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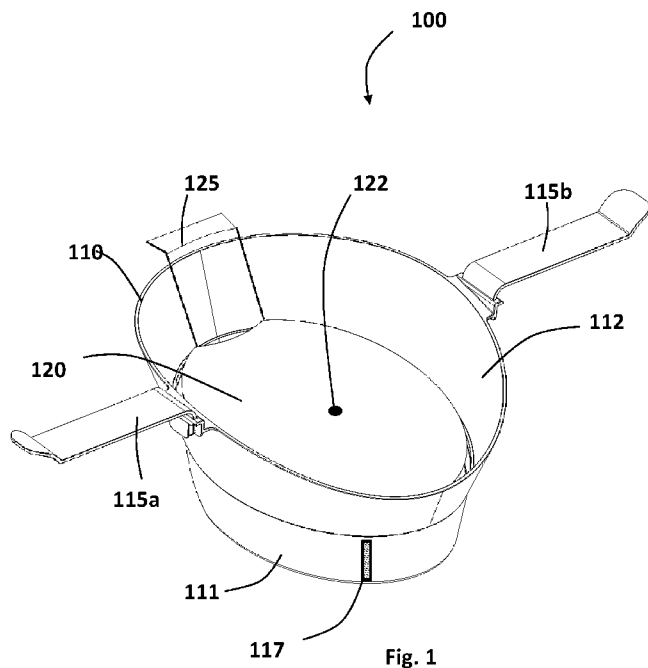
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(54) Title: APPARATUS, SYSTEM AND METHOD FOR MEASURING URINE FLOW AND/OR QUANTITY



(57) Abstract: An apparatus for measuring at least one measure related to urination of an individual such as urine flow rate and/or urine quantity. The apparatus is configured to produce acoustic and/or electromagnetic signals indicative of the at least one urination measure upon having urine applied there-over. The invention also provides systems and methods that detect the acoustic and/or electromagnetic signals originating from the apparatus being used by the individual and analyze the detected signals to calculate the at least one measure therefrom by using a designated application module operable via an end device using acoustic sensing means or data receiving means of the end device for detecting the acoustic and/or electromagnetic signals.

APPARATUS, SYSTEM AND METHOD FOR MEASURING URINE FLOW AND/OR QUANTITY

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims priority from US provisional patent application No.
5 61/991,695 filed on May 12, 2014, which is incorporated herein by reference in its
entirety.

FIELD OF THE INVENTION

[0002] The present invention generally relates to apparatuses, systems and for
monitoring voiding of an individual and more particularly to apparatuses, systems and
10 methods for measuring urine volume or other quantitative measures and/or urine flow.

BACKGROUND OF THE INVENTION

[0003] Patent publication no, US3363619 A describes the production of an ink
audiogram by means of recording the sound made by voiding urine. In the voiding
audiograms, the energy is represented as sound intensity or decibels which are plotted
15 along the Y axis herein and the time of voiding is plotted along the X axis.

[0004] Patent publication no. WO2009143113 teaches systems and methods for
assessing lower urinary tract function from urinary flow data via sound analysis and
user-provided information regarding the lower urinary tract symptoms (LUTS) of
frequency, urgency and urge incontinence. Embodiments of the LUTS assessment
20 systems include a computer and a telephone or a digital recording mechanism to
capture the sound of one or more urination events, which are stored as audio files in a
database. The LUTS assessment systems may include sound analysis software for
analyzing the strength and duration of each urination event and may include a web-
based software application for viewing the results via the Internet or other network.

25 [0005] US Patent no. 7811237 teaches systems for and methods of assessing
urinary flow rate via sound analysis. Embodiments of the uroflow measurement
systems include a computer and a telephone or a digital recording mechanism to
capture the sound of one or more urination events, which are stored as audio files in a
database. The uroflow measurement systems may include sound analysis software for
30 analyzing the strength and duration of each urination event and may include a web-
based uroflow software application for viewing the results via the Internet or other

network In one embodiment, the sound analysis software performs the steps of reading in the raw data of a selected audio file, generating a plot of the audio signal amplitude vs. time, generating a plot of smoothed data for the purpose of presenting an outline of the flow, generating a main flow plot, which is a plot of the largest continuous flow that has a strength that is greater than a predetermined minimum, and generating a set of numerical values that correspond to the strength and duration of urination.

[0006] US patent no. 8567258 teaches systems and methods that use the unique characteristic of sounds produced as urine is applied over the surface of the water to monitor men's urinary flow patterns and their dynamics. By detecting the intensity at selected acoustic frequencies, it is possible to accurately and precisely measure the urine flow rate. Techniques for analyzing urine flow and its dynamics employ sound levels that are detected with digital filters at two or more distinct frequency regions or channels of the sound spectrum. One frequency region that is designated the measurement channel is where the sound measurement intensity strongly depends on urine flow levels. Another frequency region that is designated the reference channel is where the sound measurement intensity is not dependent on urine flow levels. By using a combination of measurements from the measurement channel and the reference channel, the urine flow monitoring apparatus compensates for variations in operating conditions and other factors.

[0007] US patent no. 5078012 teaches a method and apparatus for measuring uroflow parameters by flow impulse momentum, providing measurement and print out in real time of such parameters as the flow rate curve and of maximum flow rate, average flow rate, voided volume, voiding time, flow time, and time to maximum flow rate, necessary for medical diagnosis.

[0008] US patent no. 5807278 teaches a noninvasive bladder pressure and urinary flow measurement apparatus and method, the apparatus including a pressure cuff configured to be removably mounted to the penis of the patient and an inflation system for selectively inflating and deflating the pressure cuff.

[0009] US application publication no. US20120123233 A1 describes a handheld USB Cup for use in collection of a fluidic body sample, comprising a receptacle comprising side surfaces, a bottom plate and a sensor assembly, the sensor assembly comprising at least one sensor and a slave circuitry; said sensor assembly is permanently affixed to said side surfaces or said bottom plate. The receptacle is

capable of maintaining the fluidic body sample for a sufficient time period in the vicinity of the sensor thereby the sensor is operative to provide continuous measurement of an electric, chemical or physical property of the urine.

5 SUMMARY OF THE INVENTION

[0010] The present invention provides an apparatus for measuring at least one measure related to urination of an individual being configured to produce acoustic and/or electromagnetic signals indicative of at least one urination measure upon having urine applied thereover.

10 [0011] According to some embodiments of the apparatus, the apparatus comprises an acoustic plate configured for vibrating in response to the urine flowing thereover. The acoustic plate optionally comprises an acoustic membrane.

[0012] The acoustic plate may be held in the apparatus in a tilted manner in respect to the direction of gravity to also direct the urine to flow therefrom.

15 [0013] According to some embodiments of the apparatus, the apparatus further comprises a collecting container configured for hanging over the toilet bowl or seat, for collecting urine for quantitative measuring thereof and/or for improving acoustics of the acoustic plate. The container optionally comprises an indicator for indicating a measure related to the volume of the urine therein.

20 [0014] According to some embodiments of the apparatus, the apparatus comprises at least one holder for hanging over a toilet bowl or toilet seat.

[0015] According to some embodiments of the apparatus, the apparatus comprises: a body configured for hanging over a toilet seat or bowl; a mechanical sensing device for mechanically measuring urine flow and/or urine quantity, the body being

25 configured to direct urine therefrom into the mechanical sensing device; and at least one means for producing acoustic signals indicative of the measured flow or quantity during a urination session. In these embodiments, the apparatus is configured as such to mechanically produce an electromagnetic signal indicative of a known quantity of urine whenever such quantity is measured thereby. For example, the mechanical

30 sensing device comprises a paddlewheel sensor, configured for producing an electromagnetic signal upon full or partial rotation of a wheel thereof caused by urine flow thereover, said signal being indicative of a known urine volume rate.

[0016] According to some embodiments of the apparatus, the body of the apparatus further comprises and holds thereby an acoustic plate for improving urine flow sound, said plate also being configured to direct urine into said mechanical sensing device.

[0017] According to other embodiments of the apparatus, the apparatus comprises a transducer sensor and plate attached thereto configured for sensing urination related vibrations and transforming these vibrations into electronic signals. The apparatus according to these embodiments further comprises communication means for transmitting the signals outputted by said transducer sensor to a remote end device for processing thereof for measuring urine flow rate and/or urine quantity therefrom.

[0018] The present invention further provides a system for measuring at least one measure related to urination of an individual comprising: an apparatus configured to produce acoustic signals indicative of said at least one urination measure upon having urine applied thereover; and an application module operable via an end device, the application module being configured to detect acoustic signals originating from said apparatus and calculate the at least one measure related to urine flow and/or urine quantity therefrom, wherein the application is adapted to use acoustic sensing means and processing means of the end device via which it operates.

[0019] According to some embodiments of the system, the application module is further configured to record the acoustic signals for offline processing thereof.

[0020] According to some embodiments of the system, the application module is configured to calculate at least one of the following measures: urination flow rate, urination flow rate behavior, urination volume, depending on the type and configuration of the apparatus being used.

[0021] According to some embodiments of the system, the application module is configured for adapting its calculations and measures to the type of apparatus being used by having a user interface allowing individuals to select the apparatus type at use.

[0022] According to some embodiments of the system, the types of apparatuses comprise: acoustic plate apparatus comprising an acoustic plate configured for improving acoustics of urine flow for urine flow rate and flow rate behavior measuring; acoustic plate combined with a collection container for both flow rate and volume measuring; a volume measuring apparatus comprising a directing bowl shaped body and a mechanical sensing device configured for direct urine quantity measuring, which produces an indication electric signal upon sensing a known quantity of urine for the

application to detect thereof; a combined apparatus comprising the volume measuring apparatus and the acoustic plate placed thereover for flow and volume measuring.

[0023] According to some embodiments of the system, the mechanical sensing device comprises a paddlewheel sensing device having a wheel of blades rotatable about an axis upon application of urine thereof and one or more magnets rotatable by the wheel for producing electromagnetic signals (through the Hall effect), the signals being indicative of a known urine volume rate, wherein the bowl shaped body being configured to direct the urine to flow into said wheel.

[0024] According to some embodiments of the system, the application module is further configured to indicate the measured or calculated parameters using display means of the end device.

[0025] According to some embodiments of the system, the application module is further configured to transmit the measured or calculated data to a remote end device.

[0026] According to some embodiments of the system, the application module is further configured to record the measuring of multiple urination sessions of each individual via a designated voiding diary for monitoring urination behavior of the individual over time. For example, the application module analyzes the recorded diary data over time for identifying urination related conditions of the individual and alerts the individual and/or other individuals or entities regarding urination related alerting conditions identified by the application module.

[0027] The present invention further provides a method for measuring at least one measure related to urination of an individual comprising: detecting acoustic signals indicative of urine applied over an apparatus configured for producing the acoustic signals indicative of the at least one urination measure upon having urine applied thereover, using for the detection a designated application module operated via an end device used by the urinating individual to detect the signals through the end device's acoustic sensing means; analyzing the acoustic signals using said application module to calculate said at least one measure from the detected acoustic signals; outputting and/or storing data indicative of the calculated at least one measure.

[0028] According to some embodiments of the method, the method further comprises recording said detected acoustic signals for offline analysis thereof.

[0029] According to some embodiments of the method, the analysis is adaptable by the application module to the type of apparatus being used.

[0030] According to some embodiments of the method, the at least one measure comprises at least one of: urine flow rate, urine flow rate behavior, urine quantity.

[0031] According to some embodiments of the method, the apparatus is configured for at least one of: measuring urine flow rate by improving acoustics of urine applied thereover; directly measuring urine volume.

[0032] According to some embodiments of the method, for flow rate measuring the analysis process comprises: spectral envelope filtering of the detected acoustic signal resulting in a time-domain signal; decimation and low-pass filtering of the time domain signal; Log based scaling of the envelope; additional low-pass filtering; and de-convolution.

[0033] According to some embodiments of the method, the method further comprises recording measured parameters during multiple urination sessions of each individual via a designated voiding diary for monitoring urination behavior of the individual over time. The method may also include analyzing the recorded diary data over time for identifying urinary related conditions of the individual and alerting the individual and/or other individuals or entities regarding urinary conditions identified by the application module.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] **Fig. 1** shows a perspective upper view of an apparatus for collecting urine and for improving acoustics of urine flow sound for urine flow and optionally also urine volume measuring, according to some embodiments of the present invention.

[0035] **Fig. 2** shows a perspective upper view of an acoustic plate of the apparatus, according to some embodiments of the present invention.

[0036] **Fig. 3** shows a perspective upper view of a container of the, according to some embodiments of the present invention.

[0037] **Figures 4A** and **4B** show the apparatus placed over a toilet bowl: **Fig. 4A** shows the apparatus over the toilet bowl in a position that is suitable for urination for male subjects; and **Fig. 4B** shows the apparatus over the toilet bowl with the toilet seat covering thereof, in a position that is suitable for female subjects.

[0038] **Figures 5A** and **5B** show the apparatus placed over a toilet bowl in a position that is suitable for male subjects: **Fig. 5A** shows an upper view of the

apparatus and toilet; and **Fig. 5B** shows transparent side view of the apparatus and toilet.

[0039] **Figures 6A and 6B** show the apparatus placed over a toilet bowl in a position that is suitable for female subjects: **Fig. 6A** shows an upper view of the apparatus and toilet; and **Fig. 6B** shows transparent side view of the apparatus and toilet.

[0040] **Fig. 7** schematically shows a system for measuring urine flow rate using an application operable via a mobile device, according to some embodiments of the invention.

[0041] **Fig. 8** is a flowchart schematically showing a process of measuring urine flow rate using the application operable via the mobile device, according to some embodiments of the invention.

[0042] **Fig. 9** shows an interface screen with a "Go" button allowing initiating the recording of urination sound as one of the screens of the application.

[0043] **Fig. 10** shows a screen presenting an output Uroflow diary showing a histogram of flow rate vs. time.

[0044] **Fig. 11** shows Uroflow output table indicative of follow up on volume of urine samples for different measurement sessions.

[0045] **Figures 12A and 12B** show flowcharts of processes for processing the recorded urination sound signals (sound data), according to one embodiment of the invention: **Fig. 12A** shows the entire processing flow; and **Fig. 12B** shows a de-convolution process for non-linear compensation.

[0046] **Figure 13** shows an exploded view of an apparatus for collecting urine and for improving acoustics of urination sound for urine flow and volume measuring, according to other embodiments of the invention.

[0047] **Fig. 14** shows a transparent side view of the apparatus of **Fig. 13**, according to the other embodiments of the invention.

