Dec. 8, 1931. A. I. ABRAHAMS 1,835,739

SOUND AMPLIFIER

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Fig. 1

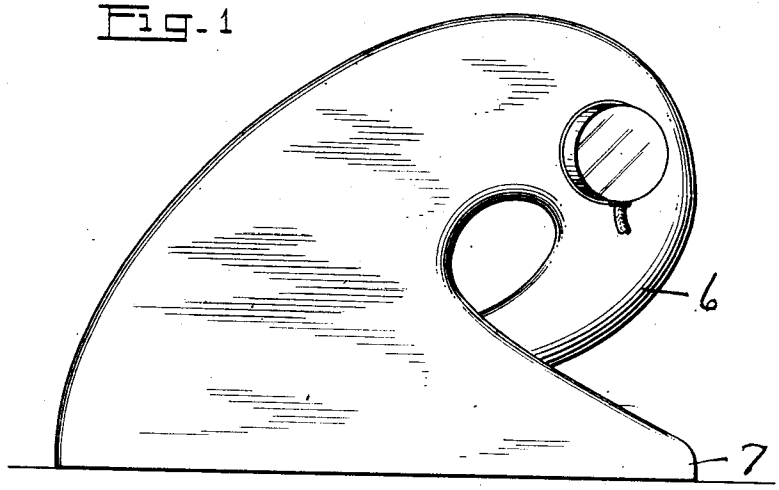
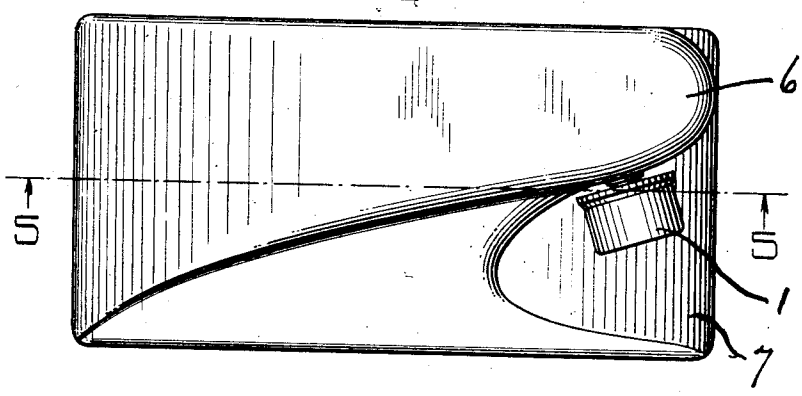


