TALKING-MACHINE RECORD.

This application is a division of application filed May 7, 1923, Serial No. 637,198. In said application I describe and claim certain improvements in the art of recording and reproducing sounds, in which the improved talking machine record herein described and claimed is utilized.

As now made, talking machine records permit the recording of sounds over a very limited period of time, generally in the neighborhood of three minutes, more or less; as a result any music recorded thereon is necessarily abridged and mutilated, and so-called talking records are limited in subject matter.

The limitation as to time in existing talking machine records is made necessary by the conditions of the art as now practiced. It being an essential that the sounds which are to be directly reproduced from the record shall be loud enough to fill a large sized room, it has been found necessary to make use of a relatively ponderous sound-box carrying a relatively large diaphragm, the whole resting upon a pointed needle which tracks the record and which engages the record with a pressure of many thousand pounds per square inch. To prevent such a needle from cutting and destroying the record material with which it engages, it is necessary that the record material should be moved with respect to the needle at a relatively high speed, and experience has shown that a mean surface speed in the neighborhood of 40 inches per second is desirable in practice. It has been found that at this surface speed of the material a sound-box of sufficient weight to give the necessary sounds can be supported by a needle with commercial results as to wear, provided the record groove is of sufficient width to give a relatively extended bearing surface for the needle when the point of the latter has worn down sufficiently to fill a substantial portion of the record groove, and therefore it is the present practice to make these record grooves substantially .005 inch in width and with a depth ranging from .002 to .003 inch.

The amplitude of the sounds reproduced from the record depends upon the extent to which the groove may vary on either side of its medial line or in other words upon the amplitude of the lateral or vertical undulations of the record groove, and I have observed from a study of many records that the maximum sounds recorded represent a vibration of between .001 and .002 of an inch. To permit the recording of sounds represented by an amplitude of this order or possibly greater, and at the same time provide sufficient material between adjacent grooves to properly actuate the needle and prevent it from short-circuiting, it has been necessary in practice to employ a feed of the order of .01 inch, whereby the lands between the grooves will be of a mean width of .005 inch, corresponding with that of the record groove. These limitations as to width of groove, width of lands, and surface speed make it impossible with a record disk of a diameter of 10 or 12 inches or thereabouts, or a corresponding cylinder, to secure a sound record of much more than 3 minutes in length, with corresponding restriction as to character and subject matter.

What I propose by my present improvements, is to very greatly extend the capacity of a record of the present standard size by obtaining thereon a record of sounds of an hour or more representing an extension of 25 fold as to time. In this way it will become possible to record very long musical compositions or to record several long musical compositions on one face of a record; it will become possible to make a record of stories of considerable length; it will become possible on two or three double faced records to record an entire novel, since three records would represent six hours of solid reading; and it will become possible to record upon a record disk of very small size a much longer selection than can possibly be recorded and satisfactorily reproduced under existing conditions on records of standard size. My improved record will be especially acceptable to the blind, to whom reading by existing methods is tedious and unsatisfactory.

What I propose, in brief, is to make a record groove of microscopic size, preferably of the order of .001 inch in width, or at least substantially and materially narrower than any talking machine record of which I have knowledge. The depth of the groove is not important, so long as it shall be in reasonable proportion to the width. I have frequently cut record grooves of the order of a thousandth of an inch in width and
have found that the ordinary recording material is sufficiently uniform and amorphous to permit such a groove to be cut with great smoothness and sharpness.

In cutting a record groove of the width indicated, I make use of a proportionate surface speed or approximately so; that is to say, if the width of the groove is reduced five-fold to .001 inch, the surface speed is preferably reduced in proportion, to preferably a shaft speed of about 16 turhps per minute or a mean surface speed of the order of eight inches per second.

The sounds which I record in such a groove of extreme narrowness and formed at low speed are so controlled or adjusted that the recorded amplitude thereof will bear substantially the same ratio to the surface speed as with existing practice; that is to say, if the maximum amplitude of sounds as recorded on present records is of the order of .001 inch, then with my improved record the recorded amplitude will be approximately .0009 inch. This control of the sounds to be recorded may be effected in many ways, as by using original sources of small volume, or by using a recording diaphragm of relatively great thickness to limit the amplitude of its response, or by using a recording diaphragm of small diameter so as to have a limited response, or by adjusting the leverage of the needle arm of the recording device whereby the movement of the cutting stylus will be properly limited.

It will be seen that the proposed record will have substantially the same relations as to width, surface speed and amplitude as existing records. With such a record it becomes possible to make a proportionate reduction in the pitch of the record groove; with the example under consideration the pitch will be reduced from .01 inch to .002 inch.

