Oct. 13, 1931. L. DE FOREST 1,827,283

SOUND REPRODUCER

Filed Jan. 29, 1927

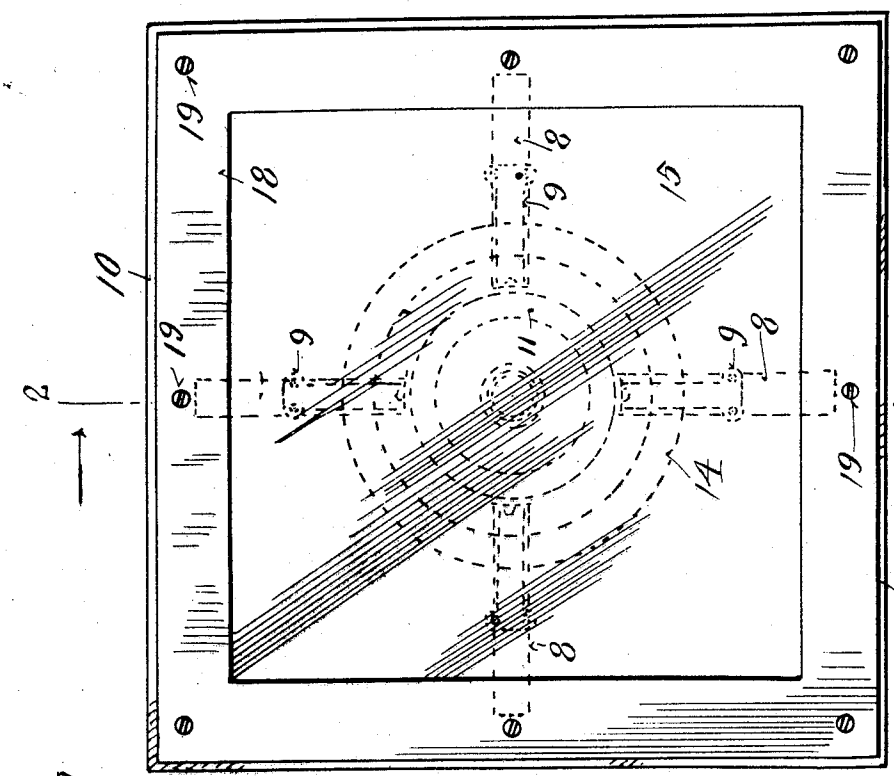


Fig. 1.

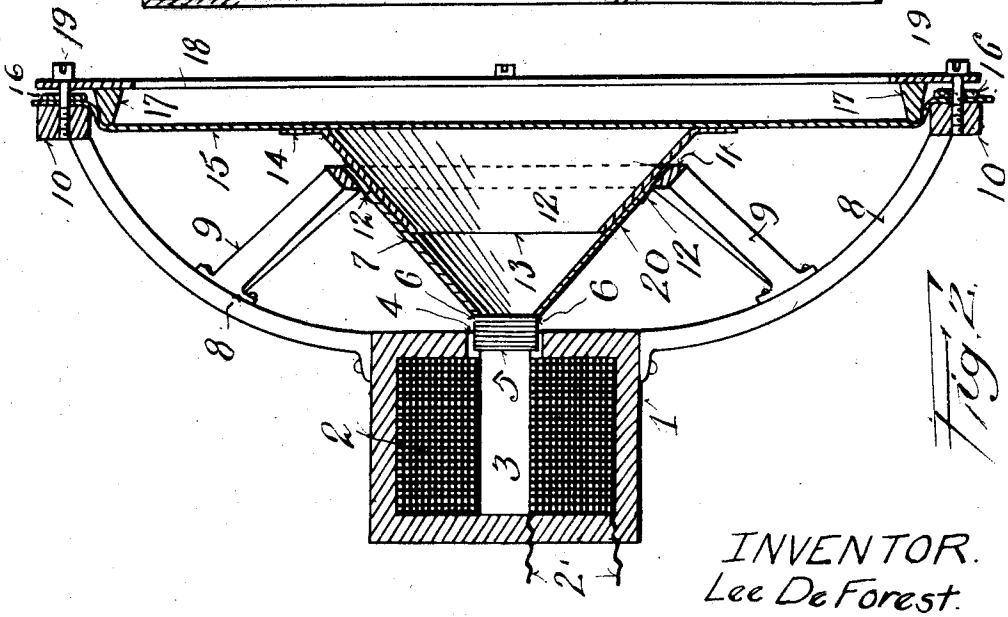


Fig. 2.

