(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 452 066 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
29.12.2010 Bulletin 2010/52

(21) Application number: **02711908.0**

(22) Date of filing: **11.02.2002**

(51) Int Cl.:
H04R 1/28 *(2006.01)*

(86) International application number:
PCT/FI2002/000104

(87) International publication number:
WO 2002/074007 (19.09.2002 Gazette 2002/38)

(54) BASS-REFLEX LOUDSPEAKER SYSTEM AND METHOD OF MANUFACTURING THE SAME

BASSREFLEX-LAUTSPRECHERSYSTEM UND VERFAHREN ZU SEINER HERSTELLUNG

SYSTEME DE HAUT-PARLEUR RESONNANT ET PROCEDE DE FABRICATION ASSOCIE

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

(30) Priority: **19.02.2001 FI 20010313**

(43) Date of publication of application:
01.09.2004 Bulletin 2004/36

(73) Proprietor: **Genelec OY**
74100 Iisalmi (FI)

(72) Inventor: **MARTIKAINEN, Ilpo**
FIN-73110 Mäntylahti (FI)

(74) Representative: **Lipsanen, Jari Seppo Einari et al**
Seppo Laine Oy
Itämerenkatu 3 B
00180 Helsinki (FI)

(56) References cited:
JP-A- 2000 078 681
JP-A- 2001 157 286
US-A- 3 730 291
US-A- 3 923 124
US-A- 5 623 132

EP 1 452 066 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a bass-reflex loudspeaker construction according to the preamble of claim 1.

[0002] The invention also relates to a method according to the preamble of claim 7 for manufacturing a bass-reflex loudspeaker structure.

[0003] The invention is in particular suited for use in bass-range loudspeakers.

[0004] Among the requirements set for loudspeaker enclosures in the reproduction of low-frequency sounds, the most important factors are related to the capability of the enclosure to take internal pressure variations with deformations as small as possible (requiring stiffness) and the freedom of the enclosure from structural resonances. Generally, the enclosure is made from planar panels that are supported and stiffened from within the enclosure. As curved surfaces are structurally much stiffer than planar surfaces, also spherical, cylindrical and other equivalent shapes have been employed in the structures of loudspeaker enclosures.

[0005] One basic loudspeaker enclosure construction for reproduction of low-frequency sounds is the bass-reflex enclosure. Herein, the enclosure opening made for the loudspeaker unit is complemented with another opening that frequently has a duct connected thereto. Then, the air contained in the duct forms an acoustic impedance (a mass), while the air contained in the enclosure forms an acoustic capacitance (a spring), and the resonant frequency of this combination is dimensioned to cooperate with the loudspeaker unit. At the lowest frequencies, the combination exhibits a resonance, whereby the resonant circuit acts as a load to the loudspeaker unit. Then the excursion of the loudspeaker unit is small and the major portion of the radiation takes place via the reflex opening. When the goal is to reproduce sound in the very low-frequency range, the resonant frequency of the overall system must be lowered by way of either increasing the volume of the enclosure or the acoustic mass of air contained in the reflex duct. In many cases, a large size of the enclosure becomes a disadvantage that must be avoided, whereby the length of the reflex duct must be made long. Since the radiation occurring at the resonant frequency takes place via the reflex duct, the desired acoustical power output affects the flow velocity of air in the duct. If the flow velocity in the duct increases above a given limit value, the flow becomes turbulent thus evoking sound distortion and compression. Hence, the minimum cross section of the duct is determined by the desired acoustical power output. When a higher acoustical power is desired, the duct cross section area must be increased but the duct becomes longer consequently. A long duct cannot be fitted straight into an enclosure and a conventional approach has been to fold the duct in different angles, but abrupt bends cause turbulence even at small air flow velocities. The dimensioning of a bass-reflex loudspeaker and electrotechnical solutions to the problems thereof have been described widely in the literature of the art and, e.g., in European patent EP 0 322 686.

[0006] US 3730291, US 3923124 and JP 200007868 describe horn loudspeakers.

