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(54) **MICROPHONE ARRANGEMENT FOR A RADIO DEVICE**

(57) The invention relates to a microphone arrangement (10) for a radio device (60). The microphone arrangement (10) comprises an acoustic chamber (12) which is arranged within a housing (1) of the radio device (60); a sound channel (11) which is arranged to connect the acoustic chamber (12) to an outside of the housing

(1); a cover (2) which is arranged between the acoustic chamber (12) and the sound channel (11); a microphone (4) which is arranged in the acoustic chamber (12); and a foam element (3) which is inserted in the acoustic chamber (12) in order to reduce sound reflections in the acoustic chamber (12) .

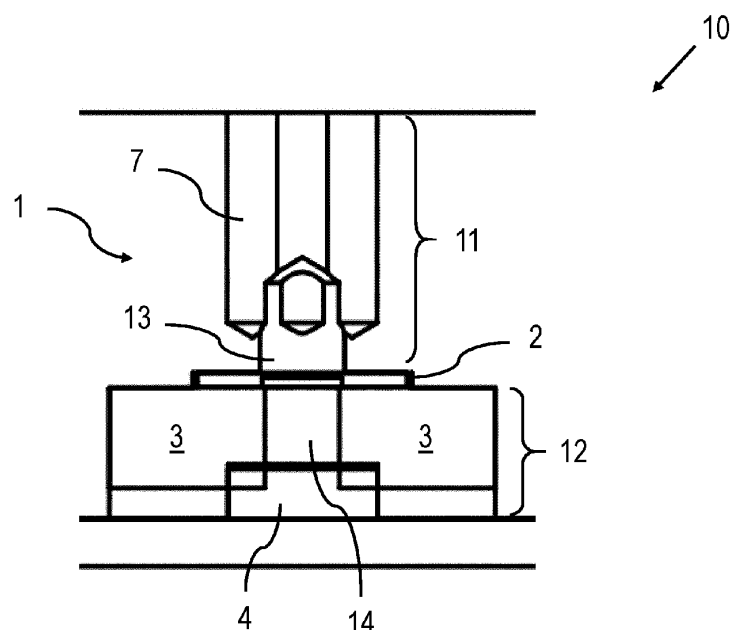


Fig. 1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a microphone arrangement and to a radio device comprising such a microphone arrangement.

BACKGROUND OF THE INVENTION

[0002] Handheld radio transceivers, such as two-way radio transceivers or walkie-talkies, have a microphone to receive speech signals from a user. For the sake of protection, the microphone is often placed on the inside of the radio transceiver. A speech signal from the user can be transmitted to the microphone through an opening in the cover of the device.

[0003] Often, such radio transceivers are carried on the chest or in the shoulder area of the user, such that there is a certain distance between the microphone and the mouth of the user.

[0004] However, the placement of the microphone within the device and the carrying position of the device can negatively affect the audio quality of a received audio signal. In particular, the speech quality of a speech signal can be reduced. For example, the received audio signal can be overlaid by ambient noise or by sound reflections from inside the radio transceiver.

[0005] One way around this problem is to place the microphone in a protected area outside the radio transceiver and closer to the mouth of the user. The document EP 0 686 408 B1, for example, discloses a respiratory mask having an inner mask for covering mouth and nose, wherein the inner mask has a first and a second microphone connectable to a transceiver apparatus. Thereby, the first microphone is located in the inner mask so that when the respiratory mask is worn it is positioned opposite the mouth and is oriented substantially toward the same. The second microphone is oriented substantially towards an inhalation valve. Both microphones pick up ambient noise, but the first microphone favors speech pick-up over ambient noise so that both microphones provide output signals, which can be processed to separate the breathing noise from the speech.

[0006] However, it is desirable to improve the audio quality of a radio transceiver without separation the microphone from the transceiver.

[0007] Thus, it is an objective to provide an improved microphone arrangement, and to provide an improved radio device, which avoid the above-mentioned disadvantages. In particular, it is an objective to provide a microphone arrangement and a radio device with improved audio quality.

SUMMARY OF THE INVENTION

[0008] The object of the present invention is achieved by the solution provided in the enclosed independent

claims. Advantageous implementations of the present invention are further defined in the dependent claims.

[0009] According to a first aspect, the invention relates to a microphone arrangement for a radio device, comprising: an acoustic chamber which is arranged within a housing of the radio device; a sound channel which is arranged to connect the acoustic chamber to an outside of the housing; a cover which is arranged between the acoustic chamber and the sound channel; a microphone which is arranged in the acoustic chamber; and a foam element which is inserted in the acoustic chamber in order to reduce sound reflections in the acoustic chamber.

[0010] This achieves the advantage that the sound quality of the microphone arrangement can be enhanced. In particular, the foam element prevents diffuse scattering and reflections of sound within the acoustic chamber, e.g. from the chamber walls. Thus, an overlay of a speech signal from the user with such reflected or scattered sound signals can be prevented. For example, the speech quality of a received speech signal can be improved in this way.

[0011] The radio device can be a handheld radio transceiver, such as a two-way radio transceiver or a walkie-talkie.

