

DESCRIPTION ITRE20110067

DESCRIPTION

The present invention relates generally to the field of sound reproduction by electrical means. More specifically, the present invention refers to planar magnetodynamic loudspeakers which can reach higher sensitivity levels, that is, emit sounds of greater intensity with the same voltage as the applied electrical signal, than obtained with the known technique.

To better understand the field of the present invention, a typical cross-section of a planar magneto-dynamic loudspeaker according to the known technique is shown in FIG. 2, where the vibration of the sound-generating membrane is excited by the interaction between the field B1 or B2 generated by permanent magnets 100a and 100b, different only due to the orientation of the poles, and the current of the musical signal passing through conductors 105a and 105b glued to the membrane 104 made with a thin plastic sheet of comparable perimeter measurement at the maximum wavelength of the sounds to be emitted, usually rectangular and mechanically stretched. It should be noted that in order to maintain the resulting forces on the conductors 105a and 105b all agree that the electrical connections between them must be made in such a way that the current flows in reverse directions following the inversion of the direction of the magnetic field (B1 and B2).

Figure 3 shows a cross-section of a loudspeaker as described above, however, according to a known technique, a layer of magnets has also been added above the membrane in order to increase the intensity of the magnetic field and consequently the speaker sensitivity. The increase in question reaches almost 6 dB, that is the doubling of the magnetic field and the acoustic pressure generated at the same voltage applied to the terminals of the speaker. To obtain this result it is necessary that the magnets of the second layer have the same polarities facing those of the first layer, then in repulsion. This repulsion force was calculated in the case of a useful magnetic field of 0.3 Tesla and a membrane surface of 3500cm^2 in 700QN. Using to hold the magnets 100 a steel sheet 101 of 4mm thickness when the distance between the closing screws 102 of 250mm has a bending of 2mm. The bending of the plates 101 limits the applicability of this speaker scheme to widths of a few centimeters, making it impossible to remission of low-frequency sounds.

The present invention shows how it is possible to remove this limitation. The bending of the plates 101 leads to an increase in the distance between the magnets of the two layers and consequently a reduction in the magnetic field, which is contrary to our purpose of increasing it to increase the sensitivity of the speaker. Furthermore, the bending of the sheet constrained by the screws causes a rotation in the constraint points at which the frame 103 for supporting the membrane 104 is fixed. This membrane must be kept in tension to give it a principal frequency of resonance that is not too low, typically between 30Hz and 40Hz, in order to prevent the vibrations from creating such excursions as to cause it to collide with the magnets with electrical signals of low intensity at low frequency. Well the rotation of the constraint point between the sheet and frame geometrically creates a reduction of the distance d of FIG.3 between the binding points of the membrane, causing a reduction in the tension of the membrane.

This is seen in FIG. 4 showing the deformed section with d becoming of.

This reduction is very sensitive because, based on the elasticity of the material used for the membrane, generally 6-12 micron thick polyester, the elastic elongation imposed during the

tensioning is of 2-4mm, while the reduction of distance d caused by the rotation of the constraint, and therefore of the frame, is of the order of 1-3mm. In essence, the tension can also be canceled. It should be noted that in order to allow the free emission of the sound it is necessary for the plates 101 to have numerous openings 106 as can be clearly seen in FIG. 5 which shows a cutaway front view of a planar magnetodynamic speaker with a double layer of magnets. Also in FIG. 5 it is shown how the conductors 105a and 105b can be more than one for each zone with magnetic field B1 or B2, in this case there are three, however, having failed to show the electrical connection between them.

The present invention teaches how it is possible to avoid the problem of reducing the tension of the membrane 104 by using a frame 103 for constraining the membrane that is not integral with the sheet 101. Further teaching consists of the fact that the frame can be made in a way that is not excessively rigid, which would involve greater bulk, cost and weight, by making the mounting and contrast screws 102 of the magnetic repulsion pass through holes made therein. Moreover, in order to maintain the position of the membrane centered with respect to the two layers of magnets in order to avoid reducing its useful stroke, it is shown that it is convenient to use elastic elements 107 which act as a centering device and as a damper for any vibrations of the frame. These elastic elements 107 can be springs or rubber rings inserted in the screws and inserted between sheet metal 101 and frame 103, hence discontinuous centering elements, or, better, of the rubber profiles that copy the perimeter of the frame, both for the part higher than for the lower one.

A further advantage brought by the insertion of the centering elastic elements 107 is constituted by the fact of being able to vary the proximity of the two magnetic layers integral with the plates 101a and 101b simply by pulling more or less the screws 102; this allows to vary the intensity of the magnetic field B1 and B2 and consequently the sensitivity and damping of the speaker.

Evidently the approach of the magnets involves a reduction of the maximum excursion allowed for the vibratory movement of the membrane, therefore it is not advisable to exaggerate it.

