Nov. 28, 1939. C. W. LOWE 2,181,490

ELECTROPLATING APPARATUS

Filed July 9, 1936 2 Sheets-Sheet 1

FIG. 1

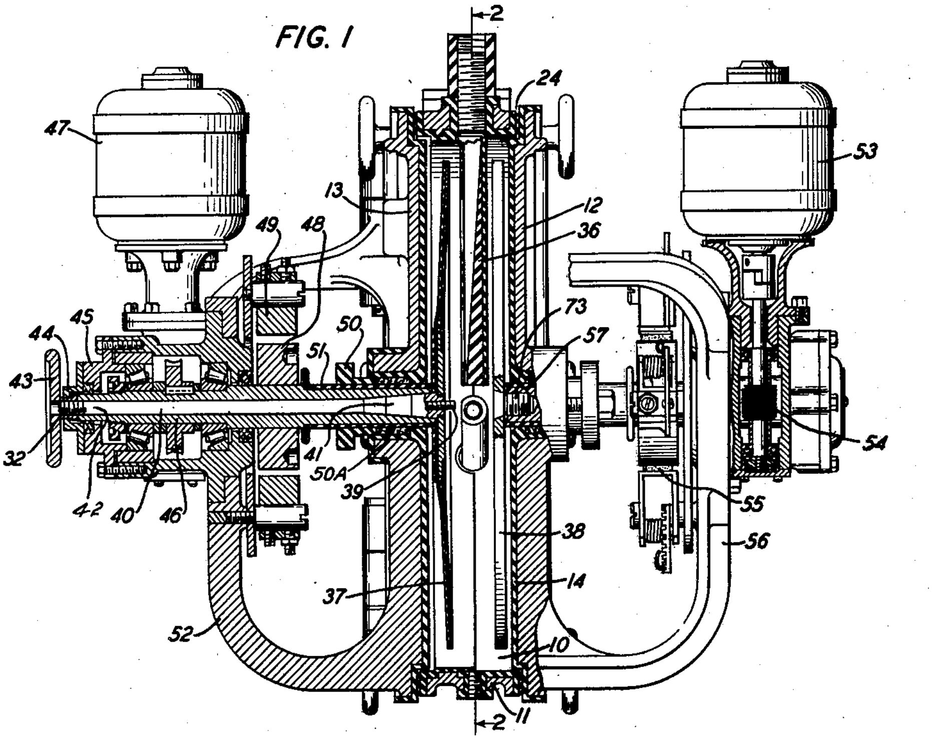
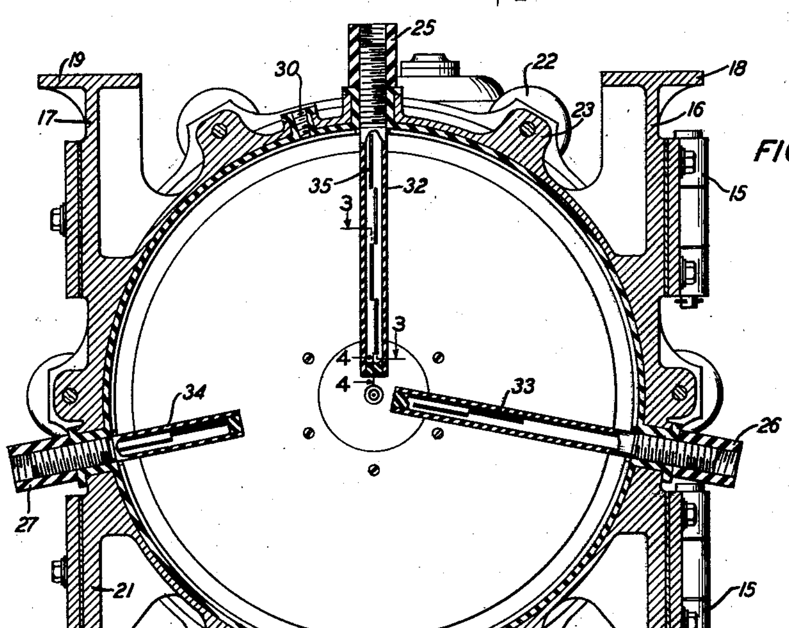