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By his Attorneys Darby & Darby.

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# UNITED STATES PATENT OFFICE

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL TALKING PICTURES CORPORATION, A CORPORATION OF DELAWARE

## SOUND REPRODUCER

Application filed January 29, 1927. Serial No. 164,582.

This invention relates broadly to improvements in sound reproducing devices.

One of the objects of this invention is the provision of a new and novel combination of vibrating diaphragms to produce a loud speaking device adapted to have a natural period of vibration covering a range approximately equal to that of sound vibrations ordinarily encountered in the reproduction of speech, music and the like.

A still further object of this invention is the combination of a vibrating membrane consisting of one portion in the form of a plane flexible surface under tension, and another portion associated therewith which is conical in formation.

A still further object of this invention is the provision of supporting means for a membrane of the type described above which also provides a support for associating the vibrating means with the membrane.

A still further object of this invention is the provision of a conical loud speaker flexibly supported at its outer edge and connected to a plane stretched diaphragm to produce a device for sound production which is adapted to produce both the higher and lower frequencies encountered in sound reproduction.

These and many other objects are successfully sought by the construction disclosed hereinafter.

This invention resides substantially in the construction, combination, arrangement and relative location of parts as will be fully described below and claimed in the appended claims.

Referring to the drawings—

Figure 1 shows a top plan view of the device showing the relative location of the parts, and

Figure 2 is a vertical cross-sectional view taken on the line 2—2 of Figure 1 looking in the direction of the arrows.

One of the common faults of the usual types of devices for reproducing sound from electrical variations is that they are unable to reproduce faithfully both the lower and higher frequencies as are encountered in ordinary speech and music reproduction. I have found that it is possible to more nearly approach the ideal in this respect by employing a vibrating membrane or tympanum consisting of a plane flexible member under tension and associated with a smaller conical membrane. The larger plane surface is adapted to reproduce more faithfully the lower frequencies, while the conical member is adapted to reproduce higher frequencies. By varying the relative proportions of the plane and conical members I have found it possible to more nearly reproduce sounds over the full range of frequencies ordinarily encountered in sound reproduction.

Referring to the drawings, I have shown a magnetic casing at 1 within which is mounted a solenoid winding 2 having the current terminal or leads 2′. Mounted within the solenoid is a core 3 which projects into an annular gap 4 formed in the casing 1. A series of radiating arms 8 are mounted on the casing 1 and in turn provide support for the arms 9 to which is secured a flexible ring 12 of any suitable material such as fabric, leather, etc. The outer free edge of the conical membrance is secured to the flexible ring 12 in any suitable manner and has mounted on its smaller end a small coil or winding 5 which encircles the core 3 and lies within the annular gap 4. The winding 5 is provided with the current terminal 6 as shown. On the outer ends of the radiating arms 8 is supported a ring 10 which may be of any configuration, but which is shown as square in the drawings. Attached to the frame or ring 10 is a thin flexible plane membrane 15. This membrane can be made of any suitable flexible material such as parchment, very thin metal as aluminum or duralumin, sheepskin, or a woven fabric such as silk or linen. In the case of fabrics I prefer to impregnate the same with a suitable moisture proof varnish or lacquer. The membrane, of course, will assume the shape of the supporting frame-work which may be circular, rectangular or polygonal.

A supplemental cone 13 which has the same angle of expansion as the cone 7 is mounted within the cone 7 and cemented through at 20. The outer edge of the sup-

plemental cone is flanged at 14 and is rigidly secured to the stretched membrane 15 in any suitable manner. A covered ring or member is shown at 18 which lies over the ring 10 and secured thereto by means of machine screws 19. Arranged between the membrane and the cover member 18 are the wedge shaped members 17 which may consist of straight strips or a complete ring and may be made of any suitable material such as rubber, for example. When the ring 18 is drawn down towards the ring 10 by tightening the machine screws 19 pressure is transmitted through the stretching frame or strips 17 to vary the tension on the membrane 15 to any desired degree. By varying the tension on this membrane it is, of course, apparent that its natural period of vibration may be adjusted to any suitable value.

