June 17, 1924. 1,498,384

O. J. KENYON

ACOUSTIC DIAPHRAGM

Filed March 7, 1922

FIG. 1

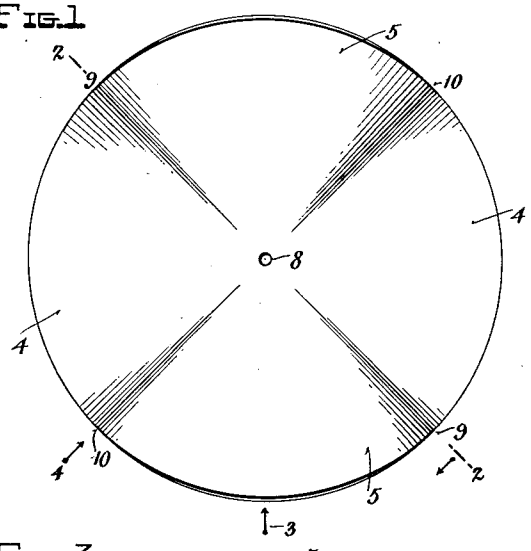


FIG. 2

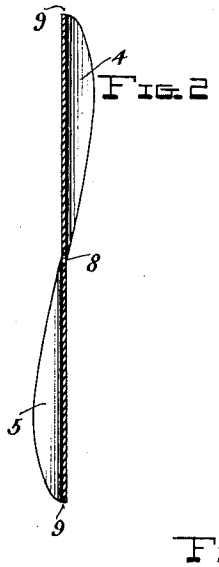


FIG. 3

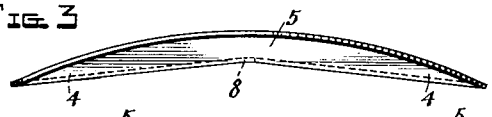


FIG. 4

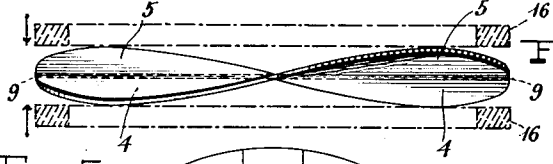


FIG. 9



FIG. 5

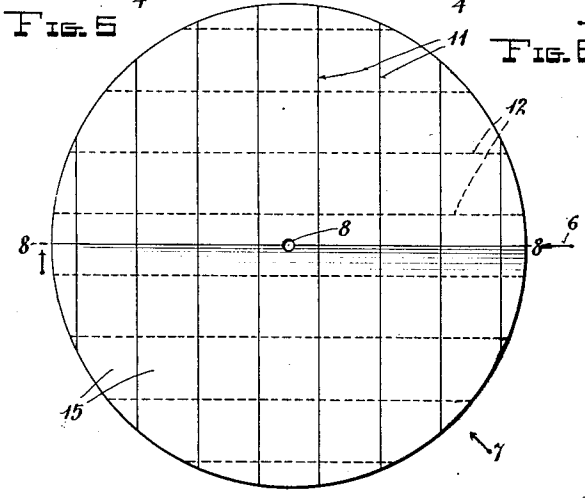


FIG. 6

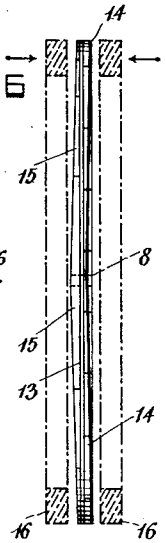
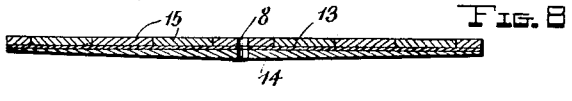


FIG. 7



FIG. 8



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by

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UNITED STATES PATENT OFFICE.

OADES J. KENYON, OF SANTA BARBARA, CALIFORNIA.

ACOUSTIC DIAPHRAGM.

Application filed March 7, 1922. Serial No. 541,810.

To all whom it may concern:

Be it known that I, OADES J. KENYON, a citizen of the United States, residing at Santa Barbara, in the county of Santa Barbara and State of California, have invented new and useful Improvements in Acoustic Diaphragms, of which the following is a specification.

My invention relates to acoustic diaphragms, and more particularly to those of the kind adapted to be used in sound recording and sound reproducing machines of all kinds, and the primary object thereof is to provide a diaphragm which will enable a more natural reproduction of the originally recorded sound waves to be obtained. It is based on the principle that inasmuch as nearly all musical instruments, as well as the human voice, create their sound waves through the use of a medium under tension, the diaphragm for reproducing these vibrations should also be under a tensile stress in order that its vibrations may sympathize more nearly in exact accordance with the original vibrations.

