

J. W. AYLSWORTH.
 PROCESS OF MAKING DUPLICATE PHONOGRAPH RECORDS.
 APPLICATION FILED SEPT. 17, 1909.

1,060,577.

Patented May 6, 1913.

2 SHEETS—SHEET 1.

Fig. 1

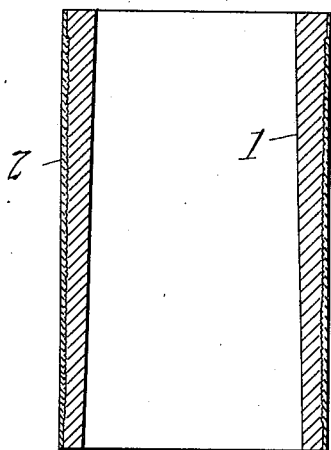


Fig. 2

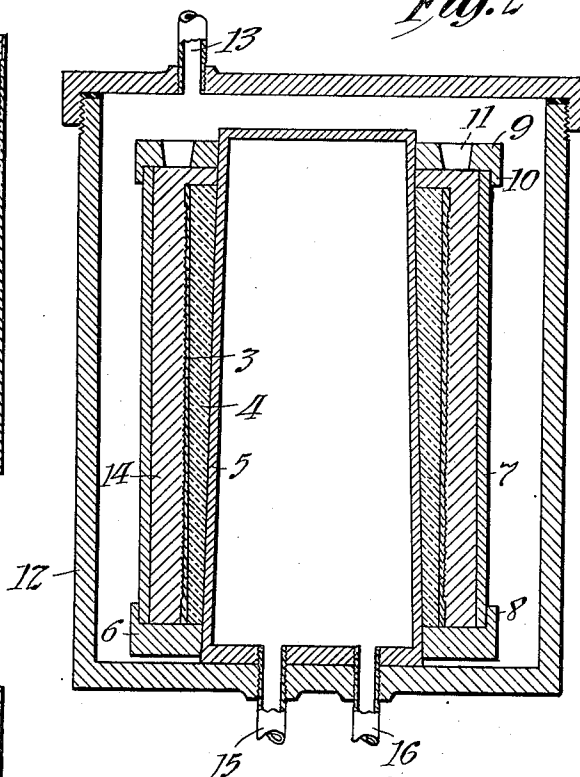
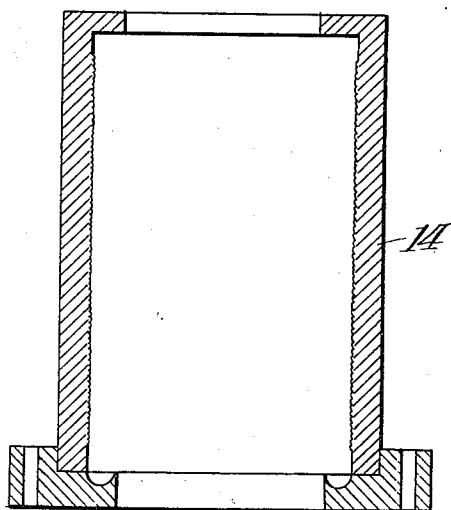


