



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.04.2021 Bulletin 2021/15

(51) Int Cl.:
H04R 1/02 (2006.01)

(21) Application number: **20201355.3**

(22) Date of filing: **12.10.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **10.10.2019 GB 201914701**

(54) **IMPROVED LOUDSPEAKER ENCLOSURE**

(57) A loudspeaker enclosure comprising at least two walls and a front baffle fixed by a fixing means to all the walls of the cabinet which are adjacent to the front baffle, the fixing means comprising a first securing structure and a first laminar adhesive strip, wherein the first securing structure comprises a frame secured to the inside of all

the walls of the cabinet adjacent to the front baffle, proximate their edges which are adjacent to the front baffle, and wherein the perimeter of the rear face of the front baffle is fixed to the first securing structure by the first laminar adhesive strip.

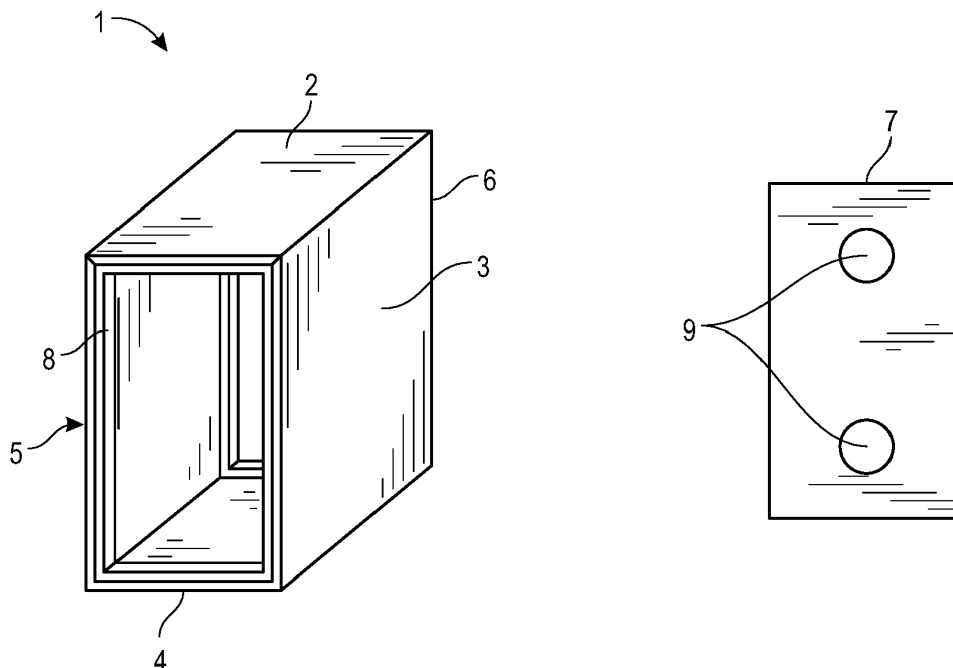


FIG. 1

Description

Background of the invention

[0001] Dynamic (conventional) loudspeakers feature drive units called woofers and tweeters, being diaphragms attached to voice coils and suspended in a magnetic field, typically mounted on the front face of an enclosure which comprises top, bottom, sides and back panel. The front panel, typically facing the listener, is known as the 'baffle'.

[0002] Electrostatic or ribbon 'panel' loudspeaker systems use a different principal of operation and generally do not use an enclosure.

[0003] This Patent is concerned with the assembly of dynamic loudspeaker systems comprising enclosure panels, where one or two panels (typically the baffle and/or back) are manufactured as separate entities and attached to the remaining side and top panels in a novel way.

[0004] An electrical audio signal from a preceding audio amplifier is fed into the drive units in the enclosure and causes motion of their diaphragms which generate a pressure wave, which radiates from the face of the diaphragm into the environment and is interpreted by the listener as a sound.

[0005] The drive units are usually secured to the baffle to prevent air leaks; this is typically achieved with tensioned screws (or bolts) around the perimeter of the drive unit chassis, clamping them securely to the baffle. Contemporary speaker designs have methods for disguising these (visually unattractive) mounting screws including mounting the drive units behind the panel and attached only to the rear of the baffle, or disguising the screws or bolts with a cosmetic 'trim piece'.

[0006] Compressible sealing gaskets are sometimes placed between the drive unit chassis and their mounting cut-out holes on the baffle typically to take-up the small unevenness between the drive unit mounting surfaces of the baffle and small undulations in the moulding of the drive unit chassis. Other thicker gaskets have been proposed.

[0007] The audio electrical signal applied to the drive units is of an alternating current, that is, as the electrical signal commands the diaphragms of the drive units to move towards the listener positive sound pressure radiates away from the diaphragm and when the audio signal reverses, the diaphragm is commanded to cease outward motion and retract into the cabinet causing a low-pressure in front of the diaphragm. The reproduction of audible musical notes by the loudspeaker involves this continuous fore-aft movement of the diaphragm.

[0008] As the electrical signal commands the diaphragm to move outwards, an opposing force causes the chassis of the drive unit to move inwards, and when the electrical signal commands the diaphragm to move inwards, an opposing force causes the chassis of the drive unit to move outwards. The electro-acoustic conversion

efficiency of a typical loudspeaker is of the order of 1-2%. The magnitude of the energy in the opposing force recoil action is considerable relative to the wanted sound output generated by the drive unit.

[0009] As the drive units are securely attached to the baffle, the periodic opposing force generated in the drive unit chassis (especially the low frequency woofer drive unit chassis) is efficiently coupled to baffle, and the baffle is set into periodic motion.

[0010] It is well known that there is a complex interaction of the mass, stiffness, dimensions, mounting fixtures, position of the drive units on the baffle and of the properties of materials and assembly employed throughout the entire cabinets such that, to one extent or another, all of the walls or panels of the enclosure are energised by the motion of the drive units on the baffle as the sound waves are reproduced. When the loudspeaker is reproducing music, such as typical pop music with a strong and regular beat, the recoil motion of the woofer represents a repetitive hammering on the baffle, communicated to the cabinet walls, and they respond by flexing and radiating unwanted sound, according to their properties.

