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

(11) EP 3 485 945 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.05.2019 Bulletin 2019/21

(51) Int Cl.:
A63B 23/20 *(2006.01)*

(21) Application number: **17202277.4**

(22) Date of filing: **17.11.2017**

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

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(54) DEVICE AND METHOD FOR PELVIC FLOOR TRAINING

(57) A device for training pelvic floor muscles comprises a rigid housing (1) for a user to sit on, comprising a ridge (2) with an opening (4) facing the pelvic floor muscles of the user sitting on it, a beam (5) arranged in the housing (1), being flush with or protruding from or facing the opening (4) in the ridge (2), adapted to couple to an activity of the pelvic floor muscles of the user, and a sensor (11) for sensing a movement of and/or a force exerted on the beam (5). A further aspect of the invention concerns a method for training pelvic floor muscles of a user, in particular being performed using the device.

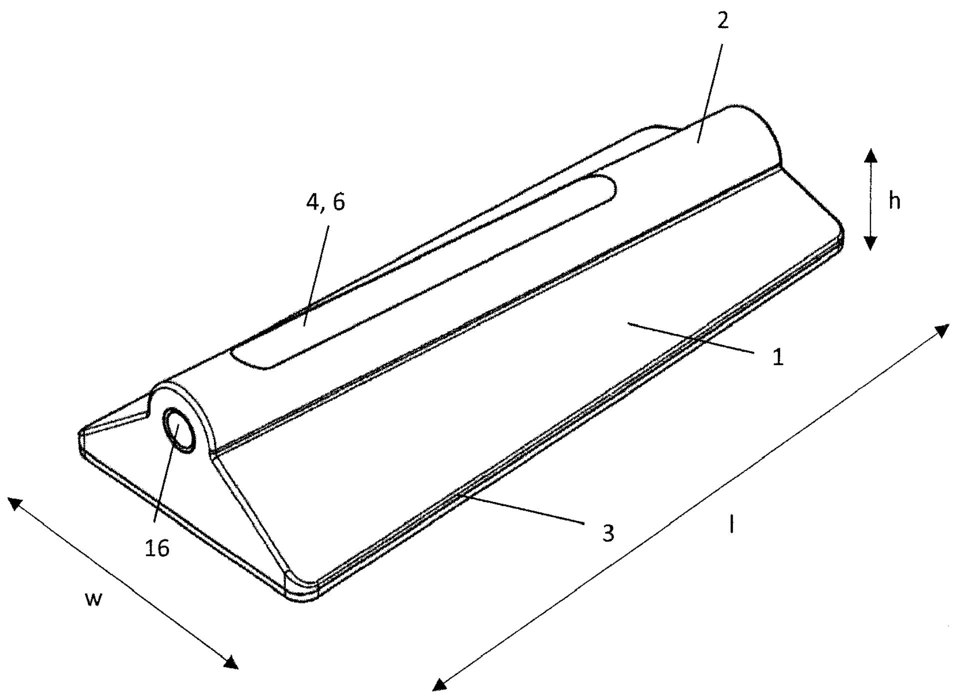

FIG. 3

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Description

Technical Field

[0001] The present invention relates to a device and a method for training pelvic floor muscles of a user. The device comprises a sensor for sensing an activity of the pelvic floor muscles. In an aspect of the invention, an app on a remote electronic device supports the training according to the method. Further aspects of the invention comprise a system and a kit for training the pelvic floor muscles.

Background Art

[0002] The pelvic floor is composed of muscle fibres, such as the levator ani, the coccygeus muscle, and associated connective tissue, which span the area underneath the pelvis. The pelvic floor is important in providing support for pelvic organs, e.g. the bladder, intestines, and the uterus (in women), as well as for the maintenance of continence. However, it can be damaged in pregnancy and childbirth or through pelvic surgery.

[0003] The pelvic floor muscles may be trained by specific exercises, also known as Kegel exercises. As a support for such training, various devices exist, of which some are only applicable by women. However, compliance with a pelvic floor training is often poor, unless the user gets direct feedback, and/or is supervised by a third party, such as a medical doctor. For this reason, some training devices comprise sensors for sensing an activity of the pelvic floor muscles, a disadvantage being that the sensed quantity does often not only indicate an activity of the pelvic floor muscles, but additionally depends on an activity of other muscle groups, such as gluteal and/or abdominal muscles.

Disclosure of the Invention

[0004] The problem to be solved by the present invention is to provide a device and a method for training pelvic floor muscles of a user, which overcome the disadvantages and limitations of the existing methods and devices, or which represent an alternative to the existing methods and devices.

[0005] The problem is solved by a device for training pelvic floor muscles, comprising a rigid housing for a user to sit on comprising a ridge with an opening facing the pelvic floor muscles of the user sitting on it, a beam arranged in the housing, being flush with or protruding from or facing the opening in the ridge, adapted to couple to an activity of the pelvic floor muscles of the user, and a sensor for sensing a movement of and/or a force exerted on the beam.

[0006] In an embodiment, the housing may have a triangular cross-section, or the ridge may protrude, a shape of the housing making it convenient for the user to sit on it. The opening in the ridge allows to sense an activity of the pelvic floor muscles which is transferred to the sensor via a beam. The housing is rigid, e.g. preferably made of metal or hard plastic, such that it does not significantly deform when a user sits on it. Because of the rigidity of the housing and the spatial limitation of the opening, an influence of an activity of other muscle groups than the pelvic floor muscles, such as the gluteal muscles, is prevented. Preferably the beam is also rigid, e.g. made of metal or hard plastic, in order to transfer a movement and/or a force to the sensor in an optimum way.

[0007] Preferably the device comprises communication means adapted to transmit a signal of the sensor to a remote electronic device, in particular wherein the communication means is a Bluetooth transmitter for connecting to a mobile device, and a power supply, in particular a battery, for supplying the sensor and the communication means with power. The remote electronic device may e.g. be a mobile phone or a computer, configured to process and output the signal. Through the preferred wireless connection between the device and the remote electronic device, e.g. by Bluetooth or WLAN, and the preferred power supply by a battery or an accumulator, the device is mobile and light-weight. In a different embodiment, however, the power supply and/or the communication means may be connected to the remote electronic device through a cable.

[0008] The device preferably comprises guiding means, in particular at least one guiding pin, to restrict movements of the beam to a direction perpendicular to the opening in the ridge, and an elastic element, in particular a pressure spring, between the housing and the beam, providing a restoring force for movements of the beam. In a different embodiment, the guiding means may comprise rails or a suspension for the beam, and the elastic element may comprise a piece of rubber. The guiding means and the arrangement of the beam allow to sense a certain muscular activity, i.e. a contraction and/or relaxation of the pelvic floor muscles, while suppressing the influence of other muscular activities in the sensed signal. The elastic element ensures that the beam is coupled to and follows the movements of the pelvic floor muscles, not only during contraction, but also during relaxation. The exact position of the elastic element between the housing and the beam is irrelevant for this purpose; in an embodiment, the elastic element may be positioned between a bottom plate of the housing and the beam; in a different embodiment, it may be positioned between the ridge and the beam.

[0009] Preferably the sensor sensing a force exerted on the beam comprises at least one load cell, where load cell denotes any kind of force sensor such as a strain gauge load cell, a piezoelectric load cell, a hydraulic load cell or a pneumatic load cell, in particular at least one strain gauge, in particular the sensor comprises two or more strain gauges arranged in a Wheatstone bridge configuration. The sensor may also comprise a pressure sensor. The load cell, in particular the at least one strain gauge, allows to precisely determine the force exerted on the beam. For that purpose, in particular the change in resistance of the at least one strain gauge is measured, e.g. in a Wheatstone bridge configuration, which yields precise resistance measurements. Preferably the sensor is initially calibrated with a known force after assembly of the device. In an embodiment, the beam acts on two load cells, and the signal of both load cells is added up.

[0010] In an embodiment, the device comprises a cap covering the opening in the ridge, which cap is preferably made from silicone. The cap makes sitting on the device for the user more convenient than an opening with a bare beam. Also, the cap protects the device from the ingress of dust and water. Thus usability and cleanability of the device are improved.

[0011] Preferably the housing of the device has an extension l in longitudinal direction which represents its largest dimension, a width w and a height h including the ridge, in particular wherein l < 20 cm, and/or in particular wherein w < 8 cm, and/or in particular wherein h < 4 cm. In a preferred embodiment, the choice of l, w and h, as well as the shape of the housing contribute to the convenience of the user sitting on the device. For this reason, the device may neither be too high, nor too wide, i.e. the width w should not be larger than the distance between the user's seating bones. Considerations of sitting convenience do not pose limits onto the extension 1; however, 1 may not be too large for reasons of easy portability. In a different embodiment, the longitudinal extension l, the width w and the height h may also be larger than the limits given above. This may e.g. be the case when the housing has a width w greater than the distance between the user's seating bones, so that an entire weight of the user is put on the housing.

