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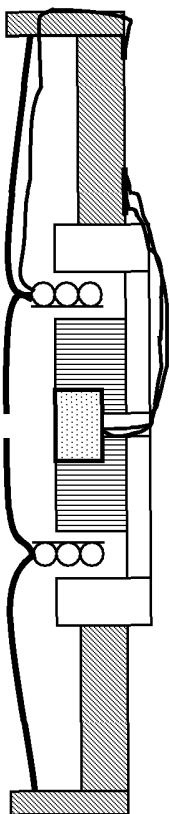
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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(54) Title: LOUDSPEAKER DRIVER WITH INTEGRATED MICROPHONE



(57) Abstract: A driver/microphone assembly is suggested, in which the microphone (2) is arranged centred with the motor (8, 9) of the driver (1) between the membrane (4) and the motor (8, 9). In order to provide coupling between the microphone (2) and the space on the other side of the membrane (4) an opening (13) is provided in the membrane (4), which is located above the microphone (2). The inventive overall assembly requires a reduced space. The contacting wires (12) of the microphone (2) are led to the rear side of the assembly through a borehole (14) in the driver's motor (8, 9). The invention can advantageously be used in active noise cancelling headsets.

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Loudspeaker driver with integrated microphone

The present invention relates in general to an electro-acoustical transducer and more particularly concerns a novel loudspeaker driver that can
5 advantageously be used in active noise cancelling arrangements, has a compact structure and is relatively easy and inexpensive to fabricate.

Active noise cancelling systems make use of the fact that acoustic waves, which have the same amplitude but are reverse in phase cancel out each other.
10 Typically, active noise cancelling systems are used in conjunction with a closed compartment that already has some noise blocking capability. The closed compartment is made in such a way that it surrounds the ears, thereby sealing the compartment from outside noise. In order to detect unwanted outside noise that enters the compartment despite of the sealing, a sound pickup, typically a
15 microphone, is provided. The microphone is placed inside the closed compartment. For providing the best performance the microphone has to be placed as close as possible to the location where the sound cancelling effect is desired to be at a maximum.

20 Known active noise cancelling systems try to bring together the microphone and the transducer, which creates the inverse-phase noise, as close as possible by reducing the size of the driver and the microphone. A reduced-size driver, however, may have limited capabilities with regard to the maximum sound pressure level that can be achieved.

25 Another known approach to bring together the driver and the microphone is to place the microphone in front of the membrane of the driver. To this end a support is used that keeps the microphone in place. However, due to the space required for the microphone the driver has to be moved away from the ear. The
30 active noise cancelling system thus becomes more bulky and less comfortable to wear. The microphone support further may have detrimental effects on the audio performance of the driver, e.g. the audio bandwidth.

It is, therefore, an object of the invention to provide a new driver concept which both reduces the size of the complete arrangement and brings together the driver and the microphone as close as possible, thereby improving the noise cancelling capability.

5

The inventive driver/microphone arrangement includes a driver that is generally known from the prior art. A membrane and a motor are secured in a support. The motor includes a magnet and a voice coil, which can move freely in an air gap. The voice coil is connected to the membrane and moves the
10 membrane in response to electrical signals applied to the voice coil. In the inventive arrangement, the magnet is provided with a recess that takes up the microphone. The recess is preferably located in the centre of the magnet. The membrane has an opening in the vicinity of the microphone. In this way, the microphone can pick up outside noise. Further, a borehole is provided in the
15 magnet, which allows for electrical wires from the microphone to be run to the rear side of the assembly.

Numerous other features, objects and advantages of the invention will become apparent from the following specification when read in connection with
20 the accompanying drawing in which:

FIG. 1 shows a driver/microphone arrangement known from the prior art; and
FIG. 2 shows the driver/microphone arrangement according to the invention.

25 In the drawing, same or similar elements are referenced with the same reference symbols.

In figure 1 and a driver 1 and a microphone 2 are located underneath each other. The driver 1 includes a support 3, which supports a membrane 4. A voice
30 coil 6 is attached to the membrane 4. The driver 1 further includes a motor assembly 7. The motor assembly 7 includes a magnet 8 and a motor pot 9, which forms a return circuit for the magnetic flux. The voice coil 6 can move freely in an air gap 11. Connecting wires 12 are provided, which allow contacting the voice coil 6 from the rear side of the assembly 1. In order to allow for a free movement

of the membrane 4 without adverse effects of air compressed in the space confined by the membrane and the support 2 due to the membrane's displacement, a borehole 14 is provided in the magnet 8. The driver/microphone assembly shown in the figure obviously needs the space for the microphone 2 in addition to the space required for the driver assembly 1. Further, the microphone 2 is placed at a certain distance from the centre of the driver 1. The driver 1 and the microphone 2 are arranged inside the compartment mentioned further above, which is not shown in the figure.

