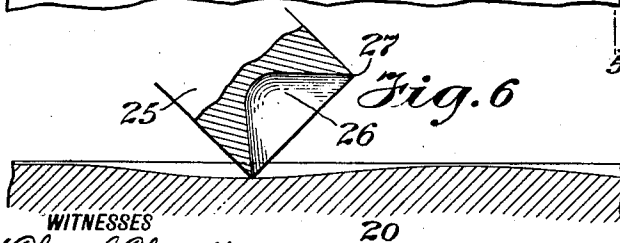
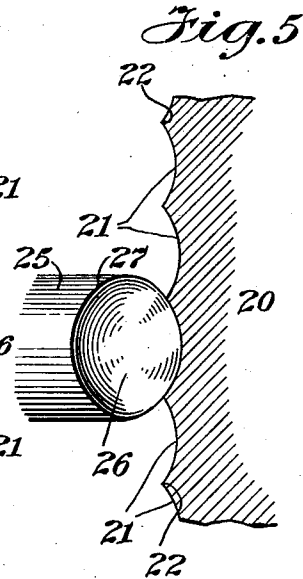
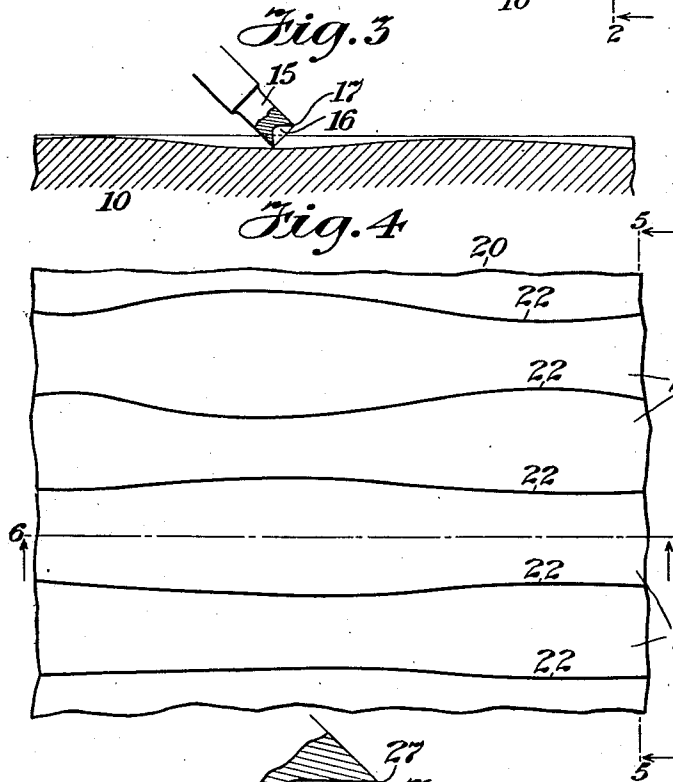
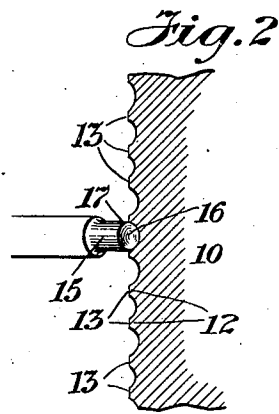
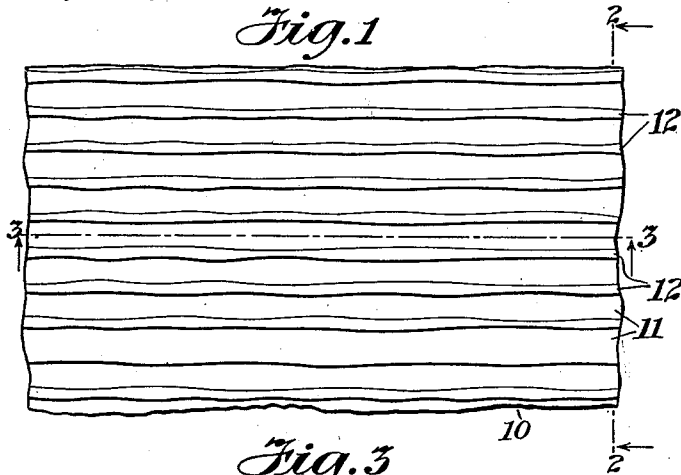


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SOUND RECORD.  
APPLICATION FILED JULY 3, 1915.

1,269,696.

Patented June 18, 1918.



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# UNITED STATES PATENT OFFICE.

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## SOUND-RECORD.

1,269,696.

Specification of Letters Patent.

