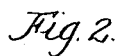
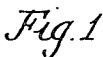


ELECTROLYTIC APPARATUS AND METHOD OF DEPOLARIZING THE SAME.

1,428,049.

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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC APPARATUS AND METHOD OF DEPOLARIZING THE SAME.

Original application filed September 16, 1919, Serial No. 254,345. Divided and this application filed February 8, 1919, Serial No. 275,860. Renewed November 5, 1921. Serial No. 513,210.

To all whom it may concern:

Be it known that I, WALTER D. NICKUM, a citizen of the United States, residing at Glendale, in the county of Los Angeles and State of California, have invented a new and useful Improvement in Electrolytic Apparatus and Methods of Depolarizing the Same, of which the following is a specification.

10 This invention relates to apparatus comprising electrolytic means wherein it is desired to maintain a current of substantially uniform strength.

15 An important object of the present invention is to avoid difficulties which have been found to arise in apparatus of this class by reason of so-called "polarization" at the circuit controlling electrodes, causing decrease or even practical cessation of the operating current under conditions at which the current should be maintained at full strength.

20 When plates of two dissimilar metals are partially immersed in a vessel containing an acidulated solution, and their outer ends are connected together by a conducting wire, 25 an electric current is set up, caused by the acid in the solution attacking the metal plates. The water of the solution is also acted upon and free oxygen and hydrogen 30 gases are liberated. The gases collect on the metal plates, partially adhering thereto, and form a film of high electrical resistance, causing a rapid decrease if not an actual stoppage of the electrical action. This effect 35 of polarization is a well known action in practically all chemical batteries.

40 It is also well known that when an electric current is caused to pass through an acidulated solution between electrodes immersed therein, a deterrent film of gas is formed on the electrodes due to the electrolysis of the water, and as these gases are poor conductors the current is practically 45 stopped. If a coil of wire wound around a soft iron core is introduced into the circuit, a high voltage induced current will surge through the circuit and break the gas film when the primary current has been 50 stopped by the collecting of the deterrent gases on the electrodes, again establishing a path for the primary current. This forming and disrupting of the gas film is very rapid and has been taken advantage of in designing certain well known types of electrolytic 55 interrupters but has the disadvantage of

being of little value on currents having a potential of less than 40 or 50 volts.

The present invention provides a method of maintaining a constant flow of low voltage current between plates or electrodes immersed in water or other electrolyte, by constantly dissipating the deterrent gas film formed by electrolysis of the water. This is effected by taking advantage of the relatively higher voltage currents induced in the secondary windings of induction coils or transformers when the primary current is varied by polarization, to break down the gas film. I have found that under suitable conditions with a properly designed induction coil or transformer the current may, by this means, be indefinitely maintained at proper value through the circuit, even with a potential difference as low as one and one-half volts.

The accompanying drawings illustrate embodiments of my invention, and referring thereto:

Fig. 1 is a diagram illustrating the principles involved in overcoming polarization.

Fig. 2 is a diagram showing a modified form of the circuits.

For the purpose of illustration, I have shown in Figs. 1 and 2 the application of the invention in depolarizing an electrolytic device constituting a circuit controller for an electromagnet coil 4, whose armature 25 controls a circuit, such as a signal circuit.

A particular application of the invention is claimed specifically in application Ser. No. 254,345, filed September 16, 1918, of which this application is a division; the present application relating to the broad process and apparatus for depolarization.

Referring to Fig. 1, which illustrates the circuits as far as is required for explaining the depolarizing action, the battery A is shown as connected in a circuit including a wire 1 leading from said battery to an impedance or choke coil 2 from which a wire 3 leads to an electromagnet coil 4, a primary winding 5 of a transformer 6 being also included in this connection. From said primary winding a wire 7 leads to an electrode 9 immersed in an electrolyte, such as a body W of water, or dilute acid, or alkaline or neutral salt solution, contained in a vessel B. From another electrode 10 of like material to electrode 9 immersed in such liquid, a wire 11 leads to an impedance or choke

coil 12 from which a wire 13 leads back to battery A. A secondary winding 15 of transformer 6 is connected at one end to wire 7 and at the other end by wire 16 to an electrode 17 between electrodes 9 and 10. Electromagnet 4 is simply typical of a translating device of some kind included in the circuit, and any other translating device may be substituted therefor, according to the specific application of the invention, or in some cases, as hereinafter explained, this translating device may be omitted. In the specific application of the invention, as illustrated in the drawings, the electromagnet may act as a relay for controlling a signal circuit, for example, the armature 25 of said electromagnet having front contact 26 and back contact 27 respectively connected by wires 28 and 29 to suitable signal means or other translating devices 30 and 31 from which wires 33 and 34 lead to wire 35 connected to one side of a battery 36, whose other side is connected by wire 37 to armature 25. With this arrangement the armature 25 will close one or the other of the branch circuits through the respective devices 30 and 31 according to the condition of energization or de-energization of the circuit through the electrolytic device comprising the electrolyte W and the electrodes immersed therein, and in this application of the invention the main object thereof is to enable continuous energization of this circuit, without interference by polarization effects.

