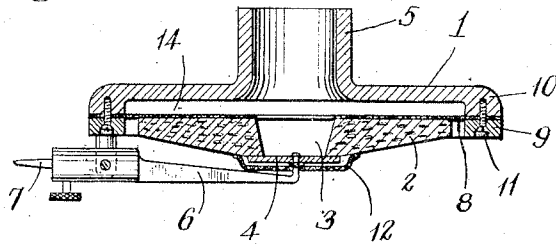


D. M. BLISS,  
DIAPHRAGM.  
APPLICATION FILED OCT. 4, 1916.

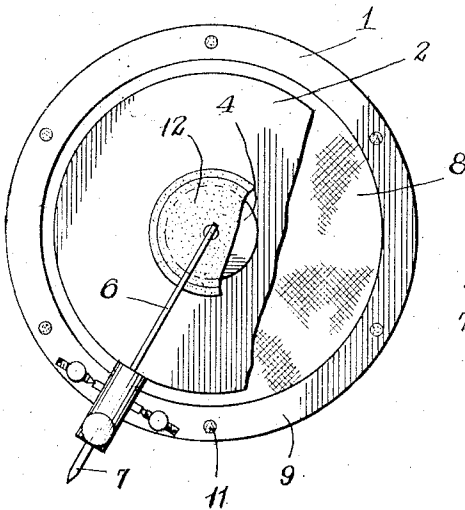
1,377,538.

Patented Sept. 3, 1918.

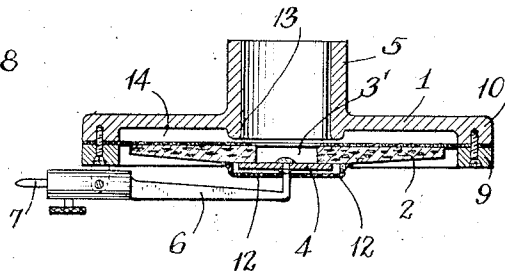
*Fig. 1.*



*Fig. 2.*



*Fig. 3.*



INVENTOR.  
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# UNITED STATES PATENT OFFICE.

DONALD M. BLISS, OF WEST ORANGE, NEW JERSEY.

## DIAPHRAGM.

1,277,538.

Specification of Letters Patent. Patented Sept. 3, 1918.

Application filed October 4, 1916. Serial No. 123,625.

*To all whom it may concern:*

Be it known that I, DONALD M. BLISS, a citizen of the Dominion of Canada, residing at West Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Diaphragms, of which the following is a specification.

My invention relates to phonograph or talking machine reproducers and especially to improved diaphragms and coating parts. In the construction of sound-boxes for phonographs the principal difficulty which has been encountered has been the fact that the mass and low resilience of the diaphragm has prevented the same from following the stylus lever accurately. For the same reasons the usual diaphragm absorbs a large percentage of the higher frequencies of sound vibration so that the more delicate over-tones are not well reproduced and the reproduction of articulation is imperfect.

In results heretofore attained the diaphragm has either been adapted to reproduce most of the tones encountered with a slighting of the higher frequencies, as stated above, or when the diaphragm has been made smaller in diameter and lighter in weight the production of the higher frequencies has been improved but results in other respects have been imperfect. Considering many of the materials now largely used for making diaphragms such as mica, celluloid, wood, fiber, thin metal and others, if a diaphragm made of such materials is constructed of a sufficiently large diameter to reproduce a tone of varying pitch in proper balance, its inertia will be so great that the higher frequencies or soprano tones will be reduced in volume and quality, articulation will be imperfect and the diaphragm will not follow the movement of the stylus lever accurately. On the other hand, as stated, if such a diaphragm is made smaller in diameter and lighter in weight, it will follow the undulations of the record more faithfully but the proper balance between the different voices, in the case of a musical record, will be lost and the result will be to give a reproduction of a thin nasal quality.

I have found that if a diaphragm be constructed in such a way that its center portion is made of material in a condition of

maximum or considerable density or resilience and the remainder or outer portion of the diaphragm be composed of material of a less density than the center portion improved results will be attained especially when the center portion cooperates with a sound chamber independently of the rest of the diaphragm surface or a deflecting or guiding surface is provided for directing the sound vibrations produced by the central portion directly into the amplifier.

In my preferred construction the main diaphragm is made of a relatively light and thick material having a large opening through its center. A small thin diaphragm of relatively dense material and higher resilience is secured on the outer face of the large diaphragm in alinement with and overlapping this opening. With this construction soprano or other tones of high frequency will vibrate the small central diaphragm practically without any dissipation in or through the heavy diaphragm of different density to which the central diaphragm is secured. Vibrations of deeper tone and greater energy, however, will vibrate the diaphragm as a whole.

The objects of my invention reside in improved construction for producing effects and embodying the principle referred to above. Other objects reside in the combinations of parts and details of construction as will appear more fully hereinafter.

In order that a clearer understanding of my invention may be had, attention is hereby directed to the following drawings forming part of my application and illustrating certain embodiments of my invention. In the drawings, Figure 1 represents a central vertical section through a sound box embodying one form of my invention, Fig. 2 is a bottom plan view of the same and Fig. 3 is a central vertical section showing a modified form of my invention.

