

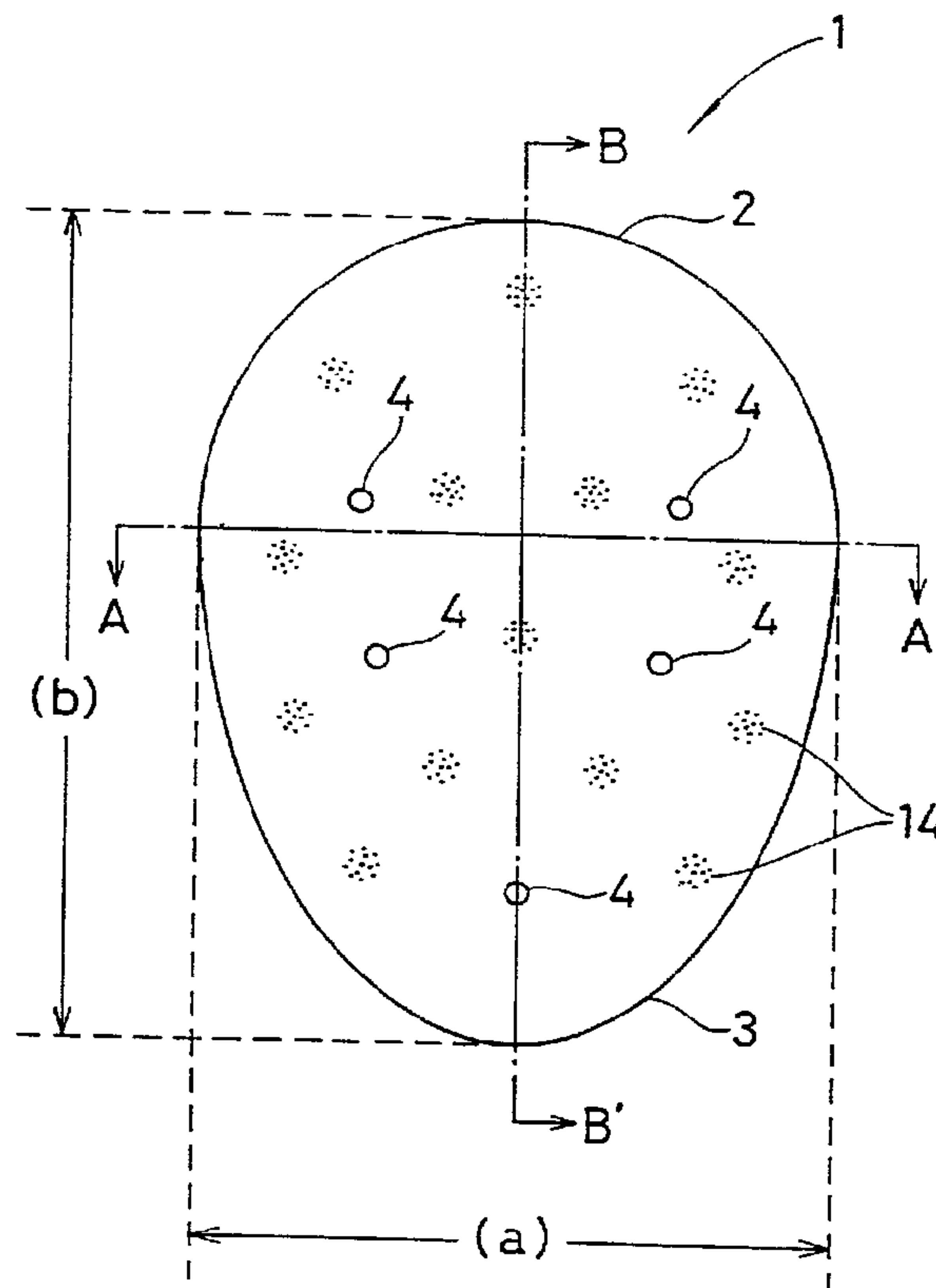


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(54) Title: HIP PROTECTOR



(57) Abrégé/Abstract:

A hip protector (1), formed into a domed shape so as to cover a hip portion corresponding to man's neck of a femur, having flexibility, and also a specific flat compression strength and a lateral compression strength. Therefore, the hip protector (1) deforms elastically in an impact given so that a cavity (12) between the hip protector (1) and the hip portion becomes smaller, resulting in a shock absorbing effect and endurance. As a result, the hip protector (1) is effective to prevent a fracture of the neck of the femur in falling.



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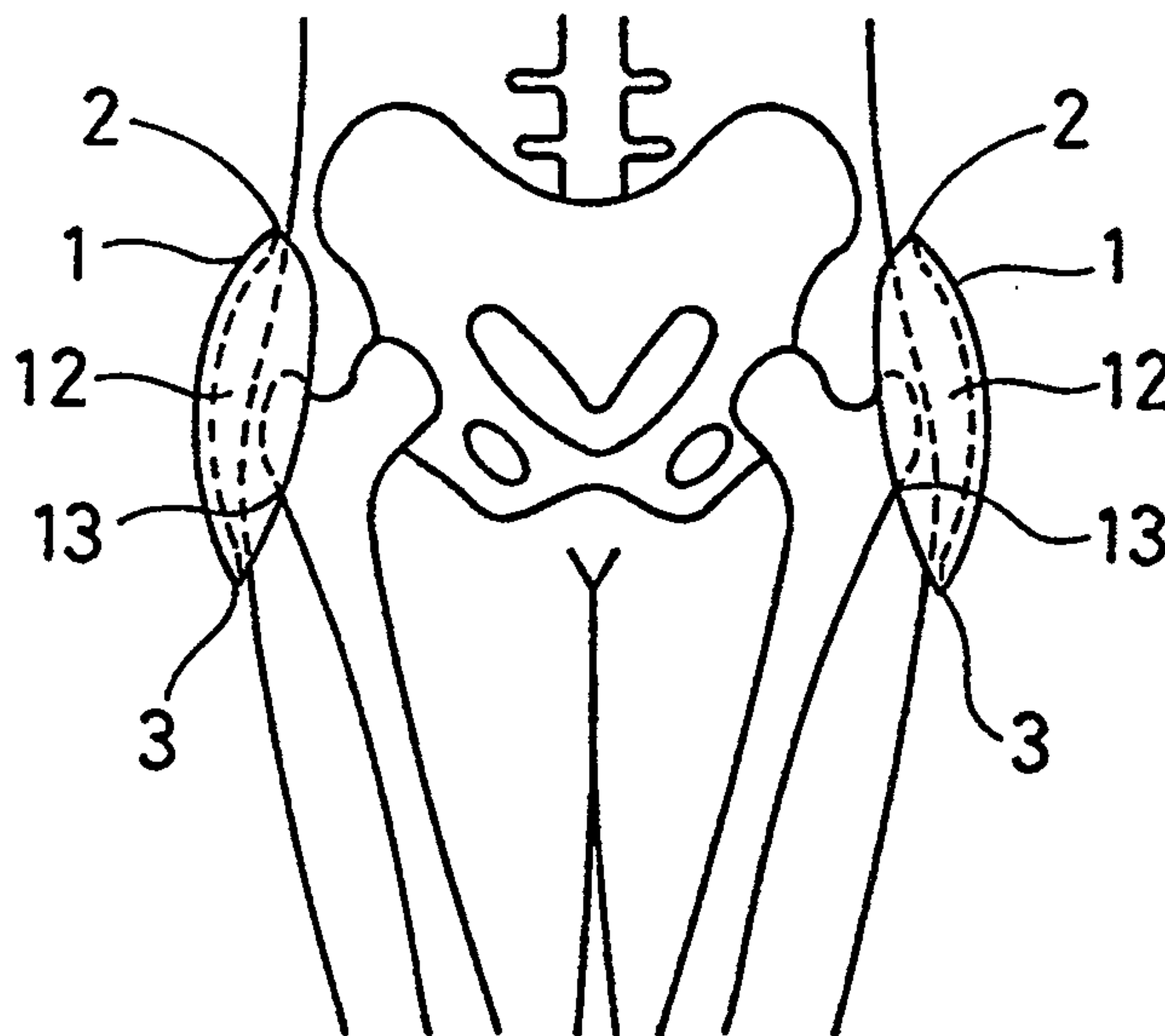
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(57) Abstract

A hip protector (1), formed into a domed shape so as to cover a hip portion corresponding to man's neck of a femur, having flexibility, and also a specific flat compression strength and a lateral compression strength. Therefore, the hip protector (1) deforms elastically in an impact given so that a cavity (12) between the hip protector (1) and the hip portion becomes smaller, resulting in a shock absorbing effect and endurance. As a result, the hip protector (1) is effective to prevent a fracture of the neck of the femur in falling.



