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RAPID-WETTING GYPSUM-BASE BACKFILL FOR CATHODIC PROTECTION

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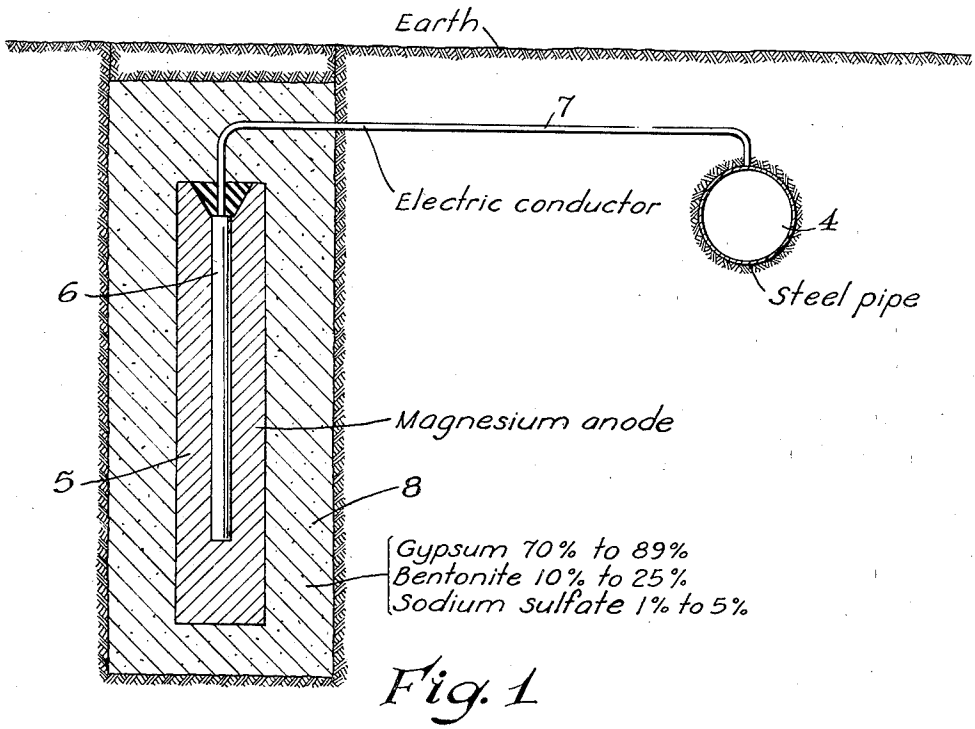


Fig. 1

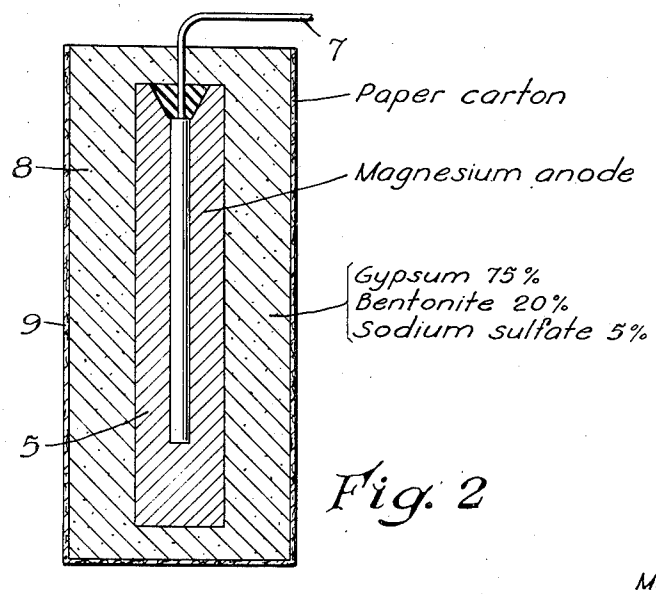


Fig. 2

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RAPID-WETTING GYPSUM-BASE BACKFILL FOR CATHODIC PROTECTION

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6 Claims. (Cl. 204—197)

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This invention relates to improved anode media for use in the galvanic protection of underground metals. It also concerns packaged anodes containing such media and protection systems using them.

In galvanic systems for the cathodic protection of pipelines and other underground structures, sacrificial anodes of a metal electronegative to the structure, usually magnesium or zinc, are buried in the earth near the structure and 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. In such service, it is often desirable, when using magnesium metal as a sacrificial anode, to bury it in a prepared bed or backfill designed to control the chemical nature of the anode environment.

The chemical requirements of an ideal backfill for magnesium anodes are various. In use, the material should have good electrolytic conductivity and yet should not be so soluble as to be leached away. It should be capable of wetting easily in ground waters, and should retain moisture during dry spells so as to avoid loss of conductivity. It should also maintain a nearly constant volume, i. e. should not swell and then shrink away from the anode, during seasonal increase and decrease in the moisture content of the surrounding earth. Further, in order to secure maximum current efficiency from the magnesium, the backfill should tend to minimize localized, i. e. useless, corrosion of the metal. On the other hand, it should promote uniformity of attack during the useful or current-producing consumption of the magnesium. In addition, it must not polarize the anode unduly or form impervious coatings on it.

These specifications are met only in part by mixtures of bentonite with a lesser proportion of gypsum, which have been the principal backfills used heretofore. In particular, these mixtures are disadvantageous in that they absorb ground water very slowly in service, and hence do not permit development of full galvanic current for several days after installation. In addition, they shrink unduly during dry weather, markedly increasing the electrical resistance of the anode circuit at such times.

