

F. W. MATTHEWS.

TALKING MACHINE RECORD, AND METHOD AND TOOL FOR MAKING SUCH RECORDS.

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1,350,510.

Patented Aug. 24, 1920.

2 SHEETS—SHEET 1.

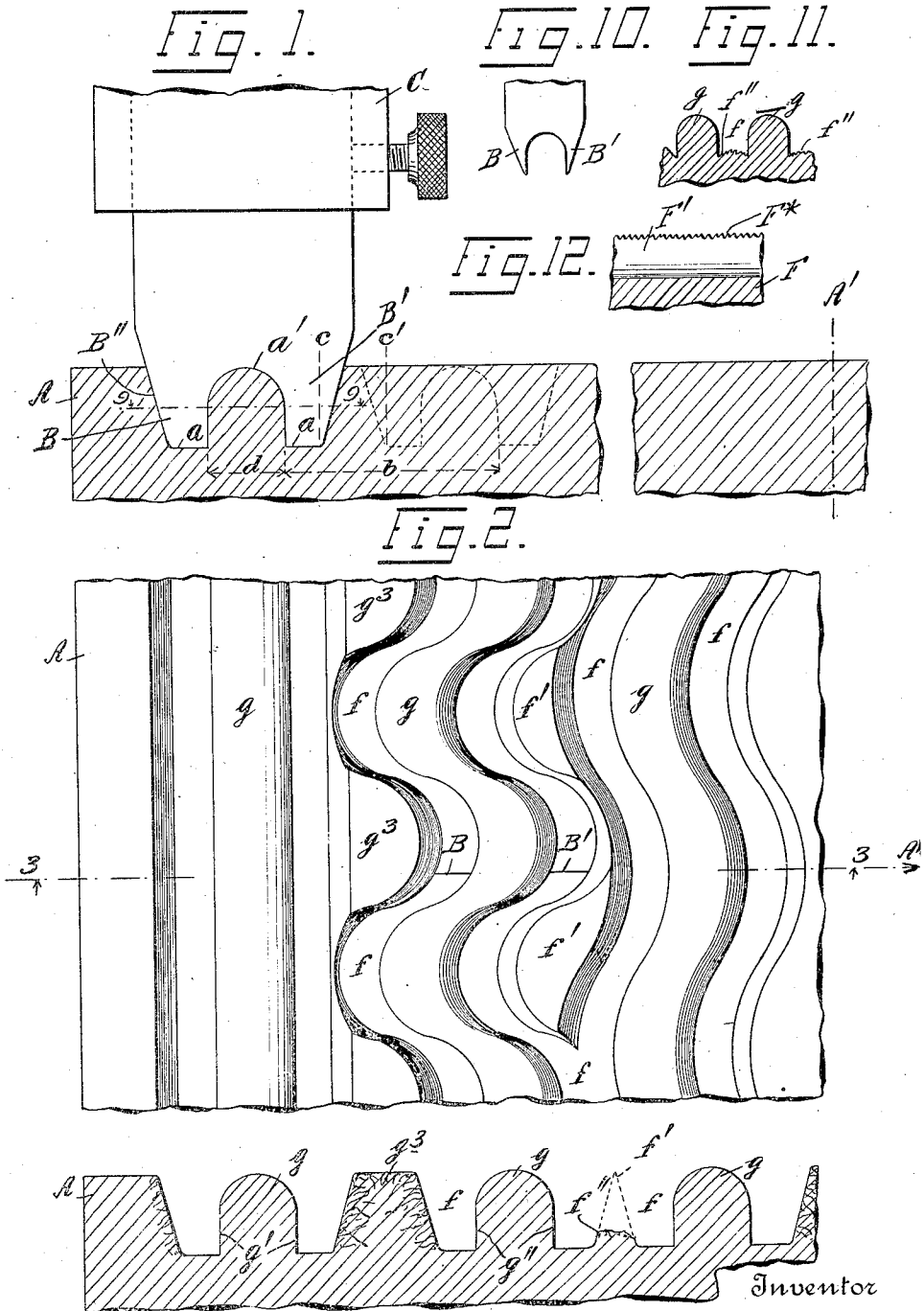


Fig. 3.

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Fig. 4.

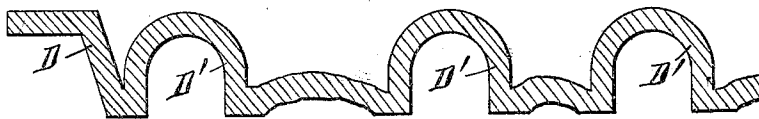


Fig. 5.

