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Device for stimulating the clitoris using a variable pressure field and use thereof**Description**

- 5 The invention relates to a device for stimulating the clitoris using a variable pressure field as well as to a uses thereof.

Background

- 10 DE 10 2013 110 501 A1 describes a stimulation device having a drivetrain, an electrochemical energy storage in the form of a rechargeable battery or a battery unit, and a control unit, the drivetrain of which consists of a rotating electric motor having an eccentric shaft, a connection rod, and a piston in at least one chamber of the stimulation device. By means of the control current in the form of direct current supplied by the rotating electric motor, the rotational speed of the electric motor and thus ultimately the frequency of the piston movement
15 is varied or controlled. The stroke of the piston is established by the defined eccentric path and thus is not modifiable during operation.

- DE 10 2016 105 019 B3 describes a stimulation device, the drive unit of which “simplifies the structure” of that in DE 10 2013 110 501 A1 and is intended to generate a “higher diversity of different vibrations.” There is no rotating electric motor provided in the drivetrain here, but instead an electric linear motor with coil elements in the primary part and at least one magnetic core, which core is guided in an axially movable manner and arranged parallel to the coil element and has at least two permanent magnets arranged in an antipolar manner, as a
25 secondary part. The magnetic core is mechanically connected to at least one actuating portion of the first chamber wall of the stimulation device. By supplying the coils or the winding of the electric linear motor or the coil elements with the supplied control current, the rotor-side magnetic core is moved axially back and forth. The maximum axial displacement path of the magnetic core is defined by the number, structure, arrangement and circuitry of the
30 coils.

- In document WO 2017/158107 A1, a massage device for massaging using pressure waves is described, which comprises a housing with a grip portion and a massage portion. In the massage portion, there is a first chamber, which has an opening to the exterior. Further, a
35 driving device for varying a volume of the first chamber is provided, wherein the driving device comprises at least a coil element and at least a magnet slidably arranged in parallel to the coil element for acting upon the first chamber.

Summary

The problem the invention aims to solve is providing a device for stimulating the clitoris using a variable pressure field as well with improved properties of use as a use of such a device for stimulating a clitoris.

To solve this problem, a device for stimulating the clitoris using a variable pressure field according to claim 1 as well as a use of such a device according to claim 15 are provided.

According to one aspect, a device is produced for stimulating the clitoris using a variable pressure field. The device has the following: a housing on which a handle portion and a stimulation portion are formed; a drive device that is arranged in the housing and configured to repeatedly provide a drive movement; a pressure chamber that is arranged in the housing in order to provide a variable pressure field and is surrounded by a chamber wall at least in portions; a movable chamber wall portion that forms a portion of the chamber wall and is coupled to the drive device such that the movable chamber wall portion can repeatedly move between different wall positions in response to the drive movement coupled thereto, as a result of which a chamber volume of the pressure chamber is repeatedly increased and decreased in order to generate the variable pressure field; a housing opening that is arranged in the stimulation portion and is fluidly connected to the pressure chamber such that the variable pressure field generated by means of the pressure chamber can be dispensed via the housing opening in the form of positive and negative pressures, particularly for acting on the clitoris; and a battery device that is configured to provide a drive energy for the drive device, wherein in the drive device, a coil device, through which an electric current flows during operation, is movably arranged in an assigned stationary permanent magnetic field and is coupled to the movable chamber wall portion in order to transmit the drive movement, wherein the stationary permanent magnet is provided by one or more permanent magnets, which are interiorly arranged with respect to windings of the coil device.

A variable pressure field within the meaning of the disclosure is a media pressure field varying in terms of time and location, said field having positive and negative pressures, a negative pressure being a media pressure that is below a reference pressure, for example the ambient pressure, and a positive pressure being a media pressure that is above the reference pressure. The medium may be a medium filling the pressure chamber. The medium may be a gas or liquid. The medium may be air, for example.

The battery device may comprise a non-rechargeable and/or a rechargeable energy storage. For example, the battery device may comprise a rechargeable battery.

5 In the device according to the invention, the stationarily formed permanent magnetic field is provided by means of one or more permanent magnets. Supplementally, one or more pole plates of the arrangement may be included with the permanent magnet(s). The magnetic flux can be concentrated by means of the pole plates.

10 In contrast to the electromagnetic drives, in which permanent magnets are moved in a electromagnetic field generated by a coil device for generating a drive movement, in the proposed device the coil apparatus is movably arranged in a stationary magnetic field. The control current from the control unit may be applied to the movably arranged coil device. In this case, the so-called Lorentz force can act on the current-conducting coil device movably arranged in the stationary permanent magnetic field, so that the coil moves correspondingly
15 when energized. The strength of the Lorentz force depends on the amplitude of the control current, the length of the coil, the arrangement of the coil with respect to the magnetic field and the flux density of the magnetic field in the air gap. The flux density of the magnetic field in the air gap is in turn determined for a given air gap by the magnet material as well as the magnet volume and/or magnet weight. A high flux rate of the magnetic field can be achieved
20 in otherwise identical conditions by increasing the magnet volume and/or the magnet weight of the stationary permanent magnets, without increasing the weight of the movable coil device. The mass to be moved can hereby be kept lower in comparison to the prior art. A lower mass can be moved more efficiently with comparatively better dynamics and be configured with fewer disturbing vibrations as well as more favorable sound emissions.

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The drive device is configured as a linear drive device, which when operating generates a linear drive movement that is coupled to the movable chamber wall portion so that on the basis of its movement, the volume of the pressure chamber is repeatedly increased and decreased so that a pressure field is generated, which can be used for the contactless stimulation
30 tion of the clitoris. In contrast to stimulation devices in which a stimulation head is moved to transmit the stimulation waves via contact, the proposed device does not require moving such a mass of the stimulation head.

35 The variable pressure field generated by means of the pressure chamber may act on the clitoris via the housing opening in the form of positive and negative pressures. For example, the variable pressure field generated by means of the pressure chamber acts on the clitoris via the housing opening when the housing opening is placed on the clitoris. The housing

opening can fully or partially cover the clitoris. For example, the housing opening can cover the clitoral glans. A portion of the housing surrounding the housing opening may contact the skin. For example, the portion of the housing surrounding the housing opening may contact the clitoris and/or a skin region surrounding the clitoris. The housing portion may substantially sealingly lay on the clitoris. For example, the portion of the housing surrounding the housing opening may contact the skin such that a media movement is impeded by the housing opening. The pressure applied to the housing opening in the variable pressure field can then act on the clitoris. A low volume flow of the medium can hereby be made possible, which does not result in complete pressure equalization with respect to the ambient pressure at the housing opening. For example, the portion of the housing surrounding the housing opening may contact the skin in an interrupted manner in such a manner that by means of the interruptions, only a low volume flow of the medium is made possible, which does not result in complete pressure equalization with respect to the ambient pressure at the housing opening.

The movable chamber wall portion may have a flexibly deformable membrane. In this embodiment or others, the membrane may be formed of a plastics material.

The flexibly deformable membrane may have an elastic membrane portion, which, during the repeated movement of the movable chamber wall portion, is expanded between the different wall positions and contracts again. Membrane portions may hereby be elastically expanded and compressed. These elastic membrane portions may consist of a plastics or a rubber material for example.

The movable chamber wall portion may be formed entirely by the flexibly deformable membrane.

The movable chamber wall portion may have a rigid wall portion, which is repeatedly movable between different assigned wall positions in response to the coupled drive movement. The rigid wall portion is movable relative to the adjoining wall portions of the chamber wall. A combination of a rigid wall portion and one or more membrane portions may be provided. To enable movement of the rigid wall portion, the latter is movably integrated in the chamber wall, for example by the rigid wall portion coupling to an adjoining wall portion by means of a recessed channel or a spring element. Such a support may be provided in general for the movable chamber wall portion.

First coil elements of the coil device may be arranged on the movable chamber wall portion. The first coil element may be arranged on the flexibly deformable membrane and/or rigid

wall portion. The first coil element may be formed partially or entirely thereon. During operation, the first coil element then moves with the movable chamber wall portion.

The first coil elements may be embedded at least in portions into a membrane material of the flexibly deformable membrane. For example, the first coil element of the coil device may be molded into the membrane material. Alternatively or additionally, the first coil element may be incorporated in the membrane material between layers of said membrane material by means of a lamination process.

10 The movable chamber wall portion may have a wall portion having a wave shape. The wave shape of the wall portion may be elastically deformable when the movable chamber wall portion is moved during operation. The wave shape may correspond to a sine wave or a zig-zag wave for example.

15 At least some of the coil elements may be arranged in the region of the wave troughs and/or wave peaks of the wave shape.