Fig. 3



Witnesses:
 Frank A. Lewis
 Dyer Smith

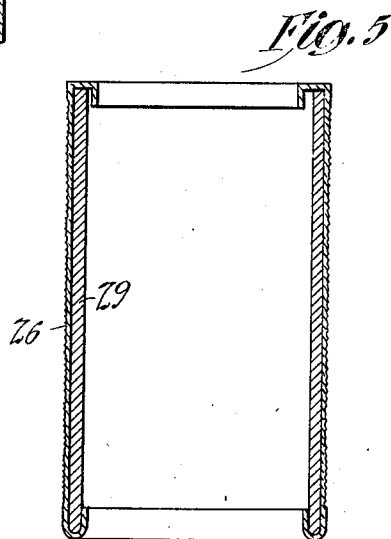
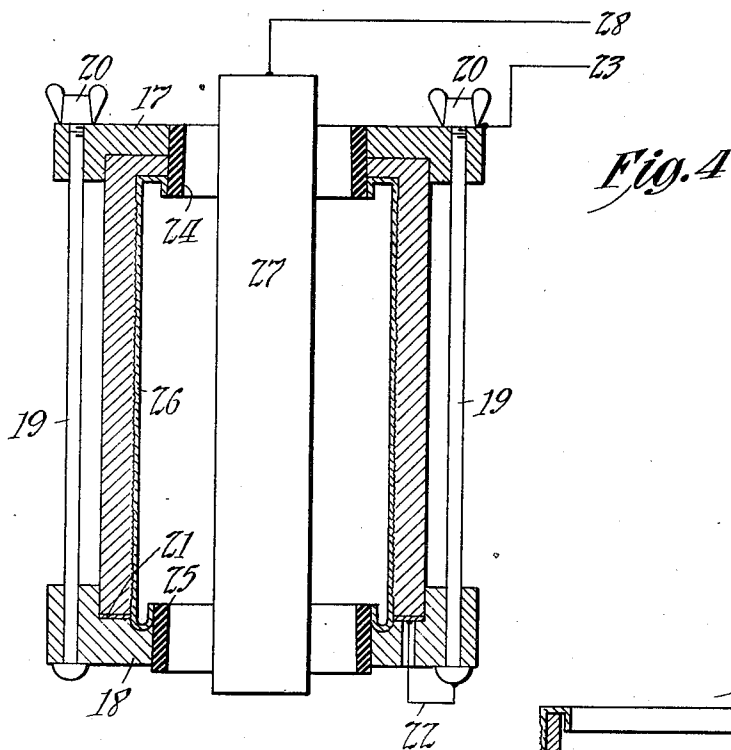
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 Jonas W. Aylsworth
 by Frank L. Avery
 his Atty.

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2 SHEETS—SHEET 2.



Witnesses:
 Francis D. Lewis
 Dyer Smith

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UNITED STATES PATENT OFFICE.

JONAS W. AYLSWORTH, OF EAST ORANGE, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THOMAS A. EDISON, INCORPORATED, OF WEST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

PROCESS OF MAKING DUPLICATE PHONOGRAPH-RECORDS.

1,060,577.

Specification of Letters Patent.

Patented May 6, 1913.

Application filed September 17, 1909. Serial No. 518,272.

To all whom it may concern:

Be it known that I, JONAS W. AYLSWORTH, a citizen of the United States, and a resident of East Orange, in the county of Essex and State of New Jersey, have made a certain new and useful Invention in Processes of Making Duplicate Phonograph-Records, of which the following is a description.

My invention relates to a process for making phonograph records in which the wearing surface is entirely of metal. The entire record may be constituted of the metal, or the latter may be merely a shell provided with a backing of other material. The process is particularly adapted to the manufacture of cylindrical phonograph records, although it may be used for making records of the disk type if desired.

Cylindrical sound records at the present time are generally made of a wax-like material molded or cast within a hollow matrix, and disk records are formed of somewhat harder material employing considerable quantities of shellac, the impression being secured from a flat matrix. With both types of record the material is subjected to considerable wear when used on a phonograph, and the production of a phonograph record easily and cheaply manufactured from metal or other substance having greater wearing qualities than the records now actually in use, is desirable.

It has been proposed to make duplicate records of metal, but such processes have been objectionable in that it has been necessary therein to destroy the matrix in order to liberate the metallic duplicate. By an invention on which application for patent Serial No. 516,309 was filed by me September 4, 1909, a process was described and claimed by which it is possible readily to free the metallic duplicate from the matrix without injury to the latter, whereby the same may be used for the production of an indefinite number of copies. By the invention forming the subject matter of the present application, the same result is attained.

The objects of my present invention, accordingly, are the commercial production of metallic duplicate sound records, the production of a novel and efficient matrix for the production of such metallic duplicates, and the processes and sub-processes hereinafter

more particularly described and claimed for producing the aforesaid metallic duplicates and the aforesaid matrix.

The method hereinafter to be described comprises four major operations. First, the manufacture of a master record. Second, the manufacture of a metallic master record. Third, the manufacture of a matrix of a large co-efficient of expansion from the metallic master, and, fourth, the manufacture of commercial metallic duplicate records from the matrix so formed.

The second step above mentioned is not present in the process described in my application Serial No. 516,309, above referred to, and the matrix of large co-efficient of expansion in the present process is specifically different from that employed in the process described in my above mentioned application. The processes covered by the two applications, however, attain the same general object as above stated, and broad generic claims to the same, which might be made in either application, are inserted in application Serial No. 516,309 above referred to.

