March 27, 1962 W. W. HAERTHER, JR 3,026,958

ACOUSTICAL DIAPHRAGM

Filed Nov. 25, 1957

FIG. 1

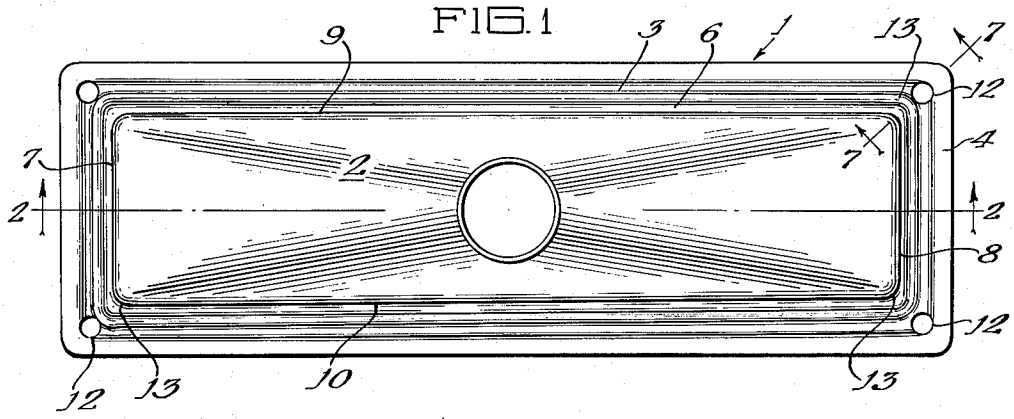


FIG. 2

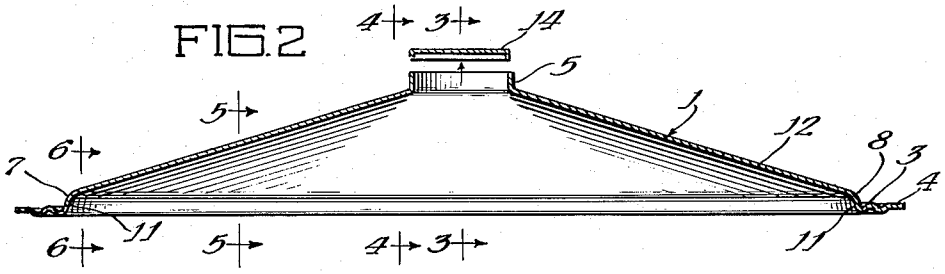


FIG. 3

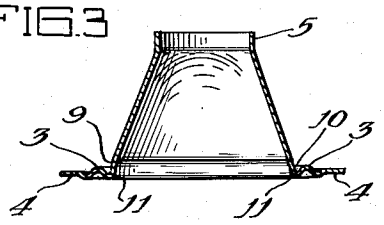


FIG. 4

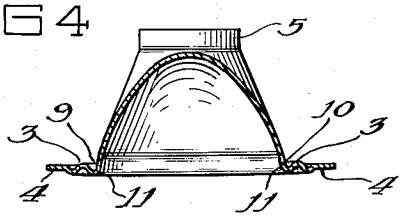


FIG. 5

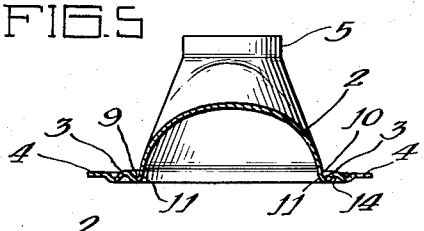


FIG. 6

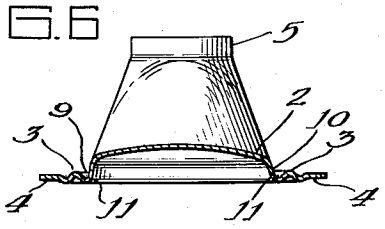
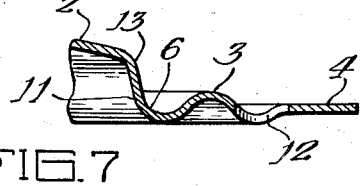


FIG. 7



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ACOUSTICAL DIAPHRAGM

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Filed Nov. 25, 1957, Ser. No. 698,823
4 Claims. (Cl. 181—32)

This invention relates in general to acoustical devices and, more particularly, to improved types of sound reproducing diaphragms.

It is a primary object of this invention to enable a novel sound producer or reproducer to be afforded, which will have a substantially even response curve, where all sounds of the audible range will be produced or reproduced with substantially equal efficiency.

Another object of this invention is to provide a novel diaphragm capable of reproducing both high and low frequency notes corresponding in intensity, timbre mellowness, and other qualities with the originally produced sound waves.

