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Abir

(54) **MONITORING PHYSIOLOGICAL CONDITION OF A SUBJECT**

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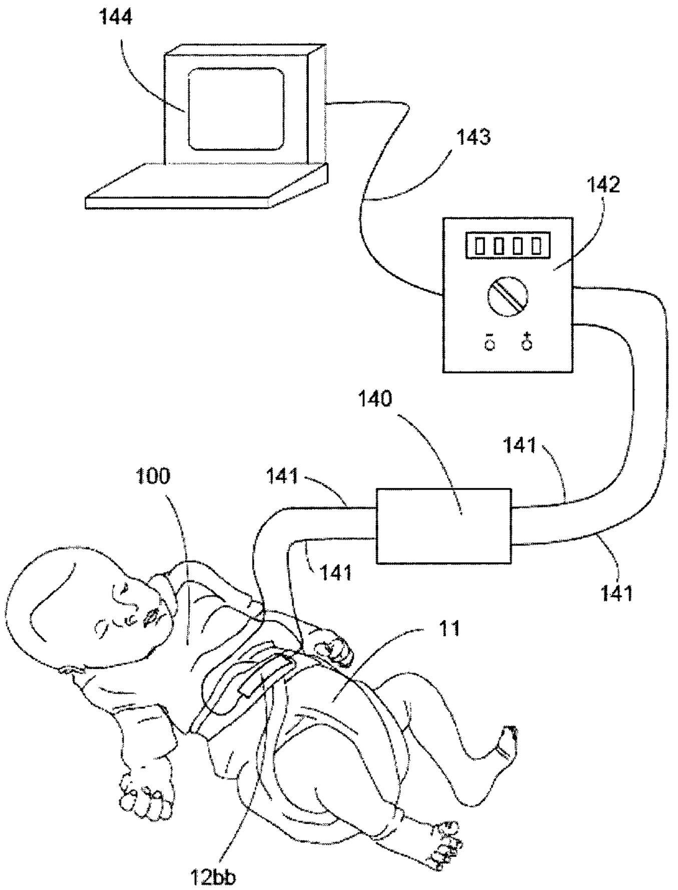
USPC **600/534**

(57) **ABSTRACT**

A system for monitoring breathing of a subject, the system comprising: (a) a wearable subject unit comprising: an elastic resistive sensor positionable such that breathing motion of the subject applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure, and a transmitter configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor; and (b) a platform unit comprising a receiver and being positionable in wireless transmission range with said subject unit, said platform unit configured to receive said signal from said subject unit and to issue an advisory signal indicative of the breathing of the subject.



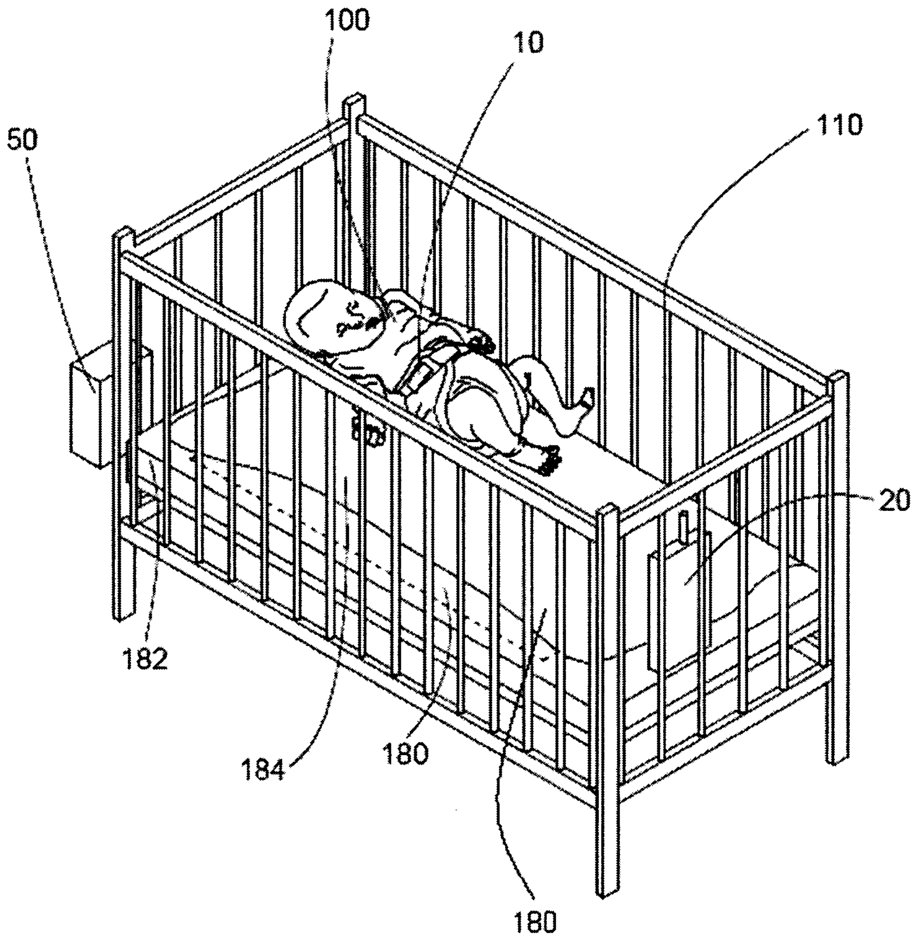
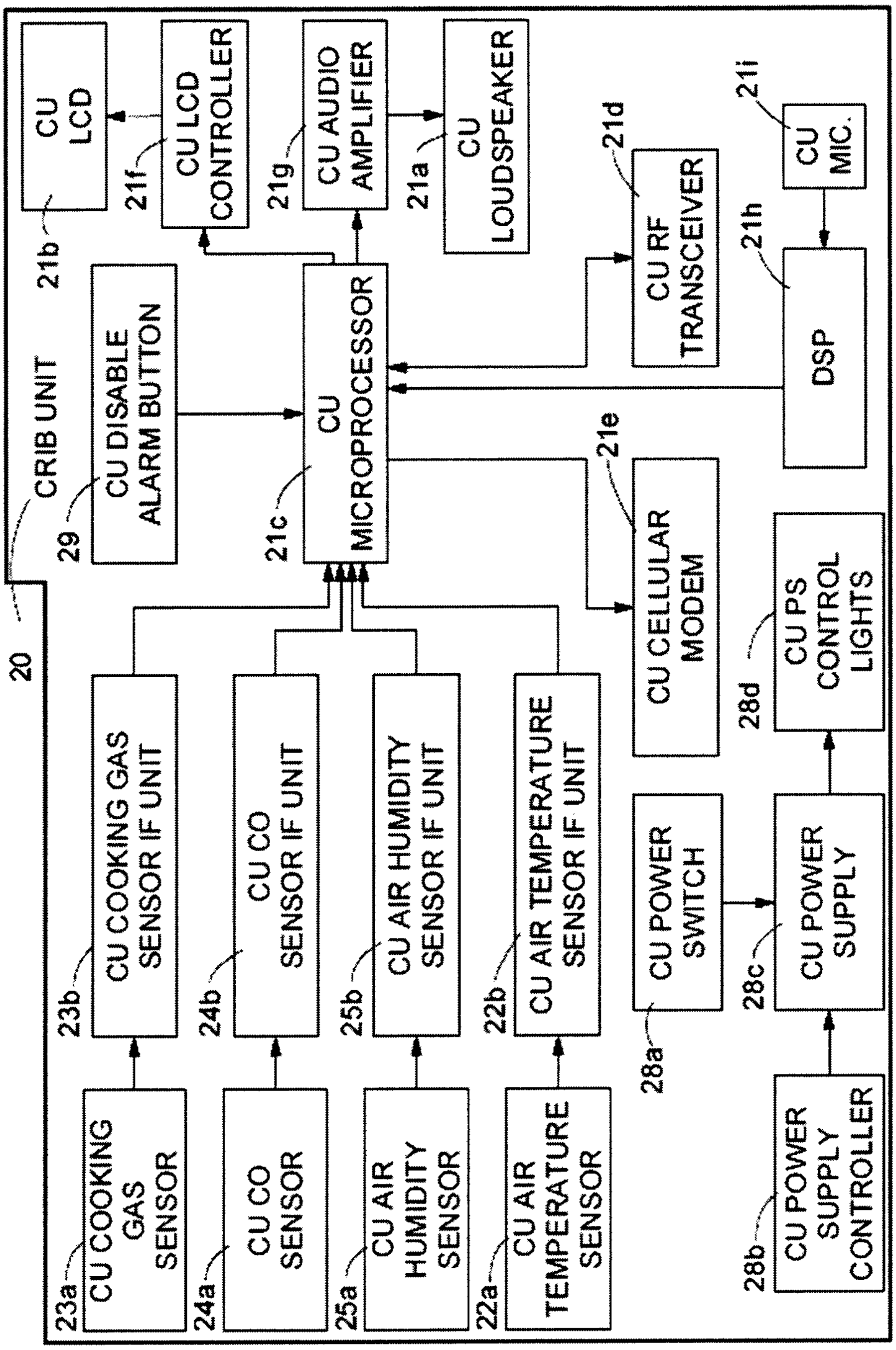


Fig. 1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CRIB UNIT
CU LCD
21b
CU LCD CONTROLLER
21f
CU AUDIO AMPLIFIER
21g
CU LOUDSPEAKER
21a
CU RF TRANSCEIVER
21d
CU MIC.
21i
DSP
21h
CU DISABLE ALARM BUTTON
29
CU MICROPROCESSOR
21c
CU CELLULAR MODEM
21e
CU PS CONTROL LIGHTS
28d
CU COOKING GAS SENSOR IF UNIT
23b
CU CO SENSOR IF UNIT
24b
CU AIR HUMIDITY SENSOR IF UNIT
25b
CU AIR TEMPERATURE SENSOR IF UNIT
22b
CU POWER SWITCH
28a
CU POWER SUPPLY
28c
CU COOKING GAS SENSOR
23a
CU CO SENSOR
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CU AIR TEMPERATURE SENSOR
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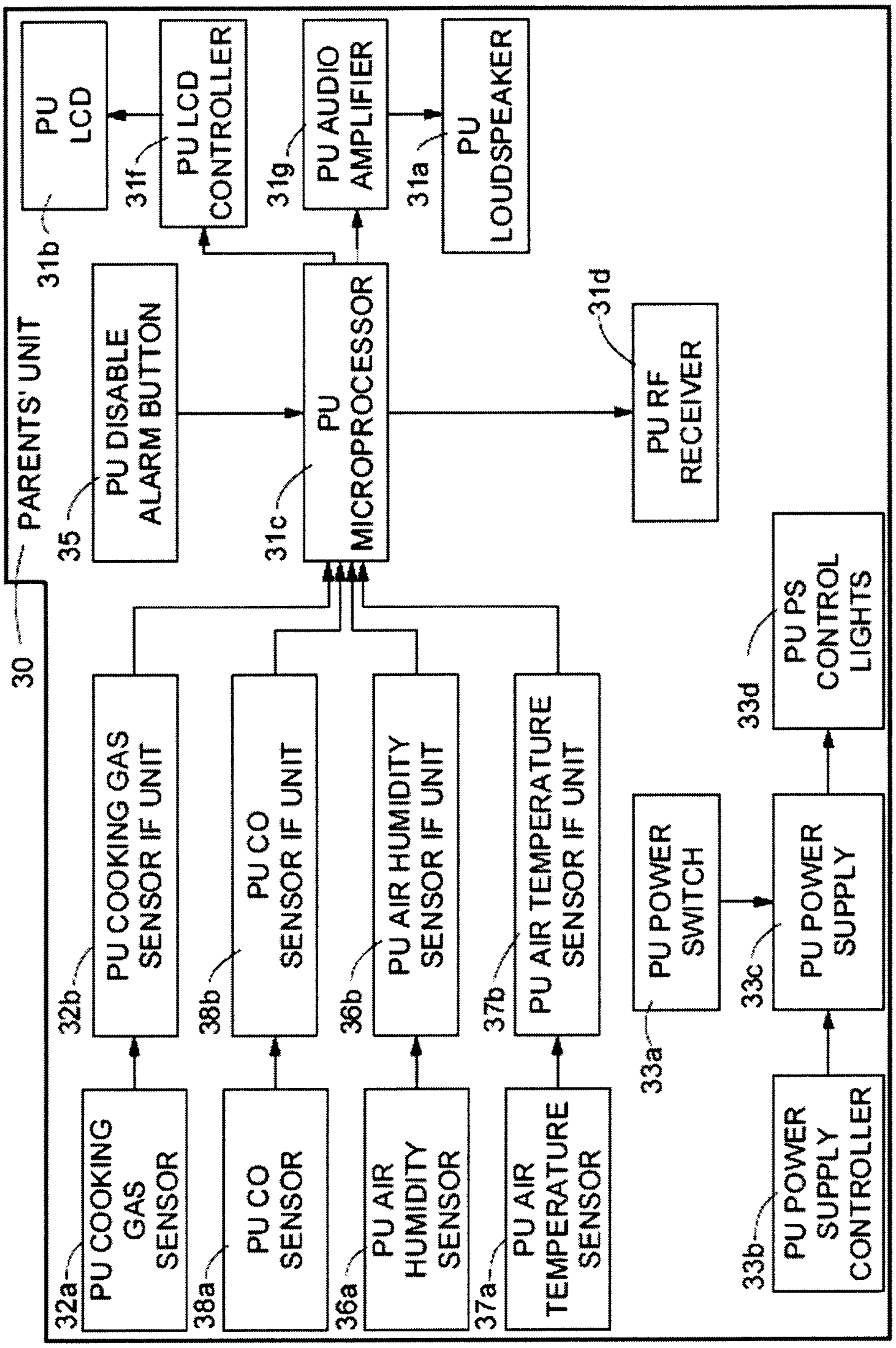
CU POWER SUPPLY CONTROLLER
28b

Fig. 5B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PARENTS' UNIT
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PU DISABLE ALARM BUTTON
31c
PU MICROPROCESSOR
31d
PU RF RECEIVER
32b
PU COOKING GAS SENSOR IF UNIT
38b
PU CO SENSOR IF UNIT
36b
PU AIR HUMIDITY SENSOR IF UNIT
37b
PU AIR TEMPERATURE SENSOR IF UNIT
32a
PU COOKING GAS SENSOR
38a
PU CO SENSOR
36a
PU AIR HUMIDITY SENSOR
37a
PU AIR TEMPERATURE SENSOR
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33b
PU POWER SUPPLY CONTROLLER

Fig. 6B

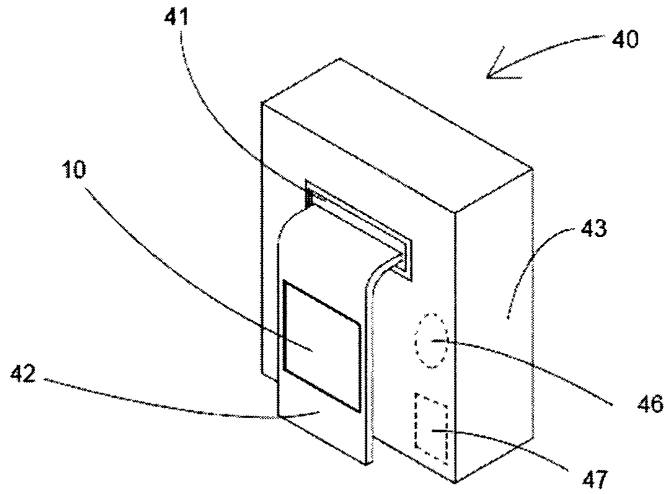
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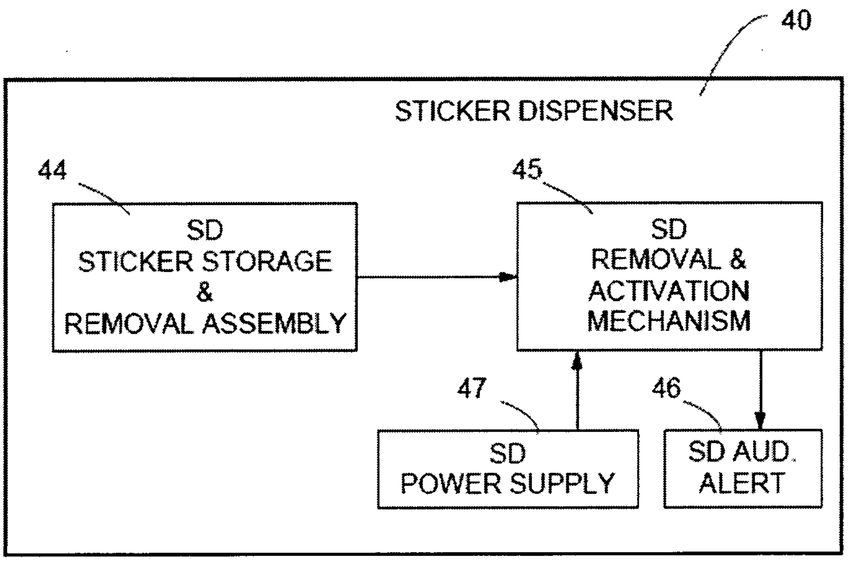
Fig. 7A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STICKER DISPENSER
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SD
STICKER STORAGE
&
REMOVAL ASSEMBLY
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SD
REMOVAL &
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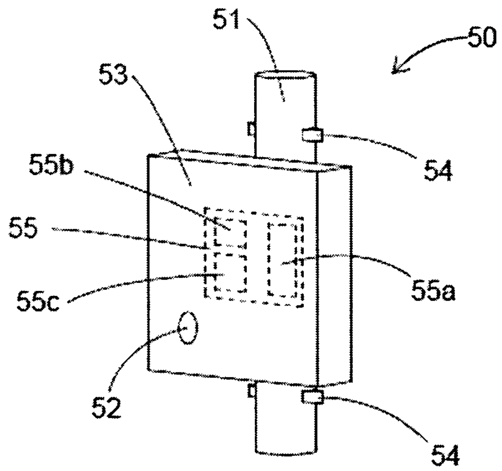
MECHANISM
47
SD
POWER SUPPLY
46
SD AUD.
ALERT

