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MAGNESIUM ANODE WITH PERFORATED CORE

Filed Aug. 29, 1952

2 Sheets-Sheet 1

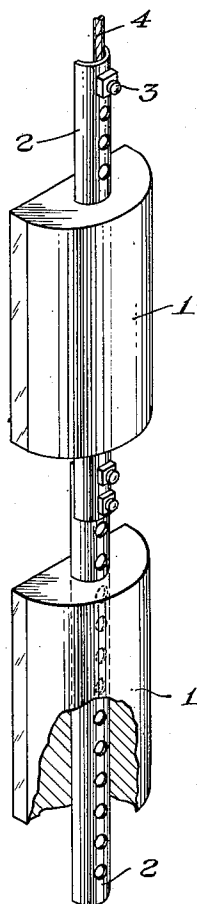


Fig. 1

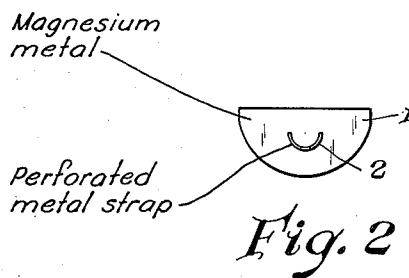


Fig. 2

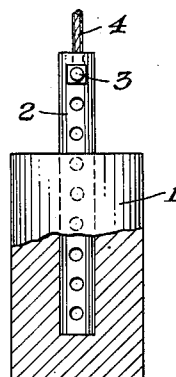


Fig. 3

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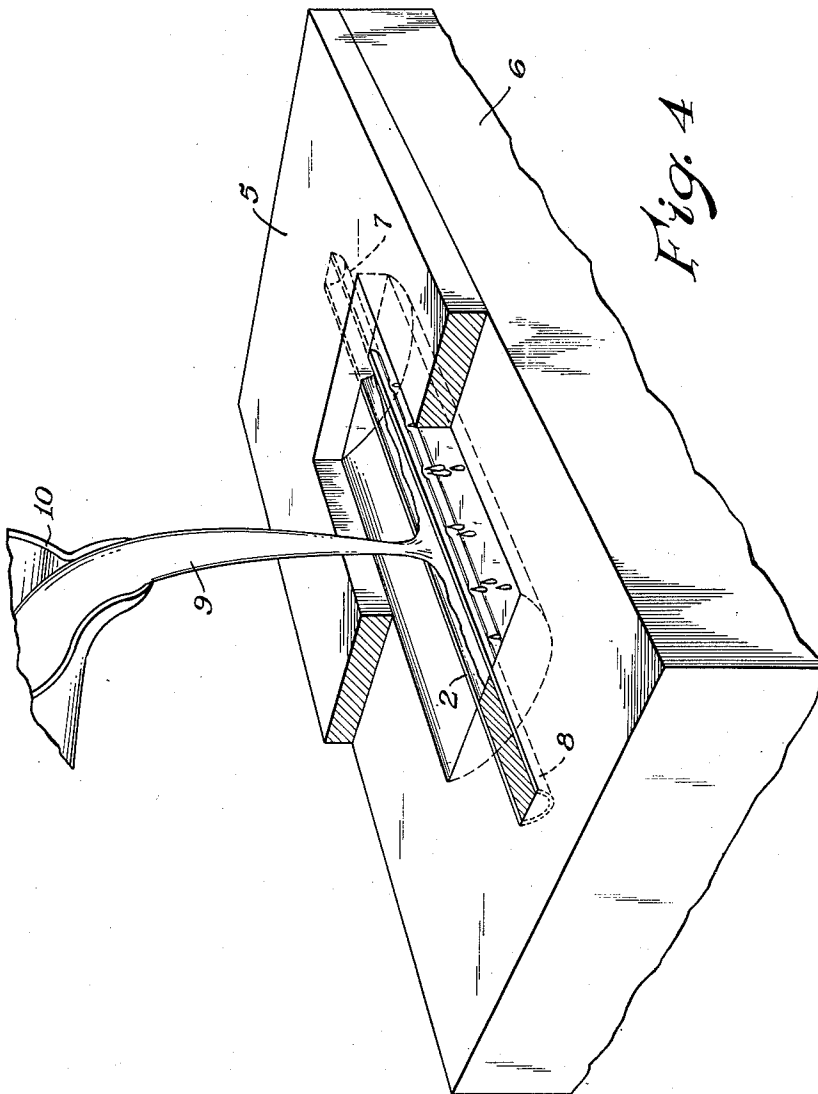


Fig. 4

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MAGNESIUM ANODE WITH PERFORATED CORE

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1 Claim. (Cl. 22—203)

This invention relates to an improved construction for magnesium anodes for use in the cathodic protection of corrodible metal structures.

