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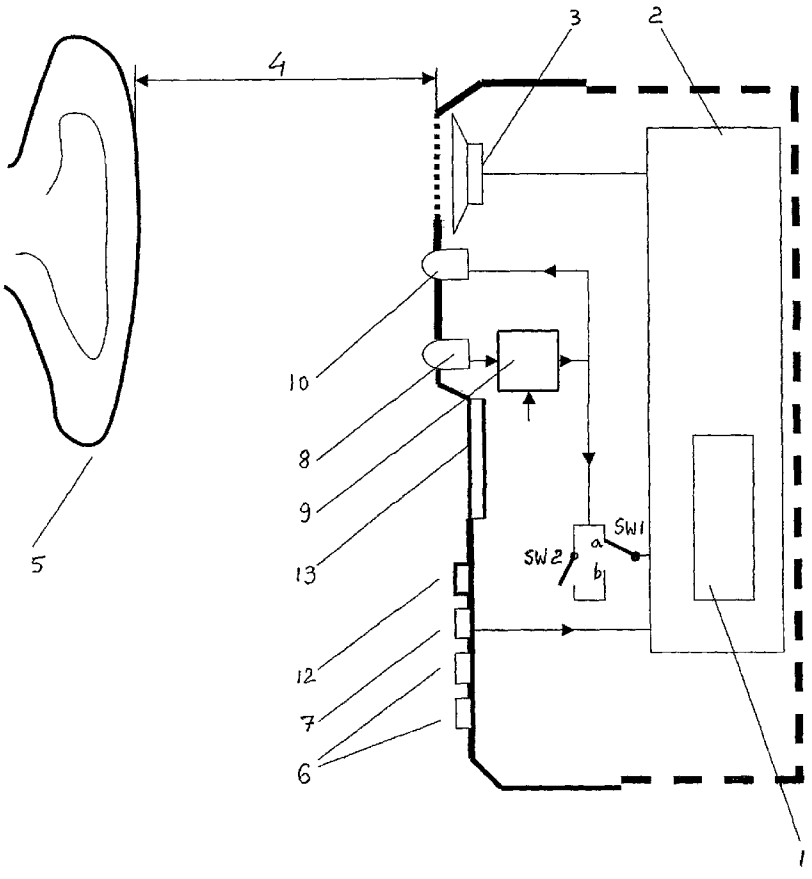
(54) Title: MULTIFUNCTIONAL MOBILE PHONE FOR MEDICAL DIAGNOSIS AND REHABILITATION



(57) Abstract: The multifunctional mobile phone performs the hearing and vision tests, through the built in or externally connected devices monitors, measures and collects data of body and environmental temperature, heart beating, lung respiration, cardiac and pulmonary auscultation, sugar level, blood pressure *etc.*, takes body photo images for the clinical assessment, displays on screen and plays back through the acoustic output instructions to conduct the diagnostic test and rehabilitation treatments, stores and updates programs for the tests and treatments and communicates with the remote medical specialist using the mobile phone network.

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MULTIFUNCTIONAL MOBILE PHONE FOR MEDICAL DIAGNOSIS AND REHABILITATION.

Field of the invention.

The invention relates to the medical tests and rehabilitation treatments provided or controlled by the mobile phone following the programs stored in the memory, loaded from the network, Internet or from the external device.

Background of the invention.

In recent years the mobile phone became one of the most popular and personal gadgets. Almost every young and older individual use the mobile phone in every day activities.
The system of the mobile phone network very effectively penetrates the society and selectively addresses it's individual members.
This advantageous situation creates the opportunity to provide a large number of people with the facilities to conduct the simple medical tests and rehabilitation treatments by extending the mobile phone functional range.
In particular, but not limited to, the screening procedures for early detection of hearing and vision impairments could benefit from this invention. More over the effectiveness of such screening procedures will significantly increase, because the number of tests and time of their performance do not depend upon the often limited time schedule and number of the specialized medical centers.
According to the invention the user of the mobile phone can perform the basic medical tests and rehabilitation treatments for himself and family members at convenient time, many times at home without paying the costly visits to the medical centers.

According to the invention the functional extension of the mobile phone applications will benefit young babies and children not covered at all or poorly covered by the screening procedures for early detection of hearing impairments.

Late detection will also significantly delay the child development and affect it's life in future.

The effectiveness of the current screening methods to detect early the hearing impairments in babies and young children is poor or nonexistent in some countries.

Early detection of hearing impairments in very young children still represents a great challenge for the clinicians despite significant advances in technology, particularly digital electronics and computing.

This results from the long existing stigma in clinical methodology limiting the conduct of the testing to specialized centers and well qualified specialists needed to carry out such testing. This imposes a high costs on testing and poor screening efficiency limiting the tests application to only a narrow group of the population. Therefore, not every baby has a chance to be tested at the right time and usually it is brought to the specialized audiological center by parents warring about their baby poor reaction to the environmental sounds and their voices. This visit occurs usually too late, when a baby already passed a critical time for the brain centers development related to the sound stimulation.

The integrity of a sensory system depends on external stimulation. Deprivation studies conclusively showed that sensory stimulus is needed for the structural development of sensory neurons as well as their functional connectivity (Webster & Webster, 1997).

Studies on children's development showed that appropriate sensory

stimulation, especially between the ages of 0 to 2 years, is critical for proper development in later years (Ross, Backet & Maxon, 1991)

If baby turns it's head towards the sound source it means not only that it can hear, but also that a proper connectivity between the hearing and motor neurons was established during the critical time. The current method for hearing screening of babies only a few months old, has the following shortcomings:

a/ the baby has to be transported to the specialized hearing center, one or two parents have to dedicate a special time and means for this visit,

b/ in a new strange environment, the baby seldom cooperate with the tester, testing takes too long or it cannot be completed during the first visit,

c/ testing requires the highly specialized, expensive instrumentation and the specialists involvement to carry on the test, and centers patient efficiency is poor,

d/ these centers cannot provide services for mass screening programs and typically test only those babies, who have already been noted by parents or family doctor as having the hearing problems and usually this happen too late.

The Australian Consensus Statement on Neonatal Hearing Screening, Adelaide, March, 2001 states that: " The average age of diagnosis of hearing impairment in centers which screen only infants known to have pertinent risk factors is estimated at 24 months.
Data from Australian Hearing indicate that the median age at detection of children with the most severe hearing impairment (> 90 dB) is between 12 and 18 months while the median age of children with mild hearing loss (< 40 dB) is around 7 years.
Effective universal neonatal hearing screening will not replace

the need for vigilance and for continued surveillance of hearing behavior and language development to detect hearing impairment in children who have not received neonatal screening or who develop permanent hearing loss at a later age."

It can be noted that planning and implementation of universal neonatal hearing screening is a major effort in many countries across the world being completed in non of them, but only more or less advanced in implementation and still limited to the specialized centers.

There is also a lack of calibrated home device which can be used for hearing test at home for children and adults as a first indicator of hearing problem before more specialized test could be done at the medical center.

According to the invention the mobile phone can also be used for the early detection of vision impairments by the mobile phone users.

According to the statistics there are about 45 million blind people worldwide and about 135 million with low vision.

In Australia there are 60,000 blind and 400,000 vision-impaired people.

An early detection of the vision impairments is the best prevention method. Early diagnosis of eye conditions saves vision and even low vision can be useful with adequate vision training and rehabilitation.

Unfortunately there are no regular screening programs and simple tools available for vision testing to every member of the society for early detection of vision impairments.

According to the invention the mobile phone can be modified for mass screening of vision. Today the mobile phone becomes a personal item supporting various needs of increasingly growing number of mobile phone users.

According to the invention it will allow the phone user to use his phone by himself for the purpose of vision screening any time, without costly visits to the specialized centers.

According to the invention the further extension of the mobile functions can benefit the hearing aid and tinnitus maskers users. Current miniaturization of the mobile phones cases and facilities to attach the phone in form of brooch or to place the phone in the upper pocket makes it convenient to extend it's basic functions to perform functions of the hearing aid, tinnitus masker and the remote control for the external hearing aid.
Popular use of the mobile phone with the earphone plugged into the ear is more cosmetically acceptable, than use of the separate hearing aid or tinnitus masker clearly showing the person handicap. More over, the programs stored in the mobile phone memory to run the built in hearing aid, tinnitus masker or remote control for the external hearing aid can be easily modified and updated through the mobile phone network to suit the best the person hearing needs or to optimize the strategy in tinnitus masking treatment.

According to the invention the modified mobile phone acoustic channel delivers through the programmable amplifier the amplified environmental noises including speech through the special earphone to the hard of hearing person ear without the necessity to use a separate hearing aid.
Change from the hearing aid mode to the normal mobile phone communication is done automatically by the incoming radio signal or manually by the user, through the mobile phone keypad.

In another extension of the mobile phone functions according to the invention the mobile phone functions provides plurality of

special sounds like single tones, white noise, gentle environmental noises for the tinnitus suffers.
These special noises stored in the mobile phone memory or loaded and optionally updated from the network following the clinical progress and strategy in the tinnitus treatment are delivered from the mobile phone acoustic output though the insert earphone to the person ear affected by the tinnitus.
Change from the tinnitus masking mode to the normal mobile phone communication is done automatically when the transmission/receiving mode of operation has been selected or manually by the user, through the mobile phone keypad.

In another extension of the mobile phone functions according to the invention the mobile phone controls parameters of the external heari

aid instead of the remote control box used by the hearing aid user and often forgotten to be taken by him when leaving home.
The typical remote control unit provide facilities to turn on/off the hearing aid, to change it's volume and to select the listening program most suitable for given acoustic environment.
Such remote control unit built into the mobile phone duplicates missing remote control box and also according to the invention it can be re-programmed through the mobile phone network to provide the hearing aid user with updated selection of the listening programs most suitable for his needs.

According to the invention the further extension of the mobile phone functions will allow to control built in or externally connected devices typically used for the body or environment temperature measurement, for monitoring the heart beating and respiration rate, for the cardiac and pulmonary auscultation, for the blood sugar level and pressure measurement and also to control devices used

in rehabilitation like neuromuscular stimulator.

Brief description of the Drawings.

Fig. 1 is a simplified view of the mobile phone with the built in distance measuring sensor and indicator facing the tested ear.

Fig. 2 is a front view of the mobile phone with the audiogram and and the electronic pointer displayed on the screen.

Fig. 3 is a simplified view showing the mobile phone acoustic output and supra aural coupler attached to the ear to deliver acoustic test stimuli.

Fig. 4 is a simplified view showing the mobile phone acoustic output and the insert ear coupler plugged into the ear to deliver acoustic test stimuli.

Fig. 5 is a simplified view of the mobile phone with the special insert earphone plugged into the ear canal to deliver acoustic test stimuli.

Fig. 6 is a simplified view of the mobile phone with attached the tube phone delivering acoustic test stimuli to the tested ear.

Fig. 7 is a simplified view showing the sound level meter to control and calibrate acoustic test stimuli intensities delivered by the mobile phone to the tested ear and placed at the distance set by the telescopic rod.

Fig. 8 is a simplified view showing the personal sound level indicat

attached to the ear with the optional external indicator.

Fig. 9 is a simplified view of the mobile phone with the attached sound level meter and the distance measuring telescopic rod with built in the microphone.

Fig. 10 is a view of the attached or built into the mobile phone a distance evaluating device based on a few narrow light beams

crossing at the point close to the tested ear.

Fig. 11 is a view of the mobile phone with built in or attached indicator to set up the correct distance between the tested eye and the mobile phone screen.

Fig. 12 is an example of the correlation between the vision test patterns and the associated alphanumeric signs to facilitate the use of the mobile phone keypad for the vision test.

Fig. 13 is an example of the vision test pattern displayed on the mobile phone screen for the color vision test.

Fig. 14 is a simplified block diagram of the mobile phone with the acoustic channel modified to perform additionally the hearing aid function.

Fig. 15 is a simplified block diagram of the mobile phone with acoustic channel modified to perform additionally the tinnitus masker function.

Fig. 16 is a simplified block diagram of the mobile phone with the built in remote control of the hearing aid.

Fig. 17 is a simplified block diagram of the mobile phone with the optionally connected external devices for the medical tests or rehabilitation controlled by the programs stored in the mobile phone memory.

The invention will be further explained in the detailed description of the preferred embodiments and methods.

In a typical mobile phone the different ring signals can be pre-selected from the memory bank and their volume is set to the predetermined level by the operator using the keypad built into the mobile phone.

According to the invention presented in Fig.1, the complex sounds limited to the narrow frequency band or single frequency tones are

stored in a digital form in the memory bank 1 of the mobile phone electronic circuit 2 in the same way as the ring signals in the ordinary mobile phone.

The intensity level of these sounds presented at the output speaker 3 of the mobile phone is set by the volume control already incorporated in the phone, but for the purpose to conduct the hearing test these intensities are calibrated according to the invention in dB scale of the Hearing Threshold Level (HTL) for the specified distance 4 between the mobile phone speaker 3 and the patient's ear 5.

According to the invention three modes of operation are possible:

a/ activating the sound "on" manually at the specified distance 4 only approximately estimated by the tester,

b/ activating the sound "on" automatically only at the specified distance 4 when the mobile phone is placed in the correct position,

c/ activating the sound "on" manually at the desired time, but only when the mobile phone is placed at the specified distance 4.

