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COATING APPARATUS

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FIG. 1

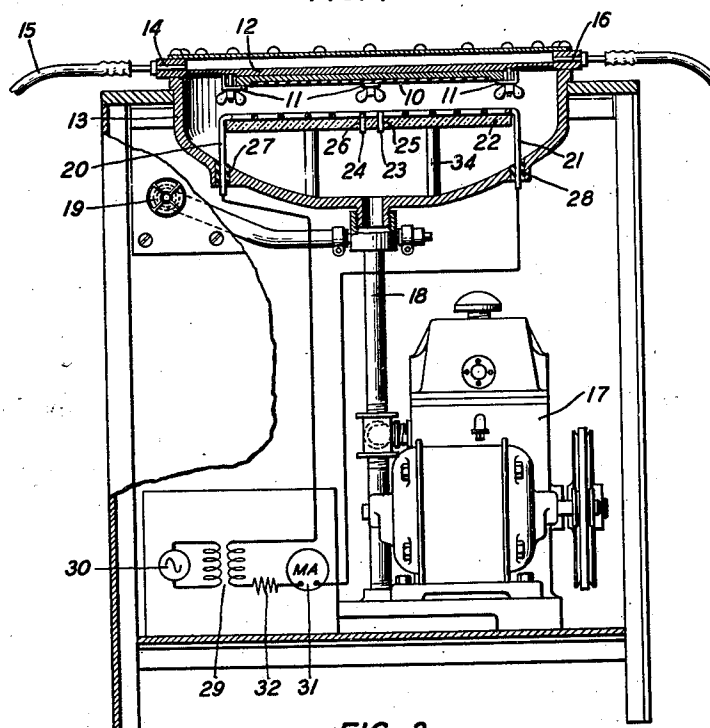
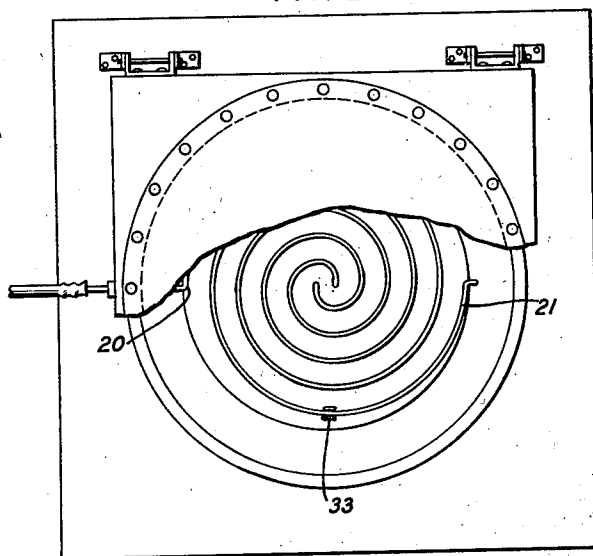


FIG. 2



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COATING APPARATUS

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4 Claims. (Cl. 91—12.2)

This invention relates to sputtering apparatus, that is, apparatus for the dispersion of electrodes in a vacuum for the purpose of coating articles with metal.

5 It has been known in the record processing art to obtain electroplates of a wax master record by coating the latter by the sputtering process. In the apparatus as heretofore used, however, the cathode was of such a shape and so positioned
10 within the sputtering chamber that the dispersion of the cathodic particles was limited to one direction or to one plane. The result was that an irregular surface, such as a sound groove, did not receive a uniform coating, the portions of the sur-
15 face which were oblique to the path of the particles receiving less per unit area than those normal to the path. The resistance of the thinly coated portions consequently was very high and the electroplate deposited thereon either poor or
20 absent entirely. Irregularities in the electroplate cause minute ridges to be formed in the finished record which appear as objectionable surface noise when the record is reproduced.

25 The object of this invention is to improve apparatus for metallicly coating objects by the vacuum dispersion of electrodes, particularly with a view of obtaining more complete diffusion of the cathodic particles throughout the coating chamber.

30 In its preferred form, the invention comprises a chamber, the gas pressure within which is controllable, a support within the chamber for an irregularly surfaced object, such as a sound record, and a cathode made of cylindrical material and formed preferably in the shape of a spiral.
35 The cylindrical surface of the cathode material insures a distribution of the cathodic particles in an infinite number of directions in any plane normal to the axis of the surface, and the spiral form
40 of the axis insures an infinite number of such planes in the chamber. The cathode is located so that the plane of the spiral is substantially parallel to the surface to be coated. For best results two
45 similar electrodes may be used in the same plane, one in the interstices of the other, and alternating current can be impressed across the terminals of the electrodes so that each is alternately an anode and a cathode.

50 The design of the electrodes may vary according to the shape of the surface to be sputtered. I have found as a satisfactory design the form illustrated in the accompanying drawing in which

55 Fig. 1 is an elevation in section of a sputtering

apparatus showing the novel electrodes in place; and

Fig. 2 is a plan view of the electrodes.

Referring now more particularly to Fig. 1, 10 is a metal-backed wax disc containing a sound
5 groove, the surface of which it is desired to coat metallicly so that an electroplated negative may be made therefrom. The disc is supported by clamp 11 from a hollow platen 12 which serves as
10 a cover for chamber 13. The hollow portion of platen 12 is provided with an inlet port 14 connected through hose 15 to a suitable source of refrigerant, and an outlet port 16 from which the
15 refrigerant may be discharged. Any fluid refrigerant may be used, though I prefer to use cold water because of its universal availability.

