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ELECTROLYSIS SWITCH

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FIG. 1

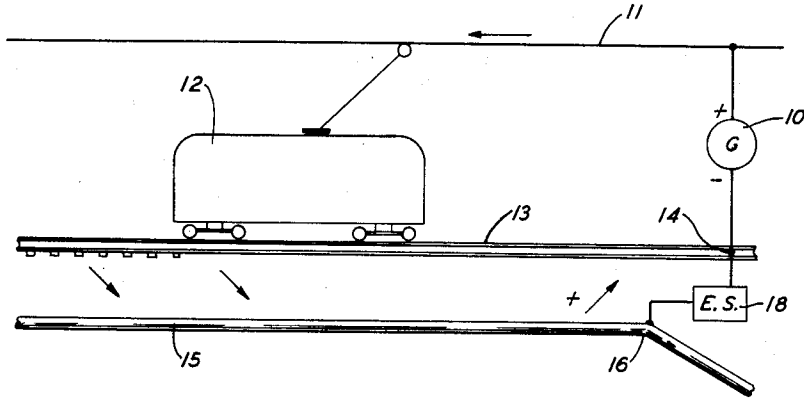
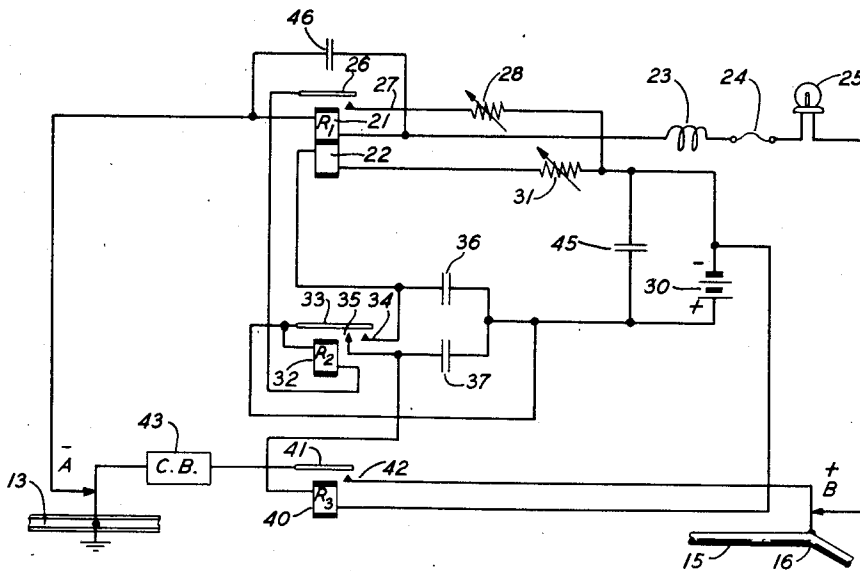


FIG. 2



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## UNITED STATES PATENT OFFICE

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## ELECTROLYSIS SWITCH

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7 Claims. (Cl. 171-316)

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This invention relates to electrolysis switches particularly useful in preventing electrolytic loss of metal from a structure, for example, a buried telephone cable, by earth currents flowing from the structure to a negative return such as the rails of a street-car system.

When a telephone cable runs in the earth in the vicinity of other buried or grounded conductors, potential differences may exist between the cable sheath and the other conductors such as electric power distribution lines, water pipes and the like, and when the cable is in positive relation to the other conductors distinction of the cable sheath may take place, resulting in serious interruptions to the service and necessitating expensive repairs. The loss is averted by making a metallic connection between the cable sheath and the negative return, preferably at the points on each between which the voltage is greatest.

An object of the invention is to provide an improved means for avoiding electrolytic losses from buried metallic structures.

Often when the voltages productive of electrolysis are between the cable and a rail carrying direct current with fluctuations, the functioning of an electrolysis switch is interfered with. This interference is avoided by the present invention by the use of a capacitance-inductance circuit.

Another object of the invention therefore is to provide an electrolysis switch of which the operation is unaffected by a fluctuating component in the current flowing in a negative return.

