Jan. 1, 1935. A. G. RUSSELL 1,986,536

APPARATUS FOR METALLICALLY COATING PHONOGRAPH RECORDS

Original Filed May 19, 1931

FIG. 1

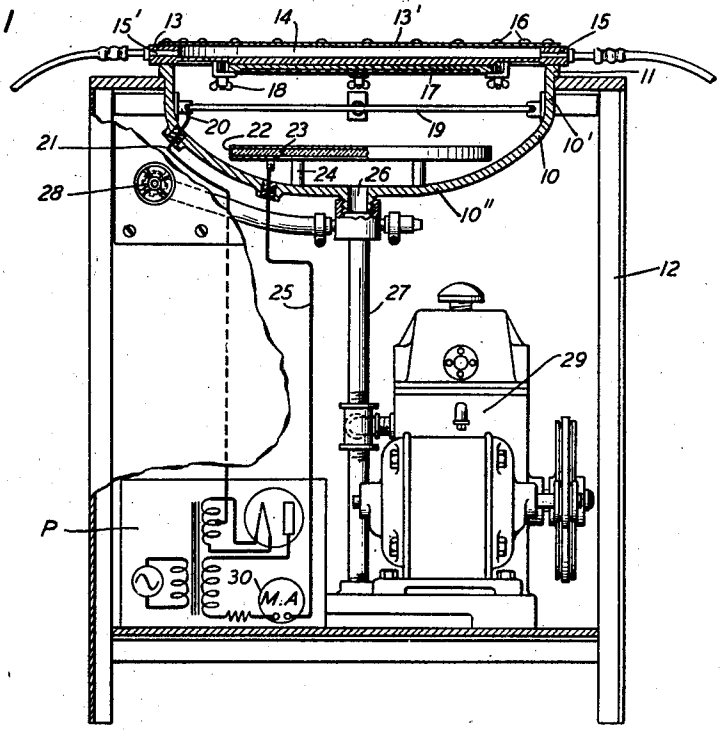
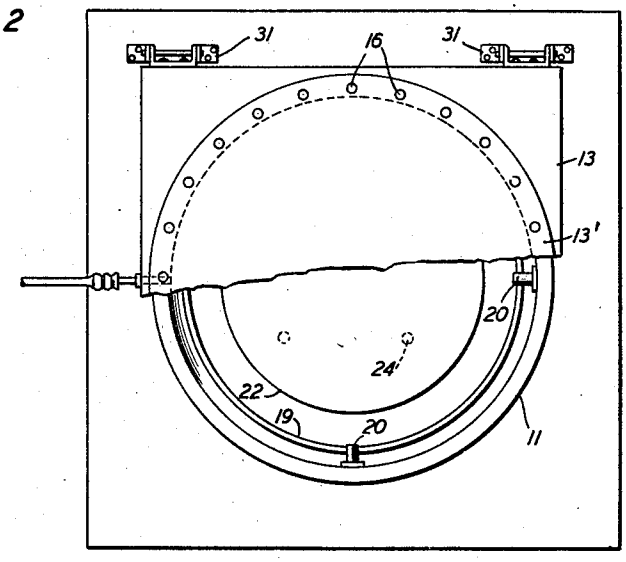


FIG. 2



INVENTOR
A. G. RUSSELL
BY
ATTORNEY

Patented Jan. 1, 1935 1,986,536

UNITED STATES PATENT OFFICE

1,986,536

APPARATUS FOR METALLICALLY COATING PHONOGRAPH RECORDS

Alexander G. Russell, Red Bank, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Original application May 19, 1931, Serial No. 540,866. Divided and this application August 19, 1932, Serial No. 629,485

7 Claims. (Cl. 91—12.2)

This invention relates to apparatus for metal coating articles by the vacuous dispersion of electrodes commonly known as sputtering and particularly to such apparatus employing cooling means for the article to be sputtered.