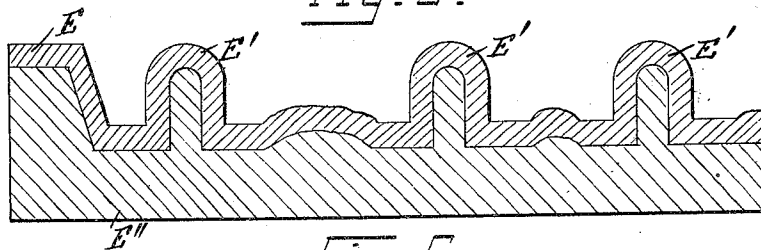


Fig. 6.

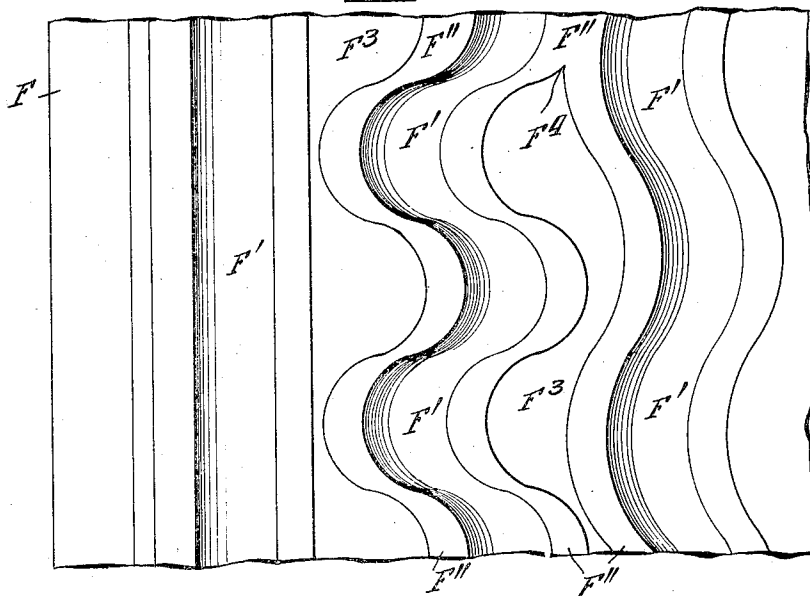


Fig. 7.

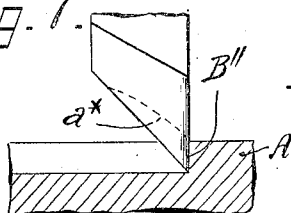


Fig. 8.

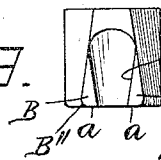
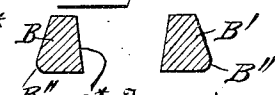


Fig. 9.



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# UNITED STATES PATENT OFFICE.

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TALKING-MACHINE RECORD, AND METHOD AND TOOL FOR MAKING SUCH RECORDS.

1,350,510.

Specification of Letters Patent. Patented Aug. 24, 1920.

Application filed February 20, 1918. Serial No. 218,195.

*To all whom it may concern:*

Be it known that I, FREDERICK W. MATTHEWS, a citizen of the United States, and resident of West Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Talking-Machine Records, and Methods and Tools for Making such Records, of which the following is a specification.

In the making of flat records or disk records for talking machines, the present practice consists in cutting a record groove into the surface of a disk of relatively soft material by means of a recording stylus vibrated in accordance with the sound waves while the disk is being rotated, this stylus also moving gradually across the face of the disk, so that a spiral record groove is produced. The record thus cut can be used directly for reproducing sound, although in commercial manufacture, this soft master record is not sold, but the records put on the market are duplicates obtained from the master record in well-known ways.

In contradistinction to the usual procedure outlined above, I do not produce or cut a record groove, but cut a soft record ridge on the face of the record disk, and the cut record thus obtained cannot be used directly for reproducing the recorded sounds, in conjunction with the usual talking machine reproducers, but from this first disk having a cut record ridge, I produce, by molding or similar operations as explained below, commercial records having sound record grooves and therefore adapted to be played in conjunction with the customary reproducing needles or styli. It has been found in practice that records made in this novel manner possess marked advantages as to clearness of sound and absence of grating noises, and can be played a great number of times with the same needle, without material injury to the record.