Second coil elements of the coil device may be arranged on a coupling component which is coupled to the movable chamber wall portion. The second coil elements may be provided in addition or alternatively to the first coil elements. The second coil elements may be arranged exclusively and completely on the coupling components, for example as a wire winding on a component body. For example, a moving coil construction may hereby be provided. A coil winding may be arranged on a rod-shaped component body, which, during operation, when electrical current is applied to the coil device, is immersed into the stationary permanent magnetic field and moved out of it again repeatedly in order to generate the drive movement. The drive movement provided hereby with the coupling component may be transmitted directly to the movable chamber wall portion or conveyed thereto via additional coupling components.

30 The chamber wall may have an additional movable chamber wall portion which forms a portion of the chamber wall and is movable between different wall or movement positions. The additional movable chamber wall portion is formed separately from the movable chamber wall portion in the region of the chamber wall. For example, it may be arranged opposite the movable chamber wall portion. The additional movable chamber wall portion is movable or displaceable relative to the adjoining wall portions of the chamber wall. The additional movable chamber wall portion may not be coupled to the drive movement; it may be configured as a freely vibrating wall portion and thus as a sound absorption component. The coupling or

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integration of the additional movable chamber wall portion in the chamber wall may be configured in a comparable manner to or differently from the connection of the movable chamber wall portion; in contrast to the movable chamber wall portion, there is no coupling to the drive device. Mutual pairs of a movable and an additional movable chamber wall portion may be provided, for example such that the assigned chamber wall portions are arranged opposite each other. During operation, the additional movable chamber wall portion is optionally made to vibrate when the movable wall portion is repeatedly moved due to the drive movement.

- 10 The coil device may be at least partially arranged in an installation space between mutually opposite permanent magnets. At least in one of the operating positions, in which the coil device is moved toward the permanent magnets, the coil device may be arranged in the installation space between the mutually opposite permanent magnets. As an alternative to the design of an installation space between mutually opposite permanent magnets, it may be provided that the coil device is arranged only on one side opposite the permanent magnet or permanent magnets.

One or more permanent magnets, by means of which the assigned stationary permanent magnetic field is provided, may be arranged on the chamber wall. The permanent magnet(s) may be configured to form a chamber wall portion. The pressure chamber may be formed having multiple pressure subchambers that are fluidly interconnected. The housing opening for the variable pressure field to act on the clitoris for contactless stimulation may be arranged in a distal or end-side pressure subchamber, whereas the movable chamber wall portion, which is repeatedly moved during operation in order to generate the variable pressure field, is arranged in the region of a proximal or front-side pressure subchamber. A passage for the fluid connection is formed between adjoining pressure subchambers, which passage may have a narrowed cross-section in contrast to the fluidly interconnected pressure subchambers.

- 30 During operation, separately formed coil elements of the coil device may be operable with different electric currents. If separately formed coil elements have different electric currents flowing through them, this makes it possible to design the repeated movement of the respective coil elements during operation so as to be individual, for example in regard to deflection amplitude and/or a deflection frequency, so that variable pressure fields of different types can be generated. For example, the variable pressure field can initially be generated substantially using one of the coil elements, in order to then model this pressure field using a

movable chamber wall portion which is connected to another repeatedly movable coil element when operating.

5 The coil device may have an upper and a lower partial coil, which are arranged on the carrier of the coil winding in a superimposed manner. The upper and lower partial coil may have electrical contacts that are separate from each other. During operation, different electric currents may be optionally applied to them. The different electric currents may hereby differ in regard to one or more current parameters, for example amplitude, polarity and/or amplitude trend over time. The upper and lower partial coil are formed separately from the movable
10 chamber portion on the carrier.

The upper and lower partial coil may be arranged, at least in the neutral rest position, about which there is then movement or vibration during operation, opposite permanent magnets or pole plates, although an embodiment may also be provided in which one of the partial coils
15 is opposite permanent magnets, whereas the other partial coil is arranged opposite the pole plate.

According to the invention, the permanent magnets are interiorly arranged in relation to the coil windings. In other non-claimed configurations, the permanent magnets may be exteriorly
20 arranged with respect to the coil or below the coil winding(s). A massage device is known from US 2005/0203446 A1, in which a permanent magnet is arranged below coil windings of a coil device, not interiorly.

It may be provided that before operation, in which the movable chamber wall portion is
25 moved forward and back (or up and down) in relation to the starting position, the coil winding(s) arranged on the carrier are moved (deflected) out of a neutral rest position to then be moved or displaced about this shifted position during operation. During operation, a current with a non-alternating polarity can be applied to the coil, which simplifies the electrical power supply. Such a preliminary movement or deflection may occur against a pretensioning device, which provides a pretensioning force against the deflection, for example a spring
30 mechanism. During operation, the pretensioning device providing the pretension may have an assisting effect on moving the coil device and thus the movable chamber wall portion.

During operation, an electric current is applied to the coil device, the frequency and/or amplitude of which current are adjusted by a control device.
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Description of the embodiments

Additional embodiments are described in greater detail below with reference to figures of a drawing. In the figures:

- 5 Fig. 1a is a schematic representation of a device for stimulating a clitoris using a variable pressure field in a front view;
- Fig. 1b is a cross-sectional view of the device for stimulating a clitoris from Fig. 1a;
- Fig. 2 is a schematic representation of arrangements for a stimulation device having a pressure chamber, which is formed having one or two pressure subchambers;
- 10 Fig. 3 is a schematic representation of arrangements for a stimulation device having two pressure subchambers each;
- Fig. 4 is a schematic representation of an arrangement for a stimulation device, in which a double drive is provided;
- 15 Fig. 5 is a schematic representation of an arrangement for a stimulation device, in which two actively movable chamber wall portions are provided in the region of the pressure chamber;
- Fig. 6 is a schematic representation of arrangements for a stimulation device, in which coil elements are integrated in a movable chamber wall portion;
- 20 Fig. 7 is a schematic representation of an arrangement for a stimulation device, in which coil elements are also integrated in the movable chamber wall portion;
- Fig. 8 is a schematic representation of arrangements for a stimulation device having a pressure chamber, which has two pressure subchambers, coil elements being integrated in a movable chamber wall portion;
- 25 Fig. 9 is a schematic representation of an arrangement for a stimulation device, in which, in contrast to the design in Fig. 9, the pressure subchambers are connected to each other by means of a lateral passage;
- Fig. 10 is a schematic representation of arrangements for a stimulation device, one or two additional movable chamber wall portions being provided;
- 30 Fig. 11 is a schematic representation of arrangements for a stimulation device, in which the pressure chamber has two interconnected pressure subchambers;
- Fig. 12 is a schematic representation of arrangements for a stimulation device, in which a movable chamber wall portion is arranged between permanent magnets;
- 35 Fig. 13 is a schematic representation of arrangements for a stimulation device, in which a movable chamber wall portion has a wave shape;

- Fig. 14 is a schematic representation of arrangements for a stimulation device, in which the movable chamber wall portion has a wave shape, the pressure chamber being formed having two pressure subchambers;
- 5 Fig. 15 is a schematic representation of an arrangement for a stimulation device, in which, in contrast to the design in Fig. 15, two pressure subchambers are interconnected via a lateral passage;
- Fig. 16 is a schematic representation of arrangements for a stimulation device, in which the movable chamber wall portion has a wave shape, additional movable chamber wall portions being provided;
- 10 Fig. 17 is a schematic representation of an arrangement for a stimulation device, a movable chamber wall portion having a wave shape being arranged between two permanent magnets;
- Fig. 18 is a schematic representation of an arrangement for a stimulation device, in which the coil device has separate coil windings and permanent magnets are arranged on the outside;
- 15 Fig. 19 is a schematic representation of an arrangement for a stimulation device, in which the coil device has separate coil windings and permanent magnets are arranged on the inside;
- Fig. 20 is a schematic representation of an arrangement for a stimulation device, in which the coil device has separate coil windings and permanent magnets are arranged on the outside at the top;
- 20 Fig. 21 is a schematic representation of an arrangement for a stimulation device, in which the coil device has separate coil windings and permanent magnets are arranged on the outside on the bottom;
- 25 Fig. 22 is a schematic representation of an arrangement for a stimulation device, in which permanent magnets are arranged on the inside in relation to the moving coil;
- Fig. 23 is a schematic representation of an arrangement for a stimulation device, in which permanent magnets are arranged on the outside in relation to the moving coil;
- 30 Fig. 24 is a schematic representation of an arrangement for a stimulation device, in which the permanent magnets are arranged underneath in relation to the moving coil;
- Fig. 25 is a schematic representation of an arrangement for a stimulation device, in which the moving coil is first moved out of a neutral rest or starting position; and
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Fig. 26 is a schematic representation of an additional arrangement for a stimulation device, in which the moving coil is first moved out of a neutral rest or starting position.

- 5 Fig. 1a shows a schematic representation of a device for stimulating (stimulation device) the clitoris using a variable pressure field in a front view; Fig. 1b shows the stimulation device in a cross-sectional view.

10 The stimulation device 20 is a, for example portable, electrical or small device, which has a housing 21, a housing opening 22 for placing onto the clitoris 30, operating elements 23, a indicator 24, an on-off switch 25, an optional socket 26 and a battery device 28, for example having a rechargeable battery.

