(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 437 227 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.04.2012 Bulletin 2012/14

(51) Int Cl.:
G08B 21/04 *(2006.01)*

(21) Application number: **11004342.9**

(22) Date of filing: **26.05.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **26.05.2010 CZ 20100419**
23.08.2010 CZ 20100629

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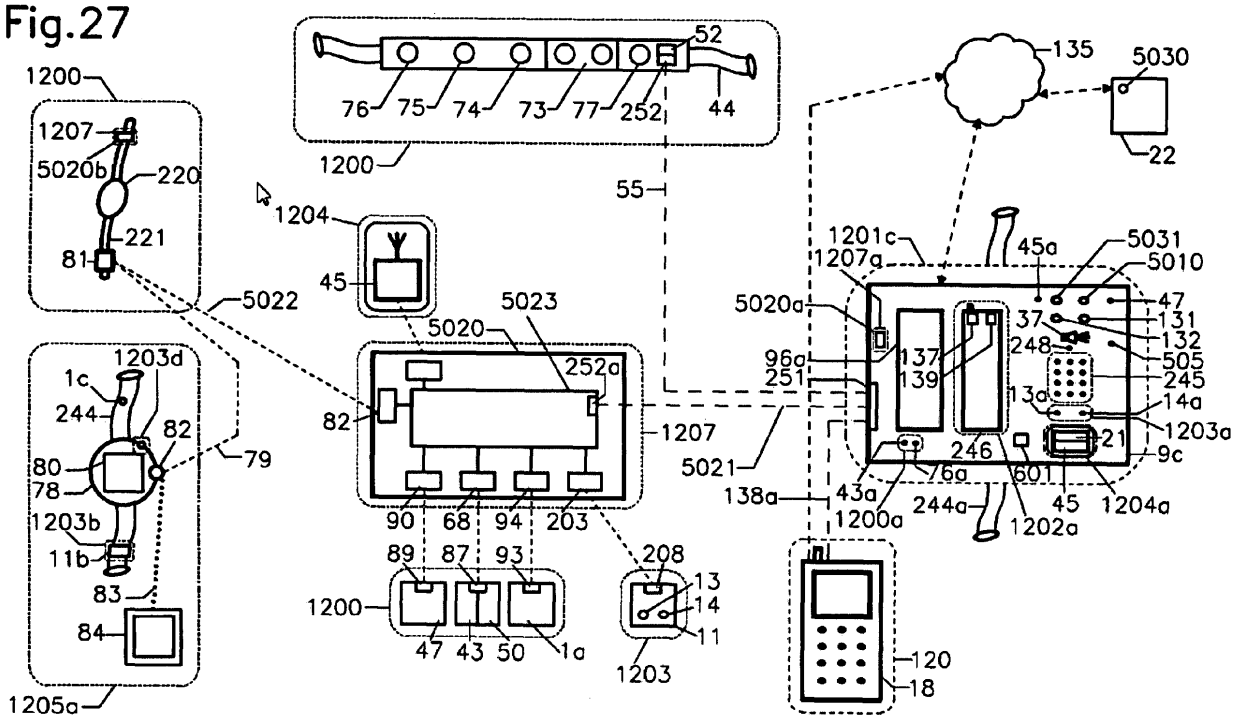
(54) **The activation of alarm of persons in danger**

(57) The personal emergency alarm device consists of the movement sensor (1) communicating with the control unit (2), which sets off the alarm sent to the surveillance centre (22), unless the movement sensor detects any movement during a time interval which the monitored person may set using the button (24). If the monitored person is not in emergency, he/she may reset the alarm delay by the button (13) on the wireless controller (11) before the alarm is actually set off.

Fig.27



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Description

Technical field

[0001] The invention concerns the activation the alarm of persons in danger, where the monitoring system will set off the alarm when the monitored persons fail to show alertness or movement, or when other monitored functions are beyond the set limits, indicating that the persons are in danger. It is possible to set the delay of the alarm activation for movement and alertness, where on a warning signal the activation of the alarm, before actually being activated, can be manually reset to confirm the normal condition, so that the delay of the alarm activation is counted again from "zero". For the monitored functions, the alarm may be reset and is repeated at a set time with the possibility to automatically state the location of the monitored person when calling in the rescuers.

The current state of technology

[0002] With stationary devices, the current technology allows for setting off the alarm on the basis of monitoring persons in a room where they are usually located using a movement sensor. On the sensor, it is a technician, not a user — the monitored person — who sets a time period within which the system must record the movement of the monitored person, or it will set off the alarm, which is transmitted to the surveillance centre. The drawback is that unless the monitored person moves within the preset time period, the alarm will go off without the monitored person being able to stop it. For that reason, the monitoring times are preset at relatively long periods of 10 to 12 hours. After such a long time during which the monitored person may become incapacitated, particularly if this happens at the beginning of the monitored time, it takes hours before the alarm is set off, possibly causing help to come too late. To prevent frequent alarms, the time for setting off the alarm cannot be preset at a shorter interval. Moreover, each adjustment requires an intervention by a technician, which is costly and prevents the monitored person to reset, and therefore to stop, the alarm before the technician is being called in, which poses a burden on the surveillance centre as it must check every alarm. Only a sensor is used for monitoring movement, indicating an overall movement of the monitored person, which in certain cases may not be sufficiently precise and may lead to a failure. Before any action the surveillance centre staff may contact the monitored person to check whether the person is incapacitated.To this end, it uses a speaker phone, which is automatically activated at incoming call from the surveillance centre. If there are more rooms on the premises of the monitored person, these phones must be placed in all rooms to ensure connection, which is costly. Also the monitoring movement sensors must be placed in all rooms to be monitored. The monitoring system which monitors persons for movement and therefore activity is stationary under current technology, which means that it cannot be used by monitored persons outside the premises where it is installed. However, it is also outside the monitored premises that a monitored person may be incapacitated. The current devices do not monitor a normal reaction of the monitored person, but only the person's movement. The movement itself, for instance during a fit accompanied by compulsive movement or a movement of a person that does not have control over himself/herself due to mental indisposition, may not mean that the monitored person is in full possession of his/her senses and not in danger. Nor do the current devices monitor the heart rate or other functions that inform of the health condition of the monitored person and provide an automatic alert in the event that any values exceed the preset limits, i.e. an emergency occurs. With stationary device, the surveillance centre cannot connect to the monitoring system on its own initiative to check health functions, particularly to check the degree of danger. If mobile devices, such as mobile phones or other transmitters such as transceivers, are used, they only serve to continuously or periodically transmit various health information rather than to notify of a state of emergency, which is not assessed at the location of the monitored person. In particular, there is no alarm or automatic data transmission if the monitored functions exceed certain limits and the monitored person is in danger. In addition, mobile phone systems totally lack the above-mentioned functions to monitor movement and confirm normal reactions and other states of the monitored person with assessment at the location of the monitored person and automated alarm indicating the state of emergency; they also lack the option of setting the alarm delay or resetting the system before the alarm is actually set off. Current mobile phones used to emit emergency signal when the monitored person is in danger allow sending the exact location established through the GPS to the surveillance centre. The disadvantage is that the GPS only works in an open space with a direct line of sight to a sufficient number of satellites, which means that it does not work inside buildings and areas shaded by them. These drawbacks of the current state of technology are partially dealt with by patent no. PV 2010-419, applied for by its inventor. The present invention, which is being filed, addresses the drawbacks mentioned above to the extent they have not been addressed by the said patent; the drawbacks which have been addressed are now addressed in a better way and in greater detail, allowing better results. This particularly involves the test of normal reaction, the localization of the monitored person, the prompt display of health functions, for instance, on a bracelet, adding more sensors allowing the displaying of the heart rate behaviour and the ECG graph and their evaluations, including an automated alarm when the values normal limits, as well as other aspects. The new elements of the invention are at the same time the objectives of the filed invention; the description of the invention includes descriptions of functions addressed in the previous invention, adding new

elements which improve the original solution. This method has been chosen because it allows for a complete and clearer explanation of the essence of the newly filed invention; if the description of the previous invention mentioned in the application were omitted, this application would be less complete.

[0003] **The objective of the invention** is to create a personal emergency alarm device, where the monitored person could prevent false alarms from being set off, particularly when monitoring movement of persons in the event that there is no movement and the person is not in danger; they delay cloud be preset by the monitored person. Second, to allow for monitoring normal reaction with the option of preventing the alarm and setting the alarm delay by the monitored person. Third, to create a device that would allow monitoring and communication on the entire monitored premises without having to set up phones and sensors in all rooms. Fourth, to create a device that would serve to monitor important functions, evaluate them in the location of the monitored person and set off alarm in emergency not only in the rooms of the monitored premises, but also outside it, wherever the monitored person is located. Fifth, to allow for heart rate monitoring and the monitoring of other health and other functions which may be important for the monitoring of the status of the monitored person, with an automatic alarm in the event that the function exceed the set limits; all this would be evaluated in the location of the monitored person who could prevent any false alarm. Sixth, to allow the localization of an incapacitated person by other methods than GPS. **The disadvantages of the current technology are removed and the objective of the invention is met** by the personal emergency alarm device. The function of the device basically consists in automatically reporting the readiness to send alarm to the surveillance centre with a warning signal if the movement sensors do not detect any movement of the monitored person. It also involves other sensors monitoring the health functions of the monitored person, which are conveniently evaluated at the location of the monitored person. When the set limit is exceeded, the device immediately indicates readiness to set off alarm by a warning signal of a preset length. The device also contains a reset unit which enables the monitored person to reset the alarm during the warning signal before the alarm is actually set off, or otherwise the device will set off the alarm. The delay for starting the warning signal for movement monitoring may be set by the monitored person. The delay is the time interval within which a movement must occur. Should a movement occur, the movement and other sensors that monitor movement reset the set time interval, so that it runs again starting from zero. If no movement is detected within the set time interval, the warning signal is activated. When monitoring normal reaction, the reset of the delay for movement and other sensor alarm is conveniently switched off, so that the reset must be executed by the monitored person after the expiry of the set time interval for confirming normal reaction, regardless of whether there is any movement. The device also allows the monitoring of heart rate and other health functions. If permitted limits set for these functions are exceeded, the monitored person is conveniently notified using a warning signal, so that he/she may reset the alarm without it actually being set off. After reset when monitoring movement, the delay automatically runs again from zero for a preset period of time before activating another warning signal before alarm. If limits are exceeded when monitoring heart rate or other health functions, the warning signal is activated immediately. The alarm may be reset by the monitored person during the warning signal. If conditions for setting of the alarm do not cease after the alarm is set off, the device will activate other alarm warning using a warning signal on the expiry of a delay set by the monitored person. The delay may also be set by the surveillance centre, including exclusively, if necessary. If the reset is not activated, the alarm is set off. The option of resetting the alarm of exceeding the limit for health functions may be cancelled by the surveillance centre. The data from the sensors are concentrated in the central control unit for the purposes of evaluating the alarm. With a stationary device communicating via phone lines, the central control unit is conveniently located in the monitored space. After being evaluated, the data is conveniently forwarded to the surveillance centre on request. In the event of alarm, the data may conveniently be forwarded automatically. The important thing is that the state of emergency may be evaluated in the monitoring device on the part of the monitored person and the alarm is set off only in case of emergency, with the possibility of simultaneously forwarding the data from sensors, indicating the state of emergency. This means time savings in communication channel traffic as compared to systems with data evaluation in the surveillance centre, where data is streamed continuously or at relatively short intervals for evaluating the state of emergency. However, there are delays in declaring the state of emergency with these systems, depending on the frequency of data transmission. With devices that meet the objective of the invention, it is possible to only transmit the alarm signal rather than the complete data, which is easy from the communication point of view. The data on the condition of the monitored person may conveniently be transmitted only on request. The movement may be monitored not only using movement sensors, but also using other sensors such as shock sensors or footstep sensors worn by the monitored person to eliminate error from only one type of movement sensor.

[0004] The possibility to set a time interval for setting of alarm and reset by the monitored person enables to conveniently set a shorter alarm delay as compared to systems where the setting is done by a technician, which is costly, cannot be done immediately, does not lend the possibility of a reset by the monitored person in the event of a false alarm. The monitored person may from time to adjust the delay, for instance at a shorter interval for everyday activities and at a longer interval for sleep. A shorter

alarm delay has the advantage that in the event of incapacitation, help may be called earlier that with the current system, where a longer delay is set to prevent false alarms, since no reset is possible. In the event that the monitoring system records the cause of the alarm, the monitored person may use the reset function to prevent setting off a false alarm. This will make the operation of the surveillance centre less costly, particularly if it monitors a large number of persons. Using this new technology enables the surveillance centre to only with actual rather than false alarms. Reset may conveniently be executed remotely using a wireless device, which the monitored person can operate anywhere on the monitored premises from the reset block.

[0005] Since the detection of movement by itself does not mean that the monitored person is not incapacitated, for instance during fits which elicit compulsive movement or for other reasons, it is possible to conveniently switch off the reset with movement and other sensors by the monitored person. In that case, the monitored person must react to the warning signal, which is regularly transmitted by the monitoring device, by pushing the reset button to confirm he/she is able to react normally, or else the device will set off the alarm. The time interval between warning signals is user-adjustable by the monitored person, including the option to cancel the warning signals altogether. In the latter case, when the set time limit for movement is exceeded, provided that the reset is not activated by the sensors and the health functions are outside the limit, the alarm is set off immediately. The alarm may also be switched off.

[0006] The monitored person may conveniently carry a mobile phone to communicate with the surveillance centre through a basic phone unit located on the monitored premise, so that there is no need to place speaker phones all over the premises. The monitored person may conveniently wear the movement sensor. The sensor may wirelessly be connected to the security centre on the monitored premises or the movement sensor evaluation unit, which may transmit information on the movement of the monitored person to the central control unit for evaluation. This will cut down on movement sensors on the monitored premises. The sensor worn by the monitored person detects even minor movements, such as rotations and forward bends, which would not be detected by a stationary sensor, mounted on the wall of the monitored room. Along with movement sensors, the monitoring device may involve other sensors, such as sensors to monitor heart rate, shocks, footsteps, etc.

[0007] The monitored person may wear equipment for measuring heart rate, ECG, blood pressure, breath, body temperature, oxygen in blood or other bodily functions, which are important for evaluating the state of emergency of the monitored person and his/her health condition. This data are concentrated into the unit for evaluating sensors, which is worn by the monitored person. The unit will forward the relevant data to the stationary central control unit, which is located on the monitored premises. The control unit evaluates the data for setting off the alarm, if needed, and sends it to the surveillance centre in the event of alarm automatically or only at the surveillance centre's command. The health information may conveniently be transmitted as acoustic signal through a phone line, data through a modem or over the Internet.

[0008] The device for the activation of alarm for persons in emergency, which serves the said functions in a stationary design, where the communication with the surveillance centre is conducted via a phone line, consists of the sensor unit, the central control unit and the communication unit.

[0009] The sensor unit conveniently consists of individual sensors and units for evaluating sensors. The purpose of the sensor unit is to monitor movement or health functions, such as heart rate, ECG, body temperature, breathing, etc. The sensors are evaluated and the processed data are forwarded to the central control block for evaluation, taking into account the delay of alarm for movement and normal reaction confirmation, as well as the limits for health functions and an alarm reset from the reset unit. If the preset time or health function limits are exceeded, the central control unit sends a warning signal. Unless reset, the alarm is set off. The central control unit is the central element of the device, which is designed to meet the objective of the invention together with the other units. The communication unit ensures communication with the monitored person and sending alarm to the surveillance centre via fixed lines. The reset unit conveniently consists of a remove reset unit, which serves the monitored person to reset alarm during the warning signal.

[0010] The above-mentioned data and information on the monitored person may be transmitted as data or voice through a mobile operator network using a mobile phone that the monitored person carries with him/her. The monitoring system may be mobile, which is made possible by the fact that the monitored person has the monitoring sensors with the sensor control unit and the central control unit on him/her. Alarm or other information, if needed, is transmitted using a mobile phone, which may conveniently communicate with the surveillance centre. This makes it possible to use the monitoring device also outside the monitored premises, wherever the monitored person moves. The monitoring device may be combined: the stationary device described above may be used on the monitored premises, while a mobile phone and sensors, worn by the monitored person, may be used outside the premises.

[0011] The mobile, the stationary or the combined device will send a signal to notify the monitored person that some of the monitored functions or time has exceeded the preset limit and, as a consequence, the state of emergency has occurred. The monitored person may prevent alarm by a reset during the warning signal. The benefit of the solution is that the surveillance centre only has to monitor the functions when an alarm is set off, rather than continuously or periodically. The functions outside limit

may conveniently be transmitted to the surveillance centre simultaneously with the alarm or upon request. If a mobile phone is used for voice and data transmission, the monitored person conveniently wears all the necessary sensors and monitoring devices connected to the central control unit, which evaluates them. In addition, the monitored person is connected via Bluetooth or other medium to the said mobile phone for the transmission of alarm data to the surveillance centre. The central control unit may conveniently located in the mobile phone or, alternatively, separately from the mobile phone. The abovementioned device for alarm activation may conveniently include a GPS device, which monitors the person's movement and complement movement and other sensors, which reset the alarm delay if a change of location, and therefore a movement in space, has occurred. The delay is reset in the event that the GPS device detects a movement of the monitored person. The GPS device may also send the location of the monitored person in the event of alarm. This enables the surveillance centre to send rescue directly to the location of the monitored person. Since the GPS system only works in an open space where satellites are directly visible, the GPS data are conveniently stored in a memory to allow tracking the route of the monitored person until the GPS signal is lost to locate the person more easily. From the moment of a loss of the GPS signal, the system may regularly ask the monitored person to report his/her whereabouts. The reporting may conveniently be done orally or using a keyboard.

[0012] The recorded data are transmitted to the surveillance centre if rescuers must be sent. Locations with no GPS signal may conveniently be located by mobile operators using location from mobile signal transmitters, such as BTS, upon the request from the surveillance centre or automatically upon request from the central control unit via a mobile phone. Since location obtained in such a way may not be sufficiently precise, for a detailed location the monitored person may conveniently carry a transmitter that transmits signals, which may possibly be impulse signals to save battery energy and improve power. The transmitter is switched on automatically on alarm or on request from the surveillance centre. The rescuers may locate the transmitter using a special receiver with rotating antennas to establish the directions of the highest-intensity signal from two spots and locate the monitored person at their intersection. In indoor conditions the direction of the highest-intensity signal is conveniently located using one antenna and is followed by the rescue team when searching for the monitored person. This will make it easier to identify the monitored person's location. Appropriate devices and sensors may be used to monitor movement, heart rate and other health functions which are vital for monitoring emergency. During emergency or upon request, the data may conveniently and automatically be sent via a mobile phone to the surveillance centre in the event that it exceeds the preset limit or take on a value associated with alarm. When using the mobile phone, it is possible to apply reset by the monitored person, to set alarm delay or to use other functions, as specified for the stationary device. The surveillance centre may, particularly on alarm activation, conveniently connect to a stationary monitoring device located in the area of the monitored person or to a mobile device worn by the person to establish the values of the monitored functions and to communicate with the monitored person. A speakerphone may be switched on by the surveillance centre of the monitored person. The described alarm activation device may include a button to set off an emergency alarm, controlled by the monitored person. The device transmits the location of the monitored person. The emergency alarm may conveniently be activated by voice. Regular heartbeat is essential for establishing the correct functioning of the heart. It is necessary to set limits of irregular heart beat. The limit is expressed as a number of beats per a unit of time during which the number of beats differing in the time of beat from the average beat is monitored, where the time interval between beats is measured. Deviating beats may be excluded from the calculation of the average length of beat. Alarm is set off when the limit is exceeded. The limits may be adjusted. It is possible to exclude any speeding up or slowing down of the heartbeat caused by more or less intensive physical exercise by evaluating the regularity of the differing number of beats per a unit of time, where the average time of the beat is calculated while setting a shorter interval. The software to establish the deviations is located in the central control unit. It controls the unit and has been designed to this end.

[0013] Is some cases, the monitoring of the regularity of heart beat is not sufficient to evaluate whether the heart function is normal. During certain arrhythmias, particularly tachycardia, the heartbeat may be relatively regular with a normal frequency, but the atrium vibrates at a high frequency, which is an undesirable condition. On the contrary, during a sinus, i.e. normal, rhythm, the heartbeat may be irregular, caused by extrasystoles or preliminary contraction.

[0014] That is why the described device can not only compare the heart rate, but using a two-lead ECG also the normal sinus behaviour of heartbeat taken as a standard, to the measured deviations, particularly in a larger number of regular waves or P-waves during tachycardia or F-waves during fibrillation, or other changes against the normal condition, which testify to atrium vibration at a faster or irregular pace. It also evaluates the disappearance of the P-wave, testifying to arrhythmia, particularly the atrium fibrillation. These and other irregularities, which may testify to a serious condition, such as myocardial infarction, will set off the alarm and transmit the ECG curve upon the surveillance centre's request or automatically.