In the first mode of operation the tester positions the mobile phone at the distance he estimates as being close or equal to the specified distance 4 and presses button 7 to activate "on" the testing sound stored in the mobile phone memory 1 selected by him prior to the test.

In the second mode of operation the distance measuring sensor 8 sends the control signal to the one input of the comparator 9 whose second input receives the reference signal Vref. When the mobile phone is placed at the specified distance 4 from the

patient's ear 5 then both input signals of the comparator 9 should be the same and then the output signal from the comparator 9 through the changeover switch SW1 set in position "a" is delivered to the mobile phone complex circuitry 2 to activate "on" the testing sound. Additionally the light indicator 10 controlled also from the output of the comparator 9 confirms correct position of the mobile phone. In this mode of operation both sound and light indicator are turned "on" automatically, when the distance of the mobile phone speaker 3 from the patient's ear 5 is the same as the specified distance 4.

In the third mode of operation switch SW1 is set in position "b". When the mobile phone is positioned at the specified distance 4, then only light indicator 10 will come "on" indicating to the operator correct distance between the patient's ear 5 and the speaker 3. The testing sound can be delivered to the patient later by pressing at the desired time button 12 which will close the switch SW2, providing that the position of the mobile phone did not change ea. the light indicator 10 stays "on".
In the second and third mode of operation the action of the distance measuring sensor 8 ensures, that the intensity of the testing sound delivered to the patient's ear 5 will meet the calibration requirements at the specified distance 4.

To test the hearing by the patient himself, he has to select using the mobile phone keypad 6 the type of the acoustic stimulus, it's intensity level he wants to hear from the specified distance 4 and mode of operation.
While holding the mobile phone at this distance from his ear 5 he presses the "on" switch 7 to activate the sound "on"

in the first mode of operation.
For given frequency band or single tone, the tester can change the stimulus intensity level using the keypad 6 to find out, what is the lowest level of the acoustic stimulus he can hear. After that, he marks this level on the external audiogram form or using an electronic pointer controlled by the keypad 6, he marks this point on the audiogram showed in the display window 13.
If the second mode of operation has been chosen by the patient, then he has to move the mobile phone at the ear level out of the ear and at the specified distance 4 the testing sound will be automatically produced.
In the third mode of operation the patient position the mobile phone at the specified distance 4 and when the light indicator 10 is "on", he presses the button 12 to close "on" the switch SW2.

The hearing test according to the invention can be performed by the operator himself or in case of disabled person, young children or babies the second person can perform the test in any of these 3 modes of operation.

Setting the test parameters such as stimulus frequency and intensity and also recording of the test results can be done according to the invention in a simple way showed in Fig. 2.
In this drawing the testing point is chose, using the keypad 1 and the electronic pointer 2 directly on the audiogram presented on the display 3 of the mobile phone.
Using the electronic pointer 2 and the keypad 1 desired frequency and intensity of the acoustic stimulus can be simultaneously selected for the given test point in an easy way directly on the displayed audiogram prior to the test.
After the stimulus presentation at the specified distance, the

tester will decide whether to change the stimulus frequency and/or intensity or accept them depending whether the stimulus was heard or not. If the tester accepted the stimulus as being heard then he will press the enter button or other nominated key of the keypad 1 to store the result of the hearing test in the mobile phone memory and to display it on the audiogram.
Repeating this procedure for all frequency bands or single tones will allow to build an audiogram for each ear.
As an example the mobile phone display 3 shows a few frequency bands 5: low L, medium M and high H in vertical plane and the horizontal lines 4 indicate the stimulus intensity level in dB of the Hearing Threshold Level for the specified distance between the patient's ear and the mobile phone speaker 7.
The distance measuring sensor 6 is placed at the speaker 7 side.
The light indicator 8 normally also placed at the speaker side, in case of testing a small children can be turned "off" and another light indicator placed at the back of the mobile phone can be used instead, to avoid the child false response to the light instead to the testing sound.
Using the electronic pointer 2 the tester can also mark the results of the hearing test directly on the displayed audiogram and store the final results of the test in the mobile phone memory. The data of the stored hearing test results can be sent by the mobile phone to the medical center or to the telemedicine network for the further patient management.

In another embodiment of the invention presented in Fig. 3, the mobile phone 1 adopted for the purpose to perform the hearing test has the output speaker 2 coupled with the ear 3 by means of inserting the coupler 4 with the seal 5 between the mobile

phone acoustic output 6 and the patient head 7.
The acoustic sounds patterns for the purpose of the hearing test can be stored in the mobile phone 1 internal memory 8 in a similar way like the set of the phone ring tones is stored, or they can be loaded from the external source into the mobile phone 1 internal memory 8 following the practice allowing to customize the ring tone. Selection of testing sounds patterns and their intensities calibrated in the dB scale in reference of the Hearing Threshold Level is controlled from the mobile phone 1 keypad 9 and showed on the display 10. After the testing sound pattern and it's intensity are selected, then the sound presence is activated by one of the keypad 9 button and the test result can be stored in the mobile phone internal memory for further data processing.

In another embodiment of the invention presented in Fig. 4 the mobile phone 1, has attached to the mobile phone body 2 a speculum 3 with disposable ear tip 4, which is inserted into the patient ear and allows the direct acoustic coupling with the ear canal for the purpose of conducting the hearing test. The testing sound from the speaker 5 is delivered to the patient ear through the speculum 3 and the ear tip 4. The ear tip 4 can be changed according to the patient ear canal size and the whole attachment formed by the speculum 3 and the ear tip 4 can be removed when the mobile phone normal operation is required.

In another another embodiment of the invention presented in Fig. 5 the mobile phone is provided with the socket 1 allowing to plug in preferably, but not necessary, the audiometric insert earphone 2 with the ear tip 3 and plug 4, which when plugged into the socket 1 disconnects the speaker 5 and takes over the output signal from the

mobile phone and delivers the testing sound to the patient's ear 6. When the mobile phone is provided by the producer together with the insert earphone for the hearing testing , then the testing sounds intensity produced by this earphone is calibrated in reference to the Hearing Threshold Level by the mobile phone internal calibrator and such intensity level is selected by the keypad 8 and showed by the display 9.

When the insert earphone 2 is purchased separately from the mobile phone, then it is provided with the reference table or with the bar code which contains the data of voltages required for each frequency band of the complex testing sounds or single tones to calibrate the mobile phone for each sound in reference to the Hearing Threshold Level for the individual insert earphone characteristic.

Such voltages, expressed either in analog values or in a special code, are transferred into the mobile phone digital circuitry 7 using the mobile phone keypad 8 or using the mobile phone digital input connected to the external bar reading device which allows to use the bar code automatic data transfer.

Alternatively the mobile phone calibration is done automatically or updated with the data of the earphone characteristic provided by the mobile phone network bank, storing these data for the individual insert earphones recognized by their code numbers.

In another embodiment of the invention, the Fig. 6 is a block diagram of the mobile phone 1 adopted for the purpose to perform the hearing test, whose output speaker 2 is coupled with the ear 3 by means of the phone tube 4 and tip 5 plugged into the ear canal 6. The phone tube 4 is attached to the mobile phone acoustic output 7 by the coupler 8.

The acoustic sounds patterns for the purpose of the hearing test can be stored in the mobile phone 1 internal memory 9 in a similar way like the set of the phone ring tones is stored or they can be loaded from the external module 10 connected to the socket 11 which allows the module 10 to communicate with the mobile phone electronic circuitry 12 and, but not necessary with the memory 9.
Selection of testing sounds patterns and their intensities calibrated in the dB scale in reference to the Hearing Threshold Level is controlled from the mobile phone 1 keypad and showed on the display 14. After the testing sound pattern and it's intensity are selected, then the sound presence is activated by one of the keypad 13 button and the test result can be stored in the mobile phone internal memory for further data processing.

In another embodiment of the invention the Fig. 7 is a block diagram of the mobile phone 1 placed at the distance from the ear entrance 3 controlled by the rod 4 attached to the mobile phone 1 but not touching the ear auricle 5.
The sound level meter 6 measures the sound intensity level close to the ear entrance 3 delivered from the mobile phone 1.
Selecting with the keypad 7 type and volume of each testing sound, one can calibrate in dB the sound intensity approaching the ear entrance 3 and store these levels in the mobile phone 1 memory 8.
Then the type of the testing sound and it's calibrated intensity can be read from the display 9.
After the mobile phone calibrated as described above one can perform the hearing test presenting the calibrated testing sounds to the ear at the constant distance 2 controlled by the rod 4.
Instead of the commercial sound level meter 6 the special personal sound level indicator described in the Fig. 2 can be used to calibra

the intensity of the testing sounds.
In another embodiment presented in Fig. 8 the personal sound level indicator 1 has a built in the microphone 2 and one or more light indicators 3, to indicate one or more sound intensity levels like 20 dB, 30 dB, 40 dB etc.
One of the light indicator different in color, shape or placement position to the other indicators is used to indicate,
that the sound received by the microphone 2 has intensity exceeding the maximum level of the personal indicator scale or predetermined single level typically used in the screening procedures.
The personal sound indicator 1 can be attached to the ear 4 by means of the special hook 5 or a typical head band. It also can be clipped to the ear 4 or hairs like a small brooch or it can be plugged into the ear canal 6 providing a free entrance for the sound through the special opening.
In self hearing test a person with the sound indicator 1 placed closed to the ear canal 6, can observe in the mirror placed in front of it' face, which indicator is "on" during the sound presentation, to assess the level of the sound approaching the ear canal 6.
Instead of the mirror an external light indicator 4 or a special meter can be plugged into the personal sound indicator 1 and conveniently placed in front of the person.
Alternatively, the personal sound indicator 1 with it's light indicator 3 can be placed in front of the person and only the microphone 2 is placed near or plugged into the the ear canal 6.
Desired level of the testing sound can be set up by varying the distance 7 between the ear canal 6 and the mobile phone speaker 8 and/or by adjusting the mobile phone 1 volume control.
By changing the distance 7 while presenting at the same time the testing sound from the mobile phone and observing the light

indicator 1, one can find out at which sound intensity level he can or cannot hear the testing sound.

The mobile phone 9 has stored in it's memory 10, among the ring tones, the plurality of the special hearing test signals in form of the single tones or complex sounds like the environmental filtered sounds of animals, birds etc.

The hearing test signals could be loaded into the mobile phone memory 10 through the radio link, from the Internet or from the external device 11 plugged into the socket 12, which is connected to the mobile phone 9 electronic circuitry 13. Loading of the testing sounds data from the external device 11, through the radio, infrared or ultrasound link will not change the principle of the invention.

The testing sounds could be also composed by the mobile phone user the same way like he can compose his own ring tones using the mobile phone keypad. In this case, an additional instruction, printed or displayed on the mobile phone display 14 or available from the Internet will be provided to the mobile phone user, to help him to compose the testing signals, especially for the complex sounds, if the sound spectrum has to be more accurately defined.

The personal sound indicator and the mobile phone can also be used for the hearing screening test particularly in babies and young children. In this case the second person, holding the mobile phone, approaches the baby from the side position, observes the light indicators and reaction of the baby to the testing sound.

In another embodiment presented in Fig. 9 the personal sound level indicator 1 with it's light indicator 2 is attached to the mobile phone 3 and has a distance rod 4 with the microphone 5 at the end of this rod 4 connected to the personal sound level indicator 1. The constant distance 6 between the speaker output 7

and the ear canal 8 is controlled by the length of the rod 4. Using the keypad 7 one can choose the type of the testing sound stored in the memory 10 and through the volume control adjust the sound intensity level following the indication of the light indicator 2.

In another embodiment of the invention presented in Fig. 10 the specified distance between the ear 1 and the mobile phone 2 can be estimated by creating near the entrance of the ear 1 the visible light dot 3 formed by the crossing point of two narrow light beams 4 and 5 send by the light sources 6 and 7 such as microlaser diodes or other focused light emitters.
At the specified distance only one dot 3 will be visible indicating a proper distance between the ear 1 and the sound module or mobile phone 2. Otherwise two light dots will be visible. The tester moves the sound module or the mobile phone 2 towards the ear 1 to obtain only one dot and then the testing sound can be turned "on" by the tester and delivered from the speaker 8 to the ear 1 to test the hearing.

According to the invention the mobile phone user will also be able to use his phone for the purpose of vision screening.
There is a number of vision tests which can be incorporated into the mobile phone system and it's software program.
Two examples of the basic tests for the contrast sensitivity and color discrimination will be presented, but it will not limit plurality of tests possible to perform using the mobile phone.
To conduct the vision tests, first it is important to determine the distance between the mobile phone screen and the person eyes.