Fig. 7B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55b
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55a
55c
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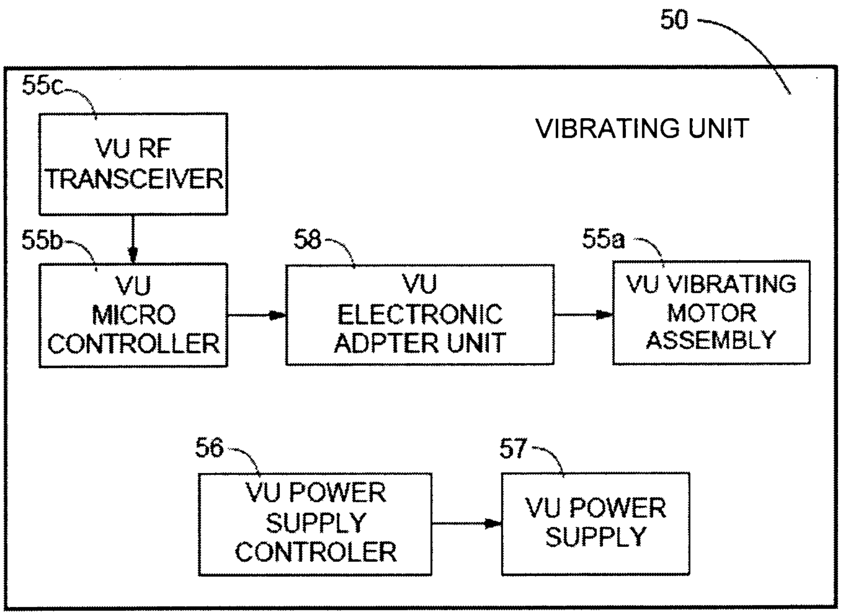
Fig. 8A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VIBRATING UNIT
VU RF TRANSCEIVER
55b
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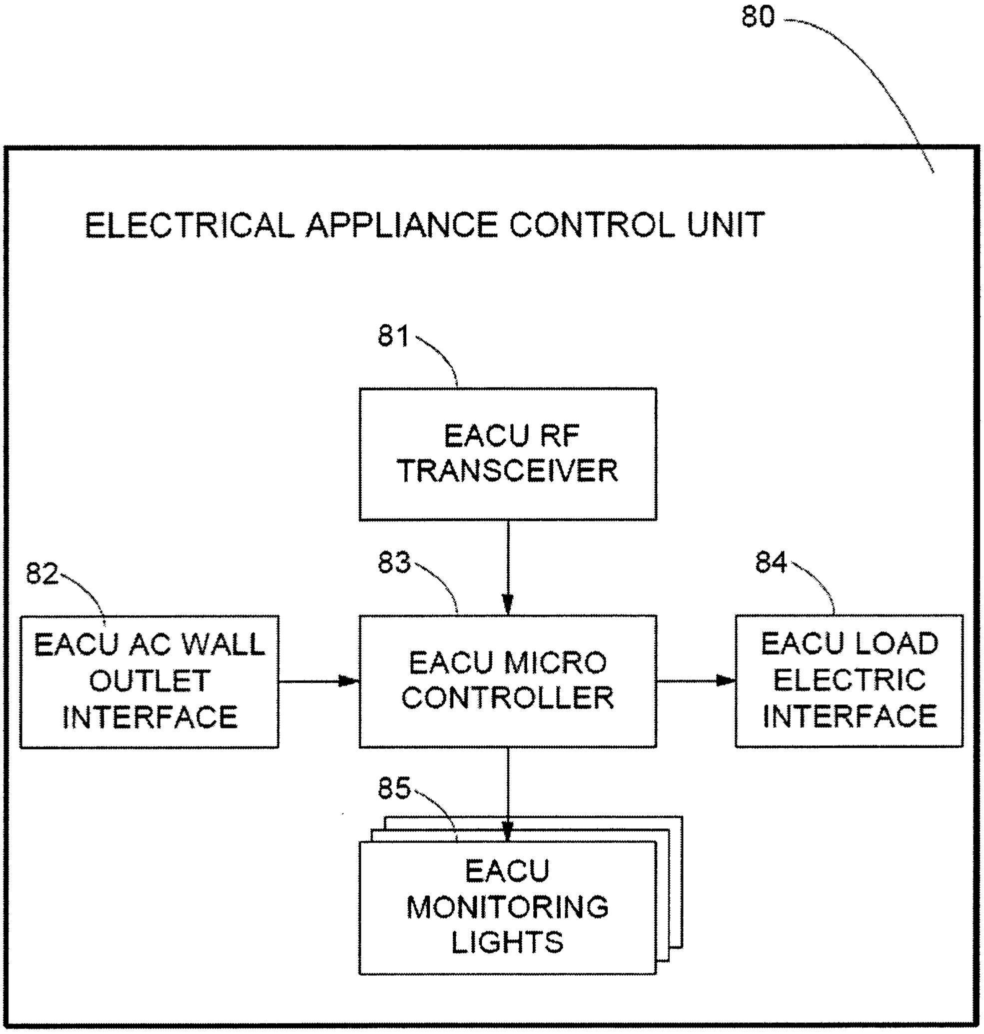
55a
VU MICRO CONTROLLER
VU ELECTRONIC ADPTER UNIT
VU VIBRATING MOTOR ASSEMBLY
56
57
VU POWER SUPPLY CONTROLER
VU POWER SUPPLY

Fig. 8B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ELECTRICAL APPLIANCE CONTROL UNIT
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EACU RF TRANSCEIVER
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EACU AC WALL OUTLET INTERFACE
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EACU MICRO CONTROLLER
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EACU LOAD ELECTRIC INTERFACE
85
EACU MONITORING LIGHTS

Fig. 9

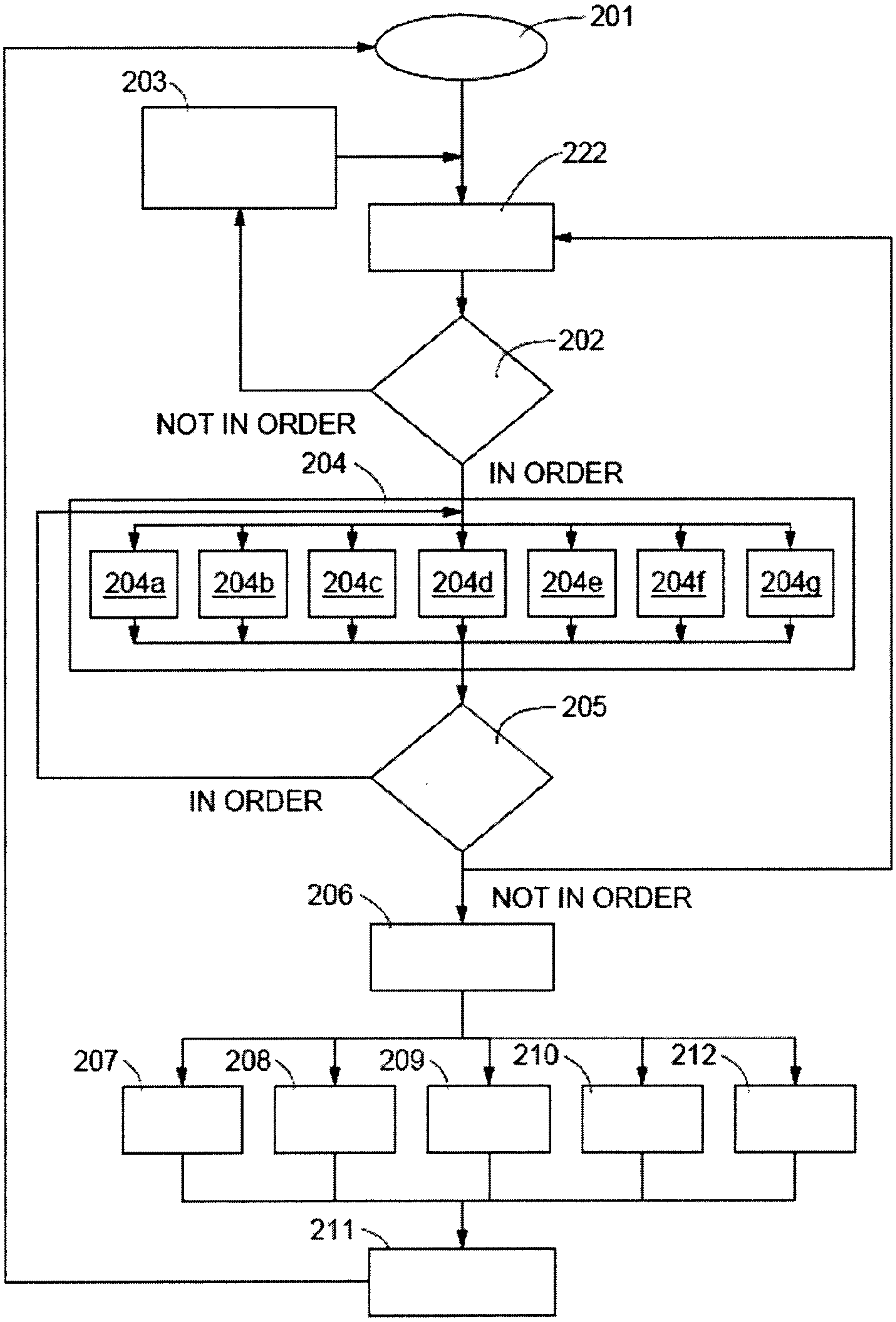
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Fig. 10