15 The housing 21 may be ergonomically configured in such a manner that it can comfortably be held with one hand and has no sharp or pointed edges. Furthermore, the housing 21 may consist of plastics material, for example polycarbonate (PC) or acrylonitrile butadiene styrene (ABS). In addition, the handle regions or the entire housing 21 may be supplemented or provided with a haptically advantageous silicone, for example in the form of a silicone coating. The housing 21 may be configured to be at least water-repelling or water spray-repelling, for example with protection class IP 24. Furthermore, the stimulation device 20
20 may be configured to be waterproof against immersion under water.

The operating element 23 or the operating elements 23 are used to set the operating mode of the device, i.e., setting the modulation of the variable pressure field. For example, the operating elements 23 may comprise at least one push button as well as at least one rotary
25 switch, or at least one touch-sensitive switch. Furthermore, the operating elements 23 may emit visual feedback regarding actuation, for example by means of integrated light-emitting diodes (LEDs).

30 An optional indicator 24 is used to inform the user about the device status and/or the setting status. For example, the indicator 24 may be formed with one single light-emitting diode, a plurality of light-emitting diodes or as an LCD display. The indicated information may be for example the switched-on state of the device, the charge state of the battery device 28 or the current setting of the modulation of the pressure field.

The on-off switch 25 is used to activate and deactivate the stimulation device 20. This on-off switch 25 may be for example a push button, which turns the stimulation device 20 on or off when pressed for longer, or a latching slide switch.

5 A socket 26 is used for the external power supply to the stimulation device 20 via an external plug 27, which for example is connected to an external power adapter. To ensure water spray resistance of the stimulation device 20, instead of the socket 26 a magnetic-inductive transmitter may be provided, which allows power transmission into the stimulation device 20 without an electrically conductive contact. The stimulation device 20 also has a battery de-
10 vice 28, having for example a rechargeable battery, for example a nickel metal hydride (NiMH) rechargeable battery, or a lithium rechargeable battery, for wireless operation. Alternatively or additionally, a (longer) power supply cable may lead out of the stimulation device. Likewise, alternatively or additionally, the magnetic contacts may be provided as a power supply connector.

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The schematic cross-section in Fig. 1b shows the housing opening 22 for placing on the clitoris 30, a pressure chamber 4, as well as the drive device 32 of the stimulation device 20.

A control device 29 controls the drive device 32, the operating elements 23 and the indicator
20 24. The control device 29 and the drive device 32 are supplied with power from the internal battery device 28 and/or the external power supply 27. The control device 29, which for example has a microcontroller or is hardwired, first controls the power supply of all loads of the stimulation device 20, and optionally a charging and discharging process of the battery device 28 and/or battery management. In particular, the control device 29 controls the drive
25 unit 32, for example the modulation of the pressure field and so on. Furthermore, the control device 29 may have a memory, in which at least one modulation or stimulation pattern is stored. The excitation of the drive device 32 can now be controlled as chosen by the user of the stimulation device 20 according to this prestored stimulation pattern via the operating elements 23. The stimulation patterns of the pressure field may optionally also be individual-
30 ly created and stored by the user via the operating elements.

Embodiments for an arrangement for a stimulation device or arrangements for the drive unit
32 and the pressure chamber 4 are described below with reference to Fig. 2 to 17, in each of which arrangements coil elements of an electromagnetic linear drive are moveably or movably
35 arranged in a stationary permanent magnetic field.

In the arrangements depicted in Fig. 2, a movable wall portion 1 connected to a carrier 5 is moved back and forth by at least one moving or plunger coil 2, attached to said carrier, corresponding to a coil power supply input by means of the control current in a magnetic field 3 provided by permanent magnets, in order to thereby move the wall portion 1 back and forth during operation in order to thereby generate a variable pressure field.

The movable wall portion 1 (for example made of a polymer or paper) as part of a pressure chamber 4 of the stimulation device is attached to a carrier 5 (for example made of aluminum, Kapton, or an aluminum-Kapton laminate). The movable wall portion 1 may be integrated into the chamber by means of a recessed channel 6, which mechanically follows the strokes of the movable wall portion 1 to the greatest extent possible without any mechanical strain. Wrapped around the carrier 5 are coil elements of a moving coil 2, which during operation are supplied with power by the control current from a control unit. The moving coil 2 consists of electrical conductors made of a material having the greatest electrical conductivity possible (for example copper or silver), which are insulated from each other and the carrier 5 by means of an electrically insulating lacquer. The magnetic field is provided by at least one permanent magnet 7, which may have a ring shape. The magnetic flux is carried by means of pole plates 9, which have a rear pole plate 8 (for example, as in Fig. 2, having a cylindrical shape) and an upper pole plate 9a (for example, as in Fig. 2, having a ring shape) across a, for example, ring-shaped air gap 10 to the cylindrical pole core 11. Just like the pole core 11, the rear pole plate 8 and upper pole plate 9 are made of a magnetic, highly permeable material (for example a soft magnetic material alloy).

For the inductance of the structurally narrowest air gap possible between the upper pole plate 9a and the pole core 11, the permanent magnet 7 requires as high a flux density as possible, which is why the strongest possible permanent magnets having flux densities of approximately 0.5 to approximately 1.2 T (for example, neodymium-iron-boron magnets) are used, which generate strong magnetic fields and have a low weight.

The carrier 5 with the moving coil 2 is structurally centered and guided in the air gap 10 by means of at least one bracket or mount 12 (for example, made of plastics material, textile fabric or paper) to prevent wobbling motions of the moving coil 1. The bracket or mount 12 is attached to a frame 13 (for example, made of plastics material, aluminum or magnesium).

To move the movable wall portion 1, the moving coil 2 is supplied with power by a control alternating current from a control unit. Depending on the current direction or current polarity in the magnetic field of the air gap 10, the moving coil 2 is moved upward or downward by

the Lorentz force. The directions of the Lorentz force, the magnetic field and the current flow are perpendicular to each other in Fig. 2. The stroke of the deflection of the moving coil 2 is determined by the amplitude of the control current. The frequency of the alternating current corresponds to the frequency of the moving coil motion and thus the frequency of the movement of the movable wall portion 1. The frequency and the stroke of the moving coil and thus the movement of the movable wall portion 1 may be controlled independently of each other in a comparatively simple manner by the current frequency and the current amplitude. The changing pressure field and the resulting variable positive and negative pressure at the erogenous body zone (clitoris) can be controlled independently of each other by the alternating compression and expansion of air from the motion of the movable wall portion 1 (or of multiple movable wall portions when operating), in other words in terms of frequency and amplitude.

Based on the direct transmission, an expanded frequency range from less than 1 Hz to several hundred Hz is easily possible using this principle. The direct current from the rechargeable battery must only be converted into alternating current. Conversion into an alternating current may comprise the turning on and off and/or the superimposition of direct current portions. An alternating current voltage can hereby be provided using a direct current offset. For example, an alternating current voltage may be provided which does not comprise any polarity change, but only a change of the voltage level given a constant voltage direction (polarity).

According to the illustration on the right in Fig. 2, the arrangement may have a pressure chamber with multiple pressure subchambers, with an additional pressure chamber 16 provided next to pressure chamber 4, so that connected pressure subchambers are provided that are connected via a connection channel 15. The housing opening for enabling the variable pressure to act on the clitoris is provided on the additional pressure chamber 16. The pressure chamber 4 and the additional pressure chamber 16 are also provided in the embodiment in Fig. 3.

Generating the variable pressure field by moving the movable wall portion 1 (and thus the positive and negative pressure) is accompanied by sounds being generated, i.e. local pressure fluctuations in the air, which can be heard by the human ear and propagate at the speed of sound. The sounds inherent with the movement of the movable wall portion 1 may be absorbed, i.e. the sound energy can be converted into heat.

In Fig. 3 (right-hand side), the sounds are dissipated in the air as heat according to the absorption principle of a plate transducer by the friction in at least one of the chamber walls 18, which is formed with another movable wall portion, as well as by the friction of the vibrating chamber wall. The chamber wall 18 vibrating for sound absorption purposes is also integrated into the chamber by a spring device 17 acting in a spring-like manner. Acoustic energy is ultimately transformed into heat and dissipated by the deformation of the spring and the thus generated friction in the spring device 17. The plate transducer is a narrow-band resonance absorber, the weight and spring deflection of which are to be selected such that the characteristic absorber frequency for a preferably high level of sound absorption as a function of the sound frequency is preferably near or in the frequency range of the movement of the movable wall portion 1. In addition, the sounds created by the piston or membrane movement are to be dissipated as heat into a porous structure according to the absorption principle.

The chamber walls 18 may be formed having a porous structure and may be integrated in the plate transducer for example or alternatively mounted on the plate transducer. The sounds are absorbed by means of the viscous current losses of the air through friction on the porous damping material and the friction from the deformation of the material. The porous absorber is a broad-band absorber, the coating thickness and material of which are to be selected such that the characteristic absorber frequency for the highest possible level of absorption is near or in the frequency range of the movement of the movable wall portion 1. By means of the absorption according to the plate transducer principle or in a porous structure, sound propagation is reduced as much as possible.

