No. 790.922. PATENTED MAY 30, 1905.

C. W. ROEPPER & W. E. HARMON.

APPARATUS FOR OBTAINING OXIDS OF ALKALINE METALS.

APPLICATION FILED JULY 22, 1903.

4 SHEETS—SHEET 1

FIG. 1.

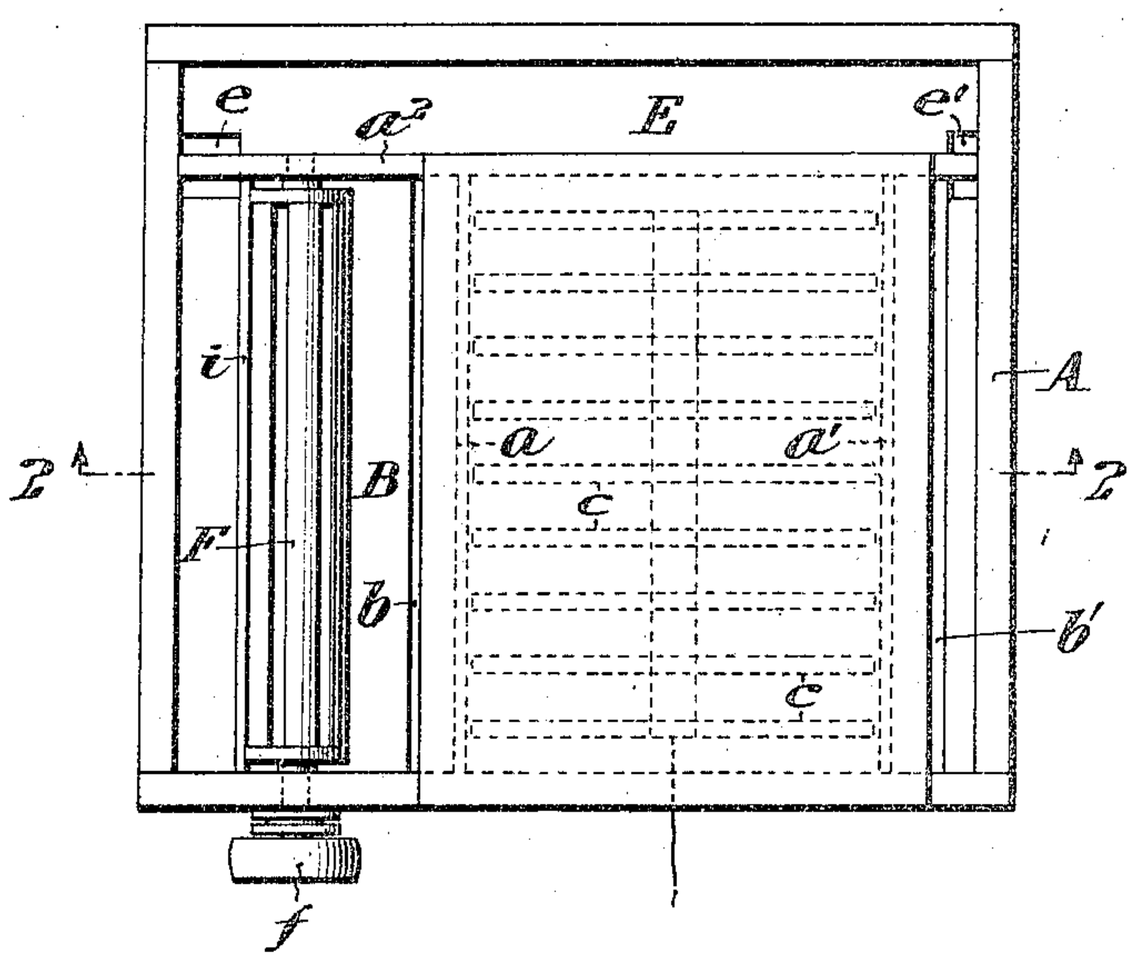
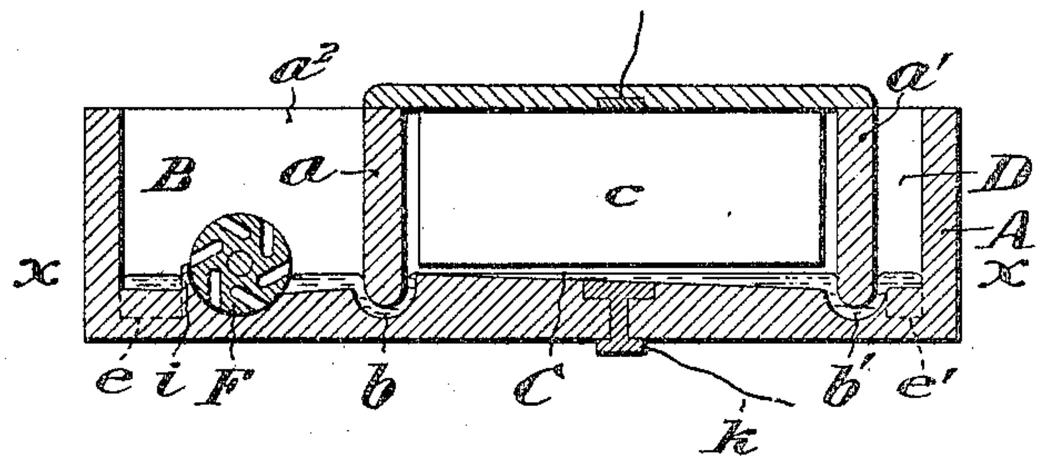


FIG. 2.