[0015] The alarm, raised by the comparison of curves or the irregularities of heartbeat mentioned above, may be switched off if the monitored person suffers from arrhythmia, which means that he/she has irregular heart-

beat, or another irregularity. The monitoring of minimum and maximum heart rate is important during arrhythmia, too. When the limit is exceeded, alarm must be set off to indicate possibly life-threatening conditions. A timely detection of any deviations in curves while setting off the alarm is also important in persons with a sinus heartbeat in order to conduct a fast medical evaluation and, if needed, intervention, to try to remedy the defect. Based on the provided curves a medical doctor may determine whether it is a life-threatening condition and, if so, arrange for the transport of the monitored person to hospital.

[0016] The device for the activation of personal emergency alarm enables in the function menu in the control unit to set the delay, on the expiry of which a warning signal is activated. The monitored person must react to the signal to confirm normal reaction, using the reset from the reset unit, otherwise the control unit will set off the alarm, which will be sent through the communication unit to the surveillance centre. The reset may conveniently be executed also by the sensor unit, particularly the movement sensors, for instance the movement sensor, the footstep sensor, the position sensor and other sensors indicating that the monitored person is physically active and therefore not in danger. The control unit may conveniently evaluate health functions supplied from the sensor unit, such as heart rate, ECG, body temperature and other functions. The warning signal is automatically activated in the event that any of the functions exceeds the limit. The monitored person may react to the warning signal with a reset, provided that the notified alarm is evaluated as false. Otherwise the control unit will set off the notified alarm. The control unit may activate the location unit. The transmitter, which is a part of the location unit, allows to locate the position of the monitored person through locating using at least two directional antennas with a receiver. The display and control unit is conveniently equipped with a wrist display to immediately monitor the health functions by the monitored person, without the necessity to take the mobile phone, which may also be used to display the functions. Essential control elements may be located here, duplicating control functions, for instance in the control, reset and communication units for immediate control from the wrist display. These elements include, for instance, the reset button, the emergency call button, and others. The wrist display may also conveniently include elements for voice communication, such as the earphone, the microphone, or the speaker for loud communication, which be immediately used through control elements in the wrist display without having to handle the mobile phone. The difference between the stationary and the mobile devices for the activation of personal emergency alarm consists in the use of phone lines for the stationary device and a mobile phone for the mobile device. An important feature of the alarm activation device is that should the connection between individual units fail, the device automatically resets the connection and establishes it again. After several unsuccessful attempts at establishing the connection, the control unit will send a warning signal, notifying the monitored person that some health or other functions are not being monitored. The control unit may be designed as an independent unit or may conveniently be comprised in another unit, such as the communication unit, running in the background of the main program in the microprocessor, which controls, for instance, the mobile phone in the unit. The run in the background is enabled by a program compiled to this end. The main program is in charge of controlling the mobile phone. More information to the individual units: The sensor unit consists of the individual sensors, some of which are generally available on the market, while others are modified or developed for the purposes of the invention. Modified sensors include the movement sensor of the mobile device, which has been modified to be worn on apparel to detect movement. The control unit controls the other units, evaluates data, initiates sending the warning signal or setting off the alarm. It consists of a central control unit, controlled by a microprocessor. The microprocessor is controlled by a dedicated program which meets the objectives of the invention. The reset unit consist of a reset unit with a remote control of the control unit. The control buttons may conveniently be doubled, in which case the reset and the emergency call may be activated using either the control unit or the mobile phone. The display unit consists of a wristwatch with a display. It is located on a wrist strap, enabling to quickly read various data, such as heart rate and its development, either in a numerical form or using curves. Should any data exceed the limits, the warning signal may be activated. The display functions are taken care of by the microprocessor unit in the wristwatch. The display unit may be equipped with control functions to enable quick control from the wristwatch. Another advantage is that the display unit may be equipped with a voice communication feature to enable phone conversation via speakerphone. This is conveniently implemented using a remote connection between the communication unit and the display unit. The communication between the display unit and other units is conveniently implemented using a radio or Bluetooth connection. The location unit is consists of a frequency transmitter with an activated control unit, which can be located with directional antennas.

A list of pictures on drawings

[0017]

Fig. 1 The personal emergency alarm device with a reset option by the monitored person within the alarm delay in the monitored room.

Fig. 2 Alarm activation device with a wireless detected and a phone in the monitored premises.

Fig. 3 The personal emergency alarm device with a mobile phone for areas covered with a GSM network.

Fig. 4 The personal emergency alarm device with communication via Bluetooth.

Fig. 5 The personal emergency alarm device with communication partially via radio waves.

Fig. 6 The personal emergency alarm device with a heartbeat curve and heartbeat for the calculation of over-limit condition.

Fig. 7 The personal emergency alarm device with a heartbeat curve with designated sections.

Fig. 8 The personal emergency alarm device with a curve of irregular heartbeat with limits.

Fig. 9 The personal emergency alarm device with a curve of normal ECG.

Fig. 10 The personal emergency alarm device with a tachycardia curve.

Fig. 11 The personal emergency alarm device with an atrium fibrillation curve.

Fig. 12 The personal emergency alarm device with a flutter curve.

Fig. 13 The personal emergency alarm device with a stationary design divided into units.

Fig. 14 The personal emergency alarm device with the movement sensor evaluation unit, the heart rate sensor evaluation unit and the sensor evaluation unit are combined in one box with the central control unit, and the communication unit is combined with the stationary phone in a common box.

Fig. 15 The personal emergency alarm device the illustration of the combination of the movement sensor evaluation unit with the central control unit, the sensor evaluation unit, the heart rate sensor evaluation unit, the communication unit and the stationary phone apparatus, in which it is located.

Fig. 16 The personal emergency alarm device where parts of the equipment are grouped into sensor units, central control units, the reset unit and the communication unit.

Fig. 17 The personal emergency alarm device with an illustration of the merger of the movement sensor evaluation unit, the wireless movement sensor evaluation unit, the sensor evaluation unit, the heart rate sensor evaluation unit, the central control unit and the wireless phone unit into a single common multifunctional unit.

Fig. 18 The personal emergency alarm device with a block scheme of the mobile phone.

Fig. 19 The personal emergency alarm device grouped into the sensor unit, the central control unit, the communication unit, the reset unit, the location unit and the control and display unit.

Fig. 20 The personal emergency alarm device consisting of the sensor unit, the control unit, the communication unit, the reset unit and the display unit.

Fig. 21 The personal emergency alarm device conveniently consisting of the sensor unit, the central control unit, the location unit, and the display unit, which conveniently comprises a remote controller and a voice communication feature.

Fig. 22 The use of the described principles of the invention of the personal emergency alarm device.

The central control unit is included in the mobile phone, which is connected to the sensors and the reset unit in the wristband via Bluetooth, represented by dot-and-dash.

Fig. 23 The personal emergency alarm device with a mobile phone in wristband used for the communication unit instead of a mobile phone.

Fig. 24 The personal emergency alarm device with the option to easily and directly monitor heart rate on the display in the wristwatch, where there is also the reset unit. The central control unit is located in the mobile phone.

Fig. 25 Solution of converter transmitting various types of signals into bluetooth and through it communicates with central control unit.

Fig. 26 Solution of communication of sensors united v block of sensors by means of bluetooth.

Fig. 27 Solution when signal from chest belt is simultaneously received, evaluated and shown both in watch and central control units for them converter transmits signal.

An example of a solution

[0018] **Fig. 1** shows a stationary device for personal emergency alarm, consisting of the movement sensor 1 communicating with the movement sensor evaluation unit 2, to which it is connected via connection 3. The unit records movement data and sends it via the wired connection 10 to the central control unit 9, which sets off the acoustic warning signal from siren 37, unless the movement sensor detects movement during a preset time in-

terval. The time interval may be set by the used — the monitored person using the button 24 with a time scale. The monitored person carries the reset unit 11, which may be used to send the reset signal to the central control unit 9 via the wireless connection 12 by pressing the reset button 13, while the central control unit 9 is sending a warning signal. The warning signal means that unless the reset signal is sent, the central control unit 9 will set off the alarm. Unless the monitored person is incapacitated, he/she will press the reset button 13 during the warning signal, which resets the alarm delay to zero and the next warning signal comes again after the preset time interval. The delay will also be reset by the movement sensor 1, which will reset the delay to zero with every movement it reports via the connection 3 to the movement sensor evaluation unit 2 and then via the wired connection 10 to the central control unit 9. This means that the warning signal is activated in the event that the movement sensor 1 does not detect any movement during the preset time and the alarm is set off if the monitored person does not respond with a reset during the warning signal. The device conveniently allows for using also other detectors, such as the heart rate monitor 220 placed in the chest belt 221, which is linked to the heart rate monitor evaluation unit 100 via the wireless connection 30 and to the central control unit 9 via connection 93. Other possible sensors include the sensors 2002, 2003 and 2004, which control other health functions, such as breath, body position and body temperature. Such sensors are worn by the monitored person in the chest belt and connected to the sensor evaluation unit 2008 via the wireless connections 2005, 2006 and 2007 and then via wire connections 2009 to the central control unit 9. If necessary, the monitored person may use the reset unit 11 to send a call for help by pressing the emergency call button 14. The call is sent via wireless connection 12 to the central control unit 9, which sends the signal via line 7 to the communication unit 5. The communication unit will send the voice alarm via the phone line 8 to the surveillance centre 22 by automatically dialling the number and passing the voice message. In this way, the central control unit 9 will send an alarm in the event that no movement of the monitored person is detected within a specified time period and the monitored person does not activate the reset. The surveillance centre 22 may use the phone line 8 to reach the monitored person via the communication unit 5 and line 6 at the stationary phone 4. The phone will automatically receive the incoming call and switch to speakerphone mode. In this way, the surveillance centre may communicate with the monitored person to check his/her condition, particularly in the event of an alarm, to prevent unnecessary interventions. The monitored person may cancel the speakerphone mode and switch to the phone by holding the reset button 13 for 2 seconds. If the monitored area consists of more rooms, it may be convenient to use more phones. For instance, if there are two rooms, and additional phone 31 may be used, connected via line 34, with more movement sensors, such as the movement sensor 32, connected via wired connection 33. In the central control unit 9, the monitored person may use the reset switch at the movement sensor 36 to switch off the reset of the preset time interval for setting the warning signal with the movement sensor 1 or the movement sensor 32. In this event, regardless of whether the monitored person is moving or not, he/she must, within the time period for sending the warning signal, manually reset the time by the reset button 13 to indicate normal reaction, i.e. that he/she is not in emergency, or else the central control unit 9 will set off alarm. The communication unit 5 may consist of a phone exchange, if more phones, such as the stationary phone 31, are connected. When using a single phone, the stationary phone 4 may take on the function of the communication unit. In this event, the phone is directly linked to line 7 and phone line 8 and is adjusted so that it can send acoustic alarm received via line 7 to the surveillance centre by dialling the centre and sending a voice message via phone line 8. It is also adjusted for automatically switching to the speakerphone mode after receiving an incoming call via phone line 8, which is received automatically during ringing.

[0019] **Fig. 2** shows the personal emergency alarm device where a wireless movement sensor 38 with a wireless phone 26 and the reset unit 11 are carried by the monitored person, possibly in a case 28. The monitored person has the phone connection as well as the movement sensor signalization and the reset option with the reach of the wireless connection with the wireless phone base station 25, the wireless movement sensor evaluation unit 39 and the receiver 4001 of the reset unit 11 located in the central control unit 9. There is no need to conduct a costly installation of phones and movement sensors in all the rooms of the monitored space provided that the wireless connection has sufficient reach. The wireless movement sensor 38 is adapted for mobile use so that the monitored person may carry it with him/her, and is connected via the wireless connection 129 to the wireless movement sensor evaluation unit 39. Wireless phone 26, which can be removed from case 28, is connected via wireless connection 15 to the wireless phone base station 25, which communicates with the surveillance centre 22 via phone line 8. During a call, the surveillance centre 22 can remotely switch the monitored person's wireless phone 26 to the speakerphone mode. The described personal emergency alarm wireless device operates on the same principles as the stationary device described in Fig. 1 with the exception that it uses a wireless phone 26 instead of a stationary phones 4 and 31, and a wireless movement sensor 38 instead of movement sensors 1 and 32. Similarly to Fig. 1, there is a chest belt with the monitored person's heart rate sensor 220. The data from sensor is sent via wireless connection 30 in the form of acoustic pulses to the heart rate sensor evaluation unit 100, which, if either the minimum or the maximum limit preset by the monitored person is exceeded, immediately sends via connection 93 an alarm indi-

cation to the central control unit 9. The alarm indication is processed by the unit into a warning signal in the form of an acoustic signal or a message. If the monitored person fails to activate reset by pressing the reset button 13, the unit will send an alarm signal via line 7 through the wireless phone base station 25 to the surveillance centre 22 via phone line 8. The alarm signal conveniently carries data on the heart rate or the heartbeat for irregular pulse using a signal for each heartbeat, which expert medical staff is able evaluate. The medical staff can remotely discontinue the heartbeat transmission by sending a code via phone line 8, so that the line can be used for voice communication. The monitored person may conveniently reset the alarm before being set off with the reset button 13 on notification by the warning signal from the siren 37. If the over-limit condition persists, the warning signal is activated again after a delay preset by the monitored person with a button with scale 24, which should be pulled before setting. The button has a dual time-set function. Along with the function described above, it also serves to set the delay of the warning signal activation for failure to detect movement by the wireless movement sensor 38. Similarly to the procedure specified in the description of Fig. 1 for the movement sensor 1, the wireless movement sensor 38 transmits information on the movement of the monitored person via the wireless connection 129 to the wireless movement sensor evaluation unit 39 and then via wired connection 10 to the central control unit 9, which will send a warning signal using the siren 37, unless it detects any movement within a time interval preset by the monitored person. The monitored person can execute a reset by pressing the reset button 13, with the time running again from zero, or else the central control unit 9 will send an alarm signal similarly as described for the heart rate monitor sensor 220. The time will be reset to zero also by any movement detected by the wireless movement sensor 38. This sensor is conveniently worn by the monitored person in such a way that it aims at the monitored area and is able to detect movement against surrounding objects. If there is another moving person, animal or other object in the monitored person's area, or for other reasons, the monitored person can switch off the wireless movement sensor with the reset button from the movement sensor 36. In this case, the time interval is not reset by movement, but only by pressing the reset button 13 by the monitored person. During the warning signal, which will sound, the monitored person must execute the reset within the preset time interval to confirm normal reaction, or else the alarm is set off. The warning signal therefore serves as a test to check whether the monitored person is in emergency. By pressing the emergency call button 14, the monitored person may activate an emergency call. The wireless phone base station 25 may conveniently include a stationary phone 301, which may, among other things, serve to establish connection with a wireless phone 26 and the surveillance centre 22. A stationary phone 4 with a communication unit 5 may also be used instead of a wireless phone, as described in Figures 1,14 and 15.

[0020] Movement sensors 1, 32 and others together with the movement sensor evaluation unit 2 may be used either in combination with a wireless movement sensor 38, or separately. The other sensors which may conveniently be used include a footstep sensor 305, a shock sensor 303 and other sensors 304 described in other figures. These sensors are connected via wireless connections 2100, 2101 and 2102 with the sensor evaluation unit 1300.

[0021] **According to Fig. 3** and the necessary personal emergency alarm devices, which are illustrated there, the communication with the surveillance centre 22 is implemented using a mobile phone 18, which is stored in a case 23 that the monitored person carries with him/her. The mobile phone 18 can easily be taken out of the case for communication. This allows to extend the monitoring from the premises to areas covered with the signal of mobile operators. The movement sensor 1 sends data on the movement of the monitored person via connection 3 to the central control unit 9, in which there is the reset unit 11 with the timer, which can be set by the user using the button with time scale 24. If no movement of the monitored person is detected during the preset time interval, the control unit will send an acoustic warning signal using the siren 37. Should the monitored person fail to press the reset button 13 after the warning signal, the unit will send alarm via Bluetooth connection 138 to the mobile phone 18, which will forward the alarm to the surveillance centre 22 via a mobile operator's network 135 by automatically dialling the number by a message or a code. The timer is reset automatically, unless switched off by the reset switch on the movement sensor 36, also by each signal indicating movement from the movement sensor 1. The reset 11 unit is conveniently placed in the central control unit case and is wired to it. The movement sensor 1 is adapted for carrying in a case by the monitored person. The case is worn so that the monitoring rays are not prevented from entering the monitored area. For carrying the case in a way that prevents the monitoring rays from entering the monitored area, the case will be wired or connected wirelessly with the movement sensor 1 attached on apparel so that the operational range covers the free area. The monitored person may send a call for help by pressing the emergency call button 14 via the central control unit 9 and a mobile phone 18. The surveillance centre 22 may reach the monitored person via a mobile phone to check his/her condition in order to prevent unnecessary intervention. The mobile phone may be adapted to automatically receive calls from the surveillance centre 22. If, after evaluating the number, the phone establishes that it is the surveillance centre 22 calling, it switches to the speakerphone mode. For other callers, it makes and acoustic notification of the received incoming call. In a state of emergency, and therefore alarm, or on request by the surveillance centre, the GPS device 21 in the mobile phone may automatically send the position of the monitored per-

son.This and other features, which are not common in a mobile phone, are taken care of by dedicated software, which is set up in the memory of the mobile phone and runs in the background of the common software, which controls the mobile phone functions. The chest belt for monitoring heart rate 221 is connected via Bluetooth 35 to the central control unit 9, which evaluates the data and if either the minimum or the maximum limit is exceeded, it will set off a voice alarm indicating the value of heart rate via Bluetooth 138 to the mobile phone 18, which will immediately sent the alarm to the surveillance centre 22.After adjusting for any deviations of the movement sensor 1, a footstep sensor 42 is used to record individual steps and providing information on the activity of the monitored person. The footstep sensor 42 is conveniently connected to the central control unit 9 via Bluetooth 53. A shock sensor 43 is also used and is connected to the central control unit 9 via Bluetooth 54. The sensor monitors shocks caused by the activity of the monitored person. The footstep sensor 42 and the shock sensor 43 reset alarm delay similarly to the movement sensor 1. These sensors may conveniently be complemented with a position sensor 50, connected via Bluetooth 51 to the control unit. The position sensor gives the position of the monitored person's body, from upright to recumbent. If there is a difference in position over time, and therefore an indication of the monitored person's activity, the position sensor 50 will also send the reset signal. If the monitored person rests in a horizontal position for a set period of time, the data from the position sensor 50 is evaluated in the central control unit 9 as a cause of alarm, which is activated. This means that if the monitored person wants to lie down, he/she must temporarily switch off the position sensor 50, or else it will set off alarm on the assumption that the monitored person has fallen down and is incapacitated. More sensors which monitor the monitored person's activity, as mentioned above, conveniently reduce the error rate of the system as compared to using only one sensor. Any additional sensors may be switched off with the additional movement sensor switch 40, while the movement sensors may be switched off with the reset switch from the movement sensor 36. This means that the sensors no more reset the delay to set off alarm. During the warning signal, the monitored person must therefore execute a manual reset to confirm normal reaction, i.e. to indicate he/she is not in a state of emergency, or else the alarm is set off. If establishing the exact position of the monitored person using a GPS device 21 in the mobile phone 18 is not possible, a position-tracking transmitter 45 is available, which is activated either automatically on sending an alarm, or remotely from the surveillance centre via the central control unit 9 and Bluetooth 56. This radio signal may be located using receivers with a rotating directional antennas and EMF meters, when measured from various locations. The monitored person is located at the intersection of the directions of the strongest signal of both receivers. This location method may also be used indoors, when the direction of the strongest signal is detected when moving around the premises and used as a search direction. This makes the location using a mobile operator's network, which may also be used, more precise.

[0022] For easier control, a part of the functions may be located externally outside the central control unit 9, for instance on a wristband 41. The reset button 13 and the emergency call button 14 are placed there, duplicating the reset button 13 and the emergency call button 14 on the reset unit 11, placed on the control unit. Since the wristband may be placed on the part of the wrist where it is not covered with a sleeve, it can host the speaker 47 and the microphone 46 for the speakerphone mode of the phone communication via a mobile network. When activated with button 216, these elements take on the functions of the microphone and the speaker, respectively, in the mobile phone, while receiving the incoming call. To cancel a call, press button 217. The cable for an external in-the-ear earphone and a microphone may be connected via connector 218. The voice communication using a mobile phone adapted to such a purpose is transmitted via Bluetooth 138 to the central control unit 9, and from there via Bluetooth 219 to the wristband 41. The advantage is a good audibility as the sound in the speakerphone mode does not get muffled by clothing, which is particularly advantageous in the event that the monitored person is incapacitated to such an extent
that he/she is unable to use a mobile phone or take it out from a pocket. For that reason, the wristband 41 also includes a siren 37, which duplicates the siren 37 in the central control unit 9. Pressing the siren control button 57 activates the siren 37 at a higher volume and the speaker, also at a higher volume, with a call for help, and these are automatically activated in an alternating way. Deactivation is conducted by pressing again the siren control button 57 or remotely from the surveillance centre. The surveillance centre may also raise the volume of the speaker 47 if there is no response to the call in order to try to call on other persons who find themselves in the monitored person's area to help. A multifunctional chest belt 44 may conveniently be connected via Bluetooth 55. The belt contains heart rate sensors and a two-lead heart rate sensor 73, a body temperature sensor 75, a breath rhythm and depth sensor 74, a body position sensor 76 and a shock sensor 77. The data from the sensors are evaluated in the central control unit of the chest belt 52 and transmitted together via Bluetooth 55 to the central control unit 9 for further processing. **Preferably, Fig. 4** shows connection using radio waves instead of Bluetooth used in Fig. 3. For instance, the wristband 41 in Fig. 4 is adapted to enable radio-frequency connection. Microphone 46 and speaker 47 are connected to the central control unit 9 via radio connection 98 using a wireless phone device, where the wireless phone base station 91 is placed in the central control unit 9, a part of the remote phone 64 in the wristband 41. Controls such as the reset button 13, the emergency call button 14 and siren 37 placed in the wristband 41, which dupli-

cate the buttons of the central control unit 9 and are connected to the central control unit 9 via radio connection 58, with modulated signals for individual elements. A transceiver 65 in the wristband communicates with the transceiver 66 in the control unit to transmit appropriate commands. Heart beats are received by the receiver 94 as a radio signal transmitted by the radio transmitter 81 from the central control unit 9 to the display 63 of the microprocessor, where they are evaluated and displayed in a numerical form as instant values of heart beat and as curves of heart beat over time.

