Dec. 29, 1959 S. E. BERGH 2,919,238

FUSED SALT ELECTROLYTIC CELLS

Filed July 22, 1957 4 Sheets-Sheet 1

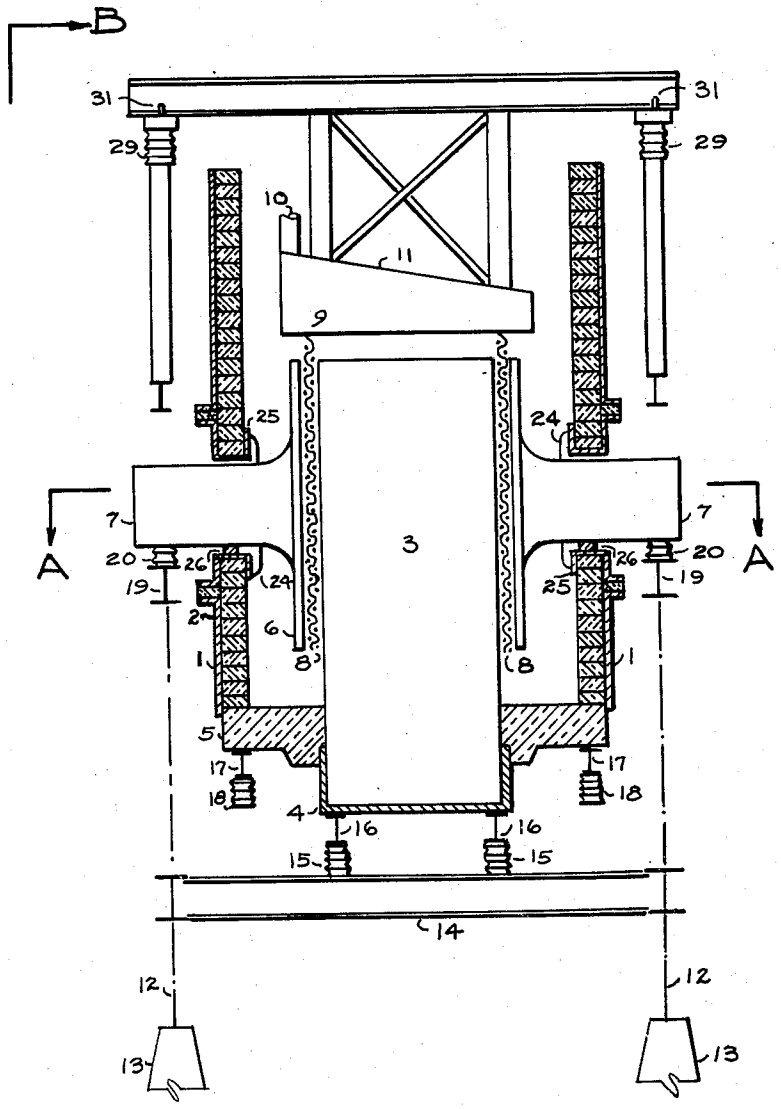


FIG. 1

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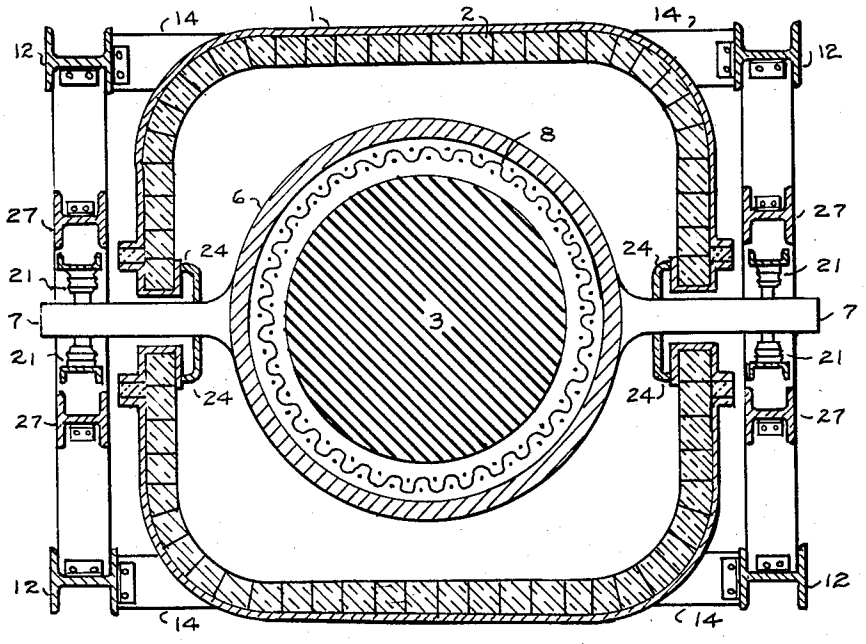