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4 SHEETS—SHEET 2.

FIG. 3.

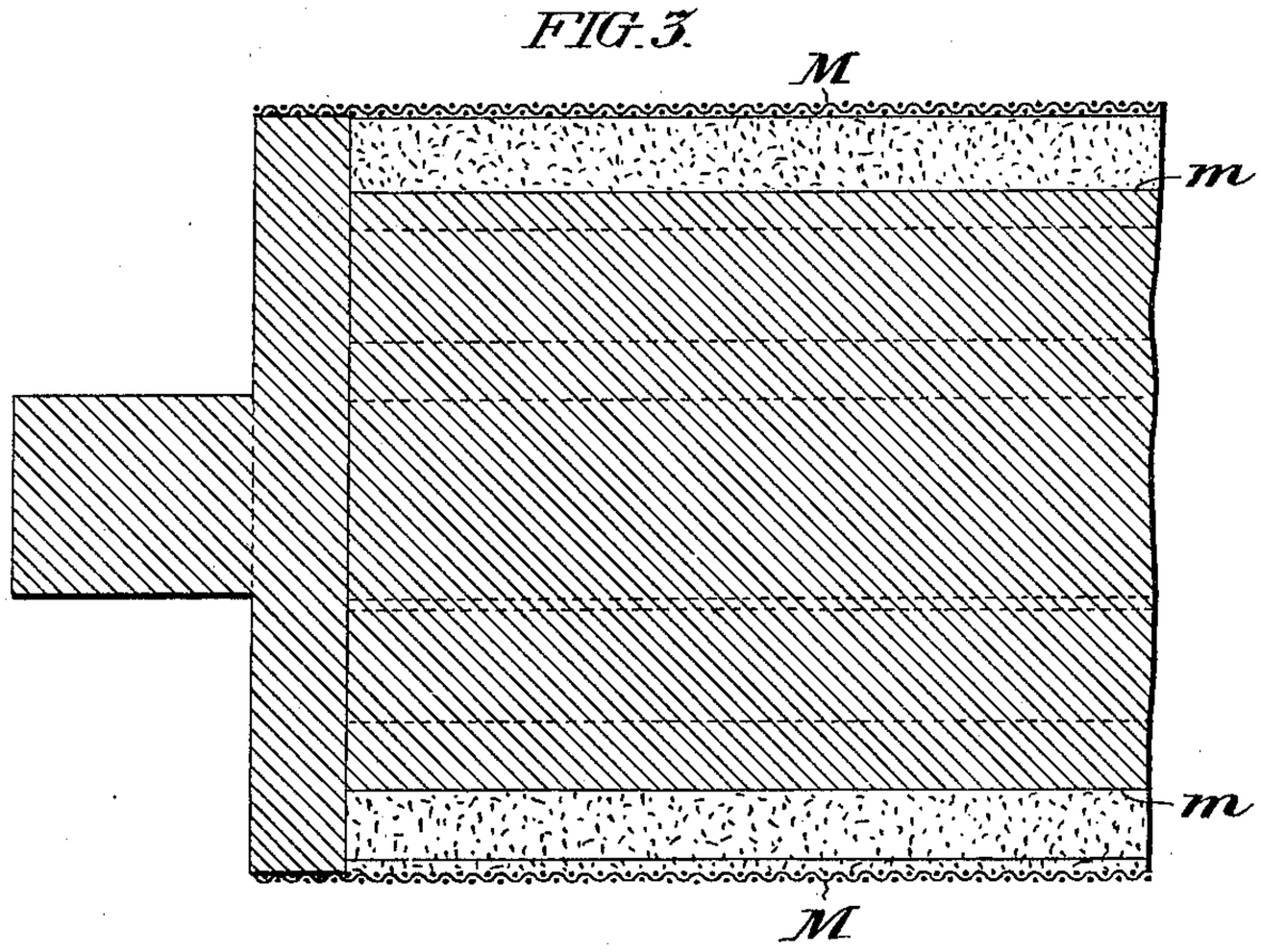
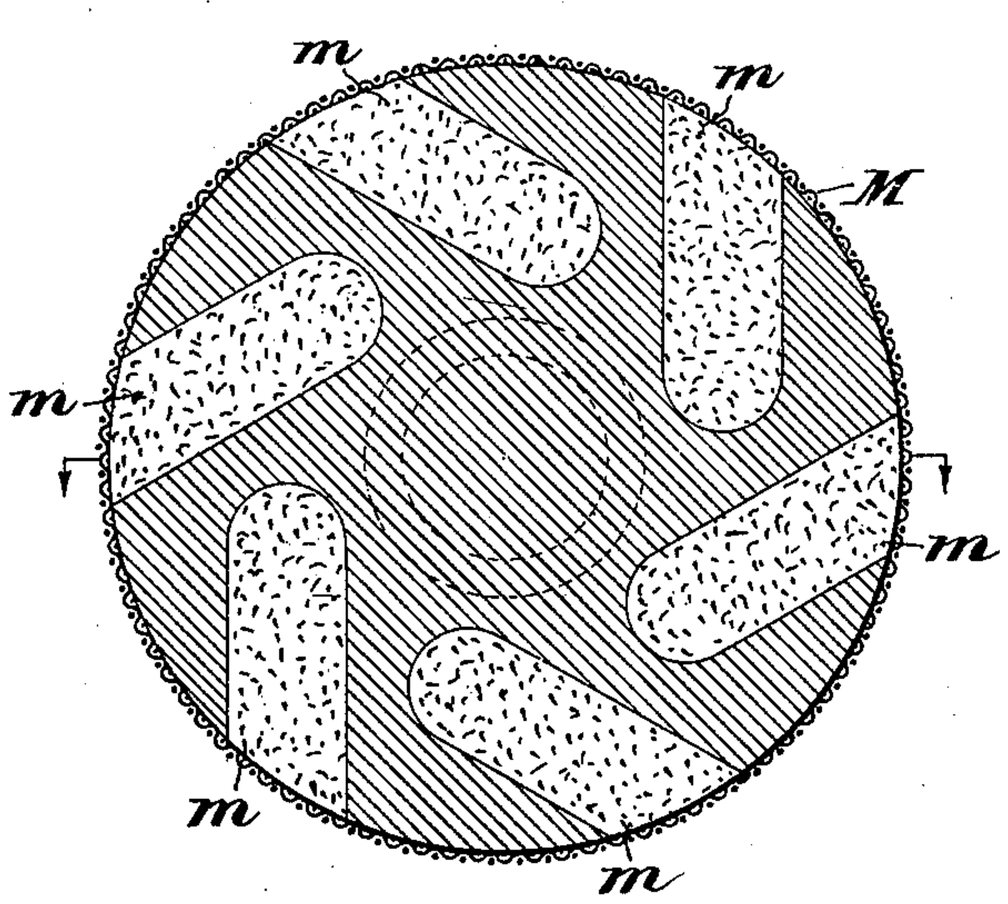


