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Van Keymeulen et al.

(54) **SENSOR ENABLED ABSORBENT ARTICLE AVOIDING LEAKAGES**

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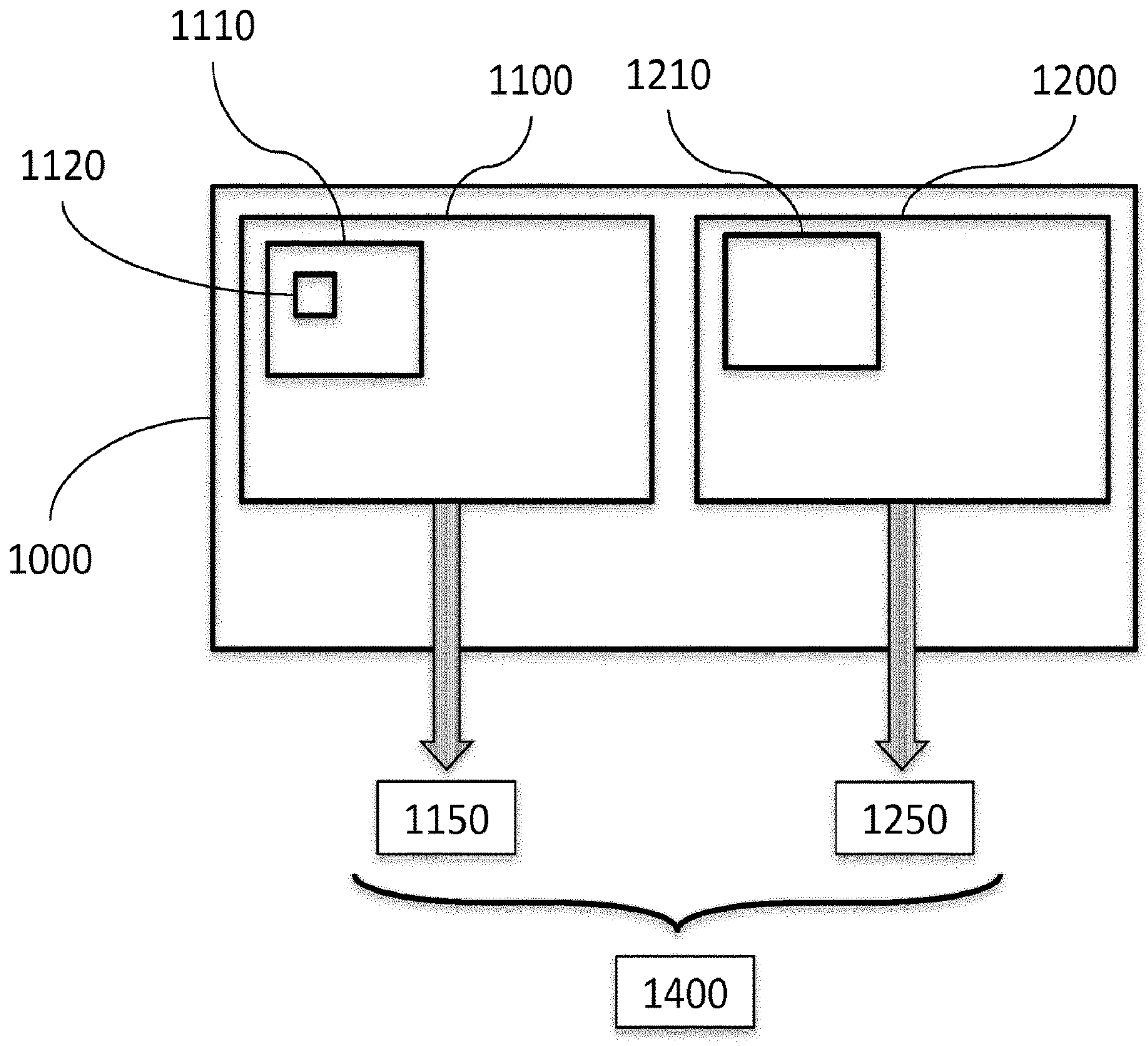
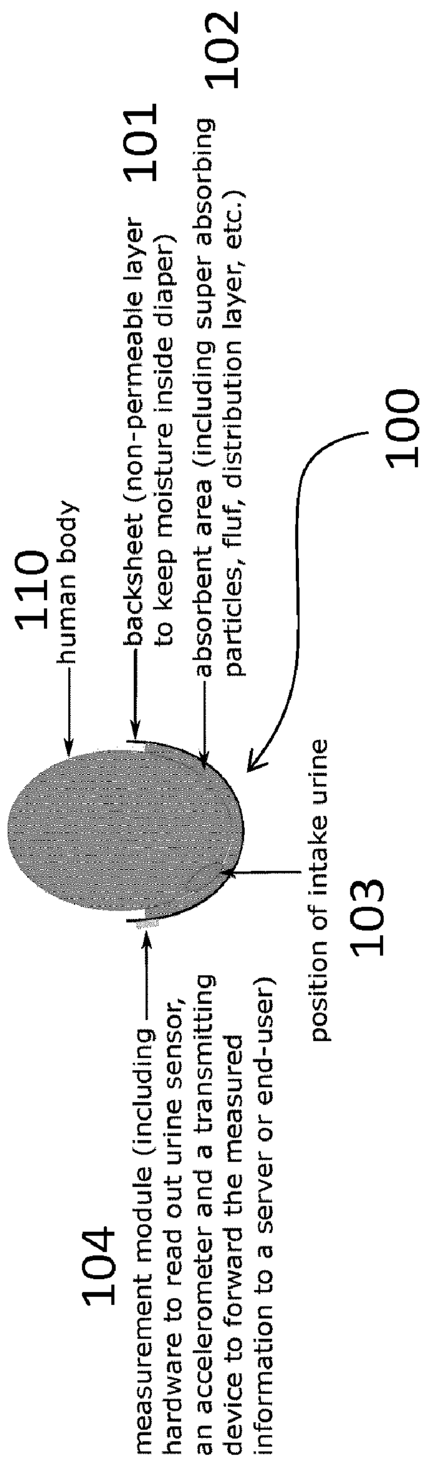
(57) **ABSTRACT**

The invention relates to an absorbent article system providing volume monitoring with a large dynamic measurement range, and body position determining with a high localization precision, herewith avoiding leakages. Moreover the system relates to identification of absorbent article types in an automated manner.





100
101
backsheet (non-permeable layer to keep moisture inside diaper)
102
absorbent area (including super absorbing particles, fluf, distribution layer, etc.)
110
human body
103
position of intake urine
104
measurement module (including hardware to read out urine sensor, an accelerometer and a transmitting device to forward the measured information to a server or end-user)

Figure 1

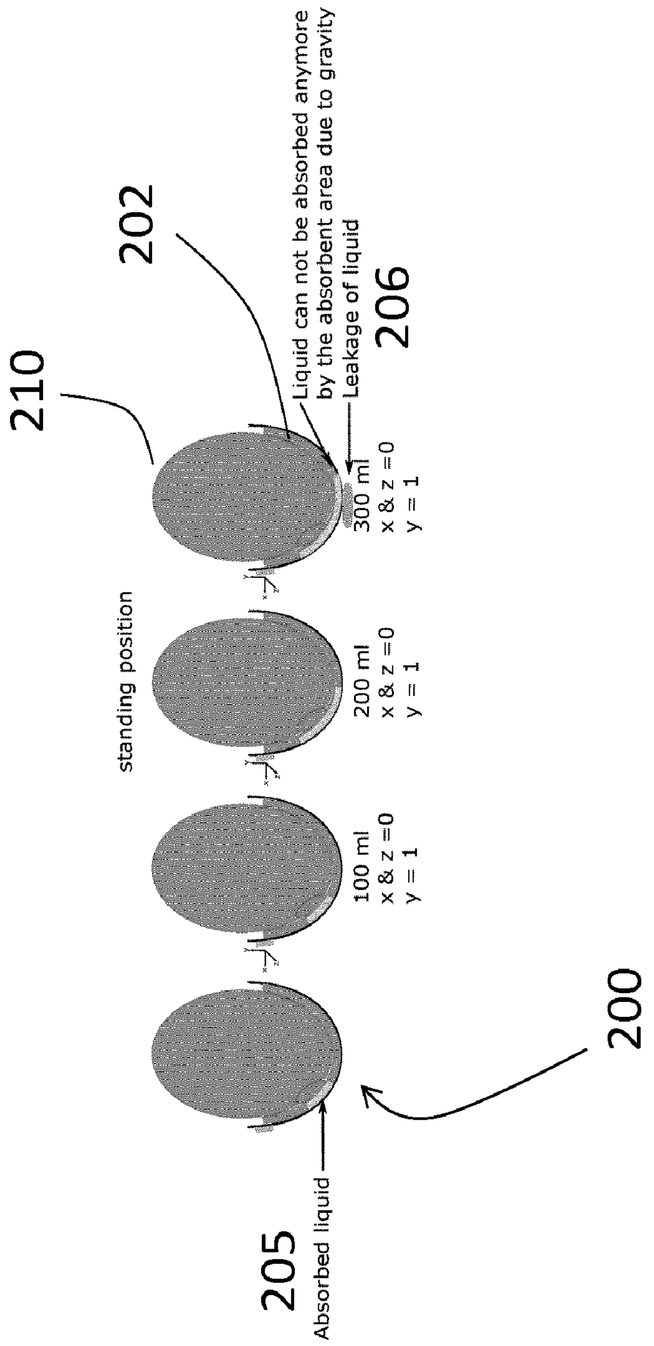
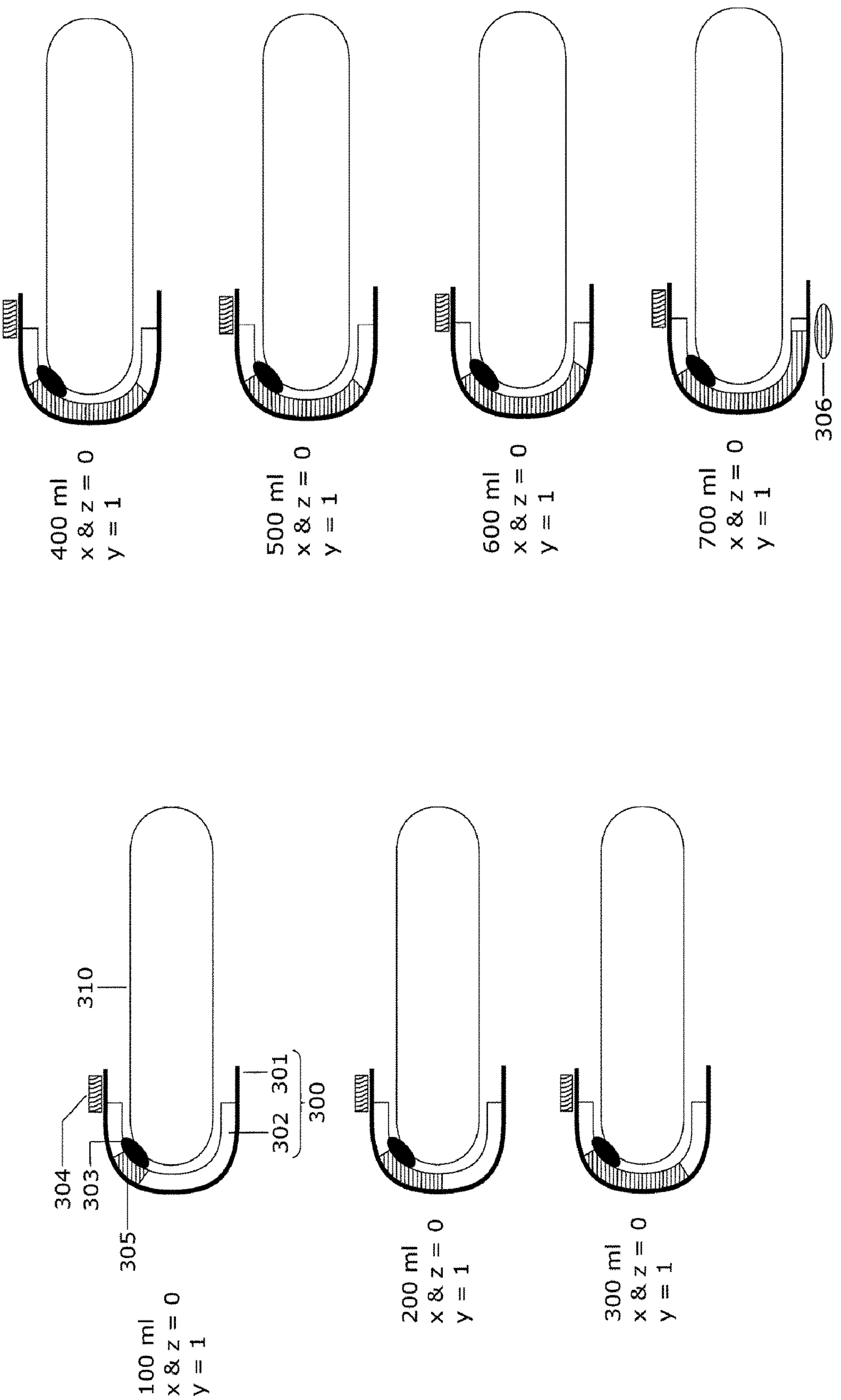

210
202
Liquid can not be absorbed anymore
by the absorbent area due to gravity
Leakage of liquid
206
standing position
100 ml
x & z =0
y = 1
200 ml
x & z =0
y = 1
300 ml
x & z =0
y = 1
200
205
Absorbed liquid

Figure 2

Figure 3


310
304
303
305
301
302
300
100 ml
x & z = 0
y = 1
200 ml
x & z = 0
y = 1
300 ml
x & z = 0
y = 1
400 ml
x & z = 0
y = 1
500 ml
x & z = 0
y = 1
600 ml
x & z = 0
y = 1
700 ml
x & z = 0
y = 1
306

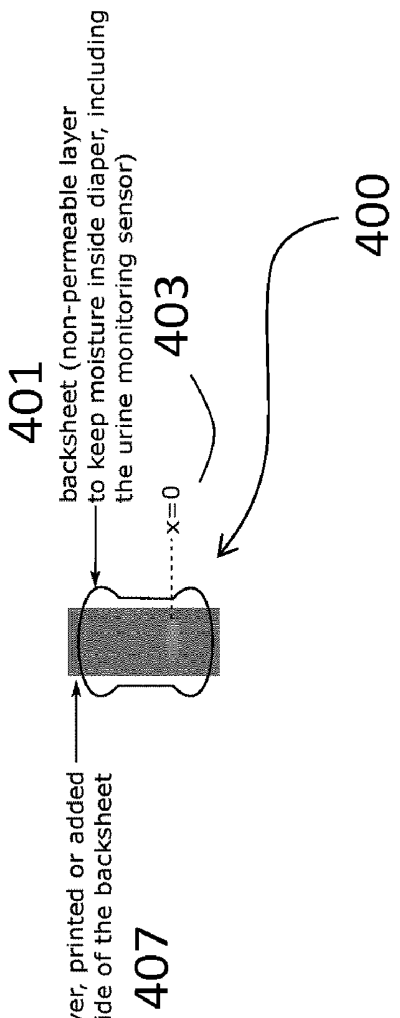

401
backsheet (non-permeable layer to keep moisture inside diaper, including the urine monitoring sensor)
403
400
x=0
sensor layer, printed or added to the inside of the backsheet
407

Figure 4

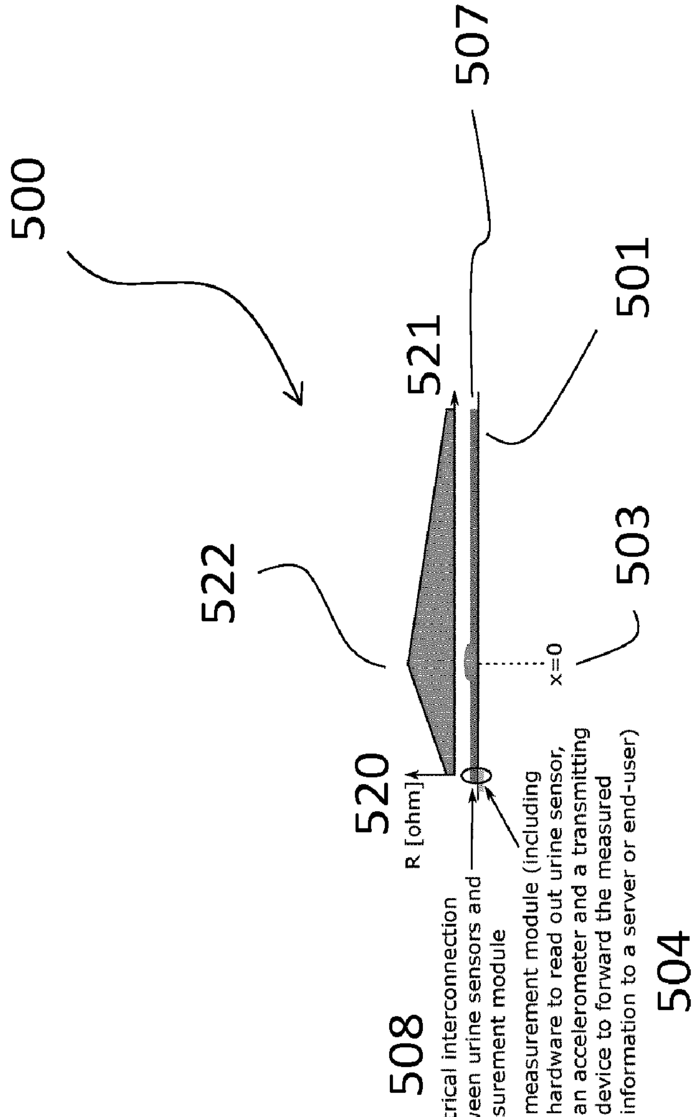

500
507
501
521
522
503
x=0
520
R [ohm]
508
electrical interconnection between urine sensors and measurement module
measurement module (including hardware to read out urine sensor, an accelerometer and a transmitting device to forward the measured information to a server or end-user)
504

Figure 5

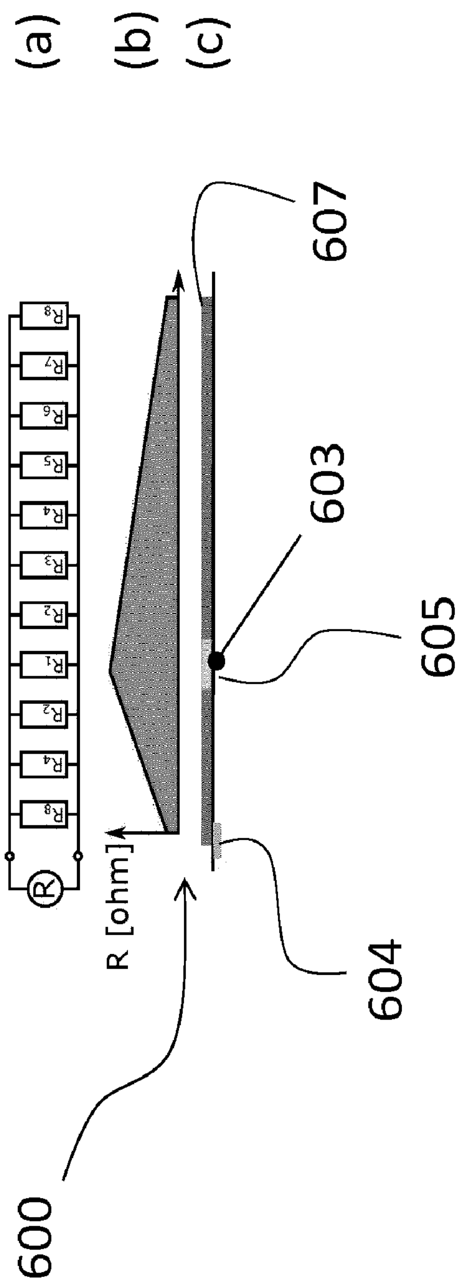
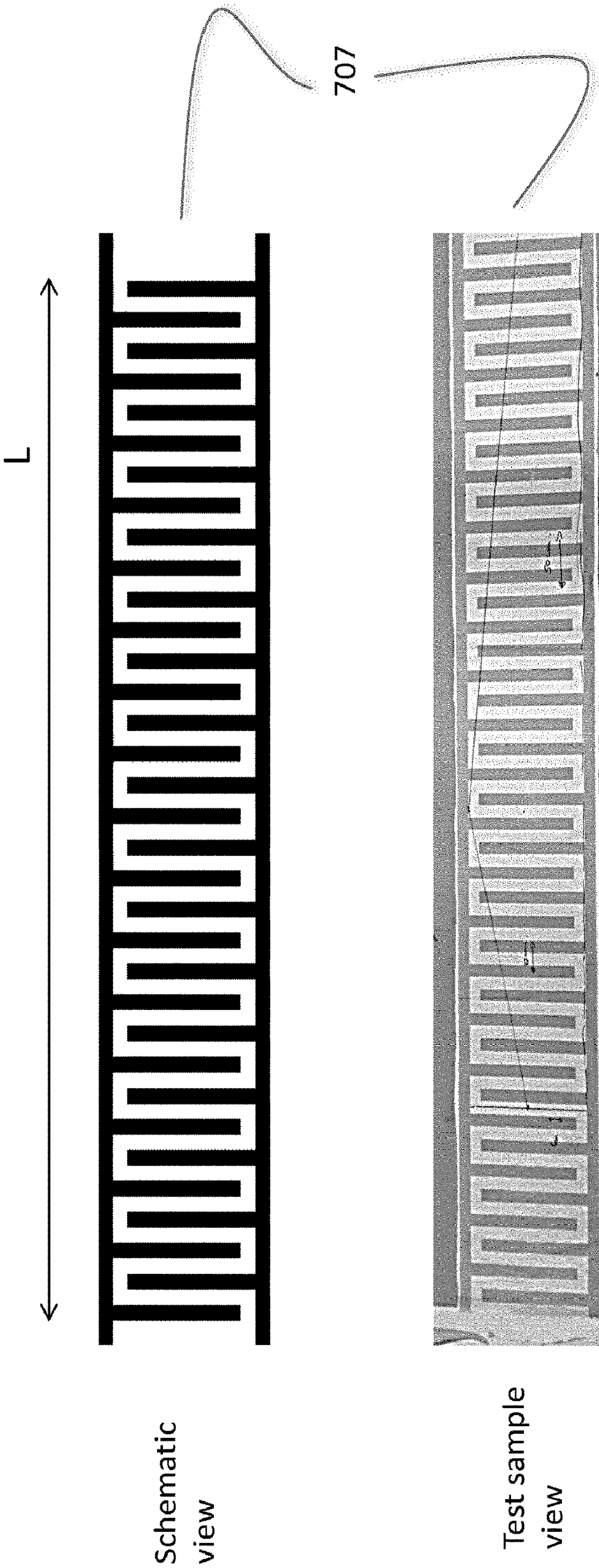


