable resilient buffer around and in contact with the layer of bibulous material for protection against damaging physical contact.

A protective electrical current can be impressed on the structural member by electrical connection to the negative pole of a battery or other source of direct current whose positive pole is connected to a nearby anode of metal, graphite, or the like submerged either in the sea nearby or in the bibulous mass; or by the use of a sacrificial anode of a metal or alloy which has a higher anodic solution potential than does the material of the structural member. For simplicity I shall describe a sacrificial metal anode which, when the structural member is iron, advantageously is formed of such metals as zinc, aluminum, magnesium, or alloys of these metals with one another. Magnesium and its alloys are particularly advantageous because of their high anodic solution potential to ordinary steel, which ranges from -0.7 to -1.3 volts. Metals above magnesium in the electrochemical series are not advantageous because they react so rapidly with water as to have an undesirably short life.

One specific device for performing the method described above is shown in Figure 2 wherein a steel structural member 11 such as a vertical pile or oil well pipe extends from above the surface of the sea 13 down into the latter and into the mud 15 at the bottom. The part 17 extending from slightly below the low tide mark 19 to slightly above the top of the splash zone 21 is surrounded by a layered mass 23 of bibulous material which absorbs sea water by contact therewith when the tide has risen and also by its wicking action even at low tide. Any suitable bibulous material may be used such as cotton wicking or an unconsolidated material such as bentonite held in position by a suitable retainer such as a cloth bag or woven wire screen. A material such as cotton wicking may be applied as a sleeve, or by winding a long tape helically around the member.

Protective electrical current is impressed upon the structural member 11 by a consumable anode 25 which is suspended in the sea 13 and is connected by a conductor 27 to the member.

The layered mass of bibulous material 23 is held firmly in position and is protected by an inflatable jacket 29 of flexible resilient protective material such as heavy rubber or a synthetic resin such as vinyl plastic or polyethylene which is positioned around and encloses it. Jacket 29 comprises an outer layer 31 and one or more inflatable compartments 33 which are carried by the outer layer 31. The three compartments 33 shown by way of illustration are connected together by conduits 37 and 39 so that when air or other inflating fluid is introduced through a valved conduit 41 attached to one compartment it also flows into

the others. Independently inflatable compartments also may be used to preclude collapse of all compartments if one is punctured.

At the top and bottom of the outer layer 31 are vulcanized or otherwise secured two collars 43 and 45 of rubber or the like which are heavy enough to take a severe battering when fluid-tightly engaging the structural member above and below the layer 23. Collars 43 and 45 have ducts 47 and 49 extending longitudinally there-through for the flow of fluids such as sea water and air to and from the annular space 51 between the jacket and the structural member. Ducts 47 may be open, or may comprise one-way vent valves such as rubber nozzles 48 through which air is vented as the tide rises, but which close as the tide falls, to retain a column of sea water in space 51. Similarly ducts 49 may be open or may include one way valves 50, which open as the tide rises to permit flow of sea water into space 51, but which close as the tide recedes to help retain a column of sea water in space 51. Valves 48 and 50 are used together for greatest sea water retention, but it is apparent that the device will be effective even if one set of valves is eliminated.

At high tide sea water from the main body of water fills the annular space 51 to the level 52 and impregnates the mass of bibulous material 23 so that after the tide level has fallen a second body of sea water is still held in contact with the part 17 to permit cathodic protection.

As shown in Figure 3 the jacket 29 comprises an outer layer or sheet 31 of rubber or similar flexible resilient material having opposite side edges 53 and 55 provided with suitable means for securing the edges together when the jacket is positioned around the metal member 11. In the modification shown the side edges are provided with intermeshing slide fastener hooks which can be meshed together by a slider 57 in a conventional way.

Collars 43 and 45 are strips of flexible material vulcanized or otherwise secured to the top and bottom edges of the sheet 31, and their opposite ends are provided with suitable fastening means such as snap fasteners 59 and 61 to secure the ends of the collars together when in position around the structural member.

The inflatable compartments 33 comprise elongated resilient rubber bags which are positioned parallel to one another in longitudinally spaced relation and extend transversely of sheet 31. Compartments 33 are secured to sheet 31 by vulcanized tabs 62 which permit limited movement of the compartments relatively to the sheet. Compartments 33 also may be formed integrally with sheet 31 by constructing the latter of two layers of rubber or the like vulcanized or otherwise secured together on longitudinally spaced areas extending transversely of the sheet, with the inflatable tubes between the layers.

When installing the jacket 29 it is wrapped around the structural member 11 at low tide and secured in position by the slide fastener 57 and the snaps 59 and 61. Thereafter air or other suitable inflating fluid is introduced through the conduit 41 to separate the layers 58 and 60 with buffering fluid, thus expanding the compartments 33 into contact with the bibulous mass 23 and distending the sides of sheet 31 so as to absorb shocks and abrasive forces.

