Jan. 16, 1934. H. F. STOSE 1,943,460

ECCENTRIC CONTROL GROOVE FOR RECORDS

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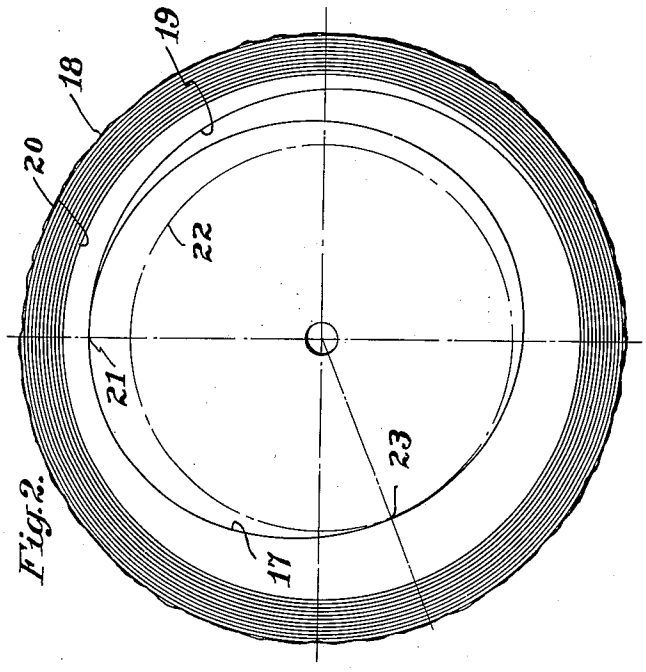


Fig.2.

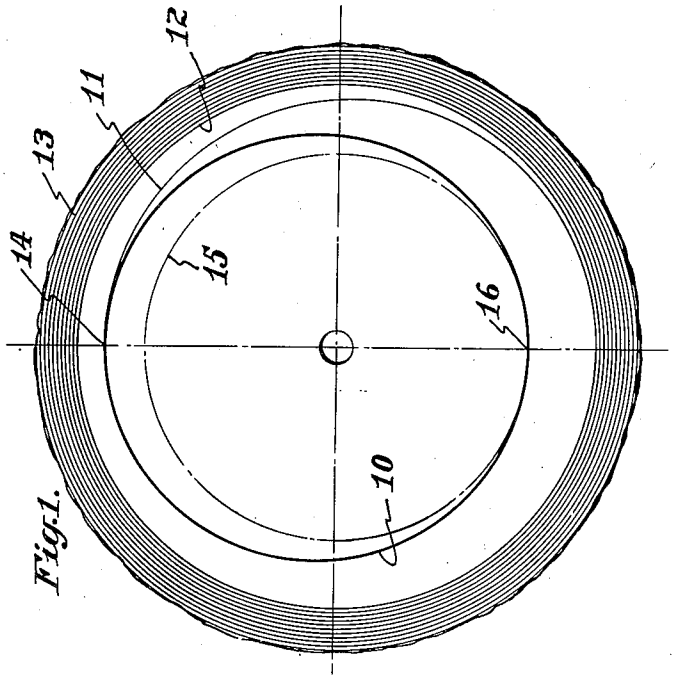


Fig.1.

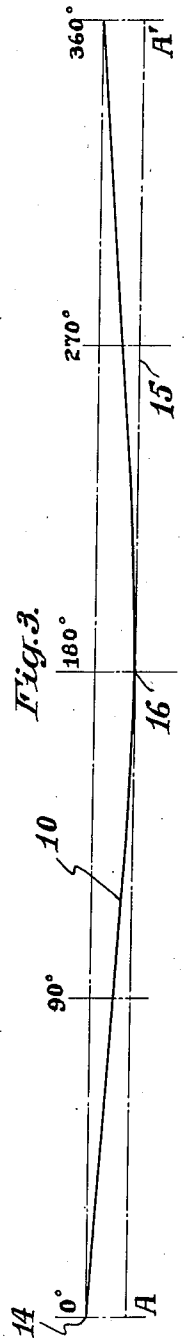


Fig.3.