[0007] GB 2333927 describes loudspeakers with both closed and reflex enclosures.

[0008] US 5821471 describes a loudspeaker including a quarter wave pipe. This type of pipe is dimensioned in a totally different manner as a reflex duct of a bass reflex loudspeaker.

[0009] It is an object of the present invention to overcome the problems of the prior art and to provide an entirely novel type of bass-reflex loudspeaker construction and a method for manufacturing the same.

[0010] The goal of the invention is achieved by way of forming at least the reflex duct portion of the loudspeaker enclosure from a curved element having a spiraling shape in its sectional plane and wall panels placed about its both sides. According to the invention, the reflex duct is composed so that outer shell of the curved spiral structure forms at least a portion of the reflex duct wall, while the spiralingly "wrapped" extension of the duct outer shell forms the other wall of the reflex duct. In other words, the envelope of the loudspeaker enclosure and the reflex duct is in practice formed from a single banded structure that is bent into a spiral shape so that the reflex duct is created by the gap remaining between the coiled turns of the spiral. In an embodiment which is very typical to the invention, the reflex duct is formed by a channel whose width is equal to the width of the curved spiral structure and whose sides are delimited by the wall panels.

[0011] More specifically, the bass-reflex loudspeaker construction according to the invention is characterized by what is stated in the characterizing part of claim 1.

[0012] Furthermore, the method according to the invention is characterized by what is stated in the characterizing part of claim 7.

[0013] The invention offers significant benefits.

[0014] The structure becomes very stiff thus being free from disturbing resonances over the operational frequency range. The length of the reflex duct is maximized by locating it to the outer periphery of the enclosure, yet avoiding discontinuities even in a long reflex duct. Hence, the loudspeaker construction can be made very compact inasmuch the reflex duct portion can be located optimally. The construction is further optimized thereby that the reflex duct serves as a portion of the load-bearing members of the loudspeaker construction. Turbulence is minimized due to the spiral, smoothly formed reflex duct, whereby also sound distortion and compression are reduced. Furthermore, a plurality of variations according to the invention can avail of very advantageous solutions in the sense of manufacturing technology, since the loudspeaker construction typically consists of only three major components in addition to the loudspeaker unit, or even less when using certain manufacturing technologies.

[0015] In the following, the invention will be examined in greater detail with the help of exemplary embodiments by making reference to the appended drawings, in which

FIG. 1 shows a front view of a first embodiment of a bass-reflex loudspeaker construction according to the invention;

FIG. 2 shows the loudspeaker construction of FIG. 1 viewed from the right side;

FIG. 3 shows a front view of a second embodiment of a bass-reflex loudspeaker construction according to the invention; and

FIG. 4 shows the loudspeaker construction of FIG. 3 in a viewed from the right side.

[0016] In the embodiment shown in FIG. 1, a loudspeaker unit 3 is mounted on a front wall panel 2. Behind the front wall panel 2 is shown by a dashed line the curved portion 1 of the loudspeaker enclosure that is implemented as a spiral structure. To the interior of the curved spiral structure 1 is formed a loudspeaker chamber 7 wherefrom to the exterior of the loudspeaker is routed a reflex duct 4 that has a reflex duct inlet end 5 placed in the loudspeaker chamber 7 and a reflex duct outlet end 6 opening to the exterior. Due to flow technical reasons, the cross sections of both the inlet end 5 and the outlet end 6 are made larger than the cross section of the center portion of the reflex duct 4. The loudspeaker construction is designed for maximum stiffness with the exception of the active loudspeaker unit 3 that acts as the acoustical generator of the system. The loudspeaker unit 3 itself serves as a delimiting portion of the loudspeaker chamber 7.

