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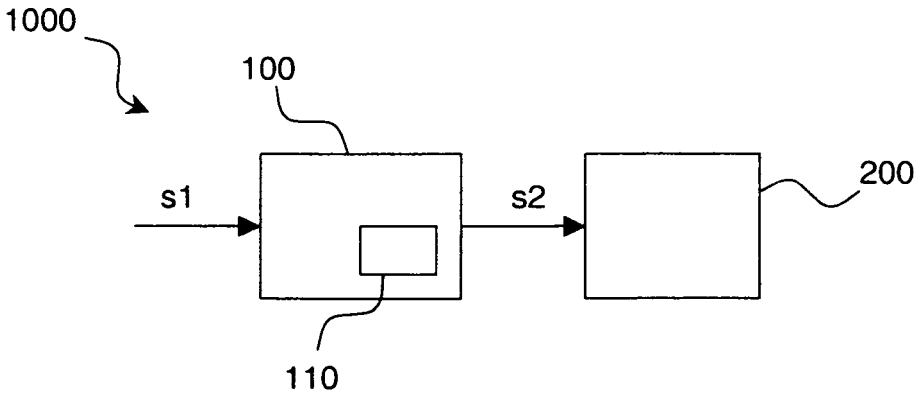
Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) Audio driver device and method of operating an audio driver device

(57) The present invention relates to an audio driver device (100) for converting an input signal (s1), preferably an electric input signal, to an output signal (s2) for driving an electromagnetic transducer (200).

According to the present invention, said audio driver device (100) comprises filter means (110) for influencing a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer (200) that is supplied with said output signal (s2).

Fig. 2a



EP 2 023 652 A1

Description

[0001] The present invention relates to an audio driver device for converting an input signal, preferably an electric input signal, to an output signal for driving an electromagnetic transducer.

[0002] The present invention further relates to an audio device comprising an audio driver device and to a method of operating an audio driver device.

[0003] Audio driver devices of the above mentioned type and corresponding methods are well known and they are for example used within audio devices which transform an electric input signal to an acoustic signal by means of a loudspeaker. Such audio devices are for instance implemented within wireless communications equipment such as cellular phones, wherein a receiving section of the cellular phone's signal processing system transforms a received radio signal into an acoustic signal that can be evaluated by a user of the cellular phone.

[0004] Further examples of widely used audio devices of the aforementioned type are implemented within portable media players or television sets or generally any type of consumer electronics device that provides for an output of speech, music or other acoustic signals.

[0005] The conventional audio driver devices share a common disadvantage in that there is only insufficient support for induction-based hearing aid systems. Such hearing aid systems have an induction coil that is provided to pick up a magnetic field emitted by a loudspeaker which is supplied with a corresponding output signal by the audio driver device. It is evident that conventional loudspeakers - although delivering a sufficient signal quality when producing an acoustic signal - in many cases do not deliver a correspondingly sufficient magnetic field for supplying the hearing aid system's induction coil. Several national authorities or other organisations have meanwhile issued standards for the hearing aid compatible operation of audio driver devices which cannot be attained by the conventional audio systems comprising loudspeakers as electromagnetic transducers.

[0006] US 2005/0281425 Al proposes to provide - in addition to a primary loudspeaker - an extra magnetic coil assembly within an audio driver device in order to increase a magnetic field output of the audio driver device. The magnetic field emitted by said extra magnetic coil assembly combines with the magnetic field of the primary electromagnetic transducer, i.e. loudspeaker, thus delivering an increased magnetic field strength for the hearing aid system's induction coil. Although increasing the magnetic field strength to a required level, this solution has the disadvantage of increased constructional complexity, weight, and production cost. The increased weight and construction volume of a solution that provides for additional electromagnetic transducers is particularly undesirable for small audio devices such as cellular phones, PDAs (personal digital assistants), and other portable equipment.

[0007] Consequently, it is an object of the present invention to improve an audio driver device of the above mentioned type such that compatibility with induction-based hearing aids is established while at the same time avoiding the disadvantages of conventional solutions such as increased complexity and weight as well as production costs.

