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(54) **A PUSH BUTTON FOR A SWITCH**

(57) The present application relates to a control element for a hearing aid. The control element being configured to activate and/or deactivate one or more functions of the hearing aid. The control element comprises a push button comprising a push surface, a plunger element, and a stop element, a switch comprising a switch housing and a switch disc protruding from an opening of the switch housing, wherein the switch being configured to activate and/or deactivate one or more functions of the hearing aid when the switch disc is forced towards said opening, and wherein the push button is movable in a direction towards the switch disc and configured to force the switch disc towards said opening of the switch housing by deforming the switch disc, when said push button is exerted by a force on said push surface, until said stop element contacts the switch housing. The present application further relates to a hearing aid comprising a control element.

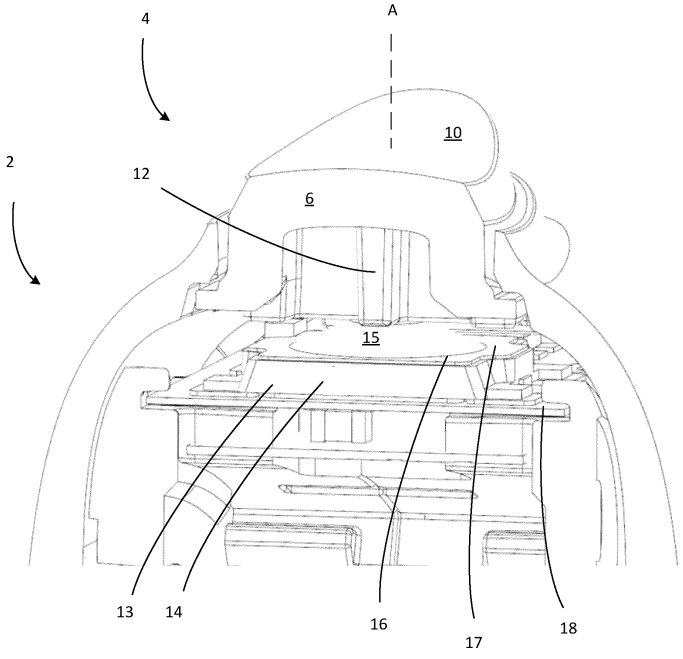

FIG. 2

EP 3 886 129 A1

Description

SUMMARY

[0001] The present application relates to a control element for a hearing aid, the control element being configured to activate and/or deactivate one or more functions of the hearing aid.

[0002] The present application further relates to a hearing aid comprising a control element.

A control element

[0003] Today, most hearing aids comprise one or more control elements for controlling at least some part of the functionality of the hearing aid. The control elements may be configured as e.g. push-button switches, toggle switches, rotary switches, or other.

[0004] For example, a control element may be configured to control the activation and deactivation of power to the hearing aid, or may be used for adjusting the volume or changing program of the hearing aid.

[0005] Due to the continuous requirement of minimising the size and weight of the hearing aids, the size of the control elements is also minimised. Therefore, it is important to maintain structural stability of the control element even in cases where it is exposed to high impacts, e.g. if the hearing aid is dropped on the floor.

[0006] For example, in case the control element is a push button switch and the hearing aid user accidentally drops the hearing aid with the push button first on the floor, there is a risk that the push button deforms the switch irreversibly, which may affect the functionality of the switch.

[0007] Accordingly, there is a need for a safety mechanism that increases the structural stability of the control element.

[0008] In an aspect of the present application, a control element for a hearing aid is provided.

The control element may be configured to activate and/or deactivate one or more functions of the hearing aid.

[0009] For example, one or more functions of the hearing aid may comprise activating and/or deactivating power to the hearing aid.

For example, one or more functions of the hearing aid may comprise adjusting the volume of the hearing aid.

For example, one or more functions of the hearing aid may comprise deactivating one program of the hearing aid and/or activating another program of the hearing aid.

[0010] The control element may comprise a push button.

The push button may be arranged partly at the outside and partly at the inside of the shell of the hearing aid, when the push button has been installed in a hearing aid.

The push button may comprise a push surface.

The push surface may be arranged at the end of the push button arranged at the outside of the shell of the hearing aid, when the push button has been installed in a hearing aid. The push surface may be directed towards the surroundings of the hearing aid.

The push button may comprise a plunger element.

The plunger element may be arranged at the end of the push button arranged at the inside of the shell of the hearing aid, when the push button has been installed in a hearing aid. The plunger element may be directed towards the inside of the hearing aid.

The push button may comprise a stop element.

The stop element may be arranged at the end of the push button arranged at the inside of the shell of the hearing aid, when the push button has been installed in a hearing aid. The stop element may be directed towards the inside of the hearing aid.

Accordingly, the push surface may be arranged at the opposite end of the push button compared to the plunger element and the stop element.

[0011] The control element may comprise a switch.

The switch may comprise a switch housing.

The switch may comprise a switch disc.

For example, the switch disc may comprise a circular shape. The switch disc may comprise a planar base connected to the switch housing and a disc part, where the disc part may protrude and/or bend away from the planar base part and thus away from the switch housing in the case the switch is at rest (e.g. not effected by the push button).

When effected by an external force, e.g. when the push button exerts a force on the switch disc, the switch disc may deform by the protruding disc part of the switch disc gradually moving towards a planar base of the switch disc. The degree of deformation may depend on the size of the force being exerted on the switch disc.

[0012] A deformation of the switch disc in response to an external force being exerted on the switch disc, may be reversible. For example, when the switch disc is exposed to an external force, the disc part of the switch may deform, but may regain its initial shape when the external force is removed.

For example, the switch may be a tactile switch. For example, the switch may be a dome switch.

The switch disc may protrude from an opening of the switch housing.

The switch may be configured to activate and/or deactivate one or more functions of the hearing aid.

The switch may be configured to activate and/or deactivate one or more functions of the hearing aid when the switch disc is forced towards said opening.

[0013] The push button may be movable in a direction towards the switch disc.

For example, the push button may be configured to move in a direction towards (and away from) the opening of the switch housing.

The push button may be configured to force the switch disc towards said opening of the switch housing.

The push button may be configured to force the switch disc towards the opening of the switch housing by deforming the switch disc, when the push button is exerted

by a force on the push surface, until the stop element contacts the switch housing.

For example, the push button may be exerted by a force on the push surface in a direction towards the switch, e.g. towards the opening of the switch housing.

For example, when the stop element contacts the switch housing the contact between the stop element and the switch housing prevents the push button (and plunger element) from moving the switch disc further towards the opening of the switch housing.

[0014] Thereby, it is provided that the switch disc is not deformed irreversibly, but instead may regain its shape at rest after each exposure to a force by the push button.

[0015] Further, by providing that the stop element determines the degree of movement of the control element towards the switch so that the stop function is not determined by other elements (surfaces, edges, etc.) of the hearing aid, the number of tolerances to be aware of are minimized thereby facilitating the manufacturing of the control element and hearing aid.

[0016] A longitudinal axis of the control element may extend from said push surface, via the centre of said plunger element, and through the centre of the switch disc.

[0017] The push button may be movable in a direction along said longitudinal axis.

[0018] The switch housing may comprise a collar.

The switch housing may comprise a collar extending at least partly around the opening of the switch housing.

The stop element may be configured to contact said collar, when the push button is exerted by a force on the push surface.