[0023] The shock sensor 43 and the position sensor 50 are connected to the central control unit 9 via a radio wave 60 receiver 68 and transmitted 67, located in the common case of these two sensors, which can conveniently be placed in the case 16. The movement sensor 1, connected to the central control unit 9 via connection 3, is also placed there. A wireless movement sensor 38 may be used as an alternative, connected via wireless connection 129 to the wireless movement sensor evaluation unit 29, which is place in the central control unit 9, which processed the data from it.

[0024] The wireless movement sensor 38 may conveniently be worn on the monitored person's clothes to have a good view of the free space around him/her.The position-tracking transmitter 45 may be switched on by the radio signal transmitter 70 with a command modulation, located in the central control unit 9 and connected via radio connection 61 to the receiver 69 in the position-tracking transmitter 45.A multifunctional chest belt 44 may alternatively be used in the illustrated device. This multifunctional chest belt 44 has sensors that measure heart rate and a two-lead curve by the two-lead heart beat sensor 73, breathing rhythm with a breathing rhythm and depth sensor 74, body temperature with a body temperature sensor 75, body position activity with a body position sensor 76 and shocks with a shock sensor 77. The sensors are connected to the chest belt control unit 52. The data and the results are further evaluated in the central control unit 9, where they are send via connection 62. If any value exceeds a limit, alarm is sent via Bluetooth 138 by a mobile phone 18 to the surveillance centre 22, which can connect to data monitoring via the mobile phone 18 and request history from the memory of the central control unit 9. The data may automatically be sent in the event of alarm. It may also be displayed on the display of mobile phone 18 on a PC 212 of the surveillance centre 22 as curves and as instant numerical values. Displaying the data on a PC 72 at the location of the monitored person is possible via an infrared link 71. The central control unit 9 may conveniently produce a warning signal before setting off the alarm. During the signal, the monitored person may reset the alarm by pressing a button.

[0025] A wristwatch 78 with display 80 may be connected to the central control unit 9 via radio connection 79, radio transmitter 81 and receiver 82. The display may show the instant value of the heart rate, the heartbeat curve over a period of time, with the possibility of browsing through history and setting the time period with controls on the wristwatch. These values are calculated in hours by the processor based on the heartbeat pulses, sent via radio connection 79. The wristwatch may be switched to normal hour operation.

[0026] The central control unit 9 contains the radio transmitter 81, which modulates the radio connection 79 with pulses at the frequency of the heartbeat, received by receiver 82 and evaluated in wristwatch 78 using a microprocessor and special software. The wristwatch 78 may produce also other data, such as the length of the distanced covered by walking or running using received pulses for each step from the footstep sensor 42 through the transmitter 360, radio connection 59 and receiver 90. It is then transmitted by the central control unit 9 via radio connection 79, also for the wristband 41 via the receiver 94, which may similarly process the heart pulses and show them on display 63 using a local microprocessor.

[0027] The wristwatch may be connected to a PC 84 via an infrared link 83 for a detailed analysis of the measured data from the wristwatch memory. The PC may also serve to program functions. There is a similar infrared link 380 also for the wristband 41. The functions of the controls of the reset switch from the movement sensor 36 and the additional movement sensor switch 40 have been described above. There is a device for evaluating the GPS geographic coordinates 21 in the mobile phone 18, which establishes the position of the monitored person. The position may, upon the surveillance centre's 22 request, be sent via a mobile network 994.

[0028] **Fig. 5** describes the multifunctional chest belt 44, which conveniently contains the chest belt control unit 52, wired 995 to the two-lead heart rate sensor 73, a breathing rhythm and depth sensor 74, a body temperature sensor 75, a body position sensor 76 and a shock sensor 77. The external sensor and unit evaluation unit 89 is connected to the footstep sensor 42 via transmitter 360, radio connection 92 and receiver 90, as well as the position-tracking transmitter 45 via transmitter 70, receiver 69 and radio connection 61; the wireless movement sensor 38 via connection 93, which is conveniently a radio frequency wireless connection 129 and receiver with a wireless movement sensor evaluation unit 39; the wristband 41 with display 63, radio connection 98; and the components of the wireless phone 27. In the wristband 41, there is also the transceiver 65 for the reset button 13 and the emergency call button 14, the siren control button 57 and the siren 37, which communicates with the transceiver 66 via radio connection 58. The data for display 63, for instance the heart rate, is transmitted via the radio transmitter 81, radio connection 79 and receiver 94, in which there is a microprocessor unit for the processing of data, such as heart rate. The data for wristwatch 78 is transmitted via the radio transmitter 81, radio connection 79 and receiver 82, in which there is a microprocessor unit for the processing of data, such as heart rate, for the display 80. Displays 63 and 80 may be used

to display, for instance, the heart rate and other curves, similarly to the case illustrated in Fig. 4. These may also be displayed on a PC 84 via the infrared link 83 or the infrared link 380. It is possible to set the functions of the wristwatch 78 and the wristband 41 from the PC 84, as well as from the mobile phone 87 or the PC 88.

[0029] The external sensor and unit evaluation unit 89 is connected via connection 302 with the central control unit 9, which is connected via link 242 to the chest belt central control unit 52, transmitting the aggregate data via Bluetooth 95 to the mobile phone 87, which sends it to the surveillance centre 22 via a mobile operator's network 135. The mobile phone 87 processes the data from the chest belt control unit 52 and the central control unit 9b, and transmits it via a mobile operator's network 135 to the surveillance centre 22. It also sends commands to the central control unit 9b, received from the surveillance centre 22 or entered via an extensible keyboard 97. As the central control unit 9b is placed on the chest belt, it does not contain any controls. The controls are instead placed on the mobile phone 87. To get a sufficient number of buttons, the mobile phone 87 is conveniently programmed so that by pressing a particular button the common functions of the mobile phone buttons are replaced by functions which are necessary for controlling the personal emergency alarm device. This enables you to place the particularly important buttons, described in Fig. 1-4 on the mobile phone 87. The buttons include the reset button 13, the emergency call button 14, the plus button 131 and the minus button 132, which serve to set the alarm delay, replacing the button with the time scale 24 from Fig. 1-4. There is also the reset switch from the movement sensor 36 and the switches of additional movement sensors 40. The mobile phone 87 with an extensible keyboard 97 is used for its larger display 96 and the possibility to change the button functions 997 with a designated button 996. A touchscreen display may be used as an alternative. It is large and makes it possible to program and change controls as needed. The curves and the data may conveniently be downloaded via Bluetooth 214 from the chest belt control unit 52 via the central control unit 9b to the PC 88 or viewed on the mobile phone display. The same is possible on the PC 410 in the surveillance centre 22 from the data sent there using the mobile phone 87 via a mobile operator's network 135 to the mobile GSM gate 411 and Bluetooth 412 on the surveillance centre's 22 request or automatically during alarm. The central control unit 9b processes data from the sensors, taking into account the time limit for showing activity. In the event that the data are beyond the preset limit, the central control unit dispatches alarm via the mobile phone 87 to the surveillance centre 22. Before that, sends a warning signal to notify the monitored person via the mobile phone 87 or the wristband 41 or the wristwatch 78. The monitored person may conveniently view the over-limit values or other data on the display of the mobile phone 87 or the wristband 41 or the wristwatch 78. If not in emergency, the monitored person may reset the alarm by the reset button 13. All functions described in Figures 1 to 4 remain applicable. The main difference is that the original control by the central control unit 9 in Figures 1-4 is not taken care of by the central control unit 9b, which is located in the chest belt. The mobile phone 87 may serve to finally process the data using special software, installed on the mobile phone 87 in addition to the usual software. This special software runs in the background of the common software for controlling the mobile phone. Along with the usual phone functions, the mobile phone 87 in this case fulfils the function of the final data processing for the personal emergency alarm device and may, to some extent, replace the central control unit 9a.

[0030] The mobile phone in the wristband 136 may alternatively be connected to the central control unit 9b via Bluetooth 130. The mobile phone in the wristband 136 may communicated via a mobile operator's network 133 with a GSM gate 411 of the surveillance centre 22 and with the PC 410 via Bluetooth 412. More space has been secured for display 215, with a SIM card 137 beneath it. The controls are located on the side of the case of the mobile phone in the wristband 300, which comprises mobile phone parts 485, a SIM card 137, a siren 37, a microphone 46 and a speaker 47. The controls on the side include, for instance, the reset button 13, the emergency call button 14, the plus 131 and the minus 132 buttons for setting time, a button to control the siren 57, a switch for the movement sensor reset 36, the additional movement sensor switch 40, and, if needed, more controls for controlling the data and the curves which should be viewed in the display 215. The following data and curves may conveniently be viewed on the displays of the mobile phone 87, the PC 88, the PC 410 in the surveillance centre 22, the mobile phone in wristband 136, connected via Bluetooth 130. For heart rate, the instant value and the curve of values over the latest time interval. It is possible to browse through previous time intervals, to increase or reduce the time interval, to automatically view only sections outside the optional limit, heart rate maximum or minimum, irregularities in heart rate, and extrasystoles. More over the ECG of the latest time period may be viewed It is possible to browse through the previous intervals, to increase or reduce the view time interval, to automatically view sections outside the optional limit, heart rate maximum and minimum, irregularities, extrasystoles and the sections with a considerable variation against the normal ECG.

[0031] The instant value and the curve for breath and temperature, adjustable similarly to other heart functions — time intervals, history, limits. The instant value and the curve of the body position and shocks, with the option of browsing in the history and changing the time interval. These data and curves are calculated in the central control unit 9b, or alternatively in the mobile phone 87, which in this case takes on the role of the central control unit 9b, which then mediates sending the data to the external sensor and unit evaluation unit 89 and back from it. The control role in the mobile phone 87 is executed in the

microprocessor unit, where it runs in the background of the main SW program processing using a dedicated dispatching SW program, which controls the functions of the mobile phone 87. The control make alternatively be taken over by the wristband mobile phone 136.

[0032] The wristband 41a and the wristwatch 78 allow to monitor the instant value of heart rate, the heartbeat curve and the intervals of irregularity. These values and curves are conveniently calculated in the wristband 41 and the wristwatch 78 in their local microprocessors from the heart rate data transmitted using the modulated radio waves, as described above. The setting of the viewed information is done using special buttons on the units.

[0033] The alarm is set off if any of the monitored functions exceeds the limits. For the heart beat, the limits are not only a minimum and a maximum, but also the preset limits of heartbeat irregularities or extrasystoles for a given time interval, or when the ECG curve shows considerable changes; it is possible to apply reset, as described above. The wristband mobile phone 136 and the mobile phone 87 may conveniently communicate via Bluetooth 95 and 130 using the central control unit 9b, if both are used. This has the advantage of dedicated the wristband to receiving only emergency calls, which are not blocked by regular calls received by the mobile phone 87. Using the said connection, the calls directed to the mobile phone 87 may be receive by the wristband by pressing the 500 button. Button 501 serves to receive calls directed to the wristband, while button 502 is for cancelling calls. Button 503 serves to dial the preset surveillance centre 22, while button 504 serves to change the function of selected buttons, for instance display 63 and the viewed values and curves, or to dial preset numbers.

[0034] The functions of the wristband mobile phone 136 may conveniently be programmed from devices such as the mobile phone 87, the PC 410 in the surveillance centre 22, or the PC 88. The device may conveniently be operated using the wristband mobile phone 136 or the mobile phone 87 separately, without the other device, or without the wristband 41, wristwatch 78 for communication with the central control unit 9b and the surveillance centre 22. If the wristband mobile phone 136 is not used and the mobile phone is used separately, the use of the wristband 41 has the advantage of being able to receive incoming calls to the mobile phone 87 by pressing the button 216. The button sends a command via radio connection 58, the external sensor and unit evaluation unit 89, the chest belt control unit 52 and Bluetooth 95. The communication is executed using the speaker 47, the microphone 46, the radio connection 98, connection 302 and Bluetooth 95. Connector 218 may be used to connect the cable for an external in-the-ear earphone and a microphone, which may be alternatively connected via Bluetooth. Along with the abovementioned buttons and controls on the wristband 41, the wristband mobile phone 136, the mobile phone 87, which may conveniently be used, it is possible to use other controls, as needed. Calls may be cancelled by pressing button 217. The wristband mobile phone 136 is adapted to the speakerphone operation, which is activated automatically when receiving a call. Extra high volume may be switched on by pressing the button 505. The wristband is equipped with earphone 506 with wired connection via connector 507 to socket 508. Plugging in the connector will automatically cancel the speakerphone operation and will switch to earphone 506. It is possible to connect to the earphone with a microphone 510 via Bluetooth 509. The connection is activated by switching on the earphone with a microphone 510.

[0035] **Fig. 6** in graph 107 illustrates regular heartbeat 101 as well as irregular heartbeat 102 conveniently transmitted by the chest belt 221 or the multifunctional chest belt 44. The time interval 103 for the calculation of arrhythmia can be set. It is also possible to set the minimum number of irregular heartbeats over a time interval which will set off the alarm.

[0036] **Fig. 7** shows heartbeats on graph 109 for assessing the irregularities of heartbeat. Time intervals 104, 105 and 106 for displaying heartbeats may be set by the monitored person or from the surveillance centre. On instruction from the surveillance centre 22, it is possible to display the time interval 104 or browse through previous time intervals 105, 106, and other, if needed. The heartbeats within the abovementioned intervals illustrated in graph 109 serve for information only and will in practice illustrate the actual behaviour of the monitored person's heartbeat. On request, it is possible to only display intervals with a specified deviation. The intervals that do not exceed the limit are not displayed. On alarm caused by irregular heartbeat exceeding the limit, the last time interval 104 in graph 109 may be sent automatically or on request by the surveillance centre via the communication path described above.

[0037] **Fig. 8** shows the time interval 124 between the heartbeats on the "x" axis and the number of beats per minute on the "y" axis, expressing the heart rate value 123. Connecting the values of the number of beats per minute, i.e. the heart rate, will create the curve 108, which illustrates the behaviour of the heart rate over the time interval. It is possible to conveniently monitor heartbeat regularity on the distance between beats at the same time with the behaviour of curve 108, which represents the heart rate, where the highest and the lowest heart rates suggest the spots of possible arrhythmia, on which the arrhythmia analysis may concentrate. For the sake of clarity, it is possible to set the minimum 701 and the maximum 700 heart rate to display only the curve where the limit values are exceeded, for instance in the neighbourhood of points 990 and 702, over a time interval; it is possible to browse through the time intervals stored in memory. If no limits are exceeded within an interval, the program may be set to disable the display of the interval. It is possible to distinguish increased heart rate due to increased physical exercise on the one hand and due to arrhythmia on the other. For this purpose, a curve of the average heart rate 1000 over a certain, adjustable time

interval 1001 has been introduced. In this case, the limits are set as a percentage of the average value of heart rate or the minimum and maximum limits are expressed as the number of beats over and under the average heart rate 1000. The average value of heart rate 1000 is automatically calculated, for instance, for the set time interval 1001 and conveniently refreshed after the expiry of such interval. During physical exercise, the average heart rate is increasing, raising the lower and the upper limits, which are derived from it, as well as the set limits for normal heartbeat. The shorter is the selected time interval, the more precisely will the physical exercise be taken into account. It is possible to set the limits for the average heart rate and to monitor the heart rate values for exceeding the preset minimum and maximum, regardless of the fact that the it may be a sinus heartbeat, in order to detect the heart function at maximum and minimum load. The central control unit 22 may set the heart rate minimum and maximum, as well as any other limits described in Figures 6, 7 and 8 via a GSM network. Alarm will be set off if any of the limits is exceeded. These limits may also be set by the monitored person to exclude alarms cause by an increased heart rate due to causes such as physical exercise. If a more intensive physical exercise is expected, the limit may be raise, if quiet is expected, it may be lowered. This enables to capture heart rate irregularities as compared to the situation where limits are set as fixed. The monitored person may reset the alarm with the reset button 13 during the warning signal if he/she evaluates that the alarm was false. Fig. 8 illustrates the example of a maximum 700 and minimum 701 heart rate limit. The alarm would be set off in points 702 or 990. The pulses for calculation are supplied from both the chest belt 221 and the multifunctional chest belt 44, which in addition supplies the ECG curve as the chest belt control unit 52 receives data from the two-lead heart beat sensor 73 in the chest belt and passes them on via Bluetooth to the central control unit 9. The chest belt 221 cannot provide the ECG curve as it only sends pulses in the rhythm of the heartbeat using a modulated radio signal.

[0038] **Fig. 9** shows a normal ECG curve 800, which is evaluated in the central control unit 9, for instance in Figures 3 and 4. The ECG curve, such as the curve 113 in Fig. 10, is scanned from the monitored person and is compared with the normal curve of a healthy individual, such as the ECG curve 800 in Fig. 9. Serious deviations set off the alarm, which is sent to the surveillance centre 22. For this method of evaluation, there are several examples of abnormal curves, compared with the normal ECG curve 800 in Fig. 9, which shows "R" waves 801, "T" waves 802 and "P" waves 803. The "T" wave 802 is usually followed with the "U" wave, which may not always be visible on the displayed ECG curve 800, which is the case here. In order to detect arrhythmia, particularly the interval 804 is compared between the "T" wave 802 and the "R" wave 801. The curve is analysed for any pathogenic waves, which are absent in interval 804 in a healthy individual, as can be seen in the ECG curve 800. The "P" wave 803 is also absent. Either phenomenon would indicate arrhythmia. If the "P" wave 803 is present, it is possible to measure the P-R interval 860. In the opposite case, it is probably arrhythmia, particularly atrium fibrillation, and the device will set off the alarm. If the P-R interval 860 is too long, it is the A-V block, which may be fatal.

[0039] If the P-R interval 860 is longer that the individually set maximum of the monitored person, the device will set off the alarm.

[0040] **Fig. 10** shows an abnormal curve 113 typical of tachycardia with a regular rhythm, which is in the monitored interval 804 indicated by waves 116, which do not occur in an ECG curve 800 of a healthy individual in Fig. 9. The "P" wave 803 is missing.

[0041] **In Fig. 11** on the atrium fibrillation curve 114 there are more waves 115 with larger amplitudes than with waves 116 in Fig. 10. Moreover, the heart rate is irregular and has a higher frequency, while the "P" wave is missing. After evaluating such deviations, the central control unit 9 would set off the alarm.

[0042] **In Fig. 12** on the atrium flutter curve 900 in the interval 804, a lot of waves 901 are apparent, while the "P" wave 803 from Fig. 9 is missing.

[0043] The personal emergency alarm device searches the interval 804 for any abnormal waves or irregular heart rate as described in Figures 9 to 12. If they do occur or the "P" wave 803 is missing, the device will set off the alarm. The alarm may conveniently be deactivated if the monitored person has already had the condition of arrhythmia and for other reasons that would too often cause alarm. During occasional arrhythmia, the alarm may be deactivated individually by being reset by the monitored person. The last time interval 104 in Fig. 7 and the last interval beyond standard are automatically displayed from the ECG curve during alarm or upon request. The display of previous time intervals from the history memory may be requested.