The drive unit is formed with few movable, low-weight components and therefore has few unbalanced free inertial forces to initiate oscillations or vibrations of the components or the housing of the stimulation device at certain movable wall portions. In addition, as shown in Fig. 3, the other movable wall portion of the chamber wall 19 can be configured optionally to have a ferrofluid 14 for damping the resonances of the moving coil 2 and a frame 13 or an enclosed chamber (not completely filled), as a result of which the cooling of the moving coil 2 and the carrier 4 is also improved by the increased heat conduction compared to air. The heat capacity of the intentionally lightweight-built moving coil 2 and carrier 5 is low.

The flexibility in the configuration of the drive allows a large amount of freedom in designing the stimulation device to shape the drive in an elongated or wide manner, and to also decrease the local pressure fluctuations propagating at the speed of sound by means of sound absorption measures in the chamber (cf. Fig. 3).

The drive unit or device has a comparatively low complexity due to the direct conversion of the electrical energy from the battery unit 28, for example from the rechargeable battery, into a translational movement of a simple moving coil coupled to the movable wall portion 1, which may be formed in the various embodiments – regardless of the actual drive – for example having a piston, a rigid wall portion and/or a membrane, which may be made of an elastic material at least in portions. The direct conversion also results in potentially higher efficiency, compact construction and low weight.

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- 10 The movable wall portion(s) 1 may be formed as an integral component of the chamber (pressure chamber – chamber, in which the variable pressure field is generated), as a result of which a good seal is ensured against compressible and non-compressible media up to a certain positive and negative pressure of the chamber.
- 15 To keep constant or increase the surface-specific force resulting from the carrier 5 on the movable wall portion 1 while simultaneously having a wide or flat design of the drive (i.e. with a compact moving coil 2 and the carrier 5), the movable wall portion 1 can be moved by means of more than one coil 2 and more than one carrier 5, as depicted in Fig. 4.
- 20 The flexibility of the drive at a constant or increased specific surface force on the movable wall portion 1 is also increased in the embodiment from Fig. 5. For absorption purposes, devices according to the plate transducer principle 17 or in the form of porous structures 18 are also provided here.
- 25 The sounds emitted on the rear side of the movable wall portion 1 are absorbed in all embodiments for example by a device according to the plate transducer principle or in a porous structure, and thereby reduced to the largest extent possible (not shown).

In the arrangement depicted in Fig. 6, fine conductors of the coil 2, through which conductors current flows, are located directly on at least one movable wall portion 1.

On at least one side of the movable wall portion 1, there is at least one permanent magnet 7, for example in the form of a bar magnet as shown in Fig. 6. For the inductance of the air gap 4 to be kept as structurally narrow as possible between the permanent magnet 7 and the movable wall portion 2 having the electrical conductors 2, the permanent magnet 7 requires the highest possible flux density, which is why the strongest possible permanent magnets with flux densities of 0.5 ... 1.2 T (for example neodymium-iron-boron magnets) are used,

which generate a strong magnetic field 3 and have a low weight. The movable wall portion 1 (for example made of a polymer or paper) as part of a first chamber of the stimulation device 9 may be integrated into the chamber by means of a recessed channel, which mechanically follows the strokes of the movable wall portion 1 to the largest extent without mechanical loads. The electrical conductors 2 on the movable wall portion 1 are made of the most electrically conductive material possible (for example copper or silver) and electrically insulated from each other by integration into the movable wall portion 1. The magnetic flux is carried by means of lateral pole plates 19 (for example, as in Fig. 6, in a rod shape) across the air gap 4. The lateral pole plates 19 are made of a material having high magnetic permeability (for example, a soft magnetic material alloy). The chamber of the stimulation device 9, the permanent magnet 7 as well as the lateral pole plates 19 are attached to a frame 8 (for example made of plastics material, aluminum or magnesium).

To move the movable wall portion 1, the thin electrical conductors 2 are supplied with a control alternating current from a control unit. The electrical conductors 2 are moved upward or downward by the Lorentz force depending on the current direction or current polarity in the magnetic field of the air gap 4. The drive forces engage uniformly with the entire surface of the movable wall portion 1. The directions of the Lorentz forces, the magnetic field and the current flow are perpendicular to each other in Fig. 6. In the variant with two permanent magnets arranged in an antipolar manner in Fig. 6 (right-hand side), the electrical conductors must be supplied with power via the two permanent magnets 7 each having a different polarity in order to effect the same movement.

The stroke of the deflection of the electrical conductors integrated in the movable wall portion 1 is determined by the amplitude of the control current. The frequency of the alternating current corresponds to the frequency of the conductor movement and thus the frequency of the movement of the movable wall portion 1. The frequency and the stroke of the movable wall portion 1 can thus be controlled independently of each other in a comparatively simple manner by the current frequency and current amplitude. The variable pressure field and the resulting positive and negative pressure on the erogenous body zone (clitoris) can be controlled independently of each other by the alternating compression and expansion of the air through the movement of the movable wall portion 1, in other words in terms of frequency and amplitude.

Due to the direct transmission, an expanded frequency range from below 1 Hz to several hundred Hz is easily possible using this principle. The direct current from the rechargeable battery must only be converted into alternating current. The conversion into an alternating

current may comprise the turning on and off and/or the superimposition of direct current portions. An alternating current voltage having a direct current offset can hereby be provided. For example, an alternating current voltage can be provided that does not comprise any polarity change, but only a change of the voltage level given a constant voltage direction (polarity).

Alternatively, the drive unit may also be formed in a ring shape as depicted in Fig. 7.

In the electromagnetically planar ring-shaped transformer, the membrane is circular. The permanent magnet 7, the electrical conductors 2, the lateral pole plate 19 as well as the bracket are ring-shaped, for example. In the symmetrical axis of the drive unit, a pole core 11 is provided to better control the magnetic field. Alternatively, the drive unit may also be connected via a connection channel 10 to a second chamber 11, as shown in Fig. 8.

Alternatively, also as in Fig. 9, there may be at least one second chamber 11 on the side of the drive unit.

In one embodiment having a second chamber 11 on the side (left) or opposite (right) of the movable wall portion 1, sound-absorbing devices may be provided according to the plate transducer principle or in a porous structure, as in Fig. 10.

By means of the sound-absorbing devices, the sound propagation inherent with the movement of the movable wall portion 1 is reduced to the greatest extent possible.

Alternatively, the two-chamber embodiments from Fig. 9 (right) and Fig. 10 (right) may also be ring-shaped.

To generate the highest possible flux density in the air gap 4 to be kept as structurally narrow as possible and to thereby keep constant or increase the surface-specific force on the movable wall portion 1, permanent magnets 7, as depicted in Fig. 12, may alternatively be arranged on both sides of the movable wall portion 1.

The design of the drive with permanent magnets 7 on both sides of the movable wall portion 1 in Fig. 12 may be executed with two permanent magnets arranged in an antipolar manner in each case above and below the movable wall portion 1 (left) or alternatively with two ring-shaped permanent magnets above and below the movable wall portion 1 (right).

The sounds emitted on the rear side of the movable wall portion 1 are absorbed in all embodiments for example by a device according to the plate transducer principle or in a porous structure, and thereby reduced to the largest extent possible (not shown).

- 5 In the electromagnetic transformer depicted in Fig. 13, fine conductors, through which current flows, are located directly on the movable wall portion 1, which has at least one thin membrane, which is folded in a lamella shape (lamellar membrane).

On at least one side of the lamellar membrane, there is at least one permanent magnet 7
10 (left) for example in the form of a bar magnet, as shown in Fig. 13. For the inductance of the air gap 4 to be kept as structurally narrow as possible between the permanent magnet 7 and the lamellar membrane with the electrical conductors 2, the permanent magnet 7 requires the highest possible flux density, which is why the strongest possible permanent magnets with flux densities of 0.5 ... 1.2 T (for example neodymium-iron-boron magnets) are used,
15 which generate a strong magnetic field 3 and have a low weight. The lamellar membrane (for example made of a polymer, e.g. polyamide, polyester or polyimide) as part of a first chamber of the stimulation device 10 may be integrated in the chamber by means of a recessed channel, which mechanically follows the travel of the movable wall portion 1 largely without mechanical loads. The electrically insulated conductors 2 on the lamellar membrane are
20 made of the most electrically conductive material possible (for example copper or silver) and bonded onto the lamellar membrane for example. The magnetic flux is carried by means of lateral pole plates 19 (for example, as in Fig. 13, in a wand form) across the air gap 4. The lateral pole plates 19 are made of a material having high magnetic permeability (for example a soft magnetic material alloy). The chamber of the stimulation device 10, the permanent
25 magnet 7 and the lateral pole plates 19 are attached in a frame 9 (for example made of plastics material, aluminum or magnesium).