[0012] The housing can be an enclosure or a cover of the radio device.

[0013] In particular, the sound channel connecting the acoustic chamber to the outside of the housing means that the sound channel forms an opening in the housing through which sound signals from the outside, e.g. from the user, can enter.

[0014] The cover can be an acoustic membrane, in particular an acoustic sealing membrane.

[0015] The acoustic chamber can be formed by a cavity in the housing.

[0016] The microphone can be arranged on a bottom side of the acoustic chamber, opposite to the cover. The microphone can comprise means for receiving an audio signal, e.g. a membrane, and an electric connection for transmitting the received audio signal to an electronic circuit of the radio device.

[0017] The foam element can be mechanically flexible and designed to fill up at least an upper section of the acoustic chamber between the microphone and the cover without leaving any gaps except for a sound conducting channel from cover to microphone.

[0018] The foam element can be formed from a synthetic rubber material.

[0019] In an embodiment, the foam element is formed from a polychloroprene material. For example, the polychloroprene material can be neoprene.

[0020] In an embodiment, the foam element is formed from a closed cell foam. This material achieves the advantage that a too strong attenuation of the audio signal by the foam element can be prevented.

[0021] For example, the foam element is formed from closed cell polychloroprene respectively closed cell neoprene. This material has the advantage of being highly

stable at temperature up to 90°C, water resistant und easily compressible.

[0022] In an embodiment, the foam element has a non-circular cross-sectional shape in a plane that lies parallel to the cover. This achieves the advantage the shape of the foam element can prevent rotation and twisting when the foam element is inserted in the acoustic chamber.

[0023] For example, the foam element has a cross sectional-shape of a circular segment in the plane that lies parallel to the cover. The acoustic chamber can be formed correspondingly to allow insertion of the foam element.

[0024] In an embodiment, the acoustic chamber is formed such that the foam element is compressed when being inserted in the acoustic chamber. This achieves the advantage that the foam element can efficiently fill up the acoustic chamber and unwanted air gaps can be avoided. The compression can also hold the foam element in place such that unwanted shifting of the foam element in the acoustic chamber can be avoided.

[0025] In other words, the acoustic chamber can be designed such that the foam element is compressed by the acoustic chamber when it is arranged in the acoustic chamber. For example, in a non-compressed state the foam element has a larger diameter, height and/or volume than the acoustic chamber.

[0026] In an embodiment, the foam element is in physical contact with a section of the microphone. This achieves the advantage that unwanted air gaps around the microphone, which could lead to sound reflections, e.g. diffuse scattering, can be avoided.

[0027] In particular, the foam element exerts a physical pressure against the microphone. For example, the foam element presses against a rim and/or side surface of the microphone.

[0028] In an embodiment, the foam element comprises a through-hole, wherein said through-hole forms a sound conducting channel between the microphone and the cover. This achieves the advantage that the audio signal from the user can be efficiently guided to the microphone.

[0029] The channel can from a sound channel from the cover to the microphone.

[0030] In an embodiment, the through-hole in the foam element is produced by punching. This achieves the advantage that the foam element with a precisely cut and placed through-hole can be produced.

[0031] In particular, punching is advantageous over other fabrication techniques such as water cutting or milling, because these techniques would generate fringes on a side surface of the through-hole or damage the foam element, which would reduce the audio quality.

[0032] For example, the pinched through-hole is round.

[0033] In an embodiment, the cover is configured to transfer sound from the sound channel to the acoustic chamber.

[0034] In an embodiment, the cover is configured to form a watertight seal for the acoustic chamber. This

achieves the advantage that the microphone can be protected from damage or contamination from the environment.

[0035] For example, the cover can be configured to seal off the acoustic chamber and to prevent the entry of dust or fluids, such as oil, gasoline or water, into the acoustic chamber.

[0036] In an embodiment, the cover comprises a polytetrafluoroethylene (PTFE) membrane.

[0037] In an embodiment, the cover is mounted in a recess of the housing of the radio device.

[0038] In an embodiment, the sound channel comprises at least one connecting hole, which is not concentric with the acoustic chamber. This achieves the advantage that, due the non-concentric arrangement of the connecting holes, the microphone can be protected from puncturing through the sound channel.

[0039] The sound channel can comprise a plurality of connecting holes, e.g. four connecting holes, which can form a grid.

[0040] In an embodiment, the sound channel comprises a cavity that is arranged above the cover, wherein the at least one connecting hole is arranged to connect the cavity to the outside of the housing. In this way, a transition from the connecting holes to the acoustic chamber can be formed.

[0041] The cavity can form a junction above the cover from which the connecting holes branch off.

[0042] According to a second aspect, the invention relates to a radio device, comprising: a housing; and the microphone arrangement according to the first aspect of the invention.

[0043] The radio device can be a handheld radio transceiver, such as a two-way radio transceiver or a walkie-talkie.

[0044] The radio device can further comprise a keypad, a loudspeaker, a display and at least one interface. The housing can be an enclosure or a cover of the radio device.

