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

(11) EP 1 414 267 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.04.2004 Bulletin 2004/18

(51) Int Cl.[7]: **H04R 9/00**

(21) Application number: **03450226.0**

(22) Date of filing: **07.10.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **22.10.2002 AT 16072002**

(71) Applicant: **AKG Acoustics GmbH**
1230 Wien (AT)

(72) Inventors:
- **Gmeiner, Thomas, Dipl.-Ing.**
  1170 Wien (AT)
- **Lehdorfer, Hannes Ing.**
  1220 Wien (AT)
- **Stöttinger, Ernst, Dipl.-Ing.**
  1090 Wien (AT)
- **Steiner, Johann**
  7121 Weiden (AT)

(74) Representative: **Patentanwälte**
BARGER, PISO & PARTNER
Mahlerstrasse 9
P. O. Box 96
1010 Wien (AT)

(54) Miniaturized loudspeakers

(57) The invention concerns a miniaturized loudspeaker that operates according to the electrodynamic principle, and particularly for incorporation in small devices, such as telephones, mobile phones, hands-free devices for telephones, headphones, or the like, with a membrane (3) and a moving coil (4) fastened to it, a membrane holder (5), a magnet system (2), and optionally a front cover (7) and/or a rear cover, as well as a digital amplifier.

The invention is characterized by the fact that the digital amplifier is arranged in the form of an integrated circuit (10) either on the magnet system (2) or on the membrane holder (5), or on the inside of the front cover (7) or the rear cover.

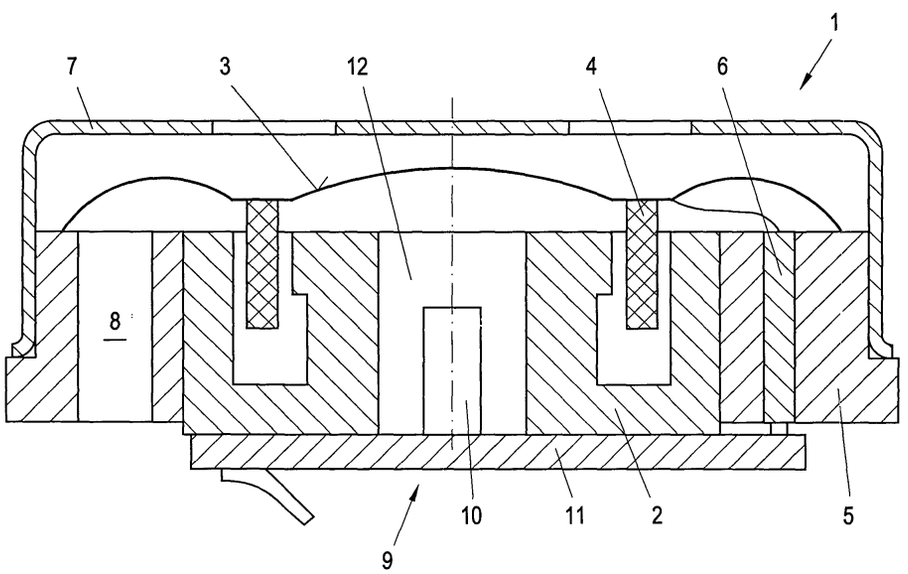

FIG. 1

EP 1 414 267 A2

Description

[0001] The invention concerns miniaturized loudspeakers that operate according to the electrodynamic principle, especially for incorporation in small devices, such as telephones, mobile phones, hands-free devices, headphones, or the like, with a moving coil fastened to it, a membrane holder, a magnet system, and optionally a front cover and/or rear cover, as well as a digital amplifier.

[0002] Such loudspeakers consist of a magnet system and a membrane with a coil fastened to it, and a membrane holder that is fastened to fit the magnet system and that also positions the membrane with reference to the magnet system, along with a front cover and a rear cover. In miniaturized loudspeakers known from the prior art, in which the amplifier or final amplifier is accommodated in the immediate vicinity of the loudspeaker, the rear cover is necessarily provided and a plate carrying the amplifier, for thermal reasons, is fastened to the outside of the rear cover.

[0003] Loudspeakers, in general, can be classified into different groups according to several criteria. An important division lies in the operating principle, where one distinguishes between electrodynamic and electrostatic loudspeakers. The latter are much more expensive, for various reasons, than loudspeakers operating according to the electrodynamic principle and are therefore only used in high-priced equipment.

