April 17, 1962 R. F. LA BARGE 3,030,295

SEALING MEANS FOR ELECTROLYTIC CELLS

Filed Nov. 9, 1959

FIG. 1.

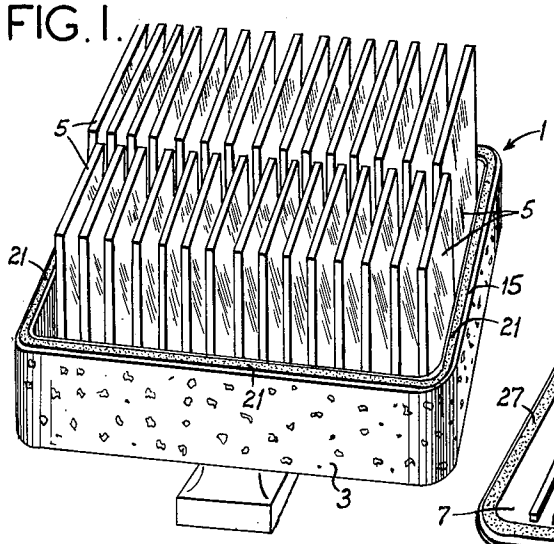


FIG. 2.

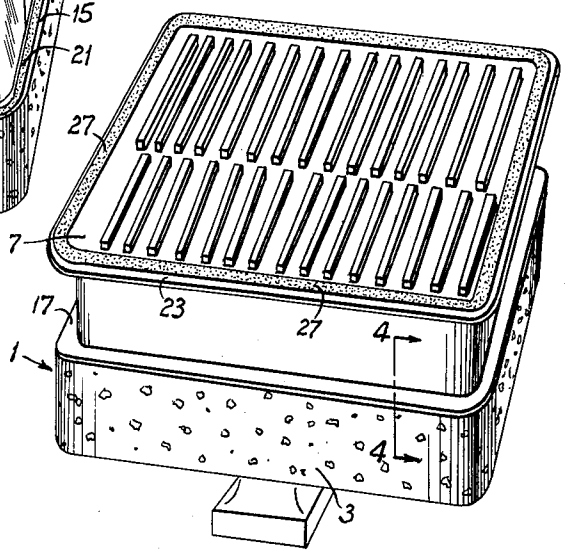


FIG. 4.

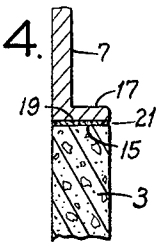


FIG. 3.

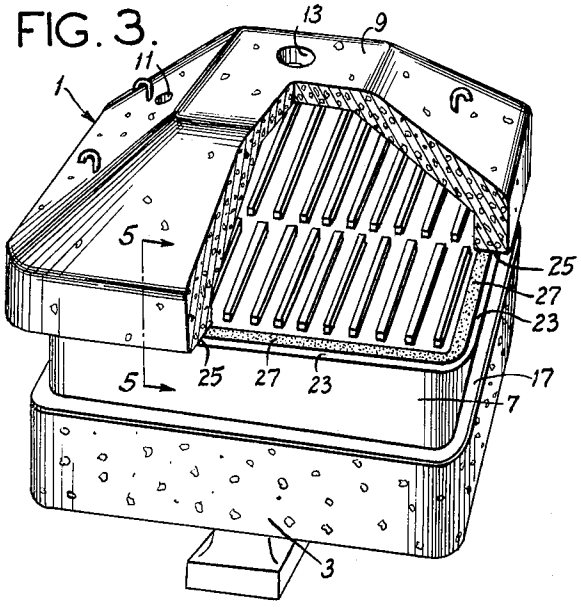
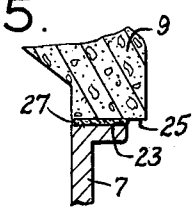


FIG. 5.



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SEALING MEANS FOR ELECTROLYTIC CELLS

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This invention relates to the sealing of electrolytic cells used in the commercial production of chlorine.

