Feb. 3, 1925.

1,524,937

E. A. KEELER

ELECTRODE FOR ELECTROLYTIC CONDUCTIVITY CELLS

Filed Jan. 10, 1924

Fig. 1.

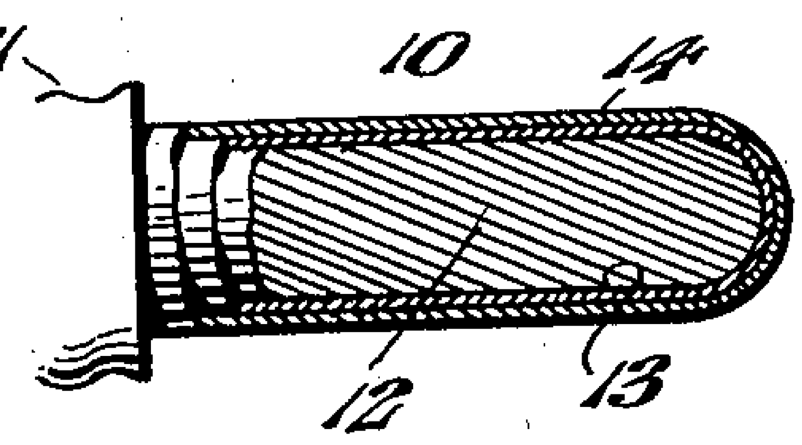


Fig. 2.

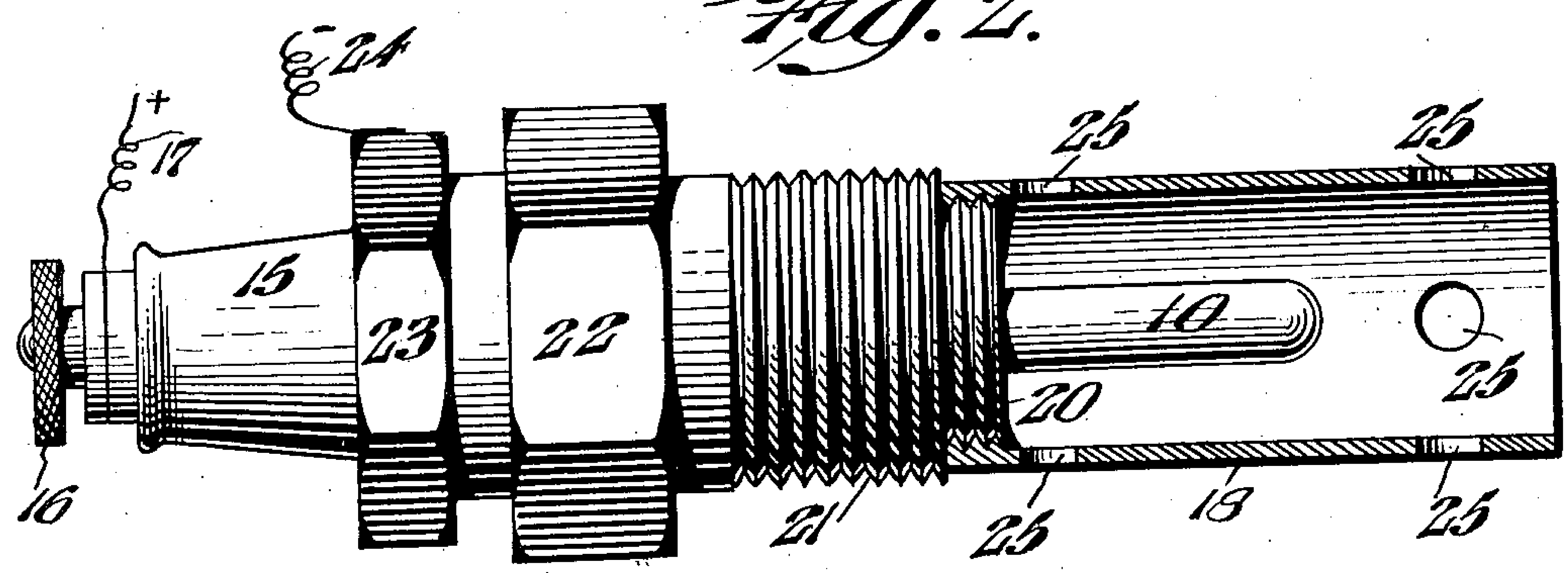


Fig. 3.