For example, the stop element may be configured to contact said collar, when the push button is exerted by a force on the push surface in a direction towards the switch and substantially along the longitudinal axis of the control element.

[0019] The push button may be configured to rest on the switch disc without deforming said switch disc.

The push button may rest on the switch disc when the push button is not exerted by a force on the push surface.

For example, when the control element is at rest, in other words, when the push button is not pressed, the push button may rest on the switch disc by the plunger element and the switch disc being in contact without the switch disc being deformed.

[0020] The plunger element may comprise a plunger surface for contacting the switch disc.

For example, the plunger surface may extend in a direction perpendicular to the longitudinal axis of the control element.

[0021] The plunger surface may have an extended shape in a direction perpendicular to the longitudinal axis of the control element.

For example, the plunger surface may have a rectangular shape in a direction perpendicular to the longitudinal axis of the control element. A rectangular shape will provide a solid contact with and easy release from the switch disc.

[0022] The plunger surface may have a cross-shape in a direction perpendicular to the longitudinal axis of the control element.

For example, the plunger surface may comprise two extended areas crossing each other and being perpendicular to each other.

A cross-shaped plunger surface may provide a symmetrical pressure on the switch disc.

[0023] The stop element may form part of the plunger surface.

[0024] For example, part of the plunger surface may comprise the stop element. In case the plunger surface has a cross-shape, at least one of the two extended areas of the plunger surface may comprise the stop element.

Thereby, the intended match between the plunger surface and the stop element may easily be reached to minimize the risk of the switch disc being deformed irreversibly.

[0025] The stop element may comprise at least one stop surface.

The plunger surface and the at least one stop surface may be flush relative to the longitudinal axis of the control element.

Thereby, the intended match between the plunger surface and the stop surface may easily be reached to minimize the risk of the switch disc being deformed irreversibly, as the exact stop position of the plunger surface relative to the switch disc is known.

[0026] The stop element may comprise at least two stop surfaces.

The two stop surfaces may be arranged on opposite sides of the plunger element.

Thereby, an immediate stop of the plunger element is provided. In case the stop element only had one stop surface at one side of the plunger element, the plunger element would potentially not stop completely after the stop element contacts the switch housing, but would twist to the side of the plunger element without a stop element before stopping completely.

[0027] The switch disc may extend further from the longitudinal axis of the control element than the plunger surface in a direction perpendicular to said longitudinal axis.

For example, the cross section of the switch disc may be larger than the cross section of the plunger surface seen in a direction perpendicular to the longitudinal axis of the control element. For example, the cross section of the switch disc may surround the cross section of the plunger surface seen in a direction perpendicular to the longitudinal axis of the control element. Thereby, it is provided that the entire cross section of the plunger surface will always stay within the cross section of the switch disc (perpendicular to the longitudinal axis) and not accidentally collide with e.g. the switch housing before deforming the switch disc sufficiently to activate the switch.

[0028] The control element may be a push button switch.

For example, the control element may be a dome switch.

A hearing aid

[0029] In an aspect of the present application, a hearing aid comprising a control element is provided.

[0030] The control element may be a control element as disclosed previously.

[0031] At least the push surface of the push button of the control element may protrude through an opening in an outer shell of the hearing aid.

[0032] An opening and/or a recess in the shell of the hearing aid may be configured for accommodating the push button. At least part of the push button may arranged outside of the shell of the hearing aid, and at least part of the push button may be arranged inside of the shell of the hearing aid.

[0033] The switch may be mounted on a printed circuit board (PCB) of the hearing aid.

[0034] The push button may be configured to be installed in the hearing aid from the inside of the outer shell of the hearing aid.

For example, the push button may have to be arranged in the opening and/or recess of the shell of the hearing aid from the inner side of the shell. Thereby, the push button may have a size and/or shape so that it is not able exit the hearing aid completely, when the hearing aid is assembled, but only part of the push button is accessible from the outside of the hearing aid.

[0035] The hearing aid may be adapted to provide a frequency dependent gain and/or a level dependent compression and/or a transposition (with or without frequency compression) of one or more frequency ranges to one or more other frequency ranges, e.g. to compensate for a hearing impairment of a user. The hearing aid may comprise a signal processor for enhancing the input signals and providing a processed output signal.

[0036] The hearing aid may comprise an output unit for providing a stimulus perceived by the user as an acoustic signal based on a processed electric signal. The output unit may comprise a number of electrodes of a cochlear implant (for a CI type hearing aid) or a vibrator of a bone conducting hearing aid. The output unit may comprise an output transducer. The output transducer may comprise a receiver (loudspeaker) for providing the stimulus as an acoustic signal to the user (e.g. in an acoustic (air conduction based) hearing aid). The output transducer may comprise a vibrator for providing the stimulus as mechanical vibration of a skull bone to the user (e.g. in a bone-attached or bone-anchored hearing aid).

[0037] The hearing aid may comprise an input unit for providing an electric input signal representing sound. The input unit may comprise an input transducer, e.g. a microphone, for converting an input sound to an electric input signal. The input unit may comprise a wireless receiver for receiving a wireless signal comprising or representing sound and for providing an electric input signal representing said sound. The wireless receiver may e.g. be configured to receive an electromagnetic signal in the radio frequency range (3 kHz to 300 GHz). The wireless receiver may e.g. be configured to receive an electromagnetic signal in a frequency range of light (e.g. infrared light 300 GHz to 430 THz, or visible light, e.g. 430 THz to 770 THz).

[0038] The hearing aid may comprise a directional microphone system adapted to spatially filter sounds from the environment, and thereby enhance a target acoustic source among a multitude of acoustic sources in the local environment of the user wearing the hearing aid. The directional system may be adapted to detect (such as adaptively detect) from which direction a particular part of the microphone signal originates. This can be achieved in various different ways as e.g. described in the prior art. In hearing aids, a microphone array beamformer is often used for spatially attenuating background noise sources. Many beamformer variants can be found in literature. The minimum variance distortionless response (MVDR) beamformer is widely used in microphone array signal processing. Ideally, the MVDR beamformer keeps the signals from the target direction (also referred to as the look direction) unchanged, while attenuating sound signals from other directions maximally. The generalized sidelobe canceller (GSC) structure is an equivalent representation of the MVDR beamformer offering computational and numerical advantages over a direct implementation in its original form.

[0039] The hearing aid may comprise antenna and transceiver circuitry (e.g. a wireless receiver) for wirelessly receiving a direct electric input signal from another device, e.g. from an entertainment device (e.g. a TV-set), a communication device, a wireless microphone, or another hearing aid. The direct electric input signal may represent or comprise an audio signal and/or a control signal and/or an information signal. The hearing aid may comprise demodulation circuitry for demodulating the received direct electric input to provide the direct electric input signal representing an audio signal and/or a control signal e.g. for setting an operational parameter (e.g. volume) and/or a processing parameter of the hearing aid. In general, a wireless link established by antenna and transceiver circuitry of the hearing aid can be of any type. The wireless link may be established between two devices, e.g. between an entertainment device (e.g. a TV) and the hearing aid, or between two hearing aids, e.g. via a third, intermediate device (e.g. a processing device, such as a remote control device, a smartphone, etc.). The wireless link may be used under power constraints, e.g. in that the hearing aid may be constituted by or comprise a portable (typically battery driven) device. The wireless link may be a link based on near-field communication, e.g. an inductive link based on an inductive coupling between antenna coils of transmitter and receiver parts. The wireless link may be based on far-field, electromagnetic radiation. The communication via the wireless link may be arranged according to a specific modulation scheme, e.g. an analogue modulation scheme, such as FM (frequency modulation) or AM (amplitude

modulation) or PM (phase modulation), or a digital modulation scheme, such as ASK (amplitude shift keying), e.g. On-Off keying, FSK (frequency shift keying), PSK (phase shift keying), e.g. MSK (minimum shift keying), or QAM (quadrature amplitude modulation), etc.