10 In figure 2 a driver/microphone assembly according to the invention is shown. The assembly is arranged inside the compartment (not shown) as discussed with regards to figure 1. The driver 1 is essentially of the same construction as the driver shown in figure 1. In contrast to the known arrangement the magnet 8 is provided with a recess that takes up the microphone 2. In order to allow an acoustic coupling of the microphone 2 with the space inside the compartment, the membrane 4 has an opening 13 above the microphone 2. In this way, the driver 1 and the microphone 2 are located close together and are advantageously arranged on the same acoustical axis. The electrical wires 12 for connecting the microphone 2 are led through a borehole 14 in the motor towards the rear side of the assembly. The originally provided borehole 14 shown in figure 1 is now sealed by the microphone 2. However, the opening 13 in the membrane provides the same effect in the inventive assembly as the borehole 14 in the driver known from the prior art.

25 The invention allows for advantageously improving the sound performance of the microphone/driver arrangement in an active noise cancelling system, in particular in active noise cancelling headsets. In particular, avoiding holders to fix the microphone on an axis with the driver improves the frequency bandwidth. On the other hand, the microphone cannot be covered inadvertently by deformed or displaced ear cushions. Further, the microphone is placed as close as possible to the location, in which the noise cancelling effect is wanted to be maximised. Bringing together the microphone and the driver has the further advantage that the phase difference between the detected signal of the microphone and the sound produced by the membrane is minimised. Again further, the overall size of

the assembly can be significantly reduced, and the production process and mounting of the assembly is facilitated.

Claims

1. Loudspeaker including
- 5 - motor means for responding to an input electrical signal by providing corresponding mechanical displacements;
- supporting means for supporting the motor means;
- membrane means coupled to the motor means for converting mechanical displacement of the motor means into acoustic energy, wherein the membrane means have a circular shape, wherein the membrane means are supported by the supporting means essentially at the outer circumference of the membrane means, and wherein the membrane means are located on one side of the motor means;
- 10 **characterised in that**
- the membrane means have an opening essentially in the centre of the membrane;
- 15 - microphone means are placed essentially between the motor means and the membrane means;
- the microphone means are placed essentially centred to the membrane means.
- 20
2. The loudspeaker of claim 1, **characterised in that** the motor means include a magnet, wherein the magnet has a recess that at least partially accommodates the microphone means.
- 25
3. The loudspeaker of claim 2, **characterised in that** the magnet has a through hole through which connection wires of the microphone means are guided to provide an accessible connection at the rear side of the magnet.
- 30
4. The loudspeaker of any one of the preceding claims, **characterised in that** first and second terminals are secured to the supporting means, wherein the first and second terminals are provided for connecting the loudspeaker and the microphone.

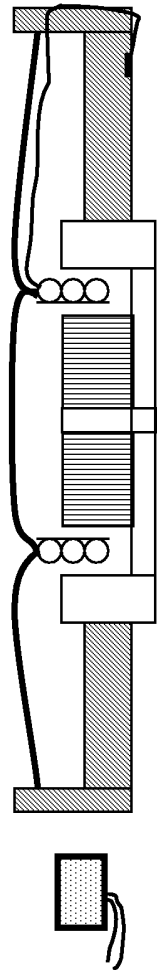


Fig. 1 Prior Art

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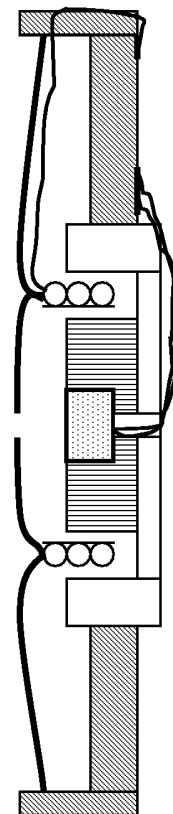


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. H04R1/10 G10K11/178		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) H04R G10K A61F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 468 610 A (MNC, INC) 29 January 1992 (1992-01-29) column 2, line 1 - line 37 column 5, line 14 - line 50 column 6, line 35 - column 8, line 45 figures 1-3	1-4
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<input type="checkbox"/> Further documents are listed in the continuation of Box C.		
<input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents :		
A document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family	
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Name and mailing address of the ISA/ European Patent Office, P.B. 5618 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer <p style="text-align: center;">Coda, R</p>	

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Information on patent family members

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