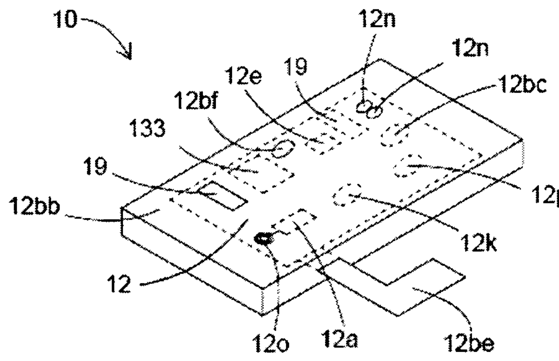


Fig. 11A

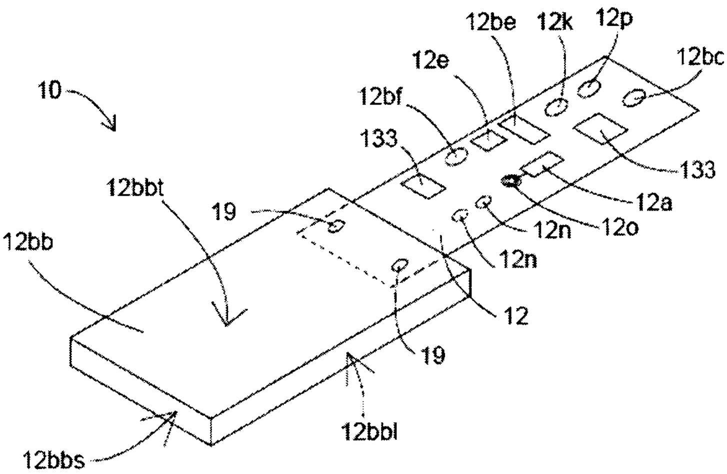


Fig. 11B

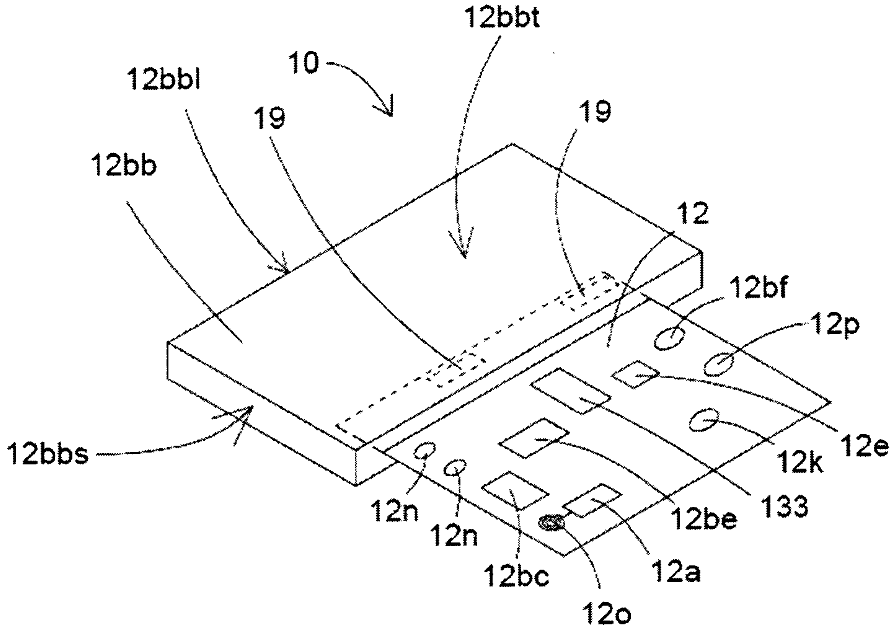


Fig. 11C

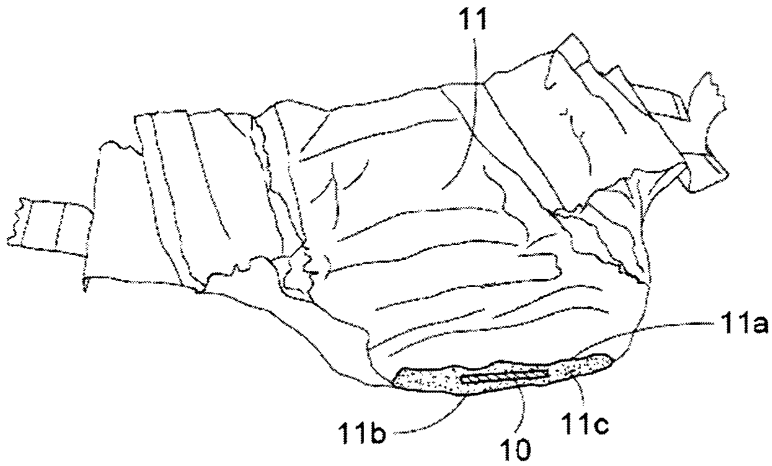


Fig. 12

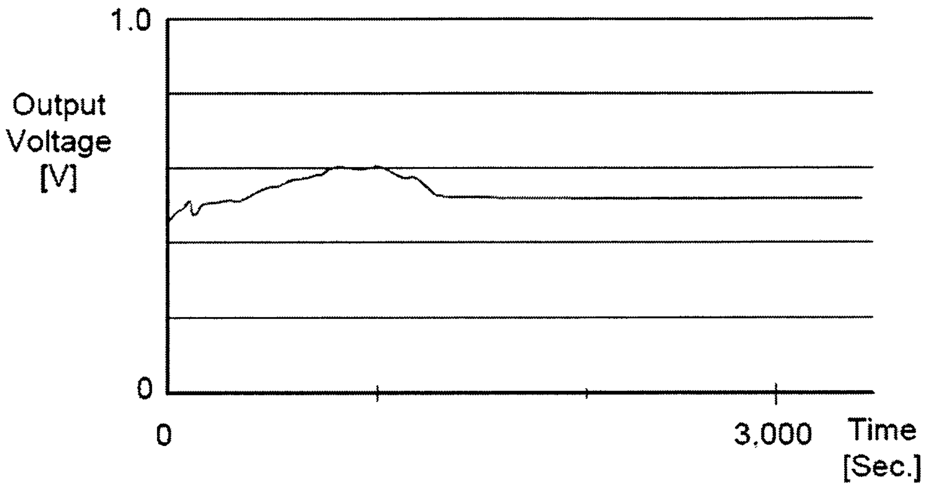


Fig. 13A

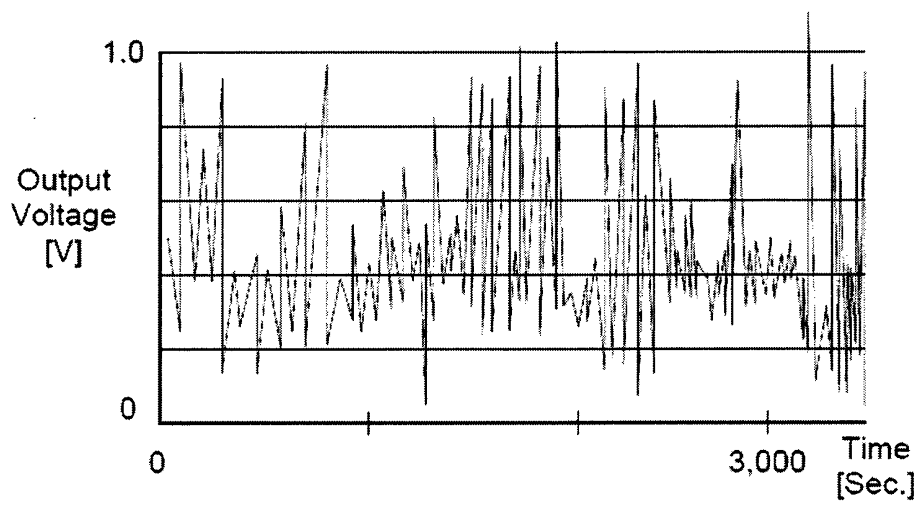


Fig. 13B

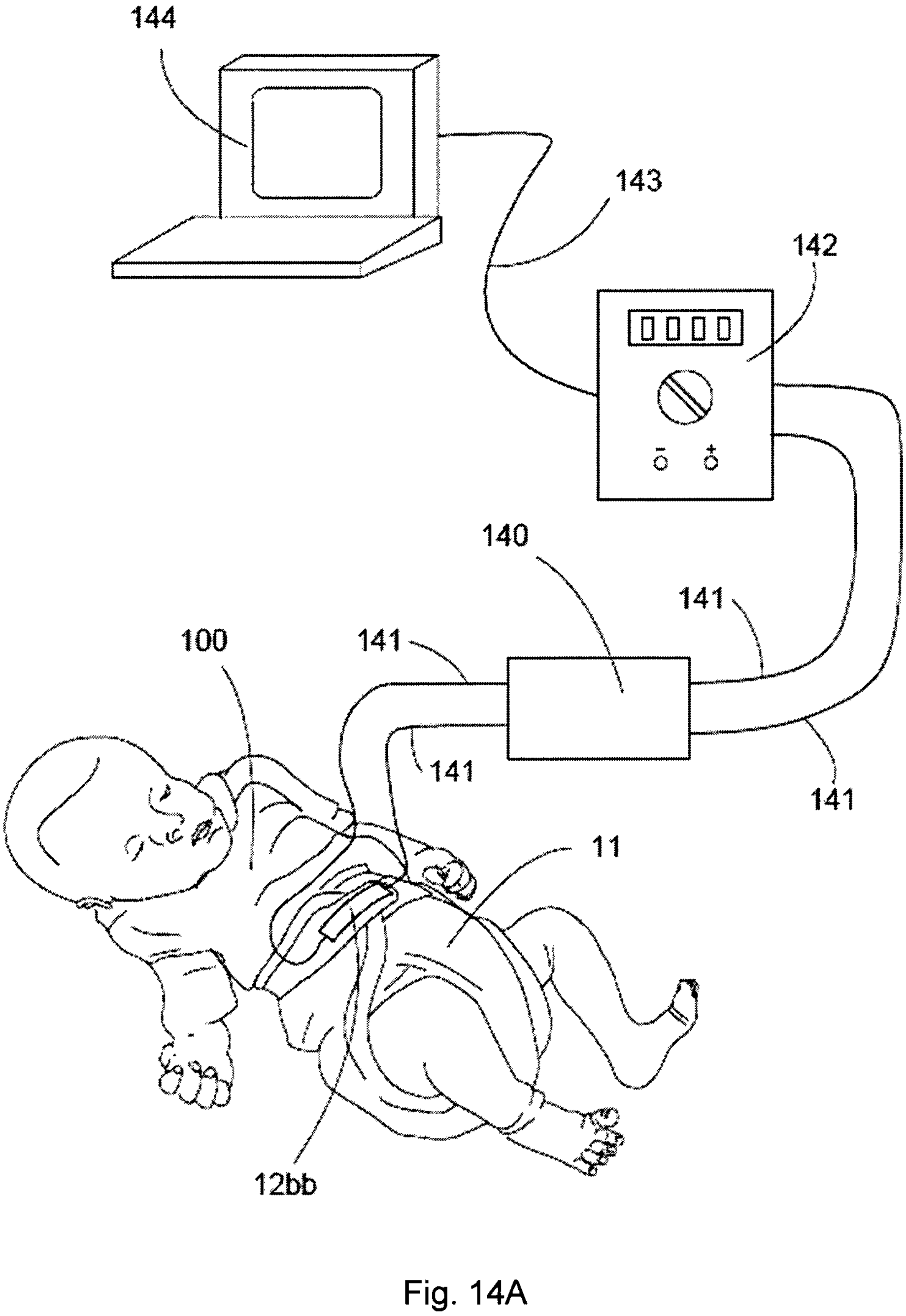


Fig. 14A

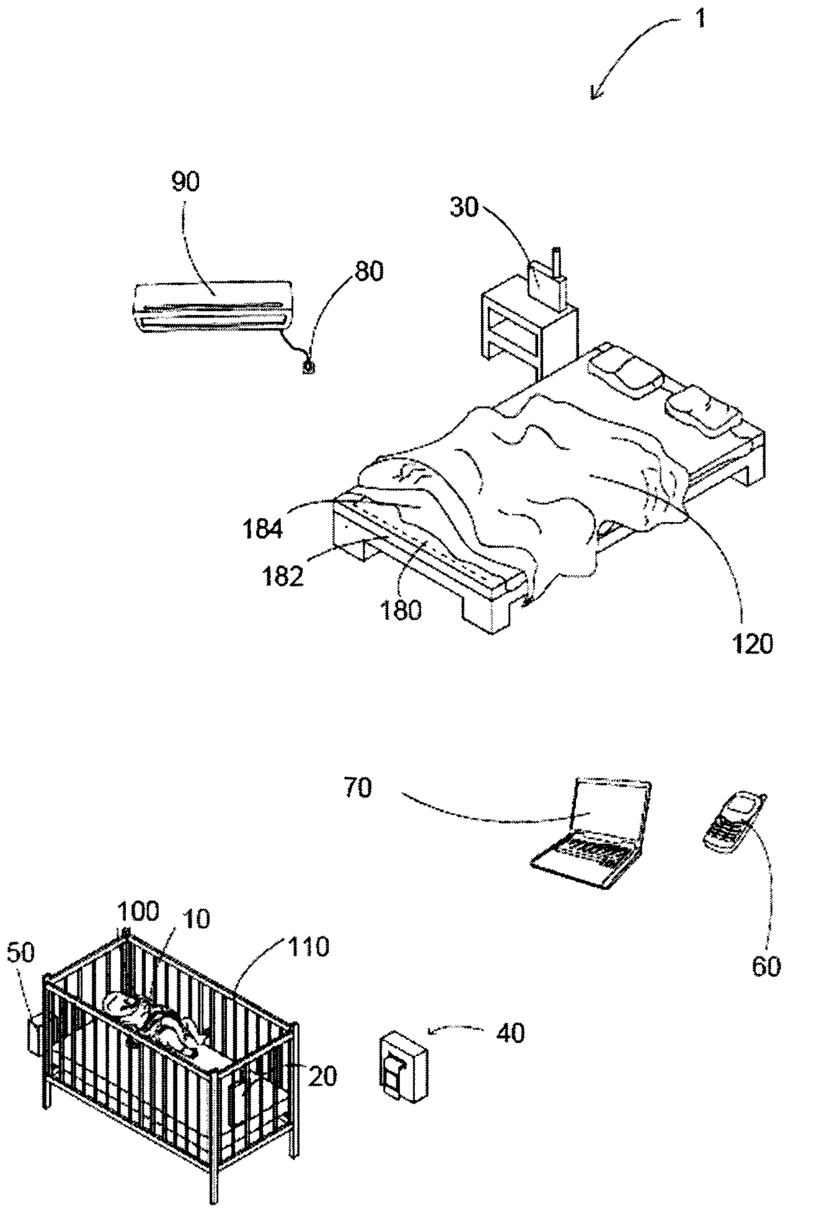


Fig. 2

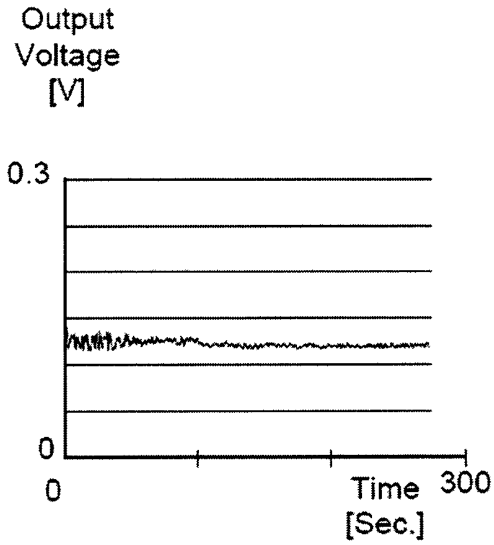


Fig. 14B

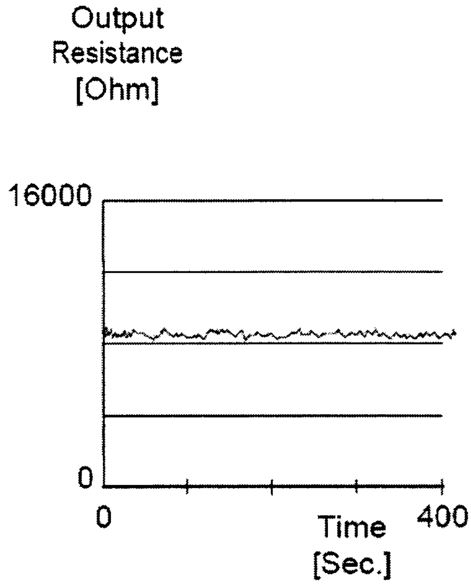


Fig. 14C

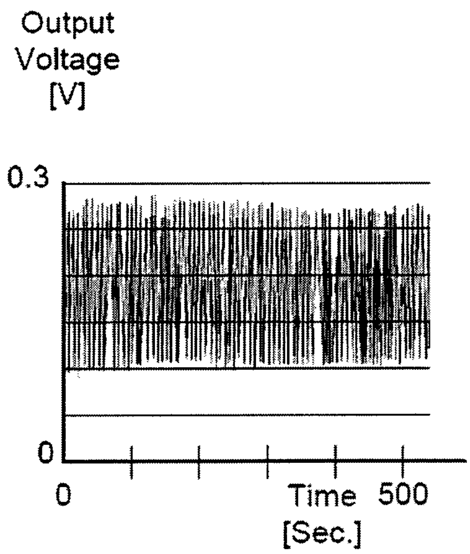


Fig. 14D

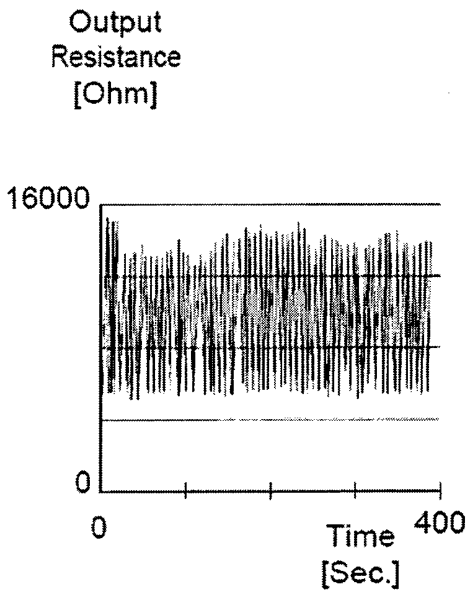
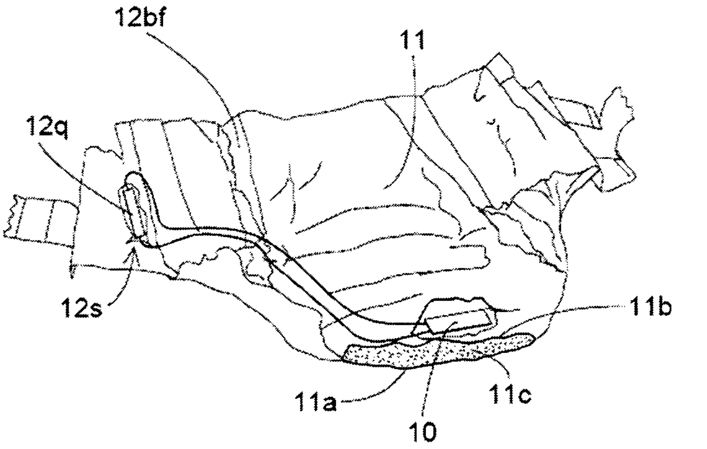


Fig. 14E



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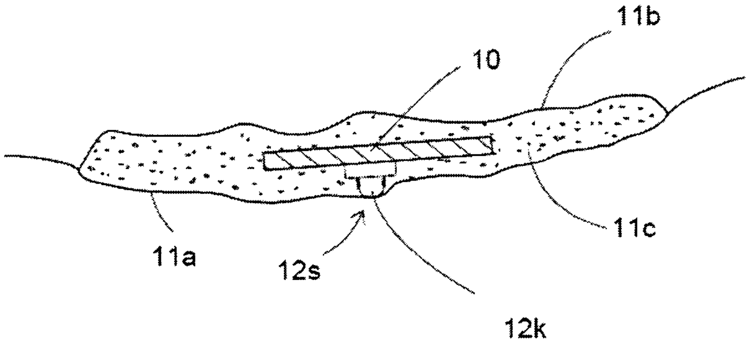

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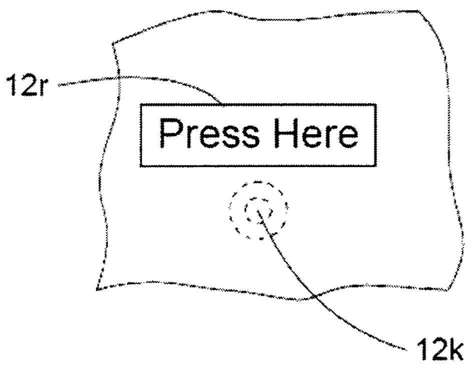

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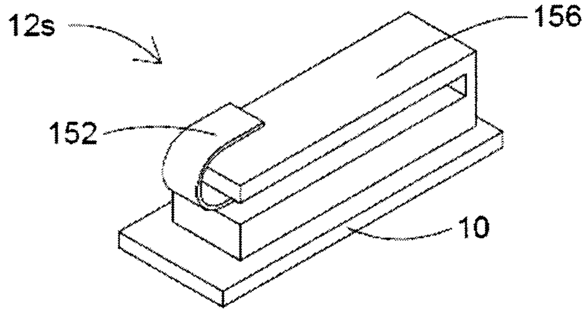

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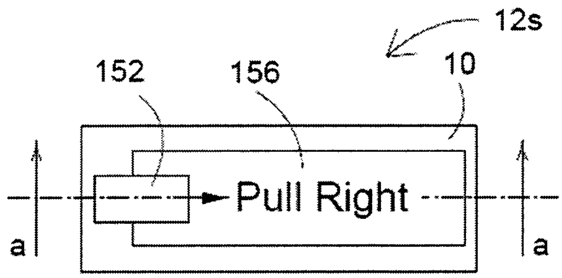
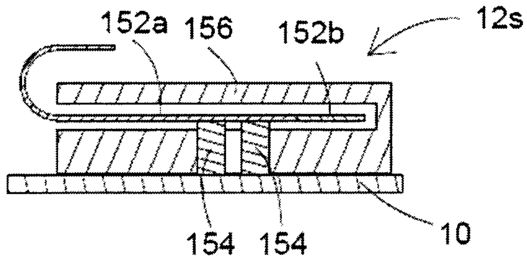


Fig. 17B



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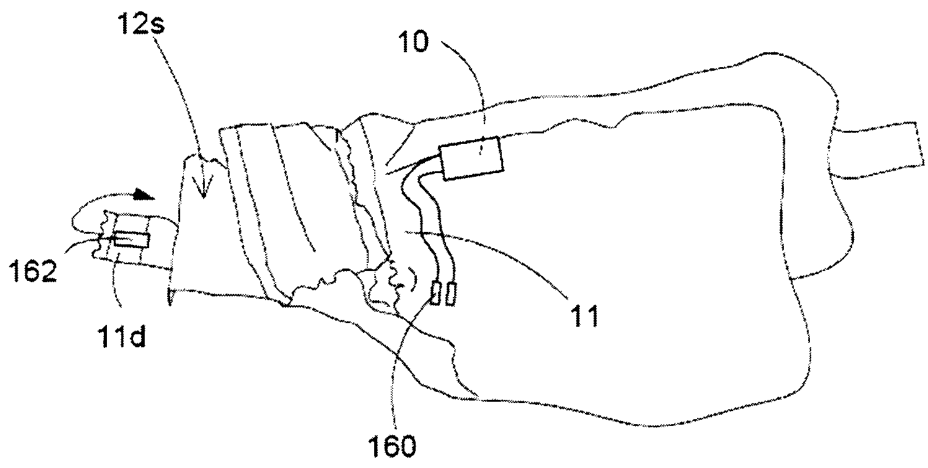

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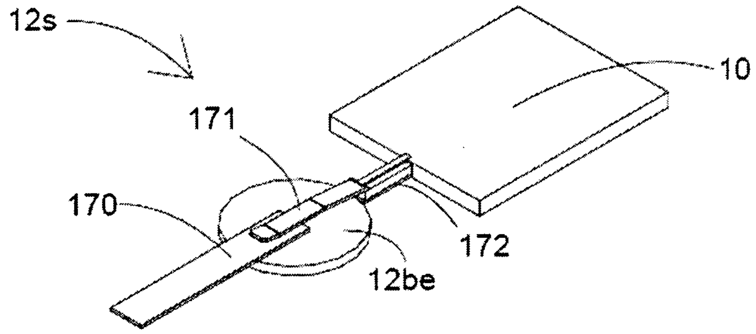

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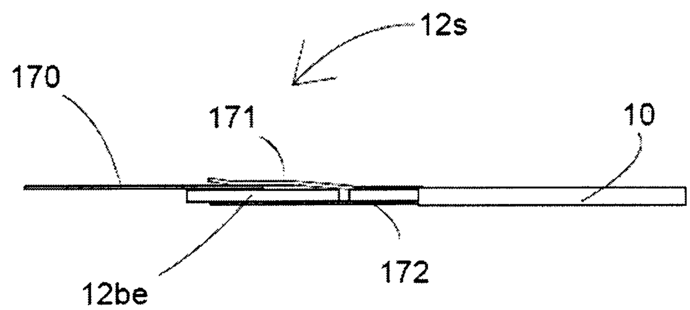
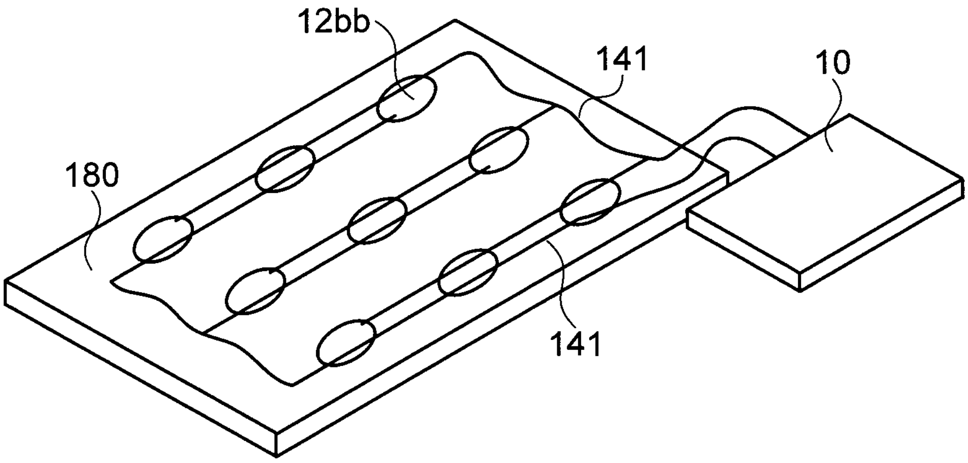


Fig. 19B



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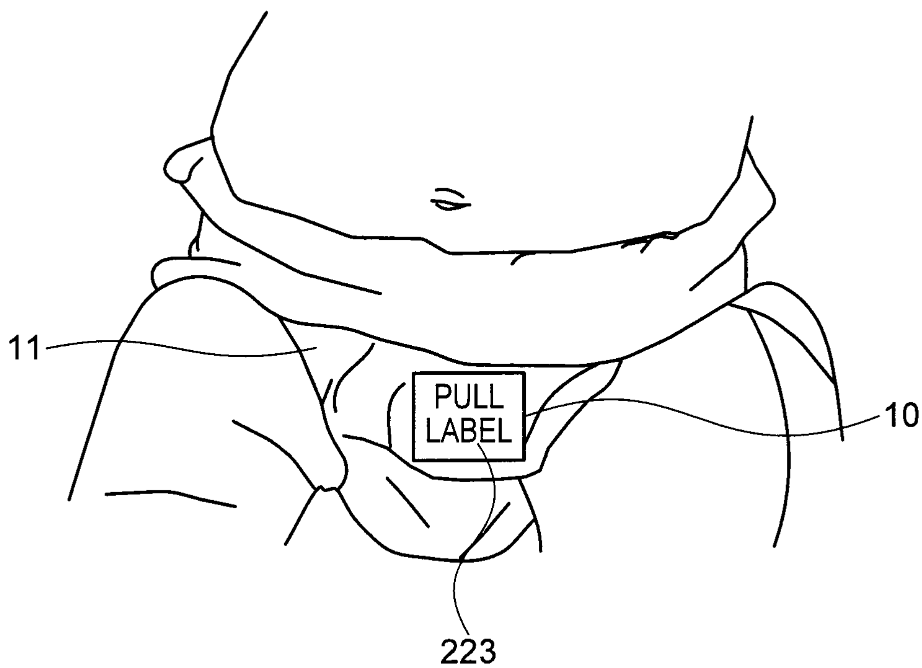


Fig. 21

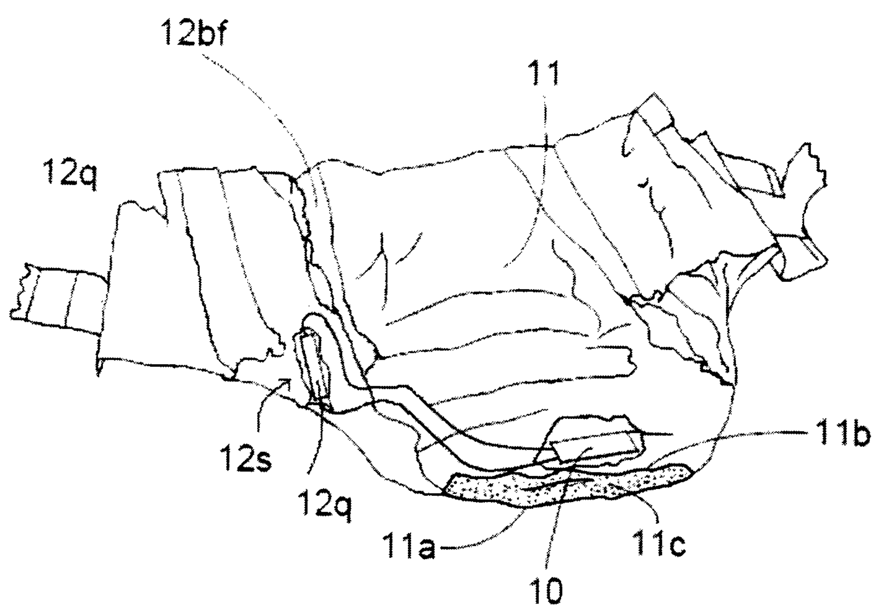
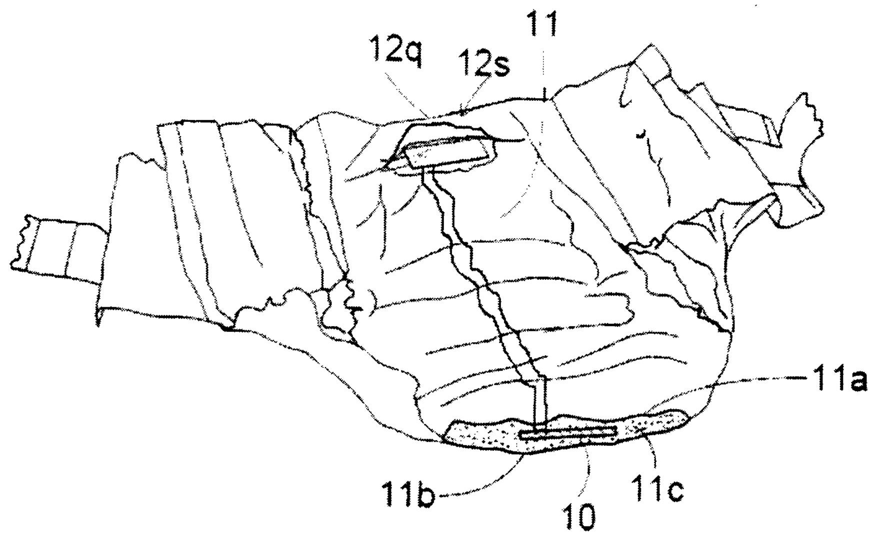


Fig. 22



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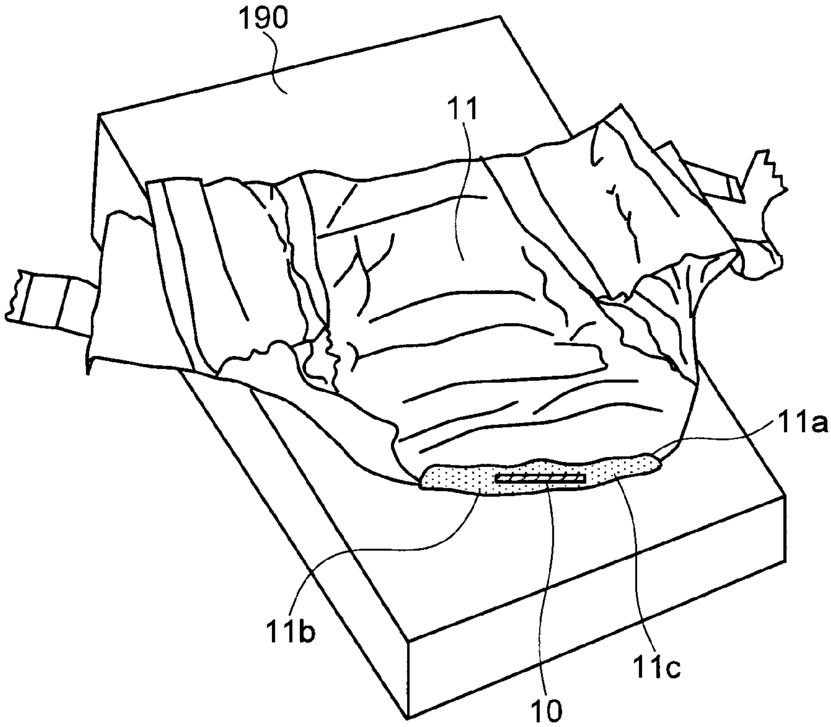

