April 12, 1932. K. D. BRYSON 1,853,721

SOUND REPRODUCER

Filed Nov. 30, 1923

FIG. 1.

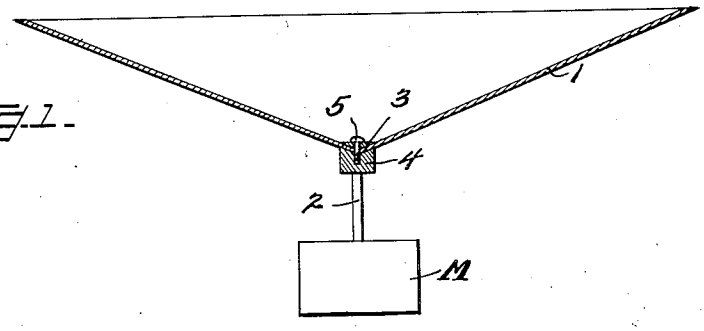


FIG. 2.

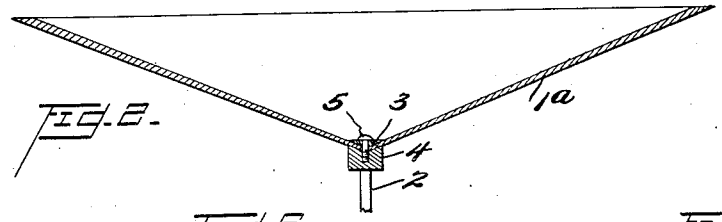


FIG. 3.

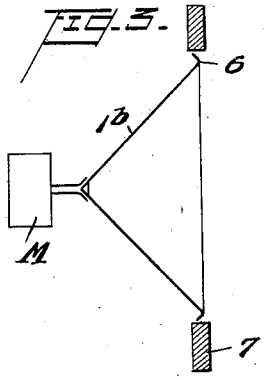


FIG. 5.

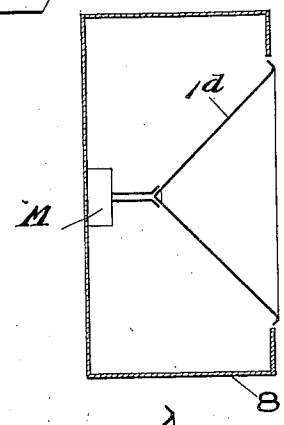


FIG. 4.

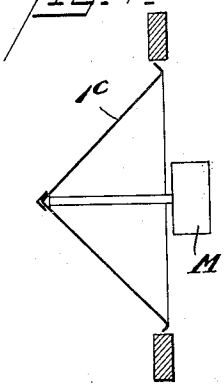
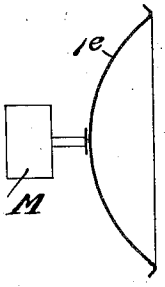


FIG. 6.



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UNITED STATES PATENT OFFICE

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SOUND REPRODUCER

Application filed November 30, 1923. Serial No. 677,613.

This invention relates to sound apparatus and more particularly to a device for reproducing sounds from such secondary sources as an armature of a magnetophone.

An object of the invention is to reproduce sounds from such sources without displeasing interference from noises originating in the sound radiating element. Another object of my invention is to provide means by which the sound waves produced by the two surfaces of a sound radiating element will be prevented from interfering. Preventing such interference has a like effect as increasing the diameter of the sound radiating element and hence I am able to produce a wider range of frequencies than has heretofore been possible with sound radiating elements of like size. In most devices heretofore employed, diaphragms with fixed edges have been used in connection with horns. Such diaphragms and horns respond better to some frequencies than to others, and usually introduce unpleasing characteristics due to the fact that the frequencies of good response do not generally form a harmonic system.

In order to avoid such objections as mentioned and to produce a device which may respond more uniformly to a relatively large range of frequencies, I employ a sound radiating element which is a light, relatively rigid structure so mounted that every part of the sound radiating element is free to vibrate substantially without external restraint other than that of the air or other fluid medium to which sound waves are imparted. Thus it is possible for every part of the sound radiating element to move backward and forward with the same amplitude. With excessive weight in the peripheral zone the inertia of the periphery is increased to such an extent that the wall of the sound radiating element has a tendency to buckle and consequently a transverse wave in the sound radiating element is set up.