In the modified form of device shown in Figures 4 and 5 a protective jacket 63 is constructed like that described above. In addition, there are provided one or more liquid retaining vessels or traps 64 between the jacket and a mass of bibulous material 65 for holding a pool of sea water after the tide level has dropped below the high tide mark. The pools of retained sea water feed the mass of bibulous material so as to assure that it will remain moist and electrically conductive. Any suitable type of vessel may be employed but it is advantageous that it be constructed as shown in Figures 4 and 5 wherein the vessels comprise annular collars which are secured in position around the structural member 66 with their upper edges 67 spaced from the mass 65 of bibulous material and with

their lower edges 69 fitting tightly against the mass so as to form an annular trough for holding the sea water.

The traps 64 may be separately secured in position before application of the protective jacket 63, or they may constitute integral parts of the protective jacket as by being constructed of rubber and vulcanized thereto. Such traps may be used in lieu of or in addition to vent valves such as described in connection with Figure 2.

It is apparent that the masses of bibulous material 23 and 65 may be separate from jackets 29 and 63 and applied independently to the structural member 11 before the jacket, or may be a sheet of material which is carried as an integral part of the jacket and is removable and replaceable therewith so that the protective device can be applied in one operation.

Obviously, many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. In combination, a metal member having a part which is normally wet only intermittently by electrolyte from a first body of electrolyte, a layer of bibulous material in contact with the external surface of said part for keeping a second body of such electrolyte in contact therewith; means for impressing a protective electrical current on said member; a jacket fitting around said member and layer in annularly spaced relation thereto, and having top and bottom edges engaging said member; passage means for the free flow of electrolyte into the annular space within said jacket; and automatic valve means controlling said passage means to permit the flow of electrolyte into said annular space and to prevent the flow of electrolyte out of said annular space.

2. In combination, an elongated structural metal member having a part which is normally wet only intermittently by electrolyte from a first body of electrolyte; an inner layer of bibulous material incasing said part and in direct contact with the external surface of said part for keeping a second body of such electrolyte in contact therewith; means for impressing a protective electrical current upon said member; a jacket sleeve surrounding said inner layer and part having top and bottom annular ends in direct continuous fluid-tight engagement with said metal member, said jacket sleeve comprising an outer electrolyte impervious layer of flexible resilient protective material in annular spaced relationship to said inner layer and part, a plurality of inflated compartments containing buffering fluid, said compartments being carried on the internal surface of said outer layer in a position parallel to one another individually surrounding and contacting the external surface of said inner layer, said top and bottom annular ends each comprising a collar integrally connected in a continuous relationship to said outer layer, said collars having ducts extending longitudinally therethrough for the free passage of said first body of electrolyte into the annular spaces between said jacket sleeve and said inner layer.

3. In combination, a metal member having a part which is normally wet only intermittently by electrolyte from a first body of electrolyte, a layer of bibulous material in contact with the external surface of said part for keeping a second body of such electrolyte in contact therewith; means for impressing a protective electrical current on said member; a jacket fitting around said member and layer in annularly spaced relation thereto, and having top and bottom edges engaging said member; passage means for the free flow of electrolyte into the annular space within said jacket; and at least one electrolyte retaining vessel surrounding said part in the annular space between said layer and said jacket, said vessel comprising an electrolyte impervious annular collar having upper and lower edges, said upper edges being in annularly spaced relation to said layer and said part, said lower edges surrounding

5

said layer in tight fitting contact therewith, said vessel and said layer forming an annular trough for maintaining a pool of electrolyte in direct contact with said layer.

4. A protective jacket adapted to be secured around an elongated structural metal member comprising an electrolyte impervious outer sheet of flexible resilient material having opposite side edges; closure means for joining said opposite side edges when said jacket is secured around said metal member; an inner sheet of bibulous material carried by said outer sheet, said inner sheet being in co-extensive parallel spaced relationship to said outer sheet and adapted to be placed in direct contact with said metal member for the absorption of electrolyte when said jacket is secured therearound; a plurality of independent inflatable elongated compartments for cushioning said metal member being carried by the interior surface of said outer sheet and positioned parallel to one another and extending transversely of said outer sheet, said compartments being located between said outer sheet and said inner sheet; conduit means for the flow of buffering fluid into said com-

5

10

15

20

6

partments; a pair of collars forming opposite end edges of said outer sheet; fastening means for joining the opposite side edges of said collars when said jacket surrounds said metal member; passage means longitudinally extending through said collars for the free flow of electrolyte into the annular space formed when said jacket is secured around said metal member, said annular space directly bordered by the interior surface of said outer layer and the exterior surface of said compartments and said inner layer; and automatic valve means controlling said passage means to permit the flow of electrolyte into said annular space and to prevent the flow of electrolyte out of said annular space.

References Cited in the file of this patent

UNITED STATES PATENTS

2,145,289	Boudreaux	Jan. 31, 1939
2,273,897	Scott	Feb. 24, 1942
2,417,849	Walters et al.	Mar. 25, 1947