Aug. 6, 1929. W. H. KITTO 1,723,550

SOUND PRODUCING DIAPHRAGM

Filed April 15, 1926 3 Sheets-Sheet 1

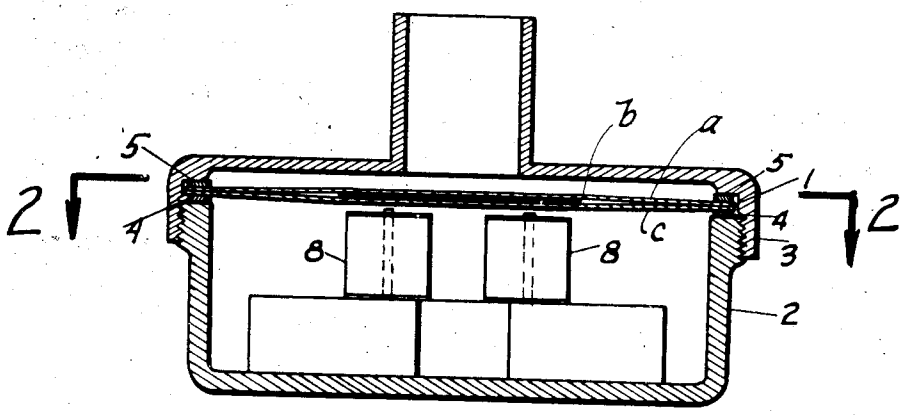


Fig. 1

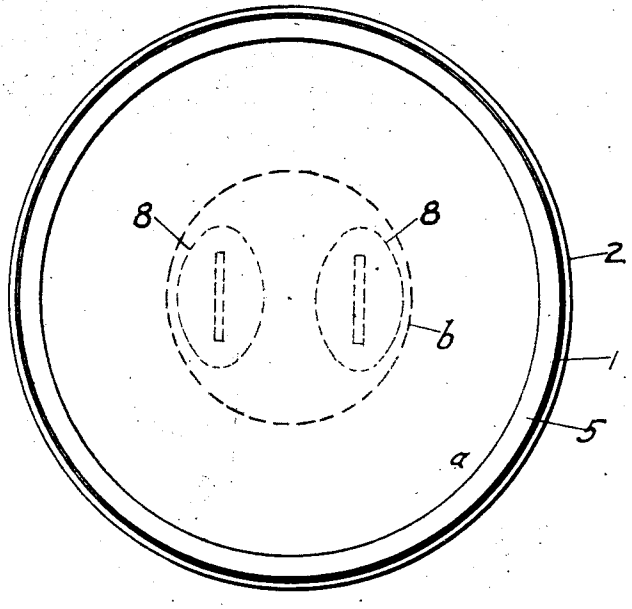


Fig. 2

INVENTOR.
William H. Kitto
BY
Myron J. Dikeman
ATTORNEY.

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SOUND PRODUCING DIAPHRAGM

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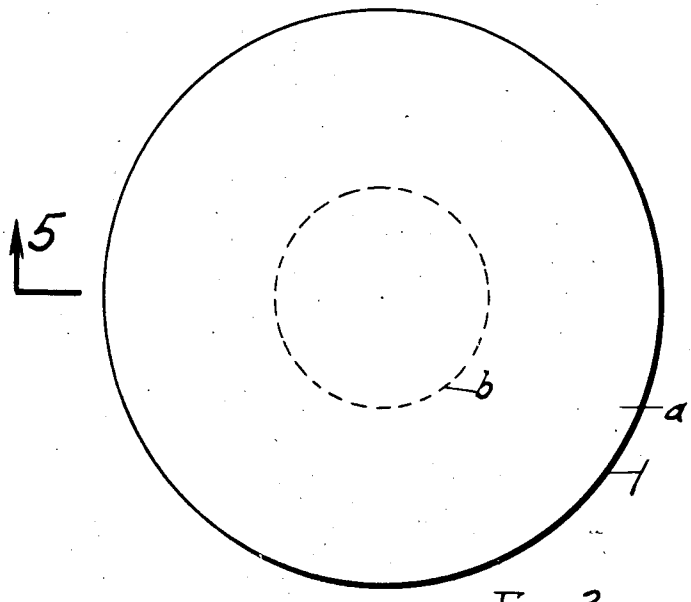


Fig. 3

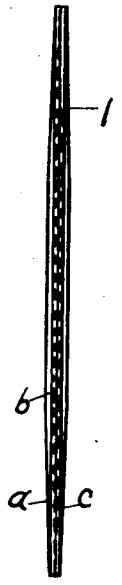


Fig. 4



Fig. 5



Fig. 6



Fig. 7

INVENTOR.
William H. Kitto
BY
Myron J. Dikeman
ATTORNEY.