[0012] In a preferred embodiment, the height h and the width w of the housing vary along the longitudinal direction for convenience of the user sitting on it, and letting the user choose a seating position with suitable pressure on the pelvic floor by varying the seating position in longitudinal direction. Besides, the variation in height h along the longitudinal direction may be such that it triggers an upright sitting posture of the user. Tangible numbers for the dimensions of an embodiment of the device are given further below.

[0013] Preferably the opening of the device with the above-mentioned dimensions is elongated in longitudinal direction and aligned with the ridge. In particular the longitudinal extension of the opening is in the range of 5 cm to 20 cm, preferably 11.7 cm, and its width is in the range of 0.5 cm to 2 cm, preferably 1.1 cm. The dimensions and the location of the opening are chosen such that the beam optimally couples to movements of the pelvic floor muscles without picking up an activity of other muscle groups. For this reason, it is sensible that in a preferred embodiment, the opening is located centrally and follows the ridge.

[0014] According to a different aspect of the invention, a kit for training pelvic floor muscles comprises a device according to any of the embodiments described above, and a pad for placing the device on. The pad is preferably made from polyurethane. The pad ensures a good and even coupling of the device to a base below, at the same time reducing a seat height of the device, and making sitting on the device more convenient for the user. Such kit may be offered to the user as a device and a pad packaged together.

[0015] Another aspect of the invention concerns a method for supporting a training of pelvic floor muscles of a user, comprising receiving data indicative of an activity of the pelvic floor muscles, determining calibration values, in particular in response to a maximum contraction of the pelvic floor muscles and an idle state, processing the received data, and outputting the processed data, in particular in a visual and/or acoustic and/or haptic manner. In particular the received data according to the method is supplied by a device as described above, and more specifically by the sensor of the device. Preferably the method is automated, e.g. in an app or a computer program.

[0016] A method does only reasonably support the training, if it is applied by the user in the first place. Hence the method is preferably designed to motivate the user to train. Already a training of 5 min per day according to the method leads to an appreciable enhancement of the pelvic floor muscle performance, thereby decreasing pelvic problems, in particular after childbirth or surgery, reducing incontinence, and improving satisfaction in the user's sexual life.

[0017] An embodiment of the method makes use of the data indicative of an activity of the pelvic floor muscles sensed by the sensor of the device. Determining calibration values is important to account for a user's anatomy and the position of the device relative to the pelvic floor muscles and the buttocks of the user. Preferably the calibration values are taken to be the maximum value x_2 of the sensed signal reached by a wilful contraction of the pelvic floor muscles, and the minimum value x_1 of the sensed signal reached by the user sitting on the device without wilful contraction of the pelvic floor muscles, i.e. the idle state. Embodiments of the processing of received data are described below. The output of the processed data may be presented in numerous different ways. The appearance of the output, however, strongly affects the motivation of the user for training, which shows the importance of an elaborate output comprising visual and/or acoustic and/or haptic feedback to the user. Embodiments of the method with visual output are detailed below. As an acoustic output, it is envisaged to translate the processed data to a tone pitch. In a different embodiment, a sound is played indicating success when the contraction of the pelvic floor muscles reaches a certain level. As a haptic output, the processed data is translated into vibrations, e.g. of the remote electronic device, in yet another embodiment.

[0018] Preferably the step of processing the received data comprises normalising the received data with the calibration values, deriving data indicative of a quantity and/or a dynamics of the contraction of the pelvic floor muscles from the normalised data, and using the derived data in a software representing tasks for the training. Normalising the received data with the calibration values makes the data between different users and different training sessions comparable, and allows for a user adaptation and for a control of the training tasks with the processed data. In an embodiment, the normalised value y may be calculated from the received data x and the calibration values x_1 and x_2 by $y = (x-x_1) / (x_2-x_1)$. Data indicative of a quantity of the contraction characterises the static behaviour of the pelvic floor muscles, whereas data indicative of a dynamics of the contraction describes the change of contraction/relaxation over time, e.g. the speed. Hence deriving such data may comprise signal processing, such as linearising a response function of the sensor, and/or translating the electrical signal of the sensor into physical quantities, e.g. speed or force, and/or taking time derivatives, and/or taking time values, and/or taking force values, and/or others. While the derived data may just be displayed as numbers and/or graphs, in a preferred embodiment, it is used to assign tasks to the user, e.g. exercises how to contract and relax the pelvic floor muscles. The tasks are accompanied by various visual and/or acoustic and/or haptic output.

[0019] In a preferred embodiment, the step of outputting the processed data comprises displaying an avatar that moves in response to the processed data, in particular wherein the avatar moves in at least one dimension. The avatar is preferably a visual representation of the pelvic floor muscles, or it may be a matchstick man or a cartoon animal. In one embodiment, the avatar moves arms and legs remaining in one place, while in another embodiment, it moves its whole body in at least one dimension. Preferably the avatar moves in a predefined manner, e.g. with a constant speed, in one dimension, while moving in response to the processed data in a second dimension. In this way, the app performing the method resembles a game, in which the user controls the movements of the avatar by contraction/relaxation of the pelvic floor muscles. Due to this "gamification" or "exergaming" (exercise plus gaming), the user is motivated for the training.

[0020] A preferred embodiment of the method comprises offering modes to the user, and in response to a selection of a mode, applying the mode in controlling the software. In particular the software supports the modes of training power and/or endurance and/or coordination of the pelvic floor muscles. Preferably tasks are assigned to the user for every mode corresponding to a training of the different criteria of pelvic floor activity.

[0021] Preferably the method comprises receiving additional data indicative of an activity of abdominal muscles of the user, processing the received additional data, and outputting the processed additional data. Using the received additional data, it is possible to detect a co-contraction of the abdominal muscles. In the case of co-contraction, the received data that should be indicative of an activity of the pelvic floor muscles, may at least partially be caused by an activity of the abdominal muscles. In particular, in the processing, the received data may be attributed to an activity of the pelvic floor muscles, if and only if the received additional data indicates negligible activity of the abdominal muscles, e.g. exceeding the activity of the abdominal muscles in an idle state by at most 2 times its standard deviation. In an embodiment, the received additional data is shown to the user as visual and/or acoustic and/or haptic output as a self-control in order to avoid a faulty execution of the training. While the spurious effect of an activity of the gluteal muscles is kept out of the data by the rigidity and the shape of the housing, for a prevention of spurious effects of the abdominal muscles, preferably an additional sensor is required, see also below.

[0022] A further aspect of the invention concerns a computer program element, comprising computer code means for performing a method according to any of the embodiments described above when executed on a processing unit. In a preferred embodiment, the computer program element is an app, which preferably includes the software and supports the user in the training.

[0023] In yet another aspect of the invention, a system for training pelvic floor muscles comprises a device according to any of the embodiments described above, and a remote electronic device, comprising a processing unit and communication means for receiving data from the device including the signal of the sensor, in particular via Bluetooth. The processing unit is configured to execute the above-mentioned computer program element. In an embodiment, the remote electronic device is a mobile device, e.g. a smartphone or a wearable, connected to the device e.g. via Bluetooth or via WLAN. In a different embodiment, the remote electronic device is a computer, e.g. a desktop computer.

[0024] Preferably the system comprises a third device, comprising an additional sensor for sensing an activity of abdominal muscles of a user, and communication means adapted to transmit a signal of the additional sensor to the remote electronic device, in particular via Bluetooth. In particular the remote electronic device is configured to use the transmitted signal for performing the method of discriminating between activities of the pelvic floor muscles and the abdominal muscles described above. In a preferred embodiment, the third device comprises an abdominal belt with the additional sensor mounted to it, in order to sense precisely an activity of the abdominal muscles. The additional sensor may comprise a coil whose change in inductance due to an activity of abdominal muscles is sensed. In a different embodiment, the additional sensor may comprise a strain gauge whose change in resistance due to an activity of abdominal muscles is sensed. It is also envisaged to apply a second belt around the chest of the user with an additional sensor. By means of the two belts together, it is possible to accurately evaluate pulmonary ventilation. The third device may be offered to the user in form of a kit together with the device and the pad.

