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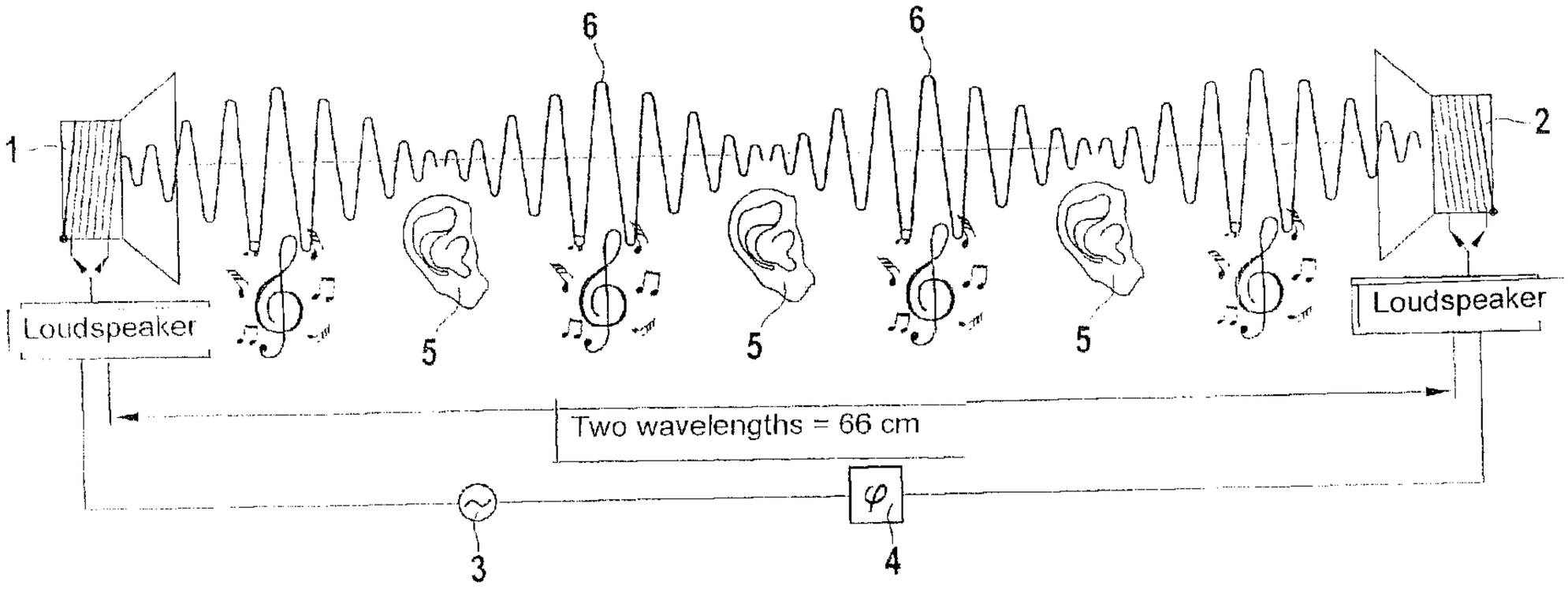

(57) Abrégé/Abstract:
In order to provide a warning to the driver depending on the driver's state, an acoustic standing wave is generated. The head of the driver is positioned in said standing wave in such a way that, in a nominal position of the head, the ears (5) of the driver are situated at nodal points of the standing wave, and in the event of any deviation from said nominal position, an acoustic warning signal can be perceived by the driver.

Absract

In order to provide a warning to the driver depending on the driver's state, an acoustic standing wave is generated. The head of the driver is positioned in said standing wave in such a way that, in a nominal position of the head, the ears (5) of the driver are situated at nodal points of the standing wave, and in the event of any deviation from said nominal position, an acoustic warning signal can be perceived by the driver.

22386-2758

Description

Title

METHOD AND SYSTEM FOR WARNING THE DRIVER

Background Information

The present invention is directed to a method for warning the driver depending on the driver's state. Video systems are known that are used to detect the driver's state and to warn him, particularly when he is at risk of falling asleep; these video systems observe how long the driver keeps his eyes closed while driving (JP-10315799 A), and, if a threshold value is exceeded, the driver is awakened or kept in a waking state using an acoustic warning sound. A similar video system for observing a driver's eyes is known from EP 1 418 082 A1.

Disclosure of the Invention

Advantages of the Invention

One aspect of the invention has the advantage that the driver is warned immediately – without having been observed via video – if his head falls to one side or toward the front. The present invention therefore effectively prevents the driver from taking a "cat nap" which often results in death. No evaluation devices are required, and no activation mechanisms are required for emitting a warning signal. The method is therefore safe, and it is resistant to spontaneously occurring disturbances from evaluation devices and warning signalling devices.