Essentially, the invention relates to sealing the joints around and between sections of electrolytic cells used in the production of chlorine with a mastic composition consisting essentially of between approximately 31.7% by weight and 36.1% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, between approximately 5.6% by weight and 6.2% by weight of GR–S rubber, between approximately 38.8% by weight and 39.8% by weight of Canadian asbestos and between approximately 15.4% and 17.1% by weight of limestone, the composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F. and to electrolytic cells having the joints thereof sealed with such a composition.

Among the objects of the present invention may be noted the provision of a method for effectively sealing the joints around and between sections of electrolytic cells used in the commercial production of chlorine; the provision of such a method involing the use of a composition which is nonoxidizing, resistant to water and water vapor, and serviceable over a wide temperature range; the provision of a method which advantageously provides a strong durable seal around and between sections of cells used in the production of chlorine; the provision of a method of sealing in which the sealing composition may be readily applied to the joints in such electrolytic cells; and the provision of electrolytic cells having the joints thereon sealed with the novel composition of the invention. Other objects and features will be in part apparent and in pointed out hereinafter.

The invention accordingly comprises the constructions and methods hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a view in perspective of the anode assembly of a conventional diaphragm cell used in the commercial production of chlorine;

FIG. 2 is a view in perspective showing the diaphragm covered cathode section in place over the anode assembly of FIG. 1 with the composition of the present invention applied to the joint between the base and the cathode section and also to the cathode section;

FIG. 3 is a view in perspective, with parts broken away, of the completed assembly of the diaphragm cell, with a sealing composition applied to the joints between the sections thereof in accordance with the invention;

FIG. 4 is a section taken on line 4—4 of FIG. 2; and,

FIG. 5 is a section taken on line 5—5 of FIG. 3.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

As is well known, chlorine is a widely used industrial chemical which is produced almost entirely by the electrolysis of fused or aqueous solutions of alkali metal chlorides. Most chlorine is produced using aqueous solutions of sodium chloride as the electrolyte according to the following reaction:

$$2NaCl + 2H_2O \xrightarrow[\text{Current}]{\text{Direct}} Cl_2 + H_2 + 2NaOH$$

The reaction is carried out in various types of electrolytic cells, the most widely used of which is a diaphragm cell having a concrete base, an anode assembly received therein, a diaphragm covered cathode section over the anode assembly and a concrete top. A strong, durable seal is required in the joint between the concrete base and the diaphragm covered cathode section and between the latter and the concrete top. Another form of electrolytic cell used in the commercial production of chloride is known as the De Nora mercury cell. This cell is composed of granite and steel plates with hard rubber covers over each plate, and a fillet is required in the joint around the outer edges of the cover sections. The seals around and between the joints of these electrolytic cells are exposed to temperatures of up to 180° F. and the action of the highly concentrated brine solution within the cell.

Heretofore, various sealing compositions have been employed for sealing the joints around and between the sections of electrolytic cells such as those described above. However, such compositions have been unsatisfactory for various reasons. Thus, they are prone to break down under the high temperature and in contact with the concentrated brine solution to which they are exposed and are thereby caused to leak. Also, they tend to harden and deteriorate during use in the joints of electrolytic cells. Further, they cannot be stored for long periods of time without hardening and/or are not adapted to be supplied in a form suitable for convenient application to the joints around and between the sections of electrolytic cells.

In accordance with the present invention, it has been found that the joints around and between the sections of electrolytic cells used in the production of chlorine may be effectively sealed with a composition generally comprising a petroleum oil vehicle, asbestos, a butadiene-styrene copolymer such as GR–S rubber and limestone, the composition having certain specified properties as more fully described hereinafter. When such a composition is applied to the joints around and between the sections of electrolytic cells in accordance with the method of the present invention, an improved seal between such joints is obtained which seal resists breaking down upon exposure to high temperatures and the action of highly concentrated brine solution and will not therefore leak under the operating conditions of the cell. Moreover, it has been found that the seals achieved through the present invention do not harden in situ, even after a substantial period of time, and that this property aids in rendering the seal leak-resistant.

