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METHOD OF AND APPARATUS FOR REFINING METALS.
APPLICATION FILED MAY 7, 1920.

1,384,499.

Patented July 12, 1921.

Fig. 1

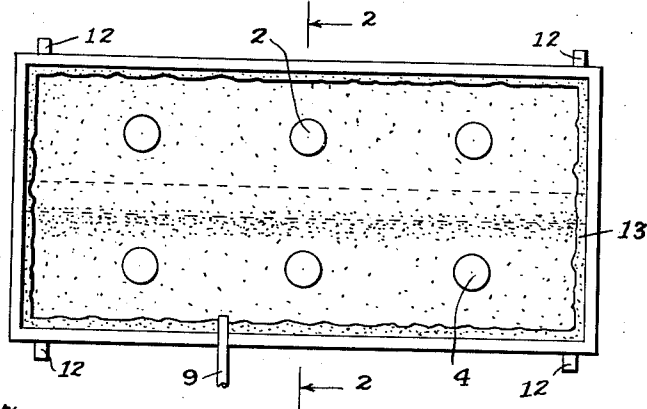


Fig. 2

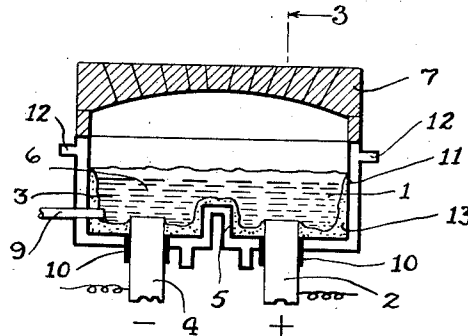


Fig. 3

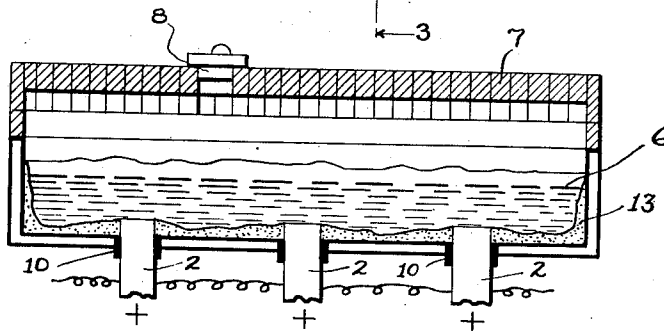
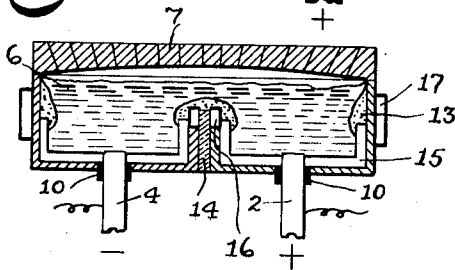


Fig. 4



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METHOD OF AND APPARATUS FOR REFINING METALS.

1,384,499.

Specification of Letters Patent.

Patented July 12, 1921.

Application filed May 7, 1920. Serial No. 379,447.

To all whom it may concern:

Be it known that I, SAMUEL A. TUCKER, a citizen of the United States, and a resident of the borough of Manhattan, city, county, and State of New York, have invented an Improvement in Methods of and Apparatus for Refining Metals, of which the following is a specification.

My invention aims to provide a method of, and apparatus for, refining metals electrolytically and aims more particularly to provide means whereby impurities may readily be separated from electrolytically deposited metal by confining such impurities within a suitable container with which the refined metal does not communicate.

While my invention may be used in connection with the refining of various metals, it has particular utility in connection with the refining of metals which are usually deposited from a fused bath, such as aluminium, magnesium, calcium, sodium, or similar metals. In connection with the refining of such metals, my invention, in one of its forms, may embody a plurality of communicating compartments which contain a suitable electrolyte and each of which is adapted to be served by suitable current conducting means, said compartments being partially separated from one another in such a manner as to prevent the impurities in one or more of them from contaminating the refined metal in other of the compartments. It will be understood, however, as pointed out above, that although my invention is particularly applicable to the refining of aluminium or similar metals, it may be applied to the refining of many other metals, and it will also be understood that the particular apparatus which I shall describe hereafter as being forms of my apparatus which I prefer may be greatly modified and that I therefore do not wish to limit myself to any of the particular details of the apparatus or process.