Figure 6

Figure 7



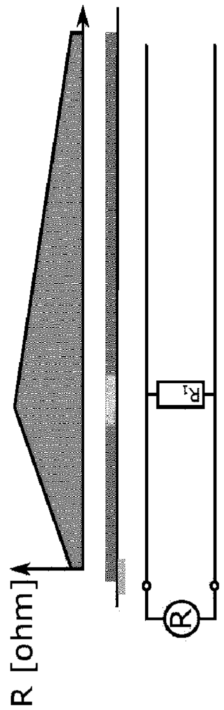


Figure 8

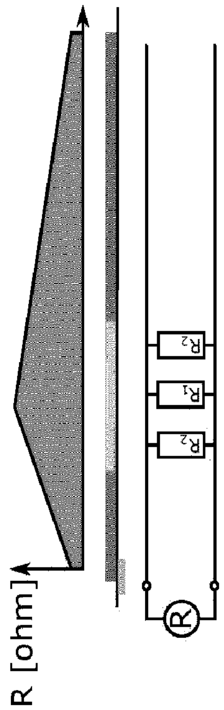


Figure 9

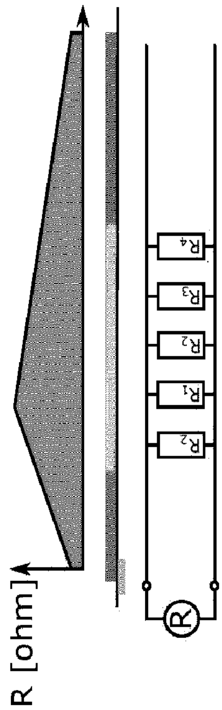


Figure 10

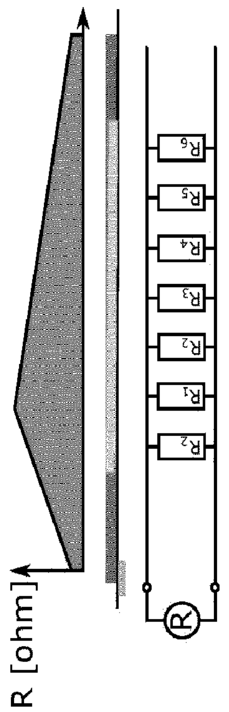


Figure 11

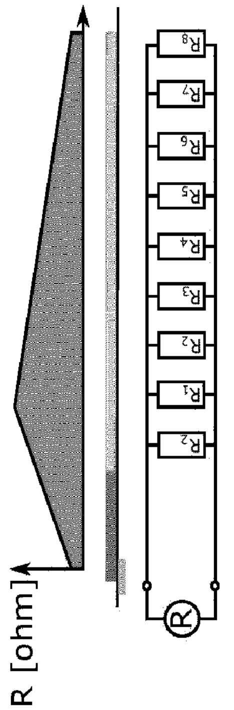


Figure 12

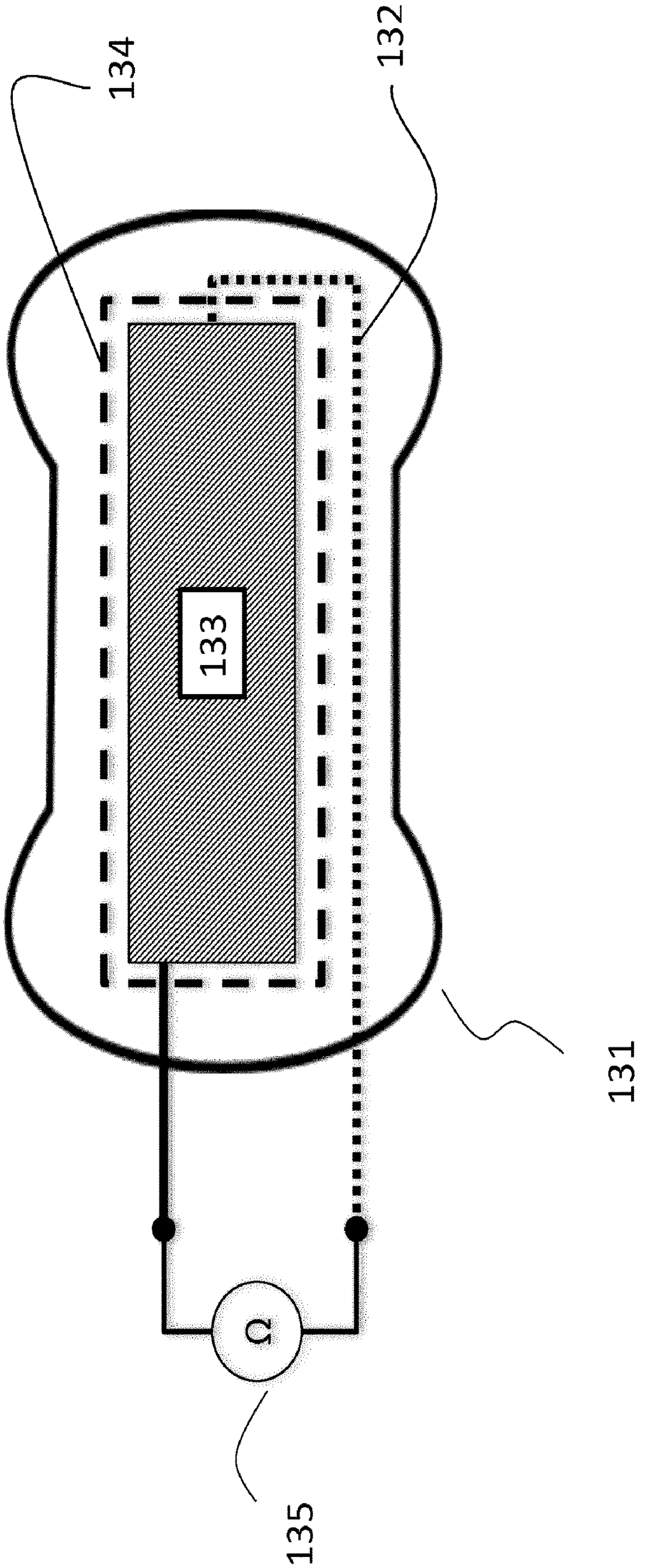


Figure 13

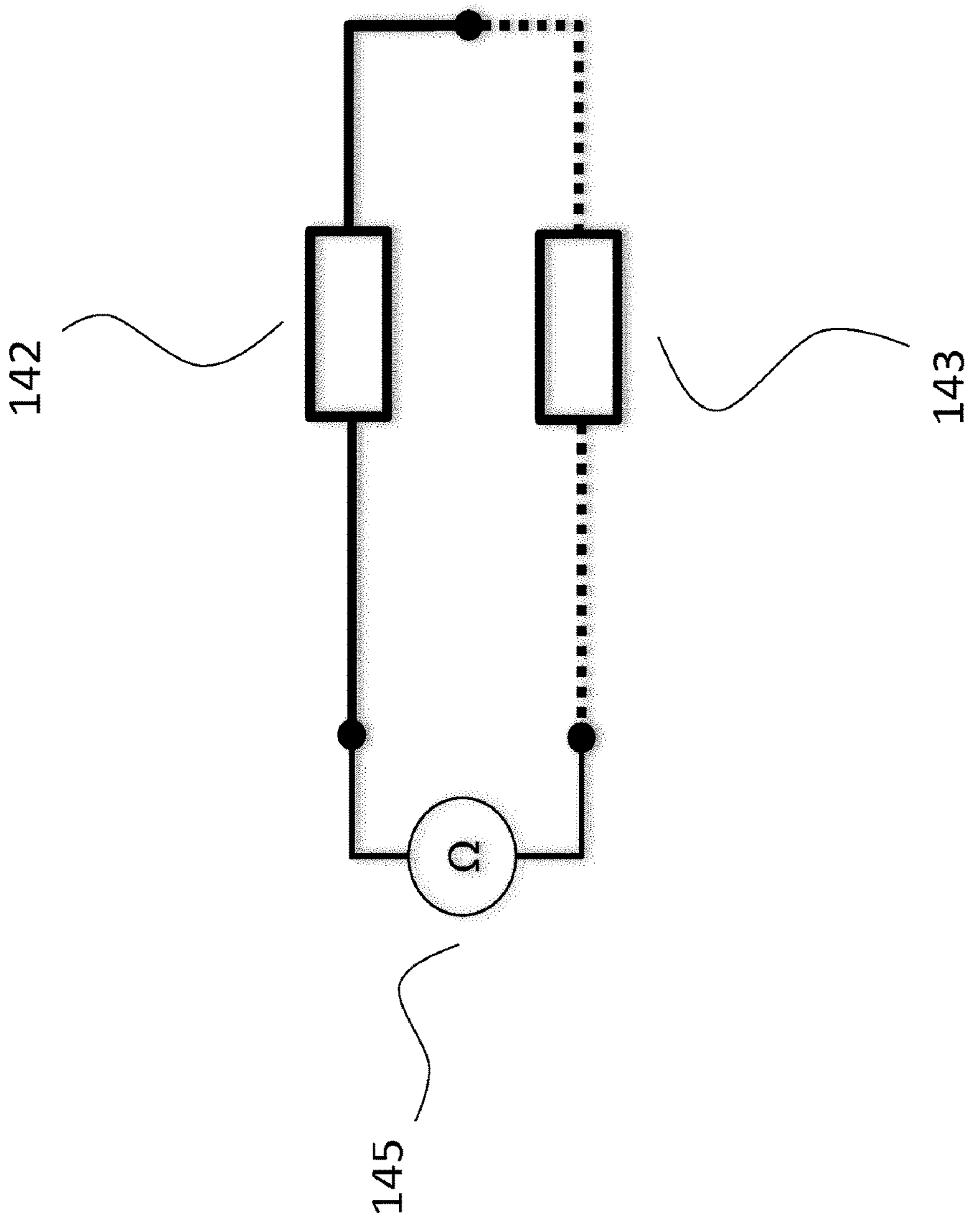


Figure 14

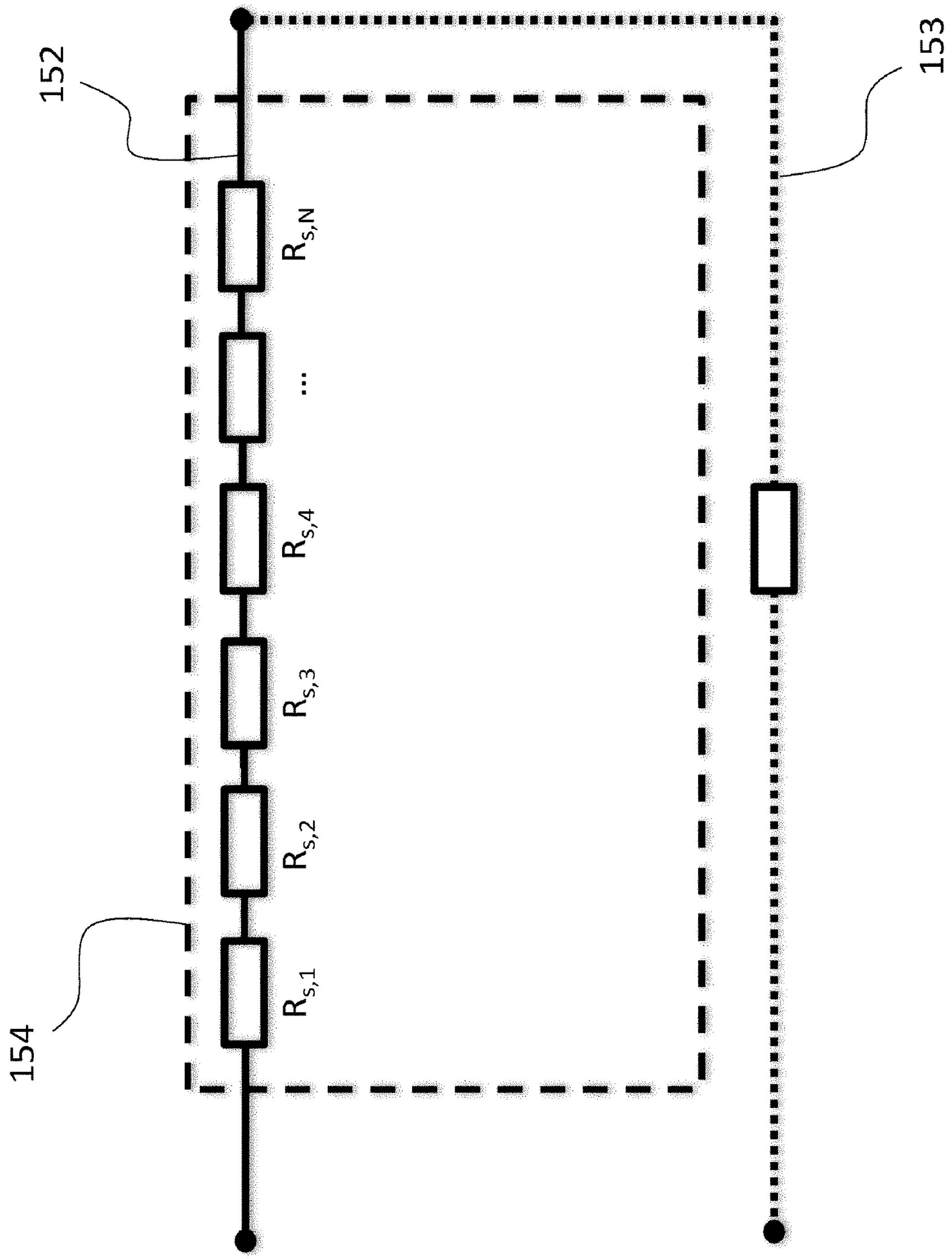


Figure 15

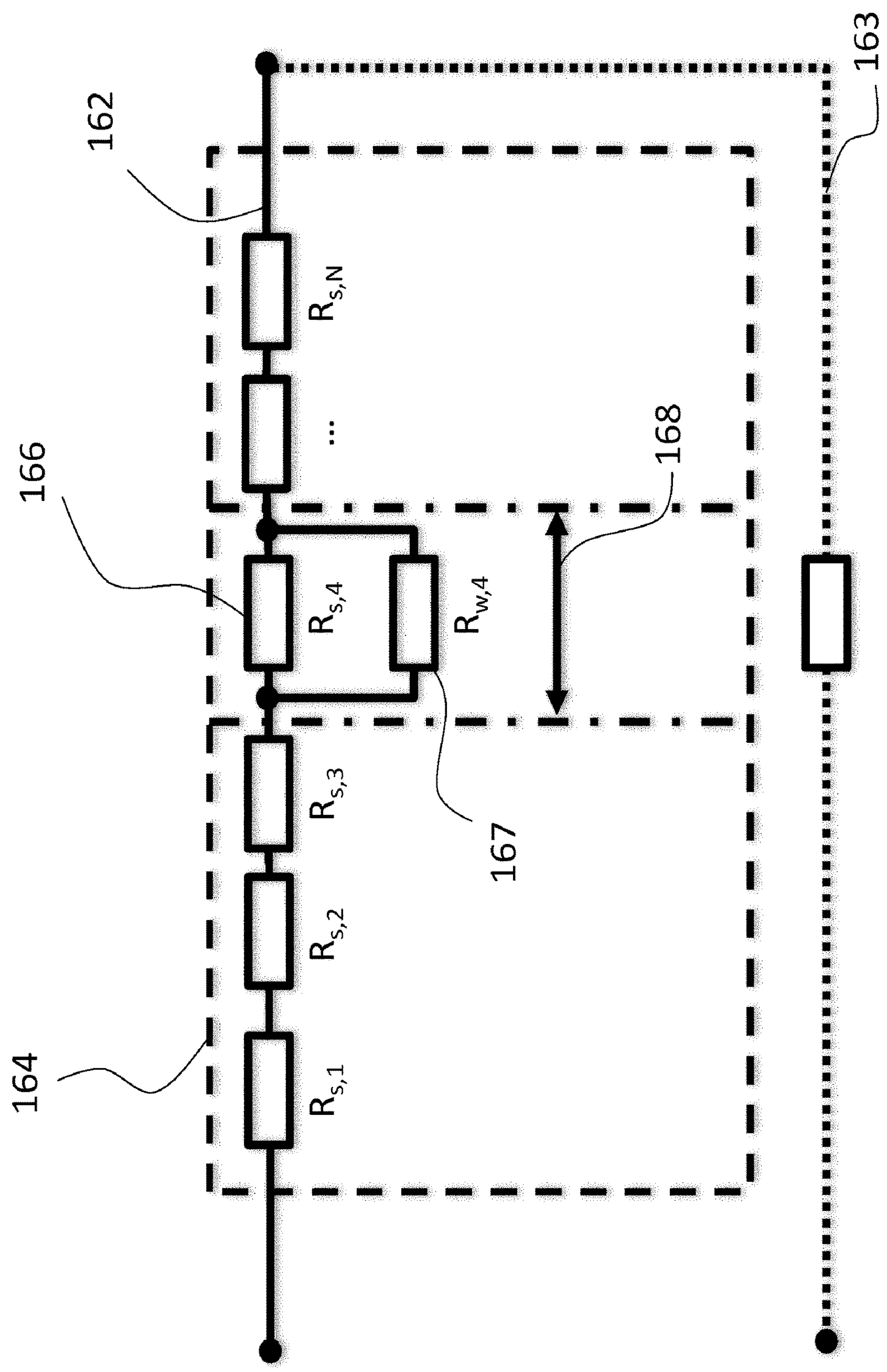


Figure 16

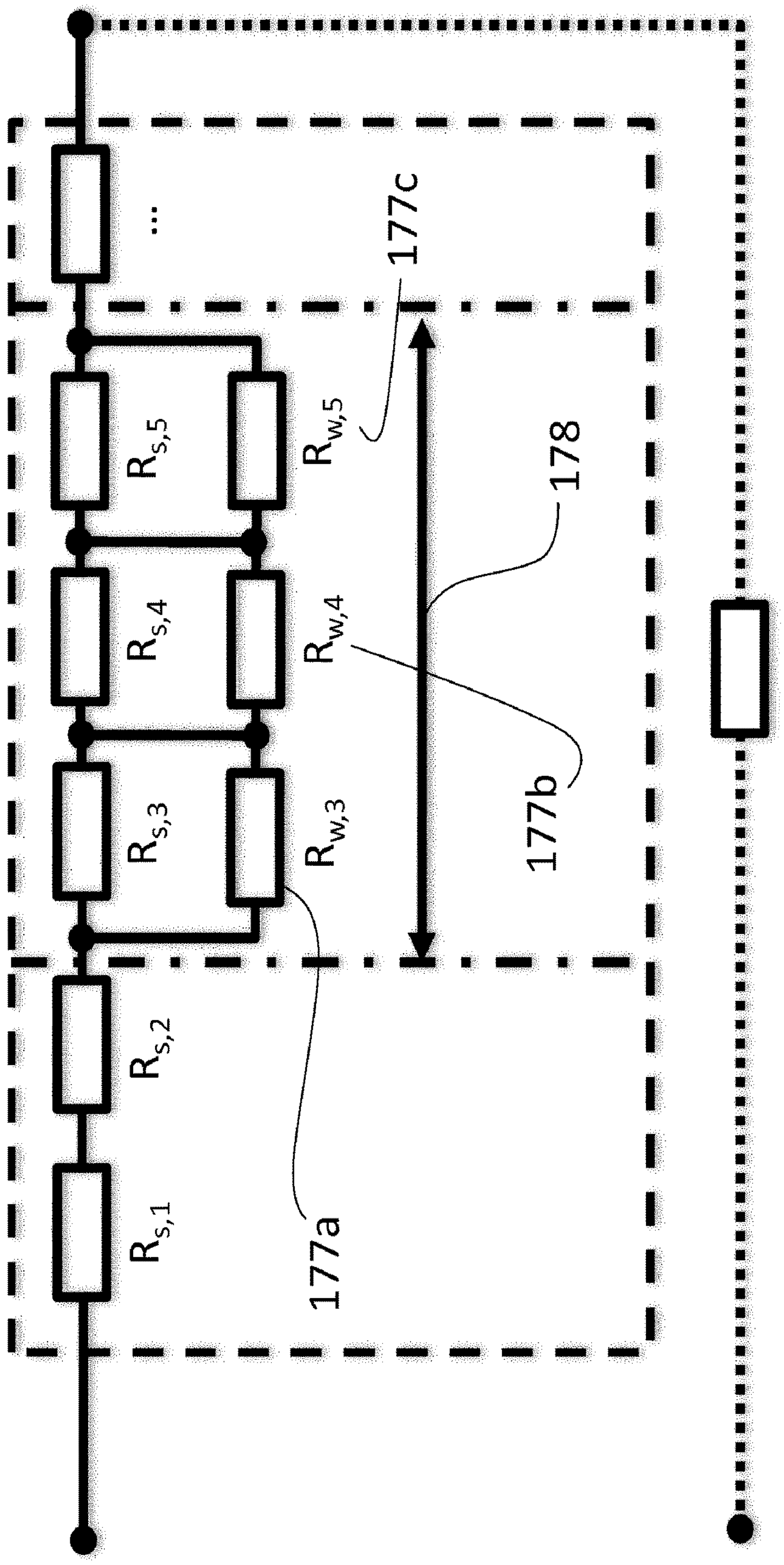


Figure 17

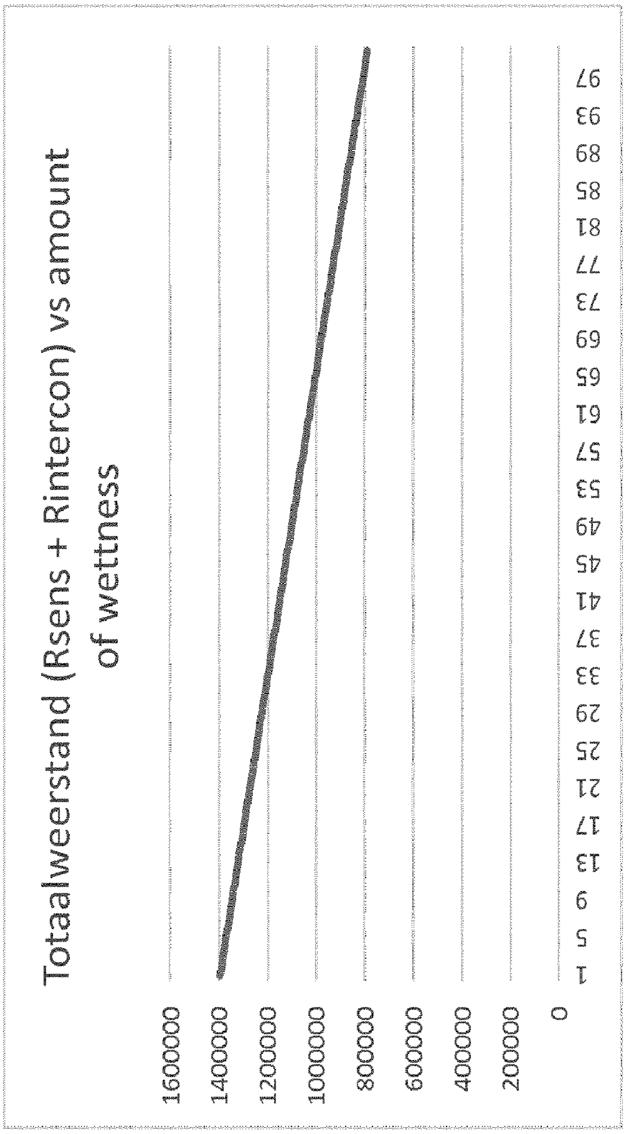

Totaalweerstand (Rsens + Rintercon) vs amount of wettness
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77 81 85 89 93 97

