



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 000 599 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
17.05.2000 Bulletin 2000/20

(51) Int. Cl.⁷: **A61G 7/057, A47C 27/08**

(21) Application number: **99922503.0**

(86) International application number:
PCT/JP99/02779

(22) Date of filing: **27.05.1999**

(87) International publication number:
WO 99/60978 (02.12.1999 Gazette 1999/48)

(84) Designated Contracting States:
DK FI GB NL SE

(30) Priority: **28.05.1998 JP 14736598**
25.05.1999 JP 14445099

(71) Applicants:
• **Hayashi Telempu Co., Ltd.**
Nagoya-shi, Aichi 460-0013 (JP)
• **Sanada, Hiromi**
Kanazawa-shi, Isikawa 920-0171 (JP)

(72) Inventors:
• **SANADA, Hiromi**
Kanazawa-shi, Isikawa 920-0171 (JP)
• **HONDA, Teruyuki,**
Hayashi Telempu Co., Ltd.
Nagoya-shi, Aichi 460-0013 (JP)

(74) Representative:
Moir, Michael Christopher et al
Mathys & Squire
100 Gray's Inn Road
London WC1X 8AL (GB)

(54) **INTERNAL PRESSURE REGULATING VALVE AND CUSHION WITH THE VALVE**

(57) A valve (3) comprising intake means (4) and exhaust means (5) is attached to a cushion comprising an elastic body (2) with air permeability surrounded airtightly by a casing material (1) with no air permeability, and an internal pressure in the cushion is automatically adjusted by the valve (3). Said intake means (4) is opened to introduce outside air into the cushion when an internal pressure in the cushion becomes equal to or lower than a predetermined value. Said exhaust means (5) is opened to discharge air in the cushion to the outside when an internal pressure in the cushion becomes equal to or higher than a predetermined value. The elastic body (2) of said cushion comprises a high elastic member (21) and a low elastic member (22) which are bonded together. This enables automatic optimization of the elasticity of the cushion in accordance with uses of a patient or the like.

EP 1 000 599 A1

Description

TECHNICAL FIELD

[0001] The present invention relates generally to a cushion used in a wheelchair, bed or the like, and more particularly to a cushion suitable for preventing pressure ulcers from occurring due to bottom out.

BACKGROUND ART

[0002] In medical and health care fields, when a patient maintains the same position in a wheelchair, bed or the like for a long time, a problem occurs that the patient's own weight causes blood flow inhibition in blood vessels, resulting in pressure ulcers in tissues. To obviate this problem, a care-giver must periodically change position of a patient, which puts significant physical and mental loads on both patient and care-giver.

[0003] Methods of reducing the aforementioned loads include a method of interposing a cushion between a patient and a wheelchair to distribute interface pressure. Such cushions include an air cushion which fills a sack with air, a water cushion which fills a sack with liquid, and a cushion which combines elastic bodies such as polyurethane foam or fiber.

[0004] For such cushions to effectively function, the degree of elasticity of cushions is important. While too hard cushions can not prevent pressure ulcers, too soft cushions can not support a body and the weight of a patient crushes a cushion to cause a so-called bottom out state, again losing the effect of preventing pressure ulcers. Pressures acting on a cushion vary in configuration of a patient or uses of a cushion.

[0005] Since conventional typical cushions have no adjustment functions for the degree of elasticity, effects for preventing pressure ulcers are not sufficiently exerted in many cases. Although some cushions have adjustment functions for the degree of elasticity, they are not freed from the inconvenience of making fine adjustment manually.

[0006] The present invention is made in view of the aforementioned problems, and it is an object thereof to provide an internal pressure adjustment valve and a cushion having the valve for automatically optimizing the degree of elasticity of the cushion in accordance with uses of a patient or the like.

DISCLOSURE OF THE INVENTION

[0007] An internal pressure adjustment valve according to the present invention is attached to a casing material which air-tightly surrounds an elastic body with air permeability, and comprises intake means for opening to introduce outside air into the casing material when a pressure in the casing material becomes equal to or lower than a predetermined value, and exhaust

means for opening to discharge air in the casing material to the outside when the pressure in a casing material becomes equal to or higher than a predetermined value.

[0008] A cushion according to the present invention comprises an elastic body with air permeability surrounded air-tightly by a casing material with no air permeability, in which a valve having intake means and exhaust means is attached to the casing material to automatically adjust an internal pressure in the cushion by the valve. Said intake means is opened to introduce outside air into the cushion when a pressure in the cushion becomes equal to or lower than a predetermined value which is lower than an outside air pressure. The exhaust means is opened to discharge air in the cushion to the outside when a pressure in the cushion becomes equal to or higher than a predetermined value which is higher than an outside air pressure. Exhaust means and intake means may be separately attached to the cushion.