I will now describe in detail the procedure which I prefer at present in carrying out my invention, it being understood that I do not wish to restrict myself to any specific process; but desire for this invention the broad protection indicated by the appended claims.

In the accompanying drawings, Figure 1 is a sectional view illustrating on a very much enlarged scale, the manner of cutting a record ridge in accordance with my invention; Fig. 2 is a top plan view, likewise very much enlarged, of a portion of the cut record thus produced; Fig. 3 is a cross section on line 3—3 of Fig. 2; Fig. 4 is a cross section showing a corresponding portion of the matrix produced from the cut record; Fig. 5 is a cross section of a corresponding portion of the die produced from such matrix; Fig. 6 is a partial plan of a final or commercial record produced with the aid of said die; Fig. 7 is a side elevation of the cutting or recording stylus, showing it in cutting position with respect to the record to be cut; Fig. 8 is a bottom view of such stylus; and Fig. 9 is a cross section through such stylus, taken on line 9—9 of Fig. 1. Fig. 10 is a front elevation of another form of recording stylus; Fig. 11 is a fragmentary sectional view, corresponding to Fig. 3, and showing the character of the groove cut with a stylus such as illustrated by Fig. 10; and Fig. 12 is a partial section taken lengthwise of the record groove of a commercial record made from a cut record such as shown in Fig. 11.

The disk or tablet A on which the record ridge is to be cut consists of any suitable material, the metallic soap composition commonly employed when it is desired to cut a sound record groove, being satisfactory for the purpose of my invention. The means for rotating the disk or tablet A, and for causing the stylus to travel in a spiral path relatively to the surface of the disk, may be of the customary character, and are therefore not shown herein. It should be noted however, that the disk is rotated in a direction opposite to that in which the finished or commercial record is rotated when being played. The stylus vibrates under the influence of the sound waves, as is well known in devices of this type, and in the particular instance illustrated, the vibrations are presumed to be in a plane parallel to the face of the disk, or, in other words, the stylus is intended to produce a "lateral" cut ridge of substantially uniform height, as distinguished from the

"vertical" cut (of varying depth) employed in the case of so-called hill-and-dale records. My invention however is also applicable to making records of this latter type. The cutting or recording stylus employed by me differs from the usual ones materially in that it has two prongs B, B'; It is fastened in a holder C of any customary or approved construction, in such a manner that each prong will engage a different portion of the disk, the preferred way being to place one prong radially inward of the other, so that their ends will be in a straight line with the center or axis A' about which the disk A revolves. Preferably, the prongs do not taper to a point, but to an edge or heel *a*. Between the prongs B, B', the stylus is preferably made at its forward face with an arch *a'* lying in the same vertical plane with the two edges or heels *a*. This contributes to regulate the depth of the cut with great accuracy, the tool entering the material of the disk A until the top of the arch *a'* is practically at the same level as the face of the disk, see Fig. 1. This is the preferred way, but I do not wish to restrict myself to it, and the cut might be deeper, bringing the top of the arch *a'* below the level of the face of the disk. The depth of the cut may be, say, from 3 to 5 one-thousandths of an inch, and the width *d* at its base (distance between the heels of the prongs) also from 3 to 5 one-thousandths of an inch, while the lateral (substantially radial) movement which both prongs B, B' perform equally in response to the vibrations of the recording diaphragm (not shown), will vary, according to the volume of the sound, the maximum amplitude of these lateral vibrations being say, from 2 to 2½ one-thousandths of an inch. When referring to the amplitude of the lateral vibrations, I mean the lateral deviation of the prong B or B' from its normal position, that is, from the position it takes when not vibrating, and not the total lateral travel of one prong point.

Fig. 1 shows the recording stylus at the beginning of its cutting operation, that is to say, at the outer end of the spiral path, assuming that the record finally obtained is to play from the periphery inward, as with most disk records now on the market. The stylus is preferably held so that its plane front surface will be vertical and approximately radial. (See Figs. 7 and 2). In Fig. 2, the two lines at B, B' indicate the relative position of the heels of the stylus prongs and also show that they are substantially in line with the center A' of the record. The cutting portion *a*, *a'* is sharp and the rear or following portion of the stylus is reduced in width or "backed off" (see *a''*, Fig. 9) so as not to deface the ridge cut by the edges *a*, *a'*. The lower end slants

