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PACKAGED MAGNESIUM ANODE WITH CEMENTED BACKFILL

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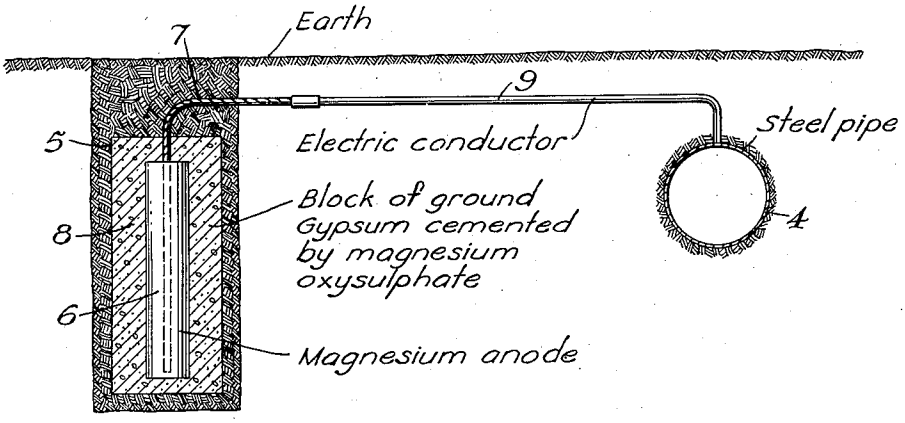


Fig. 1

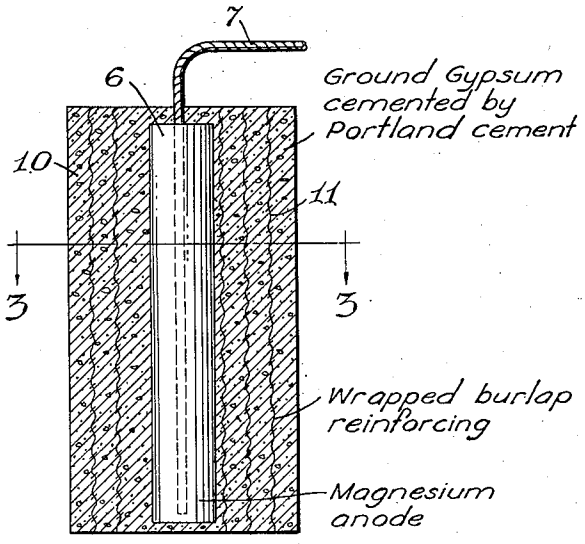


Fig. 2

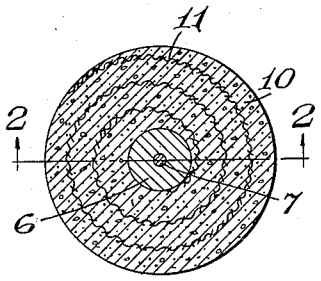


Fig. 3

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PACKAGED MAGNESIUM ANODE WITH CEMENTED BACKFILL

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6 Claims. (Cl. 204—197)

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This invention relates to improved packaged anodes for the galvanic protection of underground metals. It also concerns protection systems using such anodes.

In galvanic systems for the cathodic protection of pipelines and other underground structures, sacrificial electrodes of a metal anodic to the structure, such as magnesium, are buried in the earth near the structure and are connected to it by electrical conductors. The resulting flow of current maintains the structure cathodic with respect to the soil and greatly minimizes its corrosion. Since magnesium tends to be consumed uselessly when in direct contact with some types of soils, it is customary, in using this metal as a sacrificial anode, to bury it in a prepared bed or backfill designed to control the chemical nature of the anode environment.

In prior practice, such backfills have consisted of powder mixtures, e. g. of gypsum and bentonite, which have been tamped in place around the anode when it is being buried. In general, these powdered backfills have either been prepared at some central station, thus requiring that a bulky powder be transported to the site, or have been mixed by hand on the job, usually under conditions such that thorough mixing is seldom achieved. In either instance, careful supervision is required to insure that adequate installations are made and that materials are not wasted.

