(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 April 2017 (20.04.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/064183 A2

(51) International Patent Classification:
A61B 6/04 (2006.01) *A61G 13/12* (2006.01)

(21) International Application Number:
PCT/EP2016/074585

(22) International Filing Date:
13 October 2016 (13.10.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
01502/15 16 October 2015 (16.10.2015) CH

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: SUPPORT SYSTEM FOR SUPPORTING A PART OF THE BODY

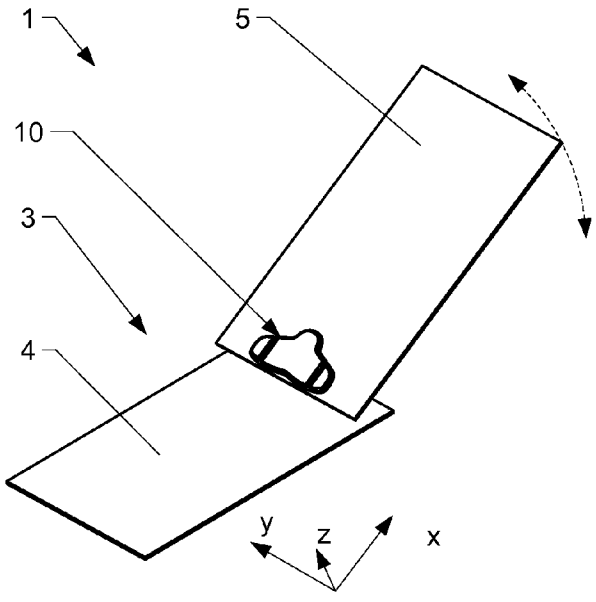


Fig. 1

(57) Abstract: The invention is directed to a support system (1) for a patient (2) comprising a support board (3) designed such that a part of the body of the patient (2) can be mounted on said support board (3). The support system (1) furthermore comprises a support member (10, 10') arranged to mechanically support the part of the body (2), and which comprises a first cushion (20, 20'). The support member (10, 10') comprises an inflatable second cushion (30, 30') arranged at least partially between the support board (3) and the first cushion (20, 20'), foreseen to press the first cushion (20, 20') away from the support board (3) against the part of the body (2) to be supported. The first cushion (20, 20') is designed to switch from a more deformable state to a less deformable state and thereby to facilitate the support of the part of the body.

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SUPPORT SYSTEM FOR SUPPORTING A PART OF THE BODY

FIELD OF THE INVENTION

The present invention is directed to a support system for patients and to a support member for such a support system.

BACKGROUND OF THE INVENTION

For various types of medical procedures, patients need to be positioned during extended periods of time. Medical procedures that require such prolonged positioning include some types of medical imaging as well as medical treatment, such as e.g. radiotherapy. However, prolonged positioning of patients in practice often turns out to be problematic, in particular (but not only) for individuals who suffer from general physical weakness. For these patients, extended periods of immobilization often cause severe discomfort or even pain. This in particular holds true for some types of radiotherapy, where patients have to be positioned and aligned in a semi-reclined position in order to obtain accurate positioning and alignment of the part of the body to be treated with respect to the radiotherapy system.

Several documents disclose systems for the positioning of patients.

US2008/0052829 A1 was published on 06.03.2008 on behalf of Goudriaan Bram De Vries and shows a reclining table comprising a stationary reclining plate and a back rest that is pivotally connected to it. Such types of reclining tables are e.g. used for radiotherapy of organs in the thoracic region, such as of the breast. The reclining table comprises

means to fix the back rest in various angular positions. Thus, e.g. the upper part of the body of a patient arranged on the reclining table can be positioned and aligned in a specified way. Although such types of reclining tables offer good adjustability for various types of medical applications and patients, some problems may emerge if they are used for certain patients and types of medical procedures. In particular, the transition region between the stationary reclining plate and the back rest in some cases turns out to be uncomfortable for the patient, depending on his/her anatomy and physical condition. So far, one tries to improve the patient's comfort by cushioning the transition region with foam material. However, in many cases such cushioning does not increase patient comfort significantly. In addition, using foam material often leads to an increased mobility of the part of the body supported by it, which in many cases interferes with the medical procedure. As well, in order to provide support for multiple patients with various anatomies multiple types of cushions are needed. As well, use of such cushions makes cleaning of the reclining table more time consuming.

DE4423755 A1 was published on behalf of GDW Genossenschaft der Werkstätten für Behinderte eG and shows an apparatus for the fixation and positioning of a part of the body. The document discloses an apparatus that can be used as seat rest for a sitting or a reclining furniture, in particular for a wheelchair. This apparatus comprises a bag filled with a filling material which comprises a plurality of bodies that are movable relative to each other. The bag can be evacuated using a vacuum pump, leading to a restriction of said movement leading to a dimensionally stable bag. Between said bag and the body, a cushion layer is arranged. Said cushion layer is a bag that can be filled with air in order to bring it in a lasting extended state. In order to apply the apparatus, in a first step the bag filled with a filling material has to be manually adjusted in order to fit the shape of the part of the body it has to be applied on. After that, the bag filled with filling material is evacuated, leading to shrinking of the bag and hence also to an improper alignment of

the contour of the evacuated bag with respect to the body contour. Because of the evacuation, the evacuated bag becomes relatively hard which – due to the improper alignment and resulting points of contact – typically causes pain to the patients when being positioned on it over extended periods of time. Subsequently, the bag filled with air is arranged between the evacuated bag and the body and is expanded, in order to fill the void space between the evacuated bag and the body caused by the evacuation of the other bag.

EP2104477 B1 was published on 30.09.2009 on behalf of ETH Zurich and shows an immobilizing device for a part of the body, in particular for the forearm. The immobilizing device comprises a bag and an outer shell in which the bag is mounted. Between the outer shell and the bag, a hollow space is formed for receiving pressured air in order to produce a force on the bag for immobilizing a part of the body. According to said patent, the bag is filled with granular material and adapted to be put over the part of the body.

WO2012/076199 A1 was published on 14.06.2012 on behalf of Pearltec AG and shows a relatively small cushion with an elongated shape for immobilizing a part of the body. The cushion disclosed comprises an air chamber and a chamber filled with granular material. The two chambers are separated by a membrane. By means of e.g. a hand pump pressured air can be pumped in the air chamber, leading to an expansion of the air chamber. In order to immobilize a part of the body, the chamber filled with granular material is placed between the part of the body and a medical device – such as a MRI-coil or a CT-holder. Subsequently the air chamber is filled with pressured air, causing the granular parts in the other chamber to become rigid, as well as a movement of the chamber filled with granular material is caused. In order to allow this movement, the chamber filled with granular material has a plurality of ventilation holes for the flux of air. Such types of

cushions are suited for immobilizing some parts of the body with respect to medical devices, such as coils.

SUMMARY OF THE INVENTION

One object of the present invention is to provide a support system for patients (human and animal) which in particular also allows to obtain an easy and more comfortable/ergonomic support of patients in a reclined – or semi-reclined – position during medical procedures. With a support system according to the present invention, a patient may be supported in a dorsal position, a ventral position or in a lateral position. However, it is not limited to such positions. Another object of the invention is to provide a support member for such a support system.

The invention is inter alia based on the finding that patient discomfort during extended periods of positioning can be caused by fatigue of muscles, tendons or ligaments which leads to critical displacements of certain parts of the body. For example, in case of reclining tables, prolonged positioning in reclined or semi-reclined positions typically leads to lowering movements and a rotation of the pelvis and/or the lumbar spine. This may lead to higher internal postural stress and hence e.g. cause lower-back pain. At the same time the altered posture typically leads to increased contact stress between the body and the support device.