[0011] As the combined surface area of the enclosure panels is usually far greater than the surface area of the drive unit diaphragms, when any panel is set into motion, the panel's surface area can become a significant radiator of sound and the magnitude of radiating resonance can approach that of the wanted sound output of the diaphragm itself at some critical frequencies.

[0012] These unwanted 'drone' resonances reduce the acoustic fidelity of the audio reproduction as they are not faithful to the music signal. They typically occur in the lower and middle registers of the audio band. Depending on the magnitude of these unwanted resonances, their decay characteristics and other factors, they may be audible to the listener or masked by the music being reproduced. They may be audible on some musical material and genres and not on others. They will tend to be more audible when the loudspeaker is playing loud, as the increased motion of the diaphragms necessarily generates an increased recoil force which is communicated to and radiated by the panels of the speaker system. The subjective sound quality of the entire loudspeaker system, when the speaker is played above a threshold loudness (which will vary from model to model, brand to brand), can become boomy, muddled and unnatural.

[0013] The motion of any part of the enclosure or diaphragm is readily measured by various methods including non-contact laser, placing appropriate microphones close to those parts or by attaching lightweight accelerometers, and these techniques are well documented.

[0014] The low frequency energy in pop music and classical music is very different in nature. Pop music relies on a loud, fast, plucked beat from electric guitar and drum. Conversely, classical music is principally crafted from bowed stringed instruments. Consequently, the more energetic, impulsive nature of pop music stimulates and exposes latent loudspeaker resonances that may

subjectively be masked by the less impulsive classical music.

[0015] The invention is the result of investigating methods over many years for reducing or eliminating unwanted cabinet resonances in response to changing consumer music preferences in speaker cabinets assembled from relatively thin panels following the British Broadcasting Corporation's loudspeaker cabinet design research pioneered in the 1960s.

[0016] The object of this invention is to provide a change in the construction and assembly method of a traditional speaker cabinet that usefully reduces unwanted cabinet resonance yet retains the advantages of relatively thin and separate panels.

Acknowledged prior art

[0017] The closest prior art to the applicant's knowledge is AU 2016313669 B2. This discloses a loudspeaker system with a cabinet made from laminated glass and acrylic materials, comprising a butt joint construction wherein the joints are held together by, in some disclosed embodiments, double sided adhesive acrylic tape. The tape serves to absorb energy and reduce the kinetic energy transferred from one panel of the cabinet to another.

[0018] As will become clear, the present invention has a number of advantages over the acknowledged prior art. In many preferred embodiments, the cabinet of the present invention is constructed from wood or wood-like material, with veneer (or, alternatively, paint), making it cheaper to construct, lighter, and safer, since these materials, unlike laminated glass, do not shatter into dangerous shards when dropped. The cabinet of the present invention is preferably made of three pieces (rather than six, as in the prior art), making construction cheaper, quicker and easier. The present invention uses a frame of internal bearers to secure the front and rear panels, making it stronger, increasing the tolerance for slight, inevitable variations in baffle/panel size, and providing a surface against which the underside of the baffle is to be attached.

[0019] Mounting the baffle or front panel directly onto the edge of the top/bottom/side panels, as in the acknowledged prior art, leaves a top-, bottom- and side-facing gap which is aesthetically displeasing and encourages the accumulation of dirt and dust, as well as the potential breakdown of the adhesive due to temperature cycling, sunlight or exposure to the atmosphere with the consequent risk of the panels separating, whereas mounting the baffle on bearers as in the present invention leaves an unbroken top, bottom and side surfaces, and a channel is provided around the baffle for a grille to cover and protect the drive (diaphragm) units, as will become apparent. The prior art design also makes it impossible to access the internal components for maintenance.

[0020] Mounting the baffle or front panel directly onto the edge of the top/bottom/side panels also presents a manufacturing difficulty. Since the double-sided tape fix-

es the two surfaces together on first contact, there is no second chance for correct alignment, and a complex mechanical means of perfect first-time alignment will be required for successful manufacture. Consumers would be unforgiving of misaligned joints, where panels protrude in an aesthetically displeasing way. Mounting the baffle on bearers, as in the present invention, means that the edges of the top/sides/bottom panels will automatically provide alignment means as the baffle is inserted between them, and disguise any slight out-of-true misalignment inevitable with cut materials. More preferably, this aspect of the invention allows for perfect alignment while avoiding contact with the side walls, using temporarily inserted guiding members, as will be described below.

[0021] The acknowledged prior art teaches away from many aspects of the present invention, in particular the use of wood-like materials, the use of a three-piece construction and the use of an internal frame. The acknowledged prior art explicitly removes cabinets made from wood-like material from consideration when seeking to address the problem of unwanted resonances in the cabinet (see the second paragraph of page 5).

[0022] Also known to the applicant is US3804195. This provides a sealing and cushioning strip 175 between the baffle and the bearer frame. The sealing and cushioning strip is not laminar, and adheres on three surfaces, to the baffle, to the bearer frame, and to the cabinet wall. It serves to dampen mechanical coupling between the bearer and the cabinet wall in order to reduce acoustic transmission consequent upon the materials selected for the cabinet. Furthermore, US3804195 does not allow for a gap between the baffle and the cabinet walls, which must be snugly fitted together according to the disclosure, and therefore reduces the ease of manufacture and prevents the use of an acoustically advantageous snap-fit grille.

Statement of invention

[0023] The present invention seeks to provide an effective method of partially mechanically decoupling certain panels of a loudspeaker enclosure from the other panels of the speaker enclosure.

