Nov. 11, 1930. H. C. HARRISON 1,781,387

DIAPHRAGM

Filed July 31, 1926

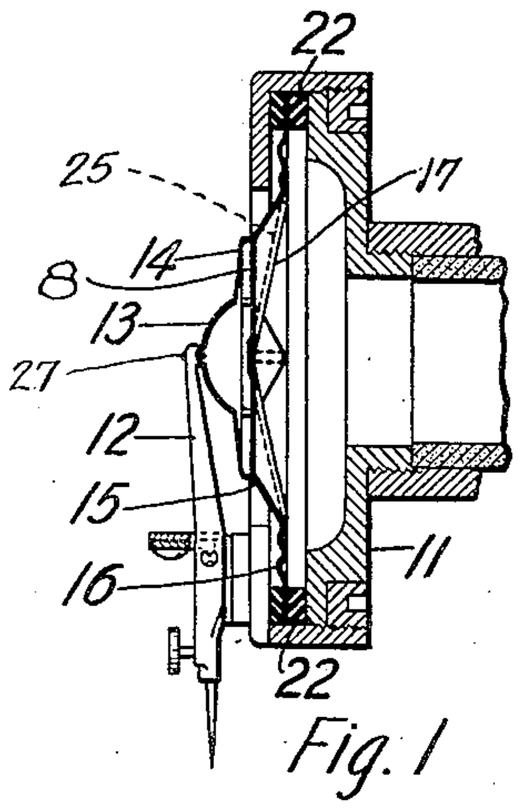


Fig. 1

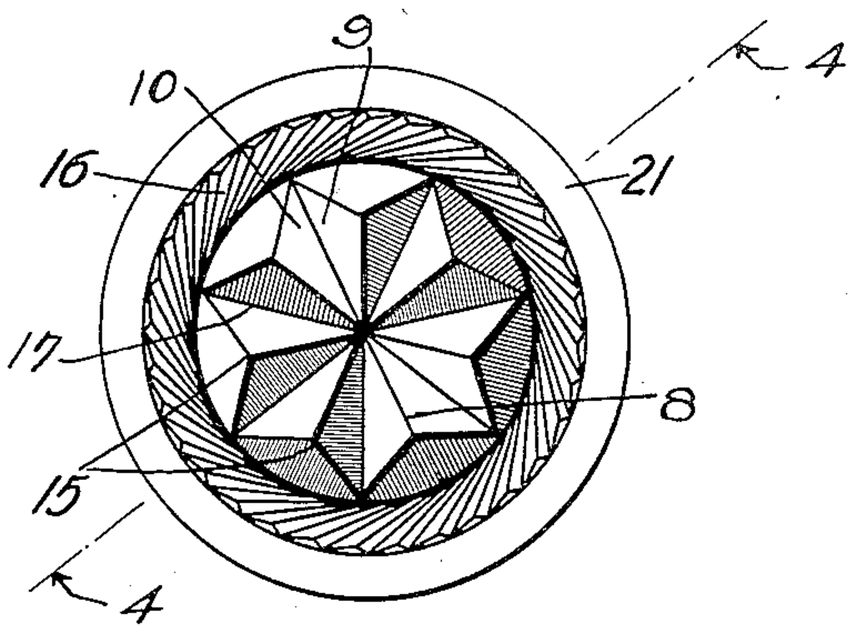


Fig. 3

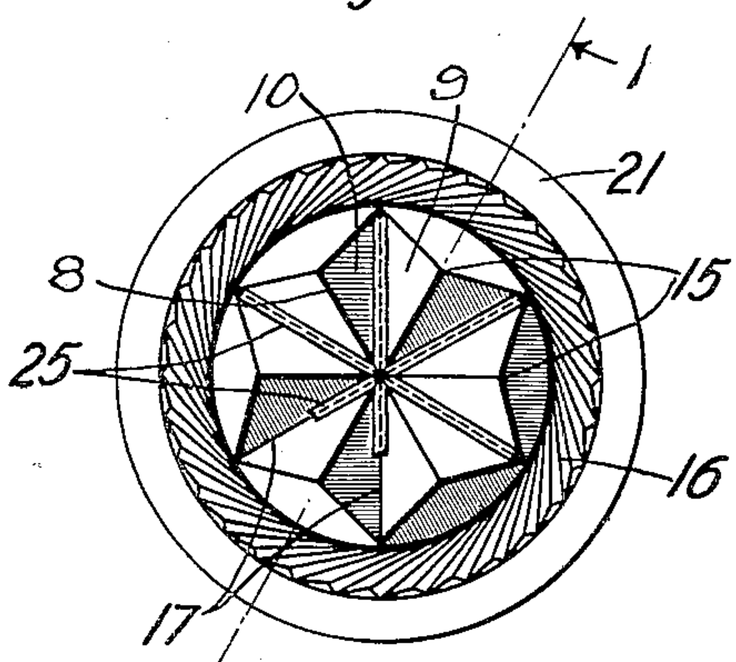
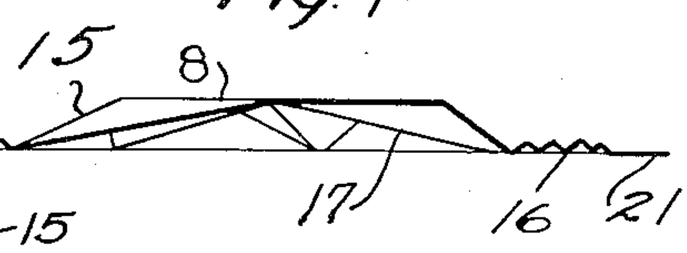


Fig. 2

Fig. 4



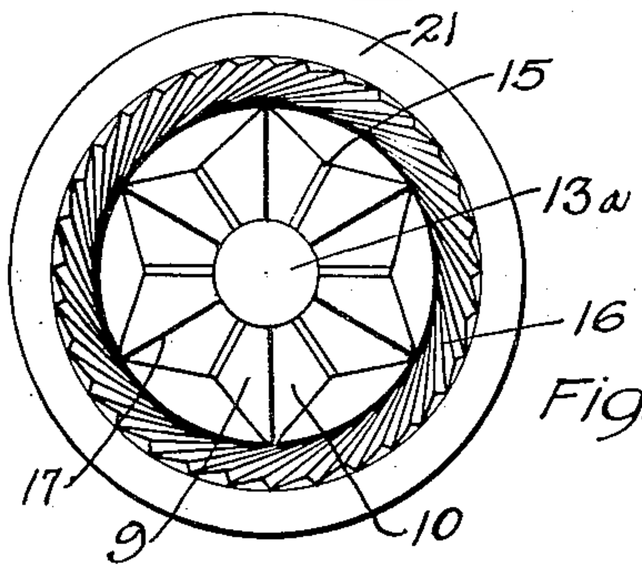


Fig. 5.

Inventor:
Henry C. Harrison,
by J. E. Roberts
Attorney.

Patented Nov. 11, 1930

1,781,387

UNITED STATES PATENT OFFICE

HENRY C. HARRISON, OF PORT WASHINGTON, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

DIAPHRAGM

Application filed July 31, 1926. Serial No. 126,313.

This invention relates to diaphragms and particularly to diaphragms of the piston or plunger type.

An object of the invention is to improve the operating characteristics of diaphragms, and particularly of diaphragms employed in acoustic devices, so as to obtain a more uniform frequency-response characteristic over a large portion of the sound frequency range.

A specific object is to increase the stiffness of the driven portion of a piston type diaphragm without appreciably increasing its mass.

As pointed out in my Patent 1,734,624, a piston type diaphragm employed in an acoustic device, such as a phonograph reproducer or recorder, should preferably comprise a flexible peripheral portion and a stiffened driven portion, both portions being of small mass. In the above noted patent there is described and claimed a plunger type diaphragm comprising a stiffened central portion and an annular flexible portion having corrugations tangential to the periphery of the stiffened portion.