[0009] The elastic body in the cushion preferably comprises a high elastic member and a low elastic member which are bonded together. The low elastic member is preferably placed in and bonded to a recess portion formed from a frame of the high elastic member. This can maintain the shape of the cushion with a soft texture being kept and increase recovering ability. A favorable maintaining property of shape is advantageous for automatic introduction of discharged air into the cushion.

[0010] The cushion having the internal pressure adjustment valve according to the present invention can automatically control the internal pressure of the cushion accurately in an arbitrary range under various usage conditions. Additionally, it maintains a soft texture and has a sufficient body support ability with no bottom touch and without losing shape.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is an external view of a cushion having an internal pressure adjustment valve according to the present invention;

Fig. 2 is a sectional view taken along II-II line in Fig. 1 and showing a configuration of the internal pressure adjustment valve;

Fig. 3 is a schematic diagram of a supporting board of exhaust means;

Fig. 4 is a schematic diagram of the exhaust means;

Fig. 5 is a graph showing a relationship between pressure differences between the inside and outside of a cushion and displacement of an umbrella portion of a check valve;

Fig. 6 is a sectional view taken along VI-VI line in Fig. 1 and showing a configuration of the cushion;

Fig. 7 is a diagram showing a state where a valve having intake means and a valve having exhaust means are attached to a casing material; and
 Fig. 8 is a diagram showing an example of an open/close valve which linearly displaces with respect to pressure differences.

BEST MODE FOR CARRYING OUT THE INVENTION

[0012] The present invention will be described according to the accompanying drawings for more detailed description thereof.

[0013] Fig. 1 is an external view of a cushion which has an internal pressure adjustment valve according to the present invention and is suitable for placement on a sitting surface of a wheelchair.

[0014] As shown in Fig. 1, the cushion comprises casing material 1 with no air permeability which air-tightly surrounds elastic body 2 with air permeability, in which casing material 1 is provided with at least one internal pressure adjustment valve 3 for communicating the inside and outside of cushion 1.

[0015] Fig. 2 is a sectional view taken along II-II line in Fig. 1 and showing a configuration of the internal pressure adjustment valve.

[0016] As shown in Fig. 2, internal pressure adjustment valve 3 has a shape in which body portion 6 in cylindrical form is fitted by a screw with cap portion 7 having exhaust hole 7a in the center thereof. Body portion 6 overlaps and is attached to casing material 1 of the cushion with flange 10 formed at the root thereof. Said body portion 6 and cap portion 7 are preferably made from rigid resin molding, for example, polyacetal, polyamide, or rigid PVC.

[0017] Said body portion 6 has intake means 4 attached thereto for introducing outside air into the cushion. Intake means 4 comprises barrel 12 having through hole 13 and lid 14 having an end fixed to barrel 12 so as to cover said through hole 13. Said barrel 12 is made from resin such as silicone resin, and with the help of its elasticity, it is fitted into aperture 15 formed in body portion 6 such that lid 14 is placed inside.

[0018] In said intake means 4, when an internal pressure of the cushion becomes equal to or lower than a predetermined value with respect to an external pressure and a pressure difference occurs over the elasticity of lid 14 between the inside and outside of the cushion, lid 14 is opened to introduce outside air into the cushion as shown with arrow A. A critical value above which lid 14 is opened can be determined by the coefficient of elasticity and shape of lid 14.

[0019] Exhaust means 5 is interposed between said body portion 6 and cap portion 7 for emitting the air in the cushion to the outside. Exhaust means 5 comprises supporting board 9 and check valve 16. As shown in Fig. 3, supporting board 9 is of circular shape and has central hole 17 formed in the center around which a plurality of air vents 8 are formed. Check valve

16 is fitted into central hole 17 of supporting board 9 from cap portion 7 side toward body portion 6. Preferably, said supporting board 9 is made from hard resin and check valve is made from silicone resin. An O-ring 11 made from rubber is interposed between said supporting board 9 and body portion 6 for increasing air-tightness.

[0020] As shown in Fig. 4, check valve 16 comprises central shaft 18, umbrella portion 19 at the end of the central shaft, and thick portion 20 at the root of the central axis. Umbrella portion 19 has an outside diameter covering at least air vents 8 of supporting board 9. The outside diameter of central shaft 18 is equal to or slightly larger than the inside diameter of central hole 17 of supporting board 9. Thick portion 20 has a tapered outside diameter toward an end thereof. The smoothness of the shape of thick portion 20 is utilized to pass thick portion 20 of central shaft 18 through central hole 17 of supporting board 9 to fix check valve 16 to supporting board 9. The area of air vents 8 and the elasticity and shape of umbrella portion 19 of check valve 16 may be used to determine a pressure difference between the inside and outside of the cushion for actuating exhaust means 5.