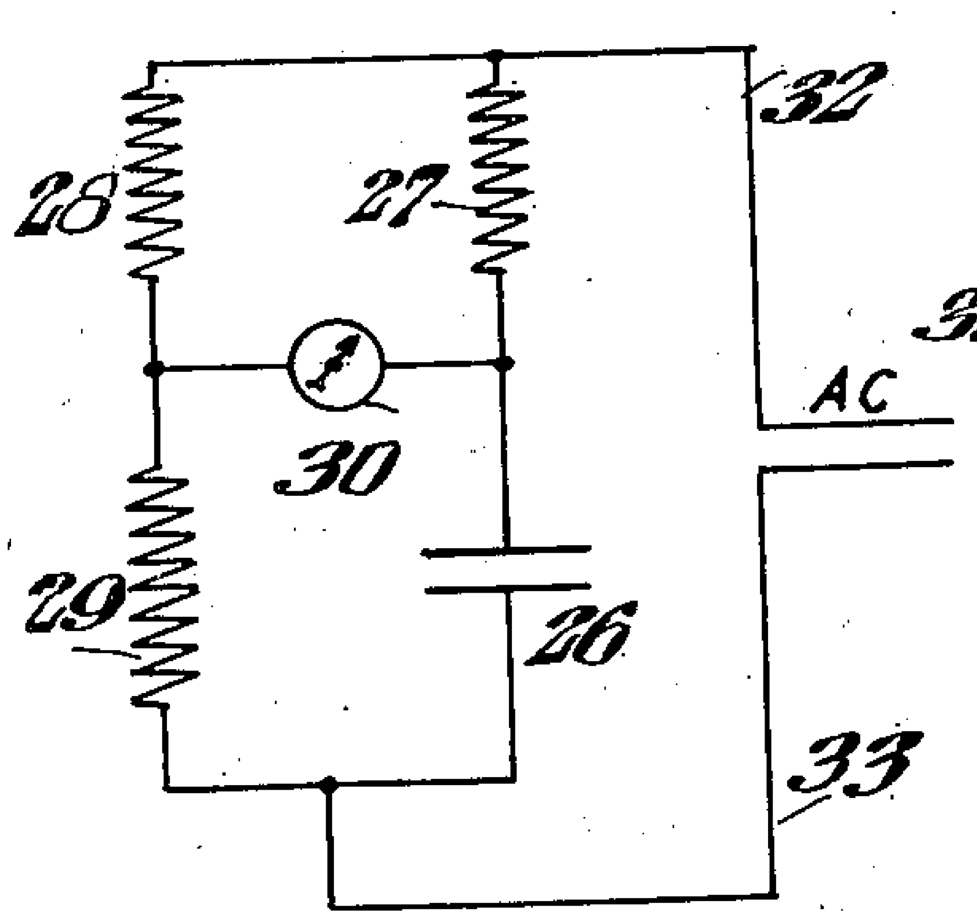
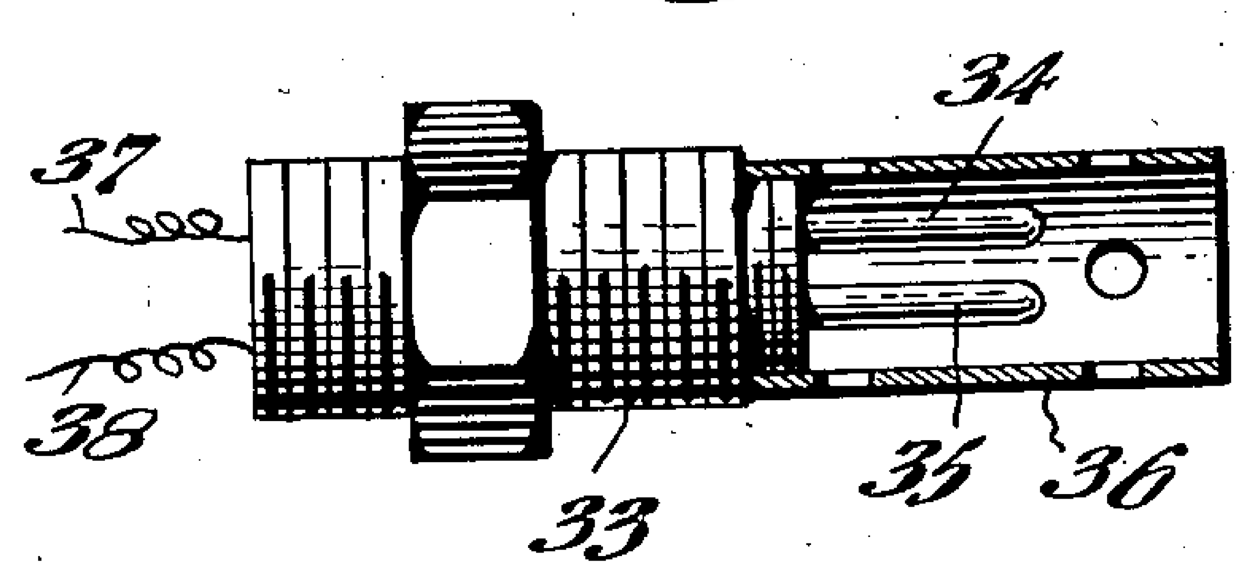


Fig. 4.