[0004] Another classification criterion that is based on passive and active loudspeakers. Ordinary loudspeakers, as generally used in hi-fi units, are passive, i.e., they are supplied via a cable with the signals to be converted to an intensity so that no additional amplification or power supply is required.

[0005] The active loudspeakers have a final amplifier incorporated in their housing, so that the signal line only delivers the information with low power and therefore can be designed particularly thin and flexible, with amplification to the desired energy level only occurring in the loudspeaker housing itself. The amplifier is then accommodated on its own chassis, as in conventional radios or the like, and the loudspeaker itself is again supplied only with the signals already having the required intensity, so that the term "active loudspeaker" is not entirely correct, but, strictly speaking, only applies to the combination accommodated in a common housing.

[0006] The employed amplifiers again can be classified, in principle, according to different criteria into analog and digital amplifiers, regardless of whether they are used in an active loudspeaker in its housing or whether a passive loudspeaker is arranged in its own housing.

[0007] An example of an extremely miniaturized loudspeaker can be gathered from US 5 001 762 A, which concerns a hearing aid that can be inserted into the ear: an electronic circuit is built onto a support plate, which contains a microphone and a loudspeaker. Nothing is stated concerning the method of action, electrodynamic or electrostatic, or the design of the loudspeaker, nor is anything disclosed about the method of operation of the amplifier, analog or digital.

[0008] The invention concerns the use of digital amplifiers with electrodynamic, miniaturized loudspeakers in small devices, such as mobile telephones, headphones, hands-free devices and the like.

[0009] It is of fundamental significance in such areas of application not only to design the, individual components as small as the prior art permits, but also to arrange them so that certain components can be dispensed with, if possible, or with several components combined into one component, with it naturally being of critical importance for the large number of pieces now being built to keep the manufacturing costs as low as possible.

[0010] The objective of the invention is to devise a loudspeaker of the type just defined that is more simply designed than the loudspeakers of the prior art and, in this manner, permits miniaturization with simultaneous cost reduction.

[0011] This objective is achieved, according to the invention, in that the digital amplifier is arranged in the form of an integrated circuit either on the magnet system or the membrane holder, or on the inside of the front cover or back cover.

[0012] The basic idea of the invention is to provide the amplifier within the volume formed by the front cover and the back cover, and therefore in the loudspeaker. If these covers, as is often the case in applications according to the invention, are missing and their function is taken over by other parts of the device, the amplifier according to the invention can be fastened to the magnet system or membrane holder.

[0013] It should be pointed out that, in the present description and claims, a magnet system or membrane holder is not necessarily understood to mean components designed in one piece, but that these components can be constructed from several individual parts and, for example, can have inserts made of electrically conducting material in order to facilitate contacting of the coil. The components known to one skilled in the art of loudspeaker technology, which are provided to achieve the desired acoustics, such as friction capstans and the like and which are considered part of the component in the context of the present invention, can also be provided in its openings and perforations.

[0014] Since modem digital amplifiers for loudspeakers of the areas of application according to the invention are highly integrated and essentially consist of an integrated circuit and optionally a few additional components, their fastening on a suitable site directly on the loudspeaker is possible without major problems for one skilled in the art and having knowledge of the invention.

[0015] The invention is presented below by means of some practical examples. In the examples

Figure 1 shows a first,

Figure 2 a second, and
Figure 3 a third variant of the invention.

[0016] As is apparent from Figure 1, a generic small loudspeaker 1 consists of a magnet system 2, a membrane 3 with a coil 4 fastened to the membrane, and a membrane holder 5. In the depicted practical example, the feed line 6 for supplying coil 4 with current and a front cover 7 are also provided. A connection opening 8 is shown purely schematically in membrane holder 5, through which the volume lying "behind" membrane 3 is connected to its surroundings, in order to achieve the desired characteristics of the loudspeaker 1. A friction capstan or the like can naturally be provided in connection opening 8 or the opening can act as such, in order to achieve proper tuning.

[0017] A digital amplifier 9, consisting essentially of an integrated circuit 10 and its circuit board 11, is arranged directly on the magnet system 2 according to the invention, in which the integrated circuit is arranged in a recess, or directly on magnet system 2, or on a passage 12 of the magnet system and not on the outside of a rear cover (not necessary according to the invention), as previously done.