As shown in Fig. 13, the lamellar membrane is overlaid in a meandering manner with parallel-running electrical conductor paths 2. The current flow direction must be identical for all
30 conductor paths since the magnetic field 3 also has the same direction everywhere in the air gap 4 to be kept as structurally narrow as possible. On the lamellar membrane, the electrical conductors 2 are guided in a meandering manner in such a way that the adjoining lamella each have current flowing through them in the opposite direction. To move the lamellar membrane 1, the thin electrical conductors 2 are supplied with energy using a control alternating current from a control unit. Depending on the current flow direction or the polarity, the
35 lamella move based on the Lorentz force toward or away from each other and press the air out of their intermediate space or suck it in. Alternatively, the movement of the lamellar

membrane can also be achieved with an alternating current voltage, which does not comprise any polarity change, but only a change of the voltage level while the voltage direction (polarity) remains constant. By the folding into a lamellar shape, a significantly increased membrane surface becomes active. Despite the comparatively large membrane surface, the entire membrane surface is driven uniformly. Alternatively, multiple permanent magnets 7 in Fig. 13 (right) can be arranged under the lamellar membranes.

The stroke of the deflection of the electrical conductors integrated in the lamellar membrane is determined by the amplitude of the control current. The frequency of the alternating current corresponds to the frequency of the conductor movement and thus the frequency of the movement of the lamellar membrane. The frequency and the stroke of the lamellar membrane movement can thus be controlled independently of each other in a comparatively simple manner using the current frequency and current amplitude. The variable pressure field and the resulting positive and negative pressure on the erogenous body zone (clitoris) can be controlled independently of each other by the alternating compression and expansion of the air through the movement of the pulling together and pushing apart of the lamellar membrane, in other words in terms of frequency and amplitude.

Due to the direct transmission, an expanded frequency range from less than 1 Hz to several hundred Hz is easily possible using this principle. The direct current from the rechargeable battery must only be converted into alternating current. Conversion into an alternating current may comprise the turning on and off and/or the superimposition of direct current portions. An alternating current voltage can hereby be provided using a direct current offset. For example, an alternating current voltage may be provided which does not comprise any polarity change, but only a change of the voltage level given a constant voltage direction (polarity).

Alternatively, the drive unit may also be connected via the connection channel 15 to the additional chamber 16, as depicted in Fig. 14.

Alternatively, as in Fig. 15, there may also be at least one second chamber 11 on the side of the drive unit.

In one embodiment having a second chamber 11 on the side (left) or opposite (right) of the movable wall portion 1, sound-absorbing devices may be provided according to the plate transducer principle or in a porous structure, as in Fig. 16.

To generate the highest possible flux density in the air gap 4 to be kept as structurally narrow as possible and to thereby keep constant or increase the surface-specific force on the movable wall portion 1, permanent magnets 7, as depicted in Fig. 17, may alternatively be arranged on both sides of the movable wall portion 1.

5

In Fig. 17, the movable wall portion 1 is located directly between poles of the permanent magnets 7 and may also be configured having multiple permanent magnets 7 side by side.

10 The sounds emitted on the rear side of the movable wall portion 1 are absorbed in all embodiments for example by a device according to the plate transducer principle or in a porous structure, and thereby reduced to the largest extent possible (not shown).

15 Fig. 18 to 24 show additional embodiments of an arrangement for a stimulation device or arrangements for the drive unit 32 and the pressure chamber 4. In each case, coil elements of an electromagnetic linear drive are movably or displaceably arranged in a stationary permanent magnetic field. For the same features, the same reference signs are used as in the preceding figures.

20 In the embodiments in Fig. 18 to 24, the suspension or mount 12, which acts as a positioning or centering device for the carrier 5 having the (moving) coil 2, is shown in a neutral starting state, in which no deflection has taken place. In contrast to this, Fig. 25 and 26 show a design in which carrier 5 having the moving coil 2 moves from the neutral starting or zero position (cf. Fig. 18 to 24) downward into the stationary permanent magnetic field 3. Together with the carrier 5, the movable chamber wall portion 1 is hereby moved downward. During
25 operation, the carrier 5 having the moving coil 2 and the movable chamber wall portion 1 oscillate about the neutral rest position, starting from the deflected starting position shown in Fig. 25 and 26. In other embodiments, in particular the examples shown in Fig. 18 to 24, oscillations occur about this neutral starting position starting from the neutral rest position shown in Fig. 18 to 24.

30

The designs in Fig. 25 and 26 make it possible in particular to apply an electrical current with non-changing polarity to the moving coil 2 in order to operate same. By contrast, a current with changing polarity is provided in other embodiments, for example in one or more of the embodiments in Fig. 18 to 24. During operation, embodiments other than those shown in
35 Fig. 25 and 26 may also be operated about a deflected position that differs from the neutral rest or starting position.

In the embodiments in Fig. 18 to 21, the coil 2 has an upper subcoil 2a and a lower subcoil 2b with separate coil windings. In regard to the examples in Fig. 18 and 19, the upper and lower subcoils 2a, 2b are each arranged opposite pole plates 9, wherein the permanent magnets 7 are arranged on the outside (Fig. 18) or the inside (Fig. 19) in relation to the coil 2. The design supports arranged on the inside forming an optimized magnetic inductance.

Also in the examples in Fig. 20 and 21, the permanent magnets 7 are arranged on the outside in relation to the moving coil 2. The arrangement shown there of the permanent magnets 7, which, in comparison to the embodiment in Fig. 18, are arranged instead of the upper pole cap 9a or the lower pole cap 9b, supports a flat design.

In comparison to the embodiments in Fig. 18 to 21, the designs in Fig. 22 to 24 use a one-piece coil 2, where here, too, the permanent magnets 7 may be arranged on the inside and outside in relation to the coil 2 according to Fig. 22 and 23. In the design in Fig. 24, the permanent magnets 7 are arranged below the moving coil 2.

In the example in Fig. 18, upper and lower pole caps 9a, 9b are provided, which are arranged above and below the permanent magnets 7. In the embodiment in Fig. 19, the upper and lower pole caps 9a, 9b are arranged above and below, and in contact with, a central pole cap 9c.

In the embodiments in Fig. 25 and 26, the permanent magnets 7 are arranged between, and in contact with, the upper pole plate 9a and the rear pole plate 8. According to Fig. 25, a spring 40 is provided, which provides a spring pretension against the depicted deflected position of the carrier 5 having the moving coil 2. Fig. 26 depicts an alternative design, in which the spring 40 is omitted. A pretension can be provided here by means of the suspension/mount 12.

The features disclosed in the preceding description, claims and drawings may be of significance both individually as well as in any combination for achieving the various embodiments.

PATENTKRAV

1. Apparat til stimulation af klitoris ved hjælp af et variabelt trykfelt, med:

- 5 - et hus (21), på hvilket et greb-afsnit og et stimulationsafsnit er dannet;
- en drivindretning (32), som er arrangeret i huset (21) og indrettet til re-
- peterbart at tilvejebringe en drivbevægelse;
- et trykkammer (4, 16), som er arrangeret i huset (21) med henblik på
- tilvejebringelse af et variabelt trykfelt i huset (21) og i det mindste afsnits-
- 10 vist er omgivet af en kammervæg;
- et bevægeligt kammervægafsnit (1), som danner et afsnit af kammer-
- væggen og er koblet til drivindretningen (32), således at det bevægelige
- kammervægafsnit (1) som reaktion på den dertil koblede drivbevægelse
- repetert kan bevæges mellem forskellige vægpositioner, hvorved et
- 15 kammervolumen i trykkammeret (4, 16) repetert gøres større eller gø-
- res mindre med henblik på frembringelse af det variable trykfelt;
- en husåbning (22), som er arrangeret i stimulationsafsnittet og står i
- fluidforbindelse med trykkammeret (4, 16), således at det ved hjælp af
- trykkammeret (4, 16) frembragte variable trykfelt via husåbningen (22)
- 20 kan afgives i form af under- og overtryk; og
- en batteriindretning (28), der er indrettet til at tilvejebringe en drivenergi
- til drivindretningen (32);

hvorved, i drivindretningen (32), en spoleindretning, gennem hvilken der under

25 driften løber en elektrisk strøm, er bevægeligt arrangeret i et tilordnet, stationært

permanentmagnetfelt (3) og er koblet til det bevægelige kammervægafsnit (1)

med henblik på at overføre drivbevægelsen, hvorved det stationære permanent-

magnetfelt (3) er tilvejebragt ved hjælp af en eller flere permanentmagneter (7),

som er arrangeret inden for spoleindretningens spolevindinger.

30

2. Apparat ifølge krav 1,

kendetegnet ved, at det bevægelige kammervægafsnit (1) omfatter en fleksibelt

deformerbar membran.

3. Apparat ifølge krav 2,

kendetegnet ved, at den fleksibelt deformerbare membran omfatter et elastisk membranafsnit, der, under den gentagne bevægelse af det bevægelige kammer-
5 vægafsnit (1), ekspanderes mellem de forskellige vægpositioner og igen trækkes sammen.

