July 24, 1951 S. G. OSBORNE 2,562,150

ELECTRICAL CONTACT FOR ELECTROLYTIC CELLS

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Fig. 1

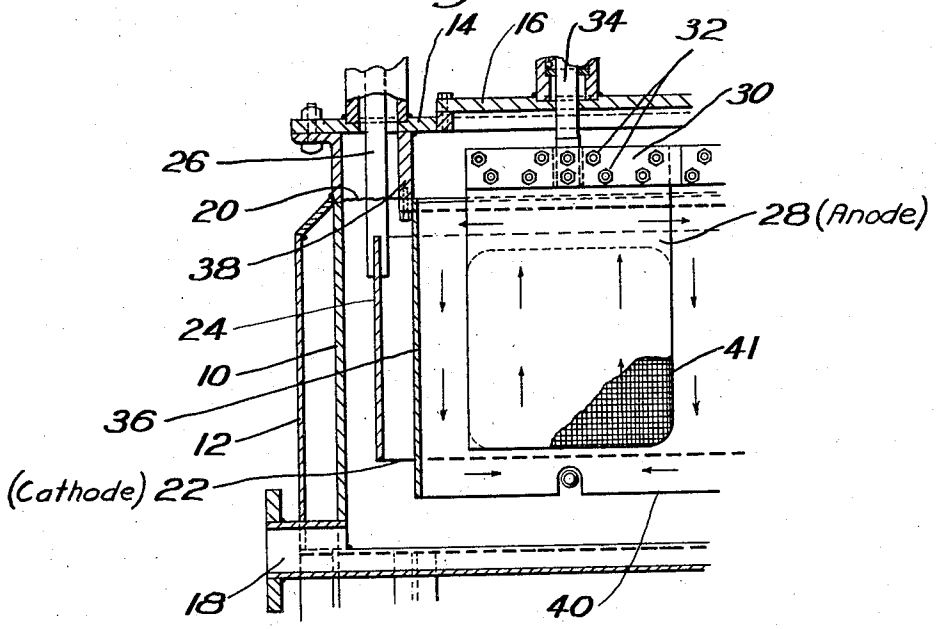
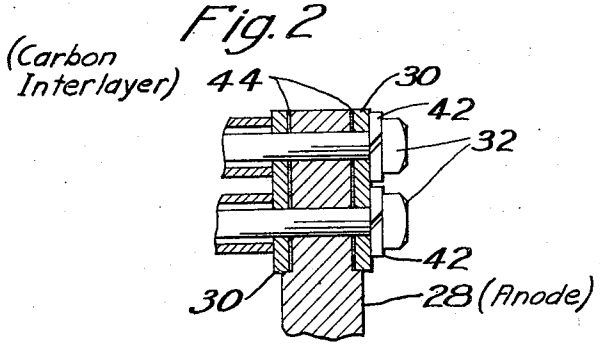


Fig. 2



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ELECTRICAL CONTACT FOR ELECTROLYTIC CELLS

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2 Claims. (Cl. 204—286)

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This invention relates to electrolytic cells and more particularly to electrolytic cells suitable for the production of hydrogen and fluorine from a molten electrolyte comprising hydrogen fluoride absorbed in an alkali metal fluoride.

Hydrogen and fluorine gases may be produced in a suitable cell by the electrolysis of an electrolyte comprising a mixture of hydrogen fluoride and an alkali metal fluoride. The cell may comprise a plurality of cathodes and anodes immersed in the electrolyte and the cell is constructed to collect the hydrogen and fluorine gases separately. Electrolytic cells for this purpose are well known in the art and one such is described in the copending patent application of Kenneth E. Stuart and Sidney G. Osborne, Serial No. 526,634, filed March 15, 1944 (now Patent Number 2,544,285). The anodes of electrolytic cells of this character may comprise nickel or carbon. Carbon has been found to be particularly satisfactory for use in this connection, the carbon anodes being at least partially immersed in the electrolyte and held in position by a suitable metal support above the surface of the electrolyte.