[0018] Figure 2, in which the same components are designated with the same reference numbers as in Figure 1, shows a variant in which an amplifier 9 is arranged on the inside of a front cover 13. The front cover has perforations 14 in order to permit the emergence sound from membrane 3. In this depiction, the usual connection opening (Figure 1) is not shown, but it can naturally be provided. An internal electrical connection 15 from membrane 3 to circuit board 11 is shown for it.

[0019] Figure 3 shows a variant that is particularly favorable, when the miniature speaker 1 is to be fit into a larger insertion part and, for this purpose, the membrane holder 5 is provided with an enclosing ring 16. The enclosing ring can be designed as a separate part or in one piece of the membrane holder. In this case, the integrated circuit 10 of the amplifier, optionally without a circuit board, can be arranged directly in a cavity or recess of the enclosing ring 16.

[0020] One or more protrusions protruding radially outward can be provided, instead of the enclosing ring, which serve for fastening of the loudspeaker; these can also be used to mount the amplifier.

[0021] Other variants are naturally also possible; for example, if a rear cover for any reason is necessary, the amplifier 9 can be arranged on the inside of this rear cover and therefore excellently protected against mechanical and electromechanical disturbances.

[0022] The external contacts that are shown as elastic tabs are shown quite schematically in the drawing. It is naturally possible to choose any other form of contacting, if the depicted form also has special advantages: compensation of tolerances and self-cleaning of the contact surface during any movement between the tab and the countersurface, which also leads to shifts on the contact surface during movements along the axis of symmetry.

[0023] Production of the miniature loudspeaker according to the invention is no problem to one skilled in the field of electroacoustics and having knowledge of the invention; also, depending on the arrangement of the amplifier, the production method must be adapted to the corresponding parts and guiding of the lines considered during assembly.

Claims

1. Miniaturized loudspeakers that operate according to the electrodynamic principle and that are provided for incorporation in small devices, such as telephones, mobile phones, hands-free devices for telephones, headphones, or the like, with a membrane (3) and a moving coil (4) fastened to it, a membrane holder (5), a magnet system (2), and optionally a front cover (7) and/or a rear cover, as well as a digital amplifier, **characterized by** the fact that the digital amplifier is arranged in the form of an integrated circuit (10) either on magnet system (2) or on membrane holder (5), or on the inside of front cover (7) or the back cover.

2. Loudspeaker according to Claim 1, **characterized by** the fact that the magnet system (2) has a recess or perforation (12), in which the integrated circuit (10) is arranged.

3. Loudspeaker according to Claim 2, **characterized by** the fact that the integrated circuit (10) fits on a circuit board (12) that is connected to the magnet system (2).

4. Loudspeaker according to Claim 1, **characterized by** the fact that the integrated circuit (10) is arranged on a circuit board that forms at least one part of the front cover (7) or a rear cover.

