No. 667,662. Patented Feb. 5, 1901.

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAPH RECORDS.

(Application filed May 8, 1900.)

(No Model.)

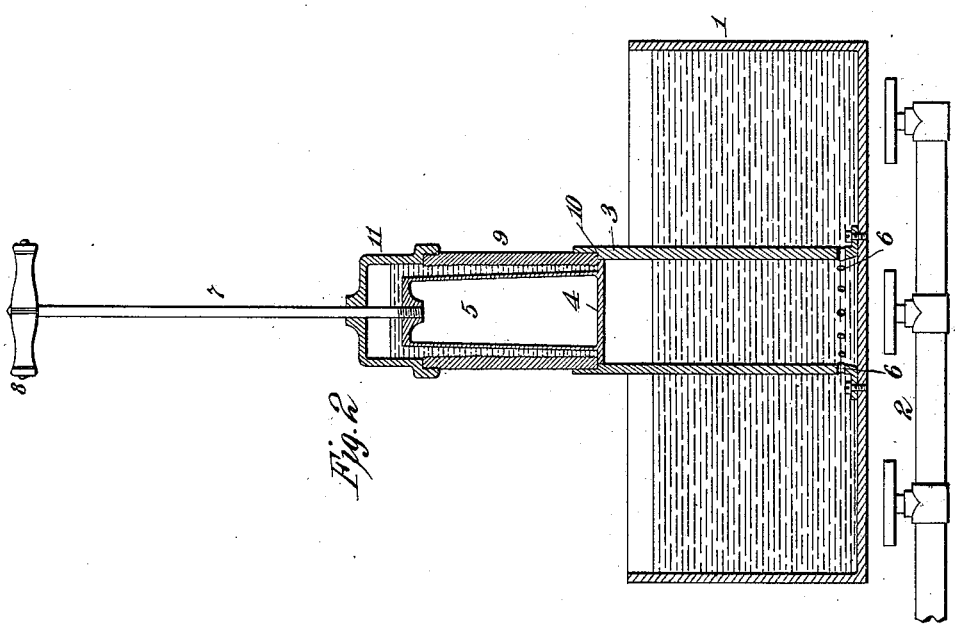

Fig. 2

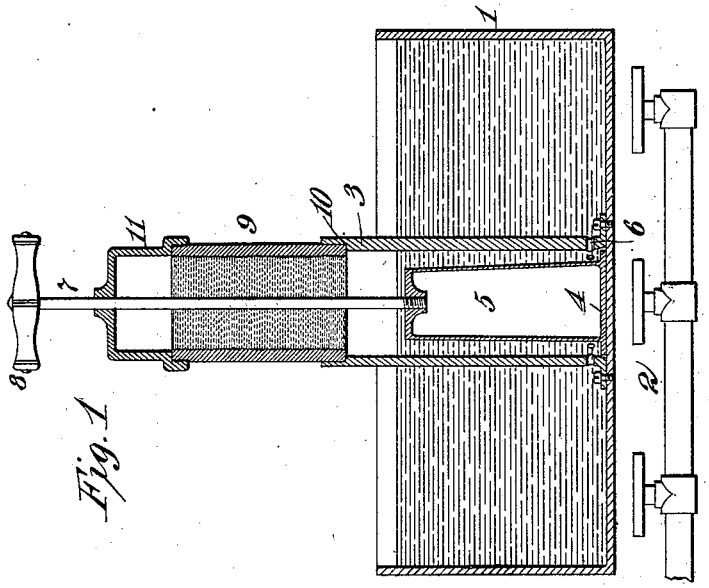

Fig. 1

Witnesses:

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THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PROCESS OF DUPLICATING PHONOGRAPH-RECORDS.

SPECIFICATION forming part of Letters Patent No. 667,662, dated February 5, 1901.

Application filed May 8, 1900. Serial No. 15,874. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, county of Essex, and State of New Jersey, have invented a certain new and useful Improved Process of Duplicating Phonograph-Records, (No. 1,036,) of which the following is a specification.

My invention relates to an improved process for duplicating phonograph-records, and the process is of the character covered by my Patent No. 484,582, of October 18, 1892, wherein a matrix of an original record is employed as a mold for the making of the duplicates. In the specific process described in my previous patent the matrix secured from the original record is divided longitudinally, so as to form a sectional mold in which are cast the desired duplicates. My present invention is designed specifically as an improvement on said process, and my object is to provide a process wherein the production of the duplicate records will be facilitated and wherein the character of the resulting duplicates will be improved, since the mold used is continuous on its bore.

My present process depends upon the fact that after a molten metallic soap or a mixture of soaps or other suitable material has been introduced within a mold carrying the representation of a phonographic record in relief on its bore and allowed to set a sufficient contraction of the resulting duplicate can be secured as to permit of a longitudinal separation of the duplicate from the mold, whereby a continuous mold can be employed for the carrying on of the process.

In order that my invention may be better understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a sectional view of a suitable apparatus for the purpose, illustrating the plunger and piston in their lowermost position; and Fig. 2, a similar view showing the same parts in their elevated positions.