[0040] The communication between the hearing aid and the other device may be in the base band (audio frequency range, e.g. between 0 and 20 kHz). Preferably, communication between the hearing aid and the other device is based on some sort of modulation at frequencies above 100 kHz. Preferably, frequencies used to establish a communication link between the hearing aid and the other device is below 70 GHz, e.g. located in a range from 50 MHz to 70 GHz, e.g. above 300 MHz, e.g. in an ISM range above 300 MHz, e.g. in the 900 MHz range or in the 2.4 GHz range or in the 5.8 GHz range or in the 60 GHz range (ISM=Industrial, Scientific and Medical, such standardized ranges being e.g. defined by the International Telecommunication Union, ITU). The wireless link may be based on a standardized or proprietary technology. The wireless link may be based on Bluetooth technology (e.g. Bluetooth Low-Energy technology).

[0041] The hearing aid and/or the communication device may comprise an electrically small antenna. An 'electrically small antenna' is in the present context taken to mean that the spatial extension of the antenna (e.g. the maximum physical dimension in any direction) is much smaller than the wavelength λ_{Tx} of the transmitted electric signal. The spatial extension of the antenna may be a factor of 10, or 50 or 100 or more, or a factor of 1 000 or more, smaller than the carrier wavelength λ_{Tx} of the transmitted signal. The hearing aid may be a relatively small device. The term 'a relatively small device' is in the present context taken to mean a device whose maximum physical dimension (and thus of an antenna for providing a wireless interface to the device) is smaller than 10 cm, such as smaller than 5 cm. In the present context, 'a relatively small device' may be a device whose maximum physical dimension is much *smaller* (e.g. more than 3 times, such as more than 10 times smaller, such as more than 20 times small) than the operating wavelength of a wireless interface to which the antenna is intended (*ideally* an antenna for radiation of electromagnetic waves at a given frequency should be *larger* than or equal to half the wavelength of the radiated waves at that frequency). At 860 MHz, the wavelength in vacuum is around 35 cm. At 2.4 GHz, the wavelength in vacuum is around 12 cm. The hearing aid may have a maximum outer dimension of the order of 0.15 m (e.g. a handheld mobile telephone). The hearing aid may have a maximum outer dimension of the order of 0.08 m (e.g. a headset). The hearing aid may have a maximum outer dimension of the order of 0.04 m (e.g. a hearing instrument).

[0042] The hearing aid may be or form part of a portable (i.e. configured to be wearable) device, e.g. a device comprising a local energy source, e.g. a battery, e.g. a rechargeable battery. The hearing aid may e.g. be a low weight, easily wearable, device, e.g. having a total weight less than 100 g.

[0043] The hearing aid may be configured to operate in different modes, e.g. a normal mode and one or more specific modes, e.g. selectable by a user, or automatically selectable. A mode of operation may be optimized to a specific acoustic situation or environment. A mode of operation may include a low-power mode, where functionality of the hearing aid is reduced (e.g. to save power), e.g. to disable wireless communication, and/or to disable specific features of the hearing aid.

[0044] For example, the control element may be configured to control at least part of the hearing aid being operated in the different modes.

[0045] The hearing aid may comprise a number of detectors configured to provide status signals relating to a current physical environment of the hearing aid (e.g. the current acoustic environment), and/or to a current state of the user wearing the hearing aid, and/or to a current state or mode of operation of the hearing aid. Alternatively, or additionally, one or more detectors may form part of an *external* device in communication (e.g. wirelessly) with the hearing aid. An external device may e.g. comprise another hearing aid, a remote control, and audio delivery device, a telephone (e.g. a smartphone), an external sensor, etc.

[0046] One or more of the number of detectors may operate on the full band signal (time domain). One or more of the number of detectors may operate on band split signals ((time-) frequency domain), e.g. in a limited number of frequency bands.

[0047] The number of detectors may comprise a level detector for estimating a current level of a signal of the forward path. The detector may be configured to decide whether the current level of a signal of the forward path is above or below a given (L-)threshold value. The level detector operates on the full band signal (time domain). The level detector operates on band split signals ((time-) frequency domain).

[0048] The number of detectors may comprise a movement detector, e.g. an acceleration sensor. The movement detector may be configured to detect movement of the user's facial muscles and/or bones, e.g. due to speech or chewing (e.g. jaw movement) and to provide a detector signal indicative thereof.

[0049] The hearing aid may comprise a classification unit configured to classify the current situation based on input signals from (at least some of) the detectors, and possibly other inputs as well. In the present context 'a current situation' may be taken to be defined by one or more of

a) the physical environment (e.g. including the current electromagnetic environment, e.g. the occurrence of electromagnetic signals (e.g. comprising audio and/or control signals) intended or not intended for reception by the hearing aid, or other properties of the current environment than acoustic);

b) the current acoustic situation (input level, feed-

back, etc.), and
c) the current mode or state of the user (movement, temperature, cognitive load, etc.);
d) the current mode or state of the hearing aid (program selected, time elapsed since last user interaction, etc.) and/or of another device in communication with the hearing aid.

[0050] The classification unit may be based on or comprise a neural network, e.g. a trained neural network.
[0051] The hearing aid may further comprise other relevant functionality for the application in question, e.g. compression, noise reduction, etc.
[0052] The hearing aid may comprise a hearing instrument, e.g. a hearing instrument adapted for being located at the ear or fully or partially in the ear canal of a user, e.g. a headset, an earphone, an ear protection device or a combination thereof. The hearing assistance system may comprise a speakerphone (comprising a number of input transducers and a number of output transducers, e.g. for use in an audio conference situation), e.g. comprising a beamformer filtering unit, e.g. providing multiple beamforming capabilities.
[0053] For example, the hearing aid may be a headset. The control element may be installed in the shell of the headset and be configured to activate and/or deactivate one or more functions of the headset.

Use

[0054] In an aspect, use of a hearing aid as described above, in the 'detailed description of embodiments' and in the claims, is moreover provided. Use may be provided in a system comprising audio distribution. Use may be provided in a system comprising one or more hearing aids (e.g. hearing instruments), headsets, ear phones, active ear protection systems, etc., e.g. in handsfree telephone systems, teleconferencing systems (e.g. including a speakerphone), public address systems, karaoke systems, classroom amplification systems, etc..