HIP PROTECTOR

FIELD OF THE INVENTION

This invention relates to a hip protector which prevents elderly or physically debilitated persons, or sportsmen from damages associated with falling such as fracture of a neck of a femur.

BRIEF DESCRIPTION OF THE PRIOR ART

Elderly or physically debilitated persons easily fall even in usual walking and often suffer a fracture or the like. To prevent such incidents, there are some devices such as handrails to support walking or non-slipping floor in hospitals and the like. However, we cannot demand such devices in general houses or everywhere we go. In addition, researches on strengthening a bone itself by drug dosage of calcium agent or the like so as to prevent a fracture or the like even when falling seem to have been conducted, resulting in insufficient effect. Thus, it is a current situation there is no effective means heretofore to prevent a fracture when falling.

In such a fall, especially a neck of a femur is often fractured. The fracture in the neck of the femur inhibits a person from walking. In this case, especially in the case of an elderly person, there is high possibility that he or she becomes a bedridden person, upon which public attention has

been focused. The effective measure has been strongly demanded accordingly to prevent the fracture when falling, especially the fracture in the neck of the femur.

We have thought over how to prevent the fracture or the like in the neck of the femur when falling. Since there is no way to prevent elderly or physically debilitated persons from falling from reasons as mentioned the above, we have reached a conclusion of taking a measure to minimize injuries such as a bone fracture even when falling. That is, we have studied a hip protector which can reduce the occurrence ratio of bone fractures caused. In addition, we have judged that such a hip protector is available for sportsmen.

OBJECT OF THE INVENTION

Accordingly it is an object of the present invention to provide a hip protector having a sufficient shock absorbing ability in spite of an extremely lightweight which can be produced relatively easily with low cost.

DISCLOSURE OF THE INVENTION

To accomplish the above object, a hip protector of the present invention is formed into an approximately domed shape so as to go along man's neck of a femur and characterized in having flexibility with the following flat compressive strength (A) and lateral compressive strength (B);

(A) a flat withstand load by a 10 mm displacement is 20 to 100 kgf.

(B) a lateral withstand load by a 10 mm displacement is 5 to 30 kgf.

Namely, the hip protector of the present invention has flexibility and is formed into an approximately domed shape so as to cover man's neck of a femur and also has the specific flat compressive strength and the lateral compressive strength. When the hip protector is attached to hip parts corresponding to man's neck of a femur, there is a cavity caused between the hip parts and concave center parts of the dome thanks to this approximately domed shape. If an impact occurs to the hip protector in the man's falling, the cavity becomes smaller due to elastic deformation of the approximately domed shape so as to absorb the impact. Further, the hip protector has sufficient flat withstand and lateral withstand to stand for the impact occurred. Therefore, if the person wears this hip protector, injuries in the neck of the femur can be effectively prevented. In addition, flexibility in the present invention means the degree of synthetic resin, lightweight rubber, non-woven fabric and the like, except for hard materials such as steels and wood. For this reason, the present invention realizes the extremely lightweight hip protector having sufficient strength to endure the impact in falling and also flexibility to soften such an impact in spite of its extremely lightweight without using heavy rigid plate such as steel plate of heavy

composite material.

In one aspect, the present invention resides in a hip protector formed into an approximately domed shape sized for placement along a neck of a person's femur, and the hip protector being formed of a flexible material and having: (A) a flat compressive strength capable of withstanding a 10 mm displacement under a compressive force of 20 to 100 kgf; and (B) a lateral compressive strength capable of withstanding a 10 mm displacement under a compressive force of 5 to 30 kgf.

More preferably, the outer contour of the approximately domed shape is an ellipse.

More preferably, a ratio of a major axis (b) and a minor axis (a) of the ellipse shape; $(b)/(a)$ is controlled in the range of 1.3 to 2.0, and a ratio of a depth (c) of the domed shape and the minor axis (a); $(c)/(a)$ is controlled within 0.1 to 0.5.

Still more preferably, the whole material comprises synthetic resin foam.

In a more preferred aspect, the hip protector has a reinforcing core embedded therein which is harder than surface material.

More preferably, a plurality of thru-holes are formed so as to surround an approximate center part of the domed shape.

Still more preferably, the hip protector has a shock absorbing ratio not less than 5%.

Next, referring to drawings, the present invention is described in detail with embodiments.

Fig. 1 is a front view of one embodiment of the present invention,

Fig. 2 is a cross sectional view taken on line A-A' of Fig. 1 along a minor axis,

Fig. 3 is a longitudinal sectional view taken on line B-B' of Fig. 1 along a major axis,

Fig. 4 is a perspective view of the hip protector in Fig. 1 seen from above,

Fig. 5 is a cross sectional view of another embodiment,

Fig. 6 is a longitudinal sectional view of the another embodiment,

Fig. 7 is a typical front view in a situation where each of the above embodiments is fixed on pants,

Fig. 8 is a typical front view illustrating a hip protector position where each of the above embodiments is fixed,

Fig. 9 illustrates a typical way of measuring flat compressive strength (A) of the embodiments and

Fig. 10 illustrates a typical way of measuring lateral compressive strength (B) of the embodiments.

EXAMPLE 1

Fig. 1 is a front view of one embodiment of a hip

protector 1 in the present invention, showing the approximately domed hip protector 1 with the convex side up and the concave side down. Fig. 2 is a sectional view along line A-A' of Fig. 1, Fig. 3 is a sectional view along line B-B' of Fig. 1, and Fig. 4 is a perspective view of the embodiment in Fig. 1 seen from above. In Fig. 1, the hip protector 1 comprising a foamed polypropylene element is oblong in plan view, whose down part 3 terminates in a comparatively acute end compared to the top part 2, wherein the minor axis (a) is set up in 11.5 cm while the major axis (b) is in 16 cm, is characterized in that a flat withstand load (A) by a 10 mm displacement is 25 kgf while a lateral withstand load (B) by a 10 mm displacement is 8 kgf, and a shock absorbing ratio is 18.3%. Besides, 5 pieces of vent holes 4 for perspiration in 0.5 cm diameter are formed in the hip protector 1 so as to pass through from the front side to the reverse side. Further, a plurality of anti-slipping areas 14 are established on the convex side of the hip protector 1 at specific intervals, while similar anti-slipping areas 14 are also established on the concave side. The thickness of the hip protector 1 is 0.85 cm and the depth (c) of the dome is 2 cm as shown in Fig. 2 and 3. Furthermore, a marginal area of the concave side 7 of the dome is chamfered and formed into a rounded rim 9 so as to slide in bending with an impact on the hip protector 1 and

not to prevent such a bending.

As mentioned above, the hip protector 1 is formed into an approximately domed shape, wherein the rounded rim 9 is established in the marginal area of the concave side 7 and the marginal area of the convex side 6 is flexible, so that a cavity 12 (in Fig. 8) is caused between the hip part and the center part of the concave side 7 when the hip protector 1 is applied on the hip part corresponding to the neck of the femur with concave side 7 inside. In such a state, if the person falls, an impact is imparted to the hip protector 1 and the compression power is added to the domed shape, the domed shape becomes flatter (resulting in smaller cavity 12) to absorb the impact (a shock absorbing ratio: 18.3%). Further, the hip protector 1 comprising a foamed polypropylene element is characterized in that a flat withstand load (A) by a 10 mm displacement is 25 kgf while a lateral withstand load (B) by a 10 mm displacement is 8 kgf due to this material and the shape. The hip protector 1 can endure fully such an impact. Since the hip protector 1 is composed of single material of foamed polypropylene element having relatively lightweight, strength, heat resistance and water resistance, the hip protector 1 itself becomes lightweight, and can be safely laundered without damages or deformation or the like in a state that it is fixed inside the user's underwear, and moreover can be boil-washed due to

heat resistance. Furthermore, since vent holes 4 for perspiration is established in the hip protector 1, the user can wear the hip protector 1 comfortably without feeling stuffiness in the hip part. Especially, it demonstrates its effect when the user becomes sweaty like in summer or in playing sports. Still furthermore, since a plurality of anti-slipping areas 14 are established in specific intervals both on the convex side and on the concave side, the user can wear an underwear 11, in which the hip protector 1 is fixed, comfortably without sliding.

