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(54) **Acoustic speakers**

(57) The subject of the invention is an acoustic speaker consisting of the enclosure and speakers: woofer and wideband, characterised in that the enclosure consists of a set of upper chambers (1) separated from each other by partitions and a set of lower chambers (2) separated from each other by partitions, moreover the wideband speaker (7) with the outlet of acoustic wave emission directed parallel to the floor is mounted in the front upper chamber (1a), whereas the woofer (8) with the outlet of acoustic wave emission directed vertically downwards is mounted in the lower chambers (2a) and (2b). Each of the upper chambers is connected to the chamber located below it by a waveguide (4) made of a hollow pipe, whereby the front waveguide (4a) is closed from the bottom a separate space creating with the chamber (1 a), and the remaining waveguides are open from both sides, creating with the following chambers a low-pass acoustic filter. Sets of upper chambers (1) and lower chambers (2) are additionally connected by means of bars (5) and (6) pressing and tightening the whole enclosure, whereby bars (5) are at the same time a metallic conductive connection between the wideband speaker (7) and feeder clamps coming out in the set of lower chambers (2), whereas the bars (6) provide support and stiffening for the whole structure.

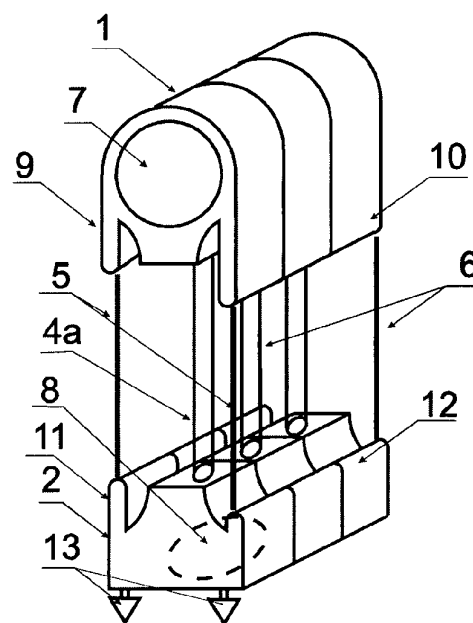


Fig. 2

Description

[0001] The subject of the invention is an acoustic speaker, in particular for transmission of sound in closed rooms.

[0002] Different solutions of acoustic speakers are known both in technical and patent literature, among others with open and closed enclosures, or possibly with an opening or a membrane. These basic types of columns are characterised by specific features, such as impulse response speed or lower cut-off frequency, depending on solution selected for the same types of speakers applied. Design of the speakers enclosure depends on type of speakers applied, and in particular on their processing band. Size of the enclosure is selected depending on lower range of processing band and requirements related to the listening room. For small rooms, monitors in the form of small sets of speakers are intended. Most frequently, these monitors are of rather small size (several centimetres high) enabling - when placed on the floor - location of any speaker at the level of a head of a sitting or standing listener. Hence, in most of practical applications, stands are used for monitor speakers. Most frequently the stands for monitors are approx. one meter high, in case of typical monitor speakers results in a fact that a high frequency or middle frequency speaker is located at the height of a sitting listener's head (i.e. approx. 1.5 meter above the floor level). This is an alternative solution for classic floor standing speakers which do not require stands. Users of monitor speakers equipped with stands pay special attention to visual and aesthetic aspects, and smaller space occupied in comparison with floor standing speakers. Unfortunately, in return - mainly due to small volume of the enclosure - the monitor speakers do not reach such low range of transmitted frequencies as it is in case of the floor standing speakers.

[0003] Numerous publications and patent specifications describe different models of monitor speakers and stands too. Most frequently the monitor speakers have the form of rectangular enclosure equipped with two or three speakers. For example, in the US 2000/434, 751 patent description, a monitor equipped with two independent speakers is presented. A similar solution can be found in the US 1991/5,067,583 patent description where the acoustic speakers set has a form of a column of a relatively small size. There are also other forms of speaker enclosures, such as for example sets of speakers intended for hanging (US 2008/D574,810S, US 1998/399,509) or being a part of home theatre sound system (US 2005/0207603). From the descriptions of industrial designs also other shapes of acoustic speakers are known (e.g. US 2010/D617,309S).

[0004] In the current state of technique many types of stands for monitor speakers are known too. These are for example stands in the form of a thin single support (foot) known for example from the following descriptions US 2004/D497,904, US 2007/0235603A1 and US 2008/D570,618 not suitable for placing on them heavy

monitor speakers. Stands suitable for placing on them heavy monitor speakers are also known (US 2008/D581,698), e.g. with one big support or a less stable one (US 1978/4,078,757). Other stands for monitor speakers profiled for certain applications can be found too, such as those in the form of a folding chair (US 1993/5,190,254) or very low ones (a few centimetres high) which are profiled rather to be used under column speakers, so called floor column speakers (US 1998/394,265 or US 2005/6,968,068 B1).