It is therefore a principal object of the present invention to provide an improved article for use in galvanic protection in which an appropriate backfill is associated with a magnesium anode in a unit package which can be installed simply by burying it. Another object is to provide a packaged anode in which loose powder is not present and a special container is not required, the backfill itself having a fixed form and being of sufficient mechanical strength to withstand stresses incident to shipment and installation.

The invention will be explained with reference to the accompanying drawing, in which

Fig. 1 is a schematic vertical section showing the manner of using one form of the new packaged anode in the galvanic protection of a buried pipeline;

Fig. 2 is a vertical section through another form of packaged anode along the line 2—2 in Fig. 3; and

Fig. 3 is a horizontal section through the article of Fig. 2 along the line 3—3 in Fig. 2.

In the packaged anodes of the invention, the magnesium metal anode is imbedded in a unitary self-sustaining backfill consisting of a cemented mass of a finely-divided or granular non-acidic solid electrolyte. In effect, then, the anode metal is encased in a body of porous stone-like material which is of such composition and size as to

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provide a suitable electrolytic environment for the anode.

In so far as known, any granular or powdered non-acidic solid electrolyte may be used in making the new packaged anodes, since the major function of this material is simply to render the backfill electrolytically conductive. In general, alkaline earth metal hydroxides and alkali- or alkaline-earth metal salts of acids which form water-soluble magnesium salts, or mixtures of these substances, are preferred. It is particularly advantageous to select an electrolyte which is only sparingly soluble in water, i. e. one having a solubility from about 0.1 to about 2 percent by weight at atmospheric temperatures. Calcium sulfate, usually in the form of gypsum ($CaSO_4.2H_2O$) or calcined gypsum, is perhaps the best choice because of its low cost and excellent performance, although magnesium sulfite is also very satisfactory.

The material used to bind together the particles of finely-divided electrolyte in making the new packaged anode may be any non-acidic inorganic cement capable of setting in the presence of water. Plaster of Paris (calcined gypsum), hydraulic cements, such as Portland cement, and magnesia cements, especially magnesium oxysulfate and oxychloride, are preferred. The proportion of cement used is not critical, but should be sufficient to insure that the electrolyte is cemented together to a unitary mass of good strength. In general, the cement should constitute at least 10 percent by weight, and better 20 to 30 percent, of the total dry constituents of the backfill.

In addition to electrolyte and cement, the backfill composition for the new packaged anodes may also contain minor proportions of other non-acidic materials, e. g. sand, gravel, crushed washed coke, and other electrolytically inert fillers. Granular magnesium hydroxide or oxide may be added, each having the desirable effect of assisting in maintaining alkalinity. Powdered or granular bentonite (montmorillonite, a sodium-type base-exchange volcanic clay) is also advantageous in that it tends to absorb and retain water and to retard leaching of the electrolyte.

In a preferred method of making packaged anodes according to the invention, the electrolyte, cement, and filler, if any, are separately ground to coarse powder form and are then mixed. The mixture is then stirred into water to form a thick slurry, which is poured around the magnesium anode while the latter is centered in a mold. After the slurry has set, the mold may be taken off, leaving the packaged anode ready for use. It is desirable, to secure a cemented backfill of good porosity, to use rather coarsely ground materials.

While, in the foregoing, the electrolyte and the cement have been discussed separately, it is

entirely possible for a single substance to function as both. For example, it is regarded as within the invention to imbed a magnesium anode in a set mass of plaster of Paris or of magnesium oxysulfate, in which case no other electrolyte or filler need be added.

A typical installation for cathodic protection, using a packaged anode according to the invention, is shown in Fig. 1, in which a steel pipeline 4 buried in the earth is being protected. The packaged anode 5 is made of an elongated cylindrical body of magnesium 6 cast around a core formed by part of a steel cable 7, the other portion of which extends beyond the anode to constitute an electrical lead-wire. The magnesium 6 is imbedded in a backfill consisting of a cemented block 8 formed by ground gypsum bound together by magnesium oxysulfate. As shown, the block 8 and its contained anode 6 are buried in the earth near the pipeline 4, with the cable 7 being connected electrically to the pipe by a conductor 9.