FIG. 4.



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4 SHEETS—SHEET 3.

FIG. 5.

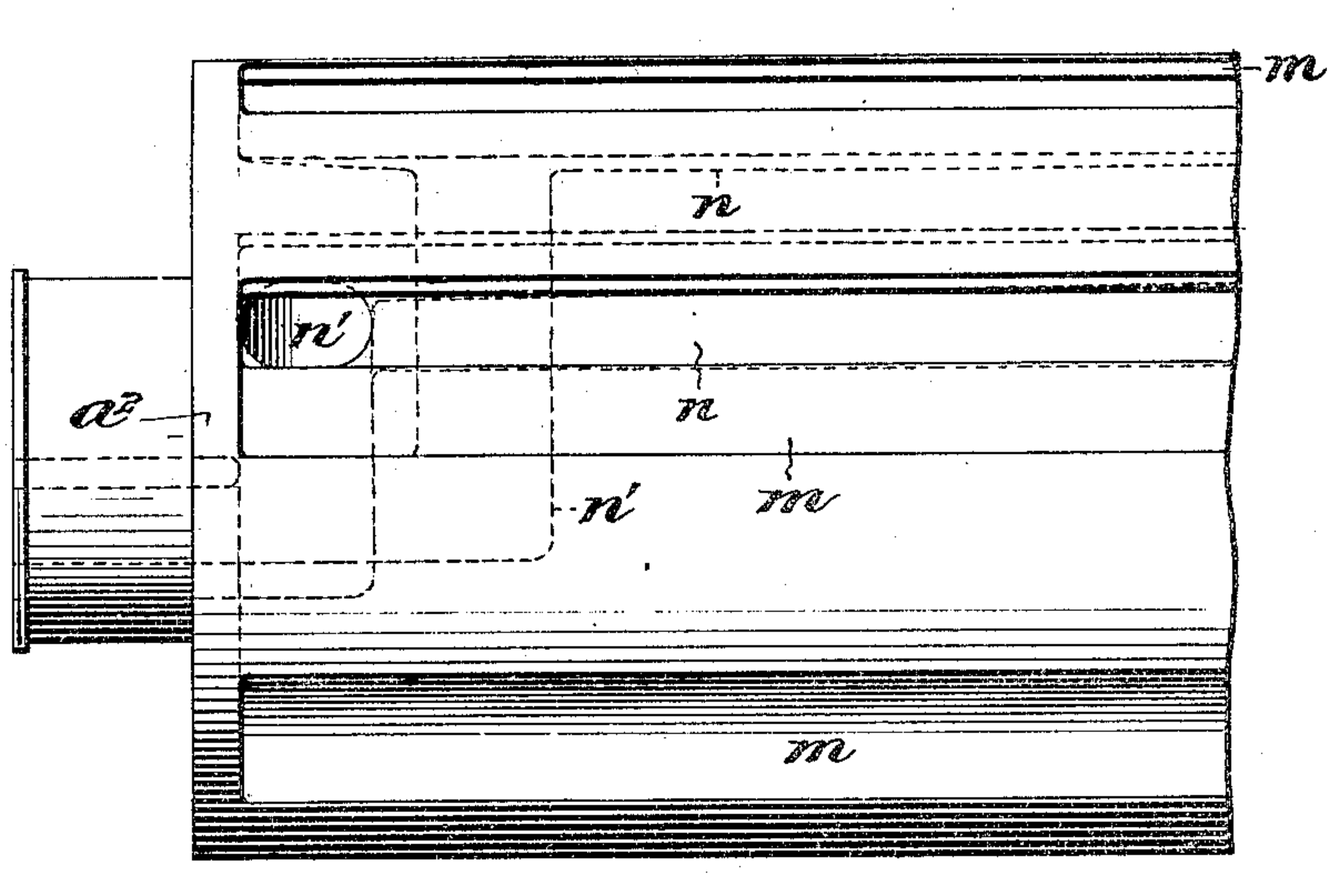
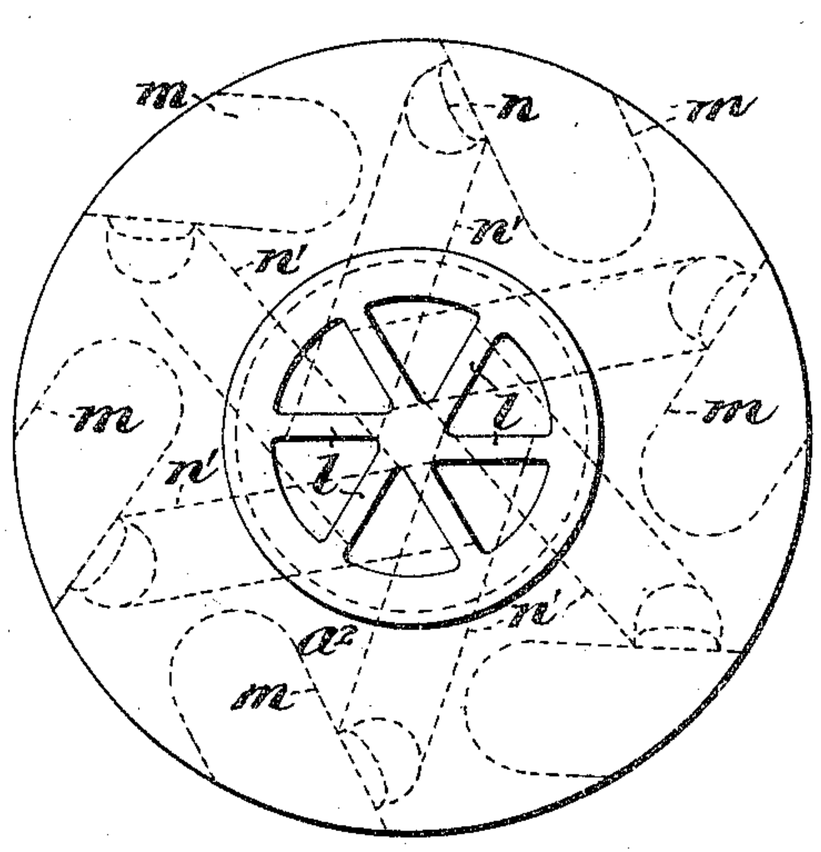