In accordance with the present invention improved operating characteristics are obtained by the use of a diaphragm having a plurality of stiffened areas to which the driving or driven device is connected. In a preferred form of the invention, each stiffened area consists of a pyramidal elevation to the apex of which one arm of a driving spider is secured.

The invention may be better understood by referring to the accompanying drawing in which:

Fig. 1 is a sectional view of a phonograph reproducer or recorder employing the diaphragm of this invention;

Fig. 2 is a front elevation of the diaphragm of Fig. 1 showing the stiffening strips;

Figs. 3 and 4 are front and cross sectional views respectively of a modified form of diaphragm without the stiffening strips and the driving spider.

Fig. 5 is a front view of the diaphragm of Figs. 1 and 2 showing the driving spider attached without the stiffening strips.

Referring to the drawing, the diaphragm which consists of one piece of material is divided into three major portions, a stiffened or central portion, a flat marginal portion 21 and an intermediate flexible portion 16. As shown, the central or stiffened portion has embossed or otherwise formed therein a plurality of pyramidal elevations whose apices 15 are nearer the periphery than the center of said central portion. The opposing lateral faces 9 and 10 of adjacent elevations form dihedral angles and have common base lines or lateral edges 17. The center of the diaphragm is shown as slightly forward of the plane of the periphery. The base lines 17, therefore, define a conical surface having pyramidal elevations formed therein. The lateral edges 8 are shown as concurrent lines in the same plane. Obviously, however, they may lie in different planes as they would be in the case where the center of the diaphragm and the periphery are in the same plane or the apices of the elevations and the center of the diaphragm in different planes. The flexible portion 16 of the diaphragm is formed by corrugating a narrow band of the diaphragm near its circumference, said narrow band circumscribing the pyramidal elevations. These corrugations extend approximately tangentially to the outer edge of the stiffened portion substantially as shown in my Patent 1,734,624 and although this structure is preferably employed in conjunction with this invention, other constructions such as a plane or circularly corrugated marginal portion may be used. The diaphragm is mounted in a suitable housing or sound box 11 by securing the flat portion 21 between the clamping rings 22. It is connected to the stylus arm 12 by the coupling member or spider 13. This spider comprises a stiff dome-shaped central portion 13^a and radially extending flexible arms 14. These arms are clinched, spot welded or otherwise secured to the diaphragm at the apices 15 of the pyramidal elevations. The stylus bar 12 is secured to the dome-shaped central portion 13^a at 27.

While an even number of pyramidal elevations may be employed, it is preferable, especially in diaphragms in which the center and the periphery of the stiffened portion are ap-

proximately in the same plane, to employ an odd number of the pyramids in order to avoid having the base lines 17 of diagonally opposite pyramids in a straight line and thus reduce the tendency of the diaphragm to flex along this line due to applying unequal driving forces to the various stiffened areas. Additional stiffening of the diaphragm is provided by the strips 25 which may be cemented or otherwise secured to the diaphragm along the angular groove formed by the sides of adjacent pyramids. These stiffening strips may be made of any suitable material, such as aluminum or one of its alloys.

In Figs. 3, 4 and 5 the stiffening strips are not shown for the sake of clearness. In Figs. 3 and 4, which show a modified form of the diaphragm having an odd number of bosses, the driving spider is also omitted in order to clearly illustrate the construction of the diaphragm.

In accordance with this invention, not only is a diaphragm or portion thereof increased in stiffness as a unit, without increasing its mass, but the full advantages of a multiple point drive are realized by developing the stiffened areas about the driving points so as to obtain the maximum stiffness at these points. It is desirable to have the central portion of a piston type diaphragm of sufficient stiffness to be resonant at frequencies above the range ordinarily employed in speech and music. When this portion of the diaphragm is not uniformly stiff, the driving force is preferably applied to the points of maximum stiffness so that the piston portion of the diaphragm may move substantially as a unit rather than in small resonant portions.