Patented June 18, 1918.

Application filed July 3, 1915. Serial No. 37,946.

*To all whom it may concern:*

Be it known that I, JOHN FLETCHER, a citizen of the United States, and a resident of Douglaston, Queens county, Long Island, State of New York, have invented certain new and useful Improvements in Sound-Records, of which the following is a specification.

It is well known that the sound records, 10 or talking machine records, now in general use, are divided into two types or classes which are known respectively as the "hill and dale" or vertically undulatory type and the "zig zag" or laterally undulatory type. 15 Records of the "hill and dale" type are usually provided in each case with an undulatory spiral groove of uneven depth forming "hill and dale" undulations corresponding to sound waves, and records of the "zig zag" type are usually provided in each case 20 with an undulatory spiral groove of substantially uniform depth forming "zig zag" or lateral undulations corresponding to sound waves.

In the usual process of producing commercial records of either the "hill and dale" or the "zig zag" type, it is customary to first form a master record by cutting in a record blank of wax or other comparatively soft wax-like material a suitable spiral groove by means of a suitable cutting tool or stylus vibrated by and in accordance with sound waves. A matrix or negative is then made from the master record by an 25 electrotyping process and the commercial records are then formed by subjecting normally comparatively hard record material, rendered temporarily plastic by heat, to the action of the matrix under great pressure, and then cooling the record material while 40 under pressure.

It has been suggested that in recording "hill and dale" undulations in a record that the resistance to the action of the recording 45 stylus varies with the depth of the groove being cut whereas in recording "zig zag" undulations there is no variation in resistance due to variation in depth of cut as the depth of cut is constant.

It has also been suggested that in reproducing sound from a "hill and dale" record the bottom wall of the record groove has to perform not only the function of support-

ing the weight of the sound box but also the function of vibrating the stylus and diaphragm and consequently is subjected to greater wear and must be considerably broader than the bottom of a "zig zag" record which is smooth and even and has to perform only the function of supporting the 60 sound box.

Moreover, it has been suggested that the use of a wide sound groove in forming a record is considered to be objectionable in that it requires the removal or displacement 65 of a relatively large amount of material from the wax master record, and consequently causes a considerable resistance to the normal action of the recording stylus during the recording process; and that it is also objectionable in that it diminishes the 70 number of words or the amount of sound measured in time which may be recorded upon a given area of record.

Prior to this invention, to avoid a rapid 75 wearing away of undulatory walls of "hill and dale" records it has been customary to provide such records with much broader spiral grooves than are usually provided in records of the "zig zag" type and in an obvious effort to economize space as much as possible the spiral grooves of such "hill and dale" records have been so formed that the successive convolutions of the groove "overlap" or meet in sharp edges, as will appear 85 hereinafter.

This invention provides a "hill and dale" record, having an extremely narrow undulatory groove, which may be used successfully in cooperation with an ordinary conically pointed steel needle in reproducing 90 sound, and which has been found to be extremely durable in use and to have practically all of the advantages of a "zig zag" record, and also certain other advantages, 95 as will appear hereinafter.

In the accompanying drawings, Figure 1 is a greatly enlarged fragmentary top plan view of a disk sound record constructed in accordance with this invention; Fig. 2 a 100 transverse section of the same on line 2—2 of Fig. 1; Fig. 3 a longitudinal section of the same on line 3—3 of Fig. 1; Fig. 4 a fragmentary top plan view of an old form of "hill and dale" sound record, drawn to 105 substantially the same scale as Fig. 1; Fig.

5 a transverse section on line 5—5 of Fig. 4; and Fig. 6 a longitudinal section on line 6—6 of Fig. 4.

Referring to the drawings, one embodiment of this invention comprises a commercial disk sound record 10 formed in any well known or suitable manner of any usual or suitable material but preferably of a substantially homogeneous material or composition which is plastic when heated and hard when cooled and which contains a small amount of a finely pulverized mild abrasive such for instance as china clay or barytes, or any other suitable material. In the face of the disk record is formed in any well known or suitable manner a spiral groove 11 in the form of "vertical" or "hill and dale" undulations corresponding to sound waves. This sound groove may be of any suitable form and dimensions, but preferably in cross section is approximately or substantially in the form of a portion of an ellipse or slightly flattened semi-circle arranged with its longer or major diameter extending either in the plane of the face of the record or in a direction parallel thereto, depending upon the depth of the groove at the particular point where the cross section is taken. Ordinarily at its deepest points the groove 11 in cross section is approximately or substantially in the form of a semi-ellipse or slightly flattened semi-circle and is slightly more than twice as wide as it is deep, but it is to be understood that this ratio between the maximum width and the maximum depth of groove may be either increased or decreased as may be found desirable, and in some cases it may be found desirable to have the maximum depth of the groove as great or even greater than the maximum width of the groove. In any case, however, the maximum width of the groove is preferably slightly less than the pitch of the spiral or the distance from the center of one convolution of the spiral to the center of a succeeding convolution, thus leaving at all times a spiral wall 12 having a flat top or outer surface 13 of appreciable width between successive convolutions.