FIG. 2

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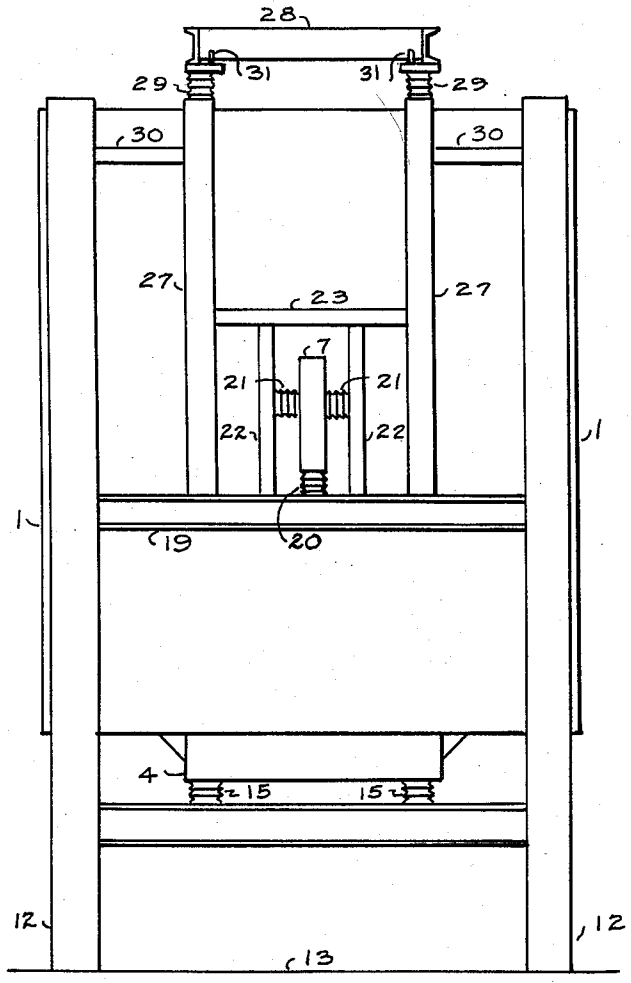


FIG. 3

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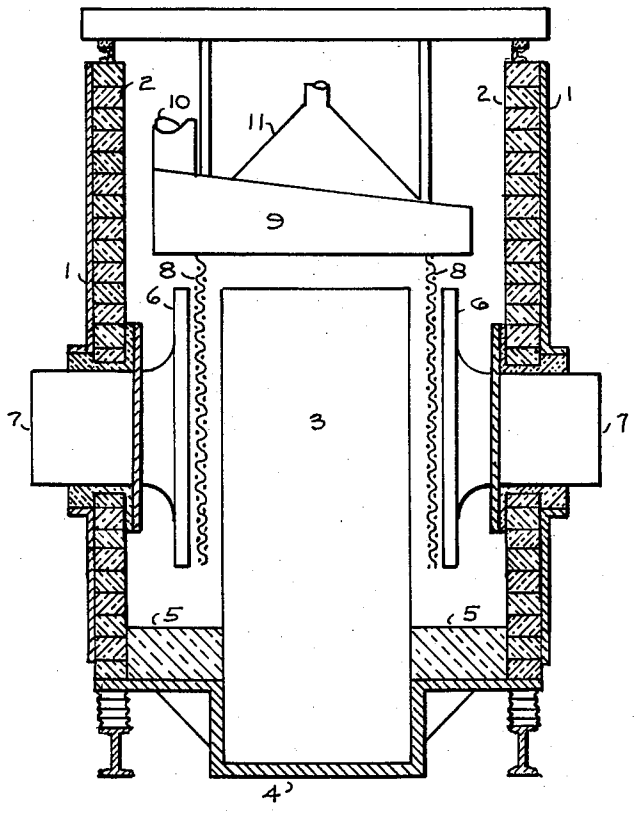


FIG. 4

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2,919,238

FUSED SALT ELECTROLYTIC CELLS

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Application July 22, 1957, Serial No. 673,492

4 Claims. (Cl. 204—247)

This invention relates generally to improvements in constructing fused salt electrolysis cells and more particularly concerns the method of supporting the basic elements of the fused salt cell suitable for the electrolytic production of sodium.