The present invention makes use of the knowledge that, when the driver's head is situated in a standing acoustic wave in such a manner that, when the head is in an expected position, the driver's ears are situated at nodal points of the standing wave, and the driver is unable to perceive and is not disturbed by a signal resulting from the standing acoustic wave. If the driver moves his head out of the expected position,

thereby moving it away from a nodal point of the standing wave, the driver perceives an acoustic warning signal via the standing wave, which is loudest in an antinode.

Preferably, in order to generate the standing wave, two loudspeakers which are situated at a defined distance apart are controlled in a phase-opposed manner, in the simplest case using a sinusoidal tone.

If the acoustic standing wave or the sinusoidal tone is generated using a frequency to which the human ear is most sensitive, e.g., 1KHz, only a relatively small amount of energy need be used to awaken the driver or to maintain the waking state.

To compensate for the expected position of the head, the solid-borne sound which occurs as a disturbance variable when the head is moved into the standing wave (deviation of the propagation speed of the sound) is preferably taken into account.

Advantageously, the excitation systems/loudspeakers which are used to generate the standing wave may be situated in the head restraint of the motor vehicle or in the vicinity thereof, and/or in the b-pillar which is close to the driver. As a result, no additional devices are required to accommodate the excitation systems/loudspeakers or to fix them in position, and the expected position may be predefined in a precise manner.

According to one aspect of the invention, there is provided a method for warning the driver depending on the driver's state, comprising the following steps: generate a standing acoustic wave, position the driver's head in the region of the standing wave in such a manner that, when the head is in an expected position, the ears of the driver are situated at nodal points of the standing acoustic wave, and, if the driver's head deviates from the expected position, an acoustic warning signal resulting from the standing wave is perceptible by the driver.

According to another aspect of the invention, there is provided a system for warning the driver depending on the driver's state, comprising the following features: an excitation system for generating an acoustic standing wave, a positioning of the

excitation system relative to an expected position of the head of the driver in such a manner that, when the head of the driver is in the expected position, the ears of the driver are situated at nodal points of the standing wave, and, upon deviation from the expected position, an acoustic warning signal resulting from the standing wave is perceptible by the driver.

Brief Description of the Drawing

Embodiments of the present invention are presented in the drawings and are described in greater detail in the description that follows.

Figure 1 shows two phase-opposed sinusoidal tones having the same frequency,

Figure 2 shows the addition of these two phase-opposed sinusoidal tones having nodal points and antinodes, and a symbolic depiction of ears situated at the nodal points.

Embodiments of the Invention

Figure 1 shows two phase-opposed sinusoidal tones having the same frequency. As shown in figure 2, phase-opposed sinusoid tones may be generated using two loudspeakers 1 and 2 which are situated at a defined distance from one another and point toward one another; in the simplest case, the phase-opposed sinusoidal tones are generated by one generator 3, wherein an 180° phase modifier may be situated in the signal path of one of the loudspeakers. The phase opposition may be attained simply by reflecting the sound wave. Figure 2 also shows the superposition of the phase-opposed sinusoidal tones to produce one standing wave. The driver's head is now positioned in this standing wave between loudspeakers 1 and 3 in such a manner that, when the head is in the expected position, ears 5 of the driver are situated at the nodal points of the standing wave, i.e. where the amplitude is the smallest. In this expected position, the driver does not perceive the sinusoidal tone. If the driver now becomes so sleepy that he is no longer able to hold his head upright, and his head falls forward or to one side, his ears move away from the nodal points, and the driver perceives the sinusoidal tone as a warning signal and wakes up. Preferably, a sinusoidal tone having a frequency of 1 KHz is used, since this is where the human ear is most sensitive (dBA durve). At this frequency, an antinodal point 6, where the sinusoidal tone/warning signal is the loudest, is located 8.25 cm away from the expected position (antinodal point 6 is symbolized in figure 2 using clefs and notes). A disturbance variable that must be taken into account is the solid-borne sound which results when the head is moved into the standing wave. Since the propagation speed of sound in the head is much faster than it is in air, the compensation for the expected position, i.e. the position of the head relative to the position of loudspeakers 1, 2, must be accounted for/corrected accordingly. The nodal points remain at the ear when the head is moved into the standing wave.

The excitation systems for the standing wave, i.e. loudspeakers 1 and 2 shown in the embodiment, may be situated in the head restraint of the motor vehicle or in the vicinity thereof. It may be advantageous to also integrate one of the loudspeakers in the b-pillar which is close to the driver, and to integrate the other one in the driver's head restraint or in the passenger's head restraint. Additional fastening devices for loudspeakers 1

and 2 may therefore be eliminated.

Instead of a sinusoidal tone, it is also possible to use a mixture of tones or a noise which is used to increase the driver's alertness and to wake up the driver if the head moves out of the expected position.

