United States Patent

Juckniess

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[54] **FILTER PRESS FLUORINE CELL WITH CARBON CONNECTORS**

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[52] **U.S. Cl.** **204/256,** 204/60

[51] **Int. Cl.** **B01k 3/10,** B01k 1/00

[58] **Field of Search** 204/252–258, 59, 204/60, 256

[56] **References Cited**

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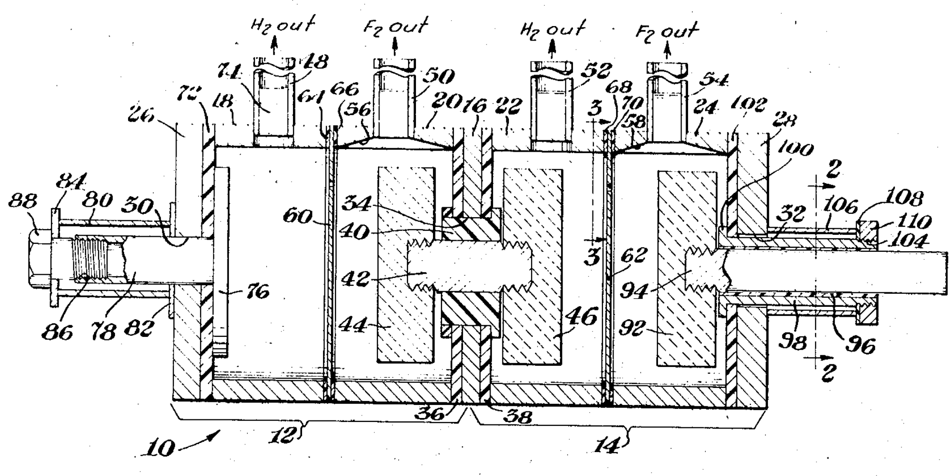
[57] **ABSTRACT**

This invention relates to a filter press type of cell wherein the connection of an anode to the cathode of an adjacent cell is through a carbon connector. Individual cells have their ends protected by a Teflon end cover plate. The carbon connector between cells passes, by means of a press fit, through a Teflon bushing. A metal diaphragm fits across each cell intermediate its ends, the diaphragms being insulated from the adjacent metal body of the cell by Teflon gaskets.

The cell bath fills the cells and extends into hydrogen and fluorine risers at the top of each cell.

4 Claims, 3 Drawing Figures



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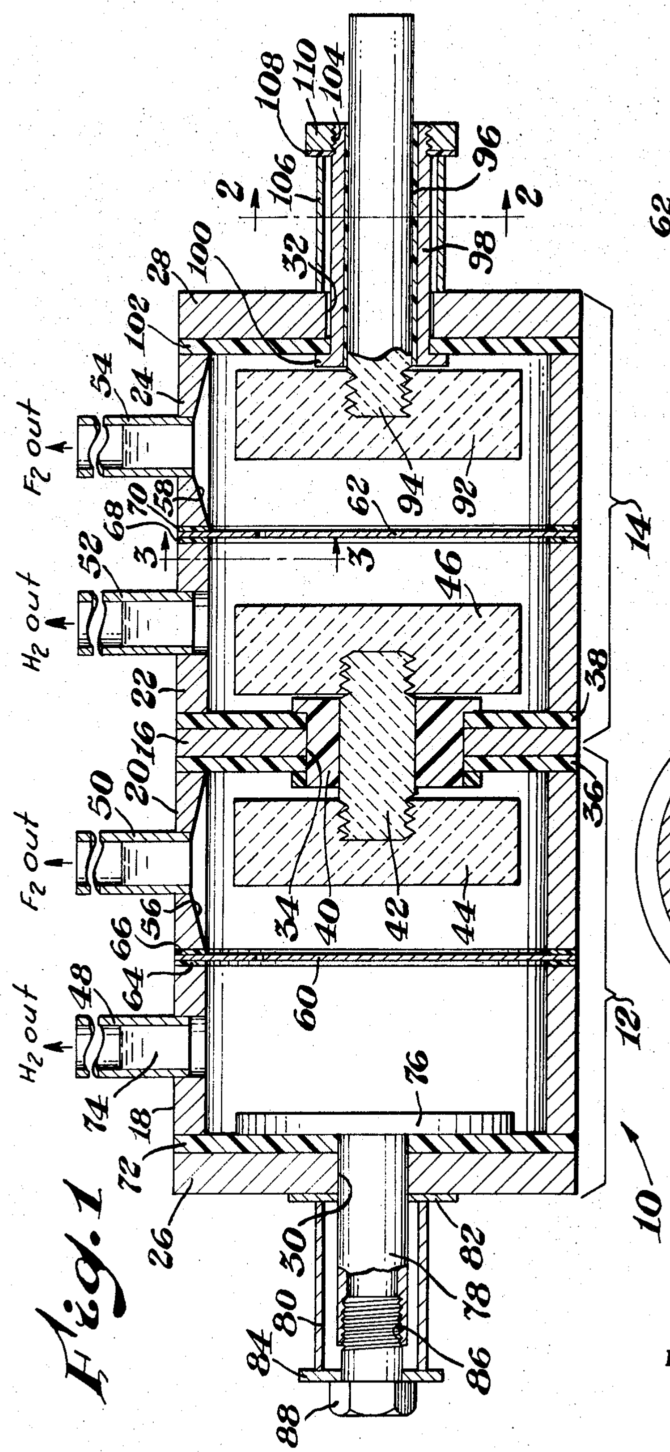