This is presented in Fig.11. In this figure the mobile phone 1 is held by the person performing the vision test at the specified

distance 2 which for some of the tests may correspond to the full length of the person arm. The tested person measures with the separate tape or the pulled out of the phone body mini tape, telescopic or one piece rode the distance between the mobile phone screen 5 and the person eyes 3 and keys value of this distance through the mobile phone keypad 4 into the mobile phone uprocessor controlled electronic system. This allows, following the software program, to automatically adjust the size of the pictures displayed on the screen 5 for the purpose of the vision test.
Alternatively, the distance measuring sensor 6 can automatically adjust the size of the images displayed on the screen 5 sending to the mobile phone electronic circuitry which controls the image size, the software data related to the distance.
The typical image displayed on the mobile phone screen for the contrast sensitivity test is presented in Fig.12.
In this test the image presented on the mobile phone screen 1 as the circle 2 consists a number of parallel lines, which can be positioned vertically, horizontally or at + or - 45 degrees.
The tested person has to correlate position of the lines within the circle 2 with one of the symbols 3 displayed on the same screen 1 and has to key in through the mobile phone keypad, one number from the numbers set 4 displayed on the same screen 1 and positioned against the symbols 3.
Position and/or density of lines in the circle 1 and also the size of the circle 2 are automatically changed due to the software program for the vision test stored in the mobile phone memory every time the number from the set 4 is keyed in. If the tested person with vision impairment is not decided, what is the position of the lines in the circle 2, then the asterix or other symbol of the keypad

can be used instead of the numbers from the set 4.
Correct, false and undecided scores of the correlation are recorded in the mobile phone memory. The total number of the circles presentation and the final results interpretation included into the operating software depends upon the criteria recommended by the medical specialists for the vision screening method.
The final pass/fail result of this test is displayed on the mobile phone screen 1 for the tested person consideration and recommends the further action like visit to the specialized medical center.

In the second example for the color vision test presented in Fig. 13 the mobile phone screen 3 is used to detect the color vision problems like incorrect color discrimination. In this test the image of number (or letter) 2 built of the same color various diameter and color intensity dots is presented on the background 3 built of multicolor, various sizes and various color intensity dots and displayed on the mobile phone screen 1.
The tested person has to key in through the mobile phone keypad the value of the number (or letter) 1, displayed on the screen 1 against the background 3. The value of the number 2, the colors of it's dots and the background 3 dots, are changed according to the accepted screening method for which the special software is stored in the mobile phone memory.
The total number of the color images presentation and the final results interpretation will depend upon the criteria recommended by the medical specialists for the color vision screening method.
The final pass/fail result and eventually more detailed comments are displayed on the mobile phone screen 1 or delivered verbally through the mobile phone acoustic output for the tested person consideration and the further action.

Presented above two examples for the vision tests in no way limit a number of other images and vision tests which could be performed with the mobile phone.
For example, various size numbers and/or letters can be displayed on the mobile phone screen for the tested person to identify them and to key them in through the mobile phone keypad.

Connecting to the mobile phone an external module with the software program to conduct the vision test will not change the principle of this invention in which the vision tests' special images are displayed on the mobile phone screen and the tested person, who looks at these images, has to perform a specific tasks related to these images and has to key in through the mobile phone keypad the results of these tasks for automatic assessment of these results following the test program software and presenting the final results and recommendation for the tested person on the mobile phone screen and/or delivering through the mobile phone acoustic output the verbal instructions stored in the mobile phone memory.
If the larger screen is required, then the mobile phone vision output can be connected to the VDU Monitor or home TV set through a special VDU or RF adapter.

In another embodiment of the invention presented in Fig. 14 the hearing aid forms a part of the mobile phone 1 acoustic channel,in which the changeover switch 2 in it,s normal position takes signal from the microphone 3 and through the programmable amplifier 4, volume control 5 and output amplifier 6 delivers the signal to the external earphone 7 used for the heard of hearing person.
The programmable amplifier 4 adjusts the frequency characteristic and compression of the amplified signal and is controlled by the mobile phone electronic circuit 8 following the data stored in the

memory 9. The data stored in the memory 9 could be changed by loading a new data from the mobile phone network or Internet to re-program the hearing aid acoustic parameters.
When the mobile phone is used in normal transmission/receiving mode, then the changeover switch 2 is switched by the electronic circuit 8 to it's second position to receive acoustic signal coming from the network. In this mode of operation the signal coming from the network is processed by the hearing aid channel comprising the programmable amplifier 4, volume control 5, output amplifier 6 and the external earphone 7. The changeover switch is automatically switched by the electronic circuitry 8 when the mobile phone is set to the transmission/reception mode or manually through the mobile phone keypad 10, when the user decides to turn off the hearing aid.

In another embodiment of the invention presented in the Fig. 15 the changeover switch 1 shown in it's normal position processes the special signal like white noise, tones or environmental sounds stored in the memory 2 for the purpose of the tinnitus masking. Next the signal from the switch 1 is delivered through the volume control 3 and the output amplifier 4 to the external earphone 5 used by the tinnitus sufferer. When the mobile phone is set to it's transmission/receiving operation mode, then mobile phone 6 internal electronic circuitry 7 automatically changes position of the switch 1 to carry on this mode of operation.
Changing the mobile phone function from the transmission/receiving mode to the tinnitus masker mode can also be done manually through the mobile phone keypad 8.
The data of the tinnitus masking signals stored in the memory 2 can be changed by loading from the mobile phone network or Internet another data for the new signals.

Additionally the date of the treatment program like changing periodically type of masking signals are stored in the memory 9 and can be updated through the mobile phone network or the Internet.

In another embodiment of the invention presented in the Fig. 16 the remote control unit 1 typically used to select functions and the listening programs of the hearing aid is built into the mobile phone 2. The control unit 1 can communicate with the remote hearing aid through the radio wave output 4, magnetic or ultrasound transducer 5 or or infrared transducer 6.
Selection of the hearing aid functions or listening programs is done through the mobile phone keypad 7 connected to the mobile phone electronic circuitry 8. The memory 9 stores a number of commends allowing to select through the remote unit 1 and the electronic circuitry 8 the desired listening programs and the hearing aid functions like microphone, telecoil, volume level and on/off mode of operation. The number of these commends can be changed or optionally updated through the mobile phone network or the Internet.

In another embodiment of the invention presented in Fig. 17 a number of the external measuring and monitoring devices D1, D2, D3 ... Dn can be connected individually to the mobile phone 1 external socket

to be controlled by the interface 3 and the mobile phone tests or rehabilitation programs stored in the memory 4 being a part of the mobile phone electronic circuitry 5. Alternatively these external devices send the analog or digital data to the mobile phone as the result of their action for further processing.
Various types of the devices measuring the body or environmental temperature, heart beating and lung respiration rate, blood sugar or pressure, monitoring cardiac or pulmonary auscultation, controlling

the treatment with the neuromuscular stimulator etc. can be interfaced with the mobile phone through the interface 3 following the standard interfacing rules.

The testing or rehabilitation programs stored in the memory 4 are changed or updated through the mobile phone network or the Internet.

WHAT IS CLAIMED IS:

1. The mobile phone performing hearing and vision tests, measuring the body and *environmental temperature, monitoring heart beating and lungs respiration rate,* performing the cardiac and pulmonary auscultation, function of the hearing aid, tinnitus masker, remote control for the hearing aid, taking the body photo images for the medical examination and providing specialized programs to control the external devices used in medical diagnosis and rehabilitation.

2. The mobile phone of claim 1, wherein the software programs for medical diagnosis and rehabilitation are factory stored or loaded into the mobile phone memory and updated from the mobile phone network or Internet and through the infrared link, ultrasound link or cable from the external sources.

3. The mobile phone of claims 1 and 2, wherein the results of the medical tests controlled by the mobile phone programs and recommendations for the patient *resulting from the test are displayed on the mobile phone screen , played back in* verbal form through the mobile phone acoustic output or transferred through the network to the medical specialist for further case management.

4. The mobile phone of claims 1, 2 and 3, wherein the mobile phone audio and video channels perform the hearing and vision tests following the test programs stored in the mobile phone memory.

5. The mobile phone of claims 1, 2 and, wherein the plurality of the acoustic test stimuli calibrated in frequency and intensity are delivered from the mobile phone output directly to the ear by the insert earphone, tube-phone, supra ear coupler, insert ear coupler, mobile phone speaker or externally connected speaker placed at the specified distance from the tested ear in sound field conditions.

6. The mobile phone of claim 5, wherein the insert earphone is provided with the special number or with the bar code allowing to obtain the earphone characteristic data from the mobile phone network for the calibration together with the mobile phone.

7. The mobile phone of claim 5, wherein the insert earphone characteristic data keyed in through the keypad or obtained from the network are used to calibrate the mobile phone together with the earphone.

8. The mobile phone of claims 1, 2 and 3, wherein the acoustic test stimuli are composed using the keypad.

9. The mobile phone of claims 1, 2 and 3, wherein the intensities of the acoustic stimuli are calibrated in reference to the Hearing Threshold Level.

10. The mobile phone of claims 1, 2 and 3, wherein selection of the acoustic test stimuli type, frequency and intensity is done by operating the keyboard and their values displayed on the screen.

11. The mobile phone of claims 1, 2 and 3, wherein acoustic test stimuli is turned "on" by pressing the keypad key or separate built in or externally connected key.

12. The mobile phone of claims 1, 2 and 3, wherein the audiogram showing frequency and intensity scale is displayed on the mobile phone screen and selection of the acoustic test stimuli frequency and intensity is done by means of the electronic pointer controlled by the operator through the keypad.

13. The mobile phone of claims 1, 2 and 3, wherein the tested person's answers to the acoustic test stimuli are recorded in the mobile phone memory and displayed on the screen by operating the keypad or separate special key by this person in self testing procedure or by the tester performing the hearing test for another person.

14. The mobile phone of claims 1, 2 and 3, wherein changing the acoustic test stimuli

frequencies and intensities is done automatically following the program stored in the mobile phone memory and pressing the key to record the positive answer.

15. The mobile phone of claims 1, 2 and 3, wherein the mobile phone volume control is used to set up the intensity of the acoustic test stimuli in sound field testing conditions by measuring the sound intensity level close to the ear entrance with the sound level meter.

16. The mobile phone of claims 1, 2 and 3, wherein the sound level meter provides the mobile phone with the feedback signal to automatically calibrate the acoustic test stimuli *intensity for given distance between the ear and the mobile phone acoustic output.*

17. The mobile phone of claims 1, 2 and 3, wherein the distance measuring telescopic rod or tape built in or attached to the mobile phone measures the distance between the mobile phone acoustic output and the tested ear.

18. The mobile phone of claims 1, 2 and 3, wherein the miniature microphone built into the tip of the distance measuring rod and placed close to the ear, provides the feedback signal to the sound level meter attached or built into the mobile phone to allow the manual or automatic calibration of the acoustic test stimuli intensities.

19. The mobile phone of claims 1, 2 and 3, wherein the distance measuring sensor built in, attached to the mobile phone or placed in proximity of the ear entrance indicates the specified distance between the ear and the mobile phone acoustic output for which acoustic test stimuli intensities delivered by the mobile phone are calibrated in reference to the Hearing Threshold Level in sound field conditions.

20. The mobile phone of claims 1, 2 and 15, wherein the distance measuring sensor enables the testing sound to be turned on only at the specified distance between the ear and the mobile phone acoustic output in sound field testing.

21. The mobile phone of claims 1, 2 and 3, wherein the words stored in the mobile phone

memory are played back at different sound intensity levels and the tested person repeats them verbally or enters them through the keypad to be assessed by the test program.

22. The mobile phone of claims 1, 2 and 3, wherein the name of one of the objects displayed on the screen is played back from the memory at different sound intensity levels by the mobile phone acoustic output and the tested person correlates object with it's name by pointing to the object on the screen or enters name of heard object through the keypad to assess the correctness of this correlation by the test program.

23. The mobile phone of claims 1, 2 and 3, wherein unparallel narrow light beams from the light sources built in or attached to the mobile phone, create at the crossing point only one dot visible on the tested person face or ear when the mobile phone is placed at the specified distance from the ear for which the sound intensities are calibrated.

24. The mobile phone of claims 1, 2 and 3, wherein the plurality of single or multicolor pictures, signs, letters and numbers stored in the mobile phone memory are displayed on the mobile phone screen to conduct the vision test.

25. The mobile phone of claim 24, wherein the letters, words or numbers displayed on the screen are read and keyed by the tested person into the mobile phone memory to record and to analyze the positive and negative answers by the test program.

26. The mobile phone of claim 24, wherein the non alphanumeric signs and special pattern pictures of various colors are displayed on screen together with corresponding numbers, letters or names, which the tested person has to correlate and record through the keypad to be analyzed by the test program.

27. The mobile phone of claim 24, wherein the distance between the tested person eyes and the mobile phone screen measured by the external or attached to the mobile phone telescopic rod, tape or distance measuring sensor does not exceed the length of the person arm holding the mobile phone and operating it's keypad.

28. The mobile phone of claim 24, wherein correct distance between the eyes and the mobile phone screen is indicated by the distance measuring sensor built in or attached to the mobile phone.

29. The mobile phone of claim 24, wherein the light intensity in the testing room is measured by built in or attached to the mobile phone photo sensor and recommendations to reduce or increase this light intensity or the screen brightness are displayed on the screen or delivered through the mobile phone acoustic output in form of verbal instructions.

30. The mobile phone of claims 1, 2 and 3, wherein the mobile phone acoustic channel performs the function of the hearing aid.

