Feb. 6, 1951 S. C. TALLMAN 2,540,498

MICROPHONE DAMPING SYSTEM HAVING REAR OPENINGS

Filed March 18, 1949

FIG. 1

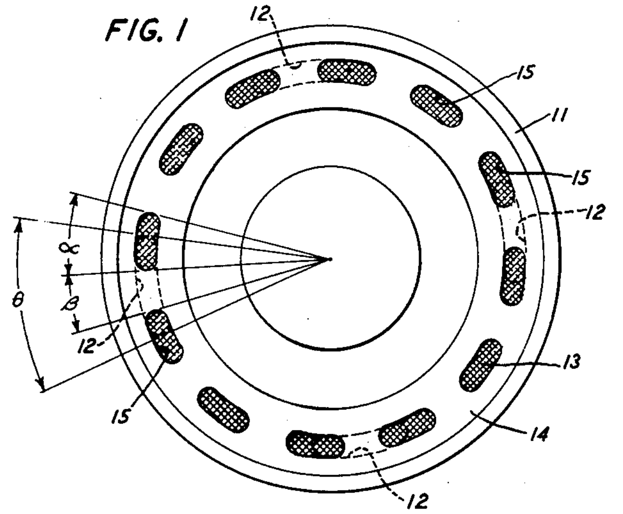


FIG. 2

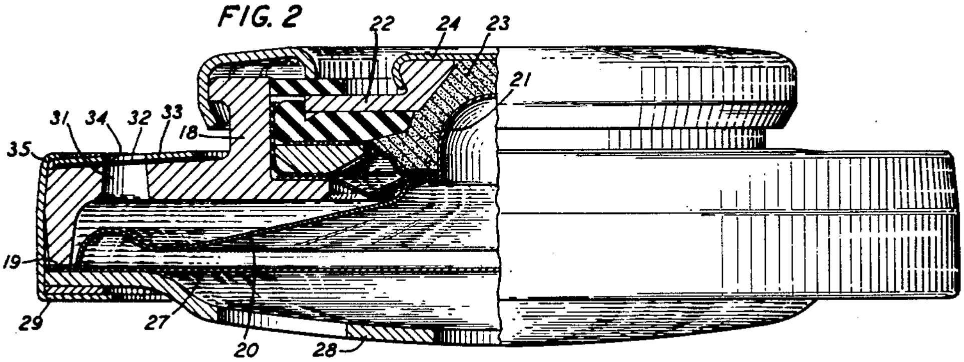


FIG. 3

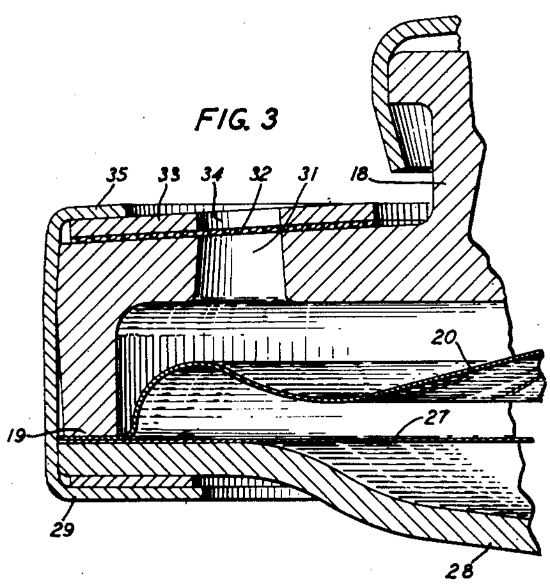
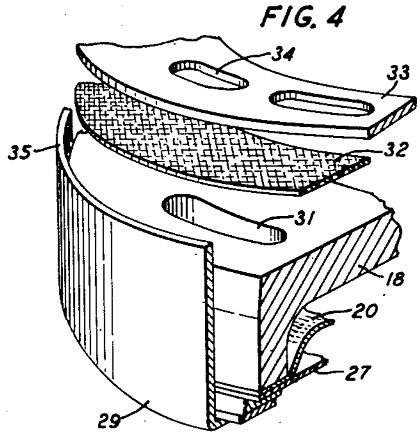


FIG. 4



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MICROPHONE DAMPING SYSTEM HAVING REAR OPENINGS

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6 Claims. (Cl. 179—128)

This invention relates to diaphragm damping systems for acoustic devices and more particularly to acoustic resistance assemblies for transmitters and receivers especially suitable for use in hand telephones.

It is well known to provide acoustic damping of a diaphragm by a controlled acoustic leak to an air chamber adjacent the diaphragm. This air leakage path to the air chamber may be of several types. Morrison et al. Patent 2,220,942, issued November 12, 1942, discloses and describes one such acoustic element in which one or more strips of acoustic silk fabric are laid over an aperture in the plate behind the diaphragm. Where the acoustic damping is provided by a plurality of such apertures over which acoustic resistance material is laid, the manufacture of the transmitter or receiver is complicated as each aperture must be carefully assembled to make certain that the proper aperture area is provided for so that the resistance damping of each device is the same as that of the others.