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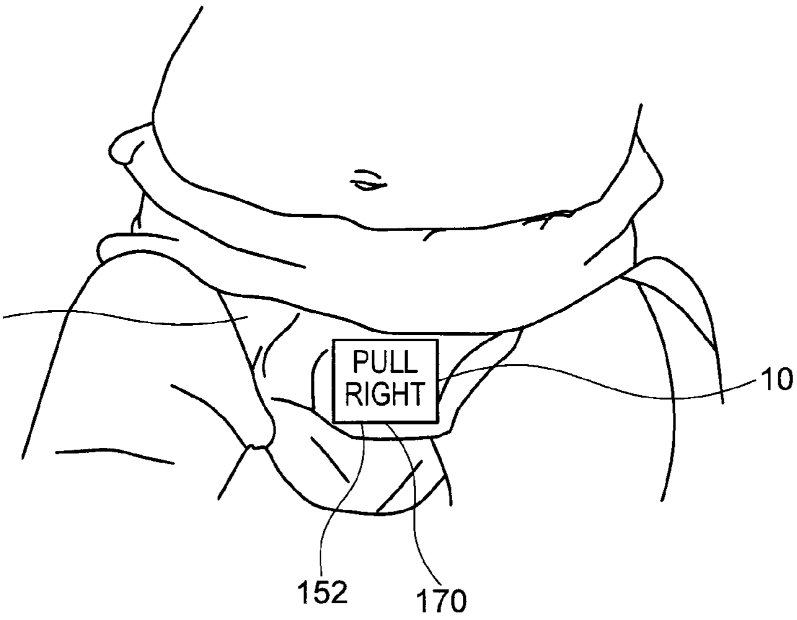

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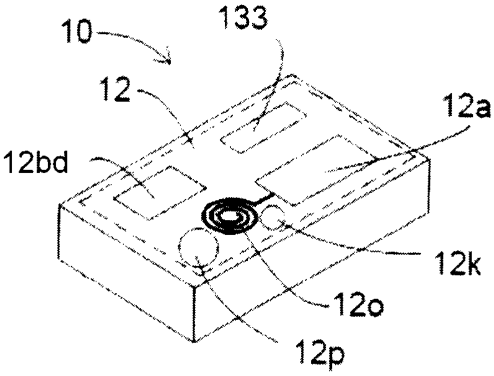
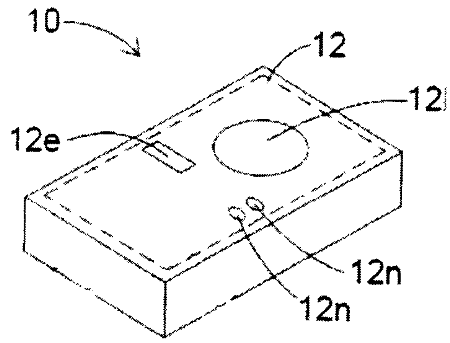


Fig. 26



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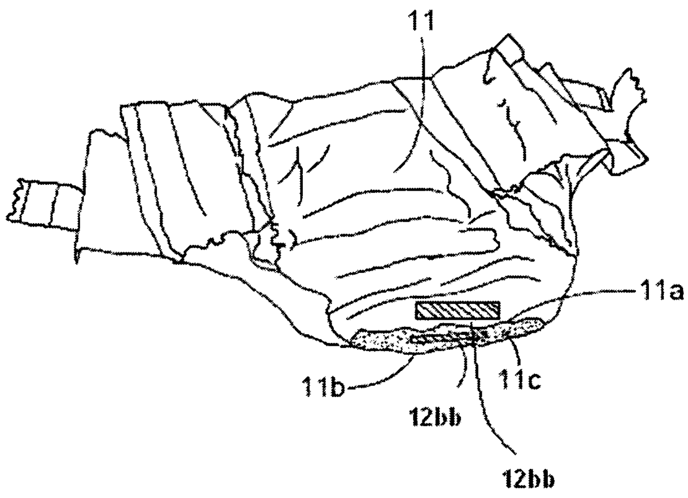

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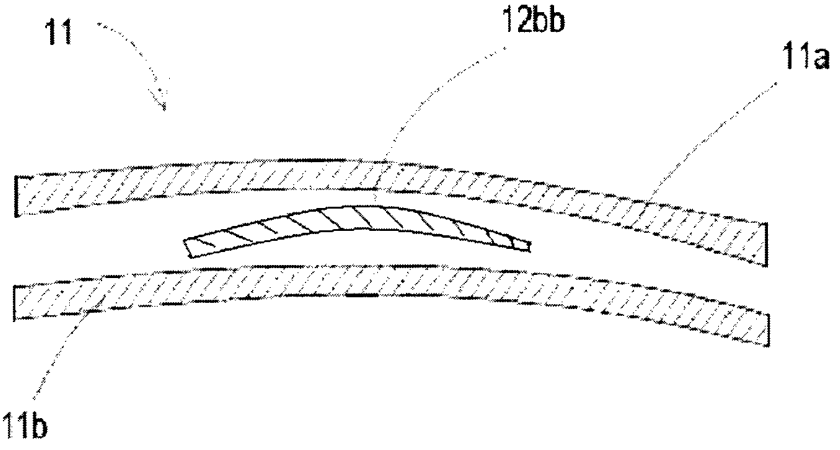


Fig. 28

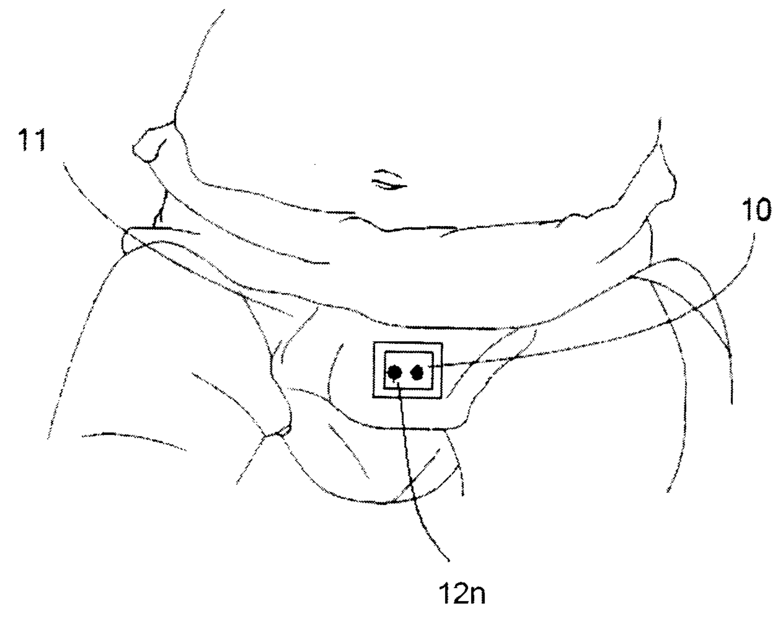


Fig. 29

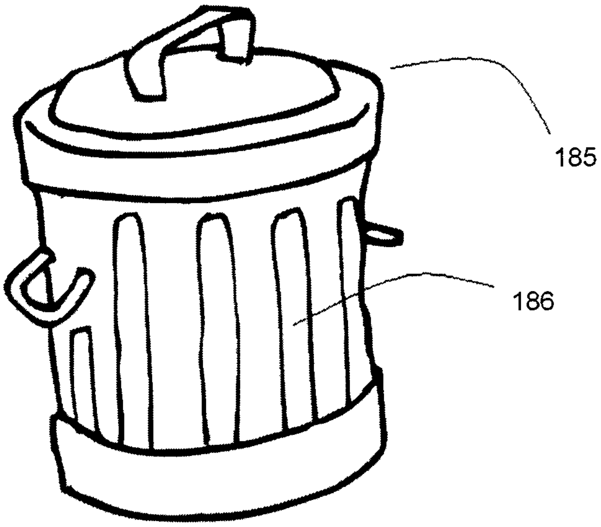


Fig. 30

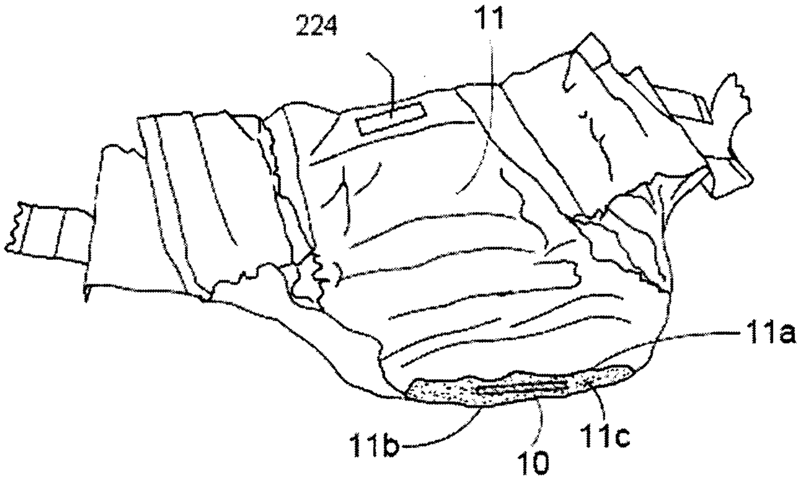
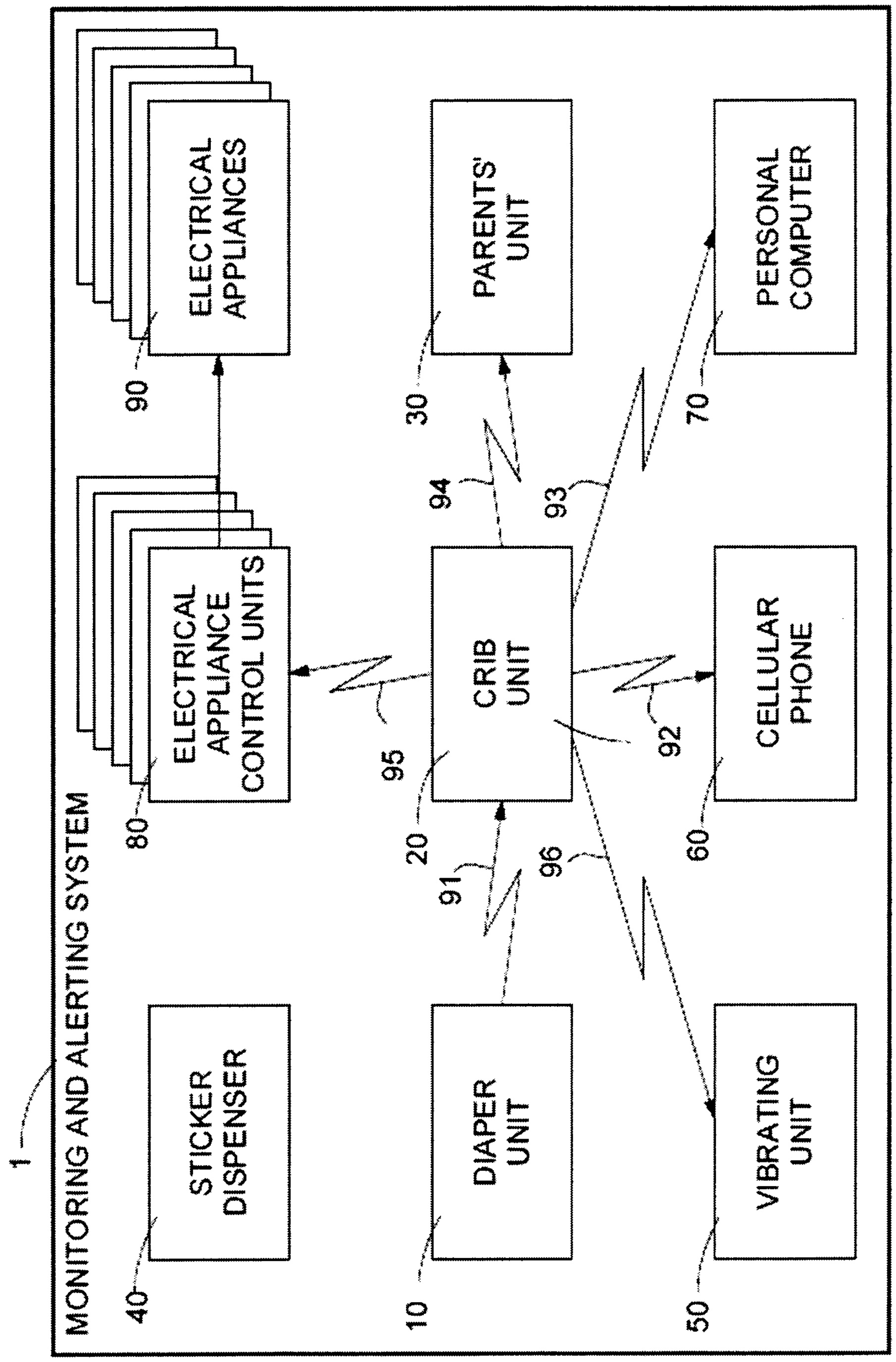


Fig. 31


1
MONITORING AND ALERTING SYSTEM
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STICKER DISPENSER
10
DIAPER UNIT
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VIBRATING UNIT
80
ELECTRICAL APPLIANCE CONTROL UNITS
20
CRIB UNIT
60
CELLULAR PHONE
90
ELECTRICAL APPLIANCES
30
PARENTS' UNIT
70
PERSONAL COMPUTER
91
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Fig. 3

MONITORING PHYSIOLOGICAL CONDITION OF A SUBJECT

FIELD OF THE INVENTION

[0001] The invention relates to system and methods for monitoring physiological conditions of a subject.

BACKGROUND OF THE INVENTION

[0002] Sudden Infant Death Syndrome (SIDS) is a syndrome in which an infant dies suddenly in its sleep due to stopping breathing.

[0003] A variety of methods for monitoring a patient's vital signs are available for doctors and care-givers these days. These range from baby monitors, which transmit the sounds and even video of a baby to its parents in a different room, to pregnant women's contractions monitors, to EKG or ECG monitors in a hospital that monitor the vital signs of a patient.

[0004] Bar Hayim (WO 2009/083980) discloses a disposable monitor that includes an adhesive sensing unit that includes a flexible conductive wire wherein the sensing unit is attached to the skin of a person being monitored.

[0005] Rahamim (WO 2009/050702) discloses an apnea detector. It incorporates a capacitive type sensor that emits an alert signal upon detecting symptoms of apnea. In one embodiment, a detector unit is in communication with a curvature sensor adapted to detect a variable curvature of a subject body surface resulting from breathing patterns of a subject. The detector unit is attached to an article of clothing of the subject. A monitoring system comprises a detector unit for detecting one or more subject related parameters of interest and for emitting acoustical information after determining that a subject related parameter of interest has a predetermined status, and a stationary unit disposed within an audible range of the detector unit for receiving the emitted acoustical information.

[0006] Scanlon (U.S. Pat. No. 5,515,865) discloses an apparatus to monitor a living being's breathing movement and, in the absence of breathing movement, the apparatus attempts to stimulate breathing. The apparatus has a base member that may be a pad placed under the baby's body.

[0007] Young (U.S. Published Patent Application 2008/0077020) discloses a method and apparatus for monitoring vital signs remotely. It describes the use of a single sensor to monitor the cardiopulmonary activity of a patient using a ballistograph.

[0008] The current state in the field of monitoring a patient's vital signs involves large and cumbersome devices which can be very uncomfortable for the patient and may limit their use with babies and infants due to their size. The devices' size and complexity dictates the price of such devices to be high and that the devices must be reused and cannot be disposable.

[0009] Furthermore, most of today's devices include a sensor that is able to sense only one type of vital sign and, in case one needs to monitor several vital signs simultaneously, one is required to use several devices.

[0010] An important aspect in preventing SIDS and sleep apnea is said to do with the air composition in the vicinity of the baby. Elements such as air temperature, humidity and presence of poisonous gases such as carbon monoxide (CO) or cooking gases (such as Propane) may contribute to SIDS and sleep apnea.

[0011] There is therefore a need in the art for a system and method to incorporate one or more sensors into a cheap, single, small and disposable device, possibly manufactured into diaper and/or clothes. Another need is for a device that could control environmental influencing devices (air conditioning, electric fan, ionizer etc.) and also monitor the air in the vicinity of the baby as part of the prevention of SIDS or sleep apnea.

SUMMARY OF THE INVENTION

[0012] According to some embodiments, there are provided unique methods, devices and systems, having a sensor for monitoring physiological conditions of a subject body. In particular, the methods, devices and systems may be used for monitoring the physiological condition of a baby. The methods, devices and system disclosed herein enable a cheap, non invasive, accurate, small and disposable means for providing real time monitoring of physiological condition of a subject being monitored. In particular, the methods, devices and systems disclosed herein provide means to monitor physiological conditions of a baby and to aid in prevention of Sudden Infant Death Syndrome (SIDS), sleep apnea as well as additional health related conditions, such as, for example, elevation of body temperature of the baby. Additionally, the devices, methods and system are able to control over environmental influencing devices (such as, for example, air conditioning, electric fan, ionizer, window openers, and the like) and are also able to monitor environmental parameters that are related to breathing in the vicinity of the subject (such as, for example, temperature, humidity, carbon monoxide (CO) concentration, light, and the like).

[0013] According to some embodiments, there is provided a sensor wherein application of pressure on the sensor causes changes in the resistance of the sensor, where the level of pressure is relative to the resistance. According to some embodiments, the sensor may be an elastic resistive sensor. In some embodiments, the sensor may be an electrically conductive sensor, such as, for example, conductive wires or printed circuit board (PCB) traces or solder pads in conjunction with conductive fabric, conductive paper, conductive paint, conductive ink, elastomer, piezoresistive sheet, or the like. In some embodiments, the elastic resistive sensor may be made of a foam material soaked with conductive electrolyte that may further be contained in a non-electrically-conductive housing, such as, for example, an air tight polymer cover.

[0014] According to some embodiments, there is provide a system for monitoring the physiological conditions of a subject body and to issue/provide an alert when these physiological conditions have changed to the detriment of the subject. In some embodiments, the physiological conditions are breath related parameters, such as, for example but not limited to: rate of breathing (number of breaths per minute), deepness of breath, lack of breathing, and the like and combinations thereof.

[0015] In some embodiments, the system may include a sensor of the physiological condition(s) of a subject body and which issues signals based on those physiological conditions. A receiver in proximity to a responsible overseer detects these signals and issues an appropriate warning signal/alert.

[0016] According to some embodiments, the sensor of the system may be a sensor (such as an elastic resistive sensor) wherein pressure on the sensor causes changes in resistance of the sensor, where the level of pressure is relative/proportional to the resistance. Additionally, a tactile element (such as, for example, a vibrator) may be included to alert/move the subject to reinvigorate him to restore normal physiological conditions. In some cases, there may also be a monitor of local environmental conditions.

[0017] According to some embodiments, the present invention may improve a sleeping baby's safety and prevents SIDS based on the monitoring of baby's physiological conditions, such as breathing, and analyzing them by a system and method that incorporate one or more sensors into a single, small and disposable device, possibly manufactured into the diaper during the diaper manufacturing or at a later time, or possibly, in the form of a sticker to be placed on a baby's diaper. In some embodiments, the system may further include a detector that is able to monitor/detect various breath related environmental conditions/parameters in the vicinity of the baby subject (such as, of example, temperature, light, humidity, CO concentration, and the like) and to further affect such conditions by controlling the operation of various devices (herein after also referred to as "electrical appliances") that may influence the environmental parameters (such as, for example, air conditioning, electric fan, ionizer, electric window openers, and the like). In some embodiments, the system may be used to monitor the air/atmosphere in the vicinity of the subject baby as part of the prevention of SIDS or sleep apnea.

[0018] In some aspects, the present invention overcome deficiencies of the background art by providing a system and method that may include one or more of the following units: (a) a "subject unit" (also referred herein to as: "wearable subject unit" or "diaper unit") placed within or on a garment used by the subject. For example, the subject unit may be placed on or within a baby's disposable diaper (optionally embedded within the diaper during manufacturing of the diaper); (b) a "crib unit" ("CU" in short, also named hereinafter as "platform unit") for receiving/relaying and processing data. The platform unit may be placed in the near vicinity of the subject, and may be permanently or transiently attached to, for example, but not limited to:, a bed, a crib, a stroller, a room, high chair, car safety seat, and the like.; (c) an "overseer unit" (also named hereinafter as "supervisor unit" or "parents' unit"), which is a receiver and monitor unit located away from the subject's vicinity; (d) a "tactile unit" (for example, a vibrating unit); and (e) at least one "control unit" (also referred to as "interface unit"), such as, for example, electrical appliance control unit (with its corresponding electrical appliance).