Fig. 2



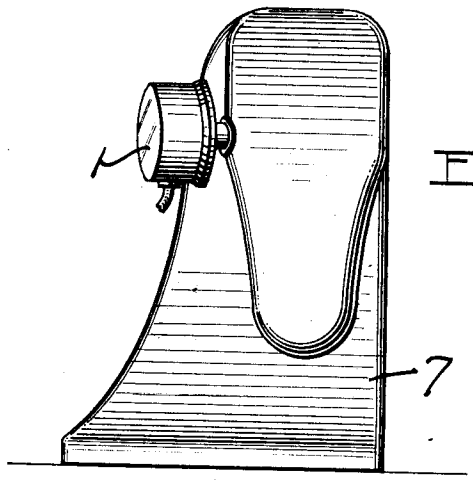


Fig. 3

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Fig. 4

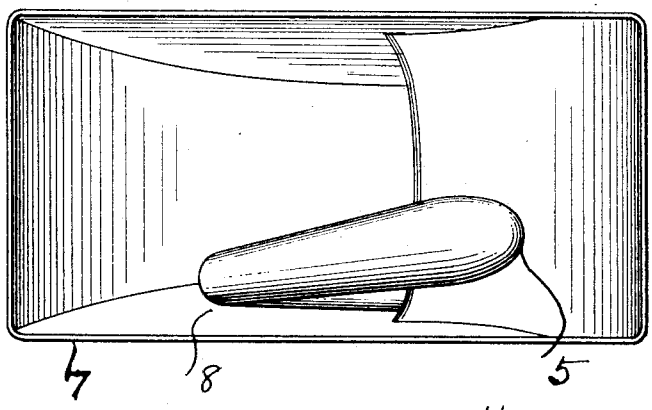


Fig. 5

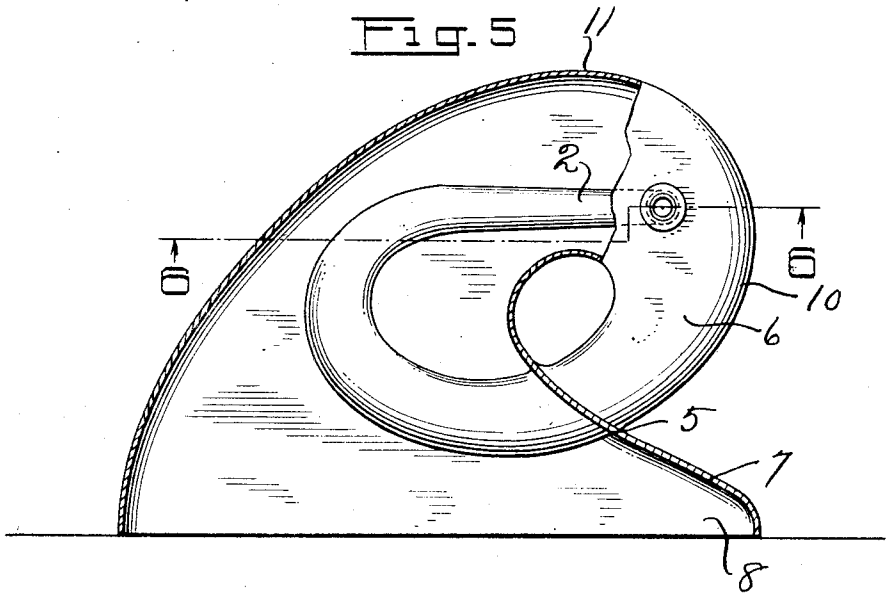
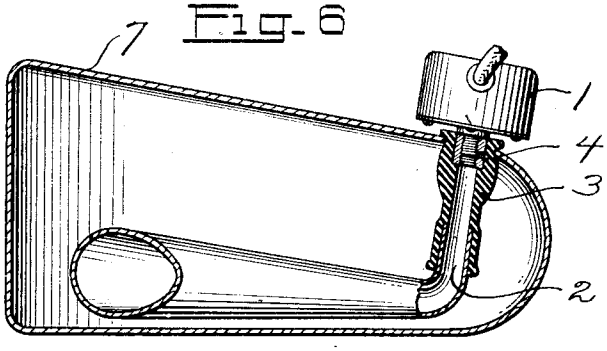


Fig. 6



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UNITED STATES PATENT OFFICE

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SOUND AMPLIFIER

Application filed August 20, 1927. Serial No. 214,427.

My invention relates to a new and improved horn or amplifier.

One of the objects of my invention is to provide a horn or amplifier which will be particularly useful in connection with radio receiving sets for producing a clear and largely amplified volume of sound, and which shall operate uniformly over the range of tone within the limits of audibility.

Another object of my invention is to provide a horn or amplifier which shall minimize the objectionable overtones produced when the diaphragm of a reproducing unit is operated beyond a given range.

Another object of my invention is to provide a horn or amplifier which shall have maximum length within a minimum space while amplifying the reproduced sounds with great uniformity over a very large range.

Another object of my invention is to provide a horn or amplifier which shall reproduce and amplify the sounds with great clearness and distinctness.

Another object of my invention is to provide a horn which shall in itself amplify tones by the use of an amplifying chamber and a reflecting surface.

Other objects of my invention will be set forth in the following description and drawings which illustrate a preferred embodiment thereof, it being understood that the above general statement of the objects of my invention is intended merely to generally explain the same and not to limit it in any manner.

Fig. 1 is a top elevation, it being assumed that the device is placed on its side when it is placed within the cabinet of a radio receiving set, for example.

Fig. 2 is a top view of the device shown in Fig. 1, represented as resting upon its open mouth.

Fig. 3 is a side elevation of the device shown in Fig. 2.

Fig. 4 is an elevation in which the observer is supposed to be looking into the open mouth of the instrument.

