Nov. 25, 1930. J. HOLLINS 1,782,614

ELECTRODEPOSITION OF METALS

Filed Jan. 22, 1929 3 Sheets-Sheet 1

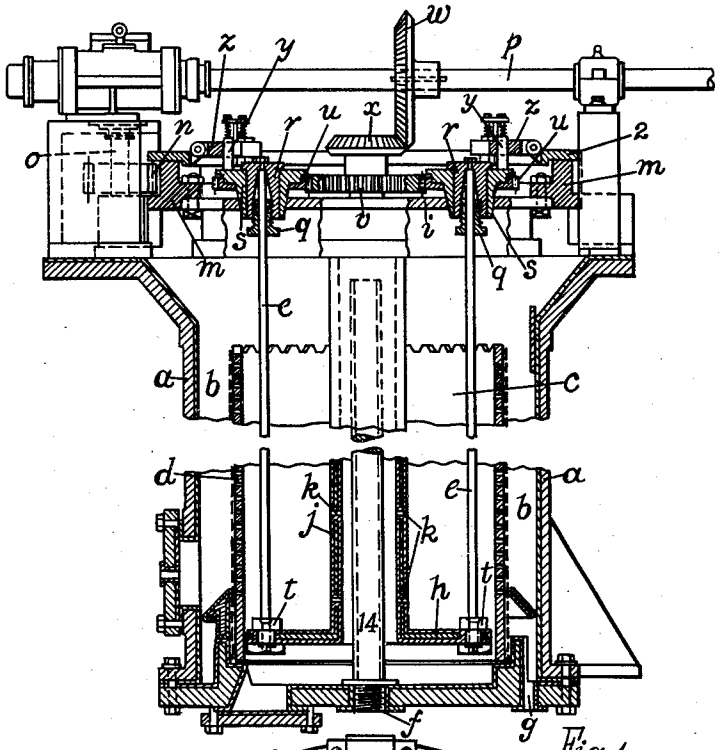


Fig. 1.

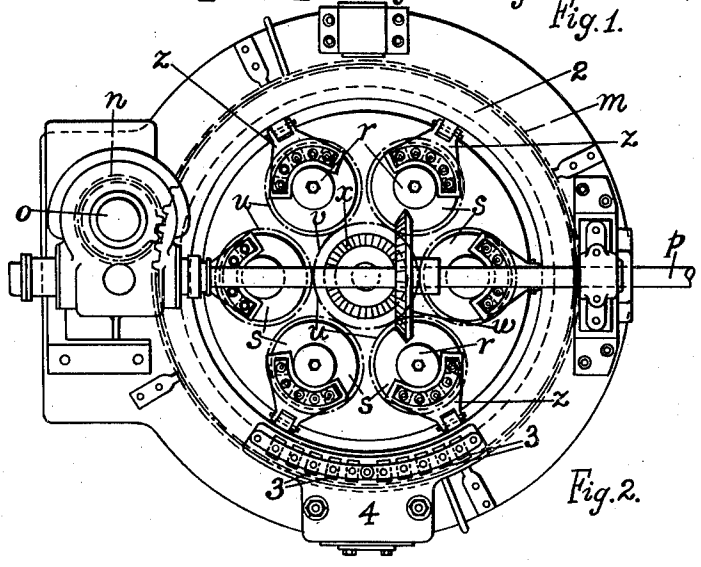


Fig. 2.