In both the above views corresponding parts are represented by the same numerals of reference.

The apparatus illustrated in the figures is designed for the duplicating of cylindrical phonographic records, and it will be so described; but the applicability of my process for the duplication of other varieties of records will be apparent to those skilled in the art.

In the drawings, 1 represents a suitable jar or tank of the proper dimensions and made of any desired material. Within the jar or tank 1 I place the material of which the duplicate records are to be formed and which may be maintained in a molten condition by the application of heat in any way—as, for example, by a gas-tube 2, supplying a number of jets, as shown. The proper level of the molten material is indicated, and this level should be approximately maintained by the addition of fresh material from time to time within the tank as the liquid material may be withdrawn during the operation. The material in the tank 1 and of which the duplicate records are to be formed may be of any suitable character; but preferably it is a metallic soap or a combination of several soaps to which has been added a material not affected by water, such as ceresin, whereby the resulting duplicates will be protected from the effects of atmospheric moisture. Mounted within the tank and secured to its bottom is an open-ended cylinder 3, in which works a piston 4. A tapered core 5 is connected to or formed integrally with the piston 4, and said core is preferably hollow, so as to present a thin wall to the material, whereby the core will very quickly reach the temperature of the molten material when it is immersed therein. A number of openings 6 are formed in the cylinder 3, near the bottom thereof, below which openings the piston 4 passes in reaching its downward position, as shown in Fig. 1, whereby the liquid material may flow through said openings into the cylinder above the piston. Connected to the core 5 is a plunger 7, having an operating-handle 8. The connection between the core and plunger is such as will permit a separation of these parts, ordinary screw-threads being shown.

9 represents a mold which rests within a shoulder 10, formed at the top of the cylinder, and which mold carries on its bore the representation in negative or relief of a phonograph-record which it is desired to duplicate. This mold is preferably obtained by

the process described in my application for Letters Patent filed March 5, 1898, Serial No. 672,650, by first depositing upon the original record a suitable metal in the form of an infinitesimally-thin film by a process of vacuous deposit, by then electroplating or otherwise securing upon the film so obtained a sufficiently thick layer of the same or different metal, and by then properly backing up the metal so deposited or otherwise applied to the vacuous film either before or after the separation of the original record from the inclosing coating of metal either by contracting the record or by melting it out or in any other suitable way. The advantage of making a matrix or mold by first depositing upon an original phonograph-record a metal by a process of vacuous deposit is that an absolutely accurate copy in negative of such record will be produced irrespective of the fineness thereof. The mold 9 is preferably made of sufficient mass or thickness as to effectively chill the molten material when the latter is introduced therein, as I shall explain. Carried by the upper part of the mold is an inclosing cap 11, which may be secured onto the mold and which forms a bearing for the plunger 7.

In carrying out my improved process with an apparatus of this type I prefer to proceed substantially as follows: Molten material being placed within the tank or jar 1 is maintained in its liquid or fluid condition by the application of heat. The mold 9, being exposed to the atmospheric temperature, is relatively cold. The plunger 7 is first depressed, so as to force the piston 4 downward within the cylinder, ejecting the liquid material from beneath it, which material passes out through the openings 6. The bore of the cylinder 3 may, as shown, be slightly enlarged below the openings 6, so as to permit the piston 4 to pass beneath the same. As soon as the piston 4 passes below the openings 6 the molten or fluid material enters the cylinder above the piston, so as to fill the cylinder to the level of the liquid in the tank or jar. Owing to the thin wall of the core 5 the latter will almost immediately reach the temperature of the molten material, so that said core will not chill the latter. If a solid core is used, it will require to be immersed within or below the surface of the liquid material for a longer time to enable its temperature to reach that of the molten mass; but with this exception the process will be equally operative with a solid core as with a hollow core.

Assuming the hollow core to be used and that its temperature reaches that of the molten material almost immediately, the plunger 7 will be elevated, so as to carry the charge of molten material above the piston into the mold, as shown in Fig. 2, a greater or less excess of material passing above the mold into the cap 11. By employing the cap 11 it will be obvious that the level of the liquid material in the tank or jar may be varied considerably without affecting the operation. The liquid molten material entering the mold 9 will engage all portions of the record formed on the bore thereof, and the materially lower temperature of the mold will result in the almost instantaneous chilling of the surface of the molten material therein. In order to facilitate this surface-chilling of the liquid molten material entering the mold, the latter may be actually cooled by artificial means below atmospheric temperature—as, for instance, by the circulation of cold water through a water-jacket surrounding the mold or by a blast of cold air equably directed to all portions of the mold. The chilling of the surface of the molten material in the mold results in the setting of the positive impression thus secured from the negative record. The chilling of the molten material in the mold progresses toward the center, and any contraction in bulk will be compensated by the surplus material within the cap 11. As soon as the material within the mold has been chilled throughout the entire thickness thereof the material with the piston, core, cap, and plunger are removed from the cylinder, and the material is allowed to cool by exposure to a cold atmosphere or by an air-blast until the solidified material has contracted away from the bore of the mold, so as to permit it to be removed therefrom by forcing the plunger downward. The plunger is then removed from the core, and the latter is extracted from the cast duplicate, carrying the positive record on its periphery before the material has contracted sufficiently upon the core as to prevent this separation. Since the conductivity of heat from the material is effected slowly, the outer surface of the molded duplicate becomes hard and set, while the inner portion thereof next to the core is still in a relatively plastic condition, so that this separation of the core can with ordinary care be readily effected. The resulting duplicates thus secured after reaching the normal temperature are properly dressed at the ends and are reamed internally to the proper size, being then ready for use.

