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(54) **SPATIAL AWARENESS DEVICE**

GERÄT ZUM ERTEILEN VON RÄUMLICHER KENNTNIS
DISPOSITIF DE SENSIBILISATION A L'ESPACE

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- **POVEY, Malcolm, James, William**
Leeds LS2 9JT (GB)
- **HOYLE, Brian, Stewart**
Leeds LS2 3AR (GB)

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(74) Representative: **Wilson, Peter**
Novagraaf Patents Limited,
The Crescent,
54 Blossom Street
York YO24 1AP (GB)

(73) Proprietor: **Sound Foresight Limited**
Warrington WA5 7YT (GB)

(72) Inventors:

- **WITHINGTON, Deborah, Jane**
Leeds LS2 3AR (GB)
- **WATERS, Dean, Andrew**
Leeds LS2 3AR (GB)

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Description

[0001] The invention relates to a Spatial Awareness Device for individuals whose vision or hearing may be impaired or lost, either due to physical abnormalities/

[0002] There are a number of guiding or locating devices for visually impaired or blind individuals, for example the guiding device described in EP 749744. This guiding device is built in two parts. One part includes a receiver and a transmitter and the other part includes a microprocessor for processing the signals received from the receiver. Additionally, the second part includes a mechanical signal generator. Typically the second part is held in a blind person's breast pocket. The transmitter emits ultrasound waves which are reflected by an obstacle. The reflective signal activates the mechanical device thus warning a user about the presence of the obstacle. The guide thus acts a proximity warning device, notably, it does not provide information in the form of a picture about the surrounding environment and what is more, it is still necessary for the blind person to use a stick to detect holes in the ground, kerb edges and stairs.

[0003] Dutch Patent NL 9301911 describes a stick for the blind or partially sighted which includes a handle into which there is incorporated a radio transmitter and a receiver. The transmitter and receiver use ultrasound, infra red or microwave radar signals to detect objects in the path of the user. The received signal is processed and used to drive a motor which in turn alters the position of a small rod protruding from the handle. A user can learn to detect distance of a nearby obstacle by monitoring the movement of the rod.

[0004] The advantage of this device is that the proximity detector and the stick are combined. However, notably, the device provides no information in the form of a picture about the surrounding environment.

[0005] Similarly, German Patent DE 2932659 also describes a walking stick for the blind into which there is built an ultrasound distance measuring system. The handle of this stick is provided with a distance range adjustment means comprising a finger operated ratchet lever. The lever can be adjusted in order to adjust the range of the ultrasound system. Using this device an individual can determine at what distance objects are to be detected. However, noticeably, this device does not provide any detailed information of the environment in which the individual is located.

[0006] In addition, each of the above devices are only for use by visually impaired or blind individuals; they are not for use by partially deaf or deaf individuals or for individuals navigating sensory deprived environments. Further they only relay limited information about the immediate environment (a radius of approximately 1 m).

[0007] A device according to the preamble of claim 1 is known from DE-A-195 25 010.

[0008] It can then be seen that there is a need to provide a device which provides an individual with relatively detailed information about the environment they occupy and more specifically a single device that will provide a visually impaired or blind individual with information about the spatial content of their environment and a partially deaf or deaf individual with information about the distance and direction of different sounds within their environment. There is also a need to provide individuals in sensory deprived environments with such information.

[0009] It is therefore an object of the invention to provide a device which overcomes the problems associated with the prior art and fulfils the aforementioned needs.

[0010] In order to solve these problems a spatial awareness device according to claim 1 is provided.

[0011] Indeed, it is known that the human central nervous system (CNS) contains "brain maps" of the visual/auditory and somatosensory (tactile) world. The brain is organised such that these maps of the different sensory modalities interact with one another and changes in one sense may impinge on another modality map. Loss of vision, for example in the congenitally blind, may result in the visually impaired having poor auditory spatial ability. Nevertheless, the majority of vision loss occurs in later life thus all the spatial maps have been laid down in the CNS.

[0012] Utilising spatial tactile sensations will use the region of the brain used for visual spatial maps and, more importantly, will use the same cells responsible for auditory localization. Thus, by utilising more than one sensory modality, the users spatial awareness can be enhanced. This can be useful, for example for effective negotiation or awareness of one's surrounds.

[0013] Radiation may be received from sources in the environment or transmitted from the device itself. The spatial awareness device comprises at least one transmitter adapted to transmit ultrasound radiation; the receivers being adapted to receive the reflected radiation. In this way, reflected radiation from objects in the environment can form the tactile map.

[0014] In alternative embodiments not falling within the scope of the invention as defined by the appended claims the radiation may be infra red radiation or microwave radar signals.

[0015] Where the radiation is both transmitted and received, it is preferred that the electromagnetic radiation or acoustic radiation is selected so as not to interfere with sounds in the human hearing range so as to avoid cutting off an additional primary sense in particular for use by the visually impaired or blind.

[0016] The tactile responsive means is controlled by a control means such as a microprocessor adapted to receive information from the receiver about the received radiation. More preferably, it converts said information, preferably by way of stepping down the frequency, so that the received echo can be turned into a tactile signal,

ideally a vibration, which an individual can feel through the tactile responsive means.

[0017] More preferably still, the control means is programmed so that the position of the tactile signal on the tactile responsive means, and corresponding part of the user's body, provides information about the location of an obstacle in the spatial environment. In this way, a spatial map is created across the body, such as across the palm of the hand.

[0018] The strength of the tactile signal may be controlled by the control means so as to provide information about the size of an obstacle in the spatial environment. Thus, in the instance where ultrasound is used, the reflection of ultrasound from a nearby obstacle will be relatively great compared to the reflection of ultrasound from a distant obstacle, and so the strength of the ultrasound echo can be directly correlated with the strength of the tactile signal or vibration providing information on the body not only about the relative location of one obstacle with respect to another but also the relative proximity to the user of one obstacle with respect to another. Thus the tactile signal may be graded to give object proximity, or even object density information, since the density of a given object will affect the nature of the reflected radiation.

[0019] The device may be fixed or mobile. Preferably the spatial awareness device is mobile and may be used to span the body at any part which is sensible to tactile sensation such as a hand, foot, back, limb or portions thereof. It may even cover a substantial part of the body surface, for example in the form of a body suit. The device may alternatively be hand-held, for example, in the form of a torch or it may be provided as a back pack or front pouch.