To obtain the degree of rigidity and lightness required for good operation, I prefer to employ a sound radiating element having one or more curved surfaces. Better results are usually obtained if that part of the active surface near the periphery is made more rigid by giving greater thickness to the peripheral zone or by increasing the curvature of the peripheral zone, or by any other suitable means which does not prevent the sound radiating element from vibrating substantially as a whole. Without such stiffening or other suitable means to prevent independent vibrations of the periphery, there is a tendency for the periphery to start independent vibrations under some conditions, and it is thus important for the sound radiating element to have such stiffening but substantially non-supporting means surrounding a portion of the periphery to prevent such independent peripheral vibrations.

The member which actuates the device by transmitting vibrations to it should be attached to the active surface at or near its central portion. A convenient means for mounting the device so as to eliminate external restraint to its motion is to have such actuating member form the sole support for the radiating element.

These and other objects will be apparent from the following description and annexed drawings, in which

Figure 1 is a diagrammatic view partly in section of one form of sound radiating element and the means to actuate it.

Fig. 2 is a diagrammatic view of another form of cone.

Fig. 3 is a diagrammatic view showing my device with a baffle surrounding the same.

Fig. 4 is a modified form of the device in which the position of the magnetophone is reversed.

Fig. 5 is a diagrammatic view of another form of baffle in connection with my device.

Fig. 6 is a diagrammatic view showing a different form of sound radiating element.

In the practical construction of my device I have found that the simplest form which gives good results is a cone of relatively thin, stiff material capable of being actuated and supported at or near its vertex.

As shown in the drawings, the cone 1 is secured to the supporting member 2 by any suitable means, such as relatively small clamping members 3 and 4, between which the cone is clamped by any suitable securing means, as

for example the screw 5. The supporting member 2 may be actuated by any suitable device, such as a magnetophone, indicated diagrammatically at M, and which gives it a longitudinal vibration.

The material forming the sound radiating element preferably should be a relatively thin, hard or stiff material, such for example as bakelite, hard rubber, wood, chemically treated or impregnated paper or the like, and the material, together with its thickness and hardness, may be varied according to the results desired. I have found, for example, that with the use of thin paper a volume substantially the same as that of a diaphragm and horn of usual construction can be obtained and that the reproduction is accurate and the quality of tone produced is excellent.

I have found experimentally that if a sound radiating element such as a disk having a plane surface is used for the sound radiating element, the volume of sound emitted is poor, probably because most of the energy is used in bending or setting up transverse waves in the material. On the other hand, a hollow, conical element tends to resonate if the angle at the vertex of the cone is too small. In order, therefore, to prevent these undesirable results, I use an element of thin, stiff material having a curved or concave surface, so designed as to give the required mechanical stiffness, and which will not resonate and yet which will give good volume. Such an element may be substantially conical and, depending on the zone material, may have an angle at its vertex of about 135°, as shown in Fig. 1, or the side of the cone may be additionally curved in a longitudinal direction so that it flares outwardly and is thus curved both transversely and longitudinally of the cone, thus forming a shape which may, in part, approach that of a spheroid or even a sphere. Such a double curved shape is diagrammatically indicated in Fig. 6 at 1*e*.

The active area of the sound radiating surface used is generally large enough to reproduce sounds effectively without employing a horn, but for some purposes it is desirable to use a smaller surface, in which case the member may be mounted in an opening in a sound barrier with a small clearance between the periphery of the member and that of the opening so as to substantially prevent interference between sound waves radiated from the back and front of the member. The barrier may be a box enclosing the source, or simply a baffle of any desired shape.

In Fig. 2 is shown a similar cone 1*a* of gradually increasing thickness.