Figure 18

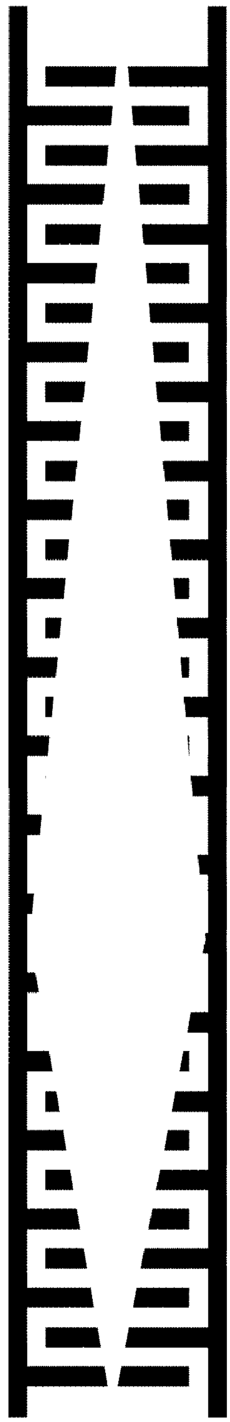


Figure 19

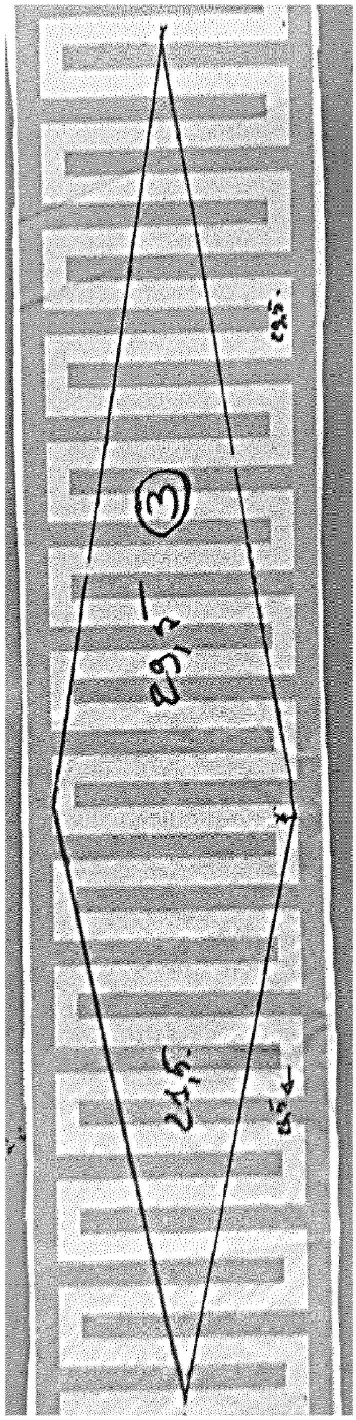


Figure 20

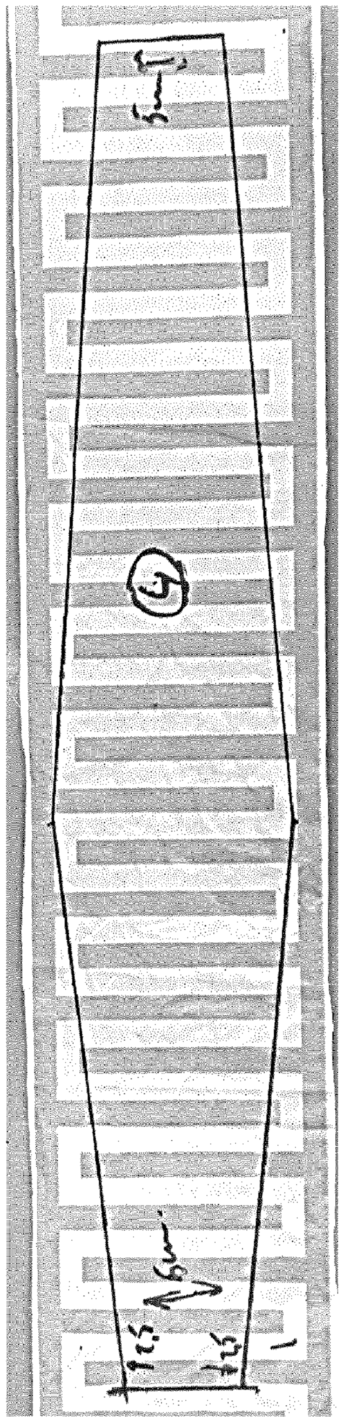


Figure 21

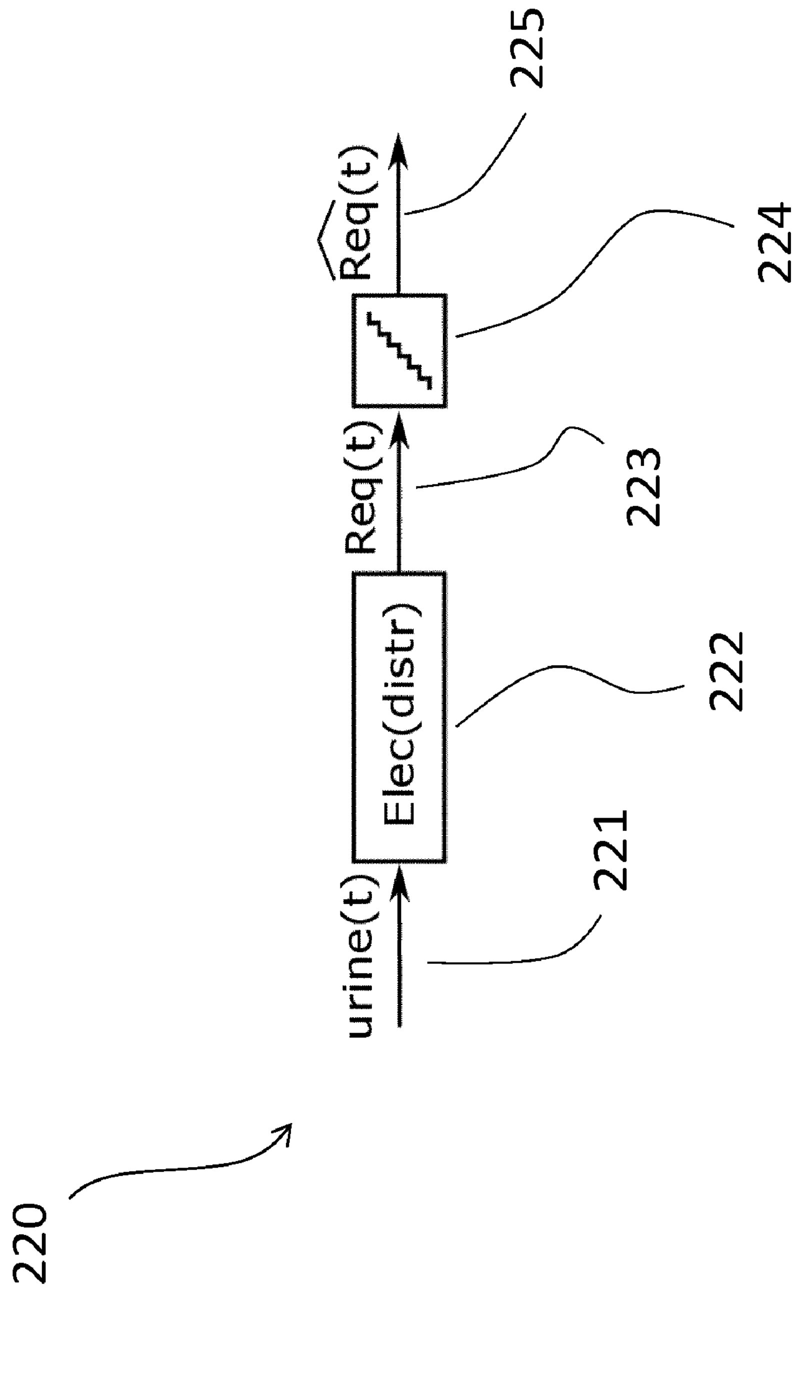


Figure 22

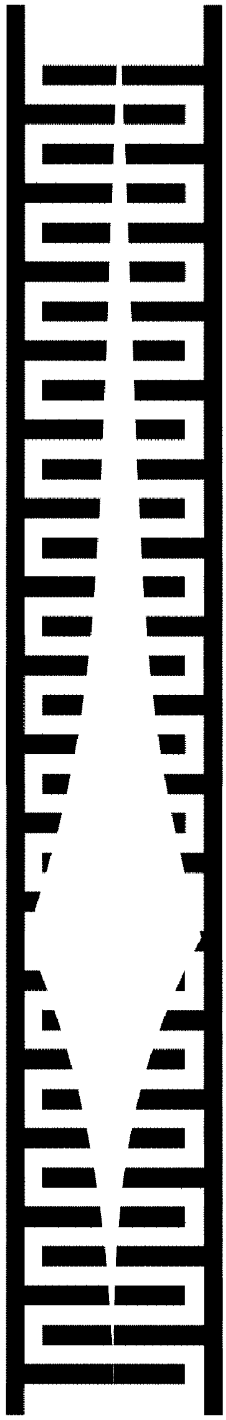


Figure 23

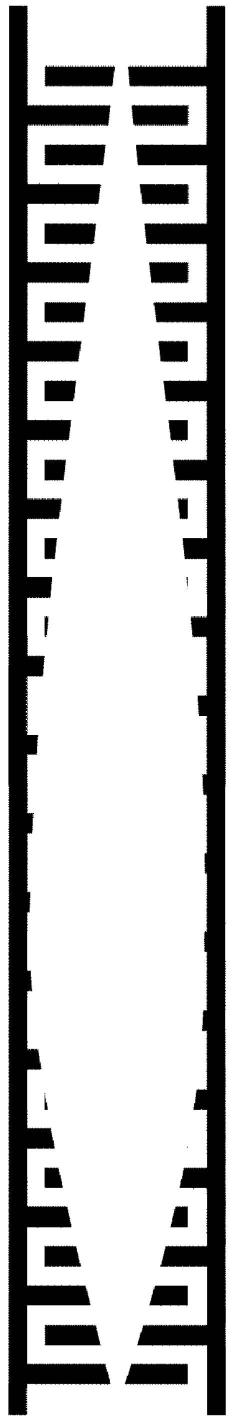


Figure 24

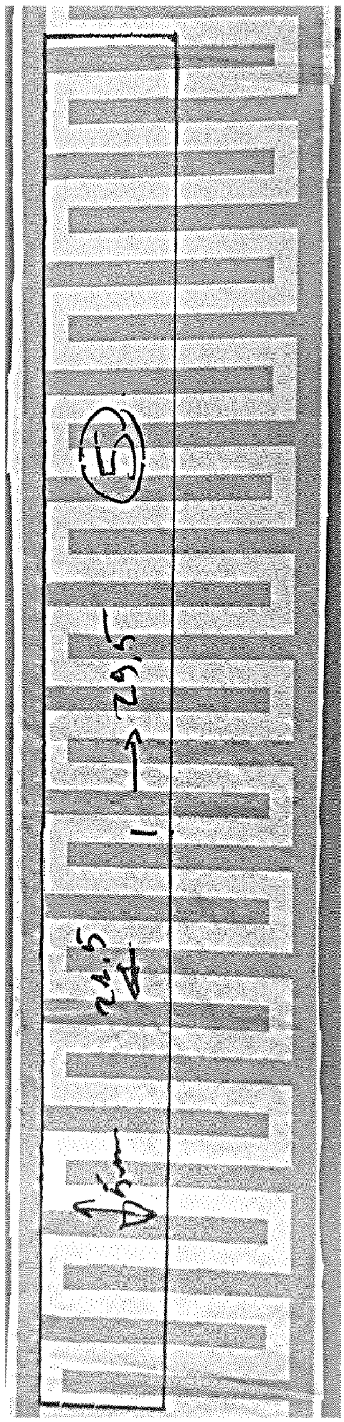


Figure 25

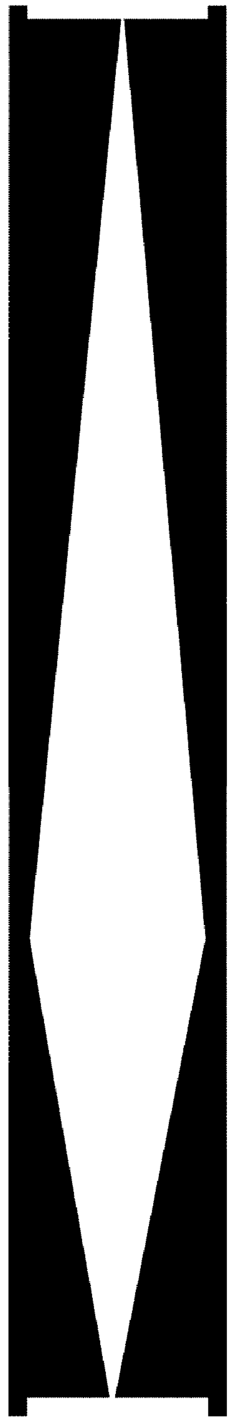


Figure 26

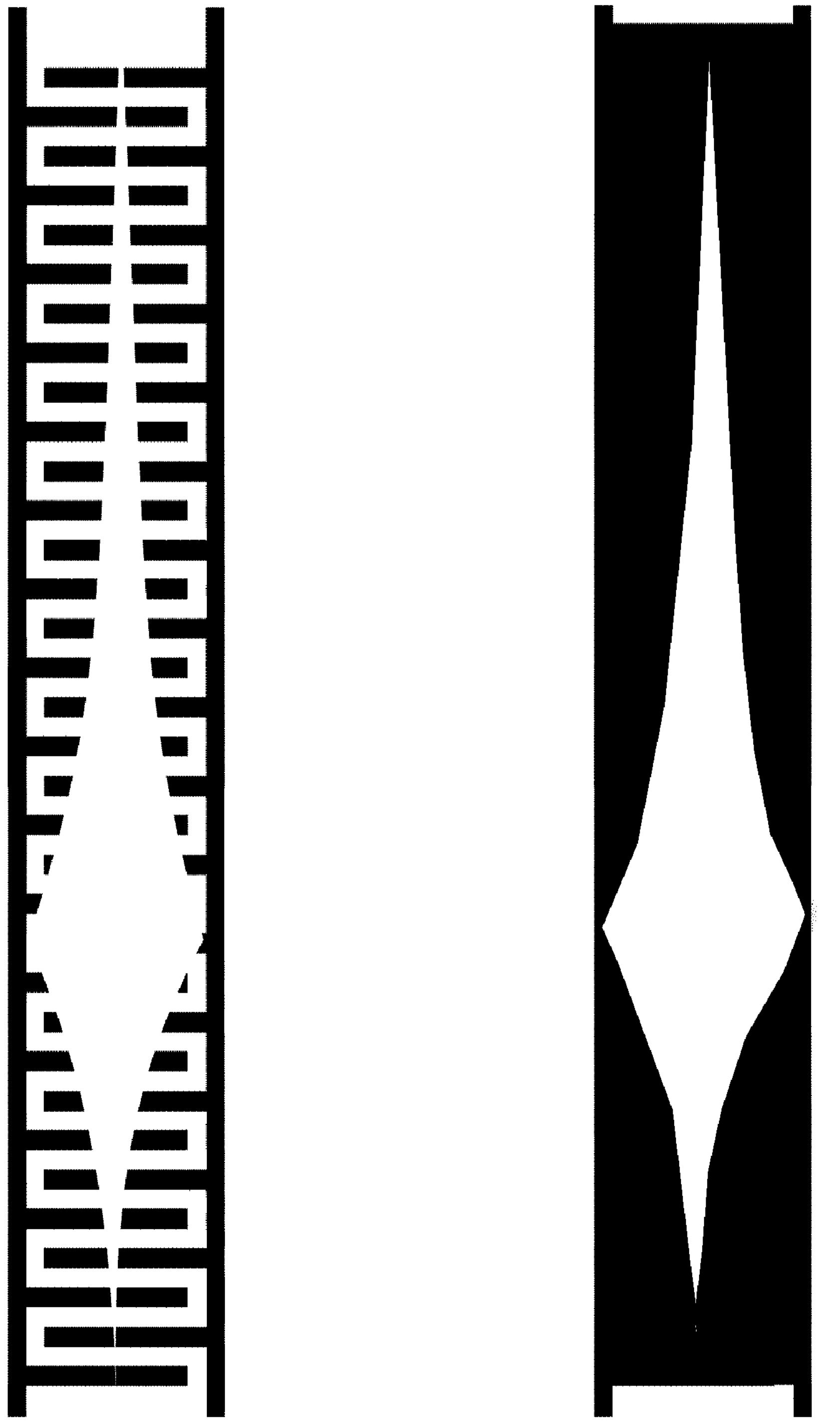


Figure 27

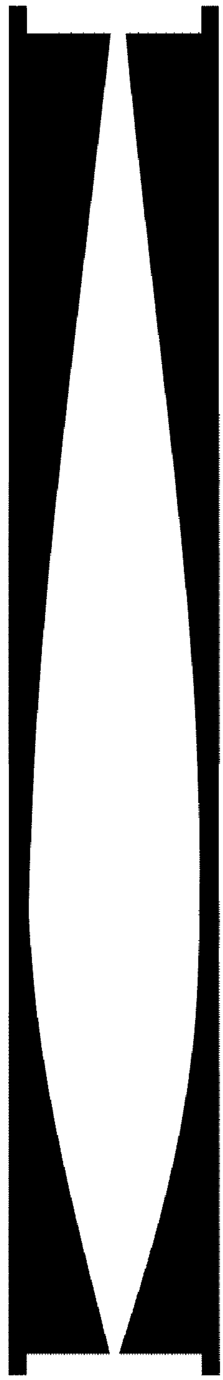


Figure 28

Figure 29

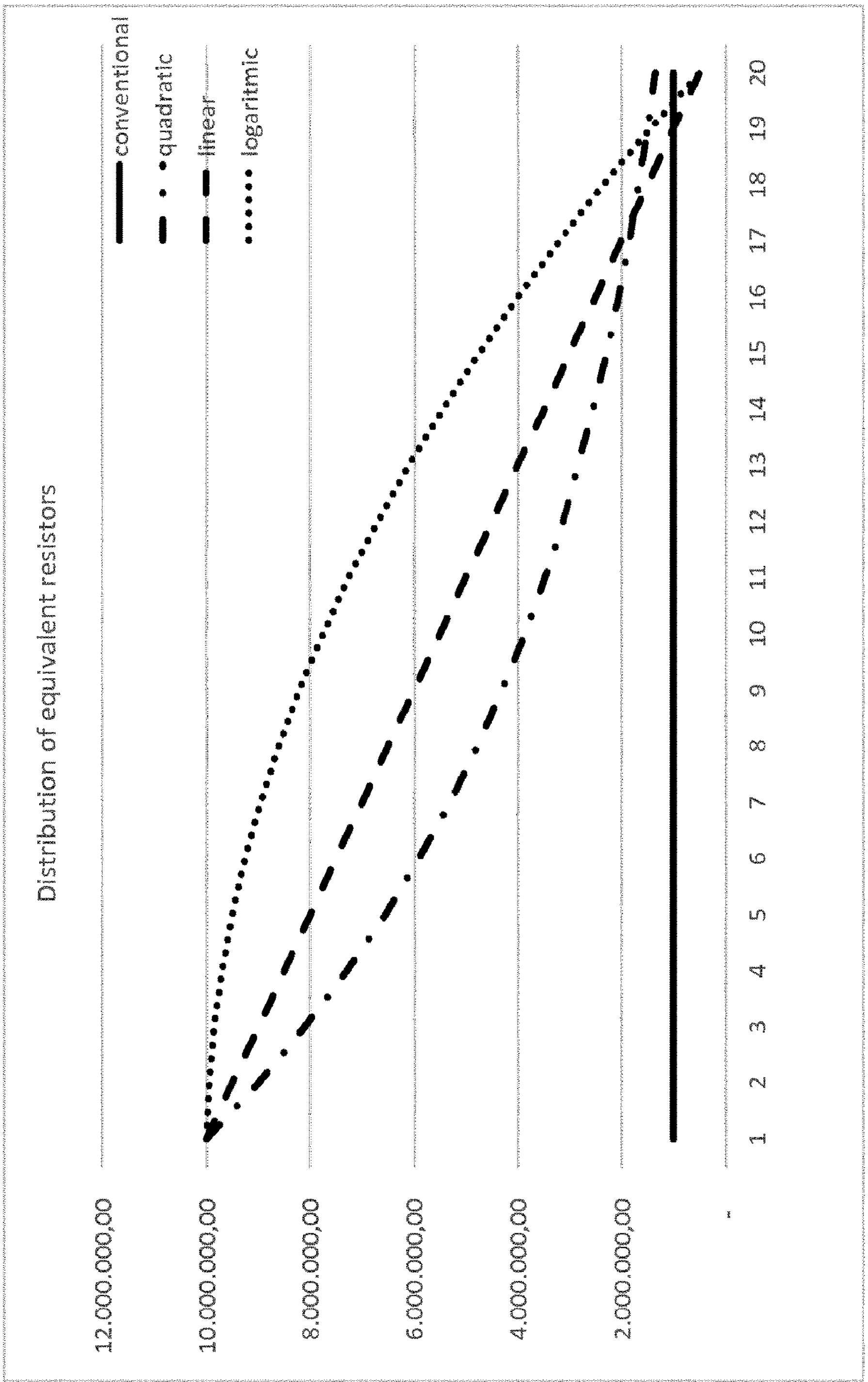

Distribution of equivalent resistors
conventional
quadratic
linear
logaritmic
12.000.000,00
10.000.000,00
8.000.000,00
6.000.000,00
4.000.000,00
2.000.000,00
-
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Figure 30

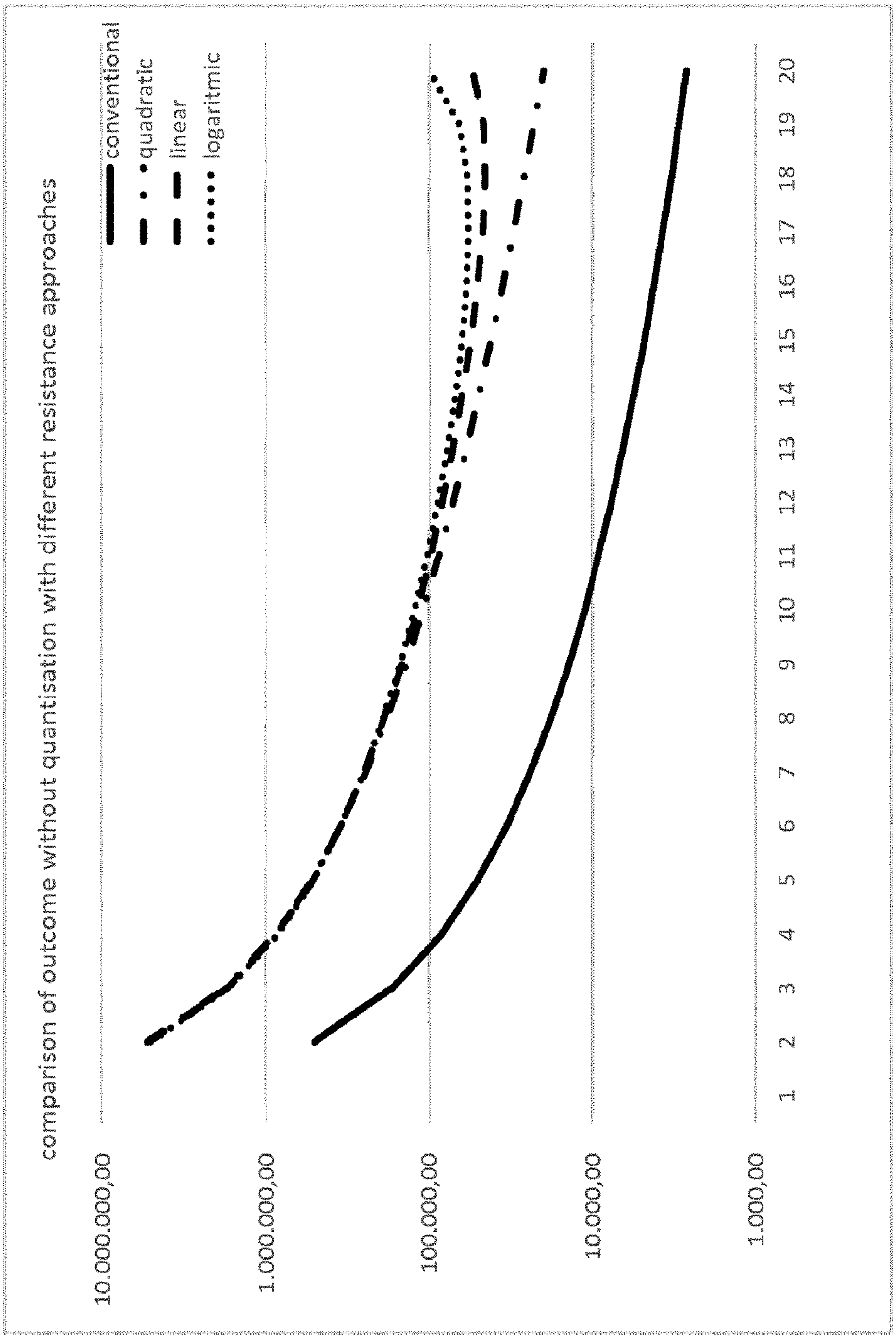
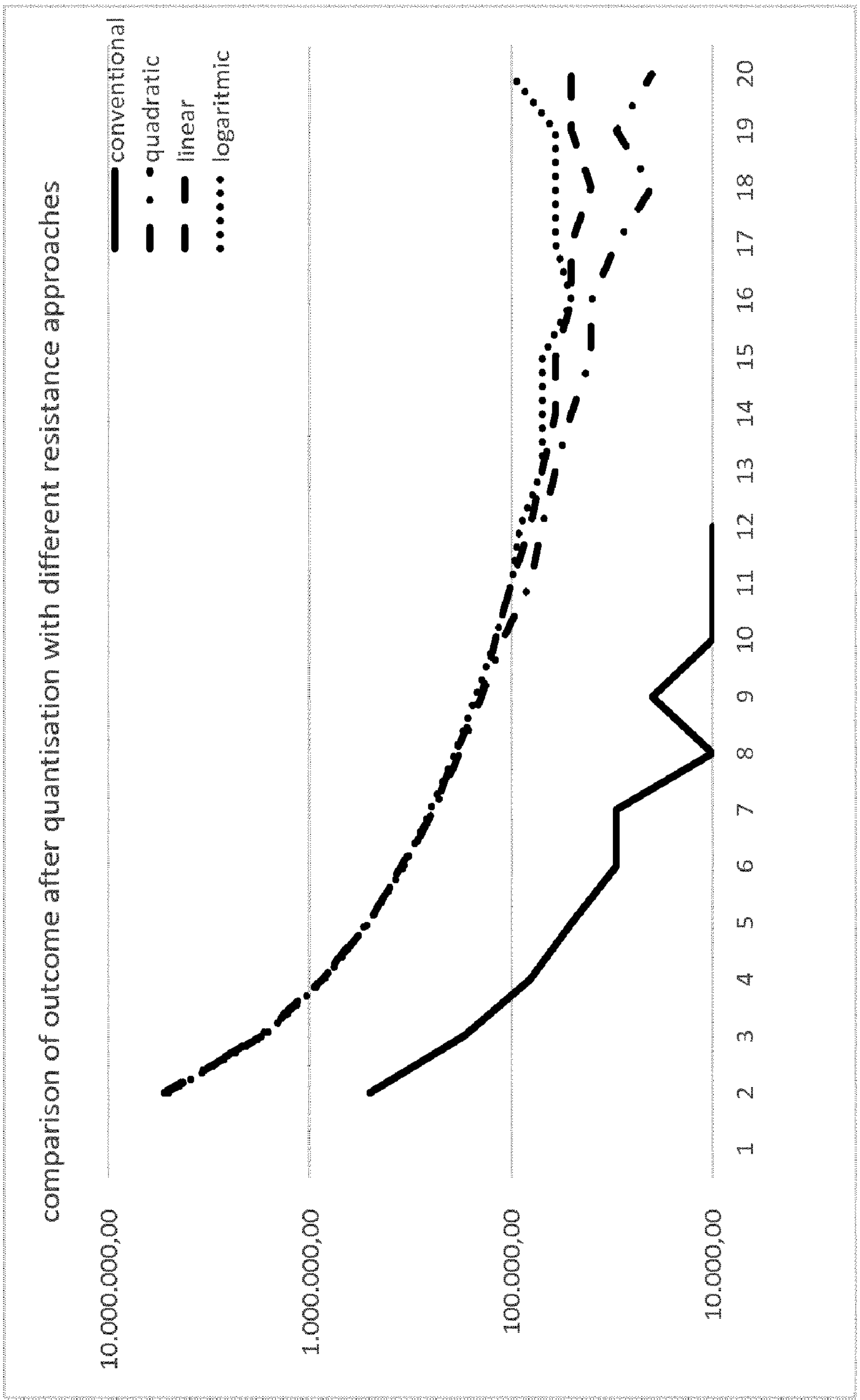

comparison of outcome without quantisation with different resistance approaches
conventional
quadratic
linear
logaritmic
10.000.000,00
1.000.000,00
100.000,00
10.000,00
1.000,00
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Figure 31


comparison of outcome after quantisation with different resistance approaches
conventional
quadratic
linear
logaritmic
10.000.000,00
1.000.000,00
100.000,00
10.000,00
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

