GOVERNMENT OF INDIA : THE PATENT OFFICE, 214, LOWER CIRCULAR ROAD, CALCUTTA-17.

Specification No. 109348, 17th February 1967. (Accepted 26th February 1968.)

Index at acceptance—70B[LVIII(5)].

ELECTROLYTIC CELL FOR THE PRODUCTION OF CAUSTIC SODA AND CHLORINE.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, Rafi Marg, New Delhi-1, India, an Indian registered body incorporated under the Registration of Societies Act (Act XXI of 1869).

The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed.

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CECRI—Central Electro-Chemical Research Institute, Council of Scientific & Industrial Research, Karaikudi.
MCIC—The Mettur Chemical & Industrial Corporation Ltd., Mettur Dam R. S.
SB—M|s. Seshasayee Bros. (Private) Limited, Tiru chirapalli.
CHEMPLAST—M|s. Chemical & Plastics India Limited, Madras, all Indian citizens.

The cell belongs to a category of electrolytic chlor alkali cells of the diaphragm type for the production of caustic soda and chlorine by the electrolysis of sodium-chloride solution.

Prior knowledge : brief description of hitherto known devices of the relevant type

In the diaphragm cell, an asbestos or similar material separates the cell cathode from the graphite anode. Brine solution used for electrolysis is fed into the anode compartments where chlorine is formed. Caustic soda and hydrogen leave the cathode chamber through the framework of the cathode, the caustic soda being obtained as a weak solution inter-mixed with sodium chloride of the brine. Diaphragm cells are used essentially for relatively low amperages ranging from 1000 amps. to 10,000 to 15,000 amps. Recent trends are to employ even higher amperages.

Some of the popular types of diaphragm cells in use abroad employ three sections—the bottom section holding the anodes, the central section being the cathode chamber which carries the diaphragm and the top section being gas collection space for the chlorine. The cathodes are made of wire mesh and the anodes are interspaced between the cathode sections. The top cover carries the chlorine gas outlet as well as the brine inlets while the cathode chamber has outlets for weak cell liquor as well as hydrogen.

Drawbacks connected with hitherto known devices

In one type of diaphragm cell which has been widely employed the wire mesh cathodes are in the form of fingers projecting into the space between the anode rows. The anode rows themselves are split into two sets staggered with respect to each other. The electric current lead-in to the anode is by means of a single circular copper bus bar. The brine feed arrangement is by means of a single inlet in the top section. Because of the staggered arrangement of anode rows and the consequent lateral displacement of the cathode fingers, fabrication is not easy. Moreover the provision of a single circular current lead-in to the anodes leads to higher resistance and consequent loss of voltage. A single brine inlet might possibly cause disturbances to the diaphragm as well as lead to inadequate mixing of the electrolyte.

In another popular type of diaphragm cell, the bottom section is made of cast iron. In this case the brine feed is from the top facing vertically downwards. The anode rows are not staggered but the anodes are placed in continuous rows with each anode placed abutting the next. This cell suffers from the draw-back that the bottom section is susceptible to corrosion while the vertical feed of brine again is not also desirable. The continuous anode tends to hamper free circulation of electrolyte.

Main object of the invention, other objects, if any

The main object of the development of an electrolytic cell for caustic-chlorine manufacture is to develop a cell which is efficient, compact, easy to fabricate with indigenous material and improvement on other known types by minimising many of their drawbacks.

The main finding (the new principle) underlying the invention

The main finding is that by arranging the anodes in rows with two gaps in each row of anodes and by making the cathodes continuous in diaphragm type of electrolytic cells for the manufacture of caustic soda and chlorine by the electrolysis of sodium chloride solution, better circulation of the electrolyte during operation is achieved resulting in high current efficiency.

According to the present invention the diaphragm type of electrolytic cell for the manufacture of caustic soda and chlorine by the electrolysis of sodium chloride solution comprises of three sections one above the other, namely (i) a bottom section incorporating (a) anodes imbedded in a lead slab and (b) three equally spaced flat busbars imbedded in the same lead slab for the distribution of current to the anodes, (ii) a middle section carrying cathodes, and (iii) a top section which acts as a cover for the cell, which is characterised in that the cathodes are continuous and the anodes are arranged in rows with two gaps in each row of anodes. Two brine inlets are provided at the sides of the top section for uniform distribution of the brine to the cell.