While the diaphragm shown and described is of the piston type having a flexible peripheral portion and a stiffened driven portion, the invention is not limited to this specific embodiment but includes other diaphragms employing a plurality of stiffened areas, for example, a diaphragm employing the stiffened structure throughout and supported at one or more of the stiffened areas and driven at one or more of the remaining stiffened areas. The diaphragm may also be of relatively large dimensions so as to function efficiently in direct acting sound radiators. The term "pyramidal" as employed in describing the diaphragm of this invention is used to include conical and variations of pyramidal and conical structures. Since the diaphragm may be employed in either a sound responsive or a sound producing device it is obvious that either a driving or a driven means may be connected to the diaphragm.

What is claimed is:

1. A diaphragm having a plurality of pyramidal elevations formed therein, and means for holding the apices of said elevations in fixed spaced relation with respect to each other.

2. A diaphragm of sheet material formed into a plurality of pyramidal elevations the base lines of which form elements of a cone having its apex at the center of the diaphragm.

3. A stiffened diaphragm having a plurality of pyramidal elevations having adjoining bases and stiffening means secured to said diaphragm at the junction of said elevations.

4. A stiffened diaphragm having a plurality of pyramidal elevations and reinforcing strips secured along the lower edges of said elevations.

5. A piston diaphragm comprising a stiffened portion, having a plurality of pyramidal elevations embossed therein, and a flexible portion having a plurality of substantially straight non-radial corrugations.

6. A piston diaphragm of thin material comprising a stiffened portion having a plurality of pyramidal elevations formed therein and a flexible portion formed by corrugations arranged substantially tangentially to the periphery of the stiffened portion.

7. A piston diaphragm comprising a stiffened portion having a plurality of pyramidal elevations formed therein, a flexible portion integral with said stiffened portion, and means for holding the summits of said elevations in fixed spaced relation to each other.

8. In an acoustic device, a piston diaphragm having a plurality of pyramidal elevations at its central portion and a flexible annular portion integral therewith, and driving means connected to each of said pyramidal elevations.

9. In an acoustic device, a diaphragm having a portion stiffened by a plurality of pyramidal elevations, and a driving means connected to the apices of a plurality of said pyramidal elevations.

10. A sound recorder and reproducer comprising a stylus bar, a diaphragm having a plurality of stiffened areas, a spider having a stiff central portion and flexible radial arms connecting said stylus bar and said diaphragm, the stylus bar being connected to the central portion of said spider and the stiffened areas of the diaphragm being connected to the radial arms of said spider.

11. In an acoustic device, a diaphragm comprising a central piston portion of substantial area and a flexible annular portion, said central portion being divided equally into a small number of pyramidal sectors having their apices nearer the periphery than the center of said central portion.

12. A diaphragm comprising a stiff central portion and a flexible annular portion, said central portion being divided into a plurality of pyramidal elevations having common lateral edges meeting at the center of the diaphragm.

13. A diaphragm of thin material having a central portion comprising a small number of formed-up pyramidal elevations having adjacent base angles at the center of said central portion and apices at a substantial distance therefrom.

14. In an acoustic device a diaphragm of thin material comprising a central portion having a plurality of similar pyramidal elevations formed therein, said elevations having base angles adjacent the center and apices at a substantial distance therefrom, and means connected with each of said apices for driving said diaphragm.

15. A diaphragm comprising a disc of thin sheet material having a plurality of formed-up pyramidal elevations, the opposing lateral faces of adjacent elevations forming equal dihedral angles.

16. In an acoustic device, a diaphragm comprising a plurality of adjacent elevations in the form of pyramids, the apices of said pyramids lying between the center and the periphery, and means connected to the apices of said elevations for driving said diaphragm.

17. A diaphragm having a plurality of pyramidal elevations formed therein, said elevations having concurrent lateral edges lying in the same plane.

In witness whereof, I hereunto subscribe my name this 27th day of July, A. D. 1926.

HENRY C. HARRISON.