July 16, 1929. F. H. BUCK ET AL 1,720,995

ELECTROLYTIC CELL

Filed Dec. 5, 1925 2 Sheets-Sheet 1

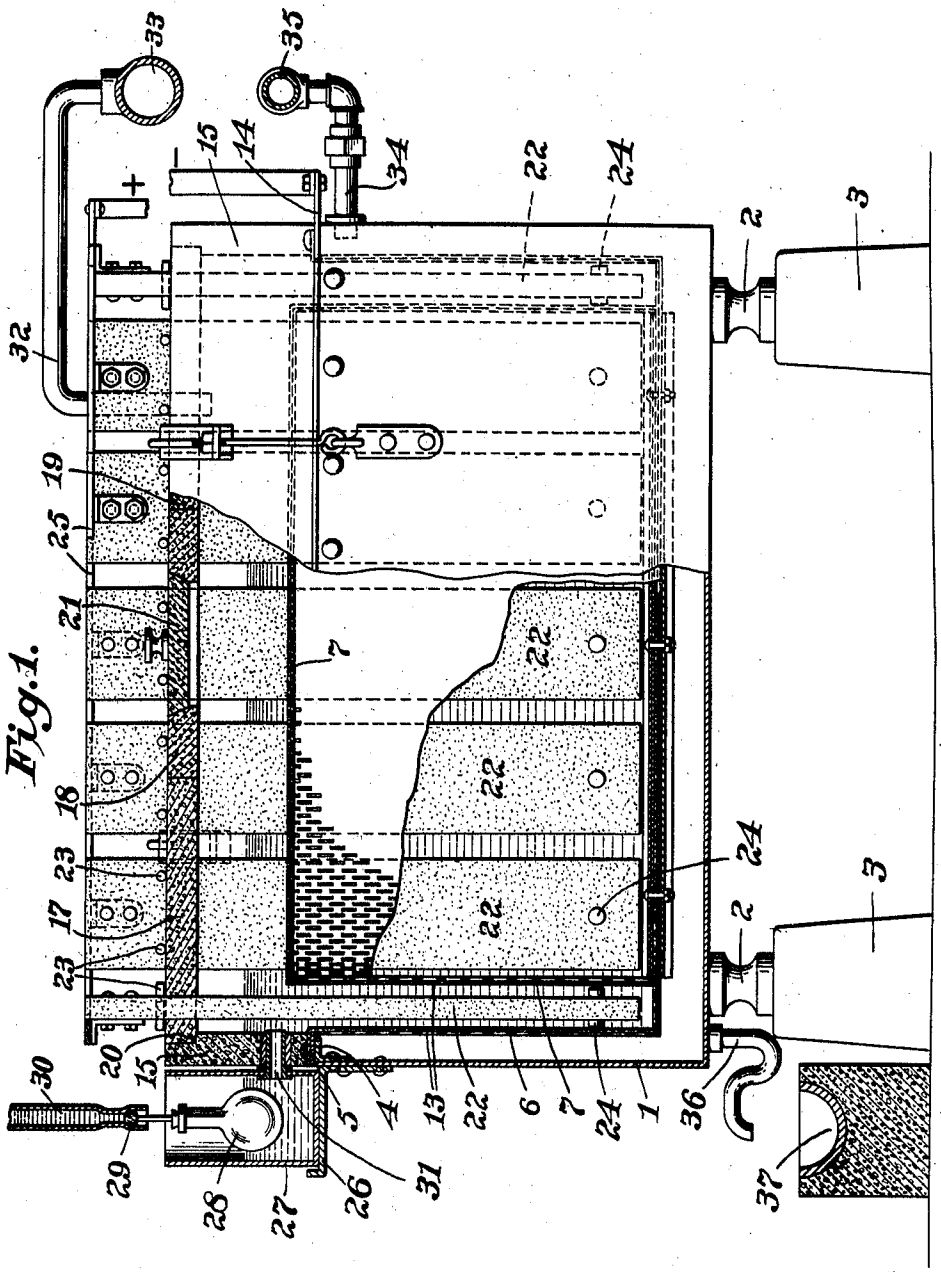


Fig. 1.