A hearing system

[0055] In a further aspect, a hearing system comprising a hearing aid as described above, in the 'detailed description of embodiments', and in the claims, AND an auxiliary device is moreover provided.
[0056] The hearing system may be adapted to establish a communication link between the hearing aid and the auxiliary device to provide that information (e.g. control and status signals, possibly audio signals) can be exchanged or forwarded from one to the other.
[0057] The auxiliary device may comprise a remote control, a smartphone, or other portable or wearable electronic device, such as a smartwatch or the like.
[0058] The auxiliary device may be constituted by or comprise a remote control for controlling functionality and operation of the hearing aid(s). The function of a remote control may be implemented in a smartphone, the smartphone possibly running an APP allowing to control the functionality of the audio processing device via the smartphone (the hearing aid(s) comprising an appropriate wireless interface to the smartphone, e.g. based on Bluetooth or some other standardized or proprietary scheme).
[0059] The auxiliary device may be constituted by or comprise an audio gateway device adapted for receiving a multitude of audio signals (e.g. from an entertainment device, e.g. a TV or a music player, a telephone apparatus, e.g. a mobile telephone or a computer, e.g. a PC) and adapted for selecting and/or combining an appropriate one of the received audio signals (or combination of signals) for transmission to the hearing aid.
[0060] The auxiliary device may be constituted by or comprise another hearing aid. The hearing system may comprise two hearing aids adapted to implement a binaural hearing system, e.g. a binaural hearing aid system.

Definitions

[0061] In the present context, a hearing aid, e.g. a hearing instrument, refers to a device, which is adapted to improve, augment and/or protect the hearing capability of a user by receiving acoustic signals from the user's surroundings, generating corresponding audio signals, possibly modifying the audio signals and providing the possibly modified audio signals as audible signals to at least one of the user's ears. Such audible signals may e.g. be provided in the form of acoustic signals radiated into the user's outer ears, acoustic signals transferred as mechanical vibrations to the user's inner ears through the bone structure of the user's head and/or through parts of the middle ear as well as electric signals transferred directly or indirectly to the cochlear nerve of the user.
[0062] The hearing aid may be configured to be worn in any known way, e.g. as a unit arranged behind the ear with a tube leading radiated acoustic signals into the ear canal or with an output transducer, e.g. a loudspeaker, arranged close to or in the ear canal, as a unit entirely or partly arranged in the pinna and/or in the ear canal, as a unit, e.g. a vibrator, attached to a fixture implanted into the skull bone, as an attachable, or entirely or partly implanted, unit, etc. The hearing aid may comprise a single unit or several units communicating (e.g. acoustically, electrically or optically) with each other. The loudspeaker may be arranged in a housing together with other components of the hearing aid, or may be an external unit in itself (possibly in combination with a flexible guiding element, e.g. a dome-like element).
[0063] More generally, a hearing aid comprises an input transducer for receiving an acoustic signal from a user's surroundings and providing a corresponding input audio signal and/or a receiver for electronically (i.e. wired or wirelessly) receiving an input audio signal, a (typically configurable) signal processing circuit (e.g. a signal processor, e.g. comprising a configurable (programmable) processor, e.g. a digital signal processor) for processing

the input audio signal and an output unit for providing an audible signal to the user in dependence on the processed audio signal. The signal processor may be adapted to process the input signal in the time domain or in a number of frequency bands. In some hearing aids, an amplifier and/or compressor may constitute the signal processing circuit. The signal processing circuit typically comprises one or more (integrated or separate) memory elements for executing programs and/or for storing parameters used (or potentially used) in the processing and/or for storing information relevant for the function of the hearing aid and/or for storing information (e.g. processed information, e.g. provided by the signal processing circuit), e.g. for use in connection with an interface to a user and/or an interface to a programming device. In some hearing aids, the output unit may comprise an output transducer, such as e.g. a loudspeaker for providing an air-borne acoustic signal or a vibrator for providing a structure-borne or liquid-borne acoustic signal. In some hearing aids, the output unit may comprise one or more output electrodes for providing electric signals (e.g. to a multi-electrode array) for electrically stimulating the cochlear nerve (cochlear implant type hearing aid).

[0064] In some hearing aids, the vibrator may be adapted to provide a structure-borne acoustic signal transcutaneously or percutaneously to the skull bone. In some hearing aids, the vibrator may be implanted in the middle ear and/or in the inner ear. In some hearing aids, the vibrator may be adapted to provide a structure-borne acoustic signal to a middle-ear bone and/or to the cochlea. In some hearing aids, the vibrator may be adapted to provide a liquid-borne acoustic signal to the cochlear liquid, e.g. through the oval window. In some hearing aids, the output electrodes may be implanted in the cochlea or on the inside of the skull bone and may be adapted to provide the electric signals to the hair cells of the cochlea, to one or more hearing nerves, to the auditory brainstem, to the auditory midbrain, to the auditory cortex and/or to other parts of the cerebral cortex.

[0065] A hearing aid may be adapted to a particular user's needs, e.g. a hearing impairment. A configurable signal processing circuit of the hearing aid may be adapted to apply a frequency and level dependent compressive amplification of an input signal. A customized frequency and level dependent gain (amplification or compression) may be determined in a fitting process by a fitting system based on a user's hearing data, e.g. an audiogram, using a fitting rationale (e.g. adapted to speech). The frequency and level dependent gain may e.g. be embodied in processing parameters, e.g. uploaded to the hearing aid via an interface to a programming device (fitting system), and used by a processing algorithm executed by the configurable signal processing circuit of the hearing aid.

[0066] A 'hearing system' refers to a system comprising one or two hearing aids, and a 'binaural hearing system' refers to a system comprising two hearing aids and being adapted to cooperatively provide audible signals to both of the user's ears. Hearing systems or binaural hearing systems may further comprise one or more 'auxiliary devices', which communicate with the hearing aid(s) and affect and/or benefit from the function of the hearing aid(s). Such auxiliary devices may include at least one of a remote control, a remote microphone, an audio gateway device, an entertainment device, e.g. a music player, a wireless communication device, e.g. a mobile phone (such as a smartphone) or a tablet or another device, e.g. comprising a graphical interface.. Hearing aids, hearing systems or binaural hearing systems may e.g. be used for compensating for a hearing-impaired person's loss of hearing capability, augmenting or protecting a normal-hearing person's hearing capability and/or conveying electronic audio signals to a person. Hearing aids or hearing systems may e.g. form part of or interact with public-address systems, active ear protection systems, handsfree telephone systems, car audio systems, entertainment (e.g. TV, music playing or karaoke) systems, teleconferencing systems, classroom amplification systems, etc.

BRIEF DESCRIPTION OF DRAWINGS

[0067] The aspects of the disclosure may be best understood from the following detailed description taken in conjunction with the accompanying figures. The figures are schematic and simplified for clarity, and they just show details to improve the understanding of the claims, while other details are left out. Throughout, the same reference numerals are used for identical or corresponding parts. The individual features of each aspect may each be combined with any or all features of the other aspects. These and other aspects, features and/or technical effect will be apparent from and elucidated with reference to the illustrations described hereinafter in which:

FIG. 1 shows an exemplary hearing aid according to the present disclosure.

FIG. 2 shows a cross section of an exemplary control element according to the present disclosure.

FIG. 3 shows a cross section of an exemplary control element according to the present disclosure.

FIGS. 4a and 4b show exemplary push buttons of a control element according to the present disclosure.

FIGS. 5a, 5b, 5c, and 5d show exemplary plunger surfaces and stop surfaces according to the present disclosure.

[0068] The figures are schematic and simplified for clarity, and they just show details which are essential to the understanding of the disclosure, while other details are left out. Throughout, the same reference signs are used for identical or corresponding parts.