[0020] In a further preferred embodiment of the invention said tactile responsive means comprises a shield, knob, plate or pad of selected ergonomic configuration. Preferably the device has an ergonomically favoured configuration which may be selected to sit within the palm of the hand and ideally running along the fingers and especially the fingertips or across the entire underside of the hand.

[0021] In another preferred embodiment of the invention the hand held device may be incorporated into a glove. The device may be water resistant so that it can be used under water by divers diving either in obscure or deep water.

[0022] Ideally, spatial mapping is performed by providing a plurality of paired transmitters and receivers each pair designed to project selected radiation radiation so as to cover a selected angular field or "field of view". Information from each pair of transmitters and receivers can then be processed by the control means and sent to a specific region of the tactile responsive means.

[0023] Additionally, or alternatively but not falling under the scope of the appended claims, a single transmitter and receiver adapted to cover a relatively wide angular field or "field of view" is provided and the infor-

mation from the single receiver is fed into a control means adapted to process information from this relatively wide angular field and then map the processed information to specific parts of the tactile responsive means thus providing a spatial map of the surrounding environment.

[0024] Additionally, or alternatively further still a single wide beam transmitter is used to transmit said electromagnetic radiation or acoustic radiation but a plurality of receivers are provided with a view to resolving spatial ambiguities.

[0025] It will be apparent to those skilled in the art of the provision of mobile devices that such a device is advantageous because it enables the user to selectively "view" the spatial environment by directing the hand or other body portion within that environment.

[0026] Moreover, it will be apparent to those skilled in the art that the effect of the Doppler shift on electromagnetic radiation or acoustic radiation will also provide information about the movement of obstacles within the environment thus depending upon whether or not an object is moving towards or away from the device will depend upon the effect on the electromagnetic radiation or acoustic radiation and thus upon whether the tactile signal grows or diminishes in intensity over a period of time. Therefore it follows that an individual standing still within an environment can use the device to determine the location of obstacles in the environment and moreover to distinguish between obstacles that are stationary and those that are moving. Clearly, as an individual learns to use the device it will be possible for the individual to learn to move with the device in the environment and to distinguish relative movement i.e. movement of an individual towards or away from a stationary object and movement of an individual towards or away from a moving object. It will be apparent that the individual will be learning to recognise not only the mapping of signals on the hand but also changes in the intensity of those signals.

[0027] It will also be apparent that the device has application in security systems and can be suitably used in sensory deprived such as dim or dark environments.

[0028] Whilst the invention has been specifically described with reference to the visually impaired or blind, the invention also has application for individuals partially deaf or deaf. In this instance, the device is adapted so that at least one receiver receives or acoustic radiation within the human hearing range; and the control means may convert this information into a tactile signal.

[0029] Additionally, the tactile signal may be mapped to a specific location on the mobile device so that an individual hard of hearing can determine from which part of his/her environment the sound originates. Moreover, the control means is also adapted to correlate the intensity or loudness of the sound with the intensity or strength of the tactile response. Thus for example, particularly loud noises will provide particularly strong tactile responses in particular regions of the tactile respon-

sive means. Alternatively, a quieter sound will provide a smaller tactile sensation in a particular region of the tactile responsive means. In this way an individual can use the spatial awareness device to obtain information about objects or sounds within the spatial environment.

[0030] In yet a further preferred embodiment of the invention the device is adapted to switch between the spatial awareness device providing information about the visual environment and the one providing information about the auditory environment.

[0031] In yet a further preferred embodiment of the invention said spatial awareness device may be provided as a pair of devices, one adapted to map to a left part of the body and one adapted to map to a right part of the body.

[0032] Advantageously, the pair of spatial awareness devices may be provided wherein one provides information about the visual environment and the other provides information about the auditory environment.

[0033] Alternatively yet again the pair of spatial awareness devices may be provided wherein one of said devices provides information about a first lateral or remote "field of view" and the other of said devices provides information about a second, opposite, lateral or proximal "field of view".

[0034] In a further aspect, a device as hereinbefore defined is used to determine the location of obstacles and/or sounds in the environment and to distinguish between obstacles and/or sounds that are stationary and those that are moving.

[0035] In a yet further aspect there is provided according to the invention a method for negotiation or awareness of an environment comprising associating a device as hereinbefore defined with an individual such that it spans at least a part of the individual's body and detecting radiation via the device.

[0036] In a yet further aspect there is provided a kit of parts forming a spatial awareness device as hereinbefore defined.

[0037] An embodiment will now be described by way of example only.

[0038] In the following description conventional circuitry and devices are used to build the spatial awareness device.

[0039] In one of its simplest forms the spatial awareness device comprises an ergonomically fashioned pad which is adapted to sit within the palm of a user's hand. The pad is provided with attachment means whereby the pad can be attached using straps or the like typically attached about the wrist or fingers of a hand. The side of the pad adjacent the palm may take one of two forms. It may be provided with protuberances which are adapted to move or vibrate upon activation; the frequency of the vibration being determined by the strength of the activating signal. Alternatively, said surface may be smooth but adapted over discrete regions to emit very small, but detectable, electric signals so that a wearer feels a tingling sensation when the pad is activated; the

strength of the tingling sensation being determined by the strength of the activation.

[0040] On the side of the pad facing outwardly and thus towards the environment there is provided at least one ultrasound transmitter and one ultrasound receiver. The "field of view" of the transmitter and receiver is selected so as to provide as much useful information about the environment as possible and is, for example, in the order of 3-4 metres. Additionally, initiation and control means may be provided so that a user can initiate the device and also preferably alter the size of the "field of view".

[0041] Embedded within the pad is a control means in the form of a microprocessor which is connected to both the transmitter, receiver and tactile responsive side of the pad using conventional circuitry. Moreover, the microprocessor is provided with means suitable for altering the frequency of the echoed ultrasound and thus stepping down the frequency so as to produce a tactile signal that is able to either vibrate the tactile protuberances or be converted into an electrical signal, using conventional means, in order to provide a small, but detectable, electrical signal.