31. The mobile phone of claim 30, wherein the acoustic channel comprises the microphone, volume control, output amplifier, external earphone and programmable amplifier controlling the frequency characteristic and compression of the amplified signal following the data of the listening program stored in the mobile phone memory and modified through the mobile phone network or the Internet.

32. The mobile phone of claim 31, wherein the switching of the acoustic channel from the hearing aid mode to the mobile phone mode is done automatically or manually through the keypad.

33. The mobile phone of claim 31, wherein the acoustic channel is used for the hearing aid and mobile phone functions at the same time.

34. The mobile phone of claims 1, 2 and 3, wherein the special acoustic signals stored in the mobile phone memory are delivered through the insert earphone to the tinnitus sufferer ear.

35. The mobile phone of claim 34, wherein the acoustic signals used for the tinnitus masking stored in the memory are changed through the mobile phone network or Internet.

36. The mobile phone of claim 34, wherein the switching of the acoustic channel from the tinnitus masker mode to the mobile phone mode is done automatically or manually through the keypad.

37. The mobile phone of claim 34, wherein changing the masking sounds follows the treatment program stored in the memory and updated through the mobile phone network or Internet.

38. The mobile phone of claims 1, 2 and 3, wherein the built in electronic device controls the functions and listening programs of the remote hearing aid through the radio wave , electromagnetic, ultrasound or infrared link.

39. The mobile phone of claim 35, wherein the number of the hearing aid functions and listening programs is limited by the data stored in the memory and optionally modified through the mobile phone network or Internet.

40. The mobile phone of claims 1, 2 and 3, wherein the images of the body parts taken by the built in photo camera are stored in the mobile phone memory and transferred through the network to the medical specialist for the clinical assessment.

41. The mobile phone of claims 1, 2 and 3, wherein the stored in memory programs control built in or externally connected devices such as sensors, microphones, electronic stethoscopes to monitor, measure and collect data of the body or environment temperature, heart beating pattern, respiratory rate, cardiac and pulmonary auscultation, sugar level, blood pressure etc.

42. The mobile phone of claims 1, 2 and 3, wherein the measured and monitored parameters are stored in the mobile phone memory for later retrieval or are transferred in real time over the network to the medical specialist.

43. The mobile phone of claims 1, 2 and 3, wherein the mobile phone programs control externally connected diagnostic instruments like electrocardiograph and the test results are sent through the mobile phone network to the medical specialist or stored in the mobile

phone memory.

44. The mobile phone of claims 1, 2 and 3, where in the mobile phone controls externally connected rehabilitation instruments like neuromuscular stimulator following the *rehabilitation programs stored in* the mobile phone memory and updated through the mobile phone network or Internet according to the rehabilitation results.

45. The mobile phone of claims 1, 2 and 3, wherein the instructions to assist in proper placement of the instruments like stethoscope, electrodes and sensors are displayed on the mobile phone screen or delivered through the acoustic output following the program stored in the memory or are received from the remote medical specialist through the mobile phone network.

46. The mobile phone of claims 1, 2 and 3, wherein the special output is provided to connect external monitor or the TV set to conduct the vision or hearing test.

47. The mobile phone, wherein the mirror with the magnifier attached or built into the mobile phone case allows to inspect the status and appearance of the face skin by the mobile phone user.

AMENDED CLAIMS
[received by the International Bureau on 11 July 2003 (11.07.03);
claims 48 - 66 added , remaining claims unchanged (4 pages)]

48. A mobile telecommunication means for performing hearing and or vision tests, the mobile telecommunication means including:

a portable receiver having an audio emitter and or video display able to be calibrated to provide definable audio and or video emissions;

a communication means allowing communication by telephone, internet, email or other means between a source and the receiver;

a processing means for receiving test instructions of a hearing and or vision test from the source, the test instructions including representations of defined audio and or video emissions

wherein the processing means instructs the calibrated audio emitter and or video display to emit audio and or video emissions substantially precisely according to the representations of defined audio and or video emissions of the test instructions.

49. A mobile telecommunication means according to claim 48, wherein the test instructions includes representations of a plurality of predefined audio and or video emissions which are to be sequentially emitted to provide a predefined test sequence including variation of frequency, intensity, gradation or tonality that provides a scientific hearing or vision test.

50. A mobile telecommunication means according to claim 48 or 49, wherein the test instructions are factory stored or loaded into a local source being the mobile phone memory.

51. A mobile telecommunication means according to claim 48 or 49, wherein the test instructions are able to be updated from a remote source by the communication means including by any one or more of mobile phone network or Internet or an infrared link, ultrasound link or cable from external sources.

52. A mobile telecommunication means according to any one of claims 48 to 51,

including an input means for recording response to the emitted to the representations of defined audio and or video emissions of the test instructions to provide a result of the hearing and or vision tests and output means for outputting result.

53. A mobile telecommunication means according to claim 52 wherein the output means is connected to communication means to provide results to remote location.

54. A mobile telecommunication means according to any one of claims 52 or 53 wherein the output means includes audio and or visual output by the receiver for outputting the result.

55. A mobile telecommunication means according to any one of claims 52 to 54 wherein the test instructions include optional sequences which are instigated according to result received by the input means for recording response to the emitted defined audio and or video emissions of the test instructions to provide an automatic change of the acoustic test stimuli frequencies and intensities or visual test stimuli.

56. A mobile telecommunication means according to any one of claims 48 to 55 wherein the audio emitter of the portable receiver includes direct emission means for maintaining calibrated sound to the ear of the user wherein the plurality of the acoustic test stimuli of test instructions calibrated in frequency and intensity by the receiver are delivered from the mobile telecommunication means output directly to the ear by the insert earphone, tube-phone, supra ear coupler, insert ear coupler, mobile phone speaker or externally connected speaker placed at the specified distance from the tested ear in sound field conditions.

57. A mobile telecommunication means according to claim 56 wherein the direct emission means includes an identity means, such as a special number or bar code, providing obtainable identifiable audio characteristic data to maintain precise audio calibration

together with the receiver of the mobile phone.

58. A mobile telecommunication means according to claim 57 wherein the obtainable identifiable audio characteristic data is directly entered through the keypad of mobile telecommunication means.

59. A mobile telecommunication means according to claim 57 wherein the obtainable identifiable audio characteristic data is obtained by the identity means and feedback from a remote source by the communication means linked to a network to calibrate the mobile phone receiver together with the direct emission means.

60. A mobile telecommunication means for controlling an audio or video outputting device, the mobile telecommunication means including:

a portable receiver having an audio emitter and or video display able to provide definable audio and or video emissions;

a communication means allowing communication by telephone, internet, email or other means between a source and the receiver;

a processing means for receiving control instructions of a hearing and or vision operating means from the source,

wherein the processing means instructs the audio emitter and or video display to emit audio and or video emissions substantially precisely according to the representations of defined audio and or video emissions of the control instructions to control operation of a hearing and or vision operating means.

61. A mobile telecommunication means according to claim 60, wherein the control instructions are factory stored or loaded into a local source being the mobile phone memory.

62. A mobile telecommunication means according to claim 60 or 61, wherein the control

instructions are able to be updated from a remote source by the communication means including by any one or more of mobile phone network or Internet or an infrared link, ultrasound link or cable from external sources.

63. A mobile telecommunication means according to any one of claims 60 to 62 wherein the hearing and or vision operating means is a hearing aid and the control instructions includes volume control, output amplifier, external earphone and programmable amplifier controlling the frequency characteristic and compression of the amplified signal following the data of the listening program stored in the mobile phone memory and modified through the mobile phone network or the Internet.

64. A mobile telecommunication means according to any one of claims 60 to 62 wherein the hearing and or vision operating means is a tinnitus aid for a tinnitus sufferer and the control instructions includes volume control, output amplifier, external earphone and programmable amplifier controlling the frequency characteristic and compression of the amplified signal following the data of the listening program stored in the mobile phone memory and modified through the mobile phone network or the Internet to mask the determined tinnitus noise frequencies.

65. A mobile telecommunication means according to any one of claims 48 to 59 further including a device for controlling rehabilitation, the device being connected to an external socket of the telecommunication means and being adapted to receive instructions from programs stored in an electronic memory circuit within the telecommunication means via an interface between the memory circuit and the external socket.

66. A mobile telecommunication means according to any one of claims 48 to 59 when used for controlling devices used in rehabilitation.