[0045] In an embodiment, the microphone arrangement is arranged adjacent to a loudspeaker of the radio device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] The invention will be explained in the followings together with the figures.

Fig. 1 shows a schematic diagram of a microphone arrangement for a radio device according to an embodiment;

Fig. 2 shows a schematic diagram of a microphone arrangement according to an embodiment;

Fig. 3 shows a schematic diagram of a microphone arrangement according to an embodiment;

Fig. 4 shows a schematic diagram of a foam element according to an embodiment;

Fig. 5 shows an exploded view of a microphone arrangement according to an embodiment; and

Fig. 6 shows a schematic diagram of a radio device according to an embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0047] Fig. 1 shows a schematic diagram of a microphone arrangement for a radio device according to an embodiment. In particular, Fig. 1 shows a cross-sectional view of the microphone arrangement 10.

[0048] The microphone arrangement 10 comprises an acoustic chamber 12 which is arranged within a housing 1 of the radio device, a sound channel 11 which is arranged to connect the acoustic chamber 12 to an outside of the housing 1, and a cover 2 which is arranged between the acoustic chamber 12 and the sound channel 11. The microphone arrangement 10 further comprises a microphone 4, which is arranged in the acoustic chamber 12, and a foam element 3 which is inserted in the acoustic chamber 12 in order to reduce sound reflections within the acoustic chamber 12.

[0049] The housing 1 is, for example, an enclosure or a cover of the radio device. The radio device can be a handheld radio transceiver.

[0050] The sound channel 11 can comprise at least one connecting hole 7. For example, the sound channel 11 comprises a plurality of connecting holes 7, e.g. four connecting holes 7, that form a grid. This grid can be an integral part of the housing 1 or it can be a part of a separate component that is mounted to the housing 1. In particular, the sound channel can be arranged in and/or formed by the housing 1.

[0051] The sound channel 11 can further comprise a cavity 13 directly above the cover 2, wherein the least one connecting hole 4 opens into the cavity. The cavity 13 can form a junction from which the connecting holes 7 branch off.

[0052] Preferably, the at least one connecting hole 7 is not concentric with the central cavity 13 and laterally offset from the cavity 13. For example, the at least one connecting hole 7 and the cavity 13 are only in contact via their respective side surfaces. In this way, a puncture protection for the acoustic chamber 12 and the microphone 4 can be generated, because an object that punctures the connecting hole 7 only hits the bottom side of the hole 7, but does not penetrate the cavity 13 or the acoustic chamber 12.

[0053] The cover 2 can be configured to transfer sound, e.g. an audio signal from the user, from the sound channel 11 to the acoustic chamber 12. For example, the cover 2 is an acoustic membrane, which can transfer sound via vibration.

[0054] Alternatively, the cover 2 can be at least partially permeable to sound.

[0055] The cover 2 can be designed to form a water-tight seal for the acoustic chamber 12. For example, cover 2 is designed to seal off the acoustic chamber 12 and to prevent the entry of dust or fluids, such as oil, gasoline or water, into the acoustic chamber 12.

[0056] The cover 2 can be a polytetrafluoroethylene (PTFE) membrane, which, e.g., comprises a PTFE fabric.

[0057] The cover 2 can be mounted in a recess of the housing 1 above the acoustic chamber 12, such that it covers the acoustic chamber 12.

[0058] The acoustic chamber 12 can be formed by a cavity in the housing 1.

[0059] The microphone 4 can be arranged on a bottom side of the acoustic chamber, opposite to the cover 2. The microphone 4 can comprise a sound absorbing element, e.g. a membrane, and an electric connection for transmitting the received signal to an electronic circuit of the radio device. The microphone 4 can be a condenser microphone or any other suitable type of microphone.

[0060] In particular, the foam element 3 essentially fills up at least an upper section of the acoustic chamber 12 adjacent to the cover 2. The acoustic chamber 12 can be formed such that the foam element 3 is compressed when being inserted in the acoustic chamber (i.e., when it is arranged in the acoustic chamber). For example, the acoustic chamber 12 has a smaller diameter than the foam element 3 in a non-compressed state. In this way, the air volume in the acoustic chamber 12 between microphone 4 and cover 2 can be reduced, which reduces sound reflections, e.g. diffuse scattering, in the acoustic chamber 12.

[0061] Preferably, the foam element 3 comprises a foam body with a through-hole 14. Said through-hole 14 can form a sound conducting channel between the microphone 4 and the cover 2 when the foam element 3 is inserted in the acoustic chamber 12.

[0062] The foam element 3 can be in physical contact with the microphone 4 and can exert a physical force against the microphone 4, i.e. it can press against the microphone 4, when it is inserted in the acoustic chamber. In this way, any unwanted air gaps in the acoustic chamber 12, besides the channel above the microphone 4, can be avoided.

[0063] For example, an audio signal can enter the radio device via the sound channel 11. The sound channel 11 guides the signal to the cover 2, which transmits the signal to the underlying acoustic chamber 12. In the acoustic chamber 12, the foam element 3 guides the sound signal directly to the microphone 4 via its through-hole 14. Thereby, the foam element 3 prevents unwanted reflections and scattering of the sound signal within an air volume in the acoustic chamber. In this way, the sound quality of an audio signal received by the microphone 4 can be enhanced.