[0024] The invention is of particular application as a development and improvement of familiar construction methods of a loudspeaker enclosure such as those developed by BBC Research Department, in which the front and rear panels are separate, removable parts held in place by screws arranged around their periphery. It replaces the usual multiple peripheral screws around the front and/or back panel with a double-sided adhesive tape (or film) appropriate to the nature of the surface to be fixed together. The use of a layer of adhesive from a 'liquid gasket' type applicator instead of already solid strips of double-sided tape is also contemplated, and is included within the scope of 'double sided tape' as used herein.

[0025] To these and other ends as will become appar-

ent, in a first aspect of the invention there is provided a loudspeaker cabinet comprising at least two walls and a front baffle fixed by a fixing means to all the walls of the cabinet which are adjacent to the front baffle, the fixing means comprising a first securing structure and a first laminar adhesive strip, wherein the first securing structure comprises a frame secured to the inside of all the walls of the cabinet adjacent to the front baffle, proximate their edges which are adjacent to the front baffle, and wherein the perimeter of the rear face of the front baffle is fixed to the first securing structure by the first laminar adhesive strip.

[0026] The cabinet walls may be made of wood, such as MDF. The securing structure may be made of wood, such as MDF, soft wood or hard wood. The front baffle may be made of wood, such as MDF.

[0027] The loudspeaker cabinet may further comprise a rear panel, and a second securing structure comprising a frame secured to the inside of all the walls of the cabinet adjacent to the rear panel, proximate their edges which are adjacent to the rear panel, wherein the perimeter of the internal face of the rear panel is fixed to the second securing structure by a second laminar adhesive strip.

[0028] The at least two walls of the cabinet may comprise a top wall, a bottom wall, a first side wall and a second side wall and the loudspeaker cabinet may be substantially a rectangular prism.

[0029] The top wall, the bottom wall, the first side wall and the second side wall may be formed of a single piece of material having length, width and thickness, wherein the length is greater than the width and both the length and the width are significantly greater than the thickness, wherein the single piece of material is folded into four sections disposed consecutively along its length, each of said sections providing a respective one of the top wall, the first side wall, the bottom wall and the second side wall.

[0030] The single piece of material may be coated with veneer on a first side defined by its length and width, and on a second, opposite side defined by its length and width.

[0031] The folded sections may be separated, by a width-wise groove of v-shaped cross-section cut into the single piece of material to substantially the depth of the single piece of material.

[0032] When the front baffle is fixed to the first securing structure, the front face of the front baffle may be substantially flush with the front edges of the walls of the cabinet adjacent to the front baffle.

[0033] When the front baffle is fixed to the first securing structure, a gap may remain between the edges of the front baffle and the perimeter of the inside faces of the walls of the cabinet adjacent to the front baffle.

[0034] The cabinet may further comprise a removable grille structure comprising a grille frame of suitable shape and dimensions to slot into the gap between the front baffle and the walls of the cabinet, and a sheet of grille material stretched over and fixed to said grille frame,

wherein the grille frame may be slotted into the gap between the front baffle and the walls of the cabinet such that the sheet of grille material covers the front face of the front baffle.

[0035] The laminar adhesive strip may be double-sided adhesive tape. It may be pressure sensitive adhesive tape.

[0036] According to another aspect of the invention there is provided a method of constructing a loudspeaker cabinet comprising the steps of: constructing a cabinet body comprising at least two walls defining the perimeter of a front face; fixing a first securing structure comprising a sub-frame to the inside of the cabinet body proximate the perimeter of the front face; applying a laminar adhesive strip to the perimeter of the rear face of a front baffle; fixing the front baffle to the front face of the cabinet by fixing the perimeter of the rear face of the front baffle to the sub-frame of the first securing structure.

[0037] The step of constructing a cabinet body may comprise the steps of: providing a piece of material having width the intended depth of the cabinet, having length the sum of twice the intended width of the cabinet and twice the intended height of the cabinet, and having thickness the intended thickness of the cabinet walls; coating both faces and edges of the piece of material in veneer or paint; cutting three grooves width-wise in the piece of material, the grooves having V-shaped cross section, the depth of the grooves being substantially the thickness of the piece of material, the four spaces defined by the grooves having dimensions to provide a top wall, a first side wall, a bottom wall, and a second side wall, of the cabinet; placing adhesive in the grooves; folding the piece of material at the grooves, forming a hollow rectangular prism structure.

Brief description of drawings

[0038] In order to aid the understanding of the invention, embodiments of the invention will be described in detail below with reference to the following drawings:

Figure 1 depicts a loudspeaker cabinet and baffle according to the present invention;

Figure 2 depicts part of a loudspeaker cabinet according to the present invention in a disassembled state;

Figure 3 depicts a side-view cross section of part of a loudspeaker cabinet according to the present invention;

Figure 4 depicts a front view of a partially assembled loudspeaker according to the present invention;

Figure 5 depicts a fully assembled loudspeaker according to the present invention, from a top view, as the grille is being fitted.

Detailed description of drawings

[0039] Figure 1 depicts an embodiment of the present invention comprising a loudspeaker cabinet 1 of rectangular prism construction, having six faces: a top 2, a first side 3, a bottom 4 a second side 5, a back 6 and a front 7. The front 7 is shown separately from the rest of the cabinet and comprises a baffle with holes 9 for receiving the drive units 17. The top 2, bottom 4 and two sides 3, 5 are formed of a single piece, as will be shown below. Although it is not shown in the figure, the inner and outer surfaces of all side panels 2-7 may be coated in a veneer, as well as their edges. Preferably, the outer veneer is a decorative veneer. Preferably, the inner veneer is a counter-balancing veneer (which serves to mitigate the tendency of MDF-like materials to bow). The inner, counter-balancing veneer is generally only necessary if the panels are hot pressed rather than cold pressed.

[0040] While it is preferred that the cabinet should be a rectangular prism, for acoustic reasons among others, other shapes are contemplated and are considered to be within the scope of the invention.

[0041] The invention is of particular application in the construction of loudspeaker enclosures where the baffle or back panels are of a wooden material such as MDF and of 9 to 24 mm thickness before veneering.