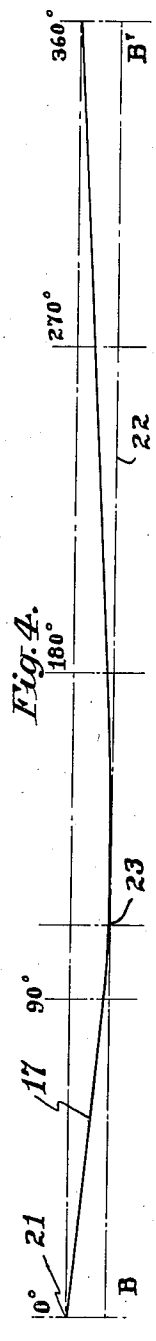


Fig.4.

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ECCENTRIC CONTROL GROOVE FOR RECORDS

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11 Claims. (Cl. 274—42)

My invention relates to phonograph records, and, more particularly, to records of the type which are adapted to control various sound reproducing instrumentalities whereby repeating and stopping devices may be actuated, or a cycle of automatic operations initiated in an automotive record changing phonograph.

More specifically, my invention relates to a supplementary terminal or control groove which is eccentrically disposed with respect to the usual spiral sound groove of a record, and constitutes an improvement over a similar control groove disclosed in the United States patents to Squibb, Nos. 1,303,125 and 1,615,243.

It is known that the terminal control groove of the conventional non-flexible record is formed to a depth considerably greater than that of the usual spiral sound groove in order that a stylus may be retained in the control groove when operating to control a mechanism of the kind described in the Squibb patents above referred to, or, until a sound reproducing instrumentality and its stylus is moved out of cooperative engagement with the record.

Recently, however, flexible records such as sheet celluloid, resin coated fibre records and the like, for example, have been introduced which are so thin that a terminal control groove equal in depth to that of a similar groove in a record of conventional type cannot be impressed therein on both sides without cutting through the record structure or otherwise seriously impairing the strength of the record. Consequently, in order to prevent unnecessary weakening of the record structure, it has been found necessary to provide relatively thin records with a terminal control groove which is only slightly deeper than the spiral sound groove formed therein.

In use, however, considerable difficulty has been experienced with thin records in which the terminal control groove is shallow, by reason of the fact that when the stylus of a sound reproducing instrumentality is in cooperative engagement with the control groove immediately after a period of sound reproduction, the accelerated to-and-fro movement imparted to the sound reproducing instrumentality has a marked tendency to cause the reproducing stylus to jump out of or otherwise to leave the eccentric groove.

When such a control groove moves the stylus toward the center of the record, it overcomes only the natural inertia of the stylus and the associated sound instrumentality. However, when the stylus is being moved outwardly, away from the center of the record, the control groove must overcome not only the same natural inerita of the moving parts but, in addition, it must exert a lateral thrust sufficiently greater to operate automatic stop mechanism or other associated mechanisms. These forces are not uniform although they go through the same cycle in every case.

Furthermore, there is an additional force which tends to move the sound instrumentality and its associated stylus toward the center of the record. This force arises by reason of the fact that, with the conventional adjustment of said instrumentality, the record groove so lies at an angle with respect to the stylus at their point of contact that there is a component of motion tending to move the stylus toward the center of the record. This force is proportional to the sine of the angle made by a line connecting the stylus with the pivot about which said instrumentality swings, and a line tangent to the record groove at a point where the stylus engages the groove. The force is greater at increased distances from the record center and, accordingly, is more important in control grooves of larger diameters.

On the other hand, the maximum lateral thrust on the stylus which can be exerted without causing it to leave the groove is constant for a given set of conditions. Accordingly, it will be apparent that the maximum force exerted at any time during the cycle is naturally the limiting force which restricts the useful cooperation of the stylus with the control groove.