[0064] Fig. 2 shows a schematic diagram of the microphone arrangement 10 according to an embodiment.

[0065] In the microphone arrangement 10 shown in Fig. 2, the microphone 4 is mounted on a backplate 6, which closes the acoustic chamber 12 on a bottom side.

[0066] The backplate 6 can be a printed circuit board (PCB) of the radio device. A part of the electrical components of the radio device can be arranged on this PCB 6.

[0067] The backplate 6 can be mounted to the housing 1. Gaskets 5 can be arranged between the backplate 6 and the housing 1 to further seal off the acoustic chamber 12.

[0068] Fig. 3 shows a schematic diagram of the microphone arrangement 10 according to a further embodiment.

[0069] In the embodiment shown in Fig. 3, the sound channel 11, the cover 2 and the through-hole 14 of the foam element 3 are laterally offset to a central axis of the acoustic chamber 12.

[0070] Besides this lateral offset, the microphone arrangement 10 shown in Fig. 3 can be essentially identical to the microphone arrangements 10 as shown in Fig. 1 or 2.

[0071] Fig. 4 shows a schematic diagram of a foam element 3 according to an embodiment.

[0072] The foam element 3 can be formed from a synthetic rubber material.

[0073] In particular, the foam element 3 is formed from a polychloroprene material, such as neoprene. The foam element 3 can be formed from a closed cell foam, e.g. closed cell polychloroprene respectively closed cell neoprene.

[0074] Using closed cell polychloroprene as material for the foam element 3 can lead to several advantages: On the one hand, using a closed cell foam prevents a too strong attenuation of the audio signal in the acoustic chamber (compared to open cell foam). On the other hand, closed cell polychloroprene is highly stable at temperature up to 90°C, water resistant und easily compressible.

[0075] The foam element 3 can have a non-circular cross-sectional shape in a plane that lies parallel to the cover 2 when the foam element 3 is inserted in the acoustic chamber. For example, the foam element 3 has a cross sectional-shape of a circular segment as shown in Fig. 4. The foam element 3 can be a cylindrical plate with a, preferably, non-circular base. The foam element 3 can have a non-rotationally-symmetric cross-sectional shape.

[0076] In particular, the shape of the acoustic chamber 12 essentially corresponds to the shape of the foam element 3, e.g. the cross-sectional shape of the acoustic chamber 12 in a plane parallel to the cover 2 may correspond to the cross-sectional shape of the foam element 3 in the same plane. The cover 2 can be shaped as a flat disc that defines a plane.

[0077] The non-circular shape of the foam element 3 can prevent rotation and twisting of the foam element 3 when it is inserted in the acoustic chamber 12. This is

advantageous because if the through-hole 14 is offset to a rotation axis of the foam element 3, a rotation of the foam element 3 would shift the through-hole 14 away from an ideal position above the microphone 4.

[0078] The through-hole 14 in the foam element 3 can be produced by a punching process. Thereby, a round sleeve can be punched out of the foam element 3 to produce the through-hole 14. In particular, punching is advantageous to other fabrication techniques, such as water cutting or milling. For example, water cutting can lead to a breaking of the cells of the closed cell foam, which can negatively affect audio quality, and milling is not suitable because the foam material is too soft.

[0079] Fig. 5 shows an exploded view of the microphone arrangement 10 according to an embodiment.

[0080] The foam element 3 in Fig. 5 has a roundish shape with a flat edge. The acoustic chamber 12 in the housing 1 has a corresponding shape. Preferably, the acoustic chamber 12 is shaped in such a way that the foam element 3 is compressed when being inserted in the acoustic chamber 12.

[0081] The acoustic chamber 12 can be sealed off via the cover 2 and the gasket 5, e.g. an O-ring. Thus, it can be prevented that liquids or dust from the outside or from within the device can enter the acoustic chamber 12.

[0082] Fig. 6 shows a schematic diagram of a radio device 60 according to an embodiment.

[0083] The radio device 60 comprises a housing 1 and a microphone arrangement 10 according to any one of Figs. 1, 2, 3 or 4.

[0084] The radio device 60 can be a handheld radio transceiver, such as a two-way radio transceiver or a walkie-talkie. For example, the radio device 60 is an ergonomic hands-free radio that can be carried by the user on the chest or in the shoulder area. The radio device 60 can be used as personalized radio.

[0085] The housing 1 can be an enclosure or a cover of the radio device 60. The microphone arrangement 10 can be arranged adjacent to a loudspeaker 61 of the radio device 60. For example, only the entrance of the sound channel 11, which can be formed by a grid of the connecting holes 4, is visible from the outside of the radio device 60.

[0086] The radio device 60 can further comprise a display 62, a keypad 63 and at least one user interface, e.g. formed by a number of buttons on the housing 1.

[0087] All features described above or features shown in the figures can be combined with each other in any advantageous manner within the scope of the invention.