A method of measuring the above compression strength is described here. Both flat compressive strength (A) and lateral compressive strength (B) are measured with a compression jig by InstronTM universal tester. The values measured by compression with a head speed at 1 mm/minute in each direction shown in Fig. 9 and 10 are obtained as the flat compressive strength (A) and the lateral compressive strength (B) respectively.

Besides, a method of measuring the shock absorbing ratio is described here. An apparatus and conditions are shown as follows.

- Apparatus: An impact tester with platter made by Toyoseiki
- A falling body: 13 mm in diameter
- Fall height: 0.4 m

- The falling body's weight: 6.5 kgs

The values are indicated in the load cell of the above apparatus as all absorbing energy (J). In addition, the formula for obtaining the shock absorbing ratio is shown below.

$$\frac{\text{all absorbing energy (J=kgm}^2 \text{ s}^{-2}\text{)}}{\text{A falling body's weight (kg) x gravitational acceleration (ms}^{-2}\text{) x fall height (m)}} = \text{shock absorbing ratio (\%)}$$

The all absorbing energy is 4.67J (joule) in example 1 under the above conditions. Therefore, the shock absorbing ratio 18.3% is derived by the above formula.

EXAMPLE 2

Fig. 5 is a cross sectional view along line A-A' of another embodiment wherein a reinforcing core 8 is embedded inside the hip protector 1 of example 1. Fig. 6 is a sectional view along line B-B' of Fig. 5. In these figures, a hard polypropylene plate member is employed for the reinforcing core 8. The shape of the reinforcing core 8 is approximately same as that of the hip protector 1 and is embedded into almost all the hip protector 1. That is, the size of the reinforcing core 8 is smaller than that of the hip protector 1 so that the reinforcing core 8 does not appear at the surface of the hip protector 1. In Fig. 5 and 6, the

reinforcing core 8 is set up at 2 mm in thickness. Since the reinforcing core 8 is embedded inside the same hip protector 1 as example 1 in this example, further higher strength can be obtained than that of the hip protector 1 in example 1. Namely, about 30 kgf for a flat withstand load (A) by a 10 mm displacement and about 10 kgf for a lateral withstand load (B) by a 10 mm displacement can be obtained, and jointly with the above improved strength, the shock absorbing ability is increased to 25%, which is bigger than that of example 1.

Now a method of manufacturing this example 2 is described. First of all, the reinforcing core 8 in an approximate plate shape having holes corresponding to the plurality of vent holes 4 and a center hole is prepared. Secondly, the reinforcing core 8 is put on a lower mold wherein a plurality of projections corresponding to the vent holes 4 are arranged so that the projections pass through the holes corresponding to the holes 4, while a upper mold having a hole corresponding to the center hole is put thereon. Both upper and lower molds are closed. Then, foamed polypropylene element is injected through the hole corresponding to the center hole so as to cover all of the reinforcing core 8 to be integrated together, which are removed after being cooled.

Thus, the hip protector 1 in example 2 can be obtained.

EXAMPLE 3

In the hip protector 1 for this example 3, nylon plate

member in 2.5 mm thickness is embedded inside the hip protector 1 of example 1. The shape of the nylon plate member is approximately same as that of the hip protector 1 and is embedded into almost all the hip protector 1. The size of the reinforcing core 8 is smaller than that of the hip protector 1 so that the reinforcing core 8 does not appear at the surface of the hip protector 1. That is, this example is a modification wherein the reinforcing core 8 (Fig. 5 and 6) in 2 mm thickness of example 2 is replaced by nylon resin plate member in 2.5 mm thickness. Therefore, further higher strength can be obtained than that of the hip protector 1 in example 2. Namely, about 80 kgf for a flat withstand load (A) by a 10 mm displacement and about 25 kgf for a lateral withstand load (B) by a 10 mm displacement can be obtained; and jointly with the above improved strength, the shock absorbing ratio is increased to 30%, which is bigger than that of example 2.

Fig. 7 is a typical front view in a situation that the hip protector 1 of example 1, 2 or 3 is installed in an underwear 11. Fig. 8 is a typical front view illustrating positioning where the hip protector 1 is installed in Fig. 7.

In these figures, the hip protector 1 is attached to a hip portion corresponding to the neck of the femur with its upper section 2 on a hip side, its lower section 3 on a leg side and its concave side 7 inside, resulting in a cavity 12

between the hip portion and the concave side 7. Therefore, if the person falls with this underwear, an impact is occurred on the hip protector 1 and the compression power is added on the domed shape. As a result, the domed shape becomes flatter so as to absorb the impact. In addition, since ten or so anti-slipping areas 14 as almost same in size as vent holes are positioned almost equally in intervals on both surfaces of the convex side and the concave side of the hip protector 1 of examples 1, 2 and 3, the hip protector 1 does not slide in the underwear 11 and is fixed therein, resulting in a comfortable feeling to the user.

COMPARATIVE EXAMPLE 1

This comparative example 1 is same as example 1 except that material is changed into polystyrene foam. A shock absorbing ratio of the comparative example 1 was measured in the same conditions as the above, resulting in 0.5J for all absorbing energy. Therefore, a shock absorbing energy is 2%, which was not enough to absorb such an impact.

COMPARATIVE EXAMPLE 2

This comparative example 2 is same as example 1 except that material is changed into 30% glass fiber reinforced polyethylene terephthalate. A shock absorbing ratio of the comparative example 1 was measured in the same conditions as the above, resulting in 0.1J for all absorbing energy. Therefore, a shock absorbing energy is 4%, which was not

enough to absorb such an impact.

Assumed that a person who wears the hip protector 1 of example 1, 2 or 3, or comparative example 1 or 2 falls, a shock absorbing test was conducted as follows. First of all, the hip protector 1 was fixed on the hip portion corresponding to the neck of the femur in dummy in 60 kgs made of rubber as shown in Fig. 7. Three hollow glass beads of 8 mm diameter and 2 mm thickness were fixed with a tape in a shape of triangle approximately in equal intervals on the hip portion of dummy covered with the hip protector 1. The dummy was overturned with body side down and then the state how the hollow glass beads were damaged was observed. The results are shown in table 1 together with the above mentioned flat withstand strength and lateral withstand strength.

TABLE 1

	FLAT COMPRESSIVE STRENGTH	LATERAL COMPRESSIVE STRENGTH	DAMAGE CONDITION
EXAMPLE 1	25	8	no damage in all 3
2	30	10	no damage in all 3
3	80	25	no damage in all 3
COMPARATIVE			
EXAMPLE 1	15	3	all 3 were broken
2	120	35	2 were broken and 1 was of no damage

(NB) A flat compressive strength and a lateral compressive strength are a flat withstand load (kgf) by a 10 mm displacement and a lateral withstand load (kgf) by a 10 mm displacement.

As shown in table 1, all three hollow glass beads of examples 1, 2 and 3 were of no damage and the hip protector 1

itself was of no crack or deformation or the like. On the other hand, all three hollow glass beads of comparative example 1 were broken and the hip protector 1 was cracked. It is thought that the flat compressive strength and the lateral compressive strength are too low due to its too soft material in comparative example 1, resulting in that the domed shape was bended to be flat and pressed down on beads. Besides, it is thought that the flat compressive strength and the lateral compressive strength are too high due to its too hard material in comparative example 2, resulting in that the domed shape was difficult to bend to be flat with an impact in falling and such an impact as added on the hip protector 1 was directly attacked on beads without enough shock absorbing effect. In addition, when an impact is given, the user feels pains in wearing the hip protector 1 in such a hard material on the hip portion and moreover the mark of the rounded rim 9 may remain on the user's skin. Therefore, such a material is not appropriate.

