

Sept. 13, 1932.

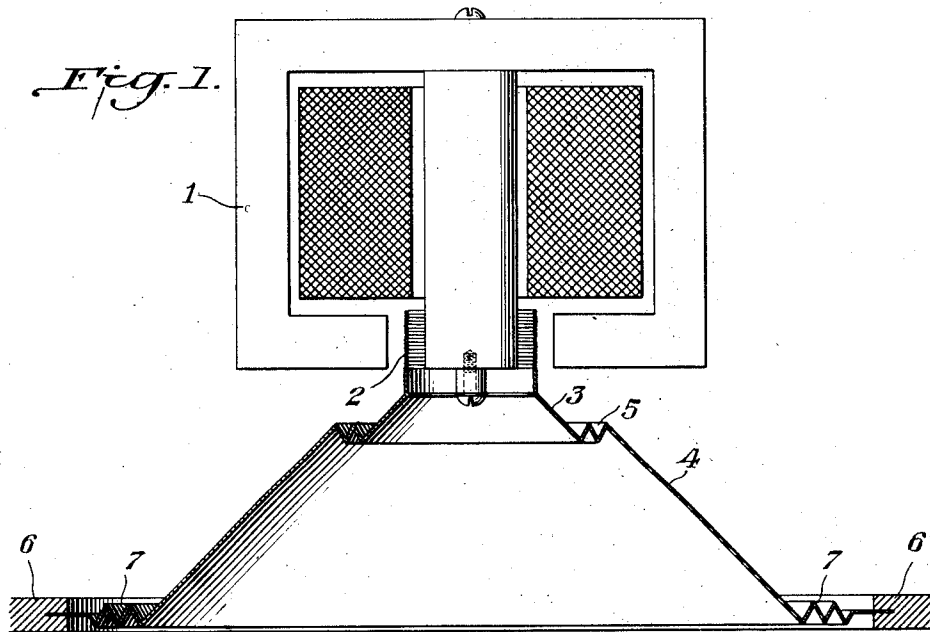
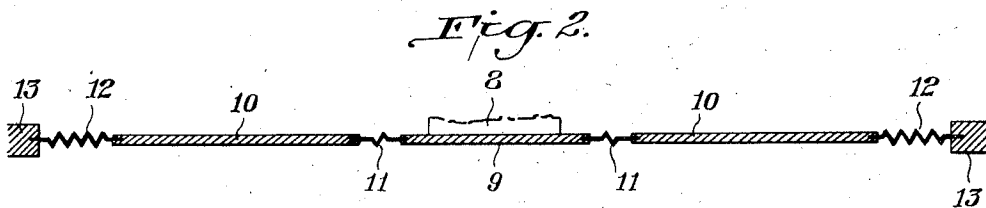
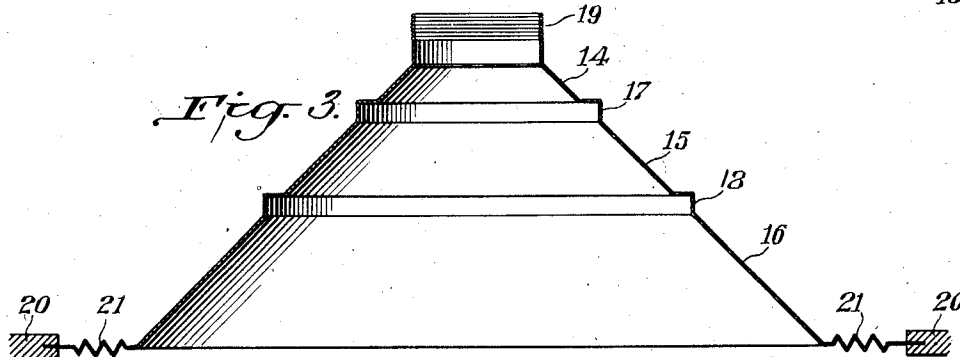
S. BALLANTINE

1,876,831

SOUND REPRODUCER

Filed June 20, 1930

2 Sheets-Sheet 1



Inventor:

