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Description

The present invention relates to a speaker system having a horn or an acoustic pipe provided in front of the speaker diaphragm and adapted for guiding sonic waves therefrom.

A speaker system is known in which a sound wave generated by a diaphragm is introduced to the second outlet opening of the speaker through a horn or an acoustic pipe provided on the front side of the diaphragm. This type of speaker systems is finding increasingly wide use because it provides a higher level of the output sound pressure and superior directivity as compared with ordinary speaker systems which do not have such a horn or acoustic pipe.

A description will be given hereinafter, with reference to the drawings, as to a known speaker system of the type having a horn or an acoustic pipe.

Referring to Fig. 9 which is a sectional view of a known speaker system of the type mentioned above, a back cavity 2 is provided on the rear side of a speaker unit 1 for the purpose of preventing radiation of reflected sound from the speaker diaphragm. A horn 9 is provided in front of the speaker diaphragm and extends towards the sound outlet opening of the speaker system. The cross-sectional area of the horn 9 is progressively increased from the end adjacent to the speaker diaphragm towards the end adjacent to the sound outlet opening of the speaker system. The horn 9 thus constitutes an acoustic path 5 which introduces the sound wave output from the speaker. The change in the acoustic impedance at the sound outlet opening of the speaker system is made extremely small provided that the horn 9 has a length which is sufficiently greater than the length of the wavelengths of sound wave of the reproduction band. In such a case, a very good matching is obtained at the sound outlet opening of the speaker system so that a flat reproduction sound pressure frequency characteristic is obtained thus realizing an ideal speaker system. Actually, however, in case of setting up the speaker system in an acoustic apparatus, it is not possible to design the horn 9 having such a large length in equipments which is sufficiently large as compared with the wavelength of sound waves in the reproduction band. Therefore, the speaker systems employing such horns usually exhibit a reproduction sound pressure frequency characteristic which contains many peaks and troughs as shown in Figs. 2B and 8B.

This is attributable to the fact that reflection waves are generated at the sound outlet opening of the speaker due to a drastic change in the acoustic impedance. In consequence, resonances are caused in the acoustic path. The same problem is

encountered also with a speaker system which makes use of an acoustic pipe in place of the horn 9. Thus, the speaker systems which employ acoustic pipes as the acoustic paths exhibit reproduction sound pressure frequency characteristics which contain many peaks and troughs. This is attributed to the fact that, as shown in Fig. 10, a resonance takes place at a frequency f which is represented by the following formula:

$$f = (2n - 1)C/4L \quad (n = 1, 2, 3, \dots)$$

where, L represents the length of the acoustic pipe, while C represents the velocity of the sonic wave.

Fig. 10 illustrates the sound pressure distribution and velocity distribution as obtained when the number n is 2 ($n = 2$).

The British Patent Specification GB-A-402 600 discloses a speaker system in which a speaker unit is mounted with its diaphragm in an opening of the front wall of the speaker unit. The rear side of the diaphragm is disposed at the beginning of an acoustic path of a predetermined, relatively large length and of flaring shape. The acoustic path is defined by a sound absorbing member made of a sound absorbing material filling the space between the surface thereof defining the acoustic path and the sidewalls of the speaker system chamber. The effect of the sound absorbing member is that the length of the path by which the sound waves are guided from the rear side of the diaphragm may be made relatively long without introducing appreciable selective box resonance effects due to reflections from the sidewalls of the chamber.

Japanese Patent Unexamined Publication No. 49-134312 discloses a speaker system in which a horn for guiding the sound wave from a diaphragm is made from a material which exhibits a small tendency of generation of reflected waves (noise), i.e., a material which absorbs the noise well. This, however, is irrelevant to the invention of this application which is intended for absorbing reflected waves attributable to a drastic change in the acoustic impedance at the sound outlet opening of the speaker system.

Accordingly, an object of the present invention is to provide a speaker system having flat sound pressure frequency characteristics free of resonance peaks and troughs without requiring that the length of the horn or the acoustic pipe is increased.

According to the present invention, there is provided a speaker system comprising: at least one speaker unit having a diaphragm; an acoustic path for guiding sound waves generated on the front surface of said diaphragm; and a sound absorbing member made of a sound absorbing material provided in a predetermined portion of said

acoustic path; wherein said acoustic path is defined by said sound absorbing member and wherein a partition member is disposed to separate said sound absorbing member from said acoustic path in such a manner that at least a portion of said sound absorbing member is exposed to said acoustic path.

Fig. 1 is a sectional view of a speaker system in accordance with the state of art;

Fig. 2A is graph illustrating the sound pressure frequency characteristics of the speaker system of Fig. 1;

Fig. 2B is a graph illustrating the sound pressure frequency characteristics of another known speaker system;

Figs. 3(a) to 3(c) are perspective views of different examples of known speaker systems;

Fig. 4 is a sectional view of a first embodiment of the speaker system in accordance with the present invention;

Fig. 5 is a sectional view of a second embodiment of the speaker system in accordance with the present invention;

Figs. 6(a) and 6(b) are a sectional view and a front elevational view of an essential part of a third embodiment of the speaker system of the present invention;

Fig. 7 is a sectional view of a fourth embodiment of the speaker system of the present invention;

Fig. 8A is a graph showing the sound pressure frequency characteristics of the fourth embodiment;

Fig. 8B is a graph illustrating the sound pressure frequency characteristics of a known speaker system;

Fig. 9 is a sectional view of a known speaker system; and

Fig. 10 is an illustration of particle velocity distribution and sound pressure distribution in a longitudinal section of the acoustic pipe.