It is known to use a relay responsive to a range of voltages, positive from structure to return, and serving to control the closing of a main "drainage" switch to establish the metallic path between the structure and the return. It is desired that the responsive relay operate to disable the drainage path when the structure-to-return voltage becomes negative or falls to a prescribed low positive value. Unless the responsive relay is arranged to operate at a voltage considerably higher than that at which it releases, chatter of this relay is a common result. If chatter is avoided by the above-described arrangement, the relay may not operate until the positive voltage, structure to return, has become damagingly high.

Both these undesirable results can be precluded by providing independent adjustment, instead of mutual adjustment, of operate and release voltages for the responsive relay. In the prior art, such voltages have been provided for by adjustments of magnetic pull and of biasing spring acting on the relay armature. The present invention effects adjustment of the operate voltage and provides a holding voltage independently adjusted which keeps the relay operated until the structure-to-return voltage falls to

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zero or to a negligible positive value. It is thus another object of the invention to provide an electrolysis switch capable of reliable operation, without chatter between narrowly spaced values of voltage, and simple in construction.

The invention will be understood from the following description with reference to the accompanying drawing in which:

Fig. 1 schematically represents the conditions of electrolytic loss; and

Fig. 2 is a diagram of the switch indicated in Fig. 1.

While the invention is described in its application to a direct-current source of electrolytic losses, it will be recognized that an alternating voltage between structure and return may be appropriately rectified in order to use the switch.

Referring to Fig. 1, 10 designates a generator supplying direct-current power with the indicated polarity to a car 12 through an overhead line 11 and rails (one shown) 13, understood to be in good contact with the earth. Underground metal sheathed telephone cable 15 parallels rails 13 for some distance. At some point 16 the cable will be closest to the negative terminal of generator 10, and at this point it is desirable to install electrolysis switch 18 between the cable sheath and point 14 on the rail. When the cable sheath is negative to the rail return, it loses no metal by anodic electrolysis, but when the sheath is positive to the rail, currents of the order of amperes or hundreds of amperes may flow through switch 18.

Fig. 2 diagrammatically illustrates switch 18 of Fig. 1. Switch terminals A and B are connected respectively to rail 13 and to cable 15. Winding 21 of relay R<sub>1</sub> is connected between terminals A and B in series with inductance coil 23, fuse 24 and ballast lamp 25. Relay R<sub>1</sub> is a polar relay having two independent windings 21 and 22. By adjusting the magnetic pull on armature 26, biased only by its natural stiffness, it is arranged that a voltage of 0.25 volt, for example, from B to A, shall operate armature 26 to make contact 27 connected through fixed resistor 28 to the negative terminal of battery 30, which may be the central office battery of a telephone exchange located at a distance from the point of insertion of switch 18 or may be an integral part of the switch. To the same terminal of battery 30 is connected one terminal of winding 22 through a variable resistance 31, and windings 21, 22 are so related that when battery current flows through winding 22 it shall aid the current in winding 21 in holding armature 26 operated.

Relay R<sub>2</sub> has a winding 32, an armature 33 and two contacts 34, 35 with which armature 33 makes simultaneous contact when operated. Armature 33 is connected to the positive terminal

of battery 30. Condensers 36 and 37 are spark suppressors. Armature 26 of relay R<sub>1</sub>, when operated by the electrolysis voltage between A and B, connects battery 30 across winding 32 in series with resistor 28 and armature 33 operates to contacts 34, 35. The positive terminal of battery 30 is thus connected through contact 34 to the other terminal of winding 22, through which current now flows, aiding that in winding 21.

Contact 35 is connected through winding 40 of relay R<sub>3</sub> to the negative terminal of battery 30. Thus when armature 33 operates to contact 35, battery current flows in winding 40, operating armature 41 to contact 42. The cable is connected to contact 42, the rail through circuit breaker 43 to armature 41. Relay R<sub>3</sub> is a heavy duty relay, the armature and contact of which are capable of carrying currents of a hundred amperes or more between cable and rail. The voltage difference between these objects is accordingly across a low resistance path and remains so until the release of armature 26 of relay R<sub>1</sub>. This release takes place when the voltage across winding 21 is reduced to an adequately low value.