[0019] According to some embodiments, the diaper unit may include one or more sensors (such as, for example, micro-sensors) to monitor the baby's breathing by analyzing the mechanical movement of the lower abdomen to detect various breath related events, such as, for example, cessation of breath, shortness of breath, breath rate, rhonchus and cessation of breath during sleep (sleep apnea). In some embodiments, the diaper unit also may include a body temperature sensor (such as a thermometer for measuring the baby's body temperature).

[0020] Exemplary sensors for use in the diaper unit are, for example, nut not limited to: an electrically conductive elastomer made by Chomerics, (part number: 10-04-2463-S6305), a conductive paper made by PASCO (part number: PK-9025), and Piezo resistive sheet (Velostat™). Additional options for movement sensors may include, for example, but not limited to: conductive fabrics such as those manufactured by Hebei Metals Inc. Exemplary fabrics that can be used include SS Mesh Shielding Fabric, ESD Static Fabric, Staticot™, EeonTex (Catalog number: LG SLPA 10E4, made by EEONYX LTD). Additionally or alternatively, a piezoelectric film may be used, such as, for example, piezoelectric film made by Meas, part number LDT0-028K/L w/crimps.

[0021] Further options for movement/pressure sensors may be, for example, a generally non-conductive foam/sponge material soaked in a conductive electrolyte.

[0022] According to some embodiments, the elastic resistive sensor may activated (automatically or manually), prior to use. In some embodiments, there is provided an activator for electrically activating the elastic resistive sensor, wherein the activator may be selected from the group consisting of: a strain gauge, a pull strip, a circuit-shortening conductive patch, a non-conductive pull strip on a battery contact, a reed switch, a battery comprising a built-in activation mechanism and a cover for activating a Zinc-air battery.

[0023] According to some embodiments, the electronic components of various units of the system may be packaged into a single device (Application Specific Integrated Circuit—ASIC) or may be composed using discrete components. This is true for the diaper unit as well as to any of the other units described hereinafter.

[0024] According to some embodiments, the platform unit may communicate with the diaper unit using various communication routes, such as, for example, acoustic communications in audible frequencies or ultrasonic frequencies, and optionally, using a wireless link, such as radio-frequency (RF) link.

[0025] In some embodiments, the data from the diaper unit's sensors is transmitted to the platform unit to be analyzed. Should the readings from the diaper unit exceed preset/predetermined limits; the platform unit may send an alert to the overseer unit via, for example, a wireless route. The overseer unit may, in turn, alert the overseers (such as for example, parents) by means of auditory and/or visual and/or tactile means (alarm, flashing lights, vibrations, etc.). When using an electromagnetic wireless link, it is possible to use common methods of low-range RF communications, such as Zigbee, Bluetooth and DECT.

[0026] In some embodiments, in order to prevent false alarms, the acoustic communications from the diaper unit may operate in a different frequency range than that of a baby's cry which is in the range of 1,000 Hertz (Hz) to 5,000 Hz, centered around 3,500 Hz, as well as from a baby's voice centered around 400 Hz.

[0027] According to some embodiments, the platform unit may be equipped with a digital signals processor (DSP) which can analyze the signals coming from the diaper unit and distinguish between an alert and other sounds such as a baby's cry, people speaking, etc.

[0028] In some embodiments, the acoustic communication from the diaper unit to the platform unit may be encoded such that only the corresponding platform unit would communicate with its diaper unit. The encoding can be done by specific timings and frequency of the sounds generated by the diaper unit.

[0029] In other embodiments, when an alert, which is indicative of breath related condition (such as, for example, apnea, breath rate below a predetermined threshold and the like) is activated, the platform unit may signal the tactile unit to start moving the crib (for example, by vibrating/rocking the crib). Research shows that vibrating a sleep apnea subject may re-initiate spontaneous breathing.

[0030] In some embodiments, in case that the air in the vicinity of the baby does not meet the pre-defined specifications/characteristics/limits, the system may further control external electrical appliances (devices) that can influence the baby's immediate vicinity. For example, in case the temperature is not within the pre-defined specification, the system may operate an air conditioner, an electrical fan an ionizer, and the like. For example, in case the CO concentration in the baby's vicinity is too high, the system may operate an electrical window opener to allow fresh air to come into the room. In some embodiments, once the issued alert had been addressed, the overseer may reset the system and halt the alarm(s).

[0031] According to some embodiments, the diaper unit may be in the form of a disposable sticker, that may be packaged in a sticker dispenser. The sticker dispenser may be designed in such a manner, that the diaper unit is powered up/activated only after it is taken out of the sticker dispenser. Furthermore, in some embodiments, it can also be powered by detecting initial vibrations after mounted on the abdomen, as explained hereinafter with respect to the disposable sensor.

[0032] According to some embodiments there is provided a system for monitoring breathing of a subject, the system comprising: (a) a wearable subject unit comprising: an elastic resistive sensor positionable such that breathing motion of the subject applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure, and a transmitter configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor; and (b) a platform unit comprising a receiver and being positionable in wireless transmission range with said subject unit, said platform unit configured to receive said signal from said subject unit and to issue an advisory signal indicative of the breathing of the subject.

[0033] According to some embodiments, the elastic resistive sensor comprises an elastic, electrically-conductive material contained within a non-electrically-conductive housing. The elastic, electrically-conductive material is selected from the group consisting of: foam soaked in a conductive electrolyte, a conductive fabric, a conductive paper, conductive paint, conductive ink, a conductive elastomer and a piezoresistive sheet.

[0034] In some embodiments, the wearable subject unit is embedded within a disposable diaper.

[0035] According to some embodiments, the transmitter of the wearable subject unit is a radio frequency (RF) transmitter, and the receiver of the platform unit is an RF receiver. In some embodiments, the transmitter is an acoustic transmitter, and said receiver of said platform unit is an acoustic receiver

[0036] According to some embodiments, the system may further include a remote unit configured to receive the advisory signal from the platform unit and to issue an alert to a supervisor of the subject.

[0037] According to some embodiments, the system may further include a tactile unit configured to reinvigorate the subject based on the signal from the wearable subject unit, when the signal indicates lack of breathing or breathing rate below a predetermined threshold.

[0038] According to some embodiments, the system may further include an environmental detector configured to detect at least one environmental parameter potentially affecting the breathing of the subject, the at least one environmental parameter may be selected from the group consisting of: temperature, humidity, light and carbon monoxide.

[0039] According to some embodiments, the system may further include an interface unit configured to affect the at least one environmental parameter in order to improve the breathing of the subject.

[0040] In some embodiments, the system may further include an activator for electrically activating the elastic resistive sensor, wherein the activator is selected from the group consisting of: a strain gauge, a pull strip, a circuit-shortening conductive patch, a non-conductive pull strip on a battery contact, a reed switch, a battery comprising a built-in activation mechanism and a cover for activating a Zinc-air battery.

[0041] According to some embodiments, there is provided a disposable diaper comprising: an elastic resistive sensor embedded within said disposable diaper and being positionable such that breathing motion of a subject wearing the disposable diaper applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure; and a transmitter embedded within said disposable diaper and being configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor.

[0042] In some embodiments, the elastic resistive sensor comprises an elastic, electrically-conductive material contained within a non-electrically-conductive housing. The elastic, electrically-conductive material may be selected from the group consisting of: foam soaked in a conductive electrolyte, a conductive fabric, a conductive paper, conductive paint, conductive ink, a conductive elastomer and a piezoresistive sheet.

[0043] In some embodiments, the transmitter may be a radio frequency (RF) transmitter. In some embodiments, the transmitter may be an acoustic transmitter.

[0044] According to some embodiments, there is provided a disposable diaper comprising an elastic resistive sensor embedded within said disposable diaper and being positionable such that breathing motion of a subject wearing the disposable diaper applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure; a transmitter embedded within said disposable diaper and being configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor; and an activator for electrically activating said elastic resistive sensor.

[0045] In some embodiments, the activator may be selected from the group consisting of: a strain gauge, a pull strip, a circuit-shortening conductive patch, a non-conductive pull strip on a battery contact, a reed switch, a battery comprising a built-in activation mechanism and a cover for activating a Zinc-air battery.

[0046] In further embodiments, the elastic resistive sensor comprises an elastic, electrically-conductive material contained within a non-electrically-conductive housing. The elastic, electrically-conductive material may be selected from the group consisting of: foam soaked in a conductive electrolyte, a conductive fabric, a conductive paper, conductive paint, conductive ink, a conductive elastomer and a piezoresistive sheet.

[0047] In further embodiments, the transmitter may be a radio frequency (RF) transmitter. In some embodiments, the transmitter may be an acoustic transmitter.

[0048] Other objects, features and advantages of the present invention will become apparent upon reading the following detailed description in conjunction with the drawings and the claims.

BRIEF DESCRIPTION OF THE FIGURES

[0049] Exemplary embodiments are illustrated in referenced figures. Dimensions of components and features shown in the figures are generally chosen for convenience and clarity of presentation and are not necessarily shown to scale. The figures are listed below.

[0050] FIG. **1** is an isometric view of an illustrative, exemplary embodiment of a monitoring system for a baby, equipped with a diaper unit (DU), a platform unit (CU), and a vibrating unit (VU);

[0051] FIG. **2** is a schematic illustration of an exemplary embodiment of a monitoring and alerting system (MAS);

[0052] FIG. **3** is a block diagram of the monitoring and alerting system (MAS);

[0053] FIG. **4***a* is a front, perspective view of an illustrative, exemplary embodiment of a diaper equipped with a diaper unit;

[0054] FIG. **4***b* is an isometric view of an illustrative, exemplary embodiment of a diaper unit;

[0055] FIG. **4***c* is an isometric view of an illustrative, exemplary embodiment of a diaper unit containing conductive fabric sensors;

[0056] FIG. **4***d* is an isometric view of an illustrative, exemplary embodiment of a diaper unit containing a sponge material sensor with contacts for resistive sensing;

[0057] FIG. **4***e* is a block diagram of an exemplary embodiment of the diaper unit;

[0058] FIG. **4***f* is an isometric top view of an illustrative, exemplary embodiment of a diaper unit containing a piezoelectric film sensor;

[0059] FIG. **4***g* is an isometric bottom view of the diaper unit containing a piezoelectric film sensor shown in FIG. **4***f;*

[0060] FIG. **4***h* is an isometric top view of an illustrative, exemplary embodiment of a diaper unit containing a resistive sensor;

[0061] FIG. **4***i* is an isometric bottom view of the diaper unit containing a resistive sensor shown in FIG. **4***h;*

[0062] FIG. **4***k* is an isometric view of an illustrative, exemplary embodiment of a diaper unit containing multi sensor;

[0063] FIG. **5***a* is an isometric view, schematic illustration of an illustrative, exemplary embodiment of a platform unit (CU), according to embodiments of the present invention;

[0064] FIG. **5***b* is a schematic block diagram of the platform unit, according to embodiments of the present invention;

[0065] FIG. **6***a* is an isometric view of an illustrative, exemplary embodiment of a parents' unit (PU);

[0066] FIG. **6***b* is a block diagram of the parents' unit;

[0067] FIG. **7***a* is an isometric view of an illustrative, exemplary embodiment of a sticker dispenser (SD);

[0068] FIG. **7***b* is a block diagram of the sticker dispenser;

[0069] FIG. **8***a* is an isometric view of an illustrative, exemplary embodiment of a vibrating unit (VU);

[0070] FIG. **8***b* is a block diagram of the vibrating unit (VU);

[0071] FIG. **9** is a block diagram of an electrical appliance control unit (EACU);

[0072] FIG. **10** is a flow chart that illustrates a method for monitoring a baby's physiological conditions, for alerting people to conditions, and for operating electrical appliances;

[0073] FIG. **11***a* is an isometric view of an alternate embodiment of a diaper unit (DU);

[0074] FIG. **11***b* is an isometric view of another alternate embodiment of a diaper unit (DU);

[0075] FIG. **11***c* is an isometric view of another alternate embodiment of a disposable diaper unit (DU);

[0076] FIG. **12** is a view of a diaper, partially broken away, with an embedded DU resistive sensor;

[0077] FIGS. **13***a* and **13***b* are graphs of experimental results of a DU resistive sensor;

[0078] FIG. **14***a* is a schematic illustration of an experiment setup, measuring various properties of a DU resistive sensor;

[0079] FIGS. **14***b* through **14***e* are graphs of experimental results of a DU resistive sensor;

[0080] FIG. **15** is a view, partially broken away, of a diaper equipped with a diaper unit with partial cutouts, and a first type of activation mechanism;

[0081] FIG. **16***a* is a sectional front view of a diaper equipped with a diaper unit, and a second type of activation mechanism;

[0082] FIG. **16***b* is a bottom view of a diaper equipped with a diaper unit, and a second type of activation mechanism;

[0083] FIG. **17***a* is an isometric view of an illustrative, diaper unit equipped with a pull strip assembly, as a third type of activation mechanism;

[0084] FIG. **17***b* is a top view of an illustrative, diaper unit equipped with a pull strip assembly, as a third type of activation mechanism;

[0085] FIG. **17***c* is a cross sectional view along line a-a of FIG. **17***b;*

[0086] FIG. **18** is a schematic illustration of a diaper equipped with a diaper unit, and a fourth type of activation mechanism;

[0087] FIG. **19***a* is an isometric view of an illustrative diaper unit and another activation mechanism;

[0088] FIG. **19***b* is a side view of the device shown in FIG. **19***a;*

[0089] FIG. **20** is an isometric view of an illustrative diaper unit, connected to an array of DU resistive sensors laid out in a grid onto a resistive sensor support sheet using a set of conductive leads;

[0090] FIG. **21** is an isometric view of an illustrative diaper unit and another activation mechanism;

[0091] FIG. **22** is a view similar to FIG. **15**, but showing another position for the activation mechanism;

[0092] FIG. **23** is a view similar to FIGS. **15** and **22**, but showing another position for the activation mechanism;

[0093] FIG. **24** is an isometric view of an illustrative diaper unit and another discharge mechanism;

[0094] FIG. **25** is an isometric view of an illustrative diaper unit and another activation mechanism;

[0095] FIG. **26** is an isometric view of an illustrative, exemplary embodiment of a diaper unit containing a multi sensor;

[0096] FIG. **27** is an isometric view of an illustrative diaper unit similar to FIG. **4***d* and showing that the resistive sensor is printed with resistive ink or dye onto the diaper or embedded within the diaper;

[0097] FIG. **28** is an isometric view of a bent sensor;

[0098] FIG. **29** is an isometric view of an illustrative diaper unit and another activation mechanism;

[0099] FIG. **30** is an isometric view of an illustrative diaper unit and another discharge mechanism; and

[0100] FIG. **31** is an isometric view of an illustrative diaper unit and another activation mechanism.

DETAILED DESCRIPTION

[0101] According to some embodiments, there are provided devices systems and methods for monitoring a subject's physiological conditions and for alerting changes in said physiological condition. In some embodiments, there are provided methods, devices and systems for monitoring physiological conditions of a baby, by non-invasive means, and for alerting changes in said conditions so as to prevent health related conditions, such as, for example, sleep apnea and SIDS.

[0102] As referred to herein, the term "subject" may refer, for example, to a baby, a child or an adult. For simplicity of presentation, the term "baby" is sometimes used to represent all types of subjects.

[0103] Referring now to the drawings, any internal elements, placed within the units' cases, are marked using a dashed line. The arrangement and shape of the elements as they appear in the drawings is exemplary only.

[0104] FIG. **1** is a view of a baby **100**, equipped with diaper unit (DU) **10**, laying in a crib **110** equipped with platform unit (CU) **20**, and a vibrating unit (VU) **50**, according to embodiments of the present invention.

[0105] The crib includes a mattress **182** that may include an embedded resistive sensor support sheet **180** or, alternatively, the mattress **182** may be covered with a bed sheet **184** that includes the resistive sensor support sheet **180**. This sensor support sheet acts as a movement sensor.

[0106] The CU **20** is placed near the baby, possibly on the crib **110** itself, or on a nearby shelf or piece of furniture, and the VU **50** is fastened onto the crib **110** in order to ensure proper vibration of the crib **110**.

[0107] It may be appreciated that the crib is shown for illustrative purposes only. Additional environments in which the baby is situated/located, such as, for example, a baby carriage, bassinet, or any other object in which a baby is resting or positioned may be used in the various embodiments.

[0108] FIG. **2** shows a monitoring and alerting system (MAS) **1**, according to some embodiments. The crib **110** together with the baby **100**, DU **10**, CU **20**, VU **50** and optional sticker dispenser (SD) **40** may be placed away from the overseer (such as a parent) bed **120** and PU **30**, which could even be in a different room. The cellular phone **60** and personal computer **70** may usually be away from the crib **110**, as well.

[0109] Electrical appliance control units (EACU) **80** with their corresponding electrical appliances **90** are in the vicinity of the crib **110** and baby **100** in order to increase their effectiveness. (For illustrative purposes only one electrical appliance control unit with its corresponding electrical appliance is shown, but any number of such devices may be used, as necessary to control the environment.)

[0110] When the person being monitored is older than a baby and uses a bed, rather the person's bed can include a mattress **182** that may include an embedded resistive sensor support sheet **180** or may be covered with a bed sheet **184** that includes a resistive sensor support sheet **180** in order to act as a movement sensor.

[0111] FIG. **3** is a block diagram of the monitoring and alerting system (MAS) **1**, according to embodiments of the present invention, including the major units of the MAS **1** and their inter-connections. Data gathered by the sensors of the DU **10** is transmitted by the DU **10** as a diaper unit to platform unit communication **91** to the platform unit (CU) **20** and is then transmitted, as necessary, as a SMS message **92** from the CU **20** to a telephone (shown as cellular phone **60**), as an e-mail message **93** to personal computer **70**, as platform unit to parents' unit RF communication **94** to the parents' unit (PU) **30**, as platform unit to electrical appliance control units RF communication **95** to the electrical appliance control units **80**, and/or as platform unit to vibrating unit RF communication **96** to the vibrating unit **50**. The electrical appliance control units (EACU) **80** control electrical appliances **90**. In some embodiments, the personal computer **70** may be equipped with an application for monitoring the system.

[0112] The sticker dispenser **40** generally may or may not communicate with other components/units of the system. In some embodiments, the sticker dispensed may communicate by any communication route, such as, for example, by wireless means.

[0113] The MAS **1** may also include a diaper unit activation mechanism **12*s*** (not shown in FIG. **3** but herein after described), which is operatively connected to the diaper unit **10**. The diaper unit activation mechanism **12*s*** can be made so as not to require any special action for the purpose of activation of the diaper unit **10**, namely the diaper unit **10** can be activated by a simple action such as the opening of the diaper.

[0114] FIG. **4*a*** is a perspective view of a diaper **11** equipped with diaper unit **10**, according to embodiments of the present invention. The DU **10** can be placed on the diaper **11** or inside the diaper **11**.

[0115] The DU **10** can be packaged in a sticker-like package by various means, such as, illustrated, for example, by any of the embodiments described in following figures.

[0116] The functionality of each of these elements is as described by name, and will be detailed in the description of the following illustrations. The geometrical shapes of the elements as shown in the present illustration, as well as their relative size and locations relative to each other, are in no way limiting the present invention.

[0117] FIG. **4*b*** is an isometric view of a DU **10** in a sticker configuration, according to embodiments of the present invention. In the present illustration, the DU **10** is equipped with a DU adhesive tape **14** and is encased in a sensing module sticker case with the DU printed circuit board **12** and DU magnetic flux direction detector device **15** disposed inside it. All of the components are enclosed within a DU sensing module case **13**.

[0118] FIG. **4*c*** is an isometric view of a DU **10** containing conductive fabric sensors, according to embodiments of the present invention. The DU resistive sensors **12*bb*** in this figure are made of a conductive fabric material and are connected to the DU printed circuit board **12** using a pair (or more) of DU conductive wires **12*bf***, possibly yarn or nonwoven wires or printed circuit board traces or solder pads. The pressure applied on the fabric, causes changes in the resistance of the wires as the fabric touches the wires (traces or solder pads), where the pressure is relative to the resistance. By way of comparison and explanation and without being limited to any theory or mechanism, it would be the same as, if a resistor's components are connected in parallel or series in an electric circuit, any change of the resistance value or the addition or removal of a resistor will change the circuit resistance as a whole. The resistance changing feed into the converter can be a discrete chip or made integral in the microcontroller. This converter is composed of a voltage divider and an operational amplifier (hereinafter, OpAmp). The change in the resistance causes a change in the voltage divider output, thereby resulting in a change in the current fed into the OpAmp. Then, the OpAmp output is changing within the limits of its supply voltage. In some embodiments, the limits are between about 0 volts to about 3 volts. Therefore, the voltage may swing in this range at the output of the OpAmp.