It is, therefore, an object of my invention to provide a sound record with an eccentrically arranged terminal groove which is adapted to so control the accelerated inward and outward movement of a sound reproducing instrumentality and a stylus therefor, when in cooperative engagement therewith, that the tendency of the stylus to leave or jump out of the terminal-groove is reduced to minimum.

A further object of my invention is to provide a sound record with an eccentric control groove which, when cooperating with the stylus of a sound reproducing instrumentality, will cause said instrumentality to travel much more rapidly in one direction than in the opposite direction.

Another object of my invention is to provide a sound record with an eccentric control groove whereby the maximum forces acting on the stylus of a sound reproducing instrumentality, when cooperating with said groove, are equalized throughout a revolution of the control groove.

A further object of my invention is to provide a sound record with an eccentric control groove which is of substantially no greater depth than that of the conventional spiral sound groove therein.

Another object of my invention is the provision of an improved eccentric control groove which permits of its practical application to one or both sides of thin flexible records without weakening such record structures whereby such records are also adapted to control known devices which operate to bring rotatable record supports to rest or to initiate a cycle of automatic record changing operations, in an automatic phonograph, after a period of sound reproduction.

The eccentric groove, according to my invention, is so designed that the time during which the needle is moved in toward the center of the record thereby is reduced from that of conventional eccentric control grooves and the time during which it is moved outwardly thereby is increased over that required by conventional eccentric control grooves. The result is that the maximum instantaneous force during the inward motion is increased, because the same amount of work is done in a shorter time, and the maximum instantaneous force during the outward movement is decreased because, in like manner, the same amount of work is performed in a longer period of time. This results, naturally, in more nearly equalizing the maximum forces in each direction during one revolution of the record, as it allows more time for the part of the cycle during which the greater part of the work is done.

The novel features characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawing, in which

Figure 1 is a plan view of a fragmentary central portion of a phonograph record illustrating a conventional form of an eccentric terminal groove;

Fig. 2 is a similar view illustrating my improved form of eccentric terminal groove;

Fig. 3 is a development, in plan, of the conventional circular control groove which is eccentrically arranged with respect to the center of the record shown in Fig. 1;

Fig. 4 is a similar development of a substantially oval control groove which is eccentrically arranged with respect to the center of the record shown in Fig. 2, in accordance with my invention.

Referring, now, to Fig. 1 of the drawing, wherein a conventional form of an eccentrically arranged supplementary control groove is illustrated for purposes of comparison, the eccentric groove indicated therein at 10 intersects the inner or lead-in end 11 of the spiral sound groove 12 at its point of maximum eccentricity with respect to the center of the record 13 as indicated at 14. A circle 15 concentric with the axial center of the record 13 is shown in broken lines to better illustrate the distance which the groove 10 is off-set from the center of the record 13.

Assume that the record 13 is rotating in a clockwise direction with the stylus of a sound reproducing instrumentality in cooperative engagement with the spiral sound groove 12. It will be readily apparent that the lead-in end 11 of the spiral sound groove 12 will guide the stylus into initial engagement with the eccentric groove 10 at its point of maximum eccentricity as indicated at 14 and that a full half revolution of the eccentric groove 10 is required to locate its point of minimum eccentricity, as indicated at 16 under the point of the stylus. In other words, the sound reproducing instrumentality will not have been moved inwardly to its innermost position, until the stylus has traversed one half or 180° of the eccentric groove 10, or from the point 14 to the point 16 indicated thereon. The remaining 180° of the groove 10, from the point 16 to the point 14, moves the sound reproducing instrumentality in a reverse or outward direction back to its point of initial engagement with the groove 10.

Accordingly, when a sound record, which is provided with the conventional form of eccentric groove illustrated in Fig. 1, is rotated with a sound reproducing instrumentality and stylus therefor in cooperative engagement with the eccentric groove 10, the sound reproducing instrumentality is first accelerated, after a period of sound reproduction, inwardly toward the center of the record 13 and subsequently accelerated away from the record center at the same rate that it was accelerated toward the record center.