[0042] The baffle 7 and/or rear panel 6 could, alternatively, be made from a ceramics, metal or recycled material, optionally with laser- or water- cut holes for the drive units.

[0043] The invention is of particular application in the construction of loudspeaker enclosures where the side 3, 5, bottom 4 and top 2 panels are of a wooden material such as MDF and of 9 to 18 mm thickness before veneering. The cabinet, baffle and/or rear panel could, alternatively, be made from materials such as UPM Formi, plywood, chipboard, cardboard, or composite material such as recycled plastic waste, paper waste, or herbaceous or similar waste, in combination with wood or wood-like materials.

[0044] Bearers 8 are fixed to the inside walls of the cabinet, to the top 2, bottom 4 and sides 3, 5, proximate the edges to which the baffle 7 and the back panel 6 are fixed. The bearers 8 are made of wood-like material, including soft wood, hard wood or MDF. The bearers 8 are glued in place, and may additionally be held by screws or nails or other means known to a person skilled in the art. The bearers may be formed of a single piece or a frame of e.g. four straight connected pieces. In the single piece embodiment, for example, a sheet of MDF may be provided and have its central portion removed by milling in order to provide a rectangular frame. In the depicted embodiment, the bearers 8 are placed in tracks or recesses 10 in the inner surfaces of the top 2, bottom 4, and sides 3, 5, as shown in Figure 2.

[0045] Figure 2 shows the top 2, bottom 4 and sides 3, 5 in a disassembled state. These four panels 2-5 are formed of a single piece of material having length, width

and thickness, where the length of the material is the combined lengths of the individual panels 2-5 and the width of the material is the width of any one of the panels 2-5, corresponding to the depth of the cabinet 1 when constructed (typically of the order of 200 to 400 mm). The material may be coated on both sides and around the edges with veneer. The material may be wood, or wood-like material, including MDF or cardboard of suitable strength. Other materials are contemplated, some of which have been listed above. The panels are of v-cut construction, that is, each panel 2-5 is almost separated by a channel 11 of v-shaped cross section cut across the width of the material. The v-shape defines a substantially 90 degree angle, extending substantially 45 degrees each way lengthwise from the normal to the surface of the material, allowing for the eventual thickness of their adhesive joints. The depth of the channel 11 is substantially the depth of the material, but does not necessarily cut through the outer layer of veneer. Both ends of the material are cut to a substantially 45 degree slope corresponding to one side of a v-shaped channel (not shown), the precise cutting angle allowing for the eventual thickness of their adhesive joints. Various methods will be known to a person skilled in the art for providing these v-shaped cuts. One option is to use two saws, set at a 90 degree from each other. Another method would be to use a precision router bit, in which case the veneer may also be cut through. Consequently, when assembled, the material is folded about the channels 11 and forms a wrap-around, providing the top 2, bottom 4, and sides 3, 5 of the cabinet. Liquid adhesive is applied in the channels 11 before assembly. Double-sided tape would not be appropriate in the channels 11 because the area of the sides of the channels 11 to be fixed together may be too small for an effective permanent, reliable adhesive joint relying solely on tape.

[0046] The inner surface of each panel 2-6 may be partially or fully covered in a viscoelastic material 12, such as bitumen. This is typically held in place with a layer of adhesive and/or staples. This serves to allow some amelioration of acoustic resonances in the cabinet. Resonance as described in the introductory section of this specification cannot be eliminated altogether, but it can be reduced. Varying the characteristics, such as the area, mass, thickness, density, and method of attachment of the viscoelastic layer will vary the panel resonance in a generally repeatable manner.

[0047] In addition to the viscoelastic layer 12, a layer of acoustic damping material (not shown) may be provided on or near to the inner surfaces of the panels. The damping material may comprise, for example, plastic furniture foam sheet, cotton wool, sheep's wool, bonded acetate fibre, glass fibre or rockwool. Other suitable materials will be apparent to a person skilled in the art. The damping material is preferably held in place with an adhesive such as glue, although other methods of holding it in place will be apparent to a person skilled in the art.

[0048] As well as the bearers 8, other pieces of wood-

like material are fixed to the panels 2-5, parallel and proximate to the channels 11. These members 13 provide additional structural support. They are fixed to the panels by adhesive, screws, nails or other suitable means known to the person skilled in the art.

[0049] The recesses 10 and, consequently, the bearers 8 are spaced from the edges of the top 2, bottom 4 and side 3, 5 panels such that, when the front baffle 7 and the back panel 6 are fixed to the bearers 8, their outer surfaces are substantially flush with the edges of the top 2, bottom 4 and side 3, 5 panels, as shown in Figure 3. For example, if the baffle 7 is 20 mm thick and the adhesive tape 14 fixing the baffle 7 to the bearer 8 is 0.8 mm thick, the face of the front bearer 8 will be spaced substantially 20.8 mm behind the front edges of the panels 2-5.

[0050] Figure 3 shows a side-view cross sectional detail of the cabinet 1 construction. The bearer 8 is depicted, fixed to the top 2 of the cabinet and spaced from the edge as described above such that the baffle 7 when fixed to the bearer 8 by double-sided tape 14 is substantially flush with the edges of the top, bottom and sides 2-5. During assembly, the double-sided tape 14 may be applied to the removable panel (baffle 7 or back 6) and the panel 6, 7 then pressed onto the face of the bearer 8 of the cabinet body 1. Alternatively, the double-sided tape 14 may be applied first to the bearer 8 and the removable panel 6, 7 may then be pressed into place. The tape 14 should be applied to substantially the whole perimeter of the removable panel 6, 7. It is preferable to apply the double-sided tape to the baffle 7 or rear panel 6 first, rather than to the sub-frame of bearers 8 first, because the bearers 8 are recessed and it is inconvenient and fiddly to apply the tape 14 all the way round without forming inconsistencies in tension or position.