FIG. 2



INVENTOR
C.W.LOWE
BY
[signature]
ATTORNEY

Nov. 28, 1939. C. W. LOWE 2,181,490

ELECTROPLATING APPARATUS

Filed July 9, 1936 2 Sheets-Sheet 2

FIG. 3

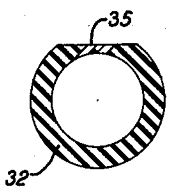


FIG. 4

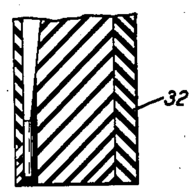


FIG. 5

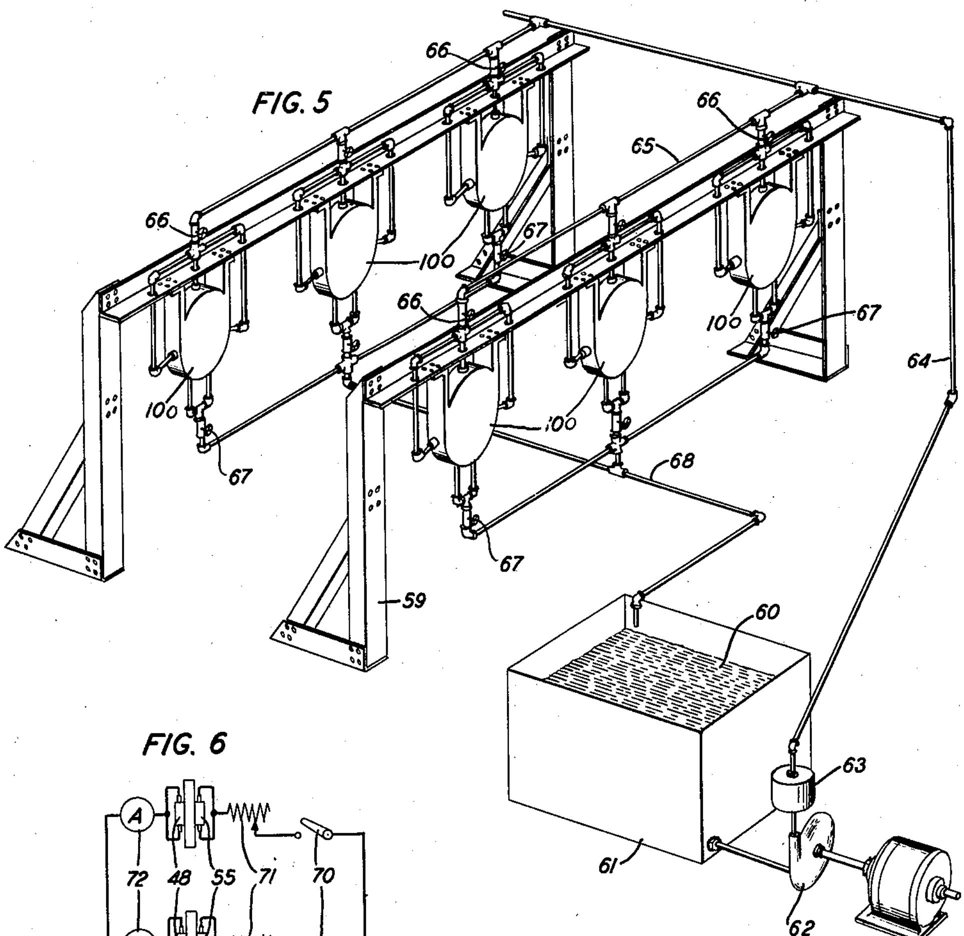
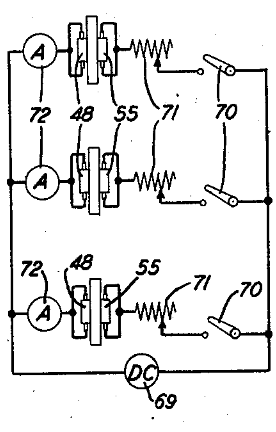


FIG. 6



INVENTOR
C. W. LOWE

BY

[signature]

ATTORNEY

Patented Nov. 28, 1939

2,181,490

UNITED STATES PATENT OFFICE

2,181,490

ELECTROPLATING APPARATUS

Charles W. Lowe, Rutherford, N. J., assignor to Electrical Research Products, Inc., New York, N. Y., a corporation of Delaware

Application July 9, 1936, Serial No. 89,789

2 Claims. (Cl. 204—5)

This invention relates to electroplating and electroforming apparatus and particularly to apparatus for plating and forming relatively flat objects. In the description which follows, the deposition of copper is contemplated, but the invention should be considered as applying to other metals as well.

