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Process and device for the transmission of sound.

The invention concerns a process for the transmission of sound by means of at least one sound transmission means, which emits sound signals perceivable by a person.

Such processes serve, for instance, in the transfer of music picked up by a microphone or recorded on a recording medium. In this connection, the sound transmission means is a loudspeaker or also a headphone which emits sound signals in such a manner that they are coupled to human hearing via the eardrum. Via loudspeakers which are placed in rooms or in headphones, the eardrum is vibrated by such acoustic signals which are, in turn, processed by the internal hearing organ of the individual. In specific, such incoming signals enter the hearing passage and make contact with the eardrum which is set into vibrating motion which is carried over to the

auditory ossicles. The third auditory ossicle then transmits such vibrations via the so-called oval window to the hearing organ.

Problematic to this well-known auditory process are acoustic signals which have a frequency somewhat under 700 Hertz (Hz). As human hearing is particularly sensitive to frequencies in the range between 700 and 6,000 Hz, a sound in this range need only have a moderate intensity to be perceived. In contrast to this, considerably higher volume is needed in order that frequencies lower than 700 Hz are perceived. This characteristic of human hearing proves to be a particular disadvantage regarding the transmission of music, as in such a case lower frequencies, i.e. under 700 Hz, are strongly suppressed.

As a result of such suppression the acoustic signals used to perform rhythm are extremely pushed into the background so that, as a result, transmitted music is less lively. In order to counteract this condition various processes are known which can make possible an effective increase of the sound pressure of low-frequency audio signals.

One known procedure, for example, involves the general increase in volume of transmitted audio waves of music. Hereby, lower frequency signals are, in comparison to mid- and higher-range signals, louder, as the suppression curve becomes flatter with increasing sound pressure.

Detrimental in this process, however, is the fact that mid- and high-range

audio signals manifest a higher wave pressure and concomitantly a considerably higher volume that, in extreme cases, is so high that the pain threshold of a person is reached or exceeded. This leads to an overburdening of the eardrum which, in the long run, can lead to hearing damage.

In another well-known procedure lower frequencies, as contrasted to mid- and/or higher-frequency audio signals, are especially amplified. This has the advantage that in the mid- and higher-frequency ranges, the pain threshold is not reached. A disadvantage here, however, is that such a procedure, to be successful, requires complex amplifiers having a variable amplification capacity (an amplification factor of about 1 to 10 million) which are exceptionally complex and, accordingly, costly and which, additionally, require a considerable energy demand. Furthermore, such systems require complex sound transmission means, for example large loudspeakers, which due to their complexity and large size can be transported only with considerable effort.

As a result, such procedures are only realized in large theaters, discos etc. For private use, such procedures are, for all practical purposes, not possible.

Accordingly, the object of the invention is to improve a process of audio signal transmission of the described category so that along with mid- and higher-frequency audio waves, low-frequency audio waves can also be transmitted economically and, technically speaking, easily and,



consequently, with extreme efficiency.

In a process for transmission of sound as described at the outset, the stated object is achieved according to the invention by the fact that for transmitting low-frequency sound signals, in particular, the sound transmission means is positioned in the chest region, in the vicinity of the breastbone, of the person so that a direct transmission path is obtained from the sound transmission means via the Eustachian tube to the auditory ossicles of the person.

The transmission especially of low-frequency audio waves by sound transmission means positioned in the vicinity of the breastbone of a person via the Eustachian tube to the auditory ossicles provides on the one hand the particular advantage that the eardrum and, thus, the dampening effect of the eardrum are bypassed. Accordingly, there is no need for compensation of the dampening effect, for example by variable audio amplification or the like, in order to achieve transmission of low-frequency audio signals in a way properly adapted to human hearing.

The process can be realized with simple technical means and requires only a relatively low amount of energy. It can, accordingly, also be effected in a mobile device.