4. Apparat ifølge krav 2 eller 3,

kendetegnet ved, at det bevægelige kammervægafsnit (1) helt er dannet af den
10 fleksibelt deformerbare membran.

5. Apparat ifølge mindst eet af kravene 1 til 3,

kendetegnet ved, at det bevægelige kammervægafsnit (1) omfatter et stift væg-
afsnit, som repeterbart kan bevæges mellem forskellige tilordnede vægpositioner
15 som reaktion på den indkoblede drivbevægelse.

6. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at spoleindretningens første spoleelementer er arrangeret på
det bevægelige kammervægafsnit (1), hvorved de første spoleelementer fortrins-
20 vis er indlejret, i det mindste afsnitvist, i et membranmateriale i den fleksibelt
deformerbare membran.

7. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at det bevægelige kammervægafsnit (1) er bølgeformet.
25

8. Apparat ifølge krav 6 og 7,

kendetegnet ved, at mindst nogle af spoleelementerne er arrangeret i området
med bølgedale og/eller bølgetoppe for bølgeformen.

30 9. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at anden spoleelementer i spoleapparatet er arrangeret på en
koblingskomponent, der er koblet til det bevægelige kammervægafsnit (1).

10. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at kammervæggen omfatter et yderligere bevægeligt kammer-vægafsnit, som danner et afsnit af kammervæggen og kan bevæges mellem forskellige vægpositioner.

5

11. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at spoleapparatet i det mindste delvist er arrangeret i et installationsrum mellem indbyrdes modstående permanentmagneter (7).

10 12. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at den ene eller flerheden af permanentmagneter (7), ved hjælp af hvilke det tilordnede, stationære permanentmagnetfelt (3) er tilvejebragt, er arrangeret på kammervæggen.

15 13. Apparat ifølge mindst eet af de foregående krav,

kendetegnet ved, at trykkammeret (4, 16) er dannet med en flerhed af indbyrdes fluidisk forbundne tryk-delkamre (4, 16).

14. Apparat ifølge mindst eet af de foregående krav,

20 **kendetegnet ved, at**, under driften, separat dannede spoleelementer i spoleapparatet kan drives med forskellige elektriske strømme.

15. Anvendelse af et apparat ifølge et af de foregående krav til stimulering af en klitoris med et variabelt trykfelt, der er frembragt af apparatet.