[0025] In a preferred embodiment, the received data and/or the processed data and/or the received additional data and/or the processed additional data as well as possible scores from the tasks are linked to a time and date and saved in a user profile on the remote electronic device. Preferably a user profile is also stored in a remote database, such as a cloud. Moreover, the received and/or processed data and/or the received and/or processed additional data as well as possible scores from the tasks are preferably transmitted from the remote electronic device of the user to a third party, e.g. a medical doctor as described above. The third party may then define further suitable tasks for the training, set new goals, and/or transmit further tasks to the remote electronic device.

[0026] In a different aspect of the invention, a device is provided for training muscles of a user. The muscles may e.g. comprise muscles moving fingers and/or toes, e.g. in a treatment of Parkinson's disease, or other muscles, e.g. in a therapeutic or fitness training.

[0027] The device comprises a housing with an opening facing the muscles or a body part to be trained, a beam arranged in the housing, being flush with or protruding from or facing the opening, adapted to couple to an activity of the muscles or the body part, and a sensor for sensing a movement of and/or a force exerted on the beam. In particular the housing comprises a ridge, on which the opening is located.

[0028] Preferably the device according to the aspect described in the two paragraphs above comprises communication means adapted to transmit a signal of the sensor to a remote electronic device, in particular wherein the communication means is a Bluetooth transmitter for connecting to a mobile device, and a power supply, in particular a battery, for supplying the sensor and the communication means with power. In particular the device comprises guiding means, in particular at least one guiding pin, to restrict movements of the beam to a direction perpendicular to the opening, and an elastic element, in particular a pressure spring, between the housing and the beam, providing a restoring force for movements of the beam.

[0029] Preferably the sensor of the device according to any of the embodiments described above sensing a force exerted on the beam comprises at least one load cell, in particular at least one strain gauge. In particular the sensor comprises two or more strain gauges arranged in a Wheatstone bridge configuration.

[0030] Preferably the device according to any of the embodiments described above comprises a cap covering the opening. The cap is preferably made from silicone.

[0031] Preferably the housing of the device according to any of the embodiments described above has an extension l in longitudinal direction which represents its largest dimension, a width w and a height h, in particular wherein $l < 20$ cm, and/or in particular wherein $w < 8$ cm, and/or in particular wherein $h < 4$ cm.

[0032] Preferably the opening of the device according to any of the embodiments described above is elongated in longitudinal direction, and in particular aligned with the ridge. In particular a longitudinal extension of the opening is in the range of 5 cm to 20 cm, preferably 11.7 cm, and its width is in the range of 0.5 cm to 2 cm, preferably 1.1 cm.

[0033] A kit for training muscles of a user comprises a device according to any of the embodiments described above, and a pad for placing the device on.

[0034] A method for supporting a training of muscles of a user comprises receiving data indicative of an activity of the muscles, determining calibration values, in particular in response to a maximum contraction of the muscles and an idle state, processing the received data, and outputting the processed data, in particular in a visual and/or acoustic and/or haptic manner. In particular the received data is supplied by the device according to any of the embodiments described above, in particular by the sensor of the device.

[0035] Preferably the step of processing the received data in the method according to any of the embodiments described above comprises normalising the received data with the calibration values, deriving data indicative of a quantity and/or a dynamics of the contraction of the muscles from the normalised data, and using the derived data in a software representing tasks for the training.

[0036] Preferably the step of outputting the processed data in the method according to any of the embodiments described above comprises displaying an avatar that moves in response to the processed data, in particular wherein the avatar moves in at least one dimension. In particular the avatar moves in a predefined manner in one dimension, and moves in response to the processed data in a second dimension.

[0037] Preferably the method according to any of the embodiments described above comprises offering modes to the user, and in response to a selection of a mode, applying the mode in controlling the software, in particular the modes representing a training of power and/or endurance and/or coordination of the muscles.

[0038] Preferably the method according to any of the embodiments described above comprises receiving additional data indicative of an activity of other muscles of the user, processing the received additional data, and outputting the processed additional data.

[0039] A computer program element comprises computer code means for performing a method according to any of the embodiments described above, when executed on a processing unit.

[0040] A system for training muscles comprises a device according to any of the embodiments described above, and a remote electronic device comprising a processing unit and communication means for receiving data from the device including the signal of the sensor, in particular via Bluetooth, wherein the processing unit is configured to execute the computer program element according to any of the embodiments described above.

[0041] Preferably the system according to any of the embodiments described above comprises a third device comprising an additional sensor for sensing an activity of other muscles of a user, and communication means adapted to transmit a signal of the additional sensor to the remote electronic device, in particular via Bluetooth. In particular the remote electronic device is configured to use the transmitted signal for performing the method according to any of the embodiments described above.

[0042] Embodiments only disclosed in combination with one or a group of aspects of the invention shall also be considered disclosed in combination with any of the other aspects of the invention.

Brief Description of the Drawings

[0043] The embodiments defined above and further aspects, features and advantages of the present invention can also be derived from the examples of embodiments to be described hereinafter and are explained with reference to the drawings. In the drawings it is illustrated in:

Fig. 1 a longitudinal cut through a device for training pelvic floor muscles according to an embodiment of the present invention;
Fig. 2 a transversal cut through the device of Fig. 1;
Fig. 3 a perspective view of a device for training pelvic floor muscles according to an embodiment of the present invention;
Fig. 4 a top view onto the device of Fig. 3;
Fig. 5 a side view onto a front end of the device of Fig. 3 from the left;
Fig. 6 a side view onto a front end of the device of Fig. 3 from the right;
Fig. 7 a transversal cut through a device for training pelvic floor muscles according to an embodiment of the present invention, placed on a base and with a user sitting on the device;
Fig. 8 a perspective view of a kit for training pelvic floor muscles according to an embodiment of the present invention comprising a device and a pad;
Fig. 9 a side view onto a longitudinal side of the kit of Fig. 8;
Fig. 10 a schematic view of a system for training pelvic floor muscles according to an embodiment of the invention comprising a device supplying a sensor signal indicative of an activity of the pelvic floor muscles, and a remote electronic device comprising communication means and a processing unit for receiving data from the device, processing and outputting the data;
Fig. 11 a schematic view of a system for training pelvic floor muscles according to an embodiment of the invention comprising the system of Fig. 10, and a third device supplying a sensor signal indicative of an activity of the abdominal muscles;
Fig. 12 a flow chart of a method for supporting a training of pelvic floor muscles according to an embodiment of the invention, which method is performed by an app on a remote electronic device;
Fig. 13 a flow chart of a training cycle of the user performing a method according to an embodiment of the invention.

Modes for Carrying Out the Invention

[0044] Fig. 1 shows a longitudinal cut through a device for training pelvic floor muscles according to an embodiment of the present invention. Fig. 2 complements Fig. 1 with a transversal cut through the device. The device comprises a housing 1 which exhibits a triangular cross-section with a central ridge 2 along a longitudinal dimension of the device as shown in Fig. 2. The housing 1 also comprises a permanently fixed bottom plate 3. The housing 1 has a longitudinal extension 1 which represents its largest dimension, a width w and a height h including the ridge. In a preferred embodiment, the longitudinal extension l is 18.7 cm, the width w varies between 7.8 cm on the left side of Fig. 1 and 6.8 cm on the right side, and the height h including the ridge 2 varies between 3.7 cm on the left side of Fig. 1 and 2.5 cm on the right side. The variation in height h triggers the user to sit in an upright seating posture, and allows the user to choose a suitable and comfortable seating position along the longitudinal extension of the housing. The housing 1 is rigid, and made of e.g. metal or hard plastic, such that a user sitting on it does not significantly deform the housing 1, see also Fig. 7.

[0045] The housing 1 has an elongated opening 4 along the ridge 2, facing the pelvic floor muscles of the user. The opening 4 preferably has a longitudinal extension of 11.7 cm, and a width of 1.1 cm. An opening that is much wider than 2 cm may make the movements of the beam susceptible to an activity of other muscle groups, such as the gluteal muscles.

[0046] A beam 5 is arranged in the housing 1 and extends into the opening 4. The beam 5 possibly protrudes from the opening 4, e.g. by at max 1 cm, or it is flush with the opening 4, or it ends below the opening 4. In the displayed embodiment, there is a cap 6 over the beam 5, covering and/or closing the opening 4 in the ridge 2. The cap 6 is preferably made from silicone or a similar material for reasons of usability, convenience and sealing, the latter allowing for easy cleaning.