Principally it would also be conceivable that the sound transmission means could be assigned to the most varied positions of the body. Thus, it would be possible to assign the sound transmission means to the throat or nasal area.



Of particular advantage, however, is the chest area in the vicinity of the breastbone. Since the breastbone is connected with the ribs, and through the latter to the pleura, acoustic oscillation can be transferred over the entire chest cavity. This results, in turn, in the area of the lungs being oscillated. From there, such oscillations progress over the pharynx and then to the Eustachian tubes from which they would progress to the auditory ossicles. The advantage here is that the entire chest cavity is used as a resonance means and thus represents a kind of low-pass case, analogous to known subwoofers. Hereby, low-frequency audio waves can be transmitted particularly advantageously while circumventing the eardrum.

In order to transmit the entire frequency spectrum of audio waves previously mentioned, an especially profitable embodiment of the process provides that the audio signals are additionally transmitted via another sound transmission means, for example a loudspeaker or a headphone, which would make possible the coupling of acoustic signals to the eardrum of the person.

In such a manner mid- and/or higher-frequency waves, in particular, could be transmitted in a conventional manner via the eardrum while at the same time, independent to this, lower-frequency waves will be additionally transmitted in an especially effective way via sound transmission means which for example could be placed in the area of the breastbone of a person.



The sound transmission means could be a loudspeaker or a resonator or the like, all known as such.

The stated object is also achieved according to the invention by a device for the transmission of sound with at least one sound transmission means, in which the at least one sound transmission means is so placed on the body of a person that a direct sound transmission path from the sound transmission means via the Eustachian tube to the auditory ossicles of the person is obtained.

In particular, regarding the selection of audio signals that are transmitted via sound transmission means placed in this way on the body of a person, it is particularly advantageous that the at least one sound transmission means is preceded by at least one distribution device for the distribution of the sound signals.

Principally speaking, the most varied configurations of distribution devices could be used; advantageously the at least one distribution device includes at least one frequency filter device.

With regard to the frequency filter means, the most varied configurations are conceivable; advantageously the frequency filter is a low pass which, technically speaking, would be particularly easy to realize.

Also possible, however, would be that the frequency filter device involve a frequency switch and a low pass, as well as a high pass - whereby mid-



and high-frequency waves passing through the high pass would be transmitted via a further transmission means which emits sound coupled to the eardrum of the person.

Sound transfer devices which could be considered here involve the most varied implementations. Technically simple implementations would be loudspeakers and/or resonators.

Further details and advantages of the invention are explained in greater detail in the following description with reference to some examples illustrated in the drawings.

In the drawings are shown:

Fig. 1: a schematic flowchart of the inventive process for transmission of sound;

Fig. 2: an inventive device for transmission of sound.

The invention concerning the transmission of sound is best described on the basis of fig. 1. As can be seen in fig. 1, sound signals are conveyed from a sound source (40) to a distribution means (50). In principle, a multiplicity of apparatuses could be considered respective to the use as distribution means (50), for example a frequency filter means or a frequency switch which, further, could for example be realized via a low pass (20) and a high pass (30). Higher-frequency sound signals would thereby be transferred via the eardrum (60) to the inner ear (80) whereas lower-frequency sound signals would be transmitted over the breastbone (70) to the inner ear (80). The transfer is effected for instance via loudspeakers (27, 37), with the subsequent loudspeaker (27) coupled with

the low pass positioned in the vicinity of the breastbone (70), while the loudspeaker linked to the high pass (37) may be configured as a headphone. It goes without saying that the lower-frequency sound signals can be additionally transmitted via the loudspeaker (37).

An example of such a setup for the transmission of sound, which is given in figure 2, includes a sound pickup or transmission device (10), for example a tape recorder or a microphone with a subsequent amplifier, or the like, which transmits signals over a signal line (11) to the frequency filter means in the form a low-pass (20) and high-pass (30).