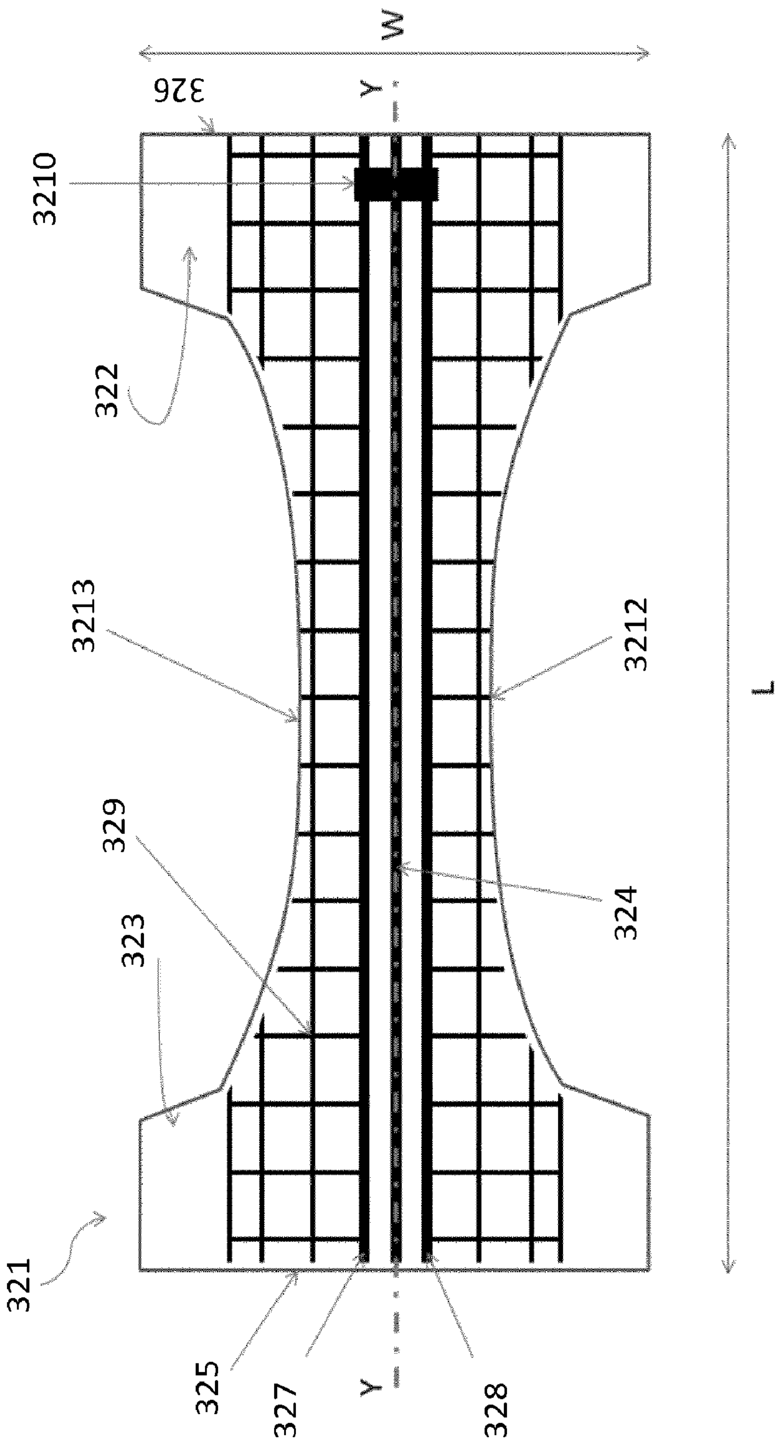


Figure 32

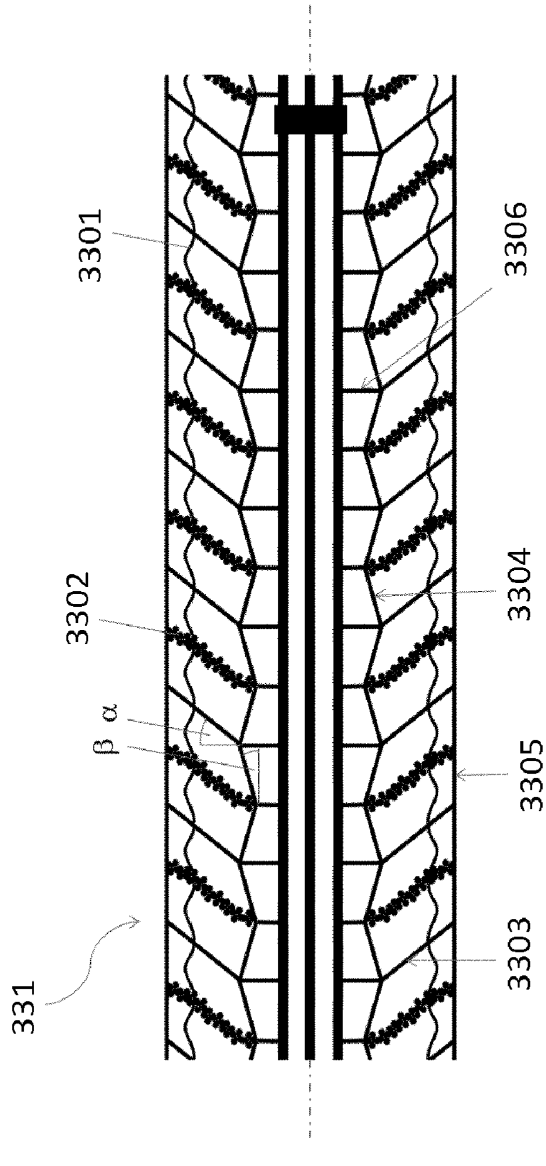


Figure 33

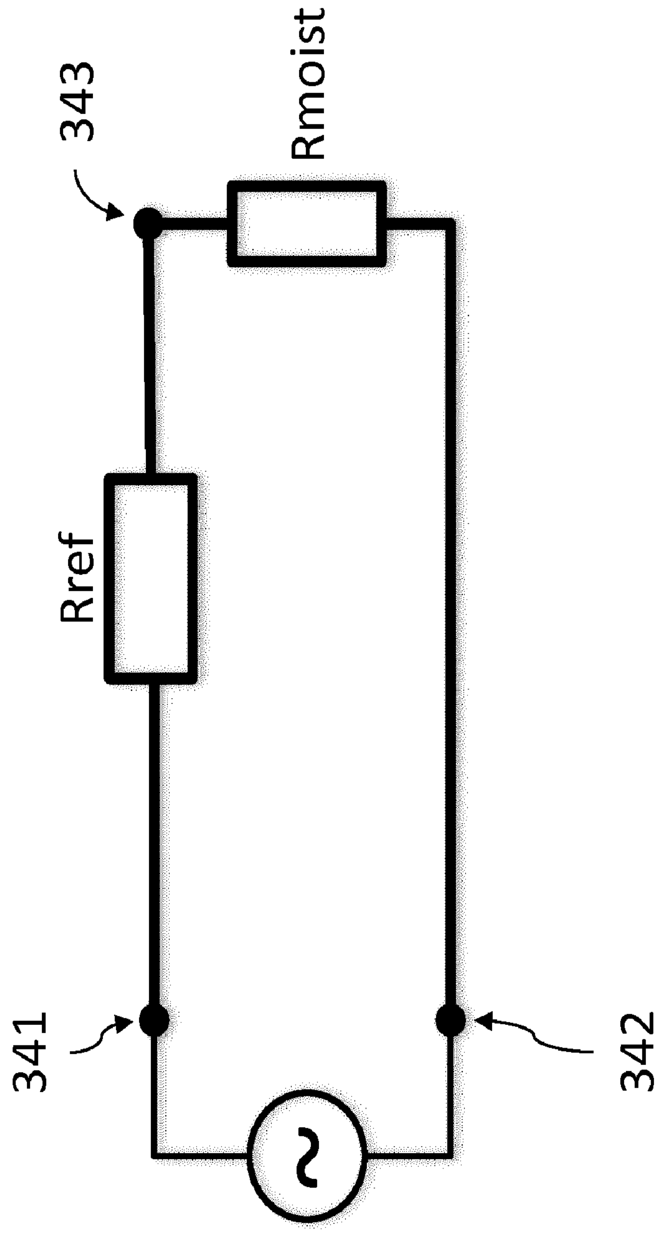


Figure 34

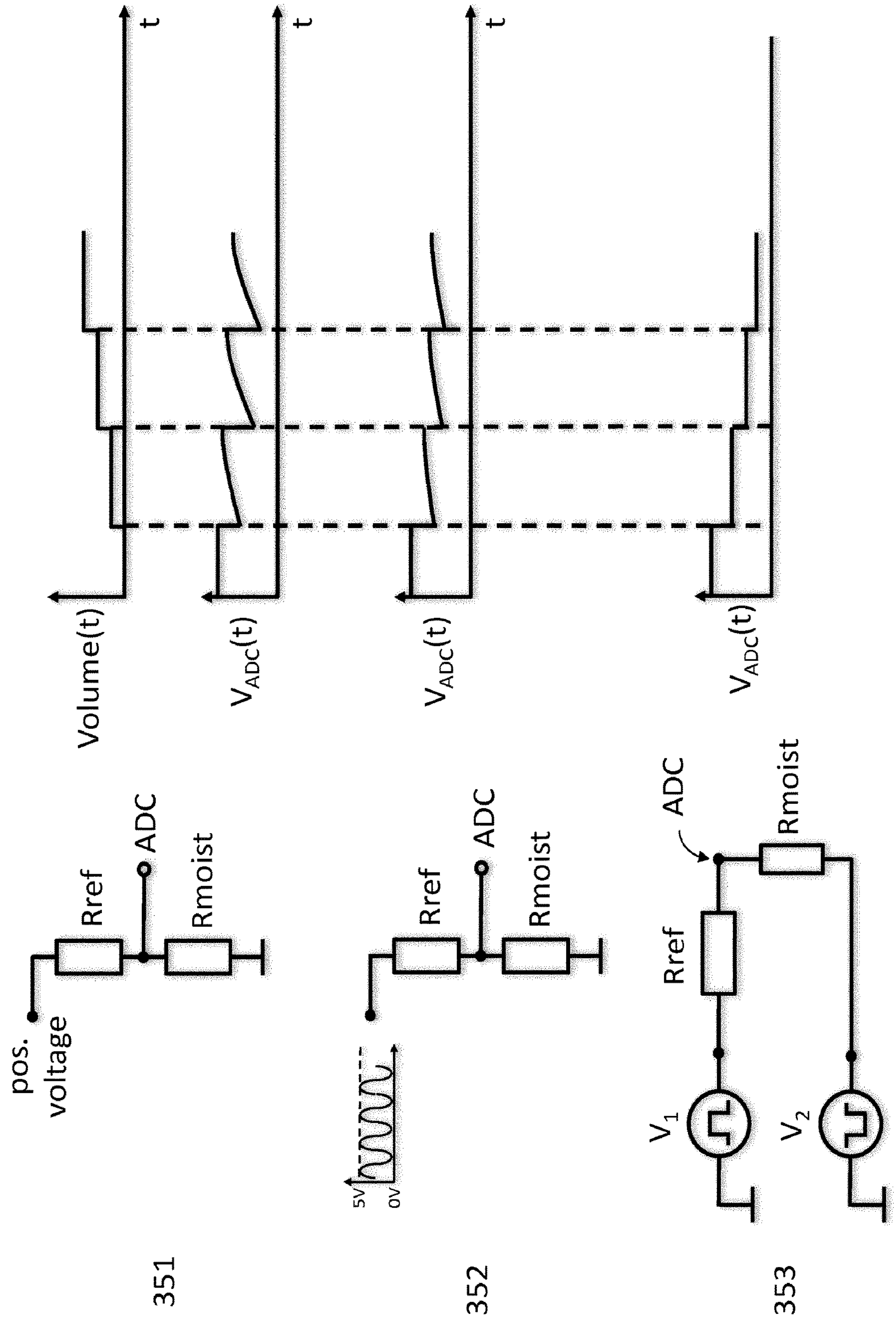
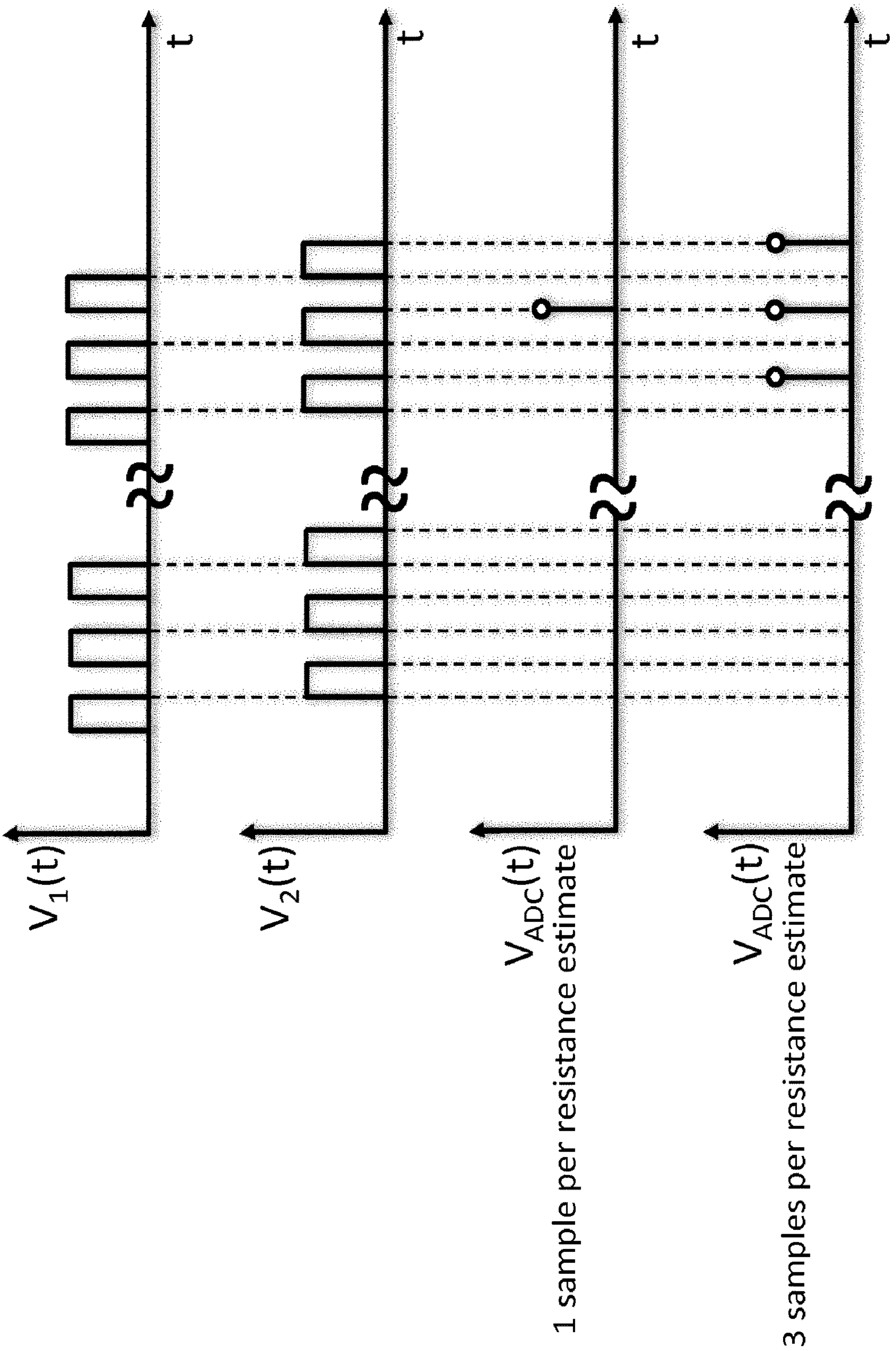

351
pos. voltage
Rref
ADC
Rmoist
352
5V
0V
Rref
ADC
Rmoist
353
V1
V2
Rref
ADC
Rmoist
Volume(t)
VADC(t)
VADC(t)
VADC(t)
t
t
t

Figure 35

Figure 36


V1(t)
V2(t)
VADC(t)
1 sample per resistance estimate
VADC(t)
3 samples per resistance estimate
t
t
t
t

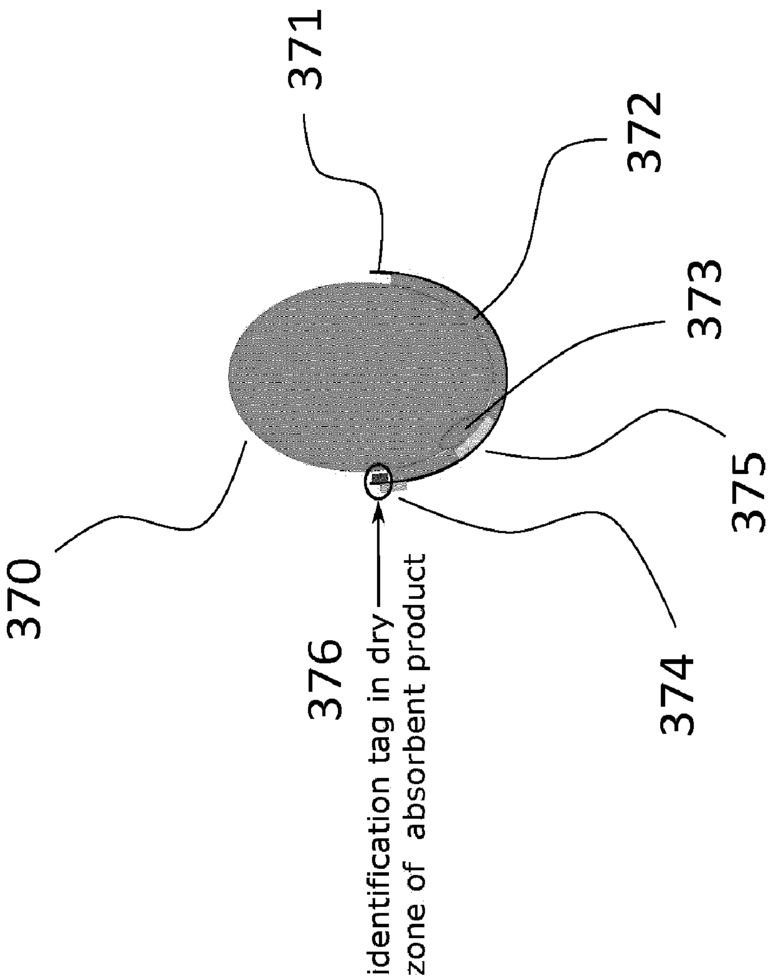

371
372
373
375
370
376
374
identification tag in dry zone of absorbent product

Figure 37

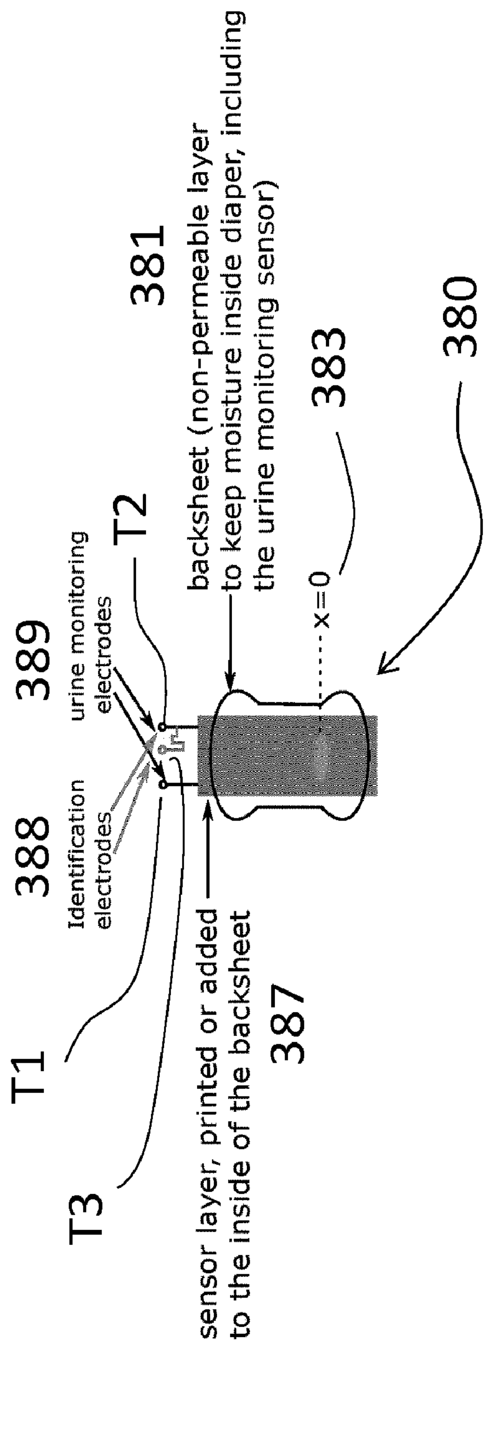

381
backsheet (non-permeable layer
to keep moisture inside diaper, including
the urine monitoring sensor)
380
383
x=0
T2
389
urine monitoring
electrodes
388
Identification
electrodes
T1
T3
sensor layer, printed or added
to the inside of the backsheet
387

Figure 38

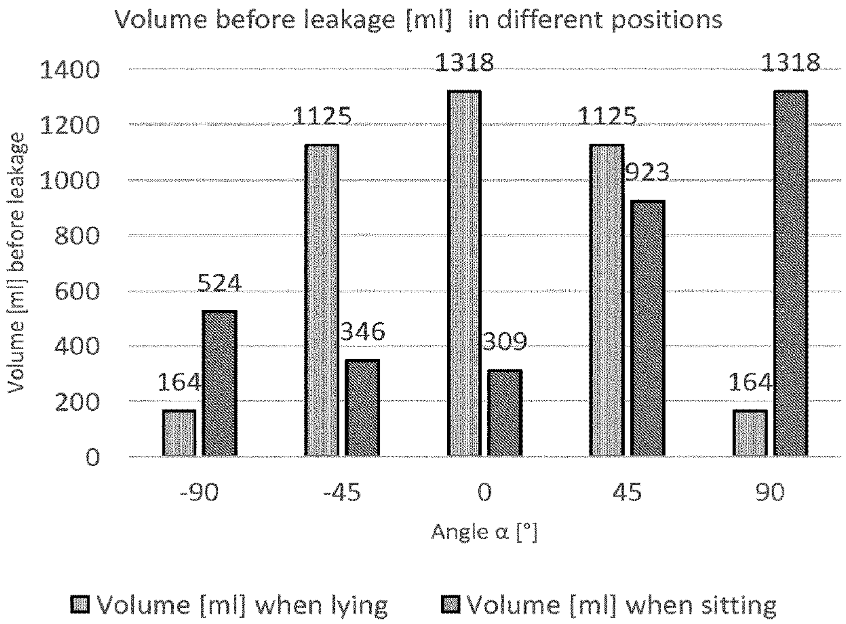
Figure 39

α

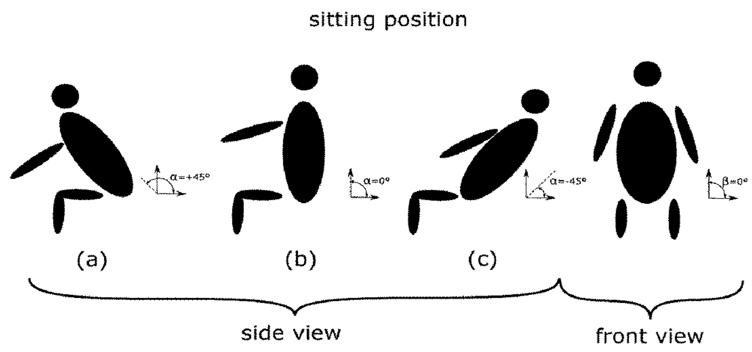
(a)

variable angle α [°]	Volume [ml] when lying	Volume [ml] when sitting
-90	164	524
-45	1125	346
0	1318	309
45	1125	923
90	164	1318