I have disclosed in the preceding description the relative arrangement of the parts employed in my invention. By mounting the solenoid within the casing as shown to provide an annular air gap it is possible to produce a very strong magnetic field when direct current of any suitable value is supplied thereto. The varying currents which represent the sounds to be reproduced are supplied to the winding 5. It will be noted that the cone 7 being mounted on the flexible ring or gasket 12 is permitted free movement in a longitudinal direction. The supplemental cone 13 transmits these vibrations to the membrane 15.

I have found that when the ordinary loud speaker having a conical membrane is operated with a power amplifier that the cone is moved so violently and through such wide amplitudes as to be unable to accurately follow the finer harmonics impressed upon the coil 5 so that the sound reproduction suffers accordingly. Excessive movement of the cone also frequently sets up as a result a very disagreeable rattle. By means of my novel combination I remedy this defect and, at the same time, increase the volume of sound given out from the cone. By actuating a relatively large diaphragm by one of these cones I have found that a relatively larger volume of air is set in motion and, furthermore, the undesired excursions of the cone are thereby greatly reduced and the ensemble of cone and stretched diaphragm follow much more accurately the electric variations impressed upon the coil 5.

I prefer to use a number of such units as I have just described, some of larger and some of smaller area. The former are the best reproducers of low frequency sounds and the latter of the high frequency sounds. I have found that it is impracticable to design a single form or size of loud speaker which is equally sufficient and satisfactory for the entire range of sound reproduction which it is ordinarily desired to secure. To overcome this deficiency it is preferable to use a number of sound reproducers of the type described above each adapted to operate at its best on more or less limited frequencies. As a result the load from the power amplifier is sub-divided and the strains on any single loud speaker unit are greatly reduced. At the same time the ensemble gives a total sound volume which is equal or superior to that which it is possible to obtain from a single unit, no matter how ruggedly it might be constructed, and with far closer approximation to fidelity of reproduction.

I am, of course, well aware that many changes in the details of construction and even the relative location of parts will readily occur to those skilled in the art. For example, it is apparent that a variety of forms of actuating mechanisms could be used as well as the shapes, sizes and types of diaphragms and means for supporting without departing from the spirit and scope of my invention. I do not, therefore, desire to be limited except as required by my appended claims.

What I seek to secure by United States Letters Patent is:

1. In a loud speaking device the combination with a suport of a tympanum thereon, a conical diaphragm secured thereto, and means to vibrate said tympanum and diaphragm.

2. In a loud speaking device the combination with a supporting framework, a tympanum on said framework, a second vibratile member secured to said tympanum, means for tensioning said tympanum, and means for vibrating said tympanum and said vibratile member.

3. In a loud speaking device the combination with a support of a composite diaphragm comprising plane and conical members securely fastened together, said plane member being under tension, and means to vibrate said composite diaphragm.

4. The combination with a framework, a support thereon and motive means on said support, of a relatively thin, flexible membrane on said framework and connected to said motive means, and means for adjustably tensioning the membrane.

5. In a loud speaker device the combination with a flat stretched diaphragm of a cone attached thereto with its axis perpendicular to the plane of said diaphragm.

6. In a loud speaker the combination with a framework of a stretched fabric diaphragm, a paper cone, and means for vibrating said diaphragm and cone.

7. In a loud speaking device the combination with a support of a stretched diaphragm, a cone supported at one edge by a flexible ring to permit longitudinal movement, means for transmitting said movement

to said diaphragm, and means for vibrating said diaphragm and cone.

8. In a loud speaking device, the combination with a support and a membrane thereon having a truncated cone attached thereto, of vibratory means on said support, and a small cone secured to said vibratory means, said small cone partially encircling said truncated cone whereby vibrations may be transmitted to said membrane.

9. In a loud speaking device, the combination with a support, a flat diaphragm thereon, and means for stretching said diaphragm, of a truncated cone attached to said diaphragm, a cone frictionally engaging said truncated cone and flexibly supported at one edge of said support and means attached to said cone for vibrating said truncated cone and said membrane.

In testimony whereof I have hereunto set my hand on this 27th day of January, A. D. 1927.

LEE DE FOREST.