[0119] Alternatively, in some embodiments, the fabric sensor can be implemented on the flexible or thin rigid PCB (printed circuit board) which would also contain the electronics. In this embodiment, it is also possible to discharge the DU battery **12** by using a pair of DU discharge contacts **12***n*.

[0120] As shown in FIGS. **26** and **32**, the elements shown as components of the DU in the present illustration comprise one possible configuration out of various options, and include: a DU printed circuit board **12**, a DU RF transceiver **12***a*, a DU movement sensor **12***b*, a DU audio sensor **12***c*, a DU infra-red transceiver **12***d*, a DU body temperature sensor **12***e*, a DU body humidity sensor **12***f*, a DU microcontroller **12***h*, DU control lights **12***i*, DU filter and amplifiers **12***j*, a DU power switch **12***k*, DU filters and amplifiers **12***l*, a DU analog to digital converter (ADC) **12***m*, a DU sensing module case **13**, DU adhesive tape **14**, a DU magnet **15**, and a DU liquid crystal display (LCD) **16**.

[0121] FIG. **4**K is a schematic block diagram of an exemplary embodiment of diaper unit **10**, according to embodiments of the present invention. The diaper unit **10** includes several sensors such as the DU movement sensor **12***b*, the DU audio sensor **12***c*, DU infra-red transceiver **12***d*, DU body temperature sensor **12***e* and the DU body humidity sensor **12***f* which continuously send their readings to the DU filter and amplifiers **12***j*. The DU filters and amplifiers **12***j* send the filtered and amplified sensor readings to the DU analog to digital converter (ADC) **12***m* for digitization. The digitized data is then sent to the DU microcontroller **12***h* for analysis. The DU microcontroller **12***h* analyzes the received data and outputs the corresponding information on the DU monitoring lights **12***i* and the DU liquid crystal display (LCD) **16**. If required, the DU microcontroller **12***h* sends out a diaper unit to platform unit communication **91** to the platform unit **20** using the DU radio frequency transceiver **12***a* or the DU acoustic transmitter **12***p*.

[0122] In order for the DU **10** to function properly, it includes a DU power supply **18** which is controlled by the DU power supply controller **17** for voltage stability, current drain and power consumption monitoring and can be turned on and off by using the DU power switch **12***k*.

[0123] FIG. **4***d* is a DU **10** containing a sponge/foam material sensor, according to embodiments of the present invention. The sponge/foam material is usually inert, but when it is soaked with highly conductive multi-purpose electrolyte (such as "Signa Spray" made by Parker) and packaged in an air tight polymer cover, it changes its resistivity when pressure is applied to it, and it is also possible in the foam manufacturing process to mix the foam resin with any conductive material such as, copper, silver, etc.

[0124] In this configuration, the DU printed circuit board **12** and all of the components on it may be embedded within the sponge/foam material.

[0125] In this embodiment it is also possible to discharge the DU battery **12***be* using a pair of DU discharge contacts **12***n*.

[0126] FIG. **4***e* is a diaper unit **10**, according to embodiments of the present invention. This exemplary embodiment of the diaper unit **10** contains a DU movement sensor **12***b* such as a DU piezoelectric film sensor **12***ba* and/or a DU resistive sensor **12***bb* followed by a DU resistance to voltage converter **12***bc*, or any other suitable device for measuring movement.

[0127] The DU resistive sensor **12***bb* may be an elastomer based sensor, a fabric based sensor, a paper based sensor, a piezoresistive sensor, a sponge based sensor foam based sensor or any other material that changes an electrical property as it deforms when a pressure is applied to it.

[0128] An elastomer is a material that changes its resistivity when it is stretched or bent. A conductive fabric sensor (such as made by EEONYX and called EeonTex, catalog number: LG SLPA 10E4), or conductive paper (such as PK-9025 made by PASCO), or Piezo resistive sheet (such as Velostat™) with conjunction with conductive yarn (such as "Silver plated Nylon Yarn" P/N PY16125 made by Statex Production & Distribution PLC) or with any other conductive wires/pcb solder pads is a combination that causes changes in the resistance when pressure is applied to them or by bending them. A sponge/foam based sensor uses a sponge/foam soaked with a highly conductive multi-purpose electrolyte (such as "Signa Spray" made by Parker) and packaged in an air tight polymer cover, and changes its resistivity when pressure is applied to it.

[0129] The output of the DU movement sensor **12***b* (which is a low voltage signal) is input to a DU control unit **133** and in particular to a DU amplifier **130** that amplifies the low voltage signal from the DU movement sensor **12***b* and the output of the DU amplifier **130** is input to a DU filter **131** for noise removal. The output of the DU filter **131** is input to the DU comparator **132**. When the voltage level of the DU filter **131** output is high enough, above a predefined level, the DU comparator **132** outputs a logic "1" signal. Otherwise, the DU comparator **132** outputs a logic "0" signal. This comparison can also be done within the DU microcontroller **12***h* using an internal comparator, or sampling the DU filter **131** output by its (uC) internal ADC by averaging the digital counting, etc. The DU comparator **132** output is input to a single DU monostable multi-vibrator **134** with output logic level latch, implemented by a DU Flip-Flip **135**, or by a DU microcontroller **12***h* with zero, one or more sensors such as a DU body temperature sensor **12***e*. Other sensors may also be added for additional functionality. The DU control unit **133** controls the DU RF transceiver **12***a* and/or the DU acoustic transmitter **12***p*, which communicates with the platform unit **20** (not shown in the present drawing). Depending on its inputs via the DU RF antenna **12***o*, the DU RF transceiver **12***a* also sends incoming communications from the platform unit **20** (not shown in the present drawing), to the DU control unit **133**. These communications may contain system status updates. Power is supplied to the DU **10** components from the DU battery **12***be* and is activated by the DU power switch **12***k*.

[0130] In some embodiments, the mechanical pressure on the sensor may be different each time a diaper is put on the baby; therefore, the analog input voltage that the sensor will produce depends on its bending and is different on each occasion. The sensor produces resistance change and then DU resistance to voltage converter **12***bc* converts it to voltage for processing. This architecture may cascade with several comparators (block **132**) and mono-stable multivibrators (block **134**). Each of the comparators may be configured for different presets of input voltage, and also it might have a logic AND/OR/NOT/XOR gate (any combination) at the outputs of the mono-stable multivibrators in order to get the absolute decision for alerting without false alarms.

[0131] It is not possible to control the precise place and the tightness of the diaper when diapering a baby. Therefore in one embodiment (FIG. **28**), a bent shape of the sensor may be used as a default. This may override the gap between the abdomen and the diaper.

[0132] When the two DU discharge contacts **12***n* are shorted, or when for a known/predetermined period of time there is no abdomen movement, the DU **12***h* may drive current through the DU load resistor **136**, or any kind of load component or electronic circuit, in order to deplete the charge of the DU battery **12***be*.

[0133] FIG. **4***f* is a diaper unit **10** containing a piezoelectric film sensor **12***ba*, according to embodiments of the present invention. The elements shown as components of the DU **10** in FIG. **4***f* comprise one possible configuration out of various options of the top side of the DU **10**, and include: a DU printed circuit board **12**, a DU RF transceiver **12***a*, a DU acoustic transmitter **12***p*, a DU power switch **12***k*, a DU control unit **133**, a DU piezoelectric film sensor **12***ba* and a DU RF antenna **12***o*.

[0134] FIG. **4***g* is a diaper unit **10** containing a piezoelectric film sensor **12***ba*, according to embodiments of the present invention. The elements shown as components of the DU **10** in FIG. **4***g* comprise one possible configuration out of various options of the bottom side of the DU **10**, and include: a DU printed circuit board **12**, a DU body temperature sensor **12***e* and a DU battery **12***be*.

[0135] FIG. **4***h* is a diaper unit **10** containing a resistive sensor, according to embodiments of the present invention. The elements shown as components of the DU **10** in FIG. **4***h* comprise one possible configuration out of various options of the top side of the DU **10**, and include: a DU printed circuit board **12**, a DU RF transceiver **12***a*, a DU acoustic transmitter **12***p*, a DU power switch **12***k*, a DU control unit **133**, a DU resistive sensor **12***bb*, a DU resistance to voltage converter **12***bc* and a DU RF antenna **12***o*.

[0136] FIG. **4***i* is a diaper unit **10** containing a resistive sensor, according to embodiments of the present invention. The elements shown as components of the DU **10** in FIG. **4***i* comprise one possible configuration out of various options of the bottom side of the DU **10**, and include: a DU printed circuit board **12**, a DU body temperature sensor **12***e*, and a DU battery **12***be*.

[0137] With the configuration shown in FIG. **4***d*, the DU resistive sensor **12***bb* (FIG. **27**) is printed with resistive ink or dye onto the diaper **11** or embedded within the diaper **11**, and the DU **10** is attached onto the diaper so that the DU resistive sensor **12***bb* connects to the DU **10** by means of the two DU resistive sensor contacts **19**.

[0138] FIG. **5***a* is a platform unit (CU) **20**, according to embodiments of the present invention. Some of the elements of the CU **20** are within the interior of CU **20** and are marked with a dashed line. The elements shown as components of the CU **20** in the present illustration comprise one possible configuration out of various options, and include: a CU case **20***a*, a CU magnet **20***b*, a CU printed circuit board **21**, a CU loudspeaker **21***a*, a CU liquid crystal display **21***b*, a CU microprocessor **21***c*, a CU RF transceiver **21***d*, a CU cellular modem **21***e*, CU microphone **21***i*, a CU air temperature sensor **22***a*, a CU cooking gas sensor **23***a*, a CU carbon monoxide (CO) sensor **24***a*, a CU air humidity sensor **25***a*, CU control light **26**, a CU power supply control light **27**, a CU power switch **28**, and a CU disable alarm button **29**. The functionality of each of these elements is as described by name, and will be detailed in the description of the following illustration. The geometrical shapes of the elements as shown in the present illustration, as well as their relative size and locations relative to each other, are in no way limiting the present invention.

[0139] FIG. **5***b* is a block diagram of the platform unit **20**, according to embodiments of the present invention. The platform unit **20** includes several sensors such as the CU cooking gas sensor **23***a*, the CU carbon monoxide sensor **24***a*, the CU air humidity **25***a* and the CU air temperature sensor **22***a*. Each sensor transmits its readings to the corresponding sensor interface unit (a CU cooking gas sensor interface unit **23***b*, a CU carbon monoxide (CO) sensor interface unit **24***b*, a CU air humidity sensor interface unit **25***b* and a CU air temperature sensor interface (IF) unit **22***b* respectively) which convert the sensor data into microcontroller readable data.

[0140] The CU microprocessor **21***c* analyzes the data from the sensors and outputs the appropriate signals to the CU liquid crystal display **21***b* (via the CU liquid crystal display controller **21***f*) and to the CU loudspeaker **21***a* (via the CU audio amplifier **21***g*). Additionally, the CU microprocessor **21***c* communicates with the CU RF transceiver **21***d* and the CU cellular modem **21***e*.

[0141] The CU microphone **21***i* listens for acoustic transmissions from the diaper unit **10** (shown in FIG. **4***b*) and sends its data to the CU digital signals processor (DSP) **21***h* to analyze and detect specific frequencies sent by the diaper unit **10**. When the CU DSP **21***h* detects a valid communication, it signals the CU microprocessor **21***c*.

[0142] In some embodiments, when the DU is working, it may produce an acoustic sound in a known interval, which indicates a proper functionality when received by the CU.

[0143] The CU disable alarm button **29** signals the CU microprocessor **21***c* to turn off the alarm once it had started.

[0144] In order for the CU **20** to function correctly, it includes a CU power supply **28***c* which is turned on by the CU power switch **28***a* and is controlled and monitored by the CU power supply controller **28***b*. The CU power supply **28***c* has several CU power supply control lights **28***d* to display its status.

[0145] FIG. **6***a* is a parents' unit (PU) **30**, according to embodiments of the present invention. Some of the elements of the PU **30** are within the interior of PU **30** and are marked with a dashed line. The elements shown as components of the PU **30** in the present illustration comprise one possible configuration out of various options, and include: a PU case **30***a*, a PU printed circuit board **31**, a PU loudspeaker **31***a*, a PU liquid crystal display **31***b*, a PU microprocessor **31***c*, a PU RF receiver **31***d*, a PU cooking gas sensor **32***a*, a PU power supply control light **33**, a PU power switch **34**, and a PU disable alarm button **35**.

[0146] FIG. **6***b* is a block diagram of the parents' unit **30**, according to embodiments of the present invention. The parents' unit **30** includes several sensors such as the PU cooking gas sensor **32***a*, the PU carbon monoxide sensor **38***a*, the PU air humidity sensor **36***a* and the PU air temperature sensor **37***a*. Each sensor transmits its readings to the corresponding sensor interface unit (a PU cooking gas sensor interface (IF) unit **32***b*, a PU carbon monoxide sensor interface unit **38***b*, a PU air humidity sensor interface unit **36***b* and a PU air temperature sensor interface unit **37***b* respectively), which converts the sensor data into microcontroller readable data.

[0147] In some embodiments, the PU microcontroller **31***c* analyzes the data from the sensors and outputs the appropriate signals to the PU liquid crystal display **31***b* (via the PU liquid crystal display controller **310** and to the PU loudspeaker **31***a* (via the PU audio amplifier **31***g*). Additionally, the PU microcontroller **31***c* communicates with the PU RF receiver **31***d*.

[0148] The PU disable alarm button **35** signals the PU microcontroller **31***c* to turn off the alarm once it starts.

[0149] In order for the PU **30** to function correctly, it includes a PU power supply **33***c* which is turned on or off by the PU power switch **33***a* and is controlled and monitored by the PU power supply controller **33***b*. The PU power supply **33***c* has several PU power supply control lights **33***d* to display its status.

[0150] FIG. **7***a* is a sticker dispenser (SD) **40**, according to embodiments of the present invention. The elements shown as components of the SD **40** in the present illustration comprise one possible configuration out of various options and include: Several diaper units (DU) **10** on a SD sticker strip **42**, a sticker dispenser (SD) **40**, a SD strip opening **41**, a SD case **43**, a SD auditory alert **46** and a SD power supply **47**.

[0151] The sticker dispenser **40** holds the SD sticker strip **42** in the SD sticker and removal assembly. The DU **10** units are attached on the SD sticker strip **42**, in a manner that enables their easy removal, for the purpose of using them as necessary. The SD sticker strip **42** comes out of the sticker dispenser **40** through the SD strip opening **41**.

[0152] The geometrical shapes of the elements as shown in the present illustration, as well as their relative size and locations relative to each other, are in no way limiting.

[0153] FIG. **7***b* is a block diagram of the sticker dispenser **40**, according to embodiments of the present invention. The individual DU **10** units (not shown in the present drawing) are stored on the sticker strip **42** (not shown in the present drawing) within the SD case **43** (not shown in the present drawing) inside the sticker storage a removal assembly **44**. Once a DU **10** (not shown in the present drawing) is removed from the SD sticker strip **42** (not shown in the present drawing), the SD removal and activation mechanism **45** includes one polar magnet and the DU **10** is turned on automatically as its magnetic flux device (such as the Murata P/N:AS-M15TA-R) feels the fixed magnet within the SD removal and activation mechanism **45**, and the DU **10** makes a specific sound to indicate it is active.

[0154] The SD auditory alert **46** will sound to indicate that the entire available DU **10** units in the SD **40** have been used up. In order to function properly, the SD **40** is equipped with a SD power supply **47**.

[0155] FIG. **8***a* is a vibrating unit (VU) **50**, according to embodiments of the present invention. The elements shown as components of VU **50** in the present illustration comprise one possible configuration out of various options and include: a VU grip pole **51**, a VU **18**, power supply light **52**, a VU case **53**, a VU lock screw **54**, a VU printed circuit board **55**, a VU trembling motor assembly **55***a*, a VU microcontroller **55***b*, and a VU RF transceiver **55***c*.

[0156] The functionality of each of these elements is as described by name, and will be detailed in the description of the following illustration.

[0157] Some of the elements of the VU **50** are within the interior of VU **50** and are marked with a dashed line.

[0158] The geometrical shapes of the elements as shown in the present illustration, as well as their relative size and locations relative to each other, are in no way limiting the present invention.

[0159] FIG. **8***b* is a block diagram of the vibrating unit (VU) **50**, according to embodiments of the present invention. The VU RF transceiver **55***c* is constantly waiting to receive the alert signal via the RF communication platform unit to vibrating unit RF communication **96** (not shown in FIG. **8***b*, shown in FIG. **3**). Upon receiving the alert signal it signals the VU microcontroller **55***b*. The VU microcontroller **55***b* operates the VU electronic adapter unit **58**, which in turn operates the VU trembling motor assembly **55***a*. At this stage, the VU RF receiver **55***c* is waiting to receive a reset signal via the RF communication platform unit to trembling unit **96** (not shown in FIG. **8***a*, shown in FIG. **3**). Once the reset signal is received, it signals the VU microcontroller **55***b*, which turns off the VU electronic adapter unit **58** and the VU trembling motor assembly **55***a*. It is also possible to have the VU turn itself off after a predefined period of time.

[0160] In order for the VU **50** to function properly, it includes a VU power supply **57** which is controlled by the VU power supply controller **56** for voltage stability, current drain and power consumption monitoring.

[0161] FIG. **9** is a block diagram of an electrical appliance control unit (EACU) **80**, according to embodiments of the present invention. The EACU **80** connects to an AC wall outlet on the EACU AC wall outlet interface **82** and to an electrical appliance on the EACU load electrical interface **84**. The EACU microcontroller **83** receives commands from the CU **20** (not shown in the present drawing), via the EACU RF transceiver **81**, to allow electrical connection between the EACU AC wall outlet interface **82** and the EACU load electrical interface **84**, providing electricity to the electrical appliance. The EACU monitoring lights **85** are used to indicate the status of the EACU **80**.

[0162] FIG. **10** is a flow chart that schematically illustrates a method for monitoring a baby's physiological conditions, for alerting, and for operating electrical appliances in accordance with an embodiment of the present invention.

[0163] Upon power up of the MAS **1**, it enters the start stage (stage **201**). Proper power up of the system includes first turning on the CU **20** and the PU **30**, and receiving an indication from the CU **20** and PU **30** that they are functioning correctly (via their control lights or LCDs).

[0164] The first stage in the operation of the system, is the "measure air composition in the vicinity of the DU" (stage **222**) where the DU **10** measures the different parameters of the air in the vicinity of the DU **10** such as, for example, the air humidity, temperature, CO_2, etc.

[0165] Immediately following that, the MAS **1** moves to the "test air composition in the vicinity of the DU" (stage **202**) in which the DU **10**, begins to test the air composition in its vicinity testing for hazardous materials such as carbon monoxide and cooking gas.

[0166] Should the air composition fail to meet the specified criteria for safety, namely 'not in order', the MAS **1**, goes to "operate electrical appliances" (stage **203**) in which the MAS **1**, operates the EACU **80**, that in turn operates the corresponding electrical appliance in order to influence the air composition. For example, the EACU **80**, operates an electrical window opener to allow fresh air to enter the room.

[0167] In the case where the air composition test done in "test air composition in the vicinity of the DU" (stage **202**) is within the specifications, namely 'in order' the system moves to the "measure breath parameters" stage (stage **204**) where the DU **10**, measures the baby's breath parameters such as movement of the lower abdomen Following that, the DU **10** should be turned on (by one of the implemented methods).

[0168] At this point, the DU **10** sounds (or transmits) a predefined sequence to the CU **20** for a communication check ensuring proper communications between the DU **10** and the CU **20**.

[0169] The DU **10** then waits for several abdomen movements before moving into the full operative mode. This is done in order to prevent false alarms upon opening of the diaper **11** before placing it onto the baby.

[0170] Stage "measure breath parameters" (**204**) may be composed of several simultaneously occurring measurements such as "regular breath—Eupnea" (sub-stage **204***a*), "fibrillation" (sub-stage **204***b*), "respiratory arrest" (sub-stage **204***c*), "Dyspnea" (sub-stage **204***d*), "Bradypnea" (sub-stage **204***e*), "Hyperpnoea" and "Tachypnea" (sub-stage **204***f*) as well as a Built-In-Test (BIT), (sub-stage **204***g*). Thresholds and algorithms for detecting the various measurements are programmed into the CU microprocessor **21***c*.