Another object is to enable a novel, effective sound reproducing diaphragm having a rectangular shape to be afforded.

Yet another object of the present invention is to afford a novel rectangular-shaped diaphragm of the aforementioned type wherein the vibratile portion is constructed in a novel and expeditious manner.

A further object is to provide a novel rectangular-shaped diaphragm wherein the vibratile portion has a novel cup-shaped construction.

Another object is to provide a novel rectangular sound-reproducing diaphragm, the parts of which are constituted and arranged in a novel and expeditious manner.

Yet another object of the invention is to enable a novel rectangular, sound-reproducing diaphragm having the aforementioned characteristics to be afforded, which is thin and light in weight.

Another object is to enable a novel and practical diaphragm of substantially rectangular shape to be afforded, which has a large frontal area and provides good sound-reproducing characteristics.

A further object of the present invention is to afford a novel diaphragm of the aforementioned type wherein the vibratile portion thereof is effectively responsive, as a unit, to both high and low frequency vibrations.

Other and further objects of the present invention will be apparent from the following description and claims, and are illustrated in the accompanying drawings which by way of illustration show a preferred embodiment of the present invention and the principles thereof, and what is now considered to be the best mode in which it is contemplated to apply these principles. Other embodiments of the invention embodying the same or equivalent principles may be used, and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is a rear elevational view of a diaphragm embodying the principles of the present invention;

FIG. 2 is a longitudinal sectional view taken substantially along the line 2—2 in FIG. 1;

FIG. 3 is a transverse sectional view taken substantially along the line 3—3 in FIG. 2;

FIG. 4 is a transverse sectional view taken substantially along the line 4—4 in FIG. 2;

FIG. 5 is a transverse sectional view taken substantially along the line 5—5 in FIG. 2;

FIG. 6 is a transverse sectional view taken substantially along the line 6—6 in FIG. 2; and

FIG. 7 is an enlarged detail sectional view taken substantially along the line 7—7 in FIG. 1.

A diaphragm 1, embodying the principles of the present invention, is shown in the drawings to illustrate the preferred embodiment of the present invention.

In general, the diaphragm 1 embodies a concave vibratile portion 2 connected by an undulated portion 3 to a substantially rectangular-shaped supporting flange or rim 4, disposed outwardly thereof and adapted to be clamped between the supporting braces, or the like, of a speaker, not shown.

The vibratile portion 2 is of a convex-rearwardly shape, flaring generally outwardly and forwardly from a tubular-shaped nipple 5 at the centrally located apex thereof to a substantially rectangular-shaped base 6 having two parallel short ends 7 and 8 connected by two parallel longitudinally extending sides 9 and 10, disposed substantially perpendicular thereto, FIGS. 1, 2 and 3.

The diaphragm 1 is of one-piece construction, and may be made of any suitable material such as, for example, accreted fibrous material.

The vibratile portion 2 of the diaphragm 1 which, it will be remembered, is generally convex-rearwardly in shape, embodies a smooth, sloping construction from the nipple 5 outwardly and forwardly to all sides of the base 6, FIGS. 1–6. The depth of the cup-shaped vibratile portion 2 gradually decreases in a substantially straight line along the longitudinal center line of the diaphragm 1 from the nipple 5 to both of the ends 7 and 8, FIG. 2. Throughout its length, the vibratile portion 2 of the diaphragm 1 decreases in depth from the longitudinal center line thereof outwardly toward the side edges 9 and 10, as shown in FIGS. 3 to 6, inclusive. At the longitudinal center of the diaphragm 1, the depth of the vibratile portion 2 decreases, transversely from the longitudinal center line thereof to the side edges 9 and 10, along substantially straight, relatively steep lines, FIG. 3. From the nipple 5 longitudinally outwardly toward each of the ends 7 and 8, the depth of the vibratile portion 2 diminishes, transversely to the length thereof, at a gradually decreasing rate between the longitudinal center line thereof and the longitudinal sides 9 and 10, FIGS. 4 and 5 and 6. Thus, the slope of the sides of the vibratile portion 2 outwardly of the longitudinal center line thereof, gradually diminishes from a substantially frusto-conical shape, FIG. 3, through an elliptical shape, FIG. 4, a substantially semi-circular shape, FIG. 5, to a gently rounded shape, somewhat less than semi-circular, adjacent the ends of the vibratile portion, FIG. 6. With this construction, the body of the vibratile portion 2 is curved and tapered in substantially all directions, while affording a relatively deep concavity from the front thereof and a relatively large frontal area, to thereby afford a strong, relatively rigid vibratile portion which tends to vibrate as a unit, and which is well reinforced against independent movement or flapping of the end portions thereof.

