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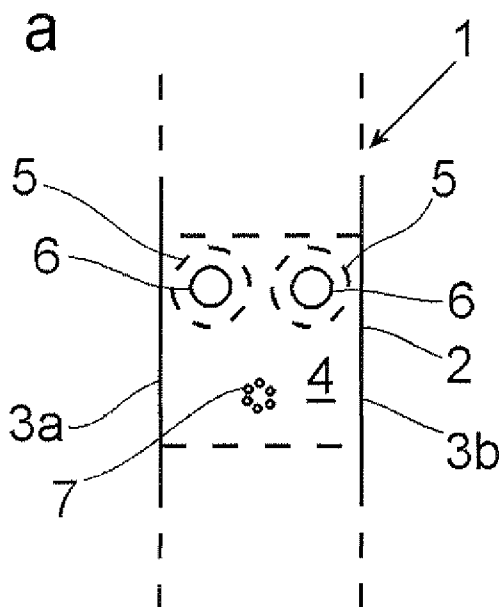
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(54) Title: **SPEAKER APPARATUS OF A WIRELESS COMMUNICATION DEVICE**



(57) Abstract: The invention relates to a speaker apparatus (1) of a wireless communication device, the speaker apparatus (1) comprising a housing (2) comprising several side walls (3a,...3d) defining a space (4) therebetween, the space (4) for accommodating sound transducers (5) therein, the housing (2) comprising outputs (6,7) for transmitting sound generated by the sound transducers (5). For providing high quality stereo sound in hands free mode and high quality sound in handset mode with a housing (2) of the speaker apparatus (1) having a reduced size, two sound transducers (5) are provided being capable of generating sound with the same frequency response and the same phase response, at least two high pressure outputs (6) are arranged relative to the two sound transducers (5) such that stereo sound with a high sound pressure generated by the two sound transducers (5) could be transmitted to the user and at least one low pressure output (7) is arranged relative to the two sound transducers (5) such that sound with a low sound pressure generated by the two sound transducers (5) could be transmitted to the user.

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Speaker apparatus of a wireless communication device

The invention relates to a speaker apparatus of a wireless communication device, the speaker apparatus comprising a housing comprising several side walls defining a space therebetween, the space for accommodating sound transducers therein, the housing comprising outputs for transmitting sound generated by the sound transducers.

Moreover, the invention relates to a method for controlling a speaker apparatus of a wireless communication device, wherein the speaker apparatus comprises a housing comprising several side walls defining a space therebetween, the space for accommodating sound transducers therein, the housing comprising outputs for transmitting sound generated by the sound transducers.

A portable hand-held apparatus such as a mobile phone comprises a speaker apparatus nowadays. An acoustic audio technology plays an important role for the user of such an apparatus. Using the example of a mobile phone, said mobile phone typically has an earpiece speaker. The earpiece speaker can be a device which is held against the user's ear to listen.

Also an integrated hands free speaker (IHF speaker) is known for use with mobile phones or the like. The IHF speaker is a device, which has loud enough sound to allow the user to listen without the need of holding the phone directly against the user's ear.

Earpiece speakers and IHF speakers, respectively, require sound outputs being directed to the side walls of the housing of a corresponding speaker apparatus. The sound output of an earpiece speaker, also called low pressure output in the following, is used for transmitting sound with a low sound pressure generated by a membrane or the like as sound transducer. The low pressure output is

arranged such that it could be easily reached and could be covered by the user's ear. The sound output of an IHF speaker, also called high pressure output in the following, is used for transmitting sound with a high sound pressure generated by a corresponding sound transducer.

The speaker apparatus of the wireless communication device, e.g. of the mobile phone, may be switched by the user or may switch automatically between hands free mode and handset mode. Hands free mode means that the sound generated by the IHF speaker is transmitted to the user through the respective high pressure output with a high sound pressure, such that the user is not required to hold the communication device directly against his ear. Handset mode means that the sound generated by the earpiece speaker is transmitted to the user through the respective low pressure output with a low sound pressure, such that the user may listen to the sound by holding his ear against the low pressure output.