25

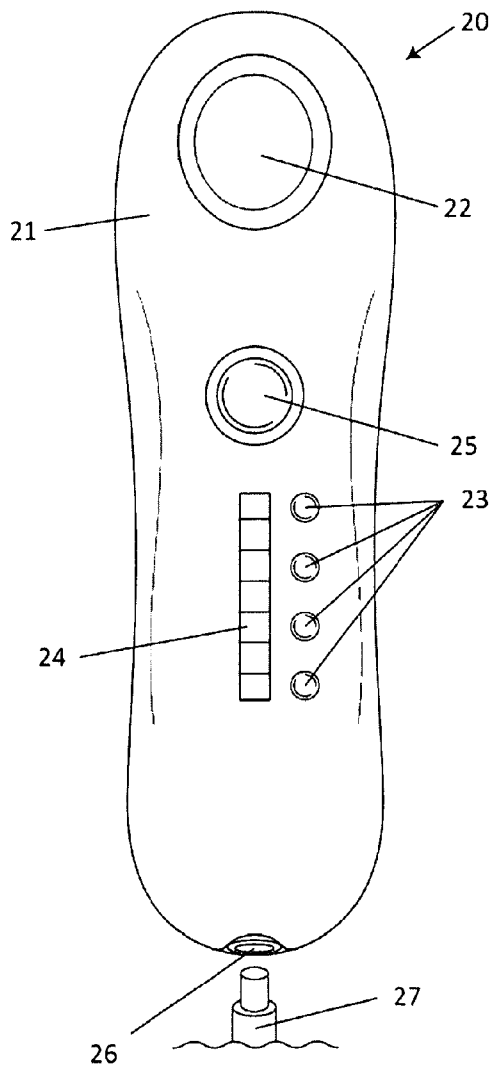


Fig. 1a

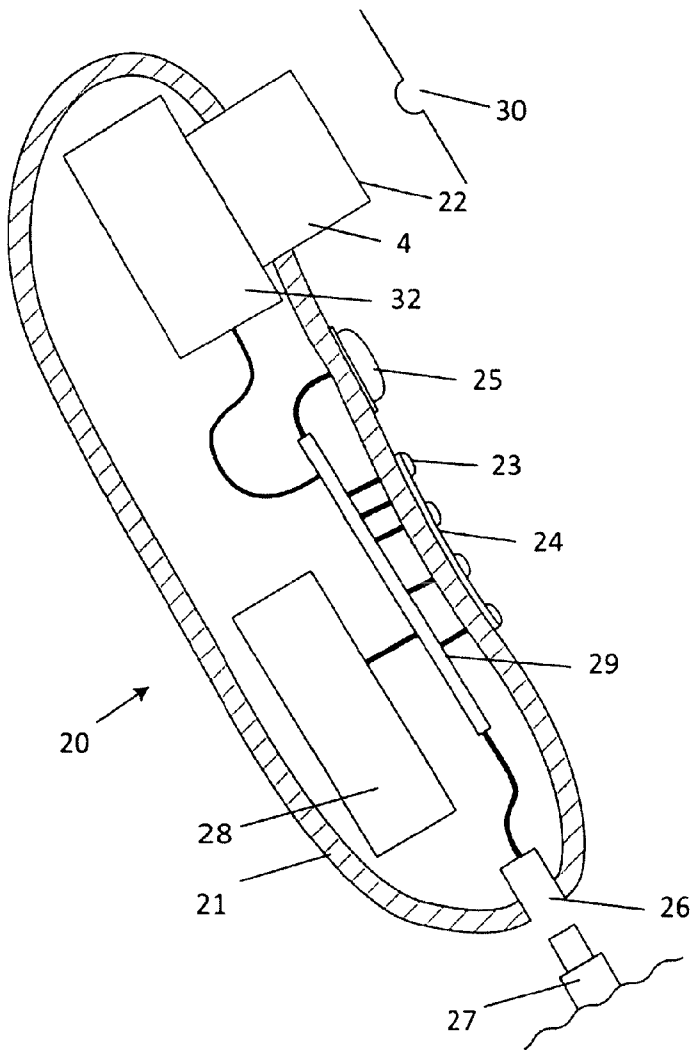


Fig. 1b

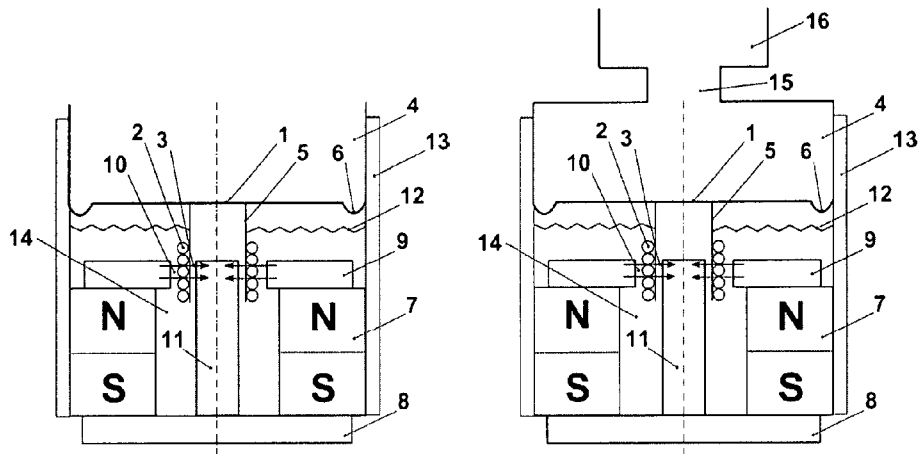


Fig. 2

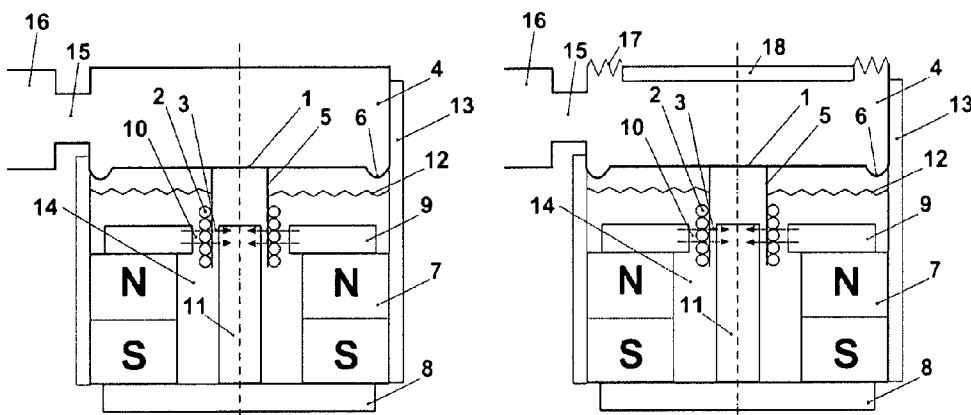


Fig. 3



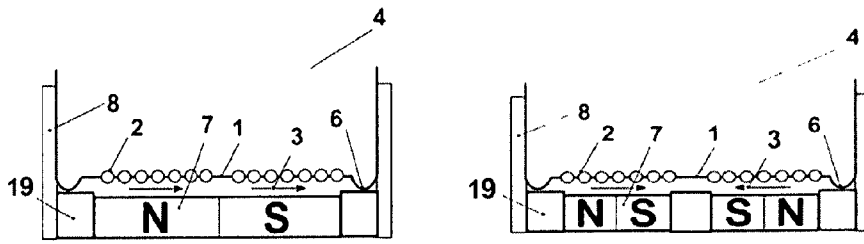


Fig. 6

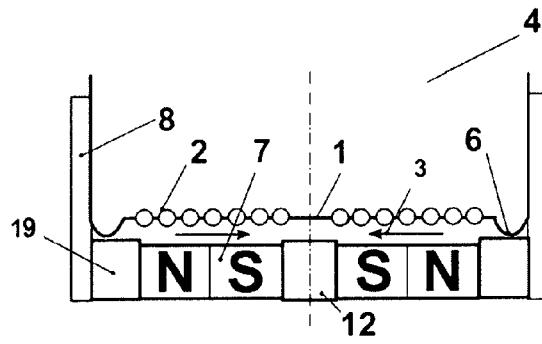


Fig. 7

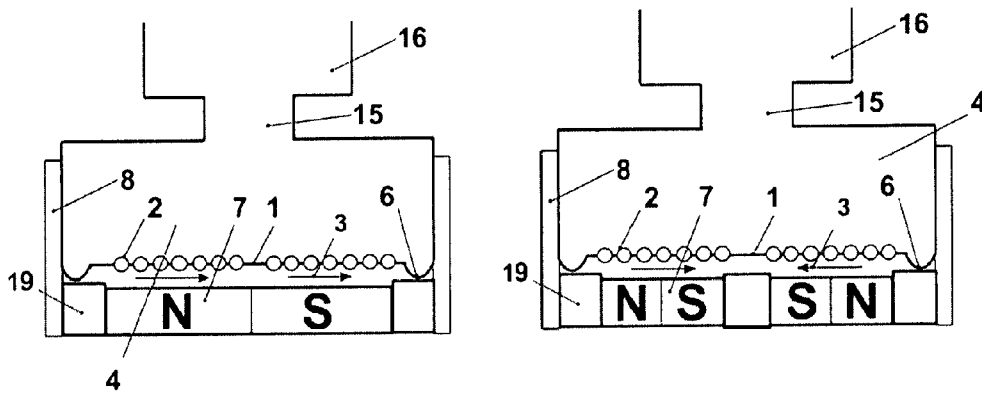


Fig. 8

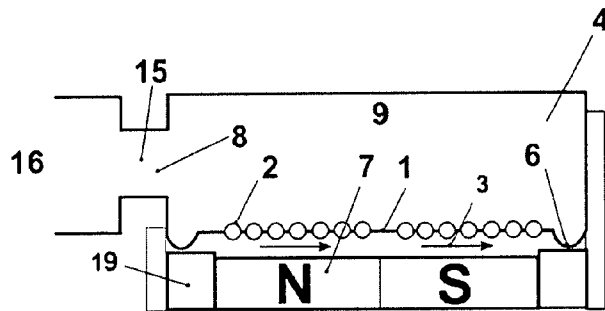


Fig. 9

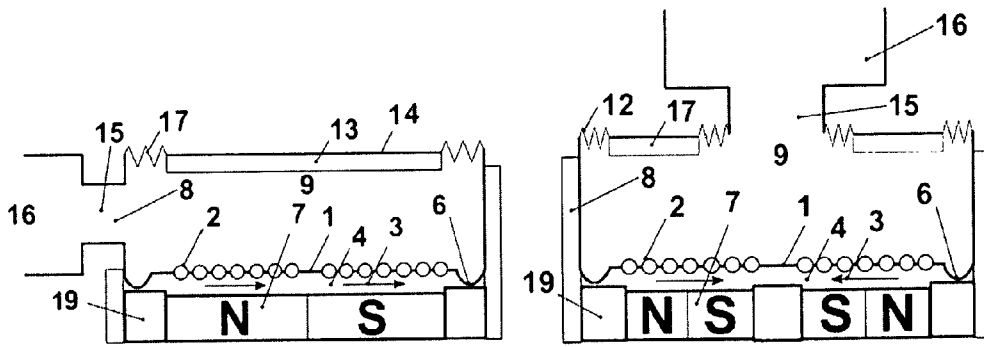


Fig. 10

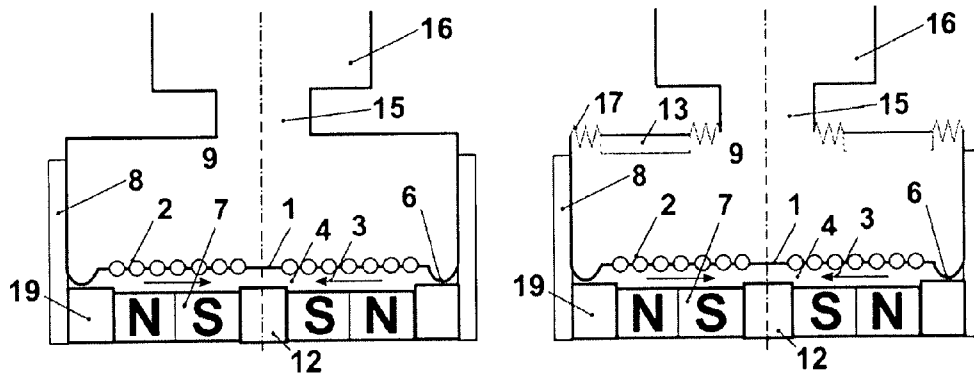


Fig. 11

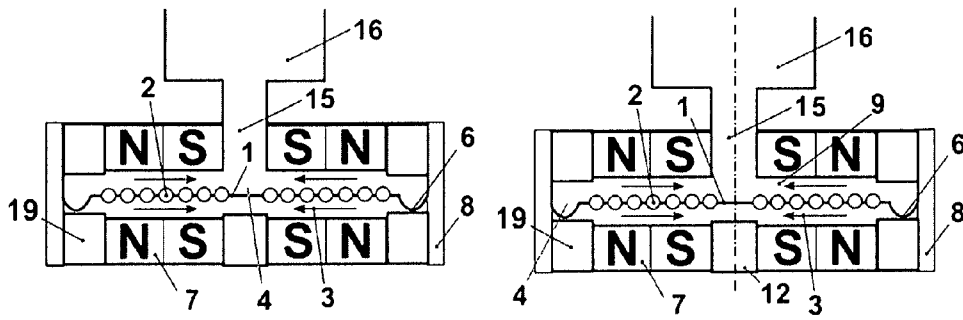


Fig. 12

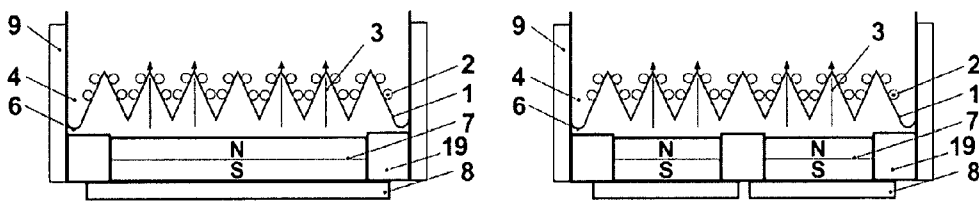


Fig. 13

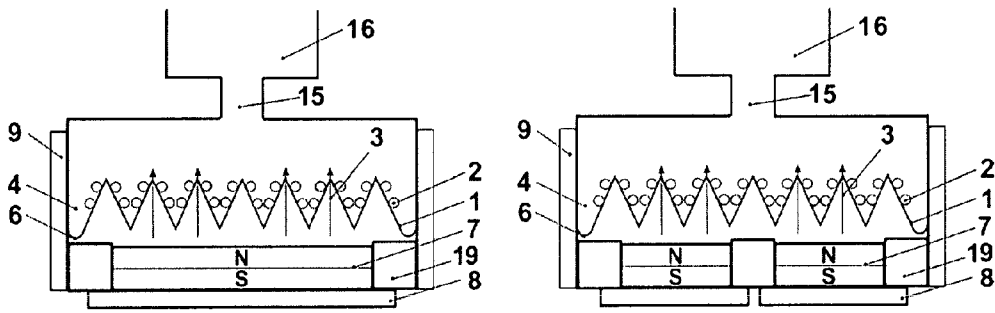


