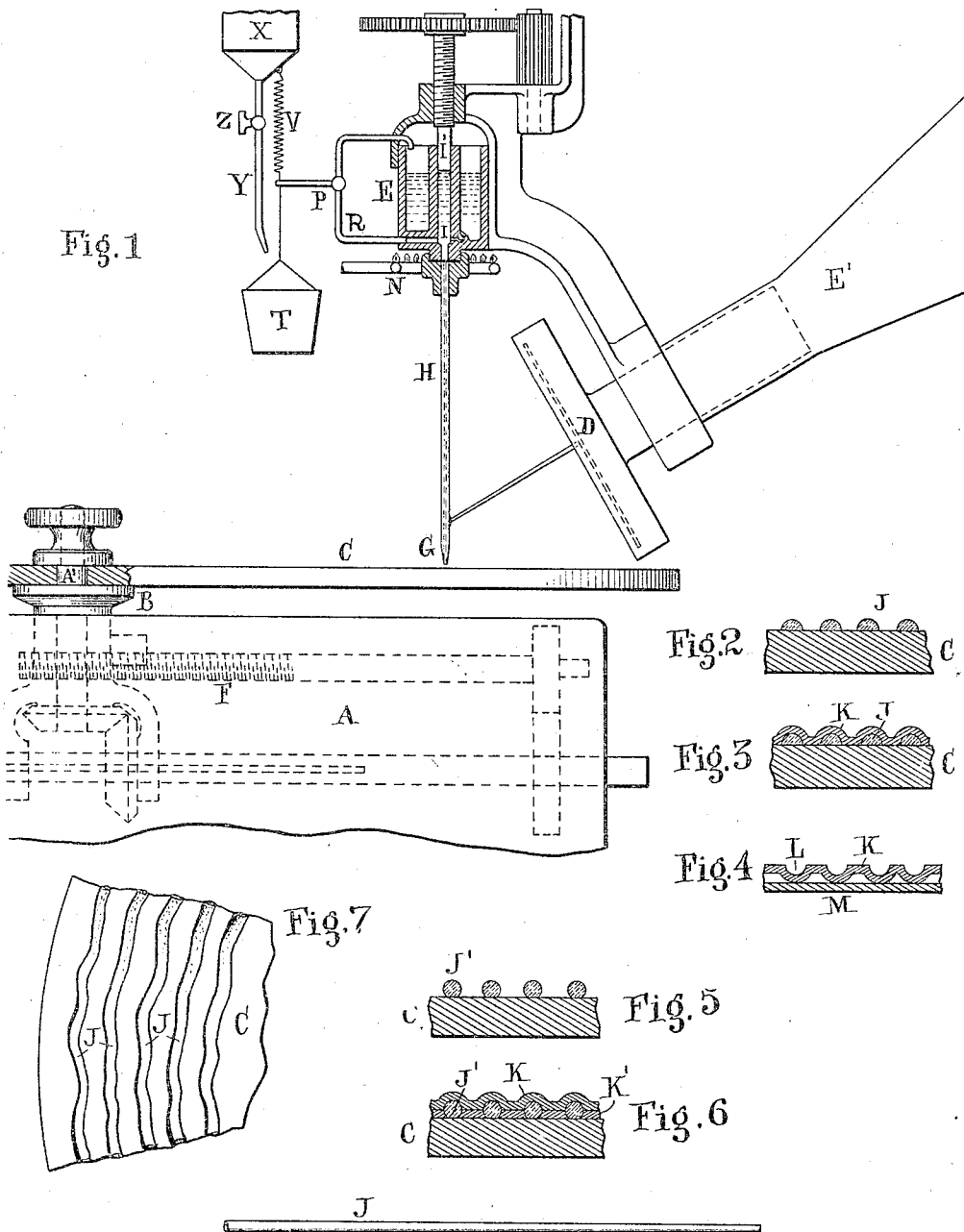


R. L. GIBSON.
 MANUFACTURE OF RECORDS FOR SOUND REPRODUCING MACHINES.
 APPLICATION FILED AUG. 17, 1907.

943,631.

