

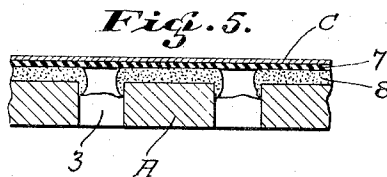
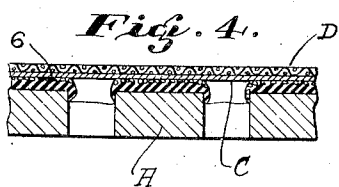
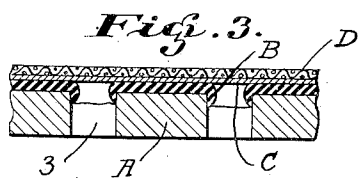
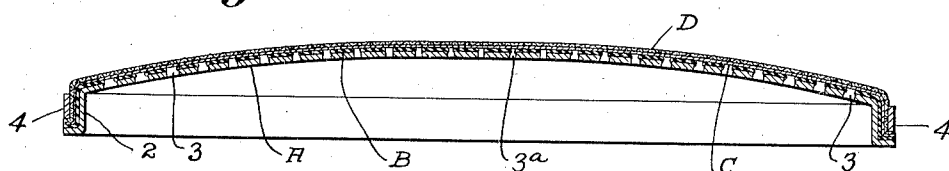
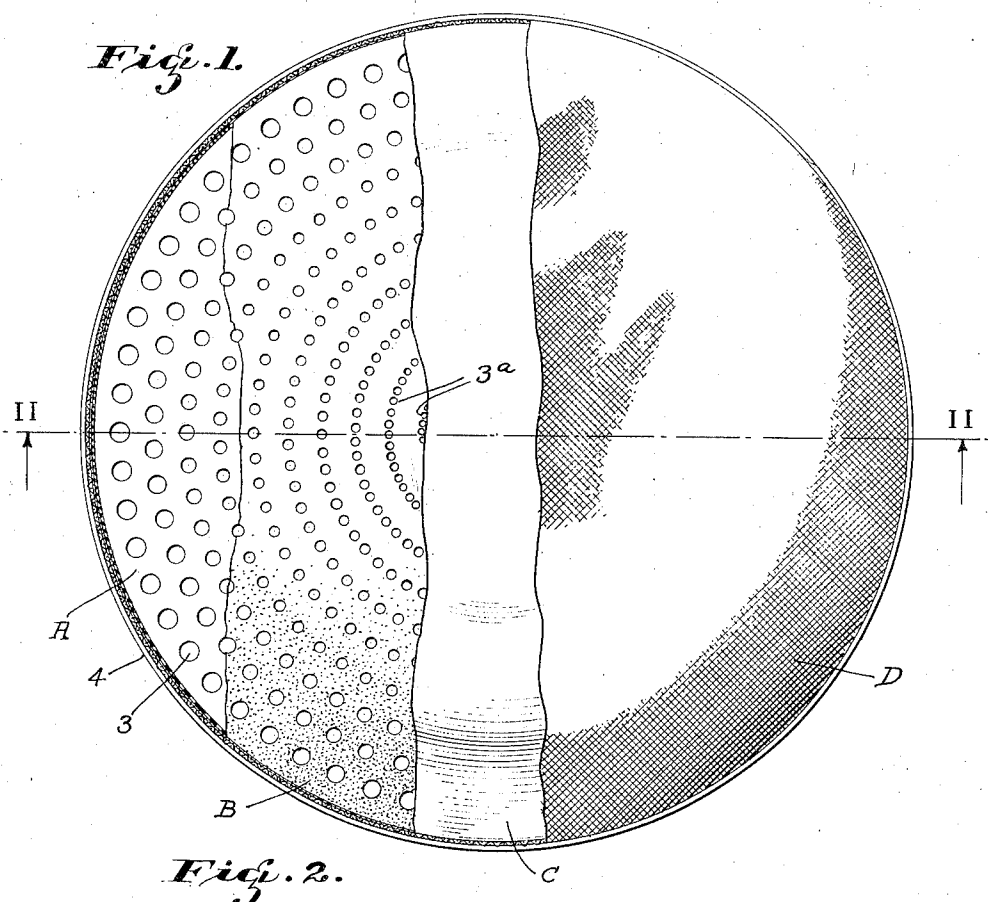
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ACOUSTIC DEVICE

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UNITED STATES PATENT OFFICE

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ACOUSTIC DEVICE

Application filed May 25, 1927. Serial No. 194,010.

