Title: WATERPROOF MICROPHONE MEMBRANE

Abstract: A waterproof microphone membrane for protecting the microphone (6) of a waterproof device, said device comprising a housing (5), an internal pressure equalizing valve (7) and an external pressure equalizing valve (8). According to the invention, the waterproof microphone membrane comprises a waterproof membrane (1) and a double-sided tape (2).
Waterproof microphone membrane

The invention relates to a waterproof microphone membrane according to the preamble of claim 1.

For instance firemen and construction workers as well as soldiers often have to work in damp and dirty conditions. This sets special requirements to the equipment used by them. Particularly sensitive to moisture and dirt are various electronic devices, for example two-way radios.

Generally the housings of two-way radios or corresponding communication devices are easily protected against moisture and dirt by using sealing at the housing seams or by welding the seams together. However, from the point of view of the use of two-way radios, the essential thing is that the microphones or amplifiers cannot be completely encased inside the housing owing to their acoustic features. On the other hand, a microphone for instance is particularly sensitive to dirt and moisture.

For protecting a microphone, the microphone can be placed inside the device, so that sound is conducted thereto along a waveguide. This does not, however, prevent moisture from penetrating into the device. On the other hand, the microphone can be easily protected from contact and major dirt by protecting its sound opening in the device housing for example by a metal or plastic grill. For protection against moisture, the sound opening can in turn be covered by a waterproof membrane. Conventionally these waterproof membranes are manufactured of a technical membrane material, such as Gore-Tex membrane.

This kind of protection arrangements where the protection against mechanical contact and major dirt is provided by a metal grill or the like, and against moisture by a waterproof membrane, are known for instance from the patent publications US 5,701,355 and US 6,188,773. In the solution of the first publication, the voice opening of the microphone is covered by a waterproof membrane that is held in place by means of a grill locked in the microphone housing. In the other publication, a waterproof membrane is attached to a support collar made for instance of metal, which in turn is attached in place in between the front plate attached by screwing and the microphone housing.
A problem with both described protection arrangements is that the waterproof membrane is attached in place by means of mechanical solutions. These increase manufacturing expenses and restrict the fastening options of the waterproof membrane. In addition, if the employed waterproof membrane is a technical membrane with a porous structure, the membrane can be blocked for instance by oil.

The object of the present invention is to achieve a novel waterproof microphone membrane without the above described drawbacks.

For achieving this, the waterproof microphone membrane according to the invention is characterized by what is set forth in claim 1.

Preferred embodiments of the invention are characterized by what is set forth in the dependent claims.

A waterproof microphone membrane according to the invention is economical and easy to manufacture in large series, and it can easily be attached in the sound openings of the devices to be protected. A waterproof microphone membrane according to the invention has a low acoustic attenuation, and it can easily be cleaned of dirt and dust. In addition, a microphone membrane according to the invention is not blocked by for instance oil.

In the specification below, the invention is described with reference to the appended drawings, where:

Figure 1 illustrates the structural elements of a waterproof microphone membrane according to an embodiment of the invention, seen from the top,

Figure 2 illustrates the structural elements of a waterproof microphone membrane according to an embodiment of the invention, seen from the top,

Figure 3 illustrates a cross-section of the structure of a waterproof microphone membrane according to an embodiment of the invention,

Figure 4 illustrates a cross-section of the structure of a waterproof microphone membrane according to an embodiment of the invention, and

Figure 5 illustrates a waterproof microphone membrane according to an embodiment of the invention, seen as attached to the device to be protected.
Figures 1 and 3 illustrate the structural elements of a waterproof microphone membrane according to a preferred embodiment of the invention, as well as a cross-section of said microphone membrane. The waterproof microphone membrane according to the invention comprises a waterproof non-porous membrane 1 and a double-sided tape 2. The waterproof membrane 1 can be for instance PET membrane, the thickness of which can be for instance 10 micrometers. As for the thickness of the double-sided tape 2, it can be for instance 0.2 or 0.125 millimeters.