[0005] In practice, in home and study conditions the solution most frequently applied is, however, a classic stand for monitor speakers with one or a few thick supports, known for example from the US 2008/D581,698 description. This solution is an undividable whole. As it was mentioned hereinabove, the biggest disadvantage of small column speakers use (monitor speakers) is a limited low range of processing.

[0006] The objective of this invention creators was elimination of the disadvantage referred to hereinabove through effective volume increase reached by using a hollow waveguides (serving also as supports) and chambers, and hence increase of the processing band range, without the necessity of undesired, extensive increase of the column size.

[0007] This objective was reached thanks to an innovative design of the column speakers containing an enclosure and speakers: woofer and wideband, **characterised in that** the enclosure consists of a set of upper chambers, separated by partitions, whose number is generally unlimited and a set of lower chambers, separated by partitions, whose number is proportional to the number of upper chambers. Uneven partitions, used in the set of upper chambers, starting from the first partition separating the front upper chamber from the second chamber, through the third partition separating the third chamber from the fourth one, etc. until the last uneven partition, are closed, and hence they separate the chambers hermetically, whereas in even partitions, starting from the second partition, openings are made, transmitting acoustic waves. In the set of lower chambers it is the opposite, i.e. in the uneven partitions, starting from the first one, openings are made, transmitting acoustic waves, whereas the even partitions, starting from the second one are closed and hence they separate the chambers hermetically. A wideband speaker with the outlet of acoustic wave emission directed parallel to the floor is mounted in the upper front chamber, whereas the woofer with the outlet of acoustic wave emission directed vertically down is mounted in lower chambers: front (first) and the second. Each of the upper chambers is connected to the chamber located below it via a waveguide made of a hollow pipe which is at the same time used as a support for the upper chamber, whereby the front waveguide going from the front chamber is closed from the bottom forming a separate space with it, whereas the other waveguides are open from two sides, creating an acoustic low-pass filter whose order depends on number

of chambers and waveguides. Sets of upper and lower chambers are additionally connected by means of bars pressing and tightening the whole enclosure, whereby two of them are at the same time a metallic conductive connection between the wideband speaker and feeder clamps coming out in the set of lower chambers, whereas the remaining ones provide support and stiffening for the whole structure.

[0008] The waveguides may have a different cross-section, in particular in the shape of a square, rectangle, polygon, circle or ellipsis.

[0009] The set of lower chambers is placed on feet, hence a space (gap) between the floor and a woofer is made, enabling a free outlet of acoustic wave emission.

[0010] Preferably, chambers with waveguides are made in such a way that subsequently to assembly they are a hermetic tight whole which may be relatively easily dismounted.

[0011] Preferably, the wideband speaker is located at the height of a sitting listener (approx. 1.5 meter above the floor).

[0012] Preferably, the enclosure is assembled from several separate parts enabling adjustment of the column speakers height.

[0013] Increase of the woofer processing band range is reached through the use of lower and upper chambers space and vertical waveguides made of pipes (which are supports at the same time). The waveguides, and chambers whose volume is much bigger, are empty inside, and the manner in which they are connected ensures effective increase of acoustic channel volume for the woofer, which increases the range of processing band without the necessity of undesired increase of the column size. The sequence of repeated elements: chamber, contraction (waveguide), chamber, contraction (waveguide), etc. is a low-pass acoustic filter for the woofer. Location of chambers and waveguides in accordance with the invention causes that the acoustic filter, regardless the order, is compact and relatively small in size. Reaching such parameters in another way would in practice require building of a very long sequence of elements (involving placing all elements in one axis) which would be neither practical nor handy.

[0014] Solution in accordance with the invention enables also an easy change of the acoustic channel volume by lowering the waveguide height and by changing the proportion between the volume intended for individual speakers.

[0015] Fig. 1, beside the block diagram shows of the low-pass acoustic filter, its analogue equivalent is also presented. In this filter, electric inductance L_{el} and capacitance C_{el} were placed according to their acoustic equivalents L_{ak} and C_{ak} . As results from both these systems it is an acoustic filter/low-pass filter. Both the filter order and its other parameters are determined by size, number and mutual proportion of the chambers and waveguides.

[0016] Tightness of acoustic channels of the column

is ensured first of all by bars pressing the whole enclosure which at the same time provide support and stiffening for the whole structure.

