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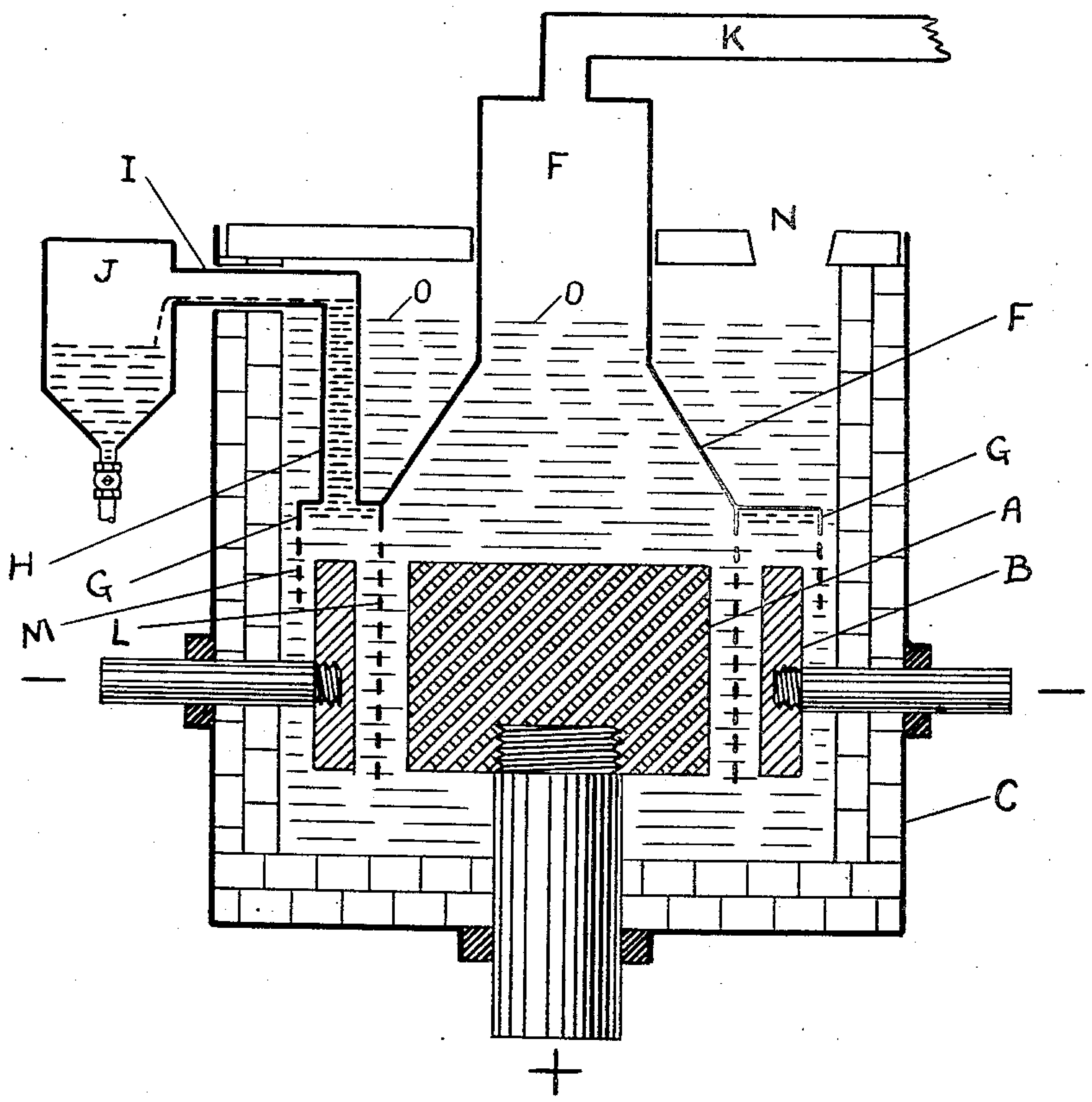

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ELECTROLYTIC PROCESS AND CELL.