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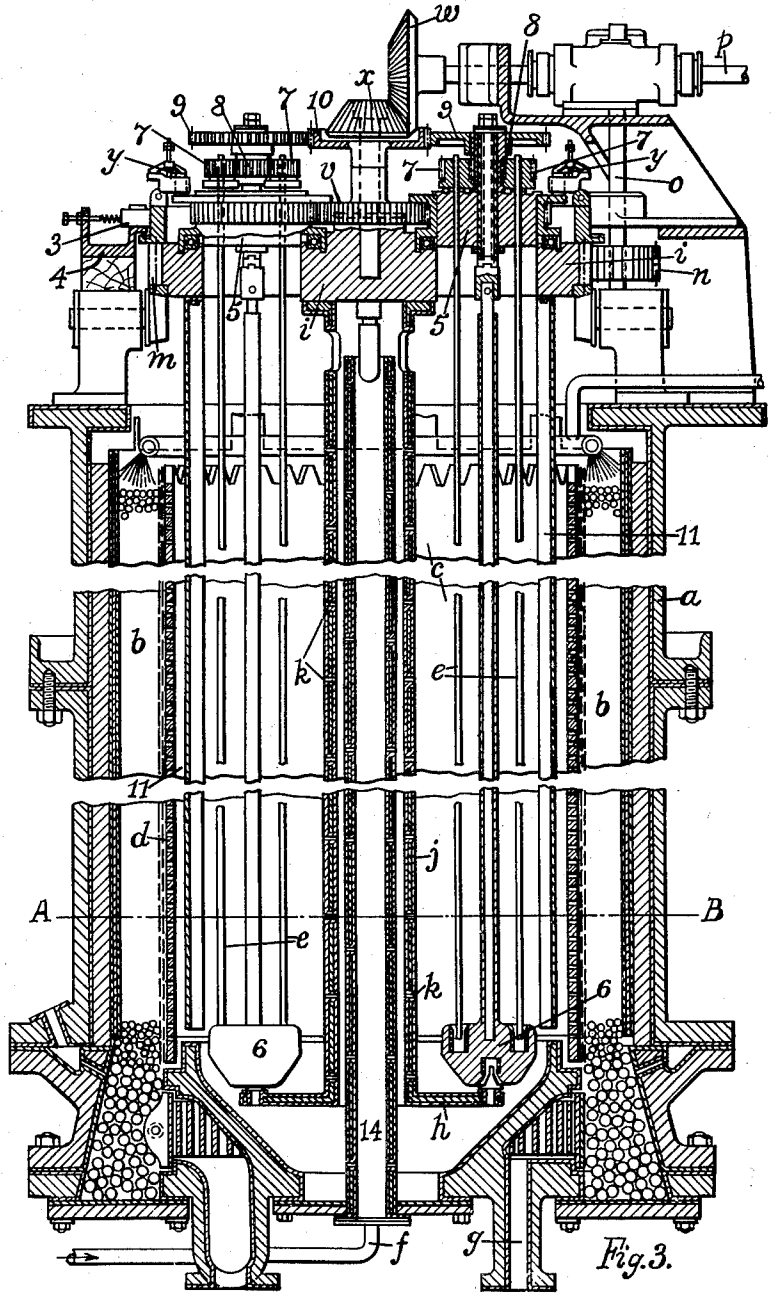


Fig.3.

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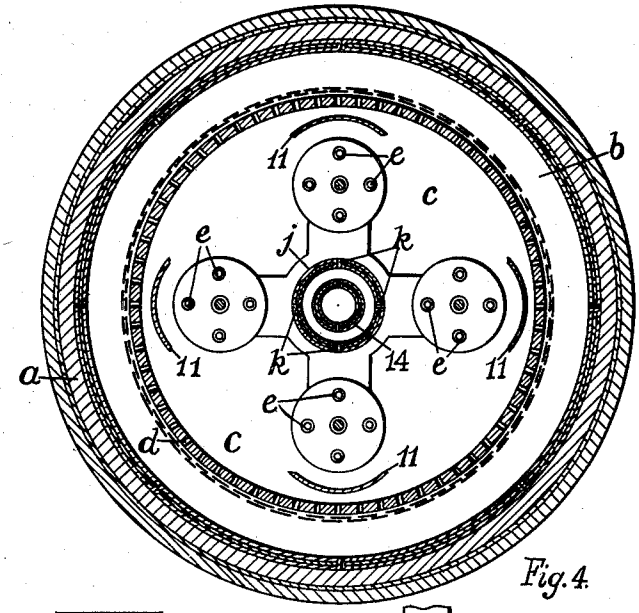


Fig. 4.

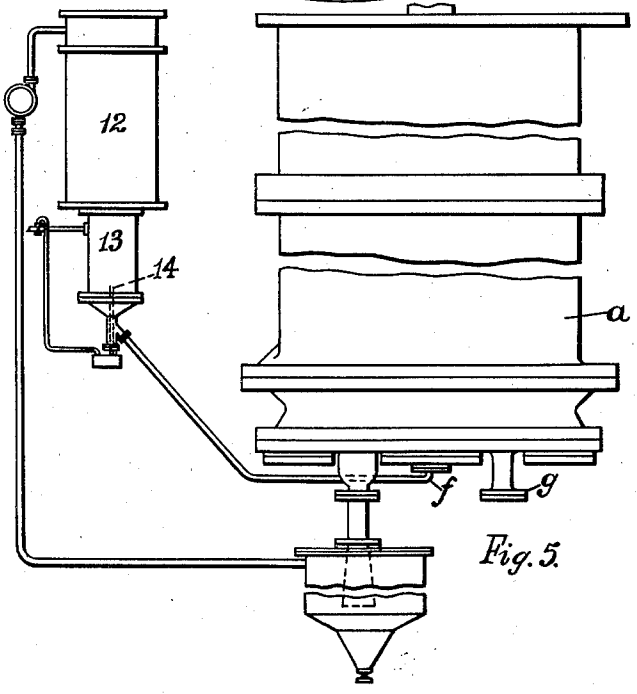


Fig. 5.