In order to solve at least one of the aforementioned problems, a support system according to the present invention typically comprises a support board designed such that a part of the body of the patient can be mounted on said support board. The support system furthermore comprises a support member arranged to mechanically support the part of the body, and which comprises a first cushion. The support member comprises an inflat-

able second cushion arranged at least partially between the support board and the first cushion, foreseen to press the first cushion away from the support board against the part of the body to be supported. Typically the first cushion is designed to switch from a more deformable state to a less deformable state and thereby to facilitate (respectively support) the support of the part of the body. When the part of the body is mounted on the support system, the part of the body may be pressed on the support board and/or the support member by gravity. Alternatively or in addition the part of the body may be pressed on the support board and/or the support member by means of e.g. a fixation device, such as e.g. a belt.

In a variation of the invention, the first cushion is designed to reversibly switch from a more deformable state to a less deformable state. Hence, such a variation allows multiple use of the first cushion.

The filling material may be a liquid or gel, such as a non-Newtonian fluid, in particular a dilatant fluid. In a variation of the invention, the filling material comprises an electrorheological fluid, in particular an electrorheological liquid. For such a variation of the invention, an electrical field may be applied in order to switch the filling material to a less deformable state. In another variation of the invention, the filling material comprises a magnetorheological fluid, in particular a magnetorheological liquid. For such a variation of the invention, a magnetic field may be applied in order to switch the filling material to a less deformable state.

In an embodiment of the invention the filling material is an interlockable material that when compressed interlocks and thereby achieves a less deformable state. For some applications, the filling material may be an interlockable material that interlocks and thereby achieves a less deformable state when the first chamber is evacuated. For some applica-

tions, the support system may comprise a pump in order to at least assist evacuating of fluid from the first chamber. Thus, compaction of the first chamber may be supported.

Good results may be obtained if the filling material is a granular material whose granules are configured to interlock with each other when being compressed. In such an embodiment of a support system, the granules (granular base material) inside the first chamber are compressed against each other and hence interlock such that the first cushion forms some kind of rigid shell that closely aligns with the contour of the part of the body to be supported. Thus, a more even stress distribution on a larger area of the part of the body's surface, if compared to the conventional support systems can be obtained. Thus, local stress concentration within the part of the body can be decreased.

Good results may be obtained if the granules of the granular material have a mean diameter of between 1 and 3 mm. A particularly good adaptation to the outer contour of the part of the body to be supported can be obtained if the granules have a mean diameter of between 1.2 and 2.2 mm. For some applications where an increased cushioning effect is required, the granular material may be at least partially made from expanded polypropylene (EPP).Thus the first cushion can adapt easily to the outer contour of the body, while the granules are still able to interlock reliably with each other if compressed by forces of a magnitude typically obtained in patient support. Good interlocking may be obtained if the granular material is made from expanded polystyrene (EPS). For applications where an increased cushioning effect is required, the granular material may be made from expanded polypropylene (EPP).

The support board may e.g. be – or may be part of – a stretcher or a surgical table. It may be a plate-like structure or comprise multiple plate-like structures – such as multiple plate-like portions interconnected by a grid. The second cushion may comprise an inner

second chamber to which fluid can be added in order to inflate the second cushion e.g. by a pump. Thus, an evenly distributed force can be applied on the first cushion which facilitates a good support of the part of the body. Fluid may e.g. be a gas (such as air) or a liquid (such as water). The second cushion may comprise a fluid connector to which a fluid line (e.g. a tube) can be interconnected in order to add fluid to the second chamber or evacuate fluid from the second chamber. In an embodiment, the second chamber is fluidically interconnected an automated pump. For some applications, the second chamber may be interconnected with a pressure gauge for measuring the fluidic pressure inside of the second chamber. The pressure gauge may be connected to a display that provides information about said pressure. The pressure gauge may also be used in order to control an automated pump – as described above. Thus the quality of the support may be assessed; respectively pressure settings may be reproduced in subsequent supports. The support member may also comprise means limit the maximum fluidic pressure inside of the second chamber, as e.g. a pressure relief valve. Such a means may be used in order to restore a pressure setting of a previous supports to prevent injuries due to mechanical overloading of the part of the body, as e.g. caused by suppression of blood flow.

Alternatively or in addition to a pressure gauge to measure the fluidic pressure inside of the second, the support system may also comprise a means to measure the mass and/or volume of the fluid that is added to the second chamber. Such an embodiment can be advantageous for certain applications, as explained in more detail below.

Thanks to the support system with a support member according to the present invention it becomes possible to easily establish proper, load-bearing support to regions of the body that cannot be contacted using conventional support systems. In particular, also parts of the body that have a curved outer contour can be supported in an easy and advantageous and reliable manner, as will be explained in more detail below. Hence, if

compared to conventional systems relatively large supportive contact interfaces between the support member and the body can be established. This allows to distribute contact forces and hence reduce contact stress concentration in the body. In addition, also parts of the body that cannot be supported by conventional systems due to e.g. a concave contour of the body – such as the lordosis – can be supported by the support system according to the present invention if desired. Therefore, the second cushion may be configured such that it can be inflated to a thickness that is sufficient in order to displace the first cushion until it presses against the part of the body. As well, when pressed against the body, the first cushion forms a rigid cast-like shell which helps to maintain the shape of the anatomical region over time. In addition – depending on the contour of the part of the body – it may form some type of positive locking interaction between the support member and the part of the body. Thus, unwanted displacements and rotations of the part of the body when in semi-reclined position, as will be explained in more detail below.

In an embodiment, the support system comprises a third cushion arranged at least partially between the first cushion and the part of the body to be supported. The third chamber may be at least partially filled with a liquid and/or a gel and/or a granular material. For some applications, the third cushion may comprise means to add and/or remove liquid and/or gel from inside of the third cushion and/or to measure and/or control temperature of the third cushion. Hence, e.g. the temperature of the part of the body to be immobilized may be controlled.

For some purposes the support system may comprise a single first cushion and multiple second cushions. For other applications, the support system may comprise a single second cushion and multiple first cushions. Good results may be obtained if the support member comprises multiple second cushions, whereof at least two second cushions

comprise second chambers that are fluidically interconnected with each other. Hence – if desired – isobar pressure may be obtained in multiple second cushions.

In a variation of the invention the support board comprises a first portion and a second portion, the second portion being pivotally connected to the first portion. Hence, using such a variation of the invention, a patient may be supported in a fully reclined or semi-reclined position, as will be shown in more detail below.

For some applications, such as to provide good support to a patient positioned in a semi-reclined position, a first support member can be arranged at the second portion of the support board, such that the second cushion of the first support member at least partially extends along a first support face of the second portion. The first support member may have an essentially planar shape and may be arranged such that it can support the lumbar region of the patient. Good results may be obtained if the first cushion in a non-loaded state has a thickness of between 5 and 20 mm, in particular of about 10 mm. The same holds true if the second cushion can be inflated to a mean thickness of between 5 and 20 mm, in particular to about 10 mm. Alternatively or in addition the support system may comprise a second support member that is arranged at the first portion of the support board, such that the second cushion of the second support member at least partially extends along a second support face of the first portion. Hence good support of the pelvic region can be provided.

In an embodiment the support member comprises a second chamber in which a connecting element mechanically interconnects the second chamber's front wall with its rear wall, restricting at least locally the distance between front wall and the rear wall when the second chamber is inflated by adding fluid. Thus the degree of deformation of the second cushion when being inflated can be controlled. The connecting element may comprise an

adhesive or a plastic weld that connects the front and the rear wall (as will be explained in more detail below). Connecting elements may e.g. be formed as quilt-type baffles or box-type baffles.

For some applications, the second support member may essentially have the shape of a triangular prism, comprising two bases (base faces) and three lateral faces (circumferential faces). Thus e.g. for support boards that comprise a first and a second portion that are pivotally connected with each other, good support of the body in the transitional region between the first and second portion of the support board can be obtained for a large range of different pivot angles.

In an embodiment of the invention, the first cushion may at least partially extend along one lateral face of a support member formed as a triangular prism, while the second cushion extends at least partially along at least one of the two other lateral faces, as will be shown in more detail below. Such an embodiment allows a particularly good support of the pelvic region.

