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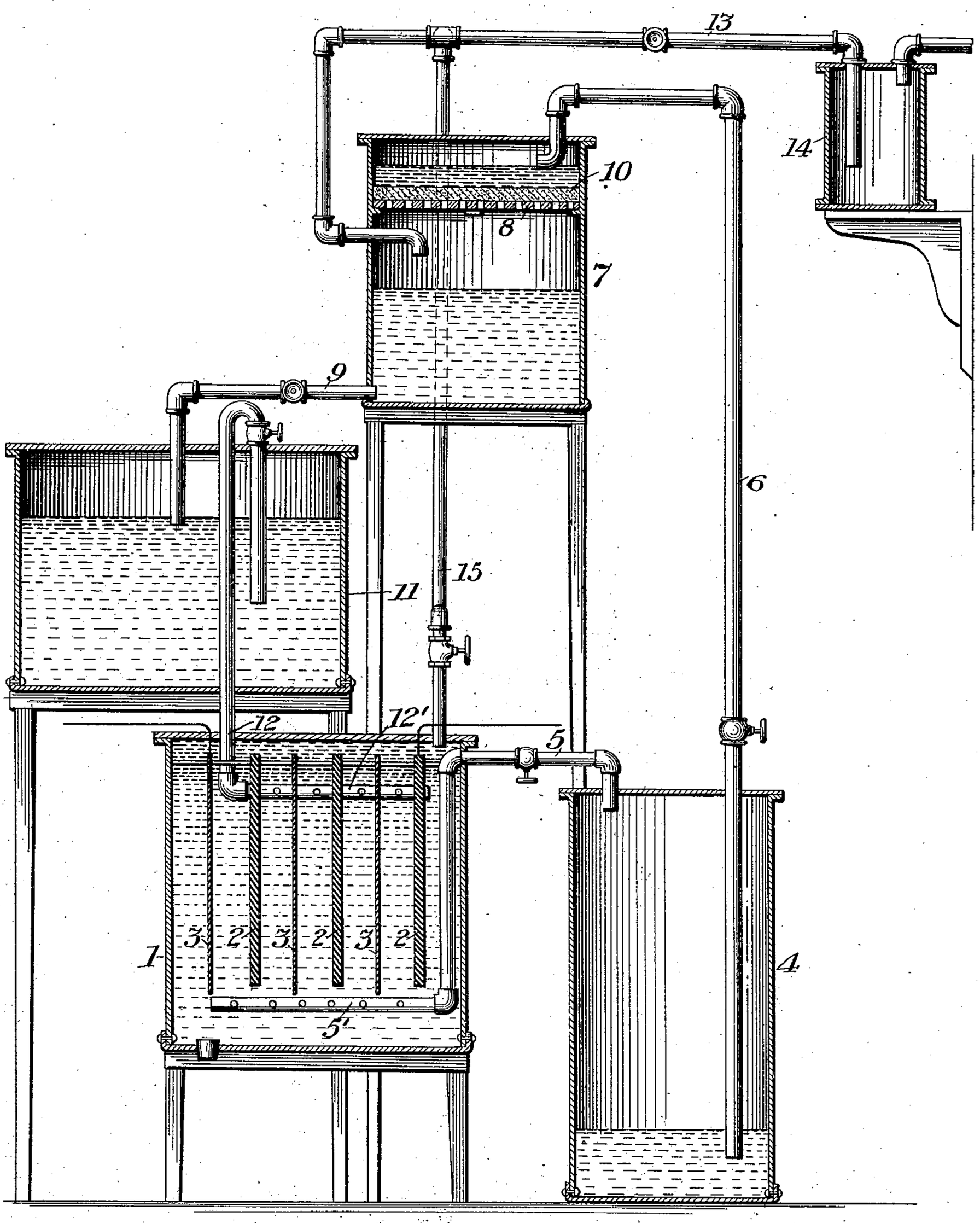
W. McA. JOHNSON.

ELECTROLYTIC APPARATUS.

APPLICATION FILED JAN. 13, 1903.

NO MODEL



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No. 742,443. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

WOOLSEY McA. JOHNSON, OF HARTFORD, CONNECTICUT.

ELECTROLYTIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 742,443, dated October 27, 1903.

Application filed January 13, 1903. Serial No. 138,858. (No model.)

To all whom it may concern:

Be it known that I, WOOLSEY McA. JOHNSON, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Electrolytic Apparatus, of which the following is a specification.

This invention relates to the electrodeposition of metals under such conditions as will yield a deposit of improved character, and comprises an apparatus particularly adapted to the electrodeposition of metals and to the treatment of the electrolyte.

In the deposition by means of electric current of such metals as are electropositive to hydrogen, of which metals nickel may be taken as an example, a certain quantity of hydrogen, depending upon the current density used, is liberated at the cathode at the same time that the metal is deposited thereon. This hydrogen is in part occluded by the deposit, in part adheres thereto, and is in part dissolved by the electrolyte or otherwise held therein. I have discovered that this gas in some or all of the conditions above stated exerts an injurious effect upon the tenacity, density, and other characteristics of the electrodeposited metal. Furthermore, in the electrodeposition of metals, such as copper, which are electronegative to hydrogen an evolution of gas may also occur at the cathode, especially when a certain limit of current density is exceeded. Such metals also are injuriously affected by the gas. Furthermore, all liquids which are capable of serving as electrolytes contain under normal conditions considerable quantities of dissolved or otherwise retained gases, which may appear in part in the form of bubbles when the electrolyte is subjected to a slight rise of temperature. These gases also I have found to affect the deposited metal in an injurious manner.

My apparatus is particularly adapted for depositing metals under such conditions and with such materials as will avoid the deleterious action of such gases.

I have found that if the electrolyte is substantially freed from gases before the metal is deposited therefrom, and especially if it be maintained substantially free from gases during the plating operation, the quality of the separated metal is greatly improved, as evidenced by its increased density, hardness, and toughness, by its smooth surface, its freedom from microscopic cavities, and by other physical and chemical characteristics. As a suitable and convenient means for maintaining the electrolyte in this gas-free condition I make use of a vacuum or of such diminished pressure of air as will to a sufficient extent accomplish the desired result. Under diminished atmospheric pressure the gases held or liberated within the electrolyte quickly escape therefrom, and the solution is therefore maintained in a substantially gas-free condition. I prefer also to maintain the electrolyte in circulation between the electrodes, and I may cause it to circulate through a suitable filter capable of removing and retaining any solid particles. I find that the diminished air-pressure above referred to constitutes a convenient means for accomplishing this circulation, and to this end I may exhaust the air from an elevated receiving-tank, which preferably contains a filter and which is suitably connected with the electrolytic cell. Portions of the electrolyte are thereby transferred from the electrolytic tank to the filtering vessel and may then be permitted to flow again to the electrolytic tank. By providing a plurality of filtering-tanks and using them alternately the flow of the electrolyte may be made continuous.

For a clear understanding of the invention reference is made to the accompanying drawing, which shows one form of my apparatus in vertical section, and wherein—

1 indicates an electrolytic tank, and 2 3 anodes and cathodes mounted therein and suitably connected to a source of electric current.

4 is a closed overflow-tank connected by a valved pipe 5 with the electrolytic tank and by a valved pipe 6 with the filtering-tank 7. Said tank 7 contains a distributing-plate 8 for the electrolyte, upon which is preferably placed a suitable filter 10. Said tank 7 communicates through a valved pipe 9 with a reservoir 11, from which the electrolyte is discharged through a pipe 12 to the electrolytic cell 1. Said pipe 12 is preferably arranged, as shown, to draw the electrolyte from beneath the surface, and said tank 11 is pref-

erably closed in order that the air above the surface of the electrolyte may be maintained at diminished pressure. Preferably pipes 5 and 12 are provided within the electrolytic tank, with perforated sections 5′ and 12′ extending transversely of the electrodes and serving to provide a distributed flow of the electrolyte along their surfaces.

The filtering-tank 7 is hermetically closed and communicates through a valved pipe 13 with a vacuum-pump or other device for removing gases. (Not shown.) A trap 14 for collecting any liquid drawn over through pipe 13 may be interposed, as shown, in the vacuum-line. Said pipe 13 enters the tank 7 below the filtering-layer 10, but above the normal level of the electrolyte.