Fig. 5 is a section on the line 5—5 of Fig. 2.

Fig. 6 is a section on the line 6—6 of Fig. 5.

Heretofore, horns or amplifiers have been proposed in which one part of the horn intersected another part thereof. However, such devices have been objectionable for various reasons. For example, the structure of the horn at the line of intersection differed so substantially from the structure of the horn at the other parts thereof, that certain tones or notes were not properly reproduced and amplified. Likewise, in constructions heretofore known, the intersection between the respective parts of the horn was located in the sound amplifying zone. Likewise, in other constructions the sound reproducing unit was located in the interior of the horn so that the objectionable vibrations of the wall of the casing of the unit were also amplified.

According to my invention, the amplifier has a unit 1 which is connected to the small end 2 of the horn by means of a bushing 3 which is made of yieldable rubber. The relative thickness of said bushing is exaggerated in the drawings, as in actual practice the wall of said bushing need not be more than 1/8th of an inch thick. As shown in Fig. 6, for example, this bushing 3 intersects the wall of the horn and said bushing 3 is provided with an internally threaded metal coupling member 4 to which the end of the reproducing unit 1 can be connected. The horn is then preferably enlarged and curved to the line of intersection 5, at which point it passes through the outer wall thereof, to form an externally tapered portion 6 which continues into the outer or main wall 7 of the horn which finally terminates in the bell-mouth 8.

As shown in Fig. 6, the inner part of the horn is not diametrically located. That is, said inner part is much nearer the bottom wall of the horn than the top wall thereof. This enables a standard pattern to be utilized for forming the parts 2 and 6 of the horn, while the upper part of the horn may be made of any desired height to enable the same molds to be used for making horns of varying heights. The inner and outer parts of the horn are joined at about the point 10.

While I do not wish to restrict myself to any particular material, I prefer to form the

horn of pile fabric stiffened with a water-soluble adhesive, as shown in Max Abrahams Patent No. 1,501,032.

The inner part of the horn and the outer part thereof, up to about the point 11 indicated in Fig. 5, is preferably designed as an exponential horn and the remainder of the horn is also preferably designed as an exponential horn with a much larger relative taper or expansion factor.

It will also be noted that the sound travels out of the horn by means of repeated reflection, from the point indicated as 11 in Fig. 5 to the open mouth of the horn.

Experience has shown that the use of a soft rubber gasket 3 is preferable at the first point of intersection between the inner and outer parts of the device because the gasket 3 is soft and absorbs the sound to a certain extent, and in addition, it does not objectionably reinforce or stiffen the wall of the horn along the line of intersection between said gasket 3 and the main wall of the horn. Likewise, said gasket prevents any vibrations of the unit, or the wall of its casing from being transmitted to the wall of the horn, which would result in distortion.

It will be noted that the sound is amplified in what may be considered as two sections of the device. The first amplifying section consists of the curved tapered portion up to about the point 11, the apex or narrow end of the first section being located within the wider part of said first section. The sound is then amplified by reflection in a second section, which comprises an enclosed chamber having a reflecting wall which sends the sound waves out of said chamber. Said chamber has a large taper at and near its mouth, so that the wall thereof adjacent the line 5 could be omitted without affecting the quality of the same.

It is highly important that a horn should be of uniform stiffness at all portions of the wall thereof, because differences in stiffness tend to affect the amplification of notes, which in turn tends to form nodes at said points of intersection. Likewise, in my improved construction the unit 1 is wholly outside of the horn, so that when the vibrations of the diaphragm are sufficiently vigorous to cause corresponding vibrations in the wall of the casing of the unit, said vibrations are not amplified or transmitted by means of vibrations of the walls of the horn.

Likewise, I have found that by using stiffened cloth made according to the disclosure of U. S. Patent No. 1,501,032, that the intersection between the two parts of the horn along the line 5 does not objectionably affect any tone.

This desirable effect is enhanced by the shape of the horn shown in Fig. 5 and by reason of the fact that after the point 11 the sound waves travel out of the horn by reflection from that portion of the wall of the horn which is free from any intersection. By reason of the enlarged relative taper of the horn in the portion in which there is the single intersection between the inner and outer parts of the horn, said intersection does not objectionably affect the reproduced sound because the wall in which the intersection is present tapers away sharply from the opposite wall of the horn.