A last teaching of the present invention concerns the way in which the loudspeaker can be mounted to the object. This is illustrated by FIG.6 which shows a cross section of the speaker to the object when it is assembled. During assembly a sheet 101a with the magnets 100a and 100b glued previously in the right positions is used as a support base, above this is positioned the frame 103 with the membrane 104 glued to which the conductors 105a and 105b were previously glued. It should be noted that, in order to prevent the frame 103 from being deformed under the action of the mechanical tension applied to the membrane 104 at the moment of gluing, a removable spacer plate 110 is used. Above the membrane frame rests the second sheet 101b with the magnets 100a and 100b previously glued paying attention to face the magnets with the same polarity, then 100a with 100a and 100b with 100b. In this condition the upper sheet rises under the action of the magnetic repulsion force and, if there were no lateral confinement, it would move laterally to face the magnets 100a with 100a and 100b with 100b, that is in attraction, with the consequence of the collapse of the loudspeaker, the rupture of the membrane, the impact of the magnets, their breaking and the very difficult separation of the parts to be able to reposition them.

To overcome this problem, a base plate 101a is used which is wider than the upper sheet 101b and can be removably applied with screws 111 of the containment walls 108. These will ensure that the sheet 101b cannot move laterally while rising during assembly, allowing the screws 109, conveniently longer than the screws 102 shown in FIG. 1, to be inserted to progressively bring the sheet 101b closer to the sheet 101a by tightening them, after having extracted the spacer plate 110. At the end of the operation the screws 109 are replaced with the screws 102 of FIG. The

approximation of the sheets 101a and 101b and consequently of the magnets of the two layers is exploited by exploiting the compliance of the elastic spacers 107 and the containment walls 108 are eliminated. removing the screws 111.

The solution in accordance with one or more embodiments of the invention, as well as further features and the relative advantages, will be better understood with reference to the following detailed description, given purely by way of a non-limiting example, to be read in conjunction with the attached figures (in which corresponding elements are indicated with the same or similar references and their explanation is not repeated for brevity). In this regard, it is expressly understood that the figures are not necessarily to scale (with some details that may be exaggerated and / or simplified) and that, unless otherwise indicated, they are simply used to conceptually illustrate the structures and procedures described. In particular:

FIG. 1 shows a cross-section of a planar magnetodynamic speaker according to an embodiment of the present invention;

2 shows a cross section of a typical planar magnetodynamic speaker realized according to the known art;

3 shows a cross section of a planar magnetodynamic speaker with magnets on both sides of the membrane made according to the known technique;

4 shows a speaker section according to FIG. 3 where the distorting effect of the repulsion force between the magnets of the two layers is particularly evident;

5 shows a front view with a cutaway showing also the inner layers which constitute a planar magnetodynamic speaker with magnets both in front of and behind the membrane;

6 shows a cross section of a planar magnetodynamic speaker according to an embodiment of the present invention also showing arrangements for its construction.

With particular reference to the figures, FIG. 1 shows a cross-section of a planar magnetodynamic loudspeaker according to an embodiment of the present invention and in FIG. 5 a cutaway front view showing the various inner layers of a magnetodynamic loudspeaker planar according to another embodiment of the present invention.

The membrane 104 is made of plastic material suitable to have a good resistance and elasticity, usually polyester, polyetherimide or polyimide, with a thickness between 6 and 12 microns. It is glued to a frame 103 keeping it under mechanical tension between 0.01 and 0, 1N / m. On the membrane conductive tracks are preferably glued in aluminum foil 105, but easily replaceable with elongated elements of another shape and of other material such as copper wire, which are electrically connected in series in order to bring the electric resistance to a value between 2 and 8 ohms. The conductive tracks are covered by the current of the electrical signal in a direction (105a) or in the opposite direction (105b) depending on whether they are immersed in the magnetic field B1 or in the opposite field B2. The frame 103 has a rigidity sufficient to not deform under the action of the tensioning force of the membrane only thanks to the support on the stems of the screws 102 which pass through the holes made in it.

In addition to the frame 103, the screws 102 also penetrate the upper sheet 101b and engage in threaded holes, easily replaceable by through-holes with nut placed on the opposite side, made in the sheet 101a. To the plates 101a and 101b there are glued permanent magnets, preferably parallelepipeds in anisotropic barium or strontium ferrite or in neodymium-iron-boron, in queuing of equal magnets 100a or 100b to realize alternate parallel rows of magnets 100a and 100b, that is with polarity N upwards and downwards. Said parallel rows of magnets leave an empty space which is used to pass sound waves thanks to the realization of holes 106 in the sheets 100a and 100b.

6 shows a cross-section of a planar magnetodynamic loudspeaker according to an embodiment of the present invention which shows the assembly step.

In particular, note the differences with respect to FIG. 1: in this case the sheet 101a is wider than the sheet 101b to allow the temporary fixing of containment walls 108 by means of screws 111; furthermore, inside the frame 103 there is a removable spacer plate 110 to keep the frame 103 undeformed before the screws are inserted, first 109, then, once it has reached the closed position, replaced by 102 for final adjustment. The conductors are glued under the membrane instead of above, but this is irrelevant and they have been moved only for clarity of drawing.