[0044] The ECG graph in Fig 9-12 and the curves of temperature, position, activity, shocks and the relevant instant absolute values may conveniently be displayed on the mobile phone display 18 in Fig. 3, on the mobile phone 87 in Fig. 5, on the mobile phone in the wristband 136, on the wristband 41 and the mobile phone case in the wristband 300 in Fig. 5, which communicate via Bluetooth, as well as on a PC 72 in Fig. 4, PC 88 in Fig. 5 and PC 410 in Fig. 5 in the surveillance centre. The data received from the sensors may be processed, for instance, in the control unit. The wristband 41 in Fig. 4 and Fig. 5 and the wristwatch 78, which communicated using radio waves, may display the graph 107 in Fig 6, the graph 109 in Fig. 7 and the curve 108 in Fig. 8, which are calculated and processed in their microprocessors from the receive data and their absolute value. **Fig. 13** shows a simplified bloc scheme of the stationary device for personal emergency alarm device, which has been described in detail in Fig. 1. The movement sensors 1 and 32 are common

sensors used, for instance, in security devices. They may be in any number placed around the monitored premises. Each movement detection is led via connection 3 and wired connection 33 to the movement sensor evaluation unit 2. The unit aggregates the reports from all sensors and if movement is detected, it sends an impulse or a signal to the central control unit 9. The movement sensor evaluation unit 2 works on the principle of EZS safety exchanges and uses the logical part of the unit to evaluate sensor data with a microprocessor unit for evaluating movement sensors 559 or the TTL logic or using a relay system. The central control unit 9 is the main unit of the device. It is designed to meet the objective of the invention using a central microprocessor unit 601, and to evaluate movement signals and compare them with the time interval set by the monitored person using button with a time scale 24. If no movement is detected during the interval, it will send a warning signal of a preset length, within which the monitored person my execute a reset using the reset unit 11.

[0045] In principle, the described alarm activation device consists of the sensor block 1200, the central control block 1201, the communication block 1202 and the reset block 1203, which are shown in dot-and-dash. The sensor block 1200 consists of various sensors, such as the movement sensor 1, the heart rate sensor 220, which is conveniently place in the chest belt 221, as well as other sensors. The other components include the sensor evaluation units, such as the movement sensor evaluation unit 2, the heart rate sensor evaluation unit 100 and the evaluation units for various sensors 141, which process data from sensors 2002, 2003 and 2004 using a sensor evaluation microprocessor unit 600. The resulting data are sent from the sensor block via, for instance, connections 48 and 3 to the central control block 1201, which is designed to meet the principles of the described patent and controls other blocks. In this example, it consists of a central control unit 9, which receives data from the radio frequency receiver 203, which receives the data via a wireless connection 12 from the reset block 1203 and there located radio frequency transmitter 208, powered with battery 99. In the event of a reset, the relay in the radio frequency 203 will engage, sending a 5V impulse to the I/O circuit 200. The central control unit further consists of a potentiometer 204, controlled using a button with a time scale 24, the switch of reset from the movement sensor 36 and the 5V voltage source 205. It supplies voltage to the switch of reset from the movement sensor 36, which sends voltage to the I/O circuit 200 when engaged. It also supplies voltage to the potentiometer 204, which leads regulated voltage to the A/D converter 207 and from there to the central microprocessor unit circuit 601, which evaluates the impulse against the preset time interval. The central microprocessor unit consists of a crystal 86 for the internal clock, the microprocessor 201 and the memory 202. The central microprocessor unit 601 cooperates with the IN and OUT (I/O) circuit 200, from which it receives input data in a digital form. Based on that data, as well as the data from the A/D converter 207, it evaluates data and information in compliance with the principles of the described alarm activation device and sends a warning signal, if needed, via the I/O circuit 200 to the siren 37. Unless a reset is received from the reset block 1203, the alarm command is activated via line 7 to the communication block 1202, which sends it via the phone line 8 to the surveillance centre 22. The control block executes the function using a SW program stored in memories 202, which is designed for this purpose to meet the objectives of the described alarm activation invention. The communication block consists of a communication unit 5, which controls the stationary phone 4 and the stationary phone 31 along the principles of a telephone exchange. On receiving a call automatically, it will switch the stationary phone 4 to the speakerphone mode and communicates with the surveillance centre 22 via a mobile operator's network. The surveillance centre may request sending data from sensors through the communication unit using a signal via phone line 8 after dialling he communication unit's 5 telephone number, and further on using a signal via line 7 to the central control unit.

[0046] The stationary phone 4 and the stationary phone 31, or other phones, are standard telephones adapted for the automatic speakerphone operation on receiving an incoming call and connected via lines 6 and 17 to the communication unit 5. The reset block 1203 consists of a radio frequency transmitter 208, which will send an impulse or an emergency call signal activated with the emergency call button 14, or in the event of a reset 13 activated with the reset button 13, placed in the reset unit 11, which is the main part of the reset block 1203. If a single stationary phone 4 is used, the communication block may conveniently be contained in the stationary phone 4. The movement sensor evaluation unit 2 may conveniently be comprised within the central control unit 9, which may itself be contained in the stationary phone 4.

[0047] **As described in Fig. 14,** which is a simplified illustration of the personal emergency alarm device described in Fig. 1, where the movement sensor evaluation unit 2, the heart rate sensor evaluation unit 100 and the sensor evaluation unit 2008 are contained in the same case with the central control unit 9, and the communication unit 5 is merged with the stationary phone 4, which is placed in the common case.

[0048] **Fig. 15** is a simplified illustration of the personal emergency alarm device described in Fig. 1, with the combined movement sensor evaluation unit 2 with the central control unit 9, the sensor control unit 2008, the heart rate sensor evaluation unit 100, the communication unit 5 and the stationary phone 4, in which it is placed.

[0049] **Fig. 16** shows the personal emergency alarm device described in Fig. 2, where parts of the device are grouped into the sensor block 1200, the central control block 1201, the reset block 1203 and the communication block 1202. The actual construction of the sensor, reset

and communication uses parts available in the market, which are appropriately adapted or developed to meet the requirements of the device. The wireless movement sensor 38 is appropriately adapted for wearing by the monitored person. The wireless movement sensor evaluation unit 39 and the sensor evaluation unit 1300 contains radio frequency transmitters 209, 210 and 211 for the respective sensors. The outputs of the transmitters are led to the central control unit 9. The wireless phone base station 25 is conveniently adapted to receive the alarm signal from the central control unit 9 and to send it via phone line 8 to the surveillance centre 22. The central control block 1201, which consists of the central control unit 9 and is designed to meet the objectives of the invention, has already been described in Fig. 13. The task of the sensor block 1200 is to collect data on the health condition of the monitored person. This task is discharged by sensors described in Fig. 2. The data from the sensors are processed in the detector unit and passed on to the central control block 1201. There the data is evaluated by the central control unit 9 and compared to the preset limits. In compliance with the principles of the invention, if the limits are exceeded the central control block 1201 sends the alarm signal to the communication block 1202, unless the reset block 1203 sends a reset signal during the warning signal, which is generated by the central control block before actually setting off the alarm. The communication block sends the alarm signal to the surveillance centre 22, which may communicate with the monitored person via the communication block 1202. The reset block 1203, which is one of the main parts of the described patent, consists, in the current design, of a reset unit 11 and a radio frequency transmitter 208, which sends signals by when the reset button 13 or the emergency call 14 button are pressed. It also consists of a battery 99. It is designed so that the monitored person may easily reach it and is placed in a wristband worn by the monitored person.

[0050] **Fig. 17** shows the personal emergency alarm device, already described in Fig. 2, with an illustration of the merger of the movement sensor evaluation unit 2, the wireless movement sensor evaluation unit 39, the sensor evaluation unit 1300, the heart rate sensor evaluation unit 100, the central control unit 9 and the wireless phone base station 25 into a single common multifunctional unit 1400.

[0051] **Fig. 18** shows a simplified bloc scheme of the mobile personal emergency alarm device, which has been described in detail in Fig. 3. The principles are the same as in Figures 1, 2, 13 and 16, with the exception consisting of using a mobile phone 18 for communication with the surveillance centre 22. Fig. 18 shows the sensor block 1200, the central control block 1201, the communication block 1202 and the reset block 1203. The reset block 1203 is comprised of the reset unit 11, which may, in this example, be conveniently placed in the central control unit 9 case and wired to its via connection 19. As it may be inconvenient and lengthy to control the reset button 13 on the central control unit 9 case, which may, for instance, be placed in a pocket, in the example in Fig. 18 the reset button 13 is conveniently placed in a wristband 41 for easy access. The wristband is worn on a wrist and therefore the reset button 13, which functionally duplicates the reset button 13 on the central control unit 9 case, as well as other controls placed there, is easily accessible. The wristband 41 thus creates another remote control and display block 1205. The wristband 41 comprises the display 63, which shows values from sensors and curves composed of such values. There is also the position-tracking block 1204, which consists of a position-tracking transmitter 45. The transmitter is designed to transmit radio frequency waves at an assigned frequency and with permitted power based on the standard principles of existing technology. Units in the described blocks, if designed in accordance with Fig. 18, are conveniently connected mostly via Bluetooth, and partly via wired or radio frequency connection. In contrast to the designs described above, the sensor block now contains a multifunctional chest belt, which monitors heart rate using the heart rate sensor 220, as well as the ECG curve and other health functions described above.

[0052] It is designed so as to comprise individual sensors attached to the chest belt in a way that they are in contact with skin and monitor the respective values. The sensors are connected to the chest belt control unit, which is connected via Bluetooth 55 to the central control block 1201 and to the central control unit 9.

[0053] The Bluetooth connection allows not only to transmit heart rate data, but also the ECG curve. The central control block 1201 with the central control unit 9 is described in detail in Fig. 13, together with the sensor unit and the reset block. The communication block 1202 differs from that in Figures 1,2, 13 and 16 by using a mobile phone 18 and communication with a mobile operator's network. The mobile phone 18 is designed to communicate via Bluetooth 138 with the central control unit 9, to have integrated GPS and to allow the addition of an operating system SW, which would control the personal emergency alarm device in cooperation with the central control unit 9 and work in the background of the SW for controlling the communication part of the mobile phone 18.

[0054] **Fig. 19** is a simplified illustration of the personal emergency alarm device described in Fig. 4, grouped into the sensor block 1200, the central control block 1201, the communication block 1202 and the reset block 1203, the position-tracking block 1204 and the control and display block. This grouping has been described in Fig. 18 analogous to Fig. 3. The difference against Fig. 19 consists in that the solution in Fig. 19 predominantly uses radio wave or wired connection instead of Bluetooth, described in Fig. 18. An example is the connection of the central control unit 9 with the multifunctional chest belt 44 via connection 62, with the wristband 41 via radio connection 140 and with the position-tracking transmitter 45 via radio connection 61. The central control block 1201

controls the other blocks, is designed to meet the objectives of the patent and has been described in Fig. 13. The other blocks have been described in previous pictures, particularly Fig. 13 and Fig. 18.

[0055] **Fig. 20** shows the personal emergency alarm device consisting of the sensor block 1200, the central control block 1201, the communication block 1202, the rest block 1203, and the remote control and display block 1205. The reset block 1203 is located in the remote control and display block 1205, and includes the reset button 13. The reset button is duplicated as reset can be executed also from the mobile phone 87 or the wristband mobile phone 136 by the eponymous reset button 13, which works in parallel. The central control block 1201, composed mainly of the central control unit 9b, is conveniently place on the chest belt. A part of the function of the block may be taken over by the mobile phone 87 or the wristband mobile phone 136, which uses a dedicated SW working in the background of the SW that controls the standard functions of the mobile phone.

[0056] **Fig. 21** provides a clear picture of the principle of the personal emergency alarm device, which consists of the sensor block 1200, the central control block 1201, the communication block 1202, the reset block 1203, the position-tracking block 1204 and the remote control and display block 1205, which provides the remote control and voice communication features. The functions of these blocks have been described in the specification of the invention and previous pictures. The central control block 1201 has the central function, controlling all the other blocks. The implementation is possible using a TTL or a microprocessor design, illustrated in Fig. 21. This has already been described in Fig. 13. The difference between examples in Fig. 13 and Fig. 21 lies in the communication block 1202, where the connection is implemented using phone lines in Fig. 13, i.e. the device is stationary, while it is implemented using a mobile phone in the communication block 1202 in Fig. 21, i.e. the device is mobile. The communication block is designed so as to include the controls necessary for controlling the alarm activation device, for instance the reset button 13a, which is duplicated with the reset button 13 on other units for easy operation. It is also designed to conveniently allow communication with the central control block 1201 via Bluetooth. This is implemented using a dedicated SW program, which operates in the background of the main SW program of the mobile phone, which controls the standard operation of the mobile phone. The central control block 1201 communicates with the sensor block 1200, where more sensors may be added to the displayed sensors. The communication block 1202 conveniently offers the option of choosing the mobile phone 87 or the wristband mobile phone 136. The latter has the advantage of easy operation and communication from the wristband mobile phone 136 on the wrist, without the need to take the phone out of pocket, which is the case with the mobile phone 87. The phone has a touchscreen or a flip-up keypad and buttons on the case. For easy communication, it is equipped with a speakerphone and an additional earphone 506 with wired connection via connector 507 or an earphone with a microphone (a headset) 510 with Bluetooth 509 connection. It houses two SIM cards 137 and 139 which allow connection using two independent phone numbers, of which one is reserved for emergency calls, alarm and communication with the surveillance centre 22, and the second one for standard calling, and is not blocked by common phone traffic. An incoming call on the emergency connection line is automatically received and switched to the speakerphone mode for immediate communication with the monitored person. Either the wristband mobile phone 136, or the mobile phone 87 may be used. The wristband mobile phone 136 is used for emergency display control and emergency communication, while the mobile phone 87 is used to detailed viewing, programming and other standard communication to prevent fast discharge of a relatively low-capacity battery of the wristband mobile phone 136. The remote control and display block 1205 consists of the wristwatch 78 with a display which serves to display data on health functions, such as heart rate and the relevant time-series curves calculated in the microprocessor in the wristwatch 78. In addition, the wristband 41 allows easy remote control and voice communication. The sensor block is designed with various sensors, which may be connected according to individual needs of the monitored person. The reset block 1203 and the position-tracking block 1204 have been described in previous pictures. Individual blocks may communicate with one another conveniently via Bluetooth, radio frequency waves, wired connection or any other suitable connection, or any combination of them. In the event of a failure of connection between blocks, the device will try to use reset and an initialization process in the SW program to renew the connection. If the attempts fail after a specified number of repetitions, the device will send a warning signal to the monitored person to notify him/her that he/she is not monitored any more.

[0057] **Fig. 22** shows the use of the described principles of the invention for a simplified economic execution of the personal emergency alarm device, where there central control unit 9a is conveniently located in the mobile phone 87, connected to sensors, such as the heart rate sensor 220a, and the reset unit 11a, conveniently placed in the wristband 240 via Bluetooth 241, depicted in dash-and-dot. A multifunctional chest belt 44 may alternatively be used instead of the chest belt 221. Some of the sensors may conveniently be placed in the mobile phone 87. The central control unit 9a operates in the microprocessor unit of the mobile phone 87 using a dedicated SW program in the background of the main operating system which controls the functions of the mobile phone 87. The functions of the mobile phone have been described in Fig. 5. There is an additional possibility to design one of the keypad buttons, for instance, the button 5000. Pressing and holding the button for two seconds will change the functions of the control buttons of the

mobile phone 87 to the selected functions necessary for controlling the personal emergency alarm device, and back. This applies to the plus button 131 and the minus button 132, used to set the time interval for setting off the warning signal. It is possible to insert 2 SIM cards 137 and 139 into the mobile phone. They allow calls to two independent phone numbers, where one can be used for regular phone communication, while the other one will exclusively be dedicated to emergency communication, for instance with the surveillance centre 22. When an incoming emergency call is not received by the monitored person, it may automatically be received by the mobile phone 87 after the mobile phones has rung for the preset number of times, with switching to the speakerphone mode via the speaker 47, which may switch to extra high volume though an acoustic command of the caller to capture the attention of the monitored person or its neighbourhood, if the monitored person does not respond. The described device consists of individual blocks, the sensor block 1200 and the reset block 1203, described in previous pictures. The reset block 1203 reduplicates the reset block 1203a in the mobile phone 87a body, offering emergency control. External devices, such as the chest belt 221, complement the mobile phone 87a and may fulfil the basic functions of the personal emergency alarm device, regardless of whether, and if so, how many and what external devices are used, as specified in detail in Fig. 24.

[0058] **Fig. 23** illustrates a similar example to the one described in Fig. 22, where the personal emergency alarm device uses the wristband mobile phone 136a instead of the mobile phone 87a for the communication block 1202. The speaker 47 conveniently takes over the function of the siren 37a and, in addition, ensures the intermediation of acoustic communication. On the case of the wristband mobile phone 300 there is a camera 5010, which is directed to the space in the direction of the wristband as the clothing may be rolled up there not to block the view. If the incoming call has automatically been received, the surveillance centre 22 may use acoustic commands over the mobile line to switch on the camera for monitoring the neighbourhood of the monitored person and its activity, if the image in the camera is moving. This may conveniently be used also for resetting the time interval for setting off the warning signal. In that case, the camera is left switched on and if the image changes, i.e. if the monitored person moves, the time interval will be reset. The described sensors and external units may be deployed as needed, i.e. some, or in an extreme case even all, of the sensors may not be used. The wristband mobile phone 136a or the mobile phone 87 may still serve some important functions of the described invention. For details, see Fig. 24. A body temperature sensor 75a may easily be placed in the wristband mobile phone 136a under the case of the wristband mobile phone 300 to touch the skin. There may also be the movement sensor 1b, which is placed on the right side of the wristband mobile phone case 300 directed to the space across the wrist, to which the wristband may be moved to prevent the sleeve from blocking the view. On the same spot, there is also the camera 5010, which may serves as a movement sensor, from which the central control unit 9a evaluates whether the image is moving, which would indicate a movement of the monitored person.

[0059] **Fig. 24** illustrates an economical example of a personal emergency alarm device solution with the possibility to easily and immediately monitor heart rate on display 80 in wristwatch 78, which may also include the reset unit 11b, located in the wristband 244 or in the wristwatch 78 as the lid reset unit. This is made possible by the central control unit 9a placed in the mobile phone 18. The central control unit works in the background of the main operating SW program of the mobile phone 18 with the help of a dedicated SW program designed to meet the principles of the presented invention, as described in the previous pictures. This brings savings as compared to the device with a separate central control unit 9. More considerable savings are effected thanks to the conversion block 1207, which covers the radio frequency connection to Bluetooth connection 5021, for instance from the chest belt 221, in particular from the radio transmitter 81, the radio frequency connection 5022 and the receiver 82 and other sensors. For instance, from the movement sensor 1a, which may be used as the movement sensor 1c for a free view of the neighbourhood of the wristband 244, or from the reset unit 11, which may be placed on the wristband 240 (xxx). The radio transmitter 81 transmits data from the heart rate sensor 220 simultaneously to the receiver 82 in the wristwatch 78 and the conversion block 1207. The conversion block 1207 may be placed on the chest belt 221. The heart rate sensor 220 may be wired directly to the conversion block 1207. The conversion block 1207 consists of the conversion unit 5020 together with radio frequency receivers, such as the receiver 82. The conversion unit 5020 cooperates with the other blocks via radio frequency connection 5022 and Bluetooth 5021. All the sensors in the Fig. 24 and other pictures, such as Fig. 22 and Fig. 23, including the movement sensor 1a and the external units placed outside the body of the mobile phone 18, such as wristwatch 78, are optional and may be worn as needed. If no sensors or external units are used, the mobile phone 18 or the mobile phone 87 from Fig. 22 or the wristband mobile phone 136 from Fig. 23 still take care of the essential functions of the personal emergency alarm device, particularly the confirmation of normal response by resetting with the reset button 13, or the reset button 13b, during the warning signal from the speaker 47 in the mobile phone, where the time interval for setting off the warning signal may be set by the plus button 131a and the minus button 132. Emergency call is activated by pressing the emergency call button 14. On an incoming call, after the ringing has been repeated the set number of times, the mobile phone 18 will automatically receive the call in the hands-free mode, i.e. in the speakerphone mode and the surveil-

lance centre 22 may communicated with the monitored person regardless of whether he/she can control the buttons. The surveillance centre may further use a coded signal from the coder/decoder 5030 send an acoustic or data command, decoded in the coder/decoder 5031, which will switch the hands-free operation to higher volume to capture the attention of the monitored person, if it does not respond to normal volume, or to call on the neighbourhood to call help. In this way, the surveillance centre may remotely control also other functions, such as switching on the camera 5010 for monitoring the neighbourhood, which is relevant mainly in the wristband mobile phone 136 in Fig. 4, where the camera 5010 has a free view thanks to being placed on the wrist. It may also switch on the position-tracking transmitter 45, which may be placed in the mobile phone 18 as the position-tracking transmitter 45 a, and it may also switch on the siren in the central control unit 9a to generate an acoustic signal from the speaker 47 for calling for help, with which it can communicate after switching off the siren.

[0060] The described remote control and connection using a coded signal or data via a modem, or a data connection, may serve the surveillance centre 22 to download data from sensors, images from the camera, and other information, via a mobile operator's network. Two SIM cards 137 and 139 may be used. One is used for normal phone operation, while the other is dedicated for emergency calls, monitoring, the transmission of health and other functions, and their remote control using a mobile phone connection. Sensors, such as a shock sensor 43 or a position sensor 50, may conveniently be placed in the mobile phone 18 and 87 and the wristband mobile phone 136 in Fig. 5 and Fig. 23. The implementation of this and other functions is enabled by the above mentioned central control unit 9a, controlled by a dedicated SW program, which works in the background of the main SW program that controls the common functions of the mobile phone 18.