[0017] As shown in FIG 2, the loudspeaker chamber 7 is delimited by its curved spiral structure 1, its front wall panel 2, its rear wall panel 8, which enclose the spiraling duct from its both sides, and by the loudspeaker unit 3. In FIGS. 1 and 2 the reflex duct outlet opening 6 is drawn so as to exit to the right side, but according to the invention the reflex duct outlet opening can be made to exit in any direction. Further, while in the diagrams the reflex duct 4 is drawn spiraling in a counterclockwise direction when viewed from the side of the front wall panel 2, obviously the opposite direction (that is, clockwise) is also possible.

[0018] In the benefit of certain manufacturing technologies, the front wall panel 2 and the rear wall panel 8 are located parallel to each other and perpendicular to the longitudinal axis of the curved spiral structure 1, but this detail is obviously irrelevant to the function of the present invention Loudspeaker constructions often aim to provide a spectacular look, it is thus possible, e.g., to enclose the curved spiral structure 1 with wall panels, that may be inclined in any angle in regard to each other. Neither need the wall panel 2 and 8 be planar with the provision that the loudspeaker chamber 7 and the reflex duct 4 are manufactured into a nonleaking entity. Also the operating position of the loudspeaker unit may be chosen freely, e.g., so that the loudspeaker construction can be placed in a horizontal position resting on the gable element 8 or on suitable legs mounted to the gable element 2.

[0019] The embodiment shown in FIGS. 3 and 4 is otherwise entirely equivalent with that of FIGS. 1 and 2 with the exception that herein the loudspeaker unit 3 is located on the curved spiral structure 1. Since the joint between the loudspeaker unit 3 and the curved spiral structure 1 must naturally be air-tight, this mounting technique needs a seal member not shown in the diagrams between the loudspeaker unit 3 and the curved spiral structure 1.

[0020] Using a known formula, the length of the reflex duct can be dimensioned on the basis of the volume of chamber 7 and the dimensions of the reflex duct:

$$f_r = c(S/lV)^{1/2}/2\pi$$

wherein

f_r = resonant frequency
c = speed of sound
S = cross-sectional area of reflex duct
l= length of reflex duct
V = volume of loudspeaker chamber.

[0021] As an example of loudspeaker dimensioning on the basis of the above formula, the following dimensions are obtained for a loudspeaker enclosure such as those shown in FIGS. 1-4:

Resonant frequency f_r	29 Hz
Diameter of curved portion 1	340 mm
Width of curved portion	250 mm
Height of front (and rear) wall panel	470 mm
Height of reflex duct 4	15 mm
Length of reflex duct	580 mm
Volume of chamber 7	221

[0022] Due to the spiral construction, the present invention is typically characterized in that the reflex duct 4 is curved only in one direction and its width is equal to the width of the curved portion 1. The width of the duct 4 may be reduced if so required, e.g., in the vicinity of the wall panels 2 and 8. While in the exemplary embodiments illustrated in the figures, the reflex duct 4 has a length substantially equal to haLf the perimeter of a circle, it is possible to allow the reflex duct length to vary within wide limits as dictated by the other design parameters (formula, diameter of loudspeaker unit, cutoff frequency of the loudspeaker unit and the like). Accordingly the reflex duct 4 may run even longer than a full circle about the outer perimeter of the curved portion 1 and its exten-

sion. In this special case, the reflex duct is not entirely placed along the outer perimeter of the curved portion 1.

[0023] Instead of having a cylindrically coiled wall, the curved portion 1 may also be conical.

[0024] When using casting, deep drawing or a similar technique, the curved portion may be formed from two mutually jointed parts, whereby the above-described division of the manufactured parts into a curved spiral part and its wall panels is not applicable. It may be further contemplated that the loudspeaker enclosure is designed to have a spherical shape, whereby it lacks any actual wall panels. Herein, while the joint between the manufactured parts may obviously be located in any place of the loudspeaker construction, the joint is typically made along the center plane of the piece.

[0025] The curved spiral structure 1 can be made of a metal, plastic, cardboard or the like. Due to its curved shape even a very thin structure is stiff, and its resonant frequency is in the order of several hundred Hz, which is fully satisfactory in the reproduction of bass range sounds. By laminating the curved spiral structure 1 from several layers of which at least one layer is lossy, it is possible to obtain a construction with the added benefit of attenuation of resonance frequencies.

