July 6, 1937. C. M. HOFF 2,086,226

PLATING APPARATUS

Filed Oct. 25, 1934 2 Sheets-Sheet 1

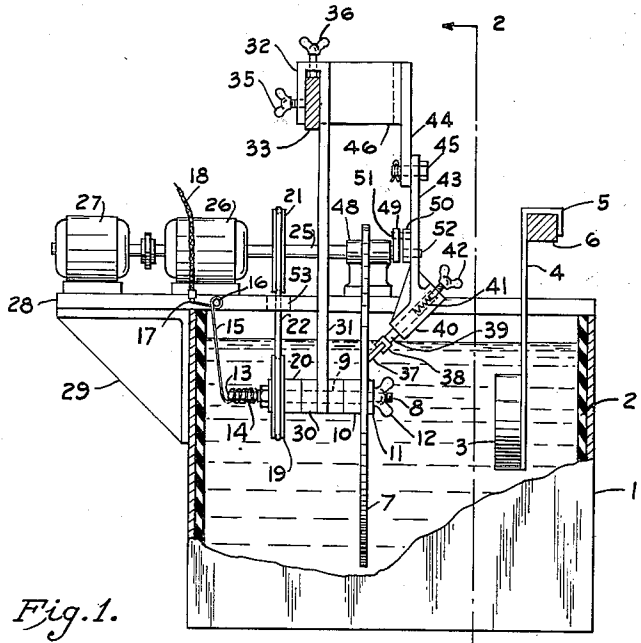


Fig. 1.

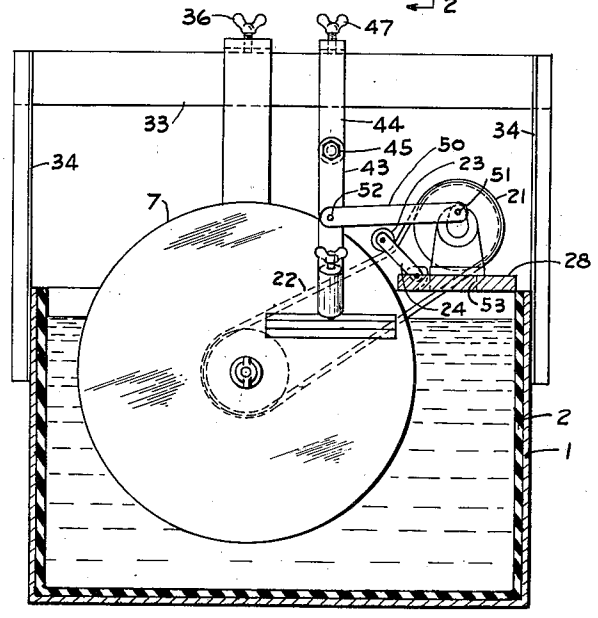


Fig. 2.

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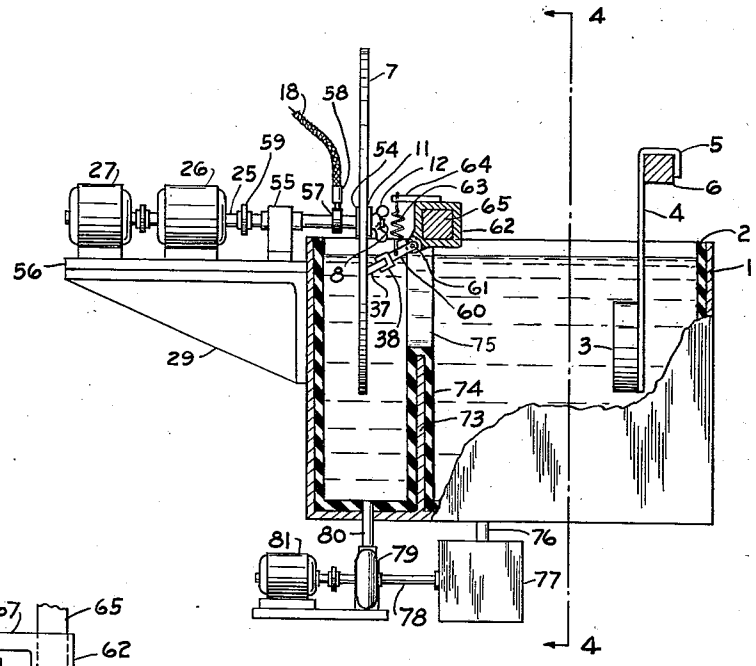


Fig. 3.