[0042] Embodied within the microprocessor is both a map of the tactile responsive means and provided in the microprocessor is a map of the surrounding environment derived from the ultrasound echo. Thus the microprocessor is adapted to direct information from the environment, or ultrasound echoes, to a specific part of the tactile responsive means and so ensure that spatial mapping is achieved. The circuitry and processing for undertaking this mapping is conventional.

[0043] In an alternative embodiment the receiver is adapted to receive sound waves within the human hearing range and the microprocessor is adapted to map these sound waves to specific parts of the tactile responsive means. Thus in this alternative embodiment of the invention an auditory map of an individual's environment is provided. Again, conventional circuitry and processing means are used in this embodiment.

[0044] Further embodiments of spatial awareness devices according to the claims are shown, again by way of example with reference to Figures 1-4 wherein:-

Figure 1 is a diagrammatic illustration of an embodiment of a spatial awareness device;

Figure 2 is a diagrammatic illustration of the circuitry used in the Figure 1 embodiment;

Figure 3 is a diagrammatic illustration of an alternative embodiment;

Figure 3a shows the embodiment in front view, Figure 3b in side view and Figure 3c in use;

Figure 4 is a diagrammatic illustration of the circuitry used in the Figure 3 embodiment.

[0045] Figure 1 shows a hand-held spatial awareness device (1) embodied within the handle of a white stick (2). At the end of the stick (2) further from the user, emitter/receiver pairs (3) are provided. Reflected ultrasound radiation is received by the receivers and processed via control means (not shown) which control tactile responsive means, shown as an array of Piezo electric transducers (4). These produce vibration in response to signals from the control means, the location and extent of the vibration corresponding to the size and location of objects detected in the environment. The transducers are mounted in a stiff material allowing good transmission of vibrations.

[0046] Figure 2 shows the control means (6) and its connections to the emitter/receiver pairs (3) and the Piezo electric transducers (4). Ultrasound at 40 khz is produced by an oscillator. This signal is fed with amplification and pulse generation to the emitter. The same pulse generator gates a superheterodyne receiver preferably of at least 5 mm diameter, allowing high gain with good signal to noise ratio. The reflected signal is then relayed to Piezo electric transducer (4).

[0047] Figure 2 also shows a front-back comparator which is provided on the underside of the strip to compare front-back amplitudes. This is for use as an edge detector.

[0048] Figure 3a, b and c shows a hand-held spatial awareness device (1) embodied within a torch (7). Vibrations are transmitted along the length of the torch handle to an array of vibrating couplers (10) forming the tactile responsive means. Depending on the pulse-echo time a timer increases or decreases the amplitude of vibrations to each of the actuators, moving the peak signal to a far indicator (11) at the base of the torch for a distant object and to a close indicator (12) at the front for a close object. The receiver receives distance information in the form of amplitude related cues as well as spatial mapping cues.

[0049] Figure 3a demonstrates the positioning of the single transmitter having a wide transmission field such as 75° or 80° with respect to a plurality of receivers each have an approximately 40° receiver field.

[0050] Figure 3c demonstrates the transmitter field (14) and receiver fields (13) in use.

[0051] Figure 4 illustrates the control means which uses similar components to those used in the previous embodiment. However, in this instance, the receiver would also sense the peak echo, switching off a timer. Depending on the pulse-echo time, the timer would increase or decrease the amplitude of the vibration to each of the transducers (4), moving the peak signal to the base of the torch for a distant object and to the front for a close object.

[0052] It can therefore be seen that the invention provides a unique way in which individuals who are either visually impaired or blind and/or partially deaf or deaf can obtain information about their spatial environment.

Claims

1. A spatial awareness device (1) comprising at least one transmitter (3) adapted to transmit a selected form of radiation, a plurality receivers (3), at least one control means (6) adapted to receive information about the received radiation from the receivers (3) and operatively coupled thereto at least one tactile responsive means (4, 10) configured in use to span at least in part the body of an individual user; the radiation being ultrasound, the transmitter being an ultrasound transmitter and the receivers being ultrasound receivers **characterised in that**, the part of the body is a hand, foot, limb or portions thereof, and **in that** the control means (6) is adapted to spatially resolve and convert received information from each receiver into a tactile signal on a specific region of the tactile responsive means (4, 10) such that the position of a signal on the tactile responsive means (4, 10) provides information about the location of an obstacle in the spatial environment surrounding the device, spatially distributed across the hand, foot, limb or portions thereof of an individual user to stimulate in a user spatial tactile sensations thereon, and **in that** the control means further is adapted to vary the vibration on the tactile response means to provide information about the proximity of an obstacle in the spatial environment
2. A spatial awareness device according to Claim 1 wherein the control means (6) comprises a micro-processor, suitably programmed to convert reflected ultrasound into the said spatial map on the tactile responsive means (4, 10).
3. A spatial awareness device according to claim 1 or 2 **characterised in that** the tactile responsive means (4, 10) comprises a plural array of discrete specific regions/parts actuatable separately by the control means, so that information processed by the control means (6) may be selectively mapped to such specific regions/parts to provide a tactile spatial map.
4. A spatial awareness device according to claim 3 **characterised in that** the tactile responsive means comprises a plurality of protuberances (10) adapted to move or vibrate on activation to produce a tactile signal.
5. A spatial awareness device according to claim 3 or claim 4 **characterised in that** the tactile responsive means comprises an array of piezoelectric transducers (4) to produce a tactile signal.
6. A spatial awareness device according to one of claims 3 to 5 wherein the tactile responsive means comprises a surface adapted over discrete regions

to emit an electrical signal.

7. A spatial awareness device according to any preceding claim wherein the tactile signal is a vibration.

8. A spatial awareness device according to claim 7 wherein the position of the vibration on the tactile response means is controlled by the control means so as to provide information about the angular location of an obstacle in the spatial environment.

9. A spatial awareness device as claimed in any preceding claim comprising a plurality of paired transmitters and receivers (3) each pair designed to project selected radiation so as to cover a selected angular field.

10. A spatial awareness device according to any preceding claim comprising a single wide beam transmitter and a plurality of receivers adapted for resolving spatial ambiguities.

11. A spatial awareness device according to any preceding claim further comprising at least one receiver adapted to receive acoustic radiation within the human hearing range and wherein the control means acts to generate a tactile signal corresponding to the acoustic radiation which is mapped to specific parts of the tactile responsive means to create a tactile map so that a user can determine from which part of the environment the sound originates.