[0008] According to the present invention, regarding the above mentioned audio driver device this object is achieved by providing filter means within said audio driver device for influencing a frequency characteristic of the input signal and/or the output signal in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer that is supplied with said output signal.

[0009] The inventive principle of influencing the input and/or output signal which is processed by the audio driver device advantageously enables to generate a predetermined frequency characteristic of the magnetic field emitted by an electromagnetic transducer such as a loudspeaker and thus eliminates the necessity to provide additional means for providing an increased magnetic field that delivers the interesting signal to an induction coil of the hearing aid. Particularly, the inventive principle advantageously enables to adapt the signal processed by the audio driver device so as to attain certain magnetic field levels within predetermined frequency ranges whereby legal requirements applying to devices that may be used in combination with inductive hearing aids may be met.

[0010] The inventive principle may advantageously be applied to existing audio driver devices which comprise configurable filter means by implementing corresponding filter characteristics, i.e. particularly without altering the device hardware.

[0011] Thereby, the inventive principle offers a simple and efficient solution to the aforedescribed problem and avoids the complex and costly approaches that provide adding additional magnetic transducers.

[0012] Preferably, the inventive filter means are configured so as to increase a level of the input and/or output signal for comparatively low frequencies, because especially for this frequency range, an ordinary loudspeaker exhibits a comparatively high attenuation of its electromagnetic field. Increasing a signal amplitude in this frequency range according to the present invention results in an increased magnetic field created by the loudspeaker which contributes to providing e.g. a constant frequency characteristic of the emitted magnetic field which is usually required by corresponding standards or governmental rules or the like.

[0013] According to a very advantageous embodiment of the present invention, digital signal processing means such as e. g. a digital signal processor, DSP, are provided for processing said input signal and/or said output signal, which enables an effective realization of the inventive filter means in form of the implementation of a filter algorithm within the DSP. Preferably, FIR (finite impulse response)-filter algorithms are used. Alternatively or addi-

tionally, other types of filter algorithms may be used to implement the inventive influencing of the frequency characteristic of the input signal and/or the output signal.

[0014] A further advantageous embodiment of the inventive audio driver device comprises a digital-to-analog converter which provides an analog output signal that may e. g. be used to directly drive an electromagnetic transducer such as a loudspeaker or the like.

[0015] A further advantageous variant of the inventive audio driver device is characterized by an amplifier for amplifying said input signal and/or said output signal.

[0016] According to yet another advantageous embodiment of the present invention, the filter means can be integrated within the amplifier.

[0017] According to a particularly preferred embodiment of the inventive audio driver device, said filter means may selectively be configured to either

a) influence a frequency characteristic of the input signal and/or the output signal in order to attain a predetermined frequency characteristic of a magnetic field emitted by said electromagnetic transducer thereby defining a first mode of operation, or to

b) influence a frequency characteristic of the input signal and/or the output signal in order to attain a predetermined frequency characteristic of an acoustic signal emitted by said electromagnetic transducer thereby defining a second mode of operation.

[0018] That is, the inventive filter means offer at least two advantageous modes of operation of the inventive audio driver device.

[0019] Firstly, a frequency characteristic of the input/output signal may be optimized with respect to a magnetic transmission function of the electromagnetic transducer used in combination with the inventive audio driver device so as to attain a predetermined frequency characteristic of the magnetic field to enable an optimized operation of the audio driver device together with an inductive hearing aid.

[0020] Secondly, if an acoustic-type mode of operation is desired, i.e. if compatibility with hearing aids is (temporarily) not required, the inventive influencing of the input/output signal may be performed so as to obtain a desired frequency characteristic of an acoustic signal emitted by the electromagnetic transducer, which improves the audio quality for a user without handicap.

[0021] Widely used ordinary electromagnetic transducers such as loudspeakers exhibit a low-pass behaviour regarding the output of an acoustic signal, whereas a magnetic signal emitted by the loudspeaker exhibits a high-pass behaviour. Therefore, e. g. in order to attain a predetermined flatness of the frequency characteristic of the acoustic signal or the magnetic signal, different filtering procedures have to be applied to optimize the acoustic output or the magnetic output, respectively, of the transducer which is used in combination with the inventive audio driver device. By appropriately choosing the filter coefficients for the inventive process of influencing the input/output signal to attain the desired frequency characteristic of either a) the acoustic output signal or b) the magnetic output signal of the transducer, the inventive audio driver device may easily be configured to the desired mode of operation, particularly without the requirement of adapting hardware.

