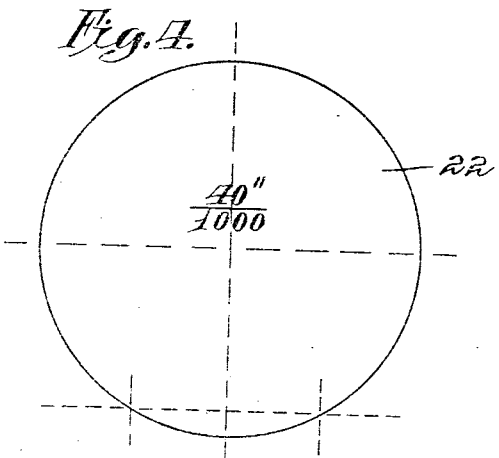
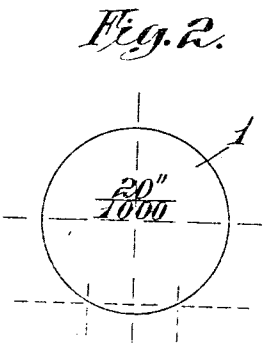
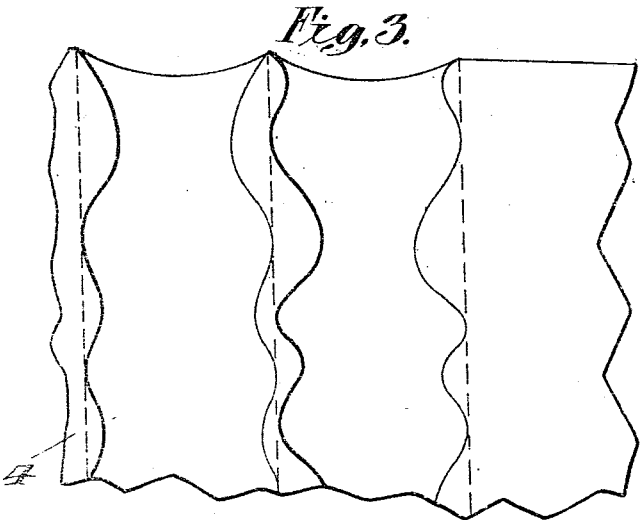
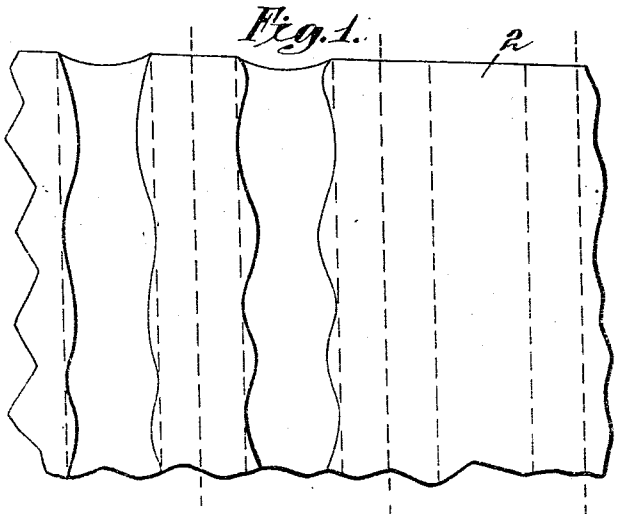


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T. A. EDISON.  
METHOD AND APPARATUS FOR MAKING SOUND RECORDS.  
APPLICATION FILED AUG. 30, 1904.

Patented Sept. 20, 1910  
4 SHEETS-SHEET 1.