12. A spatial awareness device according to Claim 11 wherein the control means is also adapted to correlate the intensity of loudness of the sound with the intensity or strength of the tactile response.

13. A spatial awareness device according to claim 11 or claim 12 wherein the device is adapted to switch between providing information about the spatial environment to one providing information about the auditory environment.

14. A spatial awareness device according to one of claims 11 to 13 comprising control means (6) and tactile responsive means (4, 10) adapted to provide one spatial map adapted to map to a left part of the body and one spatial map adapted to map to a right part of the body wherein a first one of the two spatial maps provides information about the visual environment and a second one of the two spatial maps receives information about the auditory environment.

15. A spatial awareness device according to any preceding claim **characterised in that** it is hand held and comprises a shield, knob, plate or pad having a configuration adapted to sit within the palm of the hand, contacting the fingers along their length and

/or fingertips and/ or the entire underside of the hand and **in that** the tactile responsive means are adapted to stimulate the hand of an individual and create a tactile map spanning the hand.

16. A spatial awareness device according to claim 15 wherein the hand held device is adapted to be incorporated into a glove.

17. A spatial awareness device according to Claim 15 or 16 wherein the device is water resistant so that it can be used under water by divers diving either in obscure or deep water.

18. A method for negotiation or awareness of an environment comprising associating a device as defined in any of Claims 1 to 17 with an individual such that the tactile response means thereof spans the hand, foot, limb or portions thereof of the individual, transmitting ultrasound radiation, receiving reflected ultrasound radiation, converting received information into a tactile signal such that the position of a signal on the tactile responsive means provides information about the location of an obstacle in the spatial environment surrounding the device, spatially distributed across the hand, foot, back, limb or portions thereof of an individual user to stimulate in a user spatial tactile sensations thereon.

Patentansprüche

1. Gerät zum Erteilen von räumlicher Kenntnis (1), aufweisend, wenigstens einen Sender (3), geeignet, eine bestimmte Form von Strahlung auszusenden, eine Mehrzahl von Empfängern (3), wenigstens ein Steuermittel (6), geeignet, über die von den Empfängern (3) empfangene Strahlung Informationen zu erhalten, und hierzu bedienbar verbunden wenigstens ein taktiles Ansprechmittel (4, 10), das bei Gebrauch so eingerichtet ist, dass es sich zumindest über einen Teil des Körpers eines individuellen Benutzers erstreckt, wobei die Strahlung Ultraschallstrahlung ist, der Sender ein Ultraschallsender ist und die Empfänger Ultraschallempfänger sind, **dadurch gekennzeichnet, dass** der Teil des Körpers ganz oder teilweise eine Hand, ein Fuß oder eine Extremität ist und dass die Steuermittel (6) geeignet sind, die vom jeweiligen Empfänger erhaltenen Informationen räumlich aufzulösen und in ein taktiles Signal auf einem bestimmten Bereich der taktilen Ansprechmittel (4, 10) so umzuwandeln, dass die Position des Signals auf dem taktilen Ansprechmittel (4, 10) Informationen über die Lage eines Hindernisses in der um das Gerät befindlichen räumlichen Umgebung zur Verfügung stellen, wobei das Signal räumlich so ganz oder teilweise auf der Hand, dem Fuß oder der Extremität

eines individuellen Benutzers verteilt ist, dass in einem Benutzer räumliche taktile Empfindungen darüber angeregt werden, und dadurch, dass die Steuermittel weiterhin geeignet sind, die Vibrationen auf dem taktilen Ansprechmittel so zu verändern, dass es Informationen über die Nähe eines Hindernisses in der räumlichen Umgebung zur Verfügung stellt.

2. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 1, wobei die Steuermittel (6) einen Mikroprozessor aufweisen, der in geeigneter Weise so programmiert ist, dass er den reflektierten Ultraschall in die räumliche Abbildung auf dem taktilen Ansprechmittel (4, 10) umwandelt.
3. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das taktile Ansprechmittel (4, 10) eine Mehrfachanordnung diskreter spezifischer Bereiche/Teile aufweist, die durch die Steuermittel getrennt betätigbar sind, so dass die von den Steuermitteln (6) verarbeiteten Informationen selektiv auf den spezifischen Bereichen/Teilen abgebildet werden können, um so eine taktile räumliche Abbildung zur Verfügung zu stellen.
4. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 3, **dadurch gekennzeichnet, dass** das taktile Ansprechmittel eine Vielzahl von Vorsprüngen (10) aufweist, die bei Aktivierung dazu geeignet sind, sich zu bewegen oder zu vibrieren und somit ein taktilen Signal zu erzeugen.
5. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 3 oder Anspruch 4, **dadurch gekennzeichnet, dass** das taktile Ansprechmittel zur Erzeugung eines taktilen Signals eine Anordnung von piezoelektrischen Aufnehmern (4) aufweist.
6. Gerät zum Erteilen von räumlicher Kenntnis nach einem der Ansprüche 3 bis 5, wobei das taktile Ansprechmittel eine Oberfläche aufweist, die über einzelnen Bereichen geeignet ist, ein elektrisches Signal auszusenden.
7. Gerät zum Erteilen von räumlicher Kenntnis nach einem der vorhergehenden Ansprüche, wobei das taktile Signal eine Vibration ist.
8. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 7, wobei die Position der Vibration auf dem taktilen Ansprechmittel durch das Steuermittel so geregelt wird, dass Informationen über die Winkellage eines Hindernisses in der räumlichen Umgebung zur Verfügung gestellt wird.
9. Gerät zum Erteilen von räumlicher Kenntnis nach

einem der vorhergehenden Ansprüche, das eine Mehrzahl von Paarweisen Sendern und Empfängern (3) aufweist, wobei jedes Paar dazu bestimmt ist, eine bestimmte Strahlung abzugeben, um so einen ausgewählten Winkelbereich abzudecken.