In certain industries, such as the printing and phonograph industries, it is often desirable or necessary that a matrix be produced within four or five hours. This is not occasioned merely by the economy of labor involved, but by the need for obtaining quickly certain information from the matrix. For example, it may be necessary to produce a matrix before a given edition of a newspaper goes to press, or, in the case of the phonograph industry to produce a pressing before the actors disband or leave the city for another engagement, in order to determine whether it will be necessary to make another master impression. The matrices, in addition to being produced rapidly, must also be produced in the form of an electro-deposit of very fine texture, so that the reproduction will be faithful in every detail.

It is the object of this invention to provide a method and apparatus for electrolytically depositing metal of very fine texture upon a surface with greater rapidity than has heretofore been practicable.

The novel method I employ consists in confining the electro-deposition to as small a chamber as is physically expedient, violently agitating the electrolyte within the chamber and completely renewing the electrolyte every few seconds. The smallness of the chamber greatly facilitates the agitation because of the reduced amount of electrolyte that must be agitated.

In its preferred form the apparatus by which this invention is carried out comprises a relatively large tank containing electrolyte from which one or more small chambers are supplied. The small chambers may take the form of closed cylinders, the violent agitation of the electrolyte therein being produced by oppositely rotating electrodes and a series of stationary nozzles. Intake and exhaust conduits are provided for each chamber and all the electrolyte is positively filtered before it enters the chambers, although in certain embodiments it may be possible to operate without such filters.

The preferred form of the invention is shown in the accompanying drawings in which Fig. 1 is a side elevation, partly in section, of a chamber showing the agitating means for the electrolyte; Fig. 2 is a front elevation sectioned through the center of the chamber; Figs. 3 and 4 are transverse and longitudinal sections respectively through the nozzles; Fig. 5 is a perspective of a typical installation showing a plurality of chambers supplied from a single tank, and Fig. 6 is a schematic wiring diagram of the electrical connections to the chambers.

Referring now to Figs. 1 and 2 for a detailed description of the apparatus, 10 is a chamber formed by cylindrical shell 11 and closures 12 and 13. Although the chamber is shown as a cylinder, it may take other forms if desired. It may be formed of any material, although it can usually be formed most economically from cast iron. The entire inner surface of chamber 10 is lined with rubber or other acid-resisting material 14 which may be vulcanized or otherwise applied directly upon the cast iron. This lining prevents electro-deposition upon the walls of the chambers as well as disintegration of metal parts. Around the outside of chamber 10 are disposed four large lugs 16, 17, 20 and 21 each adapted to support hinges 15 from which closures 12 and 13 may be hung. In addition, lugs 16 and 17 are provided with flanges 18 and 19, respectively, by which the chamber may be supported. If it is desired that the chamber be supported from below rather than from above, flanges 18 and 19 may be located on lower lugs 20 and 21 instead, or flanges may be provided in both locations and the chamber supported from both above and below. Closures 12 and 13 are secured to cylinder 11 by means of small handwheels 22 located at intervals around the periphery of each closure. Cylinder 11 is provided with corresponding lugs 23 containing tapped holes into which handwheels 22 are threaded. A rubber gasket 24 is supplied to make a water-tight seal between the closures and cylinder 11. Three intake ports 25, 26 and 27, are shown but the number may be increased or decreased as desired. Two exhaust ports 28 and 29 are shown at the bottom of the chamber. The exact number and location will depend upon the specific embodiment. A small test port 30, located at the top of cylinder 11, is used to determine when the chamber is completely filled with electrolyte, and to admit air, through a relief vent petcock, not shown, to facilitate draining the chamber. A similar port 31, located at the bottom of the chamber, is used to complete the draining of the latter. All ports are threaded to receive various fittings.