When the stylus of a sound reproducing instrumentality traverses the first half of the eccentric groove 10, that is, from the point 14 to the point 16, the inward movement of the said instrumentality is accelerated at a definite but not a uniform rate. This inward movement is also aided by the natural drag of the said instrumentality toward the center of the record as hereinbefore described. However, as soon as the stylus begins to traverse the remaining half of the eccentric groove 10, that is, from the point 16, back to the point 14, the movement of the sound reproducing instrumentality is reversed. The portion of the groove 10 which reverses the movement of the said instrumentality must overcome not only the inertia of the sound reproducing instrumentality and the natural drag toward the center of the record, but also such resistance as is imposed on the said instrumentality by certain devices adapted to be controlled thereby as, for example, repeating devices, turntable stopping devices and analogous structures. The reversing force which is applied to the reproducing stylus by the last mentioned portion of the groove 10 is often insufficient to move the said stylus in a reverse direction from that in which it is first moved because of the additional load imposed thereon and, as a result thereof, the stylus jumps out of the groove 10.

In this connection, reference is made to Fig. 3 of the drawing wherein a development of the conventional eccentric groove 10, illustrated in Fig. 1, indicates the point of maximum eccentricity at 14, and the point of minimum eccentricity at 16, the latter point being half way along the length of the curve representing the eccentric groove 10. In this development, the circle 15 naturally appears as a straight line, A, 16, A'.

In accordance with my invention, as illustrated in Figs. 2 and 4, a substantially oval shape groove 17 is eccentrically arranged with

respect to the center of the record 18 with its point of maximum eccentricity intersecting the inner or lead-in end 19 of the spiral sound groove 20 as indicated at 21.

A circle 22, concentric with the axial center of the record 18, is also shown in broken lines to illustrate that the distance which the groove 17 is off-set from the center of the record 18 is equal to that shown in Fig. 1.

Assume that the record 18 is rotating in a clockwise direction with the stylus of a sound reproducing instrumentality in cooperative engagement with the spiral sound groove 20. It will be readily apparent that the lead-in end 19 of the spiral sound groove 20 will guide the stylus into initial engagement with the eccentric groove 17 at its point of maximum eccentricity as indicated at 21 and that considerably less than one-half revolution of the groove 17 is required to locate its point of minimum eccentricity under the point of the stylus, which would occur at the point indicated at 23.

In other words, the sound reproducing instrumentality will have been moved inwardly to its innermost position when the stylus has traversed approximately only 110° of the eccentric groove 17, or from the point 21 to the point 23 indicated thereon. Consequently, a sound reproducing instrumentality, when operating in an eccentric groove developed in accordance with my invention, will accelerate the sound reproducing instrumentality to a greater rate inwardly toward the center of the record 18 than when the conventional eccentric groove is used and, since a much greater portion of the groove 17 remains for moving the sound reproducing instrumentality outwardly, the rate of acceleration outward will be much less than when the conventional eccentric groove is used. Hence, a lateral thrust of smaller instantaneous magnitude will be imparted to the stylus of the reproducing instrumentality by the remaining approximately 250° of the groove 17 and thereby obviate the forcing of the stylus out of the groove 17.

In this connection, reference is made to Fig. 4 of the drawing wherein a development of my improved control groove 17, illustrated in Fig. 2, indicates at 21 the point of maximum eccentricity, or the point at which it is farthest from the center of the record 18, and at 23 the point of minimum eccentricity, which is slightly more than one-quarter the length of the curve representing the groove 17 from the point 21. In this development, the circle 22 naturally appears as a straight line, B, 23, B'.

Inasmuch as my improved eccentrically arranged control groove 17 causes different maximum accelerations of a sound reproducing instrumentality in opposite directions and thereby exerts more nearly equal resultant maximum forces on the stylus thereof in opposite directions transversely of the said groove 17, when in cooperative engagement therewith, the use of a control groove, whose depth is substantially equal to that of the spiral sound groove, is made possible.

