W. B. THORPE.

ELECTROLYTIC APPARATUS.

APPLICATION FILED AUG. 18, 1909.

1,002,882. Patented Sept. 12, 1911.

3 SHEETS—SHEET 1.

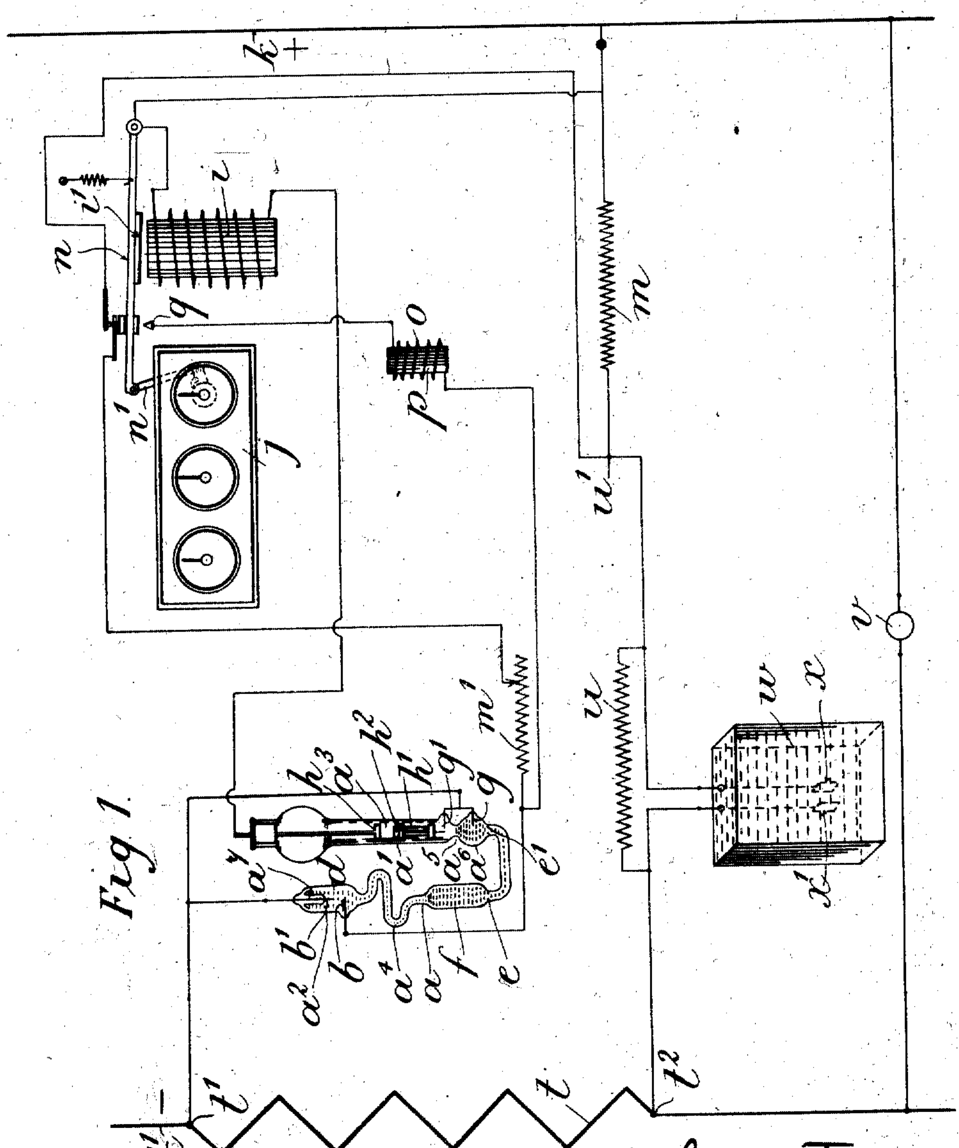

Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 2

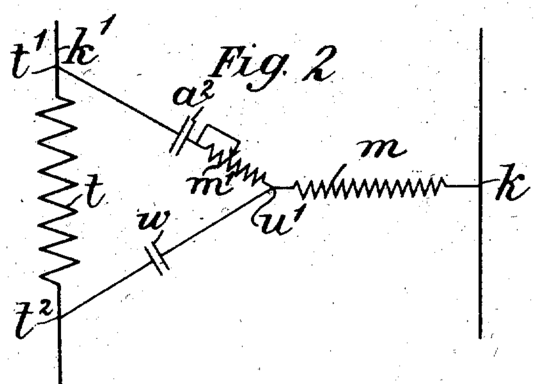
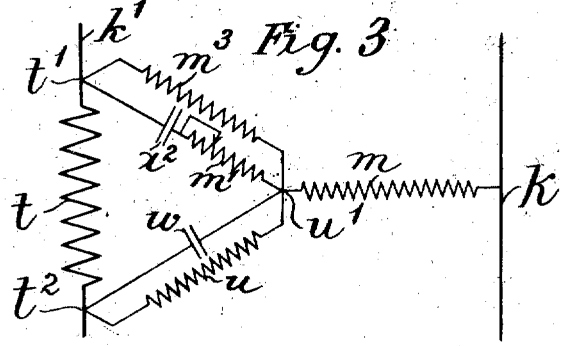


Fig. 3



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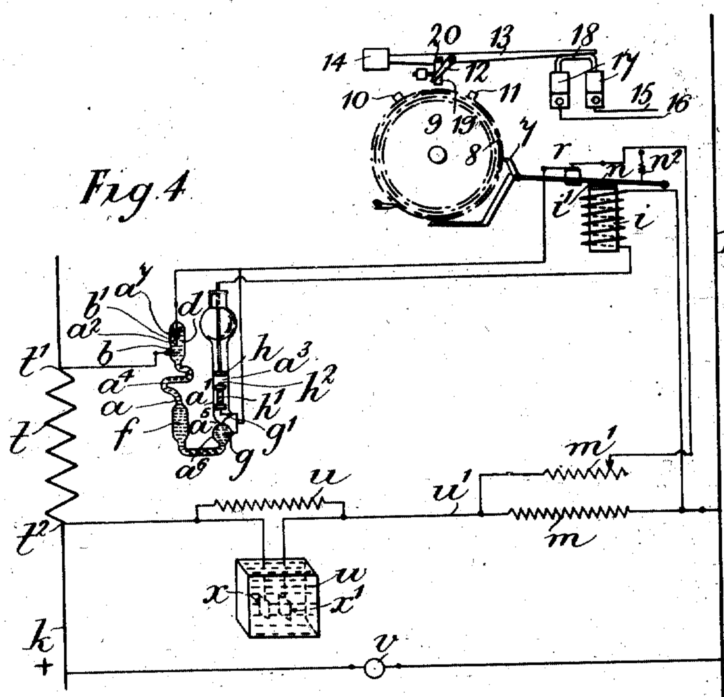
3 SHEETS—SHEET 3.

Fig. 4



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ELECTROLYTIC APPARATUS.

1,002,882. Specification of Letters Patent. Patented Sept. 12, 1911.

Application filed August 18, 1909. Serial No. 513,479.

To all whom it may concern:

Be it known that I, WILFRED BERTRAM THORPE, a subject of the King of Great Britain and Ireland, residing at Balham, in the county of London, England, have invented Improvements in Electrolytic Apparatus, of which the following is a specification.

This invention has reference to that kind of electrolytic apparatus suitable for use as or in the construction of meters, switches, and other electrical apparatus, wherein an electric current passed through such apparatus causes electrolysis of a liquid, for example acidulated water or an alkali, and the evolution of gases, for example oxygen and hydrogen.

