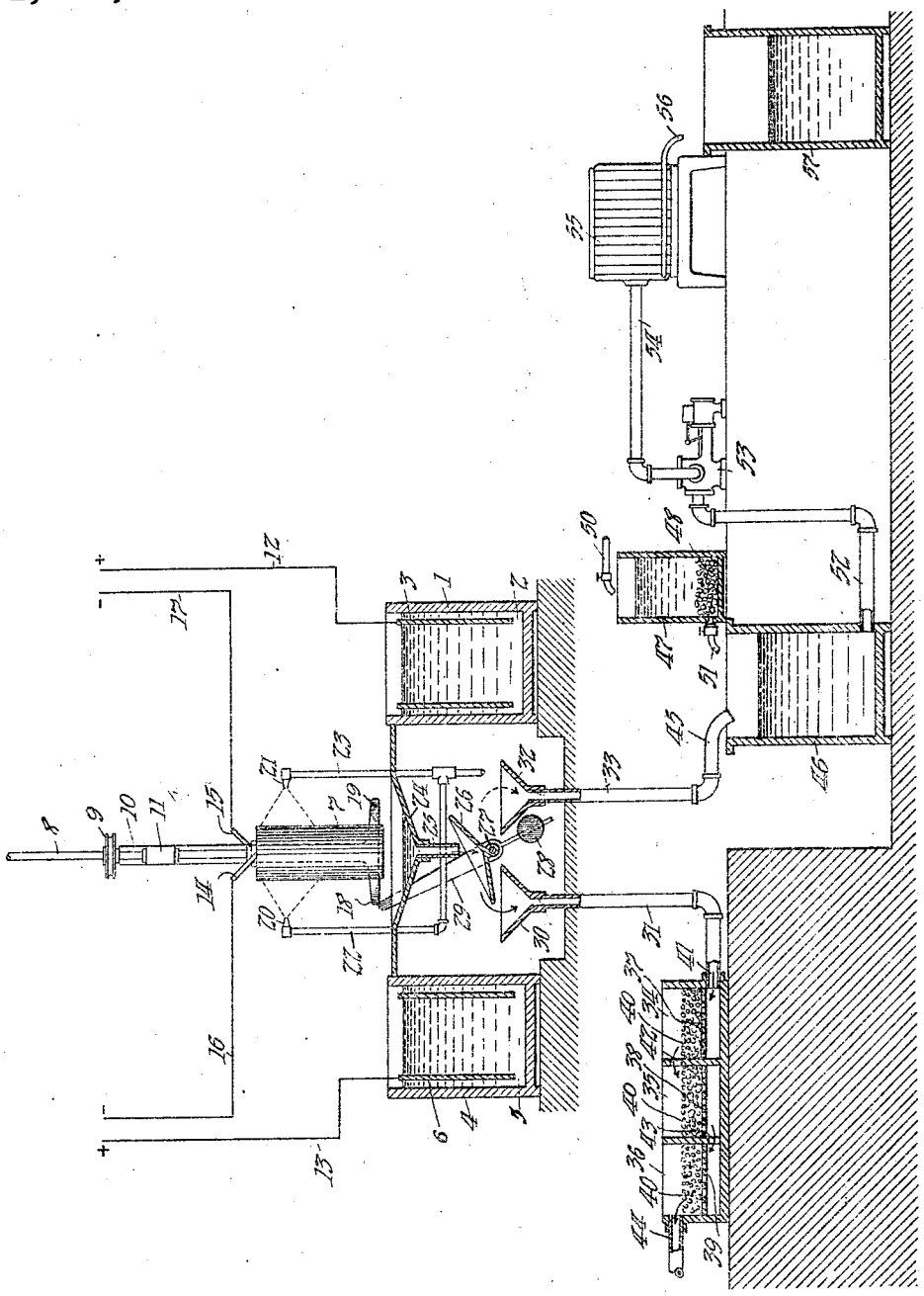
T. A. EDISON.

ELECTROPLATING APPARATUS.

APPLICATION FILED JULY 28, 1911.

1,016,875. Patented Feb. 6, 1912.



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UNITED STATES PATENT OFFICE.

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ELECTROPLATING APPARATUS.

1,016,875. Specification of Letters Patent. Patented Feb. 6, 1912.

Application filed July 28, 1911. Serial No. 641,104.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, and a resident of Llewellyn Park, West Orange, Essex county, New Jersey, have invented certain new and useful Improvements in Electroplating Apparatus, of which the following is a specification.

In Letters Patent Nos. 865,687 and 865,688, granted September 10, 1907, and No. 936,525, granted Oct. 12, 1909, I describe processes of making metallic films or flakes intended particularly for use in storage batteries of the alkaline type, and consisting generally in electro-plating alternately upon a suitable cathode exceedingly fine films or layers of a readily soluble metal, such as copper, and films or layers of the desired metal, such as nickel or cobalt or cobalt-nickel alloy. The composite sheet thus formed is removed from the cathode and cut into small portions. The small portions are then treated with suitable reagents, in which copper is soluble, but which do not affect the nickel or cobalt.