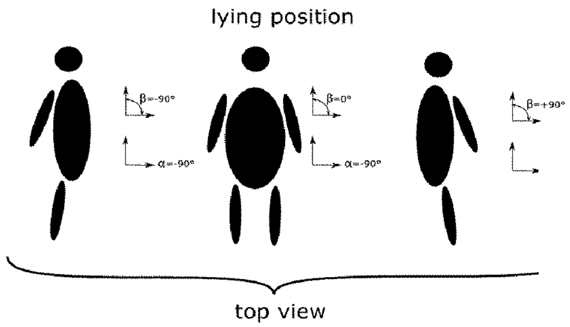
(b)



(c)



(d)



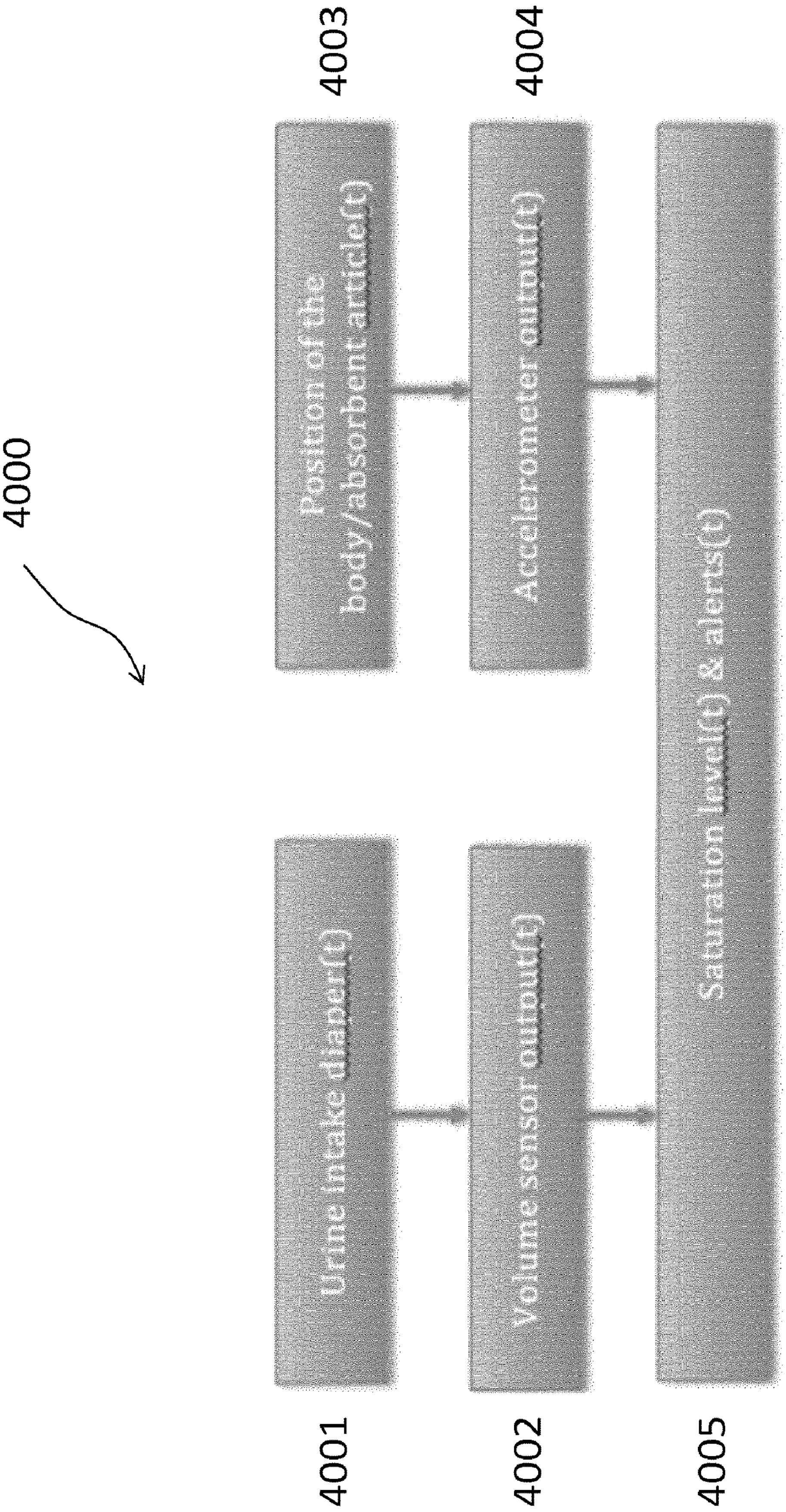
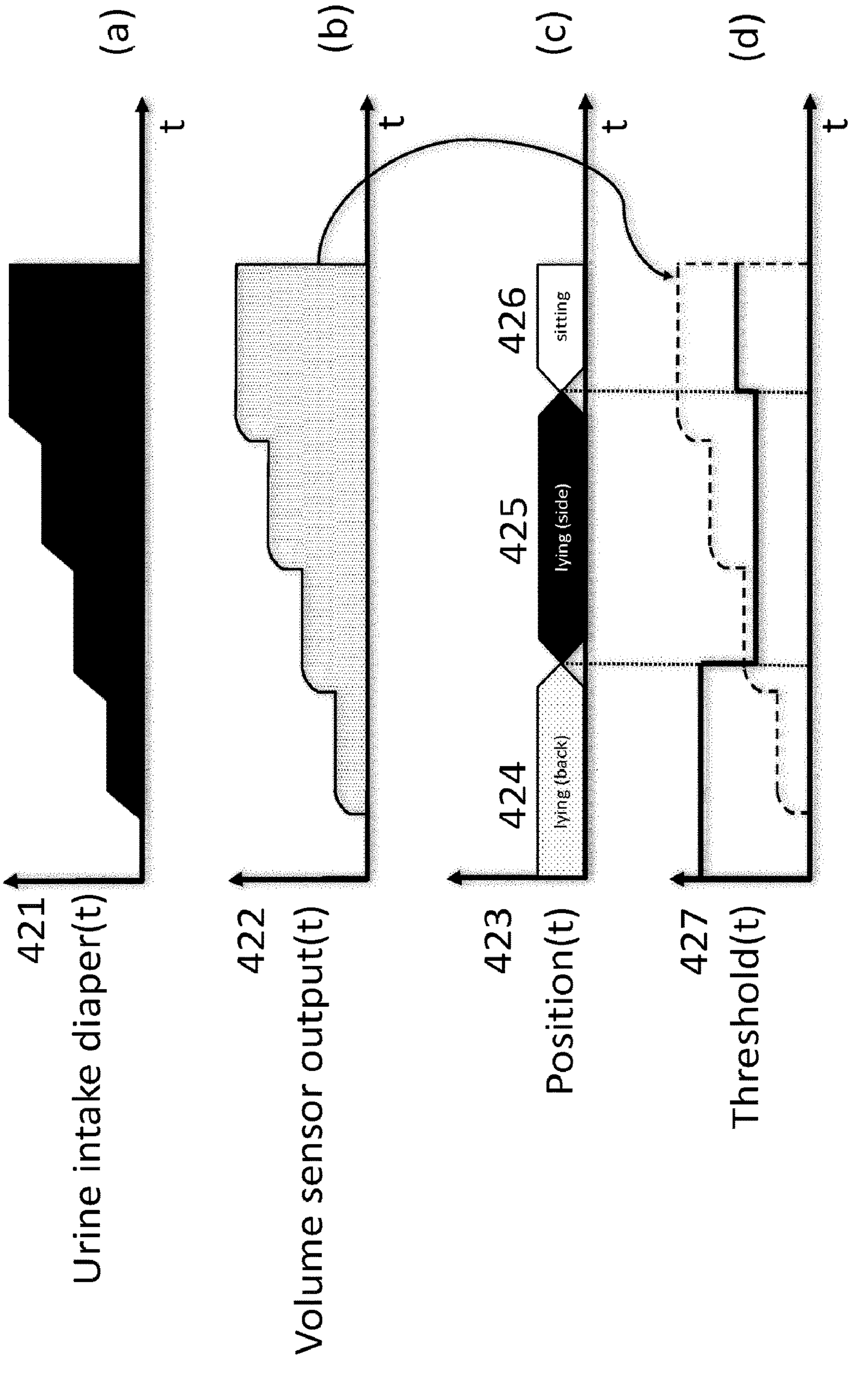

4000
4001
Urine intake diaper(t)
4002
Volume sensor output(t)
4003
Position of the body/absorbent article(t)
4004
Accelerometer output(t)
4005
Saturation level(t) & alerts(t)

Figure 40

Figure 41


(a)
(b)
(c)
(d)
t
t
t
t
426
sitting
425
lying (side)
424
lying (back)
421
Urine intake diaper(t)
422
Volume sensor output(t)
423
Position(t)
427
Threshold(t)

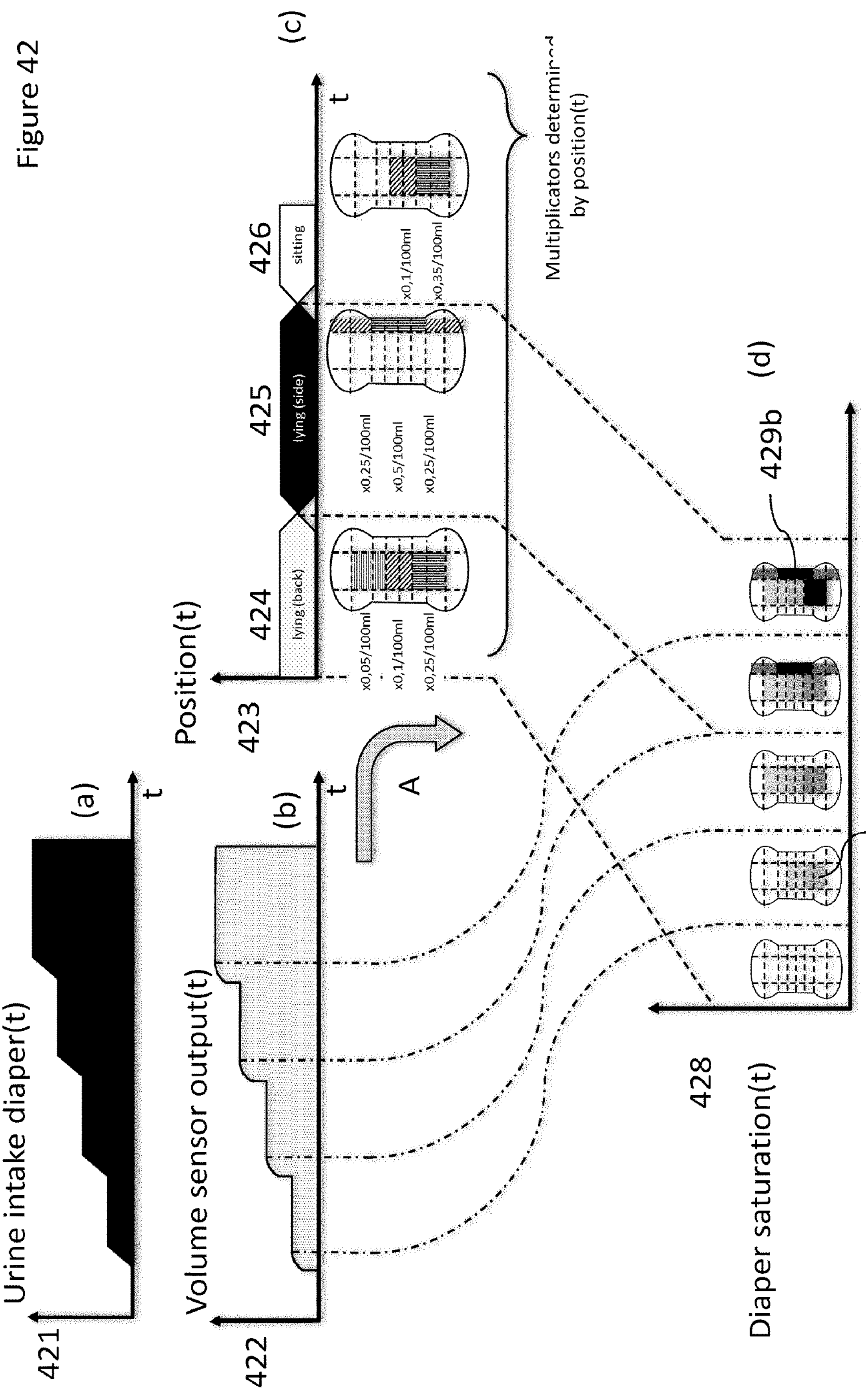

Urine intake diaper(t)
421
(a)
t
Volume sensor output(t)
422
(b)
t
A
Position(t)
423
424
lying (back)
425
lying (side)
426
sitting
(c)
t
x0,05/100ml
x0,1/100ml
x0,25/100ml
x0,25/100ml
x0,5/100ml
x0,25/100ml
x0,1/100ml
x0,35/100ml
Multiplicators determined by position(t)
Diaper saturation(t)
428
429a
429b
(d)

Figure 42

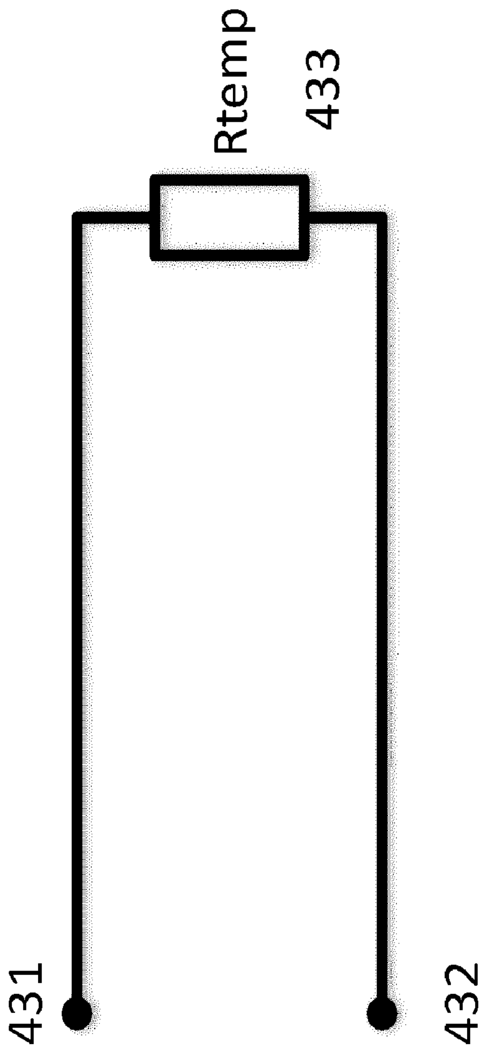


Figure 43

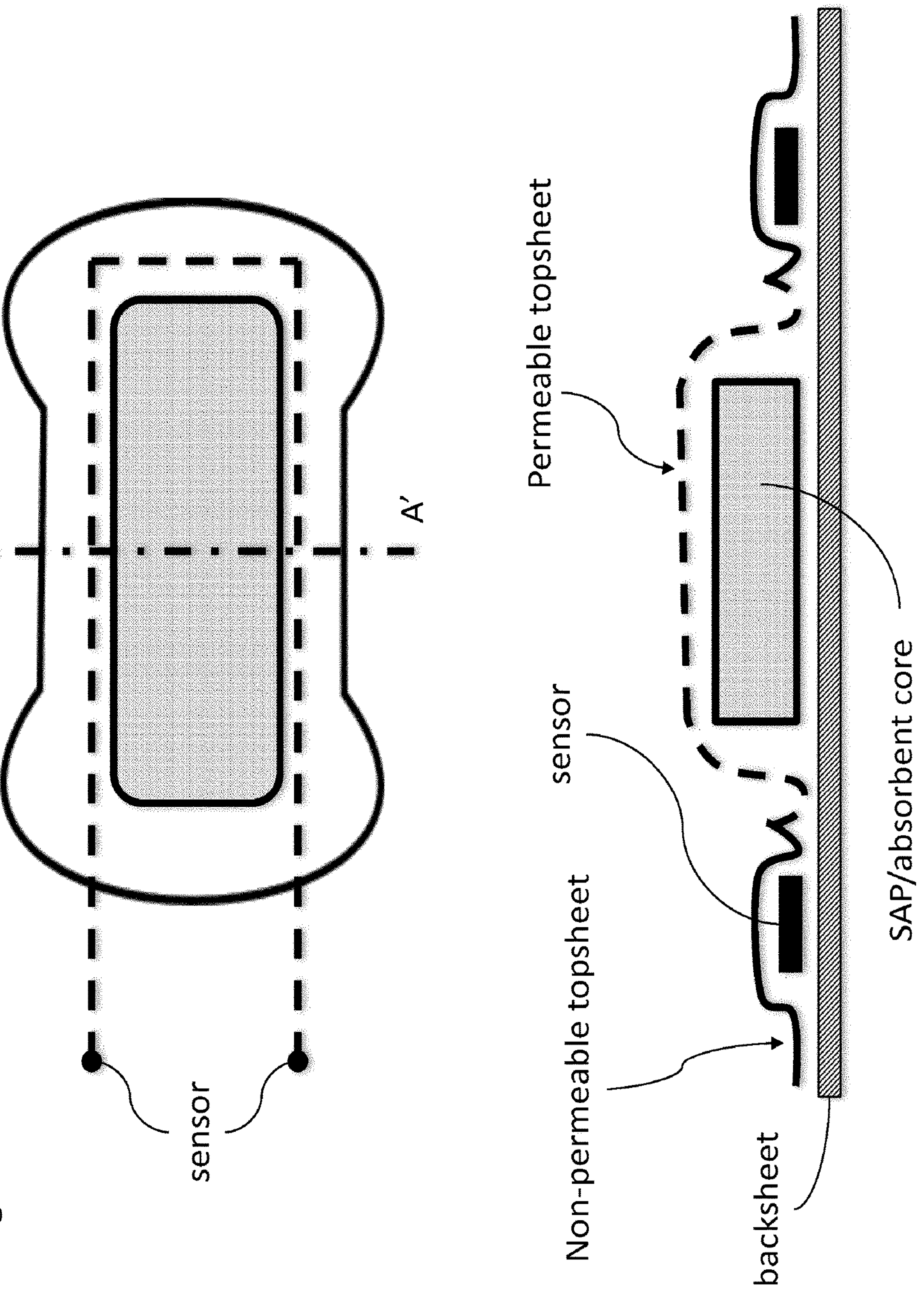
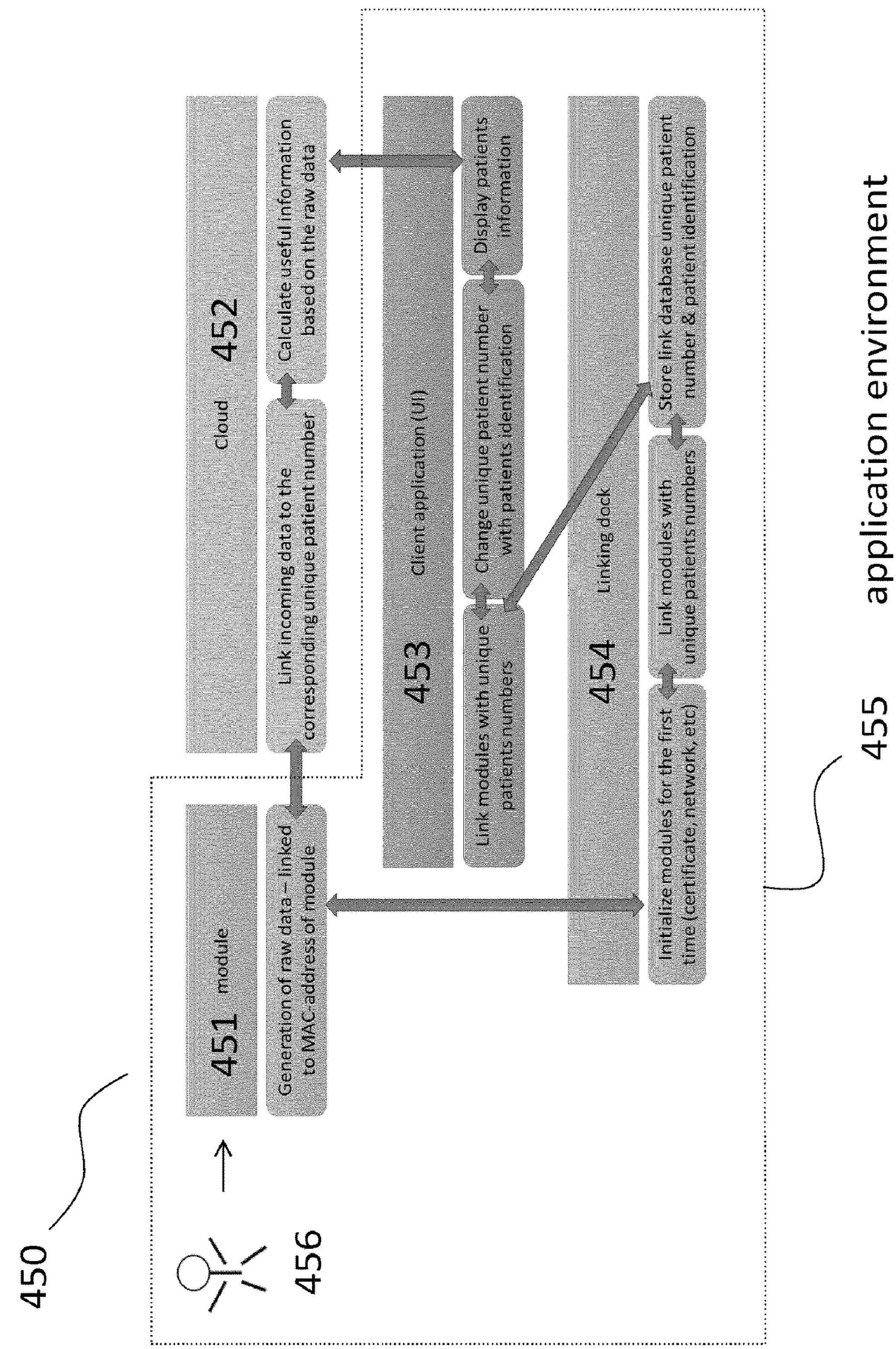

A'
sensor
Permeable topsheet
sensor
SAP/absorbent core
Non-permeable topsheet
backsheet

Figure 44

Figure 45


450
456
451 module
Generation of raw data – linked to MAC-address of module
cloud 452
Link incoming data to the corresponding unique patient number
Calculate useful information based on the raw data
453 Client application (UI)
Link modules with unique patients numbers
Change unique patient number with patients identification
Display patients information
454 Linking dock
Initialize modules for the first time (certificate, network, etc)
Link modules with unique patients numbers
Store link database unique patient number & patient identification
455
application environment

