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METHOD AND APPARATUS FOR INDICATING CATHODIC PROTECTION

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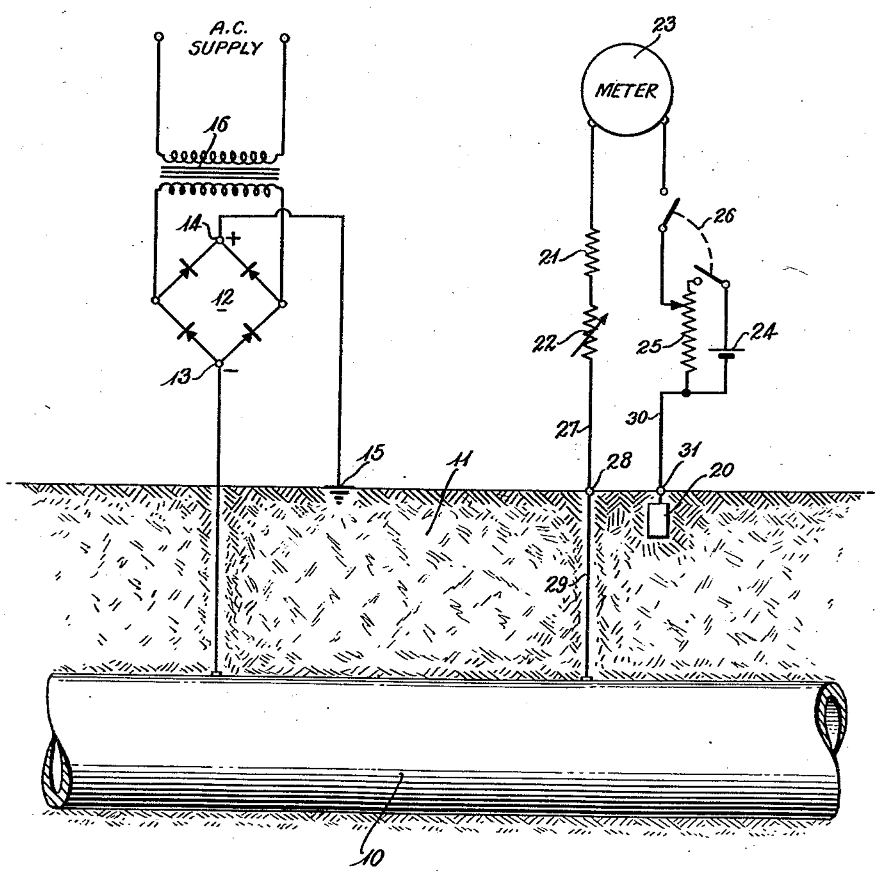


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## METHOD AND APPARATUS FOR INDICATING CATHODIC PROTECTION

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8 Claims. (Cl. 324—29)

This invention relates to a device for measuring and indicating cathodic protection with special reference to pipes and the like buried underground.

Any metallic structure, such as a steel pipe, lead cable sheath or a storage tank, when placed in an electrolyte such as wet soil, sets up a flow of current from one portion to another or to other metallic bodies analogous to local action in a battery. Stray currents from nearby electric railways or grounded power lines contribute to this action. Small quantities of the metal of the pipe or sheath, as a result of this action, go into solution at the anode where the current leaves the structure. This causes pitting, deterioration, and may even cause the ultimate failure of the structure. One of the more efficient and economical ways of counteracting this corrosion in buried structures is obtained by causing a direct current to flow from an outside source in the opposite direction to make the buried structure cathodic instead of anodic.

An example of cathodic protection, as used in the above described manner, would be to employ a full wave dry-plate rectifier and to connect the positive terminal of the rectifier to buried metal scrap or plates and the negative terminal to the structure requiring protection.

The concept of cathodic protection has also been applied to prevent rust in water tanks, stand pipes, and hot wells. The use of cathodic protection has become sufficiently wide spread in recent years, that a large amount of experiments and practical data is available to persons desiring information concerning cathodic protection.

In order to check the cathodic protection of an underground structure, it has been the practice to use, as a standard, a copper sulfate electrode in combination with a volt meter for structures buried under earth, and a calomel electrode for structures under sea water. The electrode is usually of the type known as a half-cell and the apparatus is generally portable. It is, however, possible to use electrodes of metals or materials other than copper sulfate or calomel, however, in order to use these metals or materials intelligibly, the information and data obtained must be interpolated on the basis of a standard electrode. For this reason, it has been exceedingly difficult for cathodic protection to be checked by other than skilled personnel who are fully cognizant of the electrode being used and their characteristics with respect to standard electrodes.

It is, accordingly, an object of the present invention to provide a method and device for checking cathodic protection which can be carried out by unskilled personnel.

It is a further object of the present invention to provide a method and device for checking cathodic protection of buried structures which will enable data to be directly obtained without regard to the type of electrode being employed and without the necessity of interpolating the data in the light of standard electrodes.

It is a still further object of the present invention to provide a device for checking cathodic protection which will be simpler and more efficient than methods and devices that have heretofore been advanced.



Other objects and advantages of the present invention will become readily apparent from the following description when taken in conjunction with the appended drawing in which the single figure shows the method and device of the present invention being used to check cathodic protection of a buried structure.

A normal reading between a steel pipe not involved by any electrolysis or cathodic protection and a standard copper sulfate electrode is approximately 0.55 volt. When cathodic protection is effectively applied to a buried steel pipe, this voltage will rise to values from 0.8 volt to about 2.5 volts.

It is to be understood that the above is merely representative and in no way limits the scope of this invention.