If current is allowed to flow from the positive side of battery A through wire 1, impedance coil 2, wire 3, coil 4 and primary coil 5 and wire 7, to plate 9 through solution W in vessel B to plate 10 and wire 11, impedance coil 12, and wire 13, back to negative side of battery A, the water in the solution W will be more or less decomposed by the current passing through it and gas will collect on the electrodes, the degree of electrolysis of the water depending upon the quantity of current flowing through the circuit. The gases liberated by the decomposition of the water and collecting on the electrodes in the solution W, as heretofore mentioned, quickly reduce the flow of current. Immediately on the reduction of the current an induced current of relatively high voltage is generated in the secondary coil 15 of the transformer 6 and flows through the circuit consisting of the wire 7, plate 9, solution W, plate 17, wire 16, and secondary coil 15. This secondary current being momentary of relatively higher voltage compared to the original primary current breaks down the gas film and decreases the resistance so that the current can again flow. The forming and dissipating of the gas film takes place with sufficient rapidity to allow an almost constant flow of direct current

through the primary circuit so that the coil of the relay 6 or other device in the circuit will be constantly energized as long as the plates 9 and 10 are immersed in the solution W.

Due to the varying degrees of strength of the primary circuit, the induced current in the secondary coil 15 becomes practically alternating in character and to prevent a loss of its efficiency in acting upon the gas film on the electrode plates by a certain portion of the secondary current backing up through the battery A, the impedance or choke coils 2 and 12 are introduced in the circuit to impede the transmission of such alternating current to battery A.

A more effective circuit arrangement is shown in Fig. 2 wherein the plate 17, Fig. 1, has been eliminated. The secondary coil 15 of the transformer 6 is practically bridged across the primary circuit by connection 20 to wire 11 leading to plate 10 and by connection 23 and wire 7 connecting to plate 9.

The modified circuit Fig. 2 using only two plates or electrodes 9 and 10 is just as effective as the circuit shown in Fig. 1 except that by reason of the secondary coil 15 being permanently bridged across the primary circuit, the winding of the secondary coil must be so proportioned that it will have a resistance equal to or greater than the total resistance of the primary circuit, and the relay coil 4 must be so designed that it will not be sufficiently energized by the small amount of current flowing through the secondary coil to hold the armature 25 thereof when the primary circuit has been opened by removing one or both of the plates 9 and 10 from the solution W, or when the plates have been so removed and the primary circuit permanently opened by disconnecting the battery A that the coil of the relay will not be sufficiently energized to attract its armature when the battery A is again connected, until the total resistance has been reduced by again immersing the plates 9 and 10 in the solution W. The circuit Fig. 2 is especially adapted where, for mechanical or electrical reasons, it is desirable to simplify the construction of apparatus containing the electrodes by reducing their number and also the number of wires leading thereto.

It is evident from the foregoing that other electrically operated apparatus could be introduced in the primary circuit besides the relay coil 4, or that said coil can be dispensed with by making direct connection as shown in the dotted line at $a-a$, if it is desired to use the depolarizing effect of the secondary circuit to maintain a flow of low voltage direct current through the solution W for the purpose of electrolysis. For instance, certain applications in chemistry and

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electrometallurgy whereby desired actions could be obtained with low voltage that could not be obtained with greater voltages, also the purification of water or sewage, and the application of the circuit as a depolarizer for certain types of primary batteries. In such application of the invention the electrodes 9 and 10 may constitute the electrodes of the electrolytic cell or of the primary battery, as the case may be.

It will be understood that the operation of this invention does not require complete interruption of the current by the polarizing action, it being required only that there shall be a sufficient decrease or variation of the current to produce the required inductive effect in the secondary circuit to dissipate the condition of polarization.

What I claim is:

1. In an electrical apparatus comprising a circuit including a source of direct current electrodes in contact with an electrolyte, means for maintaining the current effectiveness of such circuit, consisting of a transformer having a low tension primary coil in series with and energized by said circuit and a high tension coil in electric connection with said electrodes in such manner as to cause reduction of polarization between the electrodes when the current in the primary coil is reduced by such polarization.

2. In an electrical apparatus comprising a circuit including a source of direct current and electrodes in contact with an electrolyte, a transformer having a low tension coil in series with and energized by said circuit and a high tension coil in electric connection with said electrodes in such man-

ner as to dissipate a condition of polarization produced by the current in said electrolyte, and impedance coils between the source of current and said transformer.

3. In an electrical apparatus comprising a circuit including a source of direct current and electrodes in contact with an electrolyte, a transformer having a low tension primary coil in series with and energized by said circuit, and a high tension coil bridged across said circuit in such a manner as to dissipate a condition of polarization produced by the direct current acting on said electrolyte, and impedance coils between the source of current and said transformer.

4. In an electrical apparatus comprising a circuit including a source of direct current and electrodes in contact with an electrolyte, a transformer having a low tension primary coil in series with and energized by said circuit, and a high tension coil bridged across said circuit and having a resistance equal to or greater than the resistance of the circuit through the electrodes and the electrolyte.

5. The method of depolarizing surfaces exposed to an electrolyte and included in part of an electric circuit, which consists in causing the current variation in said circuit due to polarization to induce a current of relatively high tension and applying such high tension current to the polarized surfaces to depolarize the same.

In testimony whereof I have hereunto subscribed my name this 29th day of January 1919.

WALTER D. NICKUM.