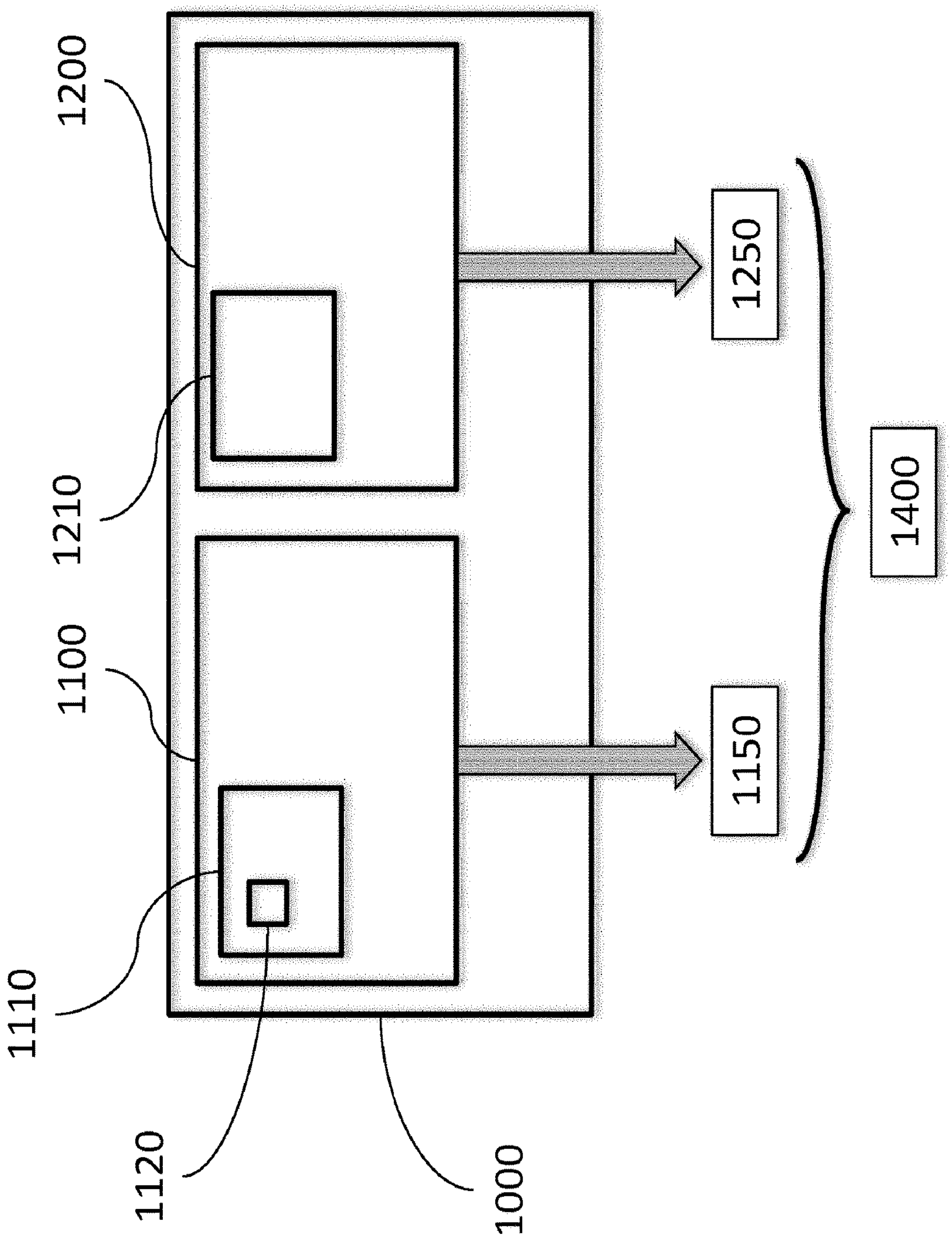


Figure 46

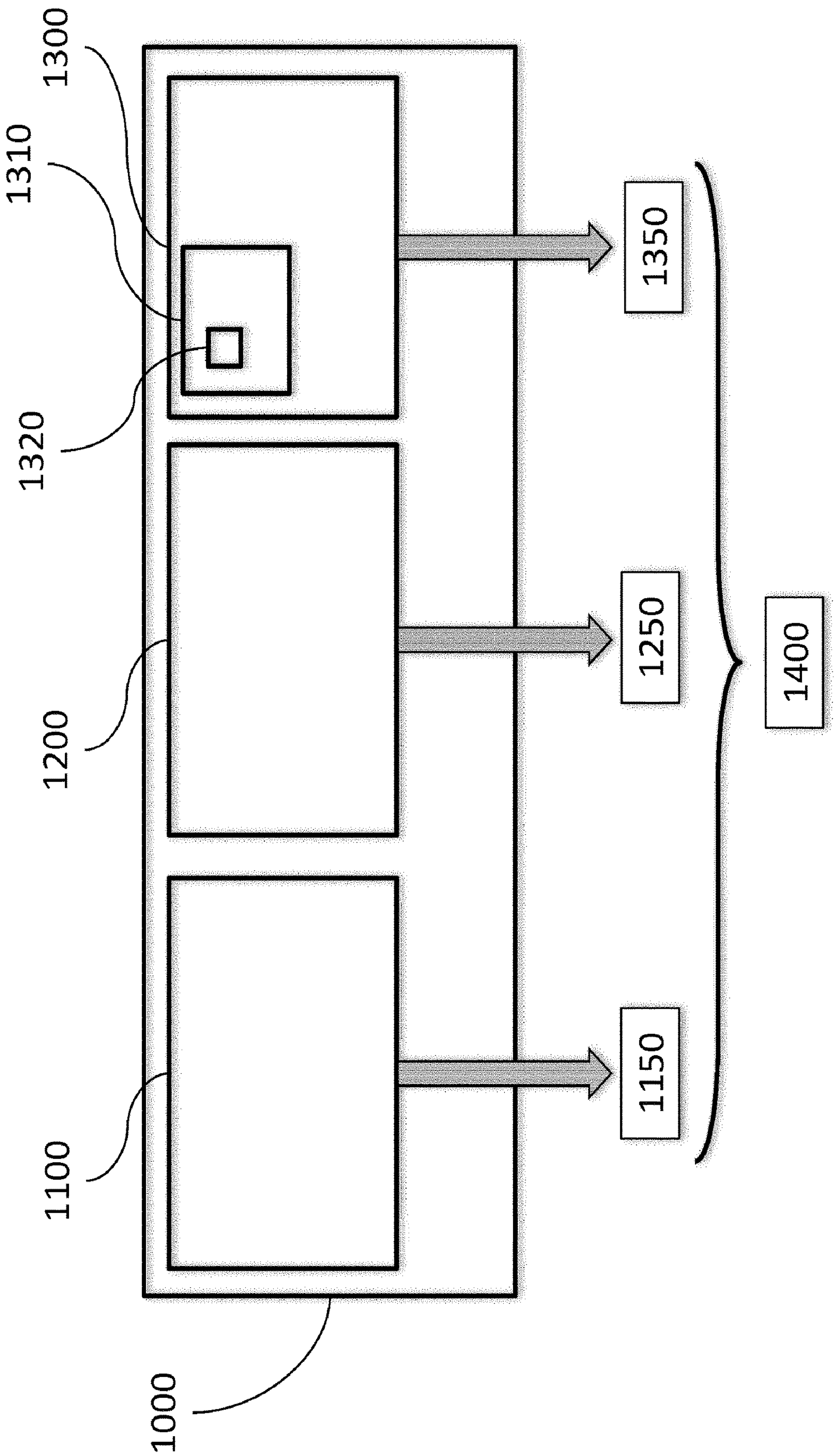


Figure 47

SENSOR ENABLED ABSORBENT ARTICLE AVOIDING LEAKAGES

TECHNICAL FIELD

[0001] The invention relates to an absorbent article system providing monitoring with a large dynamic contamination measurement range, and hence avoiding leakages. Furthermore, the system can detect leakages. Moreover, the system relates to identification of absorbent article types in an automated manner.

BACKGROUND OF THE INVENTION

[0002] Nowadays, in elderly care homes the incontinence status of residents are checked regularly (e.g. every four hours), even at night. If the absorbent article seems to be saturated, based on an interpretation of the caregiver, the absorbent article is changed. Currently, still a significant amount of the absorbent articles are changed too late, introducing leakage of urine. This brings along significant discomfort for the resident, manual labour for the caregivers (e.g. washing) and cleaning costs (of textile bed sheets, clothing, etc.). For this reason, care homes opt pro-actively for absorbent articles with higher absorption degrees than needed. Moreover, by checking the incontinence status every four hours the quality of incontinence care for the resident is not guaranteed between two checks. Furthermore, a lot of absorbent articles are changed between two shifts of caregivers to avoid complaints from the other team. Hence, the current incontinence management system consumes a lot of—even unused—raw material due to interhuman problems between caregivers and over-dimensioning.

[0003] In the art methods are disclosed to monitor contamination volume inside absorbent articles. Based upon the estimated volume an indication is given when to change the absorbent article to avoid unwanted leakges. This estimated volume inside an absorbent article as such however is not an accurate measure for avoiding leakages, since not only the amount urine but also the position of a person's body will influence the distribution of moisture or contamination in general inside the absorbent article. This brings along a need for further improvement of volume versus body position in order to better estimate the moisture distribution in absorbent articles.

[0004] Volume measurement methods are disclosed in the art using multi-electrode systems, i.e. having more than two moisture sensing electrodes, representing often a high degree of complexity (in terms of interconnection and manufacturing of the sensor system) and being a source of multiple possible errors.

[0005] Moreover, existing methods are described in the art in order to make distinction between different types of absorbent articles. In the art, electrical shorts between multi-electrode terminals are applied to determine the type of article in a digital way (short or no short). This limits the amount of different types of articles, which can be recognized by this digital approach. The system therefor requires a more simple approach, with a higher amount of recognizable or detectable types of articles.

[0006] Furthermore, in the art there is a strong focus on volume measurement inside absorbent articles, although moisture volume getting outside of the absorbent article, for example referred to when leakage of the absorbent article occurs, is also important to know. In turn, leakage itself of absorbent articles can lead to skin injuries, or residents can get a cold due to the urine e.g. wetting clothes and/or beds, seats or other furniture they are sitting or lying on within the environment, etc. Hence, a system is required next to the moisture volume measurements in order to generate an alert in case of leakage.

AIM OF THE INVENTION

[0007] The aim of the invention is to provide an absorbent article measurement system, with a more accurate though simple saturation measurement system, avoiding but also detecting leakages in a more accurate way. Furthermore, the aim is to provide a system identifying different types of absorbent articles.

SUMMARY OF THE INVENTION

[0008] In a first aspect of the invention a system is provided for monitoring the saturation level of an absorbent article, wherein the system comprises a moisture monitoring subsystem and a position determining subsystem. With saturation level is meant, the amount of contamination of an absorbent article due to intake of body liquids such as urine but also semi-liquids or even non-liquids such as feces, also containing particular moisture content. An absorbent article is for instance a diaper but sanitary napkins or towels and/or other hygienic cloths such as e.g. panty liners, sanitary pads, tampons or similar hygiene products may also be understood. The moisture monitoring subsystem referring to the moisture volume or the amount of moisture being monitored and thus sometimes also referred to as moisture volume monitoring subsystem, will measure and monitor the moisture volume of body liquid within (a particular part of) the absorbent article, whereas the position determining subsystem will indicate a position. According to an embodiment, the indicated position is the position of the position determining subsystem itself, being attached to the absorbent article in a representative way. Representative in this case means, a location on and/or in the absorbent article due to which it becomes possible to estimate the influence of gravity and body pressure on the distribution of body liquid in the absorbent article. In other words, the indicated position will correspond to a particular moisture volume or degree of contamination, being indicative for the overall level of saturation of the absorbent article. Combining position information with moisture volume measurements, a better estimate of moisture distribution within an absorbent article can be achieved, herewith identifying the locations inside the absorbent article where potential leakages may occur and thus creating appropriate alerts. When combining position and moisture volume measurement data knowledge is gained regarding the saturation level of the absorbent article. The saturation level may be determined for a plurality of local areas within the absorbent article. Such local saturation levels may be indicated locally for a particular region or part within the absorbent article, and not only or even not necessarily indicating the saturation level in general. By indicating the saturation level on a local scale, the saturation of the absorbent article can be monitored in a useful way, and hence leakages can be prevented in a much more accurate and precise manner. Useful here in previous sentence refers to the fact that global saturation of e.g. 10% of the total absorbency, in accordance with the invention, will include a kind of risk assessment (related to the position of a person) regarding a possible occurrence of leakage. An absorbent article can start leaking at e.g. 10% global saturation, if a person is laying on its side. In this case the local saturation levels will exceed 100% saturation with leakage as a result.

[0009] The system according to first aspect of the invention with volume monitoring subsystem may further comprise a sensor system, comprising a conductive circuit, i.e. material with electrical properties, more in particular the conductive circuit may comprise electrodes, e.g. moisture (volume) sensing electrodes, even more particularly the conductive circuit may comprise only one or two moisture (volume) sensing electrode(s).

[0010] According to an embodiment, the conductive circuit is characterized by resistance or—more generically speaking—impedance values (while extending resistance to AC circuits and hence not limiting to DC) representing respectively an adjusted resistance or impedance design, as defined by a (mathematical) distribution in the variation of respective resistance or impedance values over the area of the absorbent article. Such e.g. mathematical distribution used is for instance a linear distribution, a quadratic, or a logarithmic distribution.

[0011] According to a particular embodiment, the resistance or impedance values as mentioned are the highest in or near a first zone of the absorbent article, wherein the moisture impact is expected to be the largest, and these values are much lower near or at a second zone of the absorbent article, wherein the moisture impact is expected to be the smallest. Thus, the first zone is a region or a plurality of local areas within the absorbent article where it is expected that a lot or most of the (moisture) contamination will occur, and where saturation needs to occur before potential leakages can take place, whereas the second zone is a region or plurality of local areas within the absorbent article where much less, very little or almost no contamination is expected, and where saturation will occur anyway without causing any potential leakage. The conductive circuit may be applied over substantially the entire surface of the absorbent article, i.e. covering for instance the plurality of local areas, while including the first and second zone of the absorbent article as referred to above. The conductive circuit may further comprise of a printed layer of conductive material provided with non-conductive spaces, wherein possibly a part of the non-conductive spaces is related to the (mathematical) distribution as mentioned above, and/or wherein possibly a part of the non-conductive spaces is provided for optimizing usage of conductive ink. The (mathematical) distribution (e.g. mathematical for instance linear, quadratic or logarithmic) may be particularly chosen and/or applied in order to generate an adjusted resistance design as wanted or required, for example to optimize the performance for a certain application, e.g. leakage prevention, or precise moisture volume measurement up to 300 ml. With the non-conductive spaces that may be present for optimizing usage of ink, is referred to particular conductive areas where the presence of conductive material is not required in order to perform accurate moisture volume measurements. The as such created non-conductive spaces have nothing to do with the (adjusted) resistance design in terms of resistances or impedances, but only refer to the possibility of non-usage or limited usage of ink while remaining the exact—or limited reduced (e.g. −10% accuracy)—functionality of the circuit as if those non-conductive spaces were filled or covered with conductive material.

[0012] According to an embodiment of the first aspect system, the moisture (volume) monitoring subsystem generates moisture-linked (or moisture volume linked) data of the absorbent article. According to another embodiment, the position determining subsystem generates positional data, and may comprise an accelerometer or gyroscope. In a particular embodiment, the moisture-linked (or moisture volume linked) data and the positional data as mentioned are combined for indicating the saturation level of the absorbent article, preferably determined respectively for a plurality of local areas of said absorbent article. The system according to the first aspect may further comprise a data reader or interpreter, a data transmitter and a data receiving unit.

[0013] In an embodiment of the invention, the moisture (volume) measurement or monitoring of the moisture (volume) monitoring subsystem is performed by means of a so-called differential measurement approach overcoming electrical polarisation of the contamination or more in particular the contaminating substance such as e.g. urine. The differential measurement approach is based on a differential voltage measurement between two separate points in an electrical circuit as known in the art.

[0014] In a further embodiment of the invention, a third subsystem is also part of the invented system for monitoring the saturation level of an absorbent article, and being introduced to detect leakages, whereas the system comprising only the two subsystems (for moisture volume monitoring and position determining respectively) according to the invention and its particular embodiments as referred to above relate to local saturation measurements in order to avoid leakages.

[0015] According to a second aspect of the invention, an absorbent article is provided comprising the system as described above under the first aspect of the invention.

[0016] In a third aspect, the invention provides a method for monitoring the saturation level, and avoiding leakage, as well as detecting leakage in an absorbent article, using the system as above mentioned under the first aspect.

[0017] Further, in accordance with a fourth aspect, a management system for managing raw data generated by the system according to the first aspect, and being able to process the raw data to processed data, transfer the raw data and/or the processed data over a network, and link the raw data and/or the processed data with person data. The management system may comprise an electronic module for delivering the raw data; a cloud server for processing the raw data to processed data; and a client application for linking the raw data and the processed data with person data. The management system may further comprise a linking dock for initializing the electronic modules for use.

[0018] According to a fifth aspect, a moisture monitoring sensor system is provided, comprising a conductive circuit with resistance or impedance values representing respectively an adjusted resistance or impedance design, defined by a (mathematical) distribution in the variation of such resistance or impedance values. In case of a mathematical distribution, the mathematical distribution may be a linear distribution, or quadratic, or even a logarithmic distribution. The conductive circuit may comprise electrodes, preferably a pair of electrodes. Moreover, the conductive circuit may comprise of a printed layer of conductive material provided with non-conductive spaces, wherein part of the non-conductive spaces is for instance related to the (mathematical) distribution as mentioned above, and wherein other part of the non-conductive spaces is provided for optimizing usage of conductive ink.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. **1** illustrates schematically an embodiment of an absorbent article such as a diaper in accordance with the invention, as worn by a person.

[0020] FIG. **2** shows further version of the embodiment of FIG. **1** in accordance with the invention, taking into account the graded distribution of liquid inside the absorbent article when a person is in a standing position.

[0021] FIG. **3** shows further version of the embodiment of FIG. **1** in accordance with the invention, taking into account the graded distribution of liquid inside the absorbent article when a person is in a lying position.

[0022] FIG. **4** illustrates an embodiment of an absorbent article wherein a sensor system is integrated in accordance with the invention.

[0023] FIG. **5** graphically represents resistance values as a function of the position of the absorbent article, more particularly at the location of the intake region, in accordance with the invention.

[0024] FIG. **6** illustrates an embodiment of the equivalent resistor approach in accordance with the invention.

[0025] FIG. **7** shows an embodiment of a sensor system conductive circuit without adjusted resistance design.

[0026] FIGS. **8-12** illustrate further embodiments of the equivalent resistor approach in accordance with the invention.

[0027] FIG. **13**. shows a conceptual overview of a serial resistor measurement system.

[0028] FIG. **14** shows a circuit diagram describing the influence of a wetness or moisturizing event on the measured resistance in case of a serial resistor measurement system.

[0029] FIG. **15-17** illustrates the behaviour of the serial measurement system in detail for different cases of wetting.

[0030] FIG. **18** shows a graph in which the total measured resistance is show in relation to the applied wetness.

[0031] FIG. **19** shows an embodiment of a sensor system conductive circuit with adjusted resistance design, more in particular representing a linear distribution, in accordance with the invention.

[0032] FIGS. **20-21** show other embodiments of a sensor system conductive circuit with adjusted resistance design, more in particular representing a linear distribution, in accordance with the invention.

[0033] FIG. **22** shows a block diagram representing a urine volume measuring system in accordance with the invention.

[0034] FIG. **23** shows an embodiment of a sensor system conductive circuit with adjusted resistance design, more in particular representing a quadratic distribution, in accordance with the invention.

[0035] FIG. **24** shows an embodiment of a sensor system conductive circuit with adjusted resistance design, more in particular representing a logarithmic distribution, in accordance with the invention.

[0036] FIG. **25** shows yet another embodiment of a sensor system conductive circuit with adjusted resistance design, in accordance with the invention.

[0037] FIG. **26** shows another embodiment of the type of FIG. **13**, representing a different type of conductive space area, in accordance with the invention.

[0038] FIG. **27** shows another embodiment of the type of FIG. **17**, representing a different type of conductive space area, in accordance with the invention.

[0039] FIG. **28** shows another embodiment of the type of FIG. **18**, representing a different type of conductive space area, in accordance with the invention.

[0040] FIG. **29** illustrates a graphical representation of the distribution of different equivalent resistor designs, in accordance with the invention.

[0041] FIG. **30** shows graphically comparison of outcome without quantization of different resistance approaches, in accordance with the invention.

[0042] FIG. **31** shows graphically comparison of outcome with quantization of different resistance approaches, in accordance with the invention.

[0043] FIG. **32** illustrates a sensor design for monitoring wetness events with increased reliability.

[0044] FIG. **33** illustrates a potential other embodiment of FIG. **32**.

[0045] FIG. **34** illustrates a moisture measuring subsystem by means of an AC signal

[0046] FIG. **35** illustrates resistive measurement approaches in general and a preferred embodiment to perform moisture measurement.

[0047] FIG. **36** shows a timing diagram of a preferred way to implement a moisture monitoring subsystem.

[0048] FIG. **37** shows an embodiment of an absorbent article such as a diaper in accordance with the invention, as worn by a person, and indicating possible location of an identification tag.

[0049] FIG. **38** illustrates an embodiment of an absorbent article wherein a sensor layer is integrated in accordance with the invention, and indicating location of electrodes for respectively identification and moisture monitoring.

[0050] FIG. **39** shows (a) simulation table and (b) corresponding graph indicating the absorbed moisture volume just before leakage for different positions (c) sitting, or (d) lying down, of a human body, in accordance with the invention.

[0051] FIG. **40** shows a flow chart for saturation level status and/or alerts in accordance with the invention.

[0052] FIG. **41** shows graphs in time of moisture volume and body position data corresponding with local areas main thresholds in accordance with the invention.

[0053] FIG. **42** shows graphs in time of moisture volume and body position data corresponding with local areas specific position thresholds and diaper saturation level areas in accordance with the invention.

[0054] FIG. **43** illustrates an electrical schematic to implement a leakage detecting subsystem

[0055] FIG. **44** illustrates an embodiment regarding the location where the leakage detecting temperature resistor can be added inside the absorbent article

[0056] FIG. **45** illustrates a flow chart of management system in accordance with the invention.

[0057] FIG. **46** illustrates a flow chart of the system according with the invention including a moisture and position monitoring subsystem

[0058] FIG. 47 illustrates a flow chart of the system according with the invention including a moisture and position monitoring subsystem and a leakage detecting subsystem.

DETAILED DESCRIPTION OF THE INVENTION

[0059] The invention relates to a system avoiding leakage in an absorbent article, wherein the system comprises: a moisture volume monitoring subsystem with a large dynamic volume measurement range generating moisture volume data, and a position determining subsystem which determines the body position for one up to three dimensions generating position data, characterized in that the volume data and the position data are combined for indicating a graded saturation estimation of (multiple local areas in) the absorbent article. The graded local saturation can be seen as a leakage risk factor, e.g. 0% saturation means that no moisture is present in that area and that it is very unlikely that leakage will occur through this local area, where a local contamination of 95% becomes a very high risk regarding leaks when a next liquid intake takes place. With the large dynamic volume measurement range an optimization regarding generating useful moisture volume data to optimize absorbent article usage in terms of leakage prevention is achieved. In addition to the first millilitres/centilitres that are monitored (corresponding for example with 30% monitoring of the total absorbent article capacity), moisture volume monitoring is further performed at a larger range, or higher saturation degree or usage of the absorbent article. This range is particularly useful for the intended leakage prevention functionality, where liquid intake at safe zones (e.g. zones which are impossible to cause leakage because they are e.g. centrally located in the absorbent article) inside the absorbent article are less of interest, e.g. in the local areas where the first 30% of the liquid intake takes place. More particularly the absorbent article can be used for 90% (in some cases depending upon the position of the body and absorbent article over time) and more while the moisture volume monitoring sensor system still generates meaningful sensor data. Meaningful here in this sentence for example refers to whenever a liquid intake of the absorbent article takes place, even at a high global saturation level of e.g. 90% a significant change in conductivity can be notified.

[0060] Leakage Prevention System

[0061] In accordance with the invention, an absorbent article system is providing monitoring of the moisture volume saturation level with a large dynamic volume measurement range, hence introducing a system which makes it possible to use absorbent articles such as diapers in an optimum way, i.e. use to maximum absorbency capacity, and this for small as well as large sized absorbent articles, for lightly as well as highly absorbent articles, for different kind of micturition, and any kind of position of a human body. In practice, a large dynamic saturation range goes for example from 0% to 90% of the absorbance capacity in normal user condition. Next to a moisture volume monitoring system a method is described how leakages can be prevented. Since not only the moisture volume inside an absorbent article defines the moment of leakage, but the position of a person's body over time also determines the distribution of the liquid inside the absorbent article, with the invention a combination of totally absorbed moisture volume and accurate position detection of a person's body (e.g. lying, sitting or standing) over time determines when an absorbent article will most likely start leaking based upon the saturation level of the local areas inside the absorbent article. The accurate position detection as referred to, is for instance not only related to lying or sitting, but implying that a person is lying on a particular side of its body, or in case of sitting, that a person is sitting straight or under a certain angle. The system thus represents very specific design properties.

[0062] Alert Generation

[0063] For the overall system measurement or saturation indication, not only the evolution over time regarding moisture volume and position data measurements is taken into account, including heartbeat and breathing monitoring are considered in order to further estimate when an alarming saturation may occur.

[0064] Identification of Absorbent Articles

[0065] Moreover, the absorbent article system according to the invention relates to identification of absorbent article types in an automated manner.

