Nov. 7, 1967 B. M. L. HEUZE 3,351,545

DEVICE FOR CHECKING CATHODIC PROTECTION

Filed Dec. 23, 1963

Fig. 1

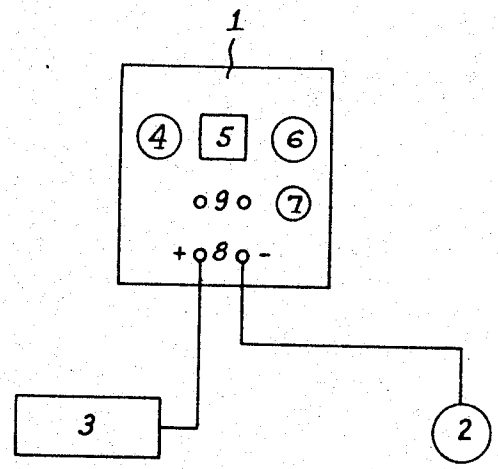
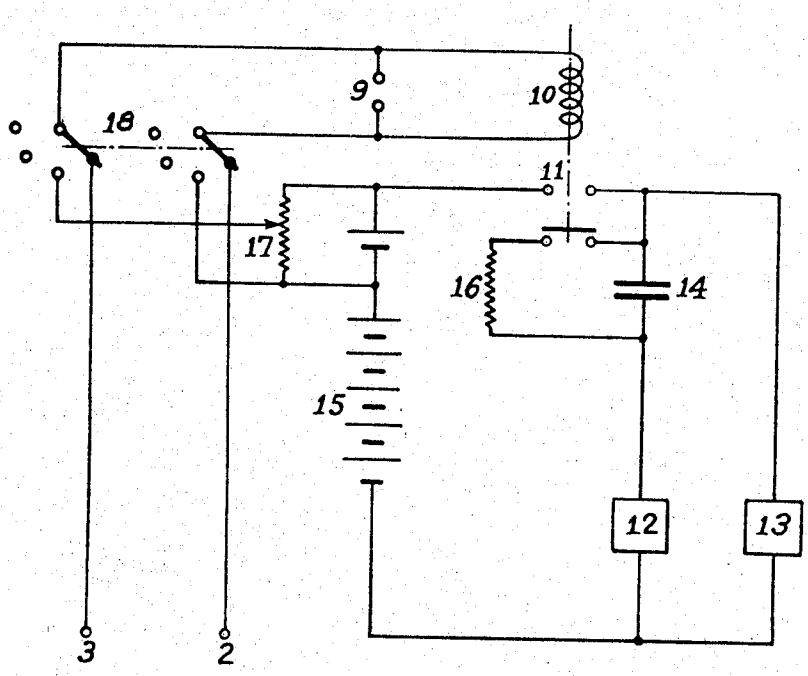


Fig. 2



INVENTOR
B. M. L. Heuze
By Holcomb, Wetherill & Brisebois
ATTORNEYS

United States Patent Office 3,351,545
Patented Nov. 7, 1967

3,351,545

DEVICE FOR CHECKING CATHODIC PROTECTION

Bernard Marie Louis Heuzé, Boulogne-sur-Seine, France, assignor to Societe d'Etudes Contre la Corrosion (Secco), Paris, France, a corporation of France

Filed Dec. 23, 1963, Ser. No. 332,633
Claims priority, application France, Dec. 22, 1962, 919,750
6 Claims. (Cl. 204—196)

ABSTRACT OF THE DISCLOSURE

The invention relates to a process and device for registering the number of times that the potential of a cathodic protection system of a structure exceeds the effective range of cathodic protection, and also registers the total period during which this ineffective potential is produced.

It is often necessary to closely check the effectiveness of a cathodic protection system or circuit applied to certain metal structures, or structures buried or submerged in soil or reinforced concrete.

This applies, for example, when the potential of a structure to be protected is not constant relative to the soil, due to the effect of exterior sources of disturbance. Thus, when the metal structures comprise underground pipes located near electrified railway lines, variable stray currents may traverse these pipes and continually modify their potential in relation to the soil.