[0017] Design of a column speaker in accordance with the invention also eliminates the necessity to provide external power supply to the wideband monitor speaker mounted in the front upper chamber. Thanks to the metallic conductive connection between the wideband speaker and feeder clamps coming out in the set of lower chambers the functionality and usability of the whole set increases.

[0018] The subject of the invention is presented in its embodiment in which Fig. 1 shows the low-pass acoustic filter (an idea of this solution), in the form of P_0 , P_1 and P_2 chambers connected by V_1 and V_2 waveguides and its electric equivalent, Fig. 2 - enclosure of the speakers set in the perspective view, Fig. 3 - elements of the column speaker design prior to their assembly, seen from the front, consisting of: front upper chamber with the installed wideband speaker, vertical waveguide, bars providing metallic conductive connection of the upper speaker to feeder clamps and the front lower chamber located on feet, whereas Fig. 4 shows the column speaker in longitudinal cross-section, including propagation of acoustic wave.

[0019] In the invention embodiment, the column speaker contains an enclosure which consists of a set of three upper chambers (1a), (1b) and (1c), separated by partitions, of a round cross-section, with arms extending from them and directed downwards (9) and (10), whereby in the lower part, each upper chamber gets a trapezoid shape providing a seat for the waveguide, (4a), (4b) and (4c) respectively, and a set of three lower chambers (2a), (2b) and (2c) separated from each other by partitions, of rectangular cross-section in lower part and trapezoid cross-section in upper part providing a seat for the supports, (4a), (4b) and (4c) respectively, with arms (11) and (12) extending from side walls of lower chambers and directed upwards, whereby the (3a) and (3b) chambers are closed and in the (3c) and (3d) partitions openings transmitting acoustic waves are made. The wideband speaker (7) with the outlet of acoustic wave emission directed parallel to the floor is coaxially mounted in the upper front chamber (1a), whereas the woofer (8) with the outlet of acoustic wave emission directed vertically down is mounted in lower chambers (2a) and (2b), moreover each of the upper chambers is connected to the lower chamber with a waveguide, (4a), (4b) and (4c) respectively, made of a circle shape hollow pipe, whereby the waveguide (4a) is closed from the bottom forming a separate space with the chamber (1a), and other waveguides (4b) and (4c) are open from two sides enabling free propagation of acoustic wave which starts from the woofer through chamber (2a) to chamber (2b), and further by the waveguide (4b) to the upper chamber (1b) where through the opening made in the partition (3 d) it enters the chamber (1c) and further by the waveguide (4c) it goes to the chamber (2c).

[0020] Sets of upper and lower chambers are additionally connected by bars (5) and (6) pressing and tightening the whole enclosure, mounted in the arms (9), (10), (11) and (12), whereby the bars (5) are at the same time a metallic conductive connection between the wideband speaker (7) and feeder clamps coming out in the set of lower chambers, whereas the bars (6) provide support and stiffening for the whole structure.

[0021] The wideband speaker (7) works in the front upper chamber (1a) connected to the waveguide (4a) in the form of a single support. Whereas the woofer (8) uses the space of three chambers (2a), (2b) and (2c), two consecutive upper chambers (1b) and (1c) and waveguides (4b) and (4c) connecting them, at the same time serving as supports for the set of upper chambers. The propagation of acoustic wave is presented on Fig. 4.

Claims

1. The acoustic speaker consisting of the enclosure and speakers: woofer and wideband **characterised in that** the enclosure consisting of a set of upper chambers (1), of unlimited number, separated from each other by partitions, and a set lower chambers (2) separated from each other by partitions, in a number proportional to the number of upper chambers, whereby uneven partitions in the set of upper chambers (1), starting from the first partition (3a) are closed, and in even partitions, starting from partition (3b) openings are made, whereas in the lower chambers set, it is the opposite, i.e. in uneven partitions opening are made, starting from (3c) and even partitions, starting from (3d) are closed, moreover the wideband speaker (7) with the outlet for acoustic wave emission directed parallel to the floor is mounted in the front upper chamber (1a), whereas the woofer (8) with the outlet of acoustic wave emission directed vertically is mounted in the lower chambers (2a) and (2b), moreover each of the upper chambers is connected with the lower chamber located below it via a waveguide (4) made of hollow pipe, whereby the front waveguide (4a) is closed from the bottom creating with the chamber (1a) a separate space, and the remaining waveguides are open from both sides, creating with the following chambers a low-pass acoustic filter whose order depends on the number of chambers and waveguides, moreover the sets of upper chambers (1) and lower chambers (2) are additionally connected by means of bars (5) and (6) pressing and tightening the whole enclosure, whereby bars (5) are at the same time a metallic conductive connection between the wideband speaker (7) and feeder clamps coming out in the set of lower chambers (2), whereas the bars (6) provide support and stiffening for the whole structure.