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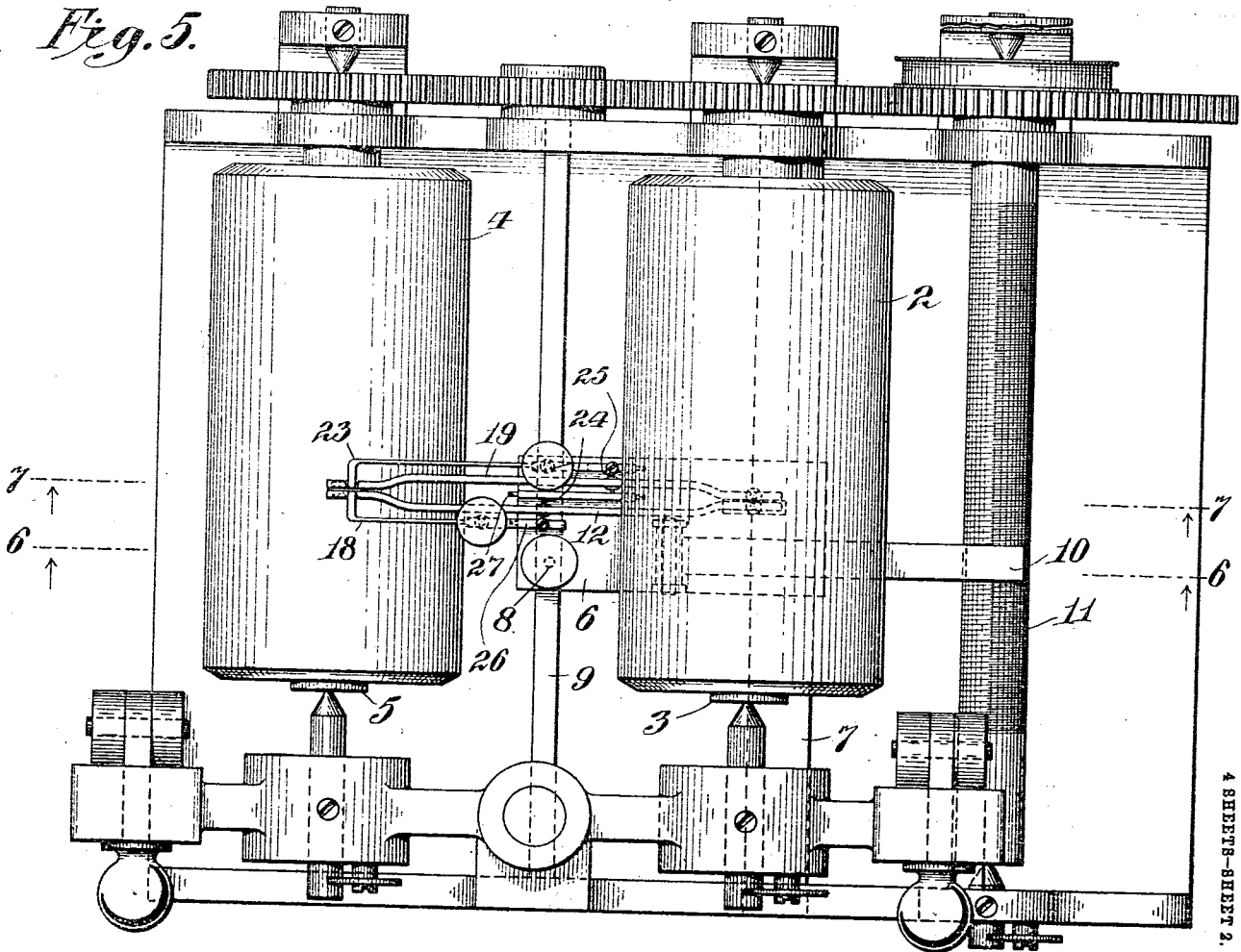


Fig. 5.