In the specification of another application for Letters Patent filed by me No. 471,936, I have described constructions of electrolytic apparatus of the kind referred to whereby such apparatus is rendered practically available for use as or in the construction of meters, recorders, switches and other apparatus. In the use of such electrolytic apparatus with positive and negative electric supply conductors and electro-magnetic means for operating mechanism, for example recording mechanism, as in a registering electricity meter, and for causing ignition of the evolved gases, there is described in the said former specification, the combination with the electrolytic cell and electric supply conductors, of a shunt arrangement comprising two equal and parallel resistances connected at one end to opposite ends of the ordinary main shunting resistance in series with one of the supply mains, and at the other end to one end of a third resistance the other end of which is connected to the second electric supply main, the electrodes of the electrolytic cell being connected across the ends of that one of the two parallel resistances that is on the dynamo or supply side of the main shunting resistance and in which the voltage drop is arranged to be greater than the back E. M. F. of the electrolytic cell so that the cell will begin to work immediately current is supplied to the lamp or other circuit with which the apparatus is used. This arrangement of electrolytic cell and shunt arrangement is found to work satisfactorily in cases where the E. M. F. or voltage between the electric supply conductors is maintained practically constant. If however the combined arrangement be used in connection with the positive and negative supply mains of an ordinary electric distributing system in which the voltage between the said mains varies from time to time from the normal voltage, it is found that the combined arrangement does not work quite accurately.

Now the present invention has for object to enable electrolytic apparatus to work accurately in connection with an electric supply circuit subject to varying voltage within ordinary permissible limits, so that recording or other apparatus used with and controlled by such an electrolytic apparatus shall be accurately operated notwithstanding varying voltage conditions. For this purpose, according to one way of carrying out the present invention there is used in conjunction with electrolytic apparatus of the kind referred to connected up between one end of the shunting resistance and the high resistance across the supply conductors and adapted to control recording or other apparatus and it may be an igniting device, as heretofore, a second electrolytic cell (hereinafter called for distinction an absorption cell) that is connected up between the high resistance and the other end of the shunting resistance on the consumption side thereof, the two cells being thus connected in parallel with each other and in series with the high resistance across the positive and negative supply conductors. The two cells and the main shunting resistance are preferably connected to the negative supply conductor, and the main or registering cell has preferably in circuit therewith, as heretofore, a high resistance for adjustment or elimination of time and temperature errors.

In the accompanying illustrative drawings, Figures 1 to 4 inclusive show, diagrammatically, various arrangements of electrolytic apparatus embodying the present invention, Figs. 1 to 3 showing the apparatus adapted for use as a registering meter and Fig. 4 for use as a switch.

In Fig. 1, a a^1 is the bent tube of an electrolytic device and a^2 the main or registering electrolytic cell therein charged with electrolyte d and provided with positive and negative electrodes b, b^1 arranged in a circuit that includes a main high resistance m and an adjustable high resistance m^1 and is adapted to be connected, when the meter is to be used, as a shunt across the positive and negative electric supply mains k, k^1 respectively, the connection to one of these mains being made at one end t^1 of the ordinary main shunting resistance t. This resistance is preferably arranged in the negative supply main k^1 as shown. i is an electro-magnet the winding of which is connected across the mains k, k^1 when the gases evolved in the cell a^2 cause the mercury column f in the tube a, a^1 to rise in the contact chamber a^3 of the electrolytic device and bring a contact h^2, carried by a float h^1, against the fixed contact h, the electro-magnet, when energized, acting through its armature i^1 and an arm n and rod n^1 to operate the registering or recording mechanism j of the meter as heretofore.