[0022] Thereby, optimized quality can be guaranteed by using the present invention both for direct audio output and inductive coupling from the transducer to a hearing aid.

[0023] A further advantageous embodiment of the inventive audio driver device provides for a manual selection of said mode of operation which may e. g. be realized by integrating a user-actuatable element such as a switch or the like. When integrating the inventive audio driver device within consumer electronics equipment, cellular phones or PDAs, choosing the desired mode of operation of the inventive audio driver device or the filter means, respectively, may also be performed via selecting a software option that is presented to a user of the device by means of a graphical interface implemented within the equipment.

[0024] For instance, the inventive selection of the filtering mode, i.e. either optimized for direct audio output or for magnetic field output to a hearing aid, may be accomplished by choosing appropriate settings within an audio settings menu of a cellular phone or by similar means of configuration.

[0025] According to a further embodiment of the present invention, it is also possible that said audio driver device is configured to automatically detect the presence of a hearing aid near said transducer and to automatically select a corresponding mode of operation depending on the presence or absence of a hearing aid near said transducer. This embodiment of the present invention advantageously offers a very high degree of flexibility when operating the inventive audio driver device and does not require user interaction to choose an optimal mode of operation.

[0026] The inventive automatic detection of a hearing aid may e. g. be performed by analyzing a current and/or voltage related to said output signal provided by the inventive audio driver device, since the electromagnetic coupling between the audio driver device or a transducer driven thereby, and the induction coil of the hearing aid causes a corresponding change in these operational parameters of the audio driver device.

[0027] Furthermore, a signal of a separate sensor may also be evaluated in order to detect a hearing aid, wherein preferably capacitive or inductive sensors are provided as proximity sensing means.

[0028] A further embodiment of the inventive audio driver device is characterized in that said filter means comprise a plurality of predefined filter coefficients, wherein a first set of filter coefficients particularly corresponds with a first mode of operation, i. e. a mode that is optimized with respect to the magnetic field output of

the transducer, and wherein a second set of filter coefficients particularly corresponds with a second mode of operation, e. g. a mode of operation which offers an optimum audio quality of an audio signal emitted by said electromagnetic transducer.

[0029] The filter coefficients may e. g. be stored within a nonvolatile memory of the signal processing means or any other device integrated within the audio driver device and may e. g. be dynamically altered in order to dynamically influence the frequency characteristic of the input signal and/or the output signal in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer. Particularly, the sets of filter coefficients may be changed during operation of the inventive audio driver device.

[0030] Various sets of filter coefficients may be provided which e. g. account for the high-pass-behavior of the electromagnetic transducer with respect to the emission of a magnetic field. Conversely, the low-pass-behavior of electromagnetic transducers may be accounted for by a further set of filter parameters. More specifically, the filter parameters may be chosen for certain types of electromagnetic transducers so as to attain predetermined frequency characteristics of either the audio signal or a magnetic field emitted by these transducers.

[0031] Generally, the filter parameters will be chosen so as to achieve a constant output level regarding the acoustic signal or the magnetic field, depending on the mode of operation chosen by the user or preset automatically.

[0032] A further solution to the object of the present invention is given in form of an audio device according to claim 10. Said inventive audio device comprises at least one audio driver device according to the present invention and at least one electromagnetic transducer which is connected to said audio driver device and supplied with the output signal by said audio driver device. In most cases, the electromagnetic transducer connected to the inventive audio driver device is a loudspeaker which both converts the supplied output signal to a corresponding acoustic signal and a corresponding magnetic field that may be picked up by an induction coil of a hearing aid. However, it is also possible to use the inventive audio driver device with such electromagnetic transducers that primarily generate a magnetic field, i.e. without emitting an acoustic signal.