In the galvanic protection of steel pipe lines, piling, and other underground and underwater structures, consumable electrodes of magnesium or other metal anodic to steel are employed. These electrodes are buried in the ground or submerged in the water near the structure to be protected and connected to it by electrical conductors. The resulting flow of current maintains the structure cathodic and greatly minimizes its corrosion.

The galvanic anodes heretofore used have ordinarily consisted of a body of a highly electronegative metal, such as magnesium or zinc, cast about a core of steel pipe or rod extending nearly the full length of the anode. This core functions as the electrical terminal and is intended to maintain structural unity of the anode. Such cored anodes are comparatively expensive to make, since even with extreme care it is difficult to obtain a strong metallurgical bond between the usual steel or galvanized steel core and the surrounding metal. Since there is little if any mechanical bonding, this type of core construction becomes grossly ineffective should the metallurgical bond fail.

It is therefore the principal object of the present invention to provide an improved anode construction which is easily and inexpensively made and which is not subject to the disadvantages mentioned. Another object is to provide an anode with an improved core construction which is strongly bonded both metallurgically and mechanically to the surrounding metal and which in service will maintain structural unity until virtually all the active metal has been consumed. A further object is to provide anodes which may more readily be installed and coupled together in multiple installations where high current output is required.

These objects are realized in the magnesium anode of the invention comprising in combination a core member comprising a perforated strap, preferably a trough-shaped strap of a metal cathodic to magnesium, such as a ferrous metal, and an anode member comprising a preponderance of magnesium cast thereabout as a sheath leaving at least one end of the core member projecting beyond the sheath. In the improved anode of the invention, the metallurgical and mechanical bonds of magnesium metal to core are easily achieved and exceptionally strong. Due to the structure of its unique core, magnesium metal will remain attached thereto until it is essentially all expended. In addition, the perforations in the core strap which projects beyond the magnesium sheath not only afford a ready attachment for the lead wire, but also provide an easy means to connect together two or more anodes, e. g. by bolting together.

The invention in a preferred form may be described with reference to the accompanying drawings, in which

Fig. 1 is a partially cut-away perspective view showing two anodes bolted together;

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Fig. 2 is a top view of one of the anodes of Fig. 1 with the bolt removed;

Fig. 3 is a cut-away perspective of an alternative anode construction; and

Fig. 4 is a diagrammatic view, partially in section, showing the mold in which the anodes of Fig. 1 are cast, and illustrating the casting thereof.

With reference to the drawings, the anodes illustrated consist of a magnesium metal sheath 1 cast about and firmly bonded to a perforated steel strap 2 which forms the electrically conducting core of the anode. This strap is shaped to an arcuate cross-section similar to the letter U along its entire length. In a preferred construction as shown in Fig. 1, the perforated metal strap 2 protrudes beyond both ends of the magnesium metal sheath 1 of the anode affording attachment by means of the perforations as illustrated. To one end of the metal strap protruding from one of the anodes is connected by a bolt 3, an electric conductor wire 4 which in turn is attached to the metal structure to be cathodically protected (not shown). To the other end of the strap 2 is bolted the protruding perforated core of another anode thereby attaching it mechanically and electrically thereto. The cut away portion shows the extent of the mechanical bonding of magnesium metal to the core through the perforations of the metal strap.

Fig. 3 is an alternative anode construction showing the perforated metal strap projecting from only one end of the magnesium metal sheath.

