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(54) Method for producing a sound signal.

(57) Method in producing a sound signal from a sound emitter having a loudspeaker which is driven by an electronic sound generator, wherein a number of selected basic frequencies are being sampled alternatingly during a predetermined period, said sampling being effected at a rate which has a maximum value equalling substantially the lowest frequency of the selected basic frequencies.

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METHOD IN PRODUCING A SOUND SIGNAL

The invention relates to a method in producing a sound signal from a sound emitter having a loudspeaker driven by an electronic sound generator.

The sound signals from a sound emitter of this type usually include a specific basic frequency and harmonics of this frequency. However, the sound spectrum then obtained is perceived to be too harmonic and "harmless"; it is desired to produce a more penetrating sound.

The purpose of the invention is to realize this, and for this purpose the method of the invention has obtained the characterizing features according to claim 1.

By the method of the invention it is achieved that the sound signal is perceived to be stronger than harmonic sound at the same sound level. Moreover, the sound will be more penetrating, because it includes several powerfully reproduced frequencies than harmonic sound and then is more difficult to mask e.g. by background noise. Finally, the possibilities of utilizing the frequency response characteristic of the loudspeaker are improved, because the sampled frequencies can include those frequencies at which the efficiency of the loudspeaker is relatively high.

In order to explain the invention in more detail reference is made to the accompanying drawings in which

FIG. 1 discloses a frequency response characteristic of a loudspeaker which can form part of the sound emitter used in practising the method,

FIG. 2 is a diagram showing the frequency over the time in one embodiment of the method of the invention,

FIG. 3 is a diagram similar to that of FIG. 2 in another embodiment of the method of the invention, and

FIG. 4 is a diagram disclosing the sound pressure level over the frequency.

An electronic sound emitter for practising the method of the invention can be of a conventional construction and thus can include as main elements thereof a tone generator, an amplifier for the signal produced in the tone generator, and a loudspeaker for emitting the amplified sound signal. It is well-known that loudspeakers of existing constructions have such a frequency response characteristic that not all frequencies within the sound frequency range are reproduced at one and the same efficiency. FIG. 1 discloses a typical frequency response characteristic of a loudspeaker, and as will be seen therefrom the several frequencies are reproduced at different intensities. If a sound emitter is constructed to produce a sound signal at a single predetermined basic frequency, it is, of course, possible to locate said basic frequency at a position in the frequency response characteristic where the efficiency is high, but at one hand such adjustment must be performed at rather high precision and at the other hand the position of the frequency may change due to uncontrolled factors, mainly the surrounding temperature.

In the method of the invention, a number of basic frequencies to be included into the sound signal are selected not simultaneously but alternatingly, and in FIG. 1, three basic frequencies to be selected are indicated at f0, f1, and f2. These frequencies have been selected in such a manner that the loudspeaker has a relatively high efficiency at said frequencies. It is, of course, not possible to eliminate by this procedure the risk of the relative position between the frequency response characteristic and the selected frequencies being changed due to external factors, but on the contrary the risk of the three of the frequencies landing at positions on the frequency response characteristic where the efficiency is relatively low, is rather small. When selecting the three frequencies, it is accordingly possible to locate said frequencies at optimum positions on the frequency response characteristic.

In the method of the invention, the three frequencies that have been selected, are sampled according to a predetermined program. This sampling can easily be controlled by using a microprocessor which is connected to the tone generator and controls said generator according to the predetermined program. The sampling can take place in different ways. One way includes periodical sampling of the basic frequencies f0, f1, and f2 in the order mentioned, the sampling then being restarted at the frequency f0 so as to repeat the sampling in the same order. This is illustrated in FIG. 2 wherein the frequency f0 is the lowest frequency and the frequency f2 is the highest frequency, the frequency f1 being located between said two frequencies. The changeover between the frequencies then takes place abruptly as shown in the diagram of FIG. 2. The period during which each frequency is sampled is designated X ms, and this period should be substantially as long as the period of the lowest frequency, i.e. the frequency f0. In other words, the sampling should take place at a rate which substantially equals the lowest frequency of the frequencies selected. Preferably, the sampling rate should not exceed said lowest frequency, which means that the rate can equal the lowest frequency or can have a value slightly lower than

said lowest frequency.

Instead of changing over abruptly from one frequency to the next one, the method of the invention can be practised by applying a successive changeover between the frequencies as disclosed in the diagram of FIG. 3.