Referring to Fig. 1, a known speaker system has a speaker unit 1 with a back cavity 2 on the rear side thereof, an acoustic pipe 3 for guiding and introducing sound waves generated on the front side of the diaphragm of the speaker unit 1, and a sound absorbing member 4 disposed in the acoustic pipe 3 and defining an acoustic path 5.

The operation of this speaker system is as follows. The sound emitted from the rear side of the speaker unit 1 is confined in the back cavity 2 so that it is not transmitted to the outside of the speaker system. On the other hand, the sound emitted from the front side of the diaphragm is introduced through the acoustic pipe 3 to the sound outlet opening of the speaker system so as to be radiated therefrom. However, a part of the sound wave introduced to the sound outlet opening is reflected due to a drastic change in the acoustic

impedance, tending to propagate backward to the diaphragm surface. Accordingly, the reflected sound wave is conveniently absorbed by the sound absorbing material disposed in the acoustic pipe, thus eliminating existence of a standing wave in the acoustic pipe.

As will be seen from Fig. 1, the sound absorbing member 4 has a smaller thickness in the region near the sound outlet opening and a greater thickness at the region adjacent to the speaker unit 1, so that the impedance of the sound absorbing member 4 to the reflected wave is reduced to ensure a high sound absorbing effect.

Namely, the amount of the material of the sound absorbing member 4 is increased towards the front side of the diaphragm so that the impedance exhibited by the sound absorbing member 4 to the reflected sound wave is linearly changed, whereby the reflected sound wave from the sound outlet opening is effectively absorbed by the sound absorbing member without any unnecessary reflection.

The linear and progressive change in the impedance provided by the sound absorbing member may be controlled in various ways. For instance, it is possible to control the manner of change in the impedance by suitably varying the amount of the material of the sound absorbing member 4 along the length thereof, or by adjusting the flow resistance per unit area such that it is small in the region near the sound outlet opening and large in the region near the surface of the diaphragm.

Needless to say, the sound wave produced by the diaphragm can be introduced to the sound outlet opening through the acoustic path defined by the sound absorbing member 4 without being impeded by the sound absorbing member 4.

Fig. 2 illustrates the reproduction sound pressure frequency characteristics exhibited by a speaker system with the horn or acoustic pipe of Fig. 1, in comparison with the characteristics exhibited by another conventional arrangement. From this Figure, it will be understood that the other conventional speaker system exhibits characteristics B which includes peaks and troughs due to existence of a standing wave, while the known speaker system of Fig. 1 exhibits flat reproduction sound pressure frequency characteristics A up to high pitch region of the tone.

As described, the cross-sectional area of the acoustic path is increased from the end adjacent to the surface of the diaphragm towards the sound outlet opening. Such an acoustic path 5 may be defined solely by the sound absorbing member 4 as shown in Fig. 3(a) or, alternatively, the arrangement may be such that the sound absorbing member 4 and the wall of the acoustic pipe 3 in cooperation define the acoustic path 5, as shown in

Fig. 3(b).

The acoustic path 5 may have a tubular form of a constant cross-sectional area, or it may have, as in Fig. 3(c), an arrangement in which the sound absorbing member 4 has a horn-like form, while the acoustic pipe 3 is constructed to decrease its cross-sectional area towards the sound outlet opening, thus providing a constant cross-sectional area of the acoustic path 5, as shown in Fig. 3(c).

Fig. 4 is a sectional view of a first embodiment of the speaker system in accordance with the present invention.

The first embodiment of the speaker system has a speaker unit 1, a back cavity 2, an acoustic pipe for introducing acoustic waves generated on the front side of the diaphragm, a partition member 6 disposed in the acoustic pipe 3 so as to define an acoustic path 5, and a sound absorbing member 4 a part of which is disposed between the partition member 6 and the wall of the acoustic pipe 3 while the other part is exposed so as to define the acoustic path 5.

The operation of the first embodiment is as follows. The sound wave emitted from the rear side of the diaphragm in the speaker unit 1 is confined in the back cavity 2 so that it does not radiate to the outside. On the other hand, the sound wave emitted from the front side of the diaphragm is guided by the acoustic pipe 3 to reach the sound outlet opening so as to be radiated therefrom. However, since a drastic change in the acoustic impedance is generated in the sound outlet opening, a portion of the sound wave introduced to the opening is reflected so as to be propagated backward towards the front surface of the diaphragm. However, the reflected wave is absorbed by the sound absorbing member 4 disposed in the acoustic pipe 3, so that no standing wave exists in the acoustic pipe 3.

The partition member 6 is so sized as to extend over about 1/3 of the acoustic pipe 3 as measured from the surface of the diaphragm, and is intended to effectively guide the high-pitch components of the sound which tend to be absorbed by the sound absorbing member 4.

The portion of the acoustic pipe 3 which is about 1/3 the whole length of the acoustic pipe 3 as measured from the surface of the diaphragm substantially coincides with the region where the particle velocity is high. It is therefore possible to suppress the peaks of the sound pressure in the frequency region in which the standing wave is generated. The sound wave components of other frequencies are introduced efficiently to the sound outlet opening without being impeded by the sound absorbing member, because the sound absorbing member is designed in the form of a horn.

According to this embodiment, therefore, it is possible to suppress the levels of the peaks of sound pressure which are inevitably high in the conventional speaker system with a horn or acoustic pipe due to the existence of a standing wave.

Obviously, the first embodiment can be carried out with various forms of the acoustic path 5 as illustrated in Figs. 3(a) to 3(c), without impairing the advantages derived therefrom.