[0048] **Fig. 15** shows a side view of an apparatus for measuring urine volume using a paddlewheel sensing device, according to other embodiments of the invention, having a mechanical fluid volume sensor.

[0049] **Figures 16A and 16B** show an apparatus for measuring urine volume using a paddlewheel sensing device, according to other embodiments of the invention: **Fig. 16A** shows an elevated perspective view of the apparatus; and **Fig. 16B** shows a side

view of the apparatus , **Fig. 17** shows the paddlewheel sensing device of the embodiments portrayed in **Figures 16A-16B**.

[0050] **Fig. 18** shows the apparatus of **Figures 16A-16B** placed over a toilet bowl in an elevated perspective view.

5 [0051] **Fig. 19** shows a combined apparatus for measuring urine flow and volume, according to some embodiments of the invention, comprising both the apparatus portrayed in **Figures 16A** and **16B** which includes the paddlewheel sensing device for direct urine volume measuring and the acoustic plate as portrayed in **Fig. 13** for improving urination acoustics.

10 DETAILED DESCRIPTION OF SOME EMBODIMENTS OF THE INVENTION

[0052] In the following detailed description of various embodiments, reference is made to the accompanying drawings that form a part thereof, and in which are shown by way of illustration specific embodiments in which the invention may be practiced. It is understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

15 [0053] The present invention provides apparatuses, systems and methods for measuring urine flow rate or quantity (e.g. volume and/or weight) using sound detection. According to some embodiments, the apparatus is configured for directing urine as well as for improving sound detection of the urine as it flows and/or for direct measuring of urine quantity.

20 [0054] The system of the present invention includes one or more apparatuses designed to be placed over the toilet seat or bowl and configured to improve acoustics of the urination when directed towards the toilet bowl or a collecting bowl (container) and/or to directly measure the urine volume or any other quantity related measure; and
25 a software module operable via users end devices designed to use at least acoustic sensing means (e.g. microphone) of the end device for receiving signals indicative of the urination flow and/or quantity in each urination session. The application is programmed to process data/signals received from the device's acoustic sensing means and to calculate therefrom one or more urination related parameters such as volume
30 and/or flow rate during the urination session timeframe and/or flow rate changes during the urination session timeframe. The processing of course depends on the apparatus being used.

[0055] In some embodiments, the apparatus comprises an acoustic plate simply placed over the toilet bowl or seat that vibrates in response to appliance of urine thereover. This acoustic plate is designed to improve sound of the urine flow for improved measuring of the urine flow. The improvement may be manifested in simple amplitude amplification and/or by improving signal-to-noise detection and/or improving spectral separation.

[0056] According to some embodiments, the designated software application is configured for continuously recording the urine flow sound during urination and analyzing sound data indicative thereof for calculating the urine flow rate, changes in urine flow rate and/or urine volume.

[0057] According to some embodiments, the apparatus includes a container designed to collect the urine therein and the above discussed acoustic plate, which may be an acoustic membrane, placed over the upper opening of the collection container such that a space is formed between the surface of the acoustic plate and the bottom of the container. The acoustic plate may be configured for directing the urine liquid into the container and for improving acoustics of the urine flow sound when impacting the surface of the plate. According to some embodiments, the apparatus is further configured for hanging over the toilet seat or toilet bowl edge.

[0058] According to some embodiments, the plate is held over the container such that it is tilted in respect to the floor surface perpendicular to gravitational force, when the apparatus is placed over the toilet bowl or seat for directing the urine into the container. In this configuration the surface of the plate is maintained substantially empty of liquid during the urination (depending on flow rate) for optimizing the sound quality at the moment of impact of the urine against the plate during urination.

[0059] In some embodiments, the container is also configured for measuring the overall volume of the urine collected thereby. The measuring can be done manually by the individual, e.g. in cases in which the container includes a measuring scale therein allowing the individual to read the urine volume from or automatically by using any known in the art sensor or technique to measure fluid volume such as weight sensors that allow deducing the urine volume from the urine weight e.g. transducer sensors for weight or pressure measuring, mechanical volume sensors such as turbine or paddle wheel meters and the like.

[0060] The application of the system of the present invention, in some embodiments thereof, is designed to be operated through a mobile device such as smartphone, tablet device, laptop and the like. The sound of urine impacting the plate of the apparatus is recorded by using an audio sensor of the mobile device such as a microphone.

[0061] In some embodiments, the sound of urine impacting the plate of the apparatus is detected by using an audio sensor such as a separate microphone or other transducer, such as piezoelectric embedded in the apparatus. The detected audio signals can be transmitted to the mobile device wirelessly or via a wire connection e.g. by connecting the apparatus to the headphone jack of the mobile device via a cable.

[0062] According to some embodiments, the recorded audio signals are then provided as an input for an analysis algorithm of the application configured to analyze the recorded signals of the urine by using a process enabling identification of periodicities of the urine flow. The output of this process is the flow rate of the urine over time during the urination session e.g. in volume units per time units (for example ml/sec).

[0063] According to other embodiments, the apparatus includes a sensor for directly sensing urine quantity such as a paddlewheel sensing device which senses urine volume and may include a wheel having multiple paddles (wings) rotatable by the flow of the urine directed therethrough. The sensor also includes means for producing indication sound upon each one or more turning of its wheel to allow the application to measure the volume of the urine by simply identifying each indication sound during the urination session and counting the number of indications produced therethrough, each wheel spin being indicative of the volume of urine passing therethrough.

[0064] According to some embodiments of the invention, there is provided a method for measuring urine flow and/or urine quantity of an individual within a urination session by receiving a urination related sound data which is either recorded or arriving in real time from the end device's acoustic sensing means, while the individual urinates over the acoustic plate of the measuring apparatus; optionally also receiving the volume of the overall urine quantity; and processing the received data to output data indicative of the urine flow rate. In some embodiments, the analysis is done using spectral envelope filtering of the sound signal data, decimation and low-pass filtering,

log-base scaling of the signal envelope for first order correction, optionally additional low-pass filtering and special non-linear compensation such as de-convolution.

[0065] Reference is now made to **Figures 1, 2, 3, 4A, 4B, 5A, 5B, 6A and 6B**, schematically illustrating an apparatus **100** for improving acoustics for measuring quantitative urine flow rate for human male and female individuals, according to some embodiments of the invention. The apparatus **100** includes a container **110** and an acoustic plate **120**. According to some embodiments, the container **110** is configured for containing liquid therein having a containing part **111** with a funnel shaped open part **112** that widens upwardly, as shown in **Figures 1 and 3** and two hangers **115a** and **115b** for hanging the container **110** over the toilet bowl or toilet seat as shown in **Figures 4A-6B**. The hangers **115a** and **115b** can also be used for removing the container **110** from the toilet bowl **200** when urination is completed preventing contact of the individual with the container **110** for hygienic purposes.

[0066] Optionally, the container **110** also includes an indicator **117** with a scale ruler which allows an individual to view or measure the volume of urine collected inside the lower part **111** of the container **110** by, for instance being transparent allowing viewing the level of urine thereover, wherein the scaled ruler allows reading the volume associated with the level of the urine liquid.

[0067] According to some embodiments, as shown in **Figures 1, 2 and 4A-6B**, the acoustic plate **120** may be an acoustic membrane e.g. made of aluminum foil and may integrally connect to a holder **125** for hanging thereof over the toilet bowl such as shown in **Figures 4A and 6B**. The holder **125** also serves for removing the plate **120** from the container **110** when urination is completed preventing contact of the individual with the plate **120** for hygienic purposes.

[0068] According to some embodiments, as shown in **Figures 1, 2 and 4A, 5A and 6A**, the acoustic plate **120** has a marking **122** indicating the center thereof or the best position thereover to point the urine flow towards for assisting the individual (especially male individuals) in directing the urine flow for optimizing acoustic measurements of the sound the urine flow will produce.

[0069] According to some embodiments, as shown in **Fig. 2**, the acoustic plate **120** has a truncated portion **124** configured for allowing the urine falling over the plate **120** to be collected in the container **110** there-below. The plate **120** may also be tilted forming a slope between the plate **120** and the bottom of the container **110** (where the

bottom of the container **110** is substantially perpendicular to the direction of gravitation when the apparatus is placed over the toilet bowl). The slope allows directing the urine fluid from the plate **120** into the container **110** through the opening formed by the truncated part **124** of the plate **120** to optimize acoustics quality for sound measuring of the urine flow by preventing urine from accumulating over the plate **120** during urination. In this way the urine impacting the plate **120** will produce the clearest sound through the acoustic plate's membrane without or with minimum splashing of urine during urination thereover.

[0070] According to some embodiments, the apparatus **100** is designed such that it requires different positioning thereof over the toilet bowl **200** for male and female for maximum comfort and minimum splashing of the urine during each urination session.

[0071] **Figures 4A and 5A-5B** show how the apparatus **100** should be placed over the toilet bowl edge **200** for male individuals: the apparatus **100** is located at the back side of the toilet bowl **200**, where the hangers **115a** and **115b** are hung over the bowl edge and hold the container in the bowl **200**, wherein the holder **125** also hangs over the back side of the toilet bowl edge **200**.

[0072] **Figures 4B and 6A-6B** show how the apparatus **100** should be placed over the toilet bowl edge **200** for female individuals: the apparatus **100** is located at a frontal end of the toilet bowl **200** hanging thereover via the hangers **115a** and **115b**, where the toilet seat **201** can be placed over the hangers **115a** and **115b**.

[0073]

[0074] **Figures 5B and 6B** show how the acoustic plate **120** is tilted in respect to the bottom surface of the container **100**, wherein the bottom surface of the container **110** is parallel to axis "x" perpendicular to axis "z", which indicates the gravitational direction. When the apparatus **100** is positioned over the toilet bowl **200** for male individuals, as indicated in **Fig. 5B**, a non-zero angle " α_1 " is formed between axis "z" and the sloped plate **120** wherein the plate **120** is tilted by the holder **125** thereof such that its higher end is closer to the back of the toilet bowl **200**. When the apparatus **100** is positioned over the toilet bowl **200** for female individuals, as indicated in **Fig. 6B**, a non-zero angle " α_2 " is formed between axis "z" and the sloped plate **120** wherein the plate **120** is tilted by the holder **125** thereof such that its higher end is closer to the front of the toilet bowl **200**.

[0075] Reference is now made to **Fig. 7**, showing a system **900** for measuring urine flow of a individual, according to some embodiments of the invention. The system **900** includes an apparatus such as apparatus **100** and a designated software application **810** operable through the individual's mobile device **800** that is configured for recording the sound of urine flow through a urination session of the individual, using sound detection means of the mobile device **800** such as a device's microphone **801** and analyzing the recorded sound data for calculating and outputting urine flow rate over time referred to as "Uroflow" of the specific urination session. The Uroflow can be used for analyzing the urinary condition of the individual and can be indicative of various potential related diagnoses such as male benign prostatic hypertrophy (BPH); urethral stricture disease; female incontinence; voiding dysfunction; neurogenic bladder; non-neurogenic bladder; pediatric voiding dysfunction; and pre or post bladder, prosthetic or urethral surgery condition. The individual can use the application **810** to record and analyze multiple urination sessions for follow up purposes, which may help in better diagnosing the individual's condition.

[0076] According to some embodiments, the application is configured for adapting its calculation and measures to the type of apparatus being used by having an interface allowing individuals to select the apparatus type at use. In this way the same application can be used for individuals that use various types of the apparatus producing acoustic signals that are indicative of various measures.

[0077] According to some embodiments, as shown in **Fig. 7**, the application **810** processes the recorded sound of urine flow through the mobile device processor **802** and also uses input and output means **803-804** of the mobile device **800** for allowing the individual to input data such as information indicative of the specific individual, date etc. and also optionally the volume of the collected urine in the container of the apparatus as measured by the individual. The output means **804** allows presenting the Uroflow and/or urine volume or other information such as potential health related condition of the individual associated with his/her Uroflow or graphs indicative of the Uroflow of the particular session and/or statistical data indicative of a number of Uroflow measures.

[0078] According to some embodiments, the application **810** is further configured for storing the Uroflow data at the mobile device data storage or transmitting the data to be stored e.g. for keeping a voiding diary of the individual and optionally also

further analyzed through a remote server, using communication means of the mobile device.

[0079] Transmitting the data to the patient EMR (Electronic Medical Record), Doctor email/fax/SMS.

5 [0080] The mobile device can be any device that is mobile and has a processor and recording means embedded therein such as a cellular phone, a Smartphone, a tablet device, a laptop device and the like. Alternatively the recording is done via a separate recorder and the data is transmitted to be analyzed by the mobile device.

[0081] The application can be installed in the mobile device and operate solely via
10 the mobile device or be a web application that at least partially uses the mobile device's processor for processing data.

[0082] According to some embodiments, the via a designated user interface and then simply press a virtual record button to start recording the urination session before beginning to urinate and press a virtual "end" button when urination is completed,
15 where the recorded data can then be analyzed. The application algorithms are designed to automatically identify the beginning of urination and ending thereof within the recorded session by analyzing frequencies and amplitudes of the recorded sound signal. The sound is improved due to the acoustic qualities of the apparatus and can still be further noise-reduced and cleared for the calculation of the flow rate over time.

20 [0083] The system 800 allows easy and private self-measuring of urine flow rate providing the individual with a user friendly apparatus and application that can help the individual at least in recording the urine flow sound and analyzing thereof for producing the Uroflow output. The outputted Uroflow of each session or of several urination sessions of the individual can then be professionally interpreted by one or
25 more professionals to assist in the diagnostic of the individual.

[0084] According to some embodiments, the application also receives and stores user input indicative of the volume of the collected urine read by the individual through the indicator over the apparatus or measured by the individual in any other way. Alternatively or additionally, the volume of urine is automatically calculated from the
30 urine volume measurement.

[0085] According to other embodiments, the urination sound and/or vibrations is/are sensed via a transducer sensor (e.g. piezoelectric transducer) located at the apparatus, where the apparatus further includes transmission means for transmitting

signals indicative of the recorded signals via a communication link to the mobile device for processing thereof. The communication link may be wireless or a communication cable transmitting electric or optical signals.

[0086] Reference is now made to **Fig. 8**, which is a flowchart schematically showing a process for measuring urine flow rate, according to some embodiments of the invention. A preliminary step of placing of the apparatus over the toilet bowl may be required before the measuring process begins. The individual uses the designated application through his/her mobile device to initiate a measurement session **11** e.g. by entering the application and pressing a "go" button. Once the measurement session is initiated, the application begins recording sound around the mobile device until the individual stops the recording **12**. Optionally, the volume of the collected urine is inputted by the individual and received and stored by the application **13**. The recorded sound data is then processed via the application to calculate the Uroflow by using, inter alia, a non-linear compensation process (de-convolution), which will be further explained below **14**. The Uroflow is then outputted **15** and/or stored **16**.