Patented Dec. 14, 1909.



Witnesses

Daniel Webster, Jr.

A. T. Driscoll.

Fig. 8

Robert L. Gibson

By

W. H. Parker

Attorney

UNITED STATES PATENT OFFICE.

ROBERT L. GIBSON, OF PHILADELPHIA, PENNSYLVANIA.

MANUFACTURE OF RECORDS FOR SOUND-REPRODUCING MACHINES.

943,631.

Specification of Letters Patent.

Patented Dec. 14, 1909.

Original application filed June 14, 1907, Serial No 379,712. Divided and this application filed August 17, 1907. Serial No. 398,001.

To all whom it may concern:

Be it known that I, ROBERT L. GIBSON, of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in the Manufacture of Records for Sound-Reproducing Machines, of which the following is a specification.

My invention has reference to the manufacture of records for sound reproducing machines, and consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

This application is a division of my application, Serial No. 379,712, filed June 14, 1907.

Heretofore, in the manufacture of gramophone records, namely, those of disk form having a spiral groove in their face for operating a stylus of the sound box, two general methods of manufacture have been employed. The first of these relied upon the etching process, and consisted essentially of floating upon the surface of a polished disk of zinc a thin greasy or waxy coating, such as may be produced by a wax dissolved in alcohol or other solvent, and after subjecting the surface so produced to the stylus of a recording machine vibrated in accordance with sound waves whereby the spiral tracing so formed will expose the zinc, etching the exposed surface to form a spiral groove having lateral undulations which correspond to the tracing of the stylus. The etched disk so produced is then cleaned and subjected to an electroplating operation, such as employed in electrotyping, and an inverse matrix is produced which, after being backed to strengthen it, may be subsequently employed as a die from which to impress in hard rubber or equivalent compounds a record groove which may be used in the reproducing machine, such as the ordinary gramophone. In this manner, duplicates from the master record may be employed in reproducing the sound waves. Great objection, however, has always resulted from the fact that in any etching process, the lateral walls are under-cut owing to the fact that the acid eats laterally as well as vertically, and consequently the records produced under this process have not been considered satisfactory, and the process has been super-

seded. The second process, and which is that commonly employed at the present time, comprises the following steps: A disk is coated with a waxy compound, such as metallic soap, capable of being engraved, and after being carefully smoothed and leveled, the stylus of the recorder acting as an engraving tool is caused, through the rotation of the disk, to engrave a spiral groove therein of even depth and with lateral undulating side walls. This engraved disk is then dusted with plumbago and subjected to an electroplating process by which a matrix is produced having a raised spiral upon its surface; the said master matrix after being backed and strengthened is in a form capable of being used as a die for reproducing in suitable earthy compounds resembling hard rubber, duplicate records suitable for use in connection with the reproducing machine, such as the ordinary gramophone. Ordinarily, this master matrix in copper, secured by the electroplating process, is not employed as the die because it would soon wear out, and as there would be then no way of securing an accurate duplicate (since the wax engraved disk would have been injured or destroyed), it has been customary after producing the first matrix in copper to employ the same to impress one or more additional wax tablets with the spiral groove lines and to produce "dubbed" matrices from these wax impressions by further electroplating, the "dubbed" matrices so produced being then employed as the dies in the duplicating processes employed later on in the commercial manufacture.

In the first process above mentioned, in which etching was employed, it has also been customary to "dub" the matrix as desirable results would not be secured by attempting to use the zinc disk after etching more than in the first instance. In such case, the copper matrix produced from the zinc was employed to produce duplicate dies by "dubbing" operations in which the die was impressed in wax surfaces which were subsequently electroplated, thereby multiplying the defects. In no case in these prior methods has the copper matrix, produced from the engraved or etched disk, been capable of use with a gramophone instrument, as they did not have embodied in their construction a groove to receive the stylus. Moreover,

the "dubbing" operations, which have universally been employed, introduced undesirable defects and multiplies existing defects which may have been inherent in the original matrix, into the commercial records 5 which are produced from the "dubbed" dies, and this is important because the very slightest irregularity in the grooves will produce marked defects in the reproduction of sound, as is well known to those skilled in the art.