The users of wireless communication devices described above require more and more handsets which may be used with stereo loudspeakers for music and video playing. This requires three small loudspeakers, that is two loudspeakers for stereo speaker function and one loudspeaker for the earpiece function. This leads to a relatively complicated structure of a communication device having relatively large dimensions.

To reduce the complexity the number of sound transducers, that is speakers, may be reduced. But the problem of such an arrangement would be that for generating optimum stereo sound the stereo speakers have to be substantially identical. At least, both speakers used for generating stereo sound have to be capable of generating sound with substantially identical frequency response and phase response. Therefore, an arrangement using only two loudspeakers for both generating sound with a low sound pressure as well as sound with a high sound pressure is problematic insofar that it destroys the delicate acoustic symmetry which is required for generating stereo sound in a high quality. Therefore, in the state of the art, there exists no adequate solution which is capable of providing high

quality stereo sound in hands free mode and high quality sound in handset mode using a device with less than three speakers.

It is an object of the invention to provide a speaker apparatus of a wireless communication device which provides high quality stereo sound in hands free mode and high quality sound in handset mode with at the same time reduced housing sizes.

According to an aspect of the present invention a speaker apparatus of a wireless communication device of the type described above is provided, wherein two sound transducers are provided being capable of generating sound with the same frequency response and the same phase response, at least two high pressure outputs are arranged relative to the two sound transducers such that stereo sound with a high sound pressure generated by the two sound transducers could be transmitted to the user and at least one low pressure output is arranged relative to the two sound transducers such that sound with a low sound pressure generated by the two sound transducers could be transmitted to the user.

In other words, on one hand the housing size of the speaker apparatus may be reduced to a minimum, since only two sound transducers are provided. On the other hand, at the same time high quality stereo sound can be generated by using both sound transducers, which are designed in a symmetrical way for generating sound with the same frequency response and the same phase response, as typical stereo loudspeakers, that is by generating stereo sound with a high sound pressure which could be transmitted to the user through corresponding high pressure outputs.

Moreover, for handset mode an earpiece function is provided by arranging a low pressure output relative to the sound transducers in such a way that a virtual third transducer is created. Since the two sound transducers and the low pressure output are arranged relative to each other in such a way that a virtual earpiece speaker is created, a real earpiece speaker is made superfluous.

The arrangement according to the present invention has the advantage that high quality stereo sound may be generated by a speaker apparatus in hands free mode and high quality sound may be generated in handset mode, both with a housing size reduced to a minimum.

According to another aspect of the present invention each one of the at least two high pressure outputs is arranged relative to one respective sound transducer such that the sound generated by the respective sound transducer could be transmitted through the respective high pressure output to the user. In this case there are in sum three outputs provided for transmitting the sound, two outputs for the high pressure stereo sound and one output for the low pressure earpiece sound.

According to yet another aspect of the present invention at least two low pressure outputs are provided, the low pressure outputs being arranged such that they all could be covered by the user's ear. When using more than one low pressure output the single outputs could be designed with a smaller diameter, the plurality of outputs thereby forming a protective cover of the housing which at the same time allows the transmitting of sound through the cover.

According to a further aspect of the present invention the two sound transducers both have the same distance from the center of the at least one low pressure output. When using more than one low pressure output the sound transducers have the same distance from the center of the plurality of the low pressure outputs. Such an arrangement leads to an optimum quality of the sound transmitted through the at least one low pressure output. For example, it is possible to arrange the center of the at least one low pressure output in the middle between the two sound transducers, which leads to a housing of the speaker apparatus of a relatively small size.

According to another aspect of the present invention the at least two high pressure outputs and the at least one low pressure output are directed to the same side wall of the housing. It is also possible to direct the at least two high pressure outputs to a different side wall than the at least one low pressure output, for example to a side

wall opposite to the side wall to which the at least one low pressure output is directed. According to another possible arrangement the two high pressure outputs are directed to two opposite side walls, respectively, and the at least one low pressure output is directed to a further side wall connecting the two opposite side walls with each other.