One general object of this invention is to obtain an improved acoustic resistance unit that may be easily and rapidly assembled and has a prescribed acoustic resistance.

A further object of this invention is to expedite and facilitate the manufacture of transmitters and receivers.

A still further object of this invention is to prevent undesirable acoustic leakage between the parts of the acoustic resistance unit.

In accordance with one feature of this invention, a sheet or strip of acoustic resistance material is placed between two apertured members whose apertures are so proportioned that the total area of air passages through the cloth is of a preassigned constant magnitude irrespective of the angular orientation of the two members.

The invention and the above-noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a plan view of an acoustic resistance unit illustrative of one embodiment of this invention;

Fig. 2 is a side view, partly in section, of a transmitter unit illustrative of one embodiment of this invention;

Fig. 3 is an enlarged side view, in section, of a portion of the transmitter unit of Fig. 2, showing the acoustic resistance unit; and

Fig. 4 is a partial sectional and exploded perspective view showing the method of assembly of the acoustic resistance unit of the transmitter shown in Fig. 2.

Referring now to the drawing, the acoustic resistance assembly illustrated in Fig. 1 comprises an annular member 11 having a plurality of apertures 12 therein, an annularly shaped sheet of acoustic resistance material 13 which may be a silk or nylon fabric, placed on top of member 11, and a second annular member 14 having a plurality of apertures 15 therein placed on top of the acoustic resistance material 13. The superimposed annular members have the same center and their respective apertures 12 and 15 have the same mean radii and radial width. The apertures 12 and 15 are formed so that their sides are portions of the circumferences of circles drawn with the center of the annular members as their center. Thus when the annular members 11 and 14 are properly superimposed so that their centers are coincident, the apertures are also superimposed.

In accordance with a feature of this invention, the apertures are so constructed and arranged that the total area of air passages through the acoustic resistance material is constant regardless of the angular orientation of each of the annular members. Since the radial width of the apertures is the same their areas can be expressed in terms of their angular length along any circumference. The angular length of each aperture 15 can be represented by the angle α and the angular length between adjacent apertures 15 by the angle β. α and β are dimensioned so that

$$n(\alpha+\beta)=360 \text{ degrees} \quad (1)$$

where n is the number of apertures 15. Representing the angual length of the larger apertures 12 by the angle θ, the apertures 12 are dimensioned so that

$$\theta=\alpha+\beta \quad (2)$$

and thus

$$n\theta=360 \text{ degrees.} \quad (3)$$

Accordingly, if N represents the number of apertures 12 in the annular member 11, then the total aperture length in member 11 can be represented by $N\theta$. However

$$N\theta=N(\alpha+\beta)=N\alpha+N\beta \quad (4)$$

$N\beta$ thus represents the total circumferential length of aperture of member 11 that is blocked by the member 14, while $N\alpha$ represents the total circumferential length of air passage through the two annular members, or through the acoustic resistance material 13. It is readily apparent that this total length $N\alpha$ is not dependent on the relative angular orientation of the annular members 11 and 14. In assembling the unit, therefore, the top annular member 14 may be dropped rapidly on the acoustic resistance material 13 and the lower annular member 11 in any angular relation to member 11 without altering the acoustic resistance damping of the unit.

This may also be seen by noting that if the upper apertured member 14 is rotated, half of the apertures 15 in the member 14 which at present coincide with apertures 12 in the member 11 will begin to close; simultaneously, the other half of the apertures 15 will open by the same amount. As one set closes off another set opens. Therefore, since the area of the openings is independent of the angular position of the member 14 with respect to member 11, the acoustic resistance will be independent of angular position also.

Typical values I have used are, for example:

$\alpha=18$ degrees
$\beta=12$ degrees
$\theta=30$ degrees
$n=12$
$N=4$

Theoretically, the ends of the apertures 12 and 15 should be radial lines; I have found however, that the actual variation in resistance caused by making the ends of the apertures circular is very small and that production of the parts is facilitated. The outside diameters of the annular members are held in position by other equipment to automatically superimpose the centers of the two annular members; thus the outside diameters may conveniently be made the same and the members centered at the time the unit is clamped, cemented, or in some other way joined together.

Referring to Fig. 2, there is shown a transmitter unit illustrative of one embodiment of this invention. The transmitter, which may be of the general type disclosed in the application Serial No. 783,324, filed October 31, 1947, now Patent No. 2,532,694, granted December 5, 1950, of H. W. Bryant, comprises a circular bridge or foundation member 18 having a flat annular seating surface 19, a lightweight metallic diaphragm 20 the peripheral portion of which is seated upon the surface 19, a hemispherical electrode 21 affixed centrally to the diaphragm 20 and vibratile therewith, a back or fixed electrode 22, carbon granules 23 substantially filling the chamber bounded by the two electrodes, and a metallic cap 24 crimped over the back electrode. The diaphragm 20, together with a moisture-resistant screen or membrane 27 and a multiapertured cap or cover 28, is secured to the bridge or foundation member 18 by the bottom portion of the ferrule or annular band 29.