FIG. 6.



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No. 790,922. PATENTED MAY 30, 1905.

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4 SHEETS—SHEET 4.

FIG. 7.

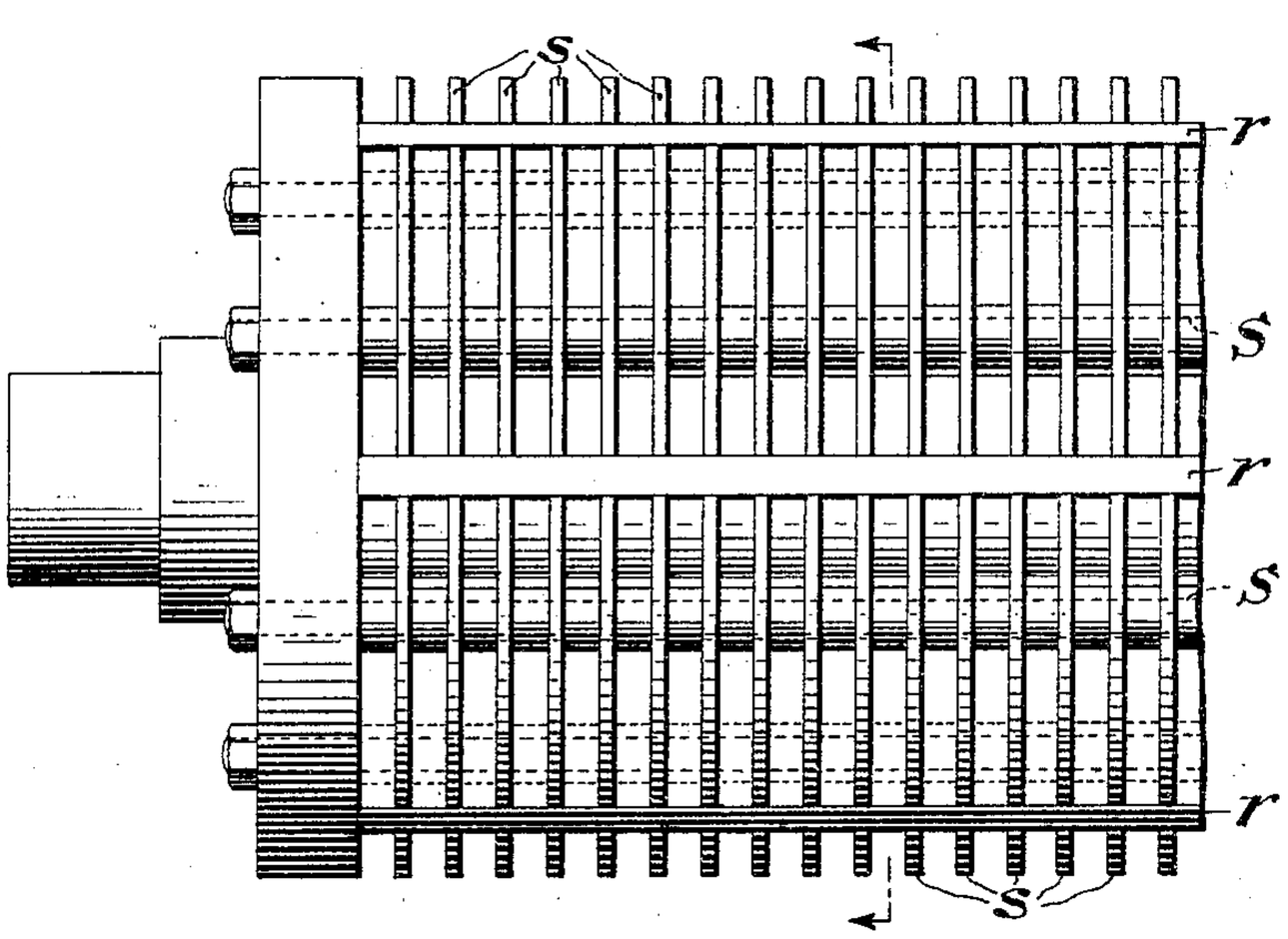


FIG. 9.

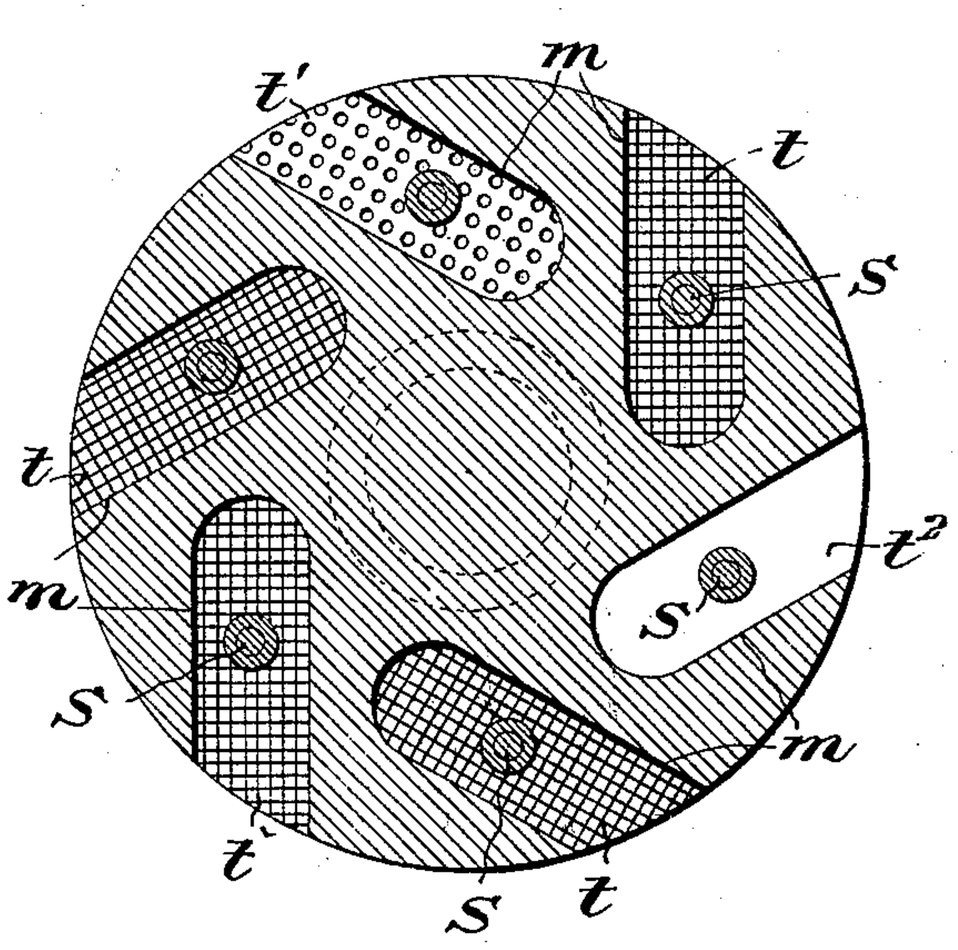
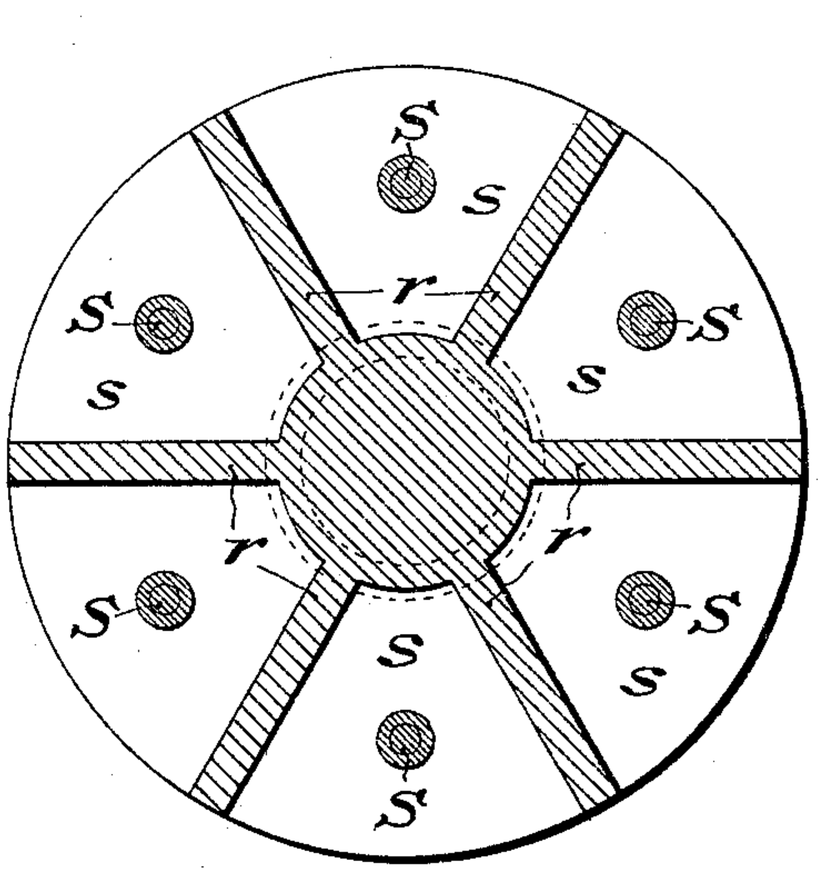