[0033] A very important advantage of the inventive principle of influencing the frequency characteristic of the input and/or output signal so as to attain a predetermined frequency characteristic of the magnetic field emitted by the transducer is given by the fact that the inventive principle can be applied to existing audio driver devices which are integrated in almost any consumer electronic equipment, cellular phone and the like. Most of these conventional devices provide for some kind of filtering algorithm to achieve a determined frequency characteristic of an acoustic output signal. When using the inventive principle together with the existing hardware, the filter parameters of the conventional hardware may advantageously be tuned so as to achieve a desired frequency characteristic of a magnetic field emitted by the electromagnetic transducer.

[0034] That is, by applying the inventive principle, existing hardware may be upgraded to offer full compatibility with hearing aids in that the magnetic field emitted by the used transducers satisfies the conditions required for a proper operation of the hearing aid systems.

[0035] Yet another advantageous solution to the object of the present invention is given by a method according to claim 11.

[0036] Advantageous embodiments and variants of the present invention are given by the dependent claims.

[0037] Further advantageous embodiments and details of the present invention are given in the following detailed description with reference to the drawings in which:

Figure 1 depicts a frequency characteristic of an electromagnetic transducer regarding an emitted audio signal and an emitted magnetic field,

Figure 2a depicts a simplified block diagram of an audio device according to the present invention, and

Figure 2b depicts a more detailed block diagram of an audio driver device according to a further embodiment of the present invention.

[0038] Figure 1 depicts a frequency characteristic of a conventional wideband loudspeaker that is used as an electromagnetic transducer within audio devices of cellular phones or other electronic equipment. The audio devices are provided with an input signal, preferably an electronic signal, representing speech, music or other acoustic signals and provide a corresponding acoustic output signal by means of said transducer.

[0039] From figure 1, it can be seen that regarding the output of an audio signal, the frequency characteristic A of the loudspeaker exhibits a kind of low-pass behavior, because frequency components of up to 500 to 600 Hz are output with a comparatively higher level than those frequency components above 600 Hz.

[0040] Conversely, regarding a magnetic field output by the loudspeaker, a typical high-pass behavior can be derived from the diagram of figure 1, cf. the frequency characteristic M. While frequencies of 700 Hz and above are output with a comparatively large level, those magnetic field components having lower frequencies, i. e. from 0 to 600 or 700 Hz, are attenuated substantially.

[0041] This is the reason for conventional audio systems' poor performance when being used in combination with hearing aids that rely on an induction coil to pick up a part of the magnetic field emitted by the loudspeaker when being fed with an output signal.

[0042] Particularly, low frequency signal components do not have a sufficient output level of the magnetic field which leads to a poor quality of an audio signal generated within a hearing aid based on the magnetic signal received from the loudspeaker. I.e., when using conventional systems to drive a loudspeaker, the user of an inductive hearing aid will only be presented with higher frequency components of a signal, since the lower frequency components are lost due to the low magnetic field level of the loudspeaker and can thus not be converted to an amplified audio signal within the hearing aid. Consequently, particularly speech cannot be recognized properly by disabled people requiring a hearing aid when using conventional audio driver devices.

[0043] According to the present invention, this issue is advantageously solved by providing specially configured filter means 110 within an audio driver device 100, a first embodiment of which is depicted by Figure 2a.

[0044] The inventive filter means 110 advantageously enable influencing the input signal s1 fed to the audio driver device 100 so as to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer 200 that is supplied with the corresponding output signal s2. I. e., the inventive audio driver device 100 is capable of selectively amplifying the input signal s1, particularly in the frequency range from 0 Hz to 700 Hz (cf. the magnetic frequency characteristic M of figure 1), in order to compensate for the high-pass behavior of the loudspeaker 200 with respect to the magnetic field emitted by it.

[0045] Thereby, the frequency characteristic M of the magnetic field emitted by the loudspeaker 200 can advantageously be tuned, for instance to have a constant output level of the magnetic field over the whole frequency range up to 3.400 Hz, which significantly improves the quality of an audio signal derived within a hearing aid from the magnetic field of the loudspeaker 200. Particularly, low frequency components of the input signal s1 are delivered to the user of the hearing aid in the same level and quality as they are for the audio signal during an ordinary audio operation of the audio driver device 100, which is also possible in a further mode of operation.