[0069] Further scope of applicability of the present disclosure will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the disclosure, are given by way of illustration only. Other embodiments may become apparent to those skilled in the art from the following detailed description.

DETAILED DESCRIPTION OF EMBODIMENTS

[0070] The detailed description set forth below in connection with the appended drawings is intended as a description of various configurations. The detailed description includes specific details for the purpose of providing a thorough understanding of various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. Several aspects of the apparatus and methods are described by various blocks, functional units, modules, components, circuits, steps, processes, algorithms, etc. (collectively referred to as "elements"). Depending upon particular application, design constraints or other reasons, these elements may be implemented using electronic hardware, computer program, or any combination thereof.

[0071] The electronic hardware may include micro-electronic-mechanical systems (MEMS), integrated circuits (e.g. application specific), microprocessors, microcontrollers, digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), gated logic, discrete hardware circuits, printed circuit boards (PCB) (e.g. flexible PCBs), and other suitable hardware configured to perform the various functionality described throughout this disclosure, e.g. sensors, e.g. for sensing and/or registering physical properties of the environment, the device, the user, etc. Computer program shall be construed broadly to mean instructions, instruction sets, code, code segments, program code, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, threads of execution, procedures, functions, etc., whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise.

[0072] FIG. 1 shows an exemplary part of a hearing aid according to the present disclosure.

[0073] In FIG. 1, the part of a hearing aid in the form of a behind-the-ear (BTE) 1 part is shown. The BTE 1 may be enclosed by a shell comprising a top shell 2 and a bottom shell 3.

[0074] At the top shell 2, one or more control elements may be installed. In FIG. 1, a first 4 and a second control element 5 are shown. The first 4 and second control elements 5 may be push button switches.

[0075] The first 4 and second control elements 5 may each comprise a push button 6,7 arranged partly outside of the top shell 2 and partly inside the top shell 2 by being accommodated in openings 8,9 of said top shell 2. The push buttons 6,7 may each comprise a push surface 10,11 adapted for receiving a push from the hearing aid user. In other words, the hearing aid user may exert a force on one or both of the push surfaces in a direction towards the inside of the BTE 1, whereby one or more functions of the hearing aid are activated and/or deactivated. After relieving the force, the push button may return to its original position (rest position).

[0076] FIG. 2 shows a cross section of a cut-out of an exemplary control element according to the present disclosure.

[0077] FIG. 3 shows a cross section of an exemplary control element according to the present disclosure.

[0078] In FIGS. 2 and 3, the control element 4 is shown to be installed at a top shell 2 of a BTE.

[0079] It is shown that the control element 4 may comprise a push button 6. The push button 6 may comprise a push surface 10, a plunger element 12, and a stop element 19. The plunger element 12 may comprise a plunger surface 12a. The stop element 19 may comprise a stop surface 19a.

[0080] In FIG. 3 it is shown that the stop element 19 may comprise two stop surfaces 19a.

[0081] The control element 4 may further comprise a switch 13. The switch may comprise a switch housing 14 and a switch disc 15. The switch disc 15 may protrude from an opening 16 of the switch housing 14. The switch may be configured to activate and/or deactivate one or more functions of the hearing aid when the switch disc 15 is forced towards said opening 16.

[0082] The switch housing 14 may further comprise a collar 17 directed towards the push button 6. The collar 17 may be a planar surface.

[0083] The push button 6 may be movable in a direction towards the switch disc 15. The push button 6 may be configured to force the switch disc 15 towards said opening 16 of the switch housing 14 by deforming the switch disc 15, when said push button 6 is exerted by a force on said push surface 10. The push button 6 may be configured to force the switch disc 15 towards said opening 16 of the switch housing 14, until said stop element contacts the switch housing 14. For example, the push button 6 may be configured to force the switch disc 15 towards said opening 16 of the switch housing 14, until said stop element contacts said collar 17 of the switch housing 14.

[0084] A longitudinal axis A of the control element 4 may extend from said push surface 10, via the center of said plunger element 12, and through the center of said switch disc 15. The push button 4 may be movable in a direction along the longitudinal axis A, when the hearing aid user presses the push button 6 in order to activate and/or deactivate one or more functions of the hearing aid.

[0085] It is shown that the switch housing may be mounted on the PCB 18 of the hearing aid.

[0086] FIGS. 4a and 4b show exemplary push buttons of a control element according to the present disclosure.

[0087] It is shown that the plunger element 12 may protrude from a lower side 20 of the push surface (not shown).

[0088] A push button collar 21 may at least partly surround the push surface (and said lower side 20). The push button collar 21 may facilitate that the push button 6 do not exit the top shell of the hearing aid in which the control element is installed.

[0089] The plunger element 12 may comprise a plunger surface 12a. The plunger surface 12a may comprise (may have) a cross-shape in a direction perpendicular to the longitudinal axis A of the control element.

[0090] The stop element 19 (and the stop surface 19a of the stop element 19) may form part of the plunger surface 12a.

[0091] As seen best in FIG. 4b, the stop element 19 may comprise at least one stop surface 19a (and in case of FIG. 4b, two stop surfaces 19a). The plunger surface 12a and the two stop surfaces 19a may be flush with each other relative to the longitudinal axis A of the control element.

[0092] FIGS. 5a, 5b, 5c, and 5d show exemplary plunger surfaces and stop surfaces according to the present disclosure.

[0093] As shown in FIGS. 5a, 5b, 5c, and 5d, many different configurations of plunger surfaces 12a and stop surfaces 19a may be contemplated.

[0094] The stop surfaces 19a may form part of the plunger surface 12a as indicated in e.g. FIGS. 4a, 4b, and 5b. Alternatively, the stop surfaces 19a may be separate from the plunger surface 12a as indicated in e.g. FIGS. 5a, 5c, and 5d.

[0095] In FIGS. 5a and 5d, the plunger surfaces comprise a cross-shape. In FIG. 5a, two of the arms of the plunger surface 12a are directed towards the stop surfaces 19a. In FIG. 5b, the cross-shape of the plunger surface 12a is rotated 90 degrees relative to in FIG. 5a.

[0096] In FIG. 5b, the plunger surface 12a comprises an extended shape. The extended shape is directed towards and in contact with the stop surfaces 19a.

[0097] In FIG. 5c, the plunger surface 12a comprises an extended shape, where the extended shape is not directed towards the stop surfaces 19a, but instead rotated 90 degrees relative to a direction towards said stop surfaces 19a.

[0098] In all of the FIGS. 5a-d, the stop surfaces 19a are shown to comprise two parts and to have a rectangular shape. It should be understood, however, that the stop surface 19a may comprise various types of shapes. For example, the stop surfaces 19a may comprise two or more separate surfaces, such as three surfaces arranged at 120 degrees intervals around the centre of the plunger element, or such as four surfaces arranged at 90 degrees intervals around the centre of the plunger element. For example, the stop surfaces 19a may be a continuous surface, such as a ring or square around the centre of the plunger element.

[0099] It is intended that the structural features of the devices described above, either in the detailed description and/or in the claims, may be combined with steps of the method, when appropriately substituted by a corresponding process.

