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Microwave hearing device uses modulated microwave pulses for providing induced sound warning directly within head of deaf person

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ABSTRACT

The hearing device has an audio voltage source (10), e.g. a microphone, delivering a positive electrical audio signal, coupled to a frequency-modulated pulse generator (12), delivering a frequency-modulated burst signal and a constant voltage source (16) providing a standard voltage in the range between 25 and 75 % of the audio peak voltage. A comparator (14) compares the audio signal voltage with the standard voltage, for activating the pulse generator when the standard voltage is exceeded, the delivered pulses causing microwaves in the range between 100 MHz and 10,000 MHz to be provided by a microwave generator (19). An Independent claim for a device for providing an audible warning is also included.

CLAIMS(7) translated from German

1. Establishment of generating a sound perception in humans, consisting of:
a) an audio voltage source providing a positive electrical audio signal voltage

b) supplying a frequenzmodulierbaren pulse generator which is connected to the audio signal source and the frequency-modulated burst signals

c) a constant voltage source that provides a standard voltage which is in the range of 25% to 85% of the audio-to-peak voltage.

d) a related with the audio signal source and the constant voltage source comparator which compares the instantaneous voltage of the audio signals with the standard voltage.

e) a compound of the comparator to the frequenzmodulierbaren pulse generator to activate the pulse generator as soon as the audio signal voltage exceeds the standard voltage.

f) is a microwave generator, the microwave generated in the range of 100 MHz to 10000 MHz, and connected to the frequenzmodulierbaren pulse generator, so that microwaves are generated only when it receives pulses from the pulse generator.

g) means connected to the microwave generator antenna that radiates to the head of a person, to generate the sound impression of the sound source.

2. The device as set forth in claim 1, wherein the frequency range for generating burst signals in the range from 1 KHz to 100 KHz, and which is for the pulses within the burst in the range of 100 KHz to 20 MHz.

3. The device as set forth in claim 1, wherein the duration of a single pulse of the pulse generator frequenzmodulierbaren in the range from 10 ns to 1 microsecond.

4. The device as set forth in claim 1, wherein the voltage standard is about 40% of the peak voltage of the audio signal.

5. The device as set forth in claim 1, wherein the antenna is of a type that into the room to head a man radiates microwaves.

6. A device for the production of auditory perception in humans, consisting of:
a) a frequency generator generating an electromagnetic carrier frequency in the range of 100 MHz to 10000 MHz

b) a frequenzmodulierbaren pulse generator which is connected to the above-mentioned microwave generator to pulse the carrier frequency with pulses having a width in the range from 10 ns to 1 microsecond, with a minimum spacing between the pulses of approximately 25 ns.

c) an audio signal generator, connected to the pulse generator frequenzmodulierbaren,

d) a transmission antenna connected to the microwave generator to emit the modulated carrier frequency to the head of man.

7. The device as set forth in claim 6, wherein the modulator of the pulse generator frequenzmodulierbaren varies the density of said bursts during a positive audio signal as a function of the audio signal voltage.

DESCRIPTION translated from German

- State of the art

- [0001]

  So far, there are rehabilitation measures such as hearing impairment conductive and sensorineural hearing loss in

  - a) a body external electronic hearing aids for sound reinforcement and delivery into the external auditory canal and in
  - b) partially and fully implantable electronic listening facilities that supply the amplified and preprocessed microphone signals on electronic / mechanical transducer to the damaged middle ear or inner ear.

- [0002]

  More sophisticated devices to b) can be combined with a cochlear transplant by the electrical signals from the speech processor of cochlear stimulation electrode are supplied in strong sensorineural hearing loss or even deafness. (Patents DE 196 38 158 A1, DE 197 52 447, DE 199 15 846 C1, DE 42 21 866 C2, DE 696 14 103 T2, US 4,729,366, US 4,850,962, US 5,859,916)

- [0003]

  However, these measures can only be successful if the behind the inner ear Hörnervenbahnen are intact; otherwise, a so-called. auditory brainstem implant must be used.

- [0004]

The insertion of a cochlear Implatates means a 3 hour ear surgery with all its risks. The operational risks associated with an auditory brainstem implant are at least equal.

- [0005]

After surgery, a complex auditory / language training must take place, which is each adapted to the age of the patient.

- [0006]

After this basic therapy lifelong follow-up is required.

- [0007]

The invention relates to a hearing device, which is characterized in that a sound perception can be effected without the involvement of the auditory organs directly in the head of a man.