By cutting down the pitch of groove five-fold and by reducing the surface speed five-fold, I increase the time represented by the record groove twenty-five fold or, say, from three minutes to seventy-five minutes, while at the same time the record groove has sounds recorded therein in proper relation to the surface speed as well as to the width of groove and width of lands between the grooves. The sounds recorded in the groove differ only from the sounds in the grooves of existing records in the respect that they are of less amplitude, but otherwise they are perfectly and accurately formed. Being recorded at low speed and involving the removal of a minute amount of material the recorded sounds are relatively free of distortions noticed in existing records which are due to removal of relatively large amounts of material at relatively high speeds.

Such a record as I have above proposed, could not be used effectively for direct reproduction; a sound box for that purpose would have to be too heavy and direct reproduction under any circumstance would be weak, owing to the limited amplitude of the recorded sounds. I, therefore, propose to use a reproducing device bearing upon the record with a pressure proportional to the width and length of the groove, say with a pressure of from one-quarter to one-half an ounce, and by suitable amplifying means I increase the volume of the sounds to the desired extent. It is possible to use exterior amplifying means to enlarge the comparatively feeble sounds on the record to any desired extent; to as loud or louder than existing records with direct reproduction, while at the same time the wear on the improved record is no greater than with present records. The sounds from my improved record may be amplified in any suitable way, for instance, for reading, ordinary listening tubes or a simple telephone may be employed, while if loud effects are wanted, the feeble sounds on the record may be amplified by an ordinary loud-speaker of the radio type or some such device having as many stages of amplification as may be desired. Devices of this kind are capable of producing enormous amplification with but relatively little distortion. If listening tubes or a stethoscope is used as an amplifying device, it will be understood that the reproducing device will be equipped with a small light diaphragm actuated directly from the record, but if the amplifying device is electrical, as is preferred, then the needle tracking the record groove will actuate a suitable microphone, the varying currents of which will either actuate a telephone directly or be amplified before reception by any suitable arrangement of thermonic valves or other amplifiers.

In order that the invention may be better understood, attention is directed to the accompanying drawings forming part of this specification, and in which:

Fig. 1, is a cross sectional view of a record of the ordinary type and dimensions, illustrating three of the grooves, with the lower end of a needle engaging the center groove;

Fig. 2, a corresponding cross section through my improved record, on the same scale, with a needle engaging one of the grooves;

Fig. 3, a plan view of the standard record shown in Fig. 1; and

Fig. 4, a similar view of the improved record.

In all of the above views corresponding parts are represented by the same reference characters.

Referring first to Figs. 1 and 3, 1 represents a small portion of an ordinary rec-
ord having a record groove 2 therein; ordinarily this record groove is about .005 inch in width, about .002 in depth, and with a pitch of .01 inch or one hundred threads to the inch. In Fig. 3, the groove is shown as having a deflection, representing sound, of .001 inch, this being the order of amplitude of maximum sounds recorded on talking machine records. It will be understood that the record is a duplicate copy obtained in the usual way from a suitable master cut in an amorphous and uniform material in the usual way.

Referring now to Figs. 2 and 4, the record groove 3, shown therein is illustrated as being one-fifth the width of the ordinary groove and one-fifth the relative length thereof; that is to say the groove is .001 inch in width and the surface speed at which it is formed is approximately eight inches per second, average; its depth is substantially proportional to the standard record shown in Figs. 1 and 3. With these proportions the record, as shown in Fig. 4, has one twenty-fifth the area of the standard record and hence the time of reproduction is increased twenty-five fold. It is of course not necessary that these dimensions shall be precisely followed; by reducing the width of the groove and proportionately reducing the surface speed the time of reproduction is increased in proportion to the product of the two factors; a record of one-third the usual width and one-third the speed will represent a nine-fold increase in time, and so on. It is important that there should be a substantial reduction in the width and surface speed as compared with present practice, since the opportunity of exterior amplification is practically unlimited and the important consideration is to increase the time of reproduction at least several fold so as to thereby extend the talking machine into fields that are now unthought of.

It will be observed that the amplitude of the recorded sound in Fig. 4 is proportional to that of Fig. 2, so far as width and length are concerned. In other words, the maximum amplitude with a record groove of .001 inch should be of the order of .0002 inch. As I have indicated a sound groove of this sort can be obtained in various ways, but of the expedients suggested I prefer to secure the desired limited range of amplitude by using an ordinary recording apparatus operated in the usual way, but I so adjust the leverage of the arm or lever which carries the cutting tool so that the deviation of the cutting tool will be properly reduced in extent; in the assumed case, the leverage will be such that the cutting tool will be vibrated only one-fifth as far on either side of the medial line as with present practice.