[0087] **Fig. 9** shows an example of a user interface screen allowing the individual to press a virtual "Go" button to begin the recording.

[0088] **Fig. 10** shows a screen presenting an output Uroflow diary showing a histogram of flow rate vs. time.

[0089] **Fig. 11** shows another Uroflow output table indicative of follow up on volume of urine samples for different measurement sessions.

[0090] Reference is now made to **Figures 12A** and **12B** showing flowcharts of processes for processing the recorded urination sound signals (sound data), according to one embodiment of the invention. In **Fig. 12A**, steps **21-37** show how the signal of the sound data is processed to determine end and beginning of actual urination and for noise reduction and signal spectral envelope filtering. Steps **36-41** show how the sound data outputted from the spectral enveloping process is further processed by using non-linear compensation (de-convolution). Steps **42-53** show how the Uroflow is finally calculated. **Fig. 12B** shows a flowchart of steps **61-70** for the non-linear compensation process.

[0091] According to this embodiment, the processing of the recorded sound data roughly includes:

[0092] 1. Spectral envelope filtering.

[0093] 2. Decimation and low-pass filtering of the time domain signal.

[0094] 3. Log based scaling of the envelope.

[0095] 4. Additional low-pass filtering.

[0096] 5. De-convolution to achieve an approximate linear relationship to the actual flow rate.

[0097] According to this embodiment, to achieve a quantitative measurement of the urine flow the total volume of the collected urine is required as an input. The objective is to achieve an output time profile proportional to an actual flow rate measurement reference permitting quantitative based flow rate estimates valid over 1 second intervals.

[0098] The defined “de-convolution” fifth stage incorporates two forms of de-convolution in addition to selective processing techniques. The approach is based on several hypotheses, namely:

[0099] 1. Log-based envelope processing of the audio is a first-order approximation to linear flow rate.

[00100] 2. Accuracy of the envelope processing is enhanced through the use of a combination of the time domain and spectral mean values. Spectral processing (quadrature correlation) has shown a natural ability to attenuate the impact of un-correlated and many artifact noise samples.

[00101] 3. One element of physical phenomena related excessive cumulative flow volume is measured and compensated. This method is a form of de-convolution followed by regeneration. The time domain flow rate from a mechanical flow reference produces a “Urofile” (Uroflow data file) result for analysis purposes. The profile of the Urofile is emulated in part through residual subtraction of “excess” flow volume. An improvement in the model predicts excess volume to occur at certain points of time based on the flow rate exceeding the saturation point to the exclusion of scalable flow rates versus time. During the urine collection and recording process the accuracy of the instantaneous value of the flow rate is highest when the localized volume on the plate is close to zero. The model assumes this doesn’t always happen (although the urine is directed by the plate slope into the container of the apparatus), causing a residual volume on the plate to be greater than zero when the input flow rate is sufficiently high. The threshold in the flow rate that is used to determine when it occurs is modeled as a high fraction, e.g., 0.9 times the maximum flow rate whereby the net accumulation

or residual exceeds zero. Similarly a depletion of the residual, if measurable, occurs when the flow rate is less than the threshold (or equilibrium point). Therefore a subtraction is implemented. This is a computation of fluid latency caused by the dispersed portions of the urine flow of high speed columniation and splashing of urine.

- 5 The model asserts that this latency is proportional to the rate of change of the flow magnitude which is the temporal gradient of the envelope magnitude. A small fraction of this magnitude change or gradient is subtracted from the normalized filtered magnitude.

[00102] 4. A second element of over-compensation has been implemented to
10 account for gravity induced delays in the flow rate. Height differences in columns and plate slope affect propagation time of water droplets. Given other effects including surface tension is hypothesized that the delay is proportional to the time gradient derived from the sound profile. This smearing of time or dispersion is compensated by a gradient subtraction technique.

15 [00103] 5. Recursive modification of the time-constant used during low-pass filtering is accentuated during the early sample values of this processing stage. Initially the time constant starts very high at 10 thousand and diminishes approximately to 20 within a small fraction of the analysis period. The original recursive coefficient used for filtering begins at 0.9995 but does not remain constant as in standard filters. it is
20 diminished over time using a second stage process. The time constant in general is approximately the $1/(1-RC)$. The reduction of RC is also handled iteratively using a factor of 0.9999 consequently the RC factor diminishes after each sample until it reaches a terminal limit. In other words, for example, $RC = 0.9999 * RC$ after each sample. Therefore the time constant gets smaller. When RC is high the filtering is high
25 and commensurately the time constant is high.

[00104] Any other methodology can be used for processing the recorded sound data for calculating the flow rate vs. time data of urination sessions and any other method for signal noise-reduction and compensation can be used to allow optimizing the accuracy of the flow rate calculation algorithm.

30 [00105] Reference is now made to **Figures 13** and **14** showing an apparatus **300** for collecting urine and for improving acoustics of urination sound, according to other embodiments of the invention. This apparatus **300** includes an acoustic plate **320** having an acoustic membrane such as an aluminum foil and a container **310**. The

acoustic plate **320** is placed over the container **310** such as to form a space between a bottom of the container **310** and the plate **320** surface to allow urine to accumulate under the plate **320**. The plate **320** is also tilted in respect to the bottom of the container such as to direct urine flow into the container **310** when the apparatus **300** is used and placed over the toilet bowl **400**. This configuration prevents urine from accumulating over the plate's surface during urination and therefor improves acoustics of the sound made by the urine flow thereover.

[00106] As illustrated in **Fig. 13**, the acoustic plate **320** also has a marking **322** for indicating the best position over the plate to which the individual is to direct his urine flow and a truncated portion **324** for forming an opening that will allow the urine to flow into the container **310**. The acoustic plate **320** also has handles **325a** and **325b** for placing the plate **320** over the container **310** and for maintaining the plate **320** over the container **310** such as to form the space between the tilted plate **320** and the bottom of the container **310**. The handles **325a** and **325b** also allow the individual to remove the plate **320** from the container **310** without touching the plate area. The container **310** includes hangers **315a** and **315b** for allowing the individual to hold the container **310** for placing it over the toilet bowl and removing it therefrom and also for hanging the apparatus **300** over the toilet bowl **400** edge as shown in **Fig. 14**.

[00107] According to some embodiments, as shown in **Fig. 14**, the bottom of the container **310** has a tilted part **317** with an indicator **318** ruler for allowing the individual to measure the volume of the accumulated urine in the container **310**.

[00108] The container may be made from any known in the art material such as plastic, formable plastic sheet, polystyrene, acrylic aluminum and the like.

[00109] Reference is now made to **Fig. 15**, which shows an apparatus **500** for measuring urine volume having a paddlewheel sensing device **501**, according to other embodiments of the invention. The apparatus **500** also includes a container device **510** and an acoustic plate **520** placed in the container such that it forms a slope to direct urine towards the bottom of the container **510**. In this particular design, the acoustic plate **520** directs the urine to another plate **511** of the container device **510** via opening **550** further directing the urine liquid to another edge thereof for directing the urine into the paddlewheel sensing device **501**.

[00110] The paddlewheel sensing device **501** allows automatic measuring of the volume of urine inside the container device **510** by having the directed urine liquid

rotate a turbine wheel **502** thereof. The wheel **502** either connects to a sound mechanism that produces a distinguishable indication sound after each individual paddle and/or full rotation of the wheel **502** or produces electromagnetic signals upon rotation using magnets for instance (designed as an Hall effect sensor). Each individual paddle and/or a full rotation of the wheel **502** is indicative of a known liquid volume portion. This distinguishable sound (e.g. caused by using a bell or a piece vibrated by the turning of the wheel **502**) is detectable and recognizable by the software application and can be recorded or simply detected in real time by the device's microphone along with urination sound. The application will automatically calculate the overall volume of the urine throughout the urination session by counting the number of times the distinguishable sound was produced by the paddlewheel sensing device **501**. The rate of the distinguishable sound (the number of times the wheel made a distinguishable sound per time unit) can also be used to calculate or improve calculations of the urine flow rate and/or changes thereof during that same urination session by the application.

[00111] Figures **16A**, **16B**, **17** and **18** show an apparatus **600** for measuring urine volume using a paddlewheel sensing device **630** or part thereof, according to other embodiments of the invention. The apparatus **600** in this case includes a bowl or funnel shaped body **610** having holders **611a-611c** configured for hanging the apparatus **600** over the toilet bowl or seat; a directing conduit **620** for directing the urine therethrough; and the paddlewheel mechanical volume sensing device **630**. The bowl shaped design of the body **610** and the conduit **620** extending from its bottom opening direct the urine through the entrance **635a** of the sensing device **630** for rotating the wheel **631** thereof over its axis "w". The sensing device **630** also includes sound producing means (not shown) which produce indication sound upon each full spin of the wheel **631** or partial spin thereof. As illustrated in **fig. 17**, the wheel **631** includes multiple blades for being rotated upon receiving urine liquid flow thereover. The sensing device **630** housing **632** is designed such that it includes an entrance **365a** tube like inlet and an exit **635b** tube like outlet. **Fig. 18** shows how the apparatus **600** can be placed over a toilet bowl **251**.

[00112] According to some embodiments of the invention, the paddlewheel sensing device **630** uses an Hall effect for generating a pulse upon predefined full or partial spin comprising magnets therein rotatable by the paddlewheel blades **631** such that when the blades of the wheel **631** spin they generate a magnetic force transformed into an electric signal (electric pulse) that may be used for generating current that can be

directed to the end device via a connecting cable **639** such as a headphone jack which can convert in turn the incoming electric signal into audio signal, or for producing RF (radio frequency) based signals (indicative of the volume portion sensed thereby) transmittable to the user's end device for reading thereof. Alternatively, the current
5 produced is used for operating a circuitry that can switch on a sound effect (not shown) for producing a distinguished sound recognizable by the application for acoustic identification of volume.

[00113] **Fig. 19** shows a combined apparatus **90** for measuring urine flow and volume placed over a toilet bowl **252**, according to some embodiments of the
10 invention. The combined apparatus **90** includes the apparatus **600** according to embodiment portrayed in **Figures 16A** and **16B** which includes the paddlewheel sensing device **630** for direct urine volume measuring and the acoustic plate **320** as portrayed in **Fig. 13** for improving urination acoustics.

[00114] The assembly **90** allows the application of the system, upon receiving
15 recorded or real time acoustic signals during an urination session of an individual, to measure both flow rate and/or flow rate behavior as well as to measure quantity of the urine. The overall acoustic signal detected by the acoustic sensing means of the end device is analyzed to distinguish sound indicative of the urine flow impacting the acoustic plate **320** from the sound produced by the paddlewheel sensing device **630** of
20 the apparatus **600** indicative of volume of urine and optionally also indicative of urine flow rate. The two distinctable acoustic signals when separated by the application can then be used for robust estimation of the urine flow rate, urine quantity and optionally also for estimating urine flow rate behavior (changes).

[00115] According to some embodiments of the invention, , the application may be
25 configured to produce a urine measurements (voiding) diary recording the measured parameters such as urine flow rate, flow rate changes and/or urine quantity for each session and identification data of the particular session such as the date and time and individual. This diary may be helpful in diagnosis of various medical conditions of the individual and will allow the individual to monitor urine related measures thereof
30 without having to go to the clinic for measuring or to report to the clinic. The data of the diary and updates thereof may be automatically transmitted to an end device of a clinic or a professional person for analysis of the recorded measures and/or be automatically analyzed by the same or another software module for diagnosing the

individual's condition or at least for identifying alarming measurement values for transmitting alerts to the individual and/or to a clinic center or professional person for further follow-up and treatment.

[00116] Many alterations and modifications may be made by those having ordinary skill in the art without departing from the spirit and scope of the invention. Therefore, it must be understood that the illustrated embodiment has been set forth only for the purposes of example and that it should not be taken as limiting the invention as defined by the following invention and its various embodiments and/or by the following claims. For example, notwithstanding the fact that the elements of a claim are set forth below in a certain combination, it must be expressly understood that the invention includes other combinations of fewer, more or different elements, which are disclosed in above even when not initially claimed in such combinations. A teaching that two elements are combined in a claimed combination is further to be understood as also allowing for a claimed combination in which the two elements are not combined with each other, but may be used alone or combined in other combinations. The excision of any disclosed element of the invention is explicitly contemplated as within the scope of the invention.

[00117] The words used in this specification to describe the invention and its various embodiments are to be understood not only in the sense of their commonly defined meanings, but to include by special definition in this specification structure, material or acts beyond the scope of the commonly defined meanings. Thus if an element can be understood in the context of this specification as including more than one meaning, then its use in a claim must be understood as being generic to all possible meanings supported by the specification and by the word itself.

[00118] The definitions of the words or elements of the following claims are, therefore, defined in this specification to include not only the combination of elements which are literally set forth, but all equivalent structure, material or acts for performing substantially the same function in substantially the same way to obtain substantially the same result. In this sense it is therefore contemplated that an equivalent substitution of two or more elements may be made for any one of the elements in the claims below or that a single element may be substituted for two or more elements in a claim. Although elements may be described above as acting in certain combinations and even initially claimed as such, it is to be expressly understood that one or more elements from a

claimed combination can in some cases be excised from the combination and that the claimed combination may be directed to a sub-combination or variation of a sub-combination.

[00119] Insubstantial changes from the claimed subject matter as viewed by a person with ordinary skill in the art, now known or later devised, are expressly contemplated as being equivalently within the scope of the claims. Therefore, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements.

[00120] The claims are thus to be understood to include what is specifically illustrated and described above, what is conceptually equivalent, what can be obviously substituted and also what essentially incorporates the essential idea of the invention.

[00121] Although the invention has been described in detail, nevertheless changes and modifications, which do not depart from the teachings of the present invention, will be evident to those skilled in the art. Such changes and modifications are deemed to come within the purview of the present invention and the appended claims.