In apparatus which I have devised for carrying out the processes described in the aforesaid patents, the cathode is dipped alternately into the copper plating and nickel plating baths. After each removal from a bath, the cathode is washed, preferably by spraying water upon it, in order to remove the film of the plating solution which clings to it. Hitherto, the wash water containing soluble copper and nickel salts has been wasted.

My present invention has for its object the provision of simple and efficient means for recovering the valuable constituents of the wash water derived from this and other similar processes.

In order that my invention may be more readily understood, reference is had to the drawing which accompanies and forms a part of this specification, and in which is illustrated, partly diagrammatically, apparatus constituting one embodiment of my invention.

Referring to the drawing, a tank 1 is provided which contains a copper plating solution 2, one constituent of which is a soluble salt of copper, preferably copper sulfate. An anode 3 of copper is contained in the copper plating solution 2. The anode 3 is preferably in the form of a hollow cylinder. A second tank 4 is provided which contains a nickel plating solution 5, one constituent of which is a soluble salt of nickel, preferably nickel sulfate. An anode 6 of nickel is contained in the nickel plating solution 5. The anode 6 is preferably in the form of a hollow cylinder. The cathode 7 is preferably in the form of a drum composed of copper or nickel. The cathode 7 is mounted upon and supported by a shaft 8, which is provided with a pulley 9 for rotating the shaft and the cathode supported thereby. The purpose of rotating the cathode is fully set forth in the patents hereinbefore mentioned. The shaft 8 and the cathode 7 are supported upon the frame 10 which is provided with the bearing 11 for receiving the shaft 8. The frame 10 is provided with mechanism (not illustrated) whereby the cathode 7 may be moved into position over, let down into, and removed from the electroplating baths contained in either of the tanks 1 and 4. The anodes 3 and 6 are connected to the positive side of any suitable source of current by means of conductors 12 and 13 respectively. The other side of the said source of current is connected to brushes 14 and 15 by conductors 16 and 17 respectively. The brushes 14 and 15 are arranged to contact with the cathode 7 in whatever position it may occupy. The frame 10 is provided with projections 18 and 19, the function of which will be set forth hereinafter.

For the purpose of washing the cathode 7 after it has been removed from either of the baths 2 and 5, nozzles 20 and 21 are provided which are supplied with water from any suitable source by means of pipes 22 and 23 respectively. A spray of water is directed upon the revolving cathode 7 by means of the nozzles 20 and 21. The wash water from the cathode 7 drips into a suitable receptacle 24, which is located between the two tanks 1 and 4 and is provided with a downwardly extending outlet 25. Beneath the outlet 25 a trough 26 or other suitable receptacle is provided, which is pivotally mounted upon the shaft 27, and is normally moved into horizontal position by means of a weight 28 rigidly connected to the said trough. The said trough 26 is also provided with an upwardly extending and projecting arm 29 which is adapted to be engaged by one or the other of the projections 18 and 19 of the frame 10 when the cathode 7 is removed from either of the

electro-plating baths into position between the nozzles to be washed. In the position of the apparatus shown in the drawing, the cathode 7 has been removed from the copper plating bath 2 into position between the nozzles, and in this movement the projection 18 has engaged the arm 29 and tilted the trough 26 so as to cause the wash water containing copper sulfate or other soluble copper salt to be emptied into a receptacle 30. It is evident from an inspection of the drawing that as the cathode 7 is moved into position over the nickel plating bath 5, the trough 26 will regain its horizontal position. After the cathode 7 has been dipped in and removed from the nickel plating bath 5 and moved back into position between the nozzles 20 and 21 to be washed, the arm 29 will be engaged by the projection 19, and the trough 26 tilted in the other direction, that is to say, in such a direction as to discharge the wash water containing nickel sulfate or other soluble nickel salt into a receptacle 32.