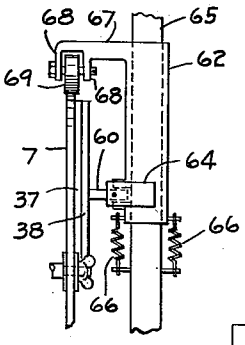


Fig. 5.

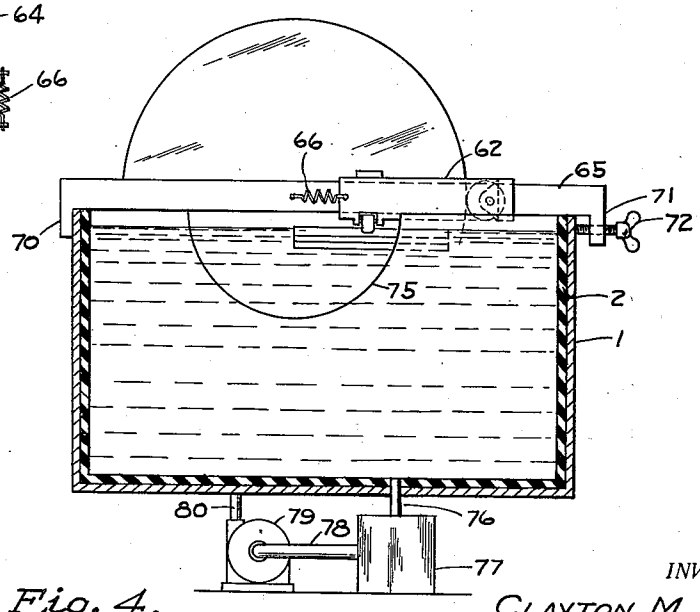


Fig. 4.

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UNITED STATES PATENT OFFICE

2,086,226

PLATING APPARATUS

Clayton M. Hoff, Lakewood, Ohio, assignor, by mesne assignments, to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

Application October 25, 1934, Serial No. 749,880

3 Claims. (Cl. 204—5)

This invention relates to the electrodeposition of cadmium, upon a suitable base, to provide a smooth and uniform surface in which sound grooves may be formed, and is particularly directed to processes and apparatus wherein a suitable base is intermittently plated by intermittent immersion in a plating bath, and wherein an electrodeposited cadmium coating is subjected, during its deposition, to a wiping action in the approximate direction to be followed by sound grooves.

In cadmium plating a suitable base, such as steel or copper disc, in the usual manner, considerable difficulty is experienced in obtaining a coating in which sound grooves may be satisfactorily formed. One of the most objectionable characteristics of the usual cadmium deposits is the large size and random arrangement of the crystals of which they are constituted. The crystals are deposited in an irregular and haphazard manner, and, although minute, they are large enough to approach in size the amplitude of recorded sound waves. The relatively large crystal structure is disadvantageous, therefore, because the walls of sound grooves cut in the metal are relatively rough and the crystal structure of the groove walls is reproduced as surface noise. The random arrangement of the crystals may cause additional surface noise or distortion by tending to deflect a cutting tool in first one direction and then another.

Another difficulty encountered in the deposition of cadmium to form a suitable surface for sound recording arises from the fact that hydrogen is liberated at the plated surface. Almost always some gas is formed, because to obtain a bright deposit it is necessary to employ a current density as close to the gassing point as possible. The gases formed rise along the plated surface and leave streaks. These streaks run straight along the surface, and, of course, may cause the cutting tool to tend to vary from its helical path, or cause surface noise in the finished record.

Another difficulty arises from the presence of insoluble material in the plating bath. Some of the insoluble material, which results largely from dissolution of the cadmium anode, adheres to the cadmium deposit, and, of course, causes the deposit to offer an uneven resistance to a cutting tool and causes surface noise in a finished record.

