

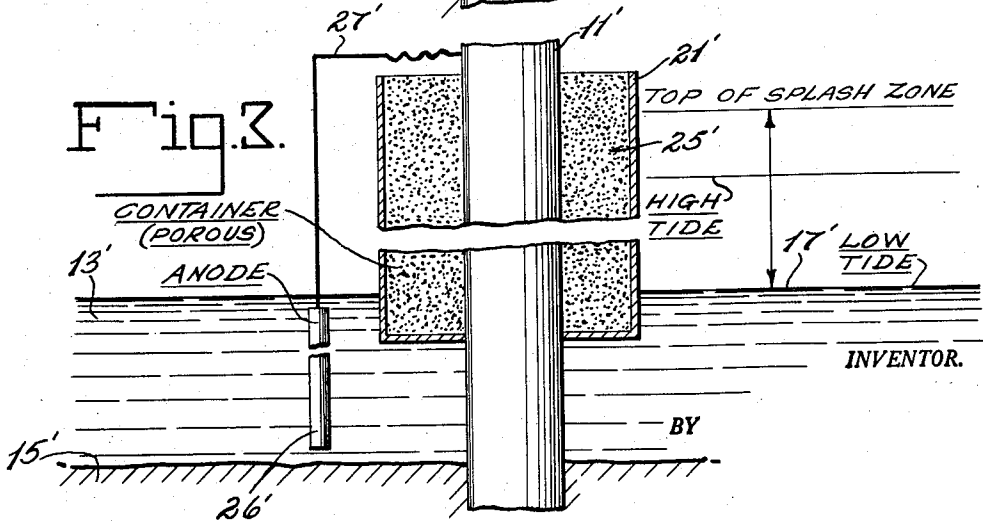
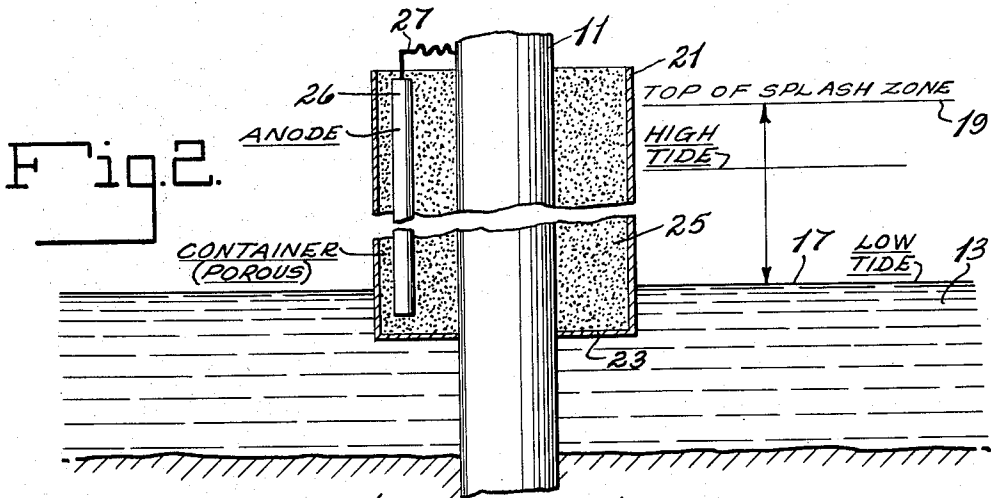
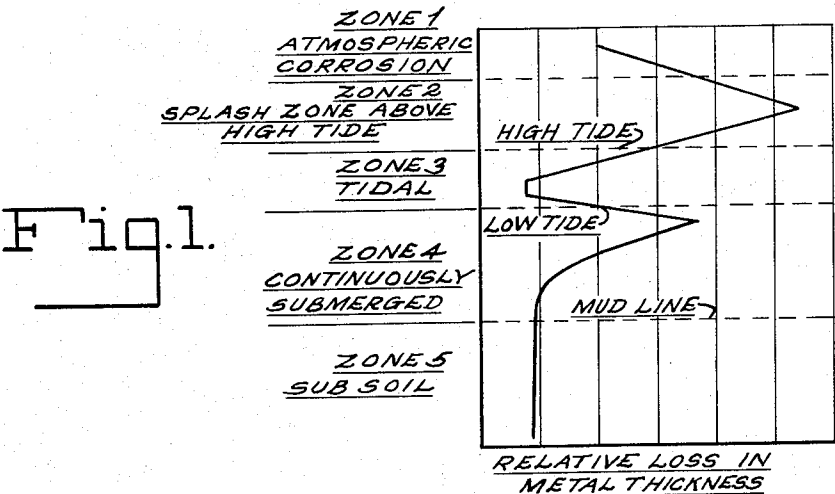
Aug. 12, 1958

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2,847,375

APPARATUS FOR CORROSION PREVENTION

Filed July 13, 1953



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APPARATUS FOR CORROSION PREVENTION

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Application July 13, 1953, Serial No. 367,678

2 Claims. (Cl. 204—197)

This invention relates to a novel method of and apparatus for protecting against corrosion a metal member having 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, 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; and

Figures 2 and 3 are vertical sectional views, parts being in elevation, showing two forms of apparatus in accordance with the invention.