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UNITED STATES PATENT OFFICE

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ELECTRODEPOSITION OF METALS

Application filed January 22, 1929, Serial No. 334,256, and in Great Britain February 25, 1928.

This invention relates to the electro-deposition of metals such as nickel, iron and copper, and has for its object to provide and comprises improved arrangements for ensuring an increased rate of deposition of metal in an economical and satisfactory manner.

Referring to the three accompanying sheets of explanatory drawings:—

Figure 1 is a sectional elevation and Figure 2 a plan view of one form of electrolyzer in accordance with my invention.

Figure 3 is a sectional elevation illustrating a modified arrangement of electrolyzer in accordance with the invention.

Figure 4 is a sectional plan view on the line A B of Figure 3.

Figure 5 is a general view illustrating the electrolyte circulating system.

The same reference letters in the different views indicate the same or similar parts.

In Figures 1 and 2, *a* indicates the electrolyzer vat, *b* the anode compartment, *c* the cathode compartment, *d* the diaphragm between the said compartments *b* and *c*, *e* the mandrels on to which metal deposits are to be made and *f* the electrolyte inlet. The electrolyte diffuses into the cathode compartment, overflows over the notched upper edge of the diaphragm *d*, flows down the anode compartment and leaves the vat through one or more outlet branches as *g*.

In accordance with my invention, I employ a number of mandrels *e* within the electrolyzing vat, and mount the same in common heads *h*, *i* at their opposite ends. The said heads are inter-connected by the hollow stem *j* which has electrolyte diffusion apertures *k* therein. The upper head *i* has a gear ring *m* secured thereto which is engaged by a pinion *n* upon a vertical shaft *o* driven by worm and worm wheel from a cross shaft *p* which is the prime motion shaft of the electrolyzer. By the arrangement described, the mandrels are revolved about the axis of the electrolyzer. Each mandrel is gripped at its upper end by an expanding collet *q* within the conical interior of the sleeve *r* which is supported by the conical bush *s* within the head *i*. The use of the expanding collets for gripping the mandrels enables mandrels which differ in diameter to be secured in the one set of bushes *s*. The bottom end of each mandrel is passed into a ring or collar *t* in the rotating head *h*.

Each bush *s* has thereon a gear wheel *u* which meshes with a common central gear wheel *v* rotated from the cross shaft *p* by the bevel wheels *w*, *x*. It will be seen, therefore, that not only do the mandrels revolve about the axis of the electrolyzer but they also rotate on their own axes. I am thereby enabled to neutralize the effects of unequal current distribution in the electrolyzer, due, for example, to anode irregularity and variations in diaphragm porosity, and so to obtain uniformity in the thickness of the deposits upon the mandrels.

The conical shape of the bushes *s* facilitates the threading of the mandrels into the collars *t* in the lower head *h*. The arrangement described also permits of the withdrawal of the mandrels without disturbing the heads *h* and *i*.

Each bush *s* is engaged on its upper face by spring loaded brushes *y* carried in holders *z* pivoted to a common ring 2 to which current is supplied by brushes 3 carried in a fixed frame 4.

In the arrangement shown in Figure 3, supplementary heads 5, 6 are carried in the upper head *i* and the lower head *h* respectively. The heads *h*, *i* are rotated about the axis of the electrolyzer by a pinion *n* as in the previous construction, and the heads 5 are rotated about their axes by the gear wheel *v* driven from the cross shaft *p* by the bevel wheels *w* and *x*. Each supplementary head 5, 6 carries the ends of a plurality of mandrels *e*. In Figures 3 and 4, there are four mandrels between each pair of upper and lower heads. Each mandrel has a gear wheel 7 secured thereto at its upper end and the several wheels 7 on the one head 5 mesh with a common gear wheel 8 co-axial with the head. The wheels 8 are on vertical shafts carrying gear wheels 9 which mesh with a gear wheel 10 driven by the bevel wheel *x*. It will be seen that with this construction, the heads *h*, *i* turn about the electrolyzer axis, the supplementary

heads 5, 6 which are carried by the heads *h*, *i* turn about their own axes, and the mandrels upon such supplementary heads also turn about their own axes. I thereby ensure a maximum of uniformity in the deposited metal with a high rate of deposition, in a plant which is very compact and efficient.