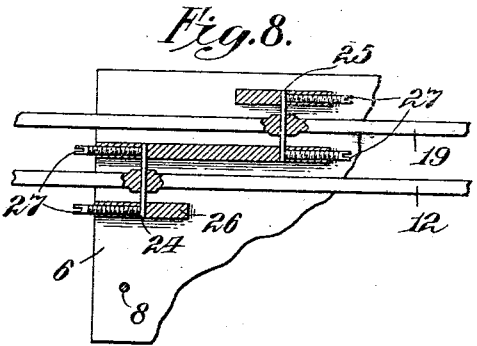
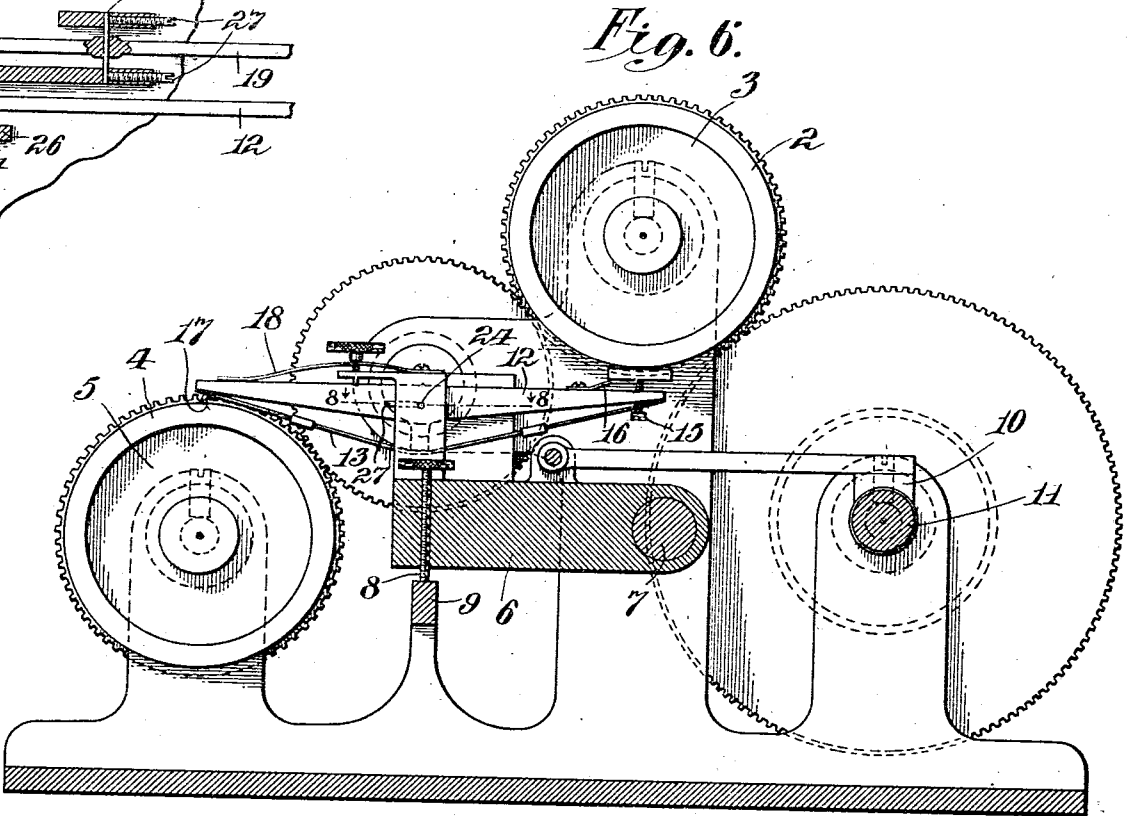
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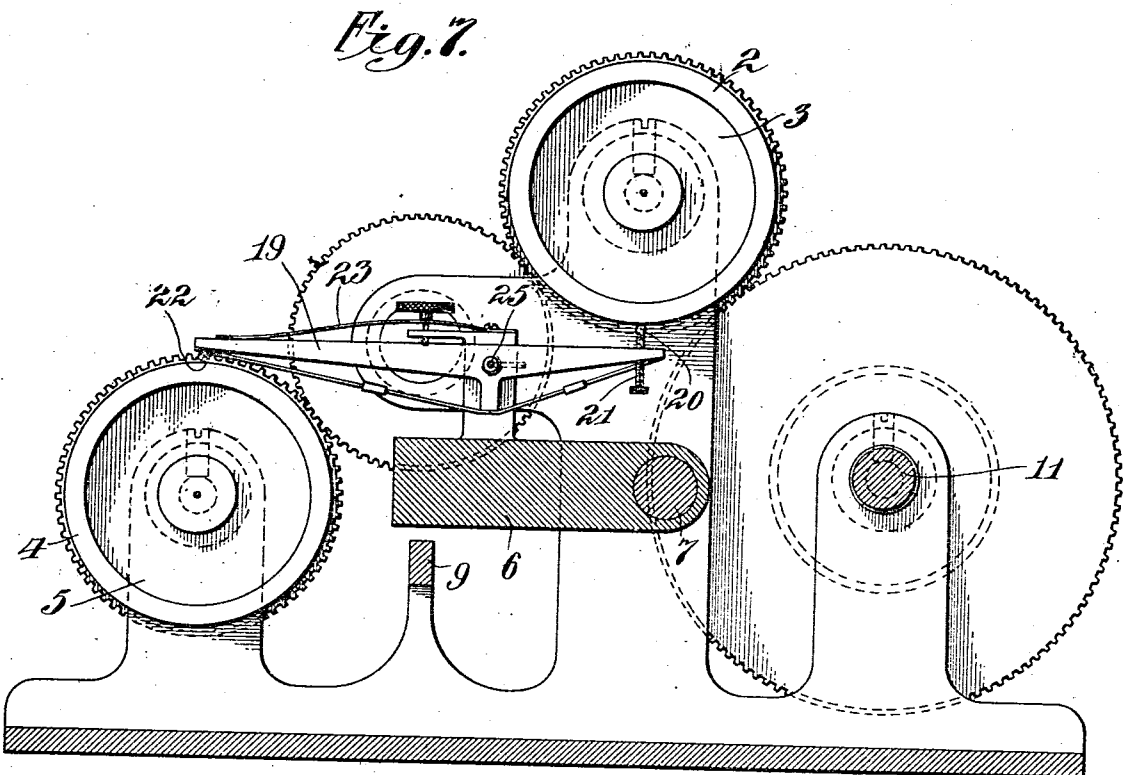
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# UNITED STATES PATENT OFFICE.