In order that the invention may be better understood, reference is made to the accompanying drawings, of which—

Figure 1 is a central vertical section through a master record, showing the formation of a temporary matrix thereon. Fig. 2 is a central vertical section of apparatus for producing the matrix within which the metallic positive records are to be formed. Fig. 3 is a similar view of the matrix after being removed from the apparatus of Fig. 2. Fig. 4 is a similar view showing apparatus for producing a metallic deposit within the matrix to form the record or record wearing surface; and Fig. 5 is a similar view of the complete record in its preferred form.

In all of these views, corresponding parts are designated by the same reference numerals.

The first step of the process consists in the obtaining of a master record. This may be obtained in the same manner and may be of the same composition as is common in the art. The master record is designated in the drawings by the reference character 1.

The second operation comprises the plating of the master record 1 with a coating of copper or zinc after application of the neces-

sary conductive coating of graphite or of gold by well known methods. This copper or zinc deposit forms a temporary matrix 2, as indicated in Fig. 1 of the drawings. The master record 1 is then removed from the zinc or copper negative or temporary matrix, and a positive metallic master is formed therein by electro-deposition. I prefer to form the metallic master of nickel. However, if the temporary matrix is formed of zinc, the master which is formed therein may be either of copper or of nickel, while if the temporary matrix is copper, the metallic master formed therein may be either nickel, iron, cobalt, silver or platinum. After suitably backing the nickel or other metallic master record, the copper or zinc temporary matrix 2 is removed by dissolving the same in an alkaline solution. This may be a solution of caustic soda or potash containing hydrogen peroxid if the temporary matrix is of zinc. If the matrix to be dissolved is of copper, the solution may be 10% cupric ammonia and 90% of strong ammonia. The cupric ammonia is formed of 5% copper sulfate, 5% ammonium sulfate, and 90% of strong ammonia.

The third operation consists in casting a substance which has a high co-efficient of expansion with respect to copper, nickel and iron, around the metallic positive to form a permanent matrix. This substance should also be chemically inert to the plating bath and insoluble in the acids which may be required to dissolve away the metallic master after the formation of the permanent matrix. The substance which I prefer to use in the present process for forming the permanent matrix is a phenol condensation product, such as that described by me in my application Serial No. 496,060, filed May 14, 1909, or that described by Baeke-land in the *Journal of Industrial and Engineering Chemistry*, published by the American Chemical Society March, 1909, page 149. The matrix may be formed by casting one of these or equivalent substances in their preliminary stages and heating the same in the mold, with or without the application of pressure to produce by chemical action the final non-plastic condition of the material in which the latter is very hard and durable, is chemically inert, and is practically infusible and insoluble in and otherwise not attacked by commercial acids. In this operation, the metal master record may be used as a core for the matrix. This operation is illustrated in Fig. 2 of the drawings, wherein the reference character 3 designates the nickel or copper or other metallic master which has been formed within the temporary matrix 2 after the removal of the original master record 1. The metallic master 3 is backed with any suitable substance 4 and the same placed upon the hollow taper

mandrel 5, which acts as a centering device. The master 3 and backing 4 are placed upon the base 6 through which the taper mandrel 5 extends. The cylindrical mold 7 is also placed upon the base 6 which is provided with upwardly directed flange 8 to retain the same. The cap 9 provided with downwardly directed flange 10 is set upon the top of the mold 7. The cap 9 is provided with openings 11 through which the material of which the matrix is to be formed may be poured. If the matrix is to be formed from a phenol condensation product or similar substance in which the use of an increased pressure during the baking process is desirable, the whole apparatus is placed within a pressure chamber 12 provided with a duct or pipe 13 leading to a suitable pump or other source of pressure. This pipe 13 may be provided with a two-way valve connection, one branch of which is connected with the pump, the other with the atmosphere.