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To all whom it may concern:

Be it known that I, JAMES CLOYD DOWNS, a citizen of the United States, and resident of Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Electrolytic Processes and Cells, of which the following is a specification.

My invention relates to the process of producing alkali metals and halogens by electrolysis of fused halide baths, as for example, sodium chloride. An object of the invention is to recover halogens containing practically no gaseous impurities. Another object of my invention is to recover metals, as for example, sodium, with a small expenditure of labor. Another object of my invention is to provide means for charging raw material, as for example, sodium chloride, into the electrolytic cell without in any way introducing impurities into the chlorine or the sodium and without complicating the recovery of either of the primary products.

Many processes and types of electrolytic cells are known to those who are skilled in the art of manufacturing alkali metals. It is likewise known that the recovery of gases such as pure chlorine from electrolytic cells utilizing fused baths consisting largely of sodium chloride is practically impossible with any of the types heretofore described in patent or other literature. My cell not only produces sodium from fused baths as efficiently, and permits of its recovery as easily as any cell heretofore known, but it has the distinct and valuable advantage that chlorine gas can be recovered almost 100% pure, at least as pure as is normally obtained from cells producing caustic soda and chlorine from aqueous solutions of sodium chloride.

One of the characteristics of cells electrolyzing aqueous solution is that the gas produced is always moist and is not readily usable in many chemical processes until after being dried. One of the advantages of the cells using fused salt baths is that the gas is given off dry; this advantage however, is lost in all types of cells previously built because of the fact that moist air from without the cell cannot be excluded from the chamber that collects and delivers gas produced at the anode. In all such cells heretofore described it has been impossible to recover as dry chlorine the gas that is produced by the electrolysis of sodium chloride. Consequently the dilute and humid condition of the chlorine in many cases makes it a liability rather than an asset.

Meeting this outstanding weakness of all previous cells I have invented a new type from which pure dry chlorine can be easily and continuously recovered; furthermore, I have provided means by which pure sodium can be easily removed, and the additional new feature that raw material, which is usually sodium chloride, is introduced into a chamber distinct from those in which chlorine and sodium collect. Hence moisture that may be present in the solid sodium chloride is driven away from the fused bath before it may react chemically with any of the contents of the other two chambers. I have therefore invented a new type of cell consisting of three chambers each effectively separated from the other, and a bath having a lower electrolyzing portion and an upper reservoir portion.

My cell for the electrolysis of sodium chloride is illustrated by the drawing which is a vertical cross-section. The most simple form of the cell is one that is square in horizontal cross-section and square or rectangular in vertical cross-section. A is the anode, B is an annular cathode, F is a collecting chamber and dome for collecting the chlorine, G is an annular sodium collector, L and M are metal diaphragms supported by F. H is a riser pipe for collecting and conducting the sodium away through the pipe I to a vessel J. K is a pipe through which the pure chlorine is delivered after being collected in F. The shell C of the cell is made preferably of iron plates and is lined with resistant refractory material such as fire brick. One of the three chambers is entirely outside of the chlorine collector and above the sodium collector. Into this the material to be electrolyzed is fed through a hole N in the cover, although the cell may be operated without a cover. Another of the chambers is entirely within the chlorine compartment F and the depending annular diaphragm L, the third chamber is included by annular collector G and that region below G and outside the diaphragm L and inside the annular diaphragm M. The bath level is shown by the dotted line O.

The anode is preferably of graphite or carbon and the cathode of iron or copper.

Suitable water cooled connections and heat insulators may be used and must be properly proportioned to the cell capacity.