In a variation of a support system according to the present invention the support member comprises a carrier means. Such a carrier means may be used to fasten and position one or multiple support member relatively easily at the support board – respectively remove them from the support board – as will be shown in more detail below. As well as the carrier means may serve as an additional support face for the patient. Good results may be obtained if the carrier means is made from a flexible sheet material. The carrier means may e.g. be made from a textile/fabric material and/or from a plastic film. Using a flexible sheet material allows easy manufacturing as well as good adaptation of the carrier means to the contour of support board as well as to the anatomy of various patients. The carrier means may be mechanically interconnected with the first and/or second cushion

e.g. by means of an adhesive or plastic welding. Good results may be obtained if it is connected by means of high frequency welding. Alternatively or in addition it may be interconnected by means of a hook and loop fastener, which allows very convenient disassembly of the support member and hence facilitates cleaning and/or replacement of components.

A variation of support member that can be produced at relatively low costs can be obtained if the first and/or the second cushion are/is at least partially made from a film or a fabric. As such, the cushions may be made from a plastic film, in particular from thermoplastic polyurethane (TPU). Using TPU allows the cushions to be assembled mostly using plastic welding, as well as it offers good disinfectability and cleanability. The cushions may also be coated with another material. As well, the cushions may comprise MRI markers and/or X-ray markers in order to be identifiable during medical imaging.

In one embodiment a wall of the first cushion directed to the second cushion and a wall of the second cushion directed to the first cushion are at least partially formed by one and the same membrane. Thus the number of components necessary to assemble/produce the support member can be reduced. For some applications the first and the second cushion may be detachably interconnected with each other. They e.g. may be interconnected by an adhesive film and/or by a hook and loop fastener.

In a variation of the invention the support system comprises multiple support members comprising second cushions that enclose second chambers, whereof the second chambers of at least two support members are fluidically interconnected. Thus advantageous support to multiple parts of the body can be provided in a cost-efficient and easy manner, as thus multiple second cushions can be inflated using a single pump. In one embodiment of the invention, multiple support members are arranged on one and the same carrier

means. In a variation of the present invention, the first cushion is at least partially arranged between the carrier means and the second cushion. Thus, the carrier means may be used in order to protect the first cushion from pollution and/or damage. In another variation of the invention, the carrier means is at least partially arranged between the first cushion and the second cushion. Thus, pollution and/or damage of the second cushion may be prevented. However, for some applications the second cushion may also be arranged between the carrier means and the first cushion.

In a variation of the invention, the carrier means is part of the first and/or the second cushion, respectively be at least part of a wall of the first and/or second cushion. Thus the number of parts needed to assemble a support member can be decreased.

The support member may comprise a fastening means in order to establish a mechanical interconnection with the support board. Good results may be obtained if the fastening means comprises a peg configured to be received by a corresponding recess arranged in the support board, such that relative movements between the support member and the support board are restricted in at least one direction. A fastening means may e.g. be arranged at the first and/or the second cushion and/or at a carrier means of a support member.

Alternatively or in addition, the support member may be fastened with the support board by means of a suction cup and/or a hook and loop fastener and/or an adhesive film – in particular a non-permanent adhesive film.

For some applications, the first cushion may comprise a passage that fluidically interconnects the first chamber with the atmosphere. Thus exchange of air between inside and outside of the first cushion is possible, facilitating changes in volume of the first cushion.

Alternatively or in addition, the first cushion may be at least partially made from a material that is permeable to air.

In a variation of the invention, a protective cover is arranged on the support member such that it prevents direct physical contact between the support member and the part of the body to be support. Thus pollution of the support member can be prevented. The protective cover may be a sheet-like structure comprising a plastic film or a fabric, in particular a non-woven fabric. A protective cover may e.g. be mechanically interconnected to the support member by a non-permanent adhesive layer. Alternatively or in addition the two may be mechanically interconnected by a hook and loop fastener. Very reliable interconnections may be obtained if the protective cover comprises a non-woven fabric that interacts with a hook portion (of a hook and loop fastener) arranged at the support board and/or the support member.

In order to obtain a support system that is easy to clean and/or disinfect, a passage may pass through the second cushion, as will be explained in more detail below. If the support member is essentially shaped like a triangular prism, a passage may be arranged at a base of the triangular prism.

In order to facilitate cleaning and disinfecting of the support member a passage of a planar support member may be arranged on the side of the carrier means opposite to the side directed to the part of the body to be supported. Thus intrusion of body liquids as well as cleaning agent, respectively disinfectant, can be prevented.

Another object of the present invention is to provide a support member for a support system as described above. Such a support member may comprise one or multiple of the features described above.

Increased patient comfort as provided by the support system according to the present invention helps to improve patient compliance which is important for patients that undergo series of medical procedures, as e.g. radiotherapy courses. Thus, a support system according to the present invention may in certain situations help to increase the success rate of some medical procedures if compared to conventional systems.

BRIEF DESCRIPTION OF THE DRAWINGS

The herein described invention will be more fully understood from the detailed description of the given herein below and the accompanying drawings, which should not be considered as limiting to the invention described in the appended claims.

Fig. 1 schematically shows a variation of a support system according to the invention in a perspective view from above;

Fig. 2 schematically shows a patient positioned on the support system of Fig. 1 in a perspective view from above;

Fig. 3 schematically shows a first embodiment of a support member according to the invention in a perspective view from above;

Fig. 4. schematically shows the support member of Fig. 3 in a perspective view from below;

Fig. 5 schematically shows a second embodiment of a support member according to the invention in a perspective view from above;

Fig. 6. schematically shows the support member of Fig. 5 in a perspective view from below;

Fig. 7a shows the support member of Fig. 5 from the side;

Fig. 7b schematically shows the inner structure of the support member of Fig. 5 from the side;

Fig. 8a/b schematically show the support member of Fig. 5 being mechanically interconnected with a support board;

Fig. 9 shows detail F of Fig. 8b;

Fig. 10 schematically shows a first method step for adapting the support member to a part of the body;

Fig. 11 schematically shows a second method step for adapting the support member to a part of the body;

Fig. 12 schematically shows a third method step for adapting the support member to a part of the body;

Fig. 13 schematically shows a fourth method step for adapting the support member to a part of the body.

DETAILED DESCRIPTION OF THE INVENTION

The foregoing summary, as well as the following detailed description of the preferred embodiments, is better understood when read in conjunction with the appended drawings. For the purposes of illustrating the invention, an embodiment that is presently preferred, in which like numerals represent similar parts throughout the several views of the drawings, it being understood, however, that the invention is not limited to the specific methods and instrumentalities disclosed.

Figs. 1 and **2** schematically show a variation of a support system 1 for a patient 2 according to the invention, which comprises a support board 3 that has a reclining (first) portion 4 and a back (second) portion 5. As indicated by the dotted double arrow, the second portion 5 is pivotally connected with the first portion 4 such that it can be pivoted with respect to the latter in order to position the upper body of the patient 2. In the tran-

sitional region between the first and the second portion 4, 5 a support member 10 is arranged in order to improve support of the lumbar region of the patient 2.

As shown in **Fig. 2**, a patient 2 may be positioned on the support board 3 such that the lower body of the patient at least partially rests on the first portion 4, whereas the upper body, including the thorax region, rests on the second portion 5 of the support board 3. The pelvis/fundament and lumbar region are positioned in the transitional region between the reclining portion 4 and the back portion. The support member 10 shown in **Figs. 1** and **2** is mechanically interconnected to the support board 3 by means of a non-permanent adhesive film (not shown in detail), which is only one of multiple possible ways to provide such a connection, as described above.