The electrolytic device shown is constructed in the manner described in my said former specification, and comprises a bent tube having constricted portions a^4, a^5, one of which, namely a^4, contains a fine thread of electrolyte to form a high resistance between the electrodes b, b^1 and the mercury f; rings e, e^1 of platinum forming a fluid tight joint with the mercury, and a contact g projecting into the bulb a^6 so as to be in contact with the mercury f and connected to the negative electrode b^1. g^1 is a second negative contact projecting into the contact chamber a^3 so as to come into connection with the mercury f when it enters that chamber and form a second connection therewith. The evolved gases are preferably ignited by a spark produced between the surface of the electrolyte d and a terminal arranged above it, and preferably formed by the negative electrode b^1, according to the invention forming the subject of another application for patent No. 513,480 filed by me on even date herewith, the igniting spark being produced when the surface of the electrolyte d, under the action of the evolved gases, falls below the electrode b^1 which is arranged vertically. o and p are respectively the winding and core of an inductive device, the winding being connected to the shunt circuit of the electrolytic device at a point between the resistance m^1 and electrode b, and also to a fixed contact q against which the armature lever n bears, when attracted by the electro-magnet i, i^1, so as to close a circuit directly across the mains k, k^1 at this time and cause a more rapid evolution of gases in the cell a^2 for depressing the electrolyte d below the electrode b^1 for producing the igniting spark which will be reinforced by the inductive action of the device o, p, also as described in the said other specification filed on even date herewith. The shunt circuit including the electrodes b, b^1 and resistances m, m^1 may include a switch r that is opened automatically when the arm n is attracted by the electro-magnet i, i^1, so as to cut the resistances m, m^1 out of circuit when the cell a^2 is connected across the mains k, k^1 through the inductive device o, p for the purpose mentioned. w is the absorption cell connected to the said shunt circuit at a point u^1 between the resistances m, m^1 and to the end t^2 of the main shunting resistance t on the consumption or lamp side v thereof, so that the main or registering cell a^2 and the absorption cell w are connected in parallel with each other across the positive and negative supply mains and in series with the main resistance m.

The absorption cell w comprises two plates x, x^1 of metal, preferably nickel, immersed in an electrolyte, preferably a solution of caustic soda. In making up this absorption cell care should be taken that (I) the plates x, x^1 are large in proportion to the electrodes b, b^1 in the main cell a^2; (II) that the internal resistance of the cell w is small compared to that of the cell a^2, and (III) that, the two foregoing conditions being complied with, the plates are large enough to take any variation of voltage, within say a limit of 10% (ten per cent.) of the normal voltage, without the voltage drop across the plates materially altering. By this means, if the plates x, x^1 be made of comparatively large size, say each about one square inch in area, considerable variation of the voltage across the electric mains k, k^1 will cause no variation in the circuit of the main cell a^2 and therefore no error in the working of this cell will take place by reason of such voltage variation, so that such cell will accurately register ampere hours. In this case the shunt resistance u (hereinafter called the parallel resistance) connected between the points u^1 and t^2 as in the former arrangement of apparatus hereinbefore referred to, may be omitted, as indicated in Fig. 2, but in order to reduce the amount of electrolytic action in the absorption cell, it is in all cases preferred to use this resistance. The internal resistance of the absorption cell w can also be so adjusted, as by increasing or reducing the distance apart of the plates x, x^1, or by varying the size of such plates, or the density of the electrolyte x^2, whichever may be necessary owing to the internal resistance of the main or registering cell a^2, that the resistance of the main cell circuit will be caused to vary in proportion to the variation in voltage.

