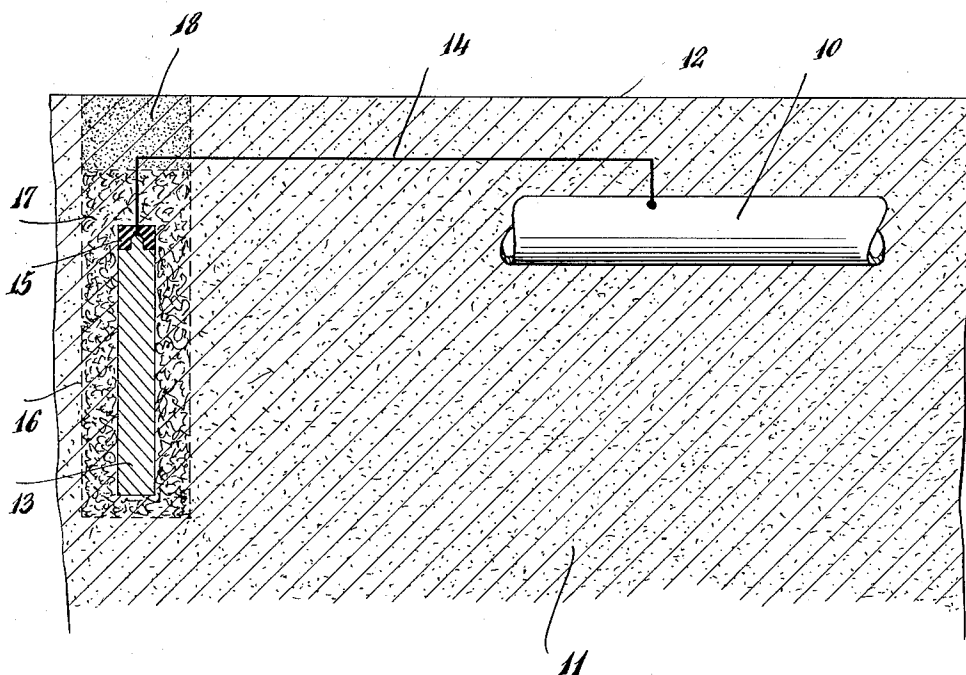


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CATHODIC PROTECTION AND UNDERGROUND METALLIC
STRUCTURE EMBODYING THE SAME
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CATHODIC PROTECTION AND UNDER-
GROUND METALLIC STRUCTURE EM-
BODYING THE SAME

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3 Claims. (Cl. 204—148)

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This invention relates to the cathodic protec-
tion of metallic underground structures where
the structure to be protected against corrosive
action is made the negative electrode (cathode)
of a cell, or a multiplicity of cells, in which the
anode is formed of a separately buried metal piece
or electrode formed of a metal electropositive
(anodic) to the metal of which the underground
structure is formed. In such installations an
electrical connection such as a wire or bus con-
nects the buried electrode to the buried metallic
structure, the earth in which the electrode and
the structure are buried serving to complete the
circuit.

The invention is directed to such cathodic pro-
tection installations when the anode of the cell,
or cells, is formed of aluminum or an alloy com-
posed principally of aluminum, i. e. containing
more than 50 percent by weight of that element,
a generic term for such metal and its alloys
being aluminous metal. Thus the present inven-
tion is concerned solely with the protection of
metallic underground structures composed, or
composed in important part, of metal or alloy
which is electronegative to aluminum. Since
most of the important metallic underground
structures, including the buried linear installa-
tions, such as pipe lines for transporting liquids
or gases, and the buried unit installations, such
as oil well casings, tower or structural footings
and the like, are commonly made of iron, steel
or other metal or alloy electronegative (cath-
odic) to aluminum, the aluminous metal anode is
adapted to the cathodic protection of most metal-
lic underground structures of commercial impor-
tance. While later reference will be made to
pipe lines since such lines are, at once, a con-
venient and important commercial form of un-
derground structure, the principles of this inven-
tion are useful whatever the type of metallic un-
derground structure which needs protection
against corrosion; provided, of course, that the
structure or important parts thereof is made of
metal electronegative (cathodic) to an alumi-
nous anode.

One leading object of this invention is the pro-
vision of means and methods by which metallic
underground structures may be efficiently pro-
tected against corrosion by the use of aluminous
metal electrodes in the protection circuit. An-
other leading object of the invention is the pro-
vision of corrosion-resistance metallic underground
installations comprising a buried structure com-
posed of metal electronegative (cathodic) to
aluminum, a separately buried anode composed

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principally of aluminum, an electrical connection
therebetween, and a specially prepared composi-
tion surrounding the anode.