Fig. 5 shows a second embodiment of the speaker system of the present invention. The second embodiment has a speaker unit 1, a back cavity 2, an acoustic pipe 3 for guiding sound wave generated on the front side of the diaphragm in the speaker unit 1, a partition member 6 disposed in the acoustic pipe 3 so as to define an acoustic path 5 and having slits one of which is located near the sound outlet opening of the acoustic pipe 3 while the other is in the region which is about 1/3 of the full length of the acoustic pipe 3 as measured from the surface of the speaker diaphragm, and a sound absorbing material received in the space between the acoustic pipe 3 and the partition member 6.

The operation of the speaker system in accordance with the second embodiment is as follows. The sound wave emitted from the rear side of the speaker unit 1 is confined in the back cavity 2 so that it does not radiate outside. On the other hand, the sound from the front side of the diaphragm in the speaker unit 1 is guided by the acoustic pipe 3 to reach the sound outlet opening so as to be radiated therefrom. A portion of the sound wave reaching the sound outlet opening, however, is reflected because the acoustic impedance is drastically changed at the sound outlet opening. The reflected wave tends to propagate backward towards the surface of the diaphragm. The reflected wave, however, is effectively absorbed by the sound absorbing member 4 in the acoustic pipe 3 so that no standing wave is generated in the acoustic pipe.

As explained before, the partition member 6 has slits in the region near the sound outlet opening and in the region which is 1/3 of the full length of the acoustic pipe 3 as measured from the surface of the speaker diaphragm, i.e., in the regions where the particle velocity is high. It is therefore possible to selectively absorb the sound wave components of frequency regions having peaks of sound pressure. Other components of the sound wave can be guided to the sound outlet opening without being impeded by the sound absorbing member 4.

Thus, the second embodiment also provides flat sound pressure frequency characteristics, by suppressing the peaks of sound pressure which are inevitably high in the known horn or acoustic pipe due to the presence of a standing wave.

Obviously, the same advantages are brought about when the acoustic path 5 of the second embodiment is modified as shown in Figs. 3(a) to 3(c).

Figs. 6(a) and 6(b) show a third embodiment of the speaker system in accordance with the present invention. As will be seen from Fig. 6(a), the third embodiment has a speaker unit 1, a back cavity 2, an acoustic pipe 3 which guides the sound wave generated on the front side of the diaphragm of the speaker unit 1, a partition member 6 disposed in the acoustic pipe 3 so as to define an acoustic path 5 and having a plurality of apertures, and a sound absorbing member 4 filling the space between the wall of the acoustic pipe 3 and the partition member 6.

As will be seen from Fig. 6(b), the apertures 10 formed in the partition member 6 have a diameter of 8 mm and are arranged at a pitch of 30 mm.

The operation of the third embodiment of the speaker system will be described hereinafter. The sound emitted from the rear side of the diaphragm of the speaker unit 1 is confined in the back cavity 2 so that it does not radiate to the outside. On the other hand, the sound wave emitted from the front side of the diaphragm is guided to the sound outlet opening through the acoustic pipe 3 so as to be radiated therefrom. A portion of the sound wave reaching the sound outlet opening of the acoustic pipe 3, however, is reflected to propagate backward towards the front surface of the diaphragm, because a drastic change in the acoustic impedance takes place at the sound outlet opening. The reflected sound wave, however, is absorbed by the sound absorbing member 4 which continuously extends over the entire area of the inner surface of the acoustic pipe 3 so that establishment of standing wave in the acoustic pipe 3 is prevented.

In this embodiment, the partition member 6 has apertures 10 of 8 mm diameter arranged at a pitch of 30 mm. The reflected sound wave causes a resonance with the air in the apertures so that a large sound absorption rate is obtained in the region near 1 KHz, thus enabling absorption of the second peak of the sound pressure in the acoustic pipe 3 which has a length of 40 cm. Other peaks are directly absorbed by the sound absorbing member 4 rather than by resonance with the air in the apertures. The diameter and the pitch of the apertures 10 can be varied as desired to enable absorption of the peak of a variety of frequency regions. Obviously, the configuration of the acoustic path 5 may be varied as illustrated in Figs. 3(a) to 3(c), without impairing the advantages.

Fig. 7 shows a fourth embodiment of the speaker system in accordance with the present invention. This embodiment has a high-pitch tone speaker unit 7, a low-pitch tone speaker 8, a back

cavity 2, an acoustic pipe 3 for guiding the sound waves generated on the front surfaces of both speaker units 7 and 8, a partition member 6 disposed in the acoustic pipe 3 so as to define an acoustic path 5 and having slits one of which is located near the sound outlet opening of the acoustic pipe 3 while the other is in a region which is about 1/3 of the full length of the acoustic pipe as measured from the end surface of the diaphragm in the speaker unit, and a sound absorbing member 4 disposed in the space defined between the wall of the acoustic pipe 3 and the partition member 6.

The operation of the speaker system in accordance with the fourth embodiment is as follows. The sound waves emitted from the rear side of the high-pitch and low-pitch tone speaker units 7 and 8 are confined in the back cavity 2 so that it does not radiate outside. On the other hand, the sound waves from the front side of the diaphragm in the speaker units 7 and 8 are guided by the acoustic pipe 3 to reach the sound outlet opening so as to be radiated therefrom. A portion of the sound waves reaching the sound outlet opening, however, is reflected because the acoustic impedance is drastically changed at the sound outlet opening. The reflected wave tends to propagate backward towards the surface of the diaphragm. The reflected wave, however, is effectively absorbed by the sound absorbing member 4 in the acoustic pipe 3 so that no standing wave is generated in the acoustic pipe.