[0026] The loudspeaker construction shown in FIGS. 1-4 may be designed to be independent, to function as a so-called subwoofer optimized for the bass range only or, alternatively to serve as a component in a loudspeaker construction covering the sound frequency band.

[0027] Typically, the loudspeaker construction according to the invention can also incorporates an amplifier.

Claims

1. A bass-reflex loudspeaker construction comprising

   - a loudspeaker enclosure structure (1,2,8),
   a loudspeaker chamber (7) delimited by the loudspeaker enclosure structure (1, 2, 8),
   a reflex duct (4) connected to the loudspeaker chamber (7) which connects the loudspeaker chamber to the space outside the loudspeaker enclosure, the reflex duct (4) being so long that it cannot be fitted straight into the enclosure structure (1, 2, 8), and
   at least one loudspeaker unit (3) mounted to the loudspeaker enclosure structure (1, 2, 8) which forms a portion of the loudspeaker enclosure structure delimiting the loudspeaker chamber (7),

   characterized in that
   the loudspeaker enclosure structure (1, 2, 8) comprises a curved spiral structure (1) having outer periphery and two ends, and a width the curved spiral structure (1) being closed at both ends by a front wall panel (2) and a rear wall panel (8) so as to form the loudspeaker chamber (7),
   the reflex duct (4), having an inlet end (5) and an outlet end (6) and a center portion, is formed at least partially on the outer periphery of the curved spiral structure (1) such that the cross sections of both the inlet end (5) and the outlet end (6) are made larger than the cross section of the center portion of the reflex duct (4), and **in that**
   the reflex duct (4) has a width that is equal to the width of the curved spiral structure (1).

2. The loudspeaker construction of claim 1, **characterized in that** the curved spiral structure (1) is formed into a portion of a cast structure.

3. The loudspeaker construction of claim 1, **characterized in that** the enclosure structure comprises a reflex duct (4) which is entirely on the outer periphery of the curved spiral structure (1).

4. The loudspeaker construction of claim 1 or 2 or 3, **characterized in that** the wall panels (2, 8) are parallel.

5. The loudspeaker construction of claim 1 or 2 or 3 or 4, **characterized in that** the wall panels (2, 8) are perpendicular to the longitudinal axis of the curved spiral structure (1).

6. The loudspeaker construction of claim 1 or 2 or 3 or 4 or 5, **characterized in that** the curved spiral structure (1) is fabricated of a laminated structure wherein at least one is a lossy layer.

7. A method of constructing a bass-reflex loudspeaker construction comprising

   - a loudspeaker enclosure structure (1, 2, 8),
   forming a loudspeaker chamber (7) using the loudspeaker enclosure structure (1, 2, 8),
   connecting to the loudspeaker chamber (7) a reflex duct (4) that connects the loudspeaker chamber (7) to the space outside the loudspeaker enclosure, the reflex duct (4) being so long that it cannot be fitted straight into the enclosure structure (1, 2, 8), and
   mounting on the loudspeaker enclosure structure (1, 2, 8) at least one loudspeaker unit (3) that forms a portion of the loudspeaker enclosure structure delimiting the loudspeaker chamber (7),

   characterized in that
   the loudspeaker enclosure structure (1, 2, 8) is formed of a curved spiral structure (1) having outer periphery and two ends, and a width the curved spiral structure (1) being closed at its ends by a front wall panel (2) and a rear wall panel (8)so as to form the

loudspeaker chamber (7),
the reflex duct (4), having an inlet end (5) and an outlet end (6) and a center portion, is formed at least partially onto the outer periphery of the curved spiral structure (1) such that the cross sections of both the inlet end (5) and the outlet end (6) are made larger than the cross section of the center portion of the reflex duct (4), and **in that**
the reflex duct (4) is arranged to have a width that is equal to the width of the curved spiral structure (1).

