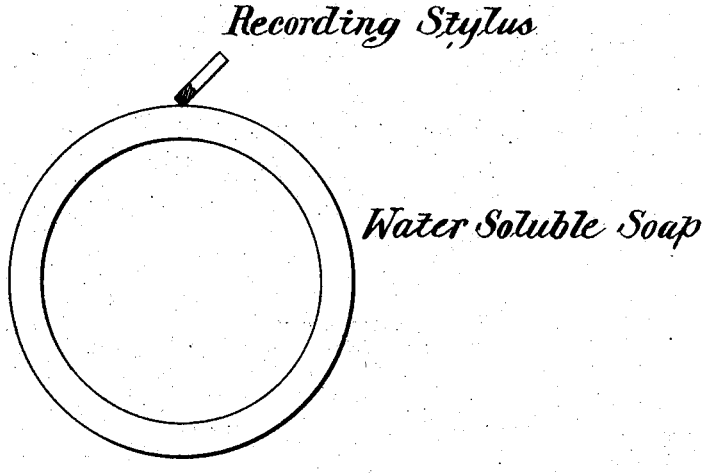
No. 790,351. PATENTED MAY 23, 1905.

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAPHIC RECORDS.

APPLICATION FILED FEB. 11, 1903.



Witnesses
Edgworth Bercene
Delos Holden

Inventor
Thomas A. Edison
By his Attorney
Frank L. Dyer

No. 790,351. Patented May 23, 1905.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY, ASSIGNOR TO NEW JERSEY PATENT COMPANY, OF ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

PROCESS OF DUPLICATING PHONOGRAPHIC RECORDS.

SPECIFICATION forming part of Letters Patent No. 790,351, dated May 23, 1905.

Application filed February 11, 1903. Serial No. 142,928.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Processes of Duplicating Phonograph-Records, of which the following is a specification.

My present invention relates to an improved process for duplicating phonograph-records from a matrix or mold, and particularly to the production of an improved master from which the matrices or molds are made.

The object of the invention is to produce an original master carrying a cut record corresponding accurately to sound-waves and free from extraneous surface variations or disturbances, so that no sound will be reproduced other than that representative of the true record. When a matrix or mold is made so as to faithfully copy such a master, as I shall describe, the resulting duplicates obtained from the matrix or mold by any well-known process are superior to records as now made, whether original or duplicate, in a number of respects to be presently pointed out.

I find that in order to produce an absolutely perfect master from which a corresponding matrix or mold can be subsequently made it is necessary to employ a material or substance which is perfectly amorphous and without crystallization, that is uniform in structure at least for a sufficient depth within its surface to receive the record, that has sufficient adhesion to permit a substantially continuous shaving to be cut by the recording device, and that, finally, is of such a character as to be readily cut by the recorder in order that the latter may form a perfectly smooth record, which while representative of the true vibrations shall not possess superfluous surface variations that at the present time and with present materials produce scratching and other extraneous sounds. When a material of this character is employed from which to construct the master, I find that owing to its relatively soft character much less power is required to cut it, so that all of the sound-vibrations will be recorded, even those representing the very weak overtones of musical instruments, also that the depth of the record can be considerably increased, so as to thereby permit very loud sounds to be recorded without danger of the recorder vibrating clear of the surface, and finally that a perfectly smooth record will be cut, even when very deep, with a substantially continuous chip, so as to entirely eliminate the scratchy sounds now due to the mere cutting of the present material.

Preferably the invention consists in the employment for the manufacture of the master of a neutral or nearly neutral soap soluble in alcohol and in hot water and by preference a soda-soap and in the manipulation of this material to put it into the required form for use in receiving a sound-record.

Reference is hereby made to the accompanying drawing, which illustrates diagrammatically the formation of a master-record according to one form of my invention.

In carrying the invention into effect I prefer to proceed as follows: Any of the finer qualities of the soaps of commerce are cut in thin slices, and, if necessary, are dried. Some of these soaps, like Pears's soap, for example, contain so little water that a special drying is not necessary. The dry sliced material is now dissolved in ethyl alcohol maintained in a heated state by hot water—in a water-jacket, for instance—until the alcohol is nearly saturated. A small quantity of water is added to clear the solution, which is then filtered through a fine cloth in a funnel heated by a surrounding water-jacket. The filtered solution is now heated in any suitable way until enough alcohol is evaporated to result in the production of a viscous mass capable of being cast into a blank by any of the well-known casting processes now used for manufacturing phonograph-blanks. These blanks may be either disk-like or cylindrical or of other form, according to the particular kind of records which are to be made. The blank after it has become cool is hard and firm enough to maintain its shape under normal conditions, its hardness depend-

ing upon the amount of water and alcohol remaining in the material. Blanks made in this way are now turned roughly to their approximate desired size and are allowed to season in a warm room for several days, during which they become gradually harder, due to further loss of alcohol and water. The blanks are then ready for use after they have been turned to the proper size for receiving the record. Phonograph-blanks made in this way are transparent, perfectly amorphous, non-crystalline, and uniform in structure throughout, and they are capable of receiving a record of sound-vibrations whose track is perfectly polished. In these respects blanks or records made as I now suggest are distinguished from blanks or records made of the recording material now universally used, since the latter is not soluble in water, is very hard and semi-crystalline, and results in the formation of a record which on reproduction produces scratchy and extraneous sounds in addition to those constituting the record itself.

