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(19)

(54) LOUDSPEAKER CABINETS

(71) We, SONY CORPORATION, a corporation organised and existing under the laws of Japan, of 7-35 Kitashinagawa-6, Shinagawa-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to loudspeaker cabinets.

Known loudspeaker cabinets are of many different shapes. Commonly they are of rectangular shape with a flat baffle plate at the front and around which is a raised edge member which projects from the general plane of the baffle plate. As the surface of the baffle plate is flat, the sound waves emitted from the loudspeaker partially propagate along the surface of the baffle plate and strike the edge member where the baffle plate meets with the side, top and bottom walls of the cabinet. Due to the abrupt change in sound impedance which occurs at the edge member, the sound waves are diffracted at the edge member. This gives the effect that the edge member is serving as an imaginary sound source which emits therefrom a low intensity secondary sound wave. As a result, interference occurs between the sound wave from the loudspeaker and the secondary sound wave. The frequency of the imaginary sound source is dependent on the distance between the loudspeaker and the edge member. As a result, the sound-pressure level at a point spaced from the loudspeaker by a predetermined distance is altered at some frequency. In particular, a trough is produced in the soun-pressure level at some particular frequency, generally in the mid-band audio frequency range. This produces a degradation of the sound quality.

According to the present invention there is provided a loudspeaker cabinet comprising: rear, side, top and bottom walls forming a loudspeaker enclosure; and a baffle plate forming a front wall of said enclosure and having at least one loudspeaker mounting hole; said baffle plate having a generally planar outer surface with shaping forward by recesses in the form of straight-walled grooves in said surface or cylindrical recesses in said surface or a recess so shaped as to leave cylindrical projections in said surface, the shaping being in each said case such as not to include opposed parallel walls between which standing sound waves would be set up.

According to the present invention there is also provided a loudspeaker cabinet comprising: rear, side, top and bottom walls forming a loudspeaker enclosure; and a baffle plate forming a front wall of said enclosure and having at least one loudspeaker mounting hole; said baffle plate having a generally planar outer surface in which is formed a first set of equally-spaced parallel V-shaped grooves whereby the remaining portions of said surface are equally-spaced parallel strips.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like reference numerals designate like elements, and in which

Figure 1 is a front elevational view of a first embodiment of loudspeaker cabinet according to the invention;

Figure 2 is an enlarged fragmentary view of a part of the surface of a baffle plate of the loudspeaker cabinet of Figure 1;

Figure 3 is a cross-sectional view taken along the line III-III in Figure 2;

Figures 4 and 5 are graphs showing sound-pressure level against frequency characteristics;

Figures 6, 8, 10, 12 and 14 are enlarged fragmentary views respectively showing parts of the surface of other baffle plates; and

Figures 7, 9, 11 and 13 are cross-sectional views taken along the line VII-VII in Figure 6, the line IX-IX in Figure 8, the line XI-XI in Figure 10, and the line XIII-XIII in Figure 12, respectively.

Figure 1 is a front elevational view of a loud speaker 1 in which the loudspeaker cabinet is a rectangular construction formed by side walls, top and bottom walls and a rear wall (not shown) which are secured together and are generally identified as walls 2. A baffle plate 3 is provided at the front and in openings in the baffle plate 3 are attached three speaker units such as a tweeter 4, a squawker 5 and a woofer 6. The arrow Y designates the normal vertical position in which the loudspeaker 1 stands.

Substantially the whole of the outer surface of the baffle plate 3 is shaped by recesses in such a way as to discourage the formation of standing waves. For example, as shown in Figure 2, a plurality of parallel elongate grooves 7, each having a V-shaped cross-section, are formed on one surface of the baffle plate 3 in mutually intersecting rows and columns so that a plurality of truncated pyramids 8, each having a square flat top are formed on the surface of the baffle plate 3 arranged in rows and columns.

If the grooves 7 and the truncated pyramids 8 are formed on the outside surface of the baffle plate 3, a part of the sound which is emitted from the respective loudspeaker units 4 to 6 and propagated along the outside surface of the baffle plate 3 is reflected by the truncated pyramids 8, with the result that such sounds are scattered over the whole surface of the baffle plate 3. Thus, there may be produced a number of secondary sound sources (imaginary sound sources) by sound reflection. In this case, however, since the reflected sounds from the secondary sound sources are at a very low level and since their frequency characteristics differ from one another, interference with the sound from the loudspeaker units 4 to 6, are averaged, and hence the total interference is greatly reduced as compared with that of the prior art loudspeakers in which sound reflection is caused at only the edge portion of the baffle plate.

The sound-pressure level against frequency characteristic and the directivity against frequency characteristic of an embodiment of the loudspeaker cabinet according to the invention will be explained with reference to the graphs of Figures 4 and 5, in which the ordinate represents the sound-pressure level in dB and the abscissa represents the frequency in Hz. In this case, the embodiment is selected in size as follows:

The dimensions of the loudspeaker cabinet:

Width	510 mm
Height	930 mm
Depth	370 mm.