[0061] **Fig. 25** shows the personal emergency alarm device which uses the conversion block 1207 to convert the radio frequency connection from external units, for instance the radio frequency connection 5022 from the chest belt 221, to Bluetooth 5021 for connection with the central control unit block 1201c, which includes the central control unit 9c. The central control block 1201c may contain optional internal blocks and units, such as the reset block 1203a, the position-tracking block 1204a, the communication block 1202a and the sensor block 1200a. The sensor block may include sensors such as a shock sensor 43a, a body position sensor 76a, and others. These blocks and sensors may alternatively be external, such as the shock sensor 43, the heart rate sensors 220 and other sensors. The communication block 1202a has all the necessary components for communication with a mobile operator's network 246. Along with the SIM card 137 it also has the optional SIM card 139 for other telephone line. The central control block 1201c with the central control unit 9c has all the necessary controls, such as the plus button 131, the minus button 132, to set the time interval to set off the warning signal. It is also possible to set the point in time at which the warning signal is set off. This is used instead of the time interval particularly when setting a longer period of time if a longer period of inactivity , such as sleep, is expected, during which the monitored person does not want to be disturbed. If the monitored person does not respond at the set time, the central control block 1201c will send an alarm to the surveillance centre 22, which will check whether the monitored person is in emergency in the following way: After dialling the monitored person's number and unless the monitored person receives the call, the surveillance centre 22 will let the phone ring for a preset number of times and then receive the call automatically, via the central control unit 9c. With automatic coded acoustic signals using the coder/decoder 5030 and the coder/decoder 5031, it may control the blocks and units in the device at the monitored person through the central control unit 9c. For instance, it may check the data from the sensors which it may request by coded acoustic commands to be sent via the phone line, or request sending images from the camera, which the monitored person can conveniently aimed at himself/herself before sleep. It may also activate the siren 37 for capturing the attention of the monitored person before the decision on intervention is taken. The coder/decoder 5030 and 5031 may be implemented using modems. For emergency connection with the surveillance centre 22, two SDV1 cards are used with separate phone numbers. One of the SDV 1 cards with a separate phone line is exclusively used by the surveillance centre 22. Regular calls may conveniently be handled through the second line in order not to block the emergency line. If there are two SIM cards, one line may be used to transmit the commands of the central control block 1201c, while the other may be used by the surveillance centre 22 to send requested data, such as health information or images from the camera 5010. This may be implemented using coded acoustic signals or SMS, or via data streams along the other mobile phone line, which is initiated by the central control unit 9c on the surveillance centre's 22 request via the first line using a coder/decoder, as described above. The described data transmission may be conducted using a single line, if needed. In that case, after sending the commands for data or image transmission any conversation must be interrupted to free the line for transmitting the requested data. The described data transmission may also be mediated by the central control unit 9a, for instance in the mobile phone 87a in Fig. 22, or the wristband mobile phone 136a in Fig. 23, which in these examples operates in the background of the main SW program, as illustrated. There is an option between an external communication unit 1202 with a mobile phone 18 connected via Bluetooth 138a on the one hand, and an internal communication unit 1202a with components for communication via a mobile operator's network 246 placed in the central control unit 9c on the other, which conveniently uses the central

microprocessor unit 601 from the central control unit 9c, which controls it. The central control unit 9c may alternatively be placed in a wristband 244 for quick control and communication. In the case, it is not necessary to wear wristwatch 78. In this case, the central control unit 9c is smaller than the pocket or the case unit. In those two cases, it has a larger sliding or flip-up display 96a, or a touchscreen to achieve maximum dimensions without the need of enlarging the whole central control unit, which would be necessary if the display was mounted next to the keyboard. The central control unit 9c may conveniently contain the conversion block 1207a with the conversion unit 5020a. This may be placed also on the chest belt 221 as the conversion block 1207b or may be a separate unit — the conversion block 1207. The picture also shows the position-tracking block 1204 as an external unit, or the position tracking unit 1204a included in the central control unit 9c. There is also the main control keypad 245, the button for switching the function of keypad buttons 248 for more functions without the need to enlarge the control area, to achieve an economical control of all the necessary functions for the purposes of the described invention. The reset block 1203, placed in the central control unit 9c may alternatively be included in the wristband 244 as the reset block 1203b or in the wristwatch 78 as the reset block 1203d, or in the central control unit 9c as the reset block 1203c. The position-tracking unit 1204a may conveniently be contained in the central control unit 9c, or it may be placed independently as a position-tracking unit 1204.

[0062] **Fig. 26** shows the connection of external units, such as the sensor unit 1200, via Bluetooth 250. It is possible choose between an external mobile phone 18 and internal parts for communication via a mobile operator's network 246.

[0063] **Fig. 27** shows a combined connection of external units to the central control units 9c using radio frequency waves, for instance the radio frequency connection 5022 from the chest belt 221, or

[0064] Bluetooth, for instance the Bluetooth connection 55 from the multifunctional chest belt 44. There is also the automatic restart after the connection between units or blocks have been interrupted, i.e. an attempt to renew the connection. If the connection fails to restart, the warning signal is initiated. If the warning signal is not reset by the monitored person, the alarm is set off.

[0065] This activity is controlled by the central control unit 9c, which monitors the fluency of data traffic, evaluating data for viewing, passing on to the surveillance centre 22 or setting of the alarm. If data from any sensor stop streaming, for instance from the two-lead heartbeat sensor 73 or the multifunctional chest belt 44, the central control unit 9c will restart the Bluetooth connections and attempts to re-establish the Bluetooth-protocol connection via the "master" Bluetooth unit 251, located in the central control unit 9c, cooperating with the "slave" Bluetooth unit 252, located in the chest belt control unit 52. If it fails, it will execute a preset number of attempts at restart, for instance 3 attempts. If the connection fails to restart, a specific warning signal is set off to notify the monitored person of the failure data stream from the sensor. This may be followed by an attempt at manual restart, or, if unsuccessful, a repair of the relevant components to establish connection. The same procedure would apply accordingly to the chest belt 221, where the central control unit 9c would initiate the restart of the receiver 82 via the conversion block 1207 and the "slave" Bluetooth unit 252a located there, and further via the conversion unit 5020. If there is a defect on the radio transmitter 81 or the chest belt 221, the chest belt cannot be restarted using this procedure. In such a case, the central control unit would initiate the warning signal and the monitoring person could try to reset of the chest belt with the radio transmitter 81 manually. If an automatic reset is requested, the solution would consist in, for instance, using transceivers instead of the radio transmitter 81 and receiver 82, so that the central control unit 9c may wirelessly send a restart command to the chest belt 221. The reset would be executed similarly for the other sensors. The described example of restart is only one of several options and restart could be executed otherwise so as to meet its purpose, i.e. to renew the data traffic, particularly from the sensors, and to send a warning signal if this is unsuccessful.

Claims

1. The personal emergency alarm device evaluates criteria for setting off the alarm from the information it receives on the health functions of the monitored person and information on the elapsed time during which the monitored person should show movement or alertness in a prescribed way. If such criteria exceed the set limits, it will set off the alarm.

2. Personal emergency alarm device in accordance with point 1, where the criteria for setting off the alarm may be set by the monitored person.

3. Personal emergency alarm device in accordance with point 1, where the monitored person may activate the warning signal before setting off the alarm. Within a preset time interval from the warning signal, the monitored person may reset the alarm. By resetting the alarm, the time to set off another alarm runs again from zero and the alarm will again be set off after the expiry of that time interval.

4. Personal emergency alarm device in accordance with point 1, where the alarm is sent via the communication medium to the surveillance centre.

5. Personal emergency alarm device in accordance with point 1, where the communication medium is a phone line.

6. Personal emergency alarm device in accordance with point 1, where the communication medium is a mobile phone network.

7. Personal emergency alarm device in accordance with point 1, where the adjustable criterion is the time interval during which the device has not detected any movement.

8. Personal emergency alarm device in accordance with point 1, where the adjustable criteria are the limits for heart rate and other criteria for normal heart function.

9. Personal emergency alarm device in accordance with point 1, where movement is detected by a movement sensor worn by the monitored person.

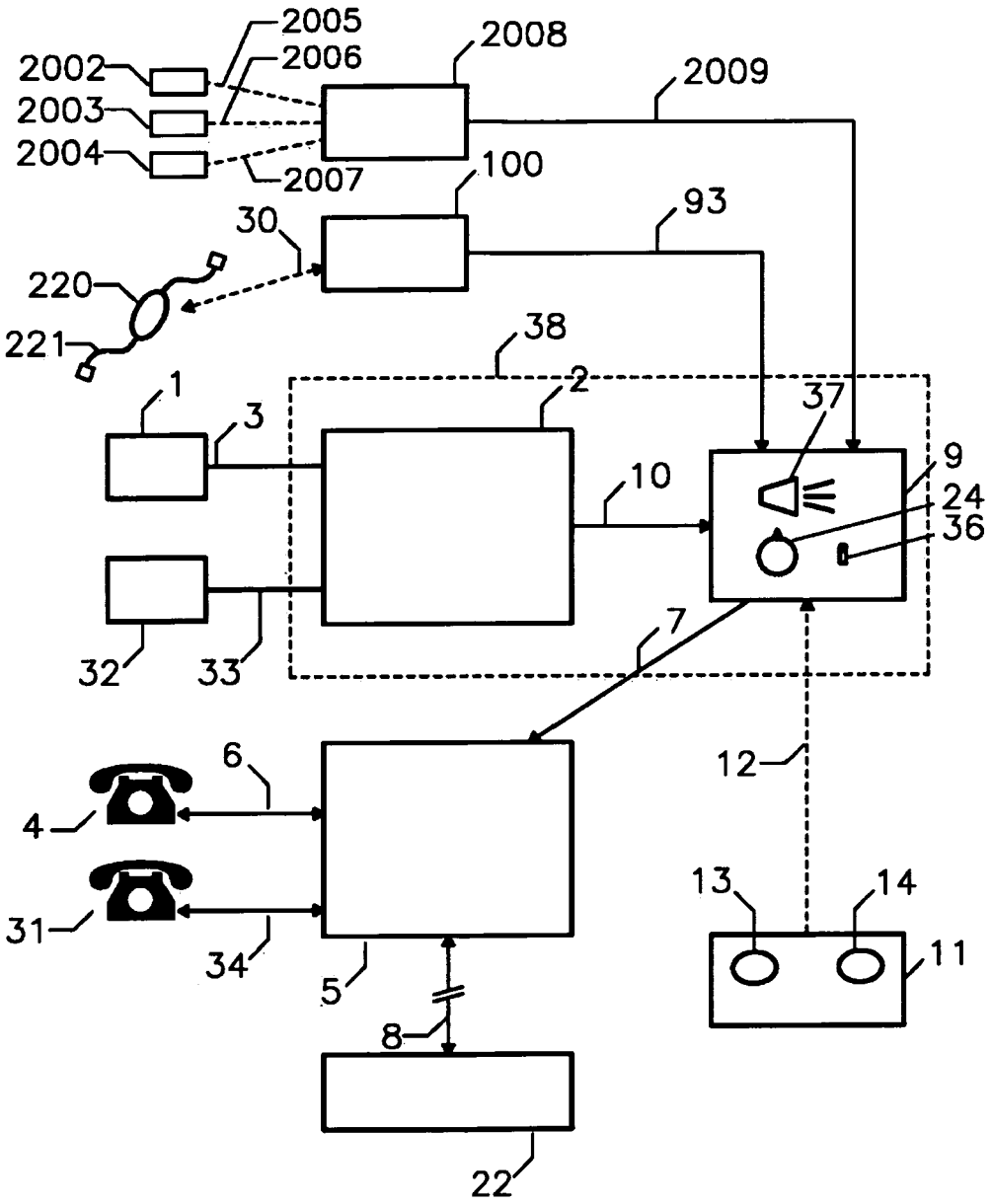
10. Personal emergency alarm device in accordance with point 1, where the reset may be executed using a remote reset unit.

11. Personal emergency alarm device in accordance with point 1, where a wireless phone is used for voice communication.

12. Personal emergency alarm device in accordance with point 1, where a request by the surveillance centre may switch the phone conversation to the speakerphone mode.

13. Personal emergency alarm device in accordance with point 1, where a mobile phone is used for communication.

Fig.1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22

Fig.2

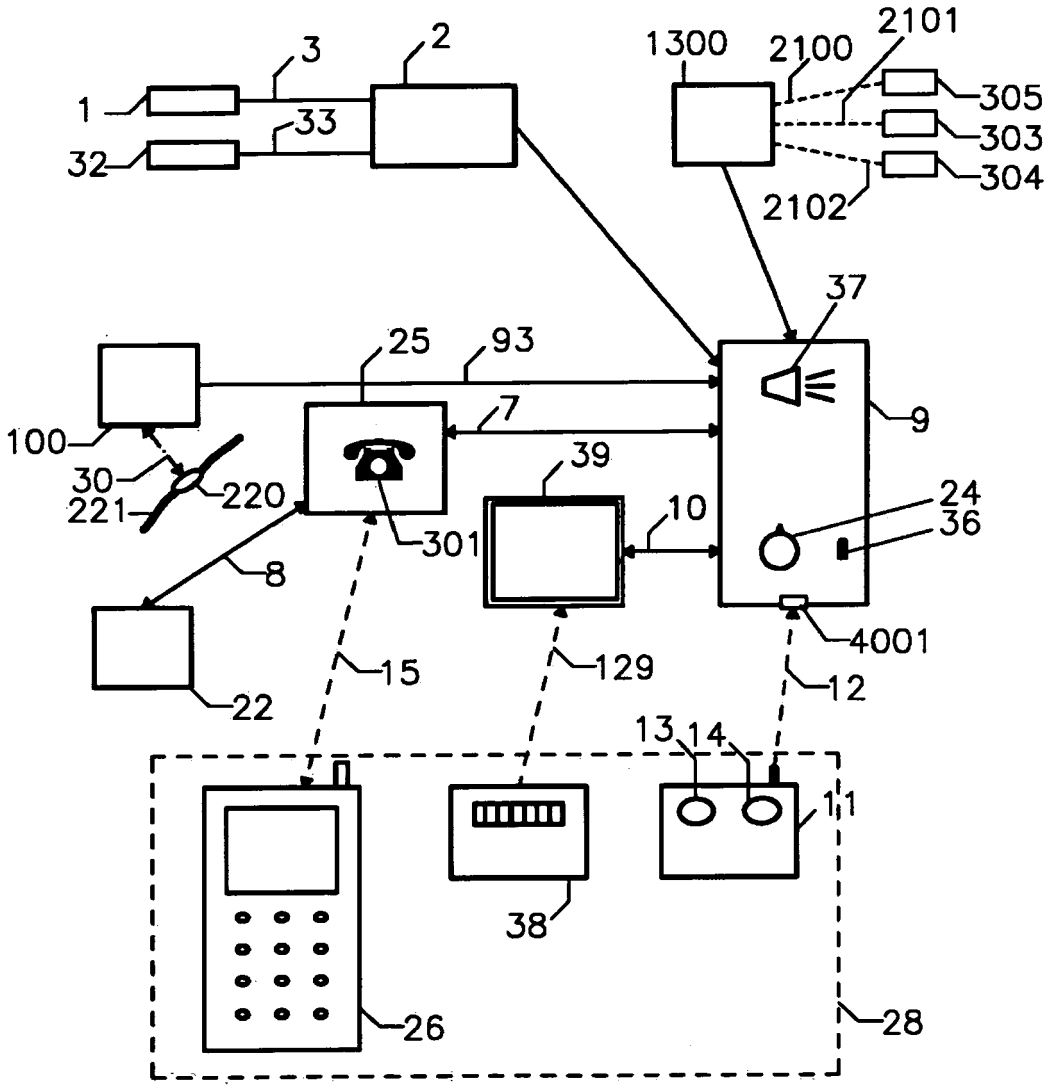
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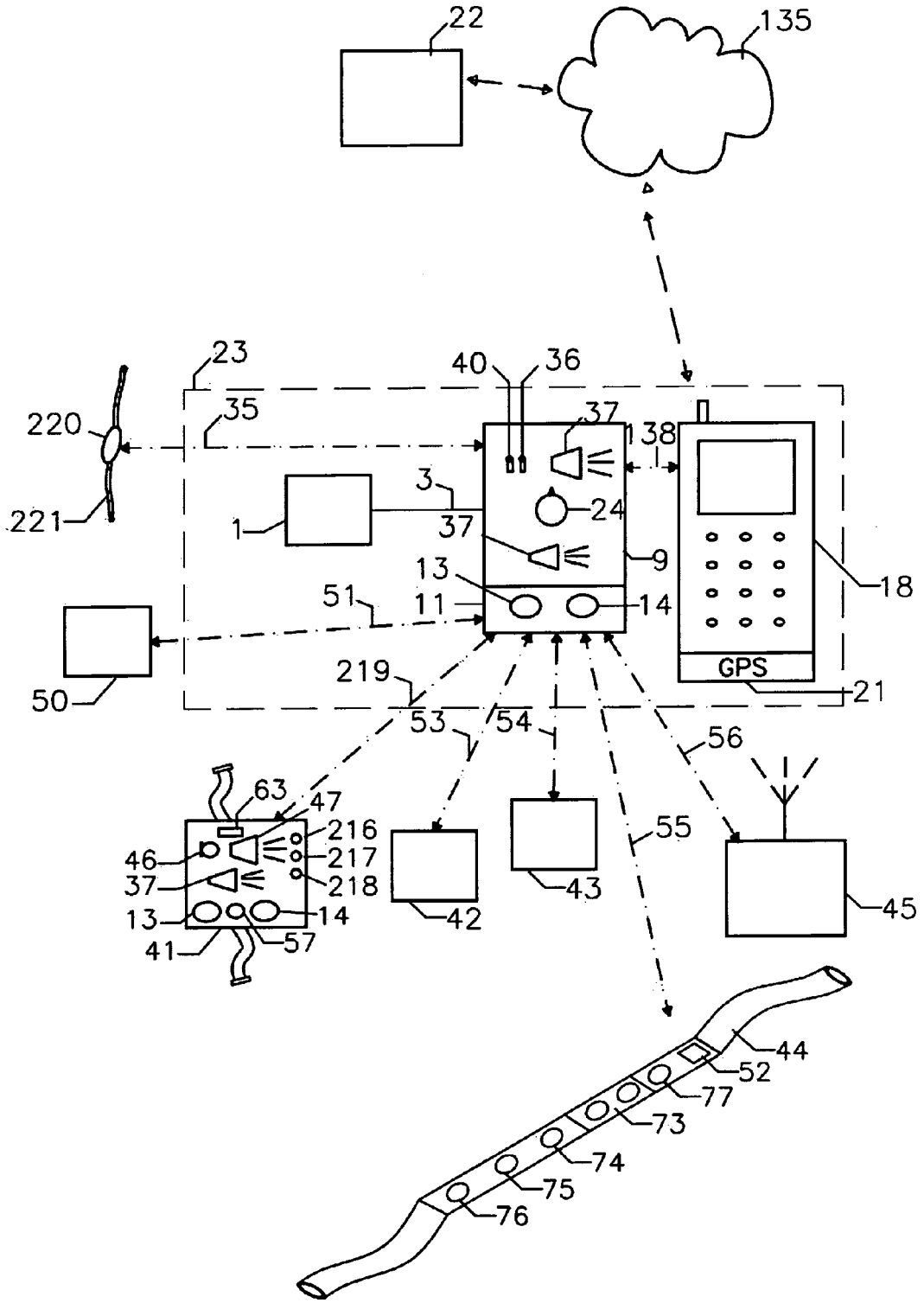
Fig.3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56
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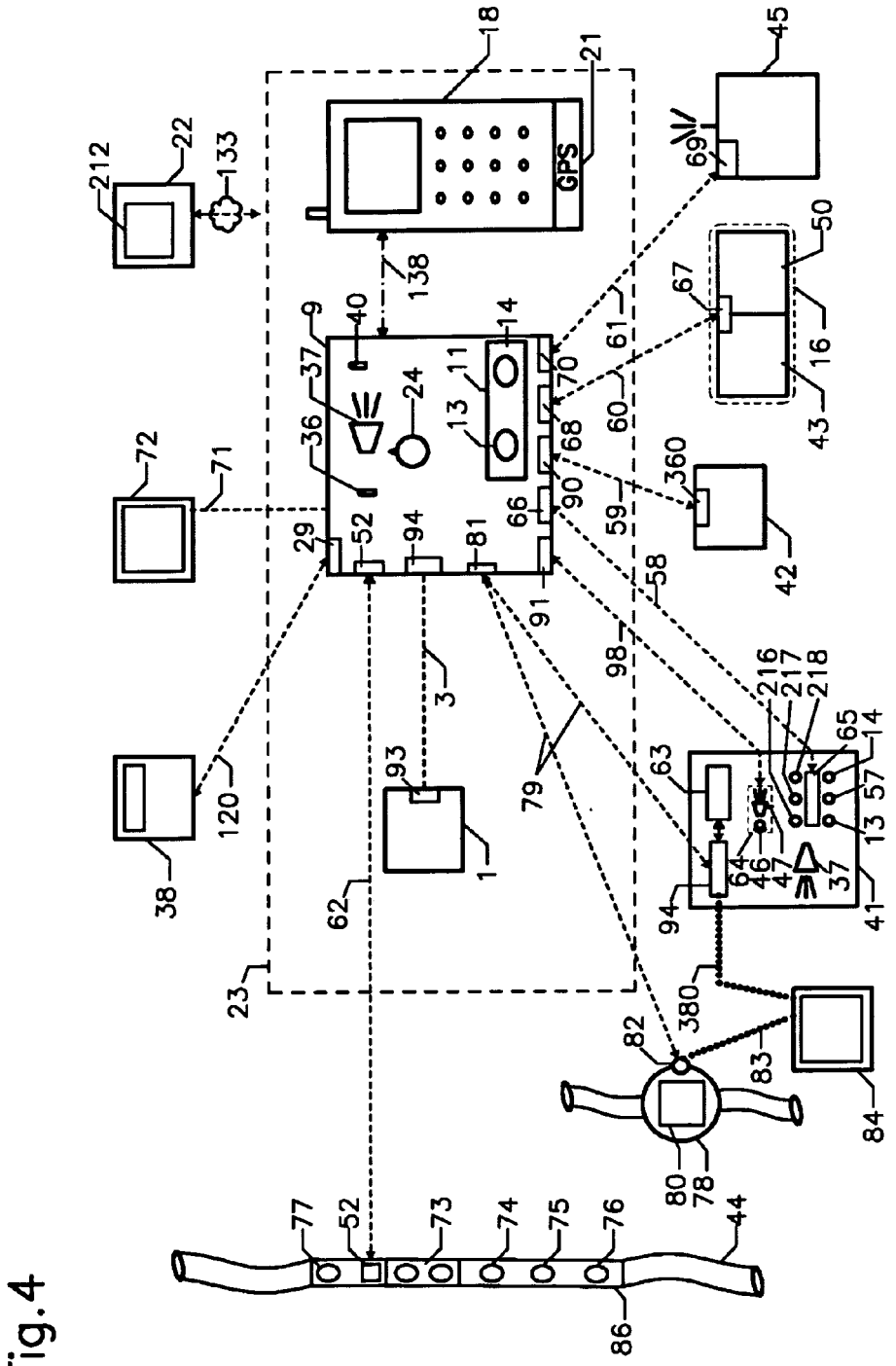
Fig.4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43
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71
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90
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52
94
81
42
58
91
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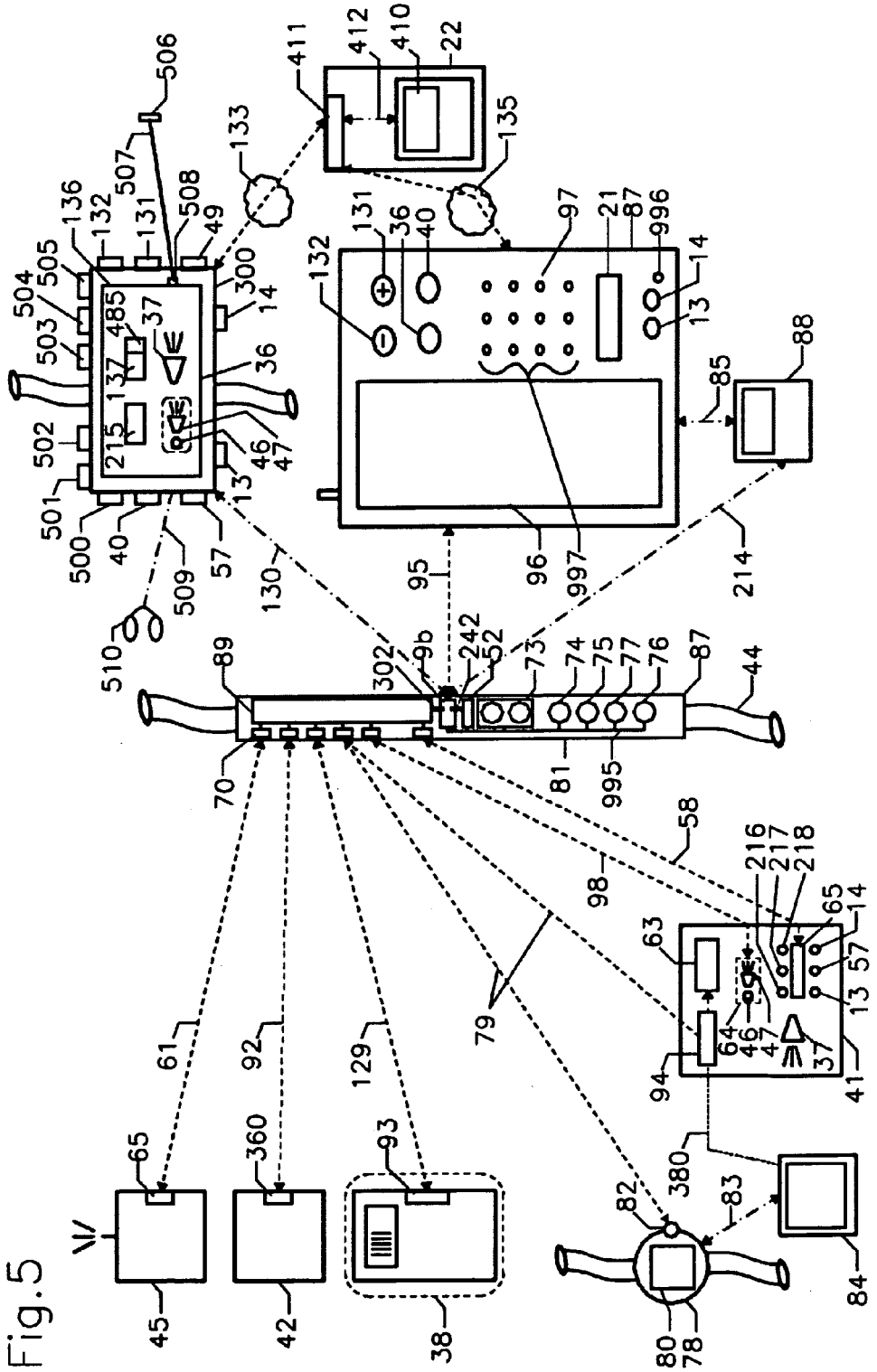