In making the installation, a suitable hole is dug, the packaged anode 5 is lowered in place, and earth is tamped around it. The electrical conductor to the pipeline is then installed and buried. In dry soils, the start of electrolytic action may be hastened by pouring water around the spot where the anode is buried.

In an alternative way of making the new packaged anodes, the backfill may contain reinforcing to strengthen the cemented mass. Preferred reinforcing materials are flexible non-conductors, most suitably porous fabrics such as burlap or canvas. A typical construction of this sort is shown in Figs. 2 and 3 in which the magnesium anode 6 is imbedded in a mass 10 of ground gypsum cemented together by Portland cement which is reinforced by burlap 11 wrapped spirally around the anode.

In making the packaged anode of Figs. 2 and 3, a suitable length of burlap is laid on a flat surface and a settable mixture of gypsum and Portland cement is spread over it as a thick layer. The anode is then laid on top at one end and is rolled along the surface to wrap the burlap and cement mixture around the anode. After the cement has set, the article is ready for use.

In field use of the invention, the number and size of anodes and the quantity of backfill required to secure effective cathodic protection of a given pipeline or other structure are determined by well-known engineering principles.

The following examples will further illustrate the invention.

Example 1

Packaged anodes were prepared in the manner illustrated in Figs. 2 and 3, using magnesium rods as anodes and canvas as reinforcing. The backfill consisted of a mixture of: ground gypsum, 75 parts by weight, as electrolyte; silica sand, 10 parts, and ground bentonite, 5 parts, as fillers; and magnesium oxide, 10 parts and magnesium sulfate, 10 parts, to form magnesium oxysulfate cement. This mixture was moistened with water, applied to the canvas, and wrapped around the anodes, after which the mixture was allowed to set.

Example 2

Packaged anodes were made up as in Example 1, except that the cementable backfill mixture was: ground gypsum, 70 parts, and magnesium sulfite 5 parts as electrolytes; ground bentonite, 5 parts, as filler; and magnesium oxide, 10 parts, and magnesium sulfate, 5 parts, as cement.

Example 3

Packaged anodes were made up as in Example 1, except that the backfill mixture was: ground gypsum, 20 parts, and magnesium sulfite, 2 parts as electrolytes; silica sand, 58 parts, as filler; and magnesium oxide, 20 parts, and magnesium sulfate, 8 parts, as cement.

Example 4

Packaged anodes were made up as in Example 1, except that the backfill was: ground gypsum, 40 parts, and magnesium sulfite, 2 parts, as electrolytes; silica sand, 36 parts, and bentonite, 2 parts, as fillers; and Portland cement, 20 parts, as cement. This mixture was wetted with a 12° Bé. magnesium sulfate aqueous solution instead of with water when it was being applied to the anodes.

All of these anodes were tested in the cathodic protection of iron in natural water and developed adequate currents at good electrochemical efficiencies.

While the invention has been described as useful in the cathodic protection of underground ferrous metal structures, it is applicable in protecting structures of any corrodible metal cathodic to magnesium. The sacrificial anodes may be either of magnesium or of a magnesium-base alloy, both being comprehended by the term "magnesium metal" as used in the claims.

What is claimed is:

1. A packaged anode for use in cathodic protection systems comprising a magnesium metal anode imbedded in a self-sustaining porous mass of a granular electrolyte selected from the class consisting of alkaline earth metal hydroxides and alkali- and alkaline-earth metal salts of acids which form water-soluble magnesium salts cemented together by magnesium oxysulfate.

2. A packaged anode according to claim 1 wherein the electrolyte has a solubility in water of from 0.1 to 2 percent by weight at atmospheric temperatures.

3. A packaged anode according to claim 1 wherein the electrolyte is calcium sulfate.

4. A packaged anode for use in cathodic protection systems comprising a magnesium metal anode imbedded in a set mass consisting essentially of granular gypsum cemented together by magnesium oxysulfate.

5. A packaged anode according to claim 4 wherein the set mass also contains a small proportion of bentonite.

6. In combination with an underground structure of a corrodible metal cathodic to magnesium, a cathodic protection system comprising a packaged anode as defined in claim 1 buried in the earth near the structure and electrically connected thereto.

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