[0046] Advantageously, the filter coefficients used within the filter means 110 may be adapted or changed so as to enable a switching between an audio-mode and a magnetic-mode of operation of the inventive audio driver device 100. The audio-mode of operation may provide for using ordinary "filter coefficients" that are optimized for a desired frequency characteristic of an audio signal emitted by the loudspeaker 200, whereas in the further, i. e. magnetic-mode of operation, the filter coefficients of the inventive filter means 110 are chosen so as to attain a predetermined frequency characteristic of the magnetic field emitted by the loudspeaker 200.

[0047] A further very advantageous embodiment of the present invention provides for dynamically influencing the frequency characteristic of the input signal s1 and/or the output signal s2, whereby various desired frequency characteristics of the audio/magnetic signals may be obtained even during an operation of the inventive audio driver device 100.

[0048] The inventive audio driver device 100 may also comprise a selection means such as a switch or a software-based configuration option (not shown) which enables a user to manually select the mode of operation, i. e. the optimization for audio output or for magnetic field output for use with a hearing aid.

[0049] A further embodiment of the present invention may also provide for automatically detecting the presence of a hearing aid near said transducer 200 and to automatically select a corresponding mode of operation, i. e. set of filter parameters, depending on the presence or absence of a hearing aid near said transducer 200.

[0050] The automatic detection of a hearing aid near the transducer 200 may e. g. performed by analyzing a current and/or voltage which is related to the output signal s2 provided by the inventive audio driver device 100, which is detectably changed in the case of an electromagnetic coupling between the transducer 200 and an induction coil of a hearing aid (not shown).

[0051] According to a further advantageous embodiment, the inventive audio driver device 100 may comprise separate sensor means such as capacitive or inductive sensor means, to detect a presence of a hearing aid.

[0052] A further very advantageous embodiment of the inventive audio driver device 100 proposes to exchange data, in particular filter coefficients of the inventive filter means 110, with a device (not shown) external to said audio driver device 100, preferably via a data interface that is comprised within said audio driver device 100 or an electronic device such as a cellular phone comprising the inventive audio driver device 100.

[0053] The inventive audio driver device 100 may be part of an audio device 1000 (figure 2a) that additionally comprises the loudspeaker 200. This combination is particularly advantageous, because the filter parameters of the filter means 110 may be adapted to the specific loudspeaker 200 during manufacturing of the inventive audio device 1000 and need not be changed later on. Said inventive audio device 1000 may be integrated in any type of electronic equipment which requires to convert electronic, optical or other types of signals into acoustic and/or magnetic signals for a hearing aid, respectively.

[0054] Alternatively, by implementing the above described inventive filtering algorithm for attaining a predetermined magnetic field characteristic, existing audio driver devices may be upgraded to be fully compatible with inductive hearing aids.

[0055] Yet another very advantageous embodiment of the inventive audio driver device 100 is characterized by indicating a selected mode of operation of the audio driver device 100, which may advantageously be achieved by outputting either an optical signal by appropriate signal means such as a light emitting diode or the like and/or by temporarily modifying said output signal s2, in particular by adding a corresponding notification signal to said

output signal s2. Thereby, a user of the inventive audio driver device 100 is advantageously informed on a mode of operation of the audio driver device 100 currently selected.

[0056] A further possibility to control the selection of operation modes of the inventive audio driver device is given in the form of a software menu integrated within firmware of a cellular phone or the like comprising the inventive audio driver device 100.

[0057] Figure 2b depicts a further embodiment of the inventive audio driver device 100.

[0058] The audio driver device 100 according to Figure 2b comprises digital signal processing means 105 for digitally processing an electric input signal s1 which is provided to the audio driver device 100 in digital form.

[0059] Advantageously, the inventive filter means 110 are implemented within the digital signal processor 105 in form of an FIR-filter algorithm that realizes the inventive influencing of a frequency characteristic of the input signal s1.

[0060] At its output, the digital signal processor 105 delivers a correspondingly filtered input signal s1' that is forwarded to a digital-to-analog converter 115 which converts the filtered signal s1' to an analog output signal s1".