[0066] Moisture Monitoring Subsystem

[0067] According to the invention, design guides are determined enabling moisture volume monitoring inside an absorbent article with only two electrodes. Such two-electrode system makes it possible to monitor the amount of absorbed liquid inside the absorbent article. Furthermore, in a particular embodiment only a resistive measurement is applied for obtaining a moisture-monitoring device in accordance with the invention. Herewith, problems are inherently solved regarding body effects that typically occur in case of capacitive measurements. The term body effect in this text refers to the influence of the human body on the measurement performance, for example; moving, the inherent presence of water in the human body, etc. Moreover, the power consumption of a resistive measurement is generally lower than capacitive or other measurement methods. While referring to such resistive measurements, conductive circuits herewith applied comprising respectively parallel as well as serial resistor circuits, or a combination of both, are part of the current invention.

[0068] Identification of the Absorbent Article

[0069] In accordance with the invention, a method is introduced where instead of a short a material comprising a conductive circuit with specific electrical properties, resistance and capacitance, is applied between the two measurement electrodes. By using this methodology the amount of different detectable types of articles is not determined by the amount of electrodes and/or terminals but by the possibility to change the electrical properties of this material, being much easier to adjust. The material properties as well as the physical design of an identification mark represented with the material chosen for use can be changed in order to change the electrical properties (and herewith the conductive circuit) between the two identification terminals.

Detailed Description of the Embodiments

[0070] The invention is related to a system that combines the moisture volume monitoring of an absorbent article such as a diaper with the position of a person's body, the person wearing such absorbent article. According to an embodiment, this can be implemented by means of two separate measurement subsystems. FIG. 1 illustrates schematically an absorbent article 100 such as a diaper in accordance with the invention, the absorbent article 100 as worn by a person 110. Amongst said two measurement subsystems, a first subsystem is a moisture-monitoring device where the sensor part is integrated within the absorbent article **100**, in accordance with the present invention, and a second subsystem, monitoring the position of a person's body **110**, and herewith the position of an absorbent article **100** worn by this person **110**, is for example an accelerometer or a gyroscope. A module **104** preferably integrates said position monitoring subsystem and the necessary electronics to capture the electrical values of the moisture or urine sensors, detecting the amount of moisture or urine present. The measurement module **104** may further comprise a transmitting device to forward the measured information to finally a server or end-user. Said module **104** can be part of the absorbent article **100** or applied on the absorbent article **100** in a representative and reproducible way. The absorbent article **100** further comprises a backsheet **101** being for instance a non-permeable layer to keep moisture inside the absorbent article **100** or diaper, and an absorbent area structure **102** including amongst others e.g. super absorbing particles, cellulosic fluff pulp, and a distribution layer. Further indicated on the absorbent article **100**, is the most likely intake region **103** or position of intake urine, i.e. the place where intake of the liquid or urine occurs. The intake region **103** can be different for different genders, body weights, types of absorbent articles, etc.

[0071] According to an aspect of the invention, will leakage be overcome by combining moisture volume and position measurement data. FIGS. **2** and **3** showing further versions of the embodiment of FIG. **1** in accordance with the invention, taking into account the graded distribution of liquid inside, or the graded saturation of the absorbent article when a person is in a standing respectively lying (in this case at the back) position. Referring to these, it can be seen that the amount of absorbed liquid before leakage is significantly higher when a person **310** is lying down in comparison with a person **210** in a standing position. If only volume monitoring is taken into account, a maximum absorbency or maximum amount of absorbed liquid **205** is reached without taking into account the position of the person's body. Hence, if only volume monitoring is taken into account to generate an alert to prevent leakage, the volume threshold to be considered is the minimum of the volume before leakage of any of the possible body positions minus a certain safety margin, due to the fact that the exact position of the body cannot be predicted. Amongst the two described cases, i.e. standing or lying down, the minimum volume before leakage is at standing position, where the maximum absorbency is reached at 300 ml. Hence, the absorbent article **200** has to be changed before 300 ml of urine is applied (a threshold can e.g. be generated at 250 ml), since liquid **206** cannot be absorbed anymore by the absorbent area structure **202** due to gravity. When the position of the body is taken into account the absorbent articles can be used for their full or rather close to their full capacity, or better referred to as optimum capacity being potentially significantly more than this 300 ml. In FIG. **3**, representing the lying (at the back) position, is depicted that 300 ml of absorbed liquid **305** is not yet halfway the maximum absorbed volume before leakage, whereas the close to full capacity of the absorbent area structure **302** is reached at 500 ml. The absorbent article **300** gets saturated at 700 ml of absorbed liquid **305** due to urine distribution, and hence leakage of liquid **306** appears. According to a particular embodiment, the system further comprises hart beat and breathing monitoring in order to relate stress and/or other type of emotional or physical conditions of a person with the contamination that occurs.

[0072] Moisture Monitoring Subsystem

[0073] FIG. **4** illustrates in accordance with the invention an embodiment of an absorbent article **400** wherein a sensor system **407** is integrated. The sensor system **407** comprises of a conductive circuit layer or wire structure printed or added onto the inner side of the backsheet **401** of the absorbent article **400**, wherein the inner side is defined as the side towards a person's body (here not shown). The sensor system **407** may comprise of multiple sensors pointing towards the absorbent area structure of the absorbent article, i.e. in the direction towards a person's body. The intake region **403** or wetting point is also shown in FIG. **4**.

[0074] FIG. **5** illustrates where the electrical interconnection **508** between on the one hand the measurement module **504**, including hardware to capture the electrical values of the moisture or urine sensor, to determine position via e.g. an accelerometer and to use a transmitting device to forward the measured data to a server or end-user, and on the other hand the moisture volume sensor system **507**, applied onto the backsheet **501** of the absorbent article **500**, takes place. Also shown is where the intake of the liquid happens, the so-called intake region **503**. In accordance with an embodiment of the invention, the resistance **520** of the urine sensors in dry condition in function of the location **521** inside and along the length of the absorbent article **500** is depicted. It is clearly illustrated that the resistance reaches a maximum **522** at the intake region **503**, also referred to as wetting point.

[0075] Parallel Moisture Volume Measurement Approach

[0076] According to an embodiment of the invention, and as yet mentioned above, a two-electrode sensor system can be used for moisture volume monitoring of the absorbent article. In the remaining part of the description, this system will be referred to as being based on a parallel volume measurement approach. According to a particular embodiment, resistive measurements are used for performing the volume monitoring. FIG. **6** illustrates with FIG. **6**(*a*) electrical circuit of a two-electrode system with so-called equivalent resistor approach. The resistors are present in this approach when moist is applied at that specific region. The region **603** where moist **605** is absorbed, is indicated in FIG. **6**(*c*) as well as the measurement module **604** location. FIG. **6**(*b*) shows the local corresponding resistance graph as a function of diaper location along its length. In other words, in case moist is present over certain area in FIG. **6**(*c*), the corresponding resistance of FIG. **6**(*b*) needs to be added in the equivalent resistor representation of FIG. **6**(*a*). In case no moist is present the local resistance is infinite. It is noted that the resistance distribution in FIG. **6**(*b*) is arbitrary chosen, This can be uniform, logarithmic, random, etc. Preferred resistance distributions are also part of the invention, and will be discussed further below, as well as the way they need to be implemented.

[0077] In FIG. **7** an example of conventional uniform distributed moist measurement electrode system is given, wherein the conductive circuit of the two-electrode sensor system **707** is characterized by a uniform pattern along the length of the absorbent article, indicated by the arrow L. A schematic view (above) as well as a test sample view (below) of such conductive circuit with electrodes is represented.

[0078] Rx is the resistance when a certain point is wet, for example where the absorbed liquid **605** within an absorbent article **600** is depicted in FIG. **6**(*b*). In case the absorbent article **600** remains dry, no resistance is measured. The idea behind the so-called equivalent resistor approach is now discussed.

[0079] The idea behind different (gradually decreasing) resistances at different (gradually chosen) locations as illustrated in FIG. **6**(*a*) and also referred to as the equivalent resistor approach is the following. Considering first a sensor system **707** comprising a conductive circuit that has a uniform pattern along the entire length of the absorbent article (as in FIG. **7**), therefore introducing a uniform local resistance distribution, in contrary with the arbitrary chosen example of FIG. **6**(*b*). This introduces that equal parallel resistances between the two electrodes of the equivalent resistor system of FIG. **6**(*a*) are added in case of moist at that certain area. The equal parallel resistances are also schematically depicted between the electrodes of the two-electrode sensor system **707** in FIG. **7**. If every Rx is the same (as opposed to FIG. **6**) and moisture is gradually added to the diaper and distributed inside the diaper, the measured total resistance will decrease. Due to the fact that the resistors are added in a parallel manner the influence of the additional resistors on the total resistance, appearing due to flow of liquid contamination, will decrease. For example, Rx initially being for instance 1 kOhm will later on, when moisture gets distributed, be represented as 2 parallel Rx's of 500 Ohm, and much later on, when moisture gets even more distributed, be represented as 3 parallel Rx's of about 300 Ohm. Hence, the sensor measurement system comprising of equal parallel resistors in wetted condition, can only be used for a limited dynamic range of liquid intake, whereas the resistances or the values of the more parallel resistors are getting too low, and will finally be reduced to an insignificant measure especially when sample noise is taken into account. The sensor measurement has only a limited dynamic moisture measurement range, due to the influence of added of parallel resistors with equal value being negligible from a certain amount of moisture saturation. This will finally lead to insignificant measure of moisture volume for high volumes, because sample noise and other disturbances can become bigger than the influence of the added parallel resistance. Measurements show that only 30% of the total capacity of an absorbent article can be monitored accurately in case of an equally distributed resistance at every point of the sensor system, i.e. the resistance being equal at every point of the sensor system.

[0080] Referring now again to FIG. **6**, when increasing the resistance Ri of the two-electrode sensor system **607** at the intake region **603** where the intake takes place, and decreasing the resistances Ri+1, Ri+2 . . . Ri+n gradually from that point or area towards the tail ends of the absorbent product **600**, the dynamic range will increase. Here, the initial parallel resistance is significantly higher in value than the subsequent ones, left and/or right from the initial one as shown in FIG. **6**(*a*). With FIGS. **8** to **12** is now further explained how increase of absorbed liquid determines the final resistance. FIG. **8** illustrates a very simplified version of the equivalent resistor approach with only one resistance and limited liquid intake of for instance 100 ml, and wherein the measured resistance equals R1. In FIG. **9** the equivalent resistor approach is shown with three parallel resistances and for instance a 200 ml liquid intake, and wherein the measured resistance equals R2//R1//R2 i.e. R2 being parallel with R1, being parallel with R2. The R2 resistors are dominant due to lower resistance and thus stronger current flow. In FIGS. **10**, **11** and **12** the equivalent resistor approach is shown respectively with five, seven and nine parallel resistances and e.g. respectively corresponding 300 ml, 400 ml and 500 ml liquid intake. Respectively, the R3 and R4 resistors, R5 and R6 resistors, and R7 and R8 resistors are dominant due to lower resistance and thus stronger current flow.

[0081] Serial Measurement Approach

[0082] As an alternative to the abovementioned parallel resistance measurement system wherein two parallel tracks or resistors are used to measure the contamination, an embodiment with a serial approach can also be implemented. A conceptual overview of such serial resistor approach measurement system is given in FIG. **13**. Instead of two wet electrodes only one electrode **132** becomes wet during the normal moisturizing or contaminating use of the absorbent product **131**. A second electrode **133**, also called the dry electrode, and represented by resistance Rinterconnect, is used to feedback the measurement signal of the first electrode **132**, the wet electrode, and represented by resistance Rsens. The potential wetting zone **134** or region that can become wet of the absorbent article **131** is also indicated in the conceptual drawing. As further illustrated, the total resistance **135** is measured between the two electrodes **132**, **133**.

[0083] FIG. **14** shows a circuit diagram, for describing the influence of a wetness or moisturizing event on the measured resistance **145** when a serial approach is applied. Now the measured resistance **145** comprises of a fixed resistor value of the second (dry) electrode **143** and a variable resistance value of the first (wet) electrode **142**. The resistance of the first and respectively second electrode **142**, **143** are in dry conditions determined by the production method and materials used for the absorbent article **131**. In wet condition however, the resistance measured over the first electrode **142** is based on the initial dry resistance and the resistance caused by wetting the diaper material **131**, whereas the resistance measured over the second electrode **143** equals its non-varying value from the dry condition status.

[0084] The abovementioned wetting influence is further described with FIG. **15-17**. The physical effect that occurs during wetting is explained relying on the fact that an electrode **152**, **162** has a certain surface area, the potential wetting zone **154**, **164**, and that the surface area of the electrode's sensor material causes the initial resistance of the electrode. On top of this sensor material, superabsorbent polymers (SAP) and fluff (pulp) are applied determining the absorbent article **131**. In dry condition this results just in the initial resistance of the electrode as output value, defined as $\text{Rsens}=\Sigma_{i=1}^{N}R_{s,i}$, whereas the resistance measurement Rmeas between first electrode **152**, **162** and second electrode **153**, **163** equals Rsens+Rinterconnect. Once the diaper is wetted, the surface of the sensor material gets covered with a blend of urine or others e.g. other body liquids and/or metabolic by-products, amongst which blood may also appear for instance, SAP and fluff. While referring to FIG. **16**, with respect to the resistance measurement, such wetted diaper with region of wetness **168**, will cause a significant local decrease of (the initial dry) resistance **166** due to the fact that a blend of wet material including part of the absorbent article material will cause an additional resistance **167** in parallel because of an additional conductive layer of wet material within the region of wetness **168** on top of the conductive electrode surface remaining dry. The first electrode resistance Rsens is now $\Sigma_{i=1}^{3}R_{s,i}+\Sigma_{i=5}^{N}R_{s,i}+R_{s,4}//R_{w,r}$. In FIG. **17**, an embodiment of the serial resistor approach is depicted, wherein a larger region of wetness **178** is indicated and being characterized by the parallel resistances **177***a*, **177***b*, **177***c*. Correspondingly, a first electrode resistance Rsens is given by $\Sigma_{i=1}^{2}R_{s,i}+\Sigma_{i=6}^{N}R_{s,i}+ +\Sigma_{i=3}^{5}R_{s,i}//R_{w,i}$.

[0085] As can be seen in FIG. **18**, one of the advantages of this serial resistor approach is that the correlation between wetness events and total measured resistance is linear, as opposed to the parallel approach, discussed further below while explaining the graphical representations of FIG. **24-25**. A disadvantage is that the dynamic range is rather limited due to the fact that the dry electrode has a certain known resistance, which will never be influenced due to wetting. Decreasing this disadvantageous effect can be done in two ways: one is decreasing the resistance of the dry electrode, however there will always be physical limitations; the second solution is to give the measurement electrode a non-uniform distribution, optimized in such a way that the wanted measurement volume can be measured with the highest accuracy. As mentioned before, optimizing the use of the diaper is aimed at with respect to the present invention, not the direct wetness in formation. For that reason, the sensitivity of the sensor layer system is optimized as described in next section.

[0086] General Design Guidelines for the Resistive Moisture Sensor

[0087] FIG. **19** shows an embodiment of a sensor system conductive circuit with adjusted resistance design, more in particular representing a linear distribution, in accordance with the invention. FIGS. **20** and **21** show respectively two other different versions of how one can implement different parallel resistors over the sensor system area. This is mainly done by increasing and/or decreasing the distance between the two electrode fields, by means of cutting out or removing part of the conductive circuit. In particular, conductive material is removed or cut out in such way, such that the resistance becomes very high at the location of the intake region, and then gradually decreases towards the tail ends of the absorbent article. A high resistance is achieved by removing or cutting out more conductive material, whereas towards the tail ends of the absorbent article most of the conductive circuit is retained representing a much lower resistance, though stronger current flow.

[0088] To discuss the advantages of the disclosed monitoring system according to the invention, the data output is simulated based upon a block diagram **220** that represents a urine volume measuring system. As illustrated in FIG. **22**, the input **221** of the volume measuring system is urine over time, urine(t). The final outcome **225** is the measured resistance Rquantized(t), changing over time. The resistance of the electrodes Req(t) **223**, inside the diaper being contaminated with urine is a function of the applied urine **221**, urine(t), and the chosen electrode distribution **222**, Elec (distr). The resistance is measured by means of digital measurement equipment **224**. Due to this the measured outcome Rquantized(t) **225**, is not the same as the actual resistance of the measurement system Req(t) **223**.

[0089] According to an embodiment, the simulation for achieving the measured resistance as described above, is done for four different types of distributions of electrodes, i.e. applied onto four different types of two-electrode sensor systems. A first sensor system design comprises a conventional distribution of measurement electrodes, as displayed in FIG. **7** representing a uniform pattern without cutting away a part of the conductive material. Next to this architecture, a linear (FIGS. **19** to **21**), quadratic (FIG. **23**), and logarithmic (FIG. **24**) distributed sensor system is simulated. A linear distributed sensor system can be achieved by cutting out a linear shape of the conventional material as is displayed in FIG. **20** and FIG. **21**. Such linear shape being defined as a geometric shape, more in particular a polygon. The best performance of absorbent article having the largest dynamic range is achieved with the logarithmic distribution of the conductive material, of FIG. **24**. The logarithmic distribution is characterized by removing a logarithmic shape out of the conventional distribution from FIG. **7**, and wherein the logarithmic shape is defined as a shape characterized by a logarithmic function. Similarly, the quadratic distribution of FIG. **23** is characterized by removing a quadratic shape out of the conventional distribution from FIG. **7**, and wherein the quadratic shape is defined as a shape characterized by a quadratic function. Whereas mostly symmetrical examples are illustrated, the invention also covers asymmetrical designs as for instance shown in FIG. **25**.

[0090] Referring again to the example of conventional distribution of measurement electrodes depicted in FIG. **7**, more particularly the conductive circuit of the two-electrode sensor system **707** being characterized by a uniform pattern, also referred to in the art as 'fingered electrodes' (and being off-the-shelf available). Besides such 'fingered electrodes' architecture used as a basis for removing conductive material and hence creating adjusted resistance designs as illustrated by FIGS. **19** to **25**, other adjusted resistance electrode designs, with either more or less conductive material present, are also possible and are evenly covered by the invention. Notwithstanding that fact that mainly 'fingered electrodes' were envisaged, other examples are for instance shown in FIGS. **26** to **28**, wherein geometrical shapes are cut out of a full plane conductive material sheet.

[0091] FIG. **29** illustrates an embodiment in accordance with the present invention, of how the total resistance can be distributed or may vary with the amount of wetness or moisture volume, in case the parallel equivalent resistors approach as in FIG. **6** is applied for the resistance measurement. With this graphical representation only examples are given, in order to show the trends of the outcome, respectively for conventional, linear, quadratic and a logarithmic distribution of a non-conductive cut out shape within the conductive circuit design as depicted in FIGS. **7**, **19**, **23** and **24**. On the vertical axis or so-called y-axis the total resistance is displayed, whereas the horizontal or x-axis corresponds with the resistance of the equivalent parallel resistor at the location within the diaper when it becomes wet. With FIG. **30** a graphical embodiment of the incremental difference in total resistance Req is displayed. On the y-axis the differentiated total resistance is depicted, whereas the x-axis represents the amount of the equivalent parallel resistors increasing with the distribution of wetness or moisture volume within the diaper when it becomes more and more contaminated. For example, when the x-axis has index **2**, the total resistance iteration **1** is subtracted with the total resistance of iteration **2**. The achieved numbers give an insight regarding the easiness to distinguish the current contamination with urine from previous and following urine applications. The graphs with FIG. **31** show comparable simulation results as generated with FIG. **30**, although here quantisation noise is also taken into account.

[0092] Sensor Guidelines for Increased Sensing Reliability in Case of Delamination of Absorbent Article Core Components

[0093] In FIG. **32** is depicted a substrate **321**, suitable for incorporation into an absorbent article **100** for automatic detection of moisturing events therein. The substrate **321** comprises a first surface **322** capable of being arranged proximal to a body facing side of the absorbent article **100** and a second surface **323** opposite said first surface **322** and capable of being arranged proximal to a garment facing side of said absorbent article **100**. According to an embodiment of the invention the substrate **321** comprises moisture sensing tracks **329** which may form a grid pattern across the substrate **321** and wherein the grid comprises resistive (and/or conductive) elements running both substantially parallel to the longitudinal axis y-y as well as substantially perpendicular thereto. This grid arrangement is beneficial for ensuring reliable sensing of moisturing events also upon saturation of the product which inevitably results in expansion of the absorbent core of the absorbent article and thus more prone to delamination of the absorbent core components (e.g. the core wrap) from the backsheet. Surprisingly such a grid structure has been found to be beneficial in providing continued and reliable detection also in such extreme conditions.

[0094] In a preferred embodiment, the grid pattern may vary across the surface of the substrate **321**, and arranged such that the distance between each resistive (and/or conductive) elements (also referred to herein as members) is lower at positions proximal to the lateral edges **3212**, **3213** and the sides **325**, **326** of the substrate **321** as compared to other regions of the substrate **321** typically proximal to the center thereof. An advantage is to permit accurate risk of leakage detection which has been found most necessary at proximity to the edges of the product.

[0095] Also depicted in FIG. **32**, is the width W of the substrate **321** extending perpendicular to the length L thereof. A central track **334** is extending parallel to a length L of the substrate **321**. In an embodiment, the moisture sensing tracks **329**, being in electrical communication via one or more shortening elements **3210**, are in the form of a repeating grid and/or pattern along the length L of the substrate **321** and a dimension substantially perpendicular thereto, said grid and/or pattern preferably comprising a plurality of at least partially interconnected resistive members **3301**, **3302**,**3**- **3303**, **3304**, **3305**, **3306**, of a sensor track **331** in particular while referring to FIG. **33**, each having a shape selected from straight lines; curved lines; wave-like; geometrically shaped such as squares, parallelepipeds, parallelogram, triangles, circles, ellipses, dots, and combinations thereof; decorative elements such as flowers, butterflies, and combinations thereof; and combinations thereof. Preferably, the moisture sensing tracks **329** form of a repeating grid or pattern along the length L of the substrate **321** and a dimension perpendicular thereto, said grid and/or pattern preferably comprising a plurality of at least partially interconnected resistive members each having a shape selected from straight lines and/or curved lines, where lines can be replaced by interconnected decorative elements that form a pattern along the track. The width of said lines and/or the connected pattern that is replacing the lines may be of up to 50% of the distance between neighboring tracks. The tracks in longitudinal direction may be arranged in parallel to the side tracks **327**, **328** or at an angle to it of up to 45°, preferably from 2° to 30°, more preferably from 5° to 25°. Other tracks can be arranged perpendicular to the side tracks **7**,**8** or on an angle to it of up to +/−45° preferably from 2° to 30°, more preferably from 5° to 25° (the angles measure either as a positive or negative angle e.g. +45° or −45°).

[0096] In a preferred embodiment, a plurality of the resistive members, preferably a majority, more preferably all, extending in a direction towards the lateral side edges **3212**, **3213** of the substrate **321** are at an angle α to the longitudinal axis y-y, said angle α being from 2° to 45°, preferably from 5° to 30°, more preferably from 8° to 25°, even more preferably from 10° to 20°. An advantage of this arrangement is that during the application step in the process, a reduction of the wear and tear of the components is achieved compared to when the members extend at angles of greater than 45° (especially right angles). This arrangement has been found beneficial to still provide accurate sensing also at saturation conditions (which may lead to delamination issues as described above) hence making it a highly optimal arrangement from both a functionality as well as production point of view.

[0097] Preferably, a plurality of the resistive members wetness sensing tracks **329**, preferably a majority, more preferably all, extending in a direction towards the first and/or second ends **325**, **326** of the substrate **321** are at an angle β to the longitudinal axis y-y, said angle β being from 2° to 45°, preferably from 5° to 30°, more preferably from 8° to 25°, even more preferably from 10° to 20°. An advantage of this arrangements is that the benefits described above are further exacerbated.

[0098] Differential Volume Measurement

[0099] In an embodiment of the invention, the moisture (volume) measurement or monitoring of the moisture (volume) by the moisture monitoring subsystem is performed by means of a so-called differential measurement approach in order to overcome electrical polarisation of the contamination or more in particular the contaminating substance e.g. urine, within (or even getting outside of) the absorbent article. The differential measurement approach is based on the application of a differential or complementary voltage over two separate points in an electrical circuit as known in the art.

[0100] In a preferred embodiment the moisture volume measurement is performed as shown in FIG. **34**. A differential or complementary actuation signal, defined as an electrical signal transmitted as a pair of complementary (opposite) signals over a pair of conductors, is applied at terminals **341** and **342** of the measurement circuit by means of an AC voltage source. The measurement circuit of FIG. **34** further represents a resistive moisture sensor and a reference resistor. The resistance of moisture Rmoist is measured by an analog-to-digital convertor (ADC) at location **343** by using a conventional voltage divider (as known in the art) wherein the reference resistor with resistance Rref is remained constant. The resistance of the moisture sensor will depend on the moisture volume, or else the contamination indicating a certain degree of saturation within the absorbent article.