[0100] As used, the singular forms "a," "an," and "the" are intended to include the plural forms as well (i.e. to have the meaning "at least one"), unless expressly stated otherwise. It will be further understood that the terms "includes," "comprises," "including," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It will also be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element but an intervening element may also be present, unless expressly stated otherwise. Furthermore, "connected" or "coupled" as used herein may include wirelessly connected or coupled. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. The steps of any disclosed method are not limited to the exact order stated herein, unless expressly stated otherwise.

[0101] It should be appreciated that reference throughout this specification to "one embodiment" or "an embodiment" or "an aspect" or features included as "may" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. Furthermore, the particular features, structures or characteristics may be combined as suitable in one or more embodiments of the disclosure. The previous description is provided to enable any person skilled in the art to practice the various aspects described herein. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects.

[0102] The claims are not intended to be limited to the aspects shown herein but are to be accorded the full scope consistent with the language of the claims, wherein reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Unless specifically stated otherwise, the term "some" refers to one or more.

Claims

1. Control element for a hearing aid, the control element being configured to activate and/or deactivate one or more functions of the hearing aid, the control element comprising

    - a push button comprising a push surface, a plunger element, and a stop element,
    - a switch comprising a switch housing and a

switch disc protruding from an opening of the switch housing, wherein the switch being configured to activate and/or deactivate one or more functions of the hearing aid when the switch disc is forced towards said opening, and
- wherein the push button is movable in a direction towards the switch disc and configured to force the switch disc towards said opening of the switch housing by deforming the switch disc, when said push button is exerted by a force on said push surface, until said stop element contacts the switch housing.

2. Control element according to claim 1, wherein a longitudinal axis of the control element extends from said push surface, via the center of said plunger element, and through the center of said switch disc, and where said push button is movable in a direction along said longitudinal axis.

3. Control element according to any one of claims 1 or 2, wherein the switch housing comprises a collar extending at least partly around the opening of the switch housing, and where the stop element is configured to contact said collar, when the push button is exerted by a force on the push surface.

4. Control element according to any one of the preceding claims, wherein the push button is configured to rest on the switch disc without deforming said switch disc.

5. Control element according to any one of the preceding claims, wherein the plunger element comprises a plunger surface for contacting the switch disc.

6. Control element according to claim 5, wherein said plunger surface has an extended shape in a direction perpendicular to the longitudinal axis of the control element, such as a rectangular shape.

7. Control element according to any one of claims 5-6, wherein said plunger surface has a cross-shape in a direction perpendicular to the longitudinal axis of the control element.

8. Control element according to any one of claims 5-7, wherein the stop element forms part of the plunger surface.

9. Control element according to any one of claims 5-8, wherein the stop element comprises at least one stop surface, and where said plunger surface and the at least one stop surface are flush relative to the longitudinal axis of the control element.

10. Control element according to claim 9, wherein the stop element comprises at least two stop surfaces arranged on opposite sides of the plunger element.

11. Control element according to any one of claims 5-10, wherein the switch disc extends further from the longitudinal axis of the control element than the plunger surface in a direction perpendicular to said longitudinal axis.

12. Control element according to any one of the preceding claims, wherein the control element is a push button switch.

13. Hearing aid comprising a control element according to any one of the preceding claims, wherein at least the push surface of the push button of the control element protrudes through an opening in an outer shell of the hearing aid.

14. Hearing aid according to claim 13, wherein the switch is arranged at a printed circuit board of the hearing aid.

15. Hearing aid according to any one of claims 13-14, wherein the push button is configured to be installed in the hearing aid from the inside of the outer shell of the hearing aid.