[0061] The analog output signal s1" output by the digital-to-analog converter 115 is forwarded to an amplifier 120 which amplifies the analog output signal s1" and finally outputs the amplified output signal s2, which may be used to drive a loudspeaker 200 (figure 2a) or another electromagnetic transducer.

[0062] The implementation of the inventive principle within existing audio driver devices 100 requires no extra hardware to be added to the existing systems and may even be conducted via a firmware upgrade that enables the inventive filtering function, e.g. to suitably pre-distort the signals s1 and/or s2 in order to achieve a desired frequency characteristic of a magnetic field output by a specific loudspeaker or other type of electromagnetic transducer supplied with the so distorted signals.

[0063] Advantageously, by implementing the inventive principle, disabled people requiring hearing aids can be provided with the same speech / audio quality as known from the acoustic outputs of existing loudspeaker systems.

[0064] By changing the parameters of the filter means 110, the operation can either be optimized for direct audio output or magnetic field output, or further types of frequency characteristics that may possibly be required by certain transducers.

Claims

1. Audio driver device (100) for converting an input signal (s1), preferably an electric input signal, to an output signal (s2) for driving an electromagnetic transducer (200), **characterized in that** said audio driver device (100) comprises filter means (110) for influencing a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer (200) that is supplied with said output signal (s2).

2. Audio driver device (100) according to claim 1, **characterized by** digital signal processing means (105) for processing said input signal (s1) and/or said output signal (s2).

3. Audio driver device (100) according to one of the preceding claims, **characterized by** a digital to analog converter (115) for providing an analog output signal.

4. Audio driver device (100) according to one of the preceding claims, **characterized by** an amplifier (120) for amplifying said input signal (s1) and/or said output signal (s2).

5. Audio driver device (100) according to claim 4, **characterized in that** said filter means (110) are integrated within said amplifier (120).

6. Audio driver device (100) according to one of the preceding claims, **characterized in that** said filter means (110) may selectively be configured to either

   a) influence a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by said electromagnetic transducer (200) thereby defining a first mode of operation, or to
   b) influence a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of an acoustic signal emitted by said electromagnetic transducer (200) thereby defining a second mode of operation.

7. Audio driver device (100) according to claim 6, **characterized in that** said audio driver device (100) is configured to enable a manual selection of said mode of operation.

8. Audio driver device (100) according to one of the claims 6 to 7, **characterized in that** said audio driver device (100) is configured to automatically detect the presence of a hearing aid near said transducer (200) and to automatically select a corresponding mode of operation depending on the presence or absence of a hearing aid near said transducer (200).

9. Audio driver device (100) according to one of the preceding claims, **characterized in that** said filter means (110) comprise a plurality of predefined filter

coefficients, wherein a first set of filter coefficients particularly corresponds with a first mode of operation, and wherein a second set of filter coefficients particularly corresponds with a second mode of operation.

10. Audio device (1000) comprising at least one audio driver device (100) according to one of the preceding claims and at least one electromagnetic transducer (200), particularly a loudspeaker, which is connected to said audio driver device (100) and supplied with the output signal (s2) by said audio driver device (100).

11. Method of operating an audio driver device (100) for converting an input signal (s1), preferably an electric input signal, to an output signal (s2) for driving an electromagnetic transducer (200), **characterized in that** said audio driver device (100) comprises filter means (110) and, by means of said filter means (110), influences a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer (200) that is supplied with said output signal (s2).

12. Method according to claim 11, **characterized in that** one or more sets of predefined filter coefficients are used.

13. Method according to one of the claims 11 to 12, **characterized in that** said filter means (110) dynamically influence the frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer (200).

14. Method according to one of the claims 11 to 13, **characterized in that** said audio driver device (100) automatically detects the presence of a hearing aid near said transducer (200) and automatically selects a corresponding mode of operation depending on the presence or absence of a hearing aid near said transducer (200).

15. Method according to claim 14, **characterized in that** said step of detecting is performed by analysing a current and/or voltage related to said output signal (s2), and/or by evaluating a signal of a separate sensor, in particular a capacitive or inductive sensor, provided to detect the presence of a hearing aid.