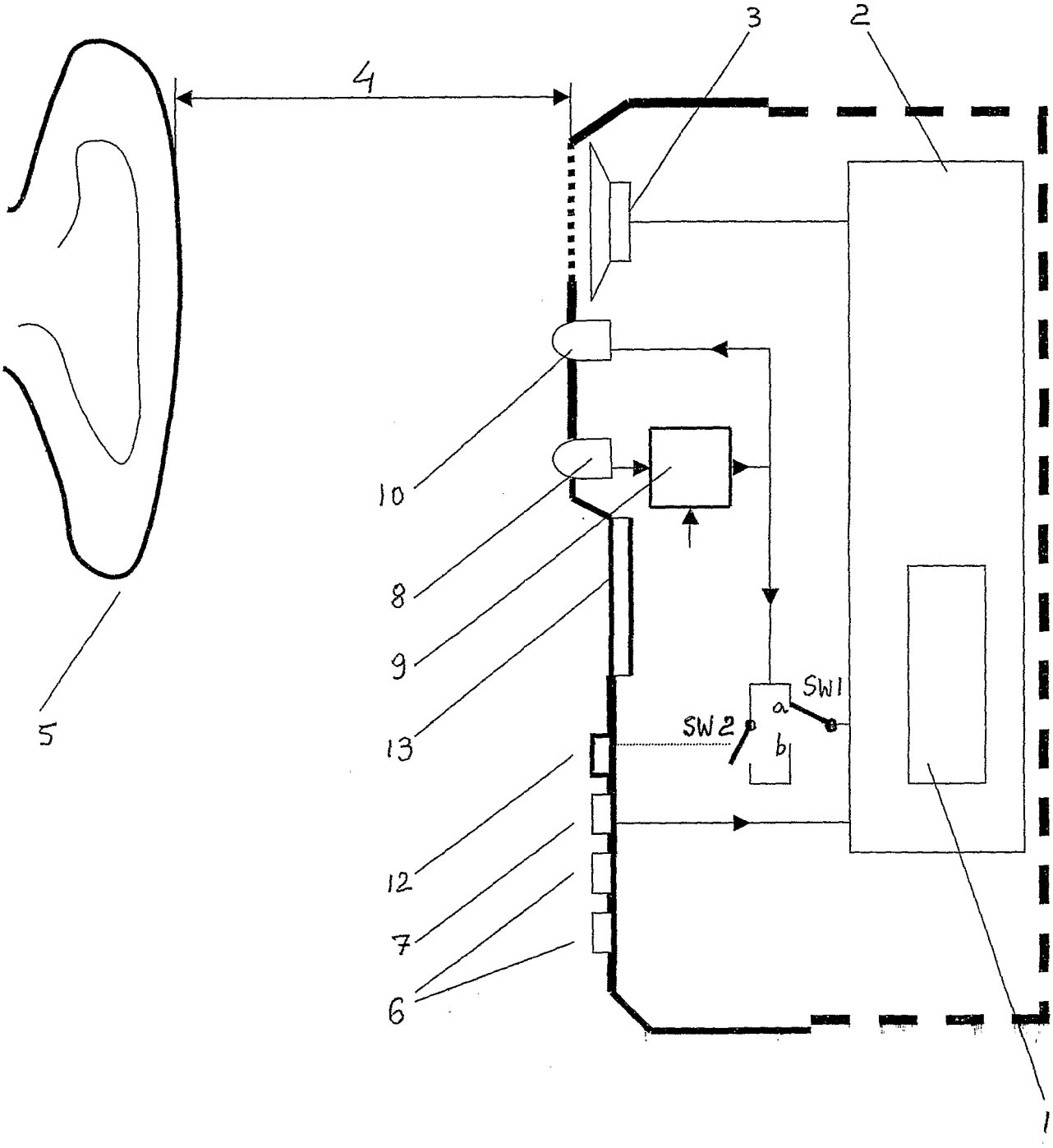

Fig. 1

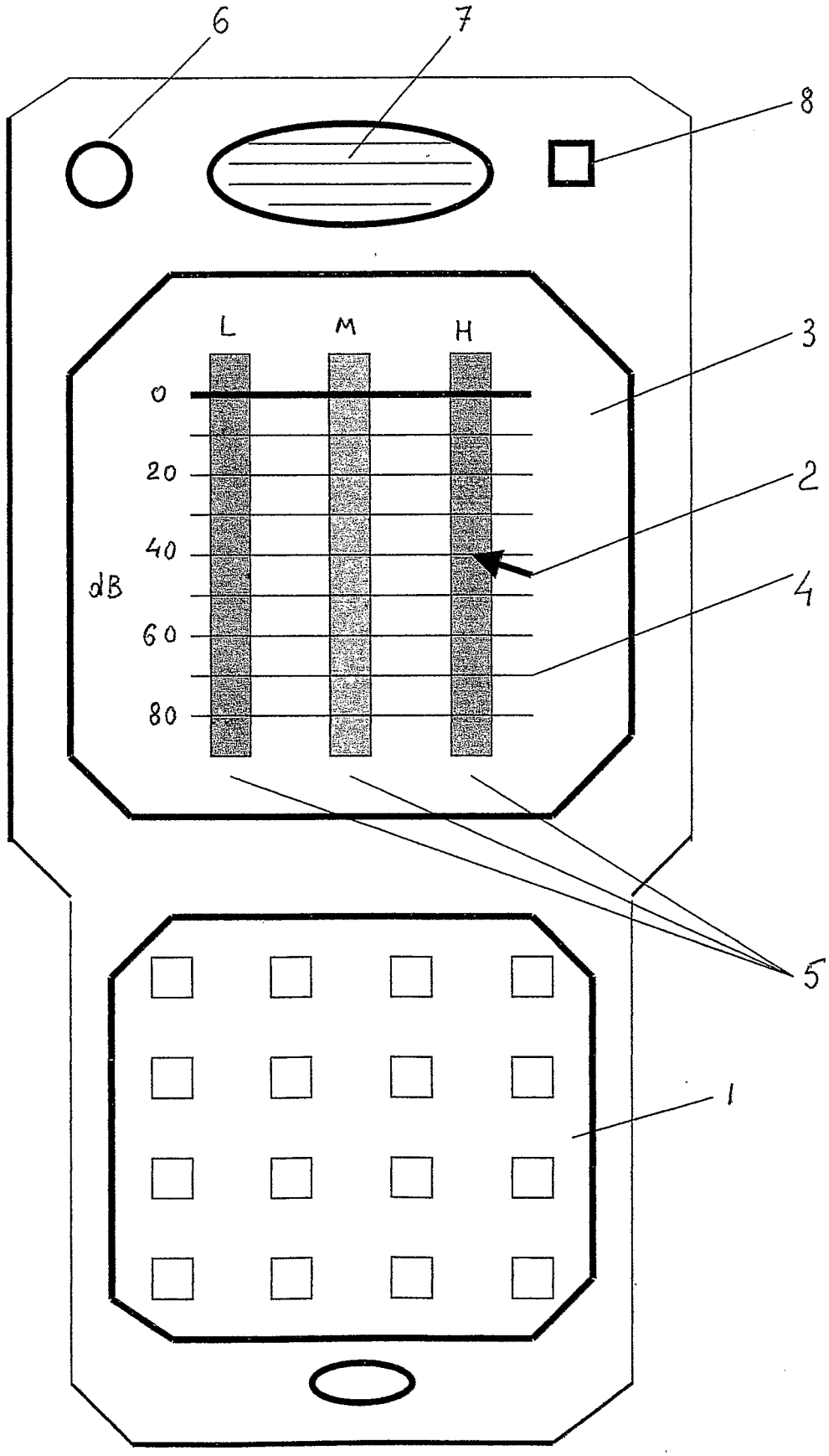

Fig. 2

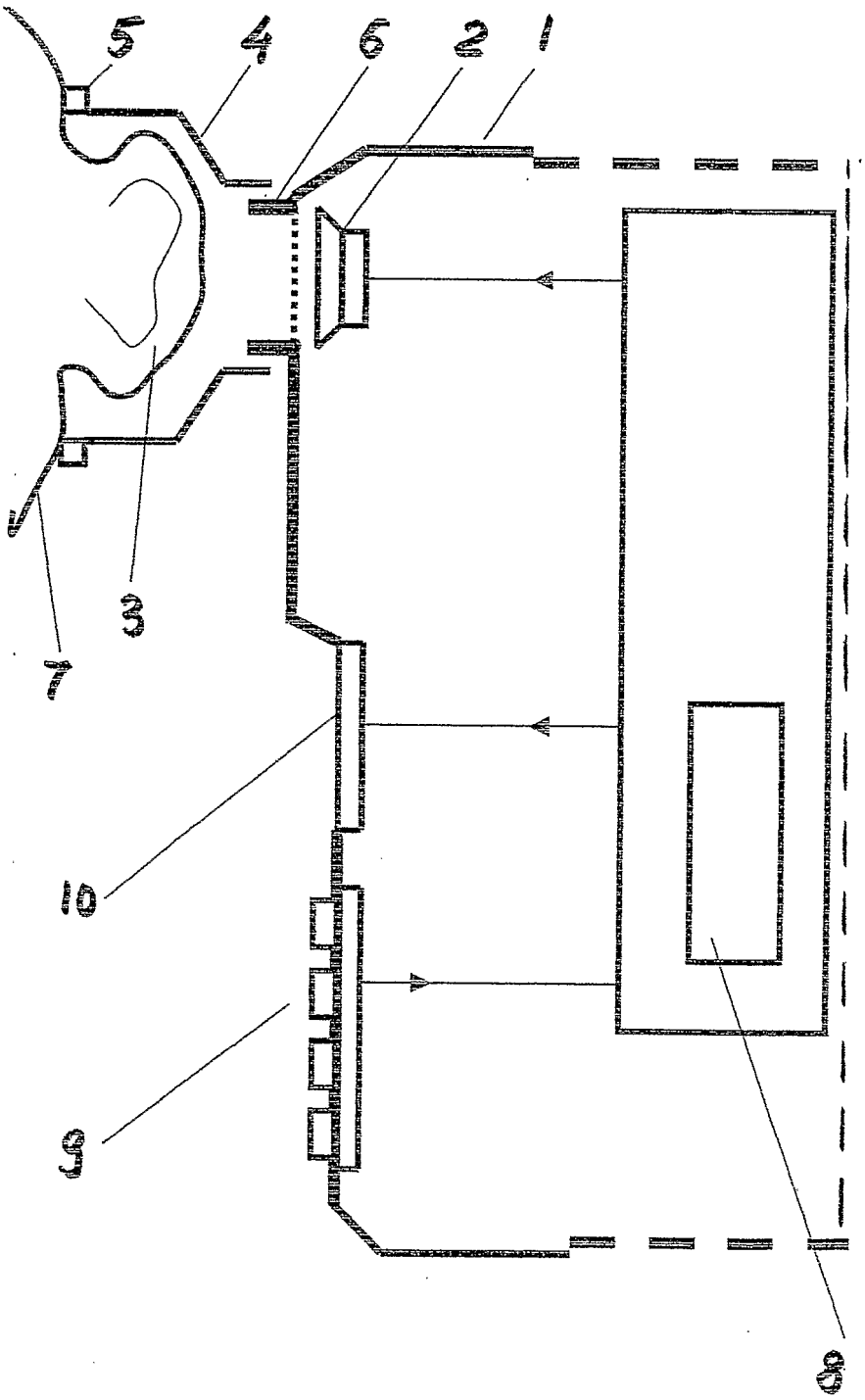

Fig. 3

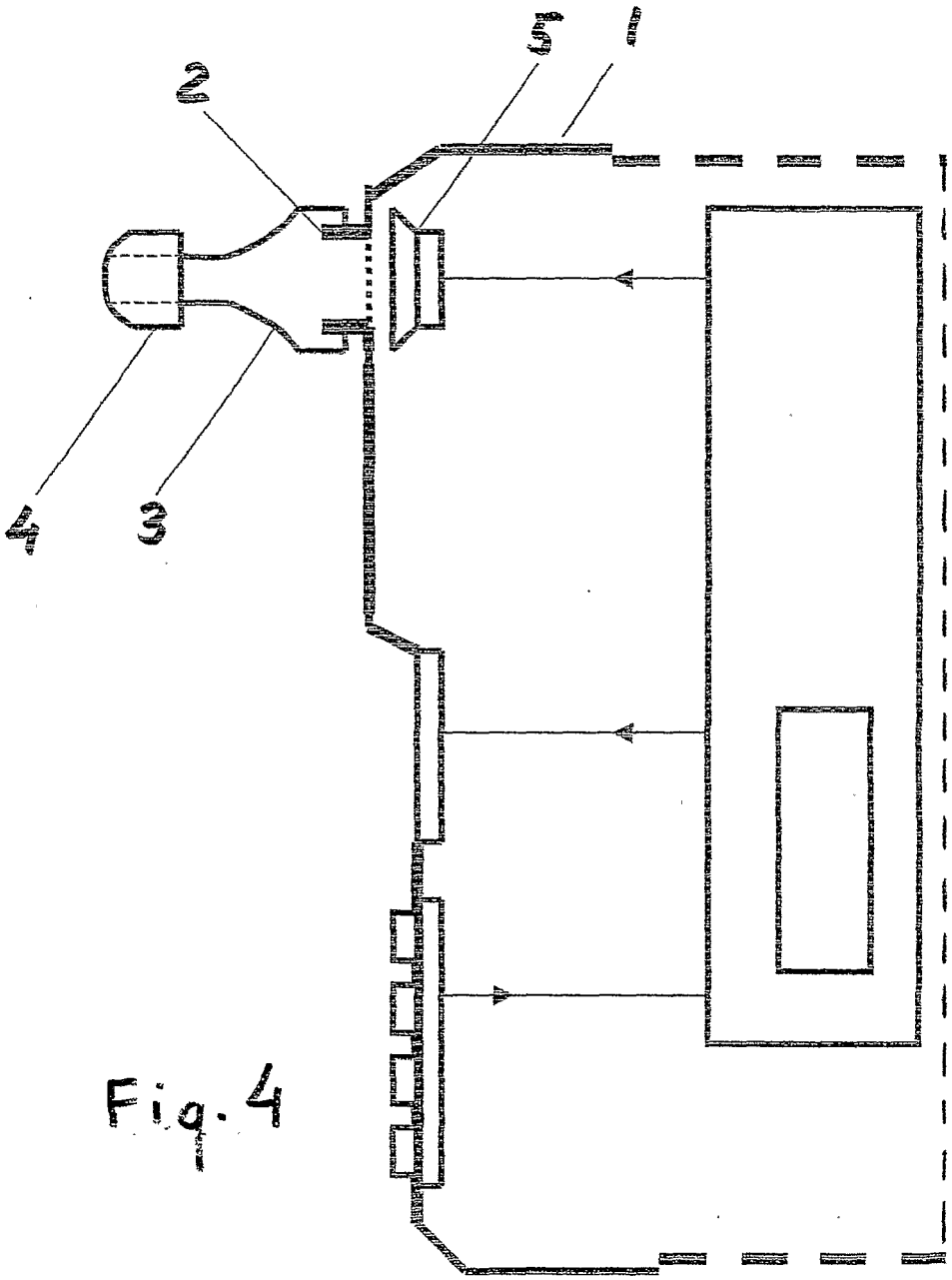

Fig. 4

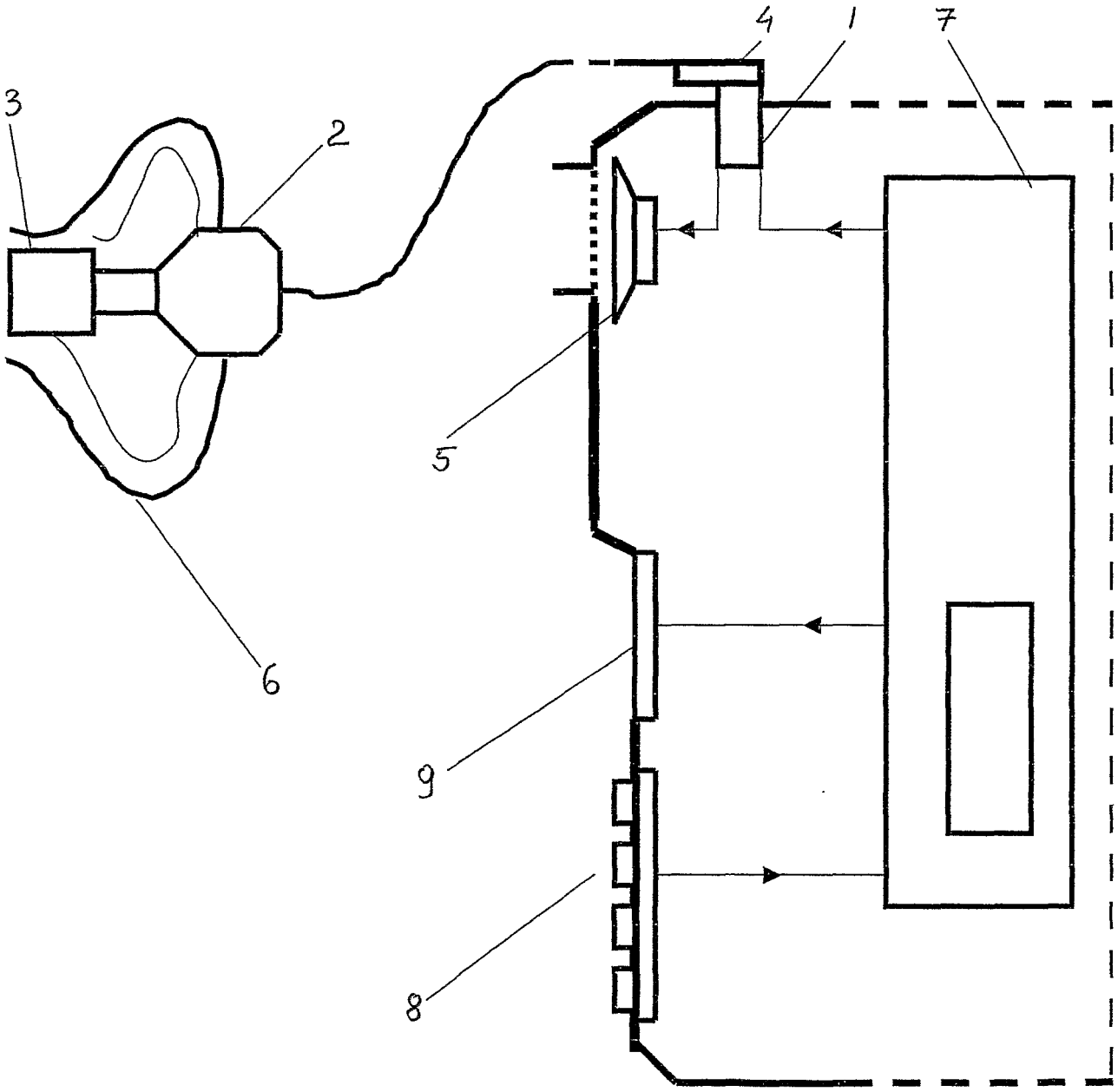

Fig. 5

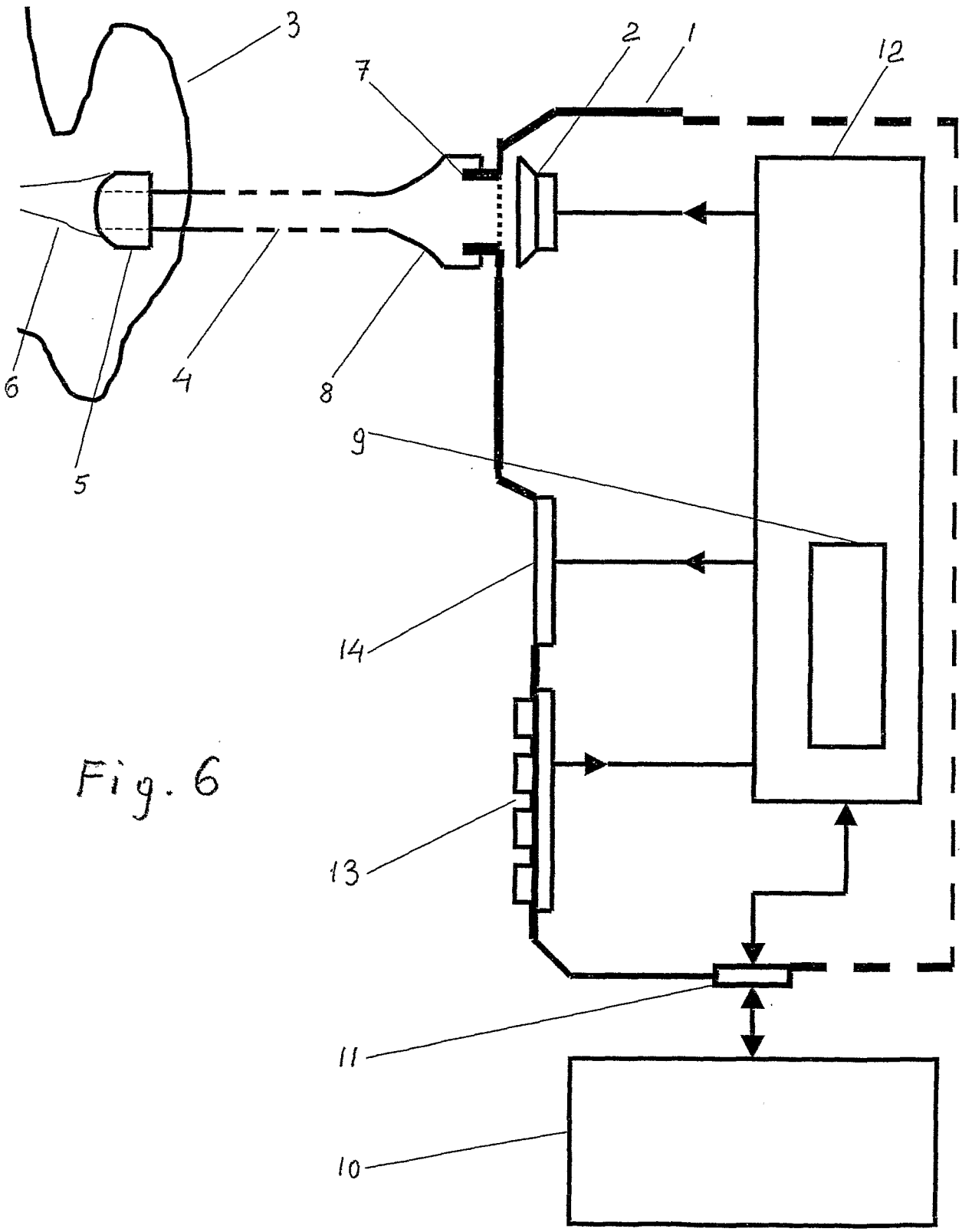

Fig. 6

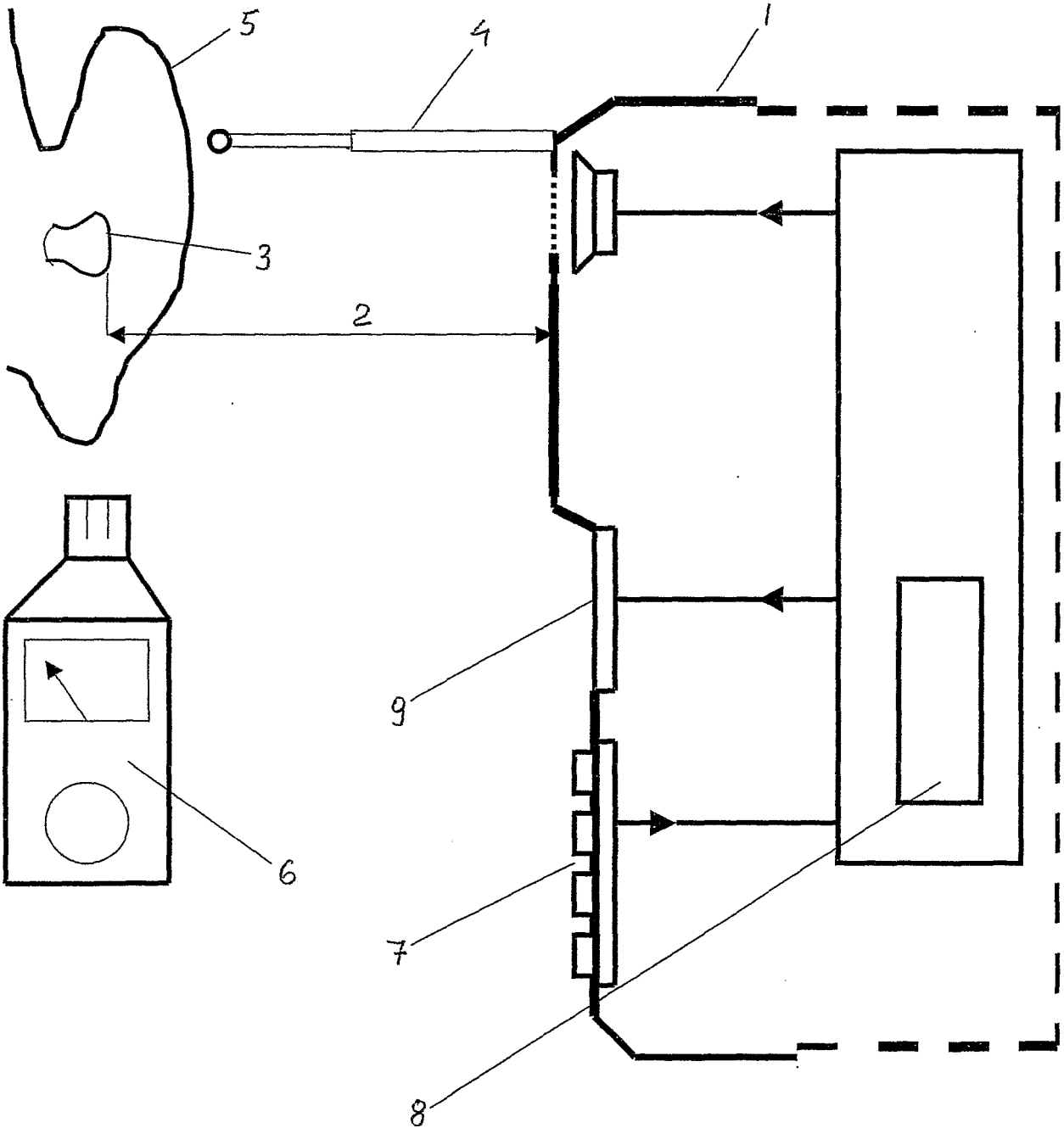

Fig. 7

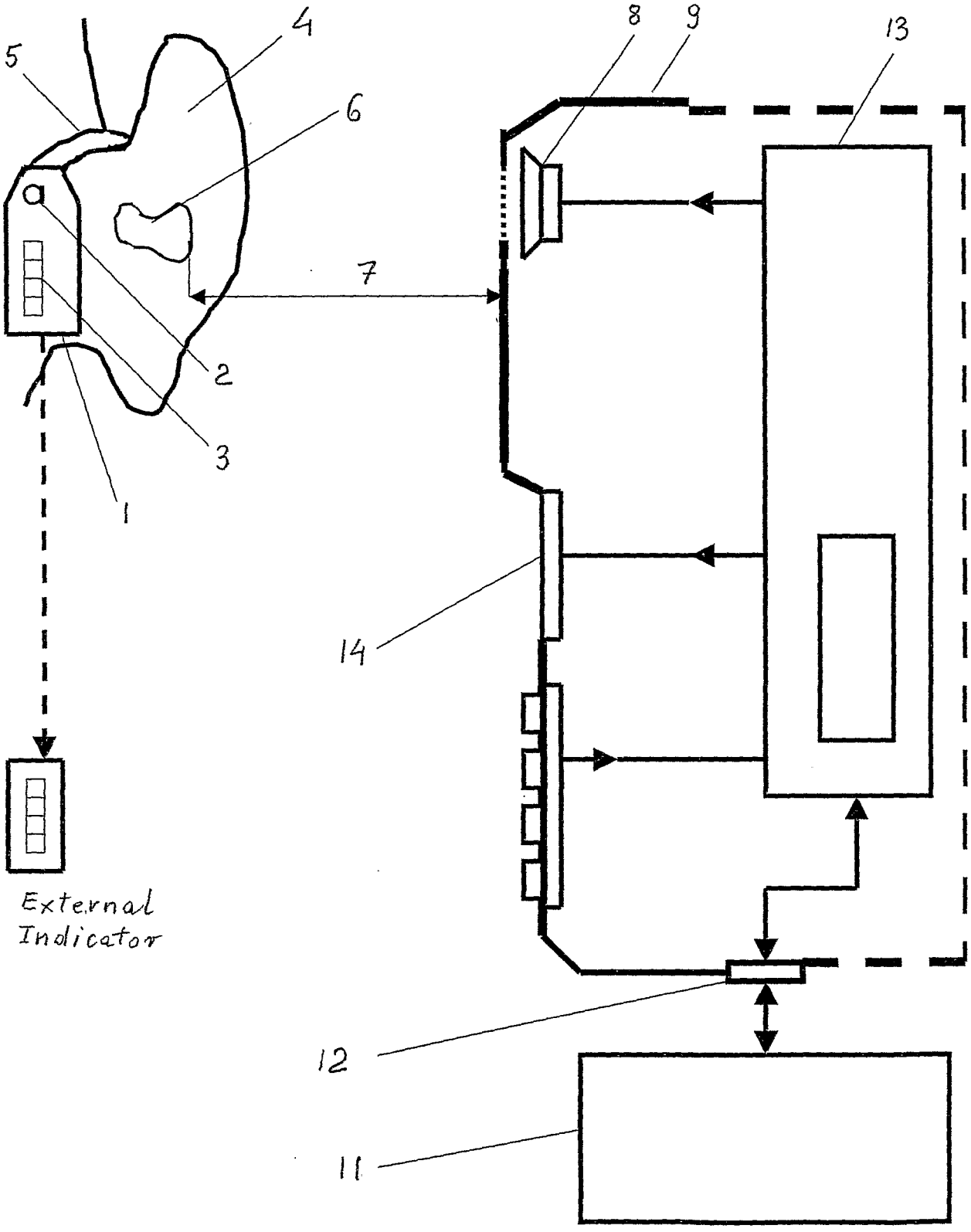

Fig. 8

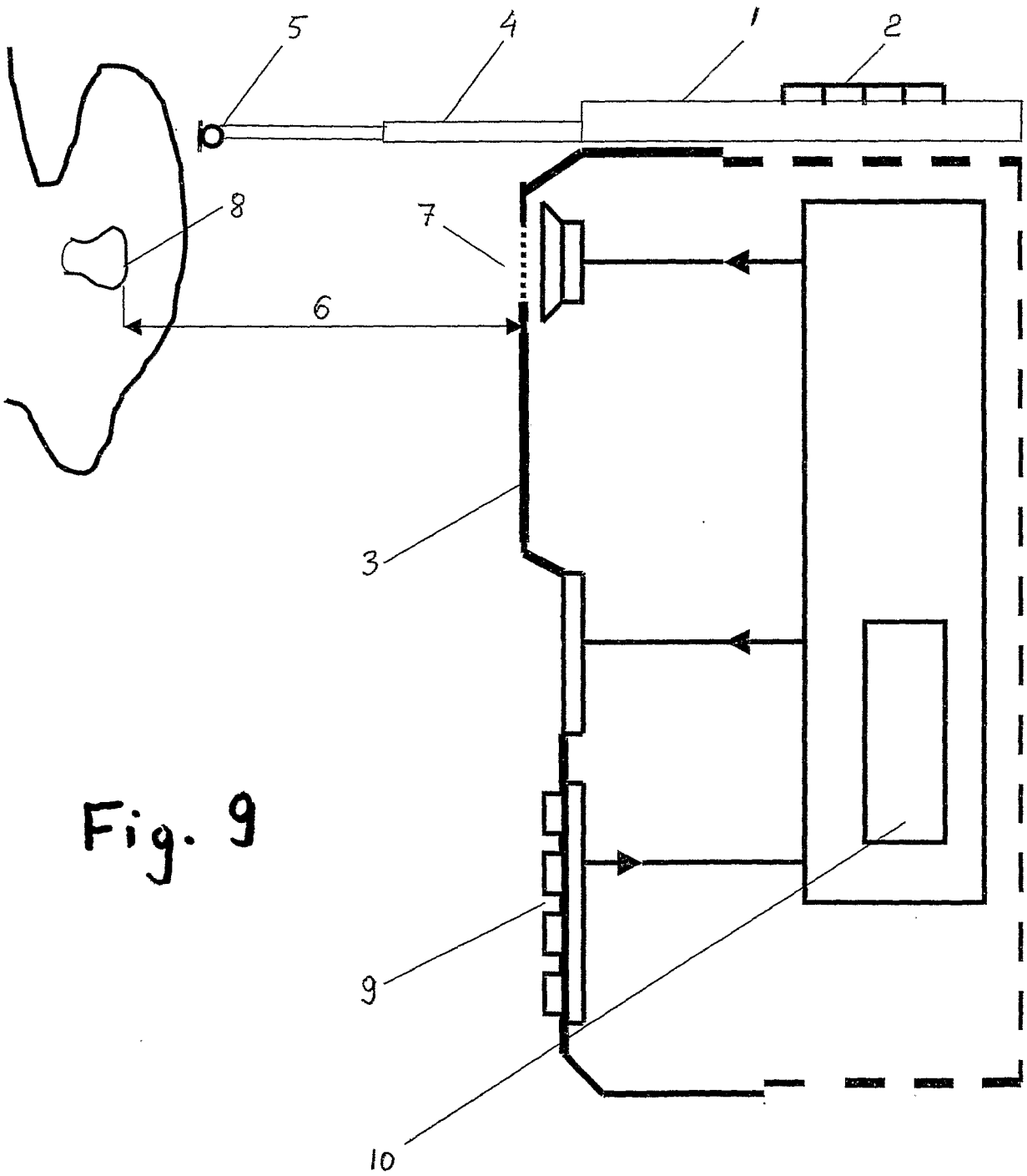

Fig. 9

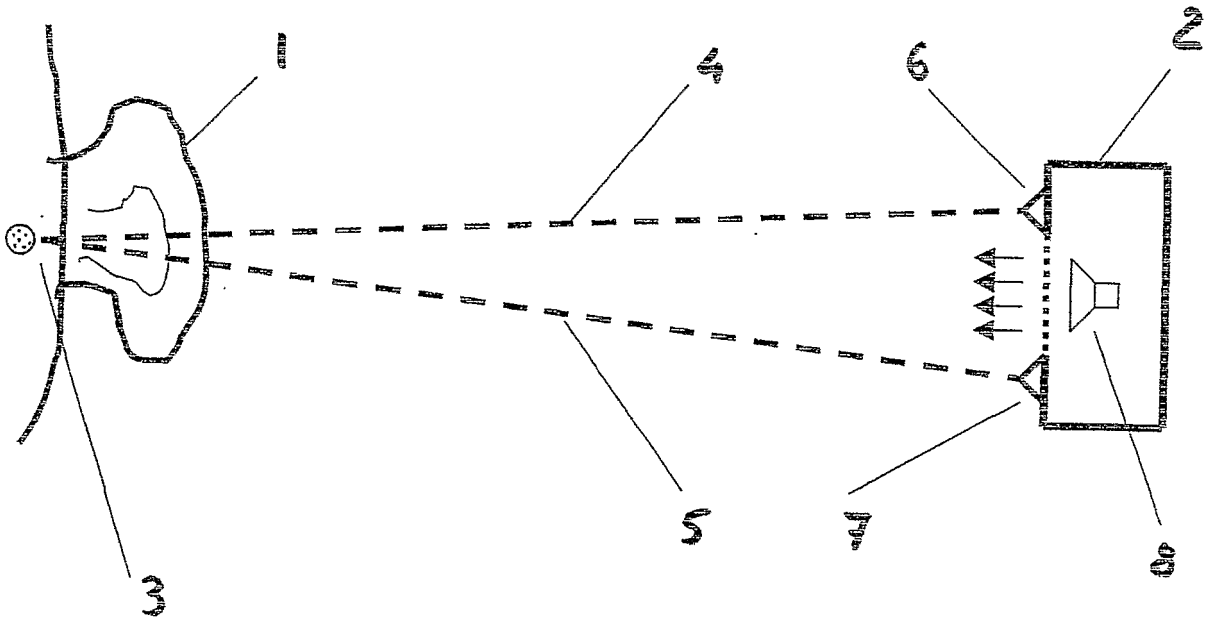

Fig. 10

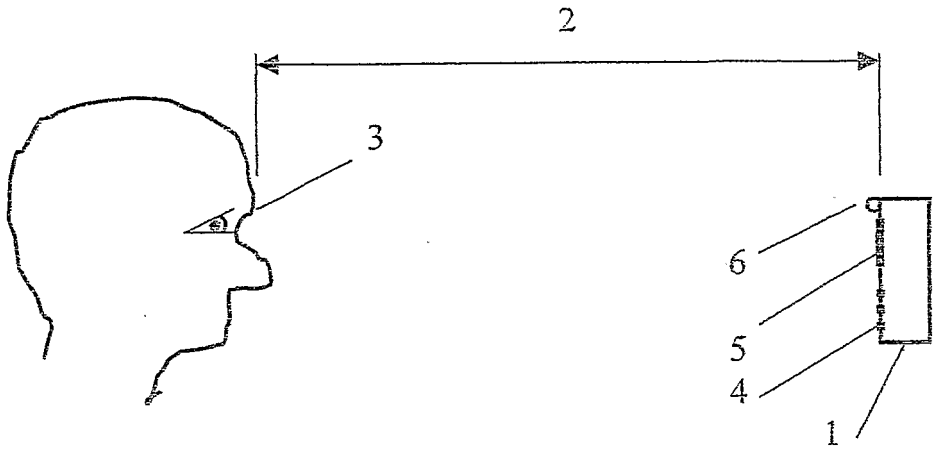

Fig. 11

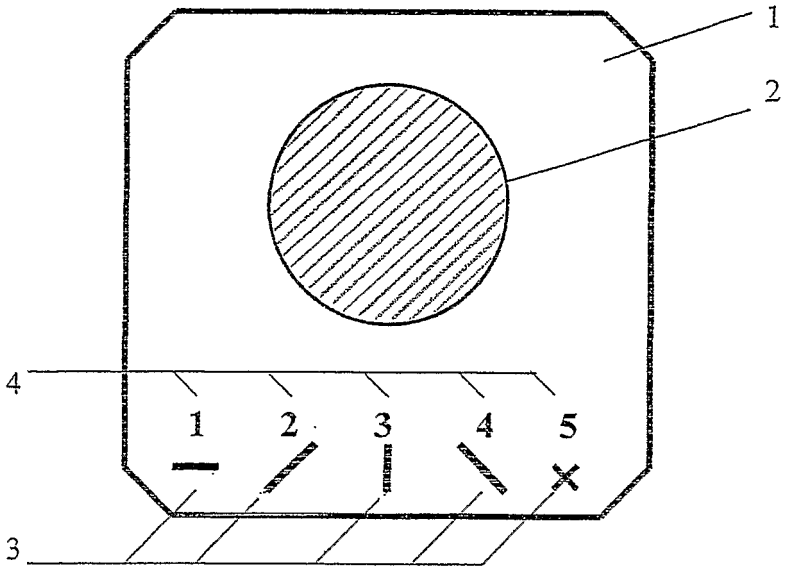

Fig. 12

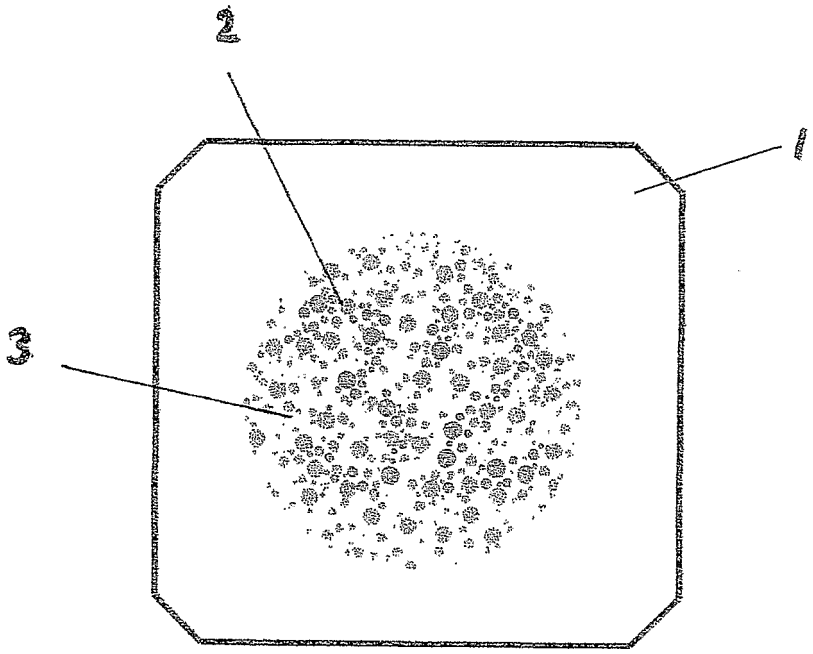

Fig. 13

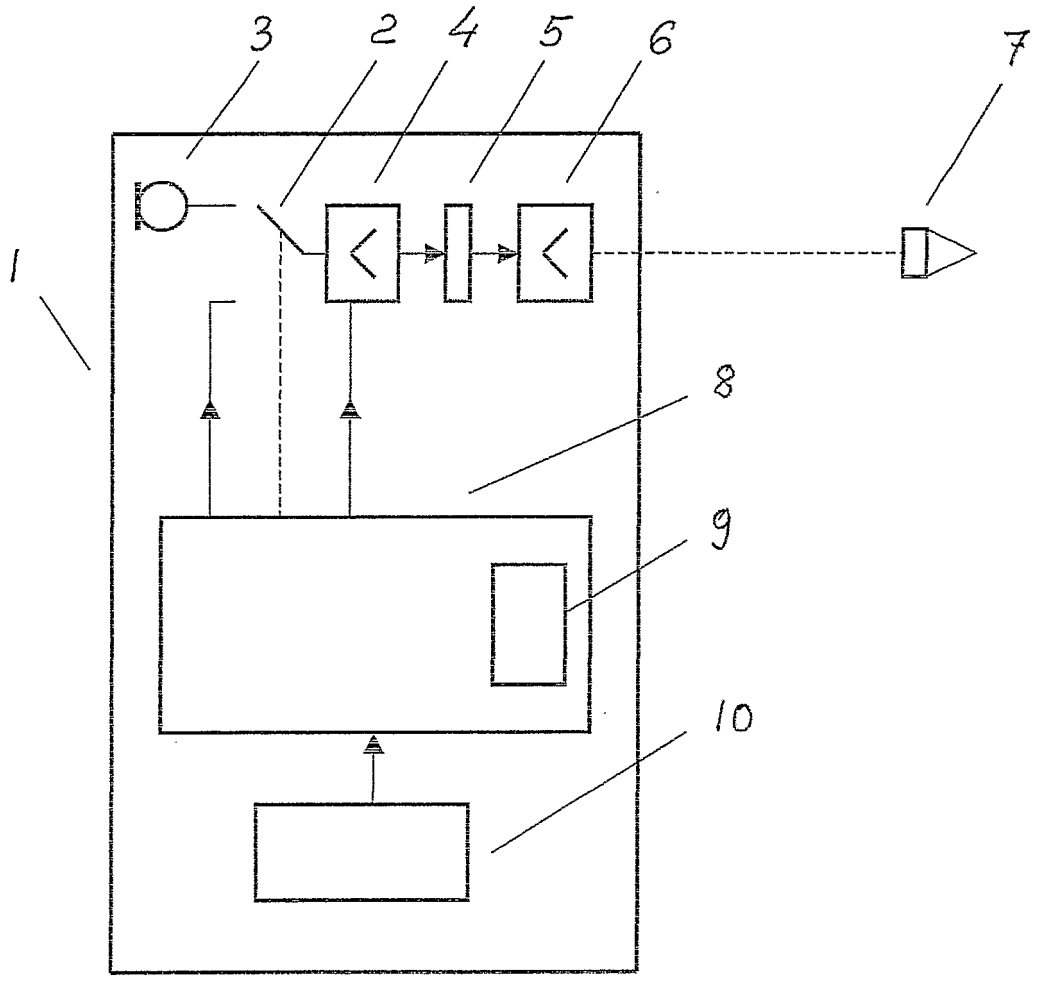