According to a further aspect of the present invention the sound transducers comprise a membrane. Transducers comprising a membrane provide high quality stereo sound. Especially when using membranes, but also when using other kinds of transducers, it is possible to generate the sound with the high sound pressure to be directed in a first direction and to generate the sound with the low sound pressure to be directed in a second direction opposite to the first direction. In this case the high pressure outputs and the low pressure outputs may be directed to opposite side walls, respectively. This leads to an arrangement with which the stereo sound may be directed in a first direction and the low pressure earpiece sound in an opposite direction. Such an arrangement also leads to a further reduction of the size of the housing, since both the high pressure outputs and the low pressure outputs may be directed to the same area of the communication device, that is at the same height, wherein for example one of which is provided at the backside and the other one at the front side.

According to another aspect of the present invention the high pressure sound and the low pressure sound, respectively, are taken from opposite sides of the sound transducers, especially from opposite sides of the transducer membrane. This is for example advantageous in an embodiment with one kind of output, e.g. the high pressure output, at the back side or lateral sides and the other kind of output, e.g. the low pressure output, at the front side. But it is also possible to provide an embodiment with all outputs at the same side, nevertheless the high pressure sound and the low pressure sound, respectively, being taken from opposite sides of the sound transducers.

Alternatively it is also possible to take, independent of the position of the outputs, the high pressure sound and the low pressure sound, respectively, from the same side of the sound transducers, especially from the same side of the transducer membrane.

According to yet another aspect of the present invention a means is provided for carrying out stereo widening. Such a means has the following advantage. Conventional wisdom requires the stereo speakers not only to be substantially identical, but also to be located as far away from each other as possible. The recommended configuration is typically that the listener and the speakers should form an equally sided triangle. However, high quality stereo widening algorithms allow the generation of stereo sound with a good quality in case that the stereo speakers are arranged very near to each other. Therefore, according to the present invention the two transducers may be placed with a minimum distance to each other, thereby further reducing the size of the housing of the speaker apparatus, and at the same time providing high quality stereo sound to the user.

According to a further aspect of the present invention the speaker apparatus is part of a mobile phone. A mobile phone with the above described features has a relatively small size and may be used for music playing or video viewing thereby providing excellent acoustical symmetry.

According to another aspect of the present invention a method for controlling a speaker apparatus of the wireless communication device is provided, wherein two sound transducers are provided which are arranged relative to at least two high pressure outputs and at least one low pressure output in such a way that the two sound transducers acoustically operate as stereo speakers in hands free mode and as an earpiece speaker in handset mode.

According to a further aspect of the present invention the two sound transducers generate sound with a high sound pressure in the hands free mode and generate sound with a low sound pressure in the handset mode.

The aforementioned method provides, as already described above, high quality stereo sound in hands free mode and optimum low pressure sound in handset mode, wherein at the same time the size of the housing of the speaker apparatus may be reduced to a minimum.

The features of the present invention presented above as well as other features will now be described in greater detail with reference to the attached drawings, wherein:

Fig. 1a illustrates in a schematic top view a speaker apparatus of a wireless communication device according to a first embodiment of the present invention,

Fig. 1b illustrates a sectional side view of the embodiment of Fig. 1a,

Fig. 2a illustrates in a schematic top view a speaker apparatus of a wireless communication device according to a second embodiment of the present invention, and

Fig. 2b illustrates a sectional side view of the embodiment of Fig. 2a.

Figures 1a and 1b schematically show a speaker apparatus 1 according to a first embodiment of the present invention. The speaker apparatus 1 comprises a housing 2, the housing comprising several side walls 3a, 3b, 3c, 3d defining a space 4 therebetween, the space 4 for accommodating two sound transducers 5 therein. In the top view (Fig. 1a) the sound transducers 5 are illustrated by a dashed line, since they are not visible from the outside of the housing 2.