The operation of this cell is simple. The direct current liberates chlorine at the anode and sodium at the cathode. The chlorine rises to the surface of the bath at F and passes out at K under its own pressure. The sodium likewise rises, is caught under G and passes upwardly in H. Since sodium has a somewhat lower density than the fused bath a column of sodium forms and eventually stands high enough in H to overflow through I into J. Continuous production of sodium results in a practically continuous overflow. The bath level is maintained constant by introducing raw material which is usually sodium chloride through a feed hole N in the cover. There being a large surface exposure of the bath sodium chloride may be introduced directly into the bath where it is melted by the heat of the latter. Any moisture that may be present in the solid sodium chloride is expelled from the bath and having no way of access to the chlorine and sodium chambers said moisture is ultimately driven to the outside air.

I do not wish to be limited to the production of sodium and chlorine in my cell, but specifically include all alkali metals, and all halogens.

Neither do I wish to be limited to cells having one solid continuous anode and one solid continuous cathode, because composite electrodes may under some conditions be used advantageously.

As a means of confining the two primary products out of contact with the feeding chamber as well as out of contact with each other, I do not wish to be limited to the use of three compartments. The simplest form of cell is one with substantially concentric electrodes and with three substantially concentric compartments; however, more complex cells may be designed and constructed in which case more than three compartments might be advantageously designed to meet the requirements that I have indicated.

In my claims I use the word "carbon" in its most general form, therefore including graphite as well as other amorphous varieties. By "domes" I mean compartments of any desirable configuration so placed in and above the bath that they collect and hold for delivery the products of electrolysis.

I claim:

1. In combination in an electrolytic cell for producing alkali metal and a halogen from fused alkali metal halide, a compartment for the reception of the material to be electrolyzed, a submerged compartment for the collection and delivery of the halogen, and a compartment for the collection and delivery of alkali metal.

2. In combination in an electrolytic cell for producing alkali metal and a halogen from fused alkali metal halide, a compartment for the reception of the material to be electrolyzed, a submerged compartment surrounding and above the anode and including a relatively small portion of the bath surface for the collection and delivery of the halogen, and a compartment surrounding and above the cathode for the collection and delivery of alkali metal.

3. An electrolytic cell producing alkali metal and a halogen from fused alkali metal halide, including as principal component parts, a shell for retaining the fused bath, an anode, a cathode, impervious walls, a submerged dome and pervious diaphragm bounding and constituting a submerged compartment for collecting chlorine, a second compartment for collecting the alkali metal produced, and a third compartment for rereiving the material to be electrolyzed.

4. An electrolytic cell producing alkali metal and a halogen from fused alkali metal halide, including as principal component parts, a shell for retaining the fused bath, an anode, a cathode, impervious walls, a submerged dome and pervious diaphragm bounding and constituting a submerged compartment around and over the anode and extending upwardly out of the bath for collecting the halogen, a second compartment around and over the cathode and extending upwardly out of the bath for collecting the alkali metal, and a third compartment distinct from the other compartments for receiving the material to be electrolyzed.

5. An electrolytic cell producing alkali metal and a halogen from fused alkali metal halide including as principal component parts a shell of iron with refractory lining for retaining the fused bath, an anode centrally located with reference to the cathode, a cathode externally located with reference to the anode, impervious walls, a submerged dome and pervious diaphragm bounding and constituting a compartment around and over the anode and extending upwardly out of the bath for collecting the halogen, a second submerged compartment around and over the cathode and extending upwardly out of the bath for collecting the alkali metal produced, and a third compartment distinct from the other compartments with relatively large exposure of bath surface for receiving the material to be electrolyzed.

6. In a fused alkali metal halide electrolytic cell, the combination of means for disengaging alkali metal and halogen, halogen collecting means disposed below the bath surface, metal collecting means, and means for separately discharging the collected halogen and metal.

7. In a fused alkali metal halide electrolytic cell, the combination of means for disengaging alkali metal and halogen, separate

halogen and metal collecting means disposed below the bath surface, and means for discharging the collected halogen and metal.

8. In a fused alkali metal halide electrolytic cell, the combination of means for disengaging alkali metal and halogen, halogen collecting means disposed below the bath surface, metal collecting means, means for separately discharging the collected halogen and metal, and means external of said collecting means for replenishing the bath.