[0047] The beam 5 couples to the pelvic floor muscles of the user sitting on the device either directly or through layers of clothing and/or the cap 6. In this way, the beam 5 follows the movements of the pelvic floor muscles, due to contraction and/or relaxation, which the user can perform in a wilful manner. In an embodiment, the movements of the beam 5 are restricted to one dimension by at least one guiding pin 7 and a linear bearing 8 as guiding means, such that the beam 5 can only move perpendicular to the opening 4 facing the pelvic floor muscles. Between the housing 1, in particular the bottom plate 3, and the beam 5, a spring 9, in particular a pressure spring, on a screw 10 is interposed as an elastic element. The spring 9 provides a restoring force for movements of the beam 5, such that the beam 5 follows closely the movements of the pelvic floor muscles.

[0048] Moreover the beam 5 acts onto a sensor 11 via a pressure pin 12. The sensor 11 in turn is mounted to the housing 1, in particular to the bottom plate 3 of the housing 1. The sensor 11 senses movements and/or force and/or pressure of the beam 5 with respect to the housing 1. In an embodiment, the sensor 11 comprises at least one load cell, i.e. any kind of force sensor, in particular at least one strain gauge, indicating a force exerted on the beam 5. In particular, two load cells are mounted between the two ends of the beam 5 and the bottom plate 3, bearing the beam 5 like a bridge. For measurement purposes, the strain gauges are preferably arranged in a Wheatstone bridge configuration for a precise determination of changes in electrical resistance, which are indicative of the force exerted on the beam 5.

[0049] The configuration of the housing 1, the beam 5 and the sensor 11 enables the device to supply measurement values that are predominantly caused by an activity of the pelvic floor muscles of a user. The location and the size of the opening 4 are chosen in such a way that the beam 5 is only displaced by movements of the pelvic floor muscles, but not by other muscle groups. Also through its rigidity, the housing 1 does not deform when a user sits on the device, and the measurement values are not or hardly influenced by an activity of other muscle groups, such as the gluteal muscles.

[0050] As power supply, the device comprises a battery 13, in particular AA battery cells supplying 1.5 V each, housed in a battery case 14 with a battery cover 15 situated in the bottom plate 3 of the housing 1. The battery 13 powers the sensor 11 as well as a printed circuit board 17 which is described below. In an embodiment, the device comprises a power button 16 for manually switching the device on and off. In a different embodiment, the device is switched on automatically when an activity is sensed, and/or switched off automatically after an idle time of a predefined duration.

[0051] In a preferred embodiment, the printed circuit board 17 comprises communication means, such as a Bluetooth transmitter 18 or a WLAN transmitter to supply data of the sensor 11. The sensor data is preferably received by a remote electronic device with an app, which processes and visualises the data. In a different embodiment, the processing of the sensor data or a part of it, e.g. a calibration of the sensor, may be performed by a processor with attached memory on the printed circuit board 17 within the device itself.

[0052] Fig. 3 displays a perspective view of a device for training pelvic floor muscles according to an embodiment of the present invention. Fig. 4 shows a top view onto the device of Fig. 3, Fig. 5 a side view onto a front end of the device of Fig. 3 from the left, and Fig. 6 a side view onto a front end of the device of Fig. 3 from the right. Visible in the view from outside in Figures 3-6 are: the housing 1 with the ridge 2, the bottom plate 3, the opening 4 which is covered by the cap 6, and the power button 16. The size of the device is chosen for portability and convenience of the user. The width of the device is deliberately chosen small enough such that seating bones of a user sitting on the device touch a sitting area outside of the bottom plate 3 of the device. Hence the longitudinal extension l of the housing 1 is preferably less than 20 cm, the width w is preferably less than 8 cm, and the height h is preferably less than 4 cm. With these dimensions, the device is sufficiently small to be mobile and also discrete when applied by the user. The size and location of the opening 4 are chosen such that the opening 4 faces the pelvic floor muscles, and such that a variation in seating position of the user does not hinder the measurements. The opening 4 preferably has a longitudinal extension in the range of 5 cm to 20 cm, and a width in the range of 0.5 cm to 2 cm. Actual numbers for the displayed embodiment are given above.

[0053] It is to be understood that the embodiment shown in Figures 3-6 is only one possible shape allowing to sense an activity of the pelvic floor muscles decoupled from other muscle groups. The triangular cross-section of the housing 1 with the ridge 2 displayed in Figures 5 and 6 makes sitting on the device convenient for the user and simultaneously allows a high degree of decoupling of movements induced by different muscle groups. Also the lozenge-shape of the bottom plate 3 as well as the varying height of the ridge 2 make sitting on the device more convenient for the user. The same effects can, however, be achieved by different shapes of the device. In a different embodiment, the housing 1 is for instance purely triangular in cross-section, where the ridge 2 is formed by the upper corner of the triangle, but not additionally protruding from the triangle. In yet another embodiment, a shape of the housing 1 even deviates from the triangular cross-section.

[0054] Fig. 7 shows a transversal cut through a device for training pelvic floor muscles 21 according to an embodiment of the present invention, placed on a base 19 and with a user sitting on the device. Preferably the base 19 is rigid for a good coupling and transmission of force. The position of the device between buttocks 20 of the user and the base 19 is such that the beam 5 couples via the cap 6 and potentially through one or more layers of clothing to the pelvic floor muscles 21 of the user. From Fig. 7 it can hence be understood how a user moves the beam 5 downwards towards the bottom plate 3 by a wilful activity of the pelvic floor muscles 21.

[0055] Fig. 8 shows a perspective view of a kit for training pelvic floor muscles according to an aspect of the present invention comprising a device as e.g. the one of Fig. 3, and a pad 22. Fig. 9 displays a side view onto a longitudinal side of the kit of Fig. 8. The pad 22 is preferably made of polyurethane, and ensures an even coupling of the device to the underlying base. Moreover, the pad 22 reduces the seat height of the device, and makes sitting on the device more convenient for the user. In a different embodiment, the pad 22 may comprise a relief for the device to be placed in, such that the device has a predefined position on the pad 22, and such that the edges of the bottom plate 3 of the housing 1 are hidden for even more convenience of the user.

[0056] Fig. 10 shows a schematic view of a system for training pelvic floor muscles according to an embodiment of the invention comprising a device 23 supplying a sensor signal indicative of an activity of the pelvic floor muscles, and a remote electronic device 24 comprising a processing unit and communication means 25 for receiving data from the device 23, in particular via Bluetooth. The processing unit is configured to execute a computer program element, e.g. an app, comprising computer code means for performing a method for training the pelvic floor muscles of the user such as the one according to Fig. 11. The sensor of device 23 senses movement and/or force of the pelvic floor muscles and the device 23 transmits the sensed data via communication means, such as a Bluetooth transmitter. The device 23 may preferably be a device according to one or more of Figures 1-9. The remote electronic device 24 may be a mobile device, such as a smartphone, or in another embodiment, it may be a computer with a computer program implemented on it. The remote electronic device 24 receives the sensed data via communication means, such as a Bluetooth receiver, and passes the data to the app executed on the processing unit of the remote electronic device 24.

[0057] The remote electronic device in the system of Fig. 10 may also comprise an interface for exporting and/or importing data from and/or tasks for the user. The interface is particularly used for communication with diagnostic and consulting purposes, e.g. between the user and a third party, such as a medical doctor. The third party gets the data of the sensor, analyses it, and proposes further suitable training to the user.

[0058] Fig. 11 shows a schematic view of a system for training pelvic floor muscles according to an embodiment of the invention comprising the system of Fig. 10, and a third device 28 supplying a sensor signal indicative of an activity of the abdominal muscles. The third device 28 is connected to the remote electronic device 24 via communications means 30, in particular via Bluetooth or WLAN. The third device 28 comprises an additional sensor 29 for sensing an activity of abdominal muscles of the user, where activity means contraction and relaxation. The data sensed by the additional sensor 29 allows to discriminate, whether a signal of the sensor for sensing a movement of and/or a force exerted on the beam is due to an activity of the pelvic floor muscles, which is the desired measurement quantity, or whether it is a spurious signal induced by an activity of the abdominal muscles.

[0059] Fig. 12 depicts a flow chart of a method for supporting a training of pelvic floor muscles of a user according to an embodiment of the invention. The method may be performed by an app executed on the processing unit of a remote electronic device. The app provides the user with a training comprising tasks, e.g. special exercises, guiding and motivating the user throughout the training. The app may also provide a help function and/or a support line, e.g. for support concerning the correct application of the device.

[0060] The first step S1 of the method of Fig. 12 comprises receiving data indicative of an activity of the pelvic floor muscles. The received data may have been measured by the sensor of a device according to Fig. 1-9. Step S2 comprises determining calibration values in response to a maximum contraction of the pelvic floor muscles and an idle state, i.e. when the user sits on the device without contracting the pelvic floor muscles. For this purpose, the app on the remote electronic device would prompt the user to contract the pelvic floor muscles as much as possible, and subsequently to only sit on the device without contracting. Then it would take the maximum and minimum sensed value of the data as the calibration values.