Figs. 3 and **4** show a variation of a support member 10 which comprises a carrier means 13 made from a flexible plastic film covered by a flexible fabric such that it can adapt to the transitional region as well as to the part of the body 2 to be supported, as will be shown in more detail below. The first and the second cushion 20, 30 are in this variation of the invention interconnected with the carrier means 13 by a plastic welding connection. However also other types of connections are possible, such as adhesives as mentioned above. On the carrier means 13 two fastening means 12 formed as pegs are arranged. The fastening means 12 are configured such that they can be received by corresponding recesses 7 in a support board 3, as will be explained in more detail with respect to **Figs. 8a** and **8b**. As shown in **Fig. 3**, a support member 10 according to the invention may also comprise multiple first cushions 20 arranged on a single second cushion 30 (shown in **Fig. 4**). As shown in **Fig. 4** a fluid connector 32 may be arranged at the second cushion 30 on the side of the support member 10 directed away from the patient 2 when the support member 10 is in a mounted state. The fluid connector 32 may be connected to a tube

and/or pump (not shown) in order to add and remove fluid from a second chamber enclosed by the second cushion 30. The support board 3 may comprise a recess (not shown) configured to receive this fluid connector 32. In addition, the support member 10 comprises multiple passages 14 that fluidically interconnect the first chambers 21 enclosed in the first cushions 20 with the atmosphere such that air can move freely into and out of the first chamber 21. In order to facilitate such flux, the support board 3 may comprise recesses (not shown) that are positioned such that they correspond with the passages 14 such that in a mounted state, the passages 14 are not covered by the support board 3 in a sealing manner. However, depending on the material, surface topology and shape of the support board 3 such recesses may not be needed in order to obtain sufficient exchange of air through the passages 14.

As shown in **Figs. 5** to **7b**, also multiple support members 10, 10' may be arranged on one and the same carrier 13. In the variation shown in these drawings, a first essentially flat support member 10 is combined with a second support member 10' that essentially has the shape of a triangular prism. In a mounted state, the first support member 10 is arranged to support the upper lumbar region, whereas the second support 10' member is arranged to support the lower lumbar region, respectively the pelvis/fundament, as will be explained in more detail with respect to **Figs. 8a**, **8b** and **9**. As illustrated in **Figs. 6** and **7b**, the support members 10, 10' comprise in total three fluid connectors 32, 32', 32'' that allow to inflate or deflate the second cushions 30, 30' of the support members 10, 10' (not shown in detail). A first fluid connector 32 is fluidically interconnected with a second chamber 31 in the second cushion 30 of the first support member 10. The second and the third fluid connectors 32', 32'' are fluidically interconnected with a second chamber 31' in the second cushion 30' of the second support member 10'. By means of fluid lines, such as tubes (schematically illustrated by dotted lines), the first and the second fluid connectors 32, 32' can be fluidically interconnected with each other, while the

third fluid connector 32'' may be connected to an air pump in order to provide fluid to the two second chambers 31, 31' and consequently inflate the second cushions 30, 30'. Hence it becomes possible to use only one pump, as well as to obtain isobar pressure within the two second cushions 30, 30'.

In the variation shown in **Figs. 5** to **7b**, the first support member 10 comprises passages 14 that are arranged as described above with respect to **Figs. 3** and **4**, while the second support member 10' comprises passages 14' that are arranged at the base face of the triangular prism, which ensures good exchange of air. The passages 14, 14' fluidically interconnect the first chambers 21, 21' with the atmosphere.

As illustrated in **Figs. 7a** and **7b**, the first support member 10 has an essentially planar shape, while the second support member 10' is essentially formed like a triangular prism, which allows them to provide good support of the pelvic and lumbar region, as illustrated in **Fig. 9**. As shown in **Fig. 7b**, the first and the second cushions 20, 30 of the first support member 10 are arranged similar to parallel layers. The first and the second cushion 20', 30' of the second support member 10' are arranged in a different way, the second cushion 30' extending along two lateral faces of the triangular prism geometry, whereas the first cushion 20' extends along the other lateral face. Such a variation turned out to provide a very reliable support to the pelvis when the second cushion 30' is being inflated. However, the second cushion 30' may also extend along one lateral face only.

Figs. 8a and **8b** illustrate one way how the support members 10, 10' can be mechanically interconnected with the support board 3. Hence, the fastening means 12 arranged at the carrier means 13 are received by corresponding recesses 7 in the second portion 5 of the support board 3. As shown, the support board may comprise multiple recesses 7 in order to position the support members 10, 10' at different locations. Such a type of fas-

tening allows easy removal of the support members 10, 10' for cleaning. As can be seen in **Fig. 8b** and **9**, where a portion of the support members 10, 10' as well as of the carrier means 13 is clipped for illustrative purposes, the first support member 10 is in contact with a first support face 11 (indicated for illustrative purposes by hachures) arranged on the second portion 5 of the support board 3, while the second support member 10' is in contact with a second support face 11' (as well indicated for illustrative purposes by hachures) arranged on the first portion 4 of the support board 3. However, the first support member 10 may in addition also be in contact with a support face of the first portion 4 and/or the second support member 10' be in contact with a support face on the second portion 5. As all passages 14, 14' are arranged on the side of the carrier 13 which is directed away from the supported patient, the parts of the support members 10, 10' that come into direct contact with the patient 2 can be easily cleaned – respectively disinfected – without the risk of cleaning agent (respectively disinfectant) entering inside of the support member 10, 10' through the passages 14, 14'. As the carrier means 13 is made from a flexible material, a good alignment of the carrier means 13 – respectively the support members 10, 10' – to the support board 3 as well as to the patient 2 becomes possible, as schematically indicated in **Fig. 9**.

Figs. 10 to **13** schematically explain in consecutive steps how a part of the body 2 is supported using a support system 1 according to the present invention. As indicated in **Fig. 10**, when the part of the body is positioned on the support system 1, the second cushion 30 is typically still relatively flat, respectively the second chamber 31 is not inflated yet. The first chamber 21 of this embodiment of the invention is partially filled with a granular material 22 comprising spherical particles of expanded polystyrene. As the first cushion 20 is not loaded, the particles of the granular material 22 can easily move relatively to each other and thus the shape of the first cushion 20 can be altered easily. The first and

the second chamber 21, 31 are separated by a single membrane which forms the front wall of the second cushion 30 and at the same time the rear wall of the first cushion 20.

As shown in **Fig. 11** and **12**, the first cushion 20 starts to deform and align with the outer contour of the part of the body 2 as soon as the part of the body 2 gets in contact with the support member 10 and starts to press against the first cushion 20. Consequently, the shape of the first cushion 20, respectively the first chamber 21 is changed, leading to moving and compaction of the granular material 22, as shown in **Fig. 12**. At the same time, the first cushion 20 starts to exert a distributed force (indicated by the small arrows) on the part of the body 2. All walls of the first and of the second cushion 20, 30 are made from a fluid-tight material. Consequently – as the volume of the first chamber 21 alters/decreases – the fluid pressure inside of the first chamber 21 changes, causing a flux of fluid through the passage 14 (indicated by the slim dotted arrows). As soon as the part of the body 2 is positioned as desired (e.g. by the medical personnel), the second cushion 30 is inflated by adding fluid (e.g. air) to the second chamber 31 in the second cushion 30, as shown in **Fig. 13**. This causes an increase of the mean thickness of the second cushion 30 and thus the first cushion 20 being pressed against regions of the the part of the body 2 which before were not in contact with the support member 10. This leads to an improved alignment of the first cushion 20 to a larger area of the outer contour of the part of the body 2, as well as a further compaction of the granular material 22, leading to a more even distribution of the contact force exerted by the support board 3 to the part of the body 2 via the support member 10. As well, the granular material 22 becomes more compacted and the friction between its particles increases (due to higher contact stresses and in-creased deformation of the particles), resulting in a stiffening of the first cushion 20. Due to the alignment of this relatively stiff shell to the typically curved contour of the part of the body 2 some type of interlocking is obtained, which is

able to prevent movements of the part of the body 2 also in directions parallel to the surface of the support board 3, as indicated by the double arrow.