As explained before, the partition member 6 has slits in the region near the sound outlet opening and in the region which is 1/3 of the full length of the acoustic pipe 3 as measured from the surface of the speaker diaphragm, i.e., in the regions where the particle velocity is high. It is therefore possible to selectively absorb the sound wave components of frequency regions having peaks of sound pressure. Other components of the sound wave can be guided to the sound outlet opening without being impeded by the sound absorbing member 4.

Fig. 8 illustrates the reproduction sound pressure frequency characteristics exhibited by a speaker system with the horn or acoustic pipe in accordance with the fourth embodiment, in comparison with the characteristics exhibited by the conventional arrangement. From this Figure, it will be understood that the conventional speaker system exhibits characteristics B which includes peaks and troughs due to existence of a standing wave, while the speaker system of the fourth embodiment exhibits flat reproduction sound pressure frequency characteristics A up to high pitch region of the tone.

Thus, the fourth embodiment also provides flat sound pressure frequency characteristics, by sup-

pressing the peaks of sound pressure which are inevitably high in the known horn or acoustic pipe due to the presence of a standing wave.

Obviously, the advantages offered by the fifth embodiment can equally be enjoyed even when the acoustic path 5 is modified as illustrated in Figs. 3(a) to 3(c).

Claims

1. A speaker system comprising: at least one speaker unit (1) having a diaphragm; an acoustic path (5) for guiding sound waves generated on the front surface of said diaphragm; and a sound absorbing member (4) made of a sound absorbing material provided in a predetermined portion of said acoustic path; wherein said acoustic path (5) is defined by said sound absorbing member (4), **characterized in that** a partition member (6) is disposed to separate said sound absorbing member (4) from said acoustic path in such a manner that at least a portion of said sound absorbing member (4) is exposed to said acoustic path (5).
2. A speaker system according to claim 1, **characterized in that** said exposed portion of said sound absorbing member (4) is located near resonance points of standing waves in said acoustic path (5).
3. A speaker system according to claim 1, **characterized in that** said partition member (6) extends from the front surface of said diaphragm to a position which is spaced from said front surface of said diaphragm by about 1/3 of the full length of said acoustic path (5).
4. A speaker system according to claim 1 or 2, **characterized in that** the region where said sound absorbing member (4) is exposed is a region where the particle velocity distribution of standing waves in said acoustic path is large.
5. A speaker system according to claim 4, **characterized in that** said sound absorbing member (4) is exposed in a region which is spaced from the front surface of said diaphragm by about 1/3 of the full length of said acoustic path and a region which is near the sound outlet opening of said acoustic path (5).
6. A speaker system according to anyone of claims 1 to 5, **characterized in that** the cross-sectional area of said acoustic path (5) is progressively increased from the end near said diaphragm towards the end near said sound

outlet opening.

7. A speaker system according to anyone of claims 1 to 5, **characterized in that** said acoustic path (5) has a constant cross-sectional area over the entire length thereof.
8. A speaker system according to either one of claims 6 and 7, **characterized in that** said acoustic path (5) is defined by the wall of said sound absorbing member (4) and the wall of an acoustic pipe (3).
9. A speaker system according to anyone of claims 1 to 8, **characterized in that** said acoustic path (5) is provided commonly on the front side of a plurality of speaker units (7,8).
10. A speaker system according to anyone of claims 1 to 9, **characterized in that** said sound absorbing member (4) is provided in an acoustic pipe (3).
11. A speaker system according to anyone of claims 1 to 10, **characterized in that** the amount of the material of said sound absorbing member (4) is progressively decreased from the end near said diaphragm towards the end near said sound outlet opening.
12. A speaker system according to anyone of claims 1 to 11, **characterized in that** the flow resistance per unit area of said sound absorbing member (4) is progressively decreased from the end near said diaphragm towards the end near said sound outlet opening.

Patentansprüche

1. Lautsprechersystem, das aufweist: Mindestens eine Lautsprechereinheit (1) mit einem Diaphragma; einen akustischen Kanal (5) zum Leiten von auf der Vorderseite des Diaphragmas erzeugten Schallwellen; und ein schallabsorbierendes Element (4) aus einem schallabsorbierenden Material in einem vorbestimmten Abschnitt des akustischen Kanals; wobei der akustische Kanal (5) von dem schallabsorbierenden Element (4) definiert ist, dadurch gekennzeichnet, daß ein Abteilelement (6) derart zum Trennen des schallabsorbierenden Elements (4) von dem akustischen Kanal angeordnet ist, daß zumindest ein Teil des schallabsorbierenden Elements (4) zu dem akustischen Kanal (5) hin freiliegt.
2. Lautsprechersystem nach Anspruch 1, dadurch gekennzeichnet, daß der freiliegende Teil des

schallabsorbierenden Elements (4) nahe den Resonanzpunkten stehender Wellen in dem akustischen Kanal (5) liegt.