[0061] Steps S3-S5 of the method concern processing the received data. Step S3 comprises normalising the received data with the calibration values. This is done to account for a variation in the anatomy between different users and for a variation in the position of the device relative to the user. A recommendation of suitable tasks by the app as described later is only possible on the basis of normalised data. Step S4 comprises deriving data indicative of a quantity and/or a dynamics of the contraction of the pelvic floor muscles from the normalised data. The quantity of the contraction describes the static behaviour of the pelvic floor muscles, whereas the dynamics of the contraction describes the changes with time, e.g. the speed. Step S4 may comprise signal processing, such as linearising a response function of the sensor, and/or translating the electrical signal of the sensor into physical quantities, e.g. speed or force, and/or taking time derivatives, and/or taking time values, and/or taking force values, and/or others. The derived data may be used to assess the performance of the pelvic floor muscles according to different aspects, such as power and/or endurance and/or coordination, and to evaluate the development of the performance over time. Step S5 comprises using the derived data in a software representing tasks for the training. The tasks may e.g. consist of reaching a certain level of contraction of the pelvic floor muscles, or holding a certain level of contraction over a certain time interval, or continuously or stepwise increasing or decreasing the level of contraction, or rapidly switching between a certain level of contraction and relaxation, or others. The tasks present a goal to the user, and through the direct assessment of achievement, the user is motivated for the training.

[0062] In an embodiment, the method offers different modes from which the user selects one, or uses the default mode. By selecting a mode, the software is controlled, in particular to support different trainings, such as a training of power and/or endurance and/or coordination of the pelvic floor muscles. Depending on the selected mode, the software adapts the tasks for training.

[0063] Step S6 of the method comprises outputting the processed data, in particular in a visual and/or acoustic and/or haptic manner. Many ways of outputting the processed data are possible. In a simple way of visual feedback, the app displays a curve indicating the level of contraction/relaxation to be reached by the pelvic floor muscles of the user over time, and additionally it shows the processed data actually reached. As an acoustic output, the level of contraction/relaxation may be translated into a tone pitch, or a sound may be played when the contraction/relaxation reaches a predefined level. For haptic feedback, the level of contraction/relaxation may be translated into a vibration of the remote electronic device in a similar way.

[0064] In an embodiment, step S6 also comprises displaying an avatar that moves in response to the processed data. The avatar is a visual representation of the pelvic floor muscle, or it may be a cartoon person as insinuated in reference 26 of Fig. 10, and it moves in at least one dimension. Preferably the avatar moves in a predefined manner, e.g. with a constant speed, in one dimension, while moving in response to the processed data in a second dimension. In this way, the app performing the method resembles a game, in which the user controls the movements of the avatar by contraction/relaxation of the pelvic floor muscles. Due to this "gamification" or "exergaming" (exercise plus gaming), the user is motivated for the training.

[0065] In step S6 different tasks or games are displayed in connection with the avatar depending on the selected training mode. For the training of power of the pelvic floor muscles, the avatar moves with a constant speed in one direction, while there are intermittent bars above it. Through a contraction of the pelvic floor muscles, the avatar jumps from the virtual ground up into the gaps between the bars and in particular collects points or symbols for a score. For the training of endurance of the pelvic floor muscles, the avatar needs to collect symbols or objects, e.g. apples, which are positioned on a certain height above the virtual ground, see references 26 and 27 in Fig. 10. This is achieved by maintaining the contraction of the pelvic floor muscles on a certain level for a predefined time interval or for as long as possible. Similarly, for the training of coordination of the pelvic floor muscles, the avatar needs to collect symbols or objects, e.g. balloons, which are positioned along a curve above the virtual ground. This is achieved by following the curve with the contraction of the pelvic floor muscles.

[0066] The output of the processed data in step S6 of the method may in an embodiment be configurable by the user through the selection of themes. The different themes correspond to different types of training suitable for different personalities or moods of the users. Preferably three themes are available: "Story" comprises training games for everybody, "Scientific" gives training goals and achievements in numbers and graphs for rational people, and "Meditative" provides exercises comprising simple geometrical shapes to relax stressed people. One of the themes is preset as a default theme, which may be changed during the course of the training.

[0067] Fig. 13 shows a flow chart of a training cycle of the user performing a method according to an embodiment of the invention. In the beginning, the user creates a user account with a user profile which is stored on the remote electronic device and preferably also in a remote database. The user profile may comprise personal data, and in particular medical indications and training goals. Next, the user executes a performance test, which is repeated weekly. The performance test starts with a calibration of the sensor according to the method described above. Then several tasks are posed to the user for assessing different aspects of the performance of the pelvic floor muscles. The aspects may e.g. be power and/or endurance and/or coordination of the pelvic floor muscles. According to the performance, the user is assigned a level for the training, which level may be different for the different aspects. Next, the user performs a daily training/gaming, which also starts by the calibration. The user may then choose an aspect for the training. It is recommended that the user trains each aspect twice a day. Every new week, the user is prompted to repeat the performance test, in particular in order to reach a new level for the training. Data relating to the performance of the user concerning the different aspects over time may be evaluated, in particular by a third party, such as a medical doctor.

Claims

1. Device for training pelvic floor muscles, comprising

   - a rigid housing (1) for a user to sit on, comprising a ridge (2) with an opening (4) facing the pelvic floor muscles of the user sitting on it,
   - a beam (5) arranged in the housing (1), being flush with or protruding from or facing the opening (4) in the ridge (2), adapted to couple to an activity of the pelvic floor muscles of the user, and
   - a sensor (11) for sensing a movement of and/or a force exerted on the beam (5).

2. Device according to claim 1, comprising

   - communication means (18) adapted to transmit a signal of the sensor (11) to a remote electronic device (24), in particular wherein the communication means is a Bluetooth transmitter for connecting to a mobile device, and
   - a power supply (13), in particular a battery, for supplying the sensor (11) and the communication means (18) with power, and

   in particular comprising

- guiding means (7, 8), in particular at least one guiding pin, to restrict movements of the beam (5) to a direction perpendicular to the opening (4) in the ridge (2), and
- an elastic element (9), in particular a pressure spring, between the housing (1) and the beam (5), providing a restoring force for movements of the beam (5).

3. Device according to claim 1 or 2,
wherein the sensor (11) sensing a force exerted on the beam (5) comprises at least one load cell, in particular at least one strain gauge,
in particular wherein the sensor (11) comprises two or more strain gauges arranged in a Wheatstone bridge configuration.

4. Device according to one of the preceding claims, comprising
a cap (6) covering the opening (4) in the ridge (2), which cap (6) is preferably made from silicone.

5. Device according to one of the preceding claims,
wherein the housing (1) has an extension 1 in longitudinal direction which represents its largest dimension, a width w and a height h including the ridge (2),
in particular wherein l < 20 cm, and/or
in particular wherein w < 8 cm, and/or
in particular wherein h < 4 cm.

6. Device according to claim 5,
wherein the opening (4) is elongated in longitudinal direction and aligned with the ridge (2),
in particular wherein a longitudinal extension of the opening (4) is in the range of 5 cm to 20 cm, preferably 11.7 cm, and its width is in the range of 0.5 cm to 2 cm, preferably 1.1 cm.

7. Kit for training pelvic floor muscles, comprising

- a device according to one of the preceding claims, and
- a pad (22) for placing the device on.

8. Method for supporting a training of pelvic floor muscles of a user, comprising

- receiving data indicative of an activity of the pelvic floor muscles (S1),
- determining calibration values, in particular in response to a maximum contraction of the pelvic floor muscles and an idle state (S2),
- processing the received data (S3-S5), and
- outputting the processed data (S6), in particular in a visual and/or acoustic and/or haptic manner,

in particular wherein the received data is supplied by the device according to one of claims 1-6, in particular by the sensor of the device.

9. Method according to claim 8, wherein the step of processing the received data comprises

- normalising the received data with the calibration values (S3),
- deriving data indicative of a quantity and/or a dynamics of the contraction of the pelvic floor muscles from the normalised data (S4), and
- using the derived data in a software representing tasks for the training (S5).

10. Method according to claim 8 or 9, wherein the step of outputting the processed data (S6) comprises
displaying an avatar (26) that moves in response to the processed data, in particular wherein the avatar (26) moves in at least one dimension,
in particular wherein the avatar (26) moves in a predefined manner in one dimension, and moves in response to the processed data in a second dimension.