Further, the size of the hip protector 1 in the above examples is not to be construed to limit the scope of the invention, however, it is preferable that a minor axis (a) is 9 to 14 cm, a major axis (b) is 13 to 18 cm, the thickness of the dome is 0.5 to 1.5 cm, a diameter of vent holes 4 is 0.2 to 0.7 cm and a depth (c) of the dome is 1.5 to 4.5 cm. Each optimum value is; 11.5 cm for a minor axis (a), 16 cm for a

major axis, 0.85 cm for a dome thickness, 0.5 cm for a diameter of vent holes 4 and 2 cm for a dome depth (c) respectively. Especially, it is essential that a diameter of the vent holes 4 should be not more than 0.7 cm to maintain the strength of the hip protector 1 while it is necessary that vent holes 4 are scattered. Furthermore, the anti-slipping areas 14 in the above examples, for fixing the hip protector 1 on an underwear and the like, are not to be construed to limit the scope of the invention, and the number or positions of the anti-slipping areas 14 may be appropriately varied in accordance with cloth material and the like. Still furthermore, examples do not limit materials of the hip protector 1 and the reinforcing core 8, any material having a flat withstand load by a 10 mm displacement of 20 to 100 kgf and a lateral withstand load by a 10 mm displacement of 5 to 30 kgf and also having flexibility in the degree like synthetic resin, and made of lightweight rubber and non-woven fabric except for steels, wood or the like is acceptable. Even still furthermore, the thickness of the reinforcing core 8 needs to be set up appropriately in accordance with the dome's thickness of the hip protector 1 and preferably 1/10 to 1/3 of the dome's thickness.

EFFECTS OF THE INVENTION

As mentioned above, the hip protector in this invention has flexibility and is formed into an approximately domed

shape so as to cover the hip portion corresponding to man's neck of a femur, and also has the above specific flat compression strength and the lateral compression strength. A cavity is caused between the hip portion and the concave center part of the domed shape in the hip protector by this approximately domed shape in a state that the hip protector 1 is applied on the hip part corresponding to the neck of the femur. Therefore, if an impact is attacked on the hip protector by falling in this state, the approximately domed shape deforms elastically so that the cavity becomes smaller, resulting in a shock absorbing. In such an impact attacking, the hip protector of the present invention has sufficient flat compression strength and lateral compression strength. For this reason, injuries or damages on the neck of the femur can be prevented effectively, if the person wears the hip protector of the present invention. In addition, flexibility in this invention means the same level as synthetic resin, lightweight rubber, non-woven fabric or the like except for steels, wood or the like. This enables the extremely lightweight hip protector having enough strength to endure the impact in falling without using heavy rigid plate such as steel plate or heavy composite material and flexibility enough to soften the impact in falling. As a result, the present invention can provide the hip protector, which can be easily produced at a low cost, having sufficient shock absorbing

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ability in spite of its lightweight.

What is claimed is;

1. A hip protector formed into an approximately domed shape sized for placement along a neck of a person's femur, and the hip protector being formed of a flexible material and having:

(A) a flat compressive strength capable of withstanding a 10 mm displacement under a compressive force of 20 to 100 kgf; and

(B) a lateral compressive strength capable of withstanding a 10 mm displacement under a compressive force of 5 to 30 kgf.

2. A hip protector according to claim 1, wherein the outer contour of the approximately domed shape is an ellipse.

3. A hip protector according to claim 2, wherein a ratio of a major axis (b) and a minor axis (a) of the ellipse shape; $(b)/(a)$ is controlled in the range of 1.3 to 2.0, and a ratio of a depth (c) of the domed shape and the minor axis (a); $(c)/(a)$ is controlled within 0.1 to 0.5.

4. A hip protector according to claim 1, wherein the whole material comprises synthetic resin foam.

5. A hip protector according to claim 1, wherein a reinforcing core which is harder than surface material is embedded therein.

6. A hip protector according to any one of claim 1 to 5, wherein a plurality of thru-holes are formed so as to surround an approximate center part of the domed shape.

7. A hip protector according to claim 1, wherein a shock absorbing ratio is not less than 5%.

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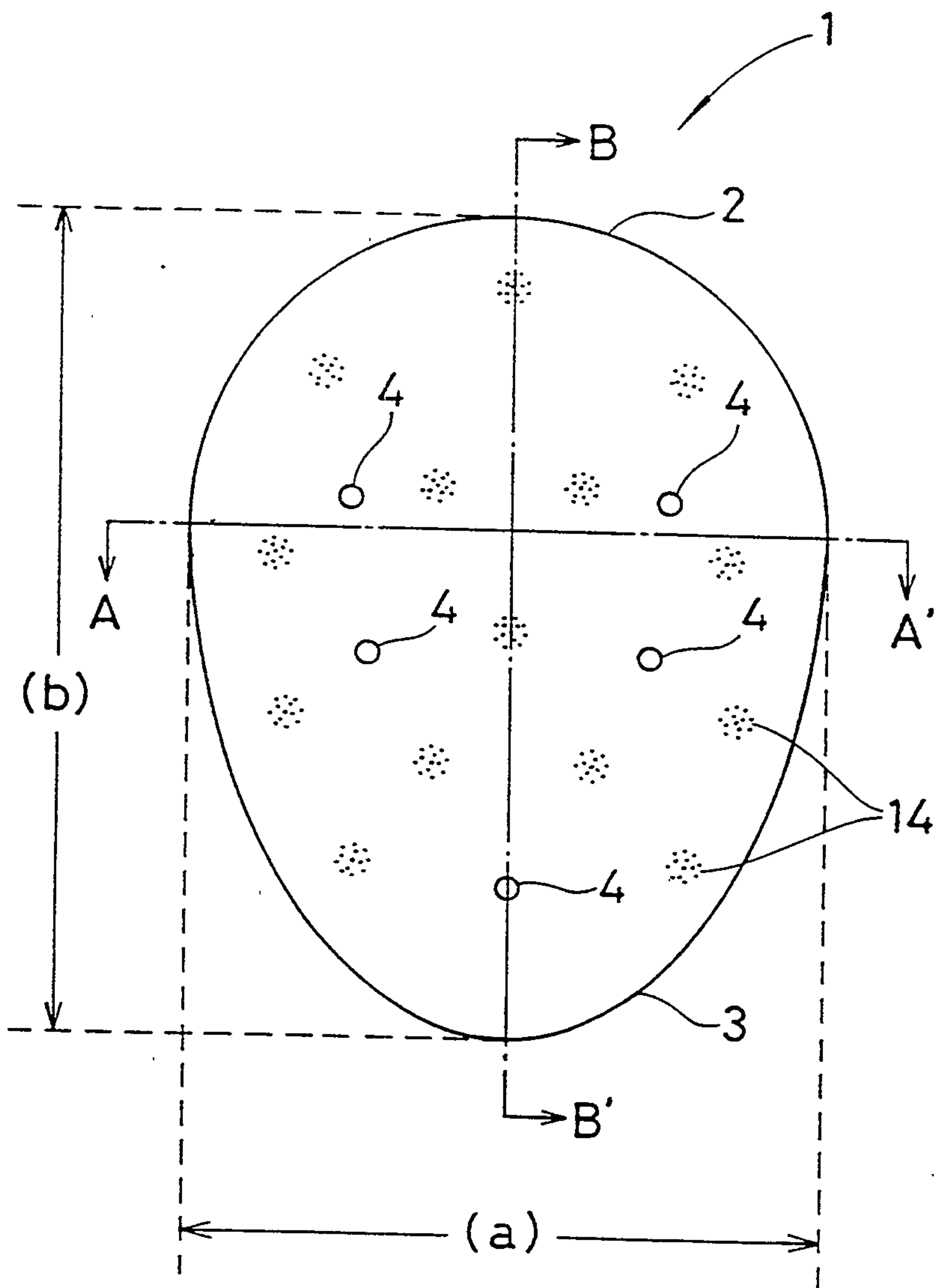