Claims

1. A microphone arrangement (10) for a radio device (60), comprising:

an acoustic chamber (12) which is arranged within a housing (1) of the radio device (60);

- a sound channel (11) which is arranged to connect the acoustic chamber (12) to an outside of the housing (1);
 a cover (2) which is arranged between the acoustic chamber (12) and the sound channel (11);
 a microphone (4) which is arranged in the acoustic chamber (12); and
 a foam element (3) which is inserted in the acoustic chamber (12) in order to reduce sound reflections in the acoustic chamber (12).
2. The microphone arrangement (10) of claim 1, wherein the foam element (3) is formed from a polychloroprene material.
 3. The microphone arrangement (10) of claim 1 or 2, wherein the foam element (3) is formed from a closed cell foam.
 4. The microphone arrangement (10) of any one of the preceding claims, wherein the foam element (3) has a non-circular cross-sectional shape in a plane that lies parallel to the cover (2).
 5. The microphone arrangement (10) of any one of the preceding claims, wherein the acoustic chamber (12) is formed such that the foam element (3) is compressed when being inserted in the acoustic chamber (12).
 6. The microphone arrangement (10) of any one of the preceding claims, wherein the foam element (3) is in physical contact with a section of the microphone (4).
 7. The microphone arrangement (10) of any one of the preceding claims, wherein the foam element (3) comprises a through-hole (14), wherein said through-hole (14) forms a sound conducting channel between the microphone (4) and the cover (2).
 8. The microphone arrangement (10) of claim 7, wherein the through-hole (14) in the foam element (3) is produced by punching.
 9. The microphone arrangement (10) of any one of the preceding claims, wherein the cover (2) is configured to transfer sound from the sound channel (11) to the acoustic chamber (12).
 10. The microphone arrangement (10) of any one of the preceding claims, wherein the cover (2) is configured to form a water-tight seal for the acoustic chamber (12).
 11. The microphone arrangement (10) of any one of the preceding claims, wherein the cover (2) comprises a polytetrafluoroethylene, PTFE, membrane.
 12. The microphone arrangement (10) of any one of the preceding claims, wherein the cover (2) is mounted in a recess of the housing (1) of the radio device (60).
 13. The microphone arrangement (10) of any one of the preceding claims, wherein the sound channel (11) comprises at least one connecting hole (7) which is not concentric with the acoustic chamber (12).
 14. The microphone arrangement (10) of claim 13, wherein the sound channel (11) comprises a cavity (13) that is arranged above the cover (2); wherein the at least one connecting hole (7) is arranged to connect the cavity (13) to the outside of the housing (1).
 15. A radio device (60), comprising:
 - a housing (1); and
 - the microphone arrangement (10) of any one of the preceding claims.
 16. The radio device (60) of claim 15, wherein the microphone arrangement (10) is arranged adjacent to a loudspeaker (61) of the radio device (60).