Fig. 14

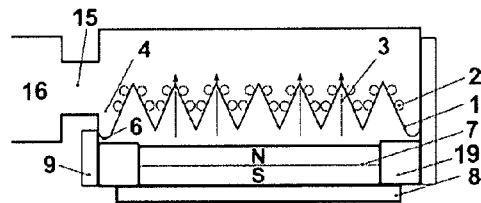


Fig. 15

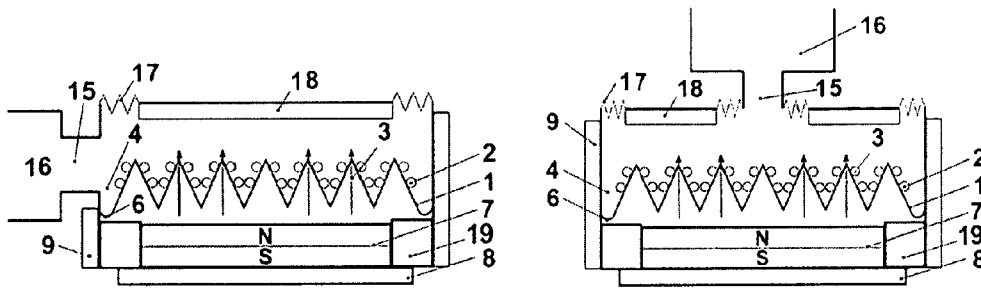


Fig. 16

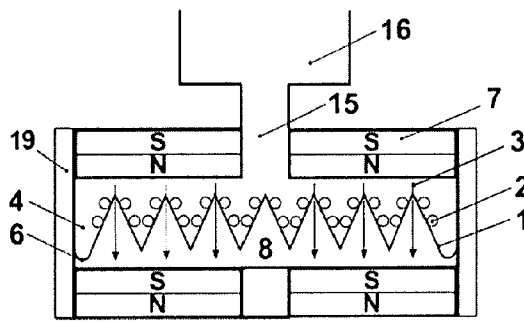


Fig. 17

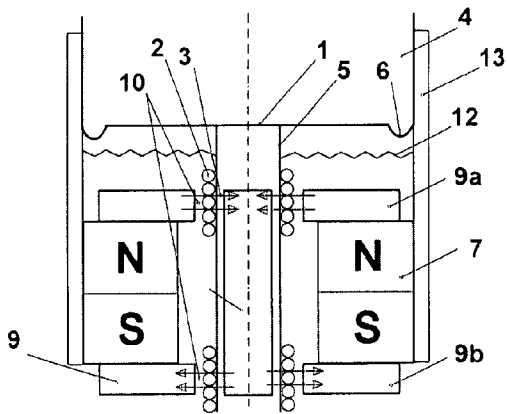


Fig. 18

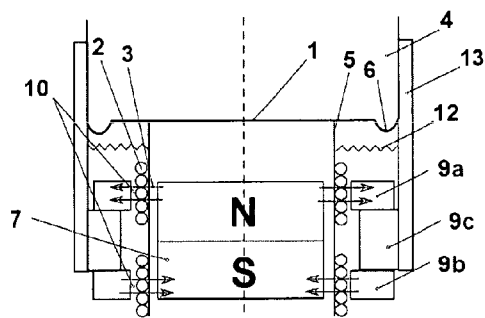


Fig. 19

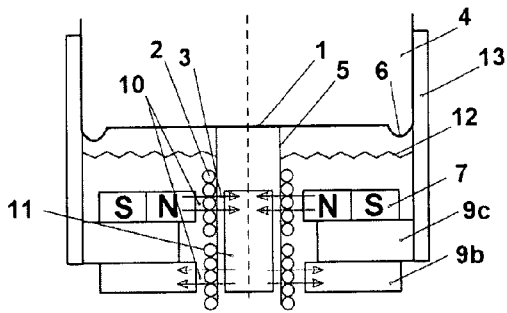


Fig. 20

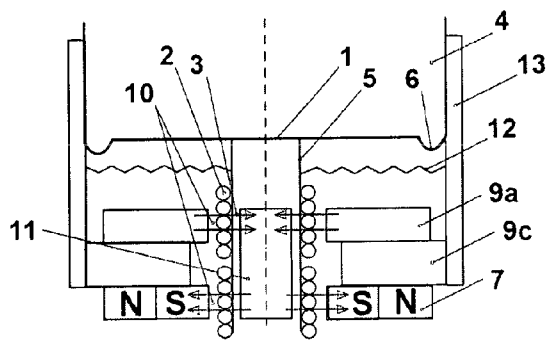


Fig. 21

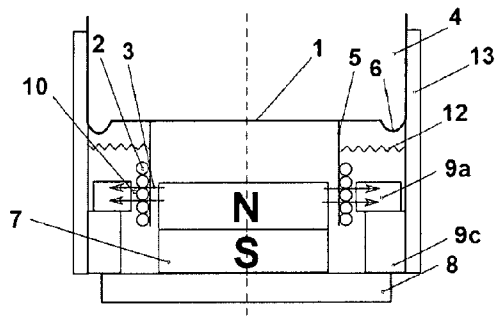


Fig. 22

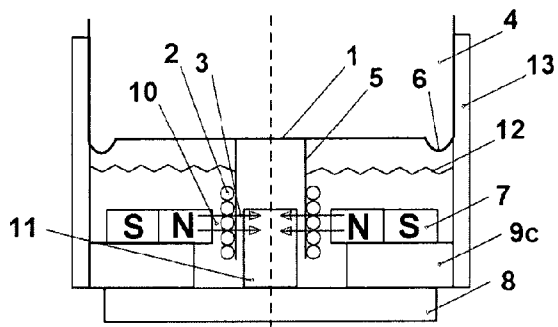


Fig. 23

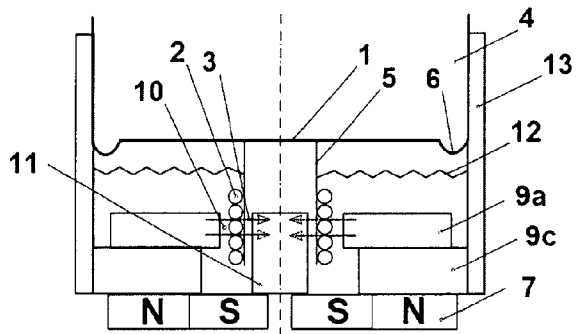


Fig. 24

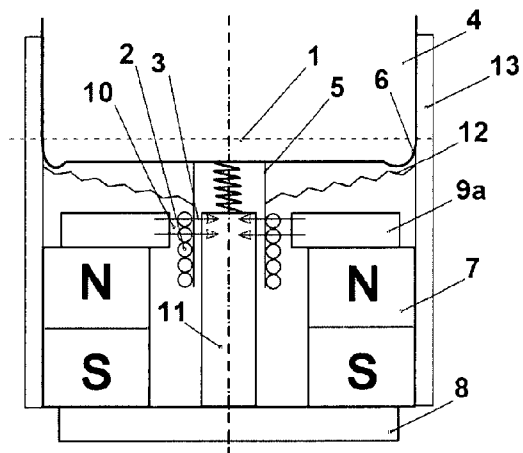


Fig. 25

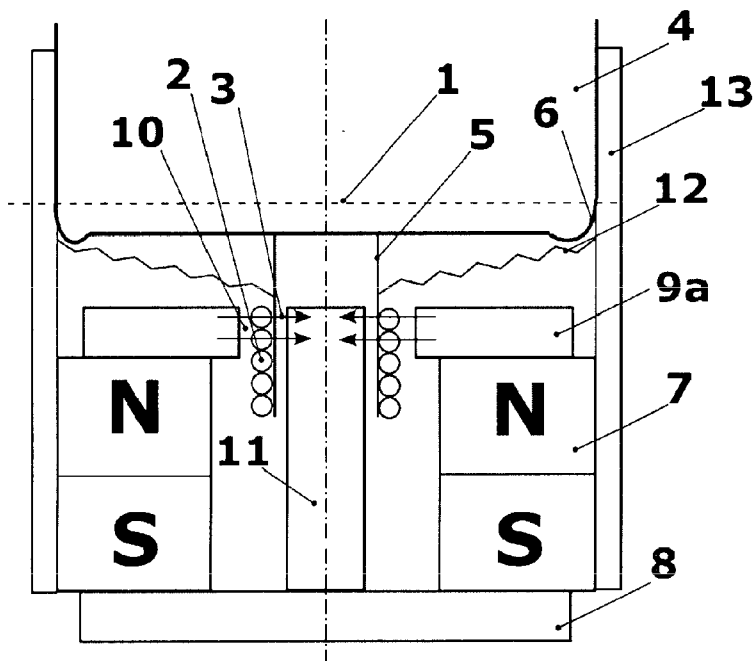


Fig. 26