In electrolytic cells of this general character considerable difficulty has been experienced in the breakage of carbon anodes adjacent the metal support and in the corrosion of the support at this point.

Accordingly, it is one object of this invention to provide means and method for reducing the tendency of a carbon anode of an electrolytic fluorine cell to break adjacent the metal support therefor.

A further object of this invention is to provide means and method for improving the electrical conductivity between the metal support and the carbon anode of an electrolytic fluorine cell.

A further object of this invention is to provide means and method for reducing corrosion adjacent the contact surfaces of a carbon anode and the metal support associated therewith in an electrolytic fluorine cell.

An additional object of this invention is the provision of a joint, and method for forming same, between the contacting surfaces of a carbon anode and a metal support of an electrolytic fluorine cell which will resist the penetration of corrosive agents such as fluorine or molten electrolyte.

An additional object of this invention is the provision of an electrolytic fluorine cell which is constructed to insure optimum electrical conductivity between the anode and metal support therefor at all times.

An additional object of this invention is the provision of an electrolytic fluorine cell which may be operated over a long period of time without interruption because of carbon anode breakage.

Further and additional objects will be apparent from the following description, the accompanying drawing, and the appended cl[illegible]

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In the operation of an electrolytic fluorine cell, fluorine gas will normally come into contact with the anode adjacent the metal support therefor. Also the molten electrolyte may contact this area due to splashing or effervescence of gas during electrolysis. It is important to prevent the fluorine gas or molten electrolyte from penetrating between the contact surfaces of the anode and the support since this may result in the deposition of fluorides. The deposition of the fluorides between these contact surfaces tends to exert considerable pressure which may result in the breakage of the carbon anode. Also these fluorides have a high electrical resistance which may result in local heating of the contact during the operation of the electrolytic cell, thus increasing the danger of breakage and the tendency of the joint to become insulated resulting in malfunctioning of the anode. Therefore, it has been found to be important that the joint between the anode and the metal support be formed so as to prevent the penetration of fluorine gas or electrolyte.

In accordance with this invention a joint between the carbon electrode and the metal support is provided which serves to strengthen the structure and which serves to prevent the penetration of corrosive fluorine or molten electrolyte between the contact surfaces. This joint comprises an interlayer of particulate carbon positioned between the electrode and the metal support at the time these members are secured together.

In accordance with one embodiment of this invention the joint between an anode and its metal support may be formed by coating the surfaces to be contacted with a suspension of carbon in a volatile liquid. The carbon anode and the metal support are then clamped or otherwise secured together and the liquid is removed by evaporation. This may be effected by baking or otherwise heating the resulting joint. Thus a structure is formed which contains no cracks or crevices thereby strengthening the contact joint and preventing the penetration of the corrosive agents thereinto.

A particularly useful carbon suspension that may be used in forming the interlayer for the electrode structure of this invention may comprise a composition known commercially as aquadag. Aquadag, sometimes used as a lubricant in other arts, comprises a dispersion of colloidal graphite in water. However, it will be apparent to one skilled in the art that any other dispersion of particulate carbon in a volatile liquid may be employed without departing from the spirit and scope of this invention. The relative proportions of particulate carbon or colloidal graphite to volatile liquid in the mixture that is used to form the interlayer do not appear to be particularly critical. However, it will be evident that the composition used should be of sufficient consistency to permit ready application to the surfaces to be contacted and which, upon evaporization of

the liquid, will leave sufficient carbon to provide an interlayer having the desired function.

As previously indicated, this invention is useful in the construction of electrolytic cells for producing hydrogen and fluorine from a molten mixture of hydrogen fluoride and an alkali metal fluoride. The invention has particular use in those anode structures comprising a carbon body secured to a support comprising a metal selected from the group consisting of iron and copper, a suitable electrolytic cell and anode structure in which this invention may be employed being disclosed in the above referred to application Serial No. 526,634. However, it will be apparent to one skilled in the art that this invention may be applied to the construction of any electrode which is adapted to be used in a fluorine cell and wherein a carbon electrode is to be secured to a metal support through which an electric current is supplied to the carbon electrode.