As indicated, the feed or pitch of the record groove is reduced in proportion to the width, that is to say when the width of the groove is reduced to .001 inch, the pitch of the groove will be reduced to .002 inch or five hundred threads to the inch.

The needle 4 which tracks the groove of my improved record is properly proportioned to the size of the groove and has practically the same relation thereto as the ordinary needle 5 tracking the regular sized groove 2; in use the relatively pointed end will quickly wear down to increase the bearing surface and fill the groove more or less; it is important that the extremity of the needle shall have the right proportion; the shank may be relatively large so as to give rigidity and permit the needle to be handled more easily. I find that the ordinary recording material is so uniform and amorphous that a sound groove of .001 inch in width may be cut therein with beautiful sharpness and clearness; moreover the methods now used of making duplicate copies from master records are so very perfect that even when the record has been reduced in width five fold as contemplated herein the copies obtained from such a master will be practically perfect and free from foreign sounds.

In securing reproduction from such a record as I have above described, I take advantage of exterior amplifying devices and I prefer to have the record actuate a microphone rather than a diaphragm as when the amplification is secured by the use of a stethoscope.

In my said application filed May 7, 1923, Serial No. 637,138, of which this is a division, I describe as an embodiment of the invention electrical appliances by which amplification is secured, and it is therefore not necessary to illustrate the same herein since the present application relates to my improved talking machine record per se.

While I have specifically described my improved talking machine record as having a groove of the laterally undulatory type, it will be understood that the invention may be carried out with records having hill and dale grooves, it being only necessary to provide a properly proportioned width, length and amplitude as herein described. If the hill and dale groove is adopted, I prefer to form the same with the wedge shaped cutter, giving substantially the cross-section of Fig. 3. With such a groove, a needle may be used for reproduction, and will track the groove with facility and certainty. A groove of this kind is preferred to one formed with a curved edge cutter and in which the groove is extremely shallow and relatively wide, since with such a groove a rounded reproducing stylus is used, generally a sapphire or diamond, and difficulty would be experienced in tracking the groove.
if reduced to the microscopic dimensions contemplated by my invention.

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

1. An improved talking machine record having a sound groove materially less than .005 inch in width, and representing sounds recorded at a surface speed materially less than forty inches per second.

2. An improved talking machine record having a sound groove materially less than .005 inch in width and representing sounds recorded at a surface speed materially less than forty inches per second, said groove being in the form of a spiral, the pitch of which is materially less than .01 inch.

3. An improved talking machine record having a sound groove materially less than .005 inch in width and representing sounds recorded at a surface speed materially less than forty inches per second and of a maximum amplitude materially less than .001 inch.

4. An improved talking machine record having a record groove materially less than .005 inch in width and representing sounds recorded at a surface speed materially less than forty inches per second, said groove being in the form of a spiral, the pitch of which is materially less than .01 inch and the recorded sounds being of a maximum amplitude materially less than .001 inch.

5. An improved talking machine record having a sound groove approximately .001 inch in width and representing sounds recorded at a surface speed of approximately eight inches per second.

6. An improved talking machine record having a sound groove approximately .001 inch in width and representing sounds recorded at a surface speed of approximately eight inches per second, said groove being in the form of a spiral the pitch of which is approximately .002 inch.

7. An improved talking machine record having a sound groove approximately .001 inch in width and representing sounds recorded at a surface speed of approximately eight inches per second, and of a maximum amplitude of approximately .0002 inch.

8. An improved talking machine record having a sound groove approximately .001 inch in width and representing sounds recorded at a surface speed of approximately eight inches per second, said groove being in the form of a spiral the pitch of which is approximately .002 inch and the recorded sounds being of a maximum amplitude of approximately .0002 inch.

9. An improved talking machine record, comprising a record disk of standard size, a sound groove therein materially less than .005 inch in width and representing sounds recorded at a surface speed materially less than forty inches per second, said groove being in the form of a spiral, the pitch of which is materially less than .01 inch.

10. An improved talking machine record, comprising a record disk of standard size, a sound groove therein approximately .001 inch in width and representing sounds recorded at a surface speed of approximately eight inches per second, said groove being in the form of a spiral the pitch of which is approximately .002 inch.

This specification signed this 11th day of February, 1924.

FRANK L. DYER.