Fig. 1

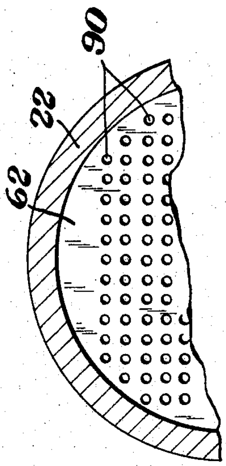

Fig. 3

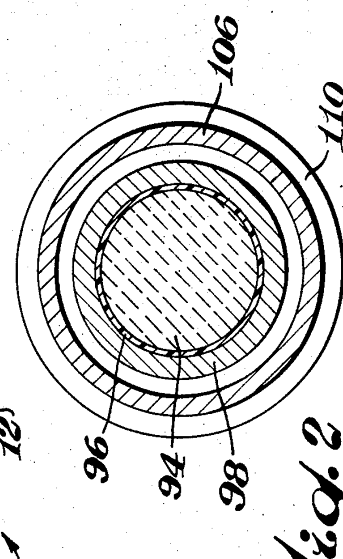

Fig. 2

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FILTER PRESS FLUORINE CELL WITH CARBON CONNECTORS

BACKGROUND OF THE INVENTION

This invention relates to electrolytic cells for use in making fluorine and particularly to a filter press type electrolytic cell for such use. Fluorine cells now in use are very complicated structures. The weakest structure is the metal to carbon anode connection in the cell. In practice, it is necessary to rebuild the cells about every 3 or 4 months.

Accordingly, a principal object of this invention is to provide an improved electrolytic cell for use in making fluorine.

Another object of this invention is to provide an improved electrolytic cell for use in making fluorine which has lower maintenance requirements than other similar cells.

A further object of this invention is to provide an improved, simpler electrolytic cell for use in making fluorine which has a relatively low capital cost.

In accordance with this invention, there is provided a filter press type of cell wherein the connection of an anode to the cathode of an adjacent cell is through a carbon connector. Individual cells have their ends protected by a Teflon end cover plate. The carbon connector between cells passes, by means of a press fit, through a Teflon bushing. A metal diaphragm fits across each cell intermediate its ends, the diaphragms being insulated from the adjacent metal body of the cell by Teflon gaskets.

The cell bath fills the cells and extends into hydrogen and fluorine risers at the top of each cell.

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawing, in which:

FIG. **1** is a side elevational view partly in section, of a fluorine cell made in accordance with this invention;

FIG. **2** is a sectional view taken along the line **2**—**2** of FIG. **1**; and

FIG. **3** is a fragmentary sectional view taken along the line **3**—**3** of FIG. **1**.

Referring to the drawing, there is shown an electrolytic cell device, indicated generally by the numeral **10**, composed of cells **12** and **14**. The two cells are separated from each other by a common end wall plate element **16** made of metal such as nickel or nickel clad metal, for example.

Each cell has a pair of hollow cylindrically shaped metal body wall elements **18, 20** and **22, 24** in cells **12, 14**, respectively. The cell assembly is closed at each end by an end plate element **26, 28**, respectively.

Each end plate element **26, 28** and the wall plate element **16** has an axial bore **30, 32, 34**, respectively, through which electrode connectors extend.

The bore **34** is of larger diameter than the bores **30, 32**. The wall plate element **16** has a Teflon (polytetrafluoroethylene) sheet **36, 38** on each side of it, the sheets **36, 38** having bores which are the same size as and aligned with the bore **34**. A two piece Teflon bushing **40** is press fitted through the bore **34** and the bores in sheets **36, 38**, with the outwardly extending ends of the bushing **40** fitting tightly against the adjacent sheet **36** or **38**, respectively.

A carbon or graphite feed-through rod **42** extends through the bushing **40** in a press fitting relationship therewith. The ends of the feed-through rod are coupled to a carbon anode **44** and a carbon cathode **46**, respectively.

The anode **44** lies within the body part **20**, and the cathode **46** lies within the body part **22**.

Each of the body part elements **18, 20, 22** and **24** is a generally hollow cylinder in configuration and each element has a riser **48, 50, 52, 54**, respectively, rising from what is the top of the device when the cells are operatively assembled. In the body elements **20** and **24**, from whose headers **50, 54**, fluorine is withdrawn, the inner wall part **56, 58**, adjacent to the headers **50, 54**, respectively, is beveled towards the header in that body element.

The body elements **18, 20** and **22, 24** are separated from each other by a diaphragm **60, 62**, respectively. The diaphragms **60, 62** are electrically insulated from the adjacent metal body elements by Teflon gaskets **64, 66** and **68, 70**, respectively.

