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(54) **A microphone amplifier for contact microphones.**

(57) To improve the clarity of speech recorded using a contact microphone (10), it is proposed that preferably after passage through a pre-amplifier (11), the electric signal from the contact microphone (10), shall be subjected to a treatment for modifying its amplitude in a first signal processing unit (12) and to a treatment for modifying its spectral structure in a second signal processing unit (13).

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### A microphone amplifier for contact microphones

The present invention relates to a method and a device for improving the clarity of speech recorded using a contact microphone.

In environments with a high noise level, e.g. certain types of aircraft, ships and land vehicles, contact microphones have long been used instead of normal acoustic microphones in order to avoid the speech recorded being drowned by disturbing background noise. The most usual type of contact microphone is the throat microphone or laryngophone, although other types do exist. Characteristic of all these contact microphones is that, if speech or other sound is to be picked up it must be in the form of applied mechanical vibration. This means that a contact microphone must always be located in direct contact with the user's throat or head.

As a result of the direct mechanical transmission of speech from the user to the microphone, the speech recorded from a contact microphone is always relatively incomplete and unarticulated. Furthermore, it contains hardly any of the harmonics which in normal speech are derived from resonance phenomena in the mouth and nasal cavity and which are of vital significance to clarity. Besides this poor ability to record speech there are several other factors entailed in the use of contact microphones which have a negative effect on the clarity of recorded speech. In the first place the transfer from user to microphone may vary greatly due to variations in the quality of the mechanical contact between microphone and user. Then there may be considerable disturbance in the recorded speech in the form of various body noises picked up by the microphone which have no connection with what is said, and also in the form of scraping noises produced by the relative movement between microphone and the part of the user's body in contact therewith. Finally, the level of the electric signal generated by a contact microphone is usually so low that it requires considerable amplification, thus causing noise both from the microphone itself and from the subsequent amplification stage.

The object of the present invention is to achieve a method and a device for improving the clarity of speech recorded using a contact microphone whereby the above disadvantages of contact microphones are considerably reduced.

The method proposed according to the invention to achieve this object is primarily characterised in that the electric output signal from the contact microphone, preferably after amplification and possibly some other form of processing, is subjected to a treatment for modifying its amplitude whereby, if its amplitude reaches or exceeds a predetermined lower limit value, it is amplified to form an

amplified signal having a higher amplitude, said amplitude being substantially independent of the first-mentioned amplitude, whereas if its amplitude is below said limit value, it is instead suppressed and prevented from being transmitted further.

The treatment of the output signal from the contact microphone described above enables a substantially constant signal level to be obtained, which is substantially independent of variations in the strength of the speech picked up by the microphone. Furthermore, if the value of said predetermined lower limit is selected in suitable manner, it is possible to effectively suppress both all disturbing sounds and electronic noise during pauses in the speech. The limit value may advantageously be adjustable to permit adjustment to a specific user of the microphone and to the specific environment in which it is to be used. The amplitude of the amplified signal may preferably also be adjustable to allow for adjustment to the equipment which is to receive the signal.

In a preferred embodiment of the invention the output signal from the contact microphone is also subjected to a treatment for modifying its spectral structure. This treatment, preferably carried out subsequent to the previously mentioned treatment of the signal for modifying its amplitude, may be performed so that components in the signal which represent sounds having a frequency lying outside a predetermined speech frequency range, are powerfully dampened or completely eliminated. In this way, disturbances occurring in the signal which derive from foreign sources of sound or from electronic noise will also be suppressed while speech is in the process of being transmitted. The above-mentioned treatment of the output signal from the contact microphone, intended to modify the spectral structure of the signal can also be designed in such a manner that the processed signal will acquire a structure corresponding better to the spectral structure of natural acoustic speech than the original output from the microphone.

The spectral treatment of the output signal from the microphone may suitably comprise filtration of the signal. This filtration should suitably be performed in the manner of band pass filtration. It may also be performed so that components lying within the relevant pass band and having higher frequency are given preference over components with lower frequency. Alternatively, or additionally, the spectral treatment of the output signal from the microphone may comprise the generation of harmonics for fundamentals included in this signal.

The features characteristic of the device according to the invention are defined in claims 6 -

10.

The invention will be described in more detail in the following with reference to the accompanying drawing showing a block diagram of a device according to one embodiment of the invention selected by way of example.