Fig. 14

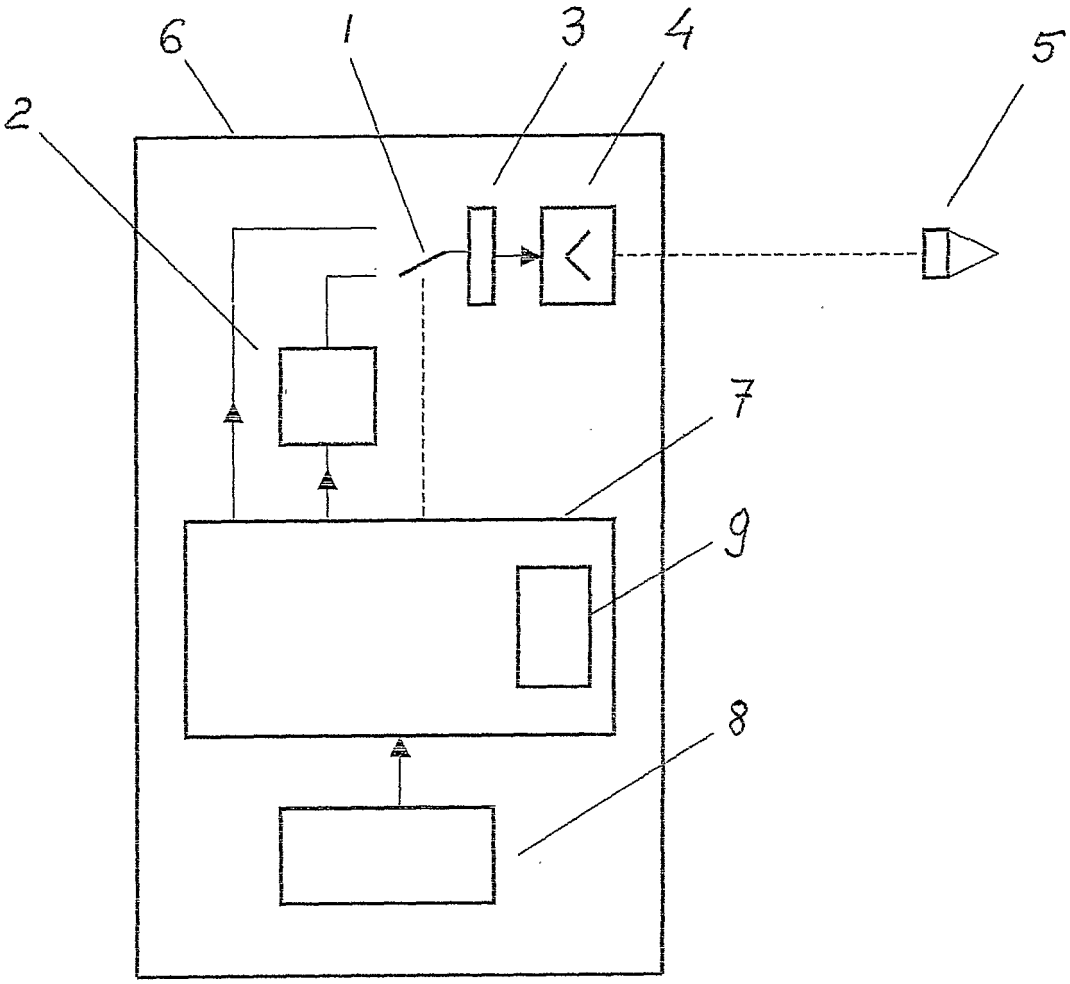

Fig. 15

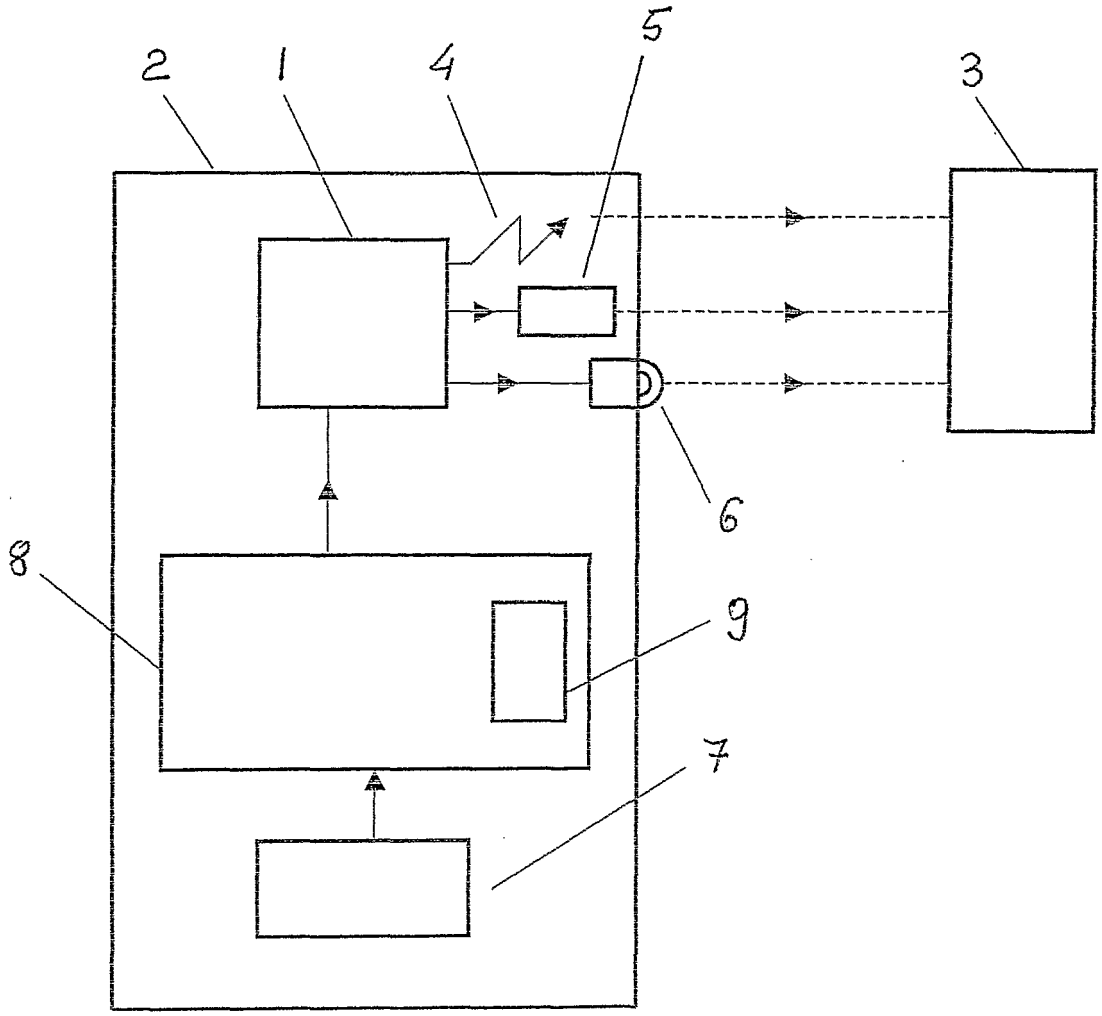

Fig. 16

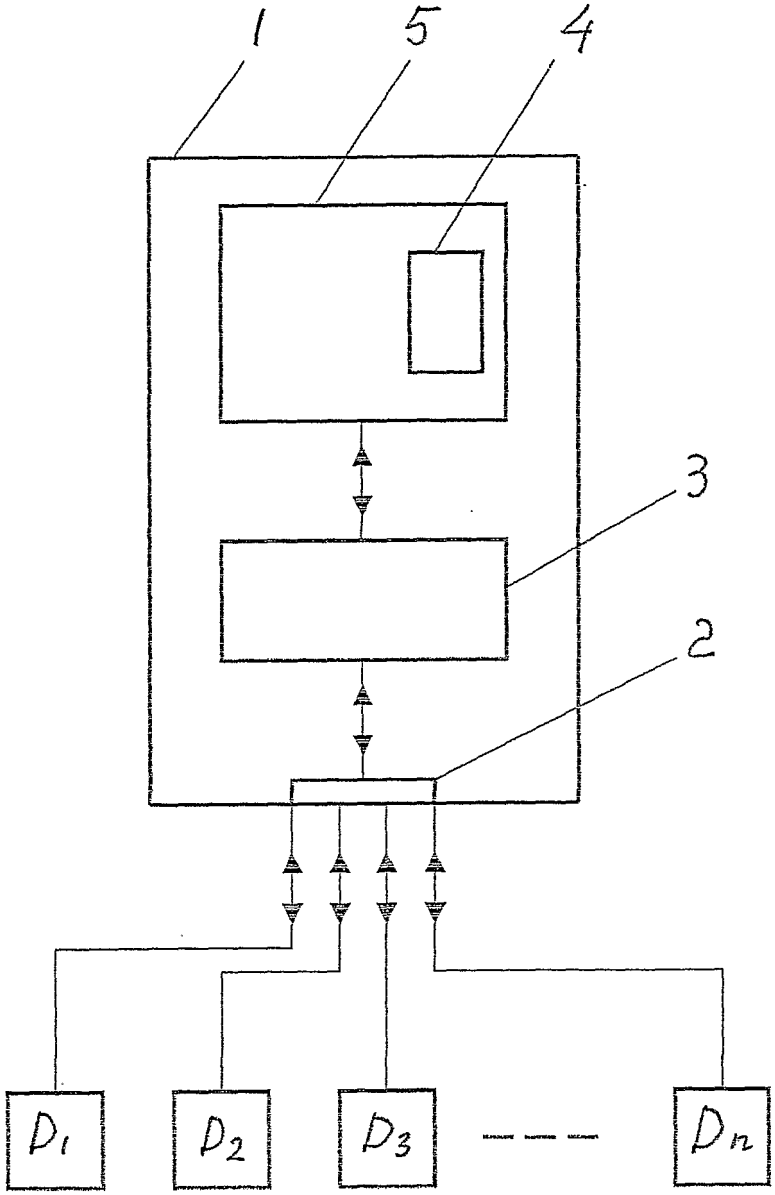

Fig. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00278

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: H04M 1/247, A61B 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT,USPTO, ESP@CE and Keywords (phone, mobile, medical, test, diagnosis, control, remote) and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2002/09396 A2 (TIVERON) 31 January 2002 See page 9 line 10 to page 11 line 21, page 20 lines 20 to 35 and figure 1	1 - 47
X	WO 2001/65810 A1 (KLAUDTKY et al.) 7 September 2001 See whole document	1 - 47