If the frequency of the standing wave is changed, a different wavelength results, thereby resulting in a different position of the nodal points. The expected position would then need to be re-compensated for, i.e. the nodal points would occur at other locations, and the position of the ears relative to the two sources of noise would need to be changed.

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CLAIMS:

1. A method for warning the driver depending on the driver's state, comprising the following steps:

- generate a standing acoustic wave,

- position the driver's head in the region of the standing wave in such a manner that, when the head is in an expected position, the ears of the driver are situated at nodal points of the standing acoustic wave, and, if the driver's head deviates from the expected position, an acoustic warning signal resulting from the standing wave is perceptible by the driver.

2. The method as recited in claim 1, wherein, to generate the standing acoustic wave, two loudspeakers positioned at a defined distance from one another are controlled using a sinusoidal tone.

3. The method as recited in claim 1 or 2, wherein the acoustic standing wave and the sinusoidal tone are generated using a frequency to which the human ear is most sensitive.

4. The method as recited in any one of the claims 1 through 3, wherein, to compensate for the expected position of the head, the solid-borne sound that occurs as a disturbance variable when the head moves into the standing wave is taken into account.

5. A system for warning the driver depending on the driver's state, comprising the following features:

- an excitation system for generating an acoustic standing wave,

- a positioning of the excitation system relative to an expected position of the head of the driver in such a manner that, when the head of the driver is in the expected position, the ears of the driver are situated at nodal points of the standing

wave, and, upon deviation from the expected position, an acoustic warning signal resulting from the standing wave is perceptible by the driver.

6. The system as recited in claim 5, wherein the excitation system is composed of two loudspeakers which may be acted upon using an acoustic signal.

7. The system as recited in claim 6 wherein the acoustic signal is a sinusoidal tone.

8. The system as recited in any one of the claims 5 through 7, wherein the acoustic signal has a frequency to which the human ear is particularly sensitive.

9. The system as recited in any one of the claims 5 through 8, wherein the solid-borne sound that occurs as a disturbance variable when the head moves into the standing wave is taken into account in determining at least one of (a) the position of the excitation system for the standing wave, or the position of the loudspeakers and (b) the distance between them relative to the expected position of the head.

10. The system as recited in any one of the claims 5 through 9, wherein at least one of (a) the excitation system for generating the standing wave, and (b) the loudspeakers is/are situated in the head restraint of the motor vehicle or in the vicinity thereof.

11. The system as recited in any one of the claims 5 through 9, wherein one excitation system for the standing wave, or one loudspeaker is situated in a b-pillar which is close to the driver, and the associated second excitation system or loudspeaker is situated in the head restraint.