[0171] After measuring the breath parameters, the DU **10**, analyzes the measured breath parameters in "analyze breath parameters" (stage **205**), and if the parameters are within the proper specification, the MAS **1**, returns to "measure breath parameters" (stage **204**) and continue to monitor the baby's breath parameters.

[0172] In the event that the breath parameters fall out of the proper specifications; the system moves into "initiate alert array" (stage **206**).

[0173] In the "initiate DU alerts" (stage **207**) where the DU sends a diaper unit to platform unit communication **91** signal in order for the CU **20** to send out the various alerts simultaneously: The "initiate crib vibrating" (stage **208**) sends out the platform unit to vibrating unit RF communication **96** signal to initiate the VU **50** to vibrate the crib. The "initiate CU alerts" (stage **209**) operates several alerts: an auditory alert using the CU loudspeaker **21***a* CU control light **26** and by sending the SMS message from platform unit to cellular telephone **92** and e-mail message **93**.

[0174] The "initiate PU alerts" (stage **210**) sends out the platform unit to parents' unit RF communication **94**, in order to initiate the PU **30** alerts using the PU loudspeaker **31***a* and the PU liquid crystal display **31***b*.

[0175] The "initiate BIT alert" (stage **212**) sends out a diaper unit to platform unit communication **91** in order to have the CU **20** sound an alert notifying that the BIT has failed.

[0176] Once the overseer (for example, parents) press the PU disable alarm button **35** or the CU disable alarm button **29** the system moves to the disable alerts (stage **211**) where it turns off all of the alerts, and following that, restarts the system at the start (stage **201**).

[0177] The software in the microcontroller has the ability to "learn" (with a proper algorithm) the typically abdomen movements for period of time. Thereafter, the initiation of an alert will be more accurate and stable, thereby eliminating false alarms. It means the DU may have the ability to adapt itself for each baby. This feature can be implemented in stage **204** as shown in FIG. **10**.

[0178] FIG. **11***a* is a diaper unit (DU) **10**, according to embodiments of the present invention. The DU **10** includes a DU resistive sensor **12***bb* that is connected to a DU printed circuit board **12** which may be built into the DU resistive sensor **12***bb* itself or via two or more DU resistive sensor contacts **19**. The DU printed circuit board **12** contains the required circuitry to communicate with the platform unit **20** (not shown in the present drawing), as well as the DU battery **12***be*, and DU power switch **12***k* and two DU discharge contacts **12***n*.

[0179] In this exemplary embodiment, the DU printed circuit board **12** is placed under or within the DU resistive sensor **12***bb*.

[0180] FIG. **11***b* is a diaper unit (DU) **10**, which is disposable, according to embodiments of the present invention. In this exemplary embodiment, the DU printed circuit board **12** is connected to the DU resistive sensor top side **12***bbt* and is connected near the DU resistive sensor short side **12***bbs* and may be embedded within the DU resistive sensor **12***bb* itself.

[0181] FIG. **11***c* is a disposable diaper unit (DU) **10**, which is disposable, according to embodiments of the present invention. In this exemplary embodiment, the DU printed circuit board **12** is connected to the DU resistive sensor top side **12***bbt* and is connected near the DU resistive sensor long side **12***bbl* and may be embedded within the DU resistive sensor **12***bb* itself.

[0182] FIG. **12** is a diaper **11** with an embedded DU resistive sensor **12***bb* in it, according to embodiments of the present invention. The DU resistive sensor **12***bb* can be manufactured into the diaper **11** between the diaper outer layer **11***a* and the diaper inner layer **11***b*, or it can be embedded within the diaper fluff material **11***c* so that the DU resistive sensor **12***bb* does not come in contact with the baby's skin.

[0183] FIG. **13***a* is a graph of experimental results of a DU resistive sensor **12***bb* in its idle state, according to some embodiments. In the idle state experiment, the DU resistive sensor **12***bb* (not shown in the present drawing), was attached to a diaper **11** (not shown in the present drawing), and placed on a table untouched. A resistance to voltage converter was connected to the DU resistive sensor **12***bb* (not shown in the present drawing), with its output captured by a Fluke 289 Data Logger. The output was sampled once every second for one hour. The voltage measured averaged at 0.574 Volts with a minimum value of 0.4884 Volts and a maximum value of 0.6348 Volts, with very little variance.

[0184] FIG. **13***b* is a graph of experimental results of a DU resistive sensor **12***bb* (not shown in the present drawing), in its active state, according to some embodiments. In the active state experiment, the same diaper **11** (not shown in the present drawing), used for the idle state experiment was put on a three week old baby and the sensors' output was captured once every second for one hour. The voltage measured averaged at 0.3812 Volts with a minimum value of 0.0508 Volts and a maximum value of 1.1033 Volts, with very high variance.

[0185] FIG. **14***a* is an experiment setup measuring various properties of a DU resistive sensor **12***bb*, according to embodiments of the present invention. In the active state experiments, a baby **100** was dressed with a diaper **11** equipped with a conductive fiber type DU resistive sensor **12***bb*. The DU resistive sensor **12***bb* was connected to a resistance to voltage converter **140** using a pair of conductive leads **141**. A second pair of conductive leads **141** connects the resistance to voltage converter **140** to a data logger **142**, which is connected to a personal computer (PC) **144** using a data logger to personal computer (PC) cable **143**.

[0186] The resistance to voltage converter **140** is measuring the resistivity of the DU resistive sensor **12***bb* and converts it to a voltage value, which is logged by the data logger **142**. The data logged by the data logger **142** is transferred to the PC **144** to be analyzed.

[0187] In order to test the resistivity of the DU resistive sensor **12***bb*, the resistance to voltage converter **140** is removed from the experiment setup and the DU resistive sensor **12***bb* is connected directly to the data logger **142**.

[0188] The same experiments were also performed in an idle state, where the diaper **11** was laid stationary on a table instead of being worn by a baby **100**.

[0189] FIG. **14***b* is a graph of the voltage measurements logged during an idle state experiment as described above.

[0190] In this experiment, data was logged every second for approximately 300 seconds. The voltage measured averaged at 0.1245 Volts with a minimum value of 0.1179 Volts and a maximum value of 0.1419 Volts, with very little variance.

[0191] FIG. **14***c* is a graph of the resistance measurements logged during an idle state experiment as described above.

[0192] In this experiment, data was logged every second for approximately 400 seconds. The voltage measured averaged at 8,590 Ohms with a minimum value of 8,262 Ohms and a maximum value of 8,956 Ohms, with very little variance.

[0193] FIG. **14***d* is a graph of the voltage measurements logged during an active state experiment as described above.

[0194] In this experiment, data was logged every second for approximately 600 seconds. The voltage measured averaged at 0.1661 Volts with a minimum value of 0.1016 Volts and a maximum value of 0.2934 Volts, with very high variance.

[0195] FIG. **14***e* is a graph of the resistance measurements logged during an active state experiment as described above.

[0196] In this experiment, data was logged every second for approximately 400 seconds. The voltage measured averaged at 10,234 Ohms with a minimum value of 5,089 Ohms and a maximum value of 15,315 Ohms, with very high variance.

[0197] According to these experiments, it is possible to define limits for deciding whether the sensor is sensing breath conditions or not, thus triggering an alert.

[0198] FIG. **15** is a diaper **11** equipped with a DU **10** with partial cutouts, and an activation mechanism **12***s* of a first type, according to an embodiment of the present invention. The partial cut outs show the DU **10** connected with a pair of DU conductive wires **12***bf* to a DU strain gauge **12***q*. It is possible to place the DU strain gauge **12***q* on the right side as well or to have two DU strain gauges **12***q* on both sides, and in any case, the present invention is in no way limited to any specific location on the diaper **11**, or quantity, of the strain gauges **12***q*. FIG. **22** shows another position for the strain gauge. Another place is shown in FIG. **23**, which is tight and shrinkable. When a person stretches this place, it is changing the strain gauge resistance.

[0199] The DU strain gauge **12***q* is used as the activation mechanism **12***s*. The DU strain gauge **12***q* is used as a power switch of the DU **10**. When the diaper **11** is folded open, the DU strain gauge **12***q* is stretched and changes its resistivity thereby turning on the DU **10**. Alternatively, the turning on mechanism may be implemented as a pull-strip (FIG. **25**).

[0200] In this way, the user does not need to perform any additional actions in order to turn on the DU **10**. The DU strain gauge **12***q* can be made out of flexible materials such as an elastomer or a conductive wire.

[0201] FIG. **16***a* is a front view of a diaper **11** equipped with a DU **10**, and a DU activation mechanism **12***s* of another type, according to an embodiment of the present invention. It shows the DU **10** equipped with a DU power switch **12***k* which in this case, made from a flexible material (such as silicon rubber) and is placed just under the diaper outer layer **11***a*. The power switch **12***k* is used as the DU activation mechanism **12***s*.

[0202] FIG. **16***b* is a bottom view of a diaper **11** equipped with a DU **10**, and a DU activation mechanism **12***s* of a second type, according to an embodiment of the present invention.

[0203] FIG. **16***b* shows a DU label **12***r* showing a message "Press Here" located over the DU power switch **12***k* as described in FIG. **16***a*. The label instructs the user on the correct location to press in order to activate the DU **10**. The label may be written in other languages as well, contain a graphic symbol, or a combination of both.

[0204] FIG. **17***a* is a DU **10** equipped with a pull strip assembly **156**, as a DU activation mechanism **12***s* of a third type, according to an embodiment of the present invention. The pull strip assembly **156** is affixed on top of the DU **10** and is used to activate the DU **10** by pulling the pull strip **152**, or the pull strip assembly **156** is affixed between the diaper outer layer **11***a* and the diaper inner layer **11***b* in DU **10** and is used to activate the DU **10** by pulling fastening flap **11***d* which connected to pull strip **152**.

[0205] FIG. **17***b* is a top view, schematic illustration of an illustrative, DU **10** equipped with a pull strip assembly **156**, as a DU activation mechanism **12***s* of another type, upon the section plane a-a is marked, according to an embodiment of the present invention.

[0206] FIG. **17***c* is a cross sectional side view a-a of illustrative embodiment of a DU **10** equipped with a pull strip assembly **156**, as a DU activation mechanism **12***s* of another type, according to embodiments of the present invention. The pull strip **152** is composed of two sections: a non-conductive portion of pull strip **152***a* and a conductive portion of pull strip **152***b*. By pulling the protruding part of the pull strip **152**, the non-conductive portion of pull strip **152***a* pulls the conductive portion of pull strip **152***b* until it moves over the two pull strip case contacts **154**, thereby closing an electrical circuit and switching on the DU **10**. At this stage, the non-conductive portion of pull strip **152***a* is pulled apart of the conductive portion of pull strip **152***b* and is discarded.

[0207] FIG. **18** shows a diaper **11** equipped with a DU **10**, and a DU activation mechanism **12***s* of another type, according to embodiments of the present invention. When the DU **10** is used in the present figure's configuration, the diaper fastening flap **11***d* is used to fasten the diaper **11** as with a regular diaper **11** except that when the diaper fastening flap **11***d* is fastened, the DU conductive patch **162** (which is placed on the inner side of the diaper, fastening flap **11***d*) comes in contact with the two DU power contacts **160**, closes an electrical circuit, and turns on the DU **10**.

[0208] FIG. **19***a* is a DU **10**, and a DU activation mechanism **12***s*, according to an embodiment of the present invention. The DU **10** is connected to a DU battery **12***be* using a first battery contact **171** and a second battery contact **172**. A non-conductive pull strip **170** is kept between the first battery contact **171** and the DU battery **12***be* so that there is no electrical contact between them and the electrical circuit is open. Only when the user removes the non-conductive pull strip **170**, does the DU **10** turn on. FIG. **19***b* is a DU **10**, and a DU activation mechanism **12***s* of a fifth type, according to an embodiment of the present invention as presented in FIG. **19***a*.

[0209] Various other known methods may be used for activating the battery and the DU **10**. These various implementations include, for example, but not limited to: reed switches,

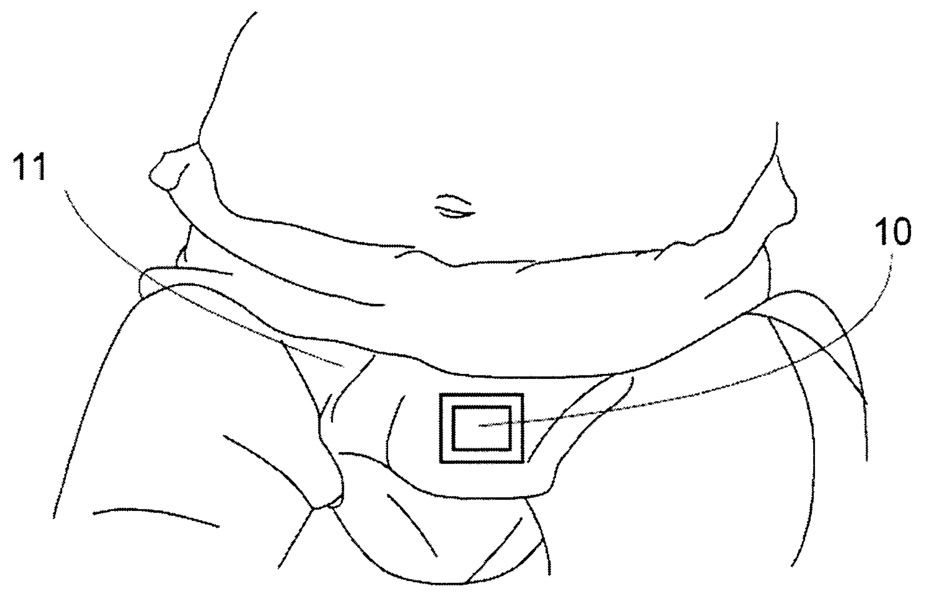

Fig. 4A

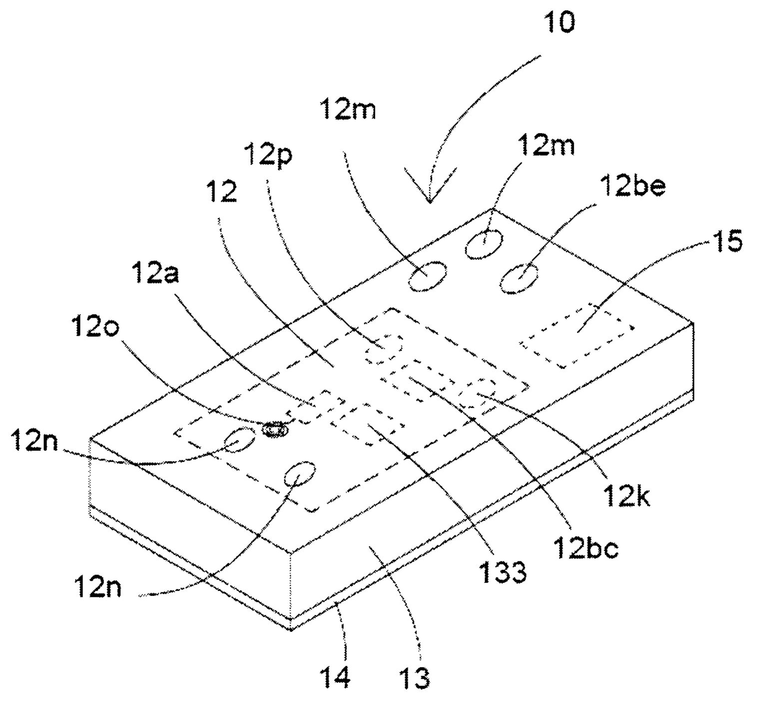

Fig. 4B

magnetic strip **224** (FIG. **31**) (e.g. when the diaper is opened then a reed switch on the sensor side is switched on (N.O. type) because the magnetic field is gone), built in activation mechanism in a battery with reed switch or pull strip (FIG. **17***a*), cover removal **223** for activating Zinc-Air battery (FIG. **21**), two discharge terminals that will short circuit by conductive label (FIG. **29**), discharge by reed switch and magnetic tray (FIG. **24**) or trash can (FIG. **30**), and discharge by magnetic field.

[0210] FIG. **20** is a diaper unit **10**, connected to an array of DU resistive sensors **12***bb* laid out in a grid onto a resistive sensor support sheet **180** using a set of conductive leads **141**, according to an embodiment of the present invention. The resistive sensor support sheet **180** may be embedded within the cribs' mattress or within the mattress' sheets.

[0211] The same principles apply to the case where the person being monitored is not a baby and sleeps in a regular bed. It is easy to implement the resistive sensor support sheet **180** in any standard mattress and bed sheet.

[0212] The various embodiments herein described involve several creative, surprising and unique features. One such aspect is fitting the electronic diaper mechanism as an integral part of the diaper—the mechanism is inserted directly into the diaper with the sensor as part of the manufacturing process (built in). Another such feature is automatic operation of the baby diaper mechanism—activation of the diaper mechanism upon opening of the diaper without any user particular activity. Unique to this disclosure is the use of sensors not previously used for sensing the physiological conditions of a body. The sensor may also be implemented as a sticker and placed anywhere on the body or in the diaper. Depending on the embodiment, the sensor may be an integral part of the electronic circuit or be made separate. To implement such embodiments, there was necessarily unique ASIC development only for this use. There is acoustic communication between the baby diaper mechanism to the in-platform unit for maintenance—acoustical communication for alerting about physiologic problems or diaper mechanism failure, or proper function indication in any known audible or non-audible sound interval. Moreover, the system influences the baby environment in order to wake him up—operating appliance to vibrate the crib. The subject unit and platform unit can be used in various places outside the baby bed, for example, as part of/associated with/integrated with/attached to a baby carriage or stroller, infant seat, crib, and the like. Further application of the system is for bedclothes—the mechanism can be embedded inside baby mattress or bed sheet with elastomeric/piezo/resistive sheet/conductive fabric which serve as the sensor device. There can be discharge of the diaper battery by: placement on a magnetic plate or trash can and activation of the diaper reed switch; automatic activation of the load resistor by the microcontroller after a period of non movement of the sensor; or by using a wireless signal. One embodiment has an embedded operating mechanism inside a battery. The platform unit also monitors the environment. There are various types of communications for alerting a responsible person—SMS, windows application, email.

[0213] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents will now occur to those of ordinary skill in the art. The invention is described in detail with reference to a particular embodiment, but it should be understood that various other modifications can be effected and still be within the spirit and scope of the invention. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

[0214] In the description and claims of the application, each of the words "comprise" "include" and "have", and forms thereof, are not necessarily limited to members in a list with which the words may be associated.

1. A system for monitoring breathing of a subject, the system comprising:

(a) a wearable subject unit comprising:

an elastic resistive sensor positionable such that breathing motion of the subject applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure, and

a transmitter configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor; and

(b) a platform unit comprising a receiver and being positionable in wireless transmission range with said subject unit, said platform unit configured to receive said signal from said subject unit and to issue an advisory signal indicative of the breathing of the subject.

2. The system according to claim **1**, wherein said elastic resistive sensor comprises an elastic, electrically-conductive material contained within a non-electrically-conductive housing.

3. The system according to claim **2**, wherein said elastic, electrically-conductive material is selected from the group consisting of: foam soaked in a conductive electrolyte, a conductive fabric, a conductive paper, conductive paint, conductive ink, a conductive elastomer and a piezoresistive sheet.

4. The system according to claim **1**, wherein said wearable subject unit is embedded within a disposable diaper.

5. The system according to claim **1**, wherein said transmitter of said wearable subject unit is a radio frequency (RF) transmitter, and said receiver of said platform unit is an RF receiver.

6. The system according to claim **1**, wherein said transmitter of said wearable subject unit is an acoustic transmitter, and said receiver of said platform unit is an acoustic receiver

7. The system according to claim **1**, further comprising a remote unit configured to receive said advisory signal from said platform unit and to issue an alert to a supervisor of the subject.

8. The system according to claim **1**, further comprising a tactile unit configured to reinvigorate said subject based on the signal from said wearable subject unit, when the signal indicates lack of breathing or breathing rate below a predetermined threshold.

9. The system according to claim **1**, further comprising an environmental detector configured to detect at least one environmental parameter potentially affecting the breathing of the subject, the at least one environmental parameter selected from the group consisting of:

temperature, humidity, light and carbon monoxide.