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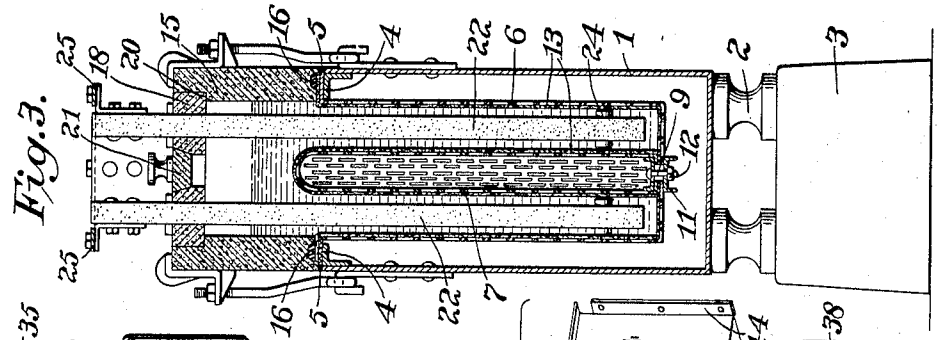


Fig. 3.

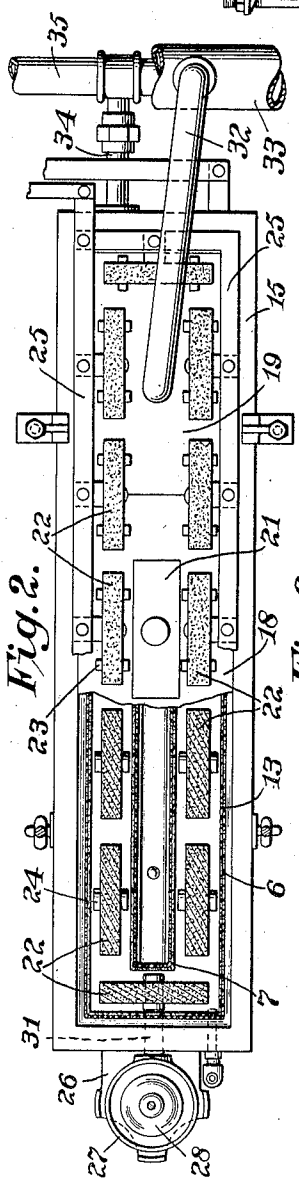


Fig. 2.

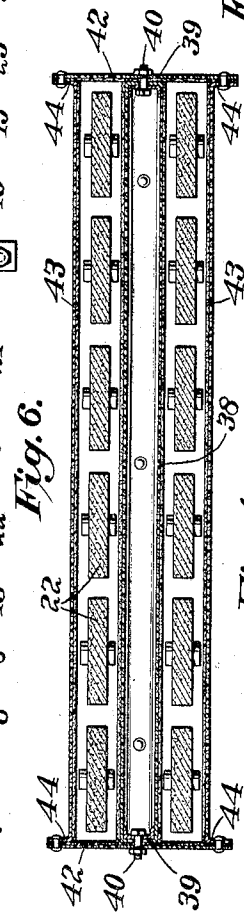


Fig. 6.

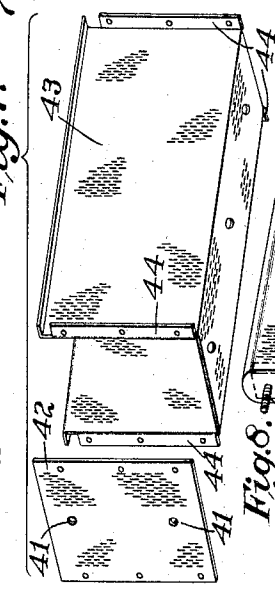


Fig. 7.

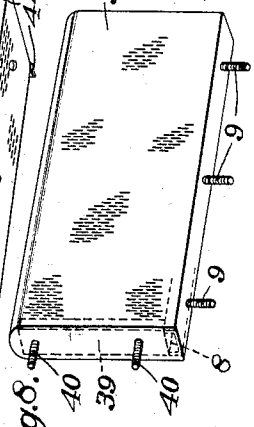


Fig. 8.

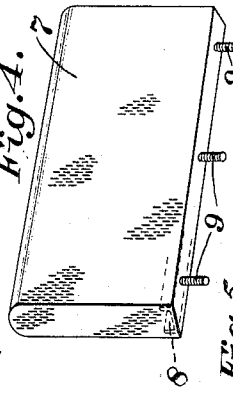


Fig. 4.