When metal structural members are employed in or near a body of water, for example when offshore oil well drilling platforms are supported by 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 submerged parts of such a steel member (zone 4; and zone 3 only periodically), but serious corrosion still has occurred above the low tide mark. Prior to the present invention no way was known for cathodically protecting parts of a steel pile or other structural metal member against corrosion when not submerged within the water.

In the following description the term "sea water" will be used for simplicity to describe one type of 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.

In accordance with the present invention there is 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. In its broadest aspect my invention involves artificially maintaining a body of an electrolyte continuously in contact with the exposed parts of the metal member while impressing a protective electrical current on the member to counteract its normally anodic state and make it cathodic.

In the preferred embodiment of the invention an electrolyte is maintained in contact with the exposed parts of the metal member by surrounding such parts with a bibulous mass of material soaked with electrolyte. Usually the soaking electrolyte is the sea water, to which the bibulous mass is exposed. Sea water is absorbed by the bibulous mass and retained therein during periods when

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the metal parts are out of contact with the body of sea water. The presence of this retained electrolyte around the highly corrodable parts of the metal structural member makes it possible to impress a protective electrical current continuously thereon.

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, which is 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 prefer to use 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 apparatus 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 of the member 11 extending from slightly below the low tide mark 17 to slightly above the top of the splash zone 19 is surrounded by a porous shell 21 spaced annularly from member 11 and having a bottom 23, to form a hollow container. Shell 21 can be formed of any suitable sea-water-permeable material such as heavy cloth, woven wire screen, wood slats, or porous plastic.

Shell 21 is packed with a bibulous mass 25 of material which will absorb water from the sea 13 to keep the wall of member 11 permanently wet from slightly above the top of splash zone 19 down to low tide mark 17. Suitable materials for the bibulous mass 25 are bonded or unbonded sawdust, or such mineral particles as bentonite clay, gypsum, or a mixture of gypsum (75%) with bentonite (20%) and sodium sulfate (5%), but it is evident that many other bonded or unbonded absorptive materials could be used within the scope of the invention. Extension of the shell 21 and the mass 25 to a position below the low tide mark assures that the mass 25 will remain wet by its wick action on the water from the sea 13. This wick action is supplemented by the water absorbed at high tide and by the splashing of waves.

A protective electrical current advantageously is impressed on the structural member 11 by embedding a sacrificial anode 26 of magnesium or other sacrificial anodic material within the bibulous mass 25 in spaced relationship to member 11 and the walls of shell 21, and connecting the anode to the member 11 by an electrical connection 27.

With the construction described above the whole structural member 11 is constantly protected against corrosion even when parts of it are exposed above the low tide mark or are splashed by waves.

In the modification shown in Figure 3 the structural member 11' is surrounded by a bibulous mass 25' contained within a shell 21', as in Figure 2. Here, however, the sacrificial anode 26' is not embedded within the mass 25' but is suspended within the sea 13' below the low tide mark 17', and is electrically connected to the mass 11' by an external electrical connection 27'. It is essential in this modification that the bibulous mass 25' be in electrical contact with the sea 13' at all times if continuous cathodic protection is to be obtained.

From the foregoing description it is evident that there have been devised an improved method and apparatus for protecting metal structural members from corrosion when they are located at places where parts are only intermittently wet. While the principles have been described primarily as applied to such structural members as vertical steel piles and offshore oil well pipes, it is apparent that they apply equally to the protection of other types of structural members subjected to similar corrosive conditions such as beams, plates, and more complex structures, whether vertical or otherwise.

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 which extends from above the surface of a body of an aqueous electrolyte down into said body below the lowest surface level reached thereby, said member having at least a part thereof above said lowest surface level that is normally wet only intermittently by aqueous electrolyte from said body; a bibulous mass of material coextensively surrounding and contacting said part and extending down below said lowest surface level; an aqueous electrolyte permeable shell coextensively surrounding and contacting said mass and retaining said mass in contact with said metal member; a sacrificial metal anode of metal which has a higher anodic solution potential than does the material of said metal member, said anode being entirely imbedded within said mass in spaced relationship

to said member and said shell and connected electrically to said metal member in a manner to permit autogenous generation and impression of electrical current upon said metal member.

2. In combination a structural iron member which extends from above the surface of a body of water down into said body below the lowest surface level reached thereby, said member having at least a part thereof above said lowest surface level that is normally wet only intermittently by water from said body, a bibulous mass of material coextensively surrounding and contacting said part and extending above and below said lowest surface level, a shell of water permeable material coextensively surrounding and contacting said mass in a manner to retain said mass in contact with said member, the top edge of said shell being annularly spaced from said member, the bottom edge of said shell being in direct continuous contact with said member; a sacrificial anode of metal which has a higher anodic potential than iron, said anode being entirely imbedded within said mass in spaced relationship to said member and said shell, said anode extending from above to below said lowest surface level and being connected electrically to said iron member to permit autogenous generation and impression of electrical current upon said member.

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