10. The system according to claim **9**, further comprising an interface unit configured to affect the at least one environmental parameter in order to improve the breathing of the subject.

11. The system according to claim **1**, further comprising an activator for electrically activating said elastic resistive sensor, said activator is selected from the group consisting of: a strain gauge, a pull strip, a circuit-shortening conductive patch, a non-conductive pull strip on a battery contact, a reed switch, a battery comprising a built-in activation mechanism and a cover for activating a Zinc-air battery.

12. A disposable diaper comprising:

an elastic resistive sensor embedded within said disposable diaper and being positionable such that breathing motion of a subject wearing the disposable diaper applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure; and

a transmitter embedded within said disposable diaper and being configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor.

13. The disposable diaper according to claim **12**, wherein said elastic resistive sensor comprises an elastic, electrically-conductive material contained within a non-electrically-conductive housing.

14. The disposable diaper according to claim **13**, wherein said elastic, electrically-conductive material is selected from the group consisting of: foam soaked in a conductive electrolyte, a conductive fabric, a conductive paper, conductive paint, conductive ink, a conductive elastomer and a piezoresistive sheet.

15. The disposable diaper according to claim **12**, wherein said transmitter is a radio frequency (RF) transmitter.

16. The disposable diaper according to claim **12**, wherein said transmitter is an acoustic transmitter.

17. A disposable diaper comprising:

an elastic resistive sensor embedded within said disposable diaper and being positionable such that breathing motion of a subject wearing the disposable diaper applies mechanical pressure to said elastic resistive sensor, wherein said elastic resistive sensor is configured to change its resistance responsive to the mechanical pressure;

a transmitter embedded within said disposable diaper and being configured to wirelessly transmit a signal based on the change in resistance of the elastic resistive sensor; and

an activator for electrically activating said elastic resistive sensor.

18. The disposable diaper according to claim **17**, wherein said activator is selected from the group consisting of: a strain gauge, a pull strip, a circuit-shortening conductive patch, a non-conductive pull strip on a battery contact, a reed switch, a battery comprising a built-in activation mechanism and a cover for activating a Zinc-air battery.

19. The disposable diaper according to claim **17**, wherein said elastic resistive sensor comprises an elastic, electrically-conductive material contained within a non-electrically-conductive housing.

20. The disposable diaper according to claim **19**, wherein said elastic, electrically-conductive material is selected from the group consisting of: foam soaked in a conductive electrolyte, a conductive fabric, a conductive paper, conductive paint, conductive ink, a conductive elastomer and a piezoresistive sheet.

21-22. (canceled)

* * * * *

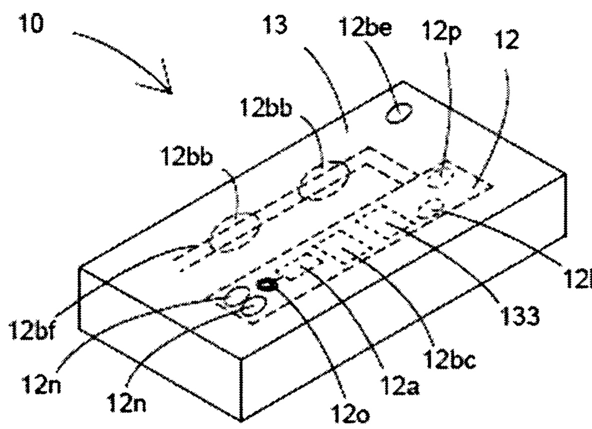
10
13
12be
12p
12
12bb
12bb
12k
133
12bf
12bc
12n
12a
12n
12o

Fig. 4C

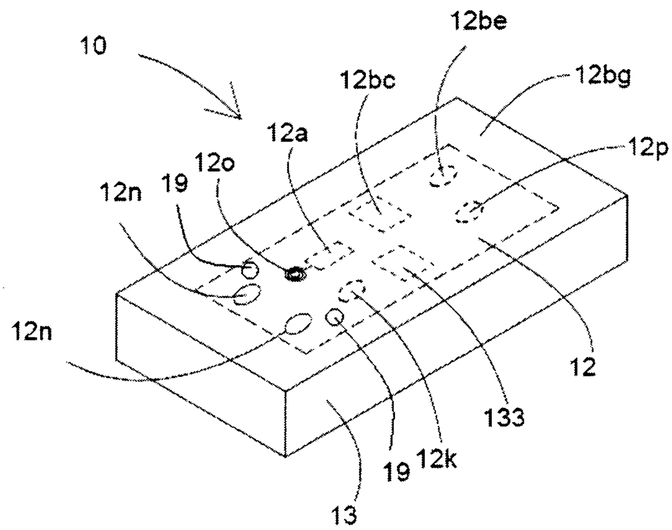
12be
10
12bc
12bg
12a
12p
12o
12n
19
12n
12
133
19
12k
13

Fig. 4D

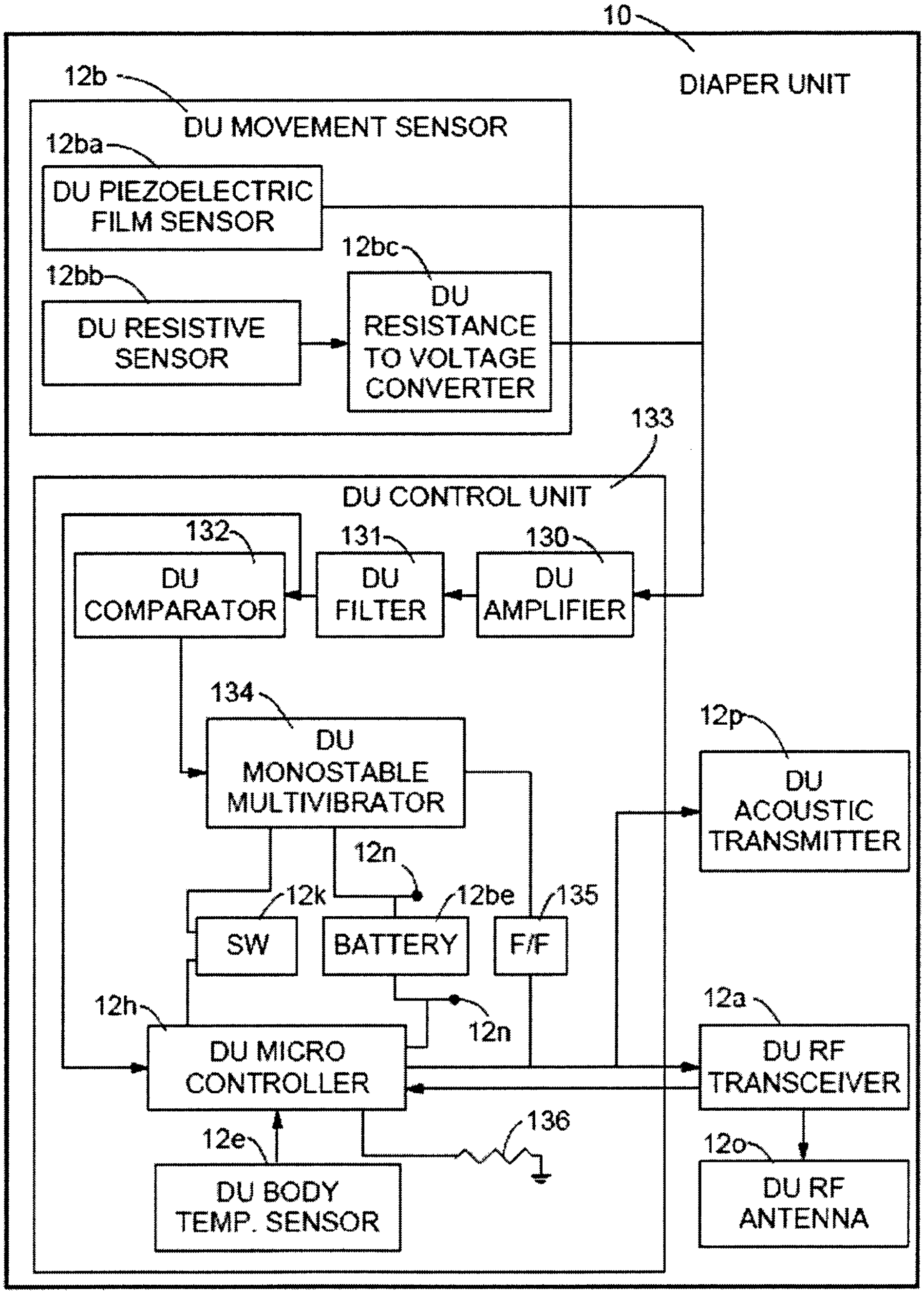
10
DIAPER UNIT
12b
DU MOVEMENT SENSOR
12ba
DU PIEZOELECTRIC FILM SENSOR
12bb
DU RESISTIVE SENSOR
12bc
DU RESISTANCE TO VOLTAGE CONVERTER
133
DU CONTROL UNIT
132
DU COMPARATOR
131
DU FILTER
130
DU AMPLIFIER
134
DU MONOSTABLE MULTIVIBRATOR
12p
DU ACOUSTIC TRANSMITTER
12n
12k
SW
12be
BATTERY
135
F/F
12n
12h
DU MICRO CONTROLLER
12a
DU RF TRANSCEIVER
136
12e
DU BODY TEMP. SENSOR
12o
DU RF ANTENNA

Fig. 4E

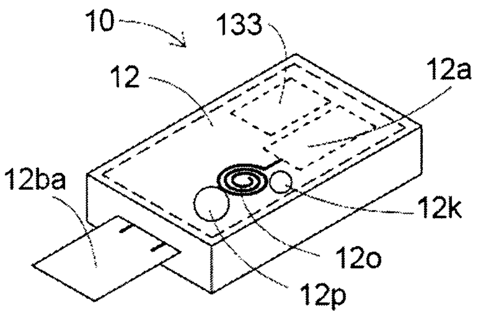

Fig. 4F

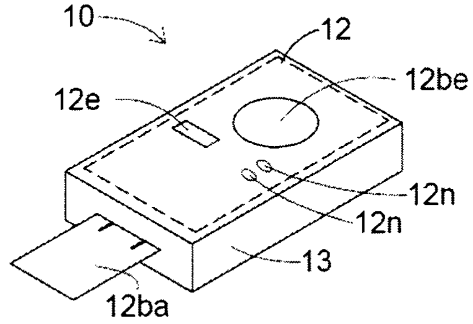

Fig. 4G

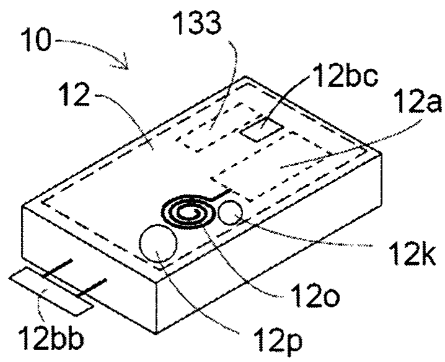

Fig. 4H

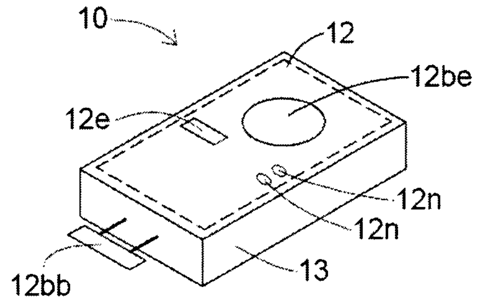

Fig. 4I

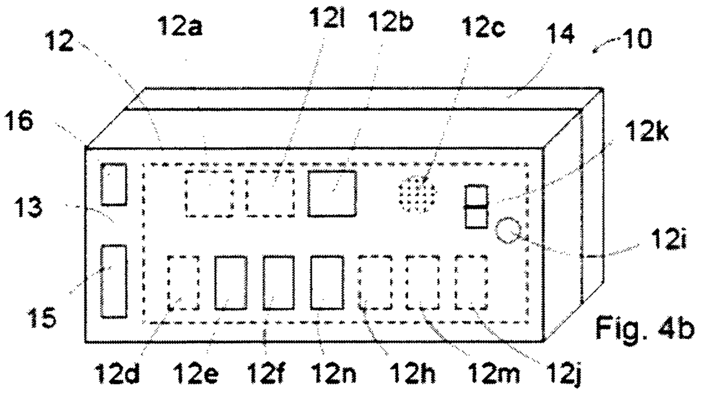
12
12a
12l
12b
12c
14
10
16
12k
13
12i
15
Fig. 4b
12d
12e
12f
12n
12h
12m
12j

Fig. 4J

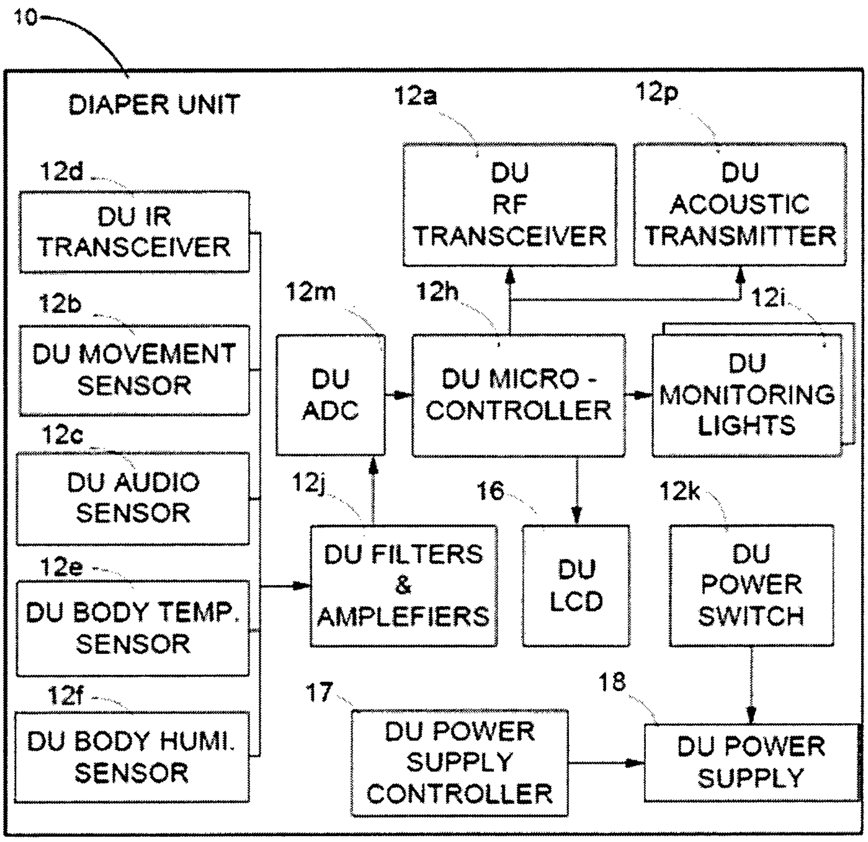
10
DIAPER UNIT
12a
12p
12d
DU IR TRANSCEIVER
DU RF TRANSCEIVER
DU ACOUSTIC TRANSMITTER
12b
DU MOVEMENT SENSOR
12m
12h
12i
DU ADC
DU MICRO - CONTROLLER
DU MONITORING LIGHTS
12c
DU AUDIO SENSOR
12j
16
12k
12e
DU BODY TEMP. SENSOR
DU FILTERS & AMPLEFIERS
DU LCD
DU POWER SWITCH
12f
17
18
DU BODY HUMI. SENSOR
DU POWER SUPPLY CONTROLLER
DU POWER SUPPLY

Fig. 4K

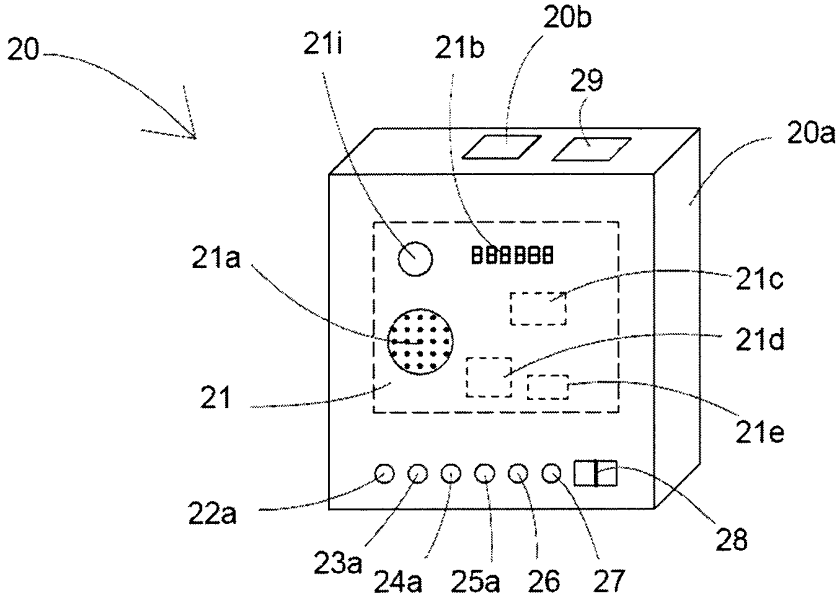
20
21i
21b
20b
29
20a
21a
21c
21d
21
21e
22a
23a
24a
25a
26
27
28

Fig. 5A

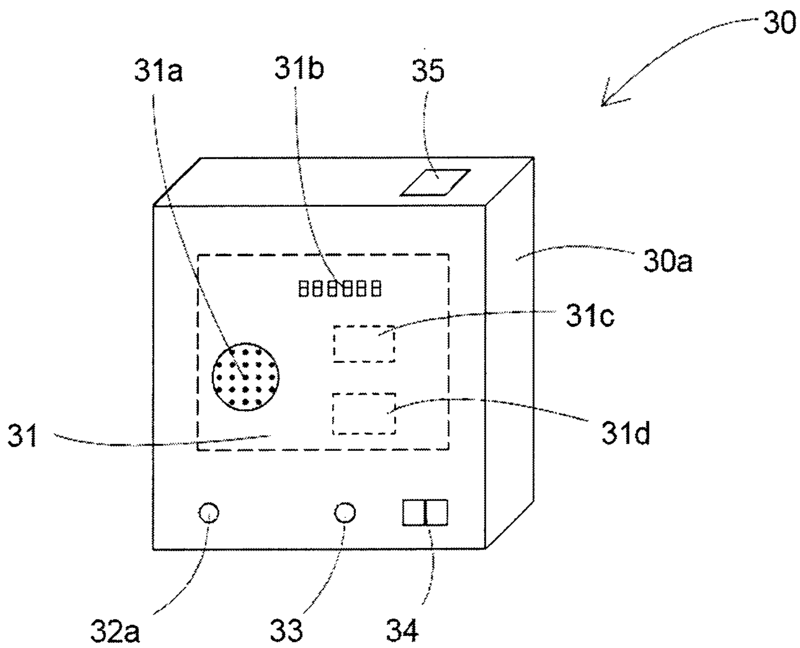
30
31a
31b
35
30a
31c
31
31d
32a
33
34

Fig. 6A

专利名称(译)	监测受试者的生理状况		
公开(公告)号	US20130165809A1	公开(公告)日	2013-06-27
申请号	US13/812761	申请日	2011-07-28
[标]申请(专利权)人(译)	ABIR EYALL		
申请(专利权)人(译)	ABIR，EYALL		
当前申请(专利权)人(译)	DIGISENSE LTD.		
[标]发明人	ABIR EYALL		
发明人	ABIR, EYALL		
IPC分类号	A61B5/113 A61B5/11 A61B5/00		
CPC分类号	A61B5/002 A61B5/1126 A61B5/4818 A61B5/6808 A61B5/6892 A61B2503/04 A61B2560/0214 A61B2560/0242 A61B2560/045 A61B2562/0247 A61B2562/043 A61B2562/046 A61B5/113 A61B5/0004 A61B5/746 A61B5/7282 A61B5/0026 A61B5/7455 A61B5/7475 A61B5/1135		
优先权	61/368654 2010-07-29 US		
外部链接	Espacenet USPTO		

摘要(译)

一种用于监测对象呼吸的系统，该系统包括：（a）可穿戴对象单元，包括：弹性电阻传感器，其可定位成使得对象的呼吸运动向所述弹性电阻传感器施加机械压力，其中所述弹性电阻传感器被配置响应于机械压力改变其电阻，以及配置成基于弹性电阻传感器的电阻变化无线传输信号的发射器;（b）平台单元，包括接收器并且可与所述对象单元在无线传输范围内定位，所述平台单元被配置为从所述对象单元接收所述信号并发出指示对象呼吸的咨询信号。