The absorption cell may be looked upon as a gas cell in which the back E. M. F. depends upon the size of the plates and the current passing through such plates. With plates of moderate size, the back E. M. F. will vary with currents of from say about .01A to .1A (decimal nought one to decimal one ampere), such as would result with voltage variation within a limit of say 10% of the normal voltage when using a sufficiently high resistance (m), although practically no difference in the back E. M. F. of the cell would result with currents of from say one to two amperes. By utilizing such varying back E. M. F. set up with varying current through the absorption cell, due to varying voltage above or below the normal, the back E. M. F. of the main or registering cell will be caused to vary proportionately to such voltage variation, as the absorption cell is connected in parallel with it and in series with the high resistance (m). In practice it is advisable to avoid, as far as possible, having to refill the absorption cell with electrolyte from time to time, owing to evolution of gases, unless the evolved gases are to be recombined by ignition. Therefore it is necessary that the evolution of gas should be as small as possible and for this reason the resistance u is preferably connected across the terminals of the absorption cell. The combined absorption cell and parallel resistance may be regarded as two resistances in parallel with each other, one of which, being of wire, varies as the current going through it, while the other does not vary with the current. The result is that by adjusting the parallel resistance u, an accurate registration in the registering cell can be obtained with a variation of voltage within the above mentioned limits. In this way the apparatus can be adapted to serve as a watt hour meter instead of an ampere hour meter, the time taken in the evolution of the gases being altered proportionately to the rise or fall of the voltage above or below the normal voltage. For a watt hour meter, each plate x, x^1 may be about one quarter of a square inch in area. The main resistance m and the parallel resistance u are adjusted for the voltage that the meter is designed for. It is preferred, where possible, to adjust the two resistances m and u to suit the lowest range of voltage supplied. The required internal resistance of the absorption cell w can be determined by testing the meter at different voltages in comparison with a standard meter, the internal resistance of the absorption cell being varied until the readings at different voltages are practically accurate for the electric energy supplied. The resistance m^1 is adjusted to cause the registering cell a^2 to act at the desired rate for a given consumption of electrical energy, say once every hour for each unit of electricity supplied.

An absorption cell such as described can be used in various arrangements of shunts for electric meters. Thus, Fig. 3 shows a similar arrangement to Fig. 2 but in which a resistance m^3 is placed in shunt across the main cell a^2 and its resistance m^1 in addition to the resistance u across the absorption cell w.

The gases evolved in the absorption cell w by electrolysis can, if required, be recombined in a manner similar to that in which the gases evolved in the main cell a^2 are recombined. The recombining of the gases in the absorption cell w by ignition may be dispensed with by forming the plates x, x^1 of catalytic platinum which, owing to the absorbing power thereof, gives off practically no gas with the very small current which is passed through the cell, and what little is given off, it readily recombines. It may also be desirable to practically prevent evolution of gases in the absorption cell when using nickel electrodes. This can be done by making the resistance m so great that the current passing through the absorption cell will be so small that practically no gases will be given off in such cell. The resistances m^1 and m are or may also be made so great that practically no gases will be given off in the main cell a^2 when no current is being supplied to the lamp circuit v.

Apparatus such as shown in Figs. 1, 2, and 3 instead of being used to operate a counting device j for registering the quantity of electricity consumed, may be adapted for use for other purposes, as for example for operating an automatic switch, for example a switch that will operate after the electrolytic apparatus has acted a given number of times, and close or open an electric switch for switching on or switching off electric or other lamps or for performing some other useful work. Fig. 4 shows an arrangement for this purpose wherein the lever n is provided with a pawl 7 to engage teeth 8 on a disk 9 provided with adjustable tappets 10 and 11, the pawl 7 engaging the disk and rotating it a step by the action of a spring n^2 each time the lever n is released after being attracted by the electromagnet i, i^1. The tappet 10 is arranged to engage, at the required time, an arm 12 fixed on a switch lever 13 and move this lever in the direction of the arrow, against the action of a weight 14, and close a circuit between two conductors 15 and 16 through a switch comprising mercury cups 17 and a movable contact 18 on the lever, which is then held in the closed position by the notched upper end of a pivoted catch 19 engaging a pin 20 on the lever. The tappet 11 is arranged to disengage the catch 19 from the pin 20 at the required time and allow the weight 14 to open the switch 17—18.

What I claim is:—

1. Electrolytic apparatus comprising a circuit having three branches adapted to be connected as a shunt between two electric supply mains, one of said branches having therein a high resistance and designed for connection to one of said mains and the other two branches being designed for connection to the second supply main, and each having therein an electrolytic cell.