With records made by my process the contraction of the material radially to separate it from the mold is accompanied by a considerable longitudinal contraction following the instant when the surface is first set by the chilling effect of the mold and progressing until the material reaches the normal temperature, such shrinkage being approximately one per cent. with ordinary blanks. For this reason it is desirable that the original record from which the matrix is made is formed on a phonograph or allied talking-machine having a fewer number of threads on its feed-screw than the instrument on which the duplicates are finally used, in order that when the contraction has progressed to its finality the pitch of the record-thread on the duplicate will correspond to the pitch of the feed-screw of the reproducing-machine or approximately to that pitch, it being possible

with modern reproducing apparatus to effect a satisfactory reproduction from a record, even when the pitch thereof differs slightly from that of the feed-screw of the machine. The pitch of the feed-screw of the machine on which the original record is made will differ from the pitch of the feed-screw of the machine on which the resulting duplicates are to be used to an extent depending upon the coefficient of contraction of the material used and will be determined by experiment with the material employed. It will be of course understood that after the mold has been removed from the cylinder and the separation of the cast duplicate is being effected therefrom a new mold and its accompanying parts may be inserted in place upon the cylinder, and the operations repeatedly carried on therewith.

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

1. The process of duplicating cylindrical phonographic records, which consists in first making an original record with a spiral record-groove of greater pitch than that desired on the duplicate to be produced, then in making a hollow cylindrical matrix or mold from said original record, carrying the record in negative on its bore, and in finally making duplicate records from the matrix or mold by introducing therein and engaging therewith material maintained in an abnormally high temperature, whereby the cooling of such duplicate will contract the pitch of the record-groove, as and for the purposes set forth.

2. The process of duplicating phonographic records, which consists in securing a mold containing the record in negative on its bore, in introducing a molten material in the mold to receive a surface impression from such record, in allowing the molten material to set, in contracting the set material, and in separating the contracted molded material by a longitudinal movement, substantially as set forth.

3. The process of duplicating phonographic records, which consists in securing a mold having a record in relief in negative on its bore, in introducing a molten material in the mold around a core, in allowing the molten material to set, in contracting the set material, in removing the contracted material and the core from the mold, and in separating the core from the molded material, substantially as set forth.

4. The process of duplicating cylindrical phonograph-records, which consists in forming a cylindrical mold with a record in negative on its bore, in introducing a molten material in the mold to form a cylindrical duplicate, in allowing the duplicate to set, in contracting the duplicate, and in removing the contracted duplicate by a direct longitudinal movement, substantially as set forth.

5. The process of duplicating cylindrical phonograph-records, which consists in forming a cylindrical mold having the record in negative on its bore, in introducing molten material in the mold around a core, whereby a hollow cylindrical duplicate will be formed, in allowing the molten material to set, in contracting the molten material, and in withdrawing the contracted material from the mold by a direct longitudinal movement, substantially as set forth.

6. The process of duplicating cylindrical phonograph-records, which consists in forming a cylindrical mold carrying the record in negative on its bore, in introducing a molten material in the mold around a core, in allowing the material to set, in contracting the material, in withdrawing the contracted material and core from the mold, and in separating the core from the resulting duplicate, substantially as set forth.

7. The process of duplicating cylindrical phonograph-records, which consists in making a cylindrical mold carrying a record in negative on its bore, and of sufficient mass to produce a chilling effect on molten material introduced therein, then in introducing within the mold a molten material, the surface of which becomes chilled by contact with the mold, then in contracting the duplicate so formed, and finally, separating the duplicate from the mold by a direct longitudinal movement, substantially as set forth.

8. The process of duplicating cylindrical phonograph-records, which consists in securing a mold carrying a record in negative on its bore, and of sufficient mass to produce a chilling effect on molten material introduced therein, then in introducing within the mold around a core a molten material, the surface of which is chilled by contact with the mold, then in contracting the material, then in removing the contracted material and core from the mold, and in finally separating the core from the material, substantially as set forth.

9. The process of duplicating cylindrical phonograph-records, which consists in maintaining in a molten condition a mass of material from which the duplicates are to be made, in sustaining a mold over the mass of molten material, said mold carrying on its bore a record in negative, in successively elevating a part of the mass of molten material into the mold, in allowing such molten material within the mold to set, in contracting the set material, and in withdrawing the resulting duplicate from the mold by a direct longitudinal movement, substantially as set forth.

This specification signed and witnessed this 30th day of April, 1900.

THOS. A. EDISON.

Witnesses:
J. F. RANDOLPH,
FRANK L. DYER.