Another important difference in this case is that FIG. 6 shows the elastic elements 107 for centering the frame 103 in an undeformed position, while FIG. 1 shows them deformed.

Naturally, in order to satisfy contingent and specific requirements, a person skilled in the art will be able to make numerous modifications and logical and / or physical variations to the solution described above. More specifically, although this solution has been described with a certain level of detail with reference to one or more embodiments thereof, it is clear that various omissions, substitutions and changes in form and details as well as other embodiments are possible. In particular, different embodiments of the invention can be put into practice even without the specific details (such as the numerical examples) set forth in the preceding description to provide a more complete understanding thereof; on the contrary, well-known features may have been omitted or simplified in order not to obscure the description with unnecessary details.

Furthermore, it is expressly understood that specific elements and / or method steps described in relation to each embodiment of the solution described can be incorporated in any other embodiment such as a normal design choice.

Similar considerations apply if the loudspeaker has a different structure or includes equivalent components. In any case, any component can be separated into multiple elements, or two or more components can be combined into a single element.

LAIMS ITRE20110067

CLAIMS 1. Loudspeaker comprising a plurality of permanent magnets (100) divided into magnets with polarity turned in one direction (100a) and magnets with opposite polarity (100b) positioned on a first plate (101a) so as to form parallel rows of magnets of equal to alternate with rows of magnets of opposite direction, a second plurality of permanent magnets (100) divided into magnets with polarity facing one direction (100a) and magnets with polarities facing opposite (100b) positioned on a second sheet (101b) so as to form parallel rows of magnets of the same direction alternated with rows of magnets of opposite direction, so that said rows of magnets face the rows of magnets of the first plurality with the same polarity, or in repulsion, a membrane made of material plastic (104) having elongated conductors (105a and 105b) integral with it which run parallel to the rows of magnets so as to be traversed through horizontally pendulum from a magnetic field (B1 or B2), said membrane being mechanically kept under tension by the constraint to a frame (103), characterized in that said frame is constrained to the sheets (101a and 101b) so as to allow perpendicular movements to the plane defined by the membrane (104).

2.

Loudspeaker according to claim 1 wherein the constraint of the frame (103) to the sheets (101a and 101b) is achieved by the passage of several screws parallel to each other and perpendicular to the plane of the membrane (104) in a hole made in the frame.

3.

Loudspeaker according to claim 2 wherein the frame (103) is kept in a centered position with respect to the two plates (101a and 101b) by elastic yielding elements (107) placed between the frame (103) and each of the plates (101a and 101b) .

4.

Loudspeaker according to claim 3 wherein said elastic elements (107) are made with strips of expanded synthetic material.

5.

Method for the realization of a loudspeaker comprising a plurality of permanent magnets (100) divided into magnets with polarity turned in one direction (100a) and magnets with opposite polarity (100b) positioned on a first plate (101a) so as to forming parallel rows of magnets of the same direction alternated with rows of magnets of opposite direction, a second plurality of permanent magnets (100)

divided into magnets with polarity facing one direction (100a) and magnets with polarity facing opposite (100b) positioned on a second sheet (101b) so as to form parallel rows of magnets of the same direction alternated with rows of magnets of opposite direction, so that said rows of magnets face the rows of magnets of the first plurality with the same polarity, ie in repulsion, a membrane of plastic material (104) having elongated conductors (105a and 105b) integral with it which run parallel to the rows of magnets so as to be traversed perpendicularly by a magnetic field (B1 or B2), said membrane being mechanically kept under tension by the constraint to a frame (103), characterized in that a sheet (101a) wider than the sheet is used (101b) at least so as to allow to fix guide elements (108) for containing the sheet (101b) defining a plane perpendicular to the sheet on which said guide elements for fixing said loudspeaker are fixed and used.

6.

Method for making a loudspeaker according to claim 5 wherein said containment guide elements (108) are fixed to the sheet (101a) with screws (111).

7.

Method for the realization of a loudspeaker comprising a plurality of permanent magnets (100) divided into magnets with polarity turned in one direction (100a) and magnets with opposite polarity (100b) positioned on a first plate (101a) so as to forming parallel rows of magnets of the same direction alternated with rows of magnets of opposite direction, a second plurality of permanent magnets (100) divided into magnets with polarity facing one direction (100a) and magnets with polarity facing opposite (100b) positioned on a second sheet (101b) so as to form parallel rows of magnets of the same direction alternated with rows of magnets of opposite direction, so that said rows of magnets face the rows of magnets of the first plurality with the same polarity, ie in repulsion, a membrane in plastic material (104) having elongated conductors (105a and 10b) integral with it which run parallel to the rows of magnets so as to be traversed perpendicularly by a magnetic field (B1 or B2), said membrane being mechanically kept under tension by the constraint to a frame (103), characterized in that the frame (103) is kept in a deformed position during assembly, in spite of the tension of the membrane (104) constrained thereto by a mechanical contrast element (110) which can be removed after assembly.

8.

Method for assembling a loudspeaker according to claim 7 wherein the mechanical contrast element is constituted by a slab of suitable dimensions.