- [0008]

This is achieved by pulsed high-frequency electromagnetic energy is radiated via an antenna through the air to the head of a human. The frequency of these high frequency energy pulse packets (bursts) is determined by the peak voltage of the audio signal. The audio signals can come from any audio sources, like microphones, CD players, tape recorders and receivers; they are perceived independently of the hearing of the person.

Drawings

- [0009]

Fig. 1 Overview - block diagram.

- [0010]

Fig. 2 diagram of an audio signal voltage curve corresponding to the sound information to perceive the recipient (person). The applied signal voltage V versus time with an additional marker of the standard voltage V. STD.

- [0011]

Fig. 3 **shows** a diagram with same time coordinate as shown in **FIG.**2, showing bursts which are frequency modulated with the audio signal voltage of **FIG.** 2

- [0012]

Fig. 4 **shows** on an enlarged time coordinate that each vertical line in**FIG.** 3 represents a burst of pulses

- [0013]

Fig. 5 shows on a further enlarged time coordinate a single pulse.

Detailed Description of the Invention

- [0014]

Because microwaves can damage human tissue, any radiated energy must be carefully adjusted in intensity to stay within the safety limits for microwave radiation.

- [0015]

As shown in **FIG.** 1, a microphone or other audio source **(10)** provides a signal voltage cable **(11)** to a frequenzmodulierbaren pulse generator **(12)** and via a branch line **(13)** to a comparator **(14).** The comparator **(14)** also receives a signal from a standard voltage source**(16).** If the voltage peak from the audio source **(10)** falls below the standard voltage, the comparator **(16)** via the cable **(17)** a signal to the frequenzmodulierbaren pulse generator **(12)** to disable it. This avoids the generation of false signals. The output of the frequenzmod. The pulse generator **(12)** via the cable **(18)** led to the input of a microwave generator **(19)** whose output is directed to the antenna **(22)** on a human head **(23)** is directed. In this way, the person **(23)** is irradiated with microwaves, which consist of short bursts.

- [0016]

The microwave generator **(19)** operates at a constant frequency of presently preferably 1000 MHz. The microwave energy is preferably pulsed with pulse widths of 10 ns to 1 microsecond. For each setting of frequenzmod. Pulse generator **(12)** this pulse width is constant. The pulses are arranged in bursts. The timing of the bursts is controlled by the instantaneous level of the audio signal voltage across the standard line voltage.

- [0017]

In addition, corresponding to the burst intervals a fluctuating frequency range of 1 to 100 kHz.

- [0018]

This non-uniform burst intervals are generated in the frequenzmodulierbaren pulse generator **(12).**

- [0019]

Fig. 2nd shows one of an audio source **(10)** generated audio signal voltage **(27),** wherein the horizontal axis represents the signal voltage, the time and the vertical axis. For illustrative purposes, the signal voltage **(27)** is illustrated as being upward two different high voltage peaks **(28** and **29)** are shown. In addition, the line of the standard DC voltage **(31)** is shown, which is generated by the standard voltage source **(16).** These standard voltage is preferably chosen so that it is approximately 50% of the maximum audio signal voltage **(28).**

- [0020]

The comparator **(14)** of **Fig.** 1 switches the frequenzmod. Pulse generator **(12)** only if the positive signal of the sound wave **(27)** exceeds the standard voltage **(31).** The negative parts are not used.

- [0021]

FIG. 3 shows two groups of bursts of microwave energy to be radiated from the antenna **(22)** to the head of the person **(23).**

- [0022]

FIG. 3 has a horizontal time axis (the same as the time axis of **FIG.** 2) and a vertical axis representing the power of the microwave pulses from the generator **(19)** in this case. On the left side of **FIG.** 3, a plurality microwave bursts **(32)** are shown which occur on the time axis when the audio signal voltage **(27)** exceeds the standard voltage **(33)** and then disappear when the audio signal voltage the standard voltage again below **(34).**

- [0023]

It should be noted that the bursts **(32)** are not equally spaced and that they are close at a higher voltage and further audio signal when the audio voltage signal is in the direction of the points **(33)** and **(34).** This corresponds to the frequency modulation in the pulse generator. **(12).**

- [0024]

Fig. 3 shows on the right a plurality of microwave bursts **(36),** which are less in number and less time to run than the burst **(32).** This corresponds to a smaller audio signal voltage on the time axis of **FIG.** 2 in the area from point**(37)** to point. **(38).** These bursts **(36)** are also analog frequency-modulated bursts **(32).**

- [0025]

Fig. 4 shows the fact that a single burst as a straight line **(32)** or **(36)** is shown in **Fig.** 3, is from 10 to 20 separate microwave pulses. The duration of the bursts is between 500 ns and 100 microseconds with an optimum at 2 microseconds. The duration of each pulse within the burst is from 10 ns to 1 microsecond, with a time duration of 100 ns is preferred.