REFERENCE NUMERALS

1	Support system
2	Patient
3	Support board
4	Reclining portion
5	Back portion
7	Recess
10, 10'	Support member
11, 11'	Support face
12	Fastening means (pegs)
13	Carrier means
14, 14'	Passage
20, 20'	First cushion
21, 21'	First chamber
22	Filling material
30, 30'	Second cushion
31, 31'	Second chamber
32, 32', 32''	Fluid connector

WHAT IS CLAIMED IS:

1. A support system (1) for a patient (2) comprising

a. a support board (3) designed such that a part of the body of the patient (2) can be mounted on said support board (3), and

b. a support member (10, 10') arranged to mechanically support the part of the body (2), and

c. the support member (10, 10') comprising a first cushion (20, 20'), and

d. the support member (10, 10') comprising an inflatable second cushion (30, 30') arranged at least partially between the support board (3) and the first cushion (20, 20'), foreseen to press the first cushion (20, 20') away from the support board (3) against the part of the body (2) to be supported,

e. wherein the first cushion (20, 20') is designed to switch from a more deformable state to a less deformable state and thereby to facilitate the support of the part of the body.

2. The support system (1) according to claim 1, **wherein** the first cushion (20, 20') comprises a first chamber (21, 21') which is at least partially filled with a filling material (22) that can switch from a more deformable state to a less deformable state.

3. The support system (1) according to claim 2, **wherein** the filling material (22) is an interlockable material that when compressed interlocks and thereby achieves a less deformable state.

4. The support system (1) according to claim 2, **wherein** the filling material (22) is an interlockable material that interlocks and thereby achieves a less deformable state when the first chamber (21, 21') is evacuated.

5. The support system (1) according to one of claims 3 or 4, **wherein** the filling material (22) is a granular material whose granules are configured to interlock with each other when being compressed.

6. The support system (1) according to claim 5, **wherein** the granular material (22) is made from an expanded polystyrene and/or expanded polypropylene.

7. The support system (1) according to one of the preceding claims, **wherein** the support board (3) comprises a first portion (4) and a second portion (5), the second portion (5) being pivotally connected to the first portion (4).

8. The support system (1) according to claim 7, **wherein** a first support member (10) is arranged at the second portion (5) of the support board (3), such that the second cushion (30) of the first support member (10) at least partially extends along a first support face (11) of the second portion (5).

9. The support system (1) according to claim 8, **wherein** the first support member (10) has an essentially planar shape.

10. The support system (1) according to one of claims 7 to 9, **wherein** a second support member (10') is arranged at the first portion (4) of the support board (3), such that the second cushion (30') of the second support member (10') at least partially extends along a second support face (11') of the first portion (4).

11. The support system (1) according to claim 10, **wherein** the second support member (10') essentially has the shape of a triangular prism.

12. The support system (1) according to one of the preceding claims, **wherein** the support member (10, 10') comprises a carrier means (13).

13. The support system (1) according to claim 12, **wherein** the carrier means (13) is made from a flexible sheet material.

14. The support system (1) according to one of claims 12 and 13, **wherein** the first cushion (20, 20') is at least partially arranged between the carrier means (13) and the second cushion (30, 30').

15. The support system (1) according to one of claims 12 and 13, **wherein** the carrier means (13) is at least partially arranged between the first cushion (20, 20') and the second cushion (30, 30').

16. The support system (1) according to any of the preceding claims, **wherein** the support member (10, 10') comprises a fastening means (12) in order to establish a mechanical interconnection with the support board (3).

17. The support system (1) according to claim 16, **wherein** the fastening means (12) comprises a peg configured to be received by a corresponding recess (7) arranged in the support board (3), such that relative movements between the support member (10, 10') and the support board (3) are restricted in at least one direction.

18. The support system (1) according to one of the preceding claims, **wherein** the first cushion (20, 20') comprises a passage (14) that fluidically connects the first chamber (21, 21') with the atmosphere.

19. The support system (1) according to claim 18, **wherein** the passage (14) passes through the second cushion (30, 30').

20. The support system (1) according to claims 11 and 18, **wherein** the passage (14) is arranged at a base of the triangular prism.

21. The support system (1) according to claims 12 and 18, **wherein** the passage (14) is arranged on the side of the carrier means (13) opposite to the side directed to the part of the body (2) to be supported.