10. Gerät zum Erteilen von räumlicher Kenntnis nach einem der vorhergehenden Ansprüche, das einen einzelnen Breitstrahmsender und eine Vielzahl von Empfängern aufweist, die geeignet sind, räumliche Mehrdeutigkeiten aufzulösen.
11. Gerät zum Erteilen von räumlicher Kenntnis nach einem der vorhergehenden Ansprüche, das weiterhin wenigstens einen Empfänger aufweist, der geeignet ist, akustische Strahlung im menschlichen Hörbereich zu empfangen, und wobei das Steuermittel so agiert, dass ein taktilen Signal entsprechend der Schallstrahlung erzeugt wird, das auf bestimmte Teile des taktilen Ansprechmittels abgebildet wird, um eine taktile Abbildung zu erzeugen, so dass ein Benutzer bestimmen kann, aus welchem Teil der Umgebung der Schall stammt.
12. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 11, wobei das Steuermittel außerdem geeignet ist, die Lautstärke des Schalls mit der Intensität oder Stärke des taktilen Ansprechens zu korrelieren.
13. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 11 oder Anspruch 12, wobei das Gerät geeignet ist, zwischen der Bereitstellung von Informationen über die räumliche Umgebung und der Bereitstellung von Informationen über die akustische Umgebung umzuschalten.
14. Gerät zum Erteilen von räumlicher Kenntnis nach einem der Ansprüche 11 bis 13, das Steuermittel (6) und taktile Ansprechmittel (4, 10) aufweist, die geeignet sind, eine auf einen linken Körperteil abbildende räumliche Abbildung und eine auf einen rechten Körperteil abbildende räumliche Abbildung zur Verfügung zu stellen, wobei eine erste der beiden räumlichen Abbildungen Informationen über die visuelle Umgebung bereitstellt und eine zweite der beiden räumlichen Abbildungen Informationen über die akustische Umgebung empfängt.
15. Gerät zum Erteilen von räumlicher Kenntnis nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es tragbar ist und einen Schutz, einen Knauf, eine Platte oder Unterlage aufweist, die so angeordnet ist, dass er in die Handfläche passt, die Finger in Längsrichtung und/oder die Fingerspitzen und/oder die gesamte Unterseite der Hand kontaktiert, und dadurch, dass die taktilen Ansprechmittel geeignet sind, die Hand eines Indi-

viduums zu stimulieren und eine sich über die Hand erstreckende taktile Abbildung zu erzeugen.

16. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 15, wobei das tragbare Gerät geeignet ist, in einen Handschuh aufgenommen zu werden. 5
17. Gerät zum Erteilen von räumlicher Kenntnis nach Anspruch 15 oder 16, wobei das Gerät wasserdicht ist, so dass es unter Wasser von in trübem oder tiefem Wasser tauchenden Tauchern benutzt werden kann. 10
18. Verfahren zum Übermitteln oder Erkennen einer Umgebung aufweisend, verbinden eines in einem der Ansprüche 1 bis 17 definierten Gerätes mit einem Individuum, dass die taktilen Ansprechmittel hiervon sich ganz oder teilweise über die Hand, den Fuß oder eine Extremität des Individuums erstreckt, aussenden von Ultraschallstrahlung, empfangen von reflektierter Ultraschallstrahlung, umwandeln der empfangenen Informationen in ein taktilen Signal, dass die Position eines Signals auf dem taktilen Ansprechmittel Informationen über die Lage eines Hindernisses in der um das Gerät befindlichen räumlichen Umgebung zur Verfügung stellt, wobei das Signal räumlich so ganz oder teilweise auf der Hand, Fuß, Rücken oder Extremität eines einzelnen Benutzers verteilt ist, dass in einem Benutzer räumliche taktile Empfindungen darüber angeregt werden. 15 20 25 30

Revendications

1. Dispositif de sensibilisation à l'espace (1) comprenant au moins un émetteur (3) apte à émettre une forme sélectionnée de rayonnement, une pluralité de récepteurs (3), au moins un moyen de commande (6) apte à recevoir des informations concernant le rayonnement reçu des récepteurs (3) et fonctionnellement couplé à ceux-ci par au moins un moyen sensible au toucher (4, 10) configuré, lors de son utilisation pour couvrir au moins en partie le corps d'un utilisateur individuel ; le rayonnement étant ultrasonore, l'émetteur étant un émetteur à ultrasons et les récepteurs étant des récepteurs à ultrasons, **caractérisé en ce que** la partie du corps est une main, un pied, un membre ou des parties de ceux-ci, et **en ce que** le moyen de commande (6) est apte à résoudre spatialement et à convertir des informations reçues de chaque récepteur en un signal tactile sur une région spécifique du moyen sensible au toucher (4, 10) de telle façon que la position d'un signal sur le moyen sensible au toucher (4, 10) fournisse des informations concernant la position d'un obstacle dans l'environnement spatial entourant le dispositif, celles-ci étant spatialement réparties sur 35 40 45 50 55

la main, le pied, le membre d'un utilisateur individuel ou des parties de ceux-ci, afin de stimuler chez l'utilisateur des sensations tactiles spatiales sur ceux-ci, et **en ce que** le moyen de commande est en outre apte à faire varier les vibrations appliquées au moyen sensible au toucher pour fournir des informations concernant la proximité d'un obstacle dans l'environnement spatial.

2. Dispositif de sensibilisation à l'espace selon la revendication 1, dans lequel le moyen de commande (6) comprend un microprocesseur, programmé de façon appropriée pour convertir des ultrasons réfléchis en ladite projection spatiale sur le moyen sensible au toucher (4, 10). 10
3. Dispositif de sensibilisation à l'espace selon la revendication 1 ou 2, **caractérisé en ce que** le moyen sensible au toucher (4, 10) comprend une matrice d'une pluralité de régions/parties spécifiques discrètes pouvant être activées séparément par le moyen de commande, pour que des informations traitées par le moyen de commande (6) puissent être sélectivement projetées sur ces régions/parties spécifiques afin de fournir une projection spatiale tactile. 15 20 25 30
4. Dispositif de sensibilisation à l'espace selon la revendication 3, **caractérisé en ce que** le moyen sensible au toucher comprend une pluralité de protubérances (10) aptes à se déplacer ou à vibrer lors d'une activation destinée à produire un signal tactile. 35
5. Dispositif de sensibilisation à l'espace selon la revendication 3 ou 4, **caractérisé en ce que** le moyen sensible au toucher comprend une matrice de transducteurs piézoélectriques (4) destinés à produire un signal tactile. 40
6. Dispositif de sensibilisation à l'espace selon l'une des revendications 3 à 5, dans lequel le moyen sensible au toucher comprend une surface apte à émettre, sur des régions discrètes, un signal électrique. 45
7. Dispositif de sensibilisation à l'espace selon l'une des revendications précédentes, dans lequel le signal tactile est une vibration. 50
8. Dispositif de sensibilisation à l'espace selon la revendication 7, dans lequel la position de la vibration sur le moyen sensible au toucher est commandée par le moyen de commande de façon à fournir des informations sur la position angulaire d'un obstacle dans l'environnement spatial. 55
9. Dispositif de sensibilisation à l'espace selon l'une

des revendications précédentes, comprenant une pluralité d'émetteurs et de récepteurs (3) appariés, chaque paire étant conçue pour projeter un rayonnement sélectionné de façon à couvrir un champ angulaire sélectionné.