For a more complete understanding of this invention, reference is made to the accompanying drawing disclosing one embodiment, wherein:

Fig. 1 is an elevational view of a portion of a fluorine cell in accordance with the disclosure contained in the above-referred-to application Serial No. 526,634, and Fig. 2 is an enlarged partial sectional view of the upper portion of a carbon anode secured to a metal support in accordance with one embodiment of the invention.

With particular reference to Fig. 1, a fluorine cell is provided comprising a cell body 10, a cooling jacket 12, removable cover plates 14 and 16, a conduit 18 for drawing off electrolyte within the cell body, said electrolyte, during operation of the cell, being normally maintained at level 20. A cathode assembly is provided comprising a cathode plate 22 supported by an end plate 24 secured to a suitable electrical conductor 26. Likewise an anode assembly is provided comprising carbon plate 28 engaged by metal supports 30 and secured thereto by suitable bolts 32. A conductor 34 is provided for supplying electrical current to the carbon anodes 28 through the metal supports 30. As previously indicated, the metal supports 30 are preferably formed of iron or copper. Means is also provided between the cathode and anode assemblies for permitting free diffusion of liquid electrolyte therebetween but for preventing the recombination of the hydrogen and fluorine gases that are liberated from the cathode and anode, respectively. This means comprises a plate 36 secured to a flange 38 depending from the cover plate 14 and an additional plate 40 secured to plate 36 extending between the cathode plate 22 and the carbon anode plate 28 and parallel thereto. The plate 40 is provided with a window adjacent the carbon anode 28 having a metal screen 41 positioned therein permitting free diffusion of electrolyte between the electrodes but preventing free hydrogen and fluorine gases from intermingling within the electrolyte.

During the operation of the cell, the electrolyte circulates by convection in the manner indicated by the arrows in Fig. 1 and the hydrogen and fluorine gases are collected separately and separately withdrawn from the cell body by means, not shown. Additional details concerning the above described fluorine cell are presented in the aforesaid patent application Serial No. 526,634, from which it will be apparent that it is preferable to provide a number of anode plates, cathode plates, and diffusion plates within a single cell body.

In accordance with the present invention each carbon anode of the fluorine cell may be secured to the metal support as indicated in Fig. 2 wherein the anode 23 is clamped between two support plates 30 by means of the bolts 32 provided with split washers 42. As previously indicated, interlayers 44 of carbon are provided between the support plates and the carbon anode. The carbon interlayers comprise graphite particles formed from a suspension thereof in a volatile liquid, such as water, and from which the water has been separated by evaporation in situ. The graphite particles fill the space between the anode and the support and are effective to strengthen the joint and to prevent fluorine gas or molten electrolyte from penetrating the structure. The formation of fluorides in the joint is thereby prevented which, if present, would increase the resistance of the joint and increase the tendency of the anode to break adjacent the support.

Other mechanical means for attaching the carbon anode to the metal support will be readily apparent to one skilled in the art.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A method of improving the resistance to penetration of fluorine gas and electrolyte between the contact surfaces of a metallic conductor and a carbon anode of an electrolytic cell for the production of elemental fluorine from an electrolyte comprising hydrogen fluoride and an alkali metal fluoride, which comprises introducing finely divided carbon in an aqueous vehicle between said surfaces and thereafter evaporating the water therefrom.

2. An electrode assembly suitably for use in an electrolytic cell for producing hydrogen and fluorine comprising a carbon member adapted to be immersed in the electrolyte of the cell, a metal support for said carbon member through which an electric current is supplied to said member, and a carbon interlayer in the joint between said member and said support formed by introducing finely divided carbon in an aqueous vehicle between said surfaces and thereafter evaporating the water therefrom.

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