INVENTOR:
Earl A. Keeler.
BY
Robert M. Barr
ATTORNEY

Patented Feb. 3, 1925. 1,524,937

UNITED STATES PATENT OFFICE.

EARL A. KEELER, OF OAK LANE, PENNSYLVANIA, ASSIGNOR TO THE BROWN INSTRUMENT COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELECTRODE FOR ELECTROLYTIC CONDUCTIVITY CELLS.

Application filed January 10, 1924. Serial No. 685,366.

To all whom it may concern:

Be it known that I, EARL A. KEELER, a citizen of the United States, and a resident of Oak Lane, county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Electrodes for Electrolytic Conductivity Cells, of which the following is a specification.

The present invention relates to electrolytic conductivity cells, and more particularly to improvements in the electrodes used in conjunction with such cells.

Electrolytic conductivity cells are used to measure the conductivity of chemical solutions, to determine the amount of salt, alkali or acid in the solution, and in carrying out this measurement the two electrodes of the cell are immersed in the solution and the resistance to current flow determined by means of a Wheatstone bridge circuit, which is the more general method of making such determination. The resistance of the electrolytic conductivity cell constitutes one arm of the bridge. In measuring the conductivity of chemical solutions by this method a serious difficulty arises in that the passage of current between the electrodes, results in the evolution of a gas, which deposits as a thin film upon the electrode, and produces an effect known as polarization, and while this deposit is practically invisible it creates sufficient increase in the resistance offered to current flow as to introduce an error into the reading of the conductivity of the solution. In other words, this thin film of gas produces an increase of resistance which indicates an apparent change in electrolytic conductivity of the solution, and therefore indicates an apparent change in the amount of dissolved materials.

Various means have been tried for minimizing the errors of polarization, one of which is to increase the area of the electrodes so that the current density is reduced and the evolution of gas distributed over a greater area, but this is impractical because of the space required. The more widely used means for reducing the errors due to polarization consists in employing electrodes which are made of a noble metal, such as platinum, gold or palladium, but even this means has disadvantages, namely, a prohibitive cost if the electrodes are made large enough to fulfil the requirements of operation, and if made, as they generally are, relatively small and delicate, they become broken and require constant repairing. The noble metals are used because platinum black or other depolarizing means can be readily deposited upon the exposed surface.

It is an object of the present invention to retain all the advantages accompanying the use of noble metal electrodes but to secure the ruggedness and strength necessary to meet the severe requirements of commercial use. It is also an object of the invention to provide an improved electrode for electrolytic conductivity cells which not only operates in an improved manner but can be manufactured and maintained at a relatively low cost.

In the accompanying drawings, Fig. 1 represents a section of an electrode embodying one form of the present invention; Fig. 2 represents a side elevation in part section of one form of an electrolytic conductivity cell employing an electrode of the present invention; Fig. 3 represents a diagram of a circuit by which the conductivity of the solution is measured with a cell embodying the present invention; and Fig. 4 represents an electrolytic conductivity cell embodying another form of the invention partly broken away to show the arrangement of the electrodes.

Referring to the drawings, one form of the present invention comprises an electrode or terminal 10, which is mounted on a base 11 of porcelain or other suitable insulating material through which a lead wire of the electrode can be conveyed to the electric circuit without making contact or otherwise short circuiting the other lead of the cell.

For the purpose of providing an electrode of substantial and rugged form, but one which retains all the efficiency and advantages of the delicate and expensive electrodes manufactured from a noble metal, such as platinum, gold or palladium, the present electrode 10 is formed of a base metal body 12, of such size and configuration as to give strength and ruggedness so that the electrode will stand up under hard usage and be unaffected by the necessary frequent cleaning and inspection. Upon this base metal body 12 there is deposited by a suitable plating process a coating 13 of platinum, though this is only by way of example, and it will be understood that the coating so deposited may be of any other suitable noble metal, the result being that the base metal has its surface transformed from one subject to corrosion and unsuited to electroplating and deposition of depolarizing film to one resisting corrosion and suited to the deposition of a depolarizing film.