It is an object of my invention to provide processes and apparatus whereby a smooth, bright, and even deposit of cadmium may be obtained. It is a further object of my invention to provide processes and apparatus whereby cadmium may be deposited in the form of very small crystals. A still further object of my invention is to provide processes and apparatus whereby streaks left by gases will be removed, and whereby insoluble matter adhering to the deposit will be arranged in the approximate direction to be followed by sound tracks. Other objects will be apparent hereinafter.

My objects are accomplished, briefly, by continuously rotating the base surface during the plating process, by only partially immersing the base surface, and by lightly rubbing the surface throughout the plating process.

By rotating the base surface and by having it partly immersed in a plating solution, the deposit is caused to be even and bright. The rotation of the partly immersed base surface causes it to be intermittently plated, which results in a bright deposit of small crystal structure.

By wiping the surface during the plating process, the deposited cadmium is kept smooth and bright. The wiping action, moreover, knocks off the ends of crystals, or bends or deforms them, so as to cause subsequently deposited metal to form new crystals at new nuclei with the result that the crystals constituting the coating are smaller. The wiping action also rubs off foreign matter and causes impurities to be arranged in approximately the direction to be followed by sound tracks. The wiping action probably has the further effect of causing the crystals to form or bend in the approximate direction to be followed by sound tracks.

In order more fully to understand my invention, reference should be had to the accompanying drawings wherein:

Figure 1 is a side elevation, partly in section, of an apparatus according to my invention.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1 of a modified apparatus.

Figure 4 is a section on line 4—4 of Figure 3, and

Figure 5 is a plan view of the squeegee and operating means of Figures 3 and 4.

In Figures 1 and 2 there is seen a steel tank 1, of conventional design, with a hard rubber lining 2. A disc anode 3 is secured, in any desired manner, to a metal strap 4 which terminates in a hook 5. The hook 5 supports the anode from the bus-bar 6, and establishes an electrical connection between the anode and bus-bar. The strap 4 is, of course, of a metal insoluble in the

bath, and, if desired, it may advantageously be covered with an insulator, such as rubber.

A metal disc 7 is mounted upon the threaded reduced portion 8 of a shaft 9. The record is held in place on 8, between a washer 10 and a washer 11, by a wing nut 12. The washer 10 is secured to shaft 9 in any desired manner, as by a set-screw.

At its opposite end, shaft 9 is reduced at 13 to receive a surrounding contact coil 14. The coil 14 rides on the reduced portion 13 and rests against the shoulder formed by reducing shaft 9. The coil 14 is an extension of a spring 15 which loops around a pin 16 and terminates at a securing means 17. An electrical connection is provided at 17 so that a lead 18 may carry a current thru wire 15 and to the shaft 9. The shaft 9, of course, forms an electrical connection with the disc 7.

A pulley 19, provided with a sleeve 20, is fixed to shaft 9 as by a key, or by a set-screw in sleeve 20. A second pulley 21 drives pulley 19 by means of a belt 22. An idling roll 23 with tensioning means 24 takes up slack in the belt 22. The pulley 21 is secured to a drive shaft 25 which is driven by a motor 27 thru a gear reduction 26. The gear reduction and motor are mounted upon a support 28 which extends the width of the tank 1. The support 28 is secured to a support 29.

The shaft 9 is supported between sleeve 20 and washer 10 by a bearing 30. The bearing 30 is in turn supported by the strap 31 which terminates at its upper end in a hook 32. The hook 32 hooks onto the bar 33 which is supported at its ends by uprights 34. The hook 32 can be locked to the bar 33 by means of a wing-bolt 35, and a wing-bolt 36 can be turned to raise or lower the record in the tank. The idler 23 permits movement of the record support assembly and keeps the belt tight.

A rubber squeegee 37 is secured in a U-shaped member 38 which is fastened to a piston 39. The piston 39 slides in a cylinder 40. In the cylinder is provided a compression spring 41. A wing-screw 42 permits an operator to vary the compression on spring 41 and, consequently, the pressure on the squeegee 37. Suitable means, not shown, are provided to prevent the piston 39 falling out of the piston when the record is not in place.

The piston 40 is secured to a strap 43 which, in turn, is secured to a support 44 by a pivot 45. The support 44 is secured to a means 46 which terminates in a hook similar to 32. This hook is provided with a wing-nut 47 similar in function to wing-nut 36, and a wing-nut, not shown, similar in function to wing-nut 35.