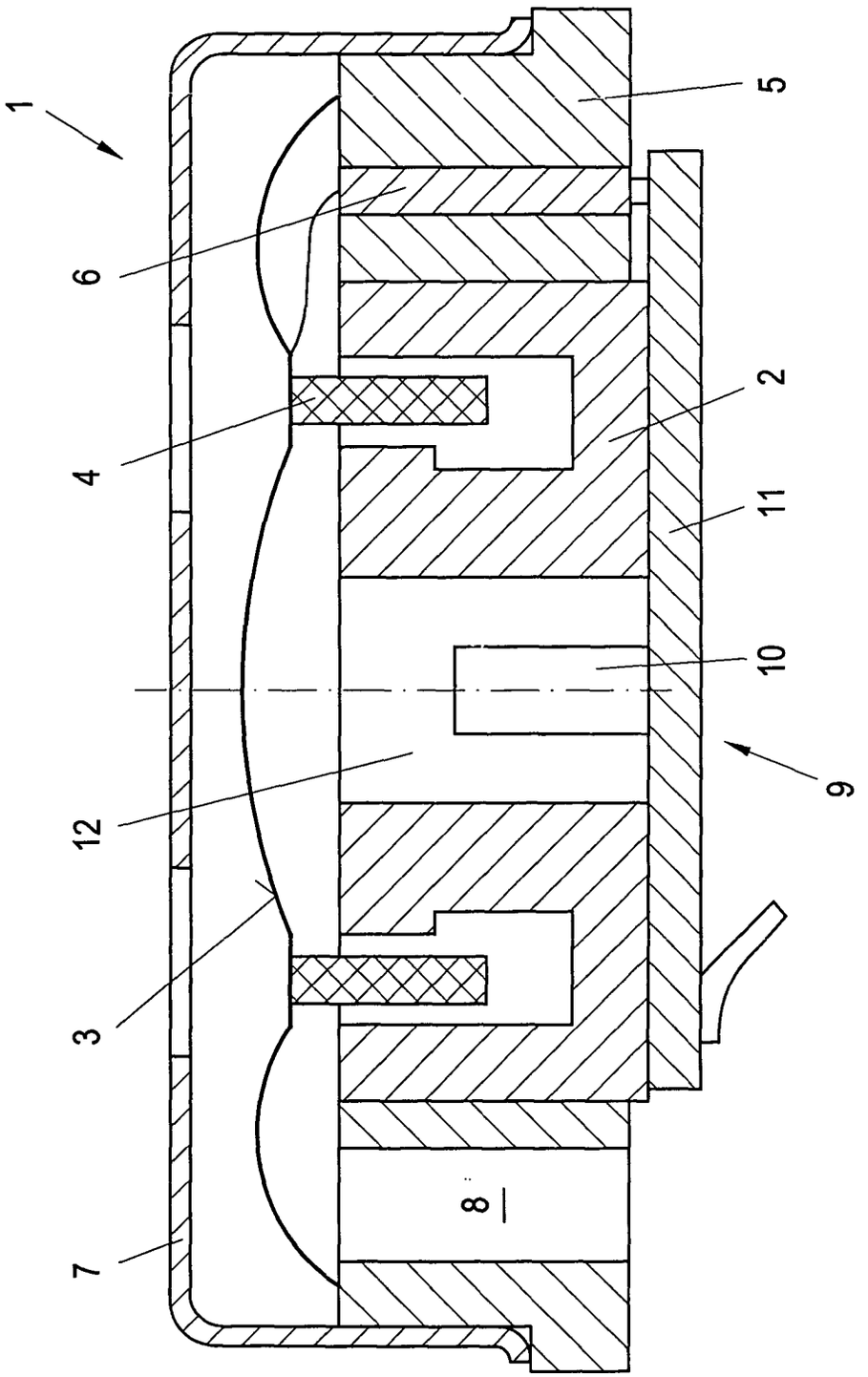

FIG. 1

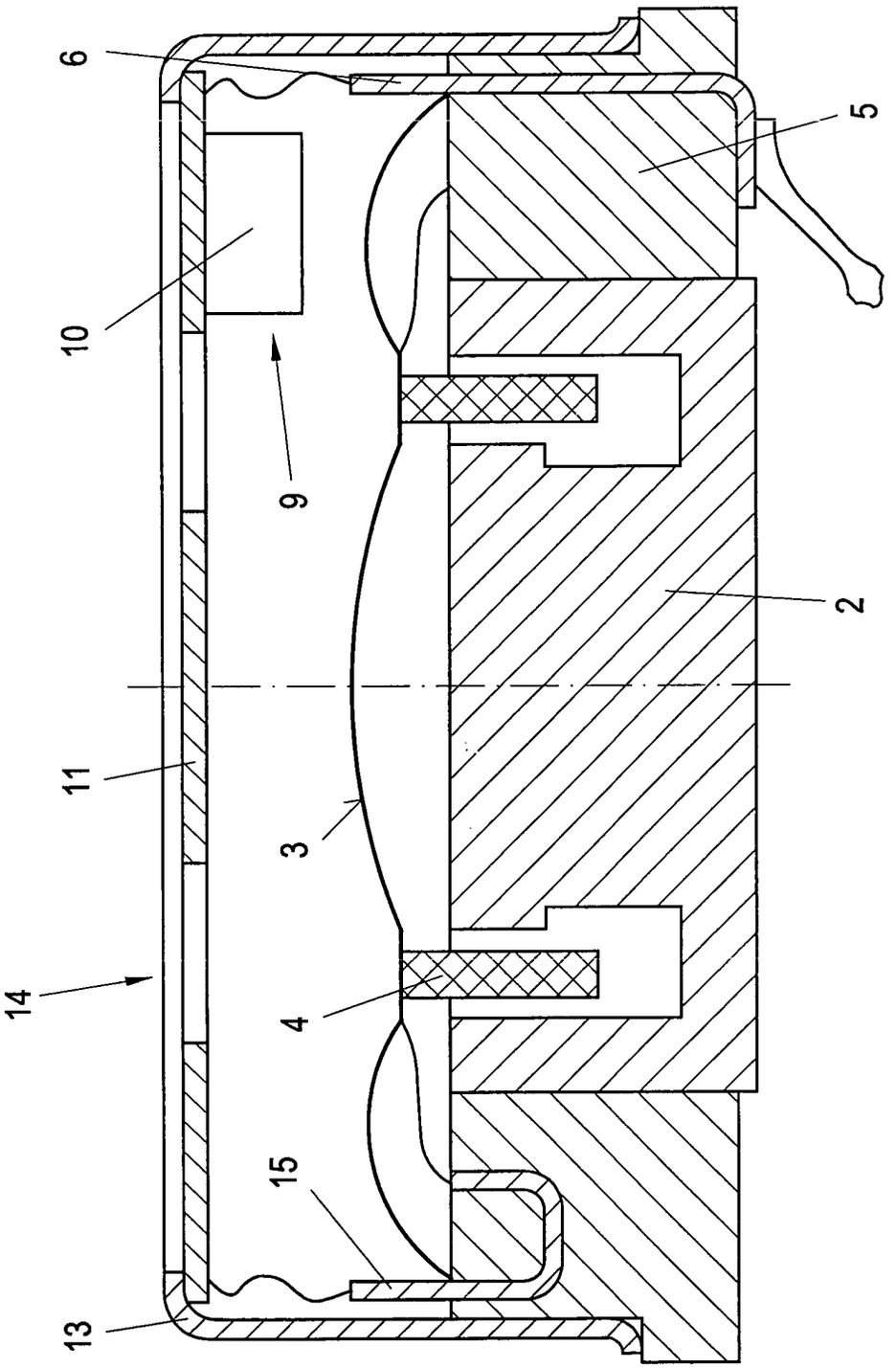