16. Method according to one of the claims 11 to 15, **characterized by** exchanging data, in particular filter coefficients of said filter means (110), with a device external to said audio driver device (100), preferably via a data interface comprised within said audio driver device (100).

17. Method according to one of the claims 11 to 16, **characterized by** indicating a selected mode of operation of the audio driver device (100), preferably by outputting an optical signal and/or by temporarily modifying said output signal (s2), in particular by adding a corresponding notification signal to said output signal (s2).

Amended claims in accordance with Rule 137(2) EPC.

1. Audio device (1000) comprising a loudspeaker (200) and an audio driver device (100) for converting an input signal - (s1), preferably an electric input signal, to an output signal (s2) for driving said loudspeaker (200), **characterized in that** said audio driver device (100) comprises filter means (110) that are configured to influence a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by said loudspeaker (200) when being supplied with said output signal (s2).

2. Audio device (1000) according to claim 1, **characterized by** digital signal processing means (105) for processing said input signal (s1) and/or said output signal (s2).

3. Audio device (1000) according to one of the preceding claims, **characterized by** a digital to analog converter (115) for providing an analog output signal.

4. Audio device (1000) according to one of the preceding claims, **characterized by** an amplifier (120) for amplifying said input signal (s1) and/or said output signal (s2).

5. Audio device (1000) according to claim 4, **characterized in that** said filter means (110) are integrated within said amplifier (120).

6. Audio device (1000) according to one of the preceding claims, **characterized in that** said filter means (110) may selectively be configured to either

a) influence a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by said loudspeaker (200) thereby defining a first mode of operation, or to
b) influence a frequency characteristic of the input signal (s1) and/or the output signal (s2) in

order to attain a predetermined frequency characteristic of an acoustic signal emitted by said loudspeaker (200) thereby defining a second mode of operation.

7. Audio device (1000) according to claim 6, **characterized in that** said audio driver device (100) is configured to enable a manual selection of said mode of operation.

8. Audio device (1000) according to one of the claims 6 to 7, **characterized in that** said audio driver device (100) is configured to automatically detect the presence of a hearing aid near said transducer (200) and to automatically select a corresponding mode of operation depending on the presence or absence of a hearing aid near said transducer (200).

9. Audio device (1000) according to one of the preceding claims, **characterized in that** said filter means (110) comprise a plurality of predefined filter coefficients, wherein a first set of filter coefficients particularly corresponds with a first mode of operation, and wherein a second set of filter coefficients particularly corresponds with a second mode of operation.

10. Method of operating an audio device (1000) comprising a loudspeaker (200) and an audio driver device (100) for converting an input signal (s1), preferably an electric input signal, to an output signal (s2) for driving said loudspeaker (200), **characterized in that** said audio driver device (100) comprises filter means (110) which are configured to influence a frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by said loudspeaker (200) when being supplied with said output signal (s2).

11. Method according to claim 10, **characterized in that** one or more sets of predefined filter coefficients are used.

12. Method according to one of the claims 10 to 11, **characterized in that** said filter means (110) dynamically influence the frequency characteristic of the input signal (s1) and/or the output signal (s2) in order to attain a predetermined frequency characteristic of a magnetic field emitted by an electromagnetic transducer (200).

13. Method according to one of the claims 10 to 12, **characterized in that** said audio driver device (100) automatically detects the presence of a hearing aid near said transducer (200) and automatically selects a corresponding mode of operation depending on the presence or absence of a hearing aid near said transducer (200).

14. Method according to claim 13, **characterized in that** said step of detecting is performed by analysing a current and/or voltage related to said output signal (s2), and/or by evaluating a signal of a separate sensor, in particular a capacitive or inductive sensor, provided to detect the presence of a hearing aid.

15. Method according to one of the claims 10 to 14, **characterized by** exchanging data, in particular filter coefficients of said filter means (110), with a device external to said audio driver device (100), preferably via a data interface comprised within said audio driver device (100).