Aug. 6, 1929. W. H. KITTO 1,723,550

SOUND PRODUCING DIAPHRAGM

Filed April 15, 1926 3 Sheets-Sheet 3

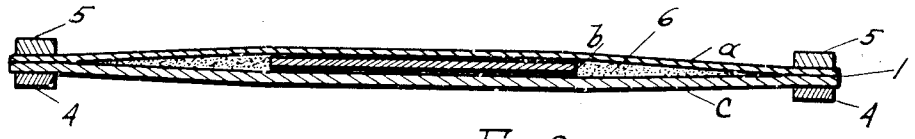


Fig. 8

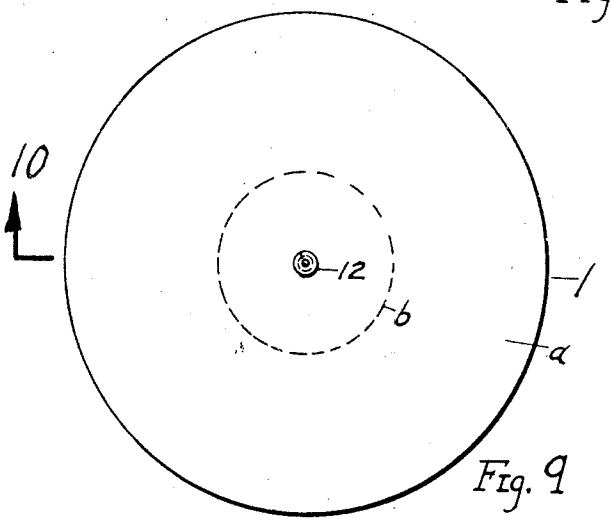


Fig. 9

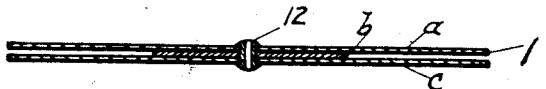


Fig. 10

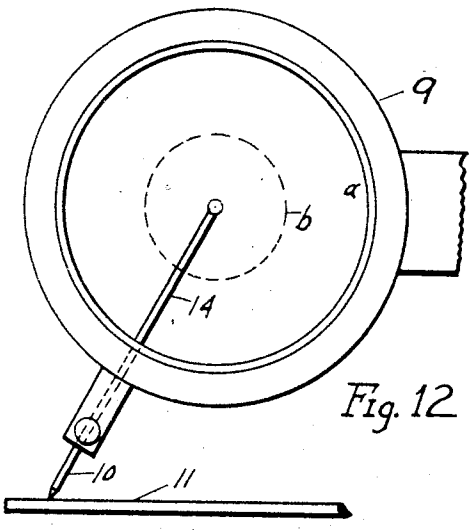


Fig. 12

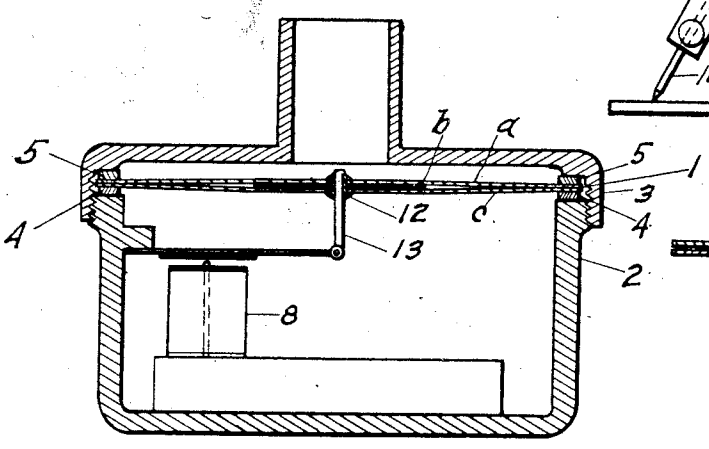


Fig. 11



Fig. 13

INVENTOR.
BY William H. Kitto
Myron J. Dikeman
ATTORNEY.

Patented Aug. 6, 1929. 1,723,550

UNITED STATES PATENT OFFICE.

WILLIAM H. KITTO, OF FERNDALE, MICHIGAN.

SOUND-PRODUCING DIAPHRAGM.

Application filed April 15, 1926. Serial No. 102,159.

The object of my invention is to produce a sound producing diaphragm, formed of several thin sheets of metal, that may be readily adapted to sound producing instruments such as radio speaking units, phone receiving sets or the phonograph sounding unit.