The composition used in the present invention is a nonhardening, heavy fibrous mastic material which may be supplied in extrusions of various diameters or in bulk form such as easy to handle slugs which are of convenient size for use in small extruding machines. Being nonhardening, the composition may be stored indefinitely without adversely affecting its usefulness for the purposes of the invention. The composition also possesses the following characteristics: excellent resistance to water and water vapor; nonoxidizing; nonflowable over a temperature range of from 0° F. to 350° F.; service temperature range of from 0° F. to 180° F.; nonbrittle even at 0° F.; noncorrosive to metal; excellent adhesion to clean, dry surfaces; nonhardening at temperatures up to 180° F.; remains permanently plastic and pliable; nonshrinking upon aging; low heat conductivity; low electrical conductivity; nontoxic and noninjurious to the skin.

Referring now to the drawings, the invention is shown as applied to a diaphragm cell generally designated 1 of a conventional type used in the commercial production of chlorine. The cell 1 consists generally of a concrete base section 3 having an anode assembly 5 received therein, a diaphragm covered cathode section 7 covering

the anode assembly 5 and a concrete top 9 over the cathode section 7. Suitable openings 11 and 13 are provided to serve as an inlet and an outlet for brine and chlorine gas respectively. As shown, the concrete base 3 has an upper edge surface 15 and cathode section 7 has a peripheral flange portion 17 presenting a lower edge surface 19. In accordance with the present invention, the joint between surface 15 and flange portion 17 is sealed by applying a bead 21 of the above-described sealing composition completely around the upper edge surface 15 of concrete base 3 and then lowering cathode section 7 into position so that flange portion 17 thereof bears upon the bead and causes it to fill the joint and adhere strongly to surfaces 17 and 19.

Similarly, the joint between the upper edge surface 23 of cathode section 7 and the lower edge surface 25 of concrete top 9 is sealed by applying a bead 27 of the composition to edge surface 21 and lowering top 9 into position so as to press surface 25 against the bead and cause the latter to fill the joint and adhere to surfaces 21 and 23 to effectively seal the joint. The resultant seals in the joints between the sections of the cell are strong, durable, nonhardening and unaffected under the normal operating conditions of the cell.

It will be understood that other types of electrolytic cells used in the production of chlorine may have the joints between and around the various sections thereof sealed in this manner, and that the outlets, inlets and fittings of such cells may also be sealed with the composition.

In general, the composition used in the invention comprises a petroleum oil vehicle, asbestos, a butadiene-styrene copolymer such as GR–S rubber and limestone. As the petroleum oil vehicle, an Oklahoma crude oil (steam refined stock) having an S.A.E. number of approximately 80 may be used. The asbestos is preferably Canadian asbestos. The composition may also include small amounts of carbon black, oleic acid, kaolin type clay and/or a sodium aryl sulfonate type wetting agent such as that sold under the trade designation "Santomerse" (marketed by Monsanto Chemical Co.).

The composition has the following physical and chemical characteristics: nonvolatile; 99% plus solids; mild, sweet odor; dark brown color; needle penetration (ASTM D5–52, total load of 50 grams five seconds at 77° F.) 80–120 mm.; good resistance to water and alcohol; good resistance to shock, heat and cold; flash point, above 450° F.; negligible shrinkage.

The following examples illustrate the invention.

Example 1

A composition for sealing the joints around and between the sections of electrolytic cells used in the production of chlorine was prepared having the following percentage by weight compositions.

Component:	Percent by weight
Oklahoma crude oil (steam refined stock) having an S.A.E. number of approximately 80	31.7
GR–S rubber (25 parts rubber; 75 parts process oil)	5.6
Oleic acid	0.7
Carbon black	0.1
Kaolin type clay	7.7
Limestone (200 mesh)	15.4
Canadian asbestos	38.8
	100.0

A dough mixer was used in preparing the above composition. The steam was turned on and the Oklahoma crude oil was first added to the mixer. The GR–S rubber was next added to the mixer and the mixer was then started. This was followed by the addition of the oleic acid and carbon black. The clay, limestone and Canadian asbestos are then each added slowly. Each of the above components is added at five minute intervals. After all components have been added, the resulting mixture is mixed for an additional twenty minutes at 160–180° F. and then removed from the mixer.