In operation the electrolyte is permitted to flow from tank 7 through pipe 9 into tank 11, thence through pipes 12 and 12′, the electrolytic vat 1, and pipes 5′ and 5 to the tank 4. By the operation of the pump the liquid in tank 4 is raised through pipe 6, discharging above the filter in tank 7. The liquid then flows through the filter and the several tanks, as before specified. In this construction the flow of the electrolyte is necessarily intermittent; but it will be readily understood that by providing a plurality of tanks 7 with suitable connections thereto and by using such tanks in alternation the flow may be rendered continuous. It will thus be seen that portions of the electrolyte are submitted to the action of diminished air-pressure, serving, as above stated, to withdraw therefrom the contained gases. The electrolyte reaches the electrolytic tank 1 in a virtually gas-free condition, and the flow through such tank should be sufficient to transfer the electrolyte to the filtering-tank 7 with sufficient rapidity to maintain the gas content low enough to avoid injury to the deposit.

The electrolytic tank 1 may be open to the atmosphere. In certain cases, however, it is desirable that such tank should be closed and should communicate with the air-pump in order that gases liberated by the electrolysis may be rapidly withdrawn and the electrolyte maintained at all times in a substantially gas-free condition.

It is obvious that the overflow-tank 4 may be open to the atmosphere without interfering in any manner with the operation of my device and that the apparatus may be otherwise modified without departing from the spirit of my invention. I prefer, however, that the several tanks be closed and placed in communication with the vacuum-pump, inasmuch as additional liquid-surface for the liberation of gases is thereby provided.

I claim—

1. An electrolytic apparatus comprising a tank, electrodes therein, and means for supplying electrolyte to such tank in a substantially gas-free condition, as set forth.

2. An electrolytic apparatus comprising a tank, electrodes therein, means for supplying electrolyte to such tank in a substantially gas-free condition, and means for rapidly withdrawing gases from the electrolyte during the depositing operation, as set forth.

3. An electrolytic apparatus comprising an electrolytic tank, electrodes therein, a closed supply-tank therefor, and means for exhausting gases from said supply-tank, as set forth.

4. An electrolyzing apparatus comprising a closed electrolytic tank, electrodes therein, a closed supply-tank therefor, and means for exhausting gases from said electrolytic tank and supply-tank, as set forth.

5. An electrolytic apparatus comprising an electrolytic tank, electrodes therein, a closed supply-tank therefor, means for exhausting gases from said supply-tank, and connections between said electrolytic tank and supply-tank, whereby a circulation of the electrolyte may be maintained, as set forth.

6. An electrolytic apparatus comprising an electrolytic tank, electrodes therein, a closed supply-tank therefor above the level of said electrolytic tank, means for exhausting gases from said supply-tank, connections between said electrolytic tank and supply-tank, whereby a circulation of the electrolyte may be maintained, and a filtering device interposed in said connections, as set forth.

7. In an electrolytic apparatus an electrolytic tank, electrodes therein, a supply-tank therefor, an exhaust-line from said supply-tank, and a distributing-plate in said supply-tank, as set forth.

8. In an electrolytic apparatus an electrolytic tank, electrodes therein, a supply-tank therefor, an exhaust-line from said supply-tank, and a filter in the said supply-tank, as set forth.

9. In an electrolytic apparatus an electrolytic tank, electrodes therein, an elevated supply-tank, a filter in said supply-tank, connections between said electrolytic tank and supply-tank, and means for exhausting gases from one or more of said tanks, as set forth.

10. An electrolytic apparatus comprising a tank, a soluble anode and a suitable cathode therein, and means for supplying electrolyte to such tank in a substantially gas-free condition, as set forth.

11. An electrolytic apparatus comprising a tank, a soluble anode and a suitable cathode therein, means for supplying electrolyte to such tank in a substantially gas-free condition, and means for rapidly withdrawing gases from the electrolyte during the depositing operation, as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

WOOLSEY McA. JOHNSON.

Witnesses:
S. S. THORNTON,
H. C. McCORMACK.