The form of my invention shown in Fig. 3 constitutes a cone 1*b* with the outer edge turned back as shown at 6 and with the baffle member, such as an annular ring 7 disposed adjacent the periphery of the cone. This ring may be of any desired width to substantially prevent interference between sound waves radiated from the back and the front of the members.

Fig. 4 shows a cone 1*c* similar to Fig. 3 with the position of the magnetophone reversed.

In Fig. 5 the baffle is indicated as a box 8 enclosing the cone 1*d*, the actuating magnetophone M being disposed within the box.

It is obvious of course that I may make a hollow sound radiating element of any desired shape, that is, the sound radiating element may vary widely in its shape for various kinds of reproduction and when two surfaces are used, they may be opposed so that a double conical, or substantially a spherical or spheroidal shape is obtained. It will be seen that it is more advantageous and efficient to design the cone so that a sound wave will be developed from the open base of the cone in substantially a plane, because the greatest pressures are developed from a given amplitude and energy input.

With any of these constructions it will be seen, however, that I have preserved the same fundamental characteristics that the active sound radiating element comprises a curved surface, every portion of which may be moved backward and forward with the same amplitude.

While applicant's preferred shape of a sound radiating element is a cone, it is to be understood that the thin, stiff material forming the sound radiating element may be of any desired shape which will give it sufficient rigidity. Preferably the sound radiating element is a sheet of thin stiff material shaped to form a hollow body presenting a concave or other curved or complex surface. Applicant therefore desires for the sake of brevity, to use the generic term "depressed" or "depressed sheet" which is to be understood as including cones or any of the shapes referred to above, it being obvious that there are many forms which the sound radiating element may take and still be sufficiently rigid to serve as operative elements.

The vibration transmitting member is preferably secured to the sound radiating element substantially at that part of the depressed portion farthest away from the plane of the periphery. Thus, when the element is conical or substantially symmetrical in shape it is secured substantially at the center of the sound radiating element, and by this term applicant intends to define the location of the vibration transmitting member as located either on the geometric center or in the neighborhood of the center of the sound radiating element.

It will thus be seen that with my device I have provided a sound radiating element which will respond accurately to the vibrations and transmit them to the air substantially like those received from the actuating

means, so that an efficient and accurate transmission in sound waves can be made of various vibrations received from the actuating means.

Furthermore, it is to be understood that the particular forms of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. In a device of the character described, a sound radiating element comprising a substantially conical body of thin, stiff material, the angle at the vertex lying between the limits marked by resonance of the enclosed air on the one hand, and bending of the cone material on the other, and a vibration transmitting member secured to said body substantially at its central portion, and forming the sole support therefor, whereby positive motion is given to the sound radiating element which is free to vibrate substantially as a whole.

2. A loud speaking device for the propagation of sound waves of relatively high intensity, including a sound radiating element comprising a substantially conical body of thin, stiff material, and a vibration transmitting member secured to said body substantially at its central portion and forming the sole support therefor, said conical body having a greater thickness near the periphery than at its central portion.

3. A loud speaking device for the propagation of sound waves of relatively high intensity, including a sound radiating element comprising a depressed sheet of thin, stiff material, a vibration transmitting member secured to said element substantially at its central portion and forming the sole support therefor, whereby said sound radiating element is free to vibrate substantially as a whole, said element being relatively slightly stiffer near its peripheral edge to prevent independent vibration in the peripheral zone thereof, and means surrounding at least a portion of the convex side of the sound radiating element to substantially prevent interference between the sound waves emanating from the convex side and the concave side of said element.

4. In a loud speaking device for the direct propagation of sound waves of relatively high intensity, a sound radiating element, a vibration transmitting member secured to said element substantially at its central portion, said element being mounted to vibrate substantially as a whole and to propagate sound waves from the entire active surface thereof direct to the atmosphere, and a sound barrier surrounding the periphery of said sound radiating element and normally out of contact therewith to substantially prevent interference of the sound waves thus produced.