At present it is considered that there should be utilized in the method of the invention two or three basic frequencies, but it is, of course, conceivable to utilize more basic frequencies than three. Moreover, it is not necessary to select the frequencies in order from the lowest frequency to the highest frequency at the sampling; the tone generator can be adjusted according to a predetermined program to alternatingly higher and lower frequencies.

The advantages achieved by practising the method of the invention have been accounted for above, and FIG. 4 of the drawings illustrates the specific advantage of greater penetration of the sound signal obtained by the method of the invention. The figure discloses a graph illustrating the sound pressure level of existing background noise, and as will be seen from the diagram, it is possible to select the three basic frequencies in such a manner that at least one of these basic frequencies has a sound pressure level above the background noise at the frequency in question. This means that the sound signal can be more easily perceived e.g. in a vehicle or in a street, or on a road having a noisy traffic.

Claims

1. Method in producing a sound signal from a sound emitter having a loudspeaker driven by an electronic sound generator, **characterized** in that a number of selected basic frequencies are sampled alternatingly with each other, each frequency being sampled for a predetermined period, and that the sampling is effected at a rate which equals substantially the lowest frequency of the sampled basic frequencies.

2. Method as in claim 1 wherein the sampling rate has a maximum value which equals said lowest frequency.

3. Method as in claim 1 or 2 wherein the sampling is effected from a lower to a higher frequency, the sampling being restarted at the lowest frequency of said selected frequencies after sampling of the highest frequency of said selected frequencies.

4. Method as in claim 1 or 2 wherein the sampling is effected alternatingly at high and low frequencies of said selected frequencies according to a predetermined program which is repeated periodically.

5. Method as in any of claims 1 to 4 wherein the sampling includes an abrupt changeover from one frequency to the next one.

6. Method as in any of claims 1 to 4 wherein the sampling includes a successive changeover from one frequency to the next one.

7. Method as in any of claims 1 to 6 wherein the selected basic frequencies include frequencies at which the efficiency of the loudspeaker is relatively high.

8. Method as in any of claims 1 to 7 wherein at least one of the sampled frequencies is reproduced at a sound pressure level above expected background noise at said frequency.