The bridge member 18 has a plurality of apertures 31 therein communicating with the chamber behind the diaphragm 20; these apertures 31 correspond to the apertures 12 in Fig. 1. A ring of damping material or fabric 32 is held in place on the bridge member 18 by an annular member 33, which has a plurality of apertures 34 therein, corresponding to the apertures 15 of Fig. 1. The annular member 33 is held firmly in place by the top portion 35 of the ferrule 29, which also serves to hold the transmitter assembly together.

I have found that the acoustic leakage between the bridge and the fabric ring is reduced by making the radial length of this leakage long and by making the back surface of the bridge member 18 convex. Thus if the bridge has a slight convex surface, such as for example three degrees convex, the force produced by clamping the flat annular member 33 on the bridge is sufficient to prevent excessive leakage between the fabric ring 32 and the bridge.

In the assembling of this acoustic resistance unit during the manufacture of the transmitter, the transmitter unit is assembled first. As shown in Fig. 4 the moisture-resistant screen 27, diaphragm 20 and bridge 18 are all first properly assembled with the ferrule 29. The acoustic resistance ring 32 and annular member 33 are then dropped into place on top of the bridge member 18 without concern for their relative angular positions. The upper portion 35 of the ferrule 29 is then bent over. The outside diameter of the annular member 33 is chosen so that the member 33 is centered with respect to the bridge 18 by the crimping tool during the bending back of the ferrule to make the mean circumference of the apertures 34 in the annular member coincide exactly with that of the apertures 31 in the bridge. Constant acoustic resistance is thus assured for each assembly without the delay and inefficiency of carefully assembling each acoustic resistance unit individually.

It is understood that the above-described arrangements are illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In an acoustic device comprising a diaphragm, means adjacent said diaphragm for controlling the vibration thereof, said means comprising a first member having therein a number of apertures arranged in a circle, acoustic resistance material extending across said apertures, and a second member overlying said first member and having therein a number of apertures arranged in a circle substantially coincident with said first circle, the angular length of one of said first apertures being equal to the angular length of one of said second apertures and the distance between said second apertures.

2. An acoustic device comprising a diaphragm and means defining an acoustic network coupled to said diaphragm for controlling the vibration thereof, said means comprising a first flat circular member opposite one face of said diaphragm and having therein a number of equally dimensioned apertures arranged in a circle, acoustic resistance material overlying said apertures, and a second flat circular member overlying said first member, having the same center therewith, and having therein a different number of equally dimensioned apertures arranged in a circle, the radius of said second circle being substantially equal to the radius of said first circle and said circles being substantially centered at the center of said circular members, said first and second apertures being of the same radial width and having sides approximating portions of the circumferences of circles centered at the center of said members, the angular length of one of said first apertures being equal to the angular length of one of said second apertures and the distance between said second apertures, the total area of acoustic material exposed through the apertures being the same irrespective of the relative angular orientation of said first and second members.

3. In a telephone transmitter, a foundation

member, a diaphragm adjacent said foundation member and defining a chamber therewith, said foundation member having therein a plurality of apertures arranged substantially in a circle, acoustic resistance material extending across said apertures, a second member overlying said foundation member and having therein a different number of apertures arranged in a circle substantially coincident with said first circle, the angular length of one of said apertures of said foundation member being equal to the angular length of one of said apertures of said second member and the angular length between said second apertures, and means joining said foundation member, said acoustic resistance material, and said second member together.

4. A telephone transmitter comprising a foundation member, a diaphragm adjacent said foundation member and defining a chamber therewith, said foundation member having therein a number of apertures arranged in a circle, acoustic resistance material extending across said apertures, a second member overlying said foundation member and having therein a different number of apertures arranged in a circle substantially coincident with said first circle, one angular dimension of the apertures of one member being equal to one angular dimension of the apertures of the other member and the angular distance between the apertures of the other member so that the total area of said acoustic resistance material exposed through the apertures is the same irrespective of the relative angular orientation of said foundation and second members, and means joining said foundation member, said acoustic resistance material, and said second member together .

5. A telephone transmitter in accordance with claim 4 wherein the surface of the foundation member adjacent the acoustic resistance material is convex.

6. A telephone transmitter comprising an annular foundation member, a diaphragm adjacent said member and defining a chamber therewith, said foundation member having therein a number of equally dimensioned apertures arranged in a circle, a ring of acoustic resistance material adjacent said foundation member and overlying said apertures, a flat annular member overlying said foundation member and having therein a different number of equally dimensioned apertures arranged in a circle, said first and said second circles being substantially coincident, said first and second apertures being of the same radial width and having sides approximating portions of circumferences of circles centered at the center of said above-mentioned circles, the angular length of one of said first apertures being equal to the angular length of one of said second apertures and the distance between said second apertures, the total area of acoustic material exposed through said apertures being the same irrespective of the relative angular orientation of said foundation and flat annular members, and means comprising a ferrule joining said foundation member, said ring, and said flat member together.

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