22. A support member (10) for a support system (1) according to one of the preceding claims.

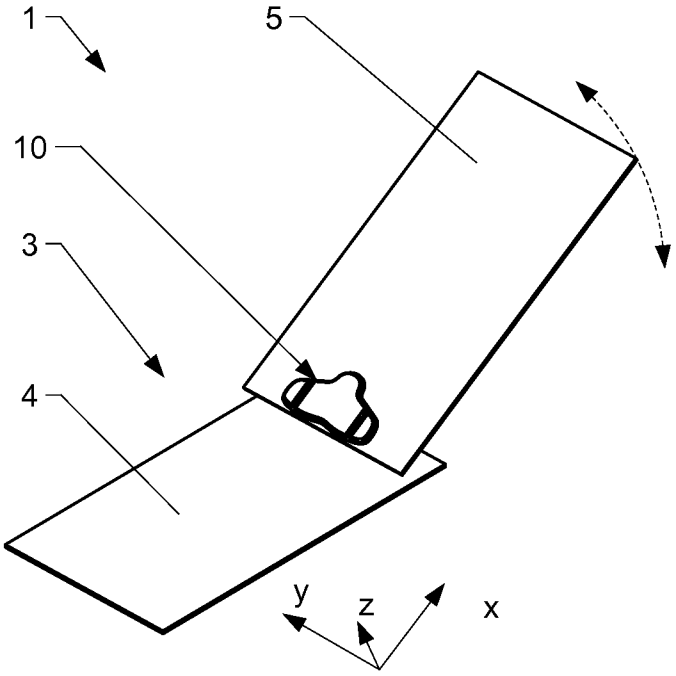


Fig. 1

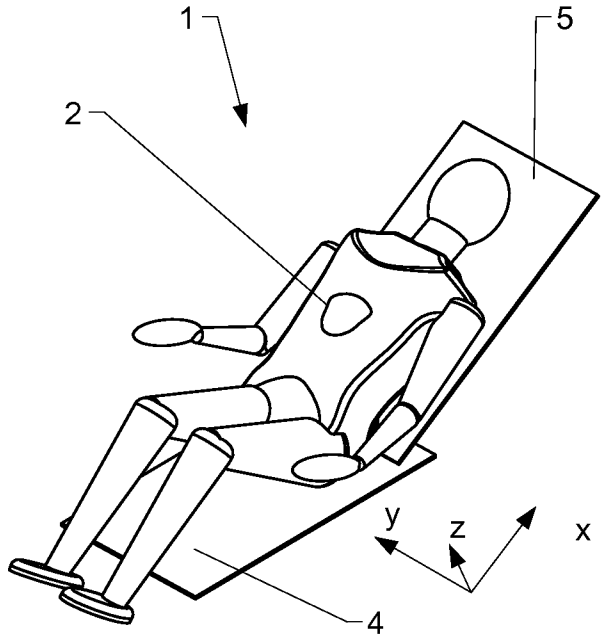


Fig. 2

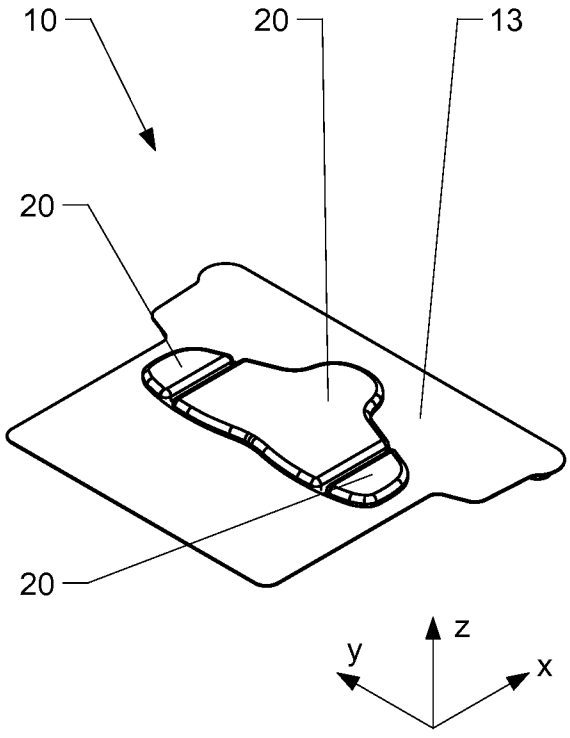


Fig. 3

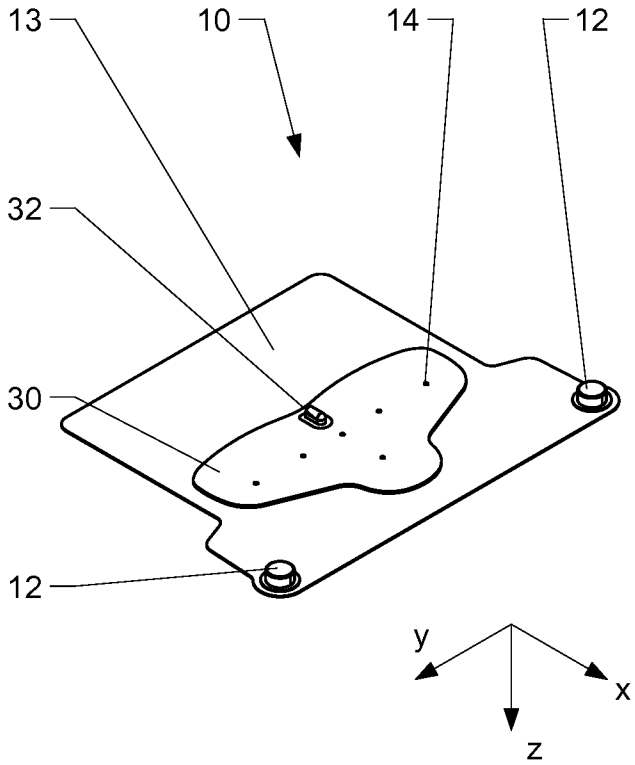