FIG. 8.



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UNITED STATES PATENT OFFICE.

CHARLES W. ROEPPER, OF PHILADELPHIA, PENNSYLVANIA, AND WILLIS E. HARMON, OF MECHANIC FALLS, MAINE, ASSIGNORS TO AMERICAN ELECTROLYTIC COMPANY, A CORPORATION OF DELAWARE.

APPARATUS FOR OBTAINING OXIDS OF ALKALINE METALS.

SPECIFICATION forming part of Letters Patent No. 790,922, dated May 30, 1905.

Application filed July 22, 1903. Serial No. 166,517.

To all whom it may concern:

Be it known that we, CHARLES W. ROEPPER, residing at 133 Phil-Ellena street, Germantown, in the city and county of Philadelphia and State of Pennsylvania, and WILLIS E. HARMON, a resident of Mechanic Falls, State of Maine, citizens of the United States, have invented certain new and useful Apparatus for Obtaining Oxids of Alkaline Metals, of which the following is a specification, reference being had to the accompanying drawings.

Our invention relates to an apparatus suitable for the practice of those processes in which alkaline oxids or hydroxids are obtained by first decomposing a salt of an alkaline or alkaline-earth metal in the presence of mercury with formation of alkaline amalgam and subsequently causing the amalgam to yield up its alkaline element, usually in the form of an hydrated oxid. These may be called "mercurial alkaline processes." It is usual in such processes to have an apparatus divided into two compartments, which may be called the "amalgamating" and the "deamalgamating" compartments, and to provide means for continuously circulating the liquid amalgam which occupies the bottom of both of these compartments from one to the other and back again. In the amalgamating-compartment alkaline amalgam is continuously formed—usually by electrolytic means. In the deamalgamating-compartment the alkaline element is continuously given off in the form of hydrated oxid to water resting upon the amalgam. This disengagement is sometimes effected electrolytically; but it is sometimes otherwise effected, as the alkaline element in the amalgam continuously tends to associate itself with the water in the form of hydrated oxid. It was discovered by one of us and forms the subject-matter of an application for Letters Patent of the United States, filed August 20, 1902, Serial No. 120,325, that in apparatus of this description the tendency of the alkaline element to disassociate itself from the amalgam occurs most markedly in those places where both the amalgam and the water are in joint contact with a conducting-surface or, as we have usually termed it, a "discharging-surface," and this application discloses various means for abnormally increasing the amount of discharging-surface to which the amalgam is brought into contact prior to its return to the amalgamating-compartment. Our present invention is based upon the discovery that the most available and most useful part of the apparatus to employ for the purpose of providing this discharging-surface is found in the wheel or transferring device by which the circulation of the mercury is effected; and to this end it consists in constructing the wheel (or at least that part of it which comes into contact with the amalgam) of iron or nickel or carbon or other suitable electrically-conductive material and also in so constructing the wheel (as by the provision of pockets) as to increase the extent of the contact of the amalgam with these conducting or discharging surfaces during its transference by the wheel. In the same connection certain other details relating to the construction of the transferring-wheel have been invented by us and are included in this application and will be described later on.