The sides 7–10 of the base 6 of the vibratile portion 2 terminate in edge portions 11 which project forwardly, FIGS. 2 and 3, and the front edge portions thereof are attached to the inner edge of the continuous undulated portion 3, which extends therearound and which projects outwardly therefrom in a direction generally perpendicular to the longitudinal axis of the nipple 5. The flange 4 is also continuous and is uniplanar, projecting outwardly from the undulated portion 3 in a plane substantially perpendicular to the longitudinal axis of the nipple 5.

With this construction, the diaphragm 1 may be mounted in a speaker, or the like, with the flange 4 clamped between the supporting braces, or the like, of the speaker, not shown, and with the vibratile portion 2 resiliently mounted on the undulated portion 3 in spaced

relation to the diaphragm-supporting portions of the speaker and to the body of the speaker, so that the vibratile portion **2** is free to vibrate within the speaker.

Four openings **12** are formed in the outer edge portion of the undulated portion **3** and the inner edge portion of the flange **4**, adjacent to, but in outwardly spaced relation to the corners **13** of the base **6** formed by the intersection of the sides **7–10** thereof, FIGS. 1 and 7. As is discussed in greater detail in my copending application for United States Letters Patent, Serial No. 698,467, filed November 25, 1957, now Patent No. 2,962,109, the openings **12** tend to prevent the diaphragm from cracking and breaking out at the corners and, it is believed, tend to prevent the end portions and longitudinal side portions of the diaphragm **1** from vibrating relative to each other, so that a diaphragm is afforded which is structurally strong and embodies good tone reproducing characteristics.

In the formation of the diaphragm **1**, the tubular-shaped nipple **5** is normally formed with a cap portion **14** closing the rear end thereof, and, as shown in FIG. 2, this cap portion may be clipped or otherwise removed therefrom prior to mounting the diaphragm **1** in a suitable speaker, or the like.

It has been found that with the diaphragm **1** constructed in accordance with the disclosure herein, the structural strength of the vibratile portion **2** is so distributed that the latter portion tends to vibrate substantially as a unit on the undulated portion **3** by which it is connected to the flange **4**, when driven by suitable members such as, for example, the voice coil of a dynamic speaker connected to the nipple **5** of the diaphragm **1**. With this construction, when the diaphragm **1** is mounted in the aforementioned manner in a speaker, remarkably true reproduction of sounds is afforded thereby.

Acoustical diaphragms of substantially rectangular shape have a number of advantages over diaphragms of other shapes such as, for example, conical diaphragms. For example, diaphragms of rectangular shape readily lend themselves to mounting behind the dashboards of automobiles and the like. By the practice of this invention a rectangular-shaped diaphragm having good structural strength and having good sound reproducing or producing qualities may be readily constructed.

Also, it will be seen that by the practice of this invention a rectangular-shaped diaphragm having a relatively large frontal area may be afforded, and it has been found that with this construction the vibratile portion **2** vibrates substantially as a unit at frequencies in the audible range, and affords remarkably true reproductions of the originally produced sound waves in such a range.

Thus, while the preferred embodiment of the present invention has been illustrated and described herein, it is to be understood that this is capable of modification and variation without departing from the purview of the following claims.

I claim:

1. An acoustic diaphragm having a vibratile portion, a supporting flange portion, and an interconnecting undulated portion, said flange portion and said undulated portion being of rectangular shape, and said vibratile portion extending outwardly from said undulated portion to a tubular nipple, said vibratile portion being substantially cup-shaped and merging from said undulated portion to said tubular nipple.

2. An acoustic diaphragm of the type defined in claim 1, and in which said vibratile portion is substantially the same width throughout its length, and longitudinally slopes from a substantially frusto-conical transverse cross-sectional shape at said nipple through a substantially elliptical transverse cross-sectional shape, and then a substantially semi-circular transverse cross-sectional shape, to a rounded transverse cross-sectional shape of less depth than a semi-circle.

3. An acoustic diaphragm of the type defined in claim 1, and in which said vibratile portion is elongated and increases in depth at a substantially straight line slope from both ends thereof to the longitudinal center portion thereof along all longitudinally extending lines spaced inwardly from said interconnecting portion.

4. An acoustic diaphragm of the type defined in claim 1, and in which said vibratile portion is elongated and increases in depth at a substantially straight line slope from both ends thereof to the longitudinal center portion thereof along all longitudinally extending lines spaced inwardly from said interconnecting portion, and in which said vibratile portion is substantially the same width throughout its length, and longitudinally slopes from a substantially frusto-conical transverse cross-sectional shape at said nipple through a substantially elliptical transverse cross-sectional shape, and then a substantially semi-circular transverse cross-sectional shape, to a rounded transverse cross-sectional shape of less depth than a semi-circle.

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