8. The method of claim 7, **characterized in that** the curved spiral structure (1) is formed into a portion of a cast structure.

9. The method of claim 7 or 8, **characterized in that** the reflex duct (4) is formed entirely onto the outer periphery of the curved spiral structure (1).

10. The method of claim 7 or 8 or 9, **characterized in that** the wall panels (2, 8) are placed in parallel.

11. The method of claim 7 or 8 or 9 or 10, **characterized in that** the wall panels (2, 8) are placed perpendicularly to the longitudinal axis of the curved spiral structure (1).

12. The method of any foregoing method claim, **characterized in that** the curved spiral structure (1) is fabricated of a laminated structure wherein at least one layer is lossy.

Patentansprüche

1. Eine Bassreflexlautsprecher-Konstruktion, aufweisend:

   eine Lautsprechergehäuse-Struktur (1, 2, 8),
   eine Lautsprecherkammer (7) begrenzt durch die Lautsprechergehäuse-Struktur (1, 2, 8),
   einen Reflexkanal (4) verbunden mit der Lautsprecherkammer (7), der die Lautsprecherkammer mit dem Raum außerhalb des Lautsprechergehäuses verbindet, der Reflexkanal (4) ist so lang, dass er nicht gerade in die Gehäusestruktur (1,2,8) eingepasst werden kann, und
   zumindest eine Lautsprechereinheit (3) befestigt an der Lautsprechergehäuse-Struktur (1, 2, 8), die einen Teil der Lautsprechergehäuse-Struktur bildet, die die Lautsprecherkammer (7) begrenzt,

   dadurch gekennzeichnet, dass
   die Lautsprechergehäuse-Struktur (1, 2, 8) weist eine gebogene Spiralstruktur (1) auf, die eine äußere Peripherie und zwei Enden und eine Weite hat, die gebogene Spiralstruktur (1) ist geschlossen an beiden Enden durch eine Vorderwandplatte (2) und eine Rückwandplatte (8) um die Lautsprecherkammer (7) zu bilden,
   der Reflexkanal (4), der ein Einlassende (5) und ein Auslassende (6) und einen Mittelteil hat, ist zumindest teilweise auf der äußeren Peripherie der gebogenen Spiralstruktur (1) gebildet, so dass die Querschnitte von beiden, dem Einlassende (5) und dem Auslassende (6) größer gemacht sind als der Querschnitt des Mittelteils von dem Reflexkanal (4) und **dadurch**, dass der Reflexkanal (4) eine Weite hat, die gleich der Weite von der gebogenen Spiralstruktur (1) ist.

2. Die Lautsprecher-Konstruktion nach Anspruch 1, **dadurch gekennzeichnet, dass** die gebogene Spiralstruktur (1) in einem Teil von einer Gussstruktur gebildet ist.

3. Die Lautsprecher-Konstruktion nach Anspruch 1, **dadurch gekennzeichnet, dass** die Gehäusestruktur einen Reflexkanal (4) aufweist, der vollständig an der äußeren Peripherie der gebogenen Spiralstruktur (1) ist.

4. Die Lautsprecher-Konstruktion nach Anspruch 1 oder 2 oder 3, **dadurch gekennzeichnet, dass** die Wandplatten (2, 8) parallel sind.

5. Die Lautsprecher-Konstruktion nach Anspruch 1 oder 2 oder 3 oder 4, **dadurch gekennzeichnet, dass** die Wandplatten (2, 8) senkrecht zu der Längsachse von der gebogenen Spiralstruktur (1) sind.

6. Die Lautsprecher-Konstruktion nach Anspruch 1 oder 2 oder 3 oder 4 oder 5, **dadurch gekennzeichnet, dass** die Spiralstruktur (1) aus einer geschichteten Struktur hergestellt ist, wobei zumindest eine Schicht verlustbehaftet ist.