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

METHOD AND APPARATUS FOR MAKING SOUND-RECORDS.

970,615.

Specification of Letters Patent. Patented Sept. 20, 1910.

Application filed August 30, 1904. Serial No. 222,702.

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, Essex county, New Jersey, have invented a certain new and Improved Method and Apparatus for Making Sound-Records, of which the following is a description.

My invention relates to an improved apparatus for making phonograph, or other talking machine records, and my object is to secure a sound record which shall be of practically exact quality, and at the same time very loud. Such a record when secured, may be used directly on the phonograph or other sound reproducing machine, but it is preferably employed as a master from which copies are obtained by any approved process of duplication, as for example, by a molding operation.

The invention is practicable for use not only for the production of phonograph records, but also for the production of so-called gramophone records, wherein the record exists as a sinuous groove of substantially uniform depth.

In making a sound record of either of the types referred to, there are certain factors which enter into the operations and by reason of which the quality of the recorded sounds is affected so that the record is not truly representative of the original sounds. The most objectionable of these disturbing influences which I have encountered in my experiments in phonographic recording, is due to the inertia and momentum of the diaphragm and the recording devices, carried by or connected with the same. As a result, when the diaphragm is subjected to vibrations of considerable amplitude, the momentum of the parts causes the recording knife to cut to a disproportionately great depth, and this aberration is manifested in the succeeding vibrations. Consequently, I find that the quality of the recorded sounds is in inverse ratio to the loudness thereof, so that when the attempt is made to make a very deep record, or a record of great amplitude, the louder notes are generally of poor quality, and are out of proportion to the notes or sounds of less amplitude. Another disturbing influence, which I have encountered in my experiments with the phonograph, and by which the quality of the records is affected, is due to the fact that the

horns heretofore used have been responsive to certain tones, either fundamental or secondary, within the range of ordinary music, and in consequence, such tones are greatly emphasized and become objectionably distorted in the reproduction. Obviously, the tones which may thus become unduly amplified, depend upon the length of the horn used, but since it has been heretofore necessary to employ horns of considerable length, say from 18 to 36 inches, in order that the sounds may be properly collected to make the record loud enough for practical purposes, the tones to which they may be responsive, either fundamental or secondary, will always exist in the range of ordinary music. I am not aware that these objections have ever been successfully overcome, and heretofore, the volume of a phonograph, or other sound record has been largely restricted because of the same.

The object of my invention is to overcome these objections.

To this end, the invention consists, in the features hereinafter set forth and claimed.

In order that the 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 diagrammatic view showing a portion of the original master, or metallic copy thereof. Fig. 2 is a cross sectional view through the original recording style, showing a recorder .020 of an inch in diameter the scale being one-half that of Fig. 1. Fig. 3 is a diagrammatic view of the amplified duplicate record. Fig. 4 is a cross sectional view through the recorder used in cutting the amplified duplicate, illustrating the same cutting to its full depth the scale being one-half that of Fig. 3. Fig. 5 is a plan view of a preferred embodiment of the mechanical duplicating apparatus. Fig. 6 is a cross sectional view showing the shaving knife for trimming the blank to the exact shape and size as the original record. Fig. 7 is a corresponding view showing the mechanism for securing the amplified copy of the original record, and Fig. 8 is a sectional view on the line 8—8 of Fig. 6. In all of the above views, corresponding parts are represented by the same numerals of reference.