Fig. 4

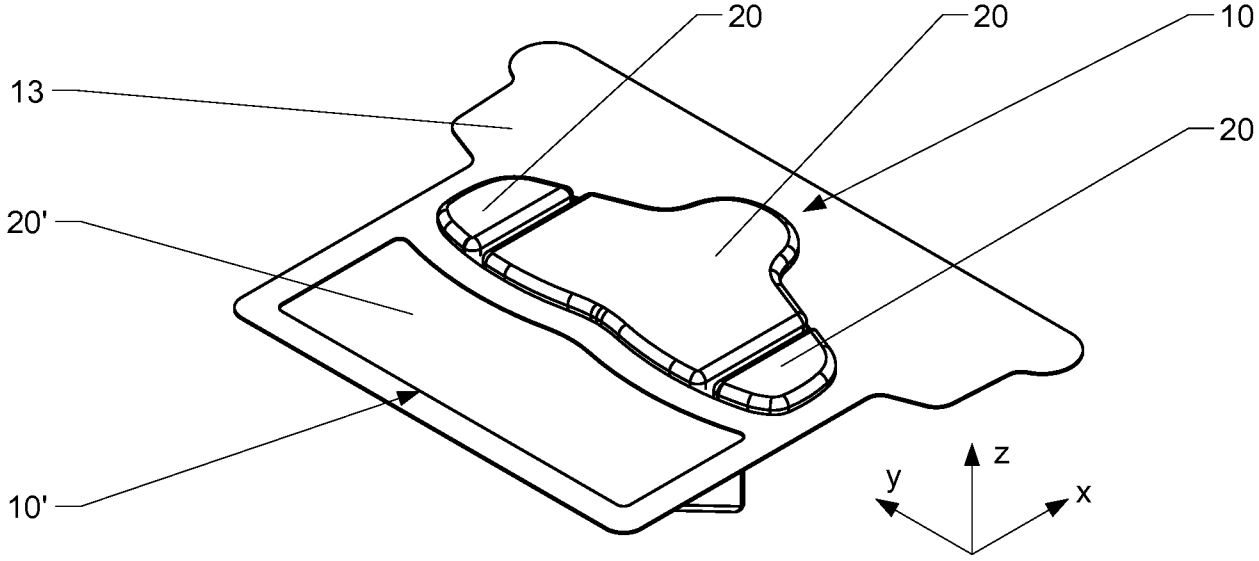


Fig. 5

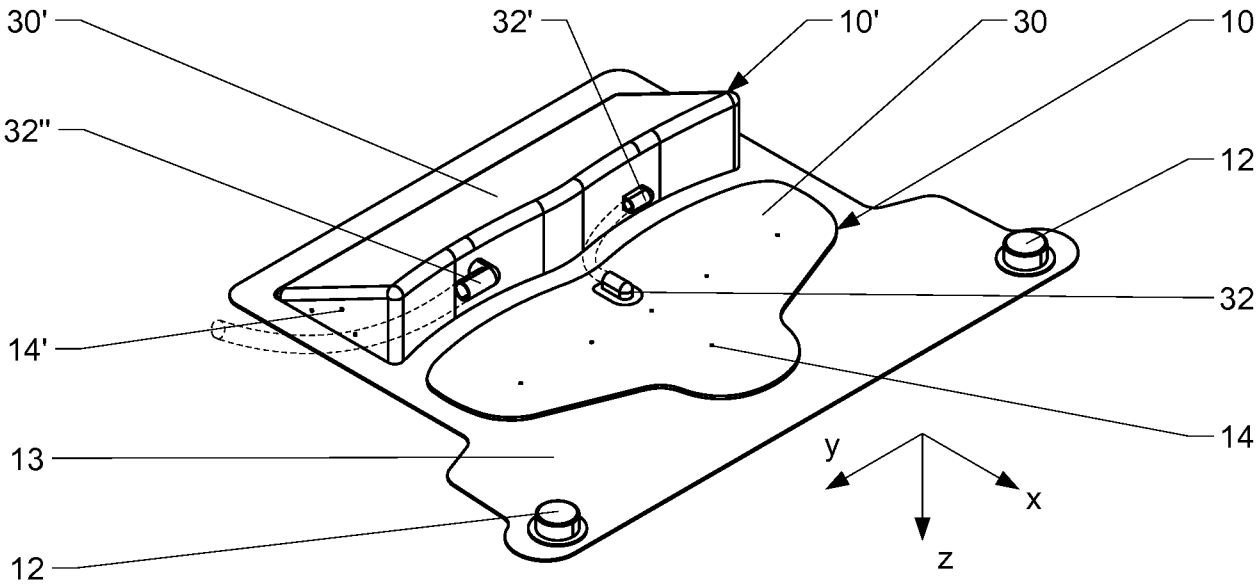


Fig. 6

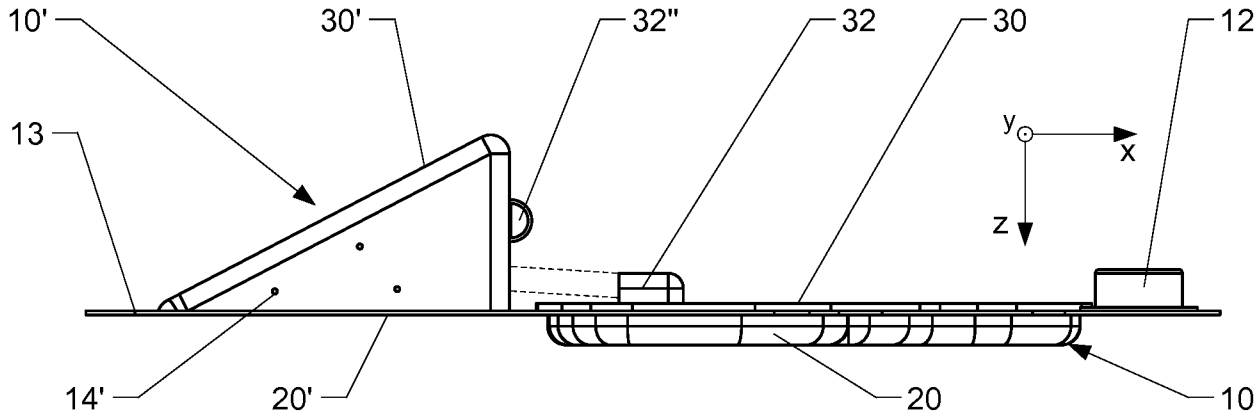


Fig. 7a

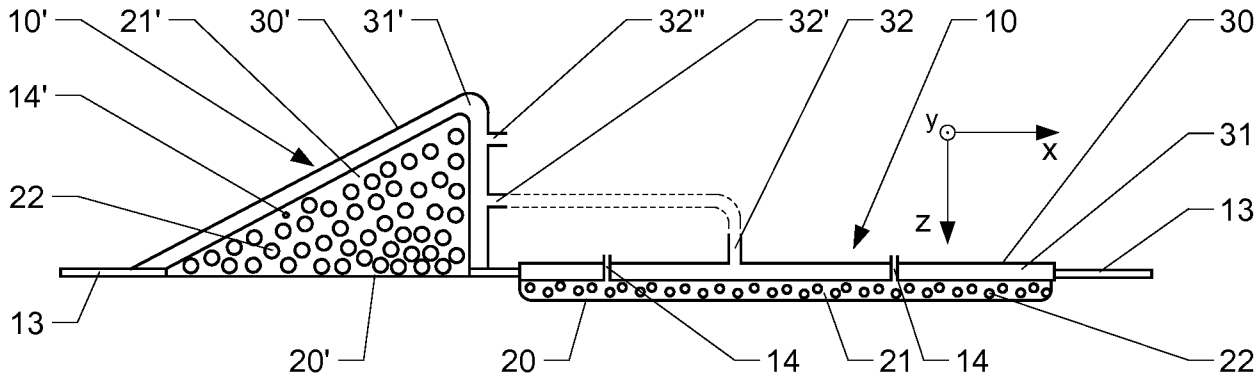


Fig. 7b

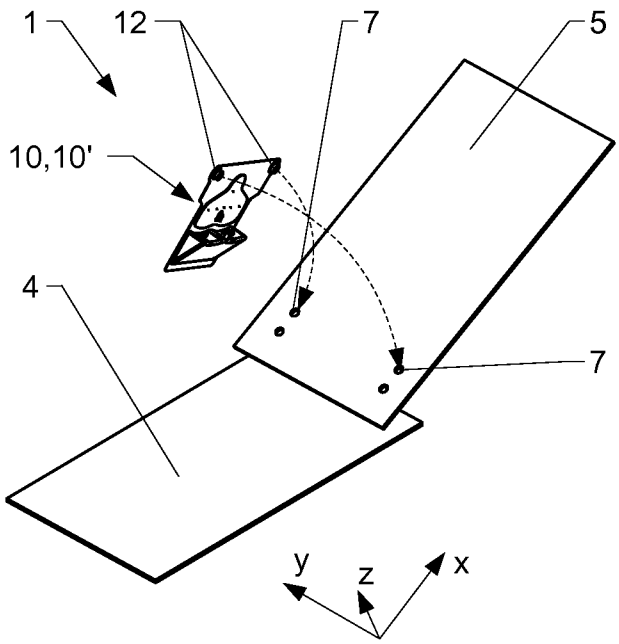


Fig. 8a