In the accompanying drawings, Figure 1 is a plan view of a typical form of apparatus which may be used for the practice of mercurial alkaline processes. Fig. 2 is a vertical cross-section along the line 2 2, Fig. 1. Figs. 3 and 4 are respectively a partial longitudinal section and a cross-section of a wheel constructed in accordance with our invention for use as transferring and discharging device in such an apparatus. Figs. 5 and 6 are respectively a partial elevation and an end view of another form of wheel which may be similarly used as a transferring and discharging device. Figs. 7 and 8 are respectively a partial elevation and a longitudinal section of another form of wheel which may be so used. Fig. 9 is a cross-section of still another form of wheel.

Referring to Figs. 1 and 2, which represent, as we have stated, merely a typical form of apparatus, A is a box or receptacle of rectangular shape. It is divided into compartments by partitions a a' a^2. Of these parti-

tions *a* and *a'* do not reach the bottom of the box, which is provided with transverse grooves or depressions *b b'* opposite to the lower edges of the partitions, thus permitting free passage of a liquid from the bottom of one compartment to another. Compartment B to the left of partition *a* we term the "deamalgamating-compartment." Compartment C between partitions *a* and *a'* we term the "amalgamating-compartment." Compartment D to the right of partition of *a'* may be termed the "preliminary" compartment. Alongside of these compartments runs the return-way E, formed by the partition a^2. The deamalgamating-compartment is in communication at the bottom with the return-way by the passage *e*. The preliminary compartment is likewise in communication at its bottom with the return-way by the passage *e'*. All of these compartments are filled at the bottom with mercury or amalgam to about the level indicated by the line *x x*, and by reason of the communications which have been referred to this body of mercury is continuous. Its circulation is caused by the wheel F, mounted transversely between the walls of the deamalgamating-compartment, the outside wall being provided with the suitable stuffing-box where the axle of the wheel passes through it. Upon the projecting axle is mounted a pulley *f*, by which the wheel may be driven. The amalgamating-compartment C is covered by a tightly-fitting lid, from the under side of which depends a series of anodes *c*, connected with a suitable electric circuit.

In operation the amalgamating-compartment C is filled with a solution of an alkaline salt—say sodium chlorid—the deamalgamating-compartment B and also the return-way E, containing water, resting upon the mercury or amalgam. A suitable electrical connection is made—as, for instance, at *k*—whereby the body of mercury is constituted a cathode in the electrical circuit which contains the anodes *c*. In compartment B the revolution of the wheel F causes constant circulation of the amalgam, drawing it from the amalgamating-compartment C, under the partition *a*, into the deamalgamating-compartment B, thence into the return-way E, thence to the compartment D, and thence back into the amalgamating-compartment. Under the electrolytic action of the current the sodium chlorid in the amalgamating-compartment is continuously decomposed, the sodium uniting with the amalgam to form an alkaline amalgam. As it is formed this amalgam is drawn into the deamalgamating-compartment where the water resting upon the amalgam continuously takes up the alkaline element from the amalgam in the form of hydrated oxid. Hitherto the wheel F, by which the circulation of the mercury is effected, has been formed of an electrically non-conducting surface. Our present invention consists in making this wheel of an electrically-conductive substance, preferably iron or carbon. We find that by so doing the discharge of the alkaline element from the amalgam into the water which rests upon it is very much facilitated. Thus the wheel instead of being merely a transferring device becomes both a transferring and discharging device.

We will now describe in detail the construction of various forms of transferring and discharging wheels which have been devised by us and which we find to be especially adapted to perform this double function.

In Figs. 3 and 4 it will be noted that the wheel has the same general construction as that shown in Figs. 1 and 2, being provided with a series of longitudinal inclined peripheral slots or pockets *m*. These slots or pockets are more or less filled with granules or lumps or pieces of electrically-conductive material, such as lumps of iron or carbon or other conducting material. To retain this material in the pockets, the periphery of the wheel is surrounded with a netting of wire-gauze M. As the wheel rotates with its lower part immersed in the amalgam and its upper part in the water the pockets continually fill themselves with amalgam. The further rotation of the wheel lifts this body of mercury, which is distributed among the carbon or metallic material placed in the pocket, and as the position of the pocket with reference to the axis of the wheel changes there are provided an immense number of conducting-surfaces in joint contact with amalgam and water, thereby effecting a continuous rapid discharge of the alkaline element from the amalgam into the water. The further rotation of the wheel throws the mercury, thus more or less completely freed of its alkaline elements, forward from the wheel over the dam *i*, which crosses the deamalgamating-compartment immediately in front of it.

In Figs. 5 and 6 we have illustrated a wheel of different construction. It is made of metal, preferably of iron, and differs from that shown in Figs. 1 and 2 in that the discharge of the amalgam from the pockets *m* is not effected over the edge of the pocket on the far side of the wheel, but is effected through the axle of the wheel which discharges directly into the return-way E. For this purpose the longer flat side of each of the pockets *m* is provided with a groove *n*, preferably near its outer edge, and this groove slopes in the direction of the end of the wheel which is in proximity to the return-way. From the lowest end of this groove a channel *n'* leads directly into the hollow axle of the wheel, which, passing through partition a^2, opens and discharges into the return-way. The hollow axle of the wheel may either form a common discharge-way or it may be subdivided, as shown in Fig. 6, by webs *l l* into as many separate discharge-ways as the wheel contains pockets,

and in this case each one of the channels n' will communicate with its separate discharge-way, for which purpose said channels will be placed somewhat out of alinement, as shown in Fig. 5. In this form of wheel the amalgam as it is lifted by the rising pocket is caused to run rapidly to the discharge end thereof along the grooves n, and in so doing the requisite discharging-surface is provided. If desired, this form of wheel may be associated with the introduction of loose conducting material into the pockets, as in the wheel figured in Figs. 3 and 4, and held therein by wire-gauze, as there shown.