16. Method according to one of the claims 10 to 15, **characterized by** indicating a selected mode of operation of the audio driver device (100), preferably by outputting an optical signal and/or by temporarily modifying said output signal (s2), in particular by adding a corresponding notification signal to said output signal (s2).

Fig. 1

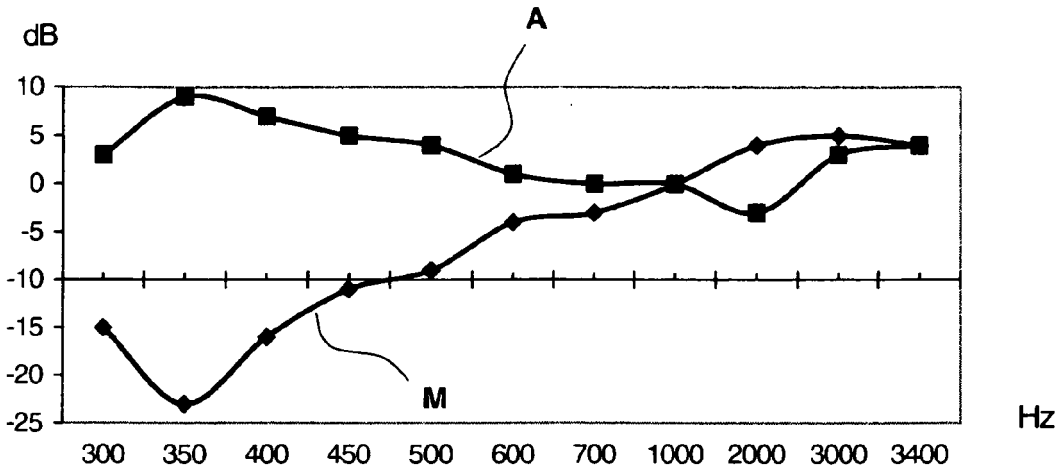


Fig. 2a

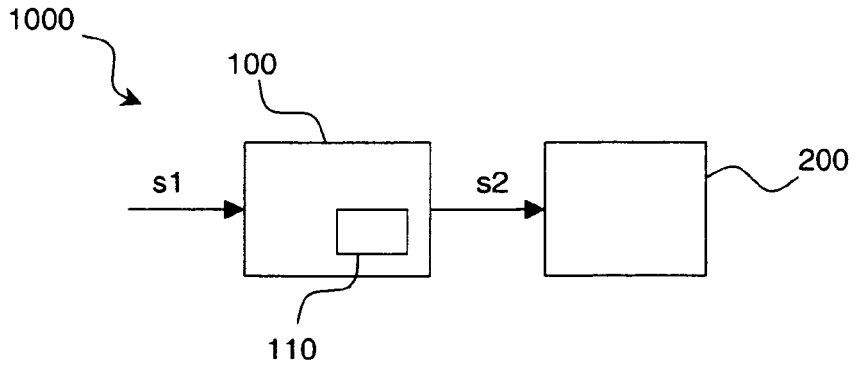
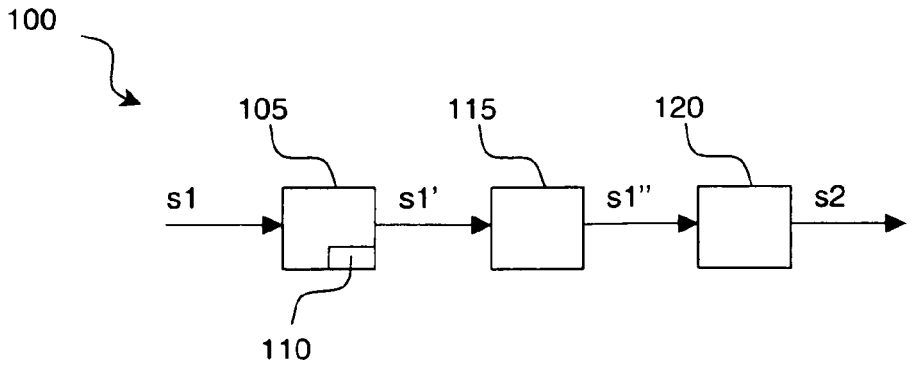


Fig. 2b



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