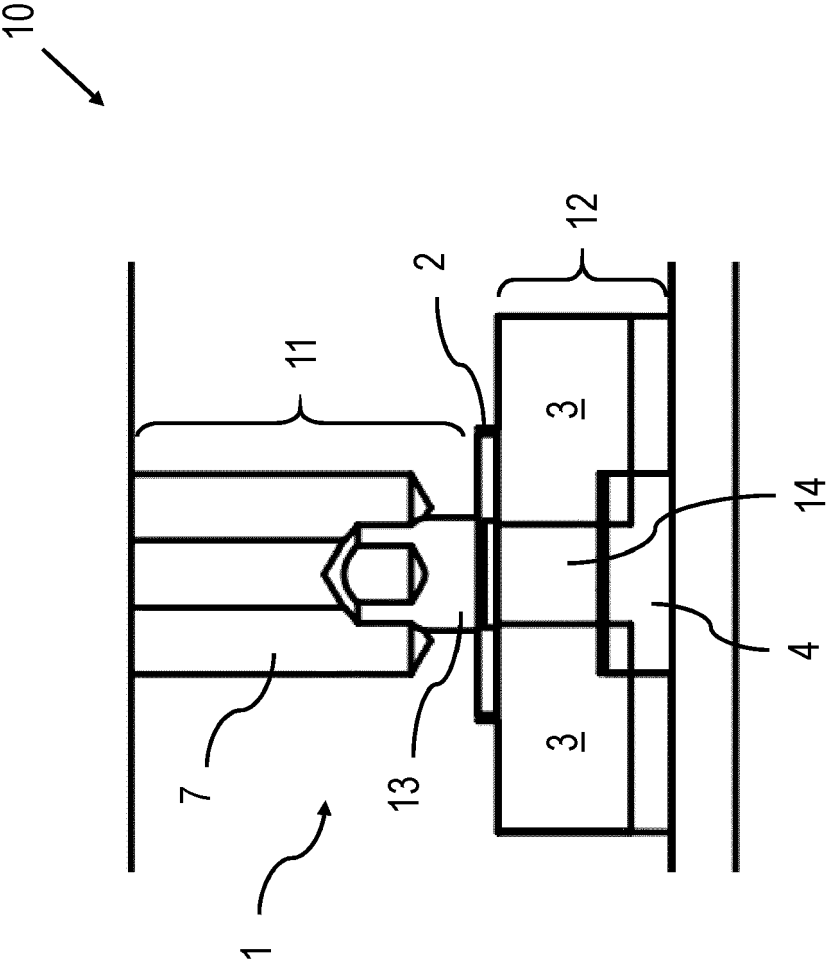


Fig. 1

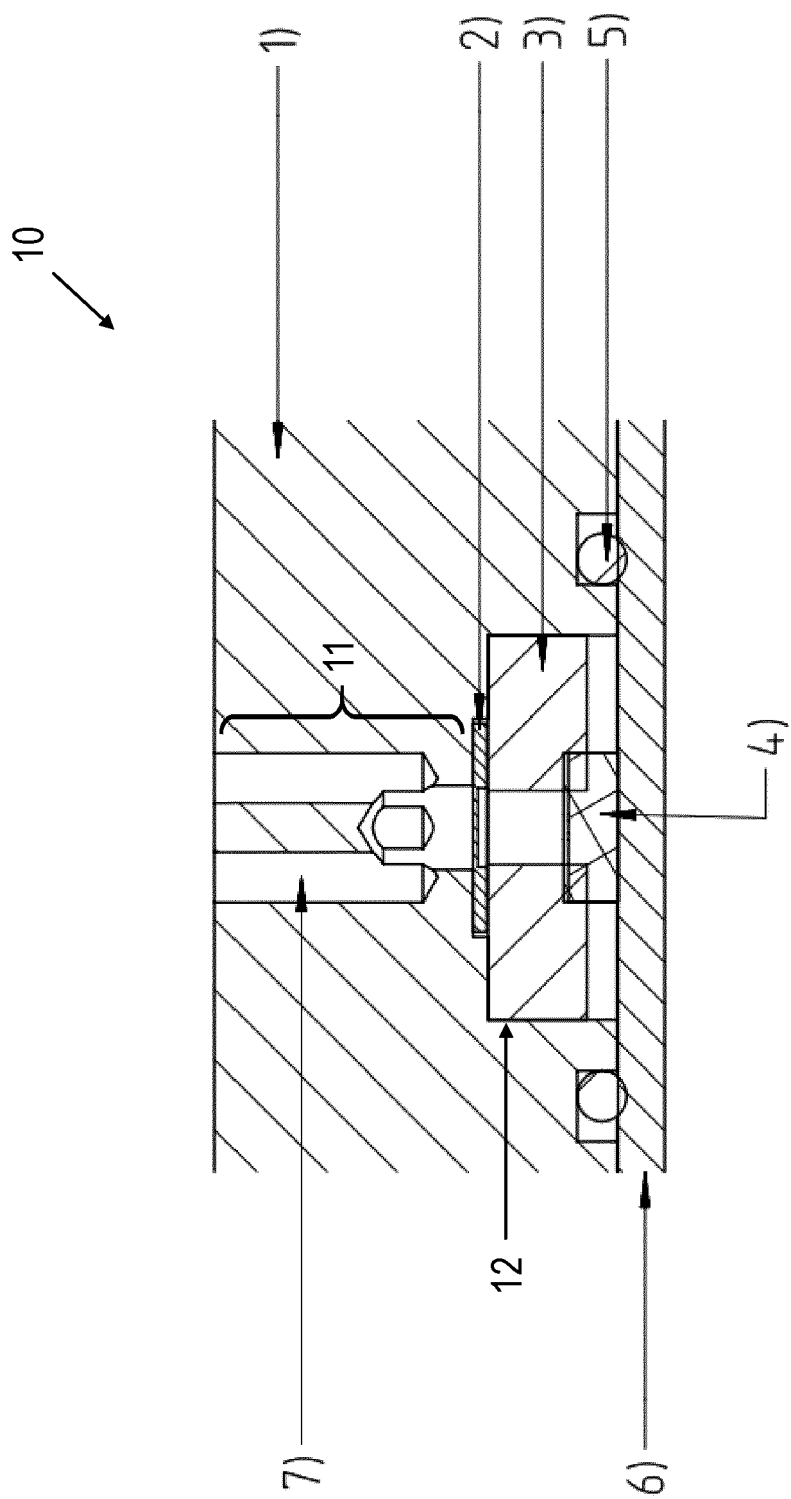


Fig. 2

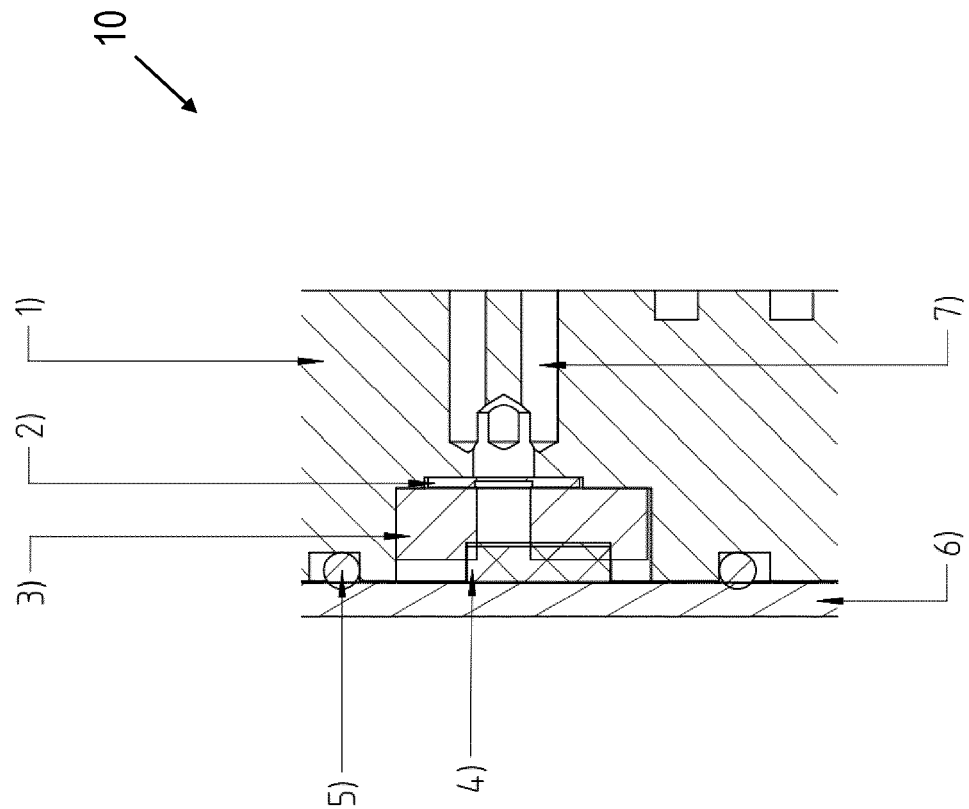


Fig. 3

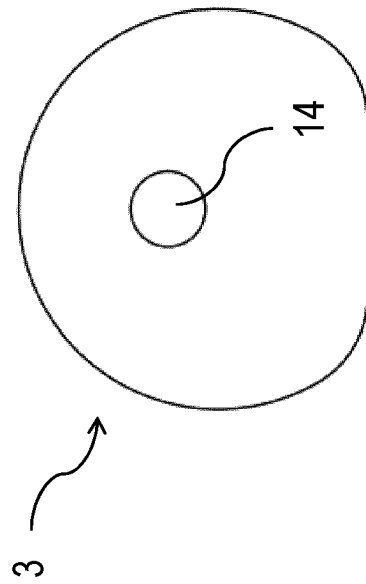


Fig. 4

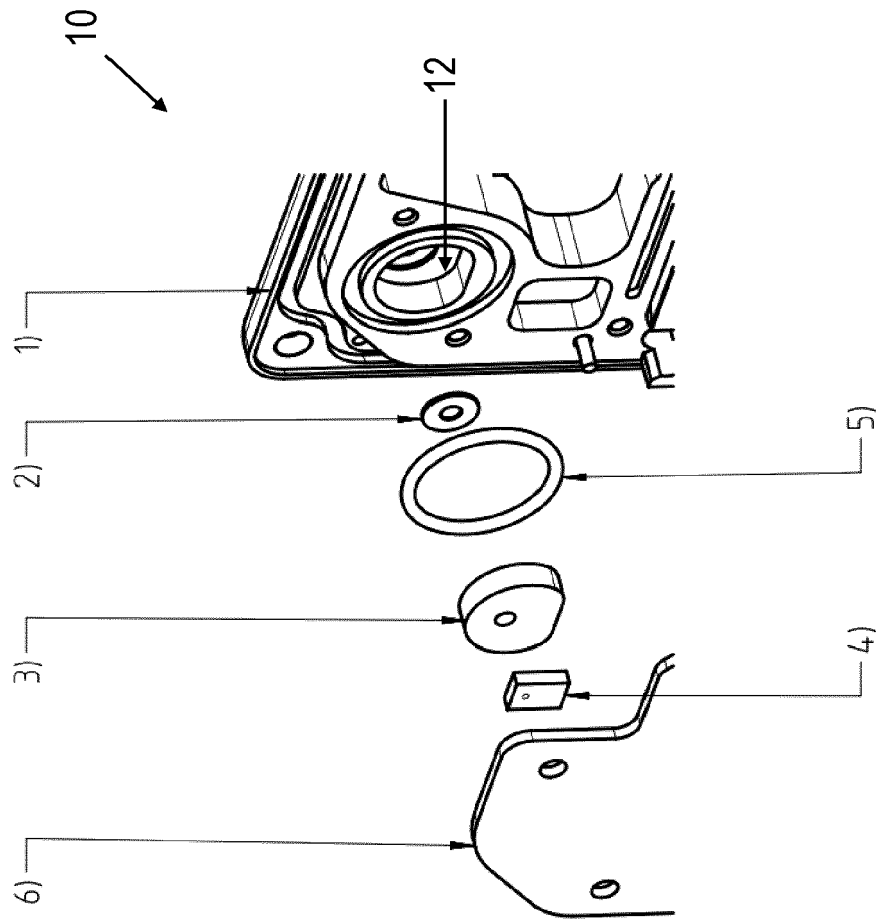


Fig. 5

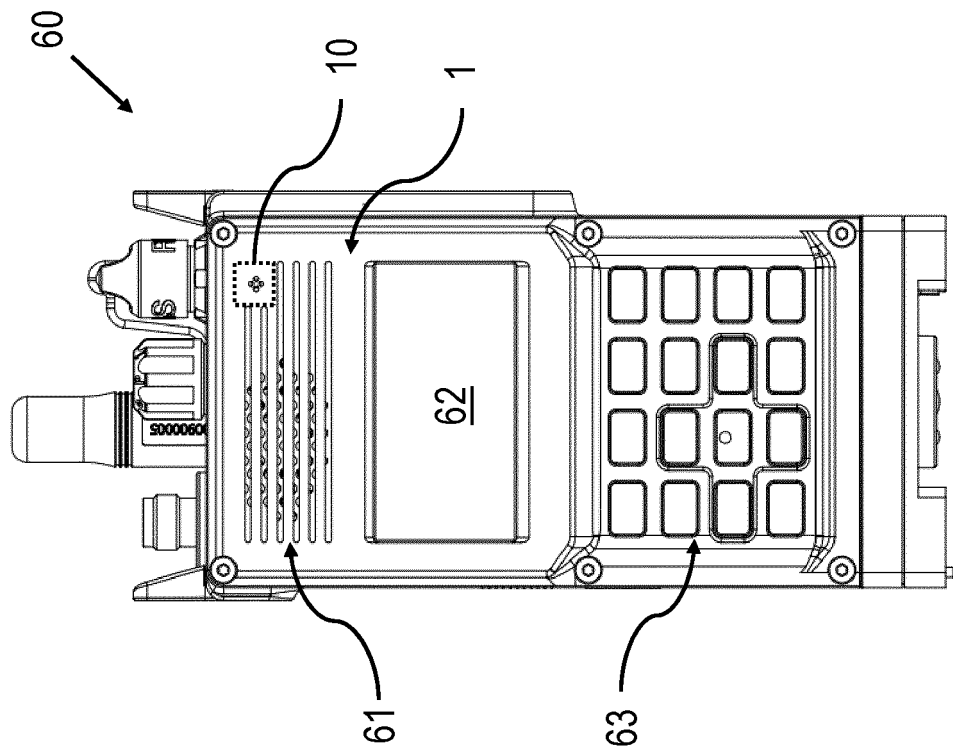


Fig. 6



EUROPEAN SEARCH REPORT

Application Number

EP 21 18 4660

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	JP 2001 333475 A (MATSUSHITA ELECTRIC IND CO LTD) 30 November 2001 (2001-11-30) * paragraphs [0001], [0025]; figures 1-3, 7, 9-10 *	1-10, 13-16	INV. H04R1/08 H04R1/28
Y	US 2012/008794 A1 (GRATKE JESSE T [US]) 12 January 2012 (2012-01-12) * paragraphs [0030], [0033]; figures 2, 6 *	1-5, 8-10, 13-16	
Y	EP 0 333 411 A2 (UNIV ESSEX [GB]) 20 September 1989 (1989-09-20) * column 2, lines 15-16 * * column 7, lines 19-36; figures 1-3 *	1-3, 5-10, 13-16	