upward and rearward, as shown in Fig. 7. The opposing or inner edges of the prongs B, B' (lower portions of the arch *a'*) cut a record ridge lying between them, said ridge having lateral undulations corresponding to the lateral vibrations of the stylus. The pitch of the spiral path, or, in other words, the radial travel of the stylus (when not vibrating) during one complete revolution of the disk A, should preferably be greater than the radial width of the ridge-cutting portion of the stylus, that is, the distance *d* between the prong heels; in Fig. 1, the said pitch is indicated at *b*. Thus, at the second turn of its spiral path, the stylus would, apparently, leave a narrow ridge (interridge) on the face of the record disk, between the points indicated by the vertical lines *c*, *c'* marking respectively, the position of the right-hand heel corner of the inner prong B' when the stylus is on the first turn of the spiral, and the position of the left-hand heel corner of the outer prong B when the stylus is on the second turn of the spiral path. The two positions of the stylus indicated in Fig. 1 do not take into consideration the lateral vibrations of the stylus; in other words, these positions are such as the stylus will assume if it is caused to travel in a true spiral path while there are no sound waves, and therefore no lateral deviations of the stylus from the true spiral path. It will be seen that at the second revolution, the stylus will, by its lateral vibrations, take away most, if not all, of the material lying between the two turns of the spiral, thus producing, at the majority of points, a groove such as *f*, although here and there, as indicated at *f'*, more or less extended burs or ridges will remain within such groove. However, after the cutting or recording operation has been completed, the disk A is cleaned with a brush or the like, and as the material of the disk is rather brittle, this brushing operation will break off most or all of the material of the burs *f'*, but in such a way as to leave a rough surface *f''*, at the bottom of the groove *f*. This breaking down, at least partially, of the burs *f'* is also assisted by the laterally flaring formation of the side edges B'' of the stylus, so that they will have a wedge action, crowding the material of the burs sidewise, and breaking them down. This effect is further enhanced by making the edges B'' rather dull, which causes them to crowd or tear the burs rather than cut them.

If *e* designates the width of the prong B or B' at its bottom or heel *a*, and if *w* designates the allowable width of the interridge and *y*, the maximum amplitude of the lateral vibrations as defined above, the following relations can be deduced from the fact that obviously the width *e* of the heel should be twice the maximum amplitude of the

lateral vibrations, minus allowable width of interridge, or  $e=2y-x$ .

$$(1) \quad b=d+2e+x;$$

and

$$(2) \quad e=2y-x;$$

substituting the value of  $e$  from (2) into (1), we have

$$(3) \quad b=d+2(2y-x)+x=d+4y-x.$$

Since  $d$ ,  $x$ , and  $y$  are known, and  $e$  is given by  $x$  and  $y$ , the pitch  $b$  of the spiral can be found from equation (3).

Interference of sound waves, at adjacent points of two successive turns of the spiral, might arise in case vibrations of maximum amplitude occurred at these points, if  $e+x < 2y$ . In practice, some risks may be taken, especially if  $x$  is taken as smaller than  $2y$ , so that  $e$  will be greater than zero.

Assuming  $y$  as 2 one-thousandths of an inch, then in the case of  $x=0$  (no interridge where two maximum vibrations meet),  $e$  would become 4 one-thousandths of an inch.

In this case, if  $d$  is taken as 5 one-thousandths of an inch, the pitch  $b$  will be figured out as 13 one-thousandths of an inch, that is to say, the spiral will have 77 lines or turns to the inch.

Assuming that  $y$  and  $d$  have the same values as just stated, and that the width  $e$  of the heel is zero (prong running to a point), the interridge width will reach its allowable maximum of 4 one-thousandths of an inch, and the pitch  $b$  will be 9 one-thousandths of an inch, that is to say, the spiral will have 111 lines or turns to the inch. In practice, I prefer to so dimension the parts that the spiral will have about 95 lines to the inch, that is to say, halfway between maximum and minimum conditions.

The groove  $f$  of the cut record produced according to my invention differs quite radically from the groove produced in the cutting of grooves by a recording stylus as practised hitherto. First, the groove  $f$ , at each portion thereof, is the result of two successive actions of the stylus, on two consecutive turns of the spiral. Second, from this it follows that the inner side of the groove (toward the axis of rotation) is not like the outer side of the groove at the same point (same radial plane), but in any radial section, such as Fig. 3, the two points, as  $g'$  or  $g''$  on the same turn or convolution of the record ridge  $g$  will correspond to each other, that is to say, they will belong to the same note or sound, while the points, as  $g'$  or  $g''$  on opposite sides of the same groove  $f$  will belong to different notes (one revolution of the disk apart). If therefore an attempt is made to play this cut record with an ordinary reproducing stylus having a single point, by placing this point in the groove  $f$  and rotating the disk A, the music