3. Lautsprechersystem nach Anspruch 1, dadurch gekennzeichnet, daß sich das Abteilelement (6) von der Vorderseite des Diaphragmas zu einer Stelle hin erstreckt, die von der Vorderseite des Diaphragmas um etwa 1/3 der Gesamtlänge des akustischen Kanals (5) beabstandet ist. 5
4. Lautsprechersystem nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß derjenige Bereich, wo das schallabsorbierende Element (4) freiliegt, ein Bereich ist, wo die Partikelgeschwindigkeitsverteilung stehender Wellen in dem akustischen Kanal groß ist. 10
5. Lautsprechersystem nach Anspruch 4, dadurch gekennzeichnet, daß schallabsorbierende Element (4) in einem Bereich freiliegt, der von der Vorderseite des Diaphragmas um etwa 1/3 der Gesamtlänge des akustischen Kanals beabstandet ist, und in einem Bereich, der nahe der Schallauslaßöffnung des akustischen Kanals (5) liegt. 15
6. Lautsprechersystem nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Querschnittsfläche des akustischen Kanals (5) progressiv von dem Ende nahe dem Diaphragma zu dem Ende nahe der Schallauslaßöffnung hin zunimmt. 20
7. Lautsprechersystem nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der akustische Kanal (5) eine konstante Querschnittsfläche über seine gesamte Länge hat. 25
8. Lautsprechersystem nach einem der Ansprüche 6 und 7, dadurch gekennzeichnet, daß der akustische Kanal (5) durch die Wand des schallabsorbierenden Elements (4) und die Wand einer akustischen Röhre (3) definiert ist. 30
9. Lautsprechersystem nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß der akustische Kanal (5) gemeinsam auf der Vorderseite einer Vielzahl Lautsprechereinheiten (7, 8) vorgesehen ist. 35
10. Lautsprechersystem nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß das schallabsorbierende Element (4) in einer akustischen Röhre (3) vorgesehen ist. 40
11. Lautsprechersystem nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß die 45

Menge des Materials des schallabsorbierenden Elements (4) progressiv von dem Ende nahe dem Diaphragma zu dem Ende nahe der Schallauslaßöffnung hin abnimmt.

12. Lautsprechersystem nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß der Strömungswiderstand pro Einheitsfläche des schallabsorbierenden Elements (4) progressiv von dem Ende nahe dem Diaphragma zu dem Ende nahe der Schallauslaßöffnung hin abnimmt. 50

Revendications

1. Enceinte acoustique comprenant: au moins un hautparleur (1) comportant une membrane; un trajet acoustique (5) pour guider les ondes sonores engendrées sur la surface avant de ladite membrane; et un élément d'absorption acoustique (4), fait d'une matière absorbant le son et disposé dans une partie prédéterminée dudit trajet acoustique; ledit trajet acoustique (5) étant défini par ledit élément d'absorption acoustique (4); caractérisée en ce qu'un élément de séparation (6) est disposé de manière à séparer ledit élément d'absorption acoustique (4) dudit trajet acoustique, de telle sorte qu'une partie au moins dudit élément d'absorption acoustique (4) soit à découvert dans ledit trajet acoustique (5).
2. Enceinte acoustique selon la revendication 1, caractérisée en ce que ladite partie à découvert dudit élément d'absorption acoustique (4) est située près des points de résonance des ondes stationnaires dans ledit trajet acoustique (5).
3. Enceinte acoustique selon la revendication 1, caractérisée en ce que ledit élément de séparation (6) s'étend depuis la surface avant de ladite membrane jusqu'à un point qui est situé, par rapport à ladite surface avant de ladite membrane, à une distance d'environ 1/3 de la longueur totale dudit trajet acoustique (5).
4. Enceinte acoustique selon la revendication 1 ou 2, caractérisée en ce que la région où ledit élément d'absorption acoustique (4) est à découvert est une région où la distribution de vitesse des particules des ondes stationnaires dans ledit trajet acoustique est grande.
5. Enceinte acoustique selon la revendication 4, caractérisée en ce que ledit élément d'absorption acoustique (4) est à découvert dans une région qui est située, par rapport à la surface 55

avant de ladite membrane, à une distance d'environ $1/3$ de la longueur totale dudit trajet acoustique et dans une région qui est voisine de l'ouverture de sortie du son dudit trajet acoustique (5).

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6. Enceinte acoustique selon l'une quelconque des revendications 1 à 5, caractérisée en ce que l'aire de la section transversale dudit trajet acoustique (5) augmente progressivement depuis l'extrémité voisine de ladite membrane jusqu'à l'extrémité voisine de ladite ouverture de sortie du son. 10
7. Enceinte acoustique selon l'une quelconque des revendications 1 à 5, caractérisée en ce que ledit trajet acoustique (5) a, sur toute sa longueur, une section transversale dont l'aire est constante. 15
20
8. Enceinte acoustique selon la revendication 6 ou 7, caractérisée en ce que ledit trajet acoustique (5) est défini par la paroi dudit élément d'absorption acoustique (4) et par la paroi d'un tube acoustique (3). 25
9. Enceinte acoustique selon l'une quelconque des revendications 1 à 8, caractérisée en ce que ledit trajet acoustique (5) est prévu en commun du côté avant de plusieurs haut-parleurs (7, 8). 30
10. Enceinte acoustique selon l'une quelconque des revendications 1 à 9, caractérisée en ce que ledit élément d'absorption acoustique (4) est disposé dans un tube acoustique (3). 35
11. Enceinte acoustique selon l'une quelconque des revendications 1 à 10, caractérisée en ce que la quantité de matière dudit élément d'absorption acoustique (4) diminue progressivement depuis l'extrémité voisine de ladite membrane jusqu'à l'extrémité voisine de ladite ouverture de sortie du son. 40
45
12. Enceinte acoustique selon l'une quelconque des revendications 1 à 11, caractérisée en ce que la résistance au flux sonore par unité de surface dudit élément d'absorption acoustique (4) diminue progressivement depuis l'extrémité voisine de ladite membrane jusqu'à l'extrémité voisine de l'ouverture de sortie du son. 50