Another object of the invention is to create or produce tensile stresses in a diaphragm without requiring the use of additional attachments and cumbersome and expensive devices to act on the diaphragm. such for example, as rigid stretching frames or rings, similar to the method employed in drum heads and the like, as heretofore proposed, but found to be unsatisfactory. The stretching frames or rings, as heretofore proposed, and the diaphragm held thereby, usually have different coefficients of expansion, in consequence of which temperature changes due to climatic or other conditions seriously affect the degree of tension in the diaphragm. Such rigid stretching frames or rings are also very unsatisfactory because of the liability of excessive stretching and consequent rupturing of the diaphragm through careless handling, or pulling away of the diaphragm from the stretching rings or frames. The expense of production, maintenance and adjustment of the rigid frame type of diaphragms, moreover, is prohibitive of their general or extensive use.

Further objects of the invention are to provide a diaphragm which will more accurately reproduce all classes of music and sound waves of every description, to provide an improved diaphragm of this character that can be installed in present phonograph or sound reproducers without material alterations, and to provide a diaphragm which will withstand greater disturbance and deflection, because of misuse or otherwise, without injury or impairment of its efficiency.

The improved diaphragm, in its preferred forms, is shown in the accompanying drawings, wherein:—

Figure 1 is a face view of one side of a diaphragm made in accordance with one embodiment of the invention;

Figure 2 represents a cross section taken through the diaphragm on line 2—2 of Figure 1.

Figure 3 represents an edge view of the diaphragm looking in the direction of the arrow 3 in Figure 1;

Figure 4 represents an edge view of the diaphragm looking in the direction of the arrow 4 in Figure 1;

Figure 5 is a face view of a diaphragm of modified construction;

Figure 6 is an edge view of the diaphragm shown in Figure 5 looking in the direction of the arrow 6;

Figure 7 is an edge view of the diaphragm shown in Figure 5 looking in the direction of the arrow 7, Figure 5;

Figure 8 represents a cross section on the line 8—8 of Figure 5; and

Figure 9 represents a development of the peripheral edge of a diaphragm constructed in accordance with the present invention.

Acoustic diaphragms embodying the present invention may be made of any suitable kind of material, and furthermore, the diaphragms may be composed of one piece or unit, or they may be composed of two or more layers or units. Well known materials commonly used for diaphragms may be used satisfactorily. I have found, however, that bamboo may be used with excellent results and with practical advantages, bamboo being pliable, vibrant and easily worked into thin strips. When this material is properly formed, built up and glued or cemented, it makes an admirable material for the manufacture of diaphragms. The natural shrinkage of bamboo in drying, after it has been assembled and glued into a diaphragm, creates internal tensile stresses that are very beneficial, such shrinkage being utilized to warp the diaphragm in accordance with the theory hereinafter explained. Non-shrinking materials may be used but they must be

formed or warped during construction of the diaphragm in order to obtain proper results.

The diaphragm as shown in the accompanying drawing, is provided with the customary center hole 8 or equivalent means of attachment of the needle arm thereto. The areas designated 4 in Figures 1 and 2, represent those portions of the diaphragm which are warped down below the center or imaginary plane in which the hole 8 is located, while the areas designated 5 represent those portions of the diaphragm which are warped up above the center or the imaginary plane in which the hole 8 is located. The extent of areas of these warped portions 4 and 5 are indicated, and they are bounded or defined by the lines 9—9 and 10—10 in Figure 1. The portions of the diaphragm directly at or under these lines 9—9 and 10—10 are in the same imaginary plane as the center hole 8, the warping of the areas or portions 4 and 5 starting at the lines 9—9 and 10—10 and gradually increasing in deviation from the imaginary plane until the zones of maximum warping assume the shape or form shown respectively in Figures 2, 3 and 4. The full line 6, Figure 9, is a development line representing the approximate track or course that would be taken by the periphery of the diaphragm shown in Figures 1, 2, 3 and 4, if such diaphragm were rolled along as an upright wheel in a straight direction. The straight line 7 in Figure 9 represents the relative course that would be taken by the center portion of the diaphragm containing the hole 8, and also the relative position of these portions of the diaphragm directly under lines 9—9 and 10—10. This line also locates the relative position of the aforesaid imaginary plane.

As previously stated, the warped areas or portions 4 and 5 merge into that part of the diaphragm which is within the imaginary plane, by gradual curves, abrupt offsets being avoided.

Obviously, the imaginary lines 9—9 and 10—10 and the warped areas or portions 4 and 5 may be increased or decreased in number, size or proportion from that shown in the drawing, and furthermore, different kinds of materials will obviously require different shaping for best results, and these variations will be included within the scope of the claims.