[0051] The invention permits the use of a wide range of double-sided adhesive tapes. In the interests of product longevity in the marketplace, specialist long-life double-sided tapes should be selected from expert manufacturers. The double-sided tape is preferably between 0.4 and 1.6 mm thick. A typical double-sided tape suitable for use in this invention is 0.8 mm thick. Preferably, double-sided tape with a foam core is used, although alternatives are contemplated. A typical width of a strip of double-sided tape suitable for the invention would be 10 mm. More preferably, a 12 mm wide strip could be used. The width, thickness and materials will be selected according to the specific cabinet, baffle, and bearer frame characteristics. Typical ratios for width to thickness of double-sided tape used in the invention may range from 13:1 to 40:1 and a preferable ratio may be approximately 20:1.

[0052] The double-sided tape used with the invention is ideally pressure-sensitive adhesive tape (PSAT). Once the baffle 7 is fixed to the frame of bearers 8 by the double-sided tape, it should stay fixed for the whole of the usable lifetime of the speaker system. A suitable adhesive should be selected with this in mind, and the surfaces of

the baffle 7 and bearers 8 should be prepared appropriately (that is, they should be clean and free from any dust or particulate contaminants and may preferably be primed with appropriate chemicals).

[0053] The principle function of the double-sided tape is to replace the screws and other fixing means in the prior art which typically permanently fix baffles 7 to bearers 8. It is important that the adhesive be selected such that the baffle 7 will not fall off the bearers, even under the affects of impact, gravity, creep, deformation or shear.

[0054] In order to improve the strength and durability of the double-sided tape 14 bond to the baffle 7 and/or rear panel 6, or the frame of bearers 8 if it is applied first to that, the double-sided tape 14 may be further secured by staples or nails applied through it at intervals along its whole length, pinning the tape to the baffle 7 and/or rear panel 6 *as well as* sticking it with its own intrinsic adhesive.

[0055] The skilled person will be well aware of the many considerations when selecting a suitable table for a strong, life-long bond capable of withstanding temperature variations, impacts and other, more constant or frequent forces, while keeping within budget. The adhesive may be rubber/resin based, or acrylic based, or silicone based, for example. Silicone based adhesives are advantageous for the long life and strength of the bond they create, but they are also the most expensive. The use of PSAT is preferable, in particular because of the speed of initial adhesion and cure.

[0056] The 'lifelong bond' between the baffle 7 and the bearers 8 is established upon first contact. This is the nature of double-sided tapes such as PSATs. For this reason, it is essential that, during assembly, the first contact is the correct contact. For example, in a preferred method of assembly in which the tape is first applied around the edges of the internal face of the baffle 7, and then the baffle is placed on the bearer frame 8, it is essential that, while the baffle 7 is being moved into contact with the bearer frame 8, no part of the exposed face of the double-sided tape comes into contact with the cabinet walls, or into premature and misaligned contact with the bearer 8. During assembly, the drive units 17 will be fixed to the baffle 7 before the baffle 7 is fixed to the bearer frame 8. Consequently, the correct alignment of the baffle 7 with the bearer frame 8 without the exposed face of the double-sided tape making an incorrect first contact will be more difficult, because the drive units 17 will alter the centre of gravity of the baffle 7.

[0057] This difficulty is mitigated by the grille-receiving gap 20 shown in Figure 3. This gap is very important, not only to reduce *direct* mechanical coupling between the cabinet and the baffle 7, and provide a useful means for fixing the grille to the speaker cabinet, but it allows for the correct alignment of the baffle 7 during assembly. Before inserting the baffle 7, a set of 'shims' or thin guiding members can be temporarily inserted around the edge of the cabinet opening, into the gap 15, to the depth of

the bearer frame 8. When inserted between these guiding members, the baffle 7 will naturally align correctly with the bearer frame 8. Once the baffle 7 is secured in place, the guiding members are removed.

[0058] As depicted in Figure 3, there is a small gap or channel 15 between the edge of the baffle 7 and the underside of the top panel 2. This same gap 15 exists all the way around the baffle 7, between the baffle 7 and the inside surface of each panel 2-5, as depicted more clearly in Figure 4. This gap 15, improves the decoupling between the baffle and the rest of the cabinet. Towards the front face of the baffle, the gap widens to provide a grille-receiving channel 20, into which the grille 19 can be placed, as will be shown in relation to Figure 5.

[0059] Figure 4 depicts the baffle 7 in place on a cabinet 1 under construction. Two main holes 16 are depicted, for receiving drive units 17. The upper hole already has a drive unit 17 in place. The second hole 16 is unoccupied. The drive units 17 are held in place with screws or other conventional means.

[0060] Also depicted in Figure 3 is a rebated hole 16. This is for receiving a drive unit 17 (shown in Figure 4). The rebated holes 16 do not have constant cross-section. As shown in Figure 1, two holes 9 are provided for the mounting of the drive units; a lip 18 shown in Figure 4 would permit an alternative arrangement whereby drive unit 17, typically a unit responsible for reproducing low frequencies, could be mounted attractively on the rear surface of baffle 18 as depicted in Figure 4.

[0061] Two investigations were undertaken by the inventor:

[0062] The baffle 7 was attached to the bearers 8 using conventional means such as screws, while the drive unit 17 was mounted to the baffle 7 by double-sided tape 14.

[0063] The drive unit 17 was mounted to the baffle 7 using conventional means such as screws, while the baffle 7 was mounted on the bearers 8 with double-sided tape.

[0064] The investigations have shown that solution (2) is particularly effective and that solution (1) would make it impossible to service the loudspeaker by removing a defective drive unit, resulting in undesirable built-in obsolescence, and an avoidable waste of natural resources.

[0065] Figure 5 depicts a completed cabinet from above, wherein a grille 19 has been partially inserted into the grille-receiving channel 20 in order to cover the baffle 7 for aesthetic purposes. The grille 19 comprises a steel band, bent into a rectangle of suitable dimensions, over which a grille cloth is stretched and glued. The steel band is inserted into the grille-receiving channel 20 to removably attach the grille to the cabinet 1 in a push-fit manner. This arrangement mitigates the need for a grille-supporting board with cut-outs corresponding to the drive units, which are common in the prior art but degrade the reproduced sound quality by increasing acoustic reflections in the middle and upper frequencies.