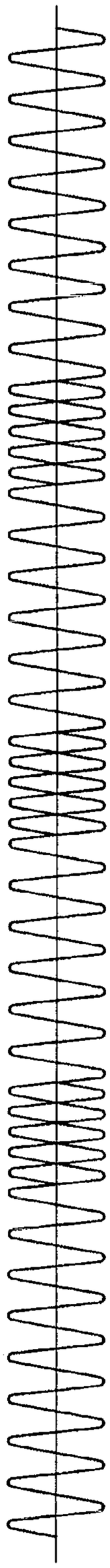


Fig. 1

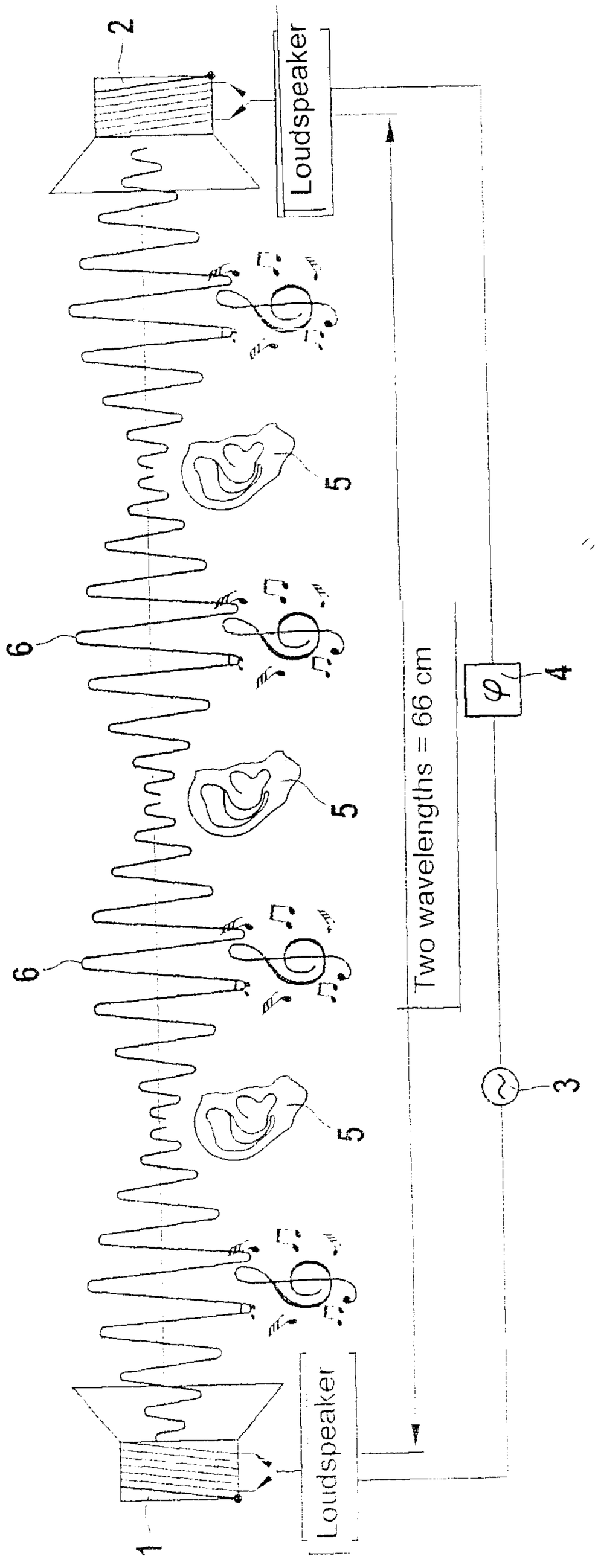
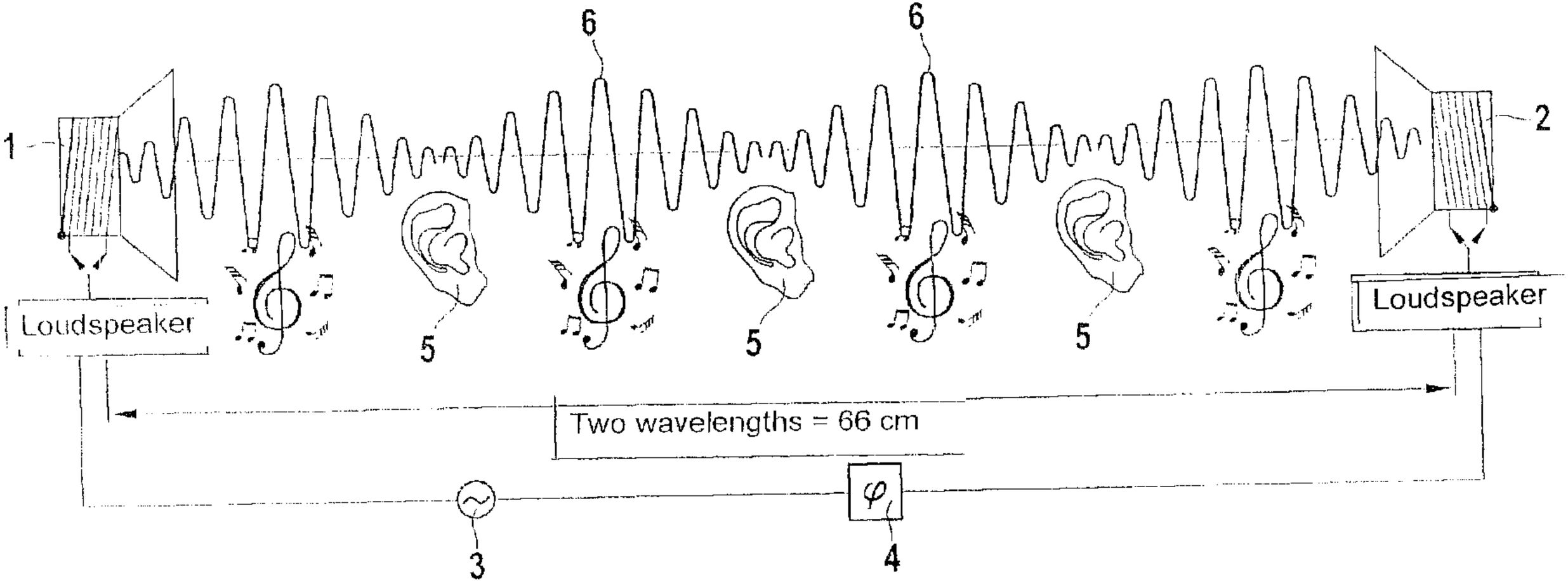

2
Loudspeaker
6
5
6
5
5
6
Two wavelengths = 66 cm
4
3
1
Loudspeaker

Fig. 2


1
2
3
4
5
6
6
5
5
Loudspeaker
Loudspeaker
Two wavelengths = 66 cm
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