11. Method according to claim 9 or 10, comprising

- offering modes to the user, and
- in response to a selection of a mode, applying the mode in controlling the software,

in particular the modes representing a training of power and/or endurance and/or coordination of the pelvic floor muscles.

12. Method according to one of claims 8-11, comprising

- receiving additional data indicative of an activity of abdominal muscles of the user,
- processing the received additional data, and
- outputting the processed additional data.

13. Computer program element, comprising computer code means for performing a method according to one of claims 8-12 when executed on a processing unit.

14. System for training pelvic floor muscles, comprising

- a device (23) according to one of claims 2-6, and
- a remote electronic device (24), comprising a processing unit, and communication means (25) for receiving data from the device (23) including the signal of the sensor (11), in particular via Bluetooth,

wherein the processing unit is configured to execute the computer program element according to claim 13.

15. System according to claim 14, comprising a third device (28) comprising

- an additional sensor (29) for sensing an activity of abdominal muscles of a user, and
- communication means (30) adapted to transmit a signal of the additional sensor to the remote electronic device (24), in particular via Bluetooth,

in particular wherein the remote electronic device (24) is configured to use the transmitted signal for performing the method according to claim 12.

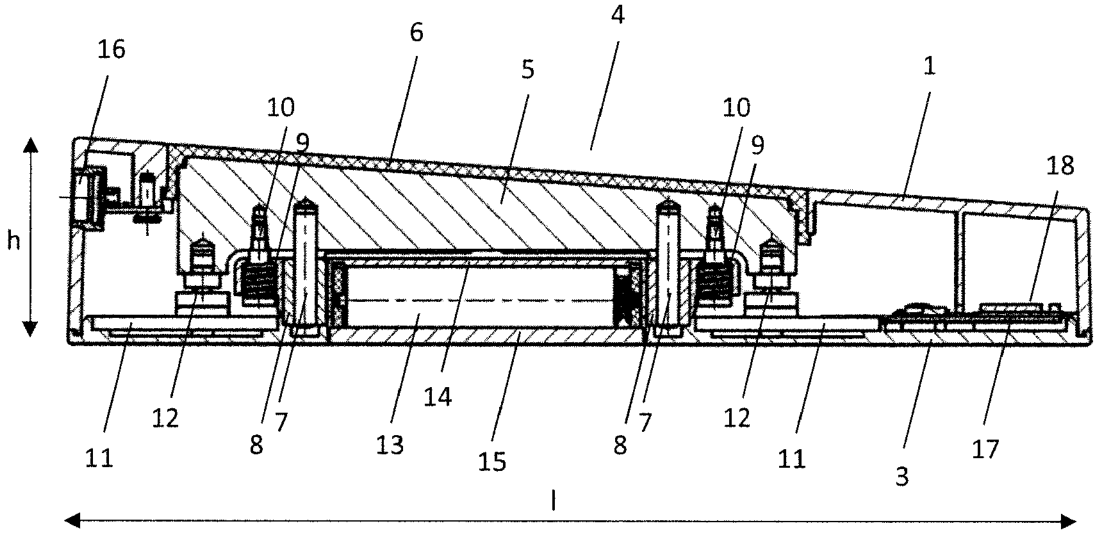
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FIG. 1

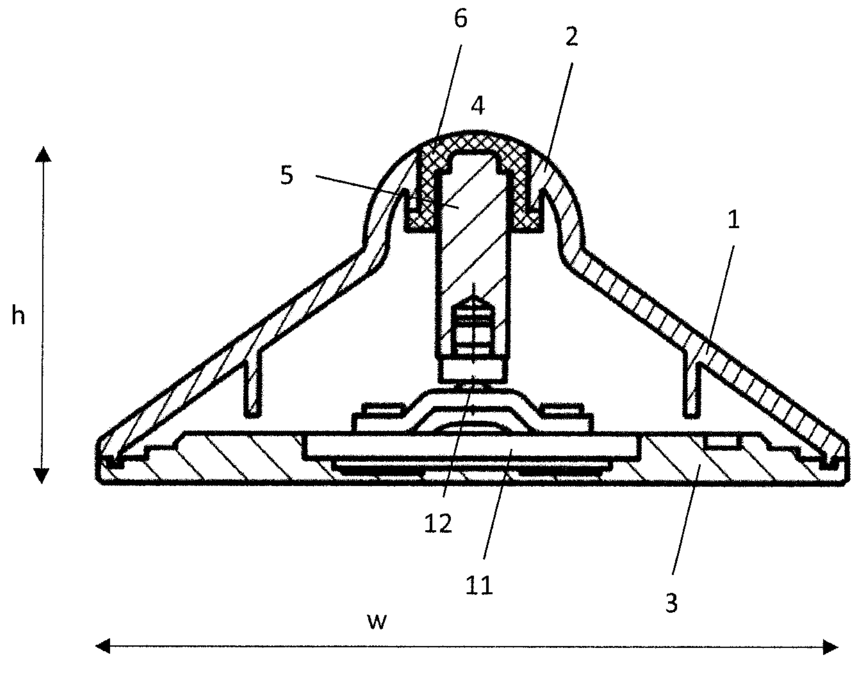
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FIG. 2