55

FIG. 1

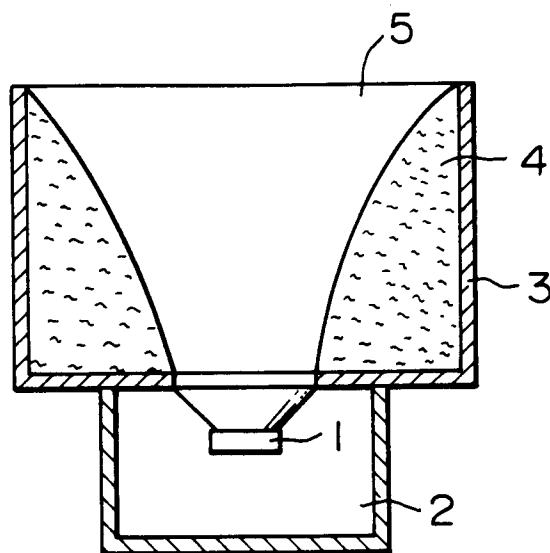


FIG. 2

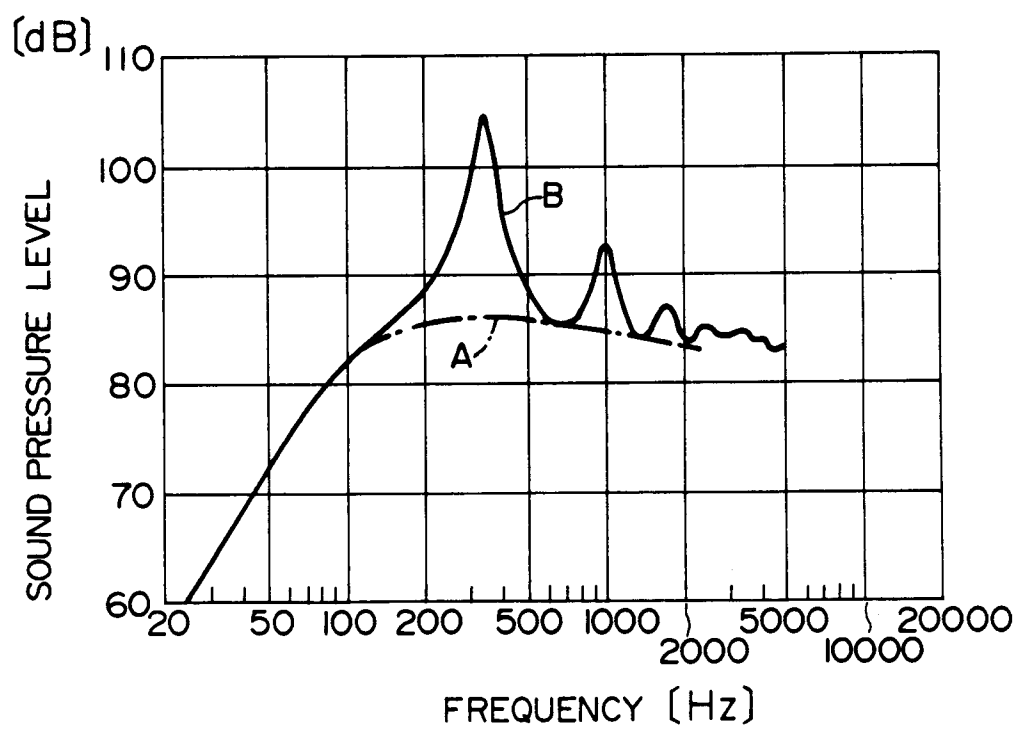


FIG. 3(a)

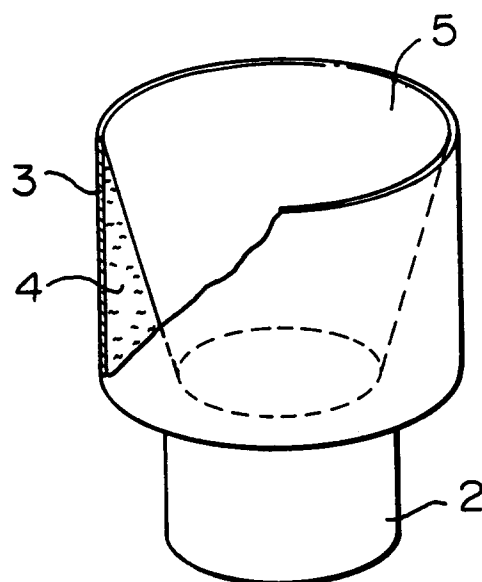


FIG. 3(b)

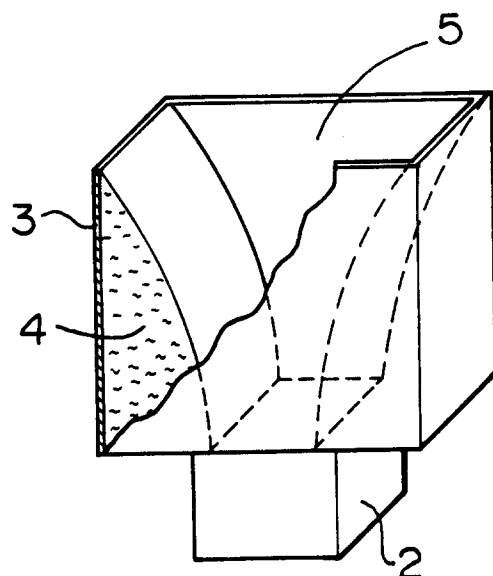


FIG. 3(c)