10. Dispositif de sensibilisation à l'espace selon l'une des revendications précédentes, comprenant un émetteur à un seul faisceau large et une pluralité de récepteurs aptes à résoudre des ambiguïtés spatiales. 10
11. Dispositif de sensibilisation à l'espace selon l'une des revendications précédentes, comprenant en outre au moins un récepteur apte à recevoir un rayonnement acoustique se situant dans la gamme d'audition humaine et dans lequel le moyen de commande a pour rôle de produire un signal tactile correspondant au rayonnement acoustique qui est projeté sur des parties spécifiques du moyen sensible au toucher afin de créer une projection tactile permettant à l'utilisateur de déterminer de quelle partie de l'environnement provient le son. 20
12. Dispositif de sensibilisation à l'espace selon la revendication 11, dans lequel le moyen de commande est également apte à corrélérer l'intensité sonore du son avec l'intensité ou la force de la réponse tactile. 25
13. Dispositif de sensibilisation à l'espace selon la revendication 11 ou 12, dans lequel le dispositif est apte à passer de la fourniture d'informations concernant l'environnement spatial à la fourniture d'informations concernant l'environnement auditif. 30
14. Dispositif de sensibilisation à l'espace selon l'une des revendications 11 à 13, comprenant un moyen de commande (6) et un moyen sensible au toucher (4, 10) apte à fournir une projection spatiale permettant d'effectuer une projection vers une partie gauche du corps et une projection spatiale permettant d'effectuer une projection vers une partie droite du corps, une première des deux projections spatiales fournissant des informations concernant l'environnement visuel et une seconde des deux projections spatiales recevant des informations sur l'environnement auditif. 35
15. Dispositif de sensibilisation à l'espace selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** est tenu à la main et comprend un bouclier, un bouton, une plaque ou une touche ayant une configuration lui permettant de tenir dans la paume de la main, en contact avec les doigts le long de leur longueur et/ou avec les empreintes digitales et/ou avec la totalité de la face inférieure de la main et **en ce que** les moyens sensibles au toucher sont aptes à stimuler la main d'un individu et 50

à créer une projection tactile couvrant la main.

16. Dispositif de sensibilisation à l'espace selon la revendication 15, dans lequel le dispositif tenu à la main est apte à être incorporé à un gant. 5
17. Dispositif de sensibilisation à l'espace selon la revendication 15 ou 16, dans lequel le dispositif est résistant à l'eau afin de pouvoir être utilisé sous l'eau par des plongeurs plongeant dans de l'eau obscure ou profonde. 10
18. Procédé de négociation ou de sensibilisation à un environnement, comprenant l'association d'un dispositif selon l'une quelconque des revendications 1 à 17 à un individu de façon que son moyen de réponse tactile couvre la main, le pied, un membre de l'individu ou des parties de ceux-ci, l'émission d'un rayonnement ultrasonore, la réception d'un rayonnement ultrasonore réfléchi, la conversion d'informations reçues en un signal tactile de telle façon que la position d'un signal sur les moyens sensibles au toucher fournisse des informations sur la position d'un obstacle dans l'environnement spatial entourant le dispositif, celles-ci étant spatialement réparties sur la main, le pied, le membre d'un individu utilisateur ou des parties de ceux-ci, afin de stimuler chez l'utilisateur des sensations tactiles spatiales sur ceux-ci. 15