In the drawings, I have shown:

In Figure 1, a plan view of one form of apparatus suitable for carrying out the process of my invention;

In Fig. 2, a sectional view thereof taken on the line 2—2 of Fig. 1;

In Fig. 3, a sectional view taken on the line 3—3 of Fig. 2; and

In Fig. 4, a sectional view corresponding to Fig. 2 of a modified form of my apparatus.

In the process for the reduction of aluminium from alumina dissolved in suitable fluorids, the arrangement ordinarily used comprises a container lined with carbon which forms the cathode of the electrolytic system and above which are suspended in contact with the electrolyte one or more anodes of carbon. The operation of this device results in aluminium in the molten state being deposited within the cathode container, whence it is drawn off by suitable means. This reduction operation necessarily results in mixing with the reduced aluminium a considerable quantity of impurities from the electrolyte, some of which are as heavy or heavier than the aluminium and consequently drop into the molten mass, whereas others of such impurities are carried down into the molten mass by the aluminium in its separation from the electrolyte.

In one form of the apparatus of my invention, I have provided one container in which the impure metal to be refined is placed and a second container in which the refined metal is deposited, there being no direct communication between these containers, the only communication being through the body of the electrolyte itself.

This apparatus may take the form diagrammatically illustrated in the drawings, in which 1 is a compartment or cell to which current is conducted in any suitable manner, as by anodes 2, and in which 3 is a cell served by corresponding cathodes 4. It will be understood that the cells 1 and 3 may take any suitable and convenient shape and that the arrangement and number of the anodes may be varied in accordance with the circumstances, and the results desired.

The compartments 1 and 3 are separated by a partition 5 which is lower than the side walls of the compartments, such partition being sufficiently high to prevent the intermingling of the metallic contents of the two cells, but low enough to permit the electrolyte 6 to form a means of communication between the two.

If desired, the entire arrangement may be covered with a suitable covering 7 of fire-brick or other suitable material, in which an aperture 8 may be provided for the admission of the metal to be refined. A suitable discharge orifice 9 may also be provided so that the process may be continuous.

In the apparatus of Figs. 1, 2 and 3, the

compartments are preferably made of sheet iron, the electrodes being insulated therefrom by suitable insulating bushings 10 and means for water cooling, such as the water jacket 11, are provided. The water jacket is provided with suitable liquid intake and outlet ports 12. By properly adjusting the temperature of the cooling water and by selecting a suitable electrolyte, the electrolyte may be caused to congeal, thus forming a coating 13 over the sides and bottom of the compartments, 1 and 3, which coating is an insulator, and thus prevents the short-circuiting of the circuit feeding the apparatus and also prevents contact between the fused metal and the metallic surfaces comprising the walls and bottom of the container.

In the modification shown in Fig. 4, the apparatus may consist of a pair of metal containers separated by a layer 14 of suitable insulating material, such as mica or other highly refractory substance and each of the containers is lined on its bottom and a portion of its sides with a conducting substance 15, such as carbon, adapted to conduct current from the electrodes 2 and 4 to the molten metal therein contained. The molten metal, however, completely covers this carbon lining during the normal working of the process and water cooling means, as at 16, is provided to cool the upper portion of the partition so that a layer of congealed electrolyte covers it as well as the sides of the container above the molten bath, as at 17, so that the fused electrolyte is prevented from coming into contact with the metallic walls or partition of the container. By this arrangement the fused electrolyte comes into contact only with molten surfaces of the pure and impure metal situated in their respective compartments and at the same time the carbon lining effectually prevents any contact between the metallic surfaces of the container and the molten metal. This arrangement makes it possible to employ less of the cooling water than is the case in the modification of the apparatus first described. In using the apparatus described above in connection with the refining of aluminium, I may use a bath composed of suitable proportions of the fluorids of aluminium and sodium to which may be added aluminium oxid in such proportions as have been found suitable for the ordinary reduction of aluminium by electrolysis or in other proportions as may be found to give good results. It will be understood that the electrolyte is not removed from the apparatus but is used continuously and that due to the electrolysis, the greater part of the impurities are eliminated and appear in the first runs of cathode metal and that thereafter the possibility of contamination of the reduced metal is greatly minimized.