CLAIMS

1. An apparatus for measuring at least one measure related to urination of an individual, said apparatus is characterized by being configured to produce acoustic and/or electromagnetic signals indicative of said at least one
5 urination measure upon having urine applied thereover.
2. The apparatus according to claim 1 comprising an acoustic plate configured for vibrating in response to the urine flowing thereover.
3. The apparatus according to claim 2, wherein said acoustic plate comprises an acoustic membrane.
- 10 4. The apparatus according to any one of claims 2 to 3, wherein said acoustic plate is held in the apparatus in a tilted manner in respect to the direction of gravity to also direct the urine to flow therefrom.
5. The apparatus according to any one of claims 2 to 4, wherein said apparatus further comprises a collecting container configured for hanging over the toilet
15 bowl or seat, said collecting container allows collecting urine for quantitative measuring thereof and/or for improving acoustics of the acoustic plate.
6. The apparatus according to claim 5, wherein said container comprises an indicator for indicating a measure related to the volume of the urine therein.
7. The apparatus according to any one of claims 1 to 6 wherein said apparatus
20 comprises at least one holder for hanging over a toilet bowl or toilet seat.
8. The apparatus according to claim 1, said apparatus comprising
 - a) a body configured for hanging over a toilet seat or bowl;
 - b) a mechanical sensing device for mechanically measuring urine flow and/or urine quantity, said body being configured to direct urine therefrom
25 into said mechanical sensing device; and
 - c) at least one means for producing electromagnetic signals indicative of the measured flow or quantity during a urination session,
wherein said apparatus is configured such as to mechanically produce an electromagnetic signal indicative of a known quantity of urine whenever such
30 quantity is measured thereby.
9. The apparatus according to claim 8, wherein said mechanical sensing device comprises a paddlewheel sensor based on Hall effect sensing by having at least one magnet connected to the wheel thereof, configured for producing

electric signals upon full or partial rotation of a wheel thereof caused by urine flow thereover.

10. The apparatus according to any one of claims 8 to 9, wherein said body further comprises and holds thereby an acoustic plate for improving urine flow sound, said plate also being configured to direct urine into said mechanical sensing device.
11. The apparatus according to claim 1 comprising a transducer sensor and plate attached thereto configured for sensing urination related vibrations and transforming these vibrations into electronic signals.
12. The apparatus according to claim 11 further comprising communication means for transmitting the signals outputted by said transducer sensor to a remote end device for processing thereof for measuring urine flow rate and/or urine quantity therefrom.
13. A system for measuring at least one measure related to urination of an individual, said system comprising:
- a) an apparatus characterized by being configured to produce acoustic signals indicative of said at least one urination measure upon having urine applied thereover; and
 - b) an application module operable via an end device, said application module being configured to detect acoustic signals originating from said apparatus and calculate said at least one measure related to urine flow and/or urine quantity therefrom, wherein said application is adapted to use acoustic sensing means and processing means of the end device via which it operates.
14. The system according to claim 13, said application module further being configured to record the acoustic signals for offline processing thereof.
15. The system according to any one of claims 13 to 14, said application module being configured to calculate at least one of the following measures: urination flow rate, urination flow rate behavior, urination volume, depending on the type and configuration of the apparatus being used.
16. The system according to any one of claims 13 to 15, said application module being configured for adapting its calculation and measures to the type of

apparatus being used by having an interface allowing individuals to select the apparatus type at use.

17. The system according to claim 16, wherein the types of apparatuses comprise:

- acoustic plate apparatus comprising an acoustic plate configured for improving acoustics of urine flow for urine flow rate and flow rate behavior measuring;
- acoustic plate combined with a collection container for both flow rate and volume measuring;
- a volume measuring apparatus comprising a directing bowl shaped body and a mechanical sensing device configured for direct urine quantity measuring, which produces an indication electromagnetic signal upon sensing a known quantity of urine for the application to detect thereof;
- a combined apparatus comprising the volume measuring apparatus and the acoustic plate placed thereover for flow and volume measuring.

18. The system according to claim 17, wherein said mechanical sensing device comprises a paddlewheel sensing device having a wheel of blades rotatable about an axis upon application of urine thereof, said bowl shaped body being configured to direct the urine to flow through said wheel, wherein said sensing device is configured such as to produce an indication electromagnetic signal upon full or partial rotation of its wheel.

19. The system according to any one of claims 13 to 18, said application module comprises a user interface allowing individuals to define beginning and ending urination session for operating the signals sensing and processing.

20. The system according to claim 19, said application module being further configured to indicate the values of the measured at least one measure using display means of the end device.

21. The system according to any one of claims 13 to 20, said application module being further configured to transmit data including the measured at least one measure to a remote end device.

22. The system according to any one of claims 13 to 21, said application module further being configured to record information measured in multiple urination

sessions over time for the individual via a designated voiding diary for monitoring urination behavior of the individual over time.

23. The system according to claim 22, said application module further being configured for analyzing the recorded diary data over time for identifying urinary related condition of the individual and alerting the individual and/or other individuals or entities regarding urination related alerting conditions identified by the application module.
24. A method for measuring at least one measure related to urination of an individual, said system comprising:
- a) detecting acoustic signals indicative of urine applied over an apparatus configured for producing the acoustic signals indicative of said at least one urination measure upon having urine applied thereover, using for the detection a designated application module operated via an end device used by the urinating individual to detect the signals through the end device's acoustic sensing means;
 - b) analyzing the acoustic signals using said application module to calculate said at least one measure from the detected acoustic signals;
 - c) outputting and/or storing data indicative of the calculated at least one measure.
25. The method according to claim 24 further comprising recording said detected acoustic signals for offline analysis thereof.
26. The method according to any one of claims 24 to 25, said analysis being adaptable by the application module to the type of apparatus being used.
27. The method according to any one of claims 24 to 26, wherein said at least one measure comprises at least one of: urine flow rate, urine flow rate behavior, urine quantity.
28. The method according to any one of claims 24 to 27, said apparatus being configured for at least one of: measuring urine flow rate by improving acoustics of urine applied thereover; directly measuring urine volume.
29. The method according to claim 28, wherein for flow rate measuring the analysis process comprises:

- spectral envelope filtering of the detected acoustic signal resulting in a time-domain signal;
 - decimation and low-pass filtering of the time domain signal;
 - Log based scaling of the envelope;
- 5 • additional low-pass filtering; and
- de-convolution for achieving of an approximate linear relationship to the actual urine flow rate.
30. The method according to any one of claims 24 to 29 further comprising recording measured at least one measure of multiple urination sessions of
- 10 each individual via a designated voiding diary for monitoring urination behavior of the individual over time.
31. The method according to claim 30, further comprising analyzing the recorded diary data over time for identifying urination related condition of the
- 15 individual and alerting the individual and/or other individuals or entities regarding urination related alerting conditions identified by the application module.

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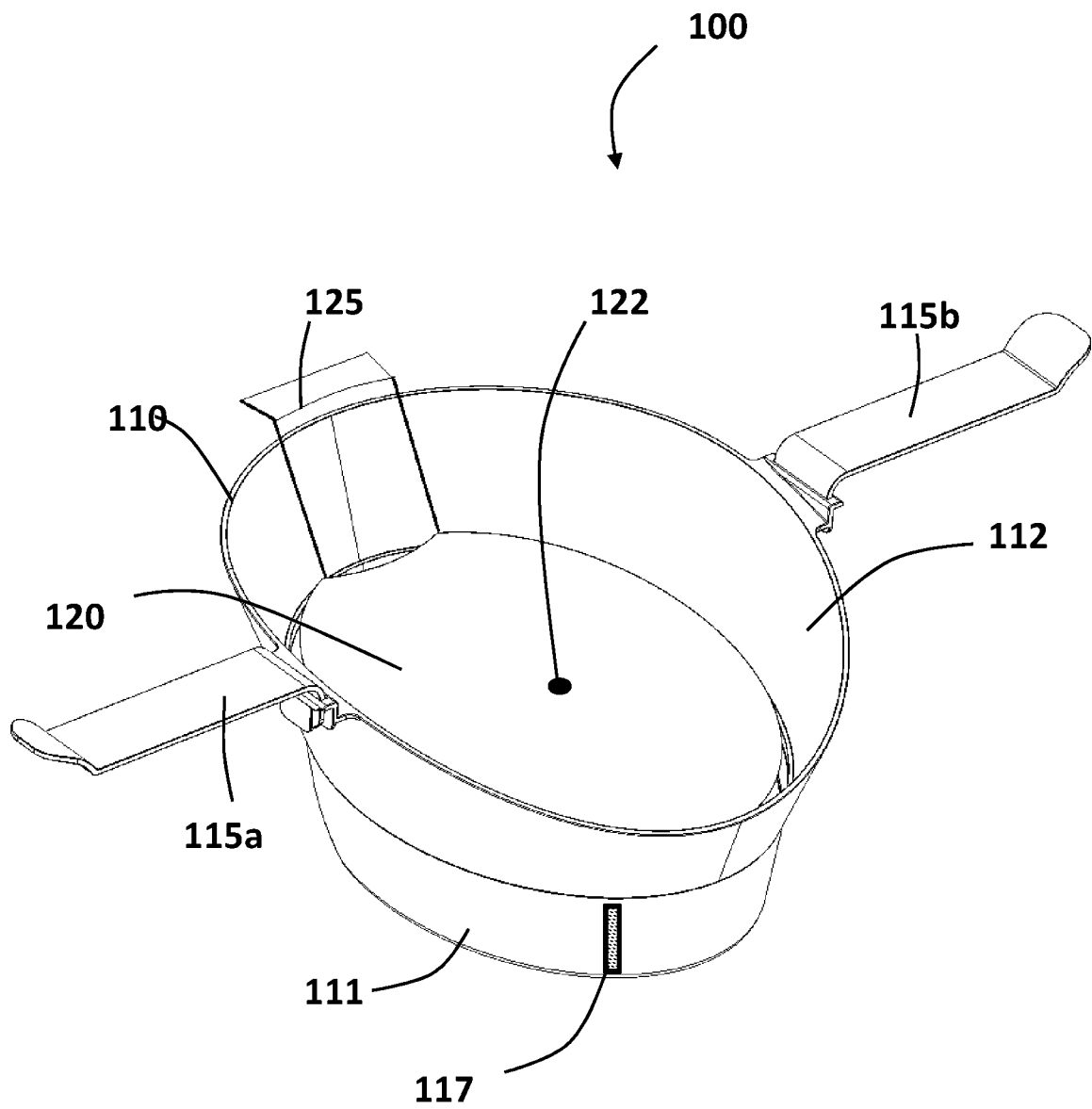


Fig. 1

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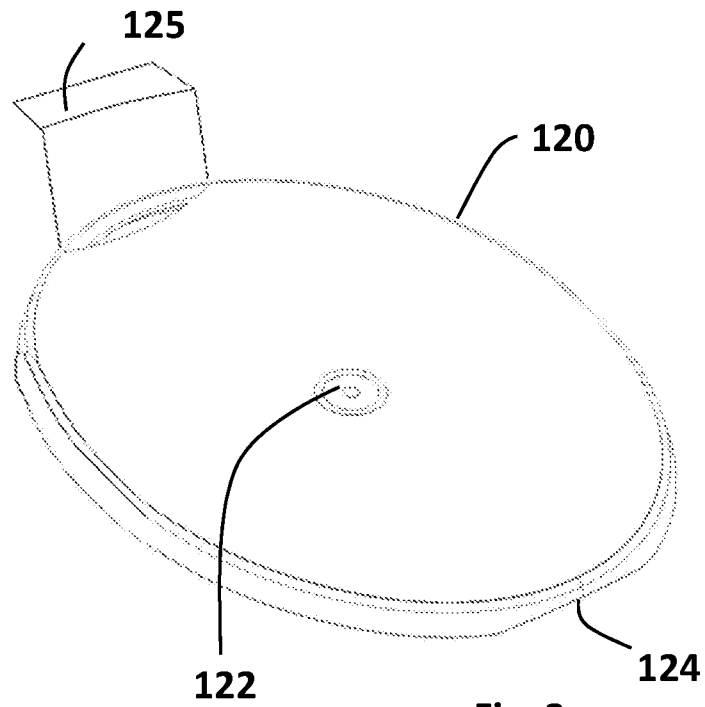