Only lower-frequency sound signals pass through the low-pass (20), where the low-pass (20) is so constructed that only sound signals lower than 700 Hz can pass through it, while at the same time mid- and higher-frequency sound signals above 700 Hz of the sound signals are filtered out by the low-pass (20).

Contrastingly, only mid- and/or higher-frequency sound signals above 700 Hz pass through the high-pass (30) while sound signals under 700 Hz are filtered out from the sound signals by the high-pass (30).

The low-pass (20) as well as the high-pass (39) may be followed by amplifiers (25, 35), designed to cover appropriately defined frequency ranges, which frequencies are then transmitted by the amplifiers to the loudspeakers (27, 37).

As mentioned above, the loudspeaker (27) is arranged in the vicinity of the breastbone (70) of a person so that a direct sound transmission path is obtained, from the loudspeaker (27) over the chest cavity, to the

Eustachian tubes, and then to the person's auditory ossicles. The chest cavity of the person functions, hereby, as an additional resonating body similar to a known subwoofer of the kind used for the transmission of low-frequency sound signals in audiotechnics.

The loudspeaker (37) can, for example, be the familiar loudspeaker, or as has already been mentioned above, a headphone or anything similar which can make possible the coupling of sound via the eardrum (60) of a person.

Via this technical apparatus, mid- and higher-frequency sound signals are transmitted in a well-known manner by utilization of the eardrum (60) of a person while lower-frequency sound signals are essentially transferred over the chest cavity and the Eustachian tubes to the auditory ossicles of the middle ear (80) of a person. As a result, one achieves a particularly realistic transmission of sound, in particular of music.

Such a technical apparatus can be realized on the basis of simple technical means. Such a system is light in weight, compact and portable and is, accordingly, useable everywhere, anytime. Particularly so if designed as a portable device similar to cassette recorders or CD-players. Further, such a system requires very little energy and even can be driven by battery so that such a system would be independent of external energy sources. Finally, such a system, on the basis of the preceding argumentation, is also particularly economical to manufacture and is, accordingly, also a good value for the customer.



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Patent claims

1. Process for the transmission of sound by means of at least one sound transmission means (27, 37) which emits sound signals perceivable by a person, characterized in that the at least one sound transmission means (27) is placed on the body of a person so that a direct sound transmission path from the sound transmission means (27) via the Eustachian tube to the auditory ossicles of the person is achieved.
2. Process of claim 1, characterized in that the sound transmission means (27) are arranged in the chest region, in the vicinity of the breastbone (70) of the person
3. Process of claim 1 or claim 2, characterized by the additional transmission of the sound signals via further sound transmission means (37) which makes possible the linking of the sound signals to the eardrum (60) of a person.
4. Process according to claims 1 to 3, characterized in that the sound transmission means (27, 37) are loudspeakers.



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5. Process according to claims 1 to 3, characterized in that the sound transmission means (27, 37) are resonators.
6. Device for the transmission of sound by means of at least one sound transmission means (27, 37), characterized in that the at least one sound transmission means (27) is placed on the body of a person so that a direct sound transmission path from the sound transmission means (27) via the Eustachian tube to the auditory ossicles of the person is achieved.
7. Device of claim 6, characterized in that the at least one sound transmission means (27, 37) is preceded by at least one distribution means (50).
8. Device of claim 6 or 7, characterized in that the at least one distribution means (50) includes at least one frequency filter means.
9. Device of claim 8, characterized in that the at least one frequency filter means is a low-pass (20).
10. Device of claim 8, characterized in that the at least one frequency filter means includes a low-pass (20), as well as a high-pass (30) and that the mid- and/or higher-frequency sound signals passing through the high-pass (30) are conveyed via a further sound transmission means (37) in association with the eardrum of a person.



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11. Device according to one of claims 6 through 10, characterized in that the sound transmission means (27, 37) are loudspeakers.
12. Device according to one of claims 6 through 10, characterized in that the sound transmission means (27, 37) are resonators.

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