The object of my invention is to overcome the existing objections in the manufacture of commercial records and to produce records in a commercial manner and form which shall 15 be more accurate in their reproductions.

Generally stated, my invention comprehends a record tablet produced by the following process: A polished surface of a rotating disk has a line-like layer of a substance of a plastic or fluid condition fed upon it through a stylus kept in a state of vibration by the recording diaphragm of a recording machine, the layer being received 25 upon the plate in the form of a spiral and in such a manner that it has undulations corresponding to the sound waves. This substance may be forced through the stylus under great pressure, if so desired. The spiral layer thus deposited upon the surface of the disk is then employed with the disk as a mold or form upon which an electrodeposition of copper is made, the copper bridging over the spiral layer. When the proper 30 thickness of copper is provided, it is then stripped from the disk in the form of a sheet and such of the spiral layer as may adhere to the copper sheet is removed by suitable solutions, and the copper record so made forms a permanent master record. 40 This metal record is a disk with a spiral groove in its surface which is in the most perfect form for reproducing sound by use of a gramophone instrument. As it is the original grooved copper record and as the recorded spiral has been destroyed, it is not advisable to use this master record as a matrix or die, and I therefore produce an electroplated disk which is a matrix in the 50 form of a die by plating copper, nickel or other metal upon the surface of this grooved metal record, producing thereby a matrix with a raised spiral corresponding to the original disk with the recorded spiral laid thereon. This matrix so produced may be 55 stripped from the original grooved copper record, and, after being backed, it may be employed as a die from which to make duplicate record tablets in suitable earthy composition resembling hard rubber, which 60 may be directly employed in connection with the reproducing gramophone instrument.

Where the primary spiral was laid upon 65 the revolving disk of a material which was

sufficiently hard to withstand reasonable pressure, the original disk so prepared may be employed to directly take an impression of the sound record in a wax surface, and this may be electroplated similarly to electrotyping, and the dies so produced employed for reproducing in earthy composition resembling hard rubber, as above. However, as in this case there is danger of the original record becoming destroyed by 75 repeated use, it is preferable to produce an electroplated master record from which future dies may be reproduced, and this would be preferably done by preparing a copper reverse with the spiral groove by electroplating and employing said grooved metal 80 master record for preparing any number of dies from which to make the commercial record tablets in earthy or hard-rubber-like compositions. 85

In case the spiral layer, laid upon the revolving disk under the action of the recorder, should be of rope-like form, that is to say, its sides having under-cut portions adjacent to the metallic disk, then in that 90 event it is customary to electroplate the record tablets so produced until there is a deposition of copper upon the plate and around the spiral rope-like layer to the depth approximately to the middle of the 95 rope-like layer, and then by interrupting the deposition and allowing the surface to become oxidized or coated with a solution of poor conductivity, and repeating the electroplating operation until the entire surface 100 including the rope-like portions are covered with copper, the outer or upper layer of deposited copper may be stripped from the first or lower layer and after being flattened and suitably backed be employed as the 105 grooved master metal record in the manner hereinbefore referred to. It is also evident that the lower layer of the deposited copper, coupled with the disk, will form a grooved master metal record which may also be employed when cleared of the rope-like material, as a master metal record from which 110 to make the dies. In this case the spiral would run from left to right instead of right to left, and the turn-table with the record 115 disk would have to be rotated in reverse direction. It will be seen that in the manufacture of grooved record disks in this manner, the grooves will be very smooth since they partake of the smoothness of the rope-like or other layer deposited by the recording stylus. The result of this smoothness is the elimination of scratchy sounds in the reproduction of music or words by the gramophone instrument and which scratchy sounds 125 so objectionably dominate reproductions from record tablets made by the processes first above referred to employing etching and engraving as the preliminary operations.