The detailed design of the cell has been worked out incorporating the features mentioned in the preceding paragraph. This design results in great ease of fabrication, lower ohmic drop in the energy supply to the anodes resulting in greater efficiency, less corrosion on the bottom, greater rigidity for the cathode chambers on account of its continuous structure resulting in greater stability in cell operation and longer life, better circulation of electrolyte due to the gaps in the anode rows and better brine distribution due to the twin inlets. All the above factors lead to greater ease of fabrication and greater flexibility and ease of operation.

A description of the cell is given below :

(i) *Cell bottom incorporating the anode assembly*

This consists of a concrete bottom which acts as a base for the cell and a container for the anode assembly. The anodes comprising of flat graphite electrodes are fixed in a lead slab. Flat copper busbars which serve to conduct current to the anodes are also fixed in the lead.

(ii) *Middle section consisting of the cathode assembly*

This consists of a rectangular steel frame inside which are fixed the continuous wire mesh cathodes. The gap between the wire mesh cathode assembly and the steel frame acts as a collection space for the caustic soda and hydrogen formed at the cathodes. The outlets for the caustic soda solution and the hydrogen are from this annular space. The asbestos diaphragm is deposited in the cathodes by immersing the latter into a bath of asbestos slurried in a cell liquor and applying vacuum. Flat copper busbars which serve to carry the current to the cathodes is welded to the outside of the steel frame.

The middle section is placed over the bottom section so that the rows of wire mesh cathodes alternate with the rows of graphite anodes.

(iii) *Top cover*

This consists of a top concrete cover which acts as a closure for the cell. In this cover, necessary openings are provided for two inlets of feed brine, brine level indicator and the outlet of chlorine gas formed at the anodes. The necessary height and thereby enough volume is provided in the top cover as free space for minimising the entrainment loss. For the assembly of the cell, the top cover is placed above the middle section. The joints between the bottom and the middle section and similarly that between the middle and the top cover is sealed with a putty after assembly.

Detailed description of the cell with reference to the accompanying drawings

The invention will now be described with the help of accompanying drawings wherein :

Fig. 1 is a plan of the invented cell.

Fig. 2 is a sectional front view of the cell.

Fig. 3 is a sectional side view of the cell.

The components of the cell are indicated by numbers in brackets in the drawing and referred to in the drawing.

The cell has three sections A, B and C, namely a bottom section A, a middle section B, and a top section C one above the other. Continuous cathodes (9) are welded to the frame of the middle section B, and three flat busbars (5) are embedded in the lead slab (3) in the bottom section A for the distribution of current to the anodes (2) which are also embedded in the lead slab (3). The anodes (2) are arranged in rows with two gaps (2A) and (2B) in each row of anodes.

The detailed description of each section of the cell with reference to the accompanying drawing is given below :

Bottom Section (A)

This consists of a concrete bottom (1) in which graphite anodes (2) are imbedded in a lead slab (3). There are two gaps 2A and 2B in each row of anodes. There is a layer of asphalt sealing (4) over the lead to prevent seepage of the electrolyte, three flat copper busbars (5) with equal spacings are also embedded in the lead. These serve to carry the current to the graphite anodes. There is a continuous groove over which rubber cord (6) is placed all along the top of the concrete bottom. These serves to form a tight closure between the middle section and the bottom section. Lifting hooks (7) which consist of angle irons fixed by bolts embedded in the concrete are provided for lifting the bottom section.

Middle Section (B)

This consists of an outer steel frame (8) with flanges and wire mesh screen cathodes (9) which are welded to the frame. The annular chamber (10) formed between the wire mesh cathode section and outer steel frame serves as a collection space for the caustic soda solution and hydrogen formed at the cathodes. The caustic soda solution outlet (11) is provided at the bottom of the middle section and the hydrogen outlet (12) is provided on the other side at top. Flat copper busbars (13) are welded to the outside of the steel frame. These serve to carry the current to the cathodes. The lifting arrangement for this section is by means of hooks (14).

Top Concrete Cover (C)

This consists of a rectangular concrete top (15). The free space (16) above the top of the middle section acts as the collection space for chlorine formed at the anodes before the exit from the cell through the opening (17). The feed brine is introduced through the openings (18). There is the necessary opening (19) for the brine level indicator. As in the concrete bottom of the cell, there are grooves all along the bottom of the top cover to place the rubber cord (20). Hooks (21) are provided for lifting purposes.

Cell Assembly

The assembly consists of the three sections mentioned above placed one above the other. The assembled cell rests on four insulators (22) which in turn rest on four concrete supports (23) placed on the ground.

The overall dimensions of a 10,000 ampere cell is 1480 mm × 1350 mm × 1060 mm height.