The dimensions of the baffle plate 3 made of wood:

Thickness (from the upper surface of the truncated pyramids 8 to the rear surface) 30 mm

Distance between the centres of adjacent truncated pyramids 8 in the row or column direction 9 mm

Depth of the groove 7 6 mm.

Dimensions of the loudspeaker units 4, 5 and 6:

Diameter of the opening for the loudspeaker unit 4 35 mm

Diameter of the opening for the loudspeaker unit 5 100 mm

Diameter of the opening for the loudspeaker unit 6 380 mm.

The sound-pressure level against frequency characteristic of this embodiment (on the front axis) is shown by a curve 10 (solid line curve) in Figure 4. As is apparent from Figure 4, the characteristic is approximately flat between low and high band cut-off frequencies 45 Hz and 18 KHz where the sound-pressure level is lowered by 3 dB from the reference level 0 dB. On the other hand, with the prior art loudspeaker cabinet, where the surface of a baffle plate is flat, the characteristic is modified as shown by the broken line portion 11 of the curve. In this case the sound-pressure level falls abruptly at the frequency 1.3 KHz and hence a trough is caused.

This illustrates the results obtained by providing the baffle plate 3 with the grooves 7 and the truncated pyramids 8 and how the sound-pressure level against frequency characteristic is affected at frequencies more than that corresponding to wavelengths of about four times the spacing of the grooves 7 and the truncated pyramids 8 of the baffle plate 3. Thus, if the propagation velocity of sound is taken as 344 m/sec, it is preferable for this spacing to be more than about 4 mm, since the audible frequency of sound is lower than 20 KHz.

In addition, the grooves 7 and the truncated pyramids 8 serve to lower the fundamental frequency of vibration of the baffle plate 3 and serve to increase the number of vibration modes. Hence, the vibration of the baffle plate 3 is distributed over a wide frequency range and accordingly the effect of interference on the sounds radiated from the loudspeaker units 4, 5 and 6 in each direction is averaged. The sounds in high frequency bands (more than several KHz) which show sharp directivity are scattered by the grooves 7 and truncated pyramids 8, so that the sound-pressure level against frequency characteristic is improved, and also the directional characteristic is improved.

The sound-pressure level against frequency characteristic of this embodiment (at an axis inclined by 30° from the front axis) is shown by a curve 12 (the one-dot chain line curve) in the graph of Figure 5, from which it will be apparent that the sound-pressure level is lowered from the sound-pressure level against frequency characteristic curve 10 (on the front axis) but is higher than a sound-pressure level to frequency characteristic curve 13 (on an axis inclined by 30° from the front axis) of the case where the surface of the baffle plate is made flat. Thus, it will be understood that the directivity in the high frequency band is improved. This means that the tone quality is less affected by the position at which a listener hears the sounds from the loudspeaker units 4, 5 and 6.

Other examples of the baffle plate, which are usable in embodiments of loudspeaker cabinet according to the invention and with the same effect, will be now described.

In the example of Figure 6 and 7, a plurality of parallel grooves 7, each of which has a V-shaped cross-section, are formed on one surface of the baffle plate 3 in the column direction and hence a plurality of elongate ridges 8 are

formed each of which has a flat top surface.

In the example of Figures 8 and 9, a plurality of parallel grooves 7, each of which is substantially the same as the grooves 7 of Figures 6 and 7 in cross-section, are formed on one surface of the baffle plate 3 in a lateral direction at right angles to those of Figure 6, and hence a plurality of flat top ridges 8 are formed, each of which is substantially the same as those of Figures 6 and 7 in cross-section.

In the example of Figures 10 and 11, in place of flat top ridges 8 there are provided a plurality of cylindrical projections 8 on one surface of the baffle plate 3 in row and column directions in a matrix. These provide the desired irregular surface on the baffle plate 3, and have the same effect as described above.

In the example of Figures 12 and 13, a plurality of cylindrical recesses 7 are formed on one surface of the baffle plate 3 in row and column directions in a matrix in place of the cylindrical projections 8 of Figures 10 and 11. Thus, around the cylindrical recesses 7, there is provided what is the equivalent of the flat top projections 8.

In the embodiments shown in Figures 1 to 3 and Figures 6 to 13, it is possible for the orientation of the shaping to be rotated by an arbitrary angle relative to the direction Y.

The baffle plate 3 may be formed of soft or hard materials such as wood, plastics, paper fibre or various other materials such as sound absorbing material.

The shaping may be formed in the surface of the baffle plate 3 itself, or it may be formed, as shown in Figure 14, on a baffle plate member 3*a* which is bonded to a flat baffle plate member 3*b*.