In my application, Serial No. 540,866, filed May 29, 1931, I disclose a sputtering chamber comprised of a metal cylinder with a removable top from which are suspended an anode in the form of an aluminum disc and a cooling coil, the latter serving to support and cool a wax record.

This invention is in the nature of an improvement over the above apparatus and has for its object the simplification of the apparatus, a feature of the invention being the incorporation of the cooling system into the top of the chamber thereby removing it from within the chamber and subjecting it to atmospheric pressure instead of the sub-atmospheric pressure prevailing within the chamber.

Another feature is the novel design of the anode whereby the size of the chamber is reduced with a corresponding economy of space and time for evacuating the chamber.

A preferred form of the invention comprises a cylindrical chamber with a removable cover. The cover is hollowed out and provided with two openings, an inlet and an outlet through which a cooling medium is pumped. Means are provided for holding a wax record against the cover so that the heat in the record can be conducted away into the cooling medium. The anode is an electro-conductive rod which may be bent in the form of a ring and secured to the side walls of the chamber with insulators although this form is not essential to the operation of the apparatus. The cathode is a removable gold plate located at the bottom of the chamber and well insulated from it. By placing the cooling system outside the chamber and the anode along the side walls, the volume of the chamber is considerably reduced and hence the time required to evacuate it is decreased. The reduced volume also permits the use of simpler and more economical evacuating apparatus and the external cooling system further increases the economy of the device since it is subject merely to atmospheric pressure and can therefore be made very simple.

The preferred form of the invention is illustrated in the accompanying drawing in which:

Fig. 1 is an elevation of the chamber and support showing the chamber in section; and

Fig. 2 is a plan view of the chamber with the cover partly cut away.

In the drawing, 10 is the chamber with cylindrical walls 10' and dished bottom 10''. The walls 10' terminate in a flange 11, the bottom face of which rests upon framework 12 on which the entire apparatus is supported. The upper face of flange 11 is ground smooth and perfectly flat to form an air-tight joint with a hinged cover 13.

The cover 13 is made of two pieces 13 and 13'. The central portion 14 of cover 13 is hollowed cut in the form of a cylindrical depression and passageways 15 and 15' comprise the mode of ingress to and egress from the hollow portion 14. The piece 13' is secured to the main piece 13 over the hollow portion 14 by means of suitable fastenings 16. Connection is made through 15 to a cooling medium which when forced through the passageway 15 circulates in the hollow portion 14 and cools the cover in contact with it. The heated medium is removed through passageway 15'.

The record 17 or other article to be coated, is placed against the cooled cover and secured to it with clamps 18. The record shown is a thin disc of wax reenforced with a metal disc such as is described in my copending application Serial No. 540,866, filed May 29, 1931. This arrangement of the cooling system is made possible because of the novel design of the anode 19. I have found that a good coating can be obtained even though the article is not placed in the direct path between the electrodes and that the anode can very well be placed off to one side if other considerations make it desirable to do so. In the present case where the apparatus is to be used for commercial purposes, the time required to evacuate the chamber to a sputtering pressure just prior to the commencing of the coating operation becomes an important factor. To reduce the time required to evacuate the chamber, it is necessary to reduce the volume of the chamber to a minimum and the most advantageous manner of accomplishing this is by reducing its height. If the anode is placed along the side of the article instead of above it, the article can be secured directly to the cover and thus the height of the chamber can be materially reduced.

Accordingly, the anode of the apparatus is comprised of a rod 19 bent in the form of a loop or ring and secured to the walls 10' by means of insulators 20. Other forms, such as segments of circles, or even a single short straight rod can be used with equally good results. A lead 21 well insulated from the remainder of the apparatus connects the anode to a source of potential P. The cathode is a disc of gold 22 or other sputterable material reinforced with a glass disc

23 which is also supported by insulators 24. A lead 25 connects the cathode to the negative side of the source of potential P.