Both the waterproof membrane 1 and the double-sided tape 2 are cut in a desired shape for example by laser. This is advantageously carried out in large series from large material sheets. At the same time, in the middle of the double-sided tape 2, there is formed an opening for the passage of sound. The ready-cut waterproof membrane 1 and the double-sided tape 2 are mutually attached by means of the adhesive surface provided on the other side of the double-sided tape. The protective paper or the like provided on the other adhesive surface is held in place, waiting for the fastening of the waterproof microphone membrane in the device to be protected.

Figure 2 and 4 illustrate the structural elements and cross-section of a waterproof microphone membrane according to another preferred embodiment of the invention. The waterproof microphone membrane according to this embodiment differs from the previous example in that it is meant for targets where the microphone membrane is subjected to mechanical contact or other mechanical strain.

The waterproof microphone membrane according to the second preferred embodiment of the invention comprises a waterproof membrane 1, a double-sided tape 2, another double-sided tape 3 and a protective plate 4. As for their properties, the waterproof membrane 1 and both double-sided tapes 2 and 3 are similar to the ones described in the first example. The protective plate 4 can be made of for instance heat-resistant plastic, and it is manufactured for instance by injection molding. It is fastened, by means of double-sided tape 3, to above the waterproof membrane 1, and it is provided with openings for the passage of sound.

Figure 5 illustrates a waterproof microphone membrane according to the invention, seen as attached to the device to be protected. In this example, the device to be protected is for example a boom microphone connected to a safety
helmet or ear protector. The boom microphone comprises a microphone casing 5 and a microphone boom 9.

Inside the microphone casing 5, there is formed a microphone chamber, in which the microphone 6 is placed. The waterproof microphone membrane is glued, by means of the lower adhesive surface of the double-sided tape 2, onto the surface of the microphone casing 5, so that it covers both the microphone chamber and the microphone 6. The protective plate 4 arranged topmost in the waterproof microphone membrane protects both the waterproof membrane 2 and the microphone 6 from impacts and mechanical contact. Thus a separate protective structure is not needed. Against the wind, for example a windshield made of foam plastic can be installed on top of the whole microphone casing.

The microphone chamber is acoustically insulated from the microphone casing 5, and for pressure equalizing, both the microphone casing and the microphone chamber are mutually connected by a pressure equalizing valve 7. The employed pressure equalizing valve can be for instance an extremely thin multifiber cable 7 that is designed so that sound cannot be conducted along it, but slow fluctuations in pressure, such as those caused by fluctuations in the temperature, can be evened out. The thickness of the cable 7 can be for instance 0.25 millimeters.

For equalizing pressure fluctuations between the microphone casing 5 and the surroundings of the device, caused for instance by temperature changes, the housing of the microphone casing 5 is provided with an external pressure equalizing valve 8. The employed pressure equalizing valve can be for instance an opening that is covered by a porous and waterproof membrane 8, for instance Gore-Tex membrane.

For a man skilled in the art, it is obvious that the invention is not restricted to the specification above, but it can be modified within the scope of the claims enlisted below. For example the protective plate 4 can be manufactured of some other material than plastic, for instance of aluminum.
Claims

1. A waterproof microphone membrane for protecting the microphone (6) of a waterproof device, said device comprising a housing (5), an internal pressure equalizing valve (7) and an external pressure equalizing valve (8), characterized in that the waterproof microphone membrane comprises a waterproof membrane (1) and a double-sided tape (2).

2. A waterproof microphone membrane according to claim 1, characterized in that it also comprises a protective plate (4) and another double-sided tape (3).

3. A waterproof microphone membrane according to claim 1 or 2, characterized in that the waterproof membrane is a PET membrane.

4. A waterproof microphone membrane according to any of the preceding claims, characterized in that the protective plate is made of heat-resistant plastic.
Fig. 1

Fig. 2
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC8: H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 6512834 B1 (BANTER et al.) 28 January 2003 (28.01.2003), Figures 3-8 and 11-14; Column 7, rows 33-68, Column 8, rows 1-68 and Column 9, rows 1-35</td>
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Further documents are listed in the continuation of Box C. 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 application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means 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

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