The electrical connection to the cathodes or mandrels is made by way of brushes 3 and *y*.

I have found that I can materially increase the weight of metal deposited on the cathodes or mandrels without exceeding the current density which is found to be the best for the production of satisfactory deposits by screening the direct path between the cathodes and anode by means of a non-conducting screen. Thus, in Figures 3 and 4, screens 11 are provided which depend from the head *i*. Such screens prevent the current passing directly between the anode material and cathodes as the latter each approach most closely to the anode material. Such screen diverts the current so that it passes to each cathode from two sides or in two paths which enables me to increase the current magnitude without increasing the current density in either path. I thus obtain deposition at a higher rate without materially increasing the cost of the plant.

The electrolyte is supplied to the electrolyzer from a filter 12 and heater 13 (see Figure 5) which may be combined in one unit, the feed being to the bottom of the cathode compartment where the electrolyte is admitted to a relatively small bore perforated tube 14 extending centrally up the cathode compartment. The perforations in said tube are proportioned and spaced to ensure an even distribution of the electrolyte up the cathode compartment. Around the perforated small bore tube is disposed the relatively large bore diffuser tube *j* which rotates with the heads *h* and *i* carrying either the cathodes or mandrels as in Figure 1, or the supplementary heads as in Figure 2. The diffuser tube *j* is also perforated to give an even diffusion of the incoming electrolyte into the cathode compartment. By the means described, I obtain within the cathode compartment, an electrolyte of practically uniform temperature and composition which is advantageous in obtaining satisfactory metal deposits upon long mandrels.

What I claim is:—

1. A vat for the electro-deposition of metals comprising, in combination, an anode compartment, a cathode compartment, a filter diaphragm between the said compartments, a rotating head above the cathode compartment, mandrels constituting cathodes suspended from said head and extending into the cathode compartment, means for rotating said mandrels about their axes, a vertical perforated tube extending up through the cathode compartment, connected to the rotating head at its upper end and providing a steady for the lower ends of the mandrels, and means delivering electrolyte within said perforated tube through which it diffuses into the cathode compartment to overflow the filter diaphragm into the anode compartment.

2. A vat for the electro-deposition of metals comprising, in combination, an anode compartment, a cathode compartment, a filter diaphragm between said compartments, a main rotating head above said cathode compartment, a plurality of separate heads carried by said main head, means for rotating said separate heads about their axes, a plurality of mandrels constituting cathodes suspended from said separate heads, means for rotating each mandrel about its own axis, heads for the lower ends of each group of mandrels, a vertical perforated tube extending up through the cathode compartment and connected so that it rotates with the main head, with means upon the lower end of such tube for supporting and steadying the heads beneath the lower ends of the groups of mandrels, and means delivering electrolyte up the interior of said perforated tube.

3. A vat for the electro-deposition of metals comprising, in combination, an annular anode compartment, a cathode compartment within said anode compartment, a cylindrical filter diaphragm between the anode and cathode compartments, a main rotating head with a gear drive thereto above the vat, a plurality of separate heads carried by said main head, a common gear wheel centrally located for rotating all the separate heads about their axes, a plurality of mandrels constituting cathodes suspended in said cathode compartment from said separate heads, a common gear wheel centrally located for rotating all the mandrels about their own axes, heads for the lower ends of each group of mandrels, a vertical perforated tube coaxial within the cathode compartment and connected to the main rotating head with means upon such tube for supporting and steadying the heads beneath the lower ends of the groups of mandrels, and means delivering electrolyte up the interior of the perforated tube.

4. In a vat for the electro-deposition of metals as claimed in claim 2, a fixed perforated tube extending up the interior of the vertical perforated tube to supply electrolyte to an annular space between the two tubes.

5. In a vat for the electro-deposition of metals as claimed in claim 2, hingedly mounted electric current conductor brushes contacting with the separate heads to supply current thereto.

6. A vat for the electro-deposition of metals comprising, in combination, an anode

compartment, a cathode compartment, a filter diaphragm between said compartments, a rotating head above the cathode compartment with individually rotated mandrels constituting cathodes suspended from said head, and screens also suspended from said head obstructing the direct path between the cathodes and anode material.

7. A vat for the electro-deposition of metals comprising, in combination, an anode compartment, a cathode compartment, a filter diaphragm between said compartments, a rotating main head above the cathode compartment, separate heads individually rotated carried by said main head, mandrels constituting cathodes also individually rotated, suspended from said separate heads, and screens suspended from said main head obstructing the direct path between the groups of cathodes and the anode material.

In testimony whereof I have signed my name to this specification.

JACK HOLLINS.