Y	US 2019/394550 A1 (MENNITT DANIEL J [US]) 26 December 2019 (2019-12-26) * paragraph [0024]; figures 1A, 1B, 1C *	2, 3	
Y	WO 2014/107734 A2 (CATALYST LIFESTYLE LTD [CN]; LAI JUNE [CN]; WRIGHT JOSHUA [CN]) 10 July 2014 (2014-07-10) * paragraph [0062]; figures 1, 2, 4A, 4B, 9 *	5	TECHNICAL FIELDS SEARCHED (IPC) H04R
Y	US 2020/234686 A1 (HOSODA KOSUKE [JP] ET AL) 23 July 2020 (2020-07-23) * paragraphs [0001], [0021], [0079]; figures 3, 5(b), 6(b) *	8	
Y	US 2013/251183 A1 (DOLLER ANDREW J [US] ET AL) 26 September 2013 (2013-09-26) * paragraph [0018]; figures 1-7 *	13, 14	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 February 2022	Examiner Fachado Romano, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



Application Number

EP 21 18 4660

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

1-10, 13-16

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 21 18 4660

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-4, 6, 7, 9, 10, 15, 16

Obvious microphone arrangement and corresponding radio device.

2. claim: 5

Microphone arrangement comprising means to reduce further sound reflections in the acoustic chamber.

3. claim: 8

Microphone arrangement comprising a specific sound guide to the microphone.

4. claim: 11

Microphone arrangement comprising an alternative cover material.

5. claim: 12

Microphone arrangement comprising an alternative arrangement for the cover.

6. claims: 13, 14

Microphone arrangement comprising means for protecting acoustic chamber and microphone from punctures.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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