Stuart Ballantine,

Byrne, Townsend & Potter,
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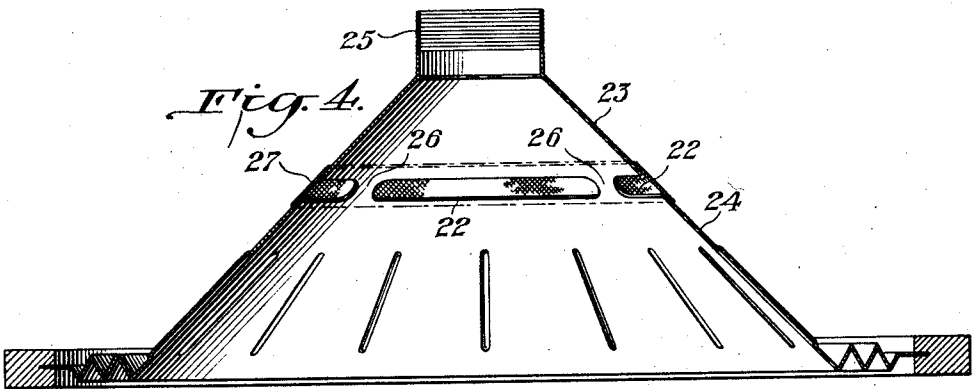
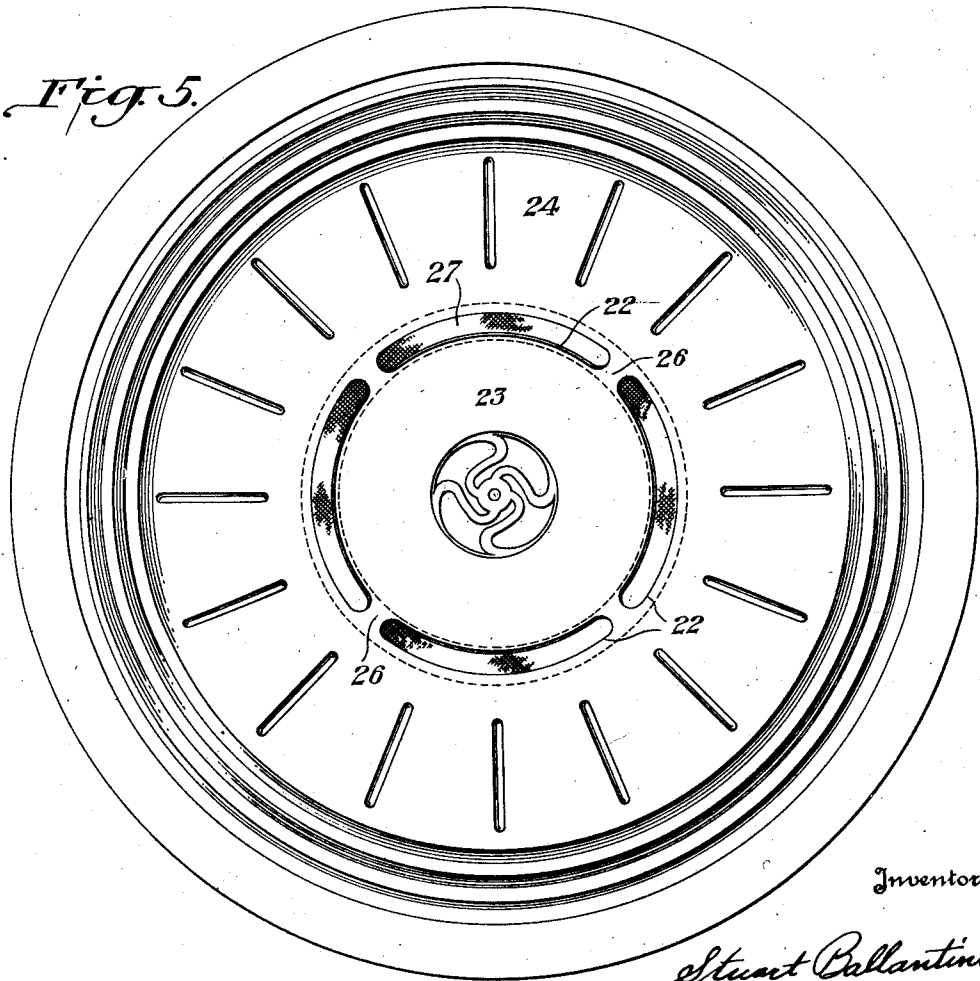
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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SOUND REPRODUCER

Application filed June 20, 1930. Serial No. 462,641.

This invention relates to loud speakers and more particularly to their diaphragms.

In existing loud speakers, considerable difficulty is experienced in covering the required range of audio frequencies in such a manner that smooth and undistorted reproduction is achieved. The response of these structures is rendered uneven by standing wave patterns set up along the diaphragm and, in the case of the conical piston type, by the interference of waves emanating from different parts of the piston surface.

These difficulties are avoided in the present invention by the provision of a composite structure in which the vibrating area is automatically adjusted, as the frequency changes, in such a manner as to avoid interference effects.

An object of my invention is to provide a loud speaker radiator which is characterized by its freedom from frequency peaks or resonance effects.

Another object is to provide a loud speaker which will automatically adjust itself to different frequencies.