2. Electrolytic apparatus comprising a circuit having three branches adapted to be

connected as a shunt between two electric supply mains, one of said branches including a high resistance and designed for connection to one main and the other two branches being designed for connection to the second supply main, one of these two branches having in circuit therewith a main registering electrolytic cell and the other having in circuit therewith an absorption cell comprising an electrolyte and metal plates, said plates being large in proportion to the electrodes in the main cell, the internal resistance of the absorption cell being small compared to that of the main cell and the size of the plates being such that any rise in voltage, within a predetermined limit, between the ends of said shunt will not cause any material voltage drop across the plates.

3. Electrolytic apparatus comprising a circuit having three branches adapted to be connected as a shunt between two electric supply mains, one of said branches including a high resistance and designed for connection to one main and the other two branches being designed for connection to the second supply main, one of these two branches having in circuit therewith a main registering electrolytic cell and the other having in circuit therewith a second electrolytic or absorption cell having a smaller internal resistance than the main cell and a low resistance connected across the terminals of said absorption cell.

4. Electrolytic apparatus comprising a main electrolytic cell and a high resistance arranged in series with each other and adapted to be connected in a shunt circuit across electric supply mains, a main shunting resistance adapted to be included in circuit with one of said supply mains and to one end of which said main electrolytic cell is connected, and a second electrolytic or absorption cell connected in series with said high resistance and to the opposite end of said main shunting resistance, substantially as described.

5. Electrolytic apparatus comprising a main electrolytic cell and a high resistance arranged in series with each other and adapted to be connected in a shunt circuit across electric supply mains, a main shunting resistance adapted to be included in circuit with one of said supply mains and to one end of which said main electrolytic cell is connected, a second electrolytic or absorption cell connected in series with said high resistance and to the opposite end of said main shunting resistance, and a low resistance connected across the terminals of said absorption cell.

6. Electrolytic apparatus comprising a main electrolytic cell, a main high resistance and an adjustable high resistance connected in series with each other and adapted to be connected in a shunt circuit across electric supply mains, a second electrolytic or absorption cell connected to said shunt circuit between the main and adjustable resistances and a main shunting resistance arranged to be included in circuit with one of said mains between the main and absorption cells connected thereto.

7. Electrolytic apparatus comprising a main electrolytic cell, a main high resistance and an adjustable high resistance connected in series with each other and adapted to be connected in a shunt circuit across electric supply mains, a main shunting resistance adapted to be included in circuit with one of said supply mains and to one end of which said main electrolytic cell is connected, a second electrolytic or absorption cell connected to said shunt circuit between the main and adjustable resistances and to the second end of said main shunting resistance, and a low resistance connected across the terminals of said absorption cell.

8. Electrolytic apparatus comprising a shunt circuit adapted to be connected across electric supply mains and comprising three branches, a main high resistance included in one branch, a main electrolytic cell with an adjustable high resistance included in a second branch and a second electrolytic or absorption cell included in the third branch, a low resistance connected across said main cell and adjustable resistance, and a low resistance connected across the terminals of said absorption cell.

9. Electrolytic apparatus comprising a main shunting resistance adapted to be connected in circuit with one of two current supply mains, a main electrolytic cell, a main high resistance and an adjustable high resistance arranged in series with each other to form a shunt circuit that is connected at one end to the said main shunting resistance on the dynamo side thereof and is designed to be connected at the other end to the second supply main, a second electrolytic or absorption cell connected to the other end of said main shunting resistance and to the shunt circuit between the main and adjustable resistances, a low resistance connected across said main cell and adjustable resistance, and a low resistance connected across the terminals of said absorption cell.

Signed at London, England this 30th day of July 1909.

WILFRED BERTRAM THORPE.

Witnesses:
T. L. Rand,
R. O. Williams.