[0021] Exhaust means 5 may be replaced by removing said cap portion 7. This enables setting of exhaust means 5 having a different actuating pressure difference value.

[0022] Check valve 16 is most preferably made from silicone resin as mentioned above for increasing the accuracy of pressure adjustment of said exhaust means 5. Umbrella portion 19 of check valve 16 functions such that it is deformed as shown with arrow B by the pressure difference between the internal pressure in the cushion and the outside air pressure to emit the air in the cushion to the outside through exhaust hole 7a of cap 7 as shown with arrow C (see Fig. 2), and the shape returns to its original state after the elimination of the pressure difference to again cover air vents 8. At this point, umbrella portion 19 is nonlinearly deformed with respect to an increased pressure difference due to its shape. Specifically, no deformation occurs until the pressure difference reaches a boundary value, and at the instance when the boundary value is exceeded, deformation occurs to open air vents 8. In the case of a linear exhaust valve, it is difficult to provide open and close in response to a pressure difference sharply with respect to a boundary value, thereby making it impossible to obtain high accuracy of pressure adjustment.

[0023] This will be described with reference to a graph shown in Fig. 5. In Fig. 5, the horizontal axis represents $\Delta P (=P_i - P_o)$ which is a difference between internal pressure P_i and external pressure P_o (atmospheric pressure) of the cushion. The vertical axis represents ΔL (see Fig. 4) which is a displacement amount of an end of umbrella portion 19 of check valve 16.

[0024] In check valve 16 of the present invention, even as ΔP is increased from zero, the end of umbrella

portion 19 is hardly deformed and ΔL maintains values near zero until predetermined critical value ΔP_1 is reached. Thus, no air in the cushion is emitted. Immediately after ΔP exceeds critical value ΔP_1 , check valve 16 is abruptly deformed to rapidly increase ΔL (the air in the cushion is emitted).

[0025] In this manner, utilizing the nature of check valve 16 which is nonlinearly deformed with respect to the difference between the internal and external air pressure of the cushion, the internal pressure in the cushion can be accurately controlled. A change in a combination of air vents 8 formed in supporting board 9 and check valve 9 can change the critical value to ΔP_2 , ΔP_3 ..., and the internal pressure in the cushion can fall within an arbitrary predetermined pressure range.

[0026] Fig. 6 is a sectional view taken along VI-VI line in Fig. 1 and showing a configuration of elastic body 2 surrounded by casing material 1 with no air permeability.

[0027] For casing material 1 with no air permeability, it is preferable to select a resin sheet in consideration of proper flexibility and durability, for example, a vinyl chloride resin sheet having a thickness of 0.10 to 0.3 mm or an urethane resin sheet having a thickness of 0.01 to 0.3 mm is preferable. The outside of said casing material 1 may be coated with a cloth having good design and texture.

[0028] A form of elastic body 2 preferable for the present invention is low elastic member 22 contained in a recess portion formed from a frame of high elastic member 21. A combination as a typical example is a cut polyurethane foam serving as low elastic member 22 attached to a recess portion formed from urethane mold foam serving as high elastic member 21. Said mold foam is obtained by molding semi-rigid elastic foam into frame shape or by bonding planar foams to form a frame. Such a configuration of elastic body 2 can keep elastic body 2 in shape as well as provide a soft texture. Deformation of low elastic member 22 in the frame causes an air suction force like a vacuum pump, and air is again introduced into elastic body 2 after air is once discharged. While urethane foam is most preferable for low elastic member 22, fiber cotton materials can be used.

[0029] In the aforementioned embodiment, the internal pressure adjustment valve having the intake means and the exhaust means is attached to the cushion. However, at least one valve having exhaust means and at least one valve having intake means, or at least one valve obtained by coupling and integrating both valves may be attached to a cushion to automatically adjust the internal pressure of the cushion.

[0030] Fig. 7 is a diagram showing a state where a valve having intake means and a valve having exhaust means are attached to a casing material.

[0031] The valve having the intake means shown in the upper portion in Fig. 7 has body portion 6a of cylindrical shape and intake means 4a. Said body portion 6a

is formed to overlap and be attached to casing material 1a of a cushion with flange 10a formed on the outer periphery of an end thereof and located in casing material 1a. Said intake means 4a comprises barrel 12a having through hole 13a and lid 14a having an end fixed to barrel 12a so as to cover said through hole 13a. Said barrel 12a is fitted into aperture 15a of body portion 6a formed in the inner periphery near a surface such that lid 14a is placed inside. Since the remaining configuration is similar to that in the aforementioned embodiment, the description thereof is omitted.