As a means for minimizing the effect known as polarization, namely, the formation of a thin film of gas over the surface of the electrode, the body 12, with its coating 13 of platinum or other suitable metal, is subjected to a further electroplating operation in a solution of approximately 3 per cent platinum chloride in order to form a film 14 over the surface of the platinum coating 13, which is known as platinum black, or, in the case of palladium, as palladium black, which film has the property of increasing the surface area of the platinum electrode and of absorbing the gases which are given off when current passes from one electrode to the other through the solution. Thus, the complete electrode or terminal is made up of a substantial body part composed of a base metal and upon which there is first an electroplated coating of a noble metal and last an absorbent deposit or film, such, for example, as platinum black.

In Fig. 2, an electrode 10, constructed and described in connection with Fig. 1, is shown, mounted axially on a porcelain insulator 15 and in electrical connection with a binding post 16, to which one wire 17 of the electric circuit is arranged to be connected. In this form of cell the second electrode or terminal of the circuit comprises a tubular member 18, which has threaded connection with the reduced neck of a metal plug 20, which has its body portion exteriorly threaded as shown at 21 for the purpose of connecting the cell to a pipe or other receptacle in which the liquid under test is placed. This plug 21 is provided with a suitable hexagon surface 22, whereby it can be gripped with a wrench for tightening in place, and also has a stuffing box structure 23 to prevent leakage of the liquid outwardly through the cell. At any suitable location in the metal body of the plug 21, connection may be made for a return wire 24 of the circuit, which includes the conductor 17. In order to bring the solution under test in the proper relation with the electrodes 10 and 18, the electrode 18 is provided with suitable perforations 25 which permit the liquid or solution to circulate freely within the electrode 18 and about the electrode 10. The cell of the character shown in Fig. 2 in operation is located in one arm of a Wheatstone bridge circuit, as shown at 26, the other arms of which have resistances 27, 28 and 29 of values such as to give the desired balanced condition to the bridge, and the measure of resistance is made by a galvanometer 30 in the usual manner. The current from a source 31 is supplied by conductors 32 and 33 to the bridge, thus completing the circuit by which current passes through the cell 26 and by the resistance of this solution in which the cell is immersed its conductivity can be determined from a reading of the galvanometer.

In Fig. 4 another form of the invention is shown in which a threaded plug 33 forms a casing enclosing two electrodes 34 and 35, each of the construction as described in conjunction with the electrode 10, and the two together forming terminals of the same circuit, which are mounted in spaced relation within a perforated tube 36 through which the test solution has free circulation. Electrodes 34 and 35 are respectively connected by conducting leads 37 and 38 to the circuit in which the cell is located. In use, the conductivity cell embodying an electrode or electrodes of the present invention is adapted to be mounted in a pipe line through which a solution under test is circulating, or it may be located in any suitable container in which is located a solution the conductivity of which is to be determined. The invention may be embodied, of course, in various ways, and it is therefore to be understood that the present showing is only by way of example, and is not in any way to limit the scope of applicant's invention.

Having thus described my invention, I claim:

1. In an electrolytic conductivity cell, a pair of electrodes forming terminals of an electric circuit and arranged to be submerged in a solution under test, one of said electrodes being formed of a base metal body plated with a noble metal and having a depolarizing film deposited thereon, and a body mounting said electrodes in insulated spaced relation.

2. In an electrolytic conductivity cell, a pair of electrodes forming terminals of an electric circuit and arranged to be submerged in a solution under test, one of said electrodes being formed of a base metal body plated with platinum and having a platinum black film deposited thereon, and a body mounting said electrodes in insulated spaced relation.

3. An electrolytic conductivity cell comprising a tubular base metal electrode, a second electrode within said tubular electrode comprising a base metal body plated with a noble metal and having a depolarizing film deposited thereon, a base mounting said electrodes in insulated spaced relation, and conducting wires respectively connecting

said electrodes to an electrical measuring circuit.

4. An electrolytic conductivity cell comprising a tubular base metal electrode, a second electrode within said tubular electrode comprising a base metal body plated with platinum and having a platinum black film deposited thereon, a base mounting said electrodes in insulated spaced relation, and conducting wires respectively connecting said electrodes to an electrical measuring circuit.

5. An electrolytic conductivity cell comprising a tubular perforated base metal electrode, a second electrode within said tubular electrode comprising a base metal body plated with platinum and having a platinum black film deposited thereon, a base mounting said electrodes in insulated spaced relation, and conducting wires respectively connecting said electrodes to an electrical measuring circuit.

6. As a new article of manufacture, an electrode for electrolytic conductivity cells comprising a rugged base metal body with a noble metal electroplated thereon and a depolarizing film deposited on said noble metal.

7. The method of forming a rugged, substantial electrode for electrolytic conductivity cells which consists of electroplating a noble metal coating upon a relatively large base metal body and then depositing a depolarizing film upon said plated metal coating.

Signed at Philadelphia, in the county of Philadelphia, and State of Pennsylvania, this 29th day of December, 1923.

EARL A. KEELER.