A plate-like metal cathode **76**, made of nickel, for example, is disposed in the body element **18**. A Teflon gasket sheet **72** electrically insulates the body element **18** from the end plate element **26** and protects the part of the end plate element **26** which is exposed to the cell bath **74** from electrolysis.

The cathode **76** has an electrical lead in the form of a hollow metal tube **78** which extends perpendicularly from the central part of the cathode **76** and through the bore **30** in the end plate element **26**.

An outer hollow tubular metal sleeve element **80** surrounds the lead tube **78**, the ends of the element **80** bearing against washer **82** and washer **84**, respectively. A bolt **88**, engaging threads **86** on the internal surface of the tube **78**, is used to pull the cathode **76** tightly against the Teflon sheet **72** to effect a fluid tight seal therewith.

Each of the diaphragms **60, 62** is usually made of nickel and contains an array of perforations **90** which extend generally across the surface area of the diaphragm except near the top of the adjacent cell body part.

A carbon anode **92** is disposed within the body element **24** and is coupled to a carbon rod **94** which is surrounded by a close fitting thin Teflon separator **96**. The rod **94** and Teflon separator **96** fit in press fitting relationship within a metal sleeve **98** which has an outwardly extending flange **100** at the end thereof which extends into the body element **24**. The body element **24** is electrically insulated from the end plate **28** by a Teflon sheet **102** which also covers the side of the end plate **28** which faces the body element **24**. The sleeve **98** has threads **104** on its outer end.

An outer sleeve **106** surrounds the part of the sleeve **98** which extends out of the end plate **28**. An insulating gasket **108** fits across the outer end of the outer sleeve **106**, insulating the nut **110** on the threads **104** from the sleeve **106**. The nut **110** is tightened to draw the flange **100** of the sleeve **98** tightly against the Teflon sheet **102**, making a seal between the flange and the sheet **102**.

With the apparatus filled to a level in the output headers, direct current of suitable polarity is applied to the anode lead **94** and the cathode lead **78** from any suitable source (not shown).

Upon application of current to the apparatus, fluorine liberated at the anodes rises through the cell bath and passes out through risers **50, 54**. Similarly, hydrogen liberated at the cathodes rises and leaves the apparatus through the risers **48, 52**. In practice, the cells are filled with bath which a mixture of potassium fluoride and hydrogen fluoride containing **40** to **50** percent hydrogen fluoride. Since corrosion is such a small problem in this cell, higher hydrogen fluoride values can be used. In conventional cells, hydrogen fluoride is kept at **42** percent or less. Higher hydrogen fluoride values give lower voltages and better power economy. The cell may be operated at 80° to 120° C., the higher temperature giving lower voltage but higher hydrogen fluoride in the hydrogen and fluorine.

While the diaphragms **60, 62** are preferably made of nickel because of its long life in such usage, magnesium or iron are also operable for such use.

The entire assembly as shown in FIG. **1** is, of course, held together in "sandwiched" form by means of suitable clamping means, not shown.

It is also obvious that more cell assemblies may be connected in series than those shown in FIG. **1**.

It is also practical to provide larger diameter cell assemblies in which a plurality of anodes and cathodes are provided in each body part of the assembly. For example, four feed through elements spaced in an array might be used, with an electrode coupled to each feed through element. The need for such assemblies occurs in bigger cells when it is impractical or uneconomical to provide a single, large electrode for the assembly.

What is claimed is:

1. Electrolytic cell apparatus comprising a plurality of cell assemblies joined together in sandwiched end-to-end series relationship, each cell including a pair of tubular nickel body parts separated from each other by a foraminous nickel diaphragm sheet, each of said body parts having a header at the top part of said cell, electrically insulating gasket means disposed between said diaphragm and said body parts, each cell being closed by an end plate which is physically isolated from any cell bath in the apparatus and electrically insulated from said body parts by sheet-like gasket means, at least one end plate of each cell also functioning as an end plate of an adjacent cell, a feed through carbonaceous element, said carbonaceous feed through element extending through an end plate which is common to two adjacent cells with an end extending into the adjacent body parts, said feed through element being electrically insulated and physically separated from said end plate by bushing means, a pair of carbonaceous electrode elements, one carbonaceous electrode element being attached to each end of said feed through element, each other end plate having an electrode lead extending therethrough and having an electrode coupled thereto and disposed within one of said body parts which is adjacent to an end plate, one of said electrodes attached to one of said other end plates being a carbonaceous anode and being rigidly coupled to a carbonaceous electrical lead which is electrically insulated from the end plate through which it extends, and the other of said electrodes attached to the other of said other end plates being a nickel cathode electrode having a rigid metal electrical lead bonded thereto, said nickel electrode being electrically insulated from said body parts.

2. Apparatus in accordance with claim 1, wherein the inner wall of the body part lying adjacent to the headers in the body part containing the anodes of said apparatus are beveled towards said headers.

3. Apparatus in accordance with claim 1, wherein metal parts of said apparatus are made of nickel.

4. Apparatus in accordance with claim 1, wherein said diaphragms are non-foraminous at the top part thereof adjacent to said headers.

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