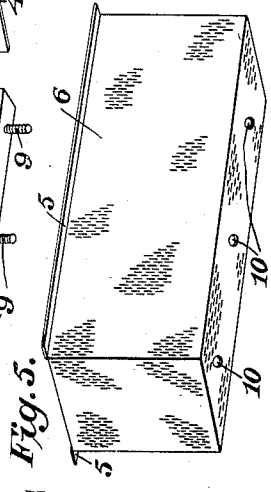


Fig. 5.

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Patented July 16, 1929. 1,720,995

UNITED STATES PATENT OFFICE.

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ELECTROLYTIC CELL.

Application filed December 5, 1925. Serial No. 73,447.

Our present invention relates to a cell of the electrolytic type which is adapted to the production of caustic soda and other products, such as chlorine and hydrogen.

While the cell of this invention is particularly adapted for the production of those reagents, yet obviously, it may be used in the electrolysis of many materials.

The principal object of the invention is the provision of a cell of the above type which will have a maximum capacity for a minimum cell volume in order that a given amount of floor space may be utilized for as large a number of cells as possible, and where a compact design reduces the internal resistance to a minimum, thus increasing the power efficiency.

To this end the invention includes a cell casing of any desired material adapted to support a cathode in the form of a perforated iron basket, which cathode is also provided with an inner portion upstanding from the bottom of the main basket and spaced from the basket walls. The inside of the outer cathode basket and the outside of the inner cathode cage are lined with asbestos or other material serving as a diaphragm, which when assembled, forms an asbestos lined endless channel into which the anode slabs of graphite or the like are inserted, the slabs being spaced from the walls of the cathode and from each other so as to allow thorough circulation of the electrolyte as well as to increase the anode surface. A suitable head is provided adapted to clamp between itself and the cell casing the cathode and the diaphragm in a gas tight joint. The head forms what may be called a gas chamber from which the gaseous products of the electrolytic action may be removed for any desired purpose. An additional outlet is provided for the gaseous products collecting in the space between the cathode and the cell casing, and still another outlet at the bottom of the casing for liquid products, from which outlet they may be conducted to any desired location. Means are also provided for automatically feeding in the electrolyte so as to maintain a constant electrolyte level in order that the operation of the cell may be continuous.

In another form the invention includes an outer cathode in which the shorter end walls are removable therefrom, as well as the inner cathode cage, so as to facilitate the placing of new and the removal of old diaphragms thereto. In this latter form the inner cathode cage extends the full length of the outer cathode basket so as to form two electrolyte containing tanks or spaces, each having its own cells or anode slabs.

The invention further consists of the novel arrangement, construction and combination of parts hereinafter shown and described.

We have illustrated in the accompanying drawings a preferred embodiment of our invention, in which:—

Figure 1 is a side elevation of the preferred form.

Fig. 2 is a plan view partly in horizontal section.

Fig. 3 is transverse section.

Fig. 4 is a detail of the inner cathode member.

Fig. 5 is a detail of the outer basket member.

Fig. 6 is a horizontal section.

Fig. 7 is a detail of the outer basket of the modified form.

Fig. 8 is a detail of the inner cathode cage.

Referring now with particularity to the drawings, our invention is shown to consist of an outer cell casing designated at 1, which may be of any desired material, which is suitably mounted upon insulators 2 resting upon the blocks or pedestals 3.

At the upper edges of the side walls of the casing 1 we provide angle irons 4 suitably bolted to the wall of the casing 1, which are adapted to support a flange 5 on the side walls of the outer cathode member, indicated generally at 6. The angle iron 4 may be placed below the top of the side walls of the container, so that the projection of the side wall above the angle will overlap all joints between head, outer cathode, and container, thus forming a double seal by filling the above socket with a suitable cement.

The outer cathode member is composed of sheets of perforated metal, preferably iron, in the present instance, welded together to form an open topped container or basket having flanges 5 at its upper ends, which flanges are adapted to rest upon and be supported by the angle irons 4.