Intake ports 25, 26 and 27 are fitted with nozzles 32, 33 and 34 respectively. Each nozzle is preferably comprised of a cylinder having longitudinal slots, or other suitable apertures 35 through which the electrolyte is emitted into the chamber. The bore of the nozzle is made progressively smaller by means of a tapered plug 36 so that the pressure of the electrolyte is substantially the same along the entire nozzle. This taper may, however, be omitted and nozzles of uniform bore used. The nozzles may be of the same length, or they may be of unequal lengths, but it is prefered that they be of sufficient length collectively to effectively spray the entire surface to be coated. It may be desirable in some cases to spray the anode as well in order to remove therefrom any accumulated sludge. The optimum spacing between the nozzle and the surface to be coated is ordinarily a small fraction of an inch. As shown in Fig. 3, the jet is preferably directed at an angle to the surface and against the rotation thereof, although this is not essential.

Within chamber 10 are also located the anode 38 and the backplate 37 against which the cathode is to be mounted. These electrodes, for the operation of this invention, are preferably in the form of flat discs, although it is not essential for such operation that they take this specific form. Since they are to be rotated at a relatively high speed, about 175 revolutions per minute in this particular embodiment, it is essential that they be balanced dynamically so as to avoid unnecessary vibrations. In the form shown, cathode backplate 37 is a slightly dished metallic support to which may be secured a phonograph recording to be electroformed. The record is screwed onto a threaded pin 39 which is secured to a spindle 40 having a tapered shank 41 at one end. Spindle 40 is threaded left-handed at its opposite end 42 and is adapted to cooperate thereat with handwheel 43, which is held in position when the spindle is not in place by collar 44 secured to bearing end cap 45. Thus by rotating handwheel 3, spindle 40 may be moved longitudinally to engage frictionally, or disengage, at its tapered end, a rotatable shaft 46. Shaft 46 is driven by a motor 47 through a reduction gearing of any suitable character.

Secured to shaft 46 is a slip ring 48 against which brushes 49 are adapted to bear to supply plating current thereto. A stuffing-box, designated generally by reference character 50, of acid-resisting material, prevents the electrolyte from escaping from chamber 10. A bearing surface, comprised of a hard rubber, or other acid-resisting sleeve 51, is supplied to protect shaft 46 from the ravages of the electrolyte. The electrolyte is used as a lubricant between stuffing-box 50 and sleeve 51.

Motor 47 and its associated gearing are supported by means of a suitable bracket 52 which may be made a part of closure 13. Although the apparatus illustrated uses separate drives for the anode and cathode, it is entirely possible to drive both electrodes from a single source.

On the anode side, motor 53, reduction gearing 54, brushes 55 and bracket 56 may be exact duplicates of the corresponding apparatus on the cathode side. Shaft 57 however need not be hollow since anode 38 is not mounted by means of a spindle, as in the case of the cathode, but by means of a screw 73. The head of this screw should be protected from electrolysis by any suitable means.

Insulation must be introduced into the framework of the machine at one or more places in order that current may get from one slip-ring to the other only by way of the electrodes and the electrolyte. This may be done in the design shown by insulating the hinges and the handwheel fasteners.

In Fig. 5 is shown a typical installation of a group of individual electroplating units. These units, designated generally by reference character 100, are hung from racks 59 which may be fabricated from angle irons or other suitable materials. The electrolyte 60 is supplied from a common tank 61 located either in the same room as units 100, or in a different room and preferably on a lower level than the units. The electrolyte is forced by means of a motor driven pump 62 through a filter 63 to a header 64 which supplies the electrolyte to one or more distributors 65 and thence to the individual units. Each unit is supplied with an intake valve 66 and an exhaust valve 67 to provide independent control of the electrolyte for each unit. The electrolyte discharged from the units is collected and run, preferably with the assistance of gravity, through a return head 68 to tank 61. Any number of units may be supplied from a single tank and any number of units may be operated simultaneously. No electrolyte can reach a unit unless it first passes through filter 63 and hence a positive filtering action is obtained. The filter may, however, be placed in the pipe line returning the electrolyte to the tank, or, as previously stated, it may be dispensed with entirely. The electrolyte is pumped at a rate which is sufficient to renew completely the electrolyte in a unit every few seconds. The tank 61 should preferably contain some suitable means for controlling the temperature of the electrolyte.