The chamber 13 is evacuated by a vacuum pump 17 which is connected thereto through a pipe 18 centrally located at the bottom of the chamber. A leak valve 19 is connected intermediate the
20 chamber 13 and pump 18 to provide a means for controlling the pressure within the chamber.

The novel electrodes are shown at 20 and 21. They are made of cylindrical material such as rods or tubing, and for economy may simply be
25 plated with the gold, silver, palladium or other metal with which it is desired to coat record 10, rather than be made entirely of the coating material. Prior to the plating, however, the electrodes
30 are bent into the form of spirals as shown in Fig. 2. This, in effect, rotates the axis of the cylindrical material through 360 degrees and more, depending upon the number of convolutions
35 in the spiral. In this manner the number of directions taken by the cathodic particles is made infinite and the diffusion of the particles throughout the chamber greatly increased. Every portion
40 of the sound groove in disc 10 therefore receives substantially an equal amount of coating material whether it is parallel to the plane of the spiral or normal to it. This tends to make
45 the electrical resistance of the coating more uniform and consequently the electroplate deposited thereon is free from the tiny unplated areas or pinholes usually found in the early stages of the plating which result in surface noise known as
"ticks" and "bats."

Various methods of connecting the electrodes to the external electrical circuit may suggest
50 themselves to one skilled in the art, the method shown here being merely illustrative. In the drawing, the electrodes 20 and 21 are shown supported upon a disc 22 of insulating material
such as glass. The central ends 23, 24 of electrodes 20 and 21, respectively, are bent at right
55

angles to the plane of the spirals and inserted into close fitting depressions or apertures 25 and 26 in disc 22. The outer ends of electrodes 20 and 21 are likewise bent at right angles to the plane of the spirals, but extend beyond the disc 22, through the lower wall of chamber 13 to the exterior. Insulators 27 and 28 in the aforementioned wall serve to keep electrodes 20 and 21 electrically distinct. The external ends of the electrodes are connected across the secondary of a transformer 29, the function of which is to step up the voltage of the source of alternating current 30 to the amount necessary to maintain a silent discharge within chamber 13. The current through the chamber may be observed with the aid of milliammeter 31 and fixed at the optimum value for normal sputtering pressures by means of resistance 32.

The electrode material may be one-quarter inch in diameter and even larger if a higher rate of sputtering is desired. Good results have been obtained with the shortest distances between surfaces of the electrodes slightly in excess of one inch, and the shortest distance between the electrodes and record surface likewise approximately one inch. The spacing between electrodes is maintained by depressions 25 and 26, insulators 27 and 28, and also by close-fitting troughs 33 on disc 22 located about 90 degrees away from the outer ends 20 and 21. The distance between the electrodes and record surface is determined by the height of supports 34 for disc 22, the supports being preferably three in number.

To operate the described apparatus the procedure outlined in United States Patent 1,986,536 to A. G. Russell may be followed. This procedure briefly is as follows: The wax master 10 is secured to cover 12, the cover is placed over chamber 13 and water is pumped through the hollow space therein until the wax has attained a constant temperature. The chamber is then evacuated to a pressure of about .5 mm. of mercury at which point the alternating current may be turned on. After approximately five minutes of operation the current is shut off, air is readmitted into chamber 13, cover 12 is raised and the completely sputtered record removed from the cover.

When it becomes necessary to remove the electrodes, as for example to clean them or to replate them with sputterable material, they are disconnected from the external circuit and then simply raised from the supporting disc 22.

It is preferable to have all edges and exposed

surfaces of the electrodes round and with as large a radius of curvature as possible to avoid the excess heating which accompanies sharp edges or surfaces with small radii of curvature.

Although the invention has been described with reference to spiral electrodes, it is understood that this is but one form in which the invention may be practiced and that the scope of the invention is not to be limited thereto but is to be determined by the appended claims.

What is claimed is:

1. A chamber, means for evacuating the chamber, an object to be coated within the chamber, a source of alternating current, and electrodes within the chamber and connected to the source of alternating current, said electrodes being substantially parallel to the surface of the object to be coated and comprising electrically distinct spirals formed from metal having a cylindrical surface and placed one in the interstices of the other whereby said electrodes are dispersed uniformly in all directions.

2. Apparatus for metallicity coating irregularly surfaced articles by the vacuum dispersion of electrodes, comprising a chamber, a support for the article to be coated within the chamber, an anode, a cathode substantially parallel to the article to be coated, said cathode being comprised of a metallic tube bent into the form of a spiral whereby it is dispersable in all directions to coat evenly all portions of the irregularly surfaced article, means for evacuating the chamber, and means for connecting the anode and cathode to a source of electrical energy.

3. Apparatus for uniformly coating disc records with metal comprising a chamber, means for evacuating the chamber, a support within the chamber for the record to be coated, electrodes within the chamber, said electrodes being circular in cross-section and formed into spirals substantially parallel to the plane of the disc record, one electrode being located in the interstices of the other, and a source of alternating current across the electrodes to disperse said electrodes, the dispersion taking place in all directions to coat all portions of the record surface evenly.

4. In a device of the type described, a cathode, means to support an object to be uniformly coated with metal substantially parallel to the cathode, said cathode comprising a cylindrically surfaced metal member formed in the shape of a spiral, whereby the cathode is uniformly dispersed in all directions.

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