As is well known, it is important to the cathodic
protection of metallic underground structures
that a steady current of relatively constant po-
tential be supplied in the cathodic protection
and that this result be achieved at a slow rate of
consumption of the metal of the anode. Here-
tofore the use of aluminum, or alloys composed
principally of that metal, in cathodic protection
circuits of the type described has met with in-
different success because the circuit did not
maintain the desired steady current of constant
potential and the anode was consumed at a high
rate, or at such a low rate as to provide inade-
quate cathodic protection. The advantages se-
cured by my invention flow from the provision
of a specially prepared composition surrounding
the aluminous anode, the combination insuring
a steady protective current of fairly constant
potential obtained at a lower comparative rate
of consumption of the metal of the anode, thus
resulting in increased operational efficiency both
from the standpoint of the protection obtained
and the amount of expended anode metal neces-
sary to such protection.

For convenience in further description of the
invention reference will be had to the attached
drawing which is a somewhat diagrammatic ele-
vational view, partly in section, of a conventional
installation designed to offer cathodic protection
to a metallic underground structure. Referring
to the drawing, a pipe line 10 is buried in the
earth 11 at a distance below the earth surface
12. At intervals along the run of line 10, but at
a distance therefrom, electrodes, such as anode
13, are buried and connected to the pipe line
10 by an electric wire or bus, such as cable 14.
A protective coating 15, which may be asphalt
or similar substance, may be used to prevent
corrosion at the point between anode 13 and
cable 14 and a similar protective coating may be
used to protect the connection between cable 14
and line 10. To install the anode 13 a hole, such
as indicated by the broken line 16, is dug in the
earth, the anode is positioned suitably in the
hole and then held in place by means of a back-
fill or mixture 17 which is tamped around the
anode. The mixture 17 usually has an earthen
base and is formed by making a water bound
sludge of earth and selected chemicals. After
the anode 13 is thus positioned an earthen cap 18
is placed in the hole to surface level. The mixture
17 preferably entirely surrounds the anode 13

but may, if desired, only surround it in part or contact only one or more surfaces thereof. In each case results are obtained but anode efficiency is greatest where the mixture substantially surrounds the anode.

In the practice of the present invention the general procedure just described is followed. As above noted, the anode 13 is made of aluminous metal while the pipe line is of some metal, such as iron, which is electronegative (cathodic) to aluminum. The improvement of the present invention consists in providing around the anode a mixture having a pH greater than about 7.5 and containing at least 1 percent by weight of the dry mixture of inorganic halide. The aluminous anode, used in combination with such a mixture, and in such a circuit as that described, functions to maintain a high current output over long periods of time and to effectively protect the metallic underground structure with which it is coupled against corrosive agents. Moreover, the aluminous anode, when used in combination with such mixture, performs this stated function at high efficiency as measured by the amount of aluminous electrode metal consumed per unit of current provided, thereby insuring that necessary replacement of the aluminous anode will be kept at a minimum thereby decreasing upkeep costs.

The base of the mixture may be earth of the type in which the structure is embedded or of any other type, or the base or carrier portion of the mixture may be some other inert material, such as sand, cellulosic material, or any material which will serve as a porous medium or base with which the active chemicals may be mixed and in which they will be retained subject to the leaching effect of ground water or other earth moisture. The inorganic halide may occur in the mixture in any form or compound, the compounds of lesser solubility having the advantage of longer withstanding leaching action. To be effective the inorganic halide should be present in amount of at least 1 percent of the dry weight of the mixture. Very large amounts may, if desired, be employed but, since usually maximum effect is reached between about 1 and 30 percent by weight additional amounts are mere surplusage. This is, however, no critical limit and an effective amount of inorganic halide may be said to be an amount of 1 percent or more by weight of the dry mixture. Usually amounts of 5 to 15 percent by weight are to be preferred. Of the halides the chlorides appear to form the most efficient mixtures from the standpoint of maintaining a steady and uniform output of current in the circuit. Usually halide salts of the alkali metals or alkaline earth metals are preferred because of the availability of such compounds and their inability to counteract any compound added to the mixture to maintain the desired alkalinity.