Main advantages of the invention

(i) The cell is compact.

(ii) The assembly of the anodes is easy.

(iii) There is a better distribution of the current to the anodes, as there are three flat copper busbars evenly placed immediately below the anode rows.

(iv) The cathode are continuous and are mechanically more rigid.

(v) The bottom of the cell is of concrete which is resistant to brine.

(vi) The top is of rectangular shape.

(vii) The brine distribution is more uniform inside the cell.

(viii) The anode rows comprise three large graphite electrodes evenly spaced in order to ensure better brine mixing.

We claim :

1. A diaphragm type of electrolytic cell for the manufacture of caustic sdoa and chlorine by the electrolysis of sodium chloride solution, comprising three sections one above the other namely, a bottom section incorporating (a) anodes imbedded in a lead slab and (b) three equally spaced flat busbars imbedded in the same lead slab for the distribution of current to the anodes, (ii) a middle section carrying cathodes (iii) a top section which acts as a cover for the cell which is characterised in that the cathodes are continuous, and the anodes are arranged in rows with two gaps in each row of anodes.

2. A diaphragm type of electrolytic cell as claimed in Claim 1 wherein two brine inlets are provided at the sides of the top section for uniform distribution of the brine to the cell.

R. BHASKAR PAI,

Patents Officer,

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH.

Dated this 10th day of February 1967.

MCIP Sant.—S/.—29 Patent/70—1-6-73—100.