[0032] The valve having the exhaust means shown in the lower portion in Fig. 7 has body portion 6b of cylindrical shape and exhaust means 5b. Said body portion 6b is formed to overlap and be attached to casing material 1a of a cushion with flange 10b formed on the outer periphery of an end thereof and located in casing material 1a. Said exhaust means 5b comprises supporting board 9b and check valve 16b having umbrella portion 19b. Supporting board 9b is of cylindrical shape and has central hole 17b formed at the bottom around which a plurality of air vents 8b are formed. Central shaft 18b of check valve 16b is fitted into central hole 17b of supporting board 9b. Since the remaining configuration is similar to that in the aforementioned embodiment, the description thereof is omitted.

[0033] The valve having the intake means and the valve having the exhaust means shown in Fig. 7 have an advantage that they present no obstacle since they are located inside the casing material. The valves may be open/close valve 25 for opening/closing air vent 28 with coil spring 26 and ball 27 shown in Fig. 8. However, since this valve is linearly displaced with respect to pressure differences as mentioned above, the control accuracy of pressure is reduced.

INDUSTRIAL AVAILABILITY

[0034] As described above, the cushion according to the present invention can be used for a wheelchair, bed or the like in medical and health care fields, or can be applied in the field of automobile seats or the like which involves sitting in the same position for a long time.

Claims

1. A cushion including an air-permeable elastic body (2) surrounded by a casing (1, 1a) of impermeable material, comprising an internal pressure adjustment valve including intake means (4, 4a) which opens to introduce outside air into said casing (1, 1a) when a pressure in said casing (1, 1a) becomes equal to or lower than a first predetermined value and exhaust means (5, 5b) which opens to discharge air from said casing (1, 1a) to the outside when a pressure in said casing (1, 1a) becomes equal to or higher than a second predetermined

value, wherein said exhaust means (5, 5b) includes a check valve (16, 16b) which responds non-linearly to a pressure difference between the inside and the outside of said cushion so as to open abruptly when said pressure difference exceeds a predetermined value.

2. The cushion according to Claim 1, wherein the exhaust means (5, 5b) further comprises a supporting member (9, 9b) for supporting the check valve (16, 16b). 10
3. The cushion comprising an internal pressure adjustment valve according to claim 2, wherein the supporting member (9, 9b) of said exhaust means (5, 5b) has a central hole (17, 17b) and a plurality of air vents (8, 8b) formed around the central hole (17, 17b), and said check valve (16, 16b) includes a central shaft (18, 18b) inserted into the central hole (17, 17b) of the supporting member (9, 9b) and an umbrella-shaped portion (19, 19b) provided at the end of the central shaft (18, 18b) and covering the air vents (8, 8b). 15 20
4. The cushion comprising and internal pressure adjustment valve according to any preceding Claim, wherein said intake means (4, 4a) includes means (12, 12a) defining a through hole (13, 13a) and a lid (14, 14a) having an end fixed to the hole defining means (12, 12a) to cover the through hole (13, 13a), and the first predetermined value for opening the lid (14, 14a) is determined by the coefficient of elasticity and shape of the lid (14, 14a). 25 30
5. The cushion comprising an internal pressure adjustment valve according to any preceding Claim, wherein said elastic body (2) includes a member (21) of low elasticity and a member (22) of high elasticity which are bonded together. 35 40
6. The cushion comprising an internal pressure adjustment valve according to claim 5, wherein the member (22) of high elasticity is placed in a frame of member (21) of low elasticity, and said intake means (4, 4a) and said exhaust means (5, 5b) are provided at said casing (1, 1a) on the side of the member (22) of high elasticity. 45
7. The cushion comprising an internal pressure adjustment valve according to any preceding Claim, further comprising at least one body portion (6) overlapping and attached to said casing (1) such that it is placed outside said casing (1) with a flange (10) formed at an end of the body portion (6), and a cap portion (7) having an exhaust hole (7a) fixed to the body portion (6), wherein said intake means (4) is attached to the body portion (6), and said exhaust means (5) is interposed between the body 50 55

portion (6) and the cap portion (7).

