



## Description

The present invention relates to a circuit for operation of a hearing aid as well as a hearing aid as such.

The hearing aid acoustician determines individually for each patient the audiometric characteristics of hearing and, on the basis thereof, makes the optimal adjustment of the operating parameter or parameters of the hearing aid. In the process, an optimal speech intelligibility is sought. However, the discomfort threshold of the patient poses a problem. In many cases, impaired hearing is especially sensitive to elevated output levels. If the impaired hearing is provided with a hearing aid adapted to optimal speech intelligibility, the patient feels this as a discomfort.

The object of the invention consists in creating a circuit for operation of a hearing aid as well as a hearing aid as such that enables the hearing aid to be operated with an optimal speech intelligibility for each patient, adjusted individually, without the patient feeling it as a discomfort during use.

As prior art, a circuit with a control unit for a hearing aid is described in US 5,396,560, which, for each channel, makes possible the adjustment of an adaptable amplification for selective enhancement of main signals and suppression of background noise.

Known from WO 94/23548 is a circuit for a hearing aid in which, via a comparator, a channel output or starting signal is compared with a threshold value of the respective channel depending on the user desires.

This object is achieved in accordance with the invention in claim 1 as well as claim 12 by the respectively characterizing features in conjunction with the respective preamble. Appropriate embodiments are claimed in the dependent claims.

In accordance with the invention, the circuit for operation of the hearing aid in the way described in the introduction comprises a control unit, wherein the operating parameter setting of the starting situation as well as that of the target situation are set in a memory system, and, by means of the control unit, the operating parameter or the operating parameters according to the setting of the starting situation can be adjusted to

the operating parameter(s) according to the setting of the target situation over a specific time interval.

Appropriately, the adjustment of the operating parameter or operating parameters occurs in uniform steps in order of magnitude and/or in time intervals. In this case, the control unit comprises a timing element or timer for adjustment of a time constant, with which the time interval can be set for adjustment of the output to the target situation.

Once a plurality of time constants have been set on the control unit, there exists the possibility that the patient himself or herself can choose a longer time constant, that is, a longer time interval, in the event that the adjustment of the two operating states is too fast.

The amplification, the threshold value and/or the control time of a compression circuit (e.g., AGC circuit), the maximum output level, and/or the frequency response are to be chosen as operating parameters of the circuit that are to be set in accordance with the invention, in each case individually or in differing combination.

The operating parameters of the starting situation should be adjusted so that the patient senses the sound to be pleasant. However, by way of the method according to the invention or the circuit to be made for it, the sound will be brought gradually to the optimal state, that is, the optimal speech intelligibility, and without it being sensed as unpleasant.

Instead of a simple circuit for ensuring a linear increase in the setting of the operating parameters when viewed over time, the control unit can also interact appropriately with a data processing unit, which provides a memory for an adjustment program. The adjustment of the operating parameter setting of the starting situation to that of the target situation occurs in this case via a specially provided program, which can be varied on an individual basis. The adjustment program enables a plurality of operating parameters to be adjusted over a specific time interval and, namely, in any desired adjustment characteristic and, if appropriate, for each operating parameter individually.

The present invention further comprises a hearing aid that is characterized by a circuit according to claims 1 – 11.

Appropriate embodiments of the present invention will be discussed below in detail on the basis of drawings. Shown are:

**Fig. 1**, the hearing aid according to the invention in a greatly simplified illustration for adjustment of an operating parameter setting of a starting situation to that of a target situation;

**Fig. 2**, another embodiment of a hearing aid using a data processing unit for ensuring an adjustment of the operating parameter setting of the starting situation to that of the target situation.

The reference number **1** in **Fig. 1** designates the hearing aid in its entirety. It comprises a microphone **2** as well as a telecoil **3**, each of which can be connected by means of an operating circuit **11** to an amplifier assembly. The amplifier assembly comprises a preamplifier **4**, a compression circuit **5** (e.g., a so-called AGC or automatic gain control circuit with a specific threshold value as well as a specific compression ratio), as well as an audio filter **6**.

Furthermore, an output amplifier **7**, which is connected to the receiver **8**, as well as an ear adapter **9** are provided. A battery **10** supplies the hearing aid **1** with electric power via an on-off switch **19**. The sound level of the hearing aid **1** can be adjusted at a sound level control **18**. A memory **13** as well as a memory **14** are connected to an input unit **16**.

In accordance with the invention, the hearing aid **1** comprises a control unit **12**, which interacts with a timer **15** as well as a memory arrangement, composed of the memory **13** for an operating parameter setting of the starting situation as well as a memory **14** for an operating parameter setting of the target situation.

The operating parameters to be adjusted involve preferably the amount of preamplification, the magnitude of the compression ratio, the magnitude of the threshold value, and/or the magnitude of the time constants of the compression circuit, the frequency bandwidth with which the sound can be adjusted to the individual hearing ability, and/or the maximum output level. The operating parameters can be adjusted either individually or together.

The individual operating parameters are adjusted via the time constants of the timer **15** in a continuous manner. It is possible with the timer **15** for the patient to

preferably select alternatively a plurality of time constants. For the case when an adjustment of the operating parameters of the starting situation to the target situation occurs too rapidly for the patient, the patient can select a slower time constant of the circuit. The setting of the operating parameters of the starting situation should be adjusted so that the patient finds the sound to be pleasant.

**Fig. 2** shows a slightly altered embodiment of the invention. In this case, the control unit **12** is connected via a D/A converter **21** with a data processing unit **17**, which is equipped with an input unit **16**, which, for example, is external and can be connected to the hearing aid, as well as with a read-only memory **20**. The respective magnitudes/data of the operating parameter adjustment according to the starting situation as well as the target situation are stored in the read-only memory **20**. The operating parameters can be adjusted for each operating parameter on an individual and patient-related basis by means of an adjustment program.

### Patent Claims

1. A circuit for operation of a hearing aid furnished with at least one variable operating parameter, **is hereby characterized** in that a control unit (**12**) is provided, the operating parameter setting of a starting situation as well as that of a target situation are set in a memory system, and, by means of the control unit (**12**), the operating parameter according to the setting of the starting situation can be adjusted to the operating parameter of the target situation over a specific time interval.
2. The circuit according to claim 1, further characterized in that the control unit (**12**) carries out the adjustment in uniform steps of the operating parameter in order of magnitude and/or in time.
3. The circuit according to claim 1, further characterized in that the control unit (**12**) has a time constant, which sets the time interval for the adjustment of the operating parameter.
4. The circuit according to claim 1, further characterized in that the control unit (**12**) has a plurality of different time constants, which can be selected at will by an operator.

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