- [0026]

Fig. 4 picks out a pulse which is shown again in **Fig.** 5. The time sequence of the pulses within the burst is uniform. The time intervals between pulses can vary from 5 ns to 10 microseconds.

- [0027]

Fig. 3 shows that the concentration of the burst **(32)** relative to the peak **(28)** of **Fig.** 2nd can be expressed as a repetition frequency. When setting the frequenzmod. Pulse generator **(12)** has a maximum repetition rate in the range of 25 KHz is selected to 100 KHz. This area is intentionally kept closely in order to keep the amount of microwave heating small.

- [0028]

  The greater distance of the burst **(32)** can also be expressed by a repetition frequency. The minimum repetition frequency is preferably 1 KHz.

- [0029]

  The goal is again to reduce the transfer of heat.

  Way of working

- [0030]

  Referring to **Fig.** 1, the sound information by the person **(23)** is to be perceived in the audio source **(10)** is entered, which may be a microphone, etc., a tape device for music, a CD-player. This audio signal is frequenzmod to that. Transmit pulse generator **(12)** and to the comparator **(14).** The comparator compares the positive components of the audio signal with the standard voltage of the standard voltage source **(16)** and when the voltage of the audio signal exceeds the standard voltage of the frequenmod.

- [0031]

  Pulse generator through the cable **(17),** the comparator and pulse generator connects, set in motion.

- [0032]

  The frequenzmod. Pulse generator **(12)** then transmits a plurality of pulses to the microwave generator **(19)** in each audio signal peak, which is higher than the standard voltage.

- [0033]

  This is graphically illustrated in **Figure** 2 **Figure** 5 **is shown:...** The audio signal **(27)** of **Figure** 2 exceeds the standard voltage **(31)** at the point **(33),** wherein the pulse generator **(12)** starts, burst signals **(32)** with the lowest frequency of approximately 1 KHz transmit. With the progress of time increases according to **(33),** the signal voltage to the standard voltage and the pulse generator **(12)** reacts with a Passenger Set of bursts until the maximum density of the burst signals **(32)** is reached at the peak maximum **(28),** for example, at a frequency of 50 KHz.

- [0034]

  The duration of each burst **(40)** is also carried a fixed setting on frequenzmod. Pulse generator controlled for. Example may be the duration of **100** ns. The frequency-modulated burst signals from the pulse generator **(12)**supplied to the microwave generator **(19)** as an interrupted direct current and the microwave generator is turned on in response of each burst **(40).** Its output is passed over coaxial cable **(21)** to a parabolic antenna **(22)** to radiate the microwave pulses to the head of the person **(23).**

- [0035]

These microwaves penetrate into the brain a sufficient distance so that the electrical activity in the interior of the brain causes the sensation of hearing impression. If the test parameters are adapted to the specific individual, it takes understandable listening impressions true; regardless of its outer Hörorganen.

Current preferred settings

- [0036]

As previously mentioned, I prefer the default voltage **(31)** approximately 50% of audio-peak voltage. This not only helps to lower the heating in the person, but also decreases the occurrence of spurious audio signals. These 50% are not critical; the useful range is from 25% to 85% of the audio-peak voltage.

- [0037]

The minimum burst repetition frequency is preferably 1 kHz and the maximum burst repetition frequency is in the range of 25 KHz to 100 KHz, which lead here the lower frequencies to less heating. The time duration of each pulse of the microwave radiation lies in the range from 10 ns to 1 microsecond, as shown in **Fig.** 5 is shown, with the shorter pulse widths produce less heat.

- Control of energy output

- [0038]

The power output is controlled by controlling the strength of the pulse frequency modulation. This results in a pulse factor of 0.005, the ratio:

- [0039]

Duty cycle of the transmitter in seconds / second. The height of a single pulse can be between 500 mW and 5 W and are on a pulse factor of 0.005, these impulses lead to an antenna-average power of 2.5 mW BEZW. 25 mW.However, these values are further reduced by the fact that the pulse frequency modulation is set so that a 0-input also provides a 0 output.

CLASSIFICATIONS

International Classification	H04R25/00, A61N5/02
Cooperative Classification	A61N5/02, H04R25/70
European Classification	A61N5/02, H04R25/70

LEGAL EVENTS

Date	Code	Event	Description
Dec 11, 2003	OR8	Request for search as to paragraph 43 lit. 1 sentence 1 patent law	
Jan 22, 2004	8105	Search report available	
Mar 17, 2005	8139	Disposal/non-payment of the annual fee	

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