At the bottom of the chamber and centrally located therein to avoid flow lines, is an outlet 26 which is connected to an air line 27 leading to a leak valve 28 and suction pump 29. This pump may be any suitable oil pump and it will be found that no auxiliary mercury pump will be necessary to assist the oil pump due to the reduced size of the chamber.

The condition of the discharge in the chamber can be ascertained to a fair degree of accuracy by means of the milliammeter 30. This milliammeter and the necessary switches and leak valve can be grouped together on a panel, not shown, near the top of the support 12.

To operate the apparatus, the cover 13 is raised and the article clamped to it. Next, the joint between the cover 13 and flange 11 is carefully cleaned and greased and the cover placed over the joint. Loose hinges 31 are used to locate the cover accurately over the chamber. The cooling medium is slowly passed through the cover until the article and cover attain a constant temperature. The evacuating pump is started and after two minutes, a potential is put across the electrodes. The milliammeter is watched closely until it shows a current corresponding to a pressure within the chamber of approximately .03 millimeters of mercury at which pressure the coating process has been found to be most satisfactory. The exact meter reading for this pressure can be determined experimentally. Further decrease in pressure is prevented by admitting air into the pump 29 through leak valve 28.

After approximately ten minutes, the potential can be removed and air readmitted into the chamber. The article will be found to have been evenly coated with the cathode material and ready for removal from the chamber.

The novel design of the anode not only reduces the volume of the chamber and the time to evacuate it, but also permits the cooling system to be placed outside of the chamber where it is readily accessible and under normal atmospheric pressure instead of vacuum pressure. This lessens the possibility of a leak and the resultant destruction of the vacuum necessary for the process. Another advantage is the desirable cooling effect produced upon the grease in the joint.

It is understood that cooling systems and forms of anodes other than those illustrated and described in this application can be used with this apparatus and the scope of the invention, therefore, is not to be limited by the above illustrative example but is to be determined by the appended claims.

What is claimed is:

1. Apparatus for metal coating articles by the vacuous dispersion of electrodes comprising an evacuated chamber with a removable wall, an anode and a cathode within the chamber, a source of suitable electrical potential connecting the anode and cathode, and cooling means within the wall for cooling the article being coated.

2. Apparatus, as in claim 2, the cooling means comprising an air-tight chamber within the wall with inlet and outlet passages, and a cold fluid coursing through the chamber and passages.

3. Apparatus for metal coating articles by the vacuous dispersion of electrodes comprising an evacuated chamber, exterior cooling means for the article being coated, a cathode, an anode comprising a ring of electro-conductive material secured to the side of the chamber, and a source of suitable electrical potential connecting the anode and cathode.

4. Apparatus for metal coating metal-backed wax records by the vacuous dispersion of electrodes comprising an evacuated apertured chamber with a removable cover for the apparatus, means for securing the record to the cover, cooling means within the cover to remove the heat in the record generated by the sputtering process, an anode and a cathode within the chamber, and a source of suitable potential connecting the anode and the cathode.

5. Apparatus for metal coating articles by the vacuous dispersion of electrodes comprising an evacuated chamber, an anode and a cathode within the chamber, a source of suitable electrical potential connecting the anode and cathode, and means entirely external to the chamber and of a lower temperature than the surrounding atmosphere for cooling a wall defining the chamber whereby the article being coated may be cooled.

6. Apparatus for metal coating articles by the vacuous dispersion of electrodes comprising an apertured evacuated chamber, an anode and a cathode within the chamber, a source of suitable electrical potential connecting the anode and cathode, a removable cover for the aperture of the chamber, means external to the chamber and of a lower temperature than the surrounding atmosphere for cooling the cover and means for securing the article to the cover whereby the article being coated may be cooled.

7. Apparatus for metal coating articles by the vacuous dispersion of electrodes comprising a chamber, means for cooling a wall defining the chamber, means for securing the article to be coated to the cooled wall, an anode and a cathode within the chamber, said anode being placed intermediate the cooled wall and cathode, and a suitable source of electrical potential connecting the anode and cathode.

ALEXANDER G. RUSSELL.