In the embodiment of this invention shown in Figs. 1, 2 and 3, the spiral record groove has 184 turns or convolutions to the inch, or in other words, the "pitch" of the groove is 1/184 of an inch (approximately .00543 plus of an inch) and the record groove has a maximum width of approximately .005 of an inch, thus leaving a spiral wall having a flat surface 13, having a minimum width of .00043 plus between consecutive convolutions of the groove 11.

The commercial record 10 constructed in accordance with this invention may be formed in any suitable manner but preferably by first cutting or otherwise forming in a soft record blank a "hill and dale"

groove of the same form and dimensions as that just described by means of any suitable tool but preferably by means of such a cutting tool as is shown in Figs. 2 and 3 and which consists of a jewel having a cylindrical portion 15 the free end of which is cupped out or countersunk as at 16 to provide a sharp circular cutting edge 17. In forming the "hill and dale" groove 11 the tool 15 is arranged in an inclined position as shown and is vibrated vertically by and in accordance with sound waves in a well known manner while the record blank is suitably rotated and is moved laterally with respect to the tool to cause the tool to cut a "hill and dale" spiral groove in the record blank. Commercial records are then made from the soft master record in any well known manner, as, for instance, by forming a suitable electrotype either directly or indirectly from the master record, backing up the electrotype and then utilizing the electrotype for pressing the commercial records.

In forming a master sound record it is customary to permit the tool to cut or form several smooth preliminary convolutions of the record groove before the tool is subjected to the action of sound waves, and these preliminary convolutions serve to receive the stylus or needle at a point prior to or in advance of the initial notes or sounds recorded upon the record and when the records are made of material which is slightly abrasive and steel needles are used, these preliminary convolutions wear the point of the needle slightly and shape it to the groove.

It has been found that commercial sound records constructed in accordance with this invention of any suitable record material but preferably of a material which is slightly abrasive, are well adapted to be used in cooperation with ordinary conically pointed needles such as are generally used in reproducing sounds from records of the "zig zag" type, and when so used are not subject to excessive wear and consequent rapid deterioration but will remain in good condition and give excellent results for a large number of sound reproductions. The slight amount of wear upon the steel needle produced by the walls of the preliminary convolutions of the record appears to be sufficient to shape the needle to the groove to such a degree that the needle thereafter slides over the "hill and dale" sound undulations of the groove without any excessive wear either on the needle or on the record.

In Figs. 4, 5 and 6 is shown very much enlarged one of the old forms of "hill and dale" records in which the record 20 is provided with a "hill and dale" spiral groove 21 having 96 turns or convolutions to the inch or a pitch of 1/96 of an inch and in which the successive convolutions overlap

and meet in sharp edges 22. In this old form the maximum width of the groove is considerably greater than the pitch of the groove and is considerably greater than  
 5 twice the maximum depth of the groove. The groove in this old form is originally formed ordinarily by a cylindrical tool 25 similar to the one hereinbefore described and having a cupped end 26 forming a sharp  
 10 circular edge 27, the diameter of which is considerably greater than the pitch of the record groove 21.

It has been found that, owing largely to the fact that in making the master record in  
 15 accordance with this invention a comparatively small amount of resistance is encountered by the recording stylus or tool, commercial records constructed in accordance with this invention give very superior  
 20 phonetic results, such for instance as improved definition and brilliancy of tone, an improved rendition of fine overtones and harmonics, a clear and characteristic reproduction of all of the various instruments and  
 25 voices in *ensemble* productions of grand operas, and other improved results.

It has also been found that by having a flat wall of appreciable width or thickness between the successive convolutions of the  
 30 record groove, these walls are not liable to become cracked or chipped either during the manufacture of the records or during subsequent use, whereas in the old form of record shown in Figs. 4, 5 and 6 a large per-  
 35 centage of the records are spoiled during the process of manufacture by the cracking or chipping of the sharp edges 22 between the record grooves 21 while the records are being cooled suddenly while under compression,  
 40 and a further large percentage of these old forms of records are spoiled while in use by the accidental chipping of these sharp edges 22.