Furthermore, the housing 2 comprises two high pressure outputs 6, each one of which corresponds to and is placed in front of a respective one of the sound transducers 5. The high pressure outputs 6 are thereby arranged relative to the two sound transducers 5 in such a way that stereo sound with a high sound pressure and a high sound quality could be transmitted to the user.

Moreover, a plurality of low pressure outputs 7 is arranged relative to the sound transducers 5 such that sound with a low sound pressure generated by the two sound transducers 5 could be transmitted to the user in a high quality, too. As can be seen from Fig. 1a, the two sound transducers 5 both have the same distance from the center of the plurality of low pressure outputs 7. Moreover, the plurality of low pressure outputs 7 is arranged in such a way that all outputs may be covered by the user's ear for optimum earpiece sound. Furthermore, as can be especially seen from Fig. 1b, the high pressure outputs and the low pressure outputs are directed to the same side wall 3d of the housing 2.

As can be seen from Fig. 1b the high pressure sound and the low pressure sound, respectively, are taken from the same side of the sound transducers 5, in this case from the same side of the transducer membrane.

The embodiment of a speaker apparatus 1 illustrated in Figures 1a and 1b has the advantage that high quality stereo sound can be generated and transmitted through first outputs 6 to the user with a high sound pressure in hands free mode, whereas in handset mode high quality low pressure sound can be transmitted to the user through further outputs 7, wherein for generating the high pressure sound on one hand and the low pressure sound on the other hand only two single sound transducers 5 are necessary, thereby at the same time providing a relatively small sized housing 2 of the speaker apparatus 1.

An alternative embodiment of a speaker apparatus 1 according to the present invention is shown in Figures 2a and 2b. Fig. 2a illustrates a schematic top view corresponding to Fig. 1a and Fig. 2b illustrates a schematic sectional side view corresponding to Fig. 1b.

The embodiment of Figure 2a and 2b differs from the first embodiment described in relation to Figures 1a and 1b in that the plurality of low pressure outputs 7 is arranged in a side wall 3c opposite to the side wall 3d in which the high pressure outputs 6 are provided.

As can be seen from Fig. 2b the high pressure sound and the low pressure sound, respectively, are taken from opposite sides of the sound transducers 5, in this case from opposite sides of the transducer membrane. Thereby the two sound transducers 5 generate the sound with the high sound pressure to be directed in a first direction, such that the sound is transmitted to the user through the high pressure outputs 6 in the first side wall 3d, whereas the same sound transducers 5 generate the sound with the low sound pressure to be directed in a second direction opposite to the first direction such that the low pressure sound is transmitted to the user through the low pressure outputs 7 directed to the opposite side wall 3c. In this special case the high pressure outputs 6 and the low pressure outputs 7 are arranged in the same area of the housing 2 of the speaker apparatus 1, which leads to a possibility to further reduce the size of the housing 2.

CLAIMS

1. A speaker apparatus (1) of a wireless communication device, the speaker apparatus (1) comprising a housing (2) comprising several side walls (3a,...3d) defining a space (4) therebetween, the space (4) for accommodating sound transducers (5) therein, the housing (2) comprising outputs (6,7) for transmitting sound generated by the sound transducers (5),

characterized in that

two sound transducers (5) are provided being capable of generating sound with the same frequency response and the same phase response,

at least two high pressure outputs (6) are arranged relative to the two sound transducers (5) such that stereo sound with a high sound pressure generated by the two sound transducers (5) could be transmitted to the user and

at least one low pressure output (7) is arranged relative to the two sound transducers (5) such that sound with a low sound pressure generated by the two sound transducers (5) could be transmitted to the user.

2. The speaker apparatus (1) of claim 1, wherein each one of the at least two high pressure outputs (6) is arranged relative to one respective sound transducer (5) such that the sound generated by the respective sound transducer (5) could be transmitted through the respective high pressure output (6) to the user.
3. The speaker apparatus (1) of claim 1, wherein at least two low pressure outputs (7) are provided, the low pressure outputs (7) being arranged such that they all could be covered by the user's ear.