Phonograph-blanks produced as I suggest are now used for receiving a sound-record made in any suitable sound-recording machine, either of the phonograph type, in which a record of varying depth is formed, or of the gramophone type, in which a sinuous record of substantially uniform depth is formed. In the making of original records at the present time, whether for use as masters or not, the ordinary wax-like material is quite friable, so that the material is removed by the recorder in the form of short chips. The removal of the material in this way makes the record-groove quite rongh, and this roughness of the record-groove is materially increased if the recorder cuts too deeply into the material. Consequently at the present time very loud records are more scratchy than softer ones. With my improved recording material as used by me, owing to its relative softness, the recorder cuts out a practically continuous shaving and makes a perfectly smooth track, and this is true even if the cut of the record is quite deep. Consequently by the use of the new material I am enabled to employ recorders having a diameter as low as .015 of an inch, whereby I am enabled, with no increase in the power used, to cut a record at least twice as deep as is now possible with the recorders of standard size—namely, about .040 of an inch in diameter.

The new material I find is too soft to permit of direct reproduction by a reproducing device, since the small waves will be immediately obliterated by the reproducer. I therefore use a record obtained as described as a master from which to construct a matrix or mold. To this end, therefore, I first provide the master with a conducting-coating, preferably by a process of vacuous deposit, as described in my Patent No. 713,863, dated November 18, 1902. The coating thus formed is extremely thin and is so uniform that it follows all the variations of the record, however minute. Besides this a conducting-coating, if applied in this way, is so smooth and polished that when incorporated in the record-surface of the matrix or mold it will not of itself produce any extraneous sound. Having coated the master with a conducting-film, I now electroplate copper thereon until a layer of the desired thickness is secured, after which the original master is removed either by shrinking or dissolving it out. The matrix or mold is now preferably backed up by a protecting-shell and is used for the production of duplicates in any well-known way, formed of the usual hard, wax-like materials. For instance, the matrix or mold can be employed for making duplicates by an expanding process, as specifically described in my Patent No. 713,209, dated November 11, 1902, in which a blank is engaged loosely with a matrix and expanded by heat and pressure to take an impression therefrom, after which the duplicates are contracted radially so as to clear the record on the matrix, from which they are then removed, or in connection with a casting process, as described in my Patent No. 667,662, dated February 5, 1901, in which molten wax-like material is introduced into a mold and allowed to set therein, after which the resulting duplicate is contracted, so as to clear the record on the mold, from which it is then removed, or in connection with any other desired process by which a duplicate record can be obtained from a matrix or mold. In any event the duplicates so produced will be superior to those made at the present time from matrices or molds secured from masters composed of the usual hard wax-like material in the following respects: First, owing to the amorphous, non-crystalline, and uniform character of the master the record formed therein will be free from extraneous sounds, and this will also be true of the resulting duplicates; second, owing to the fact that the master is formed of comparatively soft material the record made therein is more nearly representative of the sound-vibrations than is possible with harder materials, so that the resulting duplicates will more faithfully reproduce the original sounds, including even the finer overtones of musical instruments; third, owing to the ease with which the material can be cut the record formed in the master can be made very deep, so that the reproductions obtained from the resulting duplicates will be correspondingly increased in volume.

While I have described as the preferred material one formed by the dissolving of a soluble soap, by then clarifying the solution, and by finally evaporating the solvent, it will be understood that other soluble, amorphous, non-crystalline, and uniform substances may be employed either alone or in addition to

soap, by which harder or softer blanks can be obtained.

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

1. The process of making a phonograph-record which consists in obtaining a mass of exceedingly soft material, hardening the same until it is hard enough to receive a polished surface from a cutting tool or stylus, but is not hard enough to be capable of reproduction, and recording sound-waves therein while in the latter condition, substantially as set forth.

2. The process of duplicating sound-records which consists in obtaining a mass of exceedingly soft material, hardening the same until it is hard enough to receive a polished surface from a cutting tool or stylus, but is not hard enough to be capable of reproduction, recording sound-waves thereon while in the latter condition to form a master, making a matrix or mold from said master and finally in impressing the negative record carried by the matrix or mold in the surface of the desired duplicates, substantially as set forth.

3. The process of making a phonograph-blank, which consists in dissolving a water-soluble soap in hot alcohol to saturation, in then molding the blanks therefrom, and in finally partially evaporating the solvent, substantially as set forth.

4. The process of making a phonograph-blank, which consists in dissolving a water-soluble soap in hot alcohol to saturation, in filtering the clear solution, in partially evaporating the solvent to form a viscous mass, in molding the mass into shape, and in finally partially evaporating the remaining solvent, substantially as set forth.

5. The process of duplicating sound-records which consists in dissolving a water-soluble soap in hot alcohol to saturation, molding a phonograph-blank therefrom, partially evaporating the solvent from said blank, cutting a record-groove therein to form a master, making a matrix or mold from said master and finally impressing a negative record carried by said matrix or mold in the surface of the desired duplicate, substantially as set forth.

This specification signed and witnessed this 30th day of January, 1903.

THOMAS A. EDISON.

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