Another feature of my invention is the 130

production of a record groove which is wider as we approach those portions of the spiral of smaller diameter; and this is important because of the more blunt character of the stylus point of the reproducer, because of wear, when it reaches those portions of the spiral disposed more nearly toward the center of the disk. The production of this widening of the groove in a gradual manner is the result of causing the material by which the deposited spiral is made to be forced through the stylus point at a fixed rate and by the natural gradual changing of the surface speed of the disk at the point of deposition of the material. This will be understood from the fact that where the rotation of the disk is uniform, the spirals at those portions of the disk of greater diameter are naturally longer than those portions of the spiral adjacent to portions of the disk of less diameter, as each of such spirals is produced in the same time, it is evident that more material is deposited per linear inch upon the spirals of smaller diameter than upon the spirals of larger diameter, and hence will flatten out to a wider condition with the smaller spirals than with the larger. The metal record subsequently produced from this master pattern will take on the same properties. The same results may be obtained by regulating the flow of the material when the speed of the disk is uniform or varying as desired.

My invention also comprehends details which, together with the features above specified, will be better understood by reference to the drawings, in which:—

Figure 1 is an elevation illustrating diagrammatically the manner of allowing the spirals of the deposited material in the operation of a recording instrument; Fig. 2 is a cross section of a portion of the prepared master pattern; Fig. 3 is a similar cross section after the deposition of the copper preliminary to stripping; Fig. 4 is a cross section of the stripped matrix suitably backed; Fig. 5 is a cross section corresponding to Fig. 2 but in which the deposited material is in rope-like form; Fig. 6 is a similar cross section showing the manner of depositing the copper thereon in the production of the metal record; Fig. 7 is a plan view of a portion of the master record before electroplating; and Fig. 8 is a cross section of a portion of a die produced from the metal record.

A is the motor mechanism of a gramophone recording machine and while rotating the turn-table B also causes the sound box D to be traversed radially of the turn-table by the mechanical feed screw F. The sounds to be recorded are delivered into the bell-mouthed receiver E'.

G is a stylus which is supported in a vertical position and connected to the dia-

phragm of the sound box so as to be vibrated thereby. This stylus is made like a tube with an exceedingly small orifice at the bottom. The point of the stylus is held slightly above and out of contact with the metal disk C which is supported upon the turn-table or spindle A' of the motor A. The upper end of the stylus G may communicate with a reservoir I for fluid by a flexible tube H of any suitable character. The reservoir may be an open receptacle or may be in the form of a cylinder and plunger like a hydraulic ram as indicated at I' where the fluid is dense. By applying great pressure the material being forced through the stylus may be quite thick or dense. Where a more fluid material is employed, it may be incorporated with a volatile solvent so that when laid upon the disk it will quickly set and harden. Substances from which the raised line may be formed may consist of a mixture of equal parts of carnaubax wax, shellac wax and tallow, or refined asphaltum, as examples. In the apparatus shown, the plunger I' moving at a fixed speed will produce a given, constant flow at the stylus. To make this flow a minimum the valve P in the escape pipe R from the reservoir allows a maximum escape into a vessel E of the material of which the reservoir is charged. As the operation progresses the valve is gradually turned mechanically or otherwise so as to reduce the escape of material into the vessel E. This valve may be closed gradually by a weight T which may be in the form of a bucket supported by a spring V and gradually increased in weight by the dropping of water or other fluid from a tank X through a nozzle Y controlled by a valve Z. In this way the gradual lowering of the weighted bucket turns the valve P and in turn gradually restricts the escape of the material with the result of more of it being forced through the stylus upon the rotating disk to thicken the line of deposit. If desired, heat may be applied to the material during the above operation by a burner N or otherwise, as found most convenient. Any other type of apparatus may be employed for laying a thin stream of material upon the recording surface. It will now be understood that as the recording disk C is being rotated the stylus G is caused to deposit upon its surface a spiral layer of material J which if of a fluid consistency will set in the form indicated at J in Fig. 2, but if of a more solid consistency will retain a rope-like form as indicated at J' in Fig. 5.