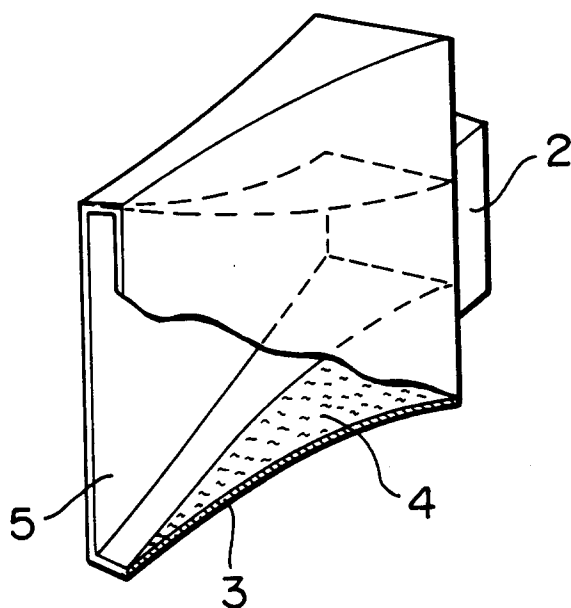


FIG. 4

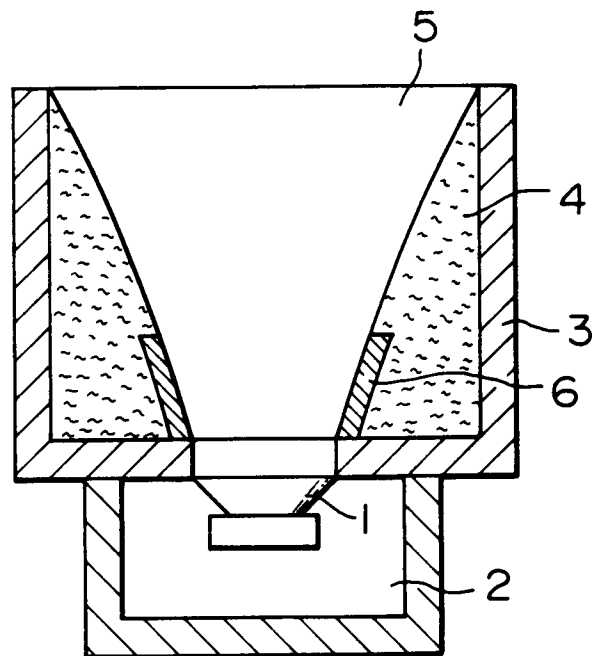


FIG. 5

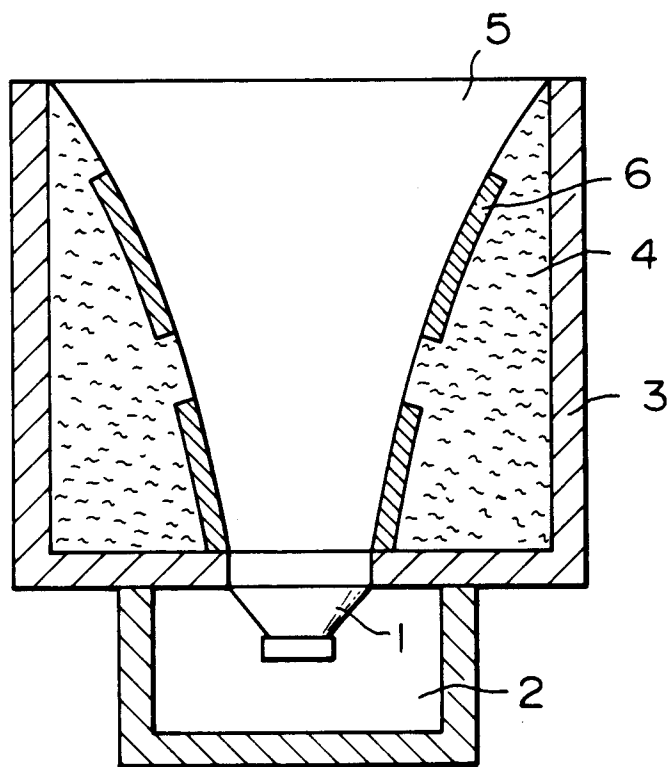


FIG. 6 (a)

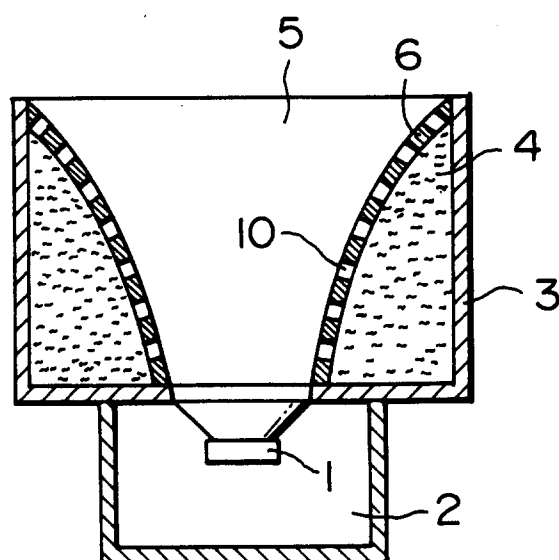


FIG. 6 (b)