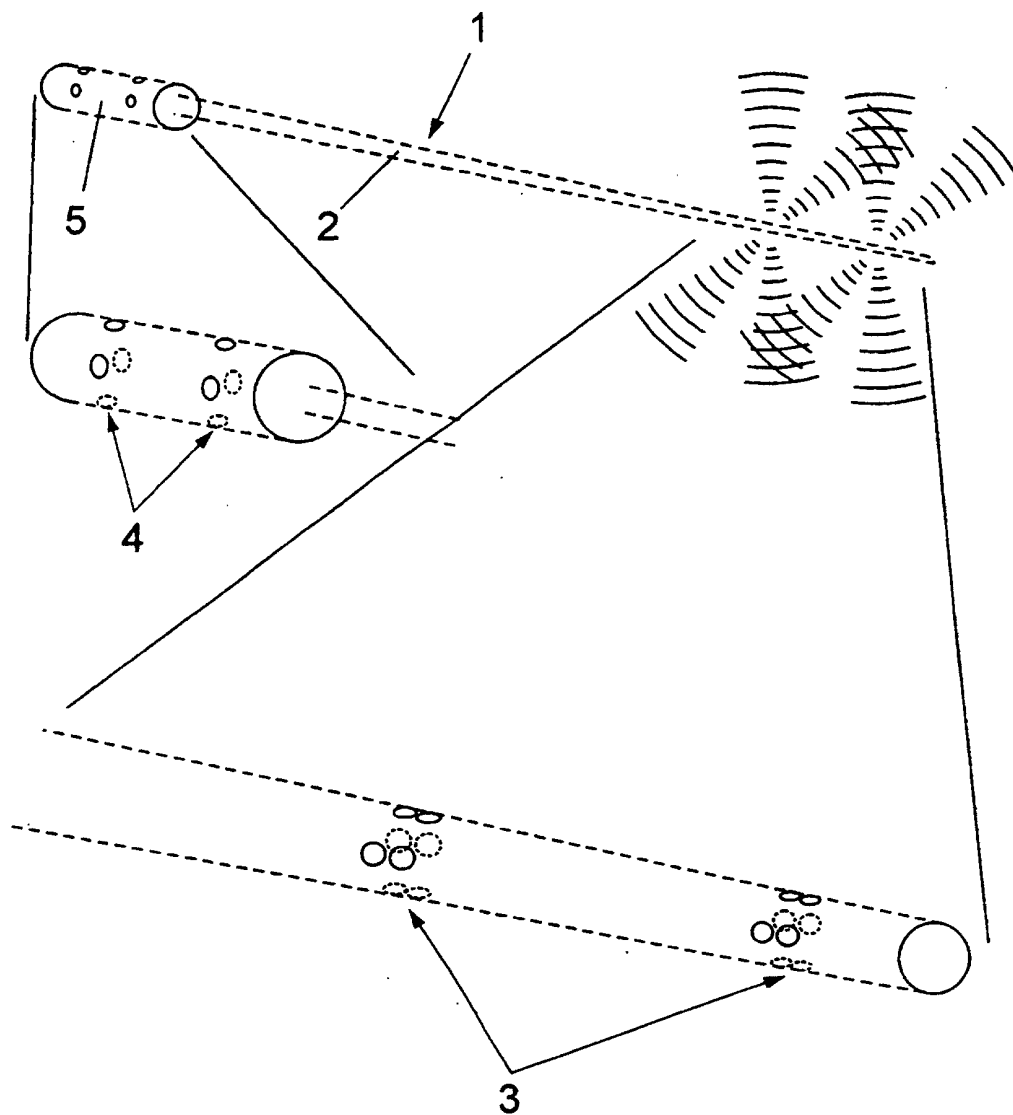
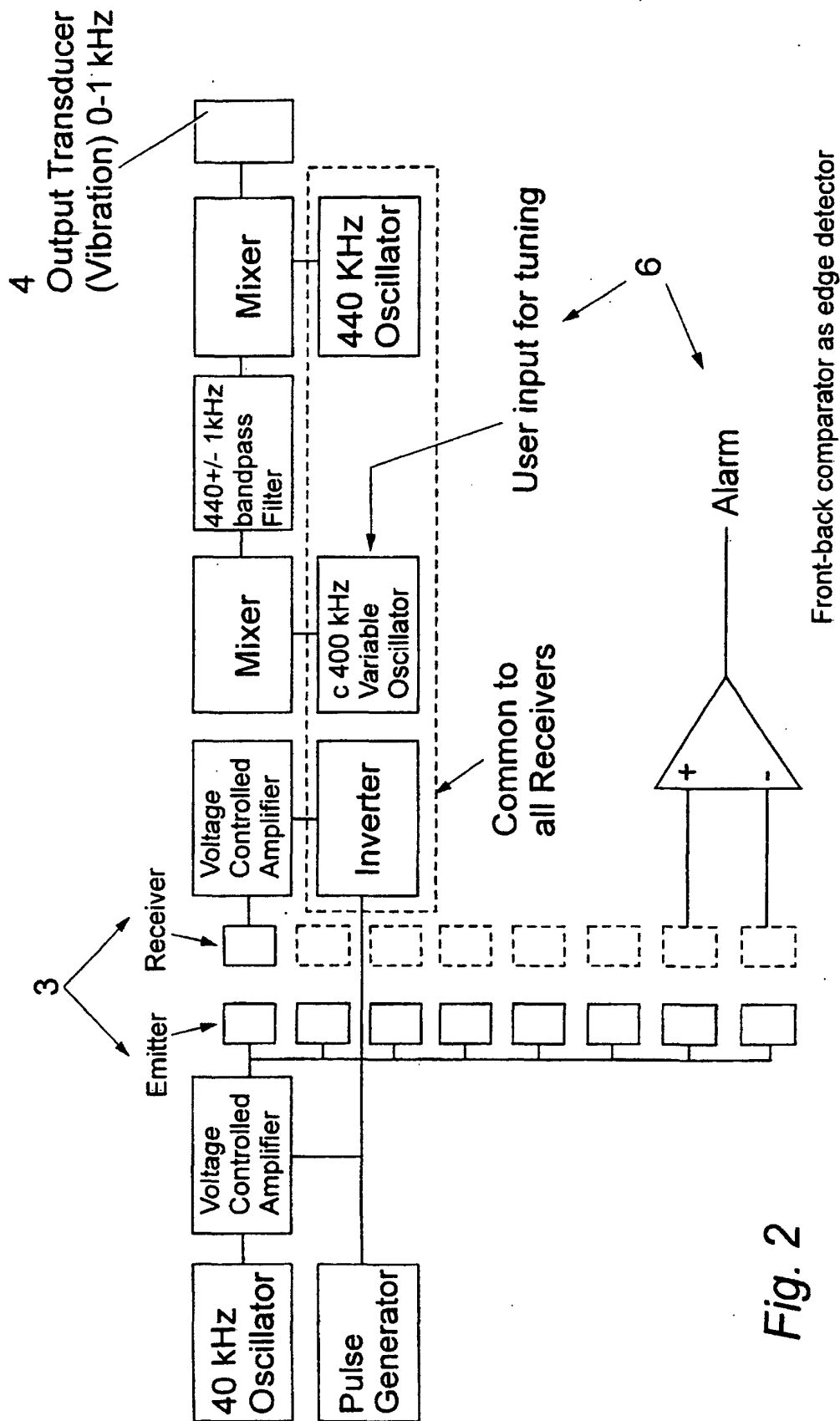