Fig.5

Fig.6

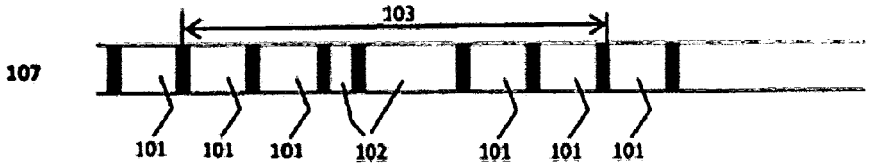


Fig.7

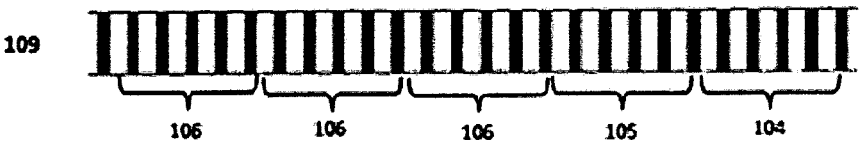


Fig.8

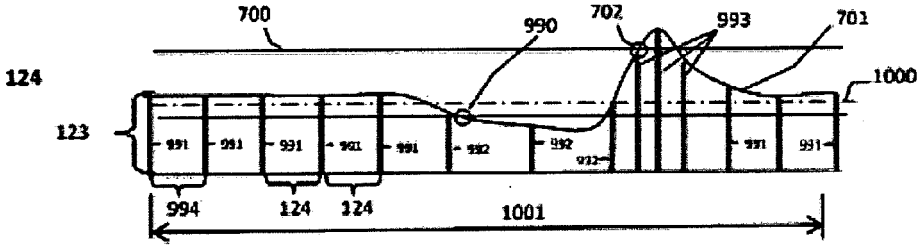


Fig.9

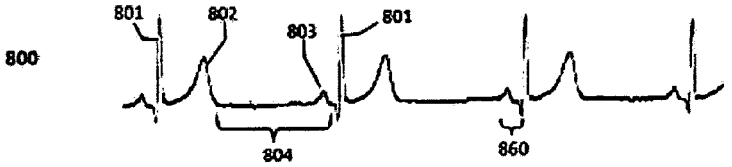


Fig.10

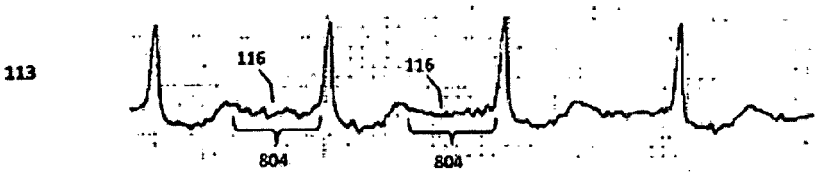


Fig.11

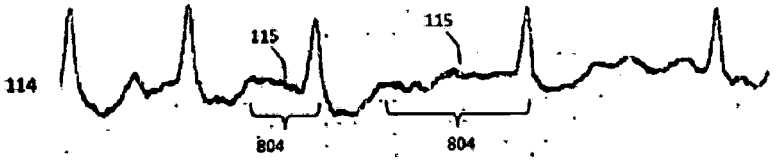


Fig.12

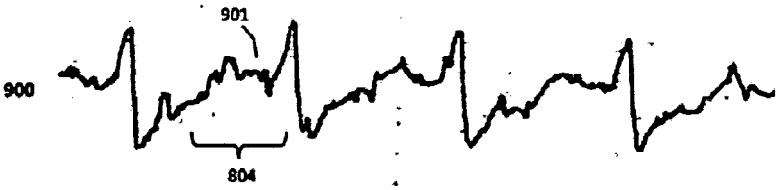
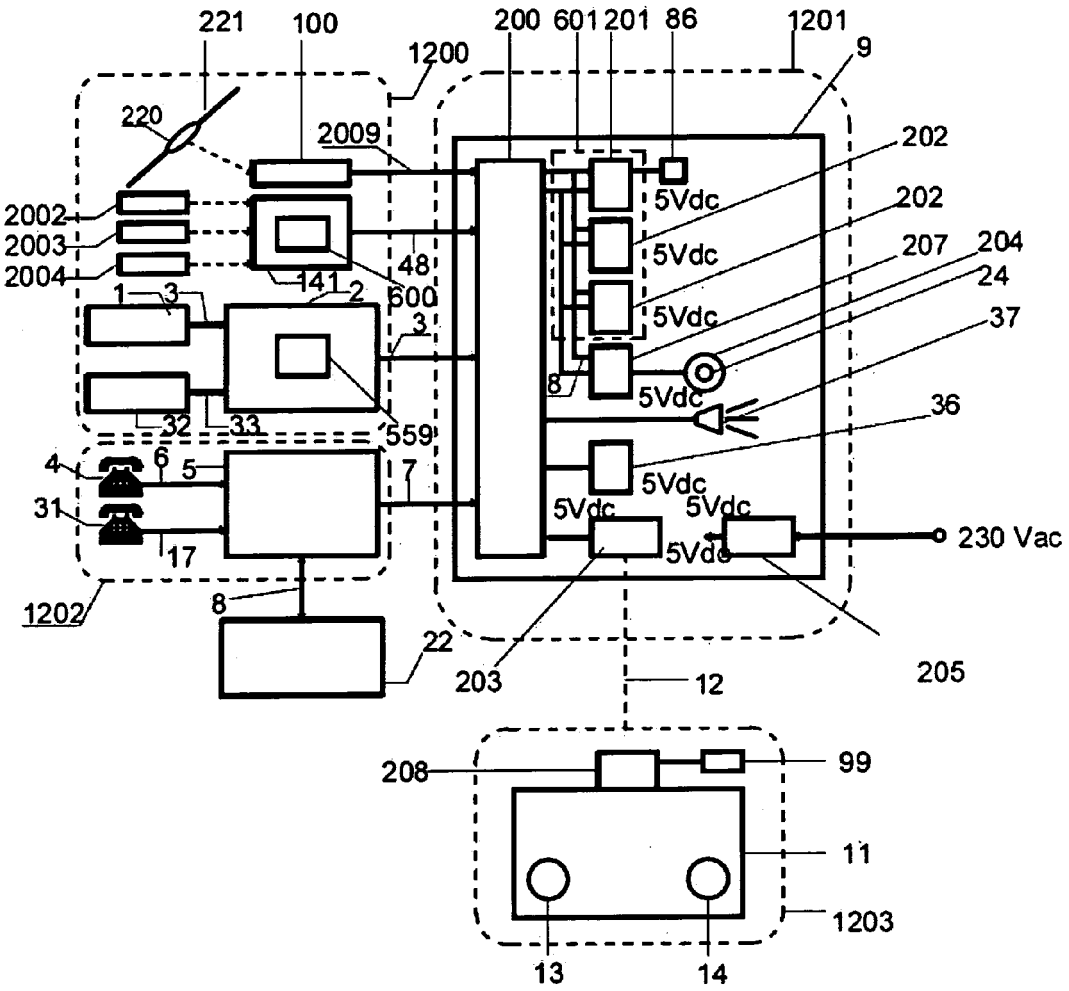


Fig. 13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5Vdc
5Vdc
5Vdc
207
204
24
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559
36
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6
5
7
5Vdc
31
17
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Fig. 14

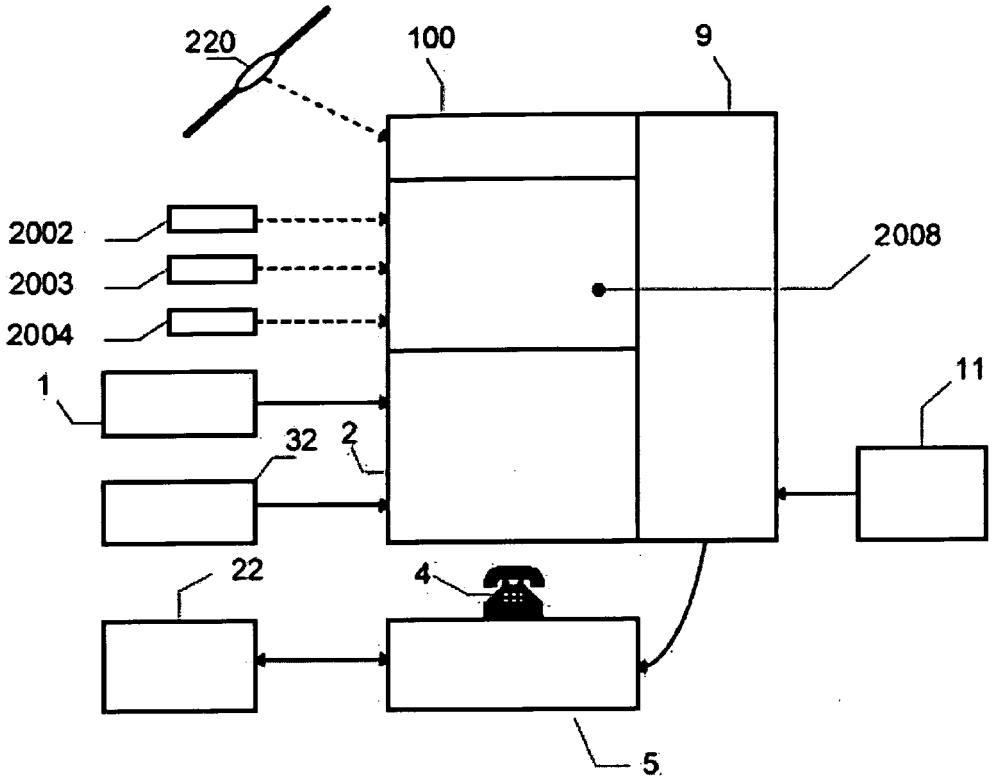
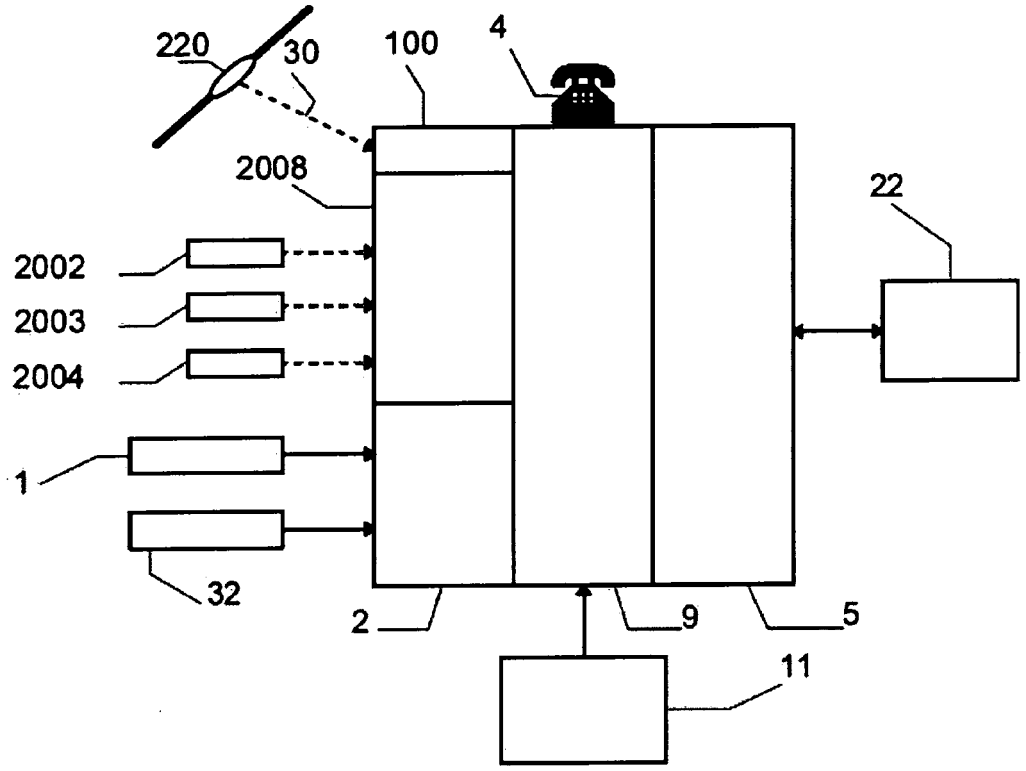


Fig. 15



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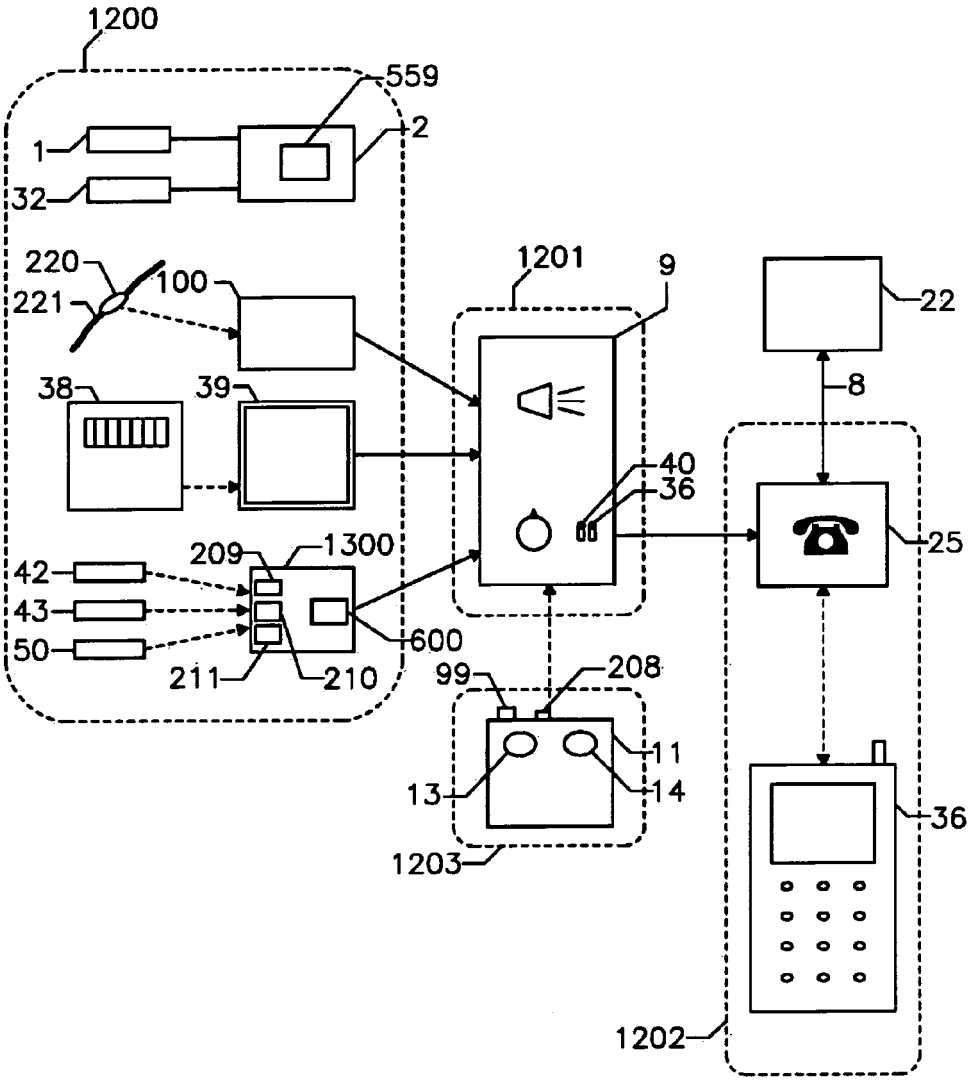
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Fig.17