The heat necessary for transforming the substance of which the matrix 14 is to be formed into a hard, durable and chemically inert substance, may be applied in any usual way. I prefer, however, to apply the heat from the inside of the matrix. Accordingly, in the drawing, the hollow taper mandrel 5 is illustrated as being provided with two pipe connections 15 and 16 which pass through the wall of pressure chamber 12 and the lower wall of mandrel 5 which is entirely closed at its ends except for the two pipe connections. A circulation of steam or other hot gases through the inside of mandrel 5 may be maintained by means of these connections, and the heat necessary for transforming the substance of which the matrix is composed into the final condensation product, thereby applied. The heat thus imparted to the inside of mandrel 5 is conducted through backing 4 and metallic master 3 to matrix 14 which is thus given the highest heat on its inner or record bearing surface. The substance of which matrix 14 is composed hardens under heat treatment in contact with the record surface carried by master record 3 and forms a perfect negative thereof. After cooling, the matrix thus formed is relieved of the metal master 3 by dissolving the same in dilute acid. Or the matrix might be separated, if desired, from the metallic master 3 by forcible expansion of the matrix away from the master 3 by the method described in my application Serial No. 487,360, filed April 1, 1909.

A modification of the method so far described may be used, which consists in compressing a celluloid or hard rubber tube around the metal master 3 to form a matrix in place of the matrix 14 of a phenol condensation product hereinbefore described. In this case, the celluloid or hard rubber tube is warmed sufficiently to render it plas-

tic. The same may be removed from the metal master 3 when nearly cold by forcible expansion, as described in my application Serial No. 487,360, above referred to, or by dissolving out the metal master 3 as previously described. These steps result in the matrix shown in Fig. 3, the same having a high co-efficient of expansion as compared with metals. In order to obtain a metallic record from a matrix of this character, the interior and the lower end are first provided with an electrically conductive coating, such as finely divided graphic or gold deposited *in vacuo*, and the matrix is then placed in a holding frame suitable for the application of current therein in an electro-plating bath. This frame is illustrated in Fig. 4 and consists of upper and lower clamping plates 17 and 18 held together by headed bolts 19 which are provided with wing nuts 20, the matrix resting upon contact plate 21 which is electrically connected by wire 22 with one bolt 19 and leading-in wire 23. Upper and lower rings 24 and 25 of insulating material are secured within plates 17 and 18 respectively and conductive coatings are applied to such parts of these rings and of the plate 18 as it is intended shall receive a metallic deposit to form the shell or positive record 26.

The anode 27 of copper, zinc, iron, or other suitable metal is inserted within the frame and connected to leading-in wire 28, and the whole is placed in a cold plating bath, and a thin coating or shell 26 of the anode metal is plated upon the matrix and adjacent parts, as shown. The plating bath should be maintained at a constant temperature, preferably below 50 degrees F., as is described in my application Serial No. 516,309, filed September 4, 1909. After the plating operation, the frame and contents are removed from the plating bath and washed, and the record removed from the matrix by warming the matrix and record sufficiently to expand the matrix out of contact with the record 26, whereupon the same may be removed from the matrix by direct longitudinal movement. Or the matrix may be forcibly expanded within its elastic limit to separate the same from the record 26 without application of heat, as described in my application Serial No. 487,360, above referred to. The record may be used as formed; or, if desired, it may be suitably backed by well known means with the backing 29. The matrix, after the removal of the metallic shell, is uninjured, and may be cleaned and dried and used in the manner described for an indefinite number of times for producing metallic records.

Having now described my invention, what I claim and desire to protect by Letters Patent is as follows:

65 1. The process of duplicating phonograph

records which consists in forming a temporary matrix around a master record, removing the master record, forming a metallic master within the temporary matrix, removing the latter, forming a permanent matrix around the metallic master of a substance whose coefficient of expansion is relatively high as compared with metals, removing the metallic master, forming metallic duplicate records within said permanent matrix, applying heat to separate the records from the matrix by relative change of diameter, and removing the records from the matrix by relative longitudinal movement, substantially as described.

2. The process of duplicating phonograph records which consists in casting about a metallic master record a matrix of a substance whose coefficient of expansion is relatively high as compared with metals, removing the metallic master, forming metallic duplicate records within said permanent matrix, applying heat to separate the records from the matrix by relative change of diameter, and removing the records from the matrix by relative longitudinal movement, substantially as described.

3. The process of duplicating phonograph records which consists in casting about a metallic master record a matrix of a non-metallic substance whose coefficient of expansion is relatively high as compared with metals, and which is not attacked by certain plating baths, removing the metallic master and depositing within the matrix formed a deposit of a metal from a plating bath by which the substance of the matrix is not attacked to form a metallic duplicate record, substantially as described.