X	EP 987047 A2 (BIOTRONIK Mess- und Therapiegerate GmbH & Co) 22 March 2000 See whole document	1 - 47

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 March 2003	27 MAR 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **R.W.J. FINZI** Telephone No : (02) 6283 2213

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00278

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6100806 A (Gaukel) 8 August 2000 See whole document	1 - 47
A	WO 2000/30529 A1 (MEDTRONIC, Inc.) 2 June 2000 See whole document	1 - 47

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU03/00278

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	200209396	AU	200176668	IT	TV20000082		
WO	200165810	AU	200144179	DE	10009882		
EP	987047	DE	19844296				
US	6100806	US	6072396	US	6337665		
WO	200030529	EP	1133255	US	6083248	AU	61769/96
		CA	2224520	EP	939662	US	5752976
		WO	9700708	US	6292698		

END OF ANNEX

专利名称(译)	用于医疗诊断和康复的多功能手机		
公开(公告)号	EP1488618A1	公开(公告)日	2004-12-22
申请号	EP2003704109	申请日	2003-03-11
[标]申请(专利权)人(译)	ERA CENT		
申请(专利权)人(译)	ERA中心有限公司		
当前申请(专利权)人(译)	ERA中心有限公司		
[标]发明人	NOWOSIELSKI JANUSZ		
发明人	NOWOSIELSKI, JANUSZ		
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摘要(译)

多功能手机进行听力和视力测试，通过内置或外接设备监测，测量和采集身体和环境温度，心脏跳动，肺呼吸，心肺听诊，血糖水平，血压等数据，拍摄用于临床评估的人体照片图像，在屏幕上显示并通过声学输出指令进行回放以进行诊断测试和康复治疗，存储和更新测试和治疗的程序，并使用移动电话网络与远程医疗专家进行通信。