WHAT WE CLAIM IS:—

1. A loudspeaker cabinet comprising: rear, side, top and bottom walls forming a loudspeaker enclosure; and a baffle plate forming a front wall of said enclosure and having at least one loudspeaker mounting hole; said baffle plate having a generally planar outer surface with shaping forward by recesses in the form of straight-walled grooves in said surface or cylindrical recesses in said surface or a recess so shaped as to leave cylindrical projections in said surface, the shaping being in each said case such as not to include opposed parallel walls between which standing sound waves would be set up.

2. A cabinet according to Claim 1 wherein said shaping is a plurality of V-shaped grooves extending parallel to one another between said top and bottom walls.

3. A cabinet according to Claim 1 wherein said shaping is a plurality of V-shaped grooves extending parallel to one another between said side walls.

4. A cabinet according to Claim 1 wherein said shaping is a first plurality of V-shaped grooves extending parallel to one another and a second plurality of V-shaped grooves extending parallel to one another and normal to said first plurality such that truncated pyramids are formed in said surface by the intersection of said grooves.

5. A cabinet according to Claim 1 wherein said shaping is cylindrical recesses of equal depth formed in a rectangular array of rows and columns in said surface.

6. A cabinet according to Claim 1 wherein shaping is such as to leave cylindrical projections of equal height in a rectangular array of rows and columns in said surfaces.

7. A cabinet according to Claim 2, Claim 3 or Claim 4 wherein the spacing between adjacent said grooves is greater than 4 mm.

8. A loudspeaker cabinet comprising: rear, side, top and bottom walls forming a loudspeaker enclosure; and a baffle plate forming a front wall of said enclosure and having at least one loudspeaker mounting hole; said baffle plate having a generally planar outer surface in which is formed a first set of equally-spaced parallel V-shaped grooves whereby the remaining portions of said surface are equally-spaced parallel strips.

9. A cabinet according to Claim 8 wherein said grooves and strips extend parallel to said top and bottom walls.

10. A cabinet according to Claim 8 wherein said grooves and strips extend normal to said top and bottom walls.

11. A cabinet according to Claim 8 wherein a second set of equally-spaced parallel V-shaped grooves similar to said first set and normal thereto are formed in said surface, whereby a rectangular array of truncated pyramids are formed in said outer surface of said baffle plate.

12. A loudspeaker cabinet substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

13. A loudspeaker cabinet substantially as hereinbefore described with reference to Figures 6 and 7 of the accompanying drawings.

14. A loudspeaker cabinet substantially as hereinbefore described with reference to Figures 8 and 9 of the accompanying drawings.

15. A loudspeaker cabinet substantially as hereinbefore described with reference to Figures 12 and 13 of the accompanying drawings.

16. A loudspeaker cabinet substantially as hereinbefore described with reference to Figure 14 of the accompanying drawings.

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1585636 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

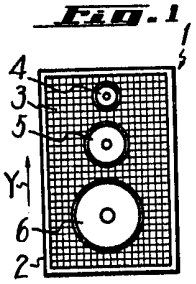


FIG. 2

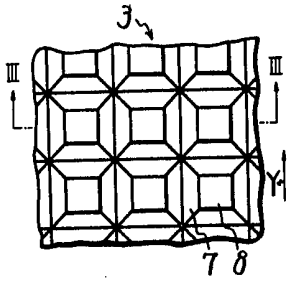


FIG. 3

FIG. 4

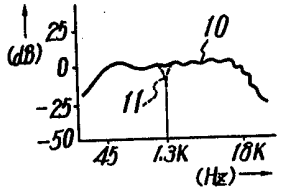
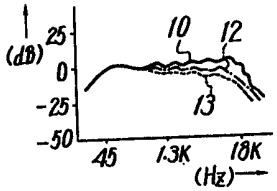


FIG. 5



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Sheet 2

Fig.6

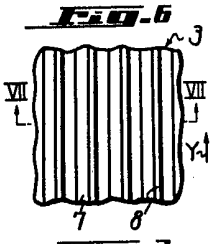

Fig.8

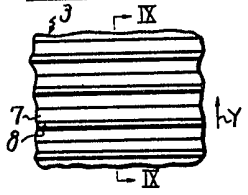

Fig.7

Fig.9

Fig.10

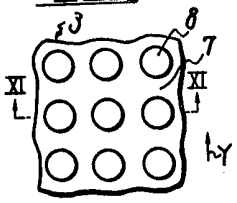

Fig.12

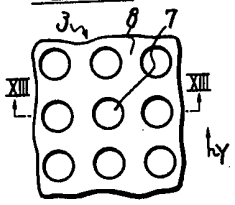

Fig.11

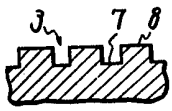

Fig.13

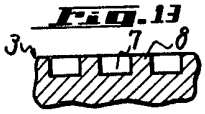

Fig.14