

Feb. 16, 1932.

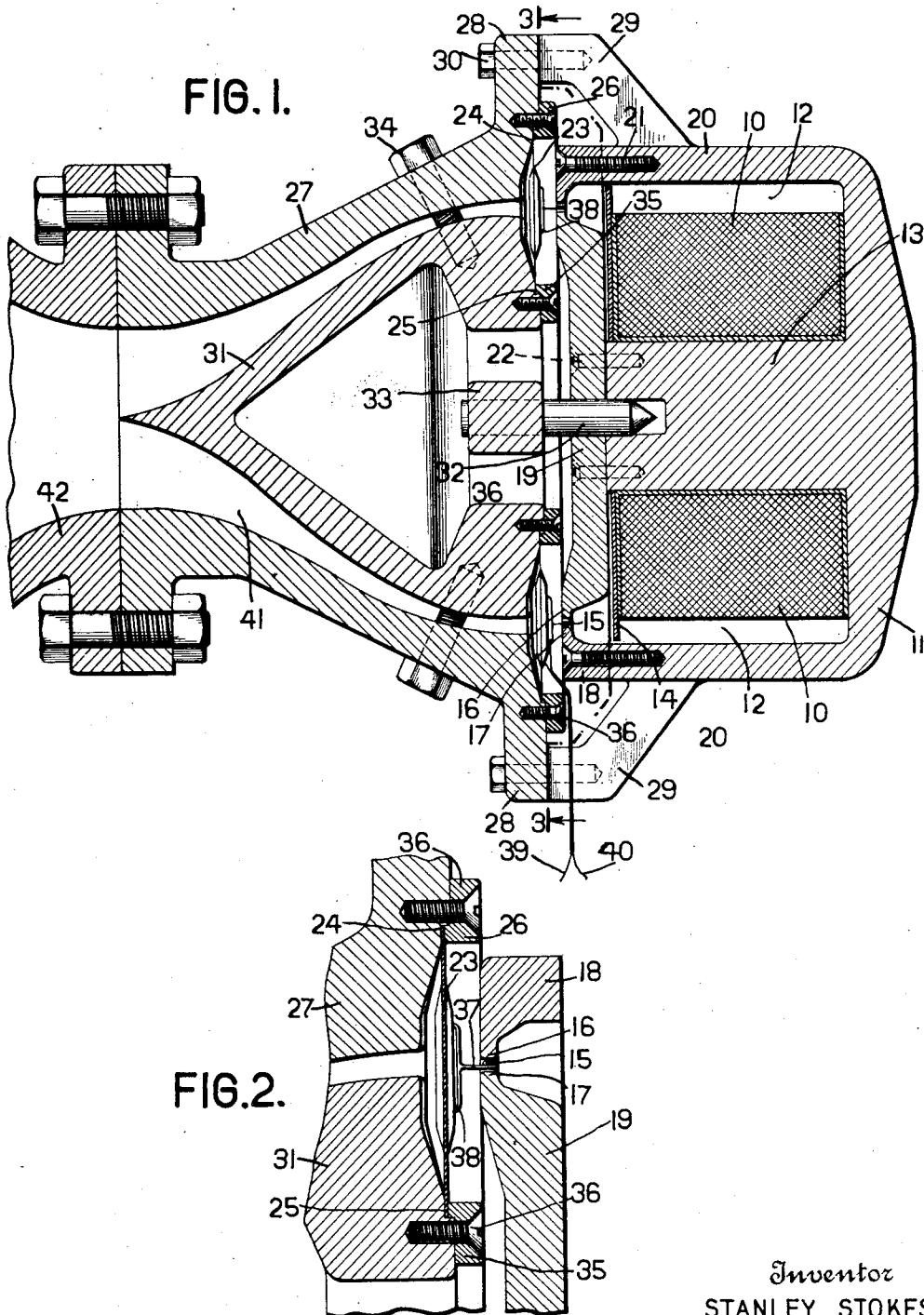
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1,845,768

LOUD SPEAKER

Filed Jan. 8, 1929

2 Sheets-Sheet 1



Inventor
STANLEY STOKES

By his Attorneys
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FIG. 3.