Fig. 1

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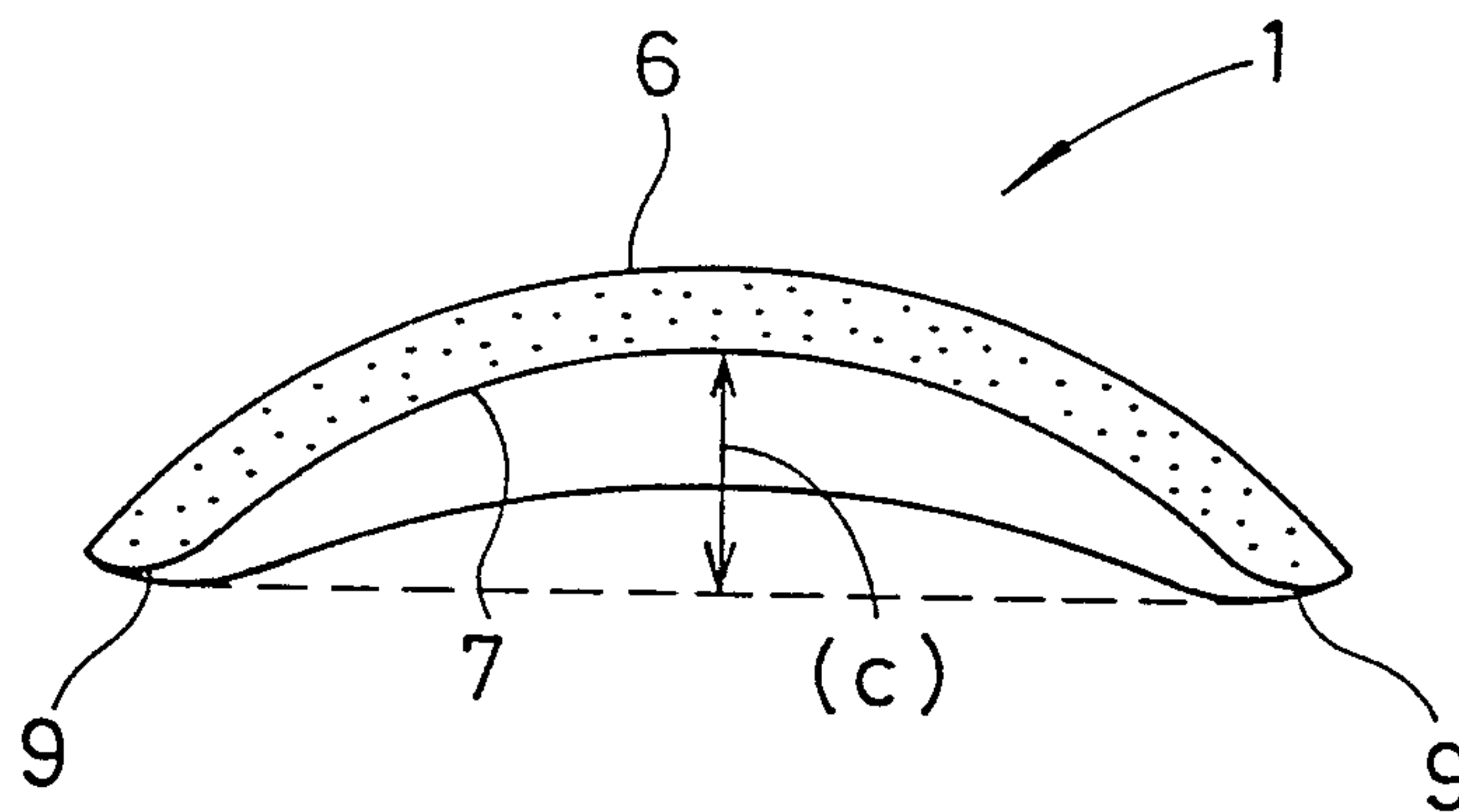


Fig. 2

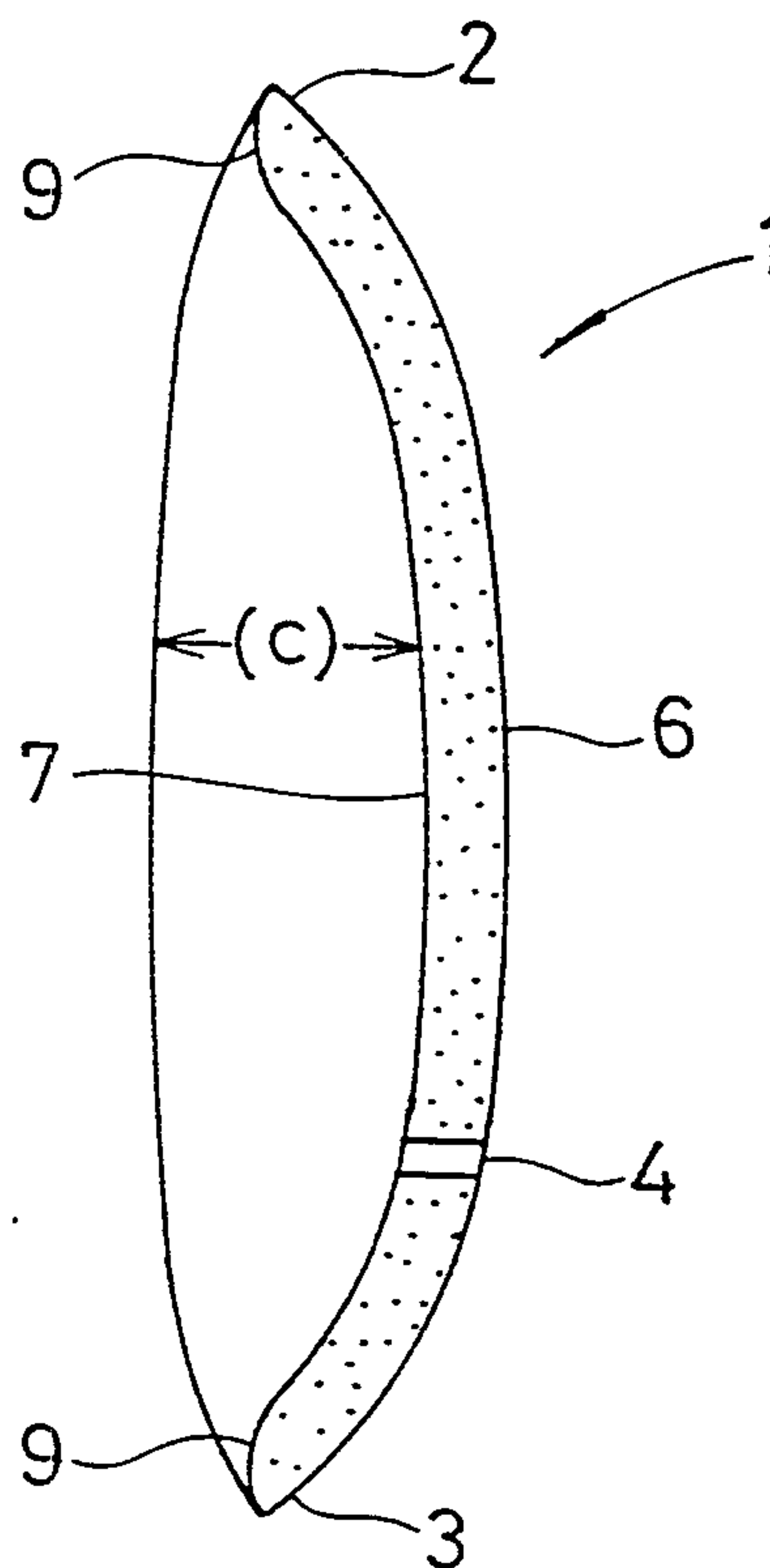
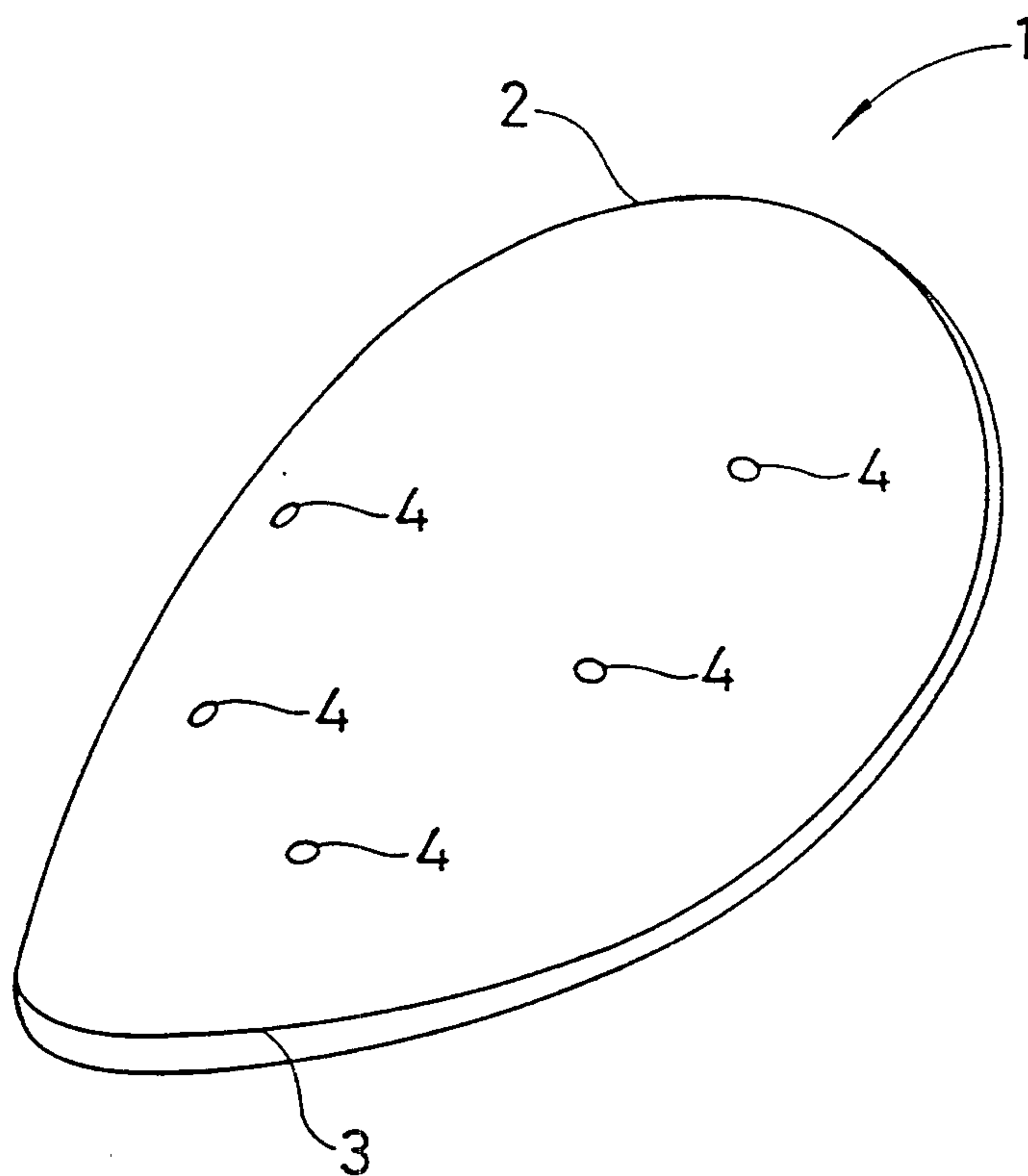