[0066] The invention demonstrates significant reduc-

tion in the unwanted acoustic resonance of the panels of the enclosure at certain critical frequencies by reducing the efficiency of coupling between panels, which otherwise stimulates and sustains mechanical-acoustic resonance.

[0067] The invention improves the cosmetic appearance of the speaker system by removing visually unattractive external screw heads. It also removes the risk of unsightly 'mashed heads' if, even on a constant screw-driver torque setting, the screw encounters unexpected resistance when driving into the bearer due to variations in density of the wood. It further removes unsightly metal screws which are prone to corrosion, discolouration and metal fatigue particularly in hot, humid climates.

[0068] The invention addresses the variability in unwanted enclosure resonance even between nominally identical products from the same production line due to the inevitable difference in screw torque between specimens consequent on small variations in panel material properties.

[0069] The invention reduces assembly time by saving the labour cost in fitting and precisely torqued peripheral screws around the perimeter of the removable panels.

[0070] The invention improves the air seal between the removable panels and the other enclosure panels, as it does not rely on the compression of screws to effect an air-seal.

[0071] The invention can be used in loudspeakers systems of the vented (ported) type or of a 'closed box' type.

[0072] The invention can be retrofitted to any loudspeaker enclosure panels that are currently removable and held in place with peripheral screws, although any unused screw holes may need to be visually disguised for market acceptance.

[0073] The embodiment described above along with the accompanying figures serves to enable a person skilled in the art to put the invention into practice. It does not limit the scope of the invention, which is determined by the claims.

Claims

1. A loudspeaker cabinet comprising at least two walls and a front baffle fixed by a fixing means to all the walls of the cabinet which are adjacent to the front baffle, the fixing means comprising a first securing structure and a first laminar adhesive strip, wherein the first securing structure comprises a frame secured to the inside of all the walls of the cabinet adjacent to the front baffle, proximate their edges which are adjacent to the front baffle, and wherein the perimeter of the rear face of the front baffle is fixed to the first securing structure by the first laminar adhesive strip.
2. A loudspeaker cabinet according to claim 1 wherein the cabinet walls are made of wood.

3. A loudspeaker cabinet according to any preceding claim, wherein the securing structure is made of wood.
4. A loudspeaker cabinet according to any preceding claim, wherein the front baffle is made of wood. 5
5. A loudspeaker cabinet according to any preceding claim, further comprising a rear panel, and a second securing structure comprising a frame secured to the inside of all the walls of the cabinet adjacent to the rear panel, proximate their edges which are adjacent to the rear panel, wherein the perimeter of the internal face of the rear panel is fixed to the second securing structure by a second laminar adhesive strip. 10 15
6. A loudspeaker cabinet according to any preceding claim wherein the at least two walls comprise a top wall, a bottom wall, a first side wall and a second side wall and the loudspeaker cabinet is substantially a rectangular prism. 20
7. A loudspeaker cabinet according to claim 6 wherein the top wall, the bottom wall, the first side wall and the second side wall are formed of a single piece of material having length, width and thickness, wherein the length is greater than the width and both the length and the width are significantly greater than the thickness, wherein the single piece of material is folded into four sections disposed consecutively along its length, each of said sections providing a respective one of the top wall, the first side wall, the bottom wall and the second side wall. 25 30
8. A loudspeaker cabinet according to claim 7 wherein the single piece of material is coated with veneer on a first side defined by its length and width, and is coated with veneer on a second, opposite side defined by its length and width. 35 40
9. A loudspeaker cabinet according to any one of claims 7 or 8 wherein the folded sections are separated, by a width-wise groove of V-shaped cross-section cut into the single piece of material to substantially the depth of the single piece of material. 45
10. A loudspeaker cabinet according to any preceding claim wherein when the front baffle is fixed to the first securing structure, the front face of the front baffle is substantially flush with the front edges of the walls of the cabinet adjacent to the front baffle. 50
11. A loudspeaker cabinet according to claim 10 wherein when the front baffle is fixed to the first securing structure, a gap remains between the edges of the front baffle and the perimeter of the inside faces of the walls of the cabinet adjacent to the front baffle. 55
12. A loudspeaker cabinet according to claim 11 further comprising a removable grille structure comprising a grille frame of suitable shape and dimensions to slot into the gap between the front baffle and the walls of the cabinet, and a sheet of grille material stretched over and fixed to said grille frame, wherein the grille frame is slotted into the gap between the front baffle and the walls of the cabinet such that the sheet of grille material covers the front face of the front baffle.
13. A loudspeaker cabinet according to any preceding claim wherein the laminar adhesive strip is any one of: double-sided adhesive tape; or pressure sensitive adhesive tape.