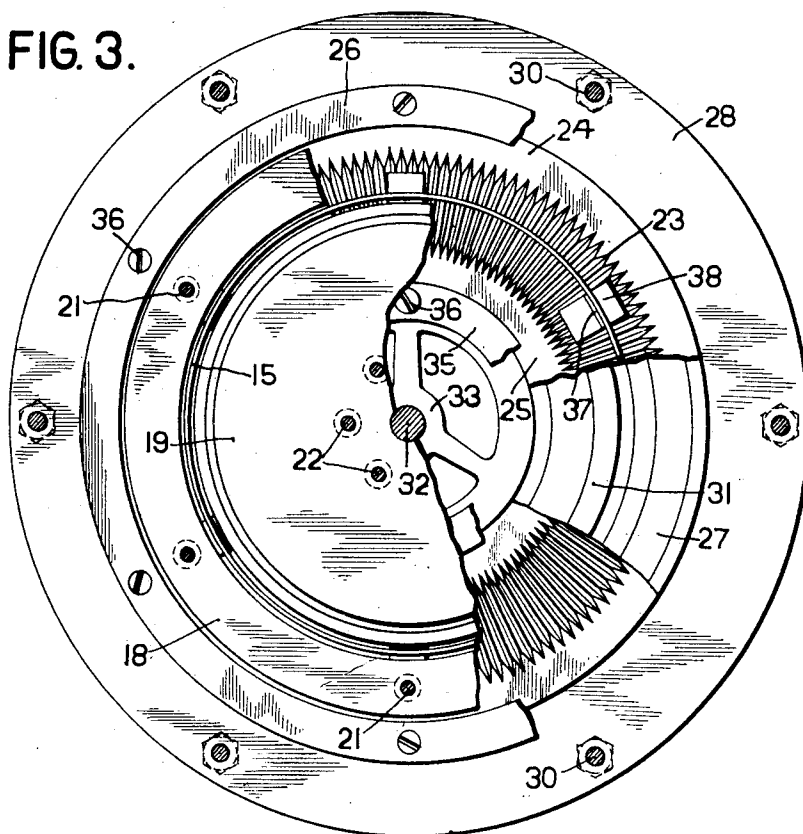
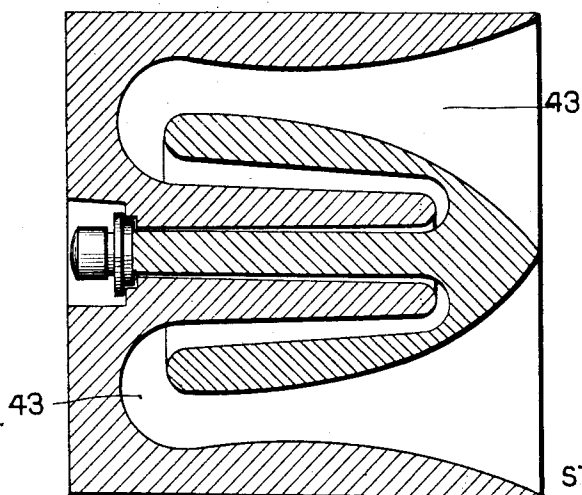


FIG. 4.



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UNITED STATES PATENT OFFICE

STANLEY STOKES, OF FERGUSON, MISSOURI

LOUD SPEAKER

Application filed January 8, 1929. Serial No. 331,078.

This invention relates to loud speaking telephones known in the art, more simply, as loud speakers.

Among the objects of the invention is to provide a device of the class described which translates electrical undulations supplied to it into sound vibrations of the desired intensity and fidelity.

Another object of the invention is to provide a loud speaker which is capable of efficient operation under maximum power output conditions.

Another object of the invention is to provide a loud speaker having an annular diaphragm and an associated sound chamber comprising an annular passage which communicates with the diaphragm, the design of the loud speaker being such as to conduct all sound waves emanating from the diaphragm outwardly through the sound chamber without causing phase displacement of the sound waves.

Another object of the invention is to provide an annular diaphragm having a natural frequency beyond the audio frequency range.

Another object of the invention is to provide a design for loud speakers which is suitable for adaptation in the production of loud speakers of small compass and of great magnifying quality.

Other objects involving novel constructions and combinations of parts will appear in the specification and in the claims thereof setting forth a preferred embodiment of my invention which may be fully understood from the detailed description and drawings, in which:—

Fig. 1 is a sectional view of a loud speaker embodying the principle of my invention.

Fig. 2 is an enlarged sectional view of a portion of the diaphragm and mounting shown in the upper portion of Fig. 1.