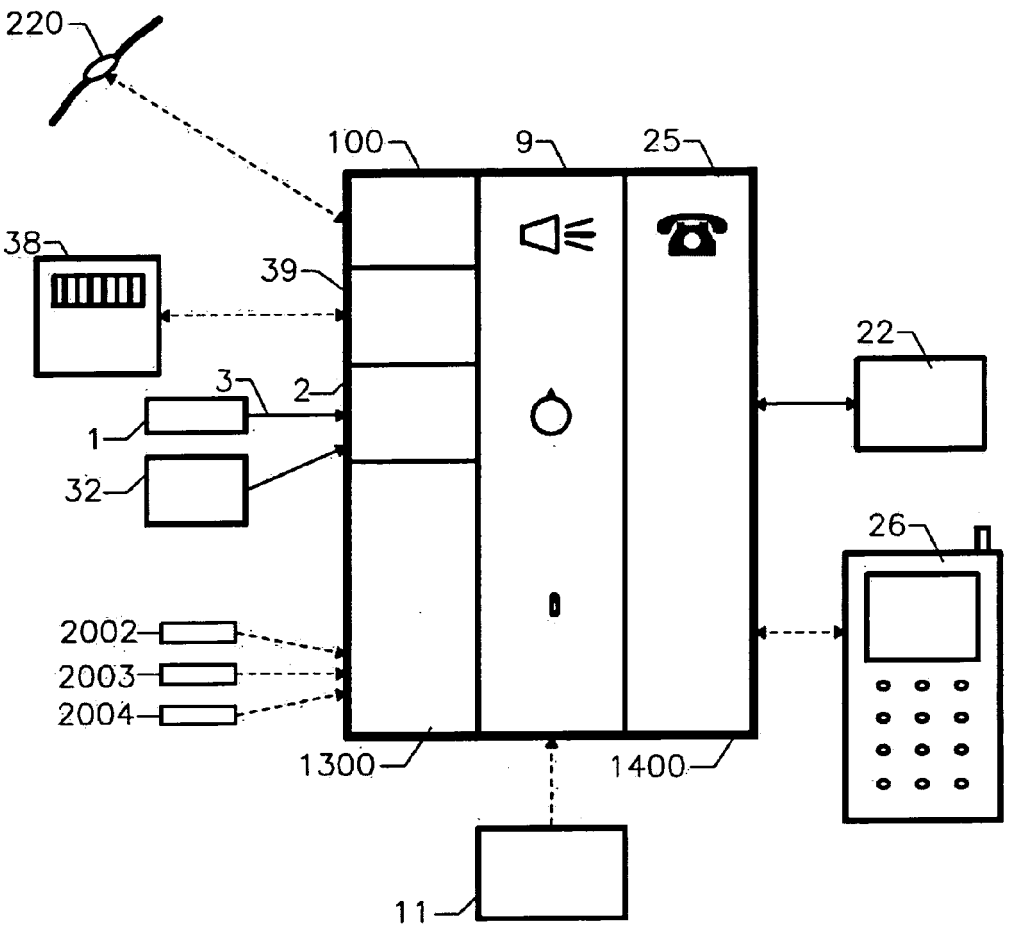

Fig.18

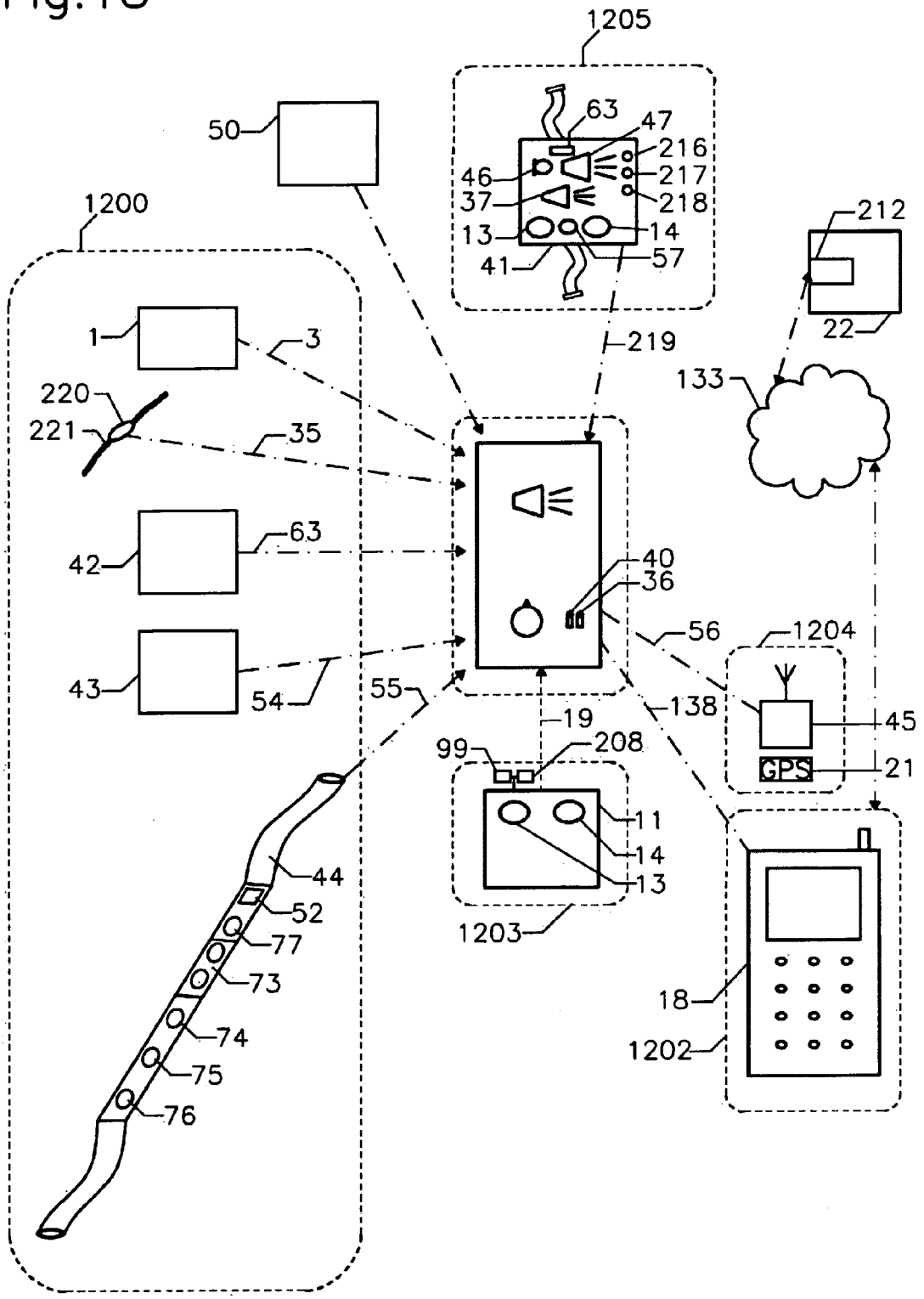
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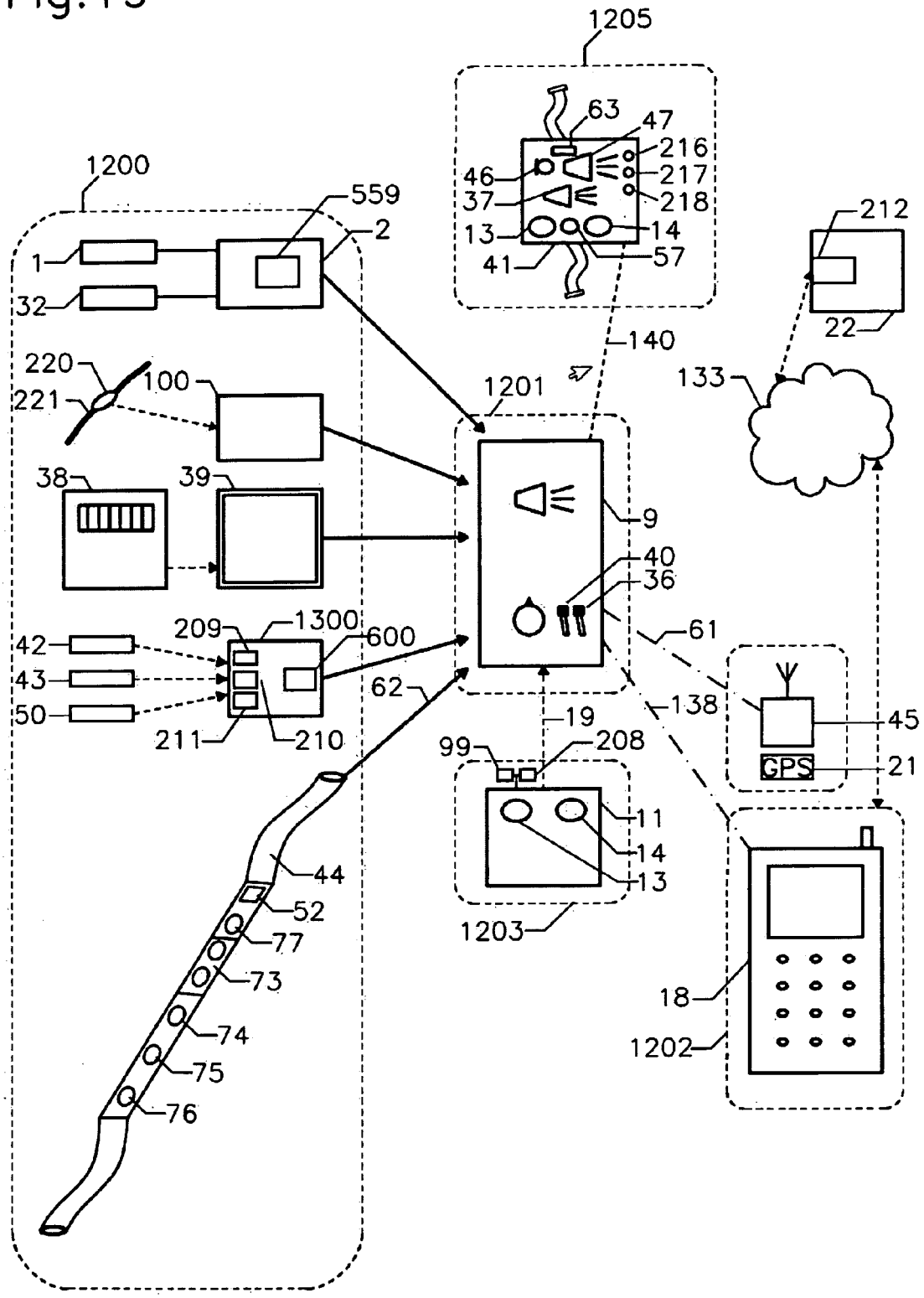
Fig.19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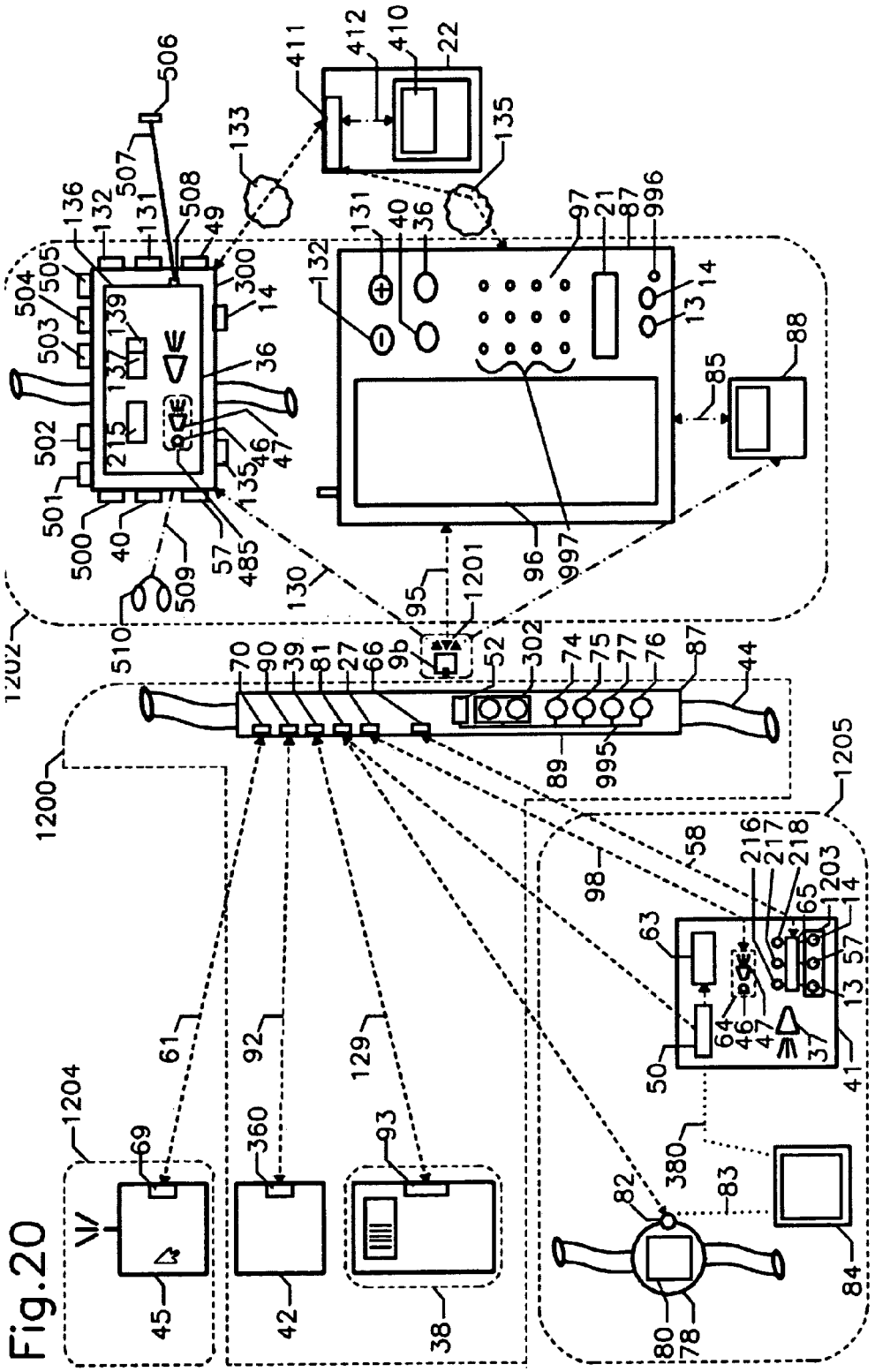
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81
27
66
9b
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Fig.20