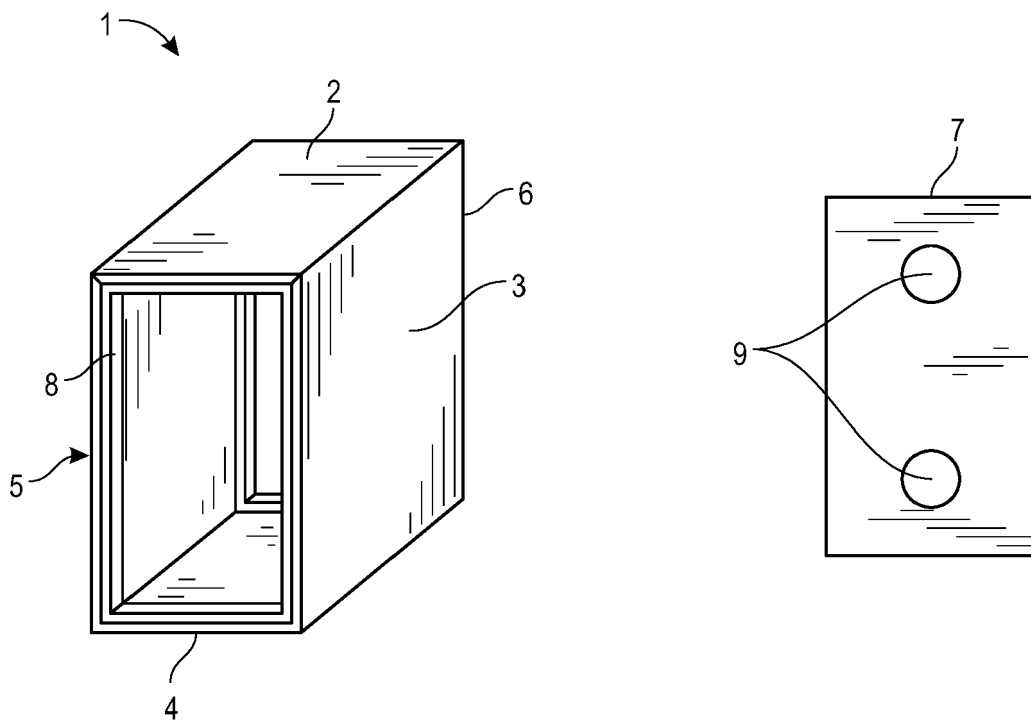


FIG. 1

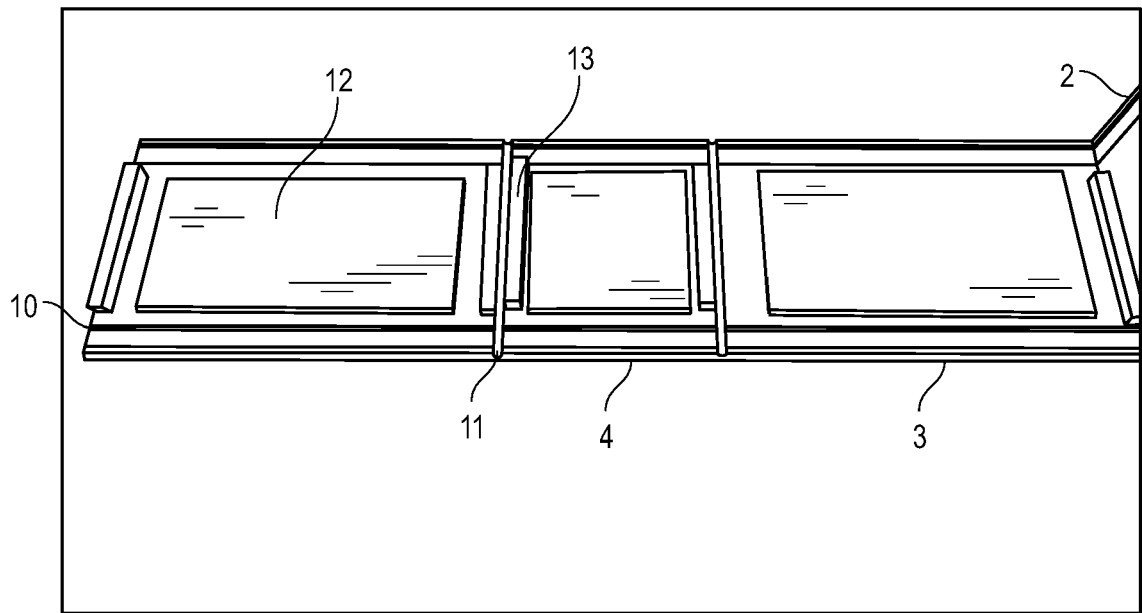


FIG. 2

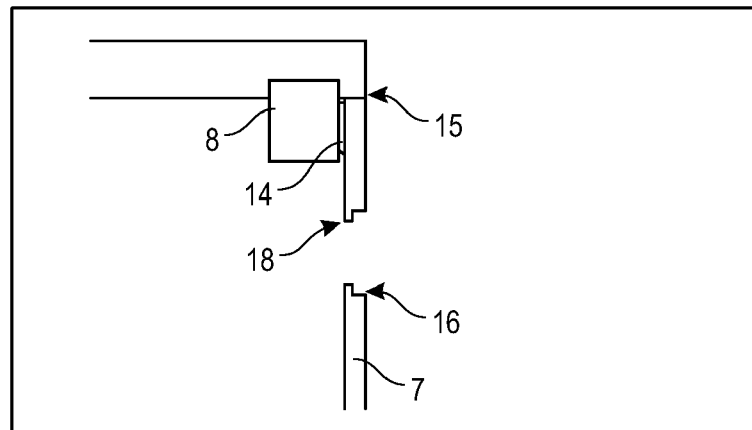


FIG. 3

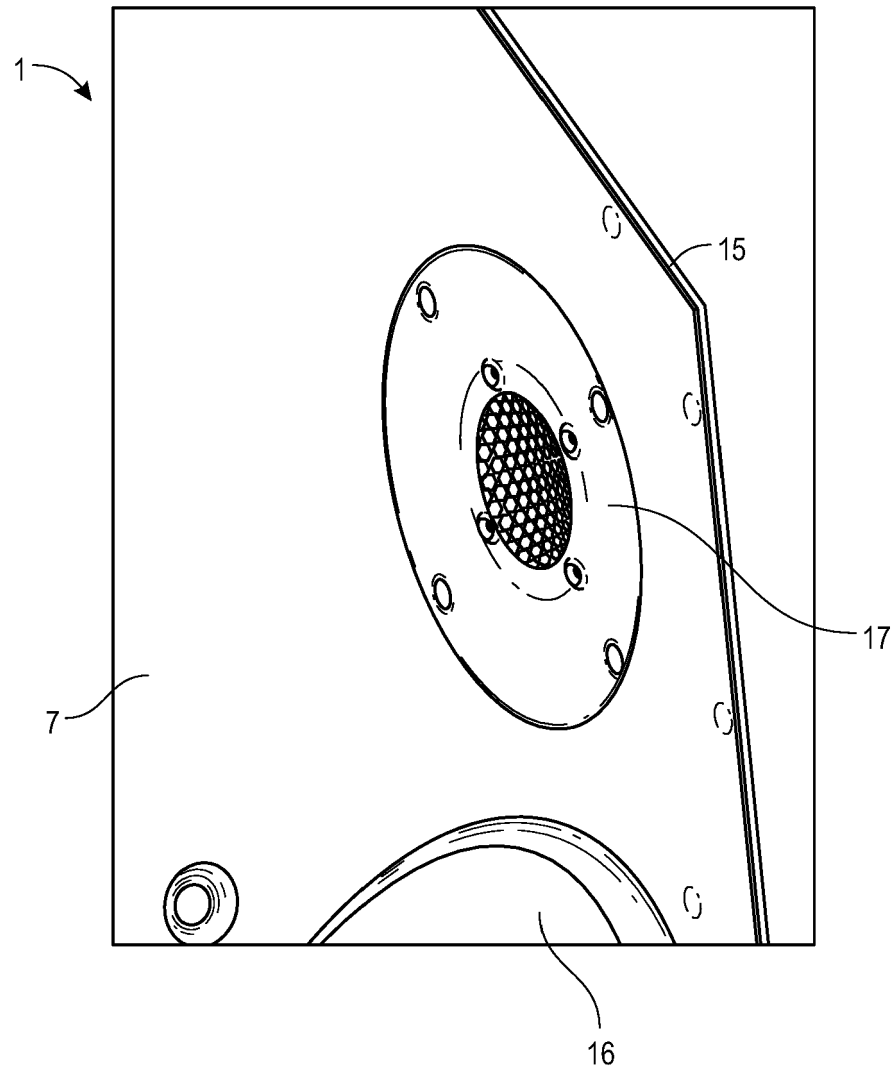


FIG. 4

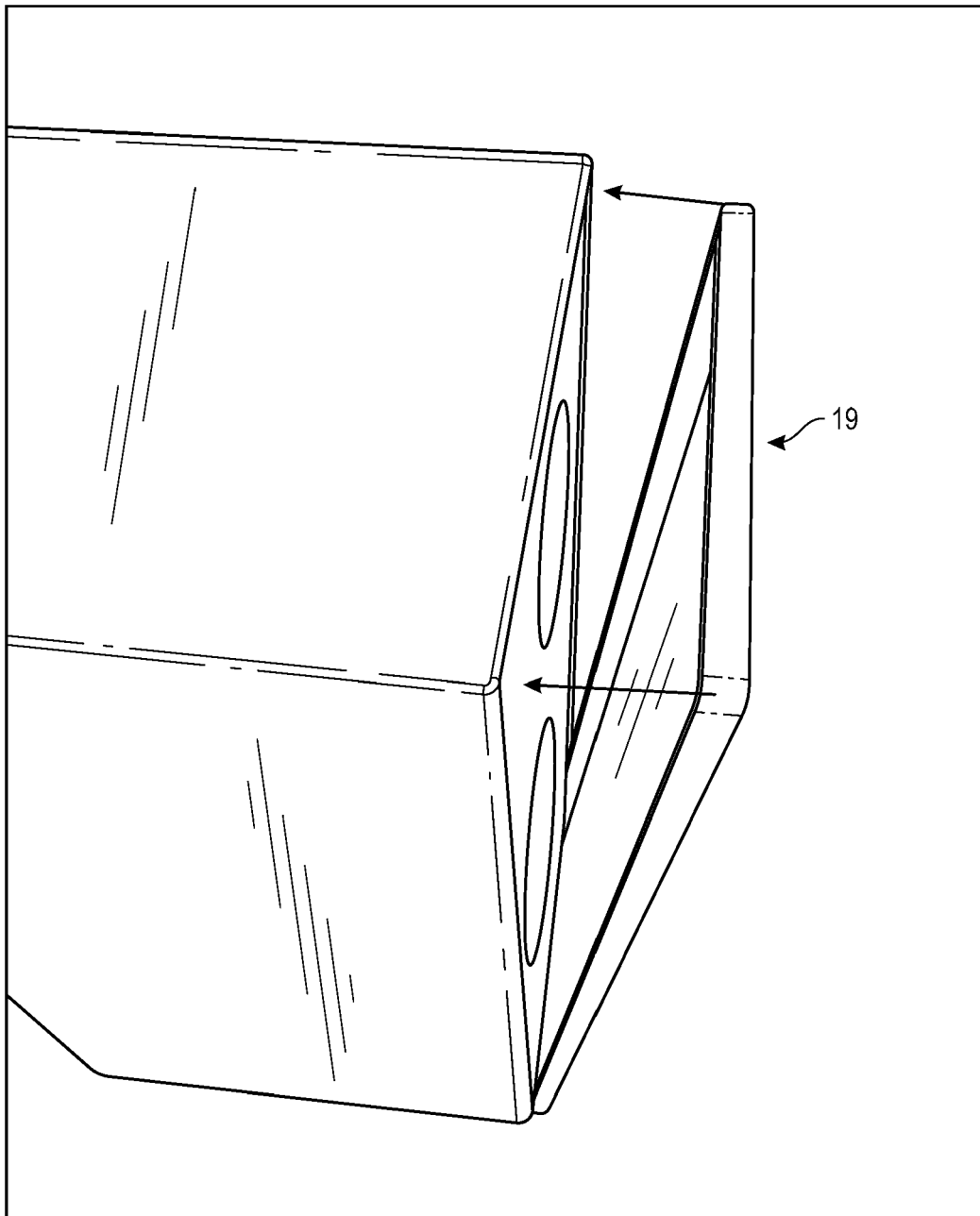


FIG. 5



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Application Number
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Place of search The Hague		Date of completion of the search 22 February 2021	Examiner Valenzuela, Miriam
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