In carrying the method into effect, I first make an original record by means of a recorder 1, (see Fig. 2) of small cross section,

the record being of low amplitude. Thus, in Fig. 1, I illustrate such a record, wherein the maximum width of the record groove is only about one-half the available surface, or about one two-hundredth of an inch. In making such a record, I am enabled to employ a very short horn, say from four to five inches in length, owing to the low amplitude of the sounds to be recorded; and such a horn is not responsive to an injurious extent to any tones within the range of ordinary music, so that the objectionable "funnel tones" may be eliminated. I find that records of this kind, although very faint, are of superior quality, not only because the work imposed on the recorder is slight, and consequently, the recorder is free to more readily respond to the original sounds, but also and principally, because the vibrations are not affected to a noticeable extent by the momentum of the parts, so that disturbances from that cause are practically eliminated. Obviously, the quality of the master record so obtained will be further improved by the employment of a very short horn, as explained, and by which the formation of "funnel tones" will be substantially overcome. Having obtained a master of this kind with a substantially perfect record thereon of low amplitude, I secure a metallic copy therefrom by any suitable duplicating process, as for example, those described in my patents, Nos. 657,527 and 680,520, dated September 11, 1900, and August 13, 1901, respectively. I now obtain an amplified copy of the metallic master thus secured, preferably in an apparatus by which the record is mechanically transferred and amplified. In such an apparatus dealing with vibrations of excessive minuteness, it is necessary that the surface on which the record is transferred should be of the exact shape as the metallic master.

It would be very difficult to secure a metallic master that would be absolutely cylindrical and much more difficult to secure a blank of absolutely the same size, and for this reason I prefer to make use of a shaving device, working in advance of the recorder and by means of which the blank will be cut to the exact size and shape of the master immediately before the record is cut therein. A suitable apparatus for the purpose is indicated in the drawings wherein the metal master 2 is carried on the mandrel 3, and the blank 4 is carried on the mandrel 5. These mandrels are rotated simultaneously by any suitable gearing at a low speed, so that the surface speed of the master is sufficiently low as to prevent any disturbing influence due to momentum or inertia of the moving parts. A carriage 6 is mounted to travel on a rod 7, and at its forward end is supported by a regulating screw 8, working on a front bar 9. The

carriage is fed longitudinally by a feed nut 10, engaging a feed screw 11. Mounted on the carriage is a lever 12, pivoted centrally and very much exaggerated in the drawings, since in actual practice the master and blank would be located very close together and a very short lever would be used. Preferably, the lever 12 is in the form of a small truss, so as to possess the maximum rigidity, and in order to prevent any flexing of the lever in operation, I prefer to maintain it under a condition of stress, as for example, by means of small adjustable tie rods 13. By stressing the lever practically to the end of the elastic limits, I secure a perfectly rigid construction by means of which the most minute movements of one end will be transmitted to the full extent at the other end thereof. At one end, the lever carries a shoe 14, made preferably of sapphire, and adjusted by a screw 15, said shoe bearing upon the surface of the master 2 and being wide enough to overlap several of the record grooves thereon. This shoe may be carried from a spring 16, as shown. At its other end, the lever 12 carries a cutting or shaving knife 17, made of sapphire, and of any suitable shape for engaging the blank 4. A spring 18 maintains the shoe 14 and knife 17 in engagement with the master and blank respectively. Obviously, when the master and blank are rotated, with the shoe 14 in engagement with the former, the knife 17 will cut the blank to the exact shape and size as the master. The carriage 6 also carries a duplicating lever 19, (see Fig. 7) whose pivot is so arranged as to give the desired amplification. Ordinarily, an amplification of two to one will be sufficient. This lever is constructed like the lever 12, and is also maintained under normal tension, being stressed practically to its elastic limits, so as to be free from vibrations. At one end, the lever 19 carries the reproducing ball 20 from the adjusting screw 21, and at the other end is provided with a recorder 22, which as shown in Fig. 4, is preferably of a diameter of about .040 of an inch. The recorder and reproducer are maintained in engagement with the blank and master respectively, by an adjustable spring 23.

In order that there may not be any lost motion at the pivots of the levers 12 and 19, I preferably mount these levers on very small torsion wires 24 and 25, carried on the brackets 26 upon the carriage 6 and held from rotary movement by the screws 27. Consequently, any movements of the levers 12 and 19 are afforded by torsional elasticity of the pivots 24 and 25, which movements are obviously slight, since the movements of the ends of the levers rarely exceed a thousandth of an inch, in practice. The recorder and reproducer work closely adjacent to the shaving knife 17 and shoe 14, as

shown, so that a sound record will be cut in the blank 4 immediately after it is trimmed off to the proper shape. By means of the duplicating mechanism described, the blank 4 will be provided with a record therein (see Fig. 3) which will correspond with that on the original master, except that it will be very much amplified. Such a record will be obviously of superior quality since, of course, the mandrels 3 and 5 will be rotated slowly enough as to prevent any momentum of the parts from affecting the duplication. The finished amplified duplicate record may now be used directly for reproduction, but it is preferably employed as a master from which duplicates are secured in any suitable way, such as by a molding process. Any other duplicating process well known to those skilled in the art, may however, be employed for securing copies from such a master.