In the production of sodium from a fused salt mixture in a cell of the Downs type (see U.S.P. 1,501,756, dated July 15, 1924) it is important that the anode, cathode and diaphragm are maintained in careful predetermined alignment with each other so as to insure efficient production and long cell life. In large commercial cells the alignment of these parts is difficult to maintain during the life of the cell in large part because heretofore the weight of these parts was supported directly on the cell shell. However, changes in temperature and other factors make it difficult to establish the proper alignment between anode, cathode and diaphragm at start-up when the cell temperature rises from room temperature to operating temperature and later during the life of the cell when it is often necessary to change the diaphragm or to shake it to dislodge adherent solids. This difficulty has been a problem of the industry for over 30 years and has not been solved satisfactorily prior to the present invention.

It is accordingly an object of the present invention to provide means for maintaining the proper alignment of anode, cathode and diaphragm with respect to each other during the life of the fused salt cell. It is another object to support the anode, cathode and diaphragm assembly combined with the product collectors independent of the cell shell. It is a further object to provide means for readily reproducing the original alignment of the diaphragm with respect to the anode and the cathode after each diaphragm change.

These and other objects of the invention are accomplished by supporting the cell shell, the anode, the cathode, and the collector-diaphragm assembly each independently of the other and on support outside of and independent of the cell or its parts thereby achieving freedom of variable distortion caused by temperature changes inherent in the old arrangement whereby all the parts or elements were supported by the cell wall.

The drawing accompanying this specification will serve to illustrate a preferred method for supporting the significant cell parts independently of each other as well as a standard cell to show the state of the prior art whereby all the other cell parts are supported on the cell shell.

Figure 1 is a vertical cross section of a fused salt sodium cell showing the relationship between the cell parts and their support independent of each other.

Figure 2 is a horizontal section at A—A of the cell of Figure 1.

Figure 3 is a schematic end view of the cell of Figure 1 from B—B.

Figure 4 shows the cell support system of a prior art standard sodium cell in vertical cross section.

The identifying numbers in the figures all correspond

to the same elements. The cell is housed in steel shell 1 lined with refractory brick 2 which together constitute the cell wall. Centrally and vertically disposed anode 3 enters the cell from the bottom where electrical contact with the external power source not shown is established by way of metal box 4. The bottom of the cell around the anode is comprised of refractory cement block 5 on which the cell wall is positioned. Cylindrical steel cathode 6 surrounds the anode and has two arms 7 extending through the cell wall for contact with the external electrical circuit not shown. Cylindrical metal wire mesh diaphragm 8 divides the space between the anode and the cathode into anolyte and catholyte zones and is suspended from the product collector system in such a way that no part is in contact with either electrode and is as nearly symmetrically centered as possible. The collector system comprises the annular sodium collector 9 with a collector or riser pipe 10 through which the sodium produced by electrolysis is removed from the cell. The collector system also includes the chlorine collector or dome 11 which collects and provides for the removal of the gaseous component of the electrolytic process from the cell. The diaphragm together with the product collectors and their sub-elements are herein referred to as the collector-diaphragm assembly.

The cell parts are supported by four main support columns 12 which rest on foundation 13. Support or beam members 14 tie in with support columns 12 and provide the support for the anode by way of insulators 15 and beams 16 which latter directly support metal box 4 in which anode 3 is fixed. Beams 17 resting on insulators 18 support the cell wall and are in turn supported on beams 14.

Beam or support members 19 support the weight of the cathode 6 by way of cathode arms 7. An insulator 20 is interposed between member 19 and arm 7. To steady the cathode arm so as to provide precise vertical alignment side supports 21 preferably insulators are provided. These side supports may be attached to braces 22 which in turn may be attached to beam 19 and brace 23. Cathode arms 7 since they pass through the cell wall and since the cell wall and the cathode expand unequally must be provided with flexible sealing means such as metal bellows or disks 24 which are integrally fastened to the cathode arm and to a metal member 25 of the wall. The cathode arms may slide on the insulators 20 as the cathode expands. The spacer blocks 26 may be used during erection and are preferably removed prior to start-up. Means, not shown, may be provided to equalize the travel of the two opposed cathode arms as they move due to cathode expansion specifically as the temperature of the cell is raised when it is placed in operation at fused bath temperatures.