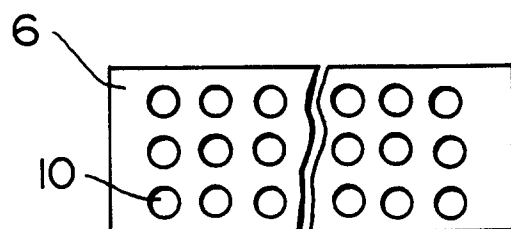


FIG. 7

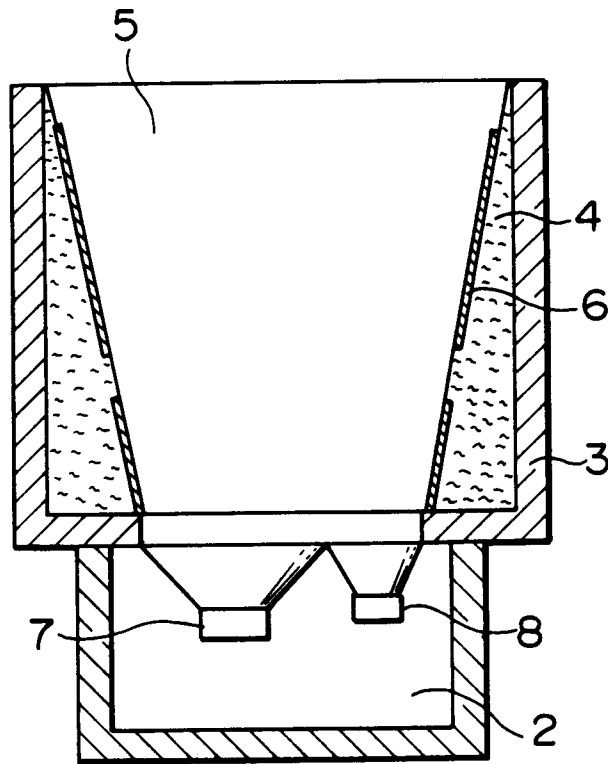


FIG. 8

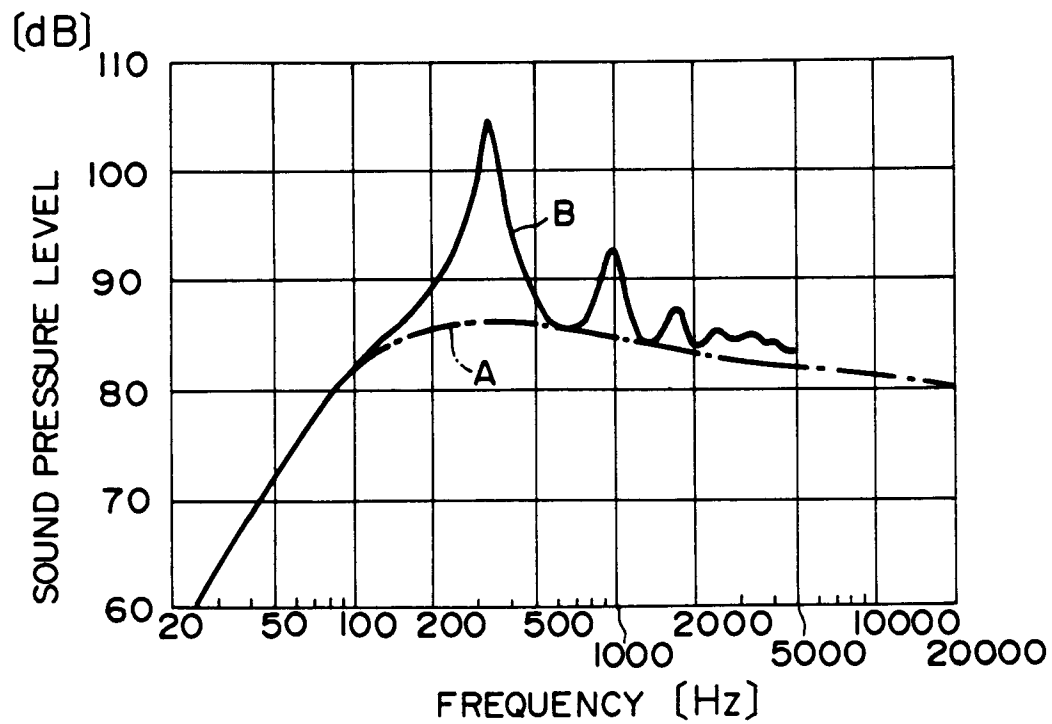


FIG. 9

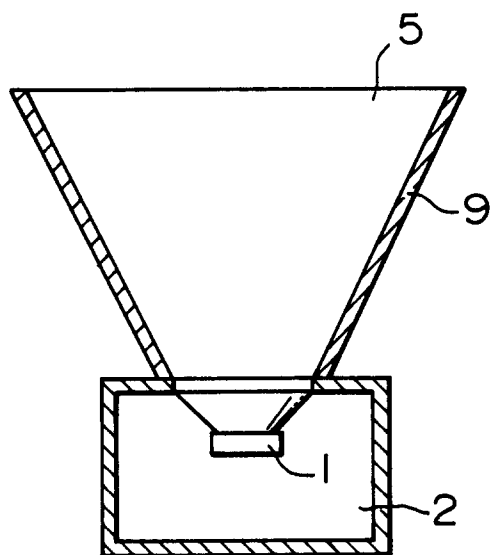


FIG. 10

$$f = 3C/4L$$

C = SOUND VELOCITY

L = ACOUSTIC PIPE LENGTH