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

1. The process of making sound records, which consists in mounting a blank upon a rotating support, trimming the blank and then, without any alteration of the position of the blank upon its support, engaging with the blank a recording stylus which is mechanically connected with a reproducer stylus tracking a master record, and rotating the master and blank at such slow speed as to practically eliminate defects due to momentum and inertia of the moving parts.

2. The process of making sound records, which consists in making a master record of low amplitude, in rotating the same adjacent to a rotating blank, engaging with the master and blank respectively a reproducer stylus and recording stylus connected by an amplifying lever connection, and in rotating the master and blank at such slow speed as to practically eliminate defects due to momentum and inertia of the moving parts, substantially as set forth.

3. The process of making sound records, which consists in first securing a record of low amplitude, in rotating the same adjacent to a rotating blank, engaging a cutting knife with the blank, regulating the cutting knife by the rotating master whereby the blank will be trimmed to the exact shape of the master, and in mechanically recording on the blank an amplified copy of the record on the master by mechanical transference, substantially as set forth.

4. The process of making sound records, which consists in first securing a record of low amplitude, in rotating the same adjacent to a rotating blank, engaging a cutting knife with the blank, regulating the cutting knife by the rotating master, whereby the blank will be trimmed to the exact shape of the master, and in mechanically recording on the blank immediately after

the action of the cutting knife an amplified copy of the record on the master by mechanical transference, substantially as set forth.

5. The process of making sound records, which consists in making a master record of low amplitude comprising the use of a recording horn of such short length as to be irresponsive to tones within the range of ordinary music, and obtaining an amplified duplicate from said master record by mechanical transference, substantially as set forth.

6. The process of making sound records, which consists in making a master record of abnormally low amplitude, and obtaining from said master record by amplifying mechanical transference a duplicate of normal or desired amplitude, substantially as set forth.

7. Apparatus for making sound records, which consists of two rotating mandrels, one carrying a master and the other a blank, of a pivoted lever, a shaving tool carried by the lever and engaging the blank, and a shoe on the lever engaging the master, as and for the purposes set forth.

8. Apparatus for making sound records, which consists of two rotating mandrels, one carrying a master and the other a blank, of a pivoted lever, a shaving tool carried by the lever and engaging the blank, and a shoe on the lever engaging the master, a second lever, a recorder carried by said lever engaging the blank, and a reproducer carried by the same engaging the record on the master, as and for the purposes set forth.

9. In apparatus for making sound records, the combination with two rotating mandrels, one carrying a master record, and the other a blank, of a duplicating lever maintained under normal stress, a recorder carried by the lever and engaging the blank, and a reproducer carried by the lever engaging the record on the master, as and for the purposes set forth.

10. In apparatus for making sound records, the combination with two rotating mandrels, one carrying a master and the other a blank, of a pivoted lever, a shaving tool carried by the lever and engaging the blank, a shoe on the lever engaging the master and means for adjusting said shoe, as and for the purposes set forth.

11. In apparatus for making phonograph records, the combination with two rotating mandrels, one carrying a master and the other a blank, of a pivoted lever maintained under normal stress, a shaving tool carried by the lever and engaging the blank, and a shoe on the lever engaging the master, as and for the purposes set forth.

12. In apparatus for making sound records, the combination with two rotating mandrels, one carrying a master and the other a blank, of a pivoted lever, tie rods for

maintaining the lever under normal stress, a shaving tool carried at one end of the lever and engaging the blank, and a shoe at the other end of the lever engaging the master, as and for the purposes set forth.

13. In apparatus for making sound records, the combination with two rotating mandrels, one carrying a master and the other a blank, of a lever mounted on a fixed pivot capable of torsional movement, a shaving tool carried at one end of the lever and engaging a blank, and a shoe carried at the other end of the lever engaging the master, as and for the purposes set forth.

14. In apparatus for making sound records, the combination with two rotating

mandrels, one carrying the master record and the other a blank, of a duplicating lever mounted on a torsional pivot, and a reproducer carried by the lever and engaging the record on the master, as and for the purposes set forth.

15. In phonographic transfer duplicating mechanism, a transfer lever consisting of a truss maintained normally under stress within the limit of elasticity, as set forth.

This specification signed and witnessed this 23rd day of Aug. 1904.

THOMAS A. EDISON.

Witnesses:

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MINA C. MACARTHUR.