Although I have shown and described a specific embodiment of my invention, I am fully aware that several modifications thereof will be readily apparent to those skilled in the art to which it pertains. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. A record having a spiral sound groove adapted to be traversed by a reproducing stylus and a supplementary control groove cooperatively associated with said sound groove, said control groove comprising a substantially oval-shape groove eccentrically arranged with respect to the center of said record and adapted to equalize the lateral forces of said groove on said reproducing stylus throughout a cycle of revolution.

2. A record having a spiral sound groove and a supplementary control groove cooperatively associated with said sound groove, said control groove comprising a substantially oval-shaped groove eccentrically arranged with respect to the center of said record with its point of maximum eccentricity intersecting the innermost end of said sound groove and its point of minimum eccentricity spaced substantially 110° from said point of maximum eccentricity.

3. A sound record having a spiral undulatory groove and a supplementary control groove continuing beyond the innermost end of said undulatory groove and comprising a substantially oval-shaped groove eccentrically arranged with respect to the center of said record with its point of maximum eccentricity intersecting the innermost end of said sound groove and its point of minimum eccentricity occurring within less than 180° from said point of maximum eccentricity.

4. A sound record having a spiral sound groove and a supplementary terminal groove cooperatively associated with said sound groove, said terminal groove being eccentrically arranged with respect to the center of said record with its point of maximum eccentricity intersecting the innermost end of said sound groove and with its point of minimum eccentricity spaced substantially 110° from said point of maximum eccentricity.

5. A sound record having a spiral sound groove and a supplementary control groove, said control groove continuing beyond the innermost end of said sound groove and comprising a substantially oval-shape groove arranged eccentrically with respect to the center of said record with its points of maximum and minimum eccentricity spaced less than 180° apart.

6. A sound record having a spiral undulatory groove and a terminal control groove associated therewith, said control groove being substantially oval-shape and arranged eccentrically with respect to the center of said record with its points of maximum and minimum eccentricity spaced less than 180° apart in one direction and more than 180° in the opposite direction whereby lateral forces which may be imparted alternately in opposite directions to a reproducing stylus when in cooperative engagement with said control groove are substantially equalized.

7. A sound record having a spiral undulatory groove and a supplementary control groove cooperatively associated with said spiral groove, said control groove comprising an endless groove so off-set with respect to the center of said record that a point on said control groove which is nearest to the said record center is spaced less than half a revolution of said control groove from a point thereon which is farthest from said record center.

8. A record having a spiral sound groove and a supplementary control groove cooperatively associated therewith, said control groove being eccentrically arranged with respect to the cen-

ter of said record with the point of maximum eccentricity on said control groove intersecting the innermost end of said sound groove and its point of minimum eccentricity spaced more than 90° from said first named point in one direction and more than 180° in the opposite direction whereby maximum forces acting on a stylus of a sound reproducing instrumentality when cooperating with said control groove are equalized throughout a revolution of said control groove.

9. A record having a spiral sound groove and a supplementary control groove cooperatively associated with said spiral groove, said control groove being eccentrically arranged with respect to the center of said record with its point of maximum eccentricity intersecting the innermost end of said spiral groove and with its point of minimum eccentricity spaced less than 180° from said point of maximum eccentricity in one direction therefrom, said control groove being substantially equal in depth to the said sound groove.

10. The combination with a sound reproducing device including a stylus of a record tablet having a spiral sound groove and a supplementary control groove cooperatively associated with said sound groove, said control groove being so disposed eccentrically with respect to the center of said tablet that the time interval during which the stylus moves toward the center of the tablet is reduced and the time during which it moves outwardly from the center of the tablet is increased.

11. As an article of manufacture, a record tablet having a spiral sound groove and an eccentric control groove substantially equal to said sound groove in depth co-operatively associated therewith, said control groove having its point of minimum eccentricity spaced substantially 110° from its point of maximum eccentricity in one direction.

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