selection or other matter recorded will not be reproduced, since the point of the reproducing stylus would engage, at the same time, portions or points such as  $g'$  and  $g''$  which do not belong to the same sound or note. A meaningless jumble of sounds or noises might be obtained by such attempt, but not a rendition of the matter recorded. The groove  $f$  therefore is not a record-groove, since the two walls of the groove have no sound-producing relation to each other. Probably it would be possible to play from the cut record above described, having a record ridge, by using, instead of the customary single-point reproducing needle or stylus, a special reproducing stylus recessed or grooved in the same manner as the recording stylus shown, and held in the proper position (preferably with its prongs in radial alinement) to straddle the record ridge  $g$ , the record being rotated, while playing, in the opposite direction to that employed for the finished commercial record having a record groove instead of a record ridge. This manner of playing from the cut record would however be inconvenient and also offer difficulties as to bringing such a recessed or forked reproducing stylus into proper straddling relation to the record ridge  $g$ . In any event, it is preferable for many reasons that the commercial record should play properly with the usual single-point reproducing needle or stylus, and as the cut record produced by me with a record ridge is not adapted to this use, I obtain from it records having a record groove.

From the original cut soft master record produced as above (and unsuited for reproducing sound with the aid of the ordinary needles or styli), I produce commercial playing records by suitable molding operations, for instance as follows: The cut record, after being brushed or otherwise cleaned as above referred to, is coated with conducting material, say graphite, in the manner customary in electro-plating. A layer or shell D of copper is then obtained by electroplating the coated surface of the cut record. If desired, this shell may be backed, say with lead, but generally no backing is employed. This copy D has on its plated or front surface a reversed reproduction of the cut record face, that is to say, where the cut record has a record ridge  $g$ , the reversed copy obtained as described has a record groove  $D'$  of the same character as the sound record grooves of the usual commercial disk records. This copy therefore is capable of reproducing the selection recorded, if the ordinary stylus of a talking machine is made to travel along such groove  $D'$ . While the copy D,  $D'$  thus constitutes a playing record, it is undesirable, for commercial reasons, to use it as

such, and it is employed as a pattern or master "matrix" for the production of other matrices from which the commercial records, are made in a well known manner. I may, for instance, obtain by electroplating or other molding operations, a die E whose surface E' is a reverse of the copy D, D' from which it is obtained, and therefore an exact reproduction of the original cut record.

10 This die might therefore possibly be used for playing the sounds recorded, if a special stylus straddling the record ridge is employed, and if the die is rotated in the "reverse" direction, as explained above with reference to the cut record. The die shell E (say, of copper) is provided with a backing E'', of any suitable material, for instance, of nickel which is a well-known material heretofore used in the process of backing

20 matrices, so that it may be strong enough for the subsequent pressing operation. From this die, commercial records F may be made from any usual or approved composition, by molding under application of heat and pressure. These records will be of substantially the same character as the disk records now on the market, and will therefore, play with the single-point needle or stylus. Actual tests of these improved

30 records have demonstrated that they produce much clearer tones, substantially free from grating noises. Furthermore, there is a marked difference between these records made according to my invention, and the usual ones, in that between the turns of the record groove F', the upper surface F'' of my records is not smooth or plane, as in the usual records, but quite rough or irregular, at least at a distance from the record groove

40 although with a cut record such as shown in Fig. 3, the commercial record would have a smooth upper surface adjacent to the edge of the record groove. This roughness is due to the reversed reproduction of the rough surface f'' in the groove f of the original cut record. In the drawings, no radial cross section of the final commercial record is shown, this being deemed unnecessary since the upper face of this final record would be

50 exactly like the lower face of the matrix D shown in Fig. 4.

In Figs. 4 and 5, the thickness of the electroplating D and E has been shown much smaller than a drawing in true proportion would require.

It will be noted from Fig. 2 that adjacent to portions of the record ridge g where there is no vibration at all (the record ridge being a true spiral at this point), or when the vibrations are of relatively small amplitude, the material between two adjacent convolutions of the record ridge may form an intermediate or false ridge g<sup>3</sup> which, however, like the surface between the convolutions of the record ridge, will be discontin-

uous. From this it follows that in the final commercial record (Fig. 6), while there may be at certain points an intermediary or false groove (such as F<sup>3</sup>), between adjacent convolutions of the spiral record groove, this false groove will not be continuous. If therefore the reproducing needle should be placed in such false groove, the rotation of the record will soon bring said needle against one of the portions F<sup>4</sup> at the end of the false groove, and by contact with such portion, the reproducing needle will be deflected and directed into the record groove.