9. In a fused bath electrolytic cell, a submerged anode and a spaced submerged cathode, an interposed diaphragm, and separate collecting domes leading out of the bath above said electrodes from opposite sides of said diaphragm.

10. In a fused bath electrolytic cell, a submerged anode and a spaced submerged cathode, one being annular and external of the other, an interposed diaphragm, and separate collecting domes leading out of the bath above said electrodes from opposite sides of said diaphragm.

11. In a fused bath electrolytic cell, a submerged central anode, an annular submerged cathode outside the anode, an interposed diaphragm, a submerged dome above the diaphragm and the anode leading out of the cell, and a submerged dome above the diaphragm and the cathode leading out of the bath.

12. In a fused bath electrolytic cell, a submerged central anode, an annular submerged cathode outside the anode and spaced from the cell wall, an interposed diaphragm, a submerged dome above the diaphragm and the anode leading out of the cell, and a submerged dome above the diaphragm and the cathode leading out of the bath.

13. In a fused bath electrolytic cell, a submerged central anode, an annular submerged cathode outside the anode, an interposed diahpragm, a submerged dome above the diaphragm and the anode leading out of the cell, and a submerged dome above the diaphragm and the cathode leading out of the bath, said latter dome being spaced from the cell wall.

14. In a fused bath electrolytic cell, a submerged central anode, an annular submerged cathode outside the anode and spaced from the cell wall, an interposed diaphragm, a submerged dome above the diaphragm and the anode leading out of the cell, and a submerged dome above the diaphragm and the cathode leading out of the bath, said latter dome being spaced from the cell wall.

15. A fused salt electrolytic cell comprising a reservoir compartment normally open to atmosphere, a metal collecting compartment having a discharge outlet leading out of the cell independently of the reservoir compartment and containing a cathode, and a gas collecting compartment having a discharge outlet leading out of the cell independently of the reservoir compartment and containing an anode.

16. The method which consists in electrolyzing a fused alkali metal halide salt, and separately collecting the metal and the halogen below the bath level as released, and discharging same outside the cell.

17. The method which consists in electrolyzing a fused alkali metal halide salt, maintaining an open bath, separately collecting the metal and the halogen below the bath level as released and discharging same outside the cell, and feeding replenishing salt into the open bath.

18. The method which consists in maintaining a fused alkali metal halide salt bath having a lower electrolyzing portion and an upper reservoir portion, electrolyzing the lower portion, and separately collecting the metal and the halogen from the electrolyzing portion as released and discharging same outside the cell out of contact with the reservoir portion of the bath.

19. The method which consists in maintaining an open fused alkali metal halide salt bath having a lower electrolyzing portion and an upper reservoir portion, electrolyzing the lower portion, separately collecting the metal and the halogen from the electrolyzing portion as released and discharging same outside the cell out of contact with the reservoir portion of the bath, and feeding raw material into the open bath.

20. The process of producing alkali metal and a halogen consisting in the electrolysis of fused halide in a cell wherein additional charges of electrolyte are fed into a chamber which is separated by diaphragm and impervious walls from both the anode and cathode chambers.

21. The process which consists in fusing an alkali metal halide, conducting the fused salt into space which is out of contact with air, electrolyzing the fused salt therein, and collecting separately as released the products of electrolysis.

22. The process which consists in fusing an alkali metal halide, conducting the fused salt into space which is out of contact with air, electrolyzing the fused salt therein, and collecting separately and out of contact with air the products of electrolysis.

23. The process which consists in fusing sodium chloride, conducting the fused salt into space which is out of contact with air, electrolyzing the fused salt therein, and collecting separately and out of contact with air the products of electrolysis.

Signed at Niagara Falls in the county of Niagara and State of New York this 28th day of July A. D. 1922.

JAMES CLOYD DOWNS.