Furthermore, in the new form of record  
 45 shown in Figs. 1 to 3, the upper portions of the side walls of the record groove are either vertical or approximately vertical at points where the groove has a maximum depth and in any case have a steeper inclination than  
 50 the side walls of the groove 21 in the old form and consequently the walls of the groove in the new form are of such a form as to serve as an effective guiding means for propelling the sound reproducing means  
 55 across the record in reproducing sounds from the record, while in the old form the groove 21 is so shallow in proportion to its width and is of such a shape that the walls of the groove are not adapted to act effectively to guide and propel a sound repro-  
 60 ducer, and require a mechanical feed for the sound reproducer to insure effective action.

Moreover, it is obvious that in the new  
 65 form of record shown in Figs. 1, 2 and 3 a

relatively large amount of sound measured in time may be recorded on a record of given area, and there is therefore an appreciable economy of material which reduces the cost of the record both at the  
 70 factory and in transportation and renders the record more convenient to handle and less liable to be injured. It is also obvious that this improved record has many other advantages over the old form of "hill and  
 75 dale" record shown in Figs. 4 to 6.

Moreover, in this improved record owing to the shape in cross section of the walls of the record groove, practically the entire wall  
 80 surface bounding or forming the groove acts as a wearing or bearing surface for vibrating the reproducing stylus and therefore this form of record has a wearing or bearing surface that relatively is much greater in  
 85 area than (roughly speaking more than double) the wearing or bearing surface which acts to vibrate the reproducing stylus in a record of the "zig zag" type. For instance, in a "zig zag" record having a record  
 90 groove of 184 turns to the inch, the groove owing to its laterally undulatory form could ordinarily have a width of not more than 2 or 3 thousandths of an inch and a depth of about the same amount and  
 95 would evidently provide a much smaller undulatory bearing surface than is provided by the improved "hill and dale" record having a record groove of 184 turns to the inch and a maximum width of about .005 as  
 100 shown in Figs. 1 to 3, particularly as the bottom wall of a laterally undulatory groove is smooth and of uniform depth and the vibration of the stylus and the feeding or propelling of the stylus across the record  
 105 is effected mainly if not entirely by the action of only one of the side walls of the groove.

While for the purposes of this invention it is preferred to form this improved record of material which is slightly abrasive, or which  
 110 contains an abrasive, it is to be understood that it is not necessary that an abrasive material be used as any other suitable material will give satisfactory results.

Moreover, although this improved record  
 115 has been shown and described as provided with a record groove which in cross section at a point of maximum depth is approximately or substantially in the form of a semi-ellipse or slightly flattened semi-circle, it is to be understood that the invention  
 120 is not limited to this particular form as at such a point the groove might be exactly semi-circular, or V-shaped or any other suitable shape. Although only one form has  
 125 been shown and described in which this invention may be embodied, it is to be understood that the invention is not limited in its application to any specific construction but might be embodied in various forms with-  
 130

out departing from the spirit of the invention or the scope of the appended claims.

*Claims.*

15 Having thus fully described this invention, I claim and desire to protect by Letters Patent of the United States:

1. A sound record having thereon a spiral groove comprising a plurality of convolutions of uneven depth forming "hill and dale" undulations corresponding to sound waves, and successive convolutions of said groove being separated at all points by a substantially flat topped wall, and said  
10 groove having a transverse sectional form which at a point of maximum width is substantially in the form of a slightly flattened semicircle.

2. A sound record having thereon a spiral groove comprising a plurality of convolutions of uneven depth forming "hill and dale" undulations corresponding to sound waves, and successive convolutions of said groove being separated at all points by a substantially flat topped wall, said groove  
20 having a maximum width less than the pitch of said spiral but equal to a major portion of said pitch, and having a maximum depth ordinarily approximating one-half of said

maximum width, and said groove having a  
30 transverse sectional form which at a point of maximum width is substantially in the form of a slightly flattened semicircle.

3. A sound record having thereon a spiral groove comprising a plurality of convolutions of uneven depth forming "hill and dale" undulations corresponding to sound waves, and successive convolutions of said groove being separated at all points by a substantially flat topped wall, said groove  
35 having a maximum width less than the pitch of said spiral but equal to a major portion of said pitch, and having a maximum depth ordinarily approximating one-half of said maximum width, and said spiral groove having a pitch of approximately one hundred  
40 eighty-four turns to the inch and said groove having a transverse sectional form which at a point of maximum width is substantially in the form of a slightly flattened semicircle.

Signed at New York, in the county of New York and State of New York, this  
50 29th day of June, A. D. 1915.

JOHN FLETCHER.

Witnesses:

A. I. GARDNER,  
K. POLIS.