Fig. 2

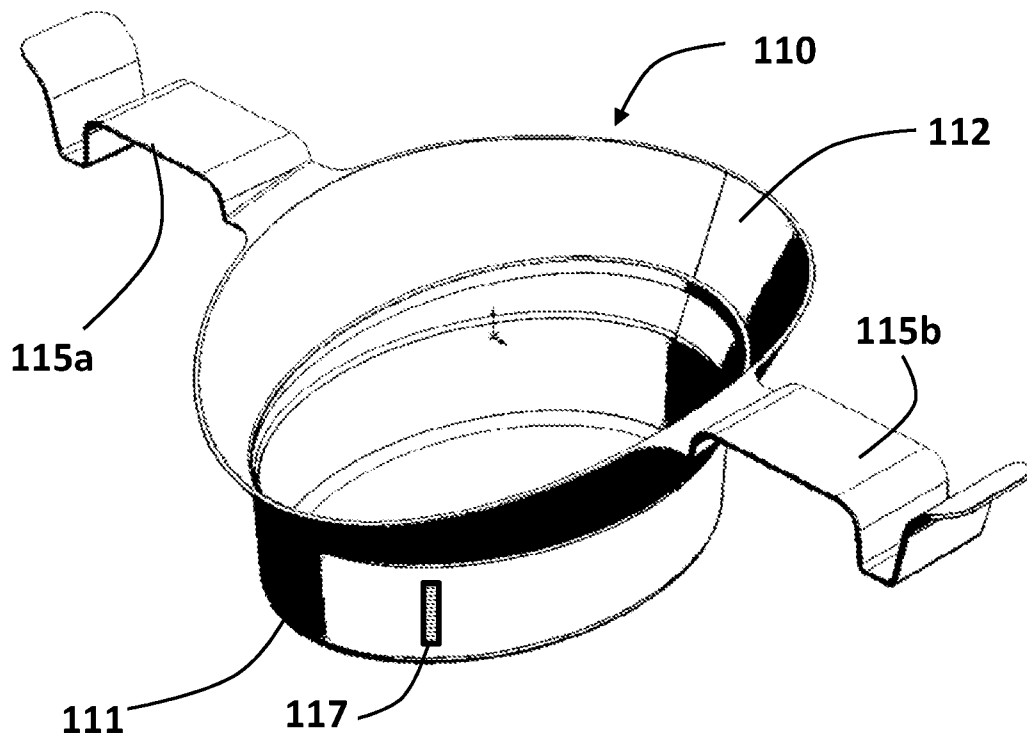


Fig. 3

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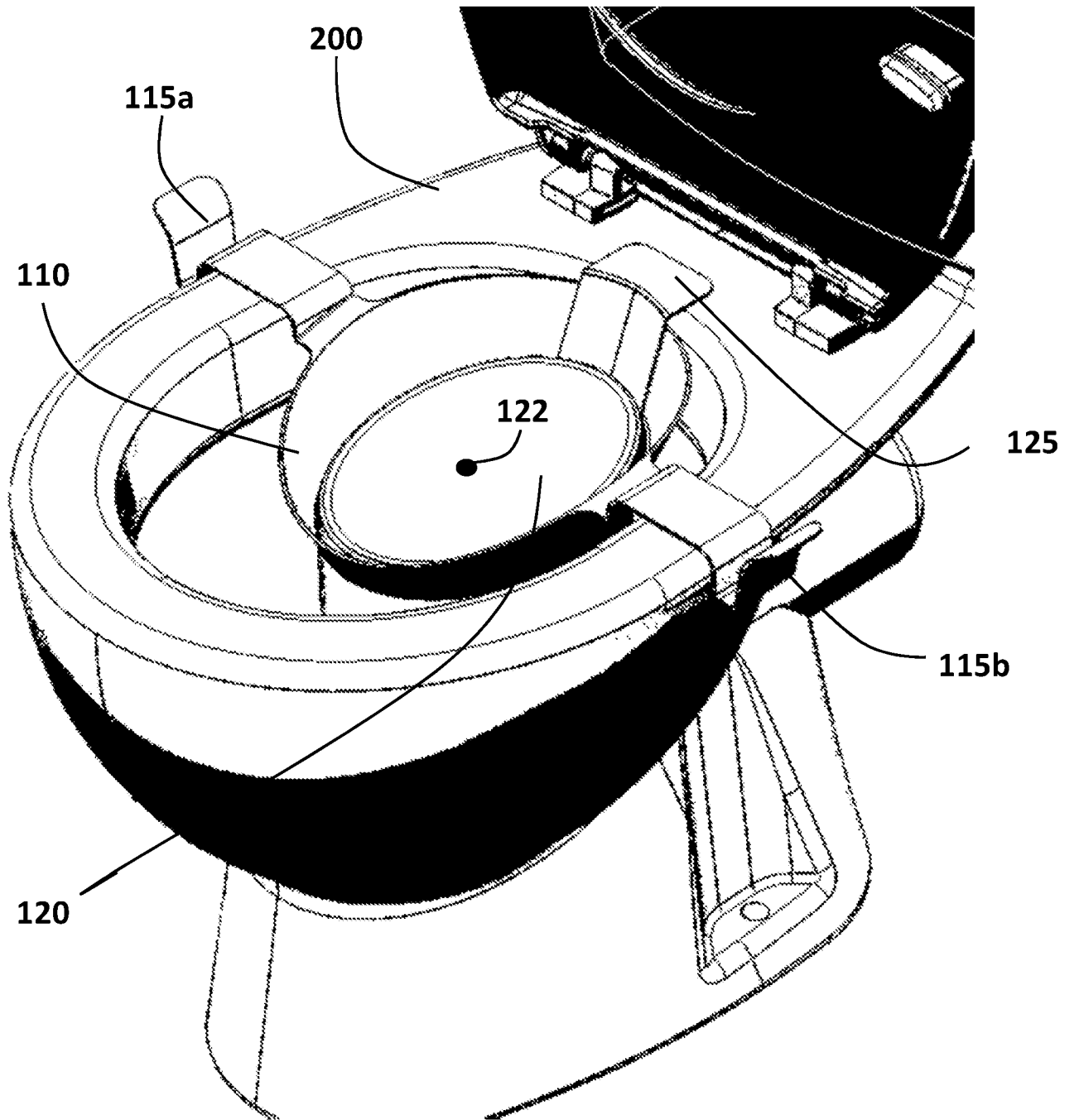


Fig. 4A

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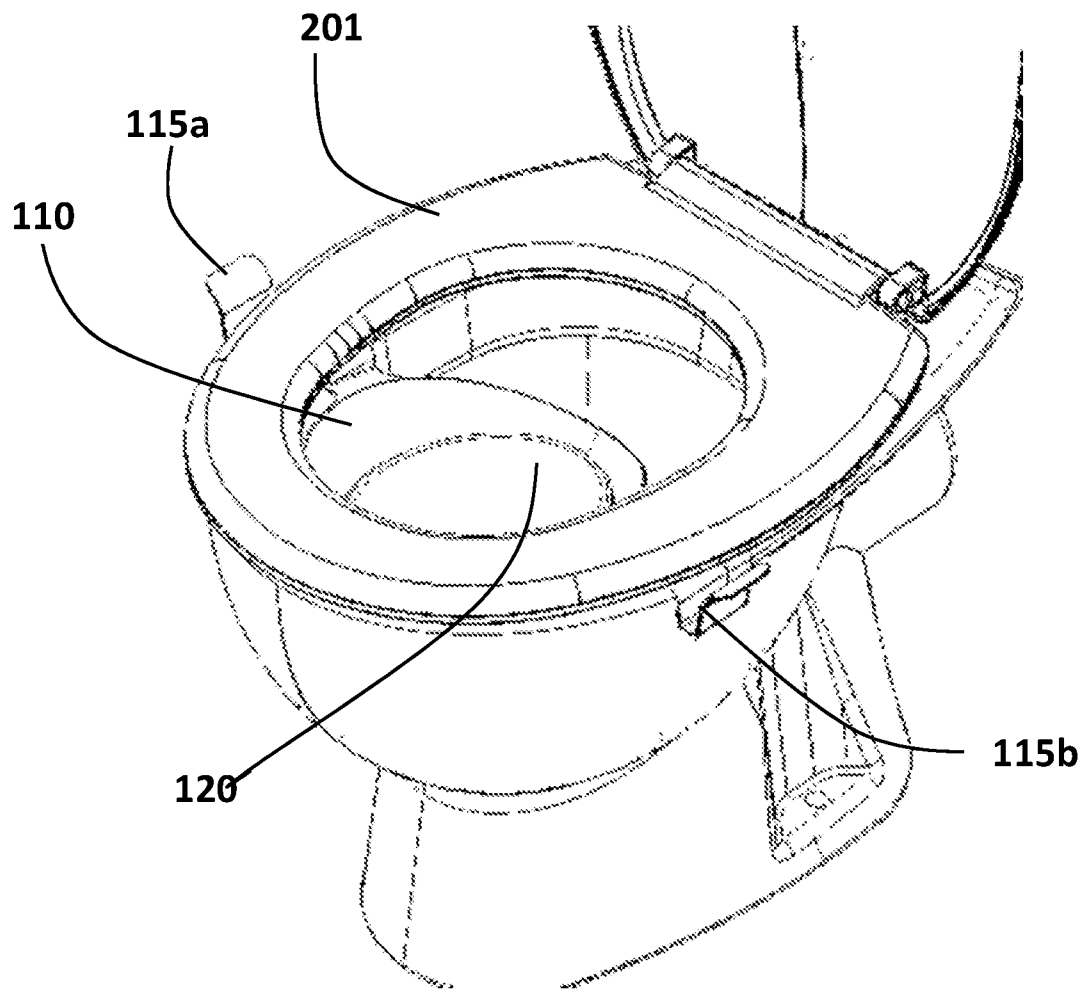


Fig. 4B

MAN

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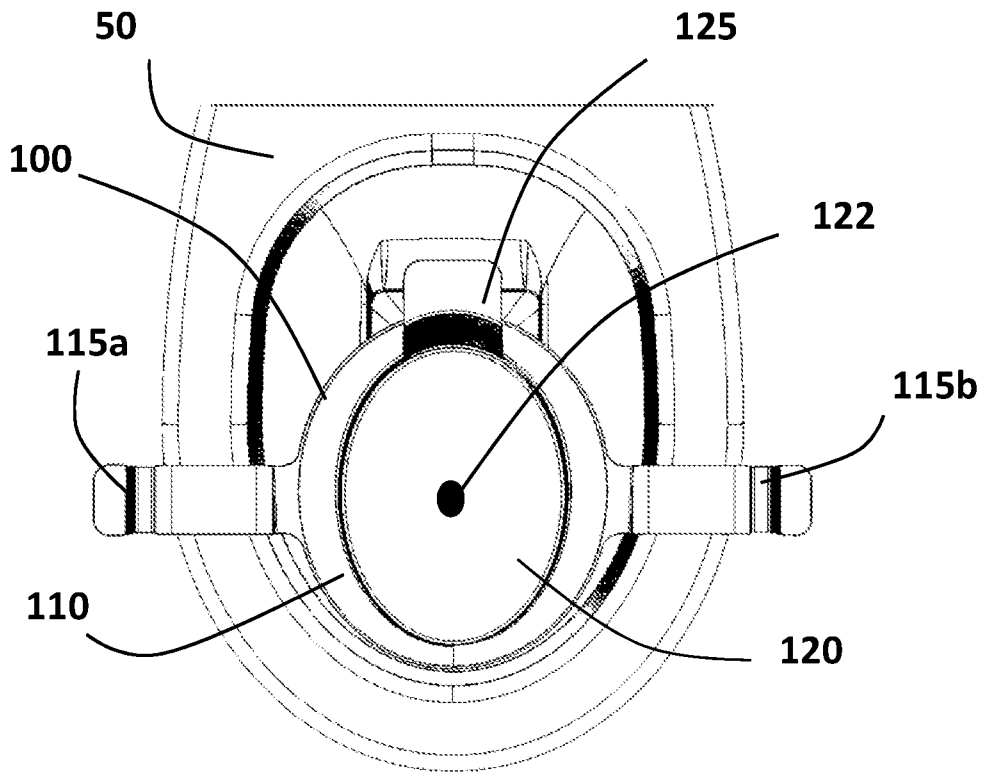