Fig. 1



8
Receivers
Murata MA40B8R (50 degree)

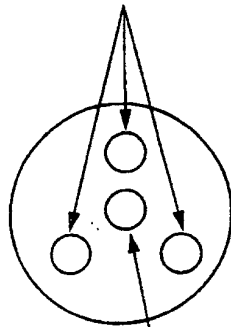


Fig. 3a

9
Transmitter
Murata MA40S4T (80 degree)

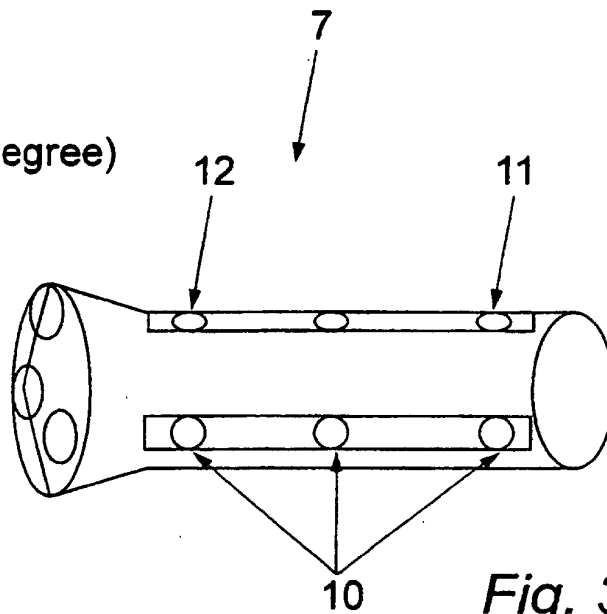


Fig. 3b

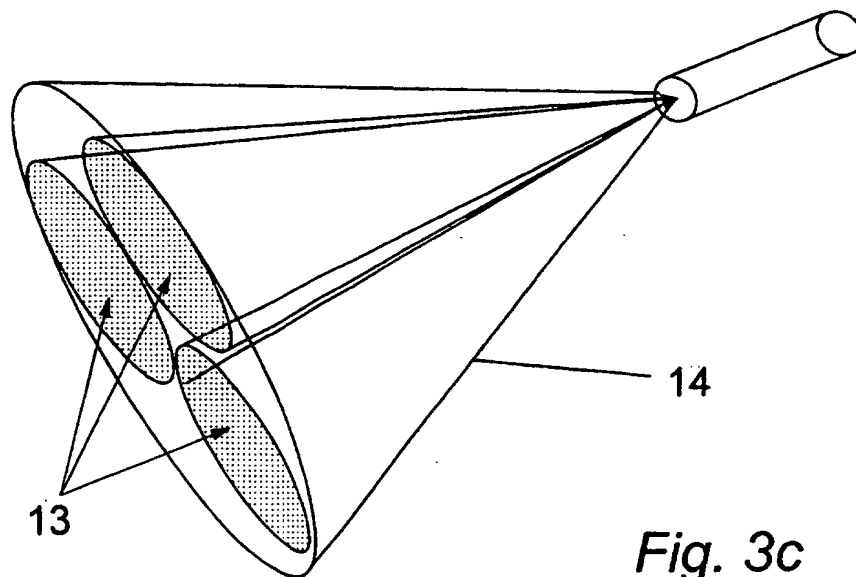


Fig. 3c

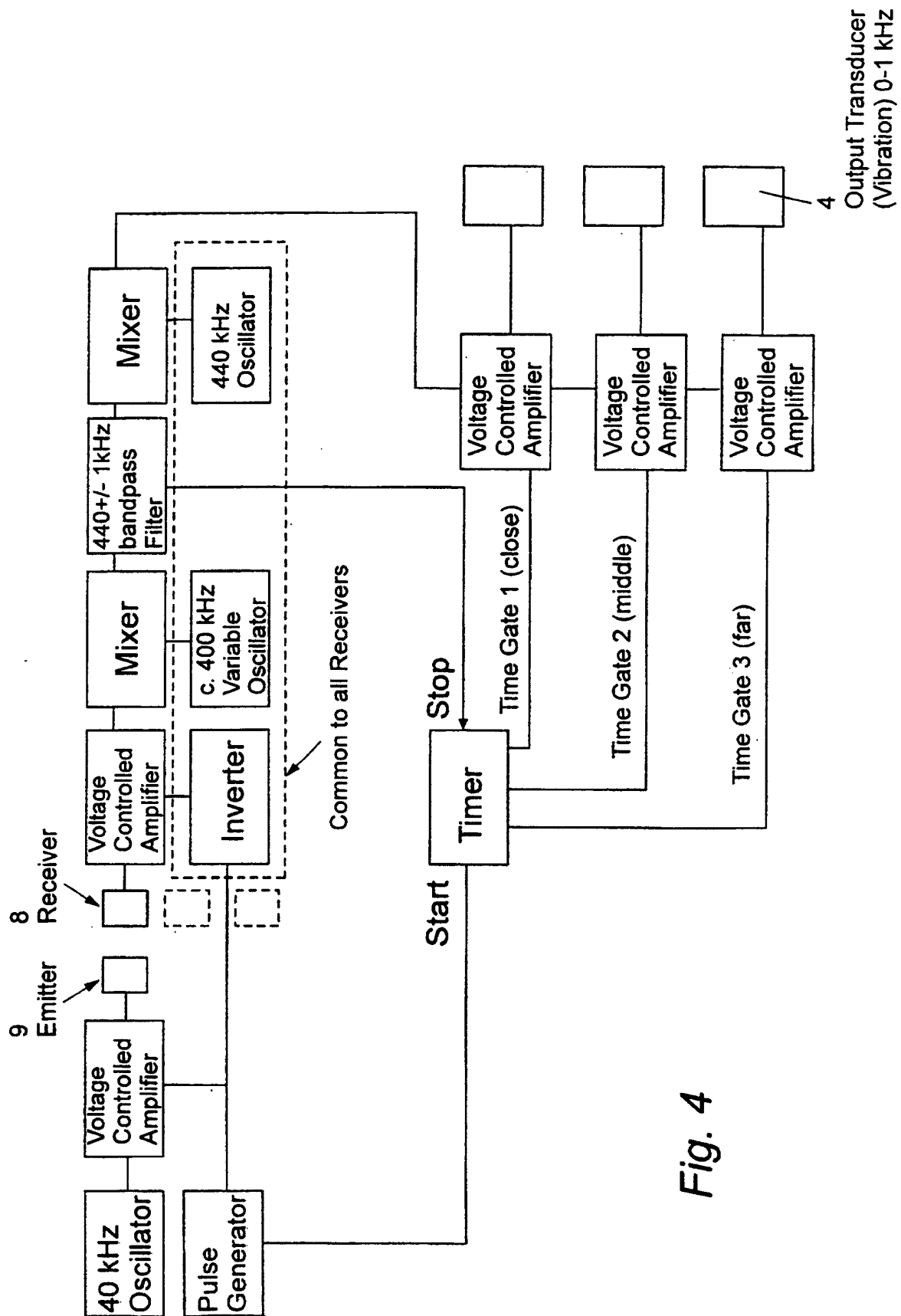


Fig. 4