Another object is to produce a laminated sound producing disc, comprising thin sheets of different metals, or materials, each capable of different rates of vibrations, and so combined into a single unit to prevent chattering of the disc, or the production of super-vibrations producing false tones and squeals.

A further object is to produce a sound diaphragm disc that will greatly enlarge the range of production of clear, distinct tones, without distortions, modifications, or squeals, and that is adapted to very low or high tones.

A still further object is to produce a sound producing diaphragm of several thin plates, so assembled as to allow the application of a lubricant between the thin sheets, for producing clear, mellow tones by the diaphragm vibrations.

These several objects are attained in the preferred form by the construction and arrangement of parts more fully hereinafter set forth.

Similar parts on all drawings are marked by similar numerals.

Fig. 1, shows my laminated diaphragm as applied to the radio speaking unit, used in combination with the electric magnets common to the radio speaker construction.

Fig. 2, is a sectional view on line —2—2— of the Fig. 1, same being shown with the speaker cap removed, showing my diaphragm as applied thereto, and its relative position to the operating magnets.

Fig. 3, is a plan view of the diaphragm, showing its circular construction and its intermediate disc.

Fig. 4, is an edge view of the assembled disc where the edges of the laminæ are closed, as when installed within the operating frame.

Fig. 5, is a sectional view taken on the line —5—5— of the Fig. 3, showing the arrangement of the various thin sheets comprising the diaphragm.

Fig. 6, is also a sectional view on the same line 5—5 of Fig. 3, where the outer edges of the thin disc sheets are closed together, as when clamped tightly within the supporting diaphragm frame.

Fig. 7 is a further cross section taken on the same line 5—5 of the Fig. 3, illustrating an exaggerated position of the diaphragm under vibrations caused by the speaker magnets, showing a straight, flat center section along which the diaphragm has a tendency to vibrate.

Fig. 8, is an enlarged detailed cross-section, also taken on the line 5—5 of the Fig 3, illustrating the assembled laminæ, having a lubricant placed between the various sheets of material comprising the diaphragm, as it appears when firmly clamped within the speaker frame.

Fig. 9, illustrates an alternate form of my disc, where same is applied to sound producing, or speaking unit having a fixed member attached to the center of the diaphragm, instead of operating same by direct influence of electric magnets.

Fig. 10, is a sectional view taken on line —10—10— of the Fig. 9, showing the central hollow assembling rivet, providing means for attaching the operating member.

Fig. 11, shows the diaphragm applied to a sound producing unit, having a central operating member attached thereto.

Fig. 12, illustrates the application of my diaphragm to the sounding head of a phonograph, the same operating by central contact of a vibrating point.

Fig. 13, is an edge view of a diaphragm using two laminæ.

I will now describe more fully the detailed construction of my device, referring to the drawings and the marks thereon.

In general my device comprises a series of thin plate discs, assembled by packing same together as leaves, operating as a single unit and forming a laminated sound producing diaphragm thereby. The thin plates, or laminæ may be assembled as dry discs, or by placing a lubricant between the discs.

It is commonly known that when a disc of thin material is caused to vibrate at a high rate of vibration, it will produce sound, and of tones which vary in pitch as the rate of vibrations of the disk is varied. This principle being in common use in telephone and radio receivers. The vibrations of the diaphragm being caused by mechanical means connected thereto, and which is usually either directly or indirectly produced by electric magnets operating on the diaphragm, or by

a vibrating member attached to the center of the disc. Where the electric magnet operates directly upon the diaphragm disc for producing the vibrations therein, the disc must possess some magnetic properties which are subject to the influence of the operating magnets, while the discs, or diaphragms, which are operated by a connecting vibrating member need not possess any of the magnetic properties therein to make them operative thereby. My laminated sound producing diaphragm is so constructed and may be made of such materials, and combination of materials as will best adapt itself to the position and means under which it is caused to vibrate within the sound producing instrument, be it either magnetically or mechanically operated.