The effectiveness of cathodic protection is only obtained on the basis of a well-defined potential threshold. This potential threshold, for example, for a steel pipe, would be —850 mv. relative to a standard reference copper or copper sulphate electrode located in contact with the soil in the immediate vicinity of the pipe. If the potential of the pipe falls below the abovementioned threshold or limit and becomes, for example, —1000 or —1500 mv., there is no disadvantage, since the cathodic protection of the steel pipe still remains effective. However, if, the potential rises above this limit and becomes, for example —500 or 0 mv., the cathodic protection becomes non-existent and there is a risk of corrosion of the pipe, which corrosion generally increases and becomes more rapid, as the potential of the pipe rises.

In the case of lead structures such as, for example, the sheaths of electric cables and tele-transmission cables, the danger of corrosion due to too high a potential is the same, but there is a similar additional risk when the potential becomes too negative; i.e. in order that the cathodic protection of the lead be effective, its potential must be maintained within certain limits beyond which there is risk of anodic corrosion on the one hand and cathodic corrosion on the other hand.

When structures of steel or lead are subjected to exterior disturbances such as those of the stray currents, or when the natural risks of corrosion due to the strength or particular chemical makeup of the soil are very considerable, the main task of the operator having produced a cathodic protection system to ensure the safety of these structures, is to maintain this device in a permanent state of reliable operation and effectiveness. In particular, it is possible, knowing the potential of the structures in relation to the soil, to determine if the cathodic protection is effective.

Recording voltmeters which facilitate this continuous checking are large, and have the disadvantage that they need constant attention if reliable operation is to be maintained. For this reason it is often preferred to use instantaneous reading apparatus even though the operator

has to increase the frequency of the instants at which measurements are made, and is still uninformed as to the behaviour of the cathodic protection in the intervening periods.

The present invention has for an object to provide a monitoring and checking process and device which fulfil the same function as a continuous indicator of the potential of the structure without possessing the same disadvantages. It allow for the simplification and the spacing in time of the operation for checking cathodic protection, whilst affording increased certainty as to the total number of possible anomalies which occur during the period between two successive checks.

This process and this device are simple and moreover allow the checking to be more rapidly effected without it being necessary to use supplementary apparatus.

According to the present invention, the checking device, which is rigidly or permanently installed, registers the number of times that the potential of the structure being checked exceeds the effective zone or range of cathodic protection, and also registers the total period during which this potential was produced.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings which show one embodiment of the invention given by way of non-limiting example. In the drawings:

FIGURE 1 is a schematic representation of the device, and

FIGURE 2 is a schematic circuit diagram of the device shown in FIGURE 1.

In the device shown in FIGURE 1, the apparatus contained in a case **1** is connected externally, by means of wires to two terminals **8**, to the structure **2** the potential of which it is desired to check, and to a reference electrode **3** respectively, preferably located in the vicinity of the structure **2** and in the same ambient environment. The reference electrode may, for example, be of the type disclosed in French Patent 1,261,438, of Apr. 10, 1961.

A voltage sensitive relay, namely a voltmeter relay **4**, is regulated to produce a signal when the difference in potential between the reference electrode **3** and the structure **2** is such that the structure is subjected to corrosion. The signal produced by the voltmeter relay **4** causes the number indicated by a counter **5** to be advanced by one unit and also sets a clock **6** into operation. When the potential of the structure subsequently reaches a value such that cathodic protection of the structure is effected, i.e. when the difference in potential between the structure **2** and the reference electrode **3** is such that there is no corrosion of the structure **2** the signal emitted by the voltmeter relay **4** is stopped and this in turn stops the operation of the clock **6**.

If, subsequently, the potential of the structure **2** reaches a value where cathodic protection is no longer effective, a new signal is emitted by the relay **4**, a further unit is registered on the counter **5**, and the clock **6** is again set into operation for the duration of the period during which cathodic protection is not effective. This clock **6** comprises a totaliser device which indicates the period during which it has functioned since initially starting.

A switch **7**, forming part of the device allows the different operations necessary for the control and adjustment of the device to be effected. For example, it successively allows:

The moving coil of the voltmeter relay to be short-circuited to immobilise it, and to slow down its oscillations (for example during transport of the device),

The controlling or checking by means of a portable or removable voltmeter connected temporarily between ter-

minals **9**, of the voltage of the batteries incorporated in the device, to determine their condition,

The adjusting and checking, by means of a portable or removable voltmeter, of the difference or change in potential for which the voltmeter relay emits the signal,

The putting into normal operation of the device.