Vertical supports 27 resting on horizontal beams 19 take the weight of the collector-diaphragm assembly by way of horizontal frame member 28 directly attached to the collector-diaphragm assembly. Insulators 29 are interposed between supports 27 and member 28. Brace members 30 between main support column 12 and vertical supports 27 may be used to provide stability. Means such as pins 31 are provided to fix the alignment of the collector-diaphragm assembly with respect to the other elements of the cell such as the cathode and the anode. On removal of the collector-diaphragm assembly from the cell during operation the original alignment of the collector-diaphragm with respect to the rest of the cell is easily reestablished as it existed before the removal by placing the pins 31 into their proper openings. The pin 31 may also be fastened on the top of insulator 29 with corresponding hole in member 28 to engage the fixed pin on placing or replacing the collector-diaphragm assembly in the cell. Other means than pins, such as

properly placed grooves or the like may be used in place of the pins, provided only that thereby the proper realignment will result on replacing the collector-diaphragm assembly after removal for repair or for replacement of the diaphragm as is often required in operating cells.

It will thus be apparent that by supporting the weight of the essential cell elements independently of the cell or the cell wall that better alignment of the cell parts, particularly of the cathode, the anode and the diaphragm with respect to each other can be maintained both during the period when the cell is heated to operating temperature and the various parts expand according to their expansion characteristics as well as easily reestablishing the proper realignment on changing the collector-diaphragm assembly and replacing it while the cell is in operation.

The cells of this invention may comprise one or more vertically disposed anodes, each with its companion opposed cathode, preferably so arranged that the cathode surrounds the anode. The cathode must have at least two preferably opposed arms extending through the cell wall. The vertically placed anode may be circular, rectangular, hexagonal or any other shape provided only that the corresponding cathode surface be disposed at a uniform distance from the anode surface throughout the electrolytic zone. The distance between the electrolytic anode and cathode surfaces must be uniform and should generally not exceed three inches and should preferably be less than two inches.

While the four elements described above are independently supported external to and independent of the cell body it is necessary that they be insulated from each other to avoid electrical short-circuits.

This invention is generally applicable to electrolytic cells involving the electrolysis of fused salt mixtures where the metal product of the electrolysis will float on the cell bath and both the anodic and cathodic products are collected at the top of the cell rather than at the bottom. The invention more specifically applies to electrolytic cells for the production of alkali metals, particularly sodium, from fused salt mixture of the halides of the metals, preferably the chlorides but fluorides may also be present.

I claim:

1. In a cell for the electrolytic production of a metal having a density below the density of the fused electrolyte and requiring a diaphragm to separate the anode and cathode zones the combination comprising four elements each supported on support external to the cell body, the first element comprising the cell shell, the second element comprising a vertically disposed anode with bottom entrance into the cell, the third element comprising a cathode surrounding the anode said cathode having opposed arms, said arms passing through the cell wall and being supported on weight bearing means outside said cell wall and the fourth element comprising collecting means for the metal and non-metal products of the electrolytic cell, a diaphragm suspended from said collecting means, said diaphragm being disposed between the anode and the cathode, said fourth element being removable as a whole from said cell.

2. In a cell for the electrolytic production of a metal having a density below the density of the fused electrolyte and requiring a diaphragm to separate the anode and cathode zones the combination comprising four elements each supported on support external to the cell body, the first element comprising the cell shell, the second element comprising a vertically disposed anode with bottom entrance into the cell, the third element comprising a cathode surrounding the anode, said cathode having opposed arms, said arms passing through the cell wall and being supported on weight bearing means outside said cell wall and the fourth element comprising collecting means for the metal and non-metal products of the electrolytic cell, a diaphragm suspended from said collecting means, said diaphragm being disposed between the anode and the cathode, said fourth element being removable as a whole from said cell and then replaceable in means fixing the exact previous alignment of said fourth element with the other cell elements.

3. In a cell for the production of alkali metal by the electrolysis of a fused salt bath the combination comprising an anode vertically disposed in the cell, said anode entering the electrolyte from the bottom of said cell, said anode being supported separately from the cell wall, a cathode surrounding said anode so as to create an electrolysis zone between said anode and said cathode not exceeding a distance of about 2 inches over the major portion of the opposed electrodes, said cathode having at least two opposed arms, said arms passing through the cell wall and said cathode and arms supported on weight bearing member outside of and independent of said cell wall, and a collector-diaphragm assembly comprising an alkali metal collector, a chlorine gas collector and a porous metal diaphragm, said diaphragm extending downward into the electrolysis zone between said anode and said cathode to create therein anolyte and catholyte zones, said collector-diaphragm assembly being supported independently of said cell wall and of said anode and of said cathode.

4. The cell of claim 3 further characterized in that the support for said collector-diaphragm assembly contains means for accurately centering said assembly so that said diaphragm will fit between said anode and said cathode without contacting either of them, said means permitting the removal of said assembly and its replacement in the predetermined alignment.

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