5. A loud speaking device for the propagation of sound waves of relatively hign intensity, including a sound radiating element comprising a substantially conical body of thin, stiff material, and a vibration transmitting member secured to said body substantially at its central portion and forming the sole support therefor, whereby said sound radiating element is free to vibrate substantially as a whole, and means surrounding at least a portion of the convex side of the sound radiating element to substantially prevent interference between the sound waves produced.

6. A loud speaking device for the propagation of sound waves of relatively high intensity, including a substantially conical sound radiating body, and a vibration transmitting member secured thereto substantially at its apex to support said body, said sound radiating body being formed of thin, stiff material, and having substantially non-supporting means provided to prevent the periphery of said conical body from starting independent vibrations.

7. A device for the direct propagation of sound waves of relatively high intensity, including a sound radiating element comprising a depressed sheet of thin, stiff material, and a vibration transmitting member secured to said body substantially at that part of the depressed portion farthest away from the plane of the periphery, and forming a support therefor, whereby said sound radiating element is free to vibrate substantially as a whole, said sound radiating element having substantially non-supporting means surrounding at least a portion of the periphery thereof to prevent the periphery thereof from starting independent vibrations.

8. A loud speaking device for the direct propagation of sound waves of relatively high intensity, including a sound radiating element, a vibration transmitting member secured to said element substantially at that part of the depressed portion farthest away from the plane of the periphery, said element being mounted to vibrate substantially as a whole and to propagate sound waves from the active surface thereof direct to the atmosphere, and a sound barrier surrounding the periphery of said sound radiating element and normally out of contact therewith to substantially prevent interference of the sound waves thus produced.

9. A device for the direct propagation of sound waves of relatively high intensity, including a sound radiating element comprising a depressed sheet of thin, stiff material, a vibration transmitting member secured to said element substantially at that part of the depressed portion farthest away from the plane of the periphery, and forming a

support therefor, and means surrounding one side of the sound radiating element to suppress substantially entirely the pressure wave developed by said side of the sound radiating element, said means being closely adjacent to, but normally out of contact with the sound radiating element when the latter is not in motion, whereby without the necessity of increasing the size of the sound radiating element the radiation of low notes from the sound radiating element is substantially increased.

10. A device for the direct propagation of sound waves of relatively high intensity, a sound radiating element comprising a depressed sheet of thin, stiff material, a vibration transmitting member secured to said element substantially at that part of the depressed portion farthest away from the plane of the periphery, and forming a support therefor, and means surrounding one side of the sound radiating element to suppress substantially entirely the pressure wave developed by said side of the sound radiating element, said means being closely adjacent to, but normally out of contact with the sound radiating element, whereby without the necessity of increasing the size of the sound radiating element the radiation of low notes from the sound radiating element is substantially increased.

11. In a device of the character described, a sound radiating element comprising a substantially conical body of thin, stiff material, the angle at the vertex of the cone being substantially more than 90°, and a vibration transmitting member secured to said body substantially at its central portion and forming the sole support therefor, whereby positive motion is given to the sound radiating element which is free to vibrate substantially as a whole, and means for preventing independent vibrations in the peripheral zone of said sound radiating element.

12. In a device of the character described, a sound radiating element comprising a substantially conical body of thin, stiff material, the angle at the vertex lying between the limits marked by resonance of the enclosed air on the one hand, and bending of the cone material on the other, and a vibration transmitting member secured to said body substantially at its central portion, and forming the sole support therefor, whereby positive motion is given to the sound radiating element which is free to vibrate substantially as a whole, and means for preventing independent vibrations in the peripheral zone of said sound radiating element.

13. In a loudspeaking device for the direct propagation of sound waves of relatively high intensity, a sound radiating element, a vibration transmitting member secured to said element substantially at its central portion, said element being mounted to vibrate substantially as a whole and to propagate sound waves from the entire active surface thereof direct to the atmosphere, and a sound barrier surrounding the periphery of said sound radiating element and normally out of contact therewith, said barrier extending rearwardly thereof to form a closed chamber for preventing interference between the sound waves propagated from the front and rear of said sound radiating element.

In testimony whereof, I hereunto affix my signature.

KENNETH D. BRYSON.