It is therefore the principal object of the present invention to provide an improved backfill for use as an anode medium in cathodic protection systems which is rapid-wetting and which undergoes comparatively little variation in volume with changes in moisture content. Another object is to provide a backfill composition in the form of a free-flowing powder particularly useful in making packaged anodes.

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

Fig. 1 is a schematic vertical section showing one manner of using the new composition as an anode backfill in the galvanic protection of a buried pipeline; and

Fig. 2 is a vertical section through a packaged anode.

The compositions of the invention consist essentially of intimate mixtures of from 70 to 89 percent by weight of powdered gypsum, from 10 to 25 percent of powdered bentonite, and from 1 to 5 percent of a water-soluble salt of a metal at least as anodic as magnesium, preferably sodium sulfate.

The gypsum used, i. e. $CaSO_4 \cdot 2H_2O$, is conveniently the naturally-occurring substance ground to a powder state. While "dusting" gypsum is operable, it is preferable to use a somewhat coarser grade, most satisfactorily one having a degree of fineness such that at least 60 percent by weight corresponds to a screen analysis of 20 to 100 mesh (Tyler Standard). A preferred gypsum is one in which from 5 to 10 percent is retained on a 20 mesh screen, from 60 to 70 percent on 30 mesh, and not over 25 percent finer than 100 mesh.

The term "bentonite," as used herein, refers to the naturally-occurring colloidal clay or volcanic ash consisting largely of one of the minerals sodium montmorillonite and beidellite and being characterized by swelling extensively in water. This product is sometimes called "alkali bentonite" in contradistinction to so-called "alkaline earth bentonite" which is almost non-swelling in water and is not operable in the present composition. In the invention, it is preferable to employ a bentonite ground somewhat less fine than the most common commercial grades. A particle size such that at least 60 percent by weight of the bentonite corresponds to a screen analysis between 20 and 100 mesh is most satisfactory.

In addition to gypsum and bentonite, the backfills of the present invention also contain a small proportion of a water-soluble salt of a metal at least as anodic as magnesium. Since the function of this salt is simply to insure high electrolytic conductivity in the backfill, a variety of salts may be used, e. g. magnesium sulfate, sodium chloride, potassium sulfate, etc. However, sodium sulfate, usually as the anhydrous salt, is greatly preferred

because it tends to insure uniformity of attack on the magnesium anode buried in the backfill.

The relative proportions of the gypsum, bentonite, and sodium sulfate must be carefully controlled within the limits stated to secure a rapid-wetting, low-swelling composition. Optimum results appear to be obtained with about 75 percent by weight of gypsum, about 20 percent bentonite, and about 5 percent sodium sulfate. This mixture has an apparent specific gravity of 1.29 and a specific resistivity when wet of 35 to 50 ohms per cubic centimeter. When the dry mixture is immersed in water, the apparent increase in volume is only 32 percent, as contrasted to far higher values, often over 100 percent, for the backfill compositions heretofore used.

If desired, small proportions of inert substances, such as sand, may be incorporated in the new backfill compositions. In general, however, such fillers offer no advantage and are omitted.

The new compositions are made by simply mixing the ingredients together thoroughly, as with a rotating tumbler, each ingredient having been previously ground to the appropriate fineness. The resulting mixture is extremely free-flowing.

The manner of using the new compositions as a cathodic protection backfill is illustrated in Fig. 1, in which a steel pipeline 4 buried in earth is being protected. The consumable galvanic anode 5 is an elongated cylindrical body of magnesium metal provided with a central iron pipe core 6. As shown, the anode is buried in the earth near the pipeline, with the core 6 being connected electrically to the line by a conductor 7. A bed of wetted gypsum-bentonite-sodium sulfate mixture 8 surrounds the anode and is in firm contact with it and with the earth.

In making the installation, a suitable hole is dug and the anode is lowered in place, after which the backfill is tamped around it. The electrical conductor to the pipe-line is then installed and buried. In dry soils, water is poured around the anode and backfill to hasten the beginning of electrolytic action.

An optional method of installation, which is particularly convenient under many conditions, involves the packaged anode illustrated in Fig. 2. In this case, a magnesium anode 5 is centered in a water-permeable container, such as a paper carton 9. The space between the anode and the container walls is then filled with a mass 8 of the backfill composition according to the invention. In installing this anode, it is necessary only to dig a hole the size of the carton 9, insert the entire package, tamp the earth around it, and make the necessary electrical connection.

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.

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

What is claimed is:

1. A composition useful as an anode medium in cathodic protection and consisting essentially of a mixture of from 70 to 89 percent by weight of powdered gypsum, from 10 to 25 percent of powdered bentonite, and from 1 to 5 percent of a water-soluble salt of a metal at least as anodic as magnesium.

2. A composition according to claim 1 wherein the salt is sodium sulfate.

3. A composition according to claim 2 wherein the gypsum and the bentonite each is of a degree of fineness such that at least 60 percent by weight thereof corresponds to a screen analysis between 20 and 100 mesh.

4. A composition consisting of a mixture of about 75 percent by weight powdered gypsum, about 20 percent powdered bentonite, and about 5 percent sodium sulfate.

5. A packaged anode for use in cathodic protection systems comprising a water-permeable container having therein a magnesium metal anode provided with means for connecting an electrical conductor thereto, such anode being surrounded by and in intimate contact with a mass of the composition defined in claim 1.

6. In combination with an underground structure of a metal cathodic to magnesium, a cathodic protection system comprising a magnesium metal anode buried in the earth near the structure and electrically connected thereto, such anode being surrounded by and in intimate contact with a bed of backfill material as defined in claim 1.

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REFERENCES CITED

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