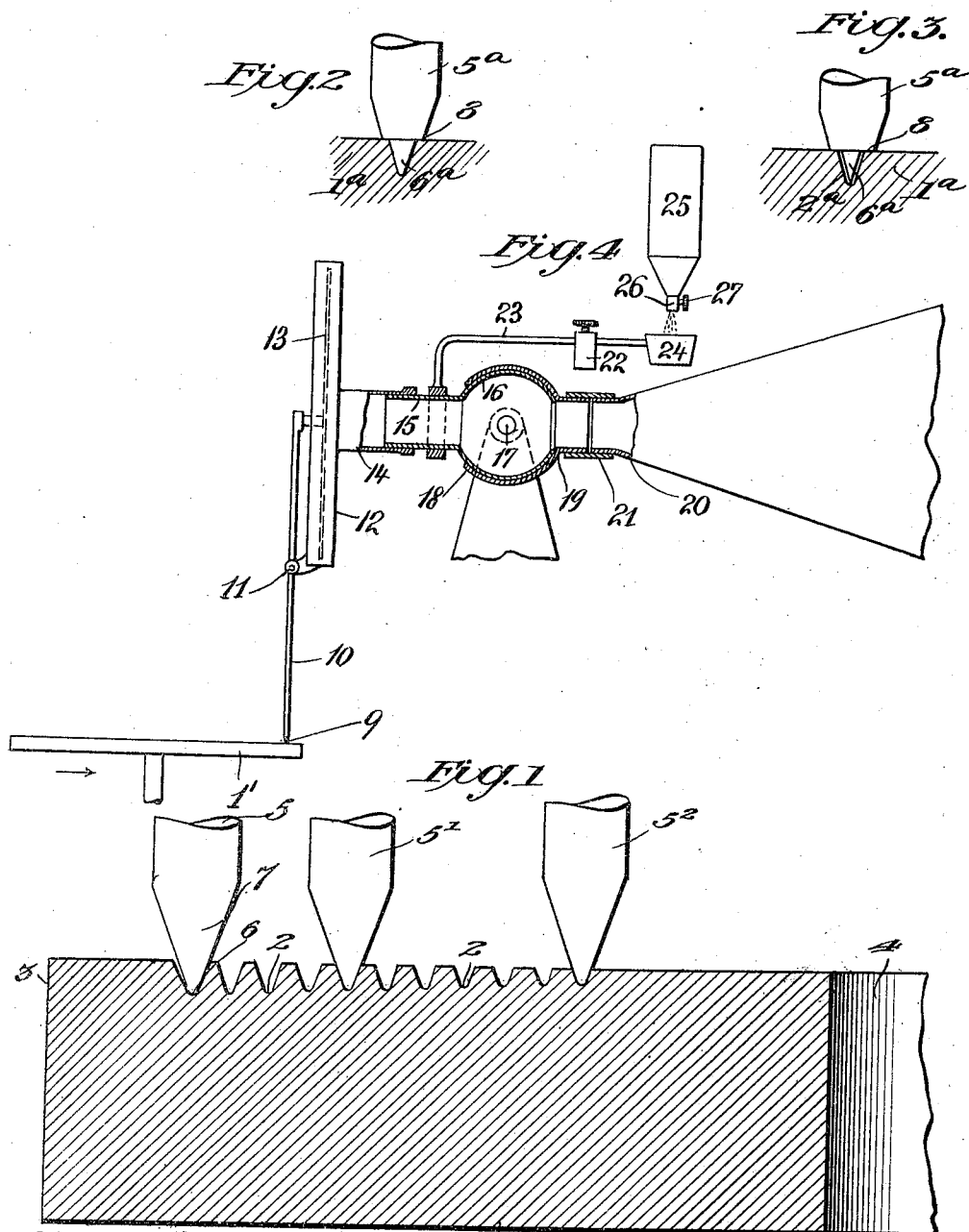


S. C. PORTER.
SOUND REPRODUCER AND RECORD.
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SOUND REPRODUCER AND RECORD.

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To all whom it may concern:

Be it known that I, STEPHEN C. PORTER, a citizen of the United States, and a resident of Martinsville, Somerset county, State of New Jersey, have invented certain new and useful Improvements in Sound Reproduc-
5 10 15 20 25 30 35 40 45 50 55