Fig. 3 is a section on line 3—3 of Fig. 1.

Fig. 4 is a sectional view of an amplifier having a folded annular passage.

My invention is particularly related to an electro-dynamic speaker, that is, one in which a portion of the conductor carrying the alternating signal current is a part of the moving system, the force producing the mo-

tion being due to the location of this conductor in a magnetic field. As shown in Fig. 1, a large field coil 10 is provided for establishing the magnetic field. The field coil 10 is mounted within a shell 11 having an annular space 12 for accommodating the coil. The central portion 13 which is disposed within shell 11 constitutes the core within coil 10. For structural reasons it is convenient to make core 13 an integral part of shell 11 and accordingly, these elements are made of iron in the form illustrated. A plate 14 closes the open portion of annular space 12.

The air gap within which the moving coil 15 of the electro-dynamic speaker is located is defined by an annular space between the edges 16, 17 of circular members 18, 19 respectively. Circular member 18 is a ring which is secured to the outer ring portion 20 of shell 11 by means of fastening devices such as screws 21 or the like. Circular member 19 is secured to the core 13 by similar fastening means 22.

One of the features of the invention involves the use of an annular diaphragm 23 whose edges 24, 25 are rigidly mounted in permanently fixed relation to normally fixed parts of the loud speaker. Accordingly, in the illustrated embodiment of my invention, the outer edge 24 of diaphragm 23 is tightly clamped by a ring 26 to the outside section 27 of the sound chamber which is a part of the loud speaker, and which will be described in detail hereinafter. Outside section 27 of the sound chamber has a flange 28 which contacts with and is supported in relation to a plurality of brackets 29 extending from shell 11. Screws 30 maintain the outside section 27 and shell 11 in fixed relation to each other.

The inside section 31 of the sound chamber is justified in concentric relation to the outside section 27 and shell 11 by means of a dowel pin 32 in engagement with a hub portion 33 of inside section 31, circular member 19 and core 13. The permanent relation of the inside and outside members of the sound chamber is insured by a plurality of screws 34 engaging each member.

The inner edge 25 of the annular diaphragm 23 is tightly clamped, by a ring 35, to the inside section 31 of the sound chamber. Rings 26, 35 are held in place by screws 36 which render them readily removable. While it is evident that the general mode of associating the various members may be varied, it is apparent that the assembled relation which has been described is one which lends itself to good shop practice and facilitates adjustments and assembly.

The various members of the loud speaker are so proportioned as to permit the use of an annular diaphragm 23 having a large area and a relatively short unsupported radial width between its edges 24, 25. The annular form of diaphragm enables a maximum amount of air to be placed in motion and to be discharged through the sound chamber under efficient operating conditions, that is, a large proportion of the power input is converted into useful power output. In order to obtain these desirable results and to obtain faithful reproduction and transmission of sound within the desired acoustic range, I design my loud speaker so that the diaphragm may be characterized by its stiffness for a large area and its high ratio of stiffness to mass of material. For example, and as a preferred diaphragm having these properties, an annular diaphragm made of duralumin alloy number seventeen S or similar material may be used. When duralumin alloy is used it may be approximately three one thousandths of an inch in thickness. The central strip of such a diaphragm may be corrugated so that stiffness and substantial "piston" action of a large area of its surface may be assured, the greatest amount of flexing being thereby restricted to those areas of the diaphragm adjacent the clamping rings 26, 35. The duralumin alloy mentioned is considered to possess the lightness and strength deemed desirable and other alloys and metals having similar properties would be suitable, as for example, beryllium. A diaphragm constructed in accordance with the present disclosure will be found to have a natural frequency above the working audio frequency range and to reproduce sound vibrations with desirable fidelity for all frequencies within the working acoustic range desired. Wave interference because of the natural frequency of the diaphragm is obviated.

The moving coil 15 is secured to the diaphragm by means of strips 37 and bridge members 38 which are spaced at intervals along the circumference of coil 15. The strips 37 are in rigid connection with the coil and with the central portion of the bridge members 38 while the edges of the bridge members 38 are permanently fastened to the diaphragm.

As is well understood, the output of any

source of locally generated currents through a vacuum tube amplifier or from a magnetic pickup is conducted to the terminals (not shown) of the moving coil 15 and the alternating signal current established in the moving coil will cause such vibration of the moving coil and diaphragm as to set up audible sound waves. Leads 39 and 40 from the moving coil may be tacked to a bridge member 38 and to the diaphragm in the manner shown.