Fig. 3

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1 : HIP PROTECTOR

2 : TOP PART

3 : DOWN PART

4 : VENT HOLES

Fig. 4

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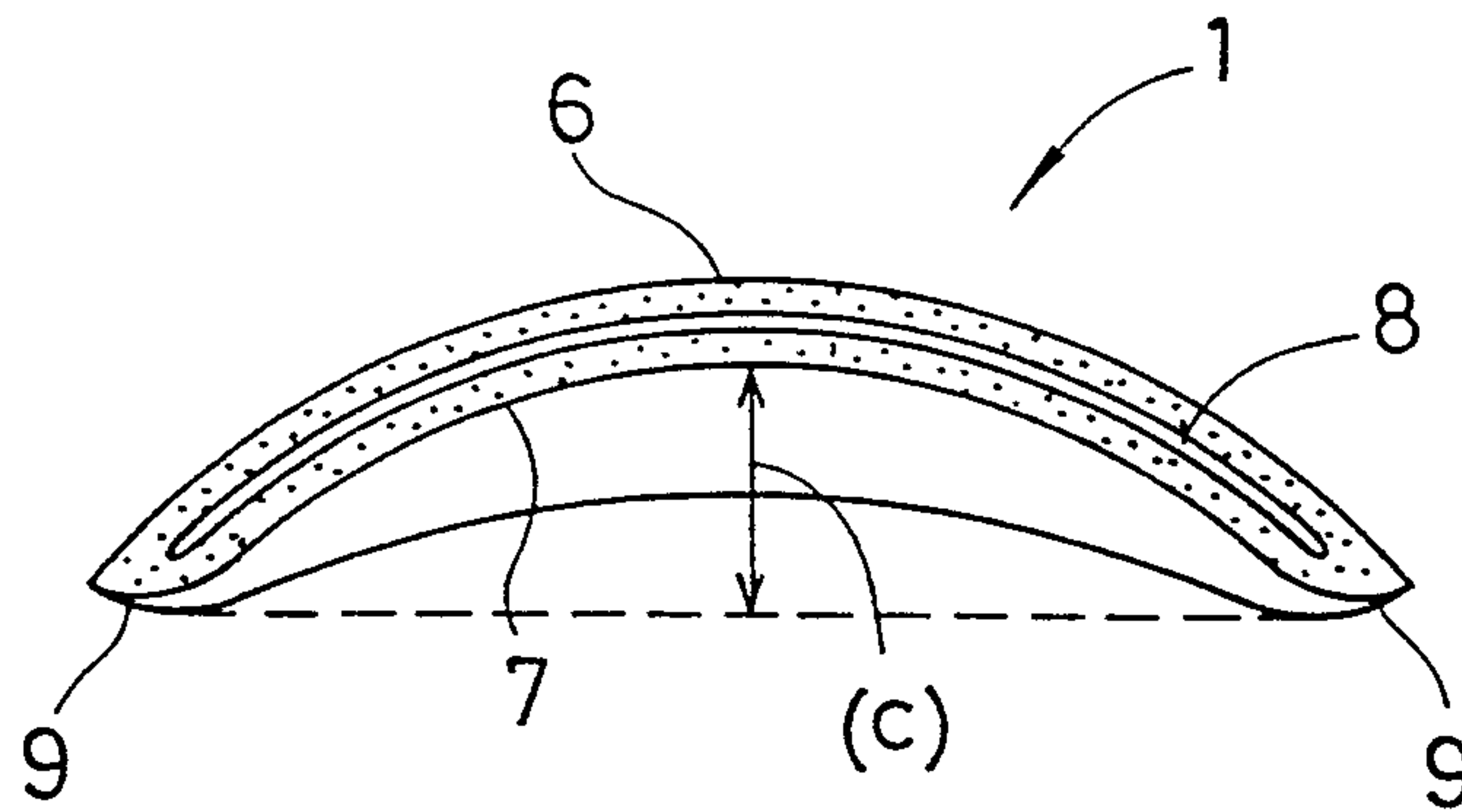