7. Ein Verfahren zum Konstruieren einer Bassreflexlautsprecher-Konstruktion, aufweisend:

   eine Lautsprechergehäuse-Struktur (1, 2, 8),
   Bilden einer Lautsprecherkammer (7) unter Verwendung der Lautsprechergehäuse-Struktur (1, 2, 8),
   Verbinden an der Lautsprecherkammer (7) einen Reflexkanal (4), der die Lautsprecherkammer (7) mit dem Raum außerhalb des Lautsprechergehäuses verbindet, der Reflexkanal (4) ist so lang, dass er nicht gerade in die Gehäusestruktur (1,2,8) eingepasst werden kann, und
   Befestigen an der Lautsprechergehäuse-Struktur (1, 2, 8) zumindest eine Lautsprechereinheit (3), die einen Teil der Lautsprechergehäuse-Struktur bildet, die die Lautsprecherkammer (7) begrenzt,

dadurch gekennzeichnet, dass
die Lautsprechergehäuse-Struktur (1, 2, 8) gebildet ist aus einer gebogenen Spiralstruktur (1), die eine äußere Peripherie und zwei Enden und eine Weite hat, die gebogene Spiralstruktur (1) ist geschlossen an beiden Enden durch eine Vorderwandplatte (2) und eine Rückwandplatte (8) um die Lautsprecherkammer (7) zu bilden,
der Reflexkanal (4), der ein Einlassende (5) und ein Auslassende (6) und einen Mittelteil hat, ist zumindest teilweise auf der äußeren Peripherie der gebogenen Spiralstruktur (1) gebildet, so dass die Querschnitte von beiden, dem Einlassende (5) und dem Auslassende (6) größer gemacht sind als der Querschnitt des Mittelteils von dem Reflexkanal (4) und **dadurch**, dass der Reflexkanal (4) eingerichtet ist, so dass er eine Weite hat, die gleich der Weite von der gebogenen Spiralstruktur (1) ist.

8. Das Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** die gebogene Spiralstruktur (1) in einem Teil von einer Gussstruktur gebildet ist.

9. Das Verfahren nach Anspruch 7 oder 8, **dadurch gekennzeichnet, dass** der Reflexkanal (4) vollständig an der äußeren Peripherie der gebogenen Spiralstruktur (1) gebildet ist.

10. Das Verfahren nach Anspruch 7 oder 8 oder 9, **dadurch gekennzeichnet, dass** die Wandplatten (2, 8) parallel angeordnet sind.

11. Das Verfahren nach Anspruch 7 oder 8 oder 9 oder 10, **dadurch gekennzeichnet, dass** die Wandplatten (2, 8) senkrecht zu der Längsachse von der gebogenen Spiralstruktur (1) angeordnet sind.

12. Das Verfahren nach einem der vorhergehenden Verfahrensansprüche, **dadurch gekennzeichnet, dass** die gebogenen Spiralstruktur (1) aus einer geschichteten Struktur hergestellt ist, wobei zumindest eine Schicht verlustbehaftet ist.

Revendications

1. Construction de haut-parleur de type bass-reflex, comprenant :

   une structure d'enceinte de haut-parleur (1, 2, 8),
   une chambre de haut-parleur (7) délimitée par la structure d'enceinte de haut-parleur (1, 2, 8),
   un conducteur de type reflex (4) raccordé à la chambre de haut-parleur (7) qui raccorde la chambre de haut-parleur (7) à l'espace situé à l'extérieur de l'enceinte de haut-parleur, le conduit de type reflex (4) étant si long qu'il ne peut pas être installé droit dans la structure d'enceinte (1, 2, 8), et
   au moins une unité de haut-parleur (3) montée sur la structure d'enceinte de haut-parleur (1, 2, 8) qui forme une partie de la structure d'enceinte de haut-parleur délimitant la chambre de haut-parleur (7),
   caractérisée en ce que :