The diaphragm —1— is made of several very thin sheets of material, either of the same thicknesses or of varying thicknesses, and preferably for small diaphragms comprising two or more sheets, or laminæ, —*a*—, —*b*—, and —*c*—, each lamina having a different rate of vibration, and all being assembled by packing together as leaves, and forming thereby a laminated diaphragm disc which is to be installed and operated as a single unit, and in the same manner as the single plate diaphragm now in common use, similar to those employed in radio and telephone work. It is commonly known that every material rigid body possesses a definite natural rate of body vibrations which will produce sound if that rate of vibration is set up therein, or will respond by sound if a like rate of vibrations is set up in near proximity. Likewise, the single diaphragm disc possesses a note of its own, a definite individual rate of natural vibration. When impinged upon by the sound of a note of its own natural pitch, it will begin to vibrate and continue such vibration at that given rate per minute for an appreciable period of time. Meanwhile, the sounds being desirably produced have passed on to other notes and pitches, so that dissonance ensues, causing false tones, squeals, breaks in sounds and chattering in addition to the normal or desired tones. This inventor has found that by making the sound diaphragm of the laminated construction, and using a different material for each lamina, thereby combining laminæ possessing different rates of body vibrations, each acting to prevent, or destroy the natural body vibration of the adjacent lamina section, and thereby eliminating the super tones, squeals, or false notes which would otherwise be produced by a homogeneous diaphragm, and that when my laminated diaphragm is supported in a frame as shown in Figs. 1, 6 and 8, clamping the outer edges of the disc sections together, the range of the laminated diaphragm has been greatly increased, the assembled diaphragm acting as a single unit, and will respond to mechanical vibrations produced therein, either by magnetic forces, or by connecting vibrating members attached directly to the diaphragm, reproducing sound tones corresponding to the rate of vibration produced therein, in the same manner as a single plate diaphragm, but with a modulated tone. The range of operation being greatly increased and will pass the rate of the natural body vibrations of each separate lamina without producing any super tones or squeals. Under the special construction of my diaphragm, each lamina —*a*— and —*c*— are tightly stressed over the inclosed lamina —*b*— by the clamping of the cover —3— over the casing —2— of the operating instrument in which the diaphragm is used, as illustrated in Fig. 8. By using the outside section —*a*— of copper, the center lamina of iron, and the inner section —*c*— of brass, each being of a different material and possessing a different rate of natural body vibration, the diaphragm may be constructed to wholly eliminate the super tones and squeals which would otherwise be produced. Other materials may also be used in forming the combinations, either metals, or materials as mica, celluloid or similar materials which is adapted to very thin sheet construction, or various combinations of these materials. It is found desirable to make the center lamina —*b*— of a smaller diameter than the inside lamina —*c*— or the outside lamina —*a*—, thus providing a means of stressing the laminæ to prevent separate vibrations of any single member due to its own special rate of natural body vibration. The outside sections —*a*— and —*c*— being firmly clamped between the supporting gaskets —4— and —5— placed between the cap —3— and casing —2— of the instrument frame. It is also found that by making the various laminæ of different thicknesses of material, each rate of body vibration may also be changed, and like results obtained, although the use of different materials for the different lamina is preferred. During the mechanical vibrations of the diaphragm —1—, the same becomes distorted as illustrated in Fig. 7, which causes a slight shifting of the adjacent surfaces one on the other, and which is greatly facilitated by the use of a thin lubricant or grease —6— placed between each lamina section, as illustrated in Fig. 8. The lubricant —6— also acts as a lamina itself, modulating the tone of sound produced thereby, and also aids in preventing separate body vibrations of the sections. If the diaphragm —1— is to be used directly under the influence of operating magnets as shown in Figs. 1 and 2 of the drawings, at least one of the lamina must be made of iron or some magnetic material, in order to respond thereto for producing the mechanical vibrations therein. However, if the diaphragm —1— is to be used with a type of

instrument utilizing vibrating contact member, either —13— or —14—, as illustrated in Figs. 11, and 12, the magnetic properties of any of the laminæ is not required, the diaphragm being vibrated by mechanical means. The diaphragm is adapted equally as well to use in a phonograph sounding head —9—, shown in Fig. 12. Should it be used in a sound producing instrument similar to the one illustrated in Fig. 11, a central hollow rivet —13— may be placed through the center of the assembled sections, and tightly riveted therein, providing means for attaching the vibrating arm —13— thereto.

While I have illustrated my laminated sound-producing diaphragm by the use of three very thin sheet discs packed together, and by the use of lubricant therebetween, it is evident my device is capable of various modifications in sizes, thicknesses, numbers of laminæ used, and the numerous combinations of various materials used therein for securing a different rate of body vibrations for each lamina, and therefore I claim any combination that is substantially a substitution of parts herein shown or described.

Having fully described my sound producing diaphragm, what I claim as my invention and desire to secure by Letters Patent is:

A laminated diaphragm adapted for producing sound vibrations, said diaphragm being made of at least three very thin disc sections, each section of a different kind of material than its adjacent section and possessing a different rate of natural body vibrations, a thin lubricant placed between each disc section, one of the inner disc sections being of a smaller diameter than the outer inclosing disc sections, all packed tightly together and capable of vibrating as a single diaphragm.

In witness whereof I sign these specifications.

WILLIAM H. KITTO.