The charge of the apparatus as initially

prepared being a non-conductor, the device may be conveniently set in operation by means of a carbon rod, operating to bridge the gap between the electrodes and thus to strike an arc which will rapidly melt down the constituents of the charge. The continued application of current to the apparatus will cause the unrefined metal to go into solution at the anode and be deposited as pure metal by electrolysis at the cathode 4. It will be noted that because of the arrangement of the divided compartments, the refined metal cannot mingle with the impure metal contained in the compartment 1.

The process may be modified in a number of ways; for instance, the initial charge may be added in molten form in order to avoid the necessity of starting as described above, and may be operated continuously by the addition through orifice 8 of unrefined metal either in solid or molten form, and by drawing off the refined metal at the orifice 9 at suitable intervals.

What I claim is:

1. A device for refining impure metal, comprising a container for the unrefined metal, a container for the refined metal, means for permitting communication between said containers through an electrolyte and for preventing communication between the metals in said containers.

2. A device for refining impure metal, comprising a container for the unrefined metal, a container for the refined metal, means for permitting communication between said containers through an electrolyte and for preventing communication between the metals in said containers and means for applying current to said containers.

3. A device for refining impure metal, comprising an anode chamber for the unrefined metal, a cathode chamber for the refined metal, and means for permitting communication between said containers through an electrolyte and for preventing communication between the metal in said containers, and means for supplying current to said containers.

4. In an apparatus for refining impure metals, a container for unrefined metal, a container for refined metal adjacent thereto, a partition partially separating said containers and an electrolyte from which refined metal is adapted to be deposited in one of said containers, within which said partition is submerged.

5. In an apparatus for refining impure metals, a container for unrefined metal, a communicating container for refined metal, an electrolyte in said containers, a partition between said containers extending to above the level of the metal in the containers and to below the upper level of the electrolyte therein and means for causing an electrolysis of the electrolyte.

6. The method of refining impure metals which comprises confining the impure metal in one of a plurality of partially separated containers containing an electrolyte, subjecting the electrolyte to electrolysis and depositing the refined metal in another of said partially separated containers. 35

7. The method of refining a metal which comprises confining the unrefined metal to one of a plurality of partially separated containers containing an electrolyte, subjecting the electrolyte and unrefined metal to electrolysis to cause the fusing of the electrolyte and the deposition therefrom of refined metal in another of said containers and preventing intermingling of the metallic contents of said containers. 40

8. The method of refining aluminium which comprises charging one of a plurality of partially separated compartments with aluminium oxid, charging said compartment and an adjacent compartment partially separated therefrom with a common electrolyte comprising fluorids and subjecting said charges to electrolysis to deposit metallic aluminium in the second of said compartments. 45

9. In a device for refining metals by electrolysis, anode and cathode compartments, and a partition separating said compartments and of such height as to permit partial communication between said compartments through an electrolyte but preventing impure metal in the anode compartment from coming into contact with refined metal in the cathode compartment. 50

10. In a device for refining metals by electrolysis, anode and cathode compartments, and means separating said compartments and of such dimensions as to permit partial communication between said compartments through an electrolyte but preventing impure metal in the anode compartment from coming into contact with refined metal in the cathode compartment. 55

11. In a device for refining metals by electrolysis, an anode chamber for impure metal and a cathode chamber, said chambers being in partial communication with each other through an electrolyte while maintaining the impure and refined metals out of contact with each other. 60

12. The method of refining metals by electrolysis which comprises the step of electrolyzing a charge of impure metal serving as an anode in an anode chamber and depositing the pure metal in a communicating cathode chamber from a superposed electrolyte.

In testimony whereof, I have signed my name to this specification this 6th day of May, 1920. 60

SAMUEL A. TUCKER.