In order that the operate and release voltages across winding 21 shall be independent, the magnetic circuit of relay R<sub>1</sub> is so adjusted that a selected voltage across winding 21 in the sense from B toward A shall operate armature 26 to contact 27. Then, by adjustment of resistance 31, the constant current in winding 22 when armature 26 is operated is made just insufficient to hold, by itself, armature 26 against contact 27, but large enough to do so when aided by a minimum current in winding 21. With such adjustments, all the relays remain operated until the drain voltage from B to A falls to a tolerable value. Resistance 31 is variable to compensate for varying lengths of line from switch 10 itself to central office battery 30.

Relay R<sub>1</sub>, a polar relay, is connected so that negative voltages from B to A do not cause operation of armature 26.

Inasmuch as the power required to operate relays R<sub>2</sub> and R<sub>3</sub> is much greater than that required to hold them operated, condenser 45 is shunted across battery 30 and is charged thereby while the relays are released. At the moment relay R<sub>1</sub> is operated, condenser 45 partially discharges and provides part of the power needed for operation of relays R<sub>2</sub> and R<sub>3</sub>. Condenser 45 recharges in less time than it takes relay R<sub>3</sub> to reoperate after having been released, and its presence permits the use of smaller gauge wires, or longer wires of a given gauge, between battery 30 and switch 18 than would be satisfactory if this condenser were left out. The capacitance of condenser 45 may be in the order of 10 microfarads or larger, as desired.

The street railway supply source, 10 in Fig. 1, is a constant voltage with fluctuations. To shunt this ripple away from relay R<sub>1</sub>, condenser 46 is shunted across winding 21 and is chosen of capacitance resonant at the ripple frequency with the inductance of coil 23. Winding 21 is then traversed by a current having a ripple component only a small fraction of that without condenser 46.

What is claimed is:

1. A switch for preventing electrolysis, connected between a metallic structure and a negative return, comprising a first, a second and a third relay, the first being a polar relay having

two magnetizing windings and an armature operating a first pair of contacts, the second relay having a magnetizing winding and an armature operating a plurality of pairs of contacts and the third relay having a magnetizing winding and an armature operating a final pair of contacts connected one to the structure and the other to the return, circuit means connecting one winding of the first relay between the structure and the return in the sense to close the first pair of contacts when the structure is positive to the return, a source of power, and means controlled by the closure of the first contacts for applying the source to the winding of the second relay to close the pairs of contacts thereof to apply the source to the other winding of the first relay to hold closed the first contacts and to the winding of the third relay to close the final contacts while the structure is positive to the return.

2. An electrolysis-preventing switch as in claim 1 including means for adjusting to a desired value the current in the other winding of the first relay whenever the source of power is applied to said other winding.

3. An electrolysis-preventing switch as in claim 2 comprising means for eliminating an alternating current from the one winding of the first relay, said means comprising a condenser shunting the one winding and an inductance in series with the one winding between the structure and the return.

4. An electrolysis-preventing switch as in claim 3 including a condenser directly shunting the source of power.

5. Means for preventing electrolysis between a metallic member and a negative return comprising a first relay operating when energized to connect the member conductively to the return and means for controlling the first relay to operate when the voltage between the member and the return attains a chosen positive value and to release when said voltage falls to a chosen lower value, the controlling means including a source of power, a second and a third relay, the second relay having a magnetic structure, a pair of windings and a normally released armature, one winding of the pair being permanently in series between the member and the return and operating the armature when said voltage attains the first chosen value to energize the third relay, the third relay when energized applying the source of power to energize the first relay and to supply current to the other winding of the pair in the sense to hold operated the armature of the first relay, and means for adjusting the supplied current to a value insufficient to hold operated the armature of the first relay when said voltage falls to the second chosen value.

6. Electrolysis-preventing means as in claim 5 including a condenser of capacitance of the order of 20 microfarads shunting the source of power.

7. In electrolysis-preventing means as in claim 5, means for by-passing from the one winding of the second relay an alternating component of said voltage including a capacitance shunting the one winding of the second relay and an inductance in series with said one winding between the member and the return, the capacitance and the inductance being tuned to resonance at the frequency of the alternating component.

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No references cited.