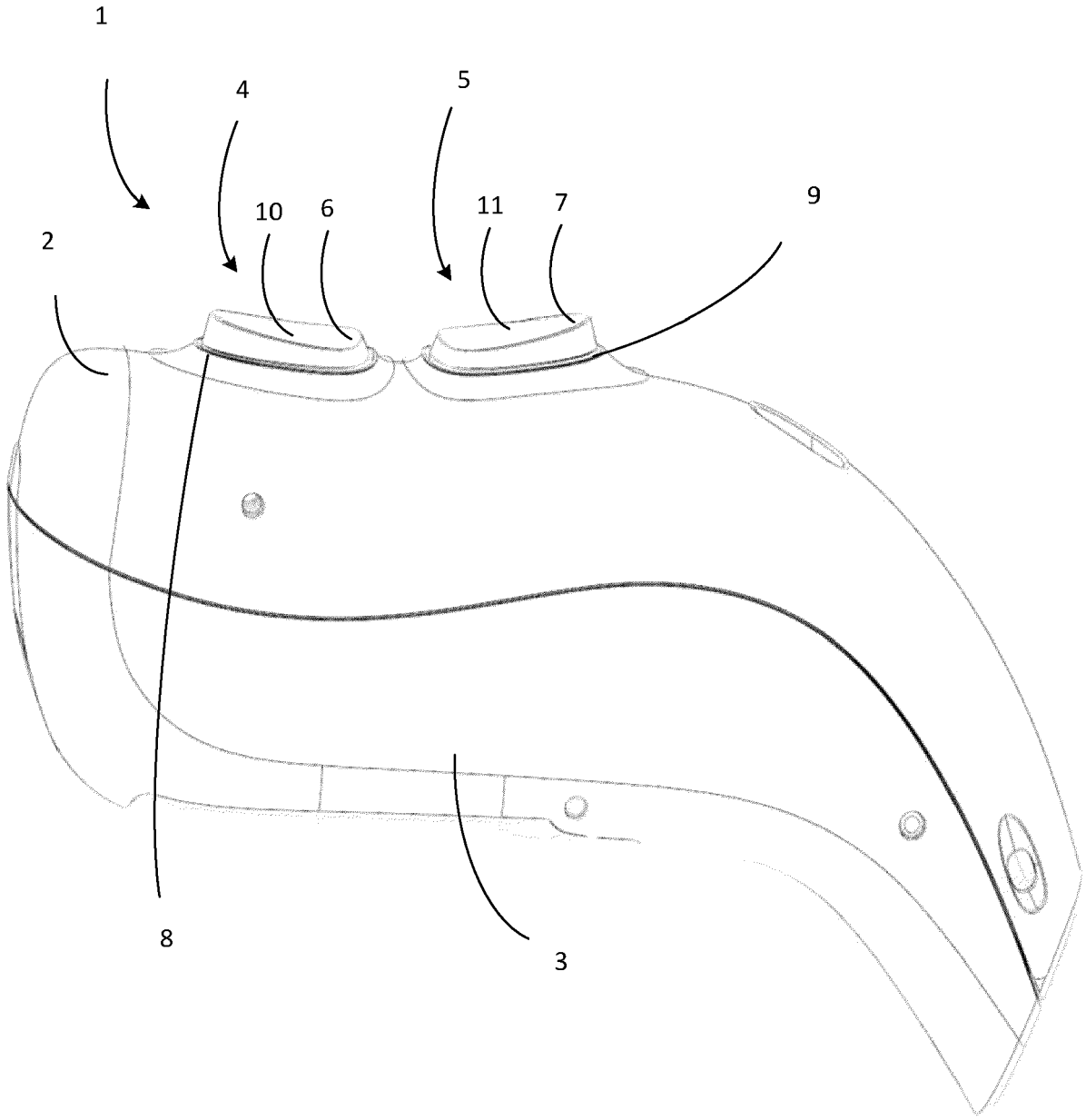

FIG. 1

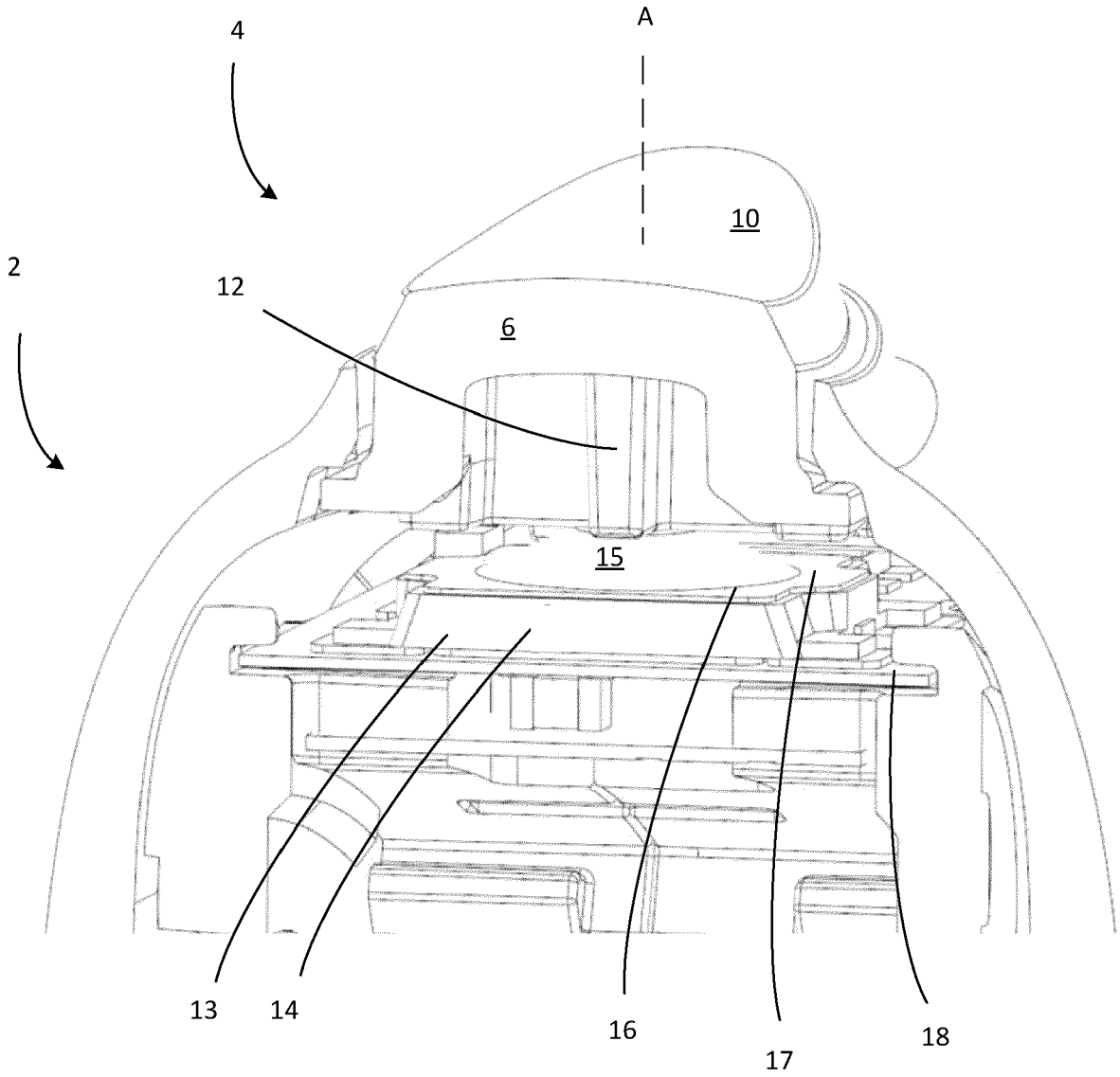

FIG. 2

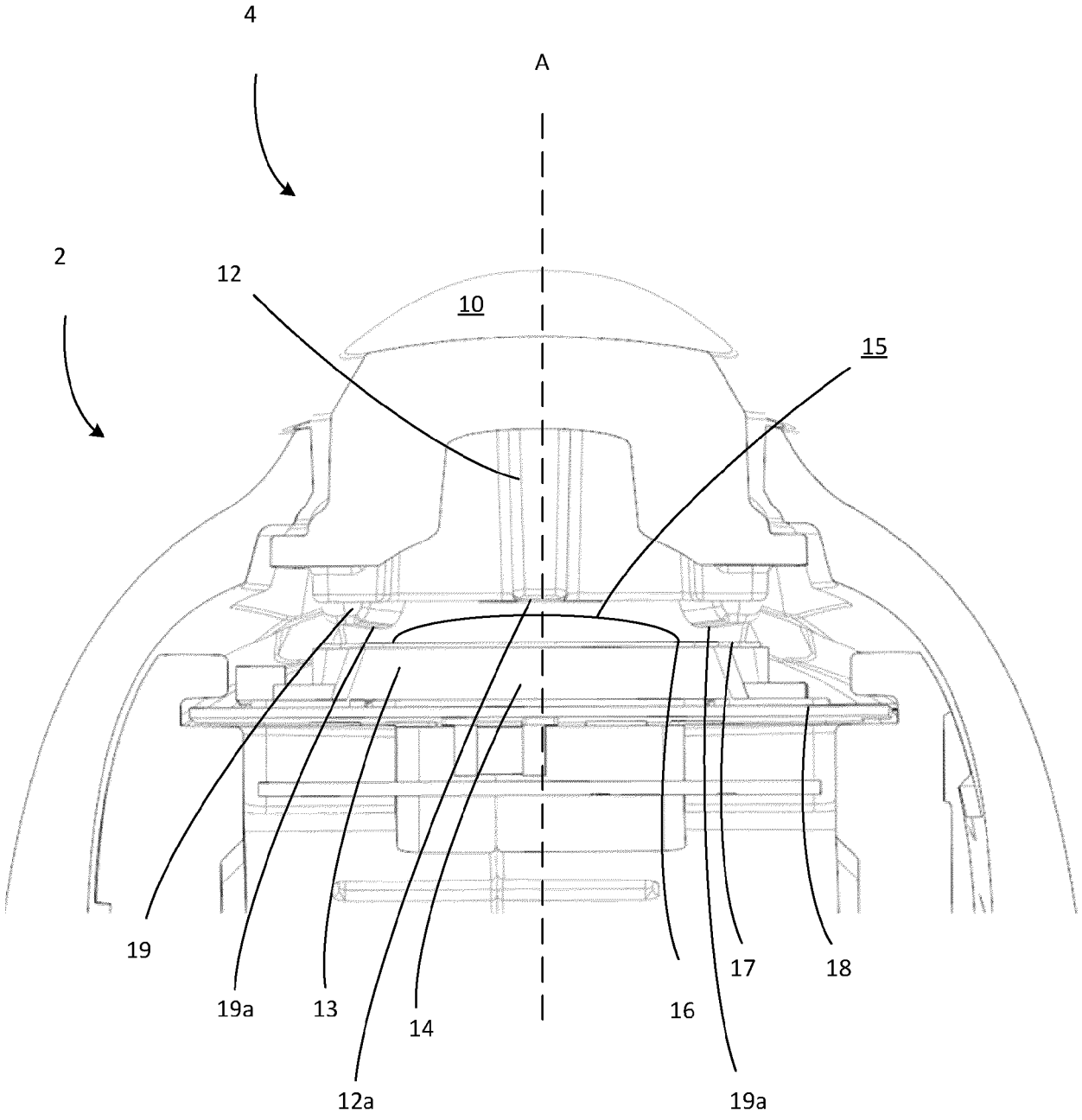

FIG. 3

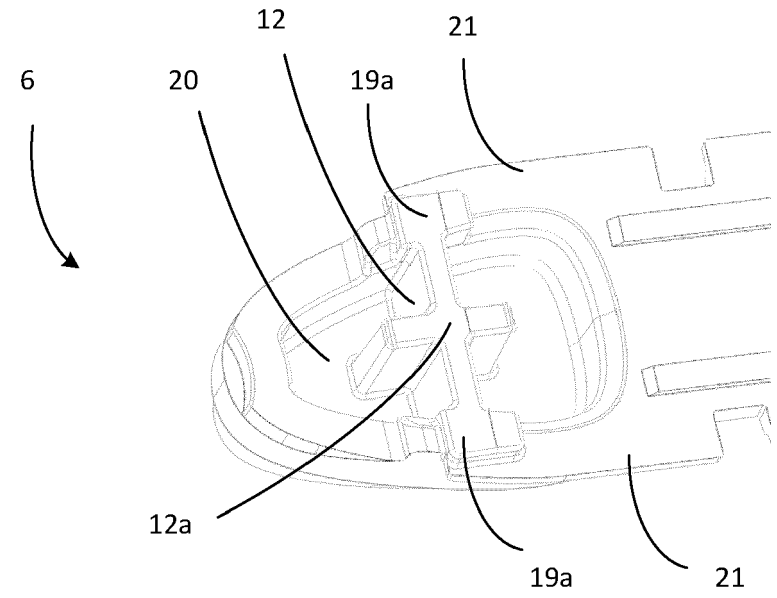

FIG. 4a

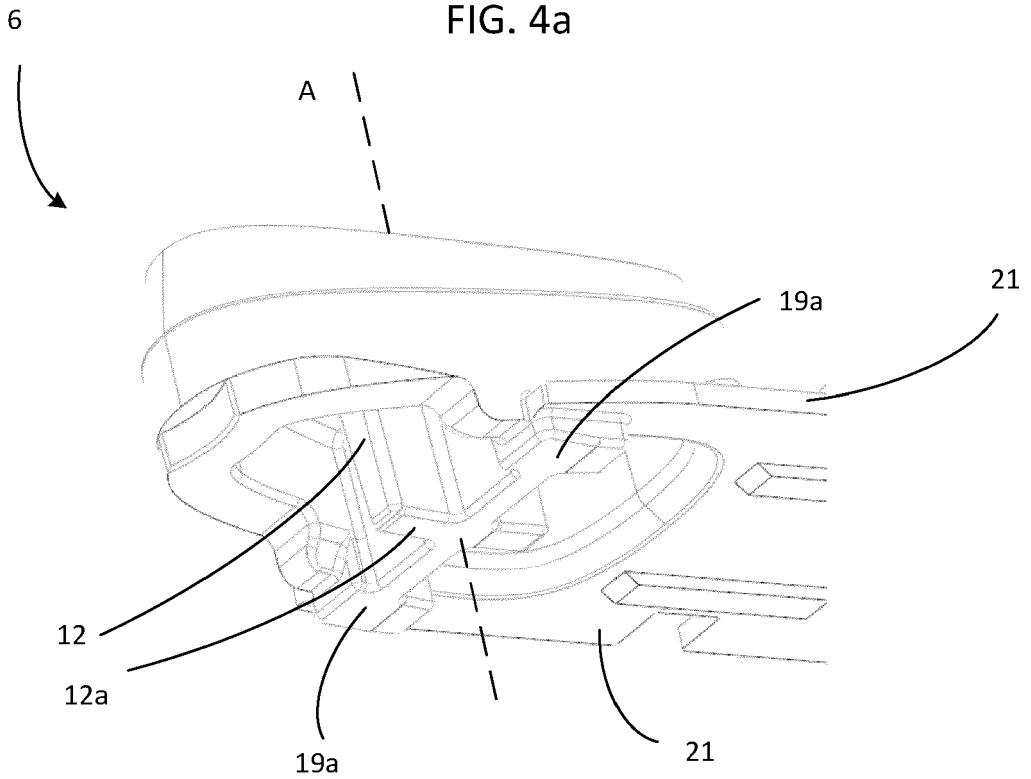

FIG. 4b

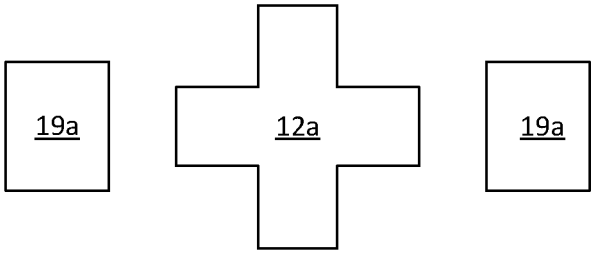

FIG. 5a

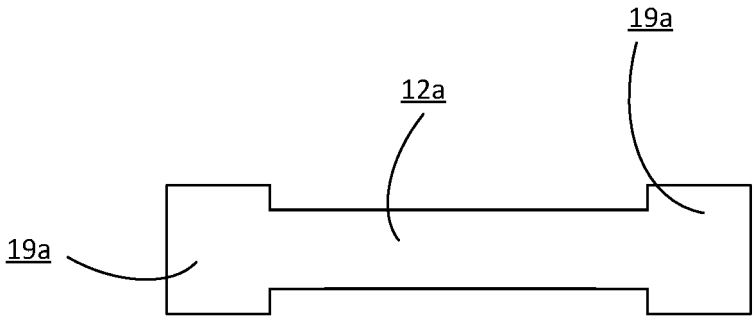

FIG. 5b

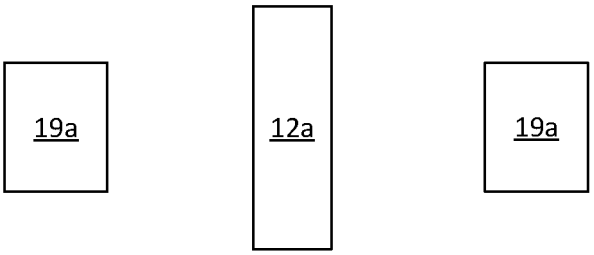

FIG. 5c

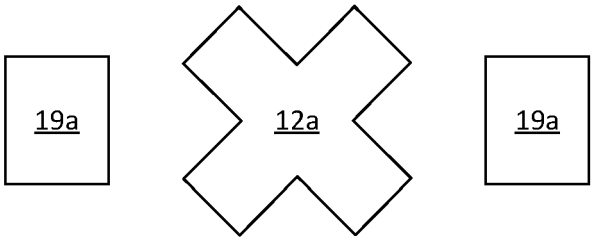

FIG. 5d

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 0469

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 March 2021	Fribert, Jan

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 20 0469

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