4. The speaker apparatus (1) of claim 1, wherein the two sound transducers (5) both have the same distance from the center of the at least two low pressure outputs (7).
5. The speaker apparatus (1) of claim 1, wherein the center of the at least one low pressure output (7) is arranged in the middle between the two sound transducers (5).
6. The speaker apparatus (1) of claim 1, wherein the at least two high pressure outputs (6) and the at least one low pressure output (7) are directed to the same side wall (3d) of the housing (2).
7. The speaker apparatus (1) of claim 1, wherein the at least two high pressure outputs (6) are directed to a different side wall (3c) than the at least one low pressure output (7).
8. The speaker apparatus (1) of claim 7, wherein the at least two high pressure outputs (6) are directed to a side wall (3d) opposite to the side wall (3c) to which the at least one low pressure output (7) is directed.
9. The speaker apparatus (1) of claim 1, wherein the two high pressure outputs (6) are directed to two opposite side walls (3a,3b), respectively, and the at least one low pressure output is directed to a further side wall (3d;3c) connecting the two opposite side walls (3a,3b) with each other.
10. The speaker apparatus (1) of claim 1, wherein the two sound transducers (5) comprise a membrane.
11. The speaker apparatus (1) of claim 1, wherein the sound transducers (5) generate the sound with the high sound pressure to be directed in a first direction and generate the sound with the low sound pressure to be directed in a second direction opposite to the first direction.

12. The speaker apparatus (1) of claim 1, wherein the high pressure sound and the low pressure sound, respectively, are taken from the same side of the sound transducers (5).
13. The speaker apparatus (1) of claim 1, wherein the high pressure sound and the low pressure sound, respectively, are taken from opposite sides of the sound transducers (5).
14. The speaker apparatus (1) of claim 1, wherein a means is provided for carrying out stereo widening.
15. The speaker apparatus (1) of claim 1, wherein the speaker apparatus (1) is part of a mobile phone.
16. A method for controlling a speaker apparatus (1) of a wireless communication device, wherein the speaker apparatus (1) comprises a housing (2) comprising several side walls (3a...3d) defining a space (4) therebetween, the space (4) for accommodating sound transducers (5) therein, the housing (2) comprising outputs (6,7) for transmitting sound generated by the sound transducers (5), **characterized in that** two sound transducers (5) are provided which are arranged relative to at least two high pressure outputs (6) and at least one low pressure output (7) in such a way that the two sound transducers (5) acoustically operate as stereo speakers in hands free mode and as an earpiece speaker in handset mode.
17. The method of claim 16, wherein the two sound transducers (5) generate sound with a high sound pressure in the hands free mode and generate sound with a low sound pressure in the handset mode.