In Figs. 7 and 8 we have shown a transferring and discharging wheel which differs from the preceding in working upon the undershot principle—that is to say, the lower and not the upper side of the wheel rotates forwardly. As before, the wheel is preferably constructed of iron and is provided with longitudinal webs r. As the wheel fits somewhat closely against the bottom of the deamalgamating-compartment, these webs continuously push or scrape the mercury along the bottom over the dam i, whence the mercury flows back into the return-way. To increase the discharging-surface of a wheel of this description, the compartments between the webs r are subdivided by a number of segmental plates s, fitting into the compartments and forming circumferential flanges. These plates are held in place properly spaced by being strung upon a bar S, running from one end of the wheel to the other in each compartment and carrying spacing-washers between the plates. All of these parts being, as before, of an electrically-conducting substance, the amalgam in the course of its transference from one side of the wheel to the other is brought into continuously-shifting contact with the water and the discharging-surfaces.

In Fig. 9 we have illustrated a form of wheel working upon the overshot principle in which the pockets m are subdivided into numerous smaller compartments by wire plates or perforated metal plates forming circumferential flanges. In the figure, $t\ t\ t\ t$ represent wire plates, and t' a perforated metal plate, while at t^2 a solid metal plate is shown. These are strung upon longitudinal bars S, as in the wheel previously described, being thereby held in place within the pockets and being spaced thereon by spacing-washers.

It will be understood that the various forms of transferring and discharging wheels which we have thus described are merely typical and that the principle of making the transferring-wheel of an electrically-conductive material and providing it with abnormally-increased discharging-surfaces admits of indefinite variation in detail.

We have spoken of the wheel as itself formed of metal, such as cast-iron. The actual material of the body of the wheel is, however, comparatively immaterial provided the surfaces thereof which come into joint contact with the water and amalgam are made of electrically-conductive material. Thus a properly-shaped wooden wheel may have its surfaces covered with iron or other conducting material and will then be equally effective for the purposes described.

In the form of apparatus described in Figs. 1 and 2 we have shown no other discharging device than the wheel. Of course other discharging devices may be associated with the wheel—as, for instance, discharging-shoes figured in an application filed August 20, 1902, Serial No. 120,325, heretofore referred to by us—and such additional discharging devices may be situated in the deamalgamating-compartment on either side of the wheel or in the return-way. It will be further understood that if the wheel is formed of a conducting substance which is at the same time magnetic—as, for instance, iron—the discharging capacity may be increased by magnetizing it; but this forms no part of our present application.

Having thus described our invention, we claim—

1. In an apparatus for the practice of mercurial alkaline processes, a transferring-wheel for effecting circulation of the mercury, formed of electrically-conductive material, and provided with pockets for carrying the mercury and also for increasing the extent of the discharging-surface in contact with the amalgam.

2. In an apparatus for the practice of mercurial alkaline processes; a wheel of electrically-conductive material mounted in the deamalgamating-compartment, and dipping both below the water and the amalgam therein; and pockets formed in the periphery of the wheel.

3. In an apparatus for the practice of mercurial alkaline processes; an iron wheel mounted transversely in the deamalgamating-compartment, and dipping below both the water and the amalgam therein; and fitted with longitudinal peripheral pockets, substantially as described.

4. In an apparatus for the practice of mercurial alkaline processes; a transferring-wheel, the pockets whereof contain pieces of electrically-conductive material; in combination with means for retaining such pieces within the pockets during the rotation of the wheel, without interfering with the entrance and discharge of the amalgam therefrom, substantially as described.

5. In an apparatus for the practice of mercurial alkaline processes; a wheel for circulating the amalgam; fitted with pockets containing a quantity of loose pieces of electrically-conductive material; and with wire-gauze around the periphery of the wheel whereby

such pieces are retained in the pocket during the rotation of the wheel, substantially as described.

6. In an apparatus for the practice of mercurial alkaline processes, a transferring-wheel fitted with longitudinal peripheral pockets; and provided with electrically-conductive plates forming circumferential flanges, subdividing said pockets into smaller compartments, and facilitating the discharge of the alkaline element from the amalgam, substantially as described.

7. In an apparatus for the practice of mercurial alkaline processes, a transferring-wheel fitted with longitudinal peripheral pockets and provided with electrically-conductive perforated plates forming circumferential flanges, partially subdividing said pockets into smaller compartments, and facilitating the discharge of the alkaline element from the amalgam, substantially as described.

In witness whereof we have signed our names to this specification, this 9th day of July, A. D. 1903, in the presence of two subscribing witnesses.

CHARLES W. ROEPPER.
WILLIS E. HARMON.

Witnesses:
JAMES H. BELL,
M. K. TRUMBORE.