In the drawing 10 denotes a contact microphone, e.g. a throat microphone. The microphone 10 is connected to the input of an amplifier 11, the output of which is connected to the input of a signal processor 12.

The signal processor 12 may in principle consist of an amplifier with an amplification factor which varies in such a manner dependent on the amplitude of its input signal that, if the amplitude of the input signal reaches or exceeds a predetermined lower limit value, it will generate an output signal having a predetermined higher amplitude, said amplitude being substantially independent of the amplitude of the signal received, whereas if the amplitude of the signal received is below said limit value, no output signal will be transmitted. The unit 12 thus operates as an amplifier, the amplification factor of which is greater than 1, preferably much greater than 1, if the amplitude of the output signal from the pre-amplifier 11 is higher than the predetermined limit value, but much less than 1, preferably 0, if the amplitude of the output signal from the pre-amplifier is lower than said limit value.

The output of the unit 12 is connected to the input of an additional signal processor 13 arranged to generate an output signal having a spectral structure which is modified in relation to the signal received by this unit and which agrees better than the signal received, with the spectral structure of natural acoustic speech. For this purpose the unit 13 may include filtering means to filter off those components in the signal received which have a frequency outside a predetermined speech frequency range. These filter means may consist of a band pass filter. The unit 13 may also comprise means for generating harmonics for fundamentals included in the signal received. If the unit 13 comprises such means for generating harmonics, the previously mentioned filtering means may consist of a high pass filter having a relatively low limit frequency arranged before the harmonics-generating, and a low pass filter having a relatively high limit frequency arranged after the harmonics-generating means.

14 designates a final stage following the unit 13, via which the output signal from the unit 13 can be supplied to the output 15 of the device. The final stage 14 may fulfil various desired functions. It may, for instance, provide the necessary interface to the circuits to which the output 15 is to be connected. It may also form a gain amplifier.

The invention is not limited to the embodiment

described above and illustrated in the drawing. Many other embodiments are feasible within the scope of the inventive concept. Means serving to modify the spectral structure of the output signal from the contact microphone may also be arranged in front of the unit 12, for example.

## Claims

1. A method of improving the clarity of speech recorded using a contact microphone, **wherein** the electric output signal from the contact microphone, preferably after amplification and possibly some other form of processing, is subjected to a treatment for modifying its amplitude whereby, if its amplitude reaches or exceeds a predetermined lower limit value, it is amplified to form an amplified signal having a higher amplitude, said amplitude being substantially independent of the first-mentioned amplitude, whereas if its amplitude is below said limit value, it is instead suppressed and prevented from being transmitted further.

2. A method as claimed in claim 1, **wherein** the output signal from the contact microphone, preferably subsequent to said treatment for modifying its amplitude, is subjected to a treatment for modifying its spectral structure.

3. A method as claimed in claim 2, **wherein** said treatment of the output signal from the contact microphone for modifying its spectral structure comprises filtration of said signal.

4. A method as claimed in claim 3, **wherein** said filtration is performed in the manner of band pass filtration.

5. A method as claimed in any of claims 2 - 4, **wherein** said treatment of the output signal from the contact microphone for modifying its spectral structure comprises the generation of harmonics for fundamentals included in said signal.

6. A device for improving the clarity of speech recorded using a contact microphone, **comprising** means (12) for modifying the amplitude of the electric output signal from the contact microphone (10), said means being arranged to be supplied with said signal, preferably via an amplifier (11) and possibly also means for processing said signal in some other way and that, if the amplitude of the signal received reaches or exceeds a predetermined lower limit value, to generate an amplified signal having a higher amplitude, said amplitude being substantially independent of the amplitude of the signal received, whereas if the amplitude of the signal received is below said limit value, said means will instead suppress the signal received and prevent it from being transmitted further.

7. A device as claimed in claim 6, **comprising**, besides the means (12), means (13) for modifying

the spectral structure of said signal, preferably located after the means (12) for modifying the amplitude of the output signal from the contact microphone (10).

8. A device as claimed in claim 7, **wherein** said means (13) for modifying the spectral structure of the output signal from the contact microphone (10) includes means for filtering said signal.

9. A device as claimed in claim 8, **wherein** said filtering means comprises a band pass filter.

10. A device as claimed in any of claims 7 to 9, **wherein** said means (13) for modifying the spectral structure of the output signal from the contact microphone (10) comprises means for generating harmonics for fundamentals included in said signal.

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