[0101] Assume an AC voltage source with square wave with a peak-to-peak voltage of 5V and a duty cycle of 50%. During the positive half of the period the voltage over Rmoist is:

$$V_{Rmoist} = \frac{Rmoist}{Rmoist + Rref} \cdot 2,5 \text{ V}$$

[0102] During the negative half of the period the voltage over Rmoist is:

$$V_{Rmoist} = \frac{Rmoist}{Rmoist + Rref} \cdot (-2,5 \text{ V})$$

[0103] This inversely applied voltage over the resistive moisture sensor is required as will follow from next examples.

[0104] The simplest way to read a resistive sensor is to use the principle of a voltage divider **351** (FIG. **35**), as yet referred to. One applies a known positive voltage at one terminal of a reference resistor, while the other terminal of the reference resistor is connected to an ADC and the resistive moisture sensor. Once the resistive moisture sensor is wetted a decrease in measured voltage will be notified. Nonetheless, after a while the voltage level increases again. This is due to the fact that once the resistive moisture sensor is wetted it will act as an electrochemical cell and the sensor will get polarized over time. If new moisture or additional moisture volume is applied, which acts as an electrolyte in the electrochemical cell, the measured voltage will drop again, and again it will increase after a while over time due to polarization. Because of this polarization effect and the long time constants to polarize it is very difficult to perform an accurate DC measurement. If one now applies a—biased with 50% of the power supply voltage—AC signal at the clamp where previously the positive voltage was applied (which happens e.g. when generating signals with microcontrollers) **352** (FIG. **35**) one will notify the same polarization effects, although here the effect will occur much slower. This results from the fact that in the DC method continuously 5V was applied and now e.g. a square wave with duty cycle 50% is applied due to which the polarization is significantly less but still present and unwanted for accurate measurements.

[0105] The last example **353** (FIG. **35**) shows how one can achieve an inversely applied voltage, later on called differential, over the resistive moisture sensor with only applying positive square waves towards the sensor setup. During the half of the period V**1** (=+5V) is high and V**2** is low (=0V) so that the voltage over Rmoist is:

$$V_{Rmoist} = \frac{Rmoist}{Rmoist + Rref}(V1 - V2) = \frac{Rmoist}{Rmoist + Rref} \cdot 5 \text{ V}$$

[0106] During the other half of the period V**1** (=0V) is low and V**2** is high (=+5V) so that the voltage over Rmoist is:

$$V_{Rmoist} = \frac{Rmoist}{Rmoist + Rref}(V1 - V2) = \frac{Rmoist}{Rmoist + Rref}(-5 \text{ V})$$

[0107] This gives us again a negative voltage value, also referred to as differential signal over the terminals of Rmoist in order to avoid polarisation.

[0108] In this preferred embodiment we present a method which lets the resistive moisture sensor experience a differential actuation signal from the microcontroller without introducing any other components.

[0109] Terminals **341** and **342** (now connected to a microcontroller instead of an ideal AC source in FIG. **39**) are during the measurement cycle the inverse signal of each other and create a symmetrical waveform, e.g. a square wave or a sine wave. This wave has a frequency of 50 Hz to 500 Hz, more preferably from 500 Hz to 5 kHz and in some cases even higher frequencies. In order to reduce power consumption both terminals are connected to ground when no measurement is performed. For diaper measurements we recommend a measurement period of 50 ms to 500 ms, more preferably 500 ms to 10 s. FIG. **36** displays a typical waveform. It can be seen that before a measurement is performed the wave needs to be present for a certain cycles. According to an embodiment, it is recommended to have at least 3 to 6 cycles, but more preferred 7 to 20 cycles are present. Multiple AC signal periods are needed in order to depolarize the absorbed liquids. Polarization occurs e.g. due to fresh body liquid entering the diaper and the associated electrochemical processes involved inside the absorbent article core, bringing along a charge difference in old absorbed liquid and newly absorbed liquid. As a result measurement mistakes will occur, which can be overcome by applying abovementioned actuation signal. The best performance regarding depolarization was notified from 7 periods of AC signal. An upper limit of 20 is introduced in order to reduce power consumption. But it is noted that if one applies abovementioned actuation signal continuously, the system will also work perfectly. A frequency of 500 Hz to 5 kHz is preferred due to the fact that lab tests showed depolarization occurs the best till 5 kHz for this typical substance and resistive moisture sensor. A lower limit of 500 Hz is preferred in order to make it possible to perform a sufficient amount of measurement cycles while the system remains a significant amount of time in power down mode. For example 50 Hz AC frequency and 20 periods per measurement, and one measurement per second would lead to a 60% power down, whereas the same performance can be obtained with 500 Hz but then the power down has a time duration of 96%. Once the cycles are performed, different ways to come up with a measured value representing the resistance of the resistive moisture sensor are possible. One can average over time, another can sample lots of values and make an FFT out of it and look at the main energy. Or, it is also possible to just look at the resistance value (corresponding to a measured voltage at that moment) at a specific cycle in the chain of cycles and a specific timing within that frame. According to an embodiment, it is preferred to sample at the second or third cycle and more preferably the fourth to the last cycle, particularly at 50% of the positive square and more particularly between 50% and 99% of the positive square.

[0110] Absorbent Article Identification

[0111] According to an embodiment, an identification tag **376** is provided within the absorbent article **380** in accordance with the present invention. As illustrated in FIG. **37**, such identification tag **376** can be printed in a zone of the backsheet **371** where no absorbent layer **372** is present. The identification tag **376** is for example a printed electro-conductive tag, implemented on top of the backsheet **371**, i.e. onto the inner backsheet side towards human's body **370**, and as far as possible away from the intake region **373** where absorbed liquid **375** is contaminating the absorbent article **380**, such as a diaper. The identification tag **376** can be a simple printed track. Based upon the length of the track the resistance of such tag track may change. As shown with FIG. **38**, one of the measurement terminals T**2** is for instance shared for the identification of the absorbent article **380**. The identification electrodes **388** are thus defined by terminal T**2** and an additional terminal T**3**. The terminal T**2** is also used to perform urine monitoring, and forming together with terminal T**1** the urine monitoring electrodes **389**. Further, within this conceptual drawing of identification and urine monitoring, as well as sharing of terminals T**1**, T**2**, T**3** of the absorbent article **380**, its backsheet **381**, the sensor layer **387** and the intake region **383** are denoted.

[0112] The advantages of the monitoring system described are straightforward. It provides in preventing early leakages and optimizes the system as much as possible. Moreover, the sensor system herewith used, is a two-electrode system that makes continuous monitoring possible over a large dynamic range due to its particular though simple design configuration. In addition, the identification system makes it possible to identify an infinite number of different absorbent articles, whereas existing systems in the art can only discriminate a limited number of types, namely N−1, where N is the number of measurement terminals.

[0113] Leakage Monitoring System

[0114] As opposed to state-of-the-art systems, the accelerometer is not particularly used to optimize the volume measurement. Here, according to an embodiment of the current invention, the accelerometer (or position) data is combined with resistive volume measurement data in order to determine the (local) saturation of the diaper.

[0115] The dependency of leakage or the different levels of contamination towards absolute saturation is now further discussed. In accordance with the invention, FIG. **39**—including FIG. **39** annex—shows the results of a lab test in FIG. **39**(*a*) and corresponding graph in FIG. **39**(*b*) indicating the absorbed moisture volume just before leakage for different positions of a human body **390**, i.e. sitting [beta]=0° under a certain variable angle [alpha var], or either lying [alpha]=−90° under a certain variable angle [beta var]. The angles [alpha] and [beta] that are used to determine different sitting respectively lying positions, are defined as follows. For the sitting position, as illustrated in FIG. **39**(*c*) the inclination of the human body **390** is here for simplicity reasons only considered as the body moving, i.e. bending forward or backward, and being associated with a variable angle [alpha]. A further consideration for the body in sitting position moving, i.e. bending also to the left or to the right is not particularly discussed, although being covered by the present invention. The angle [beta] being a measure for the inclination of the body to its left or right side is thus fixed here. Referring to the xyz-coordinates, the body **390** bending forward or backward corresponds with a rotation around the z-axis in (or parallel to) the xy-plane, this rotation identified by rotation angle [alpha]. The person **390** looking in the direction of the yz-plane (or parallel) is leaning forward on its belly towards a maximum angle [alpha]=+90°, or opposite leaning to its back towards a minimum angle [alpha]=−90°. The human body **390** bending from sitting position, or either turning from lying position, as illustrated in FIG. **39**(*d*), to its right or left side corresponds with a rotation around the x-axis in (or parallel) to the yz-plane, this rotation identified by rotation angle [beta]. Hence, in case of the sitting position as in FIG. **39**(*c*) and described above, [beta] equals 0°. Further referring to the lying position of FIG. **39**(*d*), here [alpha] is fixed to −90°, meaning that the human body **390** has bent over backwards until his/her back is in flat position, i.e. lying down. Turning to the left or to the right, and thus person is moving to one of its sides in lying position, corresponds with maximum a 90° rotation. Hence, here [beta] equals maximum +90° or minimum −90° for the sideways turning body in lying down position. As clearly illustrated by the simulation table and accompanying graph of FIG. **39**, the position of the human body **390** is of utmost importance to determine the moment of leakage, depending on the amount of contamination when the body is sitting or lying in a certain position.

[0116] As mentioned before, one of the main purposes of the present invention is to indicate for instance when a diaper has to be changed. For this purpose, data **4002** from the volume sensing elements has to be combined with the body position data **4004** as shown in the follow-up status and alert flow chart **4000** of FIG. **40**. Within this flow chart **4000**, the urine intake from the diaper as a function of time **401** is measured, leading to a certain volume sensor output over time **4002**. In parallel, or at the same time, the position of the body or the absorbent article over time **4003** is captured, leading to a certain accelerometer output over time **4004**. Status of saturation levels and/or alerts **4005** are consecutively generated originating from the position **4003** of the human body, and thus of the absorbent article on one hand, and the absorbed moisture **4001** within the article on the other hand. According to an embodiment of the invention, the accelerometer data **4004** will be used to determine threshold values to generate an alert once the measured volume exceeds such threshold. Threshold values can be generated from a simulation table, as discussed above. According to another embodiment, one can use or refer to percentages of the values indicated in a simulation table and one can relate this for example with soft and harsh alerts. As an example, a soft alert threshold can be 75% of the maximum absorbency in that typical body/diaper position, whereas for a harsh alarm this can be e.g. 90% of the maximum absorbency in that position.

[0117] As illustrated in FIG. **41**, in an embodiment one can plot the diaper's urine intake **421** as a function of time t as given in FIG. **41**(*a*), combine or compare the volume sensor output **422** over time t from FIG. **41**(*b*) with the human body or absorbent article position data **423** as generated by the accelerometer and as an example in consecutively lying on the back **424**, lying on the side **425**, and sitting position **426** illustrated in FIG. **41**(*c*). Further, with FIG. **41**(*d*) corresponding discrete threshold values **427**, e.g. extracted from simulation table and graph as discussed with FIG. **36** above, can be displayed while determining the local saturation of the diaper based upon the combined generated information. The final graph (d) from FIG. **41** clearly shows the difference between discrete thresholds from the simulation table on one hand, and represented by dotted line v the moisture volume evolution or volume sensor output over time on the other hand. An alarm needs to be communicated as soon as the person lying on its back will turn towards one of his/her sides.

[0118] FIG. **42** shows graphs in time of moisture volume and body position data corresponding with local areas specific position thresholds and diaper saturation level areas in accordance with the invention. Hence, according to another embodiment, the diaper's urine intake **421** is plotted as a function of time t as given in FIG. **42**(*a*), and the volume sensor output **422** over time t from FIG. **42**(*b*) is combined or compared with the accelerator data **423** from FIG. **42**(*c*) such that more precise urine intake estimations are generated as illustrated in FIG. **42**(*d*), wherein the diaper intake is also taken into account for combining or comparing measured data. The arrow A is indicating the direction from back to front of a person's body. The data can then again be further used or processed in combination with simulation table and graph referred to above, defining thresholds, and herewith obtaining saturation information **428** over time t inside a diaper as shown in FIG. **42**(*e*). Light coloured areas **429***a* within the diaper may cause soft alerts, whereas dark colours for a particular area **429***b* will lead to leakage alert having reached an absolute saturation measure within this area.

[0119] Leakage Detecting Subsystem

[0120] In an embodiment, another monitoring subsystem is added next to the moisture volume and position monitoring subsystem. This additional monitoring subsystem will detect leakages.

[0121] According to an embodiment this subsystem comprises a sensor system, next to the described sensor system for moisture volume measurements. This additional sensor system comprises a conductive circuit, i.e. material with electrical properties, wherein more particularly the conductive circuit will have a temperature dependency. The conductive circuit exists of two parts, a terminal part to the measurement electronics **431**, **432** in FIG. **43**, and a sensing part **433** in FIG. **43**. The sensing part **433** of this conductive circuit is applied in such a way that it does not come in direct contact with moisture. The conductive circuit needs to be electrically isolated in the measurement zones, as can be seen in FIG. **44**. With conventional production methods for absorbent articles this can be achieved by e.g. integrating this sensing part at the outer edges of the absorbent article. In this construction or configuration, the conductive circuit can be printed on the backsheet material whereas a non-permeable topsheet is applied on top. In this way, the sensing material is insulated from potential moist penetration.

[0122] When the absorbent article is applied on its carrier, in case of elderly care on a resident, the temperature dependent sensor will notify the environmental temperature (including body temperature in this case) and stabilize after a while. Once leakage occurs the moist flows on top of the insulated temperature sensors. An increase of temperature will be notified due to the fact that there will be a better contact with the human skin (which optimizes the heat transfer) and the residual heat of the urine. With this, leakages can be detected in a fully automated way.

[0123] Management System

[0124] As illustrated with the embodiment of FIG. **45**, the invention further provides in a management system **450** for managing the measured or captured data, thereby using a network wherein the data can be transmitted, taking into account privacy issues and therefore for example anonymize the data for part of the network, as is of importance for instance in a nursing home, or residential care institution or other applicant environment **455**. A module **451** being a type of hardware device is present with a person or patient **456** for capturing the measured data or sensor data, and has a unique identifier via its MAC address. The measured data or sensor data is also referred to as raw data. The module **451** is connected with the cloud **452** where the sensor data is linked with a person or patient **456** in an anonymous way, i.e. the sensor data is now corresponding with a unique anonymous person/patient number. Within the cloud **452**, the received sensor data or raw data can be processed such that e.g. based thereupon useful or required information can be computed or calculated. Referring to the application within a nursing home **455** for instance, a linking dock **454** is provided locally in the nursing home **455**, and acting as network access point and server. According to an embodiment the network is a wireless network, e.g. a local wireless network such as WLAN using WiFi and/or Bluetooth for the wireless connection. Regarding the use of a unique identifier, an SSID is then for instance used over the WLAN and is given by the linking dock **454**. The module **451** is linked with the linking dock **454** wherever the module **451** needs to be installed. Moreover, the linking dock **454** provides in initialization of the module **451**, and then links the module **451** with the unique anonymous person/patient number, stores this number and relates this number (through a database) with real person/patient identification such as a person's name for example. A client application **453** is further part of the network, and directly linked with the linking dock **454**, hence nursing home **455**. Via the client application **453**, the linking dock **454** or nursing home **455** is able to indicate which module **451** is linked with a particular person or patient **456**, whereas the real person/patient identification is stored in a database that is linked with the linking dock **454**. Real patient information can be displayed by the client application **453** such as for example a tablet. Such information includes for instance not only a real person's identification, but also processed data or computed information from the cloud **452**.

[0125] Hence, the invention not only covers a system for reading or monitoring but also for processing and managing data from clients or end-users **455**. The measured data is captured by means of an electronic device or hardware module **451** which transfer this raw data to the cloud **452** by means of a wireless data transfer, e.g. WiFi because of its common use and overall presence, so no or limited additional costs for the end-user or applicant **455**, for example a nursing home, need to be involved regarding the data transfer technology. According to an embodiment of the invention, the data is pre-processed in the capturing device **451**, whereas the heavy signal processing and computing takes place in the cloud **452**. How the data captured and pre-processed by the hardware electronics on or within the diaper, is made available for further processing and can be linked to a particular person or patient **456**, is now described.

[0126] In an embodiment of the invention, if an intelligent diaper system is introduced in an elderly care home or another (similar) environment, it is appropriate or even necessary to give the electronic modules **451**, i.e. hardware devices capturing data from the sensors, the particular and/or characterizing information regarding the network used at that certain location, such as e.g. SSID's, passwords, certificates, etc. This can be done for example by means of the so-called linking dock **454**, being or acting as a small server with WiFi interconnection possibilities. If the modules **451** are powered for the first time they will look for an access point they know to receive the information of the network they need and will work in. The network is introduced by the linking dock server **454**, which has a predefined SSID and password. The modules **451** make an interconnection with the linking dock **454** also acting as a WiFi-access point. This access point receives the unique information of the module **451**, e.g. its MAC address, and will inform the cloud server **452** that the module **451** is present in a certain elderly care home. In other words, from this moment on, the module **451** is linked to an elderly care home. This unique identification of the module **451** is stored in a database on the linking dock server **454**. Also on this server **454** is a list of persons or patients **456** and information about the identification of this person or patient **456**, e.g. floor or room where he/she is residing. During the initialisation it is possible to link persons or patients **456** with modules **451**. After this process, the cloud **452** generates a unique identification number for a person or patient **456**, which is forwarded to the linking dock **454**. This number can be anonymous for privacy reasons. The linking dock **454** has the patient identification and the unique identifier. Now also the person or patient **456** is linked to the module **451**, and hence the possibly anonymous data from the cloud **452** gets a name or real person/patient identification.

[0127] Further, according to an embodiment of the invention, the modules **451** are distributed and delivered to the corresponding persons or patients **456**. Every module **451** has a visual identification number, e.g. between 1 and 999. The care givers of the nursing home **455** can create a list of this numbers and corresponding person or patient identifications, in order to distribute, or redistribute in a later stage, the correct modules **451** to the persons or patients **456**. In a later phase for instance, if a module **451** has to be returned for cleaning or repair or general service maintenance, the care givers, can use the number on the module **451**, to change it with another module **451**. At this point, the client application **453** or GUI from the care givers gives a signal to the linking dock server **454** to update its information. In parallel, the GUI also informs the cloud server **452**, because their unique identifier also has to be linked to another module **451** delivering data about this particular person or patient **456**.

[0128] Once the modules **451** are linked to persons or patients **456**, they can transfer the raw data. This data is communicated to the cloud server **452**, which recognises the identifier of the module **451** and links this data to a unique anonymous identifier of the person or patient **456**. The cloud server **452** processes, computes or calculates useful information from this raw data and makes such information accessible in graphical representation for different end-users or care givers using a GUI or client application **453**.

[0129] The end-users such as for instance care givers or other nursing home personnel, want to retrieve or consult data. For this reason, they connect with the cloud **452** and extract e.g. the needed information for their typical department. The data from the cloud is still anonymous and the unique anonymous identifiers have to be replaced with real names and information. The client application **453** or GUI accesses the linking dock server **454** such that the useful information or other cloud data is linked to a real name of a person or patient **456**.

[0130] In summary, the module **451** thus delivers raw data linked to a unique identifier, such as e.g. a MAC address. The cloud server **452** processes such data and links such unique identifier to a unique person or patient number. The processed data can now be accessed by a client application. The client application replaces the unique person or patient number with a real person or patient identification, including for example information regarding room number, age, and name.

[0131] Battery Management

[0132] In an embodiment of the invention, the electronic hardware module **451** comprises a small battery. As mentioned above, this module **451** is responsible for delivering the raw data, and thus comprises the measuring electronics being connected to the sensing elements as integrated with the absorbent article. Both battery and measuring electronics are incorporated within the module **451**, but in contrast to examples from the art, the battery and the measuring electronics can be disconnected from each other and from the module **451**. Whenever the battery has to be replaced because it has a remaining charging capacity of only about 10% left, the battery is simply removed from the module **451** and another (e.g. full capacity) one is connected, while the measuring electronics can continue performance under power due to an existing mini charger provided and connected herewith. Time and money is saved whereas the entire module **451** doesn't have to be returned when only the low or flat battery has to be replaced.

1.-**15**. (canceled)

16. A system for monitoring the saturation level of an absorbent article, wherein the system comprises: a moisture monitoring subsystem and a position determining subsystem.

17. The system according to claim **16**, wherein the saturation level is determined respectively for a plurality of local areas of the absorbent article.

18. The system according to claim **16**, wherein the moisture monitoring subsystem comprises a sensor system comprising a conductive circuit with impedance values representing an adjusted impedance design, defined by a distribution in the variation of the impedance values.

19. The system according to claim **18**, wherein the distribution is a mathematical distribution.

20. The system according to claim **19**, wherein the mathematical distribution is a linear distribution, a quadratic distribution, or a logarithmic distribution.

21. The system according to claim **18**, wherein the impedance values are the highest in or near a first zone of the absorbent article, wherein the moisture impact is expected to be the largest, and lower near or at a second zone of the absorbent article, wherein the moisture impact is expected to be the smallest.

22. The system according to claim **18**, wherein the conductive circuit is applied over substantially the entire surface of the absorbent article.

23. The system according to claim **18**, wherein the conductive circuit comprises electrodes and/or comprises a printed layer of conductive material provided with non-conductive spaces.

24. The system according to claim **23**, wherein the electrodes comprise a pair of electrodes.

25. The system according to claim **18**, wherein:

the moisture monitoring subsystem comprises a sensor system comprising a conductive circuit with impedance values representing an adjusted impedance design, defined by a distribution in the variation of the impedance values, and

the conductive circuit comprises a pair of electrodes and/or comprises a printed layer of conductive material provided with non-conductive spaces, and

part of the non-conductive spaces are related to the distribution, and

other part of the non-conductive spaces are provided for optimizing usage of conductive ink.

26. The system according to claim **16**, comprising a plurality of sensor tracks comprising moisture sensing tracks in the form of a repeating grid and/or pattern along the length (L) of the system and a dimension substantially perpendicular thereto, the grid and/or pattern comprising a plurality of at least partially interconnected resistive members each having a shape selected from the group consisting of straight lines, curved lines, wave-like, geometric, decorative elements, and combinations thereof.

27. The system according to claim **26**, wherein:

the geometric shape is selected from the group consisting of squares, parallelograms, triangles, circles, ellipses, dots, and combinations thereof, and

the decorative elements shape is selected from the group consisting of flowers, butterflies, and combinations thereof.

28. The system according to claim **16**, wherein the moisture monitoring subsystem is based on a differential measurement approach.

29. The system according to claim **28**, wherein the differential measurement approach comprises a differential voltage measurement approach.

30. The system according to claim **16**, wherein the moisture monitoring subsystem generates moisture-linked data of the absorbent article.

31. The system according to claim **16**, wherein the position determining subsystem generates positional data and/or comprises an accelerometer or gyroscope.

32. The system according to claim **31**, wherein:

the moisture-linked data and the positional data are combined for indicating the saturation level of the absorbent article.

33. The system according to claim **32**, wherein the saturation level is determined respectively for a plurality of local areas of the absorbent article.

34. The system according to claim **16**, further comprising a leakage detection subsystem determining when leakage occurs.

35. The system according to claim **34**, wherein the leakage detection subsystem comprises a sensor system comprising a conductive circuit with temperature dependent properties, wherein the conductive circuit is insulated from moist and/or comprises temperature sensing zones applied in inherent dry areas of the absorbent article and/or is a printed layer of conductive material.

* * * * *

专利名称(译)	启用传感器的吸收性物品，避免泄漏		
公开(公告)号	[US20200196933A1](US20200196933A1)	公开(公告)日	2020-06-25
申请号	US16/622338	申请日	2018-06-15
[标]申请(专利权)人(译)	范keymeulen比约恩		
申请(专利权)人(译)	VAN KEYMEULEN比约恩		
当前申请(专利权)人(译)	VAN KEYMEULEN比约恩		
[标]发明人	VAN KEYMEULEN BJORN HELLMOLD JENS		
发明人	VAN KEYMEULEN, BJORN HELLMOLD, JENS		
IPC分类号	A61B5/20 A61B5/00		
CPC分类号	A61B5/6808 A61B2562/029 A61B5/002 A61B5/6892 A61B5/207 A61B2562/164 A61B2562/043 A61B5/6804 A61F13/15699 A61F13/42 A61F2013/424 G01N27/126 G01N33/00 G01N33/483 A61B5/0002 A61B5/202 A61F2013/429		
优先权	2017176324 2017-06-16 EP		
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摘要(译)

本发明涉及一种吸收性物品系统，其提供了具有大的动态测量范围的体积监测以及以高的定位精度来确定身体位置，从而避免了泄漏。 此外，该系统涉及以自动方式识别吸收性物品的类型。