The electrical connections to the electrodes are shown schematically in Fig. 6. A suitable source of plating current 69 supplies current to a number of units, connected in parallel, through individual switches 70, current regulating rheostats 17, anode contact rings 55, cathode contact ring 48 and an ammeter 72. Since the electrolyte is renewed so frequently it is easily possible to operate, in the deposition of copper, with current densities of 350 amperes per square foot or more. Since the amount of metal deposited is proportional to the ampere-hours of current used, it is convenient to associate with each unit an ampere-hour meter for determining when sufficient metal has been deposited.

The method of operating the apparatus just described is as follows: At the beginning of the cycle the object to be electroplated is secured to pin 39 on cathode backplate 37. This is done outside the machine. The closure 13 being then opened the spindle 40 is inserted in the shaft 46 and handwheel 43 is turned counterclockwise until a firm contact is established between the end of shaft 46 and the back of cathode backplate 37, and between the tapered portions of the spindle and the shaft. All surfaces of the object which are not to be plated are covered by means of a suitable insulating shield, and if, for any reason, it is desired, the back of the anode may be similarly shielded from the electrolyte. With the object in place on the cathode backplate, closure 13 is secured to cylinder 11 by tightening handwheels 22. Anode closure 12 is likewise secured and the electrodeposition can now be begun. This is done by first rotating both electrodes, and with exhaust valve 67 closed, or partly closed, admitting electrolyte into the chamber until it begins to leave through test port 30, which may be connected through, for example, a glass tube (not shown) to exhaust lead 68. At this point exhaust valve 67 is opened and complete circulation of the electrolyte through the unit is established. The electroplating current is then turned on, beginning, where conditions make it necessary, with a relatively low current and gradually increasing the current strength until the optimum value is reached. The apparatus is maintained in this condition until a sufficient deposit is formed at which point the current is turned off, the motors are stopped, intake valve **66** is closed, the relief vent petcock associated with test port **30** is opened, exhaust valve **67** is left open, and chamber **10** is completely drained of electrolyte. Closure **13** may then be opened, the coated object removed and an uncoated object placed on cathode backplate **37** in its place. The cycle just described is repeated as often as desired. It may be found desirable in some kinds of work to stop the machine one or more times during the process and inspect the cathodic surface for nodules and other forms of undue roughness. Such formations can be smoothed down by means of suitable abrasives, the machine reclosed and the process continued. It may also be desirable in some cases where this smoothing operation is performed to reverse the polarity for a moment after reclosing the machine in order to break up any extreme polish that may have resulted. This would be to prevent lamination of the deposit.

The electrodeposition is so rapid, that, in the case of a phonograph record matrix, a negative may be electroformed within three or four hours or even less as contrasted with thirty-five to forty hours by the apparatus heretofore used.

As is known to the art, the higher the current density, optimum plating conditions being provided in all cases, the finer the texture of the deposit.

By this invention, therefore, means have been provided for producing a deposit of finer texture in a shorter length of time.

It is understood that the foregoing description is merely illustrative of the invention and that the scope of the invention therefore is not to be determined thereby, but by the appended claims.

What is claimed is:

1. In an electroforming apparatus, a stationary chamber comprising a pair of hinged sections, a rotatable electrode located in each of the sections, a driving motor for each electrode carried by its associated section, a surface to be electroformed supported upon one electrode, and means for passing an electrolyte through the chamber.

2. In an electroforming apparatus, a pair of hinged section members each constituting a half of a closed chamber and a motor support, a rotatable electrode carried by each support and located within a chamber section, a motor for driving each electrode carried by the associated section, a surface to be electroplated supported upon one electrode, and means for passing an electrolyte through the chamber.

CHARLES W. LOWE.