Example 2

A composition for sealing the joints around and between the sections of electrolytic cells used in the production of chlorine was prepared having the following percentage by weight composition.

Component:	Percent by weight
Oklahoma crude oil (steam refined stock) having an S.A.E. number of approximately 80	36.1
GR–S rubber (25 parts rubber; 75 parts process oil)	6.2
Carbon black	0.1
Sodium aryl sulfonate (sold under the trade designation "Santomerse" by Monsanto Chemical Co.)	0.7
Limestone (200 mesh)	17.1
Canadian asbestos	39.8
	100.0

The above composition was prepared as described in Example 1.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above methods and constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. The method of sealing the joints around and between sections of electrolytic cells used in the production of chlorine comprising applying to said joints a mastic sealing composition consisting essentially of approximately 31.7% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, approximately 5.6% by weight of GR–S rubber, approximately 38.8% by weight of Canadian asbestos, approximately 15.4% by weight of limestone, approximately 7.7% by weight of kaolin type clay, approximately 0.7% by weight of oleic acid and approximately 0.1% by weight of carbon black, said composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F.

2. The method of sealing the joints around and between sections of electrolytic cells used in the production of chlorine comprising applying to said joints a mastic sealing composition consisting essentially of 36.1% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, approximately 6.2% by weight of GR–S rubber, approximately 39.8% by weight of Canadian asbestos, approximately 17.1% by weight of limestone, approximately 0.7% by weight of a wetting agent and approximately 0.1% by weight of carbon black, said composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F.

3. An electrolytic cell for the production of chlorine having the joints around and between the sections thereof sealed with a mastic composition consisting essentially of approximately 31.7% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, approximately 5.6% by weight of GR–S rubber, approximately 38.8% by weight of Canadian asbestos, approximately 15.4% by weight of limestone, approxi-

mately 7.7% by weight of kaolin type clay, approximately 0.7% by weight of oleic acid and approximately 0.1% by weight of carbon black, said composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F.

4. An electrolytic cell for the production of chlorine having the joints around and between the sections thereof sealed with a mastic composition consisting essentially of approximately 36.1% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, approximately 6.2% by weight of GR–S rubber, approximately 39.8% by weight of Canadian asbestos, approximately 17.1% by weight of limestone, approximately 0.7% of a wetting agent and approximately 0.1% by weight of carbon black, said composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F.

5. The method of sealing the joints around and between sections of electrolytic cells used in the production of chlorine comprising applying to said joints a mastic sealing composition consisting essentially of between approximately 31.7% by weight and 36.1% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, between approximately 5.6% by weight and 6.2% by weight of GR–S rubber, between approximately 38.8% by weight and

39.8% by weight of Canadian asbestos, and between approximately 15.4% by weight and 17.1% by weight of limestone, said composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F.

6. An electrolytic cell for the production of chlorine having the joints around and between the sections thereof sealed with a mastic composition consisting essentially of between approximately 31.7% by weight and 36.1% by weight of a crude oil (steam refined stock) having an S.A.E. number of approximately 80, between approximately 5.6% by weight and 6.2% by weight of GR–S rubber, between approximately 38.8% by weight and 39.8% by weight of Canadian asbestos, and between approximately 15.4% by weight and 17.1% by weight of limestone, said composition having a needle penetration between approximately 80–120 mm. and a flash point greater than 450° F. and being nonhardening at temperatures below 180° F.

References Cited in the file of this patent

UNITED STATES PATENTS

2,381,388	Tann	Aug. 7, 1947
2,576,968	Pike et al.	Dec. 4, 1951
2,610,162	Hoffman	Sept. 9, 1952
2,728,734	Cubberley et al.	Dec. 27, 1955
2,864,882	Snell	Dec. 16, 1958