ducers and Records, of which the following is a description.
My invention relates to sound reproducing devices and records, and particularly to records having a continuous record groove formed thereon of the laterally undulating type and the needle or stylus which tracks the said record groove and co-acts therewith to reproduce the sound recorded. In such records, as commonly made, the groove is in the form of a spiral upon the surface of a record disk or tablet, the groove being of uniform depth throughout its length, or of slightly increasing depth from beginning to end. The reproduction of sound from a record of this character is effected by the lateral movement of the stylus, as it follows the lateral undulations of the groove. The stylus or needle which tracks such a groove is usually formed of soft steel, and has a conical point which roughly fits within the record groove, when it is first positioned therein. When the record is rotated the point of this stylus is worn away and blunted by contact with the record surface, after the record has progressed a short distance, so that it fits within the record groove closely. At the end of the reproduction the needle has generally been worn to such an extent that it must be thrown away, and a new needle substituted before the reproducer is used again. The wear of a needle of the character referred to is sufficient to cause the same to accurately fit within the record groove after probably only a fraction of one revolution of the record, and the tracking of the needle is theoretically correct at this point at which the needle completely fits the groove. The wear of the needle, however, continues as the record is rotated which causes the tracking of the needle and the reproduction of the record to become more and more imperfect from this point to the end of the reproduction. This is so, because the continued wearing away of the point and adjacent sides of the conical bearing surface of the needle causes the latter to descend, so that the thicker portion of the needle descends to the level of the up-

per surface of the record. That is, the diameter of that portion of the cone which is at the level of the upper surface of the record at the end of the reproduction is greater than the diameter of that portion of the cone which is in line with the upper surface of the record at the beginning of the reproduction, because of the wearing away of the apex or point of the cone upon the bottom of the record groove. As the record material is relatively hard and abrasive, and the width of the groove remains the same, this results in the undercutting of the needle by the record and the formation of shoulders upon the needle, which shoulders rest upon the surface of the record and therefore support the needle. I have verified this conclusion by examination, under the microscope, of used reproducing needles. From this point to the end of the reproduction, the point and adjacent sides of the needle continuing to wear, the needle fits more and more loosely in the groove resulting in an imperfect reproduction. I overcome this difficulty by the production of a record in which the record groove is of decreasing depth from beginning to end to compensate for the wear of the needle. Preferably the decrease in depth of the groove is gradual and progressive from beginning to end, although obviously the advantage of my invention might be attained at least in part if the decrease in depth of the groove from beginning to end is not exactly uniform. The varying depth of the groove does not affect the reproduction in the type of record referred to, as the reproduction is determined entirely by the lateral movement of the needle. As the needle wears away, the bearing surface for the lower end of the same continually rises so that the portions of the conical surface of the needle upon which otherwise shoulders would be formed to support the needle, are continually rising, and the point and conical sides of the needle continue to accurately fit within and perfectly track the groove. The means by which such a record may be produced is not material to the present invention which is concerned only with the record as an article of manufacture, and with the combination between such a record and a reproducing stylus or needle, formed of soft steel or other material which is relatively soft in comparison with sapphire and

other hard stylus materials which are not adapted to wear to fit within the groove of a record formed of compositions of which commercial disk sound records are made.

- 5 It may be said, however, that a master record is made in any desired manner, having a record of decreasing depth, preferably of uniformly decreasing depth, cut or otherwise formed thereon, a matrix is made from
10 this record from which commercial duplicate records, having grooves of a correspondingly decreasing depth, may be formed by pressing or otherwise, as desired. In the formation of the master record, the cutting
15 or recording stylus may be gradually and uniformly raised during its travel, or the pressure which forces the cutting point into the record material may be gradually decreased during the making of the record,
20 or as stated, a groove of the desired character may be formed in other ways. For purposes of illustration one method and means of recording in the desired manner upon the master record will be illustrated and
25 described.

In order that a clearer understanding of my invention may be had, attention is hereby directed to the accompanying drawings, forming part of this specification, in which—
30 which—

Figure 1 represents a cross section through a portion of a record disk showing a reproducing stylus or needle in contact with the record groove of the same, the needle being
35 shown in several positions, and the needle and record being greatly enlarged for the purposes of illustration. The record formed as illustrated and the combination of the same with the stylus shown, illustrates one
40 embodiment of my invention; Fig. 2 represents in enlarged cross section a reproducing needle co-acting with a record groove of the common type, showing the formation of shoulders upon the needle above the record
45 surface; and Fig. 3 represents in enlarged cross section the same needle tracking the same groove as that shown in Fig. 2, at a point in the reproduction of the record, subsequent to the point in the reproduction
50 represented by Fig. 2. Fig. 4 represents in side elevation and vertical cross section, one form of apparatus for forming the desired record groove upon a master record.