This invention relates to a condenser or electrostatic type of acoustic device and especially to a modified form of a device shown in my co-pending application entitled "Acoustic device" filed October 4, 1926, Ser. No. 139,474.

The device shown in the application referred to consists of a rigid perforated metallic plate, a thin, flexible metallic plate and an intermediate thin flexible dielectric diaphragm. An electric potential, when applied to the plates of the condenser, causes electrostatic attraction, which varies according to the degree of applied potential, and movement is thereby transmitted to the flexible metallic plate and the diaphragm which produces sound or acoustic vibrations in the surrounding air coupled therewith.

I have discovered that the dielectric diaphragm interposed between the rigid perforated metallic plate and the thin, flexible metallic plate may be entirely eliminated by substituting a soft, yielding buffer material. This substitution permits a closer spacing between the flexible and the rigid plate with corresponding increase in efficiency, and furthermore permits the flexible plate to serve not only as the second plate of the condenser, but also as a diaphragm.

The object of the present invention is accordingly that of generally improving and simplifying the construction and operation of acoustic devices of the condenser or electrostatic type, to provide a structure which permits a closer spacing between the plates of the condenser, to provide a structure which permits the flexible plate to serve two functions: first, that of one of the plates of the condenser and second, that of a diaphragm, and further to provide a perforated rigid plate in which perforations of varying diameter may be employed.

The invention is shown by way of illustrations in the accompanying drawings in which:

Fig. 1 is a plan view of the condenser or electrostatic acoustic device.

Fig. 2 is a cross-section taken on line II—II, Fig. 1.

Fig. 3 is an enlarged cross-section of a portion of the device shown in Fig. 1.

Figs. 4 and 5 are enlarged cross-sections of acoustic devices of the character described, showing modifications of the structure.

Referring to the drawings in detail, and particularly Figs. 1, 2 and 3, A indicates a rigid perforated metallic plate which is provided with an annular rim 2. The plate may be constructed of practically any metal, for instance steel, iron, brass, copper, aluminum, etc., but it should be sufficiently thick or heavy to prevent it from vibrating when the acoustic device is being operated. The plate may have any exterior contour desired but it is in this instance shown as circular or disc shaped in general formation. The surface presented is rounded or spherical and it serves as a support for a buffer material generally indicated at B and a flexible metallic plate generally indicated at C. The buffer material is interposed between the rigid plate A and the flexible metallic plate C and a number of different buffer materials may be employed, such as a coating of thin rubber, granulated rubber or the like. In fact any material which has the quality of being comparatively soft and resilient, and it may be a dielectric material, a partially dielectric material, and in some instances it may even be formed of a material having electric conducting qualities, as will hereinafter appear.

The flexible metallic plate C may consist of practically any material. For instance, any of the metals which are capable of being rolled into a thin leaf, such as gold leaf, silver leaf, etc., or it may consist of any electric conducting material, whether metallic or otherwise, such as graphite, sprayed metal, metal deposited by electrolytic action, plating, or of metal deposited by a solution such as chloride of gold, etc.

In one form of the invention, as actually constructed and used, an ordinary perforated steel plate approximately of 16 gauge material is employed, as illustrated at A in Figs. 1, 2 and 3. This plate is cut circular or otherwise and provided with a rim 2. The main face is hammered or subjected to die action to produce a rounded or spherical sur-

face. A thin coating of rubber is then applied to the upper surface of the plate, as indicated at B, care being taken that no film is formed over the perforations indicated at 3. The thin coating of rubber may be vulcanized and the surface treated with soap-stone or the like, so as to produce a resilient, soft, yielding, non-adhesive surface. After the plate A has been coated with rubber, as specified, it is ready for the reception of the metallic, flexible plate, indicated at C. This is prepared and applied in the following manner:

A piece of thin silk cloth, paper, or the like, is spread out on a flat surface and rubber cement is applied. Gold leaf or like material is then placed on the surface and will adhere thereto, due to the application of the cement. When the cement is dried the cloth or paper having the gold leaf secured thereto is placed over the rubber coated perforated plate A, as shown in Figs. 2 and 3, that is with the gold leaf in contact with the rubber coated surface of the plate. The fabric, together with the gold leaf, is then preferably stretched to a certain degree and bent over the rim 2, and is then secured by a friction or clamping ring, such as indicated at 4. The device so constructed is ready for use and may be connected with any receiving radio set, telephone circuit or the like, but preferably with a telephone or radio circuit, which has power amplification in the audio frequency side of the circuit, the two terminals leading from the audio frequency amplifying power circuit being connected, one to the gold leaf and one to the plate A. A modulated or varying current potential is in this manner applied to the two plates and electrostatic attraction varying according to the degree of applied potential will cause movement of the flexible plate with relation to the rigid plate. The flexible plate accordingly serves not only as a second plate of the condenser or electrostatic device, but it also functions as a diaphragm, as it makes a direct coupling with the surrounding atmosphere and will accordingly convert the varying current potentials imposed on the plates into sound or acoustic vibrations. The fabric or paper to which the gold leaf is secured is indicated at D. It merely serves the function of a supporting medium for the gold leaf; practically any supporting medium may accordingly be employed, whether it be paper, silk or any other thin, flexible fabric, thin rubber sheeting or otherwise.