Within the outer cathode member is located an inner cathode member indicated generally

at 7, which also consists of sheets of perforated iron welded together to form substantially a cage. Secured inside the cage cathode 7 we provide a section of U beam 8, which beam is provided with bolts 9 extending through the bottom of the cathode cage 7. The bolts 9 are adapted to project through corresponding apertures 10 in the cathode basket 6 and a similar section of U beam 11 applied to the bottom of the basket 6 whereupon nuts 12 may be used to bolt the basket and the cage together to form substantially a unitary structure.

A diaphragm 13 of sheet asbestos or the like, is to be applied to the inside of the cathode basket 6 and the outside of the cathode cage 7, as by means of sodium silicate or the like, so that the entire cathode has its inner surface covered by said diaphragm and is adapted to receive the electrolyte, as will be more fully described hereinafter.

At the upper longitudinal edges of the basket cathode 6 we provide bus bars 14, which bars may be of iron, copper, or other material, and welded, brazed, or otherwise affixed to the flanges 5. This bus bar 14 serves as the negative electrode.

A gas chamber or head 15 is provided, which is composed preferably of a molded form of concrete or the like, and is adapted to be superimposed upon the upper edges of the basket cathode 6 so that the lower edges of the gas head 15 rest directly upon the diaphragm 13 which over-laps the bus bars 14. The lower edges of the gas head 15 are cut away as at 16, and this channel is adapted to be filled with any desired kind of acid-proof cement so that when the head is pinched upon the bus bars 14 the cement within the channel will make a fluid tight resistant joint at that point.

The gas head which we have found advantageous consists of an open bottom and top box, which is adapted to be closed by section covers 17, 18 and 19, adapted to rest upon a shoulder 20 at the upper edges of the gas head walls. The center section cover 18 is provided with a clean-out opening 21. It is understood that all of the joints in the gas head are adapted to be sealed, not necessarily permanently, with a cement of any desired character, which is well known in this art, so as to prevent the escape of any gaseous products of the electrolysis.

The anode element of the present cell consists principally of a plurality of carbon slabs 22 which are supported upon the section covers 17, 18 and 19 by means of pins 23 passing through the slabs, the slabs proper projecting through suitable apertures in the cover sections and extending into the space between the basket and cage cathodes nearly to the bottom thereof, and spaced from the walls thereof by means of the rubber stops 24. The upper ends of the anode slabs are connected together as by means of the positiv bus bar 25, to which current is supplied a desired.

Supported upon an L-iron 26 secured t the outside wall of the cell casing is a floa container 27 which is adapted to receive th float 28 having a stopper or valve 29 connect ed thereto to control the flow of electrolyt supplied through the inlet 30. Such float an valve is adapted to maintain a constant leve in the float receptacle 27, said electrolyte flow ing from the float receptacle into the interio of the cell through the aperture 31.

A gas offtake 32 penetrating one of the sec tion covers 19, is provided for conducting away the chlorine produced as a result of th desired reaction, said offtake being connecte with a main conduit 33.

A pipe 34 is also secured in the wall of th casing 1 so as to take care of any gaseous prod ucts liberated on the outside of the diaphragn 13, that is, between the diaphragm and th outer cell casing. This pipe 34 also connect with a conduit 35 so that the gases thus pro duced may be taken away.

The cell casing proper, 1, is provided witl a trap 36 through which the liquid materia produced as a result of the reaction may flow a ditch 37 being provided to conduct this ma terial to the desired location.

The operation of the device is as follows :—

A saturated solution of sodium chloride i fed through the inlet 30 until the level of elec trolyte in the cathode has risen well up int the gas head. Owing to the fact that th cathode basket and cage are lined with an as bestos diaphragm, the electrolyte will not pas through this material, but will be containe therein.

Upon completing the circuit the sodium chloride in solution will be decomposed, th chlorine migrating to and being liberated a the surface of the carbon electrodes so tha the gas as such rises through the electrolyte into the gas head and passes out of the offtake 32 into the conduit 33. The sodium of the sodium chloride migrates through the diaphragm covering the basket and cage cathodes, to the cathode, and is there liberated and as soon as liberated, reacts with the water present to form caustic soda and hydrogen. The hydrogen being on the casing side of the diaphragm, passes through the perforated cathode and out of the pipe 34 provided for that purpose. The liquid caustic soda drips from the bottom of the basket cathode and passes out of the trap 36 into the drain or ditch 37.