The receptacle 30 which receives the wash water containing the copper salt is provided with an outlet 31 leading into a series of troughs 34, 35 and 36. Each of these troughs is provided with perforated horizontal partitions 37, 38 and 39 which are located above and near the bottoms of the troughs. Each of the troughs contains metallic iron, preferably in the form of iron turnings 40, supported upon the perforated partitions 37, 38 and 39. The wash water containing the copper salt is led into the first trough through an opening 41 in its lower part and below the partition 37. This wash water passes up through the openings in the partition 37, through the iron turnings, through an opening 42 connecting the two troughs 34 and 35 and located above the iron turnings, through the iron turnings in the trough 35, through an opening 43 connecting the troughs 35 and 36 and located below the iron turnings, through the openings in the perforated partition 39 of the trough 36, through the iron turnings 40 contained in the trough 36, and then out through the outlet 44 which is provided for the trough 36 and located above the iron turnings. A chemical reaction takes place in this series of troughs between the metallic iron and the copper sulfate or other soluble copper salt solution, the result of which is that the copper is removed from the solution and appears in the form of metallic copper, while some of the iron goes into solution and the escaping liquid is a salt of iron and free from copper. In this way, the copper is recovered in a spongy, powdery form which is convenient for a variety of uses. The wash water containing the nickel sulfate or other salt of nickel flows from the receptacle 32 through a pipe 33, and by way of the spout 45 into a tank or other receptacle 46. The tank 46 is supplied continuously with a predetermined stream of a solution of sodium hydroxid or sodium carbonate from a tank 47 which is provided with an outlet 51. The tank 47 may be partly filled with solid sodium hydroxid or sodium carbonate, as is shown at 48, and water supplied from any suitable source 50. A chemical reaction takes place in the tank 46 between the nickel sulfate or other nickel salt solution and the sodium hydroxid or carbonate, which results in the precipitation of nickel hydroxid or nickel carbonate. The precipitated nickel hydroxid or nickel carbonate is removed from the tank 46 through a pipe 52 by means of a pump 53 and conveyed through a pipe 54 to the filter press 55. The insoluble nickel hydroxid or nickel carbonate is retained in the filter press 55, and the liquid reaction products escape through an opening 56 into a tank or other suitable receptacle 57. The insoluble nickel hydroxid or nickel carbonate retained in the filter press may be pressed into cakes and made into fresh sulfate of nickel by adding sulfuric acid, and used to renew the electrolyte of the nickel plating solution which has become diminished in quantity as the nickel plating process is carried out.

It will be observed that the apparatus disclosed provides continuously acting means for recovering both the copper and nickel in useful forms.

I have illustrated and described my invention as employed with a single cathode and a single pair of plating tanks, but it is obvious that it is also adapted to be used with apparatus in which these elements are duplicated indefinitely.

Having now described my invention, what I claim and desire to protect by Letters Patent of the United States is as follows:—

1. In electro-plating apparatus, a cathode for successively receiving electrolytic deposits of different metals, means for washing said cathode comprising a receptacle for receiving the wash water, a plurality of apparatus for separately recovering the valuable constituents of the wash water, and means for causing the wash water from said receptacle to run into any desired one of said apparatus, substantially as described.

2. In electro-plating apparatus, a movable cathode for successively receiving electrolytic deposits of different metals, means for washing said cathode comprising a stationary receptacle for receiving the wash water, a plurality of stationary apparatus for separately recovering the valuable constituents of the wash water, and means for causing the wash water from said receptacle to run into any desired one of said stationary apparatus, substantially as described.

3. The combination with an electro-plating bath containing a soluble salt of one metal, an electro-plating bath containing a soluble salt of another metal, a cathode to be plated with both metals, of means for washing the cathode after removal from each bath, and means for separating the wash water containing a salt of one metal from the wash water containing a salt of the other metal, substantially as described.

4. The combination with an electro-plating bath containing a nickel salt, an electro-plating bath containing a copper salt, and a cathode to be plated with both metals, of means for washing the cathode after removal from each bath, and means for separating the wash water containing a copper salt from the wash water containing a nickel salt, substantially as described.

5. The combination with an electro-plating bath containing nickel sulfate, an electro-plating bath containing copper sulfate, and a cathode to be plated with both metals, of means for washing the cathode after removal from each bath, and means for separating the wash water containing copper sulfate from the wash water containing nickel sulfate, substantially as described.

6. The combination with an electro-plating bath containing a soluble salt of one metal, an electro-plating bath containing a soluble salt of another metal, a cathode to be plated with both metals, of means for washing the cathode after removal from each bath, means for separating the wash water containing a salt of one metal from the wash water containing a salt of the other metal, and means for recovering the metals in useful form from each wash water solution, substantially as described.

7. In electro-plating apparatus, the combination with two plating baths consisting of electrolytes which differ from each other in composition, and a cathode arranged to be dipped into each bath alternately, of means for washing the cathode after removal from each bath, and means for diverting the wash water after removal from one bath into one channel and the wash water after removal from the other bath into another channel, substantially as described.

8. The combination with an electro-plating bath containing a soluble nickel salt, an electro-plating bath containing a soluble copper salt, a cathode to be plated with alternate layers of copper and nickel, of means for washing the cathode after each layer of metal is deposited, a receptacle containing metallic iron, and means for diverting and conveying the wash water containing a copper salt to the said receptacle, substantially as described.

9. The combination with an electro-plating bath containing a soluble nickel salt, an electro-plating bath containing a soluble copper salt, a cathode to be plated with alternate layers of copper and nickel, of means for washing the cathode after each layer of metal is deposited, means for converting a soluble nickel salt into insoluble form, and means for diverting and conveying the wash water containing the soluble nickel salt to the said converting means, substantially as described.

10. The combination with an electro-plating bath containing a soluble nickel salt, an electro-plating bath containing a soluble copper salt, a cathode to be plated with alternate layers of copper and nickel, of means for washing the cathode after each layer of metal is deposited, a receptacle containing metallic iron, means for converting a soluble nickel salt into insoluble form, and means for diverting and conveying the wash water containing the copper salt to the said receptacle and the wash water containing the soluble nickel salt to the said converting means, substantially as described.

This specification signed and witnessed this 24th day of July 1911.

THOS. A. EDISON.

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