A modification is illustrated in Fig. 4, in this instance the perforated plate A is covered with finely granulated rubber, or a like material. That is a material which has the qualities of being soft and resilient and preferably dielectric, the gold leaf and its supporting fabric being applied in the same manner as described in connection with Figs.

1, 2 and 3, the granulated buffer material employed in the modification shown in Fig. 4 being indicated at 6.

In Fig. 5 a form of the invention is illustrated which shows that it is not absolutely essential to employ a buffer material which is dielectric. For instance, it has been found that any soft, yielding buffer material, for instance of a gelatinous character, may be employed, a material similar to that used in printers' ink rolls and the like. This material is not exactly dielectric and it is accordingly necessary to insulate the flexible plate, indicated at C, with relation thereto. A supporting material, such as a thin sheet of rubber or the like, indicated at 7, must accordingly be employed. This is placed next to the gelatinous buffer material indicated at 8, while the gold leaf, indicated at C, is applied to the exterior surface of the supporting member 7.

It should be understood in all instances that while gold leaf has been more or less generally referred to, it is possible to employ a flexible metallic plate, which is applied to the supporting material by electroplating, spraying, etc. In fact, any flexible conductor may be employed, whether metallic or otherwise.

By referring to Fig. 1 it will be noted that the perforations indicated at 3 are of varying diameter, the innermost perforations indicated at 3^a being comparatively small and the outermost perforations comparatively large and the intermediate perforations being graduated in size. This provision of perforations of varying diameter is of considerable importance, as it has been found that tone vibrations of practically any frequency may be taken care of. The frequencies of audible tones range all the way from a few hundred vibrations per second to as much as 15,000 per second. The flexible plate C rests directly on the buffer material B, and as such forms a covering for the perforations. The covering extending over each of these perforations accordingly acts as a diaphragm and due to the fact that perforations of varying diameter are employed, a multiplicity of diaphragms of varying diameter are also employed. Actual experience has shown that a diaphragm of a given diameter will reproduce tones of a certain frequency to practically 100 per cent efficiency and that diaphragms of greater or less diameter will similarly reproduce tones having other frequencies. The general result is faithful, clear, tone reproduction.

While the device is particularly intended for use as a loud speaker in connection with radio sets, telephones, etc., it should be understood that it will also serve the function of a transmitter, this being more or less self-evident to those familiar with the art.

What I claim and desire to secure by Letters Patent is:

1. An acoustic device comprising a rigid perforated metallic plate, a soft flexible buffer material covering the unperforated portions of the plate only so as to leave the perforations uncovered and a flexible electric conductor supported by the buffer material.
2. An acoustic device comprising a rigid perforated metallic plate, a soft yielding dielectric material forming a thin coating over the unperforated portions of the plate only so as to leave the perforations uncovered and an electric conductor maintained in contact with the buffer material.
3. An acoustic device comprising a rigid metallic plate, said plate having perforations formed therein of varying diameter, a flexible electric conducting material forming a second plate and a dielectric material interposed between the plates.
4. An acoustic device comprising a rigid metallic plate, said plate having perforations formed therein of varying diameter, a flexible metallic plate covering the perforated plate and a soft, flexible dielectric material interposed between the plates and contacting with each of the plates.
5. An acoustic device comprising a rigid perforated metallic plate, a flexible plate, and a dielectric buffer material interposed between the flexible plate and the unperforated portions only of the rigid plate so as to leave the perforations uncovered by the buffer material.
6. An acoustic device comprising a rigid perforated metallic plate, a soft flexible buffer material secured to one face of the plate and covering the unperforated portions of the plate only so as to leave the perforations uncovered by the buffer material, and a flexible electric conductor maintained in contact with the buffer material.
7. An acoustic device comprising a rigid perforated metallic plate; a buffer material securing the unperforated portion of the plate only so as to leave the perforations uncovered; a flexible dielectric material covering the buffer and the perforated portions of the plate; and a flexible metallic plate supported by the dielectric material.

COLIN KYLE.