The action is continuous by reason of the fact that the float 28 allows the valve 29 to be opened as soon as the level of the electrolyte within the cell has lowered.

In the modified form of the device, as shown in Fig. 6, we have made the inner cage cathode of substantially the full length of the

outer basket cathode, which forms in effect two channels or chambers in which the carbon anodes are adapted to dip.

In this form of the invention the inner cage cathode 38 is provided with channel iron reinforcements 39, carrying bolts 40, the shanks of which project through the closed end of the cage and through corresponding apertures 41 in the removable end plate 42 of the outer cathode basket 43. In this form the removable end plate 42 of the outer basket cathode is adapted to be bolted directly to the flanges 44 on the ends thereof so that the application of the asbestos diaphragm to the end walls is facilitated greatly. It will be understood that the diaphragm may be applied to the plate 42 and then the plate bolted into place against the flanges 44.

The operation of the modified form of cell is identical with that of the preferred form, so that a description thereof will not be entered into here.

It is to be understood that in the claims where we refer to the cage portion of the cathode that we desire to cover the cage shown in Fig. 2 as well as in Fig. 6. In other words, we do not wish to be limited by this term to a cage which extends the entire length of the basket portion of the cathode, but intend to cover any kind of a cathode portion which is normally closed to the electrolyte.

Reference is here made to our co-pending divisional application #173,731, filed March 8, 1927.

Having thus described our invention, what we claim is:—

1. An electrolytic cell comprising a container, a cathode of endless channel form therein and covered with a diaphragm, and a plurality of anode slabs projecting into the cathode channel, and spacing members carried by said anode slabs for spacing the anodes from the cathode walls.

2. An electrolytic cell comprising a container, a perforated cathode therein comprising an outer basket and an inner cage, the outer walls of the cage and the inner walls of the basket being covered with a diaphragm and adapted to contain an electrolyte in the chamber formed therebetween, a gas chamber superimposed on the walls of the container, said perforated cage cathode projecting within the gas chamber.

3. An electrolytic cell comprising a container, a basket cathode portion supported by flanged upper edges upon the container, a cage cathode portion spaced between longitudinal walls of the basket portion and secured to the bottom thereof, the exposed portion of the bottom of the basket portion of the cathode being active, both cage and basket being covered by a diaphragm, a gas head resting on the upper flanged edges of the basket portion and supported upon the container, and anode slabs projecting through the gas head top into the space between cage and basket portion and means to feed electrolyte into the same space, the top of the cage portion of the cathode being above the top of the basket portion and normally submerged in the electrolyte.

4. An electrolytic cell comprising a container, a cathode therein comprising an outer basket and an inner cage, a diaphragm covering cage and basket, said basket having flanged upper edges supported upon the container, a gas head resting upon the flanged edges, the top of the cage being above the top of the basket and normally submerged in the electrolyte.

5. An electrolytic cell comprising a container, a cathode having flanged upper edges supported by the container, a diaphragm covering the cathode, a gas head comprising vertical walls corresponding to the container walls and resting upon the flanged cathode edges, a cover for the gas head, and clamping means engaging gas head and container to insure a tight joint between gas head, cathode and container, said cover being free from said clamping means, and an anode projecting through the gas head cover.

6. An electrolytic cell comprising an inner and an outer perforated cathode having spaced apart vertical walls to form an electrolyte receiving chamber therebetween, a diaphragm covering the inner face of the outer cathode, a diaphragm covering the outer face of the inner cathode, a portion of the outer cathode diaphragm being clamped between the inner and outer cathodes, an anode projecting between cathodes, and means beneath the cathodes for catching the liquid effluent dripping therefrom.

7. An electrolytic cell comprising an inner and an outer cathode, a diaphragm covering both cathodes, the diaphragm for the outer cathode passing beneath the inner cathode, an anode between the cathodes, and means beneath the cathodes for catching effluent dripping therefrom.

8. An electrolytic cell comprising an outer basket cathode and an inner cage cathode, a sheet diaphragm covering the inner vertical walls and bottom of the basket, a sheet diaphragm covering the outer vertical walls and top of the cage, the cage resting on the diaphragm on the bottom of the basket, an anode between cathodes, and means beneath the cathodes for catching effluent dripping therefrom.

In testimony whereof, we affix our signatures.

FRANK H. BUCK.
PHILIP McRAE.