Fig. 5

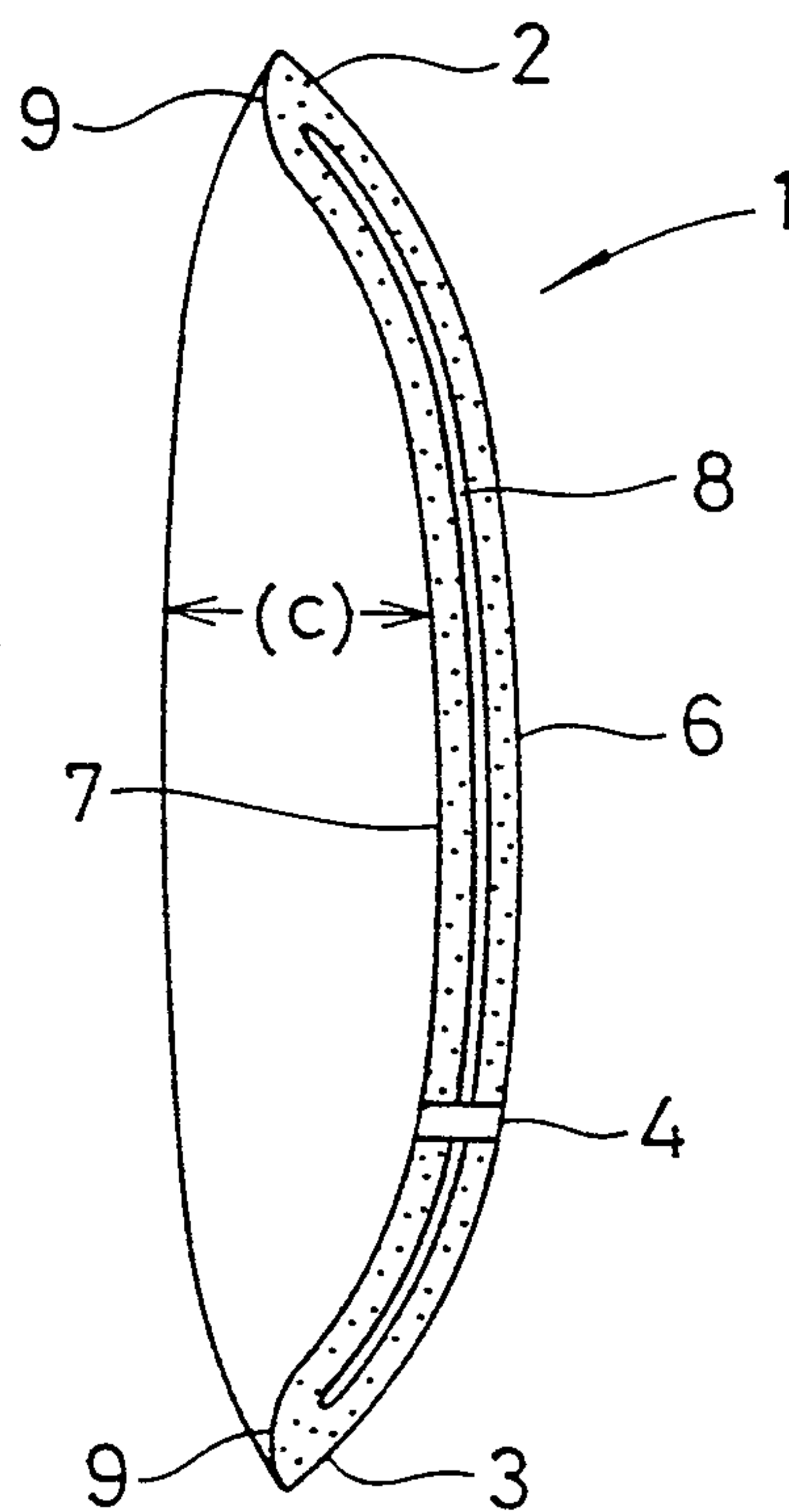


Fig. 6

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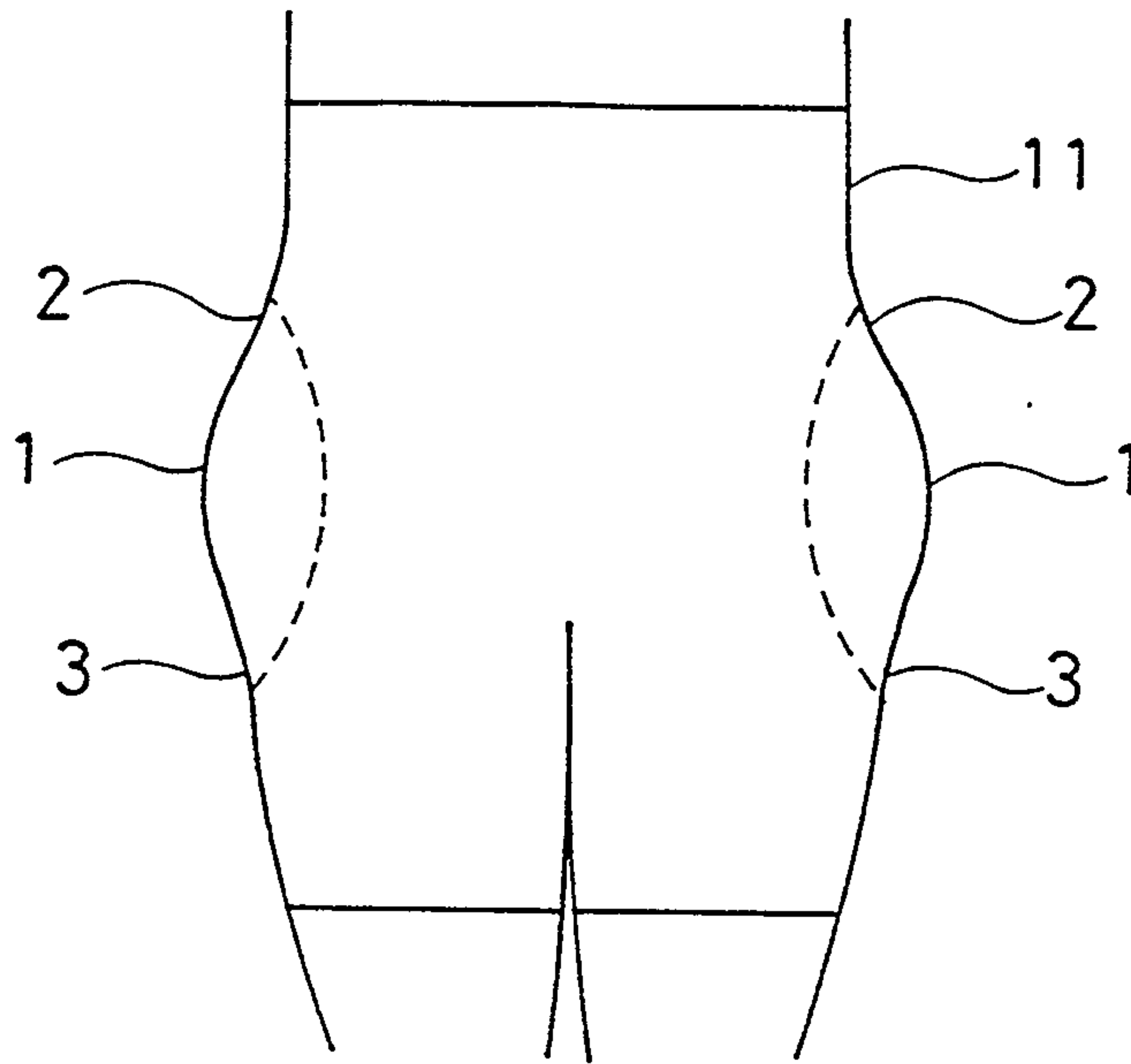