The shaft 25 is provided with a bearing 48 which is mounted on the support 28. At the end of shaft 25 is secured an arm 49. The arm 49 and the strap 43 are each pivotally connected to a link 50 by pins 51 and 52 respectively.

It is noted that the support 28 must be provided with a hole 53, shown in dotted lines, to permit passage of the belt 22.

The pulley 19, sleeve 20, bearing 30, strap 31, washer 10, and squeegee holding means 38—39, should, preferably, be made of an electrically non-conductive material. The washer 11 and wing-nut 12, likewise, may be non-conductors, but the electrical connection between the record and the shaft 9 is better when they are metal.

The operation of the device of Figures 1 and 2 may now be considered in conjunction with a description of a process according to my invention.

A polished disc of a suitable metal, such as steel or copper, which is provided with a hole at its center, is placed on the reduced extension 8 of shaft 9. The washer 11 is put on the extension 8, and then wing-nut 12 is screwed on. The wing-bolt 36 is adjusted so that the record is about two-thirds immersed in the plating solution in the tank, and the wing-bolt 35 tightened to lock the hook in place. The squeegee 37 is adjusted by means of the wing-bolt 42 so that it rests firmly against the record. The motor 27 is now started and the record rotates slowly. The squeegee is caused to rock back and forth by the link 50 and arm 51.

An electric current applied to bus-bar 6 flows thru strap 4 to the cadmium anode 3. The current passes thru the solution to the record, electrodepositing cadmium thereon. The circuit is completed thru extension 8, shaft 9, coil 14, wire 15, and lead 18.

It is known that the current density in a bath increases near the top and bottom and near the sides over that at the center. By having the outer third of the record out of the bath part of the time, the rate of deposition is decreased on that portion and the coating on the whole record is relatively constant in thickness. The intermittent plating of the outer portion of the record results, moreover, in a brighter deposit on that portion.

During the plating operation the wing-bolt 35 is loosened occasionally and the wing-bolt 36 turned so that no appreciable ridge forms at the circle between the portion of the record which is always immersed and the portion which is intermittently immersed.

The squeegee 37 acts, as heretofore noted, to burnish the cadmium as it is deposited. The wiping action of the squeegee causes the deposited crystals of cadmium to be of small size and, probably, to follow approximately circular paths. The burnishing and wiping action of the squeegee also causes the cadmium plate to be smooth and bright.

By reason of an unequal rubbing action, or by reason of impurities on the squeegee, the squeegee might form circular grooves. To avoid this, the squeegee is rocked back and forth across the rotary disc. It is noted that the relation of the disc rotation to the squeegee reciprocation should be such that a given point on the squeegee will not often correspond to a given point on the disc.

In Figures 3, 4, and 5 there is seen a modified apparatus with which my process may be practiced.

As in Figures 1 and 2, there is seen a tank 1—2 and an anode and anode supporting means 3, 4, 5, and 6.

A record disc 7 is received upon a reduced, threaded extension 8 of shaft 25. A washer 54 rests on the shoulder formed by reducing the diameter of shaft 25. The record disc 7 is held between the washer 54 and a washer 11 by a wing-nut 12. The shaft 25 is driven by a motor 27 thru the gear reduction 26. The shaft 25 is supported by a bearing 55. The motor, gear reduction, and bearing are supported on a platform 56 which in turn is supported by the means 29.

A ring 57 on the shaft 25 makes electrical contact with a brush 58 which is provided with a lead 18. The shaft 25 carries a current from the record disc to the lead 18. To prevent grounding

the current, a fiber coupling 59 is provided in the shaft 25.

A rubber squeegee 37 is fastened in a U-shaped means 38 which in turn is secured to a rod 60. The rod 60 is pivoted at 61 to a sleeve 62. A spring 63 is fastened at one end to rod 60 and, at its opposite end, to an anchoring means 64.

The sleeve 62 slides upon a bar 65. Tension springs 66 are secured to the sleeve and bar to pull the sleeve towards the left, as seen in Figure 4. At the opposite end of the sleeve, an arm 67 carries two arms 68. An eccentric roller 69 is pivotally mounted between the arms 68.