The required pH of the mixture may be obtained by adding thereto an alkaline substance. While the pH should be at least 7.5 I prefer to form mixtures having pH values of not less than 8 or 9 and mixtures of higher pH values are, in general, even more effective. While not understanding fully the mechanism of the mixture in coacting with the aluminous metal anode to maintain a steady uniform output of current in the protective circuit, I am of the belief that to some extent the efficiencies obtained by the practice of this invention are affected by the relative solubility of the corrosion product formed at the aluminous anode and therefore I prefer to use alkaline substances, such as alkali metal and al-

kaline earth metal compounds, i. e. oxides, hydroxides, carbonates and the like, which do not appear to have any insolubilizing action in the corrosion product. Such theoretical analysis is at best uncertain and while it seems desirable to adjust the pH of the mixture by the use of alkaline earth metal or alkali metal compounds, any alkaline substance may be used for this purpose with satisfactory results.

Among the aluminous metal anodes which may be selected for use in the practice of this invention some are more efficient than others. Those containing any substantial amount of copper are least preferred, while those containing substantial amounts of zinc, i. e. about 1 to 20 percent by weight seem to give the most satisfactory results. Anodes made of pure aluminum or commercial aluminum are satisfactory and where it is desirable to raise the electrode potential of that metal with respect to the metal of the structure which is to be protected best results are obtained by alloying with aluminum at least one of the following class of metals; silver, cadmium, zinc, platinum, calcium, barium, strontium, gallium, indium, bismuth and tin. Any of these metals when present in aluminum in amounts as small as 0.02 percent by weight have some effect in raising the electrode potential of that metal, but usually amounts of 0.1 percent and more are to be preferred.

In the practice of this invention the mixture which is prepared to surround the anode may, as above indicated, be tamped around the anode after the anode has been positioned in an earth hole of suitable location and size. Alternatively the mixture may be preformed around the anode and the preformed package placed in the earth hole. Preformed anode packages are, however, the invention of others, one type thereof being described and claimed in the application of R. B. Mears, Serial No. 705,508, filed October 25, 1946, and form no part of this invention, except as there may be utilized therein mixtures of the type herein described in combination with aluminous metal anodes.

Examples of the excellent results obtained by the practice of this invention were observed when aluminous metal anodes of varying composition, some being of commercial aluminum and others being of commercial aluminum alloyed with varying amounts of zinc (1 to 10 percent by weight), were installed in soils of various types in Texas in circuit with a steel pipe line. The aluminous metal anodes were, in accordance with this invention, surrounded in installed buried position with mixtures of pH greater than 8 in which alkalinity had been established by the presence of varying amounts of lime (7 to 15 percent by weight). Each mixture so formed likewise contained 7 to 15 percent by weight of sodium chloride or, in some cases, magnesium chloride. Over the observed six months' period these installed electrodes steadily maintained in each circuit, formed by connecting an electrode with an underground pipe line, a flow of current of high potential at calculated efficiencies (ampere-hour output per unit weight) varying from about 45 to about 90 percent.

Having thus described my invention, I claim:
1. In a corrosion-resistant metallic underground installation, in combination, a metallic underground structure composed of metal cathodic to aluminum, at least one underground anode composed of aluminous metal and separate from said structure, an electrical connection be-

tween said structure and said anode and a backfill in contact with said anode, said backfill comprising a carrier portion, an effective amount of at least 1 to 30 percent by weight of inorganic halide and sufficient alkaline material to impart to the backfill a pH in excess of 7.5.

2. In the method of cathodically protecting an underground metallic structure composed of metal cathodic to aluminum and including the steps of installing an underground aluminous anode and electrically connecting said anode to said structure to form a galvanic cell, the improvement consisting of contacting the aluminous anode with a backfill comprising an effective amount of at least 1 percent by weight of inorganic halide and having an adjusted alkalinity greater than that indicated by a pH of 7.5.

3. In a corrosion-resistant metallic underground installation, in combination, a metallic underground structure composed of metal cathodic to aluminum, at least one underground anode composed of aluminous metal and separate from said structure, an electrical connection between said structure and said anode and a backfill in contact with said anode, said backfill comprising a carrier portion, an effective amount of at least 1 percent by weight of a halide of an alkaline earth metal or an alkali metal and sufficient alkaline material to impart to the backfill a pH in excess of 7.5.

ROBERT HARRY BROWN.

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- "Status of Cathodic Protection Lines in 1941," by Logan (National Bureau of Standards), page 6.

Certificate of Correction

Patent No. 2,565,544

August 28, 1951

ROBERT HARRY BROWN

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 1, line 52, for "corrosion-resistance" read *corrosion-resistant*;
column 2, line 7, after "protection" insert *system*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of December, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,

Assistant Commissioner of Patents.