Fig. 7

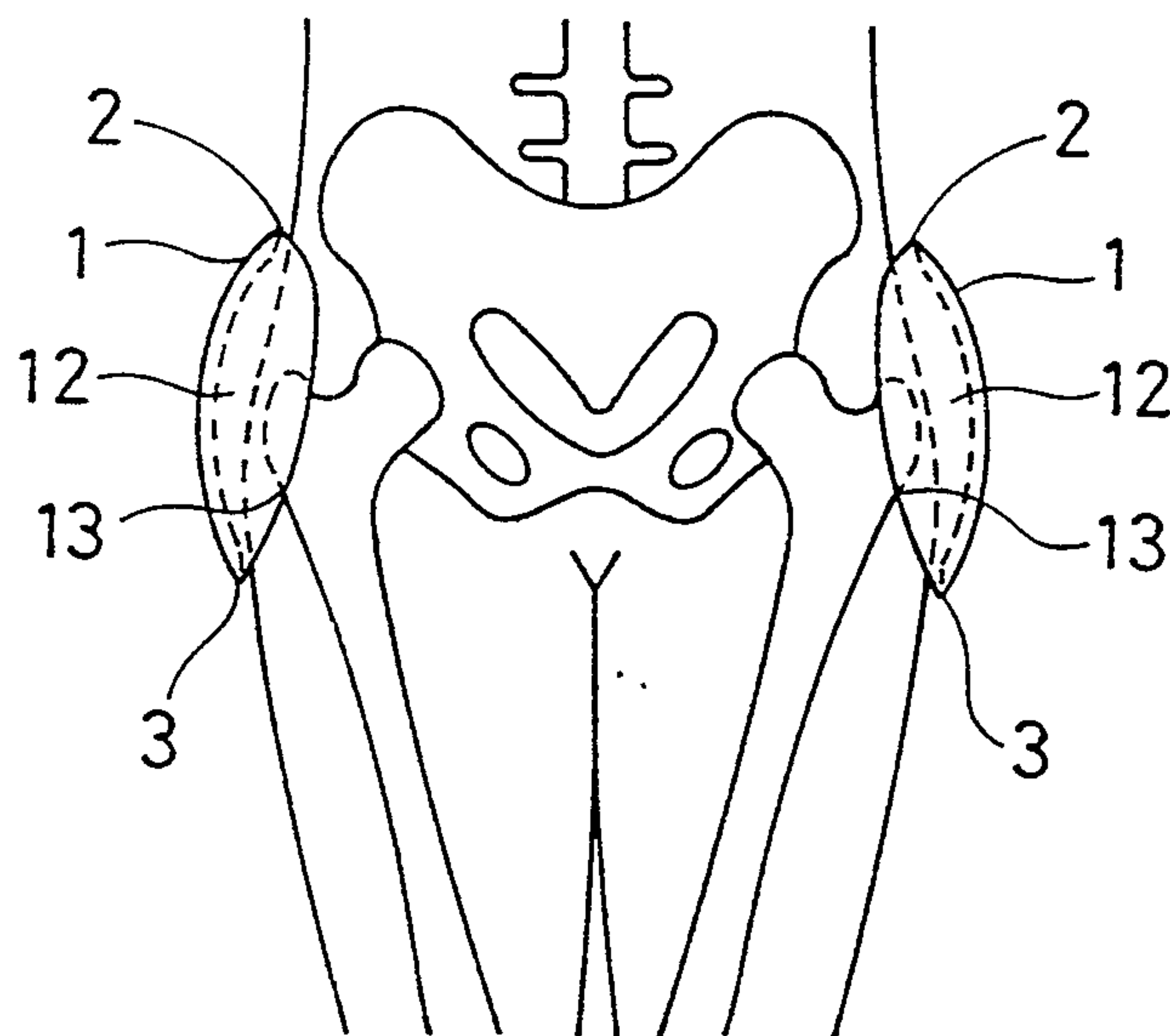


Fig. 8

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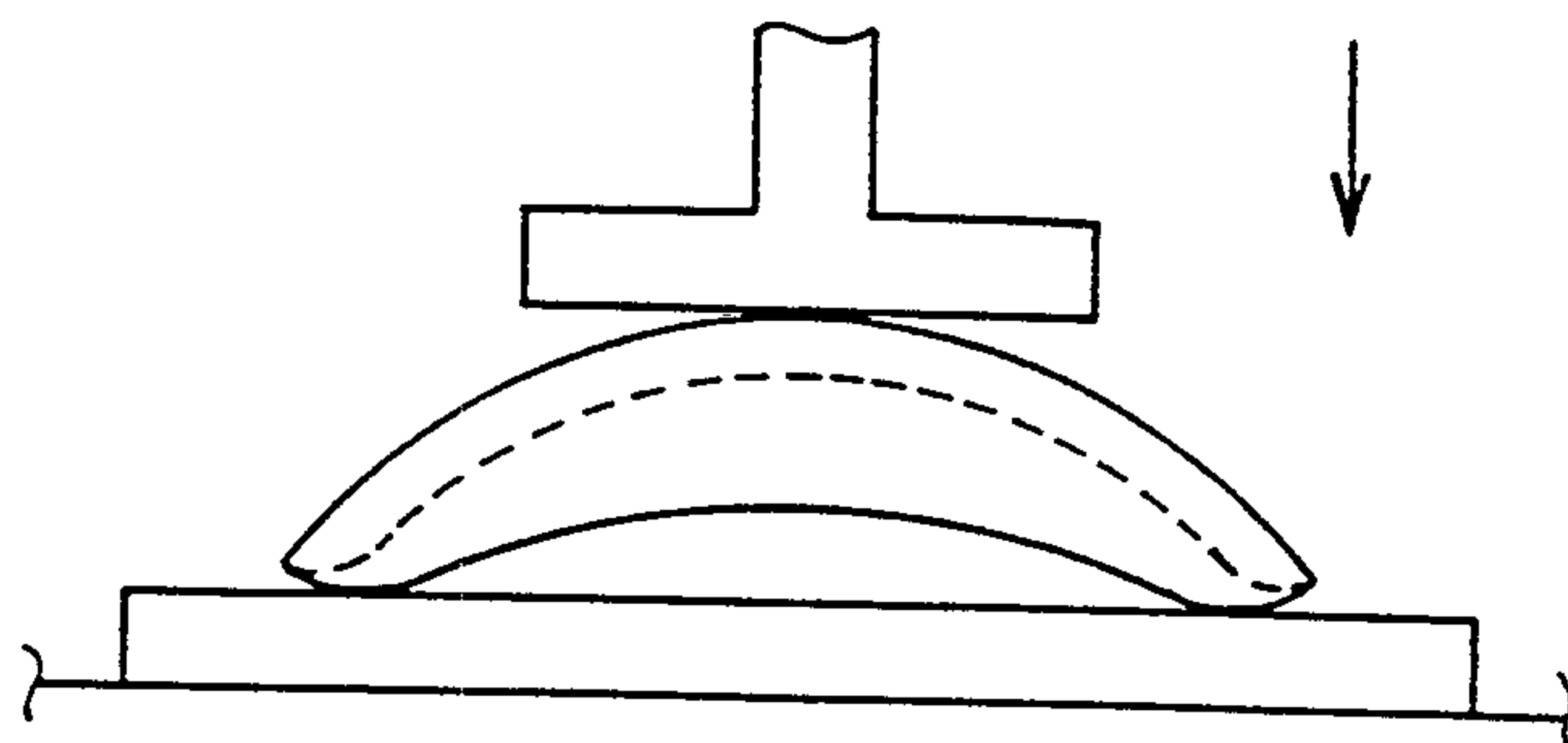


Fig. 9

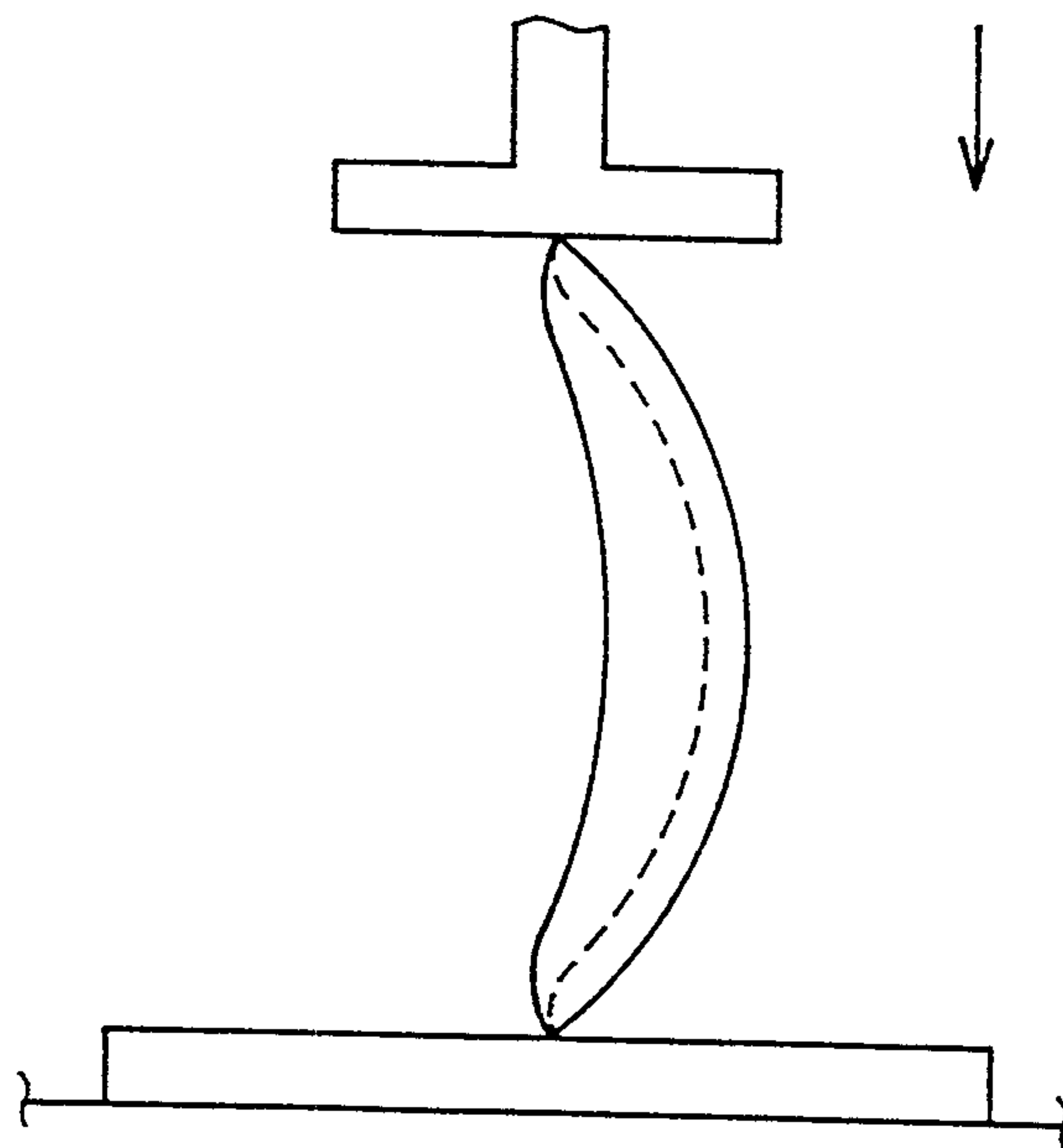


Fig. 10