In the drawings the sound record disk or
55 tablet 1 is provided with a record groove 2, which, as illustrated, is of greatest depth at its beginning, adjacent to the periphery 3 of the record, the depth decreasing preferably progressively to the end of the record
60 groove adjacent to the center hole 4 of the record. I have shown the groove as of a conical cross section slightly rounded at the bottom, although my invention is not limited to this specific form of groove. Tracking
65 the record and co-acting therewith to re-

produce the sound is the reproducing stylus or needle 5. As stated, this needle is formed of a material sufficiently soft to be worn by contact with the record groove so as to accurately fit the same, such a material being, 70 for example, steel. It has a conical lower end 6, the diameter of the shaft of the needle, shown at 7, being considerably greater than the maximum width of the groove. As shown in its position at the beginning of the 75 record to the extreme left in Fig. 1, this needle does not fit closely within the record groove. After a comparatively short distance of tracking, however, as illustrated by the position of the needle at 5', the wear of 80 the bearing surface of the needle has been sufficient to cause the same to accurately fit within the record groove. The final position of the needle is illustrated at 5², which position is nearest to the center hole of the 85 record, and in which, as is clearly shown, the depth of the groove has decreased to such an extent as to compensate for the wear of the needle, which still closely fits within the groove. The proportions of parts shown 90 in the figures, and the slant of the bottom of the groove, are exaggerated and are merely illustrative.

The defect which my invention is designed to overcome is illustrated by Figs. 2 95 and 3, in which a stylus or needle 5^a is tracking a groove of uniform or slightly increasing depth in the record 1^a. The needle is shown in Fig. 2 as having advanced far enough along the record, so that an annular 100 shoulder 8 is formed upon the needle, just above the upper surface of the record by the wearing away of the point of the needle. The needle is here represented as closely fitting within the record groove, the weight of 105 the needle being borne by the shoulders 8, which have just been formed thereon. In Fig. 3 the same needle is represented at a later point in the reproduction of the record than that shown in Fig. 2, the weight of the 110 needle is still supported by the shoulders 8, but the point and sides of the conical bearing surface 6^a of the needle have been so worn by rubbing against the bottom and sides of the record groove 2^a, as it fits very 115 loosely within the same, resulting in a faulty reproduction.

It is obvious that if it were desired to have the record begin near the center hole 4 of the record disk and progress toward 120 the periphery of the disk, the groove nearest the center would be deepest and that nearest the periphery the most shallow.

I am aware that it has been proposed to 125 compensate for the wear of the needle by forming a record groove of increasing width throughout the length thereof, but this is objectionable, because, to cite one reason, a large number of grooves are commonly 130 formed upon the record surface, and the

space between the same is extremely limited. Furthermore, increasing the width of a groove necessarily increases the depth as well, if the slant of the sides of the groove is maintained the same, thereby largely counter-acting the beneficial result of widening the groove as a compensation for the wear of a conically pointed needle.

In Fig. 4 is illustrated one of many forms of apparatus which may be employed in recording, to obtain a record groove of the desired character upon the master record, from which duplicate records are subsequently made in well known manner. As there illustrated, the master blank 1' is mounted for rotation, and is adapted to be fed toward the right, as shown by the arrow, past the recording needle 9 by suitable and well known mechanism. The needle 9 is carried by the lever 10 pivoted at 11 to the sound box 12, the upper end of the lever being secured to the center of diaphragm 13 in the sound box. The sound box has a neck 14 slidably mounted upon the end of a tube 15 having a cylindrical enlargement 16 mounted to oscillate in a vertical plane upon trunnions 17, and within a cylindrical bearing 18. The latter carries a short neck 19 which is joined to the end of the recording horn 20 by a flexible coupling 21. The weight of the sound box tends to cause the same to oscillate about trunnions 17, and cause the recording needle to sink into the record blank when the latter is revolved. The depth of the cut at the beginning of the record is regulated by a sliding weight 22 upon an arm 23 secured to the neck 15 as shown. The weight 22 may be secured at any desired point, on arm 23, beyond the pivot 17, to counterbalance the recorder and give the desired initial cut. Also carried by arm 23 is a cup 24, above which is a receptacle 25, having a nozzle 26 of a bore or opening adjustable by screw 27. The receptacle 25 may be filled with fine sand, lycopodium powder, or other fine fluid material

either granular or liquid. When the machine is started, the valve 27 is opened to the desired extent, and a fine stream of material is allowed to flow uninterruptedly into cup 24 throughout the making of the record. This results in gradually and continually decreasing the pressure on the stylus as the latter progresses from the periphery of the record toward the center of the same, resulting in the desired groove of continually decreasing depth. As the granular material falls into cup 24 in a steady stream, there is no harmful vibration imparted to the recorder thereby. Obviously, other equivalent methods of obtaining the same result may be used, if desired.

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

1. As a new article of manufacture, a sound record having a continuous record groove of gradually decreasing depth throughout its length, from beginning to end, substantially as described.

2. As a new article of manufacture, a sound record having a continuous record groove of the laterally undulating type, the depth of which decreases progressively and uniformly from the beginning to the end thereof, substantially as described.

3. As a new article of manufacture, a sound record having a continuous record groove of the laterally undulating type, the depth of which groove decreases from the beginning to the end thereof in such manner as approximately to compensate for the wear of a reproducing stylus or needle when the latter is tracking the same, substantially as described.

This specification signed and witnessed this 9th day of May, 1911.

STEPHEN C. PORTER.

Witnesses:

DYER SMITH,
HENRY SHELDON.