The anodes of the invention may readily be made according to standard foundry practice by casting magnesium metal into a suitably shaped mold, preferably a shallow open mold placed in a horizontal position similar to that shown in Fig. 4. This mold is particularly suitable for casting the anodes illustrated in Fig. 1 in which both ends of the perforated metal strap project beyond the magnesium metal sheath. As shown in Fig. 4, the mold is divided horizontally into two sections, an upper section 5 and a lower or base section 6. The perforated metal strap 2 is centered in the mold, open side up, and supported by its ends in two U-shaped grooves 7 and 8 in the upper face of the base section 6, one at either end thereof. When the upper section 5 of the mold is placed on top of the base section 6, it covers the ends of the perforated metal strap 2 which are to project beyond the expendable metal sheath, leaving the core portion of the strap exposed. Molten magnesium 9 is poured from a ladle 10 directly into the open-sided core portion of the perforated trough-like strap 2 which acts as a distributive header for the liquid metal as it flows along the strap and through the holes therein. This flowing action, coupled with the low mass of the metal strap 2, insures rapid uniform heating of the core portion of the strap and gives it a good wash which promotes metallurgical bonding.

The perforated metal straps which form the core members of the improved anodes of the invention are made from a metal cathodic to magnesium, such as a ferrous metal, especially iron or steel. A steel strap is usually employed which has preferably been galvanized or coated with zinc, tin, or some similar metal or combination of metals to promote a better metallurgical bond between the core member and the magnesium metal sheath. This strap should have sufficient rigidity to support itself in long horizontal molds without perceptibly sagging. It is also desirable that the strap be rigid enough not to warp or crawl due to the thermal shock applied by molten magnesium during casting.

Although a straight piece of perforated metal strap may be employed as a core member, it is usually preferred to form the strap along its entire length in a trough-like shape. In so doing, it is possible to attain

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a lighter, more rigid core with the inherent advantages hereinbefore described. The strap of U-shaped cross-section generally employed for the core member is a very satisfactory shape and is easily formed. Straps of other cross-sectional shapes may also be used, e. g. similar to the letters V, W, S, etc.

The dimensions of the perforated metal strap may be any convenient size commensurate with the requirements for rigidity. More preferably, the thickness of the metal strap should be great enough so that the ends thereof which protrude from the magnesium sheath will not easily bend or break, even when bolted together in multiple anode installations. The width of the strap prior to any shaping operation should be great enough to afford ready attachment at the ends, e. g. to the lead wire or for coupling to another anode. Moreover, the width of the shaped strap should not be so wide as to be unduly near that surface of the sheath which parallels the core. Generally, the width or greatest cross-sectional dimension of the core as cast in the anode is from one-fifth to one-half the greatest cross-sectional dimension of the anode. For a consumable metal sheath of given dimensions, the length of the core strap to be incorporated therein depends on whether or not it is to project from one or both ends of the sheath. Even when the anodes are so constructed that only one end of the strap projects beyond the consumable sheath, the core preferably extends nearly the full length of the anode.

It is highly desirable that there be perforations in the metal strap all along its length. It is likewise desirable that these perforations or holes be round and that they be regularly and frequently spaced all along the base of the trough-like channel of the formed metal strap, e. g. their distance apart being less than twice the diameter of a hole. The diameter of these holes is preferably greater than the thickness of the metal strap, usually from two to several times the thickness thereof. More desirably, these holes are large enough to permit molten magnesium to flow through them, and to accommodate bolts for connecting two or more anodes

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by the ends of their straps. In casting molten magnesium around a core strap so perforated, an excellent mechanical bond is attained by virtue of the magnesium which solidifies in these perforations or holes.

The cross-sectional shape of the anodes is not critical and such shapes as circular, polygonal, square, or triangular may be employed. However, a semicircular or D-shaped cross-section as illustrated permits realizing a comparatively high current output and is more readily manufactured than anodes corresponding to the above mentioned shapes. The length of the new anode is likewise not critical, but it is highly preferable that it be at least three times the greatest breadth.

The anodically active metal of the new anode may be made of magnesium or of any commercially available magnesium alloy, all such metal being included with the term "magnesium metal" as used in the claim.

Other modifications than those mentioned will be apparent from the foregoing description and may be employed without departing from the scope of the invention.

What is claimed is:

In casting a consumable anode for use in cathodic protection, the steps which comprise supporting horizontally in an open horizontal mold with its open side up, a straight rigid trough-like ferrous metal strap perforated at intervals along its length, pouring molten magnesium metal into the trough until it is submerged and solidifying the molten metal in the mold.

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