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No. 109348

NO. OF SHEETS 1

SHEET NO 1

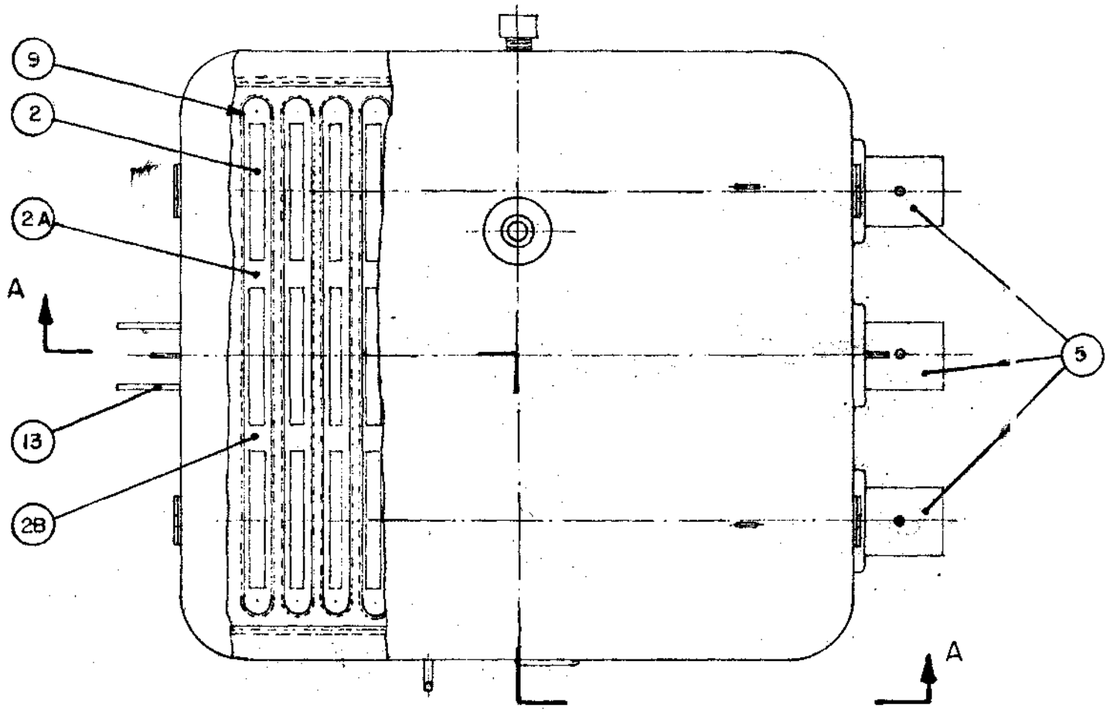

FIG. 1

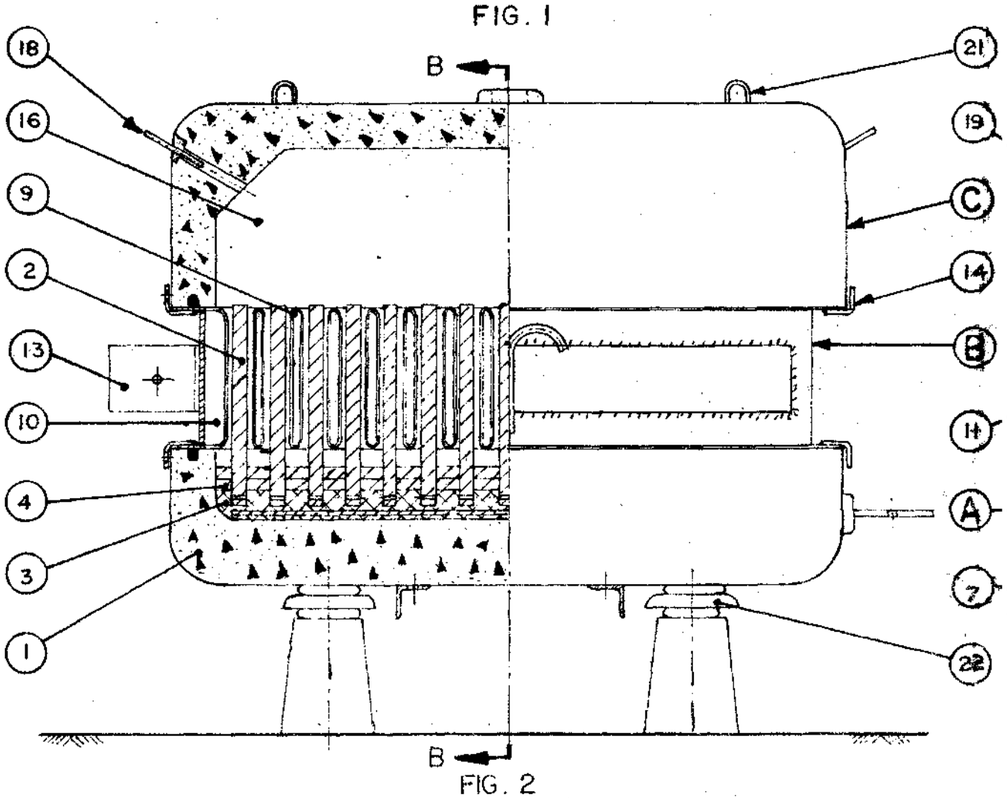

FIG. 2

(SECTIONAL VIEW A-A)

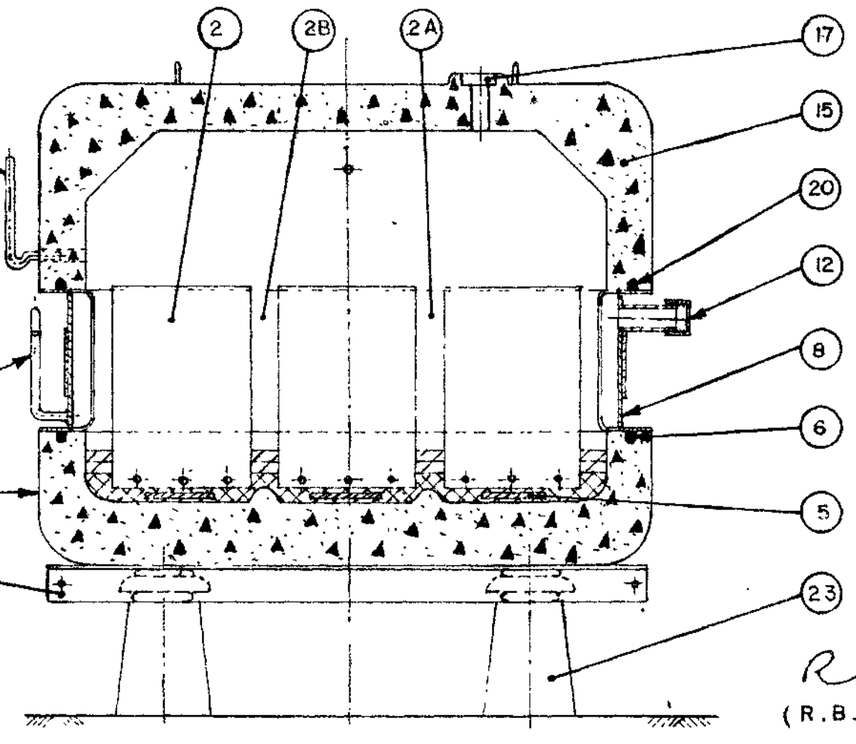

FIG. 3

(SECTIONAL VIEW B-B)

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