FIG. 2

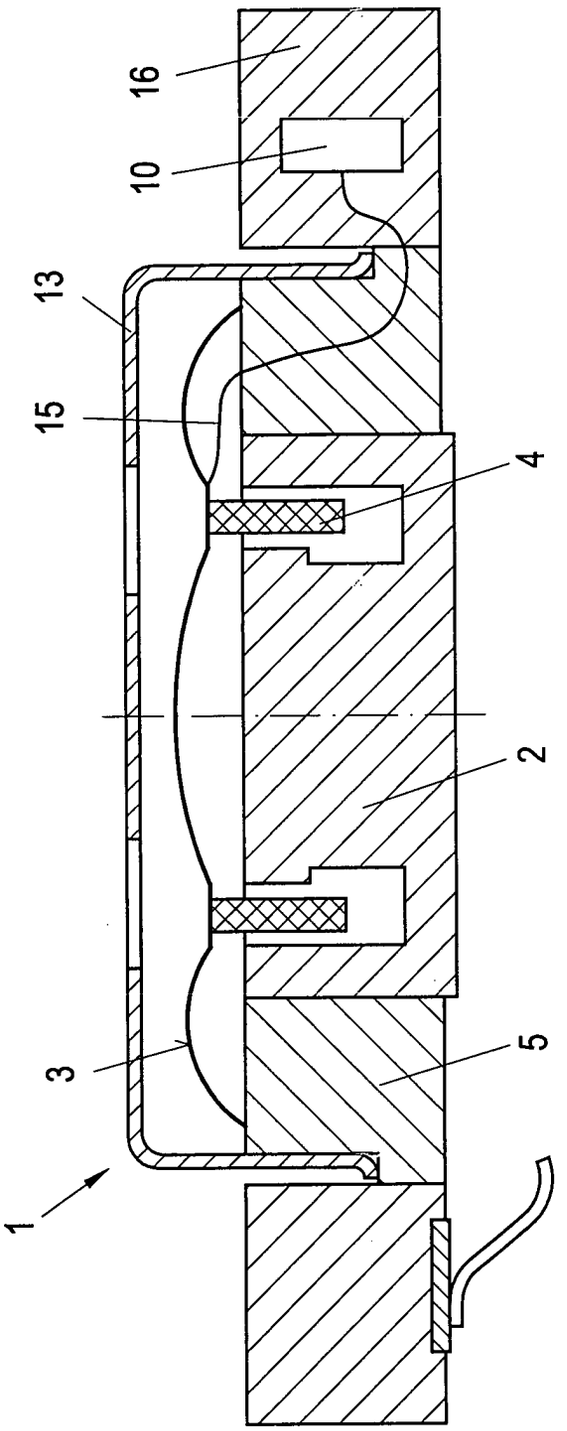

FIG. 3