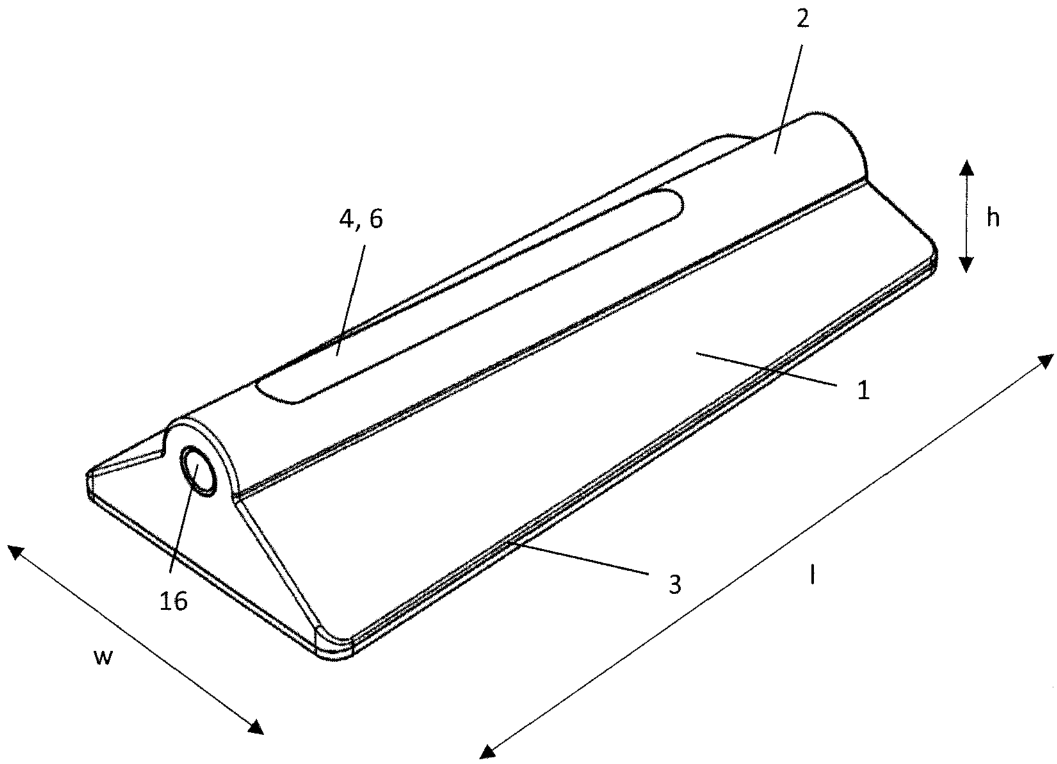

FIG. 3

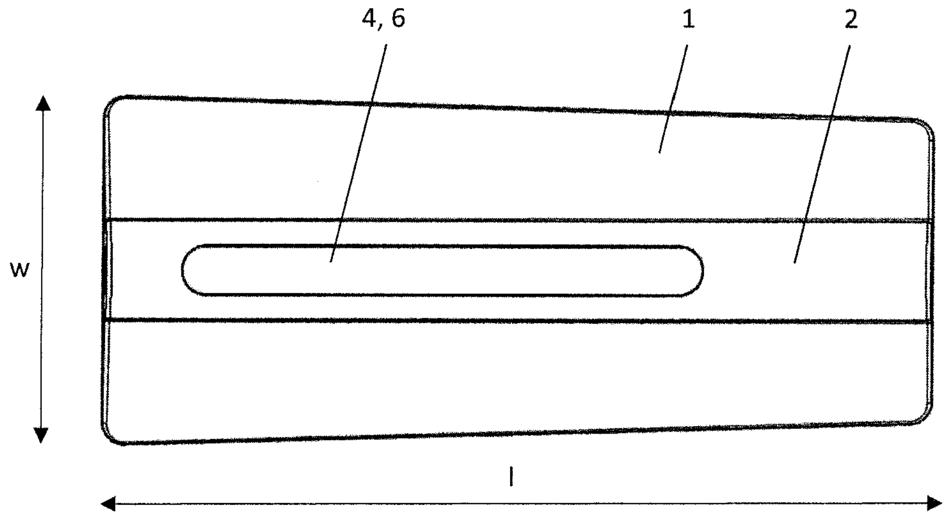

FIG. 4

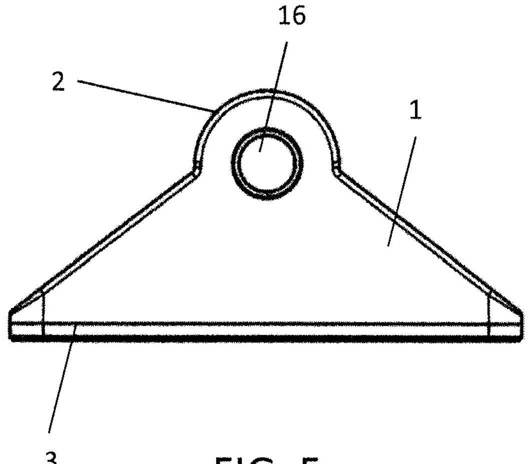

FIG. 5

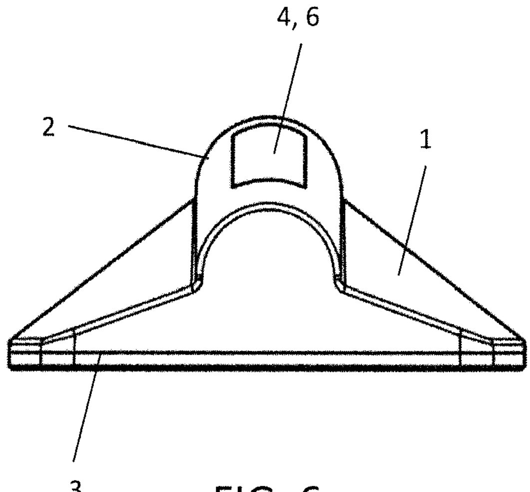

FIG. 6

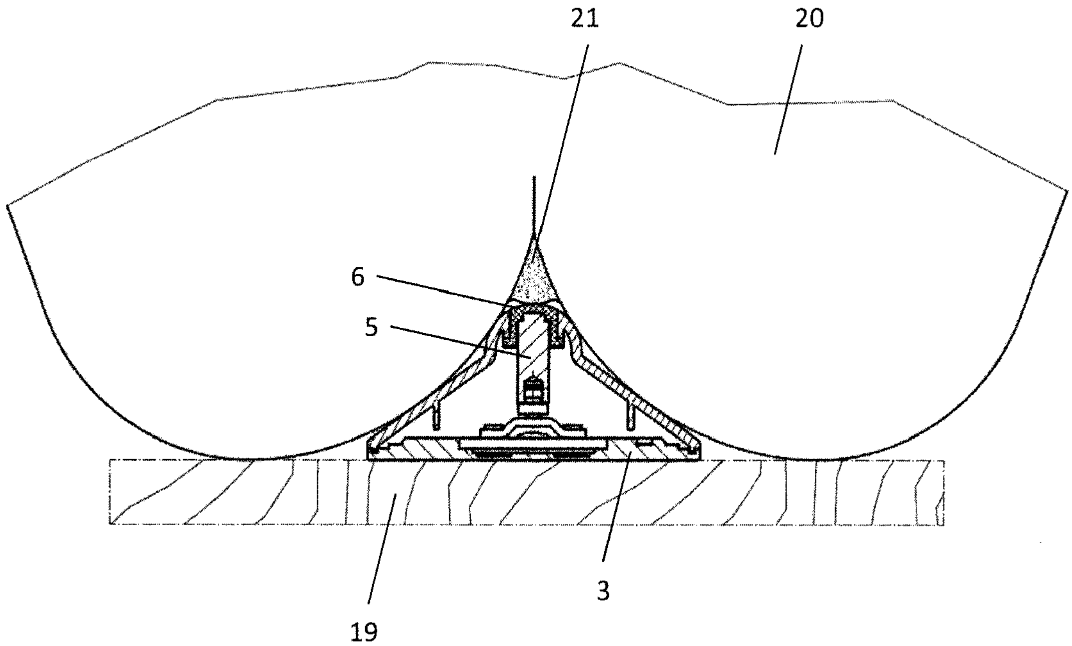

FIG. 7

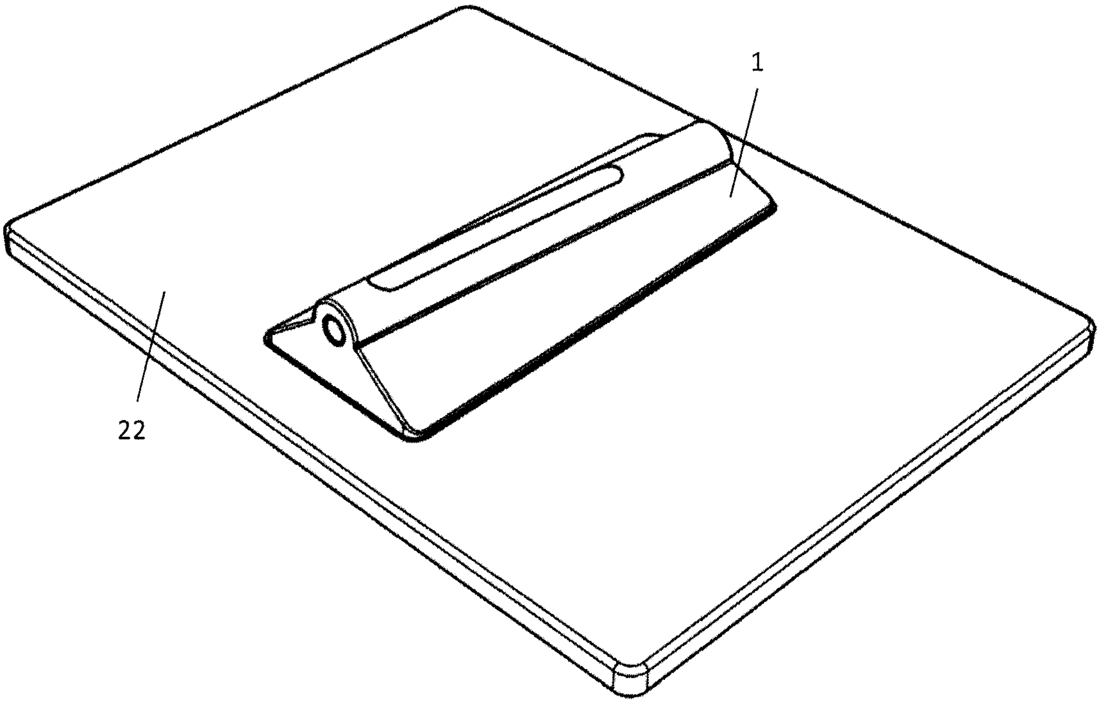

FIG. 8

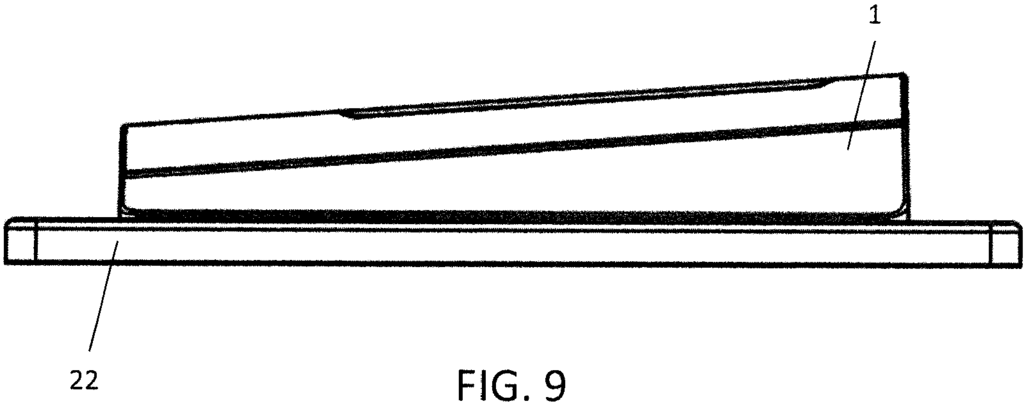

FIG. 9

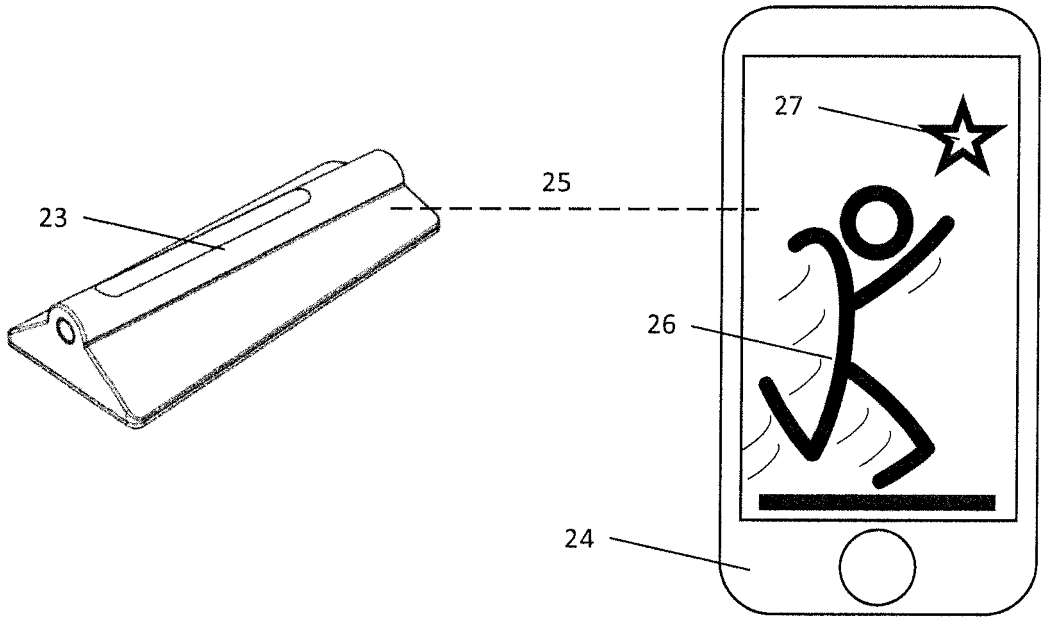

FIG. 10

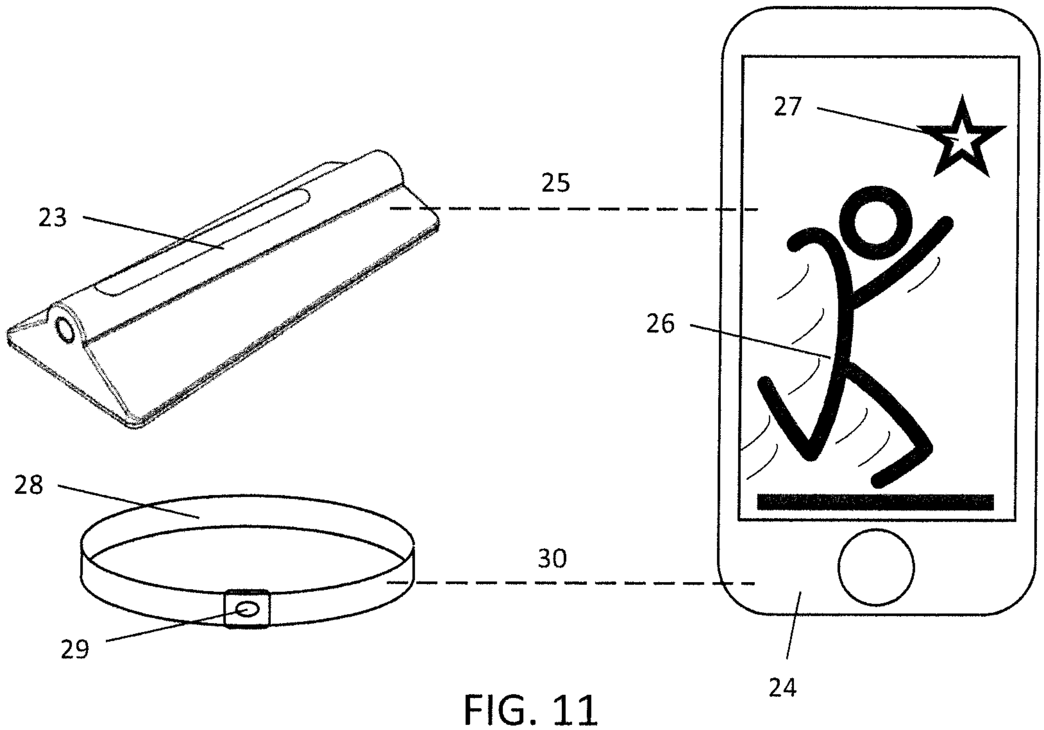

FIG. 11

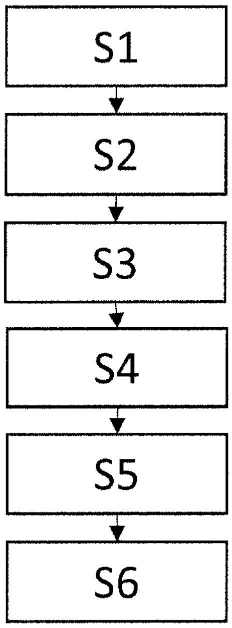
S1
S2
S3
S4
S5
S6

FIG. 12

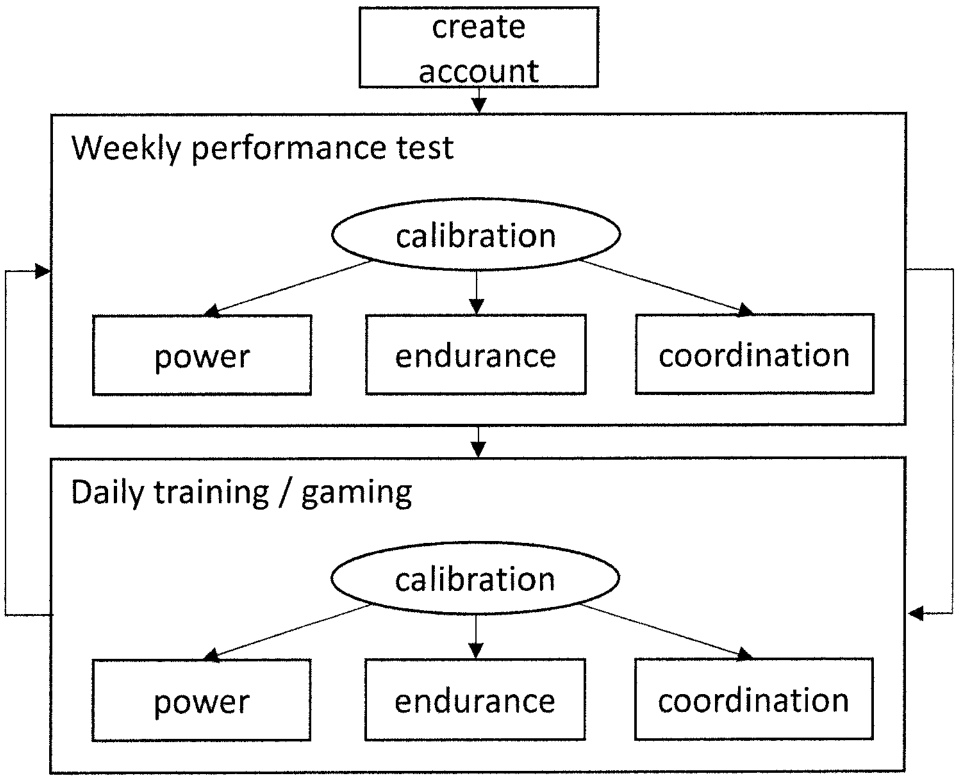
create account
Weekly performance test
calibration
power
endurance
coordination
Daily training / gaming
calibration
power
endurance
coordination

FIG. 13

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 2277

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 2011/077868 A1 (PANASONIC ELEC WORKS CO LTD [JP]; MIHARA IZUMI [JP]; NAKANO TOSHIO [JP) 30 June 2011 (2011-06-30) * translation: pages 2-5; figures *	1-9, 13-15 10-12	INV. A63B23/20
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1

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 April 2018	Borrás González, E

CATEGORY OF CITED DOCUMENTS

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18-04-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82