It will be understood that as a safeguard against the loss or destruction of the die E, I may produce a number of such dies from the same master matrix D, preserving this master matrix for the production of further dies when the original ones become unserviceable. As a further safeguard, I may make several master matrices D from the original cut record. The latter usually is not preserved. I may also, in case of need, produce a master matrix D from a die E, and use this new master matrix in the making of further dies. I do not wish to restrict myself to these particular ways of obtaining the commercial records from the original cut record.

The two prongs B, B' of the recording stylus may be tapered to points, as shown in Fig. 10, instead of being formed with heels a as in Fig. 1. When the prongs are thus pointed, the rough surface f'' at the bottom of the groove f of the cut record will extend to the edges of said groove, as illustrated in Fig. 11, and in the corresponding commercial record F the surface F'' will be rough or irregular even at the edges of the groove F', so that these edges will have a number of minute up-and-down serrations or rugosities (See Fig. 12). I have found that this novel feature of this particular type of my record is of special value in that it allows the record to be played a great number of times with the same needle or stylus, without being injured thereby. I believe this is due to the fact that the serrated edge F of the groove F' will, in case a needle is used repeatedly, abrade this needle in such a way as to keep its point sharp and in proper condition for playing.

While I have described my invention in detail with reference to the making of disk records, and particularly with a groove having lateral undulations of even depth, I desire it to be understood that my invention is not necessarily restricted to such, but that various modifications may be made without departing from the nature of my invention as defined in the appended claims.

I have referred to the operation of producing the original or master record, as a

cutting operation, but I do not wish the term "cutting" or "cut" as used in the appended claims, to be given a restricted interpretation, since such term is to be understood as including marking, scratching or any other operation in which a recording stylus forms a record ridge from the surface layer of the record body, so that said ridge is integral with the body of the record.

10 Having thus described my invention, I claim:—

1. A master sound record having a laterally undulatory record ridge formed from the surface layer of the record body.

15 2. A master sound record having a laterally undulatory record ridge formed integral with the body of the record.

3. A sound record having a laterally undulatory record ridge formed integral with the body of the record by the action of a recording tool.

4. A sound record having a laterally undulatory cut sound record ridge.

25 5. A sound record having a laterally undulating cut sound record ridge of substantially uniform height.

6. A sound record comprising a body portion and a laterally undulatory record ridge the record-forming sides of which are below the original surface of the record body.

30 7. A disk sound record having a laterally undulating spiral cut sound record ridge of substantially uniform height.

8. The herein described improvement in the making of sound records, which consists in cutting a laterally undulatory record ridge into the surface of a suitable material, by means of a stylus vibrated in accordance with the sounds to be recorded, and producing from the ridge record thus obtained, a reversed or grooved record adapted to play in conjunction with a single-point reproducing stylus.

45 9. A sound-recording stylus having two cutting prongs arranged side by side.

10. A sound-recording stylus having two prongs arranged side by side and provided with converging cutting edges at their adjacent or inner portions.

11. A sound-recording stylus having two prongs arranged side by side and provided with converging cutting edges at their adjacent or inner portions and with diverging outer edges.

12. A sound-recording stylus having an arched groove in its lower surface, forming cutting prongs at each side of said groove.

13. A sound-recording stylus grooved or notched at its lower end to form cutting prongs.

14. A sound-recording stylus having its lower surface inclined upwardly and rearwardly, and grooved in direction from front to rear to form prongs.

15. A sound record comprising a body portion and a record ridge whose record-forming portions are below the original surface of the record body.

16. A sound record comprising a body portion and a record ridge having a transversely rounded outer surface and substantially parallel side walls extending from opposite sides of said outer surface to the body portion of the record.

17. A sound record comprising a body portion and a laterally undulatory ridge corresponding to sound waves and projecting from and integral with said body portion, the outer surface of said ridge being transversely rounded in cross-section.

18. The method which consists in cutting simultaneously like undulations in both sides of a record ridge by means of a laterally-vibrating tool having cutting edges in simultaneous engagement with opposite sides of such ridge.

Signed at New York city in the county of New York and State of New York, this 9th day of February, A. D. 1918.

FREDERICK W. MATTHEWS.