8. The cushion comprising an internal pressure adjustment valve according to Claim 3 or any of Claims 4 to 6 as dependent thereon, further comprising at least one body portion (6b) overlapping and attached to said casing (1a) such that it is placed inside said casing (1a) with a flange (10b) formed at an end of the body portion (6b), wherein the supporting member (9b) of said exhaust means (5b) is of generally cylindrical shape and fitted into the body portion (6b), and the central hole (17b) and the air vents (8b) are formed at the bottom of the supporting member (9b).
9. The cushion comprising an internal pressure adjustment valve according to claim 4, further comprising at least one body portion (6a) overlapping and attached to said casing (1a) such that it is placed inside said casing (1a) with a flange (10a) formed in an end of the body portion (6b), wherein the hole defining means (12a) of said intake means (4a) is fitted into the body portion (6a) such that the lid (14a) is placed inside.
10. Cushioning equipment comprising the cushion according to any of the preceding Claims; and a replacement check valve having a different non-linear characteristic to that of the check valve (16, 16b) installed in the cushion so as to open abruptly at a pressure difference different to that at which the installed check valve (16, 16b) opens.

FIG. 1

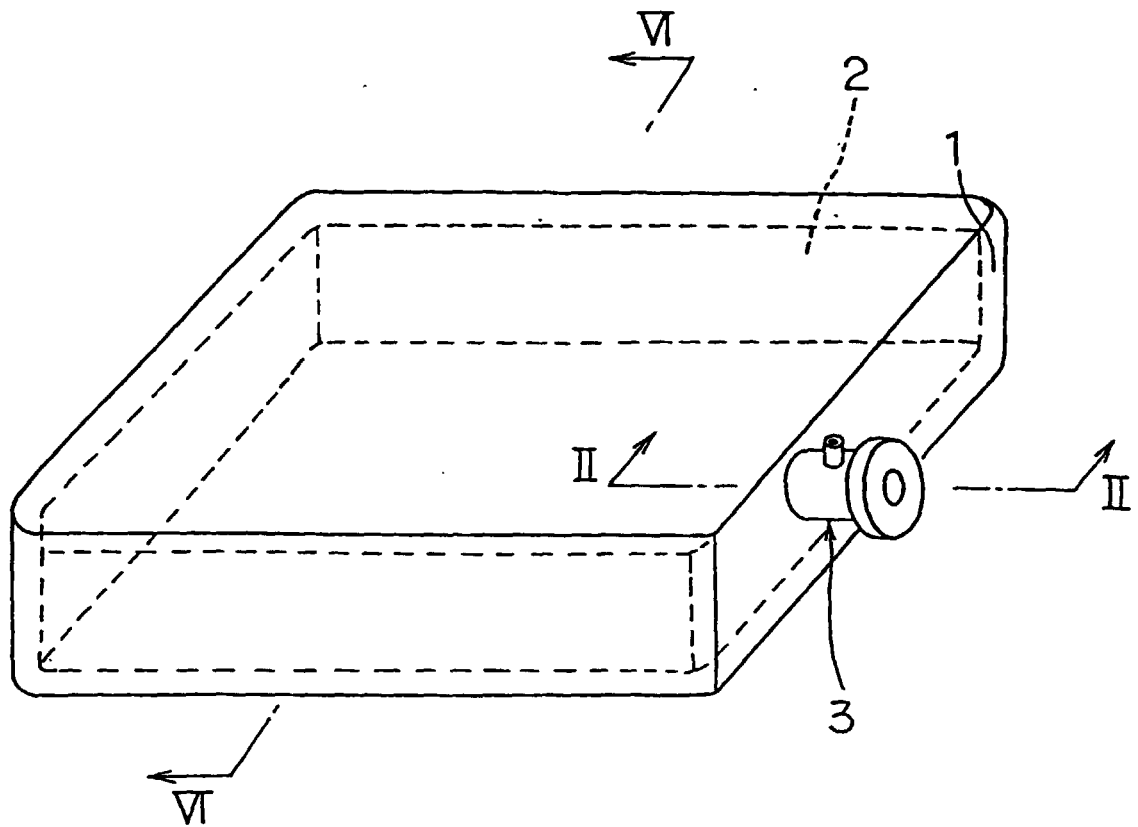


FIG. 2

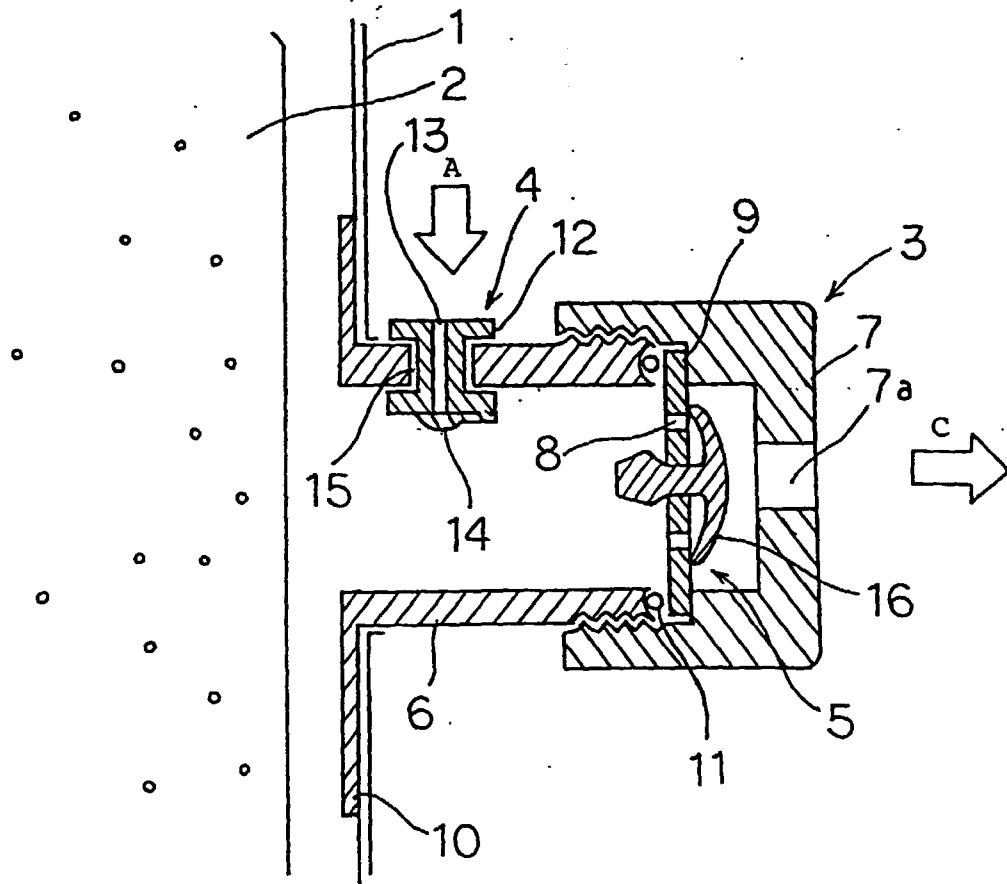


FIG. 3

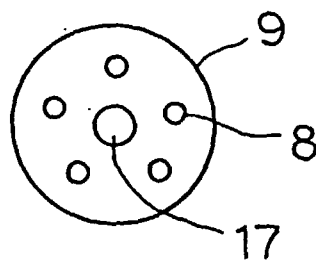


FIG. 4

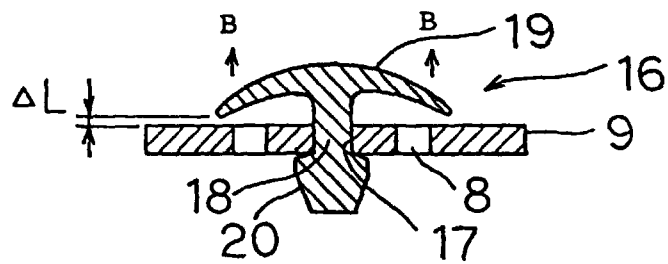


FIG. 5