4. The process of duplicating phonograph records which consists in casting about a metallic master record, a matrix of a non-metallic substance whose coefficient of expansion is relatively high as compared with metals, and which is not attacked by certain acids and certain plating baths, dissolving away the metallic master in an acid which does not attack the matrix, electrolytically depositing within the matrix a deposit of a metal from a plating bath by which the substance of the matrix is not attacked to form a metallic duplicate record, and separating the latter from the matrix by relative change of diameter, substantially as described.

5. The process of duplicating phonograph records which consists in casting about a metallic master record a matrix of a non-metallic substance whose coefficient of expansion is relatively high as compared with metals, which is not attacked by certain acids, and which has a high melting point, dissolving away the metallic master in an acid which does not attack the matrix, forming a metallic duplicate record within the matrix, and applying heat to separate the

record from the matrix by relative change in diameter of the record and matrix, substantially as described.

6. The process of duplicating phonograph records which consists in casting about a metallic master record a matrix of a non-metallic substance whose coefficient of expansion is relatively high as compared with metals and which is not attacked by certain plating baths, separating the matrix thus formed from the metallic master, depositing within the matrix a deposit of a metal from a plating bath which does not attack the matrix to form a metallic duplicate record, and separating the record from the matrix by relative change in the diameters of the record and matrix, substantially as described.

7. The process of duplicating phonograph records which consists in forming about a metallic master record a matrix of a material whose coefficient of expansion is relatively high as compared with certain metals, separating the matrix thus formed from the metallic master, forming within the matrix a duplicate record of a metal whose coefficient of expansion is low as compared with that of the matrix, and applying heat to separate the record from the matrix by relative change in the diameters of the record and matrix, substantially as described.

8. The process of duplicating phonograph records which consists in forming a master record of a substance having a high melting point, forming in a plastic condition about the latter a matrix of a substance which is plastic in one condition and which is transformed by chemical action into another condition in which it is hard and infusible by heat treatment, applying the said heat treatment to cause the matrix to become hard while on the master record, and separating the master from the matrix, substantially as described.

9. The process of duplicating phonograph records which consists in forming a master record of a substance having a high melting point, forming in a plastic condition about the latter a matrix of a phenol condensation product, applying heat treatment to transform the matrix into a hard, durable inert condition, and removing the master therefrom, substantially as described.

10. The process of duplicating phono-

graph records which consists in forming a master record of a substance having a high melting point, forming in a plastic condition about the latter a matrix of a phenol condensation product, applying heat treatment to transform the matrix into a hard, durable inert condition, removing the master therefrom, forming a metallic positive record within the matrix, applying heat to the record and matrix and separating the same, substantially as described.

11. The process of duplicating phonograph records which consists in forming a master record of a substance having a high melting point, forming in a plastic condition about the latter a matrix of a phenol condensation product, applying heat treatment to transform the matrix into a hard, durable inert condition, dissolving away the master, depositing electrolytically a metallic positive record within the matrix and separating the record from the matrix by causing relative change in their diameters, substantially as described.

12. The process of duplicating phonograph records which consists in forming a master record of a substance having a high melting point, forming in a plastic condition about the latter a matrix of a substance which hardens by chemical action under heat treatment and has a relatively high coefficient of expansion as compared with metals, heating the matrix to harden the same while on the master record, and removing the master record therefrom, substantially as described.

13. The process of duplicating phonograph records which consists in forming a master record of a substance having a high melting point, forming in a plastic condition about the latter a matrix of a substance which hardens by chemical action under heat treatment and has a relatively high coefficient of expansion as compared with metals, introducing heat inside the matrix to harden the same while on the master record, and removing the master record therefrom, substantially as described.

This specification signed and witnessed this 14th day of September, 1909.

JONAS W. AYLSWORTH.

Witnesses:

DYER SMITH,

JOHN M. CANFIELD.

Correction in Letters Patent No. 1,060,577.

It is hereby certified that in Letters Patent No. 1,060,577, granted May 6, 1913, upon the application of Jonas W. Aylsworth, of East Orange, New Jersey, for an improvement in "Processes of Making Duplicate Phonograph-Records," an error appears in the printed specification requiring correction as follows: Page 3, line 13, for the word "graphic" read *graphite*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of June, A. D., 1913.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.