Figure 5 represents a face view of a diaphragm constructed of bamboo or similar material. The lines 11 represent the approximate width of the individual pieces of bamboo. The broken lines 12 represent the strips or pieces comprising a second layer of bamboo. Each individual strip 14 of bamboo before assembly into a diaphragm is shaped in longitudinal section, as shown in Figure 8, the hole 8 being absent, of course, except in the center piece, Figure 8 representing a typical section through the completed diaphragm shown in Figure 5, and the bamboo strips 15 at the opposite side of the diaphragm being shown in cross section. 13 is a layer of paper or other suitable material which is preferably used to form a bond between the two layers of bamboo, it materially assisting also in creating tensile stresses on account of its shrinking qualities. In constructing the diaphragm of bamboo, as shown in Figure 5, all of the various bamboo strips are shaped in longitudinal section like the strip 14 in Figure 8. These strips, to which suitable adhesive is applied, are then assembled, with the paper between or without paper as desired, and held in a press until the glue or adhesive between the layers has hardened. When the diaphragm is released from the press, it is cut to the size diameter required. When the diaphragm has thoroughly dried the shrinkage of the strips at one side of the diaphragm, in a direction transversely of their length, will warp the diaphragm so that it tends to assume a concave form on that side of the diaphragm and on a diameter extending transversely to such strips, while the transverse shrinkage of the intersecting strips on the other side of the diaphragm warps the latter so that it tends to assume a concave form on that side of the diaphragm and on a diameter extending perpendicularly to the diameter first mentioned, in consequence of which shrinkage the diaphragm will assume the shape described, and substantially as shown in Figures 1, 2, 3 and 4. It is to be understood that more than two layers of bamboo may be used, if desired, and also the bamboo may be of different sectional shape than that shown in Figure 8, the size of the diaphragm controlling the numbers of layers required and the shape of each individual piece of bamboo used. In other words, various results may be obtained by making the diaphragm of uniform or unequal thickness, in whole or in part. This also depends upon the kind or kinds of material used.

Various methods may be employed in the manufacture of the improved diaphragm. The results sought may be obtained by reducing the area of the diaphragm at or near its center, or by increasing the length of the periphery of the diaphragm. Such reduction of central area or increased length of periphery may be accomplished through the application of heat or cold, applied to the diaphragm in part or in whole, singly or in combination. The desired characteristics in the completed diaphragm may also be obtained through the use of any treatment which will give the diaphragm a shape which will produce the requisite tensile

stresses in the diaphragm, the procedures heretofore described being outlined primarily as examples of methods which may be employed successfully.

In the manufacture of the improved diaphragm, care must be exercised to obtain equal warping areas on all sides of, as well as above and below the aforesaid imaginary plane; otherwise the diaphragm will assume unequal tensile stresses with results less satisfactory than will be obtained when the warped areas are placed and proportioned equally. If the warping is done entirely above or entirely below the imaginary plane, the finished diaphragm will assume a meniscus or dome shape when clamped in position in the reproducer. If the warped areas are properly produced, however, the diaphragm will assume a flat disk shape when clamped in position in the reproducer.

It will be evident, from the drawings and the foregoing description, that the completed diaphragm is a warped disk, the said warping increasing the actual circumferential length along the extreme periphery of the diaphragm over the length of the circumference of a flat disk of like diameter. The desired tensile stresses within the diaphragm are obtained by the compressive action of the customary soft gaskets or rings 16 which are used to clamp and hold the diaphragm in a more nearly flat disk shape in the sound reproducer, these tensile stresses within the diaphragm consisting of circumferential compression at and near the periphery of the diaphragm and circumferential tension at and near the center of the diaphragm.

I claim as my invention:—

1. An acoustic diaphragm comprising a shrunken and thereby warped disk capable of assuming an approximate flat shape when clamped in position between the gaskets or rings of a sound reproducer.

2. A diaphragm of the character described comprising a shrunken and thereby warped disk whose actual circumferential length along its extreme periphery is greater than the actual circumferential length of a flat disk of the same diameter.

3. A diaphragm of the character described comprising a body of bamboo which is shrunken and forms a warped disk capable of undergoing tension at and near its central portion when such disk is forced to assume a flat position or shape.

4. An acoustic diaphragm comprising a shrunken and thereby warped disk opposite portions on one diameter thereof warped by shrinkage in one direction from a given plane and other opposite portions on another diameter warped by shrinkage in a different direction from such plane, the disk being capable of undergoing circumferential compression at or near its periphery when the disk is forced to assume a flat form.

5. A diaphragm of the character described comprising a peripheral portion which is shrunken and thereby warped out of the plane in which its central portion is located.

6. An acoustic diaphragm comprising a disk of material having opposed quadrants thereof warped in one direction from the plane in which the center of the disk lies and having its other quadrants warped in the opposite direction from such plane.

7. An acoustic diaphragm comprising a disk embodying intersecting strips of material which are shrunken and thereby warp the peripheral portions of the disk out of the plane in which its central portion is located.

8. An acoustic diaphragm comprising a disk embodying intersecting strips of bamboo which are shrunken, thereby warping the peripheral portions of the disk out of the plane in which the center of the disk lies.

9. A diaphragm composed of material which is shrunken and thereby warped in a manner to create tensile stresses in the diaphragm when clamped and held in its proper flat disk shape.

10. An acoustic diaphragm comprising intersecting strips of bamboo in its construction.

11. An acoustic diaphragm composed of layers of bamboo, and a bonding and shrinking element placed between the said layers, said element producing tensile stresses within the finished diaphragm.

12. An acoustic diaphragm comprising exterior layers of bamboo and an interposed bonding element, the diaphragm being warped but capable of being forced to assume a substantially flat form.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

OADES J. KENYON.

Witnesses:
ALFRED W. ROBERTSON,
MYRNA G. WILLOUGHBY.