The voltmeter relay **10** in FIGURE 2 comprises a voltmeter having a moving coil and contacts **11** which are closed when the difference in potential between the structure **2** and the reference electrodes **3** (FIGURE 1) reaches a value to which the relay is adjusted. The closing of these contacts operates a counter **12** of known construction which counts another unit, and starts a clock **13**, also of known construction.

The operation or triggering of the counter **12** is effected by a pulse of current produced by means of a capacitor **14** at the instant when the contacts **11** close in the circuit supplied by batteries **15**. The capacitor **14** is shunted by means of a resistor **16** which allows the capacitor to discharge rapidly upon opening of the contacts **11**, and thus enables the capacitor again to supply a new pulse to the counter **12**.

The clock **13** is energised by means of the batteries **15** and only operates during closure of the contacts **11**, so that it indicates the duration of this closure.

The counter **12** and clock **13** consume very little electric current so that the batteries need be of small capacity. For example, batteries can be used such as are generally utilised for private telephone installations, such as 9 volts, 50 amp.-hour batteries. In addition, a potentiometer **17** allows the voltage of the batteries to be employed to check and regulate the voltmeter relay **10**, by switching a multiple switch **18** to a suitable position.

The values of the components of the apparatus hereinbefore described may, for example be as follows:

voltmeter relay provided with a moving coil **10**: internal resistance 20,000 ohms; contact adjustable between 0.5 and 1.5 volts
counter **12**: capable of indicating up to 9,999, and consuming instantaneously during the duration of each pulse one pulse of current of 300 ma.
capacitor **14**: 2,000 microfarads
clock **13**: power 10 ma. under 9 v.
discharge resistor **16** of the capacitor **14**: 10 ohms
batteries **15**: 9 volts—50 a.-hr.
potentiometer **17**: 1000 ohms
multi-pole switch **18**: 6 circuits, 4 positions.

It will be understood that the invention is not limited to the specific embodiment hereinbefore described, and various modifications may be made without departing from the scope of the invention as defined in the appended claims.

In particular the preceding embodiment relates to a device which ensures a pure qualitative control since it only indicates the number of potential deviations and their total duration. According to a further embodiment, the device may be quantitative if the indications which it provides relate to the degree of the risk of corrosion incurred by the structure during the period when there is no cathodic protection. It is known that this information regarding degree of risk of corrosion is dependent upon the integral of volts/hours during the deviations.

In another embodiment the apparatus comprises for example a volt/hour meter of a known type, in addition to the apparatus described above.

In another embodiment the volt/hour meter is simply substituted for the clock of the apparatus.

I claim:

1. A monitoring and recording device for the continuous checking of the effectiveness of a cathodic protection system of a structure, comprising a voltmeter relay capable of sensing, and operable by, the potential difference between a structure being protected and a reference electrode located in the vicinity of the structure, said device further including a counter, a time device and a battery connected in a first circuit controlled by said relay, said relay being adjusted to close the first circuit upon deviation of said potential beyond a predetermined value, solely for the duration of said deviation, to trigger the counter to count and record the number of deviations and to trigger the timing device to record the total duration of said deviations.

2. A device as claimed in claim **1**, wherein said timing device comprises an electric clock connected in parallel with the counter.

3. A device as claimed in claim **2**, wherein the counter is adapted to be triggered by a capacitor connected so as to be charged by the battery upon closing of the first circuit.

4. A device as claimed in claim **3**, wherein the capacitor is shunted by means of an auxiliary circuit, comprising a resistor to discharge the capacitor when the first electric circuit is open.

5. A device as claimed in claim **4**, including an input circuit by means of which the relay is connectable to said potential, said input circuit including a multi-position switch adapted to selectively and alternately connect the relay to said potential and to a potentiometer to which a voltage is applied by said cell.

6. A device as claimed in claim **1**, including a volt/hour meter integrator apparatus connected in said first circuit and adapted to be triggered by the closing of the first circuit, said apparatus comprising the timing device.

References Cited

UNITED STATES PATENTS

2,862,177	11/1958	Titterington	324—29
2,918,420	10/1959	Sabins	204—196
2,935,679	5/1960	Morton	324—28
3,061,773	10/1962	Ellison et al.	204—196
3,162,585	10/1964	DeFord et al.	204—195
3,247,500	4/1966	DeGrazio et al.	324—29
3,266,027	8/1966	Nichols	324—29

JOHN H. MACK, *Primary Examiner.*

T. TUNG, *Assistant Examiner.*