Fig. 5A

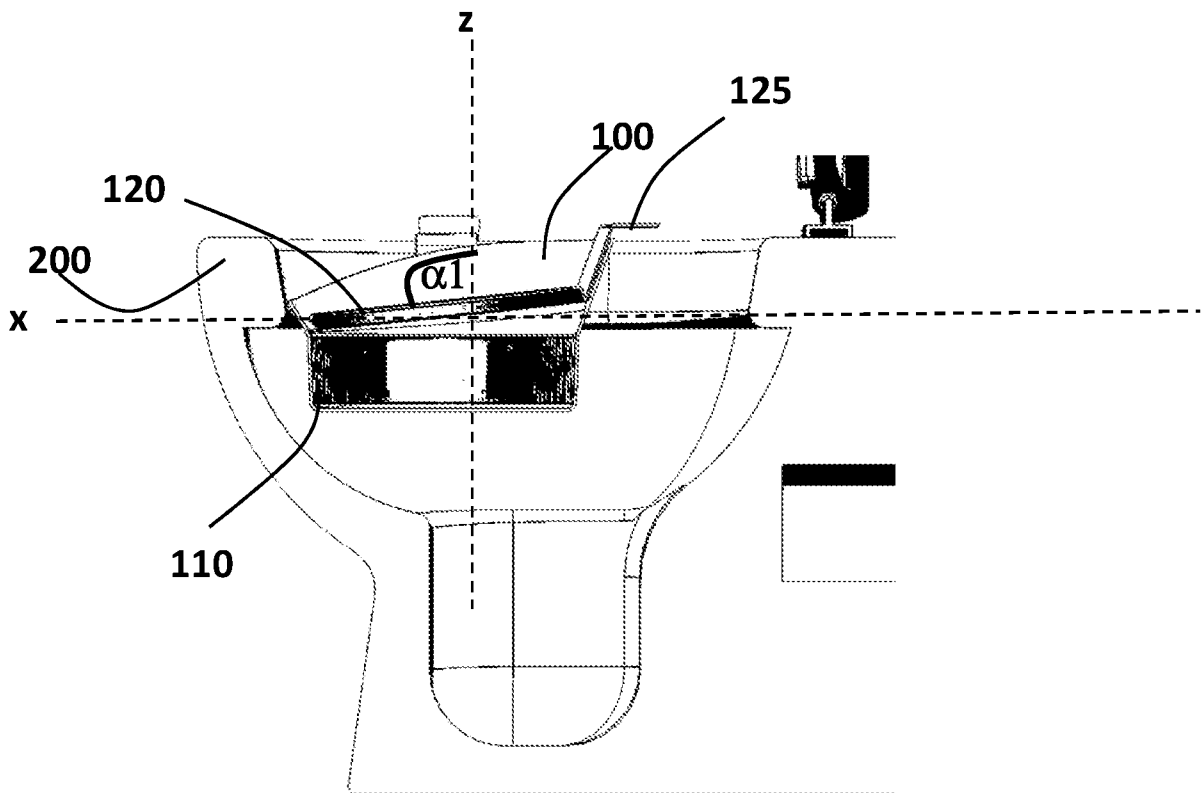


Fig. 5B

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WOMAN

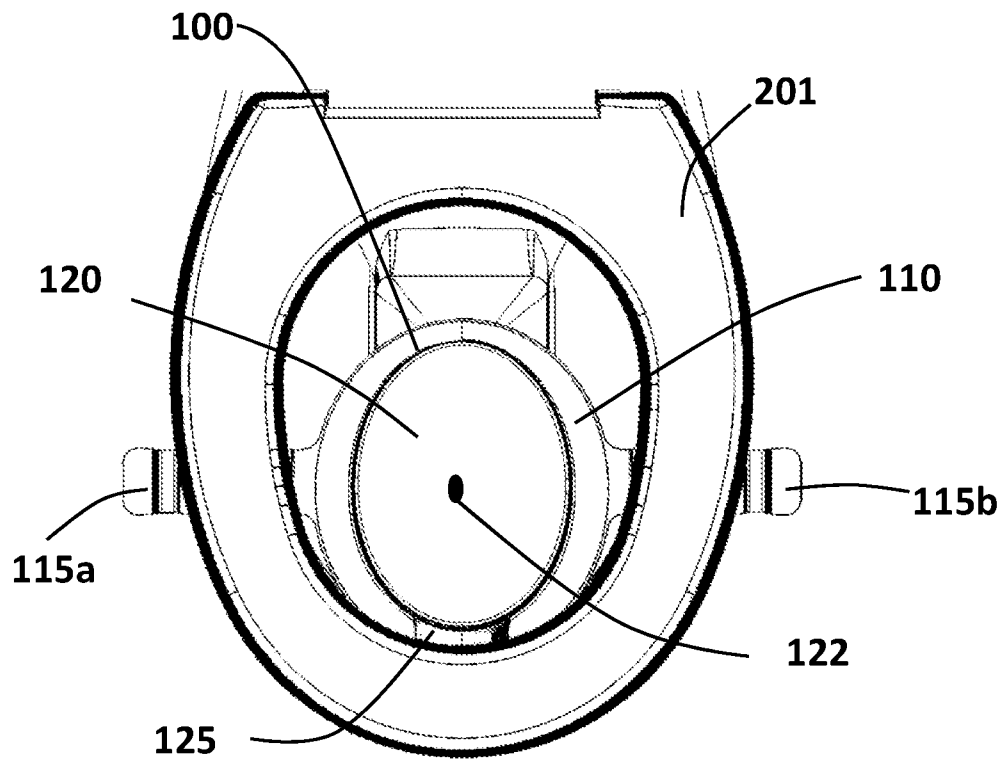


Fig. 6A

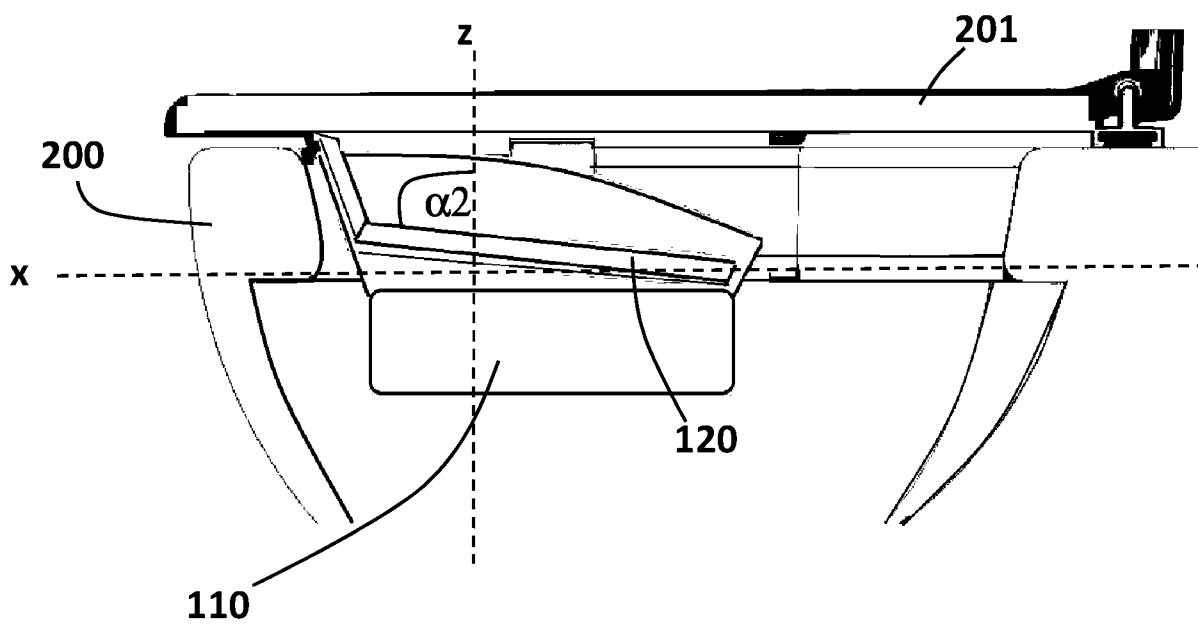


Fig. 6B

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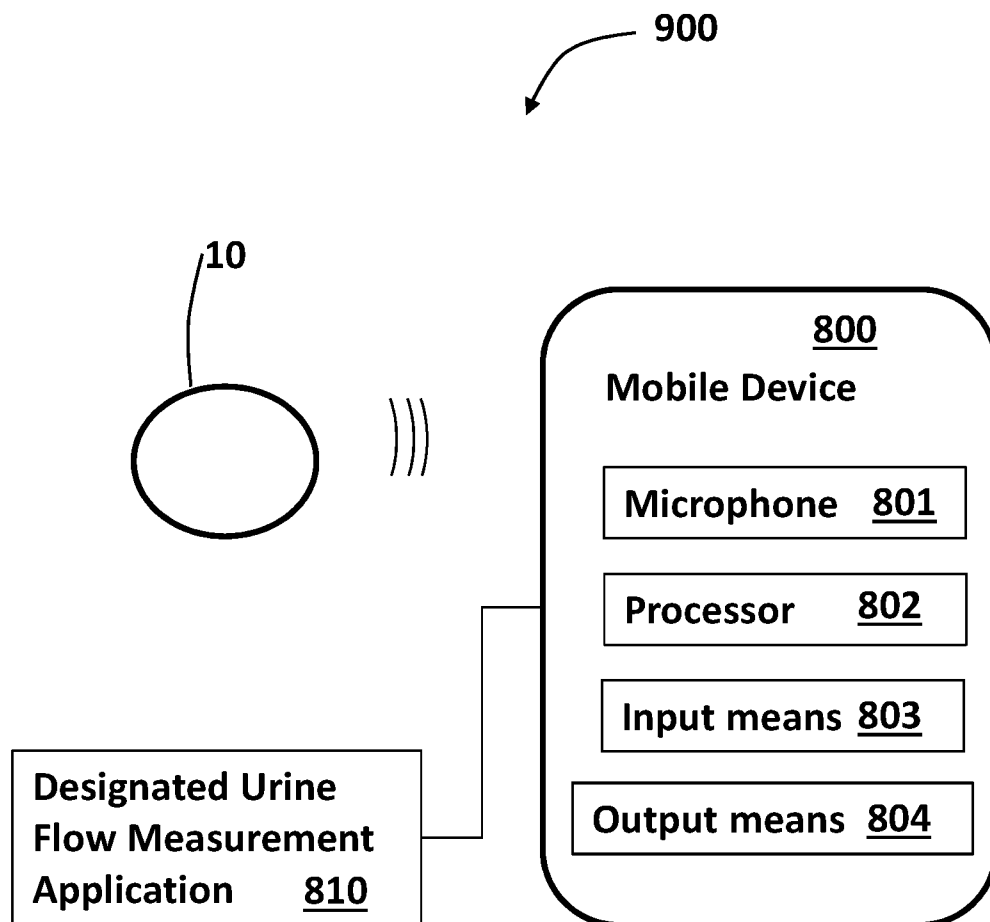


Fig. 7

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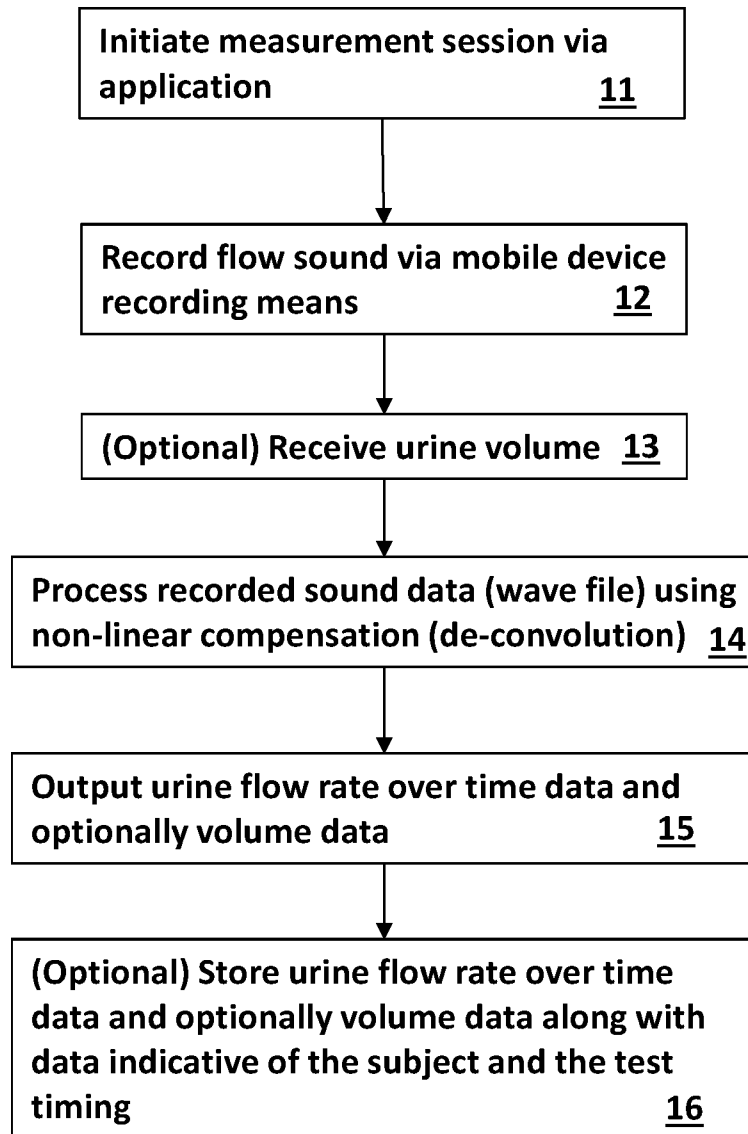


Fig. 8

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Fig. 9

iUFlow

Date/Time	5/05/2015 20:42	5/05/2015 22:10:00 PM
Volume	180	170
Qmax	14	15
Avg Flow	8	9
Voiding Time	27	24
Flow Time	22	22
TCMax	6	7

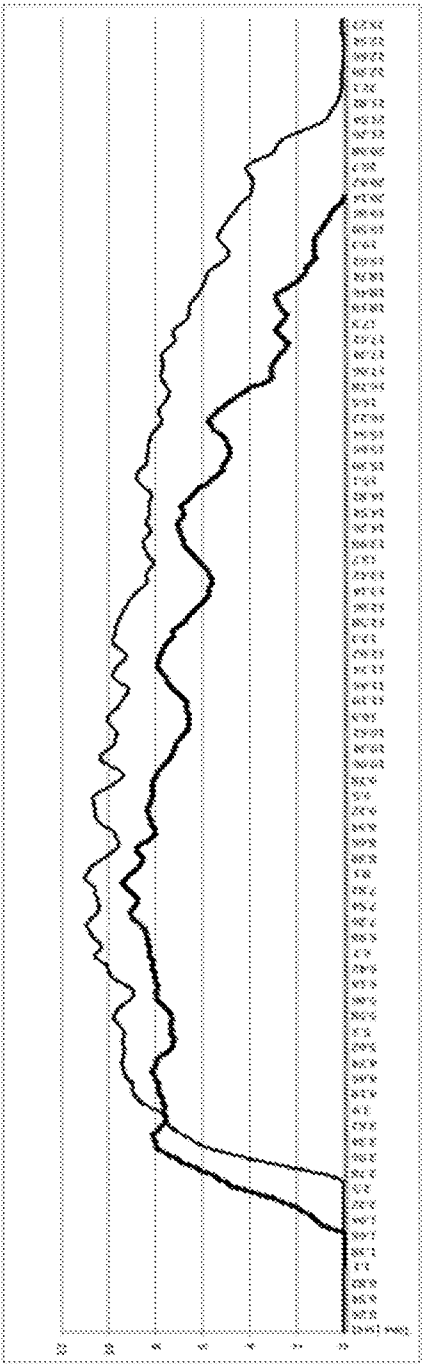


Fig. 10

Date	Time	Volume	Intake	Qmax	Voiding Time	Flow Time	Avg Flow	TQMax
5/05/2015 (6)		1364	440					
	20:37	150		21	45	45	15	10
	18:11		220					
	16:10	120		15	33	31	15	5
	12:45	270		20	45	45	15	6
	10:48	220		17	45	45	15	9
	9:24	290		18	45	45	15	7
	7:35		220					
	7:26	314		21	45	45	15	10

Fig. 11

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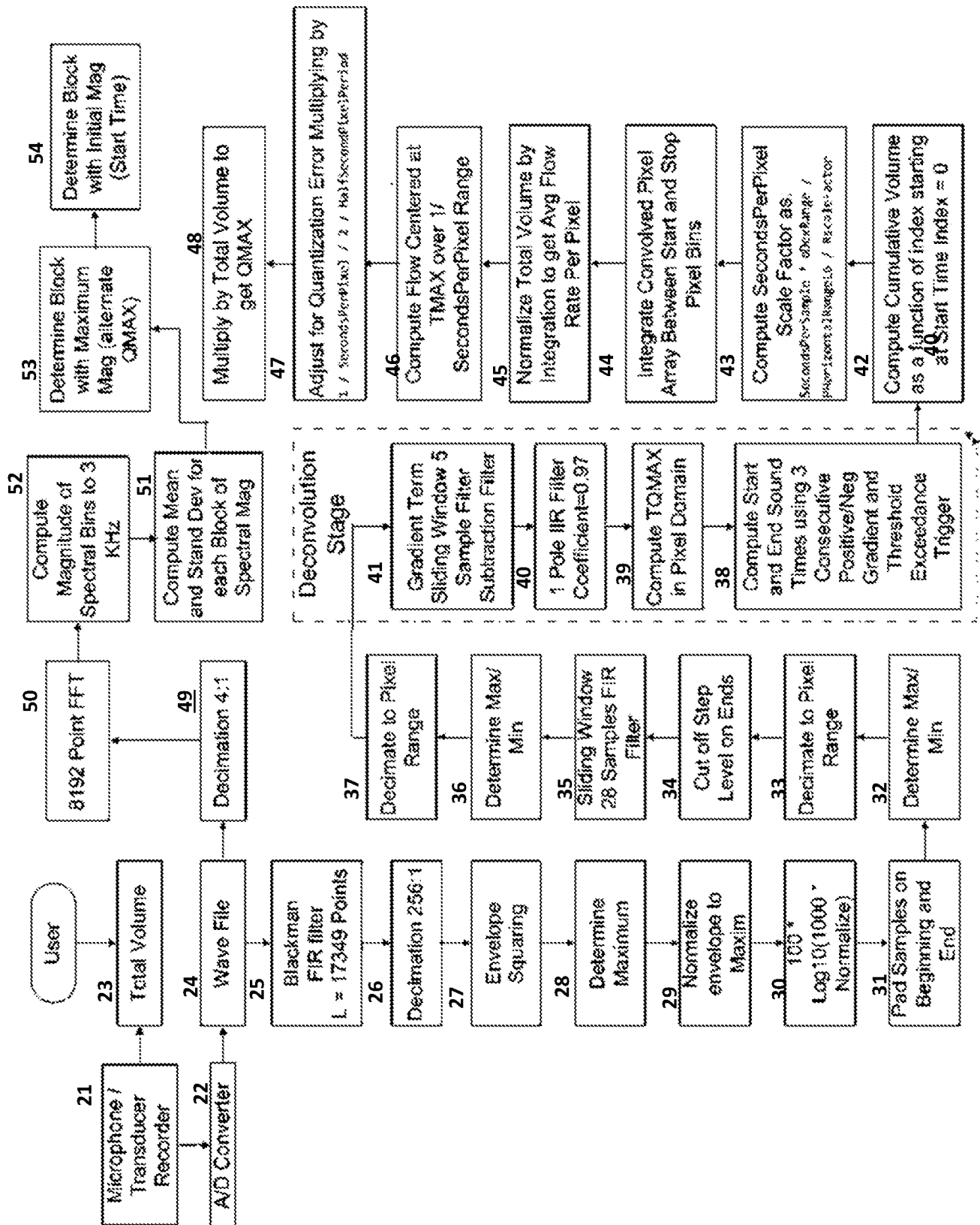