Referring to the drawing, **10** indicates a pipe buried underneath the surface of the earth **11**. In order to afford cathodic protection, a rectifier **12** is connected with its negative terminal **13** attached to the pipe **10** and its positive terminal **14** grounded at **15**. The other terminals of the rectifier are connected through a transformer **16** to a suitable source of alternating current as is conventional.

The method and device for checking the cathodic protection on the pipe **10** consists of an electrode **20** buried in the earth **11** and a novel arrangement for a volt meter. This volt meter consists of a fixed multiplier resistor **21** and a variable multiplier resistor **22**. These two resistors **21** and **22** are connected in series to one side of the meter movement **23**. To the other side of the meter movement is connected a mercury battery **24** in parallel with a voltage divider **25**. A double-pole single-throw switch **26** is connected in circuit with the mercury battery **24** and voltage divider **25**. One lead **27** of the volt meter is connected to a contact **28** permanently fixed at the surface of the earth **11**, which in turn is connected by a lead line **29** to the pipe **10**. The other lead **30** of the volt meter is connected to a contact **31** also permanently fixed, which in turn is connected to the permanently buried electrode **20**.

The electrode **20** can be composed of any metal in any form such as a rod or it can be a base having sprayed or plated film of metal. The metal can be, if desired, coated with a cement of the type used in dentistry. If desired, a non-metallic conductor such as graphite or carbon, either as rods or slabs, which if desired, can be treated with waxes, chemicals, and metal films.

By means of the particular structure of the volt meter, it is possible to use any of the above mentioned metals for the electrode **20** and still obtain direct readings from the meter movement **23** in terms of a standard electrode. By having the multiplier resistor **22** variable, it is possible to make the meter movement **23** agree with a portable meter and standard half-cell electrode regardless of the differences of voltage between the standard half-cell electrode and electrode **20**. These differences may result from the materials having different positions in the electromotive force series. The operability of resistor **22** is limited, however, to the elimination of small differences in cases where the materials are relatively close in the electromotive force series. Further, by having the multiplier resistor **22** variable, any differences due to structure in the two meters can be eliminated and also the meter movement **23** can be compensated for surrounding steel or magnetic effects for all points on the scale. It is desirable to select multipliers which are made of fine wires and thus a certain amount of lightning protection for the meter movement **23** can be had. The switch **26** functions to protect the meter from lightning damage and facilitates adjustment.

If the difference in galvanic voltage between electrode **20** and the reference standard electrode is relatively great, the mercury battery **24** and the voltage divider **25** can be adjusted with respect to the meter movement **23** so that its indications will be as though the electrode **20** were a standard electrode.

The electrode **20** can be surrounded by soil or earth as shown, or suitable chemicals commonly called backfill, which may consist of powdered or crystalline chemicals, a slurry or cements of types other than those used in building construction.

From the above description it can be seen that persons unskilled in cathodic protection, can simply, by reading the meter movement **23**, determine whether or not the pipe **10** has cathodic protection without knowing the characteristics of the electrode **20**.

On well coated insulated structures, the connection to the structure (lead **29**) can be at the point of least structure to soil potential and thus the meter movement **23** will indicate the degree of protection to the structure as a whole. If the cathodic protection is secured by an inaccessible source of electricity, such as a rectifier remotely located, which is impractical to check directly, the meter movement **23** will afford an indication as to whether the rectifier is performing its function properly.

It will be appreciated at this time that the difference between the standard electrode and any other electrode is a constant. Thus, for example, a suitable volt meter connected between a zinc electrode and a standard copper sulfate electrode will read 1.1 volts. The meter of the present invention can be arranged with a scale that centers or zeros on this constant difference and accordingly the zero in such a case would be at 1.1 volts. With such a construction, the needle of the meter can deflect either to the left or the right from its new zero thus enabling the meter to provide an indication of cathodic protection irrespective of the polarity of the binding post on the meter to which the electrode is attached.

While this invention has been shown and described in a specific embodiment, nevertheless various changes and modifications obvious to one skilled in the art are within the spirit, scope and contemplation of the present invention.

What is claimed is:

1. A method for determining cathodic protection of structures located in an electrolyte such as wet soil in terms of a standard reference electrode that comprises impressing a voltage on said structure and the surrounding soil in a direction to make said structure cathodic with respect to the surrounding soil, establishing an electrode within the soil in proximity with said structure, connecting the electrode to the structure, for measuring voltage between the electrode and the structure, and obtaining directly voltage readings between said electrode and said structure in terms of the standard reference electrode.

2. Apparatus for checking cathodic protection of a structure located in an electrolyte that comprises an electrode adapted to be placed in said electrolyte and a volt meter adapted to be connected with one lead to said electrode and adapted to be connected with its other lead to said structure, said volt meter characterized by a meter movement, multiplier resistor means including a variable component, and means to vary the voltage drop between said electrode and said structure.

3. Apparatus as defined in claim 2 wherein said means to vary the voltage drop consists of a mercury battery in parallel with a voltage divider.

4. Apparatus as defined in claim 2 wherein said electrode is selected from the class consisting of metallic and non-metallic conductors.

5. Apparatus as defined in claim 2 wherein said electrode is a metal conductor coated with cement of the type used in dentistry.

6. Apparatus as defined in claim 2 wherein said multiplier resistor means includes a fixed component.

7. Apparatus as defined in claim 2 wherein a switch is connected in series with said means to vary the voltage drop.

8. Apparatus as defined in claim 3 wherein a switch is connected in series with said mercury battery.


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