2. The acoustic speaker as claimed in claim 1, **char-**

acterised in that waveguides (4) have different cross-sections, in the shape of a square, rectangle, polygon, circle or ellipsis.

3. The acoustic speaker as claimed in claim 1, **characterised in that** the set of lower chambers is placed on feet (13).
4. The acoustic speaker as claimed in claim 1, **characterised in that** the chambers and waveguides are made in such a way that after assembly they constitute a hermetic, dismountable whole.
5. The acoustic speaker as claimed in claim 1, **characterised in that** the wideband speaker is located at the height of a sitting listener's head (approx. 1.5 meter above the floor level).
6. The acoustic speaker as claimed in claim 1, **characterised in that** the enclosure is assembled from several individual parts enabling adjustment of the column height.



Fig. 1

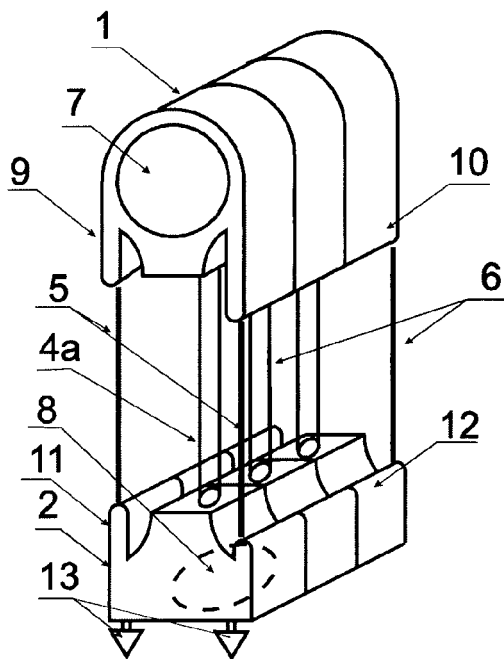


Fig. 2

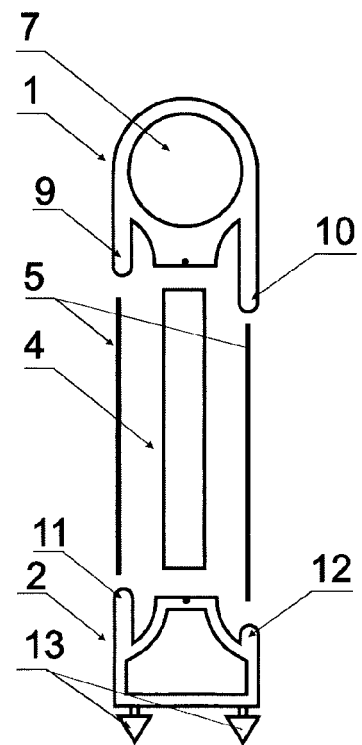


Fig. 3

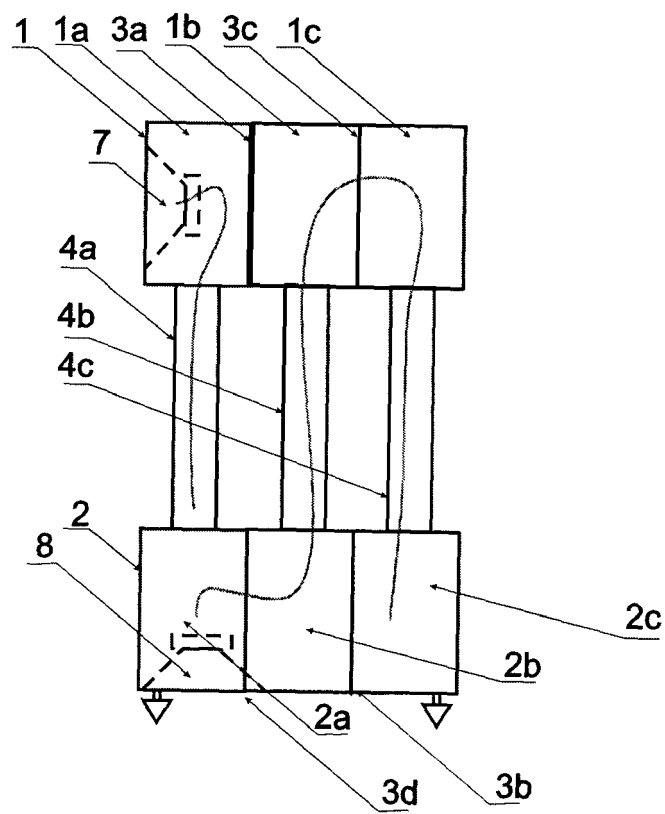


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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