Fig. 12A

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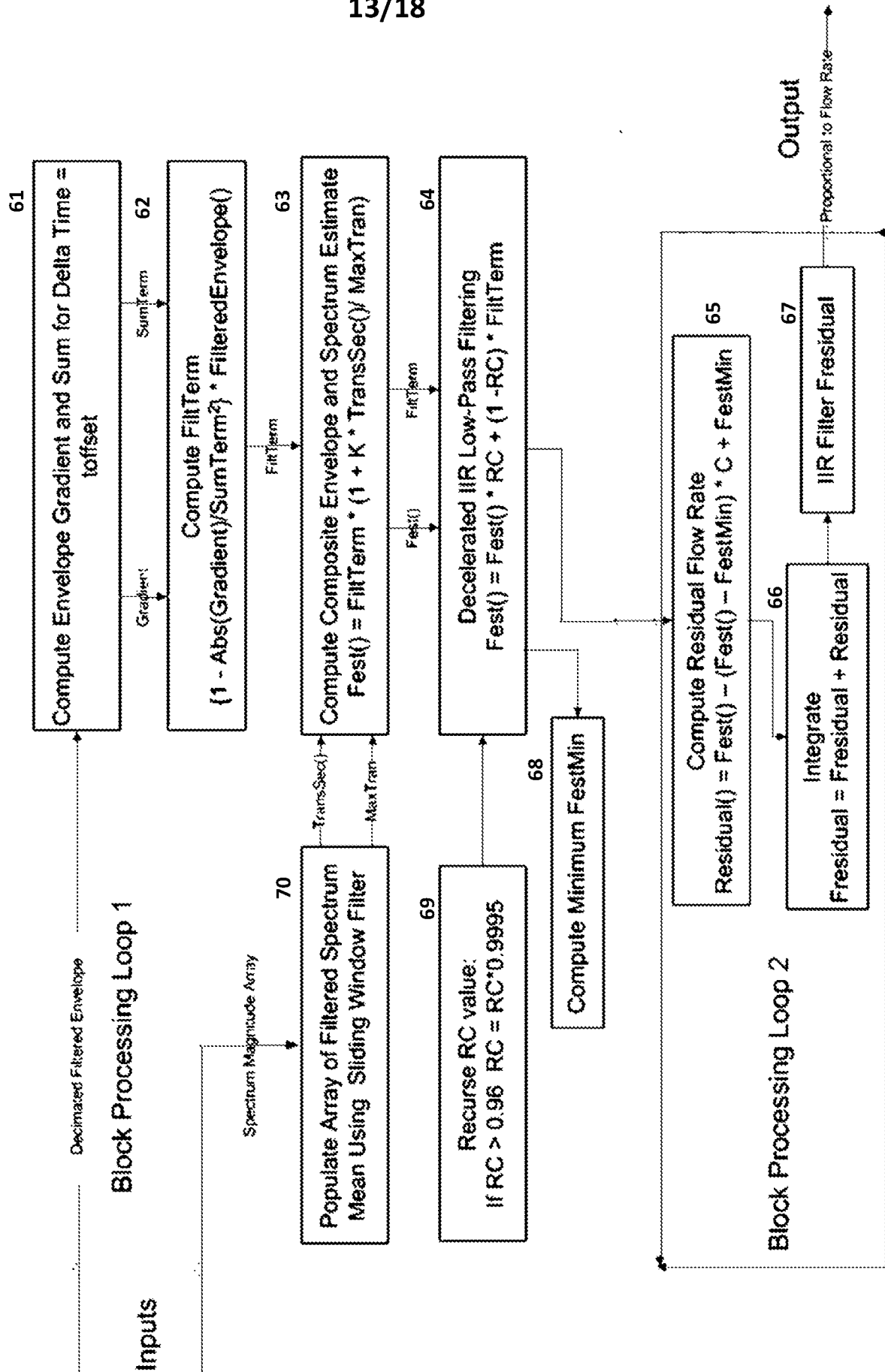


Fig. 12B

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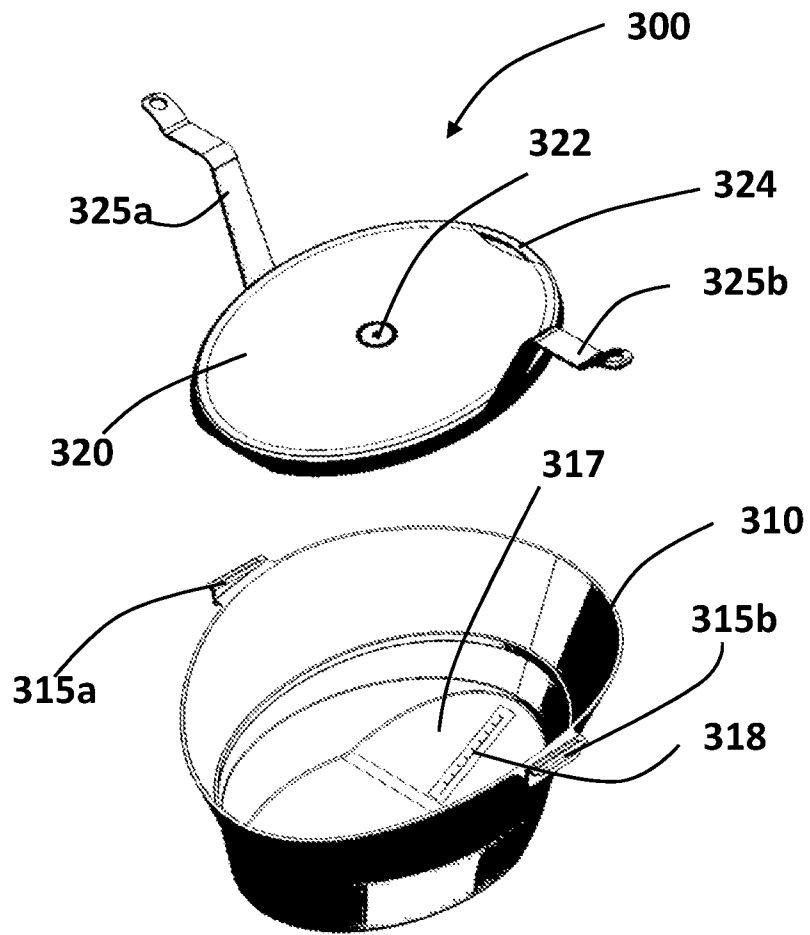


Fig. 13

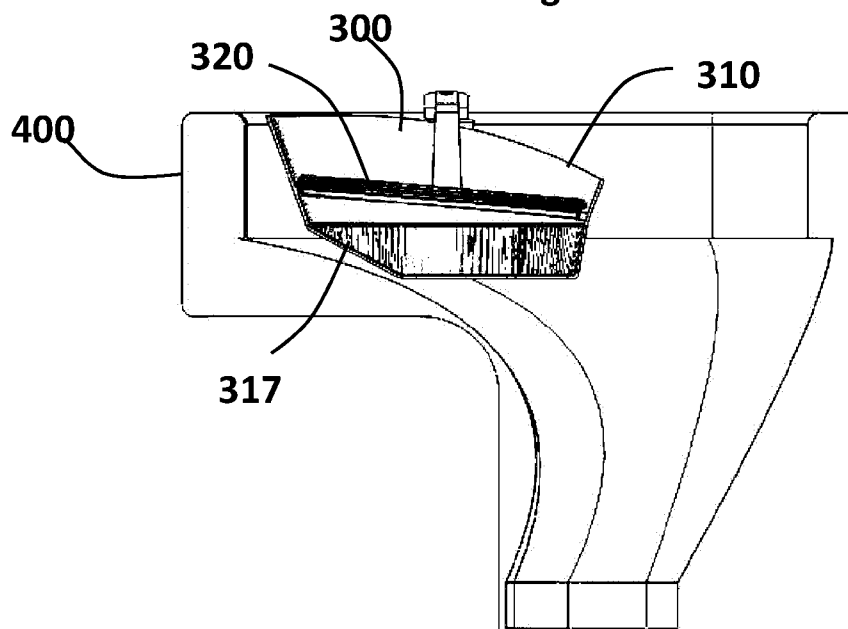


Fig. 14

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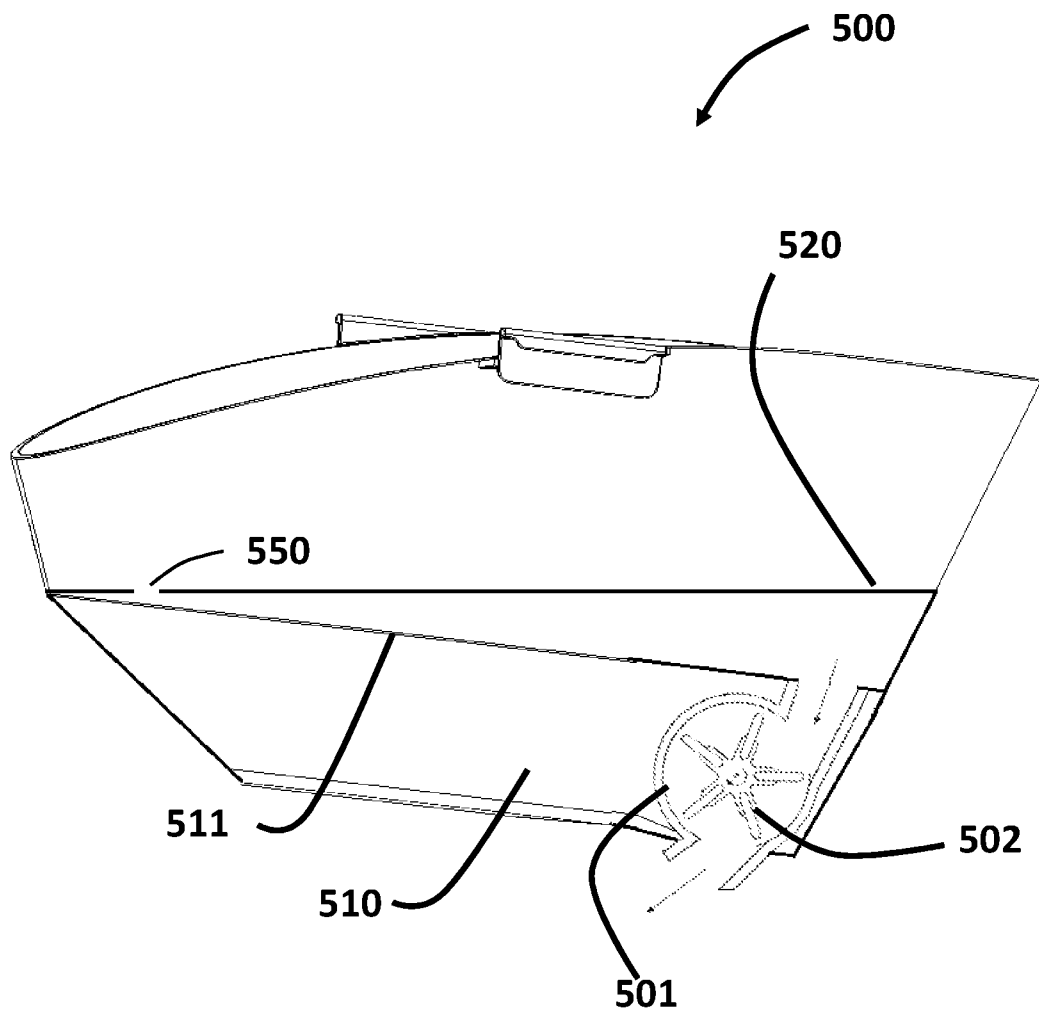