The bar 64 rests on the top of the plating tank, and at each end is provided with projections 70 and 71 which extend down the sides of the tank. A wing-bolt 72 in extension 71 may be tightened to secure the bar 65 in place on top of the tank.

A steel partition 73, covered with hard rubber 74, divides the tank. The partition extends from the bottom to the top of the tank, and is provided with a semi-circular opening 75. At the bottom of the tank there is an outlet 76 leading to a filter 77. Filtered solution is led from the filter thru pipe 78 by the pump 79, and returned to the tank thru pipe 80. A motor 81 drives the pump.

The operation of the apparatus of Figures 3, 4, and 5 is very similar to that of the device of Figures 1 and 2. A record disc is secured to the shaft 25 by means of wing-nut 12. The bar 65 is positioned so that the squeegee 37 rests firmly against the record, and the wing-nut 72 tightened. The motor is then started and the plating current turned on.

The plating current flows thru bus-bar 6, strap 4, anode 3, the plating solution, record 7, shaft 25, ring 57, contact 58, and then out lead 18.

As the record rotates, the eccentric roller 69 which rides on its edge is caused to rotate, which results, of course, in a reciprocating motion of the sleeve 62 and squeegee 37.

The record is a little less than half immersed, and so the plating is accomplished intermittently over the whole plated surface. The plating is uniformly smooth and bright, and, of course, much better than if the record were continuously plated. The center portion of the record will not be plated, but this is satisfactory as it is not customary to record near the center of the disc.

The shield 73—74 cuts down the current densities near the periphery of the disc and equalizes the thickness of deposit over the record.

Impurities and sludge resulting from the dissolution of the anode settle to the bottom of the tank where they are withdrawn thru pipe 76 and filtered from the solution. The filtered solution is returned to the tank thru pipe 80, and circulated thru opening 75. The motion of the filtered solution is in the direction of the anode, and so impurities and sludge are restrained from migrating to the record surface.

The pump 79 maintains a rapid circulation of liquid, but, if desired, it may be omitted. There is, of course, a natural circulation of the heavy sludge to the bottom of the tank which will carry the sludge and some solution to the filter. The filtered solution would then be returned to the tank by the natural circulation.

It will be readily apparent to those skilled in the art that numerous modifications can be made in the apparatus disclosed above without departing from the spirit of my invention, and that my processes can likewise be widely varied.

It will also be apparent that while I have disclosed my processes with particular reference to disc records, the processes can readily be applied to records in any form, such as cylindrical, and, by obvious modifications in the form of the record holding means and the squeegee holding means, the apparatus may readily be employed for records in other forms.

I do not intend to be limited to the specific processes and apparatus which are disclosed above for purposes of illustration, the scope of my invention appearing from the following claims.

I claim:

1. An apparatus for the electrodeposition of a smooth coating of metal comprising, means for rotating a cathode, a support positioned normal to the axis of the cathode, slidable means carried by the support, a wiper carried by the said slidable means and adapted to contact the cathode, and a roller eccentrically mounted on said slidable means and adapted to engage the periphery of the cathode.

2. An apparatus for the electrodeposition of a smooth coating of metal comprising, a receptacle, cathode and anode carrying means associated with the receptacle, an imperforate shield positioned between the anode and cathode and dividing the said receptacle, the shield being provided with an aperture of such shape as to cause an even distribution of current over the cathode area, a pipe at the lower portion of the receptacle and on the anode side of the shield for withdrawing plating solution, a filter associated with said pipe, and a pipe for returning filtered solution near the bottom of the receptacle on the cathode side of the said shield.

3. An apparatus for the electrodeposition of a smooth coating of metal comprising, a receptacle, a rotatable shaft disposed above the normal level of plating solution in the receptacle and adapted to carry a cathode partly immersed in the solution, a shield positioned between the cathode and an anode and dividing the said receptacle and the shield being provided with an opening at its upper portion, means for withdrawing a portion of plating solution on the anode side of the shield, filtering, and returning it on the cathode side of the shield, a support normal to the axis of rotation of the said cathode, slidable means carried by the support, a wiper carried by the said slidable means and adapted to contact the cathode, and an eccentrically mounted roller secured to the slidable means and adapted to engage the periphery of the cathode.

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