Referring to Figs. 1 and 2 of the drawings, a sound box 1 is provided with a diaphragm the chief member or portion of which is shown at 2 comprising a disk having a relatively large central opening 3 therethrough. The annular disk 2 may be formed of cork, wood, fiber or other suitable materials, preferably light in character, the member 2 also being of considerable thickness relatively to the other member of the

diaphragm. This other member 4 comprises a small thin disk of relatively dense material and high resilience in comparison with the member 2. Suitable materials for the central member 4 are mica, glass, metal, and compressed fiber or cork. Member 4 is secured to the outer face of member 2 about the edge of the opening 3 which latter opening, it will be noted, forms a sound chamber for the diaphragm 4 and serves to direct the vibrations produced by member 4 directly into the neck 5 of the reproducer, to which may be secured the amplifying connection.

15. The stylus lever 6 carrying stylus 7 may be attached directly to the center of the small diaphragm 4 in the usual manner. The diaphragm 2 may be mounted in a sound-box of the ordinary type between rigid rings or the like, if desired, or it may be mounted on a flexible supporting surface in the manner illustrated in the drawings. As is there shown, the member 2 is secured upon the member 8 of high tensile strength and elasticity, such for example as silk or other strong fabric or membrane, this flexible support 8 being secured under a predetermined tension between the clamping ring 9 and the annular portion 10 of the sound-box as by means of screws 11. This arrangement is described and claimed in my application, Serial Number 117,577, filed August 30, 1916.

The small diaphragm member 4, vibrating as it does to tones of higher frequency, will also tend to reproduce the scratching sounds due to the movement of the reproducing stylus over the surface of the sound record reproduced. In order to dampen out these scratching or surface sounds and to suppress the natural tone of the diaphragm 4, a disk 12, of felt or other suitable material, may be mounted directly on the diaphragm. This dampening disk is secured at its edges to the under or outer surface of the thick diaphragm member 2 adjacent to the edge of diaphragm member 4 extending across the latter to bear lightly against it.

An alternative construction is illustrated in Fig. 3 in which the main diaphragm member 2' is of less thickness than the corresponding member 2 in the form of my device previously described so that the sound-chamber 3' formed therein is of considerably less depth than the corresponding sound-chamber 3 in the form of my invention first described. This sound-chamber, being of insufficient depth to produce the best results, or the peripheral surface bounding the same being of insufficient height to properly direct the sound vibrations produced by diaphragm member 4 into the neck 5 of the reproducer, it is advisable to provide additional guiding means for this purpose. Accordingly, an annular flange 13 may be formed on the top member or cap of the sound-box

extending into the main sound-chamber 14 of the reproducer in substantial alinement with the neck 5 of the reproducer and extending into proximity to the adjacent surface of the diaphragm. It will be seen that this construction provides a sound-chamber for diaphragm member 4 partly formed by diaphragm member 2' and partly formed by the sound-box itself.

It will be seen that the constructions described above provide diaphragms which are of sufficient resilience to respond to the highest frequencies while at the same time the total area is sufficient to bring out the reproduction of musical sounds in proper balance. Also owing to the small mass and high resilience of the auxiliary diaphragm 4 the latter will follow the record vibrations very closely. The auxiliary sound-chamber or sound-directing means provided in the main diaphragm or in the body of the reproducer to coact with the auxiliary diaphragm, directs the sound from the small diaphragm 4 directly into the tone-arm of the phonograph which is connected to the neck 5, which greatly improves the quality of the music or other matter reproduced and the articulation of the same.

It should be noted that the effect of the disparity between the densities, resiliencies and masses of diaphragm members 4 and 2, is to cause the small diaphragm member 4 to vibrate practically alone in response to tones of high frequency and small energy such as soprano notes or sibilant sounds and other details of articulation. In the usual diaphragm formed of a single member the tones of higher frequency vibrate only the central portion of the diaphragm but these vibrations are absorbed and reduced in volume by the surrounding portions of the diaphragm. In the combined diaphragm described herein, however, the main diaphragm of different density from the auxiliary diaphragm 4 acts practically as an insulating non-vibratory member when the diaphragm member 4 is responding to tones of higher frequency only. That is to say, the small member 4 vibrates practically alone in such cases with the resulting improvement in volume and quality of the sounds reproduced as described.

I will now describe my invention and what I claim and desire to protect by Letters Patent is as follows:

1. In a sound reproducer, a compound diaphragm comprising a relatively thick annular disk of low density, and a small central disk of high density and relative thinness secured to said annular disk, substantially as set forth.

2. In a sound reproducer, a compound diaphragm comprising a relatively thick and light member having a central opening there-through and a thin member of high density,

relative to that of the first, secured to a face of said first member to cover the opening therein, substantially as set forth.

3. In a sound reproducer, the combination  
5 of a sound-box having a diaphragm member mounted therein, said member having a central opening therethrough, and being formed of cellular material, relatively light and thick, a second diaphragm member secured  
10 to the first, to cover said opening, said second

member being relatively thin and of high density and a stylus lever attached to said second member, substantially as set forth.

This specification signed and witnessed this 2d day of October, 1916.

DONALD M. BLISS.

Witnesses:

DYER SMITH,  
I. McINTOSH.