It will be readily appreciated that the annular diaphragm lends itself to the uniform distribution of the driving force.

Hereinbefore, I have referred to outside section 27 and inside section 31 in reference to the sound chamber of the loud speaker. These two sections form the walls of a sound chamber constituting an annular passage 41 in communication with diaphragm 23. This passage is so designed as to produce the desired amplification without wave distortion and the law of design employed in its production is suitable for obtaining dimensional variations of cross-section for any desired degree of amplification as well as for accommodating the length of the passage to any desired measurement in excess of a minimum practical limit.

In general, the cross-sectional area of the passage 41 increases exponentially away from the diaphragm and the flaring end of the amplifier may terminate in an annular passage or an open circular passage as shown in Fig. 1. In the latter case the radius of the outside wall of inside section 31 reduces to zero at the mouth of the amplifier and, if desired, an ordinary exponential horn connected as at 42, may be attached. The use of an ordinary exponential horn in conjunction with the amplifier is not indispensable, for where sufficient distance exists between the diaphragm and the mouth of the amplifier, the amplifier will be found suitable for obtaining a suitable volume whether the mouth of the amplifier ends in an annulus or in an open passage.

The conjoint relation of an annular diaphragm with an annular sound chamber enables the reproduction of high notes which are ordinarily not reproducible by a disk type of diaphragm. The high notes are reproducible because, by reason of the annular shape, the pressure waves originating at all points of the diaphragm can reach the opening 42 of the horn at practically the same time. It is readily appreciated that this result is attributable to the narrowness of the radial width of the diaphragm which is attainable by an annular diaphragm and the short path that all sound waves have to travel from any point on the diaphragm to the sound passage. The importance of this construction is manifest when it is considered that at certain frequencies within the audio frequency range high notes are reproduced and made audible

because of the elimination of phase displacement of the sound waves and the saving in power output to be had with an annular sound chamber and diaphragm.

5 It will be appreciated that the annular sound chamber in effect, consists of two horns, one within the other, utilizing the space between the two, the area of which is made to increase exactly as the area in an exponential
10 horn. The average radius measured from a central axis is much greater in this type of expanding horn than in the conventional type and, hence, for a given area the thickness of the air passage is small. Accordingly, this
15 type of annular sound passage is applicable for use as a folded horn such as is illustrated in Fig. 4. The annular passage 43 flares exponentially and is twice reversed so that a horn of great amplification is confinable in
20 but a relatively small volume.

The invention is capable of wide variation and relationship of parts without departure from the nature and principle thereof, and its use is not limited to the special applications
25 mentioned herein since, in view of the great sound intensity achievable I contemplate its use for such purposes as for signalling and measuring of altitude for aircraft.

I do not restrict myself unessentially in
30 the foregoing or other particulars, but contemplate such alterations and modifications within the scope of the appended claims as may be found advisable.

I claim:

35 1. In combination, an electromagnetic speaker having an annular diaphragm and a horn comprising an annular sound-conveying passage starting from the diaphragm and enlarging in cross-sectional area as the distance from the diaphragm increases, the an-
40 nular sound-conveying passage of said horn being folded and enlarging exponentially from the diaphragm to its mouth.

2. In combination, an electromagnetic
45 speaker having an annular diaphragm and a horn comprising an annular sound-conveying passage starting from the diaphragm, said passage being concentric with the axis of the diaphragm with its average radius increasing as the sound-conveying passage reverses
50 on itself as it increases in area from the diaphragm to the mouth of the horn.

3. In combination, an electromagnetic
55 speaker having an annular metallic diaphragm, means supporting said diaphragm and rigidly clamping its edges in fixed relation to each other, said diaphragm having its inner area stiffened whereby flexing due to vibrations is mainly limited to the portions of
60 said diaphragm outside of its inner area, and an annular sound-conveying passage opposite said diaphragm.

4. A sound amplifying device comprising,
65 in combination, a horn having a sound-conveying passage of annular cross-section

throughout its length and increasing exponentially in cross-sectional area from its beginning to its open end, said passage doubling back on itself at least twice with the smallest cross-sectional area of the passage
70 being of less average radius than the largest cross-sectional area.

In testimony whereof I hereto affix my signature.

STANLEY STOKES. 75

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