Fig. 15

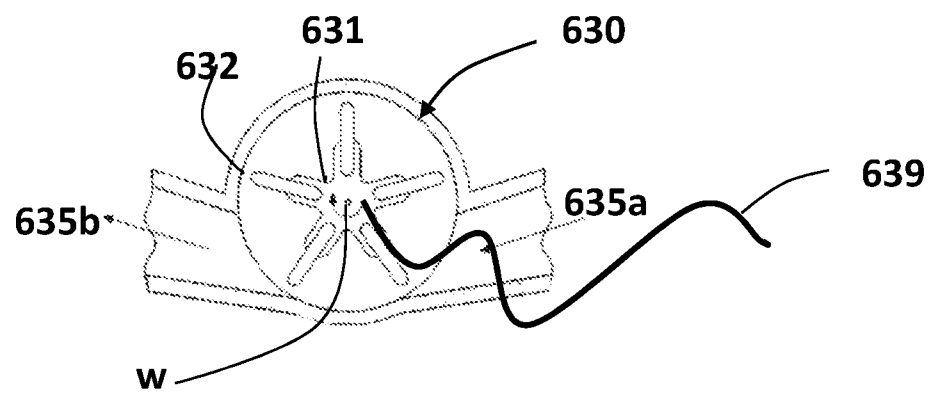
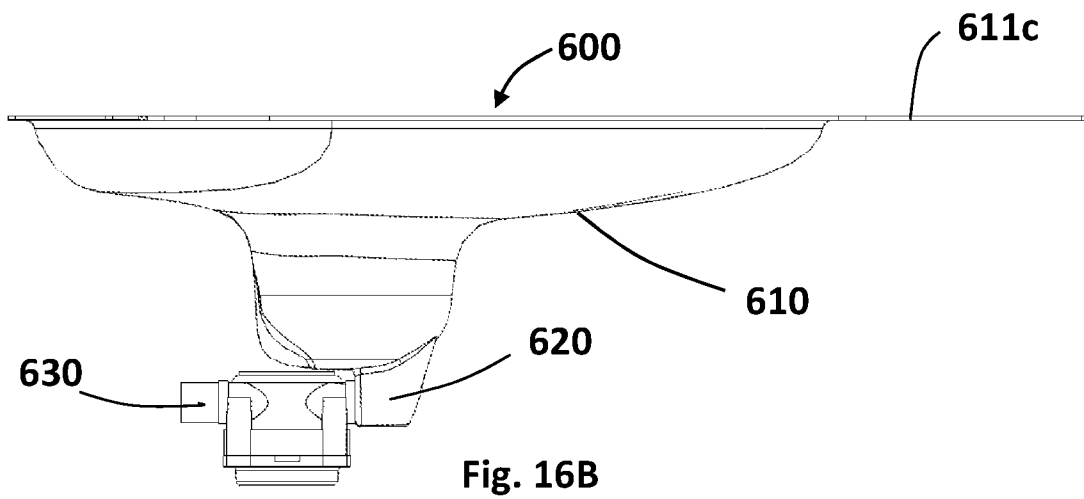
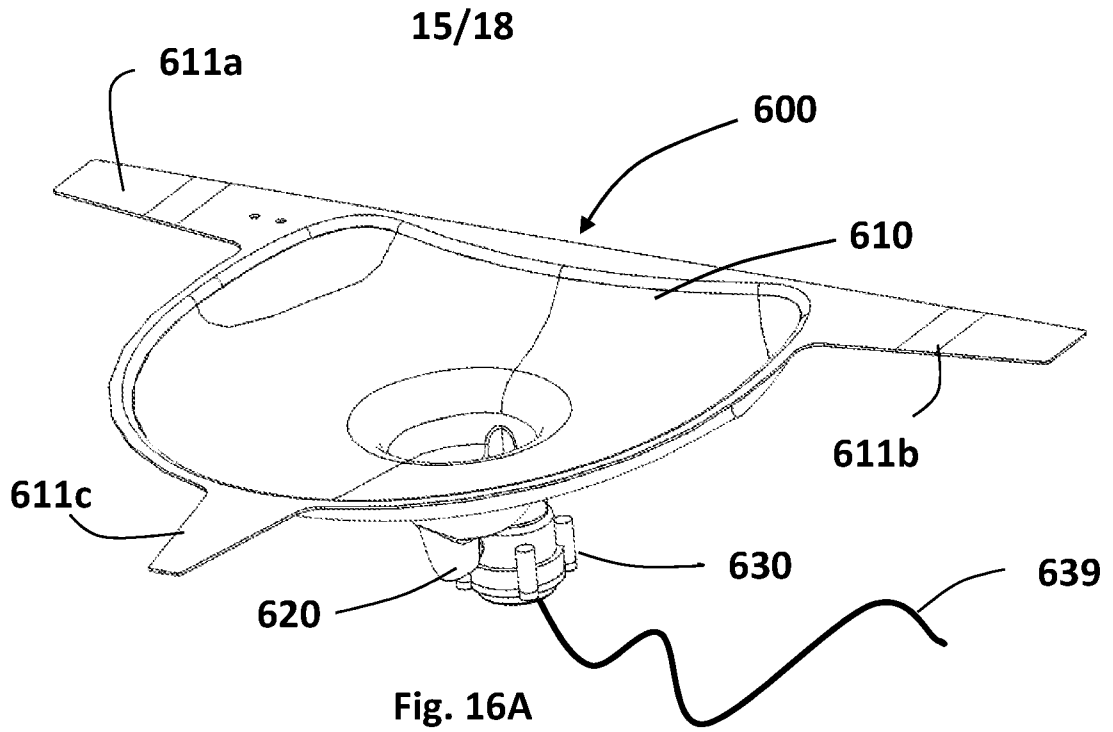


Fig. 17

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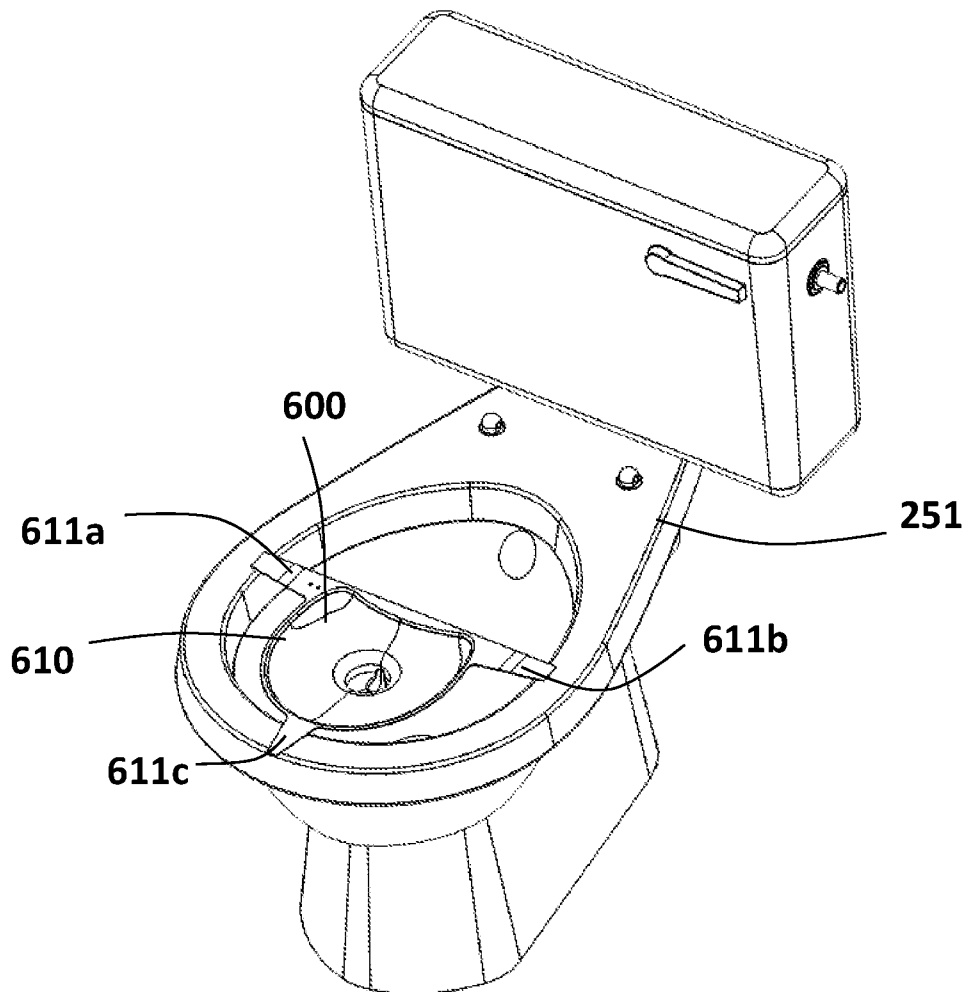


Fig. 18

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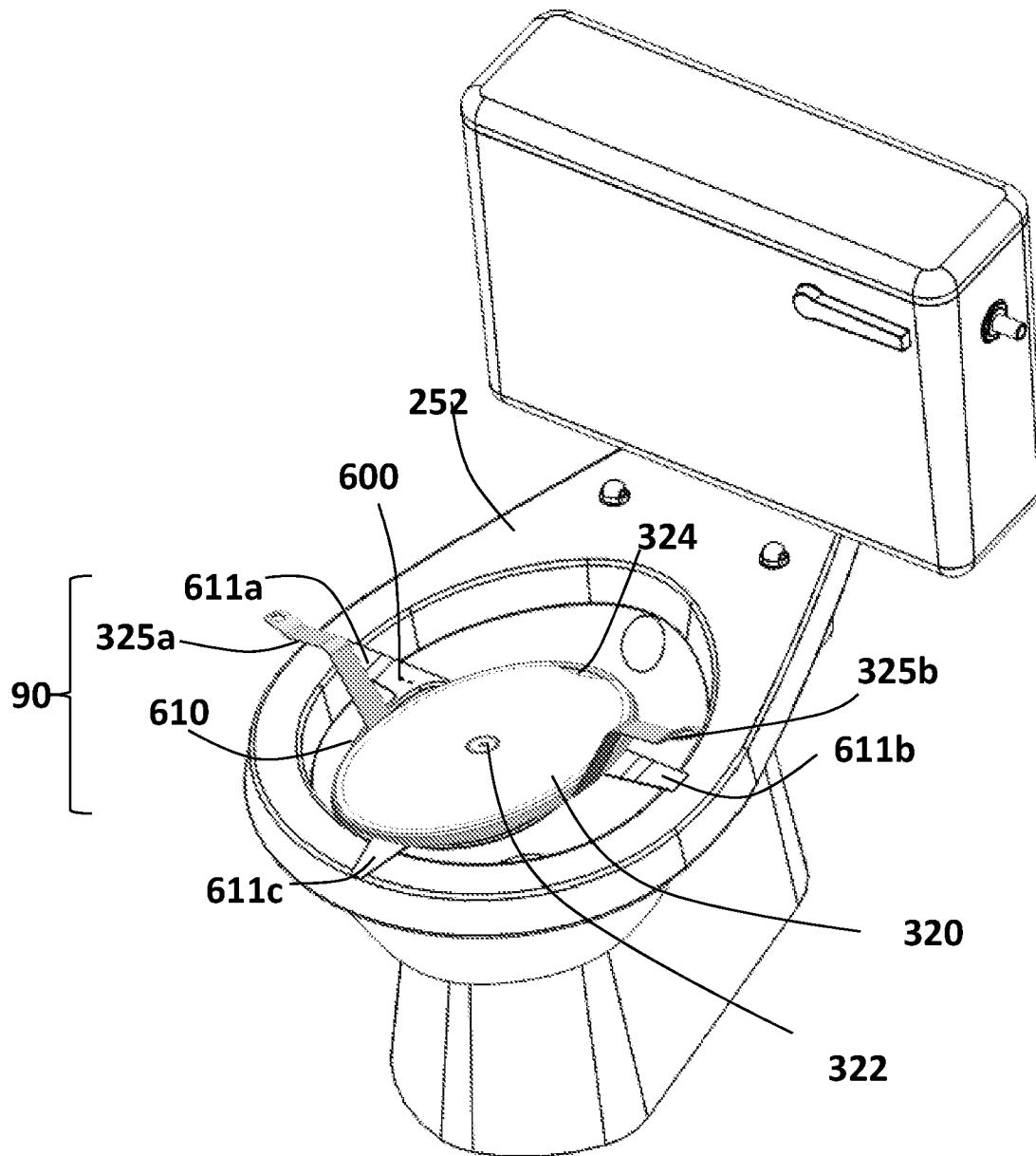


Fig. 19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2015/053478

A. CLASSIFICATION OF SUBJECT MATTER A61B 5/20 (2006.01) G01F 1/075 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC: CPC marks A61B 5/207, G01F 1/666 and keywords: (acoustic?, sound?, vibrat+, quantity, volume, +magnet+, paddlewheel) and like terms Patent lens, Espacenet: (acoustic, sound, vibrate, quantity, volume, electromagnet, paddlewheel, hall effect) and like terms		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	
☒ Further documents are listed in the continuation of Box C ☒ See patent family annex		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search 9 October 2015	Date of mailing of the international search report 09 October 2015	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au	Authorised officer Oscar Violante AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262837959	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/IB2015/053478
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6582379 B1 (STISEN) 24 June 2003 Abstract; col. 3, lines 17-20 and 25-33, col. 4, line 24-col. 5, line 37; claim 1	1 and 13-31
X	JP H09220216 A (CHIYOURIYOU SEIGYO SYST KK) 26 August 1997 Abstract	1, 13, 15-24, 26-31
X	JP H09248289 A (CHIYOURIYOU SEIGYO SYST KK) 22 September 1997 Abstract	1, 13, 15-24, 26-31
X	US 2005/0256428 A1 (AUNDAL) 17 November 2005 Abstract; Par. [0033]	1 and 7
Y	DE 3007855 A1 (FUCHS et al.) 03 September 1981 Fig. 2	1-7, 11 and 12
X	US 6079280 A (MILLER et al.) 27 June 2000 Abstract; Figs. 1 and 2a; col. 5, line 35-col. 6, line 4; claim 6	1, 8-10
Y	WO 2009/143113 A1 (THE UNIVERSITY OF VERMONT AND STATE AGRICULTURAL COLLEGE) 26 November 2009 Abstract	1-7, 11 and 12

Form PCT/ISA/210 (fifth sheet) (July 2009)

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Supplemental Box**Continuation of: Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Group i) Claims 1 (in part), 2 to 6 and 13 to 31 are directed to an apparatus for measuring at least one measure related to urination of an individual, characterised by producing acoustic signals indicative of said at least one urination measure upon having urine applied thereover.
- Group ii) Claims 1 (in part) and 8 to 10 are directed to an apparatus for measuring at least one measure related to urination of an individual, characterised by producing electromagnetic signals indicative of said at least one urination measure upon having urine applied thereover.
- Claims 7, 11 and 12 fall within the scope of either of the above groups of inventions.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is an apparatus configured to produce a signal indicative of at least one urination measure upon having urine applied thereover.

However this feature does not make a contribution over the prior art because it is disclosed in:
D1: US 6582379 B1

This document discloses an apparatus including a measuring container (1) for receiving urine, means (H) for applying a first acoustic signal to the liquid-empty part of the measuring container (1), means (H) for recording a second acoustic signal generated in the measuring container (1) in response to the first signal, and means (45) for determining a current liquid amount in the measuring container (1) on the basis of the second acoustic signal.

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a posteriori*.

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/IB2015/053478	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 6582379 B1	24 June 2003	US 6582379 B1	24 Jun 2003
		AU 5727699 A	17 Apr 2000
		DK 173976 B1	18 Mar 2002
		EP 1115333 A1	18 Jul 2001
		EP 1115333 B1	11 May 2005
		JP 2002525154 A	13 Aug 2002
		JP 4375905 B2	02 Dec 2009
		TW 403643 B	01 Sep 2000
		WO 0018298 A1	06 Apr 2000
JP H09220216 A	26 August 1997	JP H09220216 A	26 Aug 1997
		JP 3705454 B2	12 Oct 2005
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		US 7416542 B2	26 Aug 2008
DE 3007855 A1	03 September 1981	DE 3007855 A1	03 Sep 1981
US 6079280 A	27 June 2000	US 6079280 A	27 Jun 2000
		EP 1075643 A1	14 Feb 2001
		JP 2002513142 A	08 May 2002
		WO 9956092 A1	04 Nov 1999
WO 2009/143113 A1	26 November 2009	WO 2009143113 A1	26 Nov 2009
		CA 2663191 A1	13 Mar 2008
		CA 2724651 A1	26 Nov 2009
		US 2008275366 A1	06 Nov 2008
		US 7758519 B2	20 Jul 2010
		US 2008082022 A1	03 Apr 2008
		US 7811237 B2	12 Oct 2010
		US 2011029603 A1	03 Feb 2011
		US 8496604 B2	30 Jul 2013
		WO 2008030692 A2	13 Mar 2008
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			