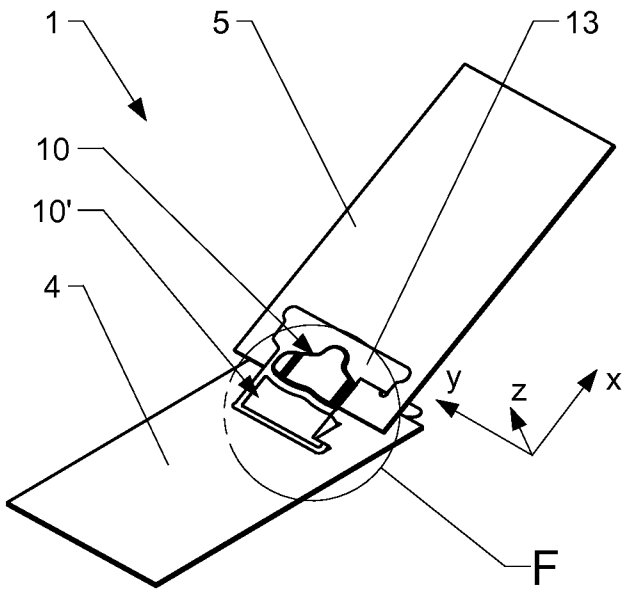


Fig. 8b

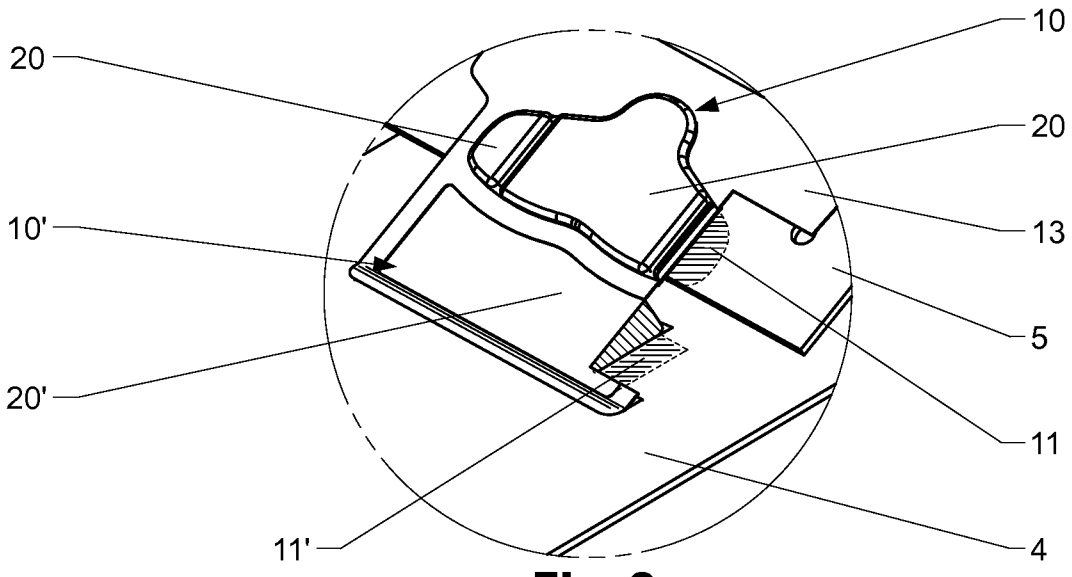


Fig. 9

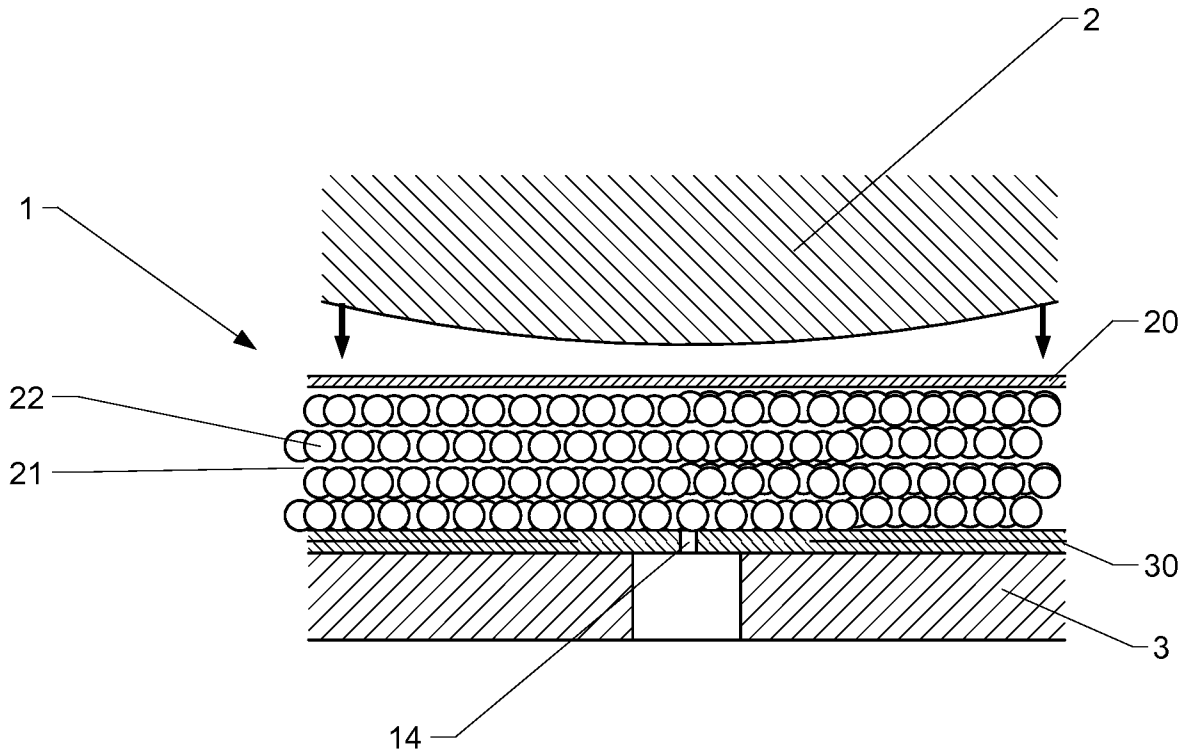


Fig. 10

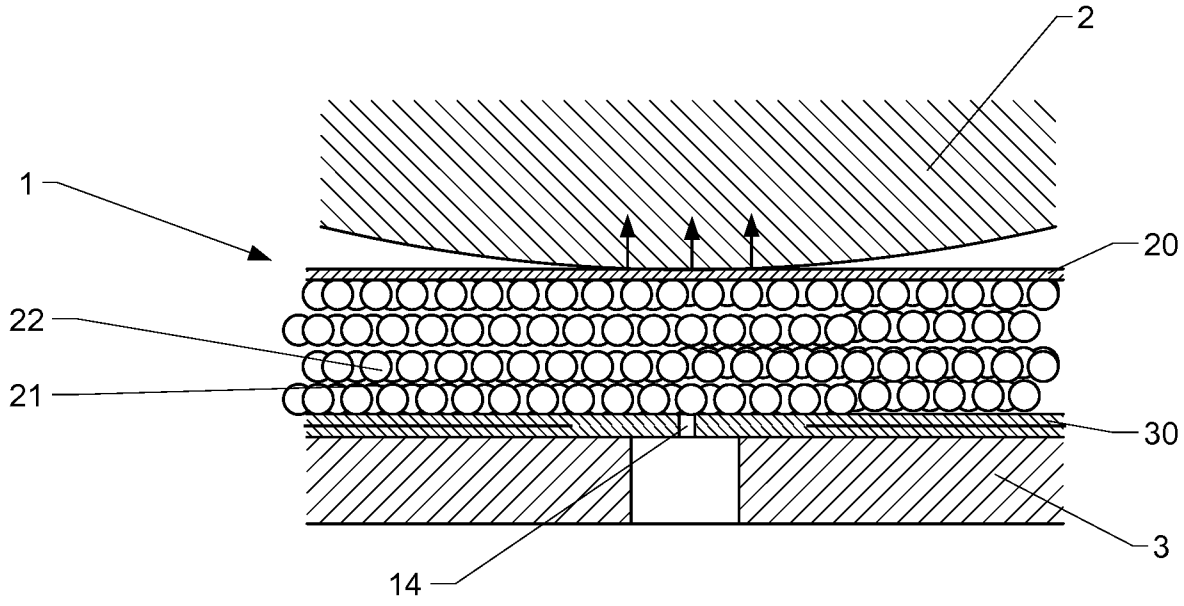


Fig. 11

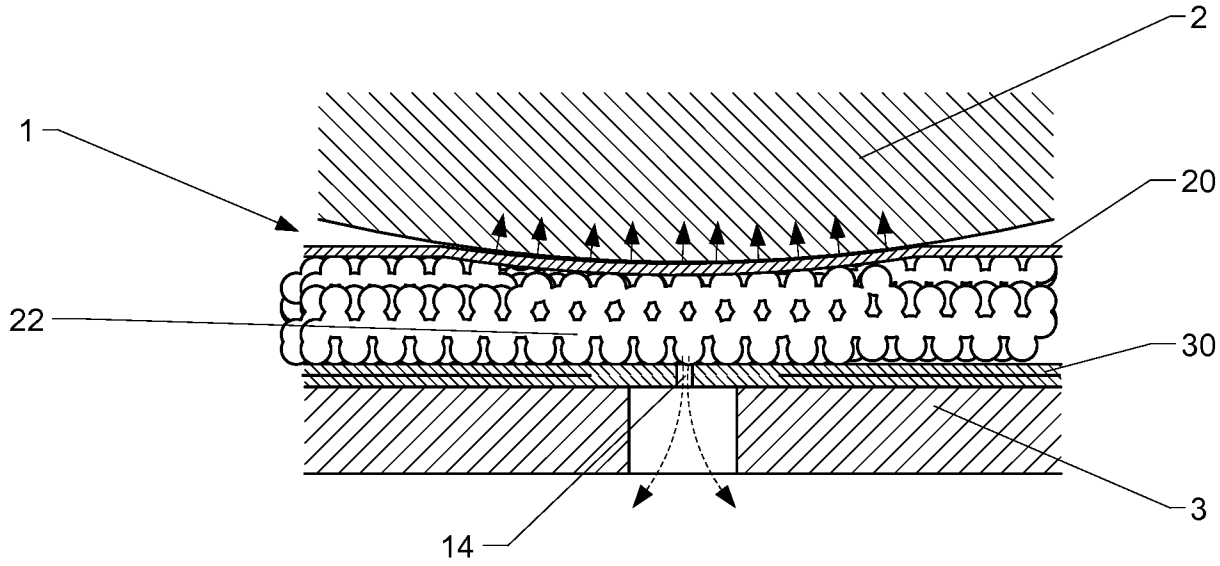


Fig. 12

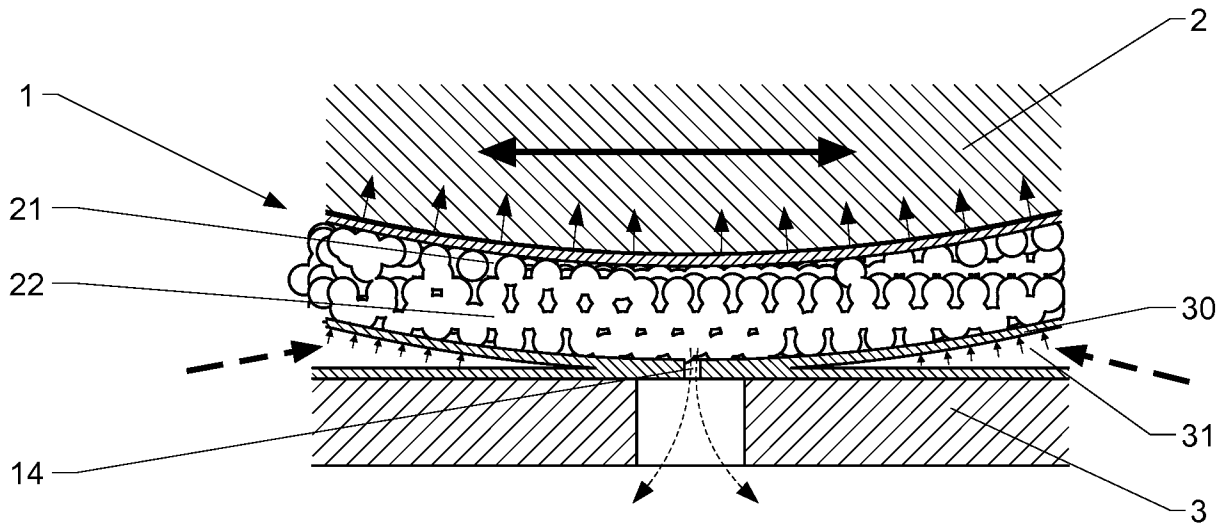


Fig. 13