   la structure d'enceinte de haut-parleur (1, 2, 8) comprend une structure en spirale incurvée (1) ayant une périphérie externe et deux extrémités, et une largeur, la structure en spirale incurvée (1) étant fermée au niveau des deux extrémités par un panneau de paroi avant (2) et un panneau de paroi arrière (8) afin de former la chambre de haut-parleur (7),
   le conduit de type reflex (4), ayant une extrémité d'entrée (5) et une extrémité de sortie (6) et une partie centrale, est formé au moins partiellement sur la périphérie externe de la structure en spirale incurvée (1) de sorte que les sections transversales à la fois de l'extrémité d'entrée (5) et de l'extrémité de sortie (6) sont plus grandes que la section transversale de la partie centrale du conduit de type reflex (4), et **en ce que** le conduit de type reflex (4) a une largeur qui est égale à la largeur de la structure en spirale incurvée (1).

2. Construction de haut-parleur selon la revendication 1, **caractérisée en ce que** la structure en spirale incurvée (1) est formée dans une partie d'une structure moulée.

3. Construction de haut-parleur selon la revendication 1, **caractérisée en ce** la structure d'enceinte comprend un conduit de type reflex (4) qui est entièrement sur la périphérie externe de la structure en spirale incurvée (1).

4. Construction de haut-parleur selon la revendication 1 ou 2 ou 3, **caractérisée en ce que** les panneaux de paroi (2, 8) sont parallèles.

5. Construction de haut-parleur selon la revendication 1 ou 2 ou 3 ou 4, **caractérisée en ce que** les panneaux de paroi (2, 8) sont perpendiculaires à l'axe longitudinal de la structure en spirale incurvée (1).

6. Construction de haut-parleur selon la revendication 1 ou 2 ou 3 ou 4 ou 5, **caractérisée en ce que** la structure en spirale incurvée (1) est fabriquée avec une structure stratifiée, dans laquelle on trouve au moins une couche perdue.

7. Procédé pour construire une construction de haut-parleur de type bass-reflex comprenant une structure d'enceinte de haut-parleur (1, 2, 8), comprenant les étapes consistant à :

former une chambre de haut-parleur (7) en utilisant la structure d'enceinte de haut-parleur (1, 2, 8),
raccorder la chambre de haut-parleur (7) à un conduit de type reflex (4) qui raccorde la chambre de haut-parleur (7) à l'espace situé à l'extérieur de l'enceinte de haut-parleur, le conduit de type reflex (4) étant si long qu'il ne peut pas être installé droit dans la structure d'enceinte (1, 2, 8), et
monter sur la structure d'enceinte de haut-parleur (1, 2, 8) au moins une unité de haut-parleur (3) qui forme une partie de la structure d'enceinte de haut-parleur délimitant la chambre de haut-parleur (7),

caractérisé en ce que :

la structure d'enceinte de haut-parleur (1, 2, 8) est formée avec une structure en spirale incurvée (1) ayant une périphérie externe et deux extrémités et une largeur, la structure en spirale incurvée (1) étant fermée au niveau de ses extrémités par un panneau de paroi avant (2) et un panneau de paroi arrière (8) afin de former la chambre de haut-parleur (7),
le conduit de type reflex (4), ayant une extrémité d'entrée (5) et une extrémité de sortie (6) et une partie centrale, est formé au moins partiellement sur la périphérie externe de la structure en spirale incurvée (1) de sorte que les sections transversales à la fois de l'extrémité d'entrée (5) et de l'extrémité de sortie (6) sont plus grandes que la section transversale de la partie centrale du conduit de type reflex (4) et **en ce que** le conduit de type reflex (4) est agencé pour avoir une largeur qui est égale à la largeur de la structure en spirale incurvée (1).

8. Procédé selon la revendication 7, **caractérisé en ce que** la structure en spirale incurvée (1) est formée dans une partie d'une structure moulée.

9. Procédé selon la revendication 7 ou 8, **caractérisé en ce que** le conduit de type reflex (4) est formé entièrement sur la périphérie externe de la structure en spirale incurvée (1).