While I have shown the gasket 3 as being inclined upwardly from the small end of the horn so that the end of the horn is not in the same plane as the plane of the convolution of the horn, I do not wish to restrict my invention to this upward inclination of the gasket 3.

It will also be noted in Fig. 6 that due to the fact that the top of the bell of the horn extends above the unit, that the unit 1 does not take up unnecessary space because the entire device can be located in a cabinet which is sufficiently large to admit the mouth of the horn.

An important feature of my invention is that the outer wall of the horn adjacent the single line of intersection between the outer and inner parts thereof plays little or no part in amplifying the sound, because this is substantially reflected from the opposite wall of the horn, as has been previously stated. For example, the wall of the horn between the line of intersection 5 and the mouth 8 could be broken away without interfering with the quality or intensity of the amplified sound. Hence, the outer wall of the horn at this point merely serves as a structural element to firmly hold the inner winding of the horn in position and the character of the amplified sound is not affected by reason of the increased rigidity of the horn around the line of intersection.

It will be noted that the narrow part of the horn forms a substantially continuous or closed curve and that the sound waves from the wider or larger portion of said closed curve element is reflected until said sound waves finally issue in a direction which is substantially perpendicular to the narrow part of the horn indicated by the portion 2 in Fig. 5.

I have shown a preferred embodiment of my invention but it is clear that numerous changes and omissions could be made without departing from its spirit.

I claim:—

1. In combination, a convoluted amplifying horn and a unit external thereto, the said horn having an inner part of relatively small diameter intersecting an outer part of relatively large diameter at two points situated within an angle of less than 180° along the curve of convolution, the small end of said inner part being provided with a gasket of sound-absorbing material which extends to

the adjacent outer wall of the horn, said unit being connected to said gasket, said gasket supporting said unit.

2. An amplifying horn having a portion of smaller taper intersecting the portion of larger taper so that said portion of relatively small taper extends within said portion of relatively large taper, the portion of relatively small taper being spaced from the central plane of the portion of relatively large taper.

3. A convoluted horn made of stiff material and having a portion of relatively small taper intersecting a portion of relatively large taper at two points situated within an angle of less than 180° along the curve of convolution, formed by intersecting parts of said rigid material, said horn having a unit external thereto, said unit being supported at and connected to the small end of the horn by material which is softer and more sound-absorbent than the stiff material of which the main body of the horn is composed.

4. A convoluted horn having a portion of relatively small width intersecting another portion of relatively large width at two points situated within an angle of less than 180° along the curve of convolution, the narrow end of said horn including the inlet end thereof forming a substantially closed curve, part of which extends through said portion of relatively large width.

5. A horn comprising a tapered portion forming a substantially closed curve, the wider end of said portion being adjacent and inclined to a reflecting wall adapted to reflect the sound waves emitted from said relatively large portion.

6. A horn comprising a tapered portion forming a substantially closed curve, the wider end of said portion being adjacent and inclined to a reflecting wall adapted to reflect the sound waves emitted from said relatively large portion, said reflecting wall being adapted to finally reflect the sound in a direction substantially perpendicular to the mouth of the open bell of the horn.

7. A convoluted horn having a wall made of rigid material and having an inner portion intersecting an outer portion at two points situated within an angle of less than 180° along the curve of convolution, that portion of said rigid material adjacent said line of intersection being substantially ineffective for amplifying the sound waves.

8. A convoluted horn having a portion of relatively small diameter extending within and intersecting the wall of an outer portion of relatively large diameter at two points situated within an angle of less than 180° along the curve of convolution, the wall of said outer portion adjacent said line of intersection being sharply inclined away from the opposite wall of the horn.

9. An amplifying horn having a portion of small taper spirally wound within a portion of relatively large taper.

10. An amplifying horn having a portion of small taper spirally wound within a portion of relatively large taper, the walls of the portion of small taper extending for a portion of their length in a direction substantially parallel to the walls of large taper.

In testimony whereof I affix my signature.

ALEXANDER I. ABRAHAMS.