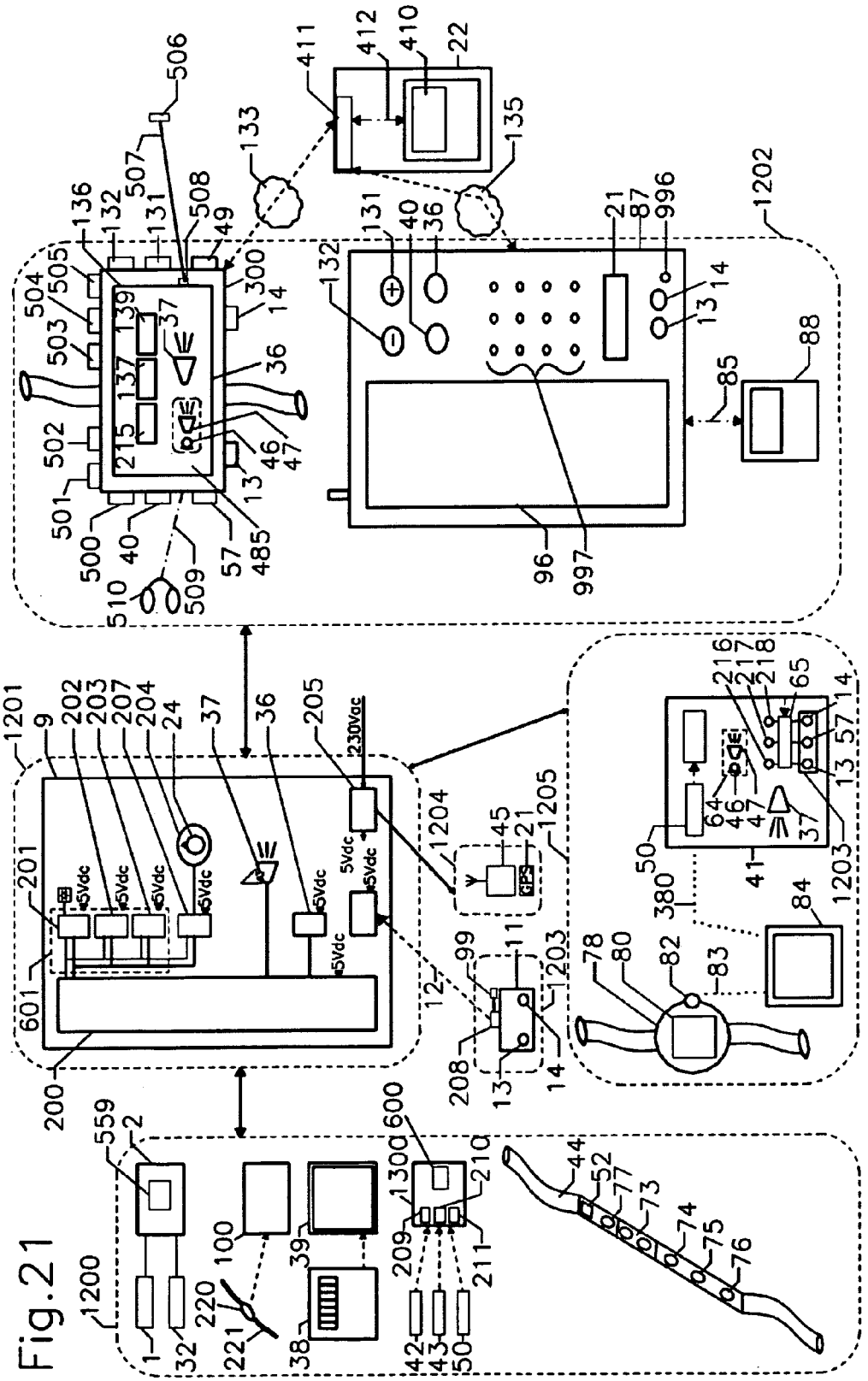

Fig.21

Fig. 22

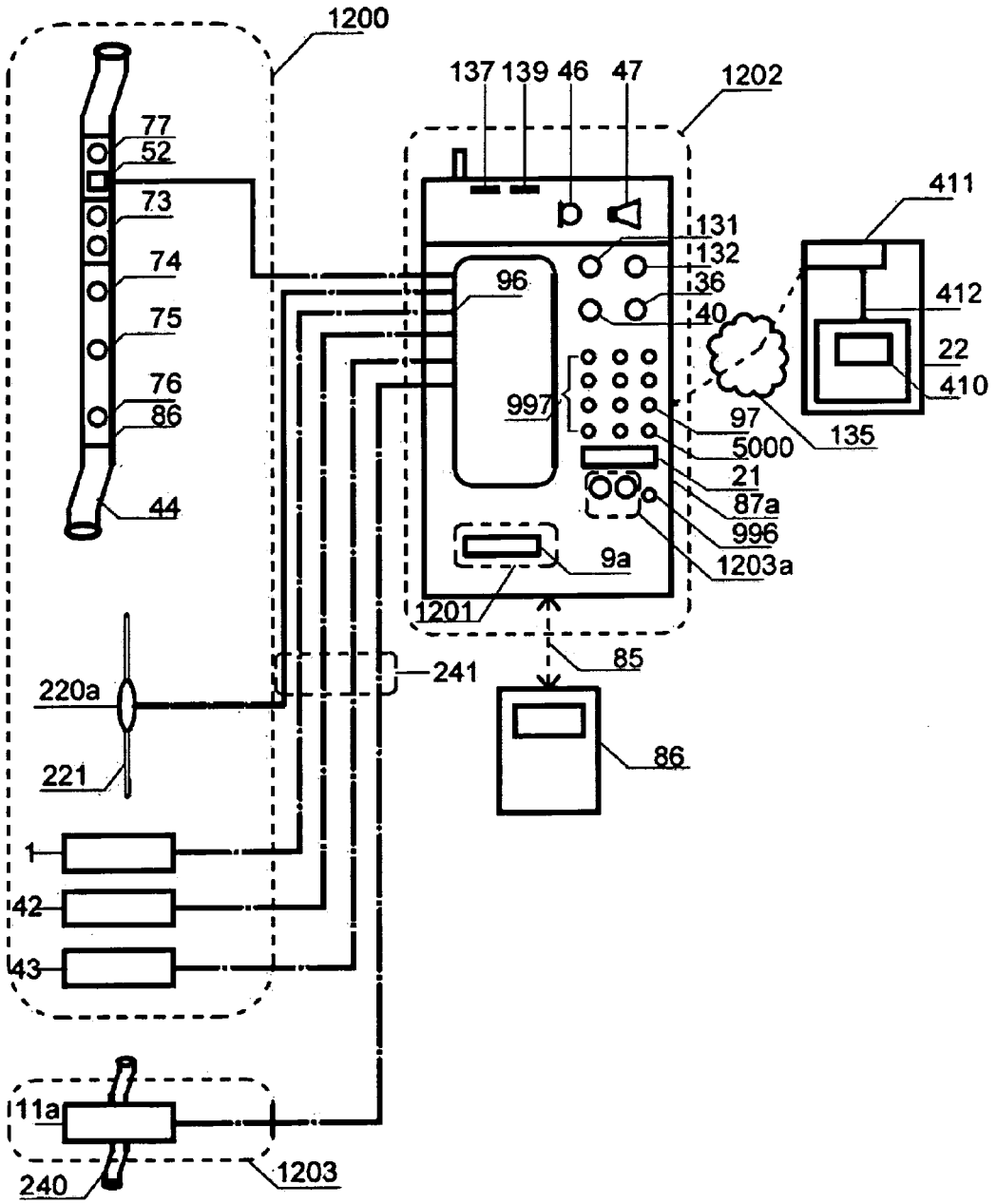
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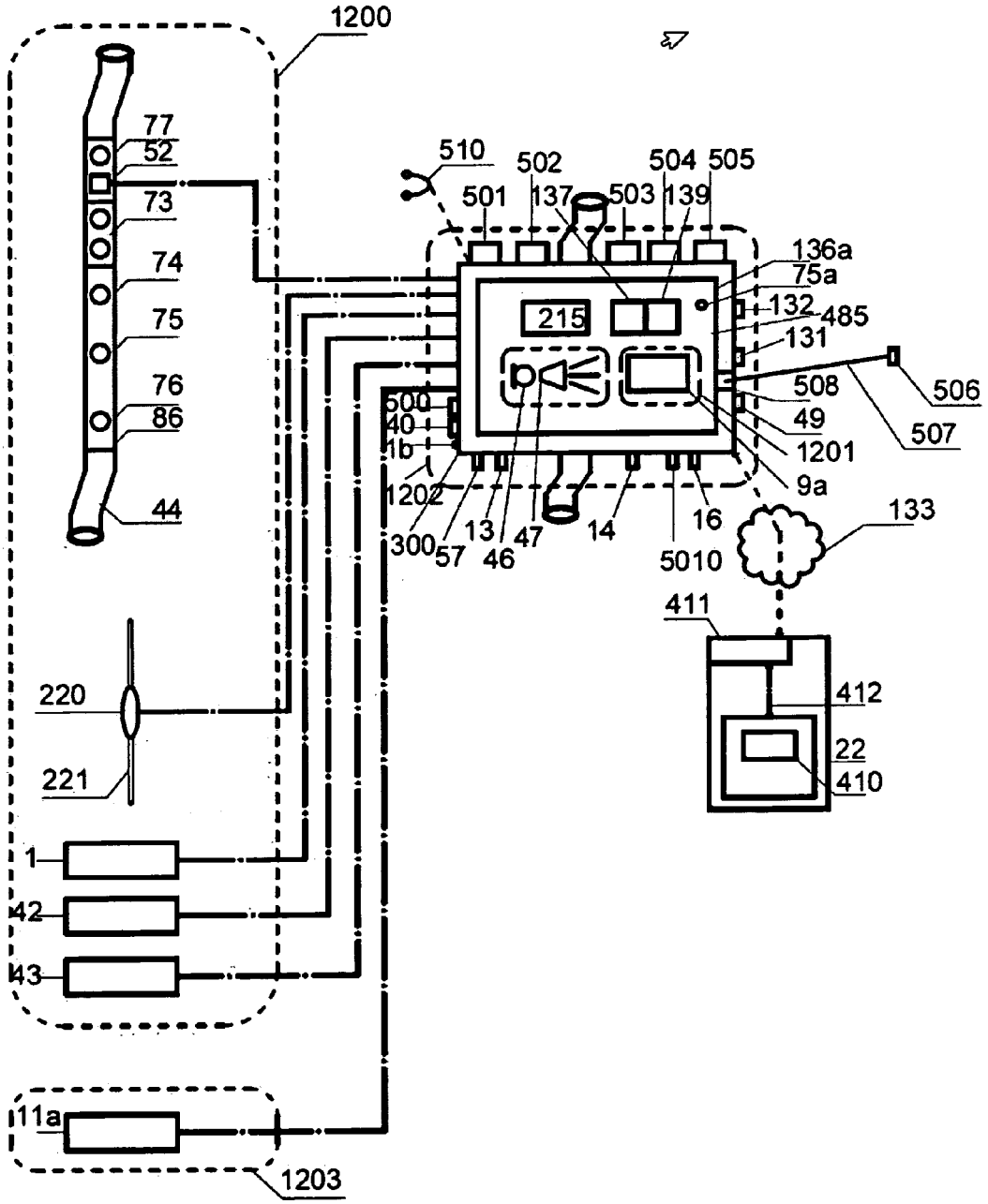
Fig. 23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500
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1b
1202
300
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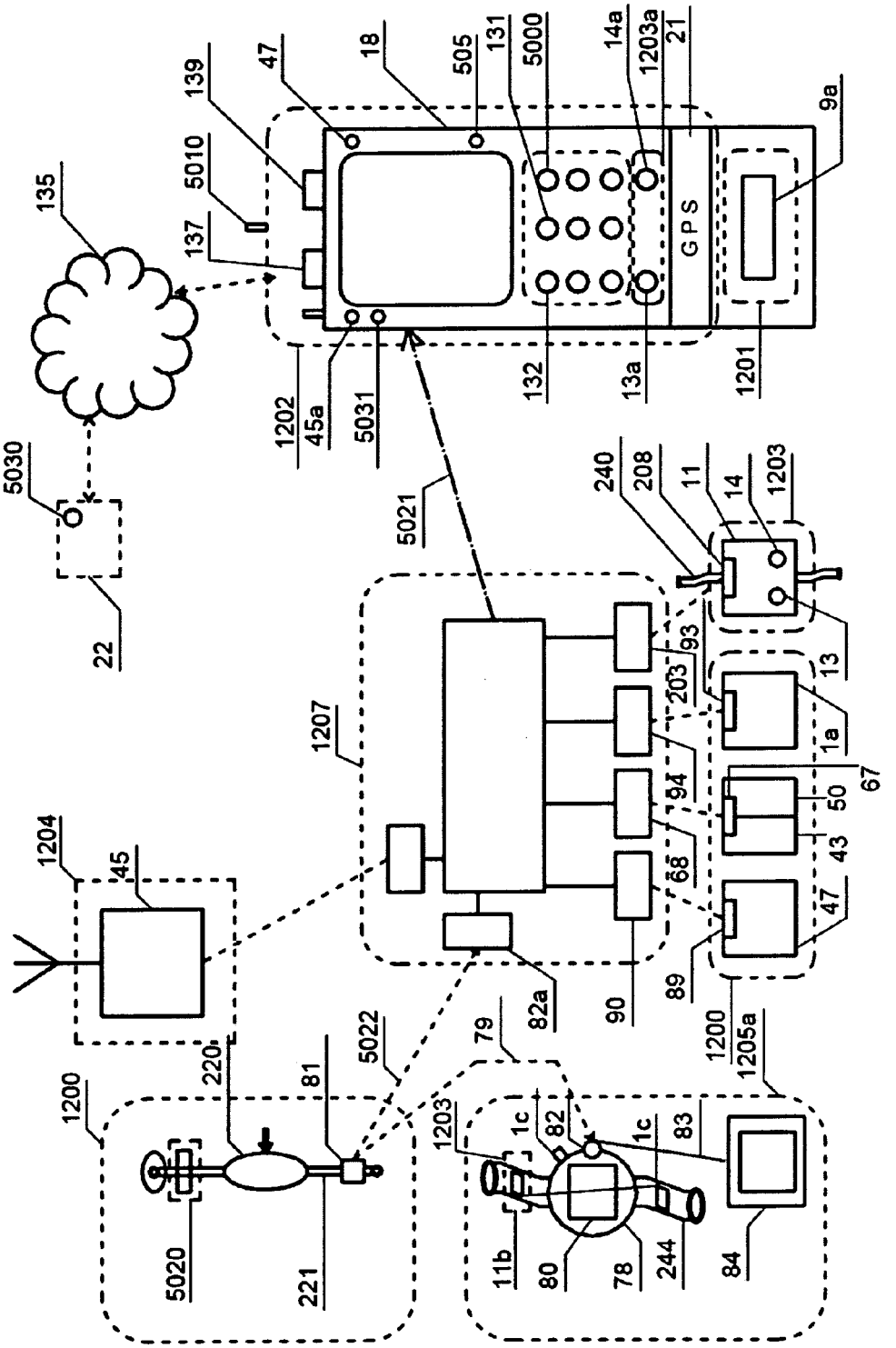
1203

Fig. 24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244
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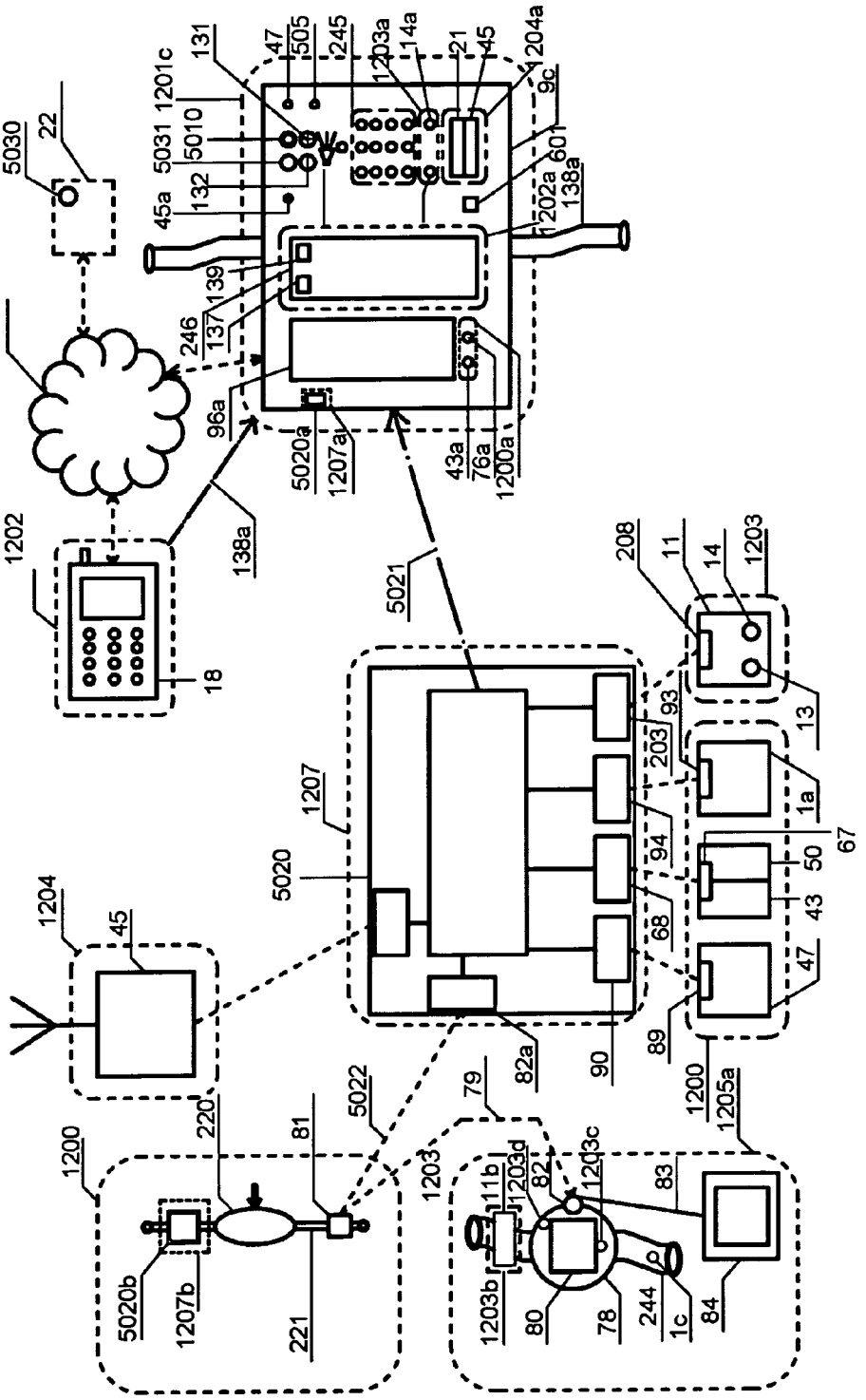
Fig. 25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76a
1200a
1202
138a
5021
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1203
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1207
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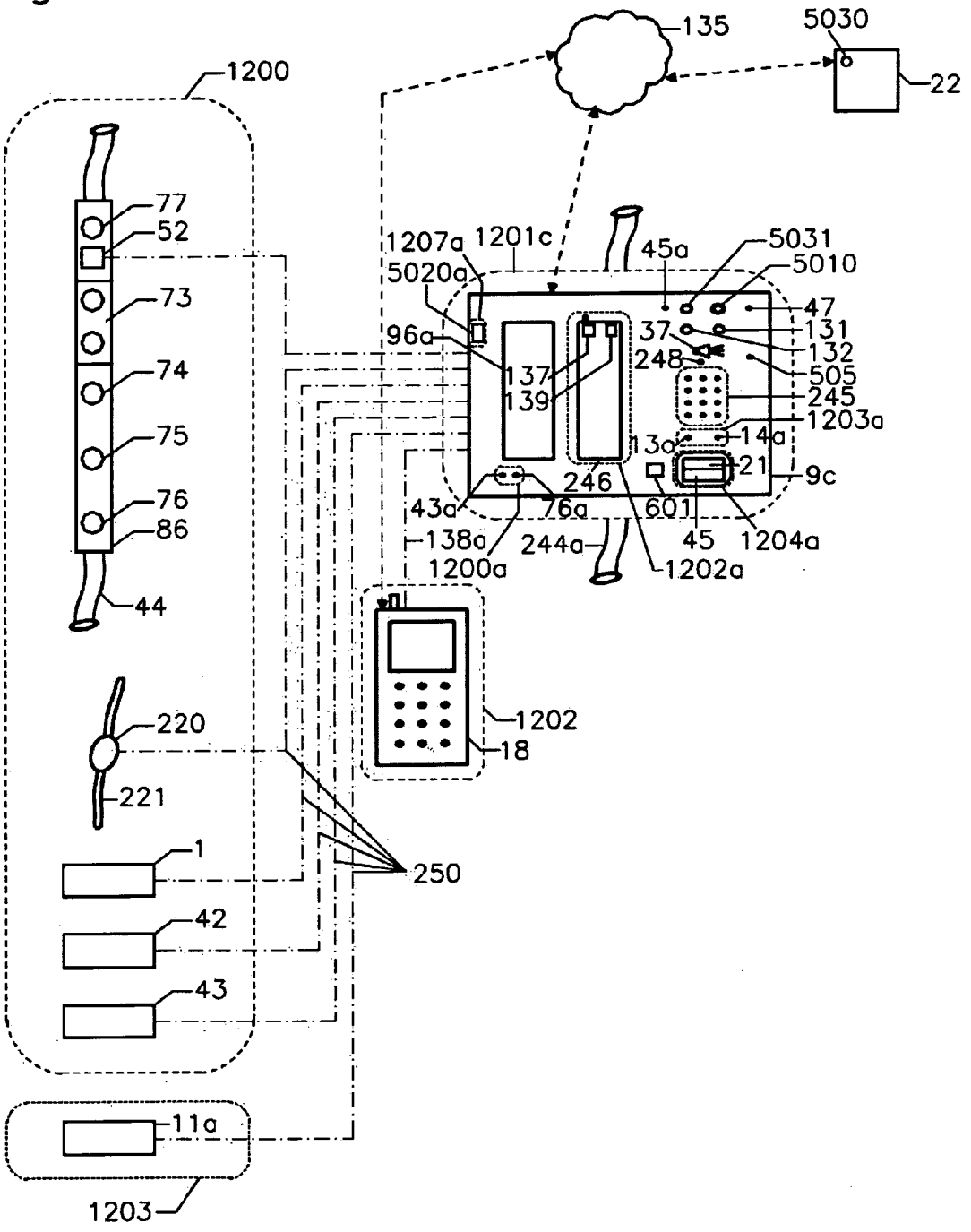
82a
90
1200
1205a
5022
79
220
81
1200
1203
111b
1203d
82
1203c
83
5020b
1207b
221
1203b
80
78
244
1c
84

Fig.26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47
131
132
505
245
1203a
96a
37
248
137
139
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14a
21
9c
246
601
43a
76a
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11a
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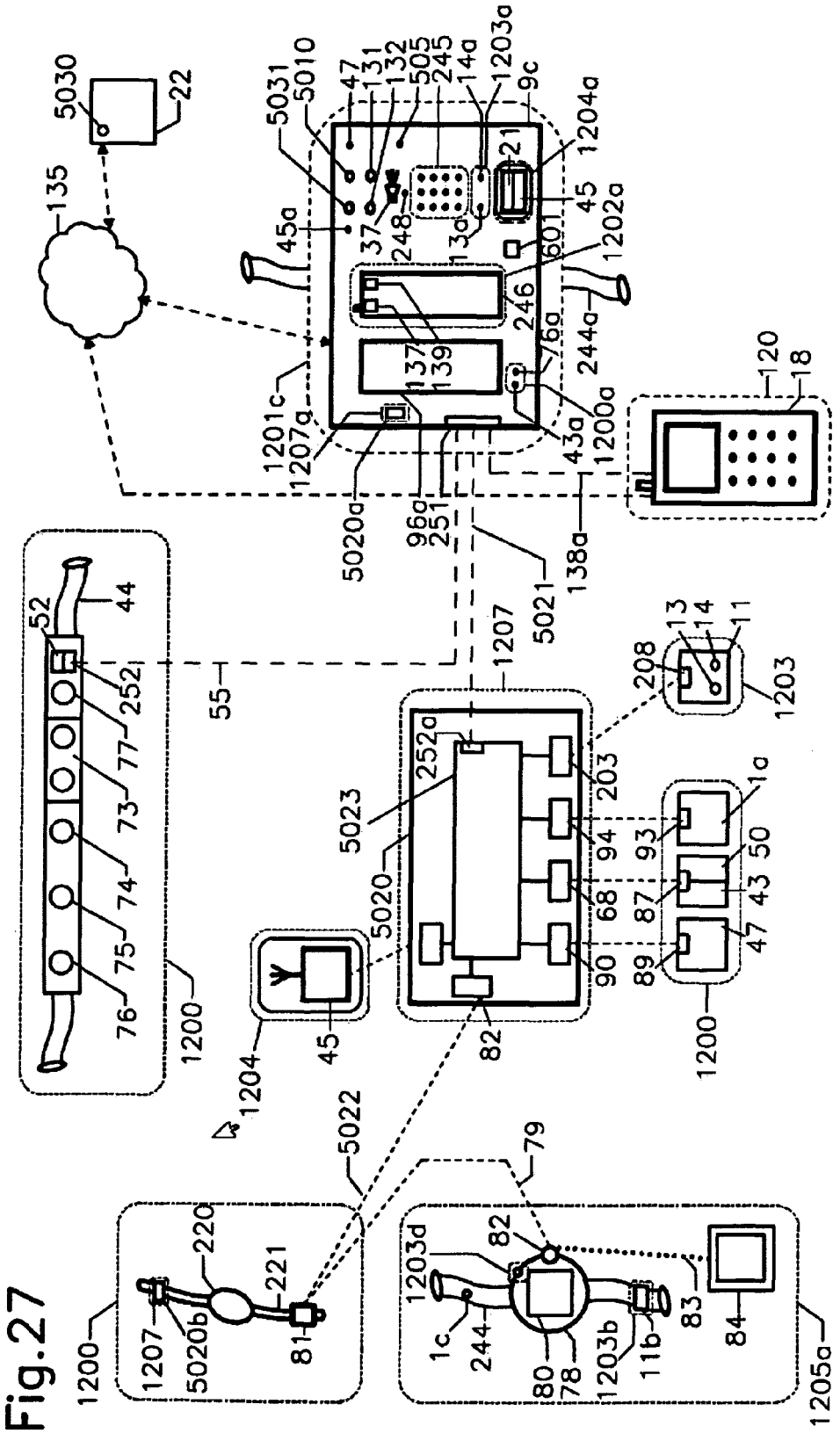
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1203
252a
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203
1a
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93
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87
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1200
1204
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5022
79
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81
1200
1203d
82
1c
244
80
78
1203b
11b
83
84
1205a

Fig.27

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EUROPEAN SEARCH REPORT

Application Number
EP 11 00 4342

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 February 2012	Plathner, B

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