As the deposition of this layer is accomplished without practical resistance to the vibrations of the diaphragm it is evident that the lateral undulations of the layer will conform very accurately to the sound vibrations. It is also evident that the amplitude

of these sinuosities or lateral undulations may be magnified to any degree desired by simply adapting the leverage of the stylus to meet the requirements.

5 After the master record is made as indicated in Fig. 2, it is coated with a layer of copper electrically deposited, first under very low voltage and later under higher voltage. If the disk C be of metal, the
10 copper will be deposited between the spirals J and gradually build up over them as indicated in Fig. 3. After sufficient copper is deposited, it is stripped from the disk and after being flattened is backed by a backing
15 plate M sweated on as indicated in Fig. 4. The matrix so produced will have a spiral groove in its surface as at L and this groove will be exceeding smooth and accurate to the sound waves which dictated its sinuosi-
20 ties. This matrix may be used to reproduce sounds or it may be employed from which to make dies (reverse) by electroplating as indicated at Fig. 8 which may be used for duplicating the records in compounds re-
25 sembling hard rubber or other suitable substances.

As before explained, the speed of the disk C on the recorder being uniform the surface speed under the stylus point will be gradu-
30 ally reduced as the recording proceeds so that if the fluid is forced through the stylus at a fixed rate the deposited material J will be of gradually increasing width so that the ultimate groove L will likewise be of gradu-
35 ally increased width from the beginning to the end of the spiral; but so slight and gradual is this change that it is hardly perceptible to the eye. This change in the size of the groove enables the style or needle of the
40 reproducer to more perfectly cooperate with the groove and compensate for the wearing away of its point. If the deposited material is in rope-like form as indicated at J' then the electroplated matrix K can not be di-
45 rectly made because of the under-cut portions. The copper deposit is performed in two operations, as follows: The first deposit is indicated at K' in Fig. 6 and extends up to the largest diameter of the material J';
50 the disk so prepared is then removed from the plating bath and the surface of the copper allowed to oxidize or rubbed with a solution such as alcohol and oil to deaden the metallic surface slightly, after which the
55 disk is put back in the bath and the second deposit K made to completely cover the rope-like portions J'. This latter deposit K may then be readily stripped from the part K' and backed as before described and illus-
60 trated in Fig. 4. It will also be seen that the plate with the part K' will likewise constitute a record tablet which will reproduce the original sounds.

While it is not necessary that the substance
65 of which the parts J and J' are formed shall

be conducive of electricity they may be so formed or may be subsequently, and before plating, coated with plumbago as in electroplating. As before pointed out, the parts J J' may be so hard when dried that they,
70 in conjunction with the disk C may be used as the matrix or master die for dubbing in wax in the making of a copper duplicate for subsequent use in duplicating the record
75 tablets.

Among the great advantages of my improved method of making matrix dies for the manufacture of commercial records may be stated—first,—the form of the undulations are more accurate conformations to the
80 sound waves than by engraving or etching; second,—the groove in the commercial record tablet is very smooth and eliminates scratchy sounds, thus insuring pure reproduction; third,—the master die for repro-
85 ducing may be made economically without “dubbing” and its incidental defects; fourth,—the master grooved record matrix is in copper and hence durable; fifth,—defects introduced by coating the record with
90 graphite employed in engraved wax records are prevented; sixth,—the record groove may have any magnitude of relative lateral undulations or sinuosities desired for any
95 fixed sound so that the reproduced sound may be louder and more distinct than the original sounds; seventh,—the record groove may be of gradually increasing width (and depth if desired) from beginning to end of
100 the record to suit the gradual blunting of the stylus point; eighth,—the durability of the record is increased because it, being formed without material resistance to the sound waves, will have more gradual curves
105 in the sinuosities and the width of groove being gradually widened prevents excessive friction between the stylus point and record; and ninth,—the tone of reproduction will be purer and more accurate than where
110 etched or engraved records are employed.