A further object is to provide a loud speaker in which the radiator is formed of a plurality of sections that are effectively in series with each other and with the driving mechanism.

These and other objects of the invention will be apparent from the accompanying drawings which are illustrative of certain specific embodiments of my invention and in which:

Fig. 1 is a section through a loud speaker of the conical piston type;

Fig. 2 is a section of a flat diaphragm radiator;

Figs. 3 and 4 are longitudinal sections through other sound radiators of the type shown in Fig. 1; and

Fig. 5 is a front elevation of the sound radiator shown in Fig. 4.

In the particular embodiment illustrated

in Fig. 1, the driving mechanism for operating the sound radiator is conventionally shown as the power unit of a loud speaker of the electro-dynamic type comprising the electro-magnet 1 and the moving coil 2.

The sound radiator is generally of conical or frusto-conical form and includes a smaller or inner frusto-conical section 3 and a larger or outer frusto-conical section 4. The base of the inner section 3 is connected to the moving coil 2 in any suitable manner and the outer edge of the inner section is connected to the inner edge of the larger frusto-conical section 4 by a compliant coupling 5 which, as illustrated, may take the form of a plurality of shallow corrugations. The front edge of the outer section 4 is connected to and supported from the stationary frame by a compliant coupling 7.

The compliant coupling 5 is designed to have such rigidity that, at low frequencies, both the sections 3 and 4 vibrate as a whole but at higher frequencies the compliant coupling 5 does not transmit sufficient power to put the relatively large mass of the section 4 into vibration. At the low frequencies, the motion of the outer section 4 is somewhat less than that of the inner section 3 due to the velocity drop in the coupling 5, but the vibratory motion of the sound radiator is substantially that of a single frusto-conical element having the combined dimensions of the sections 3 and 4. By thus damping or preventing the vibration of the outer section 4 at the higher frequencies, the response curve of the speaker will be smooth and uniform, since there is no interference such as occurs in the ordinary conical diaphragm, between high frequency waves emanated from the outer and from the inner section of the cone.

A further advantage of confining the radiation surface to the inner section 3 for higher frequencies is that, due to its smaller size, a more uniform distribution of sound is obtained.

Figure 2 illustrates the invention as applied to the flat diaphragm type of sound radiator. The impulse transmitter 8 is connected to and actuates the central section 9 which is coupled to the outer section 10 by the complaint member 11. Section 10 is in turn coupled by another complaint member 12 to a part of the frame 13. The vibrating diaphragms 9 and 10 may be constructed of balsa wood or other light, rigid material suitably reenforced. The diaphragms may have any desired peripheral outline.

Figure 3 illustrates a composite conical diaphragm similar to that shown in Figure 1, there being three sections, however, instead of two. The sections 14, 15 and 16 are coupled by compliant members 17 and 18, respectively, that function in a manner similar to that of the compliant coupling 5 in the simpler type of reproducer. The number of sections used depends upon the particular results required and the desired breadth in frequency response. As in the other embodiments, the reproducer is actuated by an appropriate driving device, such as coil 19 and is supported in a frame 20 by a compliant coupling 21.

Figures 4 and 5 illustrate a further embodiment of my invention in which a separate compliant coupling member is not used but its equivalent is formed by removing material from the radiator as indicated by the circumferential slots 22. The radiator is thus divided into an inner section 23 and an outer section 24 that are connected in series with each other and with the driving coil 25 by the radial strips 26 that separate the circumferential slots 22. Leakage through the slots 22 may be prevented, without affecting the desired properties of the connecting strips 26, by placing over the opening a thin strip 27 of leather, paper, rubber or other like material. In many cases, however, the leakage will not be substantial, or even if substantial, will not materially affect the desired performance of the sound reproducer. The outer frusto-conical section 24 may be, or, if desired, both sections may be provided with corrugations 28 to render the section or sections more rigid.

It will be apparent that the invention is not limited to the embodiments herein described, but provides a general method for modifying the action of various types of sound diaphragms or reproducers.

I claim:

1. In a sound radiator, a plurality of sound radiating elements and compliant couplings connecting said elements, said couplings comprising a plurality of annular corrugations.

2. A sound radiator, comprising a single sheet of material divided into a series of sound radiating elements by compliant couplings serially connecting said elements, said couplings being formed of a plurality of an-

nular corrugations embossed in said single sheet of material.

3. In a sound radiator, a pair of sound radiating elements, a driving device connected with one of said elements and a compliant coupling serially connecting said elements to each other, said coupling consisting of a plurality of annular corrugations, the area of the sound radiating element connected with the driving device being relatively small compared with the area of the other sound radiating element.

In testimony whereof, I affix my signature.
STUART BALLANTINE.