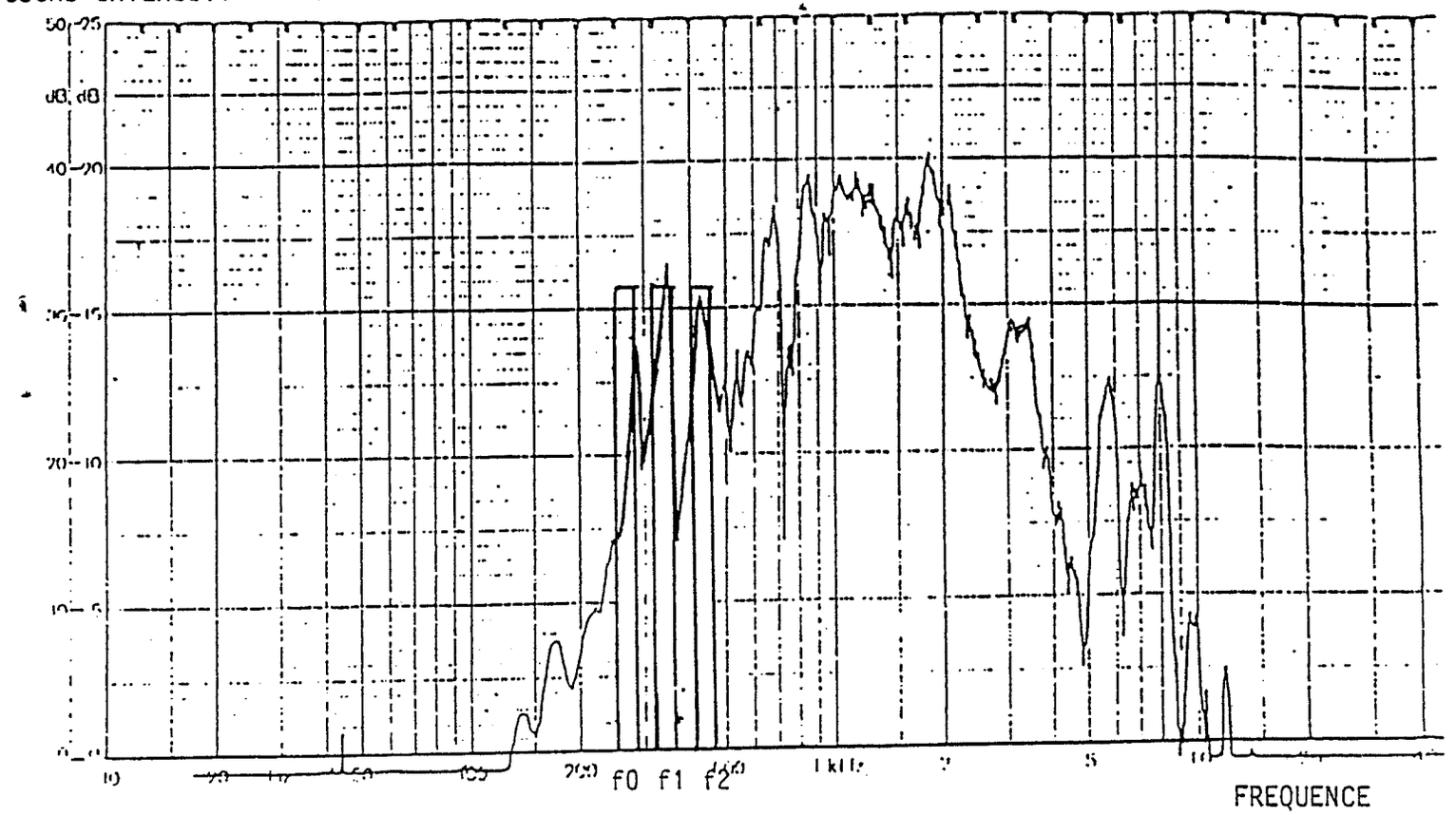

Fig. 1

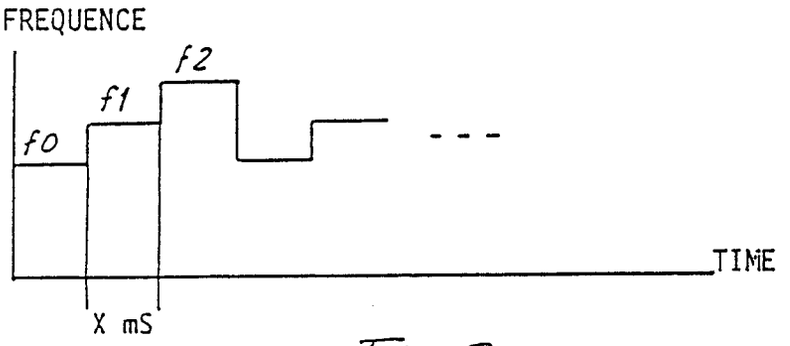

Fig. 2

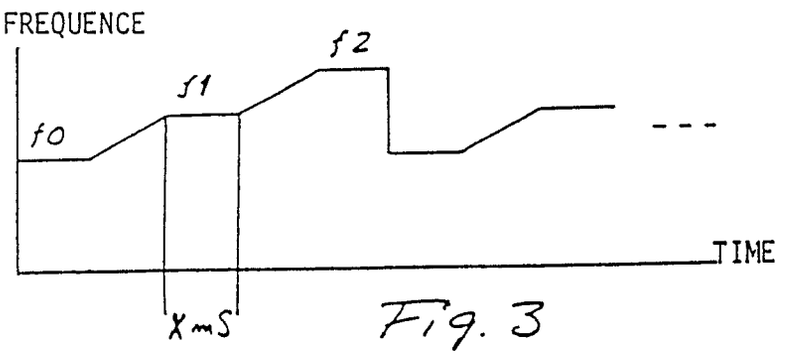

Fig. 3

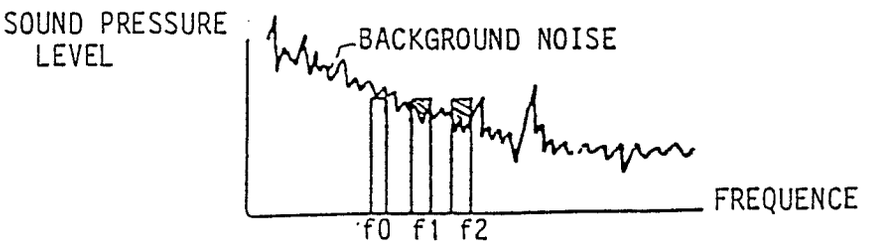

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 87 85 0089

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-3 384 074 (RAUTIOLA) * Figure 4 * ---	1	G 10 K 15/02 G 08 B 3/10
A	US-A-3 579 233 (RASCHKE) * Column 1, lines 11-58 * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

G 10 K
G 08 B
B 60 Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-11-1987	ANDERSON A.TH.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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