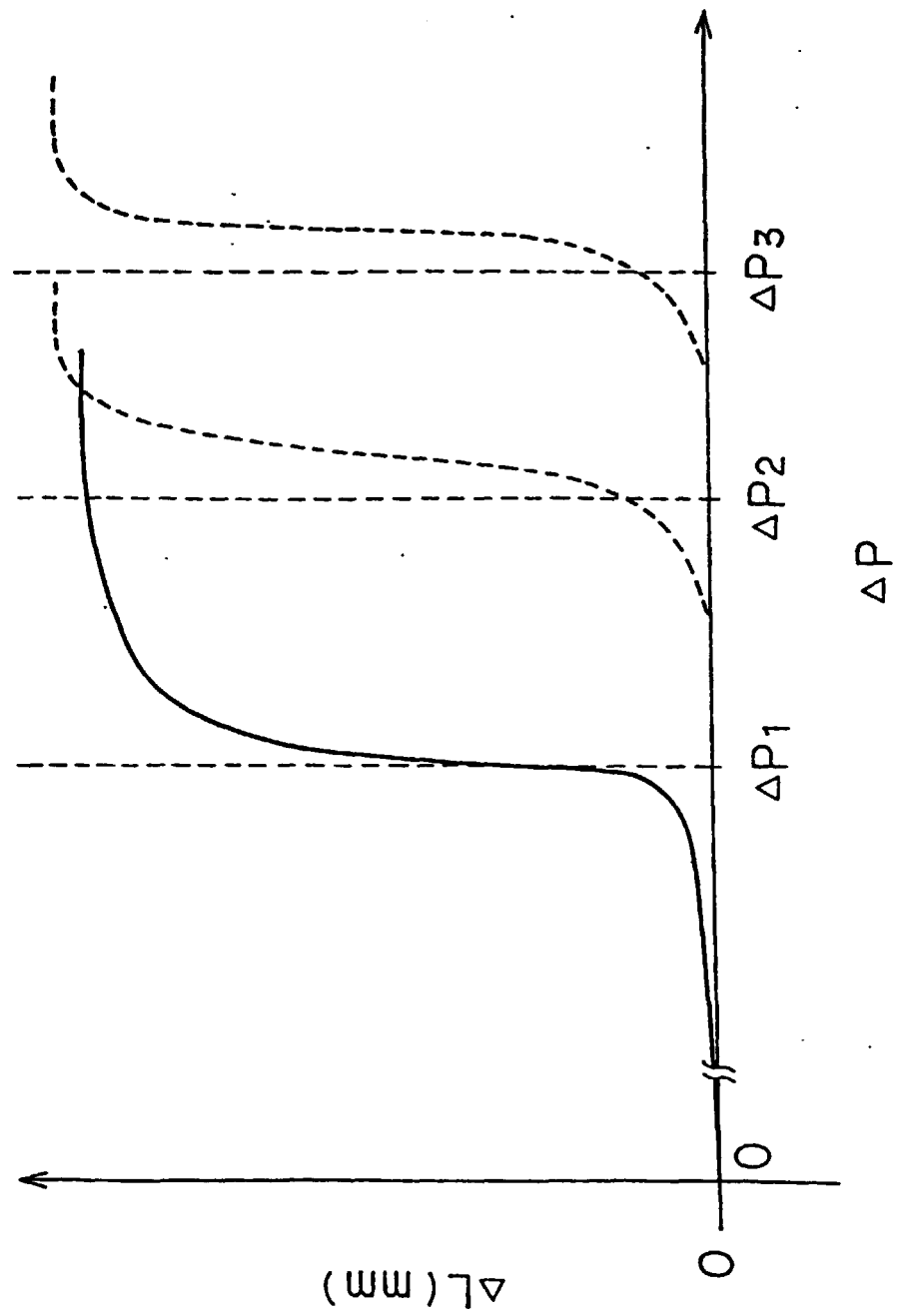


FIG. 6

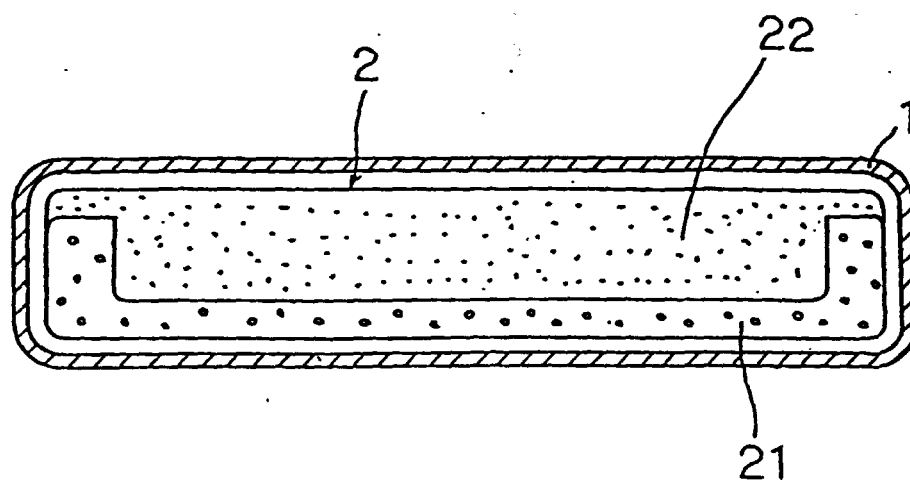


FIG. 7

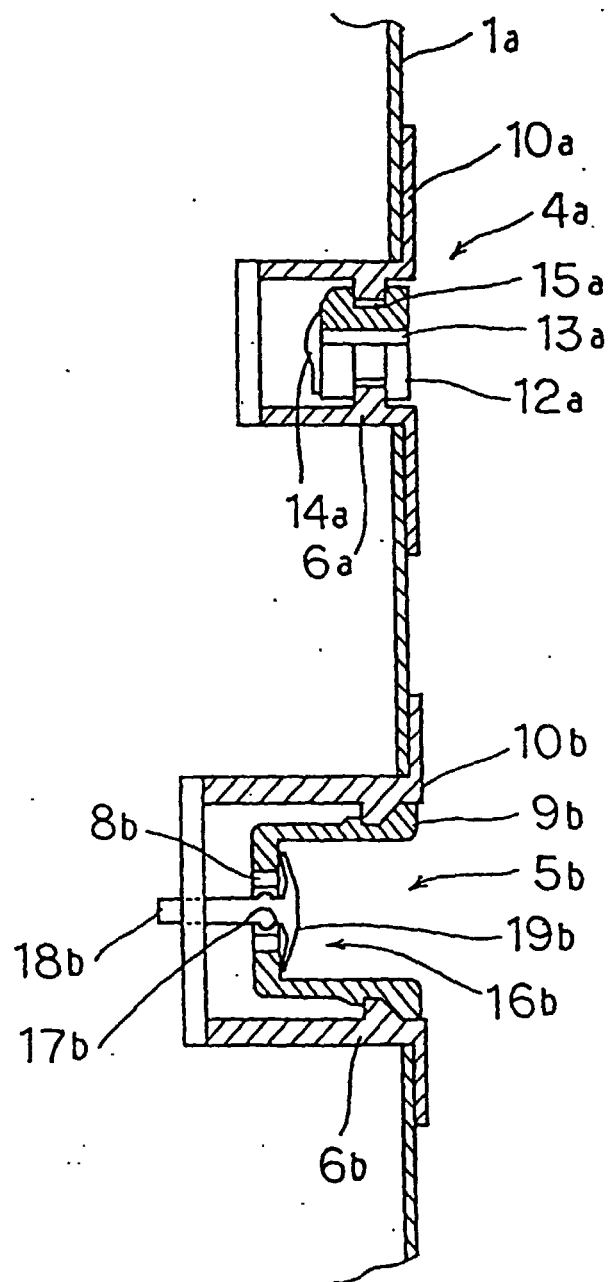
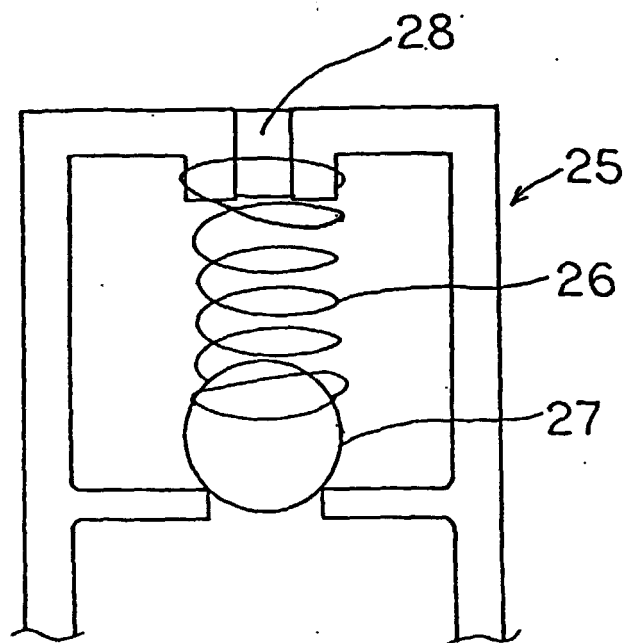


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP99/02779

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁶ A61G7/057, A47C27/08		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl ⁶ A61G7/057, A47C27/08		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-1999 Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 10-43253, A (K.K. Keepu), 17 February, 1998 (17. 02. 98), Full text ; Figs. 1 to 3 (Family: none)	1, 3, 5-7, 9
Y		2, 4, 8, 10
Y	JP, 7-88021, A (Matsushita Electric Works, Ltd.), 4 April, 1995 (04. 04. 95), Full text ; Figs. 1 to 11 (Family: none)	1, 4-6, 10
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 61-74338 (Laid-open No. 62-185984) (Toyo Tire & Rubber Co., Ltd.), 26 November, 1987 (26. 11. 87), Page 5, lines 12 to 16 ; Figs. 1 to 3 (Family: none)	2, 4, 10
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 9 August, 1999 (09. 08. 99)		Date of mailing of the international search report 17 August, 1999 (17. 08. 99)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP99/02779

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 5-24445 (Laid-open No. 6-75454) (Masahiro Chikasawa), 25 October, 1994 (25. 10. 94), Par. Nos. [0032] to [0034] ; Figs. 1 to 7 (Family: none)	8
A	JP, 5-317140, A (Matsushita Electric Works, Ltd.), 3 December, 1993 (03. 12. 93), Full text ; Figs. 1 to 5 (Family: none)	1, 5, 6

Form PCT/ISA/210 (continuation of second sheet) (July 1992)