In all cases where the electro-deposition is made upon a surface coated with plumbago, such as now in general use, the plat-
115 ing is in copper because a metal harder than copper, such as nickel, will not adhere sufficiently to prevent the curling tendency of the harder metal, but in the case of my invention I first produce my master record in copper and may then directly make my dies from it in nickel backed with copper—
120 thereby producing the strongest character of die without any interposed “dubbing” operations.

While I prefer the making of the groove of gradually increasing width it is evident
125 that it may be made of the same width by simply increasing the speed of rotation of the turn-table or disk C so as to keep the surface speed of the latter relative to the stylus the same throughout the laying of the
130

part J or J'. Devices suitable for such purpose are set out in my application Serial No. 372,432, filed May 7th, 1907. Or, instead of increasing the speed of the disk C, it may remain at same speed and the pressure on the material in the reservoir I may be gradually decreased, in which case a gradually lessened quantity of material will leave the stylus with each successive rotation of the disk C.

By my improved manner of making a sound record, it is evident that instead of incorporating into the electroplated surface of the groove a texture corresponding to the irregularities of an engraved surface in wax, of which it is a counterpart, I am enabled to produce a groove by electroplating and whose surface has a texture which is the counterpart or inverse of a surface texture of a congealed deposited fluid such as a compound capable of being made to flow by heat and pressure and set by cooling, and which has not been disturbed by any objectionable engraving or abrading operations. The surface texture of the groove of my record is, therefore, exceedingly smooth and reproduces without the objectionable sounds which are inherent to all records which are made from engraved or etched surfaces.

I have described my improvements in a manner to indicate my preferred way of employing them for commercial reproduction of record tablets, but I do not confine myself to the details either as to composition of the layers J, J' or of the materials of which the electro-deposited matrix is composed since it may be of other metal than copper; neither do I restrict myself to the manner of causing a separation between the parts K K' of the electro-deposited metal layers.

In this application I do not claim the apparatus for the manufacture of the master pattern, nor do I claim the method of manufacturing the master pattern, or master record, as these form subject matter of my original application, Ser. No. 379,712 filed June 14, 1907 hereinbefore mentioned, and of which this application is a division.

I also wish it to be understood that while I have described my invention with special reference to the making of disk records, I do not confine myself thereto as my invention may be employed to the making of any type of record where a grooved surface is required.

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

1. As a new article of manufacture, an original metal master sound record formed

of an electroplated disk with a record groove.

2. As an article of manufacture, a metallic sound record tablet in which the record groove is of increasing cross section throughout its length.

3. As an article of manufacture, a sound record tablet in which the record groove is of increasing width throughout its length.

4. As an article of manufacture, a sound record tablet in which the record groove is in spiral form of even depth and laterally undulating and of increasing width throughout its length.

5. A master record having a sound groove of increasing width throughout its length.

6. A master pattern having a raised ridge-like irregular line corresponding to sound waves and having a cross section increasing throughout its length.

7. As a new article of manufacture, an original metal master sound record consisting of an electroplated disk having a laterally undulating groove of a width at any point in its length greater than the width of the groove from said point to one end thereof and less than the width of the groove from said point to the other end thereof.

8. As a new article of manufacture, an original metal master sound record consisting of a disk formed of an electroplated mass having a laterally undulating groove of a cross section widest at the top and of a depth slightly less than its width and in which the width at any point in its length is greater than the width of the said groove between said point and one end thereof.

9. As a new article of manufacture, an original master sound record formed of an electroplated disk with a record groove whose surface has an inverse texture to that of a plumbago coated surface of a congealed deposited fluid as distinguished from an engraved or etched surface.

10. A master pattern consisting of a flat plate and having formed thereon a spirally arranged raised ridge-like laterally undulating line corresponding to sound waves and formed of a deposited wax-like material adhering to the plate widest at the bottom adjacent to the plate and rounded at the top and having a cross section corresponding to the cross section of the finished sound record groove in the record tablet to be made from said master pattern.

In testimony of which invention, I have hereunto set my hand.

ROBERT L. GIBSON.

Witnesses:

R. M. HUNTER,
M. F. DRISCOLL.