10. Procédé selon la revendication 7 ou 8 ou 9, **caractérisé en ce que** les panneaux de paroi (2, 8) sont placés en parallèle.

11. Procédé selon la revendication 7 ou 8 ou 9 ou 10, **caractérisé en ce que** les panneaux de paroi (2, 8) sont placés perpendiculairement à l'axe longitudinal de la structure en spirale incurvée (1).

12. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la structure en spirale incurvée (1) est fabriquée avec une structure stratifiée dans laquelle au moins une couche est perdue.

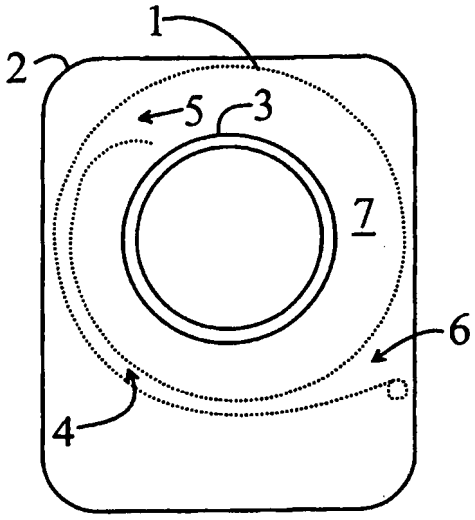

Fig. 1

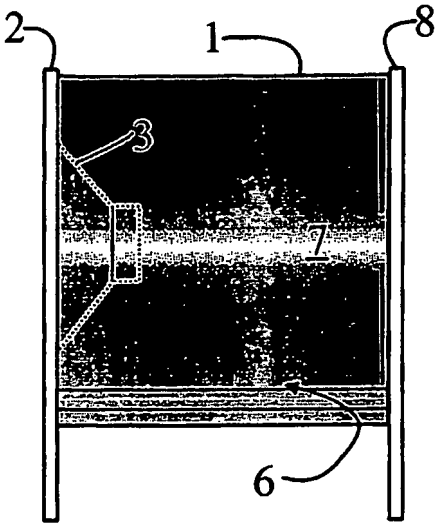

Fig. 2

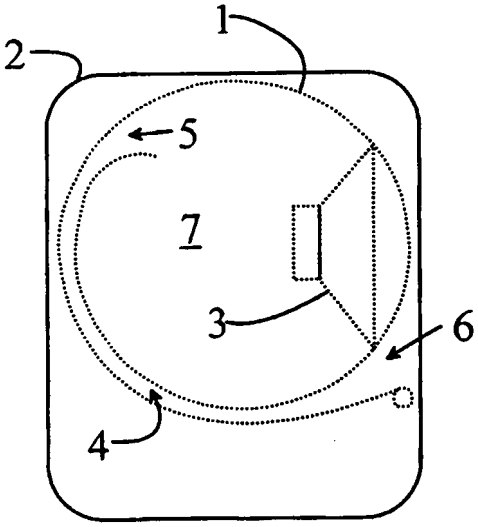

Fig. 3

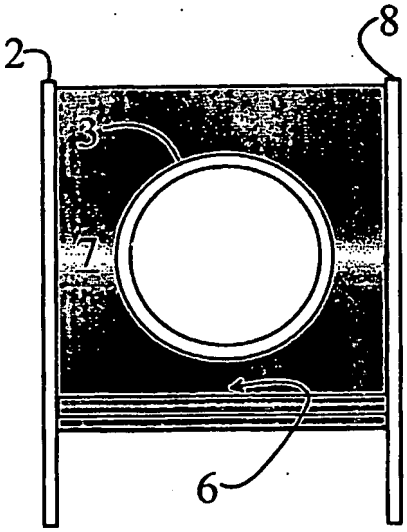

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0322686 A **[0005]**
- US 3730291 A **[0006]**
- US 3923124 A **[0006]**
- JP 200007868 B **[0006]**
- GB 2333927 A **[0007]**
- US 5821471 A **[0008]**