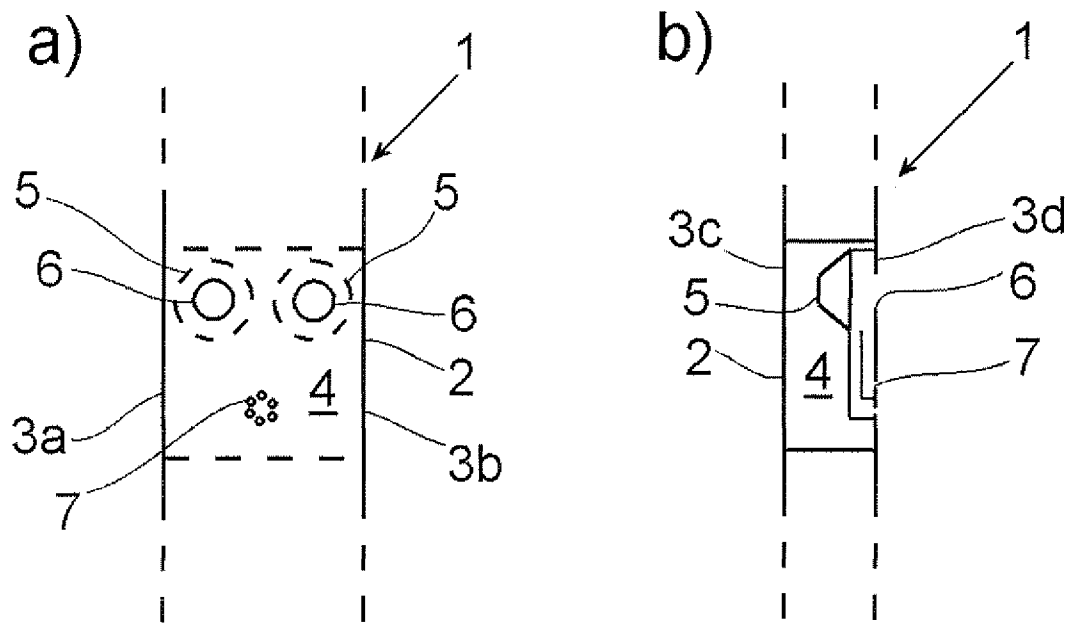


Fig. 1

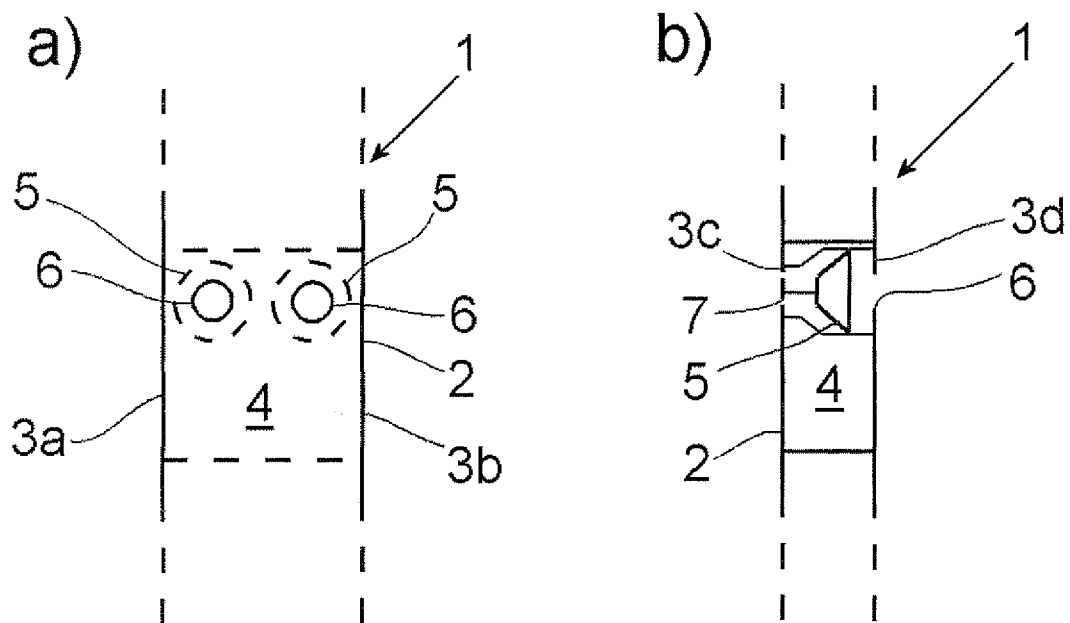


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
 INV. H04R1/28 H04M1/02

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 H04M

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/113143 A1 (ISHIDA YUUJI [JP]) 1 June 2006 (2006-06-01) paragraph [0020] - paragraph [0026]; figure 3c	1-17
X	WO 97/47117 A (NORTHERN TELECOM LTD [CA]) 11 December 1997 (1997-12-11) page 2, line 14 - line 20; figures 1-3 page 4, line 34 - page 5, line 4 page 6, line 30 - page 7, line 15	1-17
E, X	EP 1 686